moving minds

Nemetschek Structural User Contest

Inspirations in Engineering

Dear reader,

The 2013 edition of the biennial Nemetschek Structural User Contest surpasses all previous editions in both the quality of the projects as the number of participants. No less than 127 impressive projects coming from 28 countries were accepted and have been submitted by 97 competing engineering organisations.

We are pleased to welcome an increasing number of participants from continents outside Europe, coming from North America, Latin America and Africa.

The theme “Inspirations in Engineering” is excellently reflected in the submitted projects; the innovative advance in structural engineering science results in creative constructions, as well in residential environment as for infrastructure and industrial spaces.

Like in previous editions the participants are software users of the Nemetschek Structural Group: Scia Engineer, Allplan Engineering, Allplan Precast, Frilo Statics, Scia Steel Manager, TIM and finally GLASER -isb cad-. The software products cover the full spectrum of structural engineering, from design to detailing up to integrated fabrication planning.

The contest was originally set up around 5 categories: buildings, civil structures, industrial plants, industrialized planning and special structures. Since the category “Industrialized Planning” did not get the minimum of participants the submitted projects were moved to other categories. Besides the special jury prize, an additional prize has been awarded for the best approach of fabrication and execution.

Special congratulations go to the contest winners and nominees; thanks to the ‘Olympic Spirit’ of all participants sharing their experiences, this book is a source of inspiration for the whole structural engineering community.

Jean-Pierre Rammant, dr.ir.

CEO of Nemetschek Scia
Leader of the Nemetschek Structural Engineering Group

Cover page: Steel Archway at Stadium in Greece.

W Winner J Special Prize of the Jury F Special Prize for Fabrication and Execution N Nomination

● Allplan Engineering ● Allplan Precast ● Frilo Statik ● GLASER -isb cad- ● Scia Engineer

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Winners and Nominees

Winner Category 1: Buildings

Design of buildings, residences, apartments, office blocks, shopping centres, high-rise buildings… for which Nemetschek Structural Group software has been used for modelling, analysis, design and detailing.

The originality of the design and detailing of the structural work fitting with the architectural design is a decisive factor.

Nominations Category 1

Winner Category 2: Civil Structures

Any type of structure that fits within civil engineering, including any type of bridge (beam, arch, cable-stayed, suspension…), tunnels, bulkheads, locks, barrages, in short general infrastructure... for which Nemetschek Structural Group software has been used.

The level of application of engineering science is decisive.

Nominations Category 2

Winner Category 3: Industrial Buildings and Plants

Design of general steel or concrete structures, power plants, frame structures, large span halls, hangars, pre-engineered buildings..., for which Nemetschek Structural Group design or detailing software has been used.

The focus is on the size of the structure, and the level of detailing, e.g. for the steel or concrete members and connections, or reinforcement.

Nominations Category 3

Project withdrawn by the customer

Winner Category 4: Special Projects

Sustainable, ecological and green structures, scaffolding, works of art, mechanical equipment, projects such as storage tanks, conveyer belts, cold store installations, supporting structures, playground equipment, cranes, tubular connections… for which Nemetschek Structural Group analysis or design software has been used. To this category also belong stages, stadiums and spectacular roofs.

Winning criteria are: originality, complexity and creativity.

Nominations Category 4

Winner Special Prize of the Jury

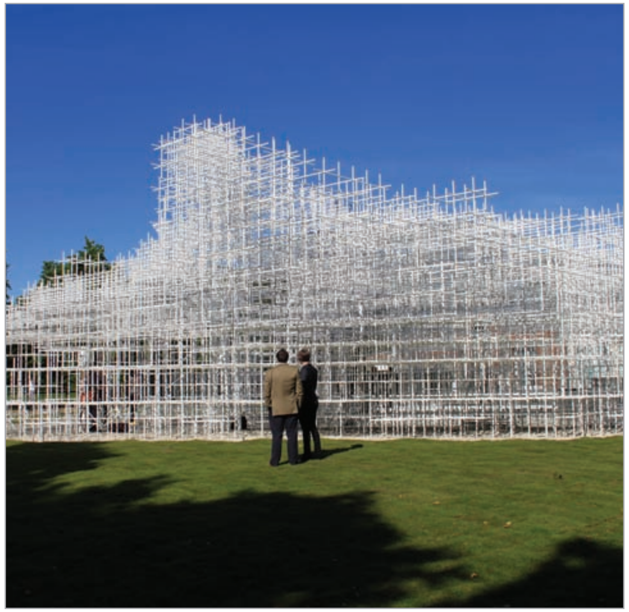
In each of the 4 categories, one winner and three nominees were selected. From all the participating projects the jury also chose a 'Special Prize of the Jury'. Special consideration went to projects illustrating the best practical application of Open BIM.

The selection criterion is the level of BIM and interoperability between the used software solutions

Winner Special Prize for Fabrication and Execution

Projects in which the detailing of reinforced concrete and steel constructions, general arrangement, formwork and reinforcement drawings, including generated bending lists, fabrication drawings and logistics are realized with Nemetschek Structural Group software. This also includes projects executed with prefabricated elements.

Focus is on the size of projects, level of detailing, interoperability, BIM, CNC, originality and fitness for execution.



The Nemetschek Structural Group - a broad product spectrum

The Nemetschek Structural Group's product portfolio addresses the design and detailing of building components, such as beams, columns, stairs, slabs and roofs as well as the modelling of full 3D structures (steel, concrete, precast, timber, aluminium). It also covers integrated solutions for precast concrete and steel structure fabrication production planning. The Group has advanced technologies for complex Finite Element Analysis, and for modelling of formwork and steel reinforcement in 3D.

The clients are as diverse as the engineering practice is: from small independent consultants up to large multidisciplinary companies, contractors and fabricators.

The software solutions of the Nemetschek Structural Group in one table

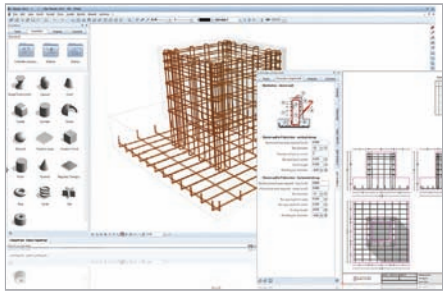
Software	CAE		CAD		Production planning, steering and logistics
	component based	model based	plan based	model based	
Frilo Statics	■				
Scia Engineer		■			
GLASER -isb cad-			■		
Allplan Engineering			■	■	
Allplan Precast				■	■
TIM					■
Scia Steel					■
Scia Steel Manager					■

Nemetschek Structural Group

Allplan Scia Frilo Glaser

Several customers are using more than one product of the Nemetschek Structural Group companies. Therefore the Group focuses precisely on those issues that help forward the productivity of these customers: improving interoperability through an open BIM (Building Information Modelling) strategy using standard exchange formats. Especially synchronisation of model data between CAE, CAD and production is one of the key advantages of the Nemetschek software, also beyond the engineering practice. Since Nemetschek is world-leader in architectural software (with its brands Allplan Architecture, ArchiCAD and Vectorworks) the Nemetschek Structural Group has close ties with the architectural world.

Being internationally active the Nemetschek Structural Group companies have a strong focus on localisation of its products; starting from a proven leadership in Eurocodes, the companies have experience all over Europe. Some brands are internationally active, in many countries: USA, Brazil, Middle East, Russia, Asia.



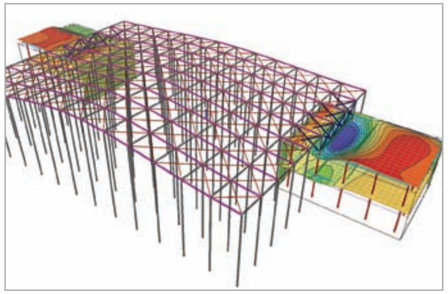
Allplan Engineering

Allplan Engineering offers the right solutions for meeting the challenges of day-to-day RC detailing work: integrated working from the first idea to the detailed general arrangement and reinforcement drawings. It provides powerful 3D modeling functionalities even for freeform components, but also supports hybrid or 2D approaches.

Allplan Precast and Precast Part Manager

Allplan Precast is based on the principle of virtual planning, production and presentation of all the processes needed up to the assembly of the precast units. Precast Part Manager supports order processing from offer handling to erection and therefore links the operational departments, such as engineering design, sales, work planning, production, delivery and assembly.

NEMETSCHEK Allplan



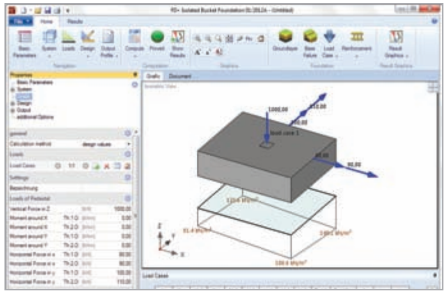
Scia Engineer

With powerful software, Scia supports its customers in the modelling, analysis, design and detailing of all kinds of structures - from complex buildings or impressive bridges through to demanding industrial structures such as energy plants. The 3D structural BIM (building information modelling) solutions from Scia are used practically everywhere.

Scia Steel and Scia Steel Manager

Scia Steel and Scia Steel Manager are manufacturing software solutions for the steel construction industry. The software can be used almost limitless from the planning of bridges to special industrial buildings; it enables an accurate execution of all production and execution processes. The production, material and resource planning are also included.

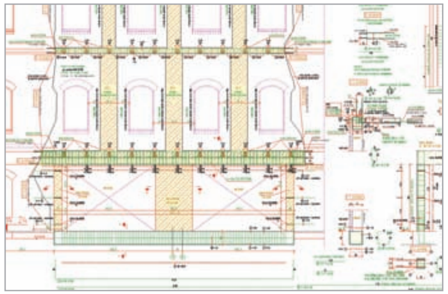
NEMETSCHEK Scia



Frilo Statics

Frilo is a provider of calculation programmes for structural design problems. The easy-to-use software enables the calculation of components such as beams, columns, frames or roofs in a variety of materials including steel, wood and concrete. The heart of the solution is the integrated know-how of the current building codes (Eurocodes, DIN-Norms). With more than 80 applications Frilo replies to a wide range of demands in practice and provide comprehensive solutions for all tasks in the engineer's office. With about 10,000 customers Frilo is one of the main players in the engineering market in Germany and around.

NEMETSCHEK Frilo



GLASER -isb cad-

GLASER -isb cad- offers CAD programmes for structural engineers. With functions, carefully adapted to the planning requirements, and well-considered detailed solutions, construction and reinforcement plannings can be processed efficiently. The programmes also shorten the process time of standard building components. FEM results of Frilo Statics and Scia Engineer can be imported and automatically converted into practical reinforcement proposals.

GLASER -isb cad-
a NEMETSCHEK Company

Jury

How were the projects judged?

An international jury, from both the academic and professional community, gathered in July 2013 for the evaluation of all submitted projects.

The jury took the following characteristics into account:

- The technical level of the design, detailing and/or the calculations (doubled points)
- The originality and prestige of the project
- The attractiveness and completeness of the presentation and the uploaded documentation
- The optimal use of the software functionalities and the illustration of a BIM process
- The overall impression of the project

In each of the 4 categories, one winner and three nominees were selected. From all the participating projects the jury also chose the 'Special Prize of the Jury' & 'Special Prize for Fabrication and Execution'.

David M J Ball FCMI MCS FRSA

David Ball Group plc
- Function: Chairman
- Specialty: Concrete Structures

Ir. Diter Braet

Victor Buyck Steel Construction
- Department: Buyck Engineering Paris
- Function: Head of Engineering Office
- Specialty: Steel Constructions

Prof. em. Dr. Ir. Willy Patrick De Wilde

Vrije Universiteit Brussel
- Department: Mechanics of Materials and Constructions
- Specialty: Large span structures, Lightweight structures, Vibrations, High Rise Structures

Ir. ph D. Yves Duchene

Bureau d'études Greisch
- Department: Special studies
- Function: Manager of special studies departement
- Specialty: Structural Engineering, Bridge Design, FEM modelisation

Prof. Dr. Ir. Jean-Pierre Jaspart

Liège University
- Department: ArGEnCo
- Function: Professor in Steel and Composite Construction
- Specialty: Stability and Resistance of Steel and Composite Structures, Connection Design, Robustness of Structures

Prof. Dr.-Ing. Jens Kina

KINA Ingenieurleistungen im Bauwesen
- Department: Management
- Function: CEO
- Specialty: Structural Engineering, Bridge Design

Prof. Ing. Alena Kohoutkova

Czech Technical University in Prague
- Department: Faculty of Civil Engineering
- Function: Dean
- Specialty: Concrete Structures

Ir. Dick Stoelhorst

BouwWise!
- Function: Consultant
- Specialty: Knowledge Management

Ing Msc Gilbert Vanden Borre

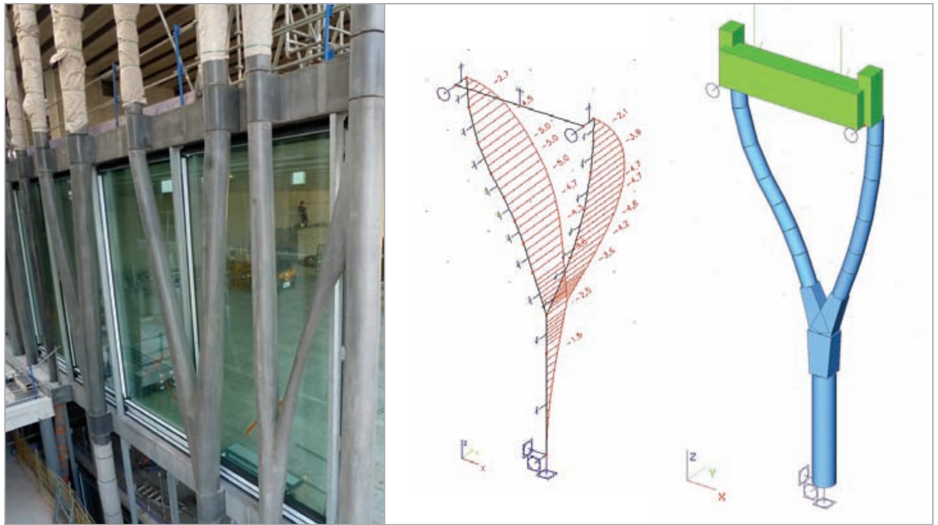
Stabiton bvba
- Department: Civil Engineering
- Function: CEO
- Specialty: Structural Engineering

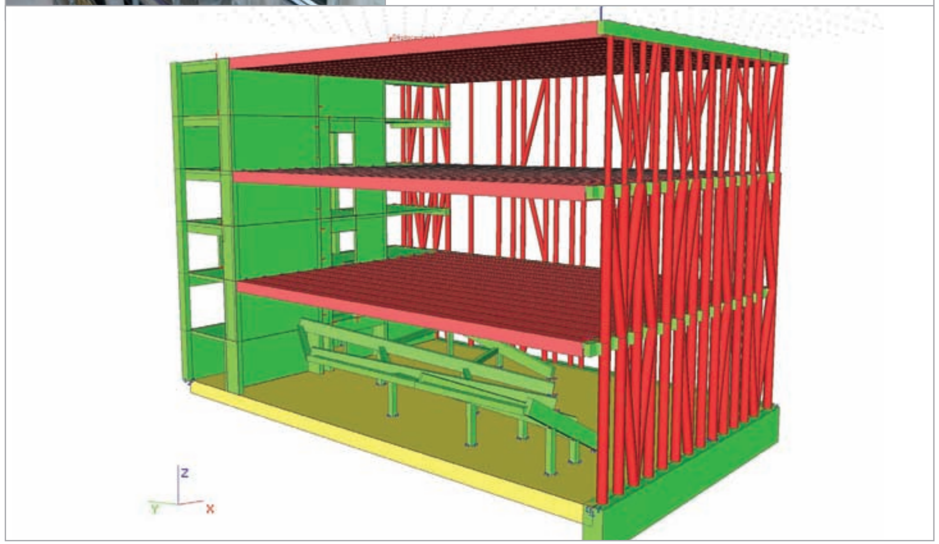
Design of buildings, residences, apartments also high-rise buildings… for which
Nemetschek Structural Group software has been used for modelling, analysis, design and detailing.

1

Winner Category 1: Buildings

Quote of the Jury: *"The jury was fascinated by the project's design and innovative use of advanced ultra high performance fiber-reinforced concrete (UHPFRC) for nearly all the main construction elements including a 130m footbridge, in combination with advanced technology of prestressing material. In addition the innovative facade creates an intricate, illuminated user experience from within the building."*





Introduction

A la suite du concours de maîtrise d'œuvre international lancé en 2002 par le Ministère de la Culture, l'équipe lauréate dont l'architecte Rudy Ricciotti est le mandataire a été chargée de la conception et de la réalisation du MuCEM (Musée des civilisations de l'Europe et de la Méditerranée) sur le môle J4 à Marseille.

Description du MuCEM

Le parti architectural retenu est de réaliser un bâtiment à la structure résolument moderne, audacieuse et soucieuse du développement durable en privilégiant l'usage des BFUP (Béton Fibré à Ultra hautes Performances) pour constituer les principaux éléments de la structure: poteaux arborescents, poutres de planchers de grande portée, résilles en façade et en toiture, passerelle de liaison avec le fort Saint Jean.
Il a fallu faire un gros travail de recherche sur la façon d'intégrer les éléments en BFUP à la structure du bâtiment du fait de l'obligation de les préfabriquer.

Structure porteuse verticale en BFUP

Les porteurs verticaux expriment par leur forme développée avec l'architecte, leur fonction structurelle. L'assemblage des poteaux entre eux, avec le radier et les poutres de rives des planchers est réalisé par une précontrainte par post-tension qui augmente aussi la résistance en traction du BFUP. La précontrainte en torons gainés graissés de chaque poteau arborescent part du pied de l'arbre. En allant vers le haut, les torons se distribuent dans les différentes branches. La mise en tension se fait progressivement par le haut suivant un phasage prédéfini.
Les poteaux arborescents participent à assurer le contreventement de la structure en façades dans leur plan, en utilisant des groupes de poteaux formant des N et des V. En phase APD, suite à la décision de rendre le bâtiment antisismique, les joints de dilatation ont été supprimés, les poutres de rives des planchers ont été précontraintes pour contrer les effets thermiques, les éléments de poteaux préfabriqués ont été articulés en tête et en pied par des rotules Freyssinet traversées par la précontrainte et l'essentiel du contreventement est reporté sur le noyau central.

Résilles BFUP en façade et toiture

Ces panneaux autoporteurs de brise soleil sont structurés à partir des brins entrelacés suivant le dessin de l'architecte. Chaque panneau de dimension 6 x3 m² est juxtaposé de façon à organiser la décente des charge selon le dessin aléatoire en continuité entre les panneaux. Les résilles de façade autoporteuse sont appuyées sur les fondations et maintenues horizontalement par des tangons bi-articulés en appui sur les montants du mur rideau du Musée.

Poutres de planchers de longue portée en BFUP

Des poutres en I accolées de 23,40 m de portée constituent les planchers des salles d'exposition du musée. Les poutres sont préfabriquées et précontraintes par pré-tension de fils adhérents. La précontrainte est dimensionnée pour être centrée sous charges quasi permanentes de façon à éviter les courbures de fluages. Pour des raisons de réglementation parasismique, ces poutres ont été réalisées en BHP C60/75 et non en BFUP, en augmentant leur hauteur de 11 cm.

Passerelle entre le MuCEM et le Fort Saint Jean

Cette passerelle piéton a 3 travées à garde-corps porteurs, de 21 m ; 68 m et 30 m, de portée. Sur un total de 130 m, elle est composée de 26 voussoirs en BFUP assemblés sous précontrainte par post tension. L'ouvrage élancé, rectiligne en plan et légèrement cintré vers le haut (41 cm) pose sur 2 appuis de chaque coté pour une porté libre de 82 m. Le platelage en dalles de BFUP avec des raidisseurs en croix de Saint-André est clavé sur les voussoirs pour former la poutre de contreventement horizontale.

Calculs réalisés avec Scia Engineer

Le logiciel a été utilisé pour les études suivantes :

- La conception des poteaux arborescents en BFUP
- Le calcul 3D du MuCEM en statique et dynamique

Les calculs statiques de dimensionnement des poteaux ont été menés en non linéaire en prenant en compte la loi de comportement du BFUP. Les essais en vraie grandeur réalisés au CSTB sur 3 poteaux droits et 3 en Y, ont permis de qualifier les 3 BFUP français et de montrer le côté raisonnablement conservatif du calcul.

Software: Scia Engineer

SICA an Assystem Company

Contact Jacques Portelatine
Address 152 Avenue Jules Cantini
13272 Marseille, France
Phone +33 496208260
Email oetienne@sica-bet.com
Website www.sica-marseille.com

Les différents collaborateurs de SICA, non cités ci-dessus, qui ont travaillé sur le projet du MuCEM sont : Marc Asencio, Pascal Baudry, Daniel Camarena, Norbert Chocron, Jean Marie Cochet, Christine Elisabeth, François Xavier Gazagnes, Karine Guendouz, Alain Laupies, Bruno Massat et Thierry Robinson.

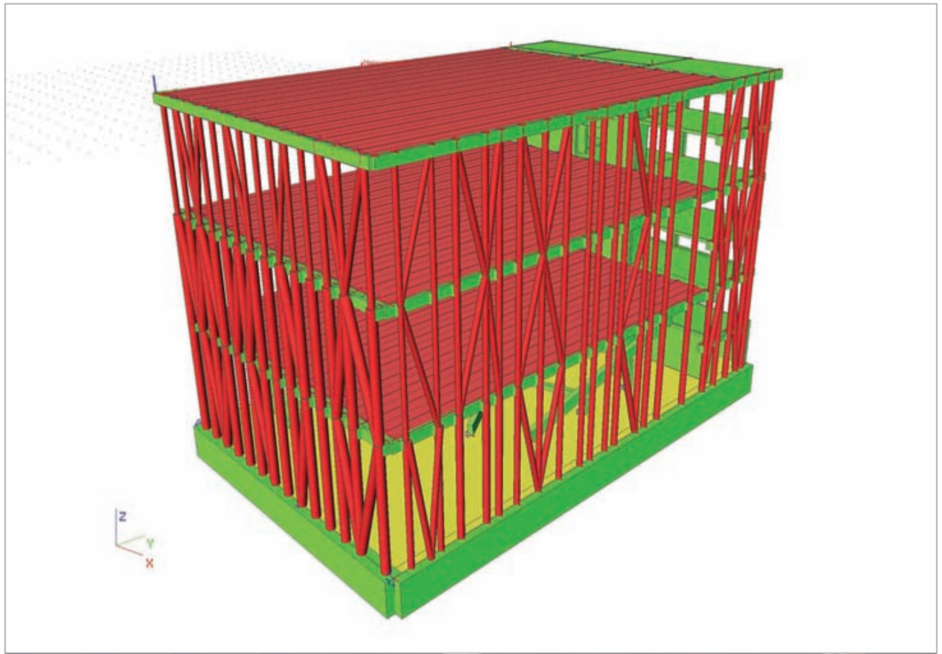
Notre bureau a à son actif des études de conception et d'exécution des structures d'ouvrages très diversifiés. Nous participons aussi au développement des nouveaux matériaux, comme nous le faisons actuellement avec les BFUP (Bétons Fibrés à Ultra hautes Performances).
SICA participe à d'autres projets d'envergures :
L'exécution de la partie G.O du Stade Vélodrome à Marseille en 1998
L'exécution de la façade et la couverture BFUP du Stade Jean Bouin en 2013
La maîtrise d'œuvre des SILO d'Arenc à Marseille en 2011 : Restructuration en bureaux et salle de spectacle.

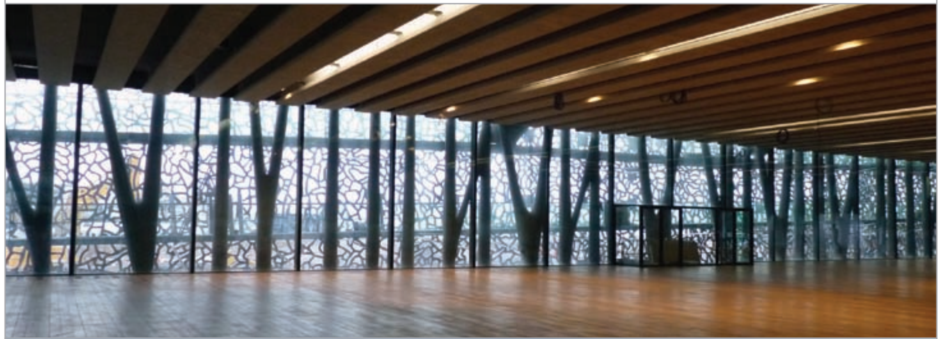
Project information

Owner	Ministère de la culture
Architect	Rudy Ricciotti
General Contractor	Dumez, Freyssinet, Bonna Sabla (préfabricant des éléments BFUP)
Engineering Office	SICA an Assytem Company
Location	Marseille, France
Construction Period	09/2010 to 04/2013

Short description | Museum of European and Mediterranean Civilisation (MuCEM)

In 2002, at the close of the international invitation for proposals for the design and construction of the Museum of European and Mediterranean Civilisation (MuCEM) on pier J4 in Marseille, the French Ministry for the Arts designated Rudy Ricciotti's team to construct the building and Rudy Ricciotti as chief architect. The EMOC (now OPPIC) was appointed as financing authority.
The building's architectural design is a resolutely modern and daring structural scheme, for which sustainable development is taken into account by giving preference to UHPFRC (ultra high performance fibre-reinforced concrete) for the construction of the structure's main elements: the tree-shaped columns, the main floor beams, the concrete skin façade and roof, and the footbridge to Fort Saint Jean.

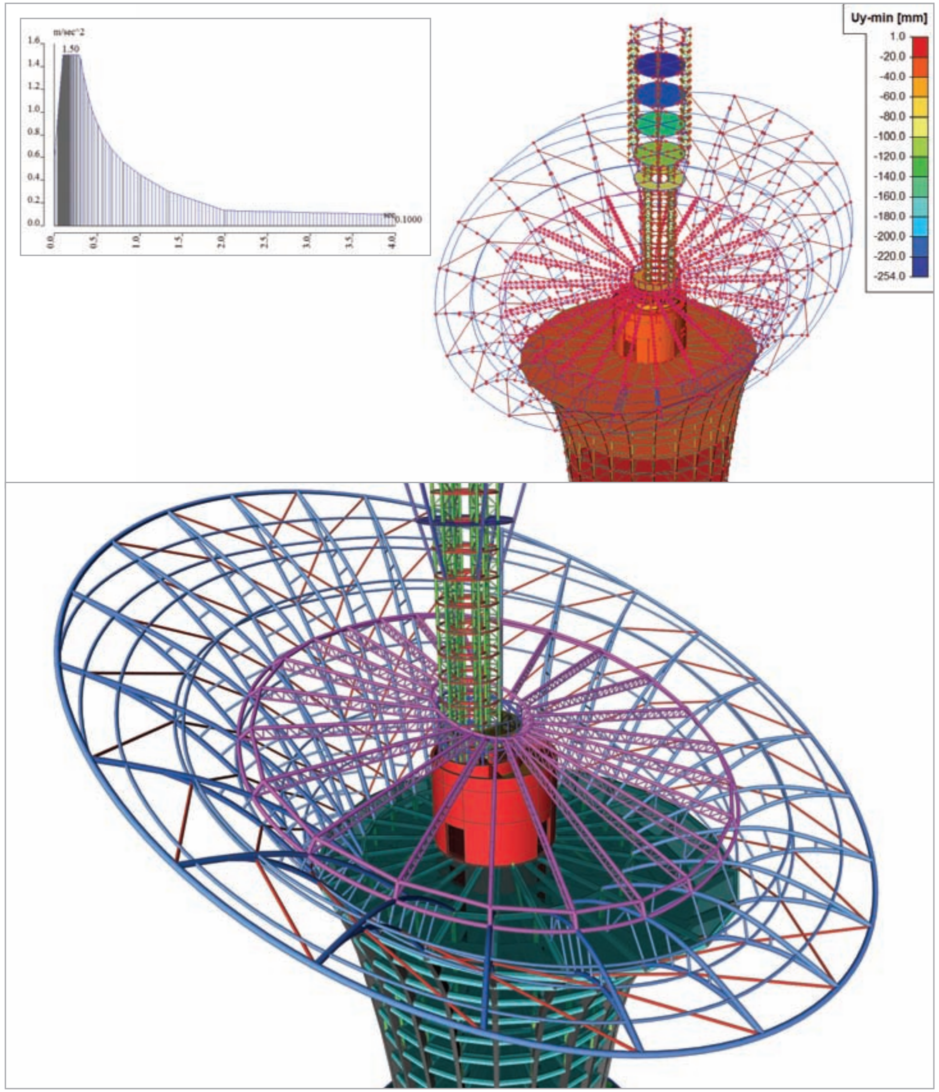




New Energy Institute - Wuhan, Province Hubei, People's Republic of China

Winner Special Prize of the Jury

Quote of the Jury: *"The jury was impressed with the unique and stunning design, the outstanding BREEAM rating for environmental performance, and its commitment to Building Information Modeling (BIM). Highest achievable durability was a primary design goal. The project will form an education/training platform for the future."*



Grontmij's consultants were responsible for the innovative and integrated sustainable approach of this extraordinary building in China. It resulted in a conceptual design for all engineering disciplines.

The Wuhan New Energy Institute, including an Exhibition Centre, is a new-build project of 70,000 m^2 gross in the Wuhan Future City development zone in Wuhan, China. The sustainability concept and the architecture of the main-building are inspired by nature: the calas lily flower, which symbolises purity, hope and greatness. The tower will be surrounded by five laboratory buildings and an exhibition centre. The combination of the BREEAM-international New Built label and a 3-STAR award of the Chinese Green Building Evaluation Label implies this building will be one of the world's most sustainable office towers.

Conceptual design

The conceptual design of this project emphasises the theme of new energy utilisation, while it meets the basic functional requirements of gathering the new energy technology industry resources from Hubei Province, from all over China, and even the whole world. After the construction is complete, it will be the most influential pilot architecture with renewable energy in central China and its main building shall be guaranteed to receive the most senior 3-Star Award in the Chinese Green Building Evaluation System. In addition, the main building shall also be aiming for the highest foreign certification with a BREEAM-international bespoke award.

Grontmij - a leading engineering consultancy

The Grontmij consortium (Grontmij, a leading engineering consultancy, together with Shanghai Xian Dai architectural and engineering group) was the bid-winning company of the international request for proposal and we signed a contract in October 2010 to work out the proposal design to a further detailed design with the goal of starting the construction in summer 2011. Grontmij has the lead in the conceptual phase of the following disciplines: process management, sustainability, architecture and urban planning (Jos van Eldonk), structural engineering, building systems engineering, energy, building physics and fire safety engineering.

Structural design and BIM

Given the short period of time of only 2 months, we had to be able to react quickly on changes in the design. Good interoperability between the software was thus very important.
The organic shape of the building was modelled by the designer and architect in SketchUp, in close discussion with the principal. During this period, the Scia Engineer model was built based on the SketchUp model and sent to Revit to create the final architectural model. This however resulted in some hiccups. With the help of the Nemetschek Scia support team, we understood that these were linked to the advanced and easy way complex shapes can be modelled in Scia Engineer, but that was incompatible with the Revit approach. To solve this, we turned the process around by first building the model in Revit, based on the SketchUp model, to then send it to Scia Engineer.
This proved to be a more reliable workflow.
Similar conversion issues appeared between Scia Engineer and ETABS (used by our Chinese partners), that we could solve as well by adapting our workflow.

Using the software package Scia Engineer made it also easier and clearer for our engineers to ascertain how the structural design best responds to special load cases such as earthquakes. Thanks to this, we were able to quickly process the rapid succession of changes in response to the client.

With these experiences in mind, our management clearly decided to expand our software and encouraged us to invest more in BIM. One of these decisions included switching to Allplan Engineering, aiming to overcome the problems of exchanging data between CAE and CAD software.

Nowadays, all experiences in BIM processes are shared across the different divisions of Grontmij. We thrive to implement this new way of working wherever possible, to bring benefits to every stakeholder of the project.

Software: Scia Engineer

Grontmij Nederland BV

Contact Maichel Moonen
Address K.P. van der Mandelelaan 41-43
3062 MB Rotterdam, The Netherlands
Phone +31 88 811 4000
Email maichel.moonen@grontmij.nl
Website www.grontmij.com

Grontmij is a leading sustainable design and management consultancy active in four business lines: Planning & Design, Transportation & Mobility, Water & Energy, Monitoring & Testing.

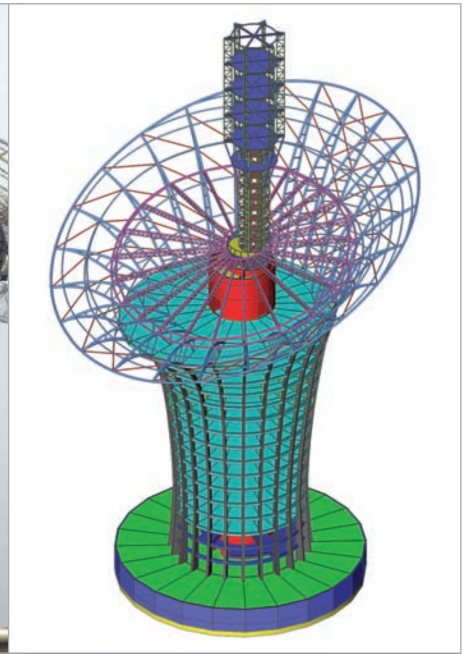
At the core of our business is the principle of sustainability by design, which is a leading value proposition for our customers. Grontmij is the third largest engineering consultancy in Europe. We have approximately 9,000 professionals around the world. We are active in the growth markets of water, energy, transportation, sustainable planning and life cycle asset management. At the heart of our business is the sustainability by design principle. It is a leading value proposition for our customers. We look to the future to enhance the world we live in. By applying sustainability considerations to all our design, consultancy and management services right across the value chain, highly-skilled expert professionals are able to create lasting solutions that plan for, connect and respect the future.

Project information

Owner	Wuhan Future City Investment & Construction Co. Ltd.
Architect	Soeters van Eldonk architecten Amsterdam
Engineering Office	Grontmij Nederland BV
Location	Wuhan, Province Hubei, People's Republic of China
Construction Period	04/2011 to 08/2013

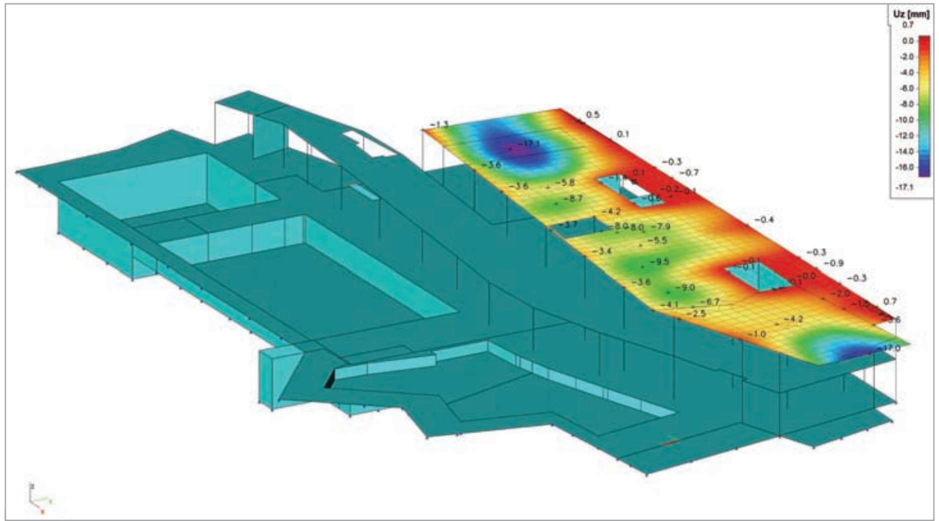
Short description | New Energy Institute

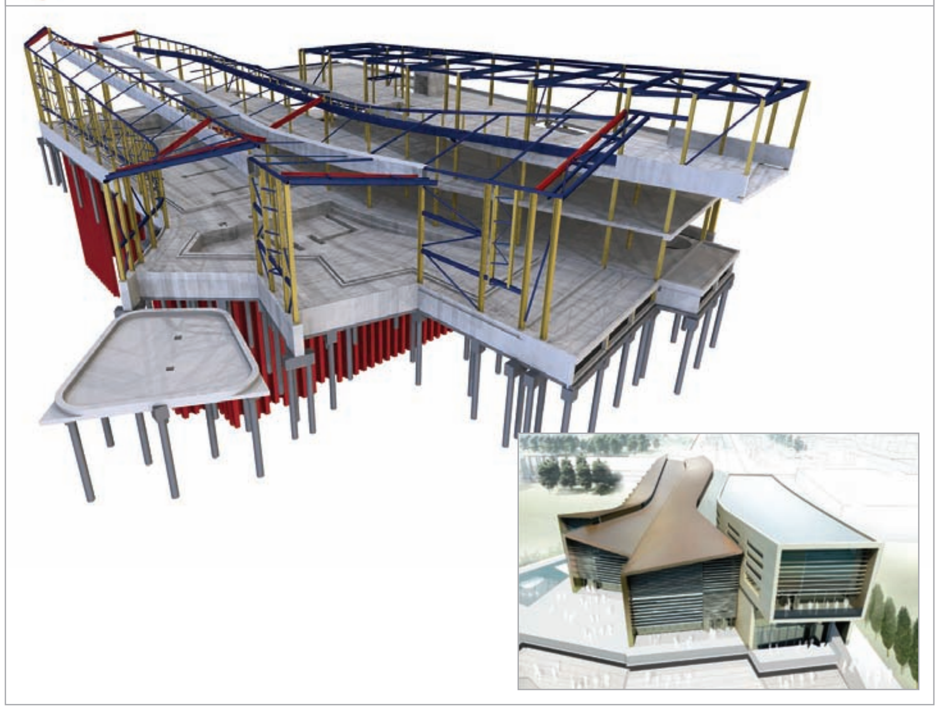
The project is divided into three construction phases, namely the conference building with underground parking, the laboratories and the office building. The underground parking and the conference building must be completed first because this information and exhibition space should increase the attraction for the whole New Energy Park. The city of Wuhan wants to make the area more attractive for the establishment of renowned companies from around the world who have anything to do with renewable energy. After the completion of this part in January 2012, the laboratories will be completed in January 2013 and the office building in June 2013.



Worthing New Pools - Worthing, United Kingdom

Nomination Category 1: Buildings





Worthing New Pools

This iconic building has been commissioned to replace an aging 1960s leisure centre and breathe new life into the architecture of Worthing's sea front. Wilkinson Eyre Architects, supported by AECOM, won the architectural design competition with their design. The sculptural form echoes the sand and driftwood of the shoreline. The new leisure centre brings inspirational design into a facility at the heart of the local community.

Concept

The signature element of the structure is the pool hall, with steps and curves achieved in a complex steel frame. Clad in copper and glass with a timber soffit, the pool hall is set alongside the timber-clad concrete frame of the leisure centre.

Asymmetric Curved Beams

The lines of the pool hall 'flow' towards the shore, supported by two doubly-curved, doubly-asymmetric, welded box sections. These are 1.3 m deep, span over 50 m and weigh one metric tonne per metre. They carry axial load, biaxial bending and torsion due to curvature. Cross-section properties were explored and optimised using the 'general cross-section' module within Scia. In addition to section checks and stability checks, Scia was used to calculate the permanent deflection that could be precambered. Checks were also made on distortional deformations, using a detailed model of the beam as a series of plates. High level clerestory glazing sits above the beams and is framed in steelwork. Movement joints were introduced in the clerestory rail to ensure that vierendeel action did not attract excessive axial load to the rail.

Stability without bracing

The North and South elevations are entirely glazed, leaving no room for diagonal bracing against the westerly wind. Lateral stability is achieved with a network of slender SHS struts concealed within the timber roof zone. These transmit axial lateral loads to the adjacent concrete frame. At the steps in roof profile, the eccentricity is resolved by taking an additional torsional moment into the fabricated box beams. This achieves a structure without either diagonal bracing of the heavy members of a portal frame.

Movements and interfaces

The steel frame supports extensive glazing, a timber roof, and copper cladding. The lateral stability system gives a relatively flexible structure. As glazing in particular is sensitive to movements, the full 3D steelwork geometry was analysed to predict the deflections under self-weight, imposed loads and wind loads. The roof geometry gave rise to interactions whereby lateral loading created vertical deflection, and vice versa. It was also critical to provide a sliding bearing for the timber roof panels, to ensure that thermal stresses could not build up and cause fixing failure. A 'movements and tolerances' report used graphics from Scia to communicate the movements that follow-on trades were required to accommodate at interfaces.

Concrete frame - dynamics and non-linear analysis

On the second floor of the leisure centre, long spans combine with a fitness studio to create a dynamically sensitive area. Modal analysis was carried out and the slab designed appropriately to eliminate dynamic effects from rhythmic activities.

The south elevation of the leisure centre cantilevers over the beach promenade. To achieve a picture window with unrestricted views of the sea, columns were omitted and replaced with a grillage of cantilevering beams. At the longest span, a 9 m concrete cantilever required a full non-linear cracked section analysis, with actual reinforcement modelled. This demonstrated that long-term deflections will be within acceptable limits.

Collaborative communication

3D analysis and draughting were crucial to communicating the design to the fabricators. A combination of Scia Engineer, Autodesk Revit and Rhinocerous were used by the design team, with both the steelworker and timber subcontractor developing 3D models of their packages from design team information.

Software: Scia Engineer

AECOM

Contact Tom Lee
Address MidCity Place - 71 High Holborn
WC1V 6QS London, United Kingdom
Phone +44 2076452000
Email tom.j.lee@aecom.com
Website www.aecom.com

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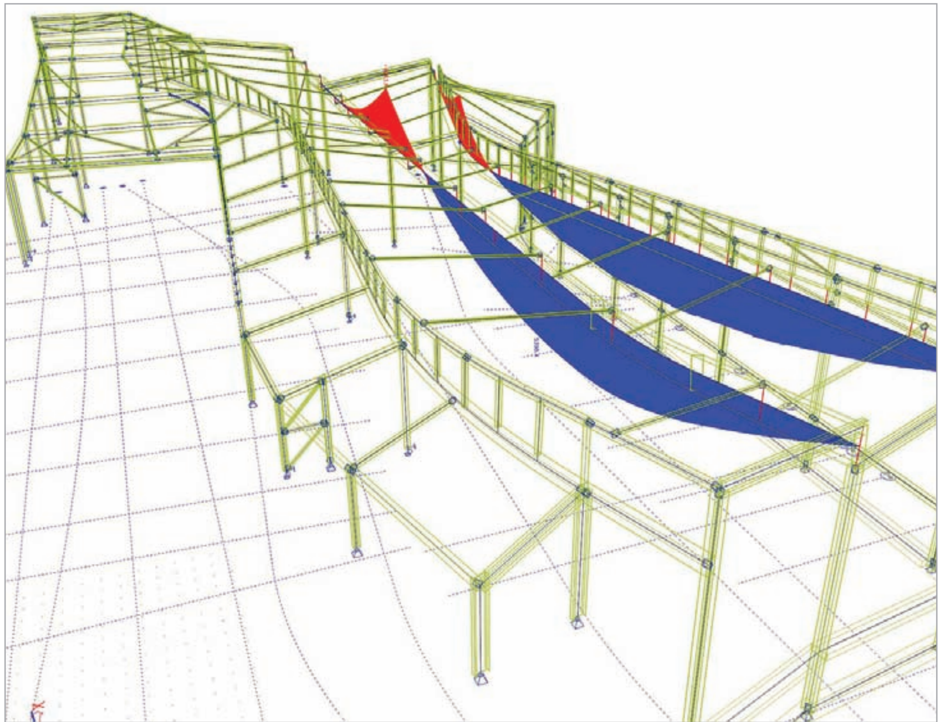
From major road and rail projects to energy generation, water management systems and creating beautiful and successful buildings and places, AECOM in Europe works closely with clients across all areas of the built and natural environment. Our teams of award-winning engineers, designers, planners and project managers ensure that our solutions outperform convention. Combining global resources with local expertise provides exceptional, high-quality, cost-effective professional and technical solutions.

Project information

Owner	Worthing Borough Council
Architect	Wilkinson Eyre Architects
General Contractor	Morgan Sindall
Engineering Office	AECOM
Location	Worthing, United Kingdom
Construction Period	09/2011 to 05/2013

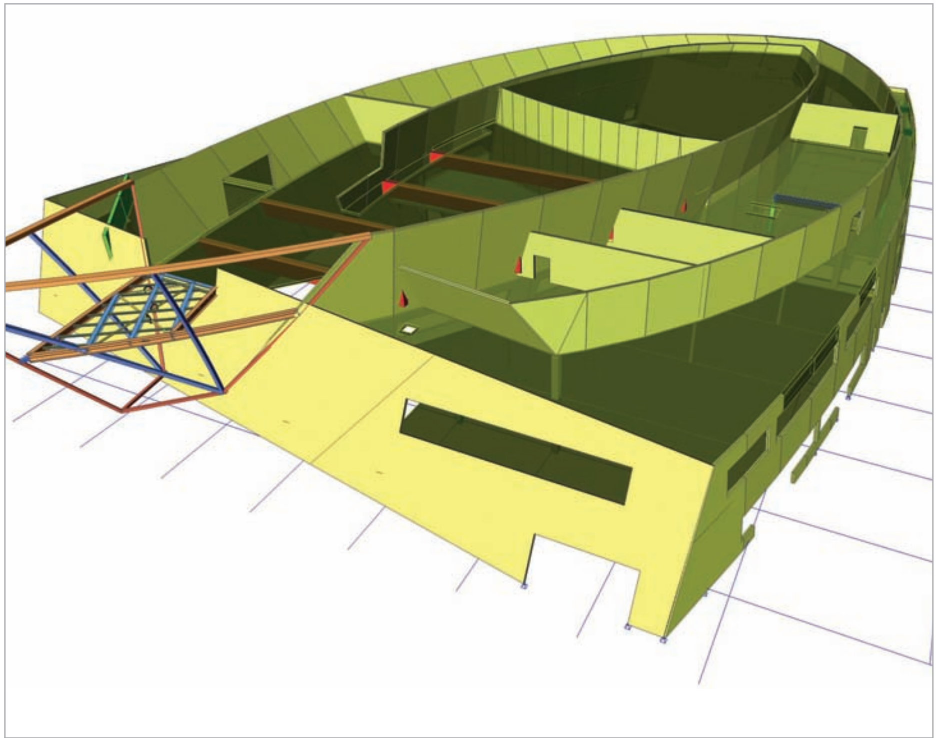
Short description | Worthing New Pools

Worthing New Pools is a landmark development on the south coast of the UK. The striking form reflects a desire to provide not just a community leisure centre, but an iconic building that will attract interest and investment to the local area.
The centrepiece of the RIBA competition-winning design is the steel framed pool hall, supported by doubly curved, doubly asymmetric box-beams spanning over 50 metres. These create a flowing roof profile reminiscent of ridges in blown sand on a beach.
Complex and irregular geometry combine with a mix of steel, timber and glass to create a sculpted and striking building. Clear communication of the geometry and the predicted movements at interfaces was essential to the successful delivery, and relied heavily on the use of Scia Engineer.



Congress Centre - Mons, Belgium

Nomination Category 1: Buildings



Software: Scia Engineer

Introduction

The Congress Centre project for the city of Mons in Belgium is a "design & build" contract won through an international competition. The building will be operational in 2015, when Mons will be the European Capital of Culture. Situated between the historic centre and the new suburban zone - which will include a train station designed by Santiago Calatrava - the Congress Centre constitutes a focal point for the economic and social development of Mons. By creating a visual link with the Beffroi tower, the intention of Studio Daniel Libeskind architects was for the building to be fully integrated into the public and cultural urban tissue. This concept, seen as "urban blossoming", is reflected in the open spiral form of the building.

The programme comprises three auditoria seating up to 800 people, multi-purpose halls of up to 1,640 m^2, offices, a restaurant, a 158-space underground parking facility and a viewing platform accessible to the public via a roof promenade. The project is currently under construction with a planned completion date in mid-2014.

Structure

The main load bearing structure is formed by curved and inclined reinforced concrete walls termed "ribbons", with their complex geometry following an ascending spiral. As well as creating a dynamic form, the ribbons are integral parts of the structure that allow the ground floor volumes to be uninterrupted by internal columns. They act as deep beams spanning as much as 28 m between supports and 15 m in cantilever. These ribbons are constructed using a novel technique of flexible prefabricated formwork panels. This structural formwork uses expanded metal sheets to contain the concrete, placed around a double layer of reinforcement mesh that provides the stiffness to the panel.

All structural elements are prefabricated to the maximum extent: whenever possible precast planks or hollow-core slabs and prefabricated walls are used. For the heavily loaded roof beams spanning over 25 m, prestressed beams are used. In order to avoid columns on the ground floor, the meeting rooms are located on a light composite slab which is suspended from the curved ribbon walls. At the tip of the building, the ribbons form a cantilevering wedge used as a viewing platform. In this specific location, the ribbons are made of a steel frame. The building is founded on a series of prefabricated piles driven into the ground. In order to gain construction time, pile caps were avoided by using a 40 cm basement slab.

Stability

Due to the inclinations and curvatures of the ribbon walls, and the fact that the slabs are on different levels in each zone, overall stability was an important issue. The structural equilibrium had to be checked both for the complete structure and the intermediate construction stages.

Modelling

The complex geometry of the building was a challenge for the development of both the calculation models and the execution drawings. Using 3D drafting software, the curved and inclined surfaces of the ribbon walls were first modeled as a series of planar panels, reflecting the way they are constructed. These surfaces could then be imported into Scia Engineer as planar 2D members and connected to the slabs, beams and columns of the project. One important advantage of using 2D members rather than shells was that all 2D components such as openings and subregions were available in the Scia software. Different FEM calculation models were created in Scia Engineer that allowed for the testing of the structure at different scales, from the global complete building to local nodes connecting multiple elements. Using different settings for the mesh calculation times were optimised. The ribbon walls were tested both in individual models with lateral supports at slab locations and in a global model that takes into account the complex interaction between the structural elements.

Several features of Scia Engineer were used according to requirements: the deformations in the concrete were calculated for the long term according to Eurocode 2, non-linear calculations were carried out for the steel structure of the viewing platform and automatic combinations in accordance with the Eurocodes were used to verify the concrete and steel elements. Specific models were also built to test the stability of elements at different construction stages using props at precise locations.

NEY & Partners Lux

Contact Giorgos Kailis
Address 3, Rue du Fort Bourbon
L-1249 Luxembourg, Luxembourg
Phone +352 788131
Email gka@ney.lu
Website www.ney.lu

Ney & Partners is a structural engineering consultancy, established in Brussels. Since its creation in 1997, the office has worked with a pro-active view on the art of engineering through the integration of the different civil works disciplines.

This integration and optimisation of structural elements aims to overcome the classic hierarchic assembly of constructive solutions. Innovative bridges, roof structures and works of art developed by our office most clearly express this vision.

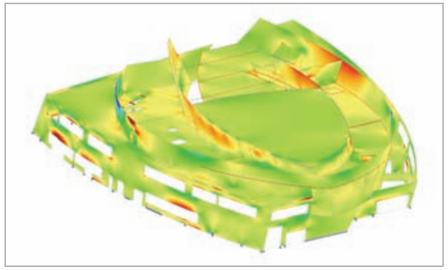
The construction project quality lies in the synthesis of specific design constraints. The structural aspect is of primary importance to this synthesis. From the very beginning of the design process, Ney & Partners conducts constant research for advanced engineering integration. In doing so, our position as an engineering consultancy goes beyond the standardised dimensioning of predefined technical solutions. Ney & Partners currently employs more than 45 civil engineers, architects and draughtsmen.

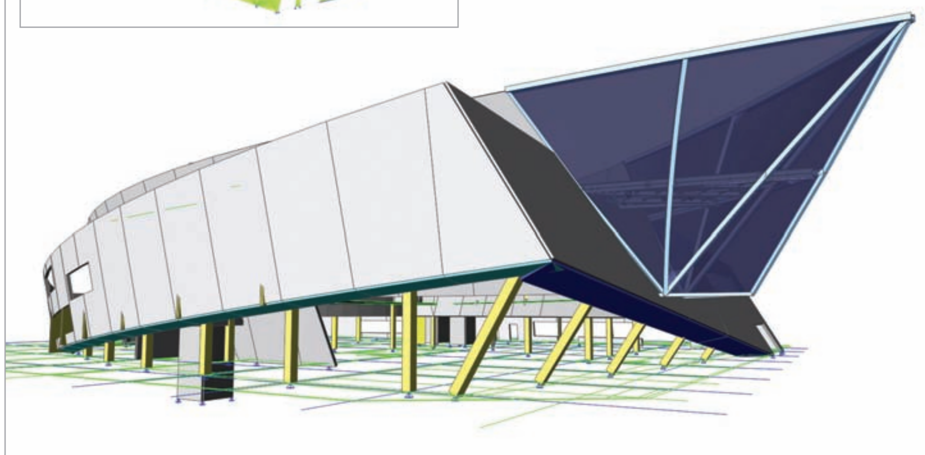
Project information

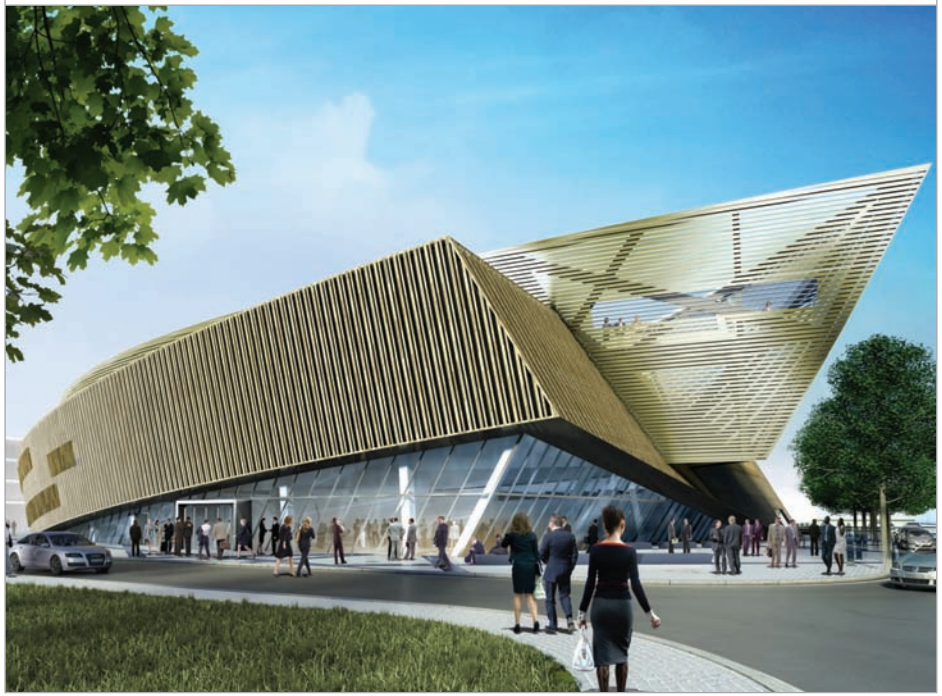
Owner	Ville de Mons
Architect	Studio Daniel Libeskind
General Contractor	CIT Blaton
Engineering Office	NEY & Partners
Location	Mons, Belgium
Construction Period	06/2012 to 03/2014

Short description | Congress Centre

The new Mons Congress Centre is a “design & build” project commissioned by the City of Mons as part of its programme for 2015 when it will be the European Capital of Culture. The building comprises several auditoria, multi-purpose halls, offices, a restaurant and underground parking. The main bearing structure is formed by curved and inclined concrete walls, termed “ribbons”, with their complex geometry following an ascending spiral. This arrangement allows great flexibility for the varied programme of the centre. These ribbons are constructed using a novel technique of flexible formwork panels. Some specific features of the structure are the following: Prestressed beams are used for the big spans around the roof glazing. The slabs are mostly prefabricated, either with precast planks or with hollow-core slabs. The meeting rooms are located on a mezzanine level which consists of a composite slab suspended from the curved ribbon walls. The viewing platform at the tip of the building is a light steel structure. All modelling was performed using Scia Engineer.

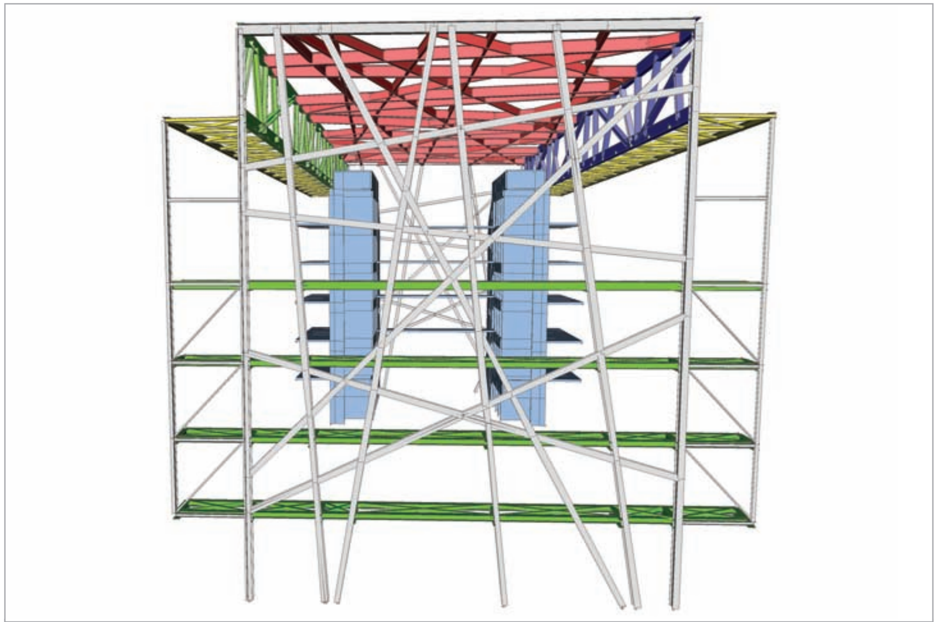


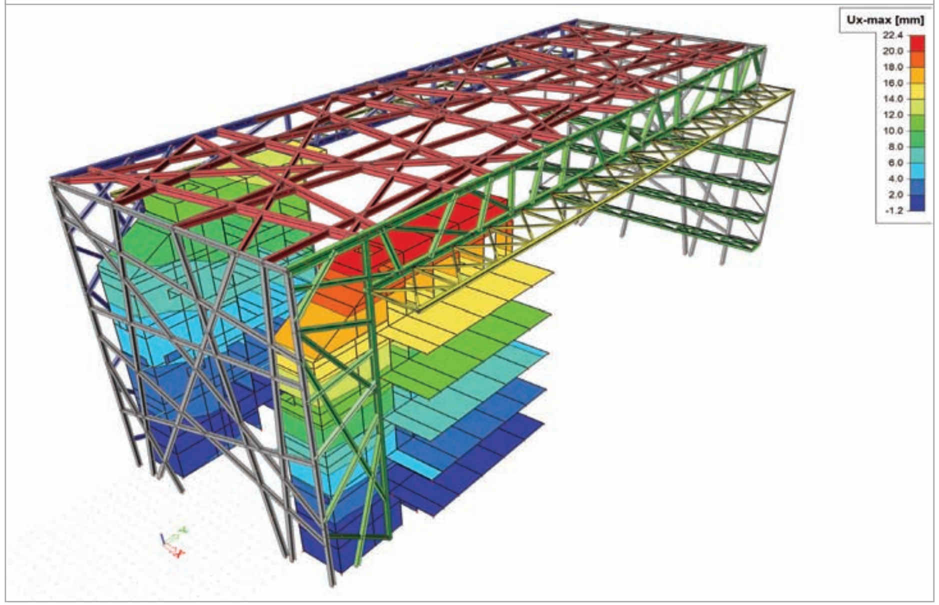




General Hospital Alma - Eeklo, Belgium

Nomination Category 1: Buildings





Project description

General hospital AZ Alma has commissioned a new regional hospital, to optimise its functions and services. Presently, the hospital still provides its services at two other locations. These locations will be given a new purpose once the hospital services have moved to the new location, foreseen for 2017.

The new hospital will count 512 beds, to be housed in two T-shaped wings, consisting of seven floors each, with a total area of 55,000 m². They will be connected by a central glazed atrium with 'panoramic' lifts. The hospital will employ 110 doctors and 1,200 co-workers. Besides the general services of a regional hospital, it will also boast a spacious polyclinic, a day clinic, a rehabilitation department and a dialysis department. Next to the hospital there will be two new car parks for staff and visitors, offering more than 1,000 places.

The central atrium will contain a whole range of communal functions, including a reception area, registration, a newspaper and magazines outlet, a restaurant, sitting areas and greenery.

Glazed atrium

The central glazed atrium between the hospital wings consists of a steel structure. Due to the large dimensions of the hospital, dilatation joints are foreseen between the atrium and the hospital wings. All beams and columns of the atrium have different angles which were sketched by the architects. This results in a random load bearing structure in both the façades and roof. The atrium measures 66 m by 28 m and is 28 m high. At the front side of the atrium, there are eight elevator shafts and two staircases, linked by post-tensioned concrete beams on each level. At the rear side of the atrium, four footbridges with a length of 28 m form the link between the two hospital wings.

The roof consists of primary beams HEB650 – spanning 21 m – and secondary beams. The primary beams are supported by two large trusses with a span of 42 m. As a matter of fact, the truss is a mixture of a triangular and a Vierendeel truss. It is supported by the rear façade and one of the elevator shafts.

The horizontal stability is assured by both the concrete shafts and the steel façades. The façades are therefore considered as a bracing mixture of a triangular and a Vierendeel. They consist of steel beams HEA300 and HEA500. The front façade (21 m by 28 m) is horizontally (perpendicular on the façade) at six points supported by the elevator shafts. The footbridges at the rear side of the atrium hang as a balcony on the rear façade, which results in moments and horizontal forces perpendicular on the façade. The rear façade is horizontally (perpendicular on the façade) supported by the footbridges which act as horizontal wind bracing trusses.

Modelling and calculation

For the structural analysis of the glazed atrium, Scia Engineer was used. Both the steel structure and the concrete shafts were modelled. The main challenge was to limit the deformations of the roof, the main trusses and the different façades according to the allowable deflections for the glass panels. There is a mobile bridge between the main trusses – for maintenance of the glazed roof – which results in additional severe limitations for the deflection of the main trusses. Scia Engineer was used for the optimisation of the steel structure, in the function of allowable deflections and strength. Concrete shafts were modelled to evaluate the collaboration of the vertical steel bracing in the façades and the concrete shafts.

Interoperability

The Scia Engineer model is also being used by the contractor to calculate all the steel connections and in making his montage study. Therefore different mounting stages and additional load cases will be added to the model by the contractor in the function of the mounting sequence. Due to the montage of the steel structure, the reactions on the foundations need to be re-evaluated. Thanks to the fact that Scia Engineer has been widely used, it is possible to use one global calculation model from both the contractor and the main design engineer.

Software: Scia Engineer

VK Engineering

Contact Frederique Noë
Address Zevenbergenlaan 2a
8200 Brugge, Belgium
Phone + 32 50 390553
Email frederique.n@vkgroup.be
Website www.vkgroup.be

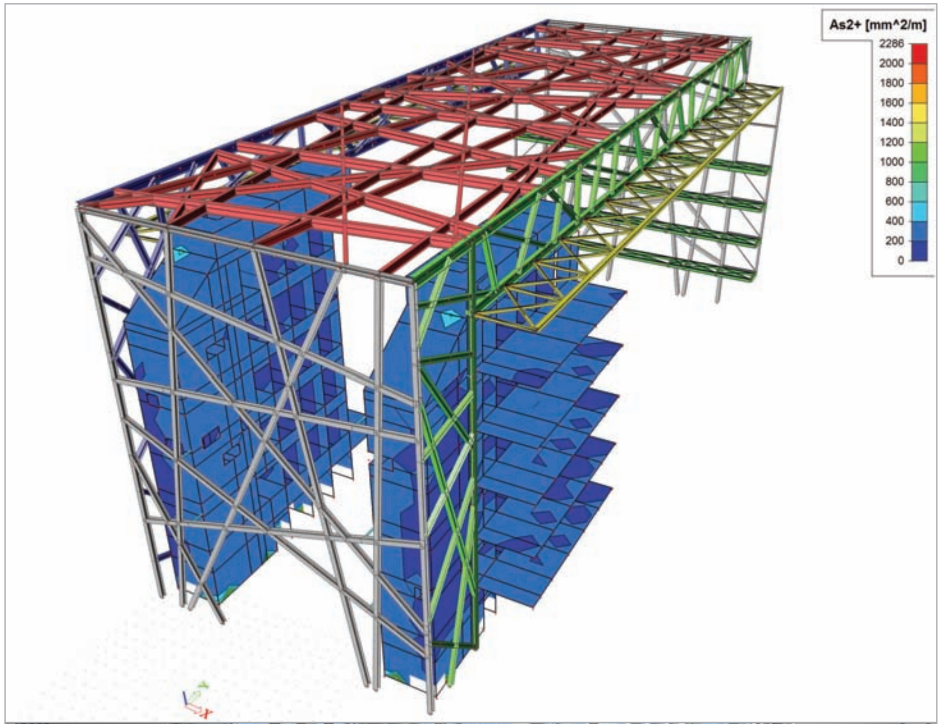
VK offers its services in four market segments: Healthcare, Buildings, Industry and Infrastructure.
Our multi-disciplinary consulting engineers undertake studies in building services and civil & structural engineering, ranging from mechanical engineering, electrical engineering and plumbing, to data communication, security and fire engineering, to concrete and structural studies.
VK keeps track of advanced technologies and studies in architecture and construction management and puts together the best team for the client's project.
Having a proven track record with many renowned architects, VK proudly looks back on the building of a portfolio that features many challenging and large-scale projects, including new constructions, as well as renovations of (classified) monuments, expert assessments and management. The new NATO-headquarters, the Antwerp law courts, the Astana National Library, and the VinMedicare Hospital in Hanoi are but a few examples.

Project information

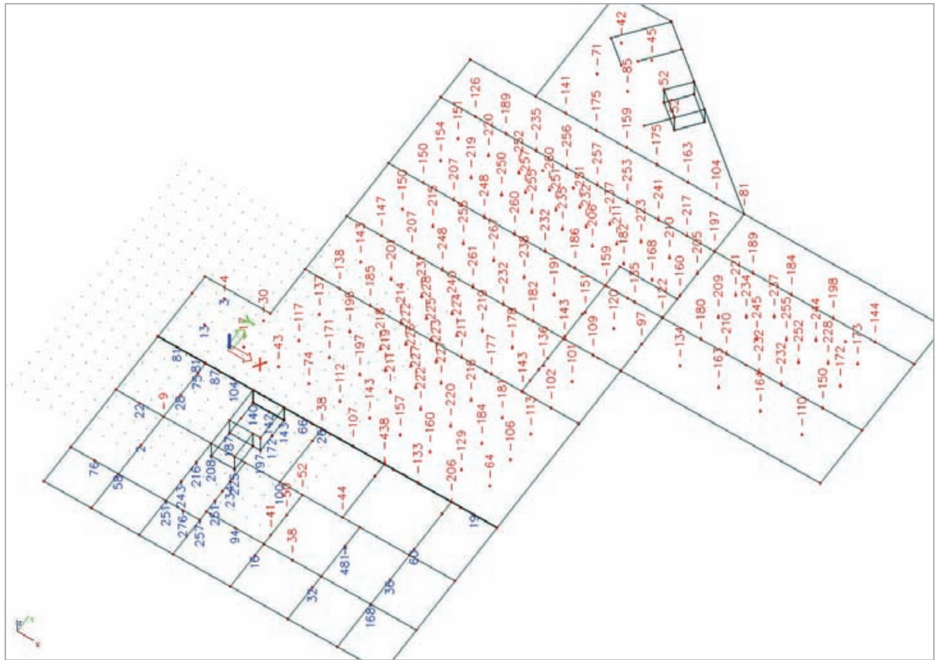
Owner	AZ Alma Eeklo
Architect	AAPROG Architecten
General Contractor	MBG - CFE nv
Engineering Office	VK Engineering
Location	Eeklo, Belgium
Construction Period	2012 to 2017

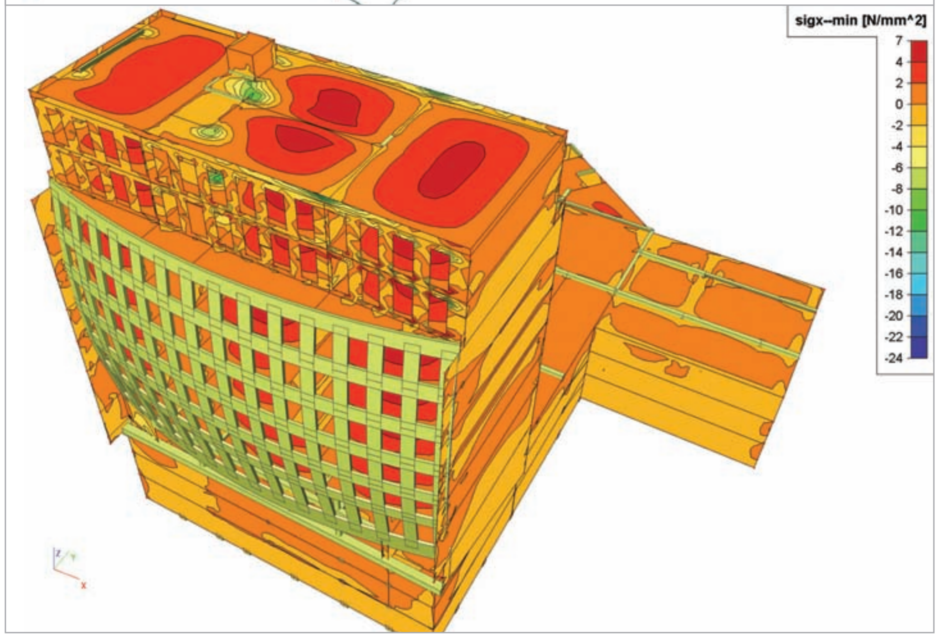
Short description | General Hospital Alma

The new general hospital of AZ Alma has a floor area of 55,000 m² on seven floors in two different wings (precast concrete structures) which are linked by a central glazed atrium. The atrium is 28 m wide, 66 m deep and 28 m high. The steel columns and beams of the atrium have varied, different angles, which results in a random structure. Horizontal stability is assured by both the steel structure and the elevator shafts. The roof is supported by steel H-beams with a span of 21 m and two main trusses (span = 42 m). Four footbridges, with a length of 28 m, hang on the rear façade and act as horizontal wind-trusses.



New Zebra - Gent, België





Wie Gent binnenrijdt kan sinds kort niet meer naast New Zebra kijken. De bolvormige gevel verbergt drie etages ondergrondse parking voor in totaal meer dan 100 wagens, kantoren en een restaurant, een polyvalente zaal met foyer en 38 woningen.

In feite is New Zebra een uitbreiding van het project Zebrastraat in de oude dierentuinwijk van Gent. De Stichting Liedts-Meesen kocht en renoveerde er enkele jaren geleden de eerste “werkmansappartementen” van Europa, in 1906 gebouwd door toenmalig stadsarchitect Charles van Rysselberghe rond een ovaalvormig binnenplein.

Sindsdien zet de Zebrastraat in op een unieke mix van wonen, cultuur en economie: 75 woningen zijn te huur volgens speciale korte-termijnformules, er is een uitgebreid cultureel programma met tentoonstellingen, concerten en debatten, vooral op donderdag avond, en een tiental zalen en polyvalente ruimtes zijn te huur voor congressen, beurzen en andere bedrijfsevents.

Met New Zebra worden deze activiteiten dus consequent uitgebreid. Zoals de site in de Zebrastraat 100 jaar na datum wordt erkend als typevoorbeeld van vernieuwende architectuur uit het begin van de 20ste eeuw, zo is het de expliciete ambitie om met New Zebra een gelijkaardige “landmark” voor het hedendaagse Gent te realiseren.

Op constructief gebied vormde, naast de bolvormige voorgevel, vooral de fundering de grootste uitdaging.

Zo is er een binnenplein ontworpen met daaronder 3 niveau’s parkeerruimte tot op een uitgraafdiepte van 9,10 meter. De ‘geringe’ bovenbelasting zorgde in combinatie met een hoge waterstand voor een aanzienlijk opdrijvend vermogen.

Anderzijds is er het hoogbouwgedeelte dat uit 8 bovengrondse en eveneens 3 ondergrondse verdiepingen bestaat.
Er is geen zettingsvoeg tussen beide gebouwdelen. Om de differentiële zettingen tussen beide gedeelten te beperken en in functie van de waterdichtheid van de betonconstructie werd beslist om het geheel op trek en drukpalen te funderen. Het paaltype is een “Ischebeck titan” micropaal die zowel op druk als trek kan belast worden. Er diende dus tevens rekening gehouden te worden met het vervormingsgedrag van de palen en met een daaruit volgende gronddruk onder de funderingsplaat.

Met behulp van Scia Engineer werd een volledig stabiliteitsmodel opgemaakt van bovenbouw én onderbouw. Met dit model en de daarop aangrijpende lasten kon de constructie van de bovenbouw perfect ontworpen worden. Eveneens konden de onderbouw en de funderingen perfect gemodelleerd worden.

Er dienden enerzijds meerdere situaties beschouwd te worden: constructiefase, vollast, minimale last en dit telkens in combinatie met een wisselende waterstand. Dit kon met Scia Engineer efficiënt geïmplementeerd worden, meerbepaald door het aanmaken van specifieke combinaties en bepaalde constructieonderdelen al dan niet in de berekeningen op te nemen door gebruik te maken van de ‘lagen’ tool.

Anderzijds was het vervormingsgedrag zeer belangrijk voor begroting van de differentiële zettingen en voor de berekening van de grondlast op de funderingsplaat. Door middel van in situ proeven werd het vervormingsgedrag van de micropalen opgemeten en zo kon door invoering van veerconstanten onder de palen en van een beddingsconstante onder de plaat de interactie tussen de paallasten en de belasting op de grondplaat onder invloed van dit vervormingsgedrag worden berekend. Beide parameters konden daarenboven in het programma als niet-lineair worden ingevoerd.
Met de beton module kon vervolgens perfect de nodige wapening in de grondplaat en wanden worden berekend, waarbij, gezien de waterdruk van ca. 9 ton/m^2, de scheurbeperking een bijzonder belangrijk gegeven was.

Meer informatie: www.zebrastraat.be

Software: Scia Engineer

Abicon N.V.

Contact Daan Verschaeve
Address Marialoopsesteenweg 2H
8700 Tielt, Belgium
Phone +32 51 402392
Email daan@abicon.be
Website www.abicon.be

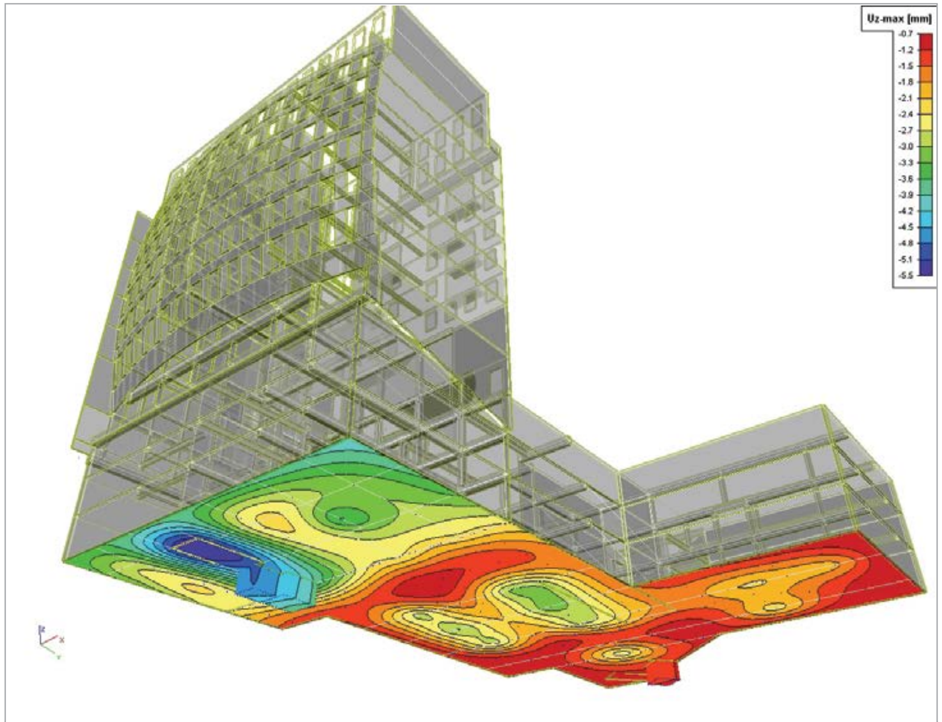
Abicon N.V. is een onafhankelijk ingenieursbureau gespecialiseerd in het berekenen van bouwkundige constructies in staal, beton en hout, zowel in de publieke als in de private sector. Onze hoofdactiviteit omvat het dimensioneren van: Industriegebouwen en stapelplaatsen, appartementsgebouwen, utiliteitsgebouwen, verkavelingen en woningen en beschoeiingen Verder adviseren we in saneringen, gevelrenovaties en gerechtelijke expertisen.
Daarenboven kunnen studies van betonconstructies onmiddellijk vertaald worden in uiterst gedetailleerde stuktekeningen, klaar voor prefabricatie van alle betonelementen. Voor de staalbouw kunnen wij eveneens alle constructies volledig uittekenen in 3D en alle werkhuistekeningen gepersonaliseerd aanleveren aan staalconstructeurs.
De grootste troeven van het kantoor zijn de ruime ervaring (30 jaar actief in de sector), de up-to-date kennis en uitgebreide software, de persoonlijke service na aflevering van de studie, het actief nadenken over economisch en het praktisch ontwerpen gepaard gaande met een grote flexibiliteit.

Project information

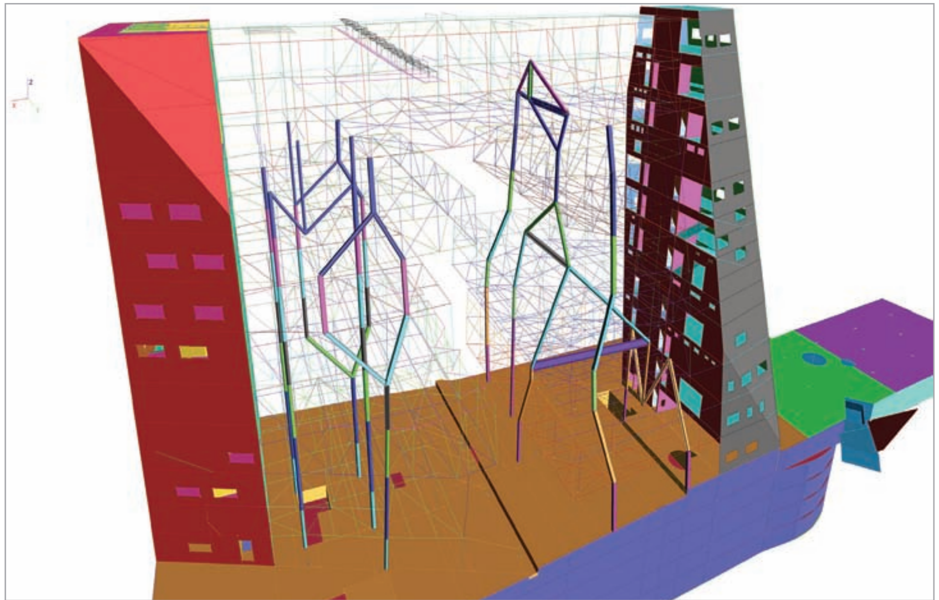
Owner	Stichting Liedts-Meesen
Architect	Restyling Groep
General Contractor	Vandewalle Construction
Engineering Office	Abicon N.V.
Location	Gent, Belgium
Construction Period	09/2011 to 04/2012

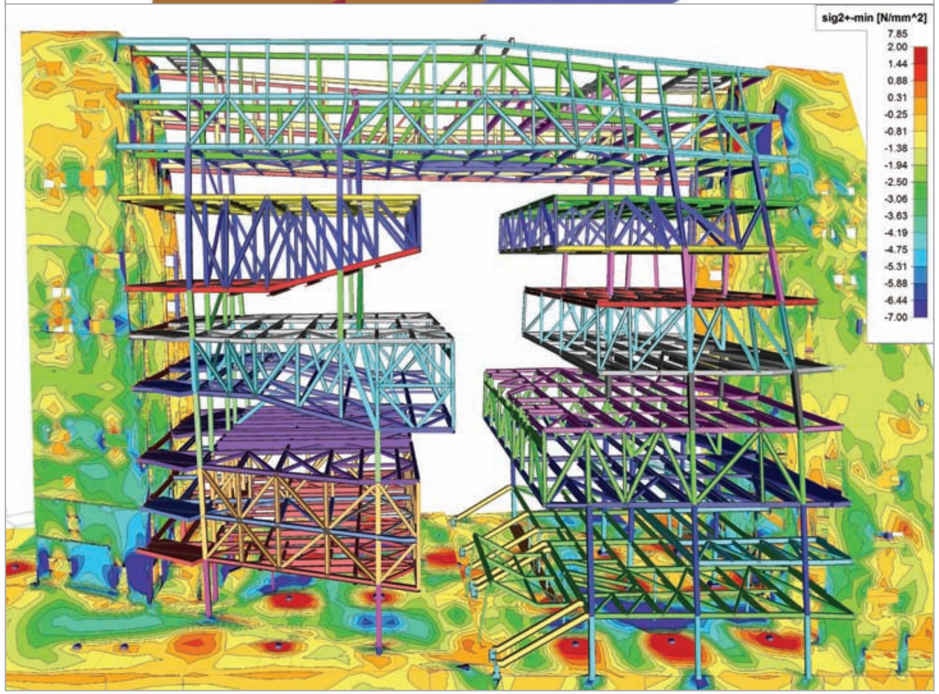
Short description | **New Zebra**

With its curved frontage in aluminium cladding, the New Zebra building is a brand new architectural landmark for the city of Ghent.
New Zebra is an extension of the Zebrastraat (-Zebrastreet-) project, an initiative of the Liedts-Meesen Foundation that provides a unique mix of housing with cultural and economic activities such as art exhibitions, seminars and corporate events.
Scia Engineer was used for the overall design, and specially for the detailed study of the foundations. Using specific combinations, all possible situations were simulated.



Groninger Forum - Groningen, The Netherlands





The Groninger Forum is a 35,000 m^2 multipurpose conference building located in the heart of the city of Groningen, just a few metres from the famous Martini Tower. Commissioned by the municipality of Groningen, NL Architects Amsterdam designed a spectacular building in which the freely accessible 40 m-high atrium provides a spectacular view over the city. The contour of the superstructure is characterised by the various wall surfaces extending obliquely in a forward or backward tilt. From this contour a ‘keyhole to the city’ that forms the atrium is achieved.
Located around the atrium, the Groninger Forum has ‘volumes’ housing five cinemas for film or debates, a ‘public demand’ cineac, training rooms, an auditorium annex theatre and various exhibition halls. Through the 20 m-long atrium, free span escalators transport the visitors, amid projections and presentations, to the indoor plazas. All the plazas located on 10 different levels, also facilitate exhibitions and presentations. In addition, the Forum houses two open stages, workstations for students and self-employed people, a grand café, a movie café, a restaurant on the top floor, a roof cinema and a library. The substructure houses a 5-storey parking garage and a single-storey bicycle parking facility.

ABT involvement

ABT is involved in feasibility studies of the plan, structural design, architectural plan development, construction management, project management and supervision, geotechnical consultancy, BIM coordination, design management and construction logistics plans.

Structural solution - unique features

The extreme oppositional oblique structure can be divided into two sections: super- and substructure. The superstructure consists of 11 floors, the substructure of a 5-layer parking garage containing approximately 400 parking spaces and 1,200 bike stable places. The gross floor area of the project is 20,300 m^2 (cultural complex) and 14,500 m^2 (substructure).
The two concrete cores on the west and east side are the main stabilising parts of the building. The steel volumes, constructed from oblique trusses, are connected to these cores. At levels 9 and 10 a steel bridge connects the two cores. In order to limit the span of the volume cantilevers, additional vertical load-bearing lines (columns) are applied. Just one of the challenging ambitions of NL Architects: the columns may not be positioned in one vertical line, at any level. The trusses have different inclinations and the position of the vertical bearing elements is irregular in all directions. All floors have horizontal bracings in order to compensate for the oblique position of trusses.
Unique for the steel trusses is that the top line of the trusses can slide at the top line until the building is complete. This prevents additional forces, partially caused by translating of the concrete core, negatively influence the steel structure.
The parking garage consists of concrete floors, walls and columns. The outer walls of the bicycle parking facility consist of traditional concrete walls. The deep basement diaphragm wall panels have the thickness of 1.0 to 1.2 m. The floors of the garage give, in addition to the vertical traffic loads, horizontal support to the outer walls because of the elongated void in the middle. In order to optimise the construction process, an underwater concrete floor (thickness: 1.0 m) is made. All floors are made of steel fibre reinforced concrete.

Scia Engineer

From an engineering point of view, the Groninger Forum is a very complex structure. During the development ABT uses Scia Engineer for all engineering challenges. In the preliminary stages, for 2D analysis of trusses and floors. Later on, in the process for 3D analysis, detailed analysis of 2nd order, stability and stiffness, of sub-sections of the building. Finally, the sub-models are merged into one overall model.
This working method has resulted in an essential and exact understanding of the behaviour of the building and also given direction to the assembly plan.
The complexity of the building shape also has an effect on building the FEM models. Connecting the sloping floors and oblique facades demands a very precise model to ensure accurate results. Also, the aligning and connecting elements in transition areas required the necessary care. Due to the interface of Scia Engineer, quick and steady editing of the geometry can easily be done.

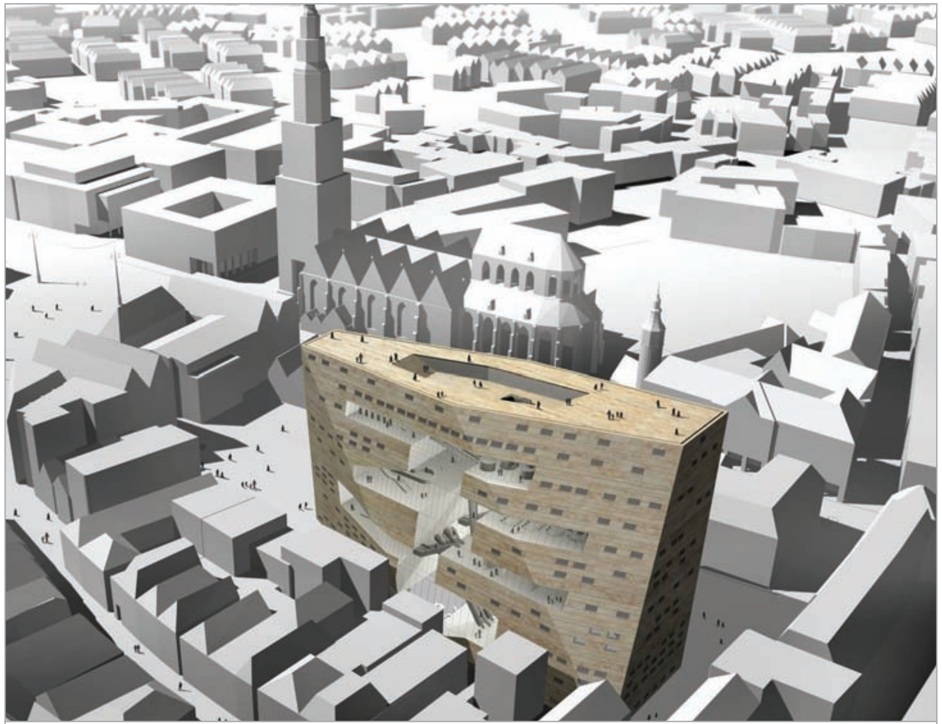
Software: Scia Engineer

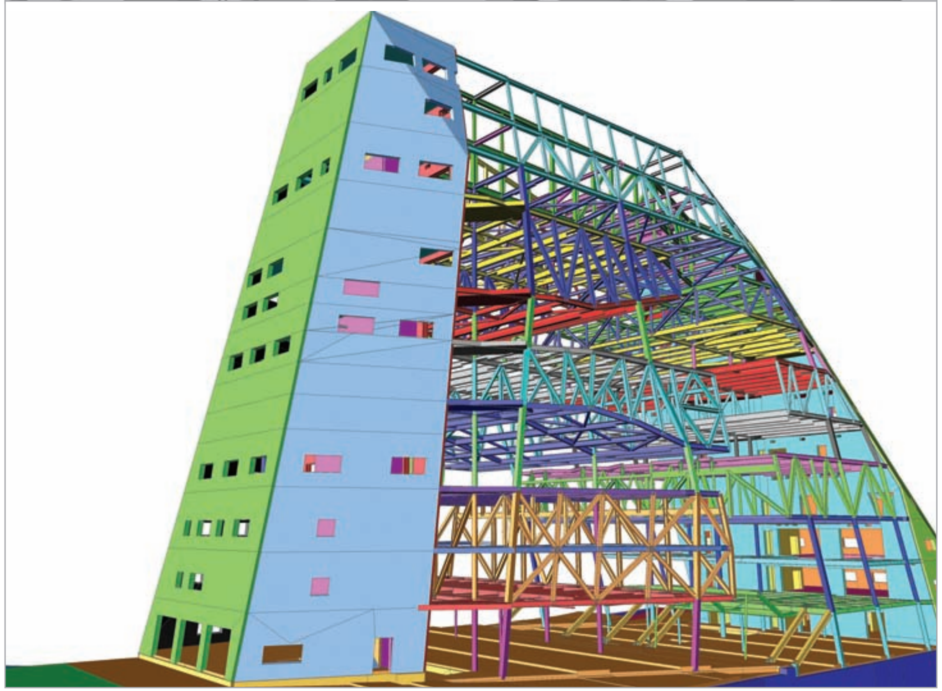
ABT bv

Contact	Matthijs van der Hulst
Address	Postbus 82
	6800 AB Arnhem, The Netherlands
Phone	+31 263683450
Email	m.vd.hulst@abt.eu
Website	www.abt.eu

ABT, an independent consulting firm, provides added value to the built environment. This applies to buildings as well as infrastructure, new developments and re-use of existing buildings. Based on our interdisciplinary engineering and process knowledge, we explore boundaries together with our clients.

Our consulting services focus on structural engineering, civil engineering, architectural engineering, building services and building physics. Design, project and building site management also form part of our areas of specialisation. Collaboration between these knowledge areas is self-evident to us. This is how we achieve high-quality, innovative solutions in which engineering is paired with knowledge. ABT is located in the Netherlands (Velp/Delft) and Belgium (Antwerp). www.abt.eu





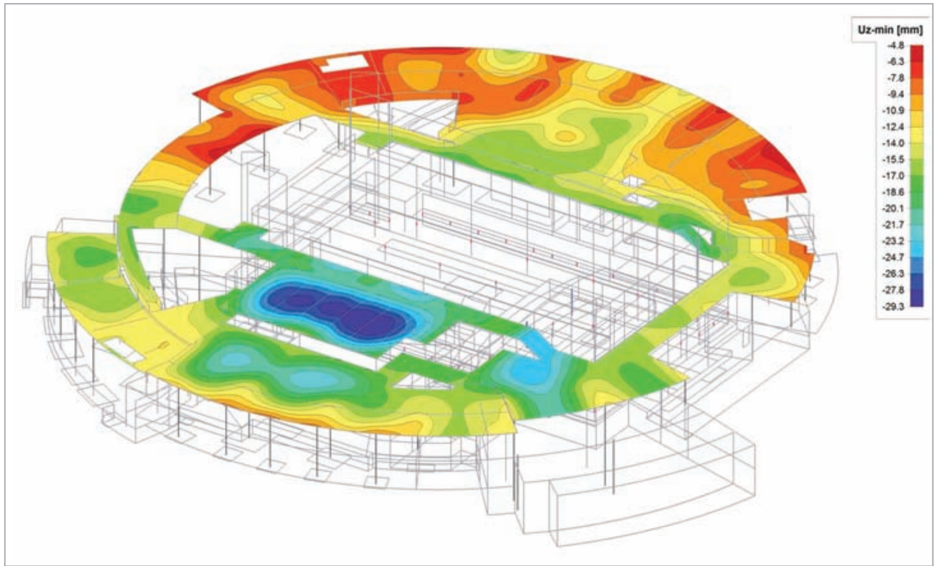
Project information

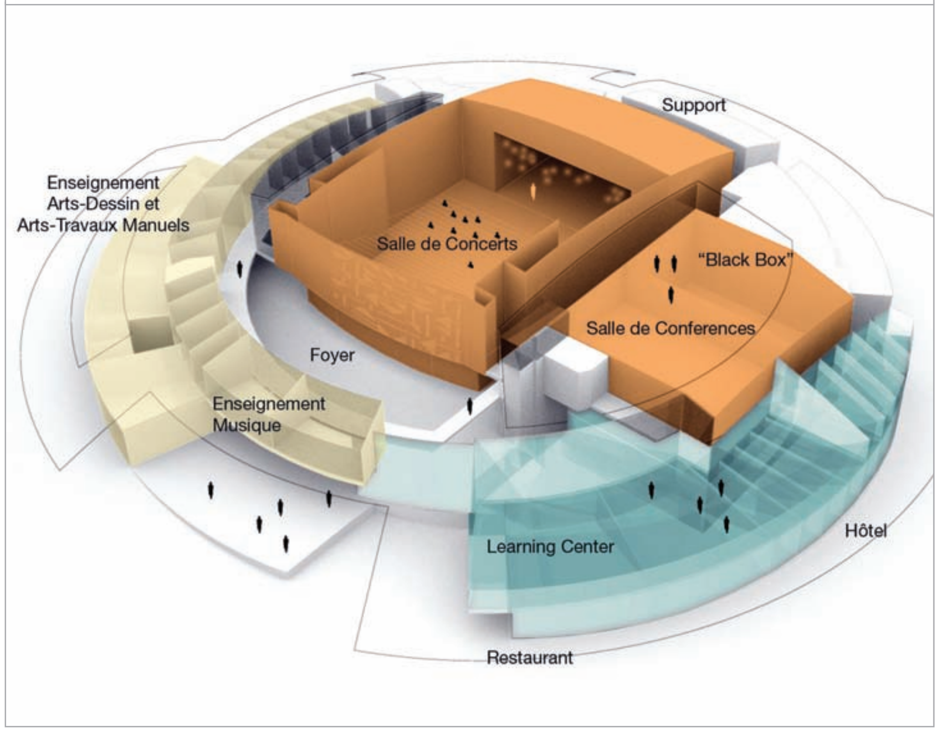
Owner	Gemeente Groningen
Architect	NL Architects
Engineering Office	ABT bv Velp
Location	Groningen, The Netherlands
Construction Period	2007 to 2016

Short description | Groninger Forum

The Groninger Forum is a multipurpose conference building located in the heart of the city of Groningen. NL Architects Amsterdam designed a spectacular building which is characterised by the various wall surfaces extending obliquely in a forward or backward tilt. From this contour a ‘keyhole to the city’ that forms the atrium is achieved. The Forum houses cinemas, an auditorium annex theatre, various exhibition halls, two open stages, workstations for students and self-employed people, a grand café, a movie café, a restaurant, a roof cinema and a library. The extreme oppositional oblique superstructure consists of 11 floors, the substructure of a 5-layer parking garage. The key features of the structure are the steel volumes and bridge, jumping load-bearing lines, oblique concrete walls and steel fibre reinforced concrete floors. ABT is involved in feasibility studies, structural and geotechnical design, architectural plan development, project management and supervision, BIM coordination, design management and construction logistics plans.

Carnal Hall - Rolle, Suisse





Le maître d'ouvrage, l'Institut Le Rosey à Rolle, entreprend la construction d'un bâtiment ayant pour but d'accueillir une salle de concert philarmonique et des salles de cours, afin de renforcer le parc de bâtiments existants.
L'ouvrage a une forme de dôme (demi-sphère) et se compose d'une structure en béton recouverte par une charpente métallique, elle-même enveloppée par des panneaux inox à sous-structure bois.

L'ouvrage se subdivise en 5 niveaux principaux soit:

- Local technique, destiné à accueillir tous les monoblocs et autres équipements techniques.
- Niveau sous-sol (uniquement en partie sud), avec un restaurant, des chambres d'hôtel et loges, ainsi qu'une "black box" destinée au théâtre et à la musique.
- Niveau rez-de-chaussée, se composant de salles de cours dédiés aux arts, un foyer, un magasin, divers locaux techniques sur la partie est et des chambres en partie sud.
- Niveau 1er étage, comprenant une bibliothèque et diverses salles de cours.
- Niveau des deux terrasses, avec au nord des installations techniques et au sud des surfaces ouvertes au public et dédiées à la détente.
- La "Box-in-box" ou la salle de concert philarmonique composée d'une scène, d'un parterre et de plusieurs balcons pouvant accueillir, au total, 800 spectateurs.

Le système porteur est composé de murs et dalle en béton armé coulé en place et de colonnes en béton armé, dont la plupart sont préfabriquées. Cette structure est recouverte par la charpente métallique soutenant une couverture en acier inox. Les façades sont en verre autoporteur.

La salle philarmonique, au centre du bâtiment, est complètement isolée phoniquement du reste de la structure et du sol par des boîtes à ressorts et un joint, servant à la fois à délier la "Box-in-box" du reste de la structure mais aussi de joint parasismique. Ce dernier permet d'éviter toute collision de la boite avec le reste de la structure.

Un soin tout particulier est apporté au traitement de surface des dalles et murs qui sont en béton apparent. En effet, un calepinage rayonnant en coordinations avec les éléments techniques a été mis en place.
Enfin, les effets des sous-pressions hydrostatiques dues à la présence de la nappe phréatique à 2 m de profondeur, ont nécessité la mise en place d'un système de rabattement de la nappe, pendant toute la durée de la construction de la structure, afin de garantir la stabilité de l'ouvrage.

Le logiciel Scia Engineer nous a permis de résoudre les nombreuses difficultés techniques du projet en modélisant l'ensemble de la structure ou des éléments particuliers afin d'analyser le comportement global et local. Nous avons réussi, grâce aux diverses possibilités du logiciel, à modéliser et résoudre les éléments particuliers comme :

- Les effets des sous-pressions.
- Les efforts en service des ressorts ou nous avons du évaluer les efforts réels et non pas les efforts donnés dans les normes afin de garantir l'isolation phonique de la Box-in-box.
- Les effets combinés et l'interface entre la charpente métallique et la structure béton.
- Les tassements potentiels ainsi que les contraintes au sol dans un terrain de qualité médiocre.

En résumé, 3 modèles principaux ont été utilisés soit :

- Un modèle global avec le radier sur des appuis à ressorts (module de réaction).
- Un modèle spécifique pour la charpente, sur appuis fixes.
- Un modèle global pour le béton sur appuis fixes.

La grande souplesse du logiciel nous a permis d'étudier dans un temps raisonnable les diverses difficultés et de tester les différents paramètres afin de vérifier l'exactitude de nos hypothèses et calculs.

Software: Scia Engineer

Alberti Ingénieurs SA

Contact Patrick Alberti
Address Avenue Eugène-Rambert 1
1005 Lausanne, Switzerland
Phone +41 728 23 94
Email info@alberti-ing.ch
Website www.alberti-ing.ch

BUREAU D' INGÉNIEURS CIVILS EPFL-SIA

Historique

Le bureau a été fondé en 1959 par Justin et Jacques Alberti, la raison sociale individuelle a été transformée en société anonyme en 1990. Patrick Alberti a rejoint l'entreprise familiale dès 1987 et la dirige depuis 2003. Le bureau est certifié ISO 9001 depuis 2000.

Organisation

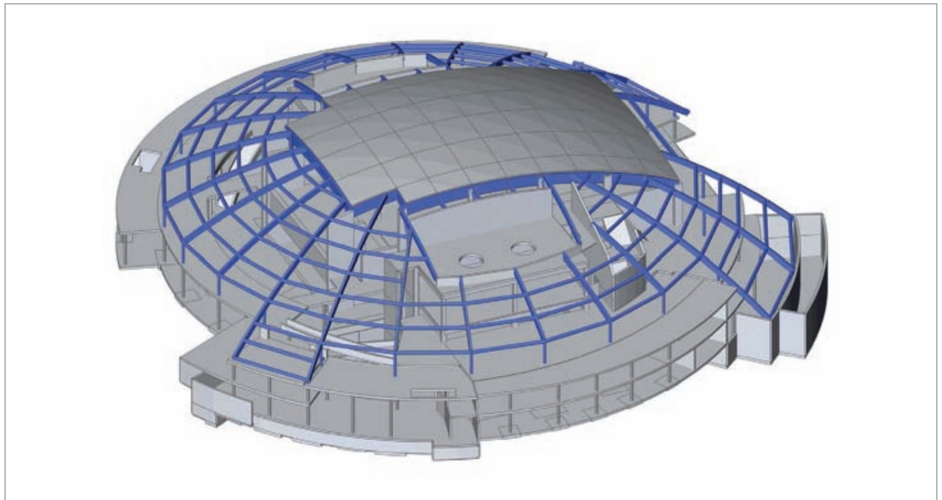
Les collaborateurs de la société d'ingénieurs Alberti Ingénieurs SA sont répartis selon les profils suivants: ingénieurs, techniciens, dessinateurs, comptable et secrétaire. Ce personnel, stable et hautement qualifié, démontre depuis plusieurs décennies son aptitude à la réalisation de projet de tout genre, du plus simple au plus complexe, dans un souci permanent d'écoute du client, d'efficacité, de rationalité, et de respect des critères de développement durable.

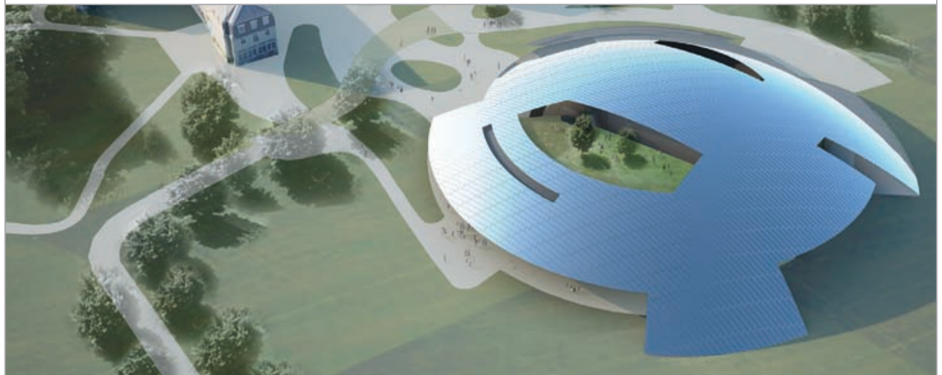
Project information

Owner	Institut Le Rosey, Rolle, CH
Architect	Bernard Tschumi Architects, NY, USA / Fehlmann Architectes SA, Morges, CH
General Contractor	ADV Constructions SA / Pittet Construction SA / Perrin Frères SA / Tuchschmid AG / HBT-ISOL SA
Engineering Office	ARUP NY Inc., NY, USA / Alberti Ingénieurs SA, Lausanne, CH
Location	Rolle, Switzerland
Construction Period	04/2012 to 07/2014

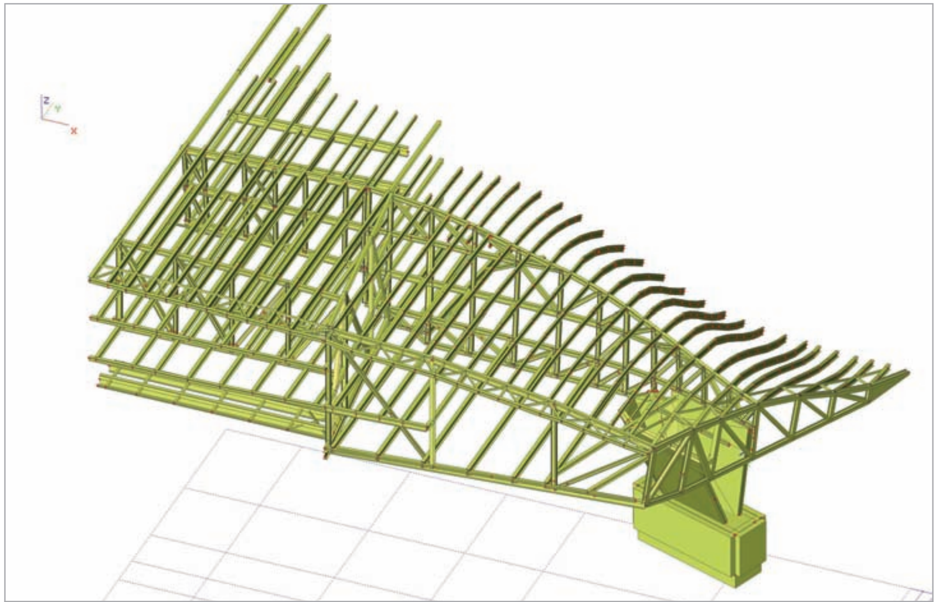
Short description | Carnal Hall

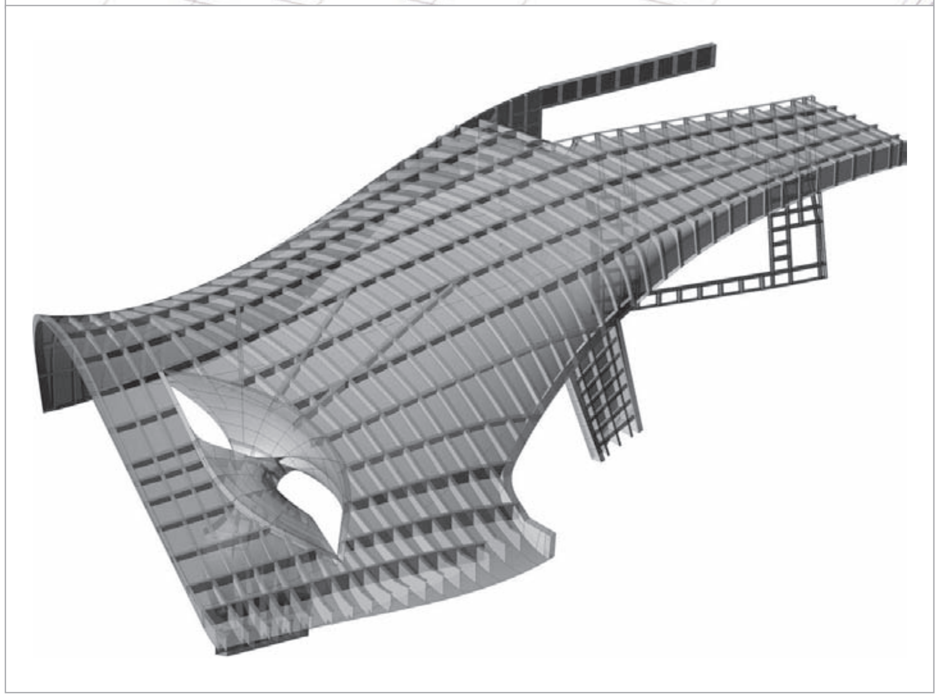
Institut le Rosey in Rolle, long known for educating many of the world's royalty as well as the children of celebrities, is about to get a state-of-the-art cultural centre, to be baptised Carnal Hall, named after the school's founder, Paul Carnal.
The new centre was designed by the Paris/New York architect Bernard Tschumi and will house an auditorium as well as several exhibit areas for the arts. The centre will be open to the public occasionally.
The Carnal Hall centre will contain: an 800-seat auditorium for concerts, theatre and conferences; music teaching rooms; art studios; a "black box" theatre; a teaching kitchen and dining room.
The whole will be an educational tool at the service of the school, Institut le Rosey.
Scia Engineer was used for all structural parts (concrete, steel, roof) and special focus went to study the acoustic isolation and the subsoil deformations.





OV-Terminal and K5 Office Building - Arnhem, The Netherlands





The OV-Terminal and the K5 Office Building are the final pieces of the complete masterplan of the reconstruction of the station area in Arnhem, the so-called Phase 2 of the project. The buildings are located next to each other and due to the organic forms they smoothly fit into each other. Both buildings are built on top of the car parking area, on top of and against the bicycle parking area (the so-called substructure) and against the K4 and K2 Office Buildings. These structures were already built in Phase 1 of the project and have a large structural interaction with each other.

Structure of OV-Terminal

The structure of the OV-Terminal consists of the structure of the roof and the structure of the balcony and road bridge. The roof structure is designed in steel and is basically a ship structure inside out. This structure is engineered and built by CSC (a ship builder) and modelled with the FEM-package Ansys. The balcony and the road bridge are reinforced, in situ concrete structures with spans of 25 m. The structure of the balcony is characterised by large beams (1.4 x 1.8 m^2), a concrete deck (0.2 m thickness) and a high number of kinks and inclinations. The road bridge is a concrete plate structure with weight-reducing elements in between.

The structure of the balcony and the road bridge is supported by a limited number of walls, of which some are inclined. Elements like the flip, the V-walls, the fronttwist and the backtwist are examples of inclined supports. This results in large horizontal forces which transfer through both the structure of Phase 1 (already built) and Phase 2 (current project) to satisfy equilibrium.

Structure of the K5 Office Building

The K5 Office Building has a steel structure composed of high truss structures with steel-concrete floor structures in between. These truss structures are necessary to support the total building on just six supports. The truss structures follow the organic form of the roof and a number of them are twisted, inclined or both. This also results in horizontal forces which should make equilibrium within the structure itself. One support, the so-called 'trumpet wall', which supports one of the trusses, is also inclined and introduces a large horizontal force of 2.5 MN in the structure of both K5 and the OV-Terminal.

Noteworthy is the fact that the stability of the K5 office building is provided by the OV-Terminal in one direction and the K5 wall structure in the other.

Use of Scia Engineer

Scia Engineer is used to model the concrete structure of the balcony and the road bridge and the steel structure of K5. The complex forms, kinks and curves of the structure, the inclinations of the supports and the complex interaction with the structure of Phase 1 and the roof made it necessary to model both structures (the balcony and road bridge of the OV-Terminal, and the K5 Office Building) in Scia Engineer.

For the balcony and road bridge structure, Scia Engineer is used to determine the horizontal and vertical load transfer. For the calculation of the reinforcement of the beams, integration strips are successfully applied.

Scia Engineer is used to calculate the load transfer and to check the steel elements with steel codes.

Software: Scia Engineer

BAM Advies & Engineering

Contact Mark Spanenburg
Address Runnenburg 12
3981 AZ Bunnik, The Netherlands
Phone +31 30 659 89 85
Email mmj.spanenburg@bamutiliteitsbouw.nl
Website www.bamutiliteitsbouw.nl

BAM Advies & Engineering is the consultancy and engineering office of BAM Utiliteitsbouw. It provides consulting, management, design and engineering expertise. This enables its customers to develop, build and maintain themselves in an optimum way. BAM Advies & Engineering has approximately 110 enthusiastic and motivated staff members.

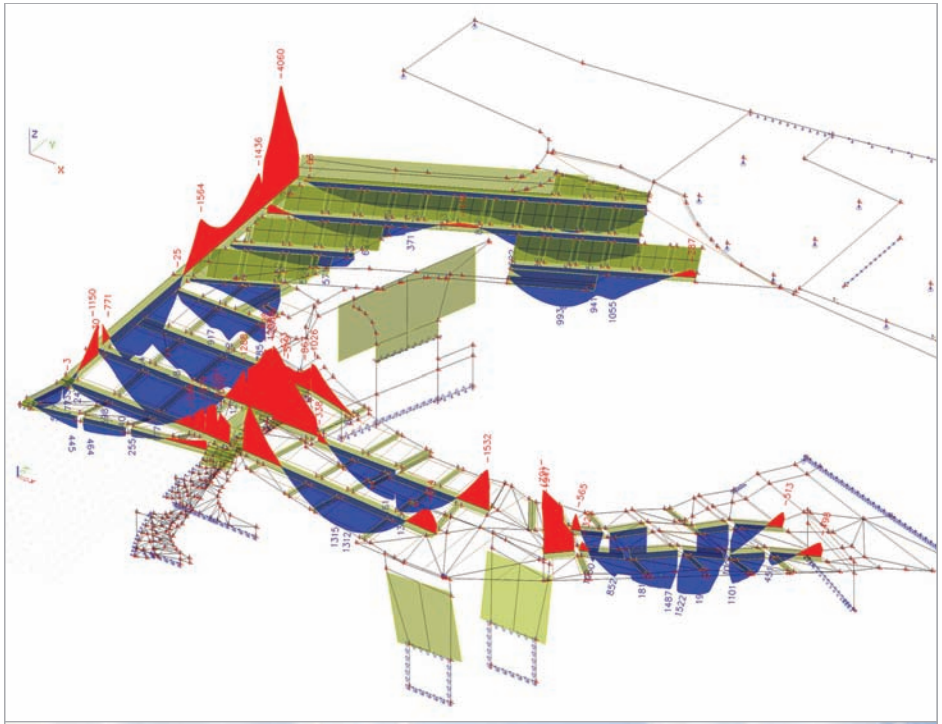
BAM Advies & Engineering is engaged in all parts of the construction process. Its services include: Design expertise, engineering and consultancy in the field of engineering, construction, installation, construction methodologies and maintenance.

Project information

Owner	Prorail
Architect	UN Studio
General Contractor	Ballast Nedam speciale projecten en BAM Utiliteitsbouw regio Arnhem
Engineering Office	BAM Advies en Engineering
Location	Arnhem, The Netherlands
Construction Period	12/2012 to 2014

Short description | **OV-Terminal and K5 Office Building**

The OV-Terminal and the K5 Office Building are the final pieces of the complete masterplan of the reconstruction of the station area in Arnhem, the so-called Phase 2 of the project. The buildings are located next to each other and due to the organic forms they smoothly fit into each other. The roof structure of the OV-Terminal is a steel ship structure inside out. The balcony and road bridge, which supports the roof, is a complex concrete structure with spans of 25 m.
The K5 Office Building is built next to the OV-Terminal and is an integral part of the project. The structure consists of steel trusses with steel-concrete floors. Noteworthy features of the project are the complex forms, the limited number of supports and the structural interaction between K5, the balcony and road bridge, the roof structure and the existing structure of Phase 1.



Forum Business Center - Bratislava, Slovakia

Description of the project

The building is designed as a reinforced concrete monolithic skeleton structure with bracing walls of the vertical core. It has 3 underground floors and 18 above-ground floors.

The foundation slab is assessed on the 5 m-thick gravel layer. Under the gravel there is a neogene clayey layer more than 30 m thick. The whole building was designed as one unit, without a dilatation joint between the high part and the underground part. The measurements of the underground part are 96 x 52 m. The foundation slab under the high part working together with reinforced concrete piles is 1,200 mm thick, under the columns there is a mushroom head for punching efforts. The foundation slab under the low part is 400 mm thick. The maximum underground water lifting power is higher than the dead load of the low part, so the structure is protected against underground water pressure by piles. All peripheral walls and slabs are designed as watertight reinforced concrete with the maximum crack width 0.25 mm.

The vertical bearing elements are reinforced concrete monolithic columns and walls. C40/50 concrete is used for the columns, C30/37 for the other vertical structure and C25/30 for the typical upper floor slabs. The walls of the vertical communication core ensure the stability of the building against wind and seismic load. The maximum seismic acceleration of 0.6 m/s^2 was used for calculation. The span of 7.8 x 8.1 m is used for the columns. The horizontal bearing elements are beamless solid slabs with reinforced concrete mushrooms heads. The thickness of the slabs for floors is 200 mm and the mushrooms heads ensure the allowed deflections and the shearing efforts. The slab over the 1st underground floor is designed for 33 kN/m^2 of dead load because there is a park with trees provided.

The layouts of the 1st and 2nd floors do not have the same shape as the other upper floors, that is why they are hung on the 3rd floor slab. This slab was reinforced by beams for this reason. The length of the peripheral columns on the 1st, 2nd and 3rd floors supporting the whole building is 12 m.

The process of work started in January 2012 and the expected deadline is June 2013. The excavation, piles and whole concrete bearing structure were completed in September 2012.

Use of Scia Engineer

Scia Engineer software was used for the static and dynamic analysis. The EN standards were used for calculation. One complete model of the main structure and some partial models for particular floors were made, and all bearing elements are designed. The Soilin module was used for the settlement calculations and for the contact tensions. Scia Engineer allows for the model of the complicated building to be produced very easily. It allows for a number of alternatives of the structure as well. There were more designs in the process of the work according to the client and architect demands and Scia Engineer permits changing of the structure very easily. The real deflections of the structure were measured on site, and the results are very near to the calculated deflections.

Software: Scia Engineer

Baran Projekt s.r.o.

Contact Jozef Baran
Address Tomášikova 3/A
821 01 Bratislava, Slovakia
Phone +421 2 43411703
Email baran@baranprojekt.sk
Website www.baranprojekt.sk

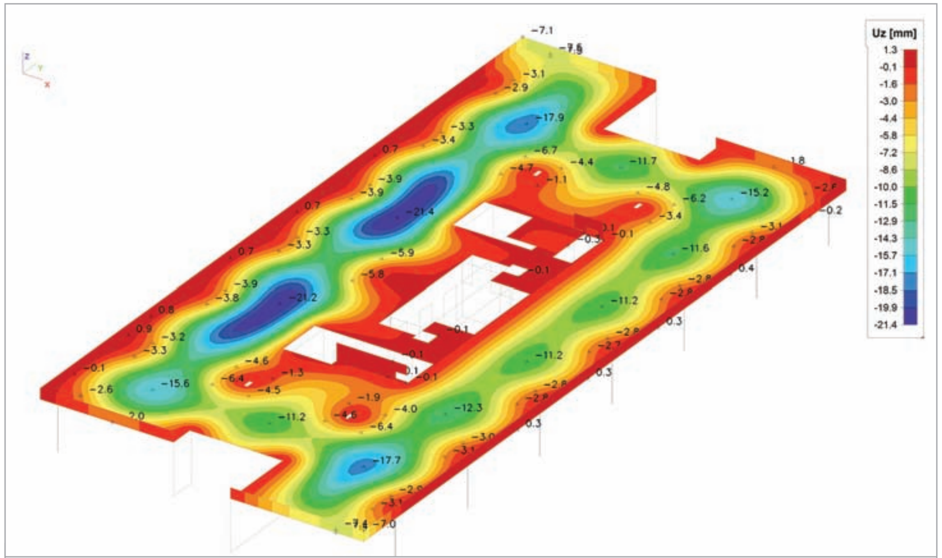
Baran Projekt s.r.o. was established in May 2006 as a continuation of already implemented projects of its founder, Jozef Baran. After graduating from the Slovak University of Technology in Bratislava in 1976, he started to work as a structural engineer at the state-owned company SPTU, one of the biggest design engineering companies in Slovakia. After the change of the political system in 1990 he passed the professional qualification examination, obtained the authorised certificate from the Slovak Chamber of Civil Engineers and in accordance with the new laws started to work as a structural engineer - entrepreneur. He has been doing this work - entailing comprehensive project documentation in the field of structural engineering, static and dynamic analysis, as well as preparing expert opinions - since his graduation. A selection of the many projects that he has worked on as a lead structural engineer can be viewed on the website www.baranprojekt.sk.

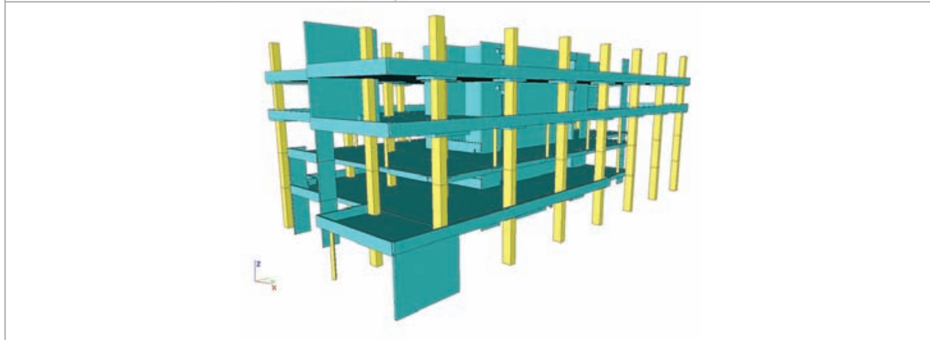
Project information

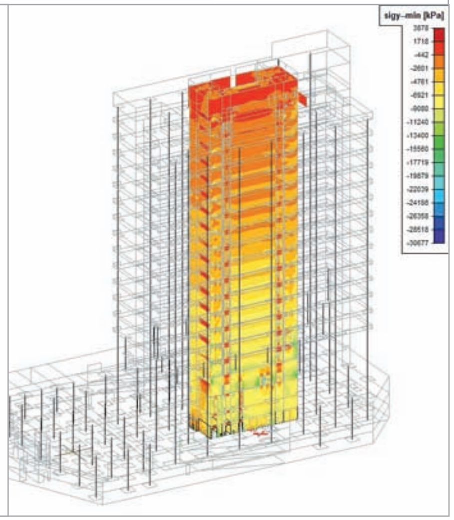
Owner	HB Reavis Group
Architect	CEPM s.r.o.
General Contractor	Skanska
Engineering Office	Baran Projekt s.r.o.
Location	Bratislava, Slovakia
Construction Period	01/2012 to 06/2013

Short description | Forum Business Center

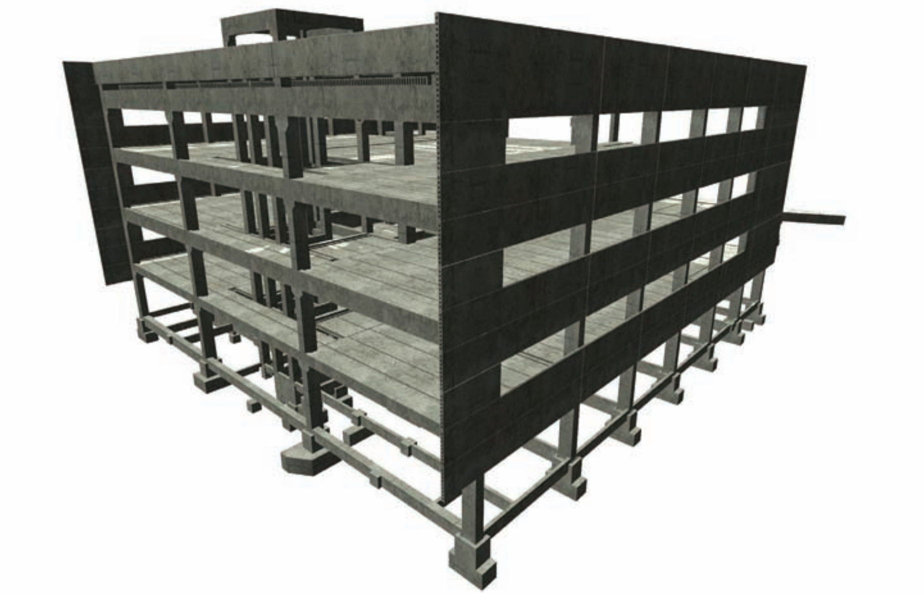
The landmark building with 18 above-ground floors is located on the corner of Bajkalská and Prievozská streets in Bratislava. There is a gross leasable area of 18,900 sq m and 350 parking spaces under the building. The developer - HB Reavis - takes the principle of good corporate citizenship extremely seriously and has established a strong corporate culture aimed at sustainable growth and continual innovation. It is the first developer in the region to implement general BREEAM certification for this project. BREEAM is the world's leading design and assessment method for sustainable buildings.

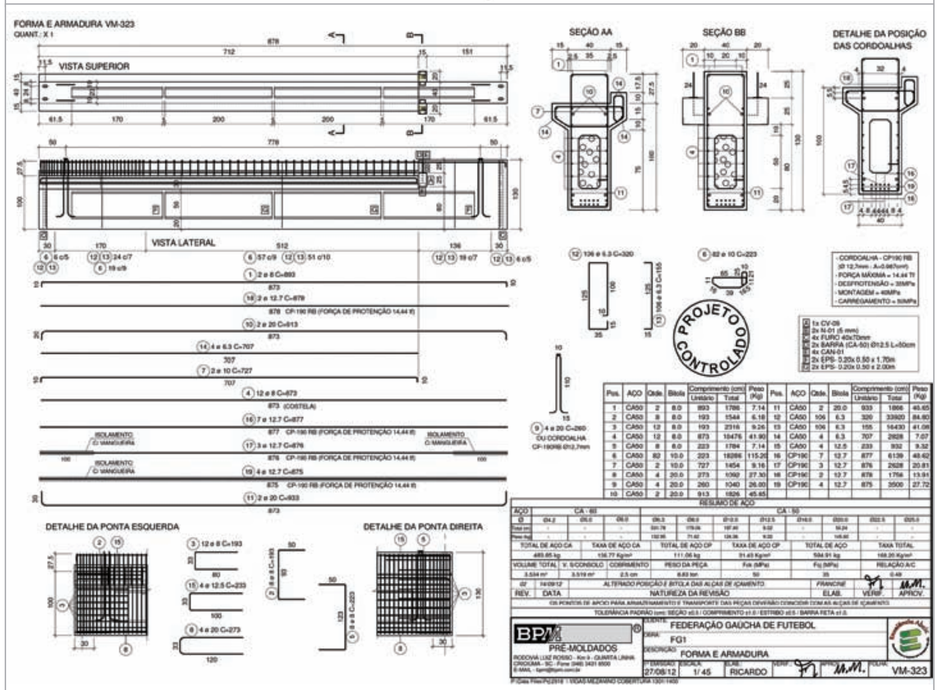






Administrative Centre Soccer Federation - Rio Grande do Sul, Brazil





Software: Allplan Precast, Scia Engineer

The building, designed for a regional soccer federation, has 4 floors, an auditorium, basement, podium and administrative rooms. The roofs was made with concrete slabs interconnected with steel domes

The biggest challenge in designing the project was to set all levels in the right position and the connections between the precast parts. The project had little or almost no repetition, and each precast piece demanded a specific detailing. There were concrete foundation walls, beams for bleachers, prestressed hollow core slabs, post-tensioned beams, prestressed beams, an access ramp, two elevator towers, and a facade with prestressed hollow core walls in balance, interaction with steel frames and stairs “in loco”. All in all, a project extremely complex and difficult to implement in precast concrete. Besides these factors, the short deadline for the design, production and assembly of parts of the structure was a significant challenge.

A lot of information was received early in the project: information about the slabs and stairs that would be executed “in loco”, the steel structures of roofs and front facade with glass skin, the machinery of elevators, etc. Unfortunately, the information was isolated, not worked into an interconnected system of information, which made us lose precious time joining and matching it.

Our strategy was to work to reconcile the initial information, check the interference and discuss them with the client and project stakeholders (structural designer for the “in loco” services, company supplier of elevators, and architects).

The project design was thorough, preventing errors in production and assembling of parts. It was possible to identify several interferences by using the 3D model Allplan Precast.

The main advantage in using Allplan Precast was error prevention and identification of interference at the time of preparing the executive project. Several cases of incompatibility were identified using the three-dimensional tool. Several pieces were detailed quickly because we already had a library with similar pieces. The design and detailing of prestressed hollow core walls and prestressed hollow core slabs were optimised due to software facilities. Using Scia Engineer was vital for the calculation of post-tensioning beams. The beams had cables with a parabolic path in the longitudinal direction, besides the lateral movement along the length of the beam. This modelling was only possible with the use of this software.

BPM Pré-Moldados

Contact	Nivaldo de Loyola Richter
Address	Rod. Luiz Rosso, 9.437 - 4ª Linha CEP 88803-470, Criciúma, SC, Brazil
Phone	+55 48 3431.8500
Email	bpm@bpm.com.br
Website	www.bpm.com.br

BPM Pré-Moldados was founded 25 years ago in the city of Criciúma. Today it is one of the companies of reference in the segment of precast concrete in southern Brazil for public works, logistics, sports complexes, educational, industrial, malls and buildings.

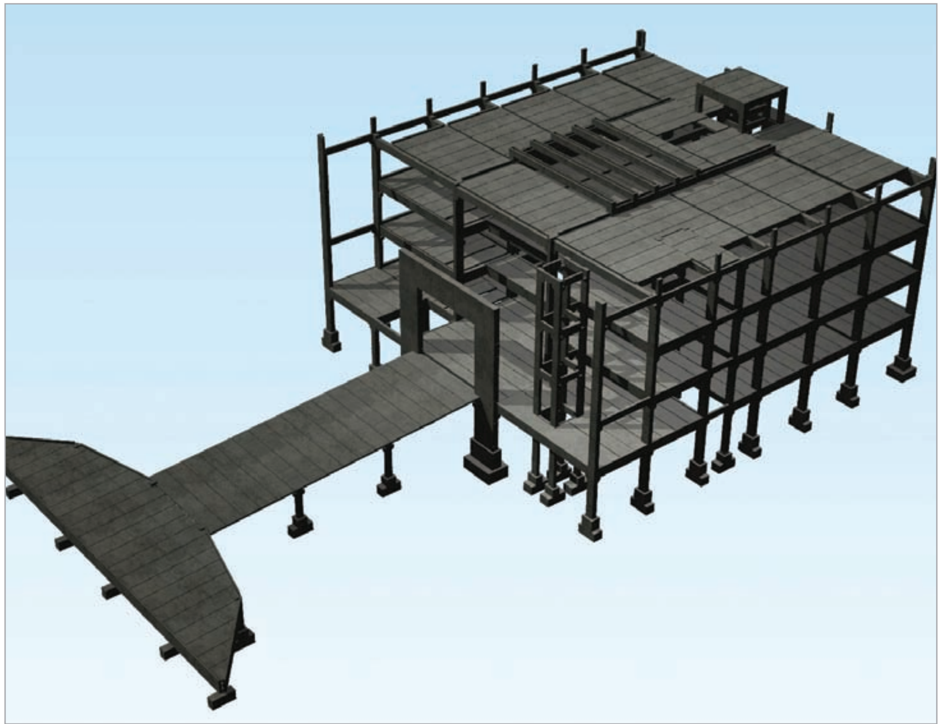
With more than 1,400,000 m² of works performed and 2.8 million metres of piles produced since the launch of its activities in 1987, BPM Pré-Moldados is conquering and consolidating its market position. This success is grounded in the quest for innovation and flexibility in the solutions to projects, cost reduction, safety and timeliness. Services are provided in compliance with the technical standards and experience of our staff.

Project information

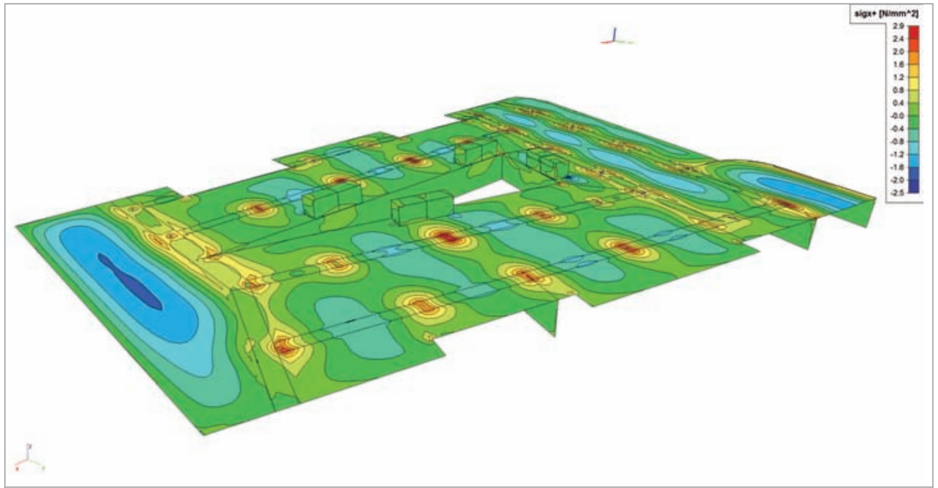
Owner	Federação Gaúcha de Futebol
Architect	Hermes Teixeira da Rosa
General Contractor	Federação Gaúcha de Futebol
Engineering Office	BPM Pré-Moldados
Location	Rio Grande do Sul, Brazil
Construction Period	10/2012 to 08/2013

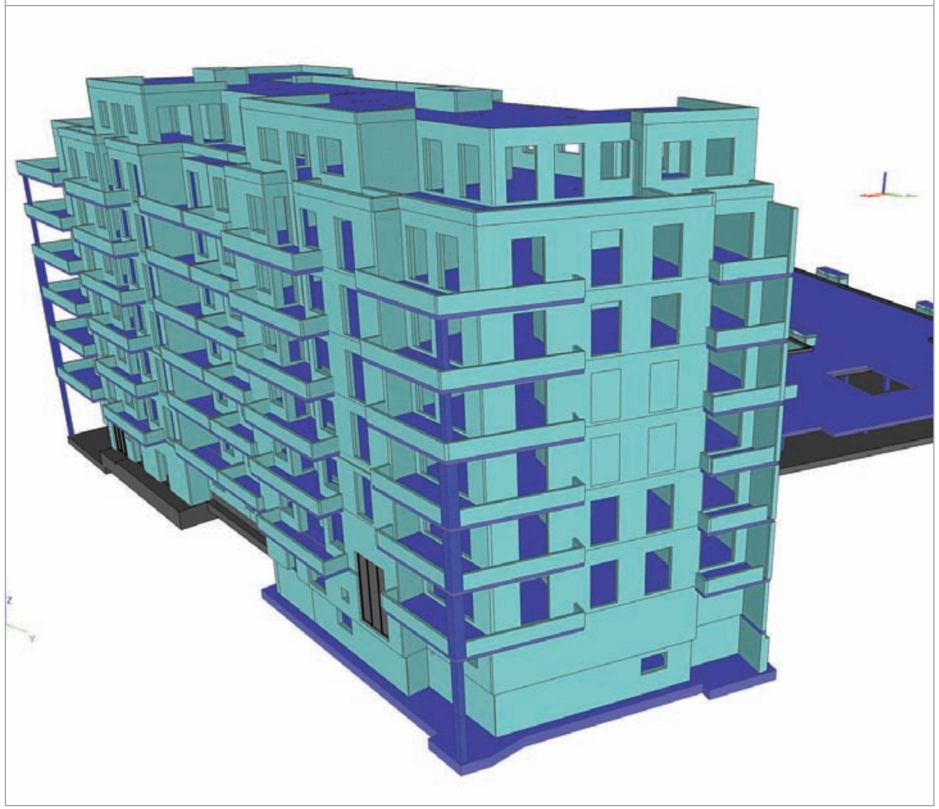
Short description | Administrative Centre Soccer Federation

This project concerns the administrative centre of the regional soccer federation in the state of Rio Grande do Sul, Brazil. This building has four floors. The roof consists of precast elements, concrete and steel. The facade is realized with prestressed panels and a glass skin. The structure also has precast elements, diversified prestressed and post-tensioned beams, prestressed wall and slabs. Everything is dimensioned with Scia Engineer and detailed using Allplan Precast.



Berlin Matthiasgärten, 7 Mehrfamilienwohnhäuser mit Tiefgarage - Berlin, Deutschland





Das Neubauprojekt „ Matthiasgärten“ beinhaltet insgesamt sieben Wohnhäuser mit jeweils 6 Vollgeschossen und einem Staffelgeschoss, sowie einer kompletten Unterkellerung mit Tiefgarage. In den Wohnhäusern befinden sich 154 Wohnungen mit ca. 70 verschiedenen Grundrissen! In der Tiefgarage sind 100 Stellplätze angeordnet. Der Höhenunterschied von 4,5 m innerhalb des Baufeldes führte dazu, dass der Eingangsbereich der Häuser 4 und 5 auf der Keller-ebene angeordnet wurde. Bauweise: Die Stahlbeton-decken werden als Fertigteildecken (Filigran) mit nachträglich ergänzter Ortbetonsicht ausgeführt. Die Außen- und Innenwände, bestehen „wo möglich“ aus Kalksandstein-Planelementen. Die restlichen Wand-bereiche erfolgten in Ortbeton. Bei dem Aufzugsschacht- und den Kellerwänden kamen Filigranelemente zum Einsatz. Alle Stützen und Unterzüge werden vor Ort betoniert. Die Balkone und Treppen bestehen aus Fertigteilen. Durch die KfW 70 Anforderung sind die 190 Balkone durch 954 Isokörbe thermisch von der Betonhülle getrennt worden. In den hochwertigen Wohnungen gab es die Vorgabe durch den Architekten auf Unterzüge komplett zu verzichten. Da die Zeitplanung so eng war, nahmen wir die angebotene Unterstützung unserer slowakischen Tochterfirma De Bondt Trencin in Anspruch. Die sieben Häuser wurden mit Allplan geplant. Unseren Bürostandard für ein Mehrfamilienhaus haben wir erweitert auf 7 Häuser. In Allplan waren dadurch 118 Zeichnungen und 2.000 Teilbilder fest belegt. Mit Hilfe des con-tura Büroassistenten in Allplan (für Wände, Stützen, Unterzüge, Decken, Fenster, Türen, Einbauteile und andere 3D Elementen) wurde das gesamte 3D-Modell erzeugt. Das 3D-Modell war und ist die Grundlage für das Erstellen sämtlicher Pläne für die Statik (Positions-, Schal-, Bewehrung- und Montagepläne), für die Architektur (Entwurfs-, Bauantrags-, Ausführungs- und Präsentationspläne) und für die Bauphysik (Wärme-, Brand- und Schallschutzpläne).

Um den einfacheren Datenaustausch zwischen Allplan und Scia zu ermöglichen, ist das Modell mit seinen Ursprungskoordinaten 0,0 in der linken untere Ecke platziert worden. Dadurch können kleinere Änderungen einfach über die Koordinaten eingegeben werden. Durch das 3D Modell war schnell klar, das der Entwurf mit der Fahrgasse unter den Häusern und den Parkplätzen im Innenhofbereich statisch nicht funktionieren würde. Durch die tiefer gelegenen Eingangsbereiche der Häuser 4 bis 7 war nicht genügend Höhe für die Unterzüge vorhanden, die die 7 Geschoße abfangen sollen. Zusätzlich fehlte der Platz für die Leitungsführung der Ver- und Entsorgungsleitungen. Die Fahrgasse wurde verschoben unter den Innenhof und wo es möglich war, wurden Parkplätze unter den Häusern angeordnet. Mit einer 25 cm dicken Decke über dem 5. Obergeschoß wurde es möglich ohne Unterzüge das Staffelgeschoß zu tragen. Die anderen Decken in den Häusern sind 20 cm stark. Die Tiefgaragendecke in Bereich des Innenhofes verfügt über einen 60 cm starken Aufbau der mit Feuerwehrfahrzeugen befahrbar ist. In den Erkern und Loggias sind Wandartige Träger eingebaut. Durch die KS-Wände (iterativ Rechnen, nur Druck) und die zu erwarten Änderungen durch Kundenwünsche haben wir die Häuser nicht als ein Modell in Scia Engineer gerechnet.

Mit Hilfe von Round-Trip Engineering zwischen Allplan und Scia wäre die Statik schneller fertig geworden, aber die Kontrolle und Prüfung der Statik wäre schwieriger und bei Änderungen müsste immer wieder das gesamte Modell durch gerechnet werden. Bei den Berechnungen wurden Bauteile mit Frilo (Stützen, Unterzüge, Kalksandstein Wände) und Scia Engineer (Decken, Bodenplatte, Treppen und Stahlbeton Wände) berechnet. Die Lastzusammenstellungen erfolgten mit Word und Excel. Mit den Frilo Dokument Designer wurden alle Dateien von einen Haus in eine Statik zusammengestellt. Mit der Allplanfunktion Fensterinhalt in Zwischenablage kopieren, können sehr einfach Skizzen in die Word- und Excel Dokumente eingefügt werden. Die Bezeichnung der 1D und 2D Elemente in Scia Engineering verläuft konform mit den Bezeichnungen auf den Positions-plänen. Auch die Lasten haben die gleichen Namen wie in der Lastzusammenstellungen. Für die Eingabe wird dadurch mehr Zeit benötigt, aber die Kontrolle verläuft viel schneller und die Lesbarkeit ist viel besser.

Software: Allplan Engineering, Frilo Statics, Scia Engineer

con-tura Architekten + Ingenieure GmbH

Contact J. Gröneveld, Dipl.- Ing.R.Meravý Murárik, PhD
Address Kronprinzendamm 15
10711 Berlin, Germany
Phone +49 30 810310700
Email jgroeneveld@con-tura.com
Website www.con-tura.com

con-tura: Fachkompetenz in Architektur, Tragwerken und Baukonstruktion

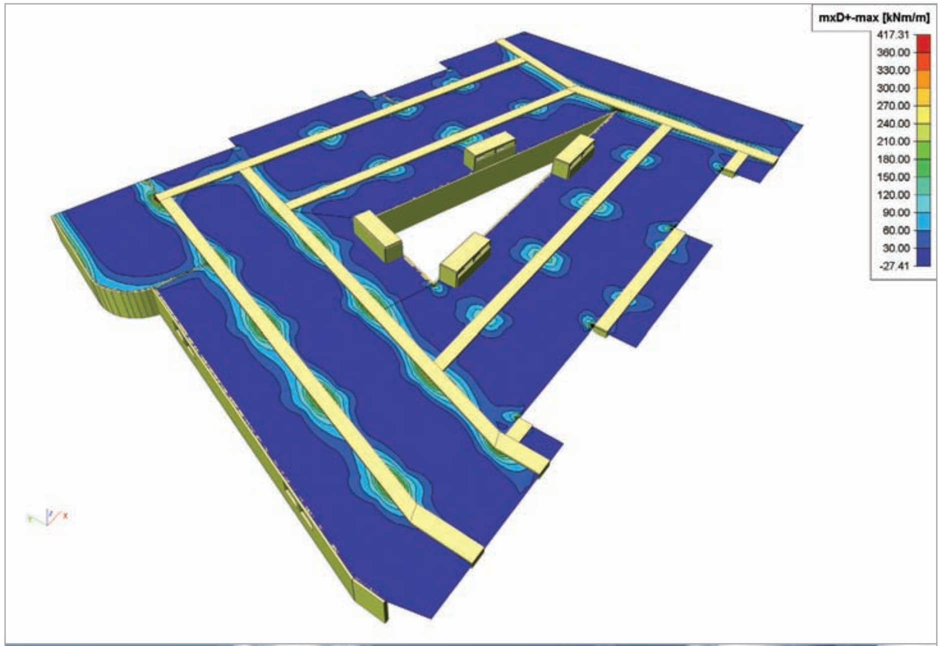
Gemeinsam mit unseren Auftraggebern aus einer ersten Idee erfolgreiche Projekte zu entwickeln und umzusetzen: Das ist die Grundlage unserer täglichen Arbeit.
Als fachkompetenter Partner verstehen wir uns als Berater und Baudienstleister. con-tura erbringt in diesen Funktionen alle Leistungsphasen des Städtebaus, der Architektur, des Baumanagements, der Tragwerkplanung und der Bauphysik.
Wissen und Technik sind bei con-tura ständig auf dem neuesten Stand. Grundlage unseres Erfolges ist das Fachwissen und die Motivation unserer Mitarbeiter. Mit den Erfahrungen aus unseren Niederlassungen in Deutschland, den Niederlanden und der Slowakei bieten wir nicht nur regionale Kenntnisse, sondern auch internationales Know-how, zum Mehrwert für unsere Auftraggeber.

Project information

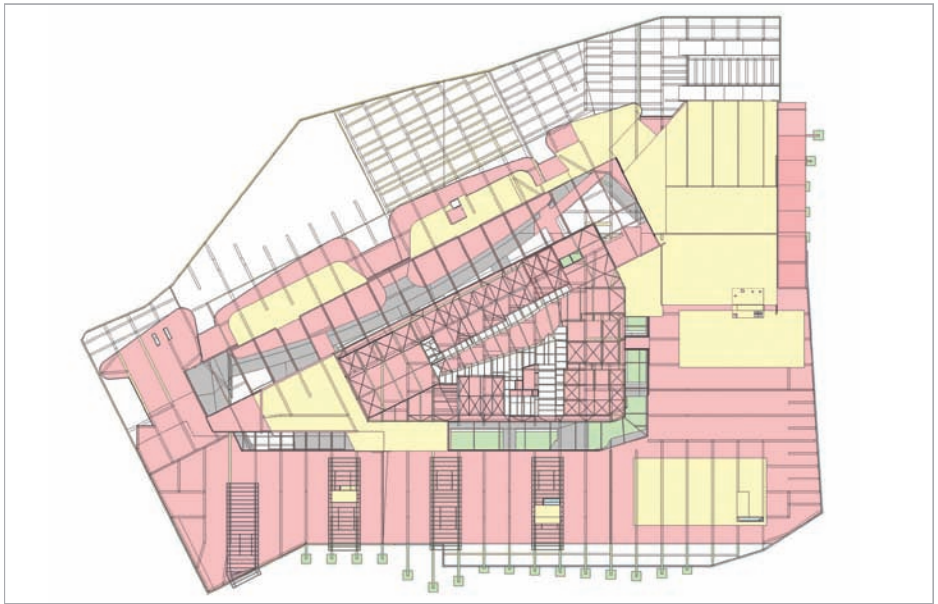
Owner	Kondor Wessels Wohnen Berlin GmbH
Architect	Gregor Fuchshuber & Partner
General Contractor	Bautec Bauunternehmung GmbH
Engineering Office	con-tura Architekten + Ingenieure GmbH
Location	Berlin, Germany
Construction Period	09/2012 to 11/2013

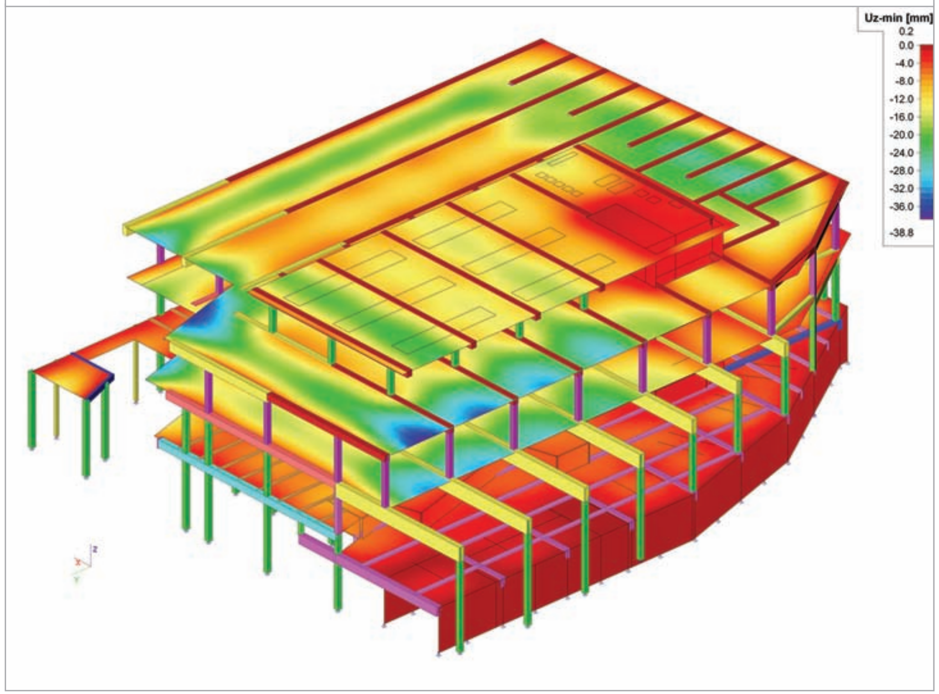
Short description | "Matthias Gärten", 7 Houses with Underground Parking

The newly built "Matthias Gärten" consists of 7 houses. Each house has 6 full floors, a staggered top floor and a garage in the basement with 100 parking spaces. Seventy different floor plans, forming a total of 154 apartments. The building plot has a height difference of about 4.5 m. In response to the site conditions, the architect designed two main entrances at basement level. The 190 balconies are designed and executed with 954 "Isokörben", which provides the required thermal separation in order to meet the "KfW 70" Standards.
The challenging task was to design a high-quality residential building without any visible beams inside. We produce all the necessary technical drawings of our construction in 3D format using Allplan 2013. For static calculations we use Frilo and Scia Engineer.



Galerie Šantovka - Olomouc, Czech Republic





Galerie Šantovka in Olomouc is a multifunctional complex with 46,000 m^2 of areas comprising shops, banks, restaurants, a car park with 1,000 spaces, cinemas, an 18-lane bowling leisure facility, warehouses, and service and loading communications. The whole object has a substantially irregular elongated shape graduating from the edges to its centre. Individual parts grow from the coherent basement and are further divided by the internal circular gallery. The largest length reached by the object is 235 m. It is divided into 14 expansion units. The building consists of two underground floors and three overground floors. Two bridge constructions are connected to the object and a third one has been projected. In order to reduce the construction time as much as possible, the object was designed as prefabricated in its greatest part. Only the necessary parts were designed as monolithic. On the 3rd overground floor, occupied by multiplexes and a theatre, it was especially steel constructions that were used, due to variability.

Description of the skeleton

The object is embedded on a monolithic base plate with stilts. The monolithic outside walls are located around the whole perimeter of the object, apart from at the locations of drive-up ramps. The staircases are prefabricated. The basic pillar raster is 8.1 m x 8.1 m, with the stilt raster being twice this measurement. The support system of the 1st overground floor - car park - consists of a reinforced concrete prefabricated skeleton. The reinforced concrete monolithic cores and beams are mutually interconnected by the semi-prefabricated panel-board with a minimum thickness of 250 mm. The beams are designed as standard with a load width of 8.1 m, to a span of 8.1 m. In the places under the tram, the load width is 4.05 m. The standard pillar size is 500/500 mm and a maximum of 700/700 mm. The reinforced concrete cores and walls are 250 mm and 300 mm thick. The support system of the 3rd overground floor - multifunctional premises, restaurants - consists of a similar prefabricated system to that of the lower sections, with added beams of the DELTA BEAM construction system. In certain places, the floor slab is necessarily finished with a reinforced concrete parapet. Bowling and multiplexes - the support system consists of steel pillars distributed around the perimeter and inside the construction, on which the solid-web steel beams are placed. The stability of the whole object is ensured by the wall and ceiling fastening. The wall construction is made of holorib. In the multiplex section, a steel ceiling grid has been designed, on which the corrugated iron with a concrete topping is placed.

Foundation and static load of the object

Prior to the object realisation, it was necessary to construct a lagged building pit for the underground floor development. The construction was built below the groundwater level. The drilled stilts' perimeter was 1,300 mm. The base plate, a maximum of 1,200 mm thick, was designed to also withstand the buoyancy of water up to the level of the inlet holes, because in the case of the load of "1,000-year water", the building would be under threat. The considered load of the multifunctional premises is from 6.5 kN/m^2 to 9 kN/m^2. Ramps for personal vehicles, trucks and sections under the tram have the load set pursuant to the applicable clauses of the ČSN EN 1991. In the places of intensive greenery, the load on the plate is approx. 23 kN/m^2. The climatic load was considered. The seismic load was not decisive in the design.

Description of the Calculation

From the project stage up to the production documentation, the construction was drawn (projected) in 3D, in the Allplan program from the Nemetschek Company. From the drawing program, elements and surfaces were exported through the ifc file in the Scia Engineer program. Subsequently, the construction was divided into expansion units. Individual units were thereafter solved separately. Moreover, other smaller sections were dealt with separately and then re-inserted to the expansion unit. Basic verification in terms of carrying capacity and deformation was evaluated in the Scia program. The whole model contained 5,787 elements - 1D and 1,156 elements - 2D. A total of 49 load conditions were used, in basic and extraordinary combinations. Production documentation of prefabricated constructions was processed for 1,400 various types of elements. The total volume of prefabricated elements was approximately 13,000 m^3.

Software: Allplan Engineering, Scia Engineer

De Bondt s.r.o.

Contact Daniel Dohál
Address Rybárska 7389
91101 Trenčín, Slovakia
Phone +421 327480011
Email ddohal@debondt.sk
Website www.debondt.sk

The planning and engineering bureau De Bondt, s.r.o., was founded in December 1996 by the parent Dutch company De Bondt B.V. and Slovak associates. Since then, the company has designed and consulted on many industrial, commercial and residential projects all over Europe - the Netherlands, Germany, the Czech Republic, Slovakia, Poland, Finland etc. - and outside Europe - Saudi Arabia, Canada, Afghanistan.

De Bondt, s.r.o. is specialised in providing technical services:

- Statics of steel, reinforced concrete, prestressed concrete and masonry constructions
- Plans and shop drawings for steel and reinforced constructions
- Optimisation of constructions,

and in providing services and consulting for developers - we can provide the complete support and documentation from the feasibility study up to the project documentation, participation in awarding the contract, technical supervision and the final evaluation of project.

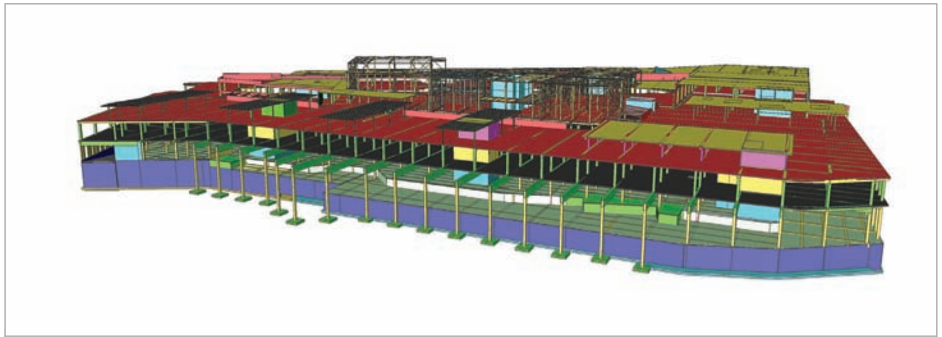
Project information

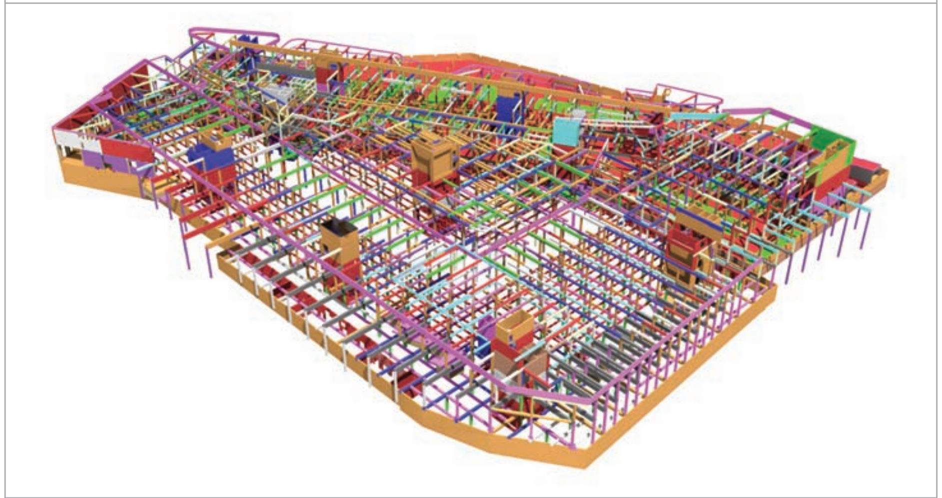
Owner	SMC Development a.s.
Architect	Benoy - United Kingdom, A8000 - Czech Republic
General Contractor	Metrostav a.s.
Engineering Office	De Bondt s.r.o.
Location	Olomouc, Czech Republic
Construction Period	01/2012 to 12/2013

Short description | Galerie Šantovka

The Šantovka multifunctional project is emerging in the original location occupied by the MILO Olomouc plant and represents an overall revitalisation of the land in the vicinity of the historical town centre. On the total area of 11 ha, a modern urban district is to be gradually built, with objects for living, commerce as well as administration.

Galerie Šantovka is the first stage of the whole project, offering more than 46,000 m² of leasable areas with approximately 180 commercial units and 1,000 parking places.

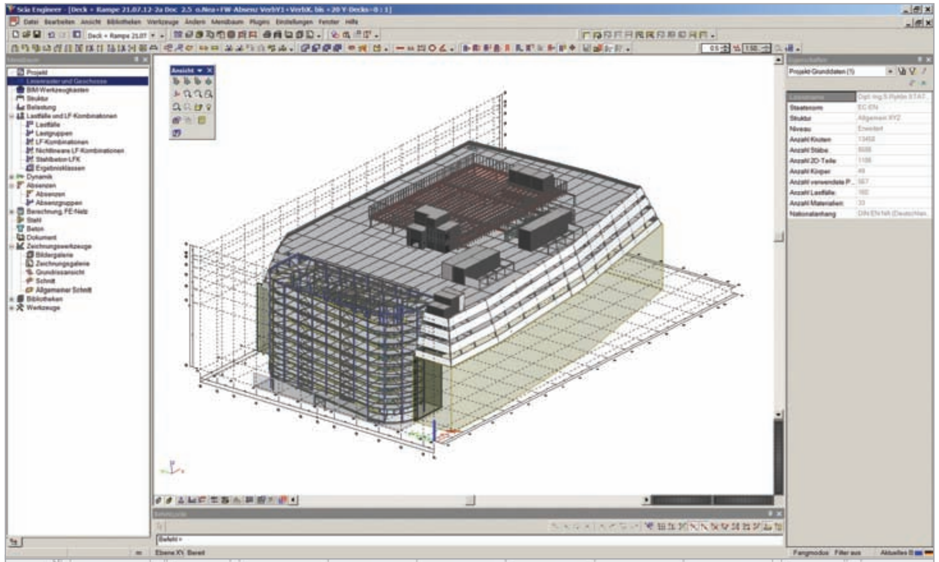


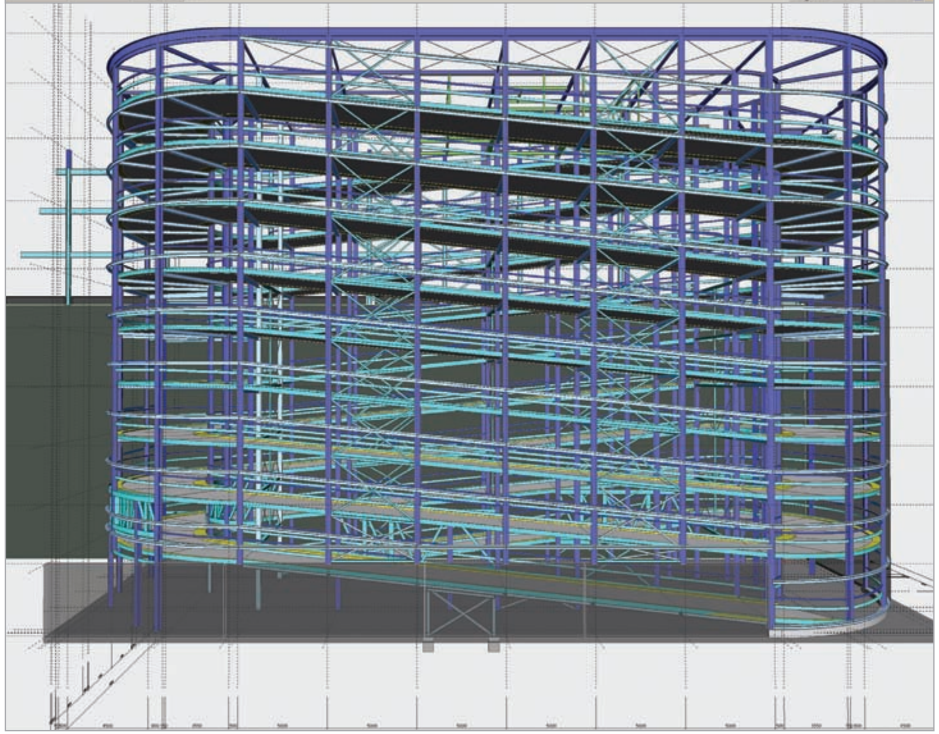


Category 1: Buildings

1

IKEA Roof Parking Space with Side Ramp - Hamburg Altona, Germany





Client

The company IKEA is known for its modern architectural designs of various types of appliances and furniture. Founded in Sweden in 1943 by 17-year-old Ingvar Kamprad, the company's name is an acronym comprising the initials of the founder's name (Ingvar Kamprad), the farm where he grew up (Elmtaryd), and his hometown (Agunnaryd, in Småland, South Sweden). As of 2013, IKEA has about 340 stores in 40 countries. Over 130,000 employees work for the company, the 47 German stores employ about 14,500 people. Last year, about 630 million people visited IKEA stores all over the world, about 100 million in Germany alone.

The Order

The first IKEA City Store has to be built on the smallest surface - about 10,000 m^2 - that an IKEA Haus has ever been built. The gross store area covers about 40,000 m^2, distributed over four floors, including the underground floor. Due to the space limit, the required parking space for 730 customer cars is placed on the top of the building at the height between 20.5 m and 31 m. It contains four parking levels. The side ramp structure, about 36 m high, connected the parkdecks with the street. About 3,000 m^2 of steel stage for the building technical equipment sits at the height of 36 m above the decks on the top of the building.

Technical data

The dimensions of the whole building with decks and ramp are about 140 x 85 x 36 m, it has in plan view an unregulated form and the walls of the parkdecks are 60° inclined.

It was divided into two parts for design:

- The main "inside" store building - about 120 x 85 x 21 m (without underground floor) - planned as a prefabricated solid structure (it was handled by the main contractor, Klein and Albert Karlsruhe, directly);
- The "outside" part of the connected parkdecks and ramp - planned as a composite steel/concrete structure with a big steel cage for the building technique above.

Five solid cores of the stairwells and lifts penetrate the decks and are used together with the bracing for the stabilisation of the structure. The main challenge was considering the effects caused by the temperature forces. The park decks and ramp surface were planned as about 26,000 m^2 of Hoesch Additiv Deck, 12 cm high, based on composite beams and steel columns. About 2,100 t of profile steel and 350 t of reinforcement were required.

Software and Model

Scia Engineer was used as the main program for the processing of the whole project. The decks and ramp structure was built up in a 3D model 1:1 according to the architecture planning and boundary of the surfaces, needed for the production of the execution drawing later. Very intensive usage of 3D Raster, Layer, Selection and Material Manager tools was indispensable.

After the required composite beams had been designed with Kretz software, the settled profiles were integrated in the 3D model. The dead structure load at the assembly stage was taken from the beam calculations and assumed as a point load on appropriate columns. The eccentricity of all the planned connections was taken into account. The surface of the decks was considered then as a 12 cm solid plate on steel support beams with reduced density.

The solid cores were rebuilt in the model too so as to consider the effects of the temperature on the "outside" building part and to define the proper bearing on the "inside" structure. It had to be calculated at once. Because of the pliability of the "inside" building structure, the bearing of the decks and ramp was modelled with adjusted springs due to the calculated deformations.

Calculation and production

Linear calculation with absences due to load cases for all beams with small stiffness was processed. The steel support structure was designed according to EC3.

All documents, overviews, elevations, structural details and steel quantities for the production were derived from the 3D model with Document, Picture Gallery and Drawing Gallery tools. Due to reaction forces of the bearing, all connection details to the main building were designed.

Software: Scia Engineer

Dipl. - Ing. S. Ryklin STATIK

Contact Sergej Ryklin
Address Liselottestrasse 17,
D-69123 Heidelberg, Germany
Phone +49 6221 830973
Email statik@ryklin.de
Website www.ryklin.eu

STATIK
Dipl.Ing. S.Ryklin

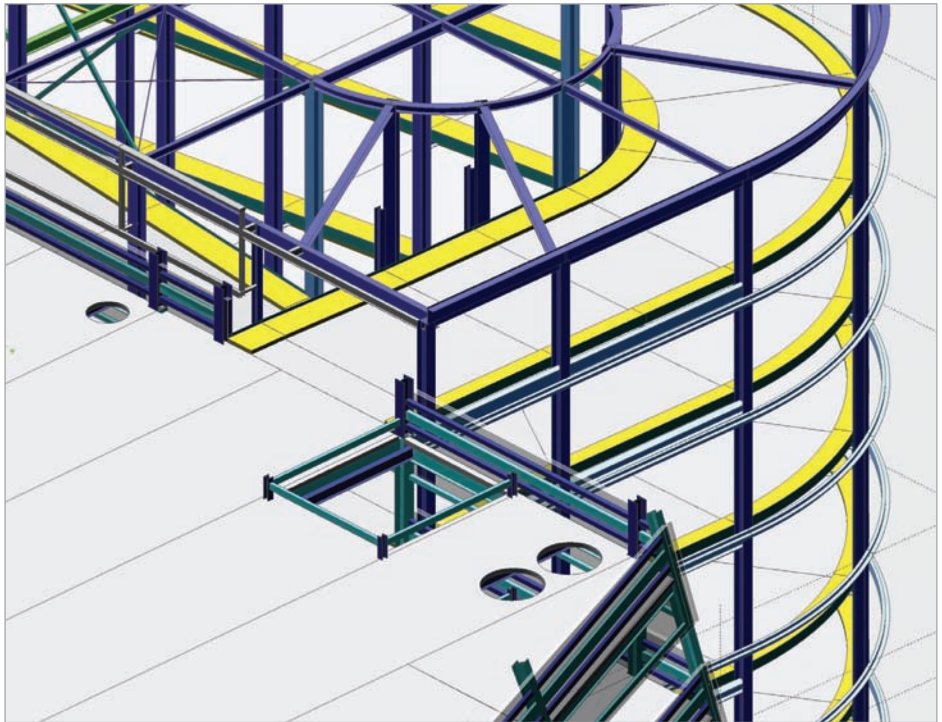
Sergej Ryklin - Born in 1963 in Moscow
1981-1985: Civil Engineering; “Bridges/Tunnels”; Since 1993: Structural designer and verifier at “Römhild & Hecker” Consulting Engineers in Landau, Germany; Since 1997: Structural designer; 2008-2009: Master’s Study at the Institute for Membrane and Shell Technologies, Anhalt University of Applied Sciences, Germany
Range of Capacity: Planning and optimisation of steel, aluminium, solid, composite, timber and membrane structures; Project consultancy; Building physics calculations; Dynamics calculations, Project verification
Philosophy: Flexibility in planning due to integral 3D design with the ability to find feasible and low-cost solutions from the draft stage on.
Experience: Residential and industrial buildings, parking spaces, pedestrian bridges, swimming pools, silos, membranes…
References: Daimler, John Deere, SAP, DB...

Project information

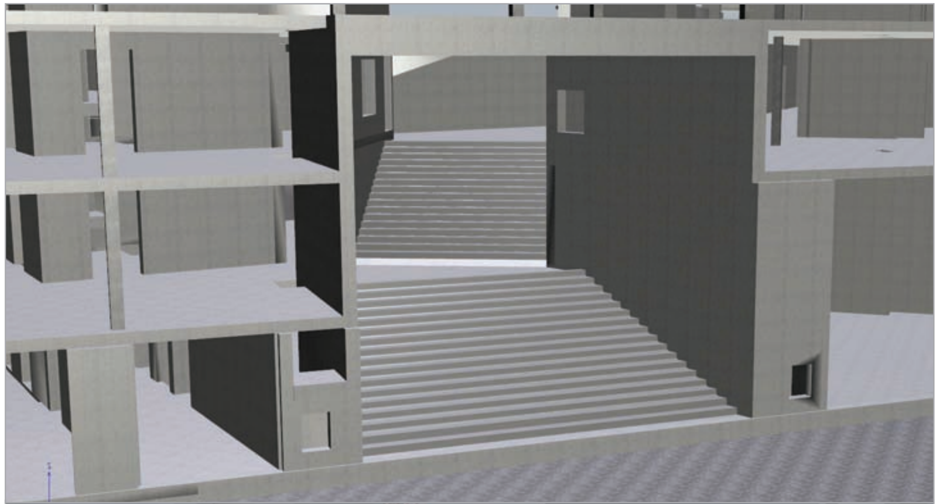
Owner	IKEA GmbH
Architect	nps tchoban voss architekten
General Contractor	Klein + Albert und Partner GmbH
Engineering Office	Dipl. - Ing. S. Ryklin STATIK
Location	Hamburg Altona, Germany
Construction Period	12/2012 to 05/2014

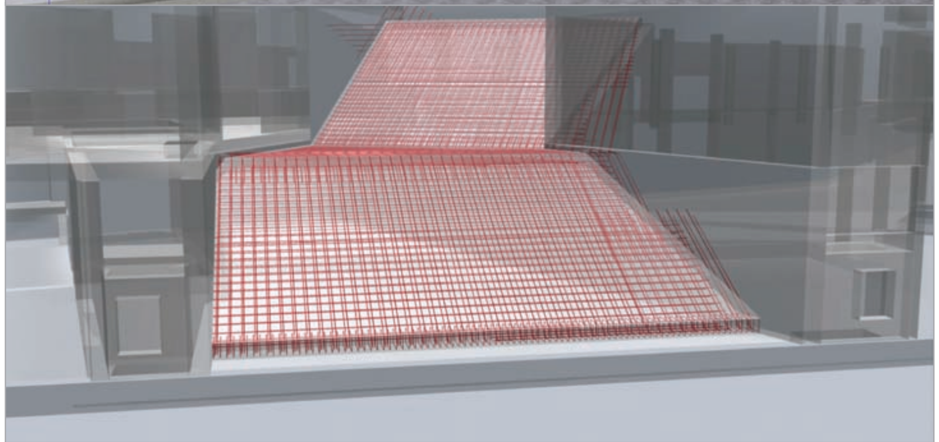
Short description | IKEA Roof Parking Space with Side Ramp

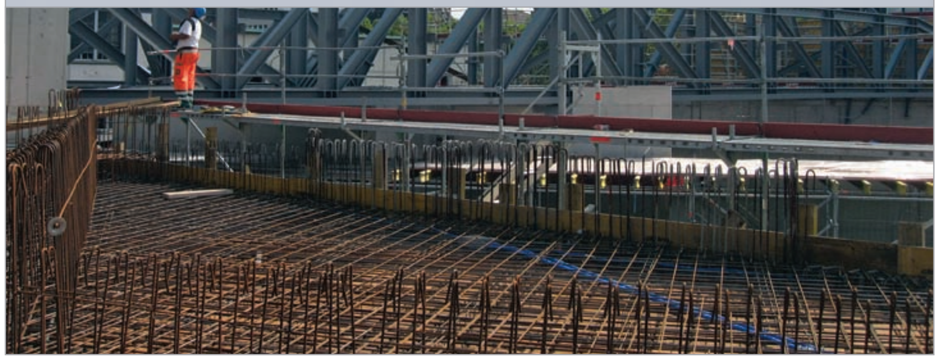
The first IKEA City Store has to be built on the smallest surface - about 10,000 m^2 - that an IKEA Haus has ever been built. The dimensions of the whole building are about 140 x 85 x 36 m. Due to the space limit, the required parking space for 730 customer cars is placed on the top of the building at the height between 20.5 m and 31 m. It contains four parking levels. The side ramp structure, about 36 m high, connected the parkdecks with the street. The “outside” part of the connected together parkdecks and ramp is planned as a composite steel/concrete structure.
Five solid cores from the main building for the stairwells and lifts penetrate the decks and are used, together with the bracing, for the stabilisation of the structure.
The 1.4GB model contains about 8,600 1D elements, 1,200 2D elements, 50 3D objects, 550 cross-sections, 33 materials and 160 loads.
The main challenge was considering the effects caused by the temperature forces.



Residential Building with Tram Depot, Kalkbreite - Zürich, Switzerland







The new building in Kalkbreite, Zurich, is situated along the SBB railway line between Badenerstrasse, Kalkbreitestrasse and Urselweg. The building has the total length of about 125 metres and the maximum width of 70 metres. It consists of a basement, the ground floor, six upper storeys and the building equipment rooms on top of the roof.

The major element of the building is the construction of a tram shed above the tram stabling area of the Zurich public transport authority, which will be enclosed and covered by the new building.

The building will be mainly residential. The storeys at the same level as the tram shed are planned to be used for offices, cinemas, shops, restaurants, etc. The necessary technical and storage areas will be provided in the basement.

The new building is designed in such a way that the tram shed will form a coherent unit with the main building both in its visual appearance and in its structure.

The project was extremely complicated and difficult in several respects. The first problem was the highly complex geometry resulting from the shape of the plot, the necessary position of the tram shed and the variety of uses which needed to be included. On the other hand, the load-bearing structure was very difficult, mainly because of the integration of the tram shed into the building. Above the exit rails from the tram depot, for example, the building must span the full width of the tram shed. This made it necessary to insert four solid steel trusses, which are integrated into the walls of the building. The middle trusses extend for three storeys, meaning that they are about 12 metres high.

The tram shed itself is covered by pre-tensioned prefabricated girders.

The tram stabling area had to be built two years before the construction of the main building. Therefore, all the necessary foundation work and building pit systems had to be executed beforehand. The foundation works within the tram stabling consist of deep bored piles to transfer the concentrated loads from the tram shed into the ground. The building itself is standing on a shallow foundation, which is located in stable gravel.

As a result of the sophisticated geometry, we were especially dependent on an effective and professional CAD program. Nemetschek Allplan fulfilled this requirement. The creation of the plans in 3D was successful, and the same method will also be used for future plans.

Software: Allplan Engineering

Dr. Lüchinger + Meyer Bauingenieure AG

Contact Andreas Gianoli
Address Limmatstrasse 275
8005 Zürich, Switzerland
Phone +41 44 421 43 00
Email agi@luechingermeyer.ch
Website www.luechingermeyer.ch/

Dr. Lüchinger+Meyer Bauingenieure AG
Konstruktiver Ingenieurbau
Fassaden- und Leichtbau

The structural engineering company Dr. Lüchinger + Meyer Bauingenieure AG was founded in 1994 and has about 50 employees in its headquarters in Zurich and its branch in Lucerne.

We deal with all aspects of structural construction engineering, facade construction and lightweight construction. Owing to our close cooperation with research institutes and our intensive involvement in various standardisation committees, we are able to work to a high quality in line with the latest engineering knowledge.

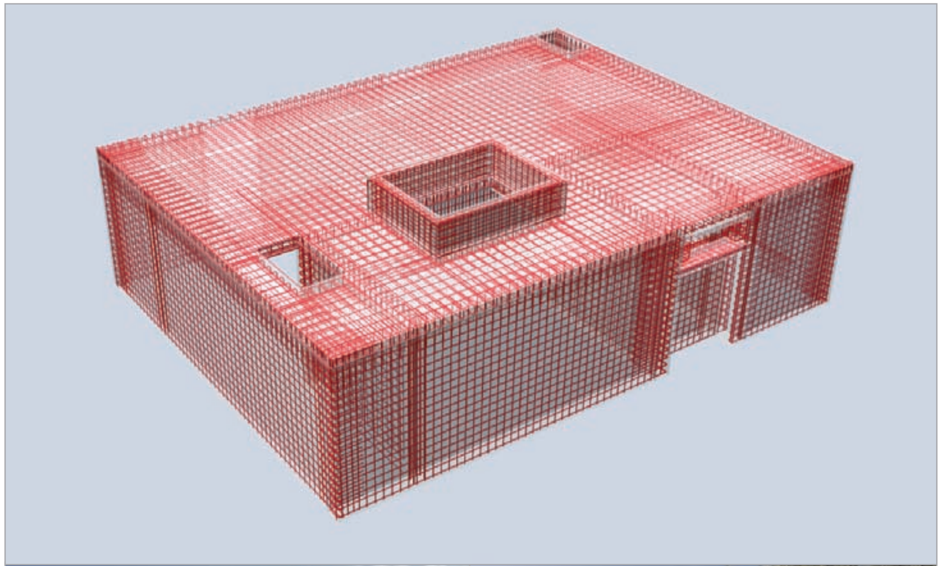
We deal with projects of any size for both institutional clients and private property developers.

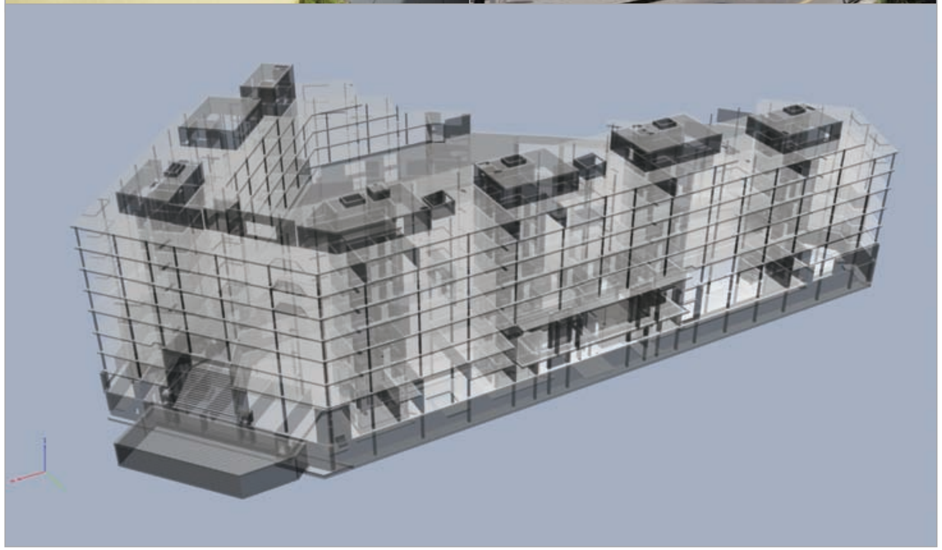
Project information

Owner	Genossenschaft Kalkbreite and AHB Zürich
Architect	Müller Sigrist Architekten AG
Engineering Office	Dr. Lüchinger + Meyer Bauingenieure AG
Location	Zürich, Switzerland
Construction Period	01/2012 to 03/2013

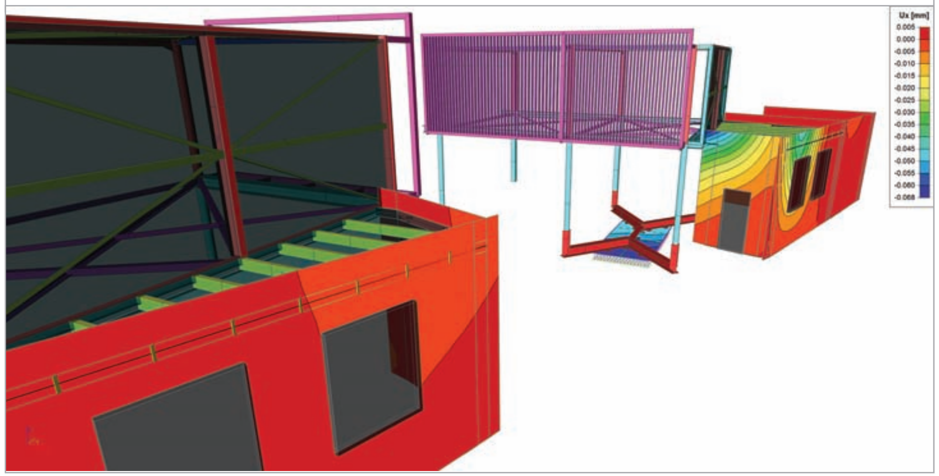
Short description | Residential Building with Tram Depot

The new Kalkbreite building is situated in the centre of the city of Zurich. The building integrates a tram stabling area and is determined by its complex geometry and the wide variety of uses. The difficult geometry of the plot and the requirements for the tram shed led to a number of highly complex challenges for the load-bearing structure. For example, the building must span the full width of the exit rails from the tram shed. This is to be implemented by inserting three-storey steel trusses into the walls.





Vismijn - Antwerpen, België



Structurele berekening

Staal

De staalconstructie is gebouwd op een bestaande parkeergarage. Deze bestaande parkeergarage dient alle krachten vanuit de staalstructuur over te dragen naar de grond.

Fundering

De garage onder de staalconstructie doet dienst als fundering. Doordat er zich een beschermde gevel in het project bevond konden we de nieuwe structuur niet overal op een normale manier funderen. Er werd dan ook geopteerd om in het midden van de kolommen een plaat te dimensioneren waarover liggers werden geplaatst. Deze liggers werden op hun beurt gekoppeld met de kolommen. Dit zodat de kolommen alsnog konden gefundeerd worden en zonder dat er risico was dat we te dicht moesten graven bij de beschermde gevel.

Ontwerpeisen staalconstructie:

De belangrijkste factor voor dit project was de uitstraling van het gebouw. Er moest zo esthetisch mogelijk gewerkt worden. Het modelleren met Scia Engineer gaf een goed driedimensionaal beeld van het gebouw weer in ontwerpfase. De klant kon zich aan de hand van het rekenmodel een beeld van de structuur vormen.

Structurele berekening

De volledige structuur berekening werd uitgevoerd door Scia Engineer. De flexibiliteit van het programma tijdens de ontwerpfase was hierbij een belangrijke troef. Door de 3D- berekening was het interpreteren van de krachtenspreiding op de bestaande structuur zeer eenvoudig.

Tijdens het project moesten de bestaande elementen gecontroleerd worden op hun resterende reserve om de nieuwe structuur te dragen. De balken die niet voldoende gedimensioneerd waren, werden versterkt door middel van het kleven van koolstofwapening aan de trekzone van de betreffende balken.
Dit gebeurde dusdanig dat de extra trekkracht wordt opgenomen door de gelijmde wapening.

Ook de controle en dimensionering tegen brand werden verwezenlijkt dankzij de Scia module.

De twee trappenhallen, die zich in de twee vleugels van het gebouw bevinden, dienen als stabilisatoren van het gebouw.

De loopbrug die zich in het midden van het gebouw bevond moest op zo'n esthetisch mogelijke manier worden uitgevoerd. Door middel van het driedimensionaal verwerken in Scia Engineer kon de klant gemakkelijk zijn opmerkingen doorspelen naar ons studiebureau. Zo konden de architecturale eisen nageleefd worden en waar nodig bijgestuurd. Dit uiteraard onder voorbehoud dat de stabiliteit niet in gedrang kwam.

Technische gegevens van het kantoor in staal

- Breedte: 30 m
- Lengte: 55 m
- Maximale hoogte: 11 m
- Tussenvloer = 350 kg/m²
- Overspanning tussenvloer = 8 m
- Lengte loopbrug = 12 m

Besluit

Door gebruik te maken van de 3D-modules van Scia Engineer is het mogelijk om alle lasten afzonderlijk in te geven.

Scia Engineer geeft een duidelijk krachtenverloop weer per element, waardoor het gemakkelijk is om de resultaten te interpreteren.

Het was ook mogelijk om de bestaande toestand mee te construeren. Hierdoor konden we de beschermde gevel mee integreren in de berekeningen.

Software: Scia Engineer

Edibo nv

Contact Jan Caelen
Address Maatheide 1302
3920 Lommel, Belgium
Phone +32 11 54.11.59
Email jan.caelen@edibo.be
Website www.edibo.be

edibo® GENERAL CONTRACTOR INDUSTRIAL BUILDINGS

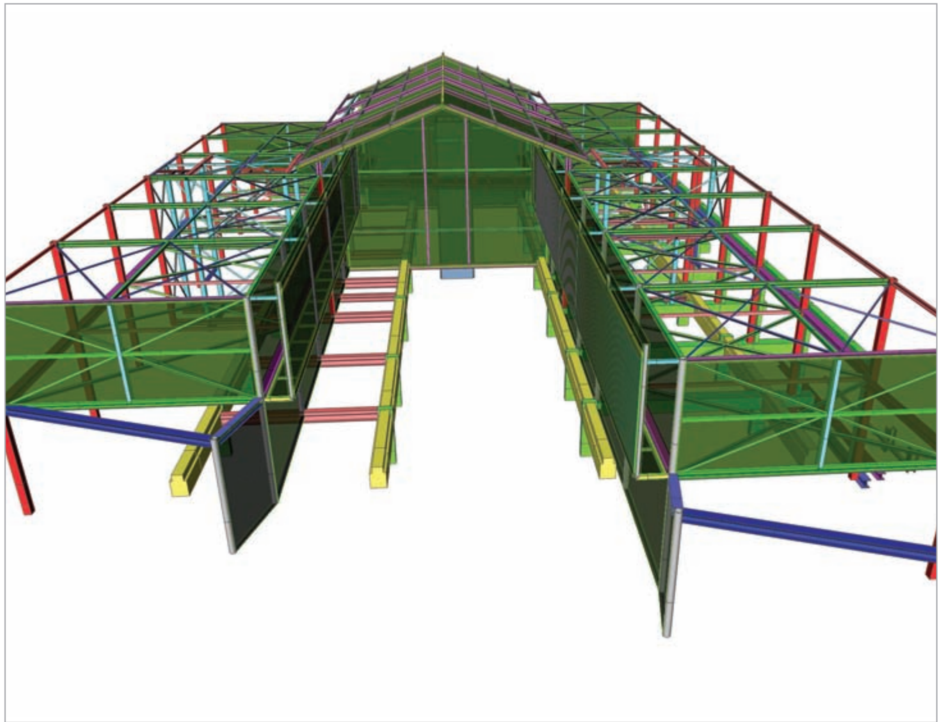
De firma Edibo, gevestigd in Lommel, is gespecialiseerd in het bouwen van bedrijfsgebouwen en kantoren. Edibo bouwt zowel nieuwbouw-, uitbreidings- als renovatieprojecten "sleutel-op-de-deur" en dit zowel in staal, beton als hout. Reeds meer dan 25 jaar bouwt Edibo schitterende referentieprojecten in diverse sectoren: multifunctionele distributiecentra voor de logistieke sector, productie- en bedrijfsruimten voor industrie (oa voedingsindustrie), KMO en multinationals, kantoorcomplexen en showrooms voor handel en dienstverlening.
Edibo onderscheidt zich door zijn toegevoegde waarde. Vanaf de ontwerp en studiefase wordt er meegedacht met de bouwheer. De interne studiedienst staat garant voor stabiliteitsstudies, fire safety engineering en bouwtechnische optimalisatie. Een oordeelkundige projectuitvoering en kwalitatieve afwerking wordt ondersteund door de ISO 9001 kwaliteitslabel en ISO 3834, evenals de OHSAS 18001 veiligheidscertificering. Tenslotte tracht Edibo steeds bedrijfsgebouwen met "onderscheidend karakter en uitstraling" af te leveren. Het realiseren van een stimulerende werkomgeving binnen het programma en het budget van de bouwheer ligt vervat in het motto "Building dreams on facts".

Project information

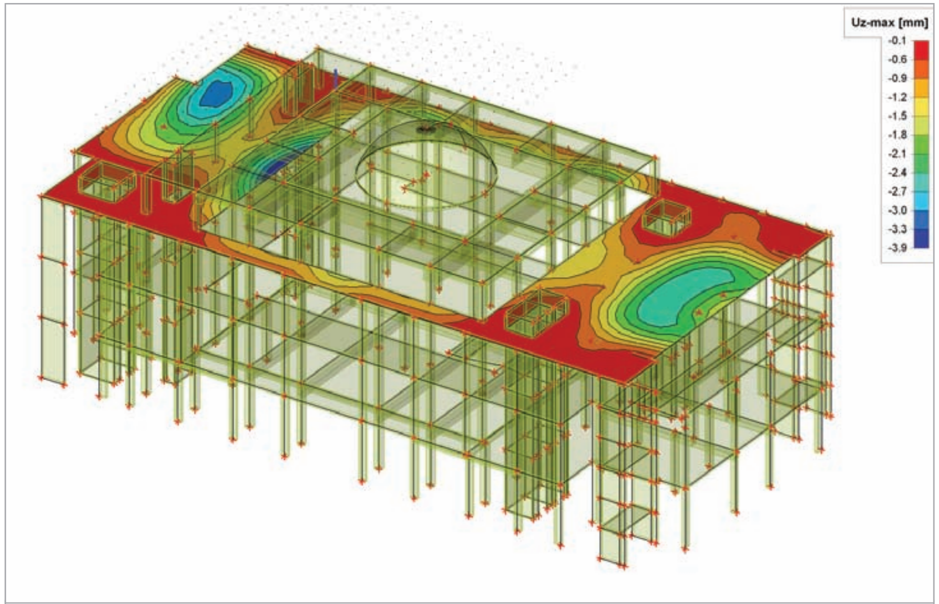
Owner	Urban Estates projectontwikkeling
Architect	ABV+ architecten bvba
General Contractor	Edibo nv
Engineering Office	Edibo nv
Location	Antwerpen, Belgium
Construction Period	01/2011 to 10/2011

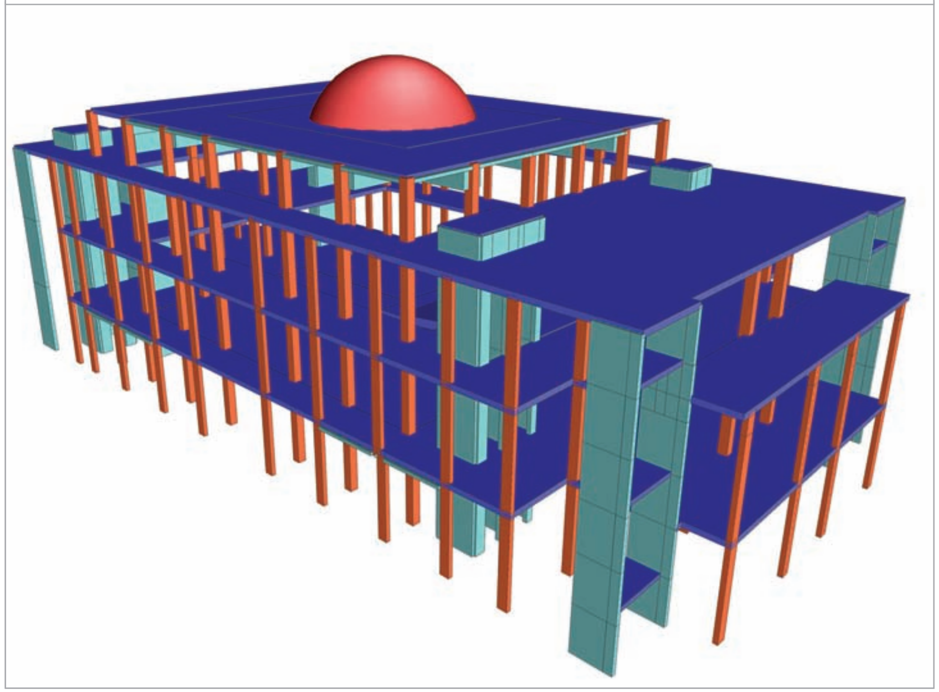
Short description | Fish Market

This project concerns an office building. The building consists of a steel structure. The difficulty of this building was to implement a new building on an existing structure. By using Scia Engineer in the early stages of the design it was possible to make sure there wasn't a clash with the existing structure.
The roof of the building needed to be reinforced. This was achieved by providing additional steel beams in the floor. This step was a very important phase during the construction.



Shree Swaminarayan Temple - Kingsbury, London





This project comprises the construction of a new Temple complex in Kingsbury, London, for the Shree Swaminarayan Gadi Community.

The purpose of the project is to locate the Temple in the centre of the community as the community's existing Temple is located on the periphery in Golders Green.

The site for this project was already developed as a building and civil engineering contractor's yard and office complex. The site comprised a substantial three storey office building to the north of the site, a single storey warehouse building to the south of the site and extensive concrete hard standing throughout. The warehouse building was demolished whilst the existing office building was partially demolished, for refurbishment later, under an enabling works contract.

The Temple complex comprises the Temple building, the Multi-Function Hall building and the refurbishment of the Office building.

The Temple building is a three storey building with an internal 18 x 20 x 7.5 m high clear clerestory space over the worship area. The structure of the building is in situ reinforced concrete framed comprising a 500 mm thick raft foundation slab bearing onto Firm to Stiff London Clay; 250 mm thick flat slabs at 1st, 2nd and Roof level augmented by downstand beams at transfer locations; and a 100 mm thick dome supported by a 250 mm slab and 1.2 m deep grillage of beams over the clerestory space. The floor and roof structures are supported by in situ RC columns and walls. The walls act as shear walls to provide stability to the structure. The structure of the building was analysed and designed using the analysis and concrete design modules of Scia Engineer. Of particular importance was the checking of the potential long term deflections of the clear span structure over the open area.

The Multi-Function Hall building comprises an 18.5 x 33.5 x 9.5 m high clear span sports hall, with viewing galleries to the rear; a three storey administration block to the western end; and a basement plant room under the eastern end. The sports hall portion is steel framed with long span glulam timber rafters over the space.

The administration block and basement plant room are in situ RC framed. This building was founded on CFA piled foundations due to Made Ground exceeding 3 m depth under the footprint of the building. The ground floor slab is a suspended 250 mm thick in situ RC flat slab. The stability of the sports hall frame is provided by horizontal diagonal bracing girders in the plane of the roof spanning between the concrete framed block to the west and vertical diagonal braced bays in the east gable wall. Shear walls provide stability to the concrete framed portion. The in situ RC structures were analysed and designed using the analysis and concrete design modules of Scia Engineer.

The refurbishment of the Office building comprises a steel framed reworking of the eastern end of the retained building to better blend in with the architectural theme for the site.

Software: Scia Engineer

Engineers HRW

Contact Keith Wilson
Address Unit 2 Blue Lion Place
237 Long Lane
SE1 4PU London, United Kingdom
Phone +44 2 074079575
Email keithw@engineers-hrw.co.uk
Website www.ehrw.co.uk

engineersHRW

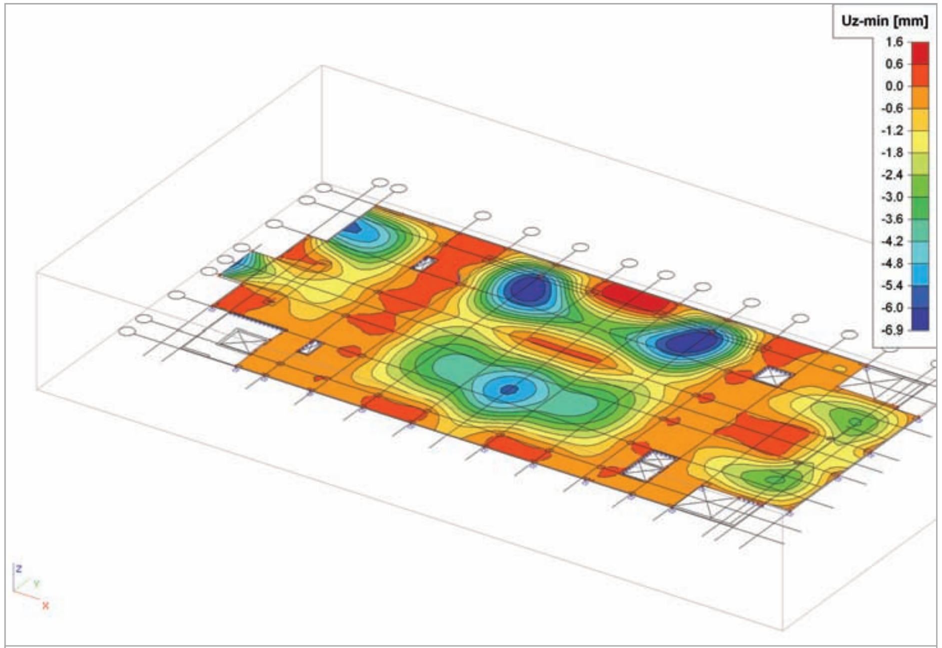
Engineers HRW was established in 2001. Since formation the company has contributed to a wide portfolio of completed work in both the public and private sectors. We have collaborated with clients, architects and fellow engineers in the design of many refurbishment and new build projects by providing well researched sound advice supported by comprehensive and detailed information delivered to programme.
We are committed to working with architects and other members of the design team to produce high quality well considered buildings. We enjoy the challenge of developing appropriate economic solutions to the client's brief, ensuring simple construction and long term durability.
A fresh approach is taken on every project. Drawing on our knowledge of current and historic building practice, the design process is supplemented by research into new and emerging technologies.

Project information

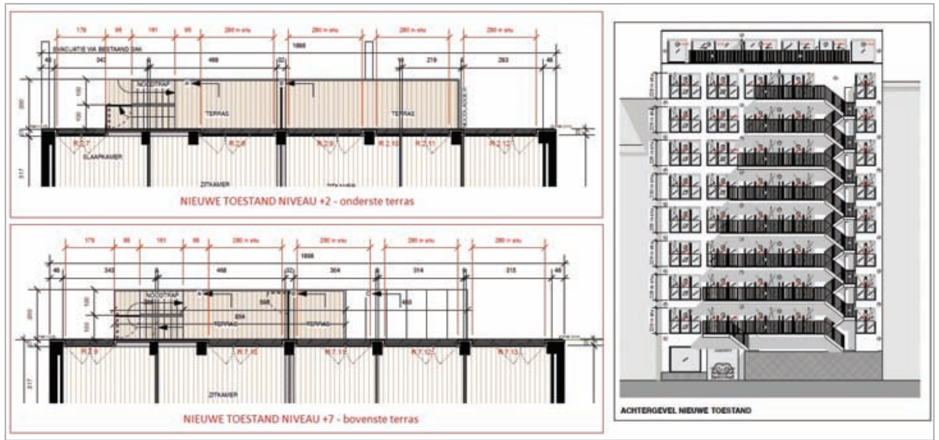
Owner	Shree Hari Community
Architect	LTS Architects
General Contractor	Foundation Developments Limited
Engineering Office	Engineers HRW
Location	Kingsbury, London
Construction Period	10/2012 to 08/2013

Short description | **Shree Swaminarayan Temple**

The project comprises the construction of a new Temple complex for the Shree Swaminarayan Gadi Community in North London. The project is located in Kingsbury, London. The complex comprises the Temple building, the Multi-Function Hall building and the Office building. The Temple building is a three storey building with an internal 18 x 20 x 7.5 m high clear clerestory space over the worship area. The structure of the building is in situ reinforced concrete framed comprising a 500 mm thick raft foundation slab; 250 mm thick flat slabs at 1st, 2nd and Roof level augmented by downstand beams at transfer locations; and a 100 mm thick dome supported by a 250 mm slab and 1.2 m deep grillage of beams over the clerestory space. The Multi-Function Hall building comprises an 18.5 x 33.5 x 9.5 m high clear span steel and glulam timber framed sports hall with an in situ RC framed three storey administration block to the western end and an in situ RC basement plantroom under the eastern end. The Office refurbishment is steel framed.



Terrasstructuur Itamar - Antwerpen, België



Project

Een voormalig kantoorgebouw van 8 verdiepingen hoog, gebouwd in 1975, wordt volledig gerenoveerd en omgebouwd tot een appartementsgebouw. Het gebouw bevindt zich op de Belgiëlei te Antwerpen. De betonstructuur werd zoveel mogelijk behouden, de niet-dragende elementen werden nagenoeg allemaal verwijderd. Op een paar niveaus werden enkele vloerplaten, trappen, balken (deels) verwijderd en werden er indien nodig verstevigingen voorzien. Aan de achtergevel van dit gebouw wordt vanaf de tweede verdieping een volledige terrassenstructuur vastgezet in de bestaande betonstructuur. De terrassenstructuur springt op iedere verdieping naar binnen zodat je op elk terras naar de 'hemel' kan zien, een zeer belangrijk gegeven voor de Joodse kopers.

Ontwerp

Het meest ingrijpende aan deze renovatie was de nieuwe terrassenstructuur aan de achterzijde van het gebouw. De terrassen werden volledig in staal uitgewerkt. Afhankelijk van de bestaande skeletstructuur zijn 4 kolommen voorzien vanaf de eerste verdieping tot bovenaan het gebouw, in totaal een lengte van ongeveer 23 m per kolom. Deze werden in verschillende stukken gemonteerd maar zijn doorlopend uitgerekend waardoor momentvaste verbindingen werden ontworpen. Deze kolommen werden op een regelmatige afstand vastgemaakt in de achterliggende structuur, in een bestaande betonkolom of betonwand, dit om een gedeelte van de verticale schuifkracht op te nemen en de knik te manipuleren en te optimaliseren. Aangezien deze kolommen onderaan niet op een bestaande structuur konden steunen, werd er onderaan een stalen console voorzien per kolom. Deze console neemt echter een deel van de optredende totale verticale reactiekracht op. Aan deze stalen kolommen werd de volledige terrassenstructuur in uitkraging verankerd. Aan de zijkant van de terrassen werd er ook een stalen vluchttrap verankerd deels aan de staalstructuur van de terrassen, deels aan de bestaande structuur.

Nemetschek Scia

De volledige stalen terrassenstructuur werd in Scia Engineer als geheel gedimensioneerd. Onderaan de kolommen werd een ondersteuning in de z- en de y-richting ingegeven. Op ieder niveau werden de kolommen ook nog enkel in de y-richting ondersteund. Met de krachten die hieruit voortkomen konden de consoles bepaald worden en kon de verankering van deze consoles en de kolommen in de bestaande structuur berekend worden. Aan deze kolommen werd de rest van de terrasstructuur opgehangen. Om een juist beeld te krijgen van de belastingen op alle liggers werd gebruik gemaakt van belastingspanelen die naar al de ingegeven liggers afdragen. In Scia Engineer werden niet enkel de liggers en de doorbuiging ervan gecontroleerd, ook de verbindingen tussen de stalen profielen zelf werden gedimensioneerd.

Software: Scia Engineer

Establis Group nv

Contact Jurgen Vantornout
Address Beversesteenweg 612
8800 Roeselare, Belgium
Phone +32 51 431200
Email jvantornout@establis.eu

Establis garandeert creatieve berekeningen en optimale oplossingen voor uw bouwkundige structuren, met een bewust gevoel voor realiteit.

Ons team in Antwerpen en Roeselare bestaat uit 20 hooggekwalificeerde medewerkers met diverse specialiteiten, ondermeer op het vlak van beton, staal, prefab, funderingstechnieken en seïsme. Wij allemaal staan klaar om uw unieke bouwproject van a tot z te begeleiden op basis van een vlotte communicatie en degelijke technische know-how.

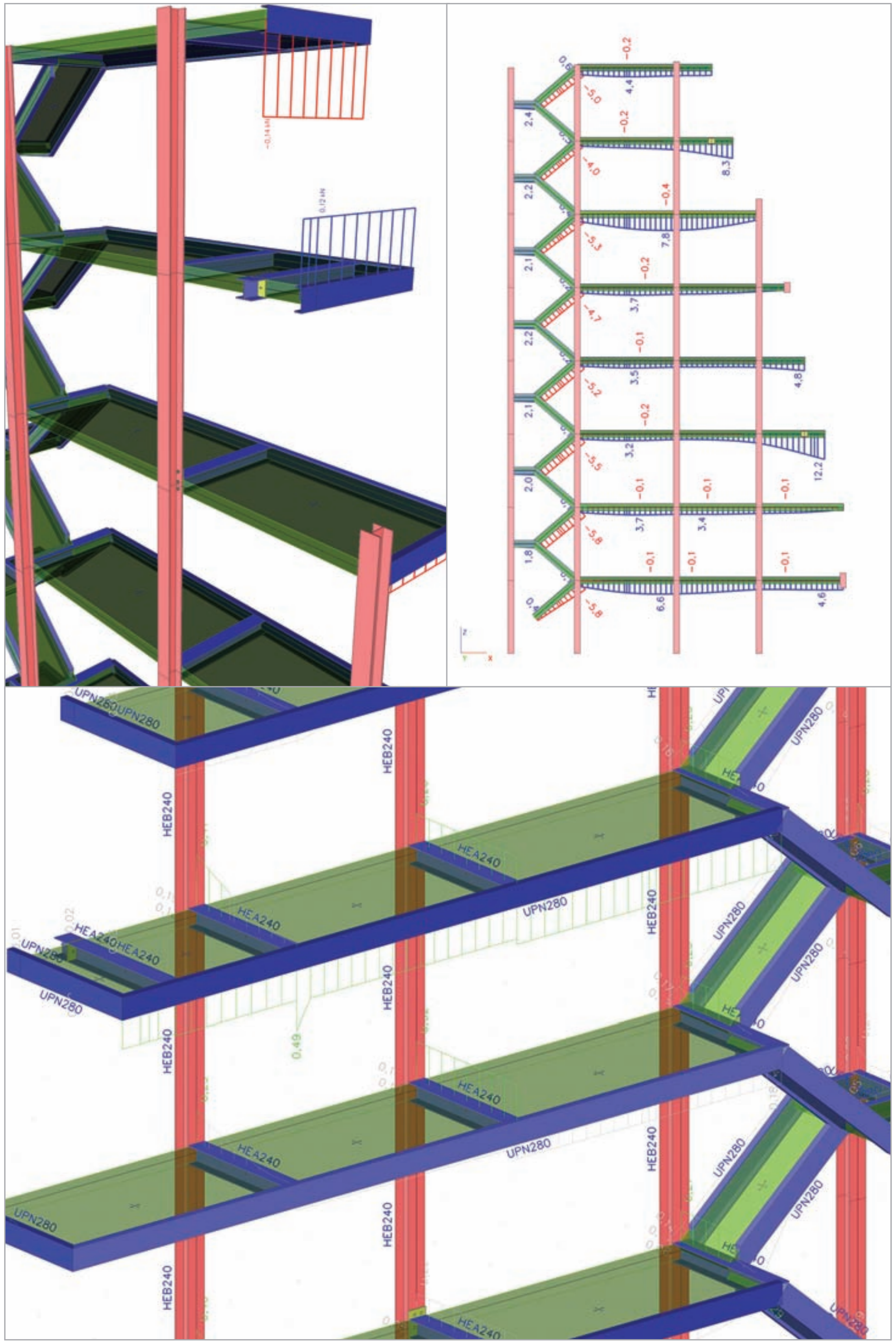
Een beroep doen op Establis betekent voor u het binnenhalen van stabiliteit op lange termijn.

Project information

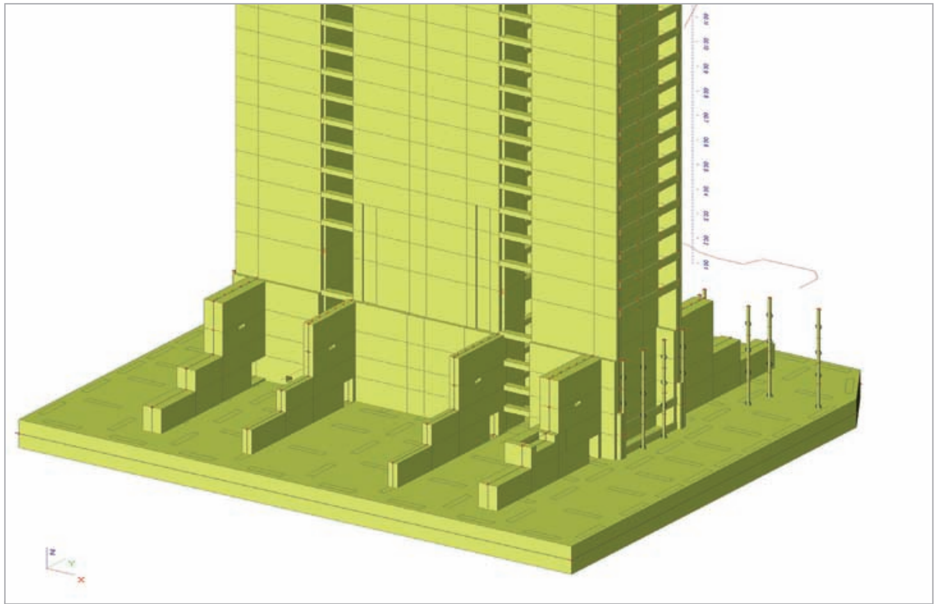
Owner	Company Itamar
Architect	Architectuurgroep Jo Peeters
General Contractor	L Interior Projects
Engineering Office	Establis Group nv
Location	Antwerpen, Belgium
Construction Period	01/2012 to 01/2013

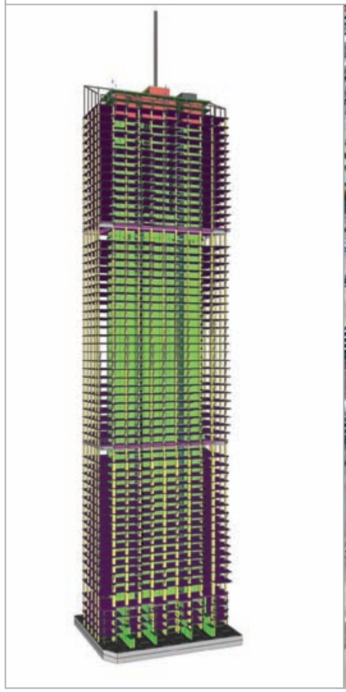
Short description | Terrace Structure Itamar

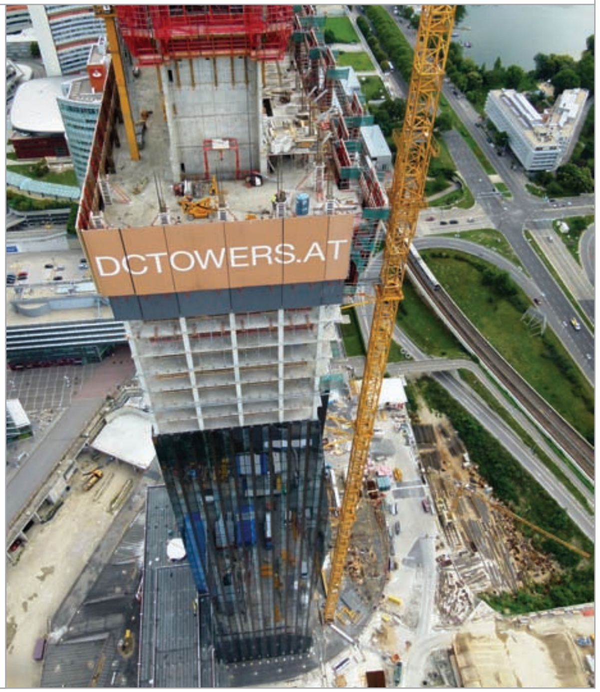
A previous 8-floor office building, built in 1975, is being renovated and converted into apartments. On the back side of the building, there is, starting from the second floor, a totally new steel terrace structure anchored in the existing concrete. Four main columns were anchored on a regular base in the concrete structure behind the columns. The terrace structure itself, as a cantilever, was anchored to the main steel columns. Not only are the beams themselves and the deflection of the beams checked, but the connections between the steel profiles are also dimensioned in Scia Engineer.



Donaucity Tower 1 - Wien, Österreich







Software: Scia Engineer

Gebäude und Situation

Das Projekt Donaucity Tower stellt städtebaulich das Wahrzeichen der Donaucity Wien, ein Stadtentwicklungsgebiet zwischen Donaufluss und Uno Hauptquartier Wien, welches seit den frühen 1990 Jahren entwickelt wird, dar.
Der architektonische Entwurf sieht in seiner Gesamtheit 2 gleichartige Tower vor, welche durch ihre Form einem in 2 Teile auseinandergerissenen Kristall darstellen. Der 2. Tower mit einer Höhe von 165 m wird erst in Zukunft gebaut.

Allgemeine Projektdaten

Gebäudehöhe gesamt 250 m mit Antenne, oberste Decke bei 220 m
60 Geschosse
Untergeschosse Fläche 40.000 m^2, oberirdisch zirka 80.000 m^2
Beginn der Planung: Juni 2006, Dauer bis Ende 2012, Baubeginn Juni 2010, Rohbaufertigstellung November 2012

Konstruktion - Gründung

Kastengründung - Schlitzwände werden im Raster so angeordnet, dass durch die Umschließung des Erdreiches mit den Schlitzwänden eine Art homogener Fundamentblock mit 25 m Tiefe entsteht. Diese Gründungsart zählt zu den Setzungsärmsten und wurde deshalb gewählt, die Auswirkungen auf die unmittelbar danebenliegende überdeckte Autobahn möglichst gering und verträglich zu machen.
Die aufgehende Struktur wurde nach umfangreichen Variantenstudien zwischen Stahl- und Stahlbetonbauteilen als reine Sahlbetonkonstruktion mit bereichsweise eingesetzten Verbundstützen gewählt. Der wesentlichste konstruktive Vorteil stellt die Homogenität der verwendeten Materialien dar, wodurch die inneren Zwangskräfte zu den unterschiedlichen Zeitpunkten der Herstellung und zeitabhängigen Verformungen minimiert werden konnten.

Aussteifung

Die Aussteifung erfolgt durch den Gebäudekern mit Aktivierung der aussenliegenden Stützen durch 2 Outriggerkonstruktionen in den Gebäudehöhe-Drittelpunkten. Die Steifigkeit der Konstruktion wurde so eingestellt, dass sich die maximale Verformung bei Windlast unter H/500 einstellt.

Die Outriggerkonstruktion wurde in Form einer 2 m starken Stahlbeton-Decke gewählt, wodurch sich maximaler Freiraum für die Haustechnik erreichen lässt. Die Logistik der Herstellung dieser Bauteile erfordert eine enge Zusammenarbeit der Tragwerksplaner mit der ausführenden Firma.

Die Schlankheit der Konstruktion: Gebäudehöhe in Bezug zur Breite der aussteifenden Konstruktion mit 1zu11, stellt einen Spitzenwert im internationalen Vergleich dar.

Zur Verringerung der auftretenden Horizontalbeschleunigungen für maximalen Nutzerkomfort im obersten Geschoss bei 10-jährigen Windspitzen auf ein nicht merkbares Maß wird ein Dämpfersystem in Form eines 300 Tonnen Pendels in den obersten Geschossen mit hydraulischem Kolbendämpfer eingebaut. Diese Konstruktion kann zur Optimierung der Dämpfungswirkung zu jedem Zeitpunkt genau auf die dynamischen Eigenschaften des Gebäudes eingestellt werden.

Gmeiner Haferl Zivilingenieure zt GmbH

Contact Martin Haferl
Address Prinz Eugen Strasse 80/9
A 1040 Wien, Austria
Phone +43 1 523 13 22
Email vienna@gmeiner-haferl.com
Website www.gmeiner-haferl.com

gmeiner | haferl bauingenieure
www.gmeiner-haferl.com

DI Manfred Gmeiner, geb. 1957
Di Martin Haferl, geb. 1963
Bürogründung 1990

Philosophie und Ziel: Entwicklung klarer, intelligenter und innovativer Tragstrukturen in intensiver Auseinandersetzung mit der Bauaufgabe und der Architektur. Katalytisches Wirken im Bauprozess zur Optimierung der architektonischen Qualität, der Wirtschaftlichkeit und Umsetzung.
Hinterlassen einer Handschrift und Botschaft in der Konstruktion als Zeugnis höchsten baukulturellen Anspruches.

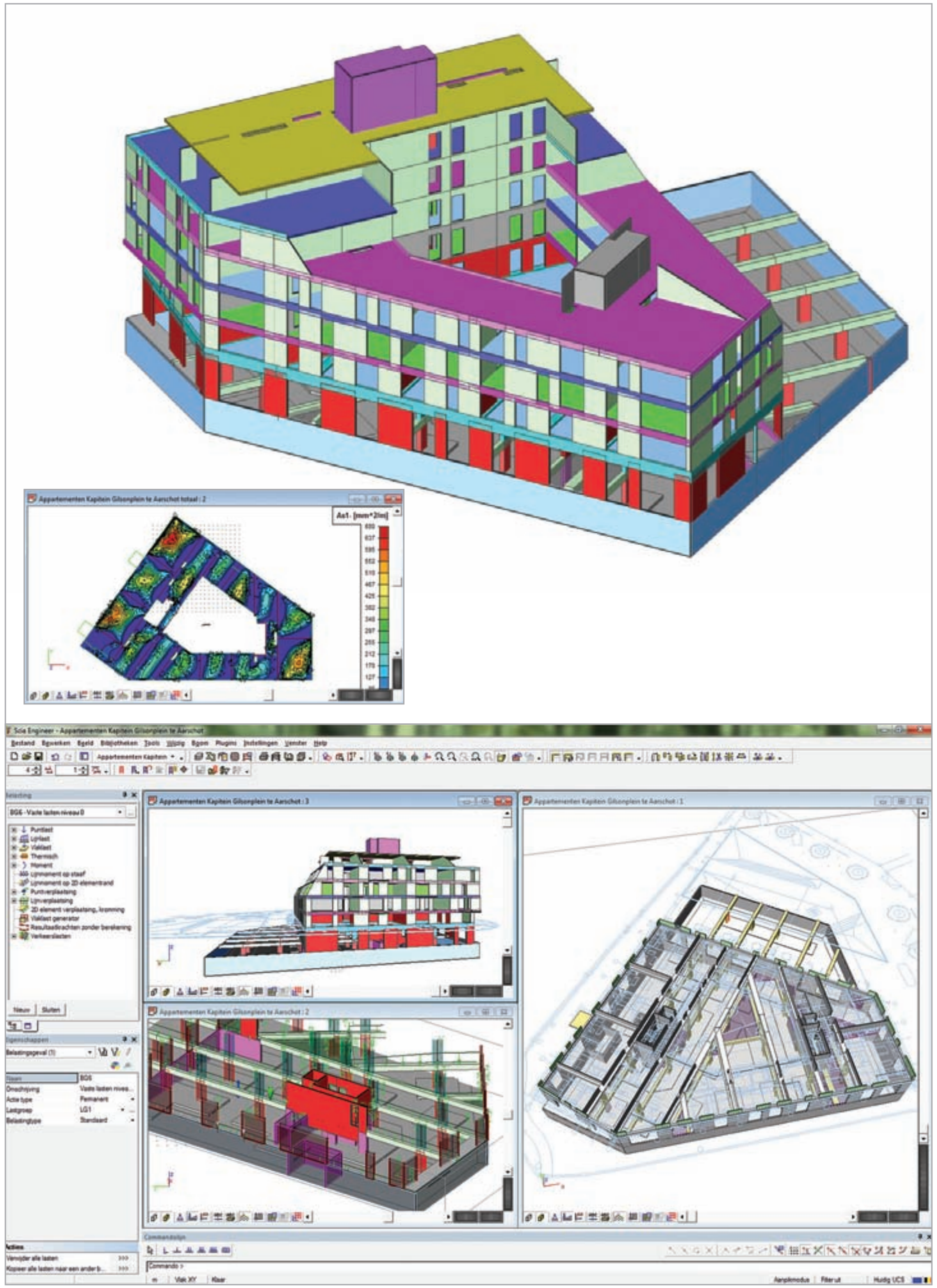
Project information

Owner	VIENNA DC Tower 1 Liegenschaftsbesitz GmbH (ein Unternehmen der WED AG-Gruppe)
Architect	Dominique Perrault, Paris, Hoffmann Janz Wien
General Contractor	VIENNA DC Tower 1 Liegenschaftsbesitz GmbH (ein Unternehmen der WED AG-Gruppe)
Engineering Office	Arbeitsgemeinschaft Bollinger Grohmann Schneider ZT GmbH - gmeiner | haferl zivilingenieure zt gmbh
Location	Wien, Austria
Construction Period	06/2010 to 12/2012

Short description | Donaucity Tower 1

The two towers, Donaucity Tower 1 and 2, represent the landmark of this urban development area. Tower 2 will be implemented in the future.
This project represents the state of the art with regard to the technical and ecological aspects.
The construction is made of reinforced concrete braced through a central core in combination with two outriggers, to implicate the columns in the bracing.
A pendular damper reduces the acceleration during massive windloads to an unnoticeable level.

“Aarschot op Sporen” Woonresidentie met Commerciële Ruimte - Aarschot, België



Het Gilsonplein in Aarschot is gelegen aan één van de belangrijkste invalswegen nl. de Leuvensesteenweg, de Steenweg op Sint-Joris Winge richting E314/A2 en is verbonden met de stationsbuurt via de Boudewijnlaan. Het is een eigentijds, modernistisch gebouw dat onderdak biedt aan 44 appartementen met een ondergrondse parkeergarage voor 56 plaatsen en 29 bergruimten. Gelijkvloers is er een commerciële ruimte voorzien van 1.200 m² voor kantoor en winkelfuncties. Het volume is hol met binnenin een daktuin. De dakconstructie vormt één doorlopend geheel met de gevels. Er is tevens een groen plein voorzien buiten het volume met een standbeeld van Kapitein Gilson.

Concept draagstructuur

Voor het gelijkvloers en de ondergrondse parking, is er geopteerd voor een skeletbouw in beton, met het oog op een zo groot mogelijke flexibiliteit (indeling van de commerciële ruimte) en zo weinig mogelijk hinder van de circulatie (op het parkeerniveau). Het gebouw is gefundeerd op een algemene funderingsplaat met verdikkingen onder de kolommen en dragende wanden. De hoger gelegen appartementen bestaan uit dragende wanden. Op niveau +1 zijn dit betonwanden, fungerend als wandliggers of m.a.w. omgekeerde balken. Hogerop zijn dit wanden in kalkzandsteen. Kolommen en balken, met mogelijkheid tot geheel of gedeeltelijke prefabricatie, zorgen op het gelijkvloers en het ondergronds verdiep voor een open structuur. Met betrekking tot de horizontale stijfheid, wordt gebruik gemaakt van afschoring op de betonwanden rond de 2 liftschachten en de trapkernen. Voor de vloerplaten is gekozen voor prédallen met een opstort in beton. De grote overspanningen zorgen voor een relatief grote doorbuiging. Met het gebruik van een doorlopende plaat, maximaal dragend in 2 richtingen, wordt dit probleem onder controle gehouden. Tenslotte is er o.w.v. de hogere gebruiksbelasting en de daarbij horende grotere doorbuigingen, geopteerd om de vloerplaat van het commercieel verdiep te voorzien in voorgespannen welfsels.

Gebruik van Scia Engineer

Scia Engineer gebruiken we reeds vele jaren. Gestart met ESA-Prima Win en vervolgens Scia•ESA PT beschikken we nu over het zeer krachtige 3D Eindige Elementenpakket Scia Engineer. Reeds van bij de start van het ontwerp werd er geopteerd om Scia Engineer als 3D software te gebruiken om het volledige gebouw te modelleren en door te rekenen omdat je zeer gedetailleerd resultaten kunt opvragen en controleren. Het genereren van de combinaties volgens de eurocode is eenvoudig en laat je bijvoorbeeld toe om via de combinatiesleutel alsook “gedetailleerde resultaten in netknopen” op te vragen wat er in die combinatie zit om tot dat moment te komen. Voor de modellering werd gebruik gemaakt van de architectuurplannen die verdiep per verdiep via de zeer eenvoudige DWG - import in een “laag” architectuur werden geïmporteerd. Dit liet ons toe om direct de dragende vloerplaten, wanden en kolommen te modelleren. De dragende metselwerkwanden in kalkzandsteen werden ook op hun juiste positie meegenomen. Het grote voordeel van Scia Engineer is dat het effect van wijzigingen in de architectuur onmiddellijk resultaat geeft bij het doorrekenen van de gehele 3D structuur. De resultaten werden achteraf in een overzichtelijk document gevoegd.

Resultaten

De totale, onmiddellijke en bijkomende doorbuiging van de vloerplaten werd berekend rekening houdend met de effectief geplaatste hoeveelheid wapening en met berekening van de stijfheid op lange termijn volgens de nationale norm. In een paar stappen kan Scia Engineer dit proces genereren waarna we een overzichtelijke weergave en toetsing van de doorbuiging krijgen. Ook de scheurwijdtes voor platen en balken werden gecontroleerd rekening houdend met de aanwezige wapening.

Door Scia Engineer te gebruiken was het mogelijk om, rekening houdend met de herverdelingscapaciteit, tot een optimale economische structuur te komen dat niet tot deze gewenste resultaten zou leiden bij een traditionele lastendaling via handberekening. Ook de planning kwam niet in het gedrang doordat de structuur snel en overzichtelijk werd doorgerekend.

Software: Scia Engineer

Grontmij Belgium

Contact Ronny Engelen
Address Herckenrodesingel 101
3500 Hasselt, Belgium
Phone +32 11 260870
Email ronny.engelen@grontmij.be
Website www.grontmij.be

Grontmij is een multidisciplinair advies- en ingenieursbureau voor duurzame infrastructuur en mobiliteit; industrie, water en energie en planning en ontwerp. Vanuit een toekomstgerichte visie geven wij kwalitatief advies en realiseren we creatieve ontwerpen en projecten. Samen met en dicht bij onze klanten uit het bedrijfsleven en de overheid, willen we waarde creëren en werken we aan totaaloplossingen. Wij doen dat met respect voor onze klanten, onze omgeving en het milieu.

Onze visie: Grontmij creëert waarde voor haar klanten, haar medewerkers en haar aandeelhouders. Wij realiseren projecten met bijzondere aandacht voor economische aspecten, innovatie en duurzaamheid.

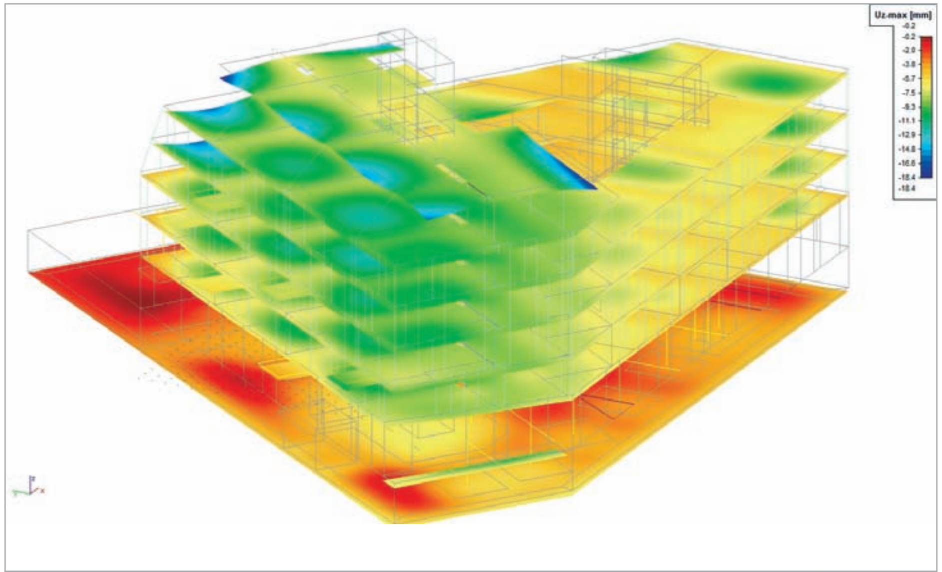
Onze missie: We willen het beste duurzame advies- en ingenieursbureau zijn in Europa. We plannen een duurzame toekomst voor en met onze klanten.

Project information

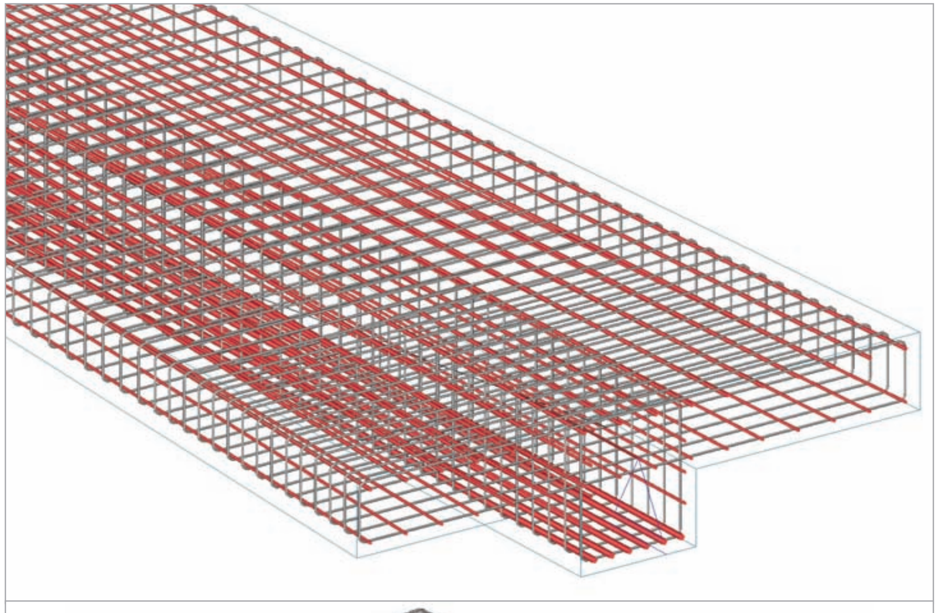
Owner	DMI Vastgoed Hasselt
Architect	HUB Architecture Antwerpen
General Contractor	Democo nv Hasselt
Engineering Office	Grontmij Belgium nv
Location	Aarschot, Belgium
Construction Period	05/2012 to 02/2014

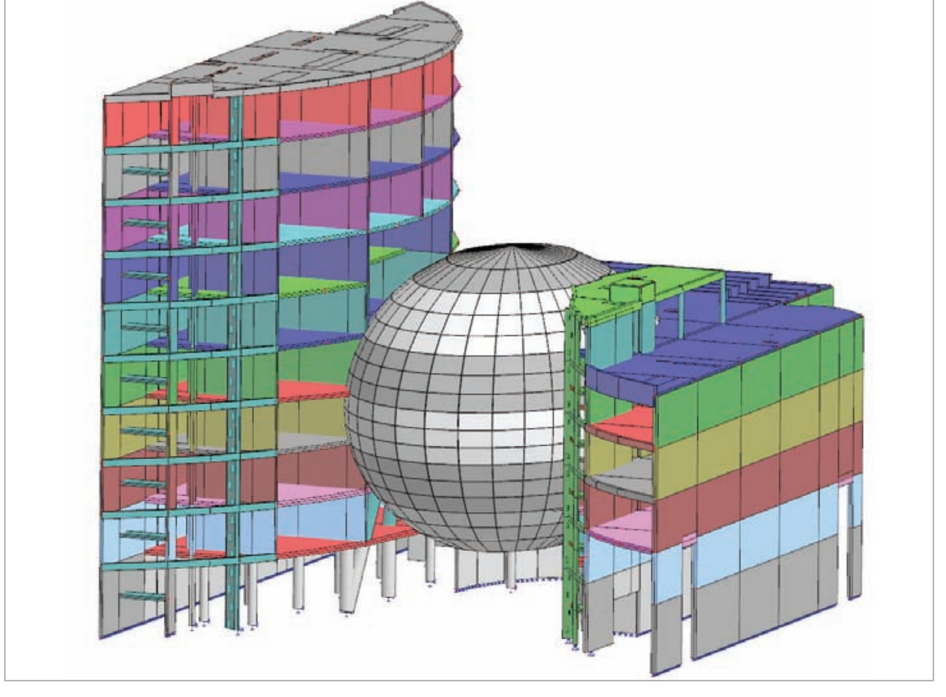
Short description | “Aarschot op Sporen” Residence with Commercial Space

The Kapitein Gilson square, next to the Leuvensesteenweg, will become the central gate to the city centre. The Kapitein Gilson residential project forms part of an urban renewal project around Aarschot train station. It is a contemporary building that houses 44 apartments with underground parking for 56 vehicles, 29 storage spaces and 1,200 m² of commercial spaces.
For the ground floor and the underground parking lot, a concrete beam - column structure was chosen to achieve the greatest possible flexibility (commercial space) and as little as possible disturbance of the circulation (on the parking level). The upper apartments consist of bearing walls. On level +1 these are concrete walls and on the other levels these are limestone.
The concrete floors are designed to handle the demands of long-term deflection in cracked concrete.



SONOCENTRUM - Brno, Czech Republic





Objekt SONOCENTRUM byl navržen v Brně jako reprezentativní stavba nahrávacího studia SONO RECORDS s víceúčelovým využitím (hotel, restaurace, parkování, nahrávací studio, koncertní a divadelní sál). Objekt je rozdělen na 2 dilatační celky. Dilatační celek SO 02 je jednopodlažní objekt založený plošně na základové desce sloužící jako parkovací prostory a umístěný v zadní části parcely. Byl realizován v předstihu v roce 2011. SO 01 je objekt se 4 podzemními podlažími (v systému bílé vany založen na vrtaných pilotách) a 9 nadzemními podlažími (v části jen s 5 nadzemními podlažími). 4.PP až 2.PP slouží jako parkovací prostory. V 1.PP je vstupní hala a restaurační zařízení. V 1.NP až 5.NP se nachází polyfunkční sál (přechází více podlažími - podrobněji je popsán v dalším textu), restaurační zařízení, galerie a ubytovací kapacita. V 6.NP až 9.NP se nachází už jen ubytovací kapacita. V suterénních podlažích se vyskytují rovněž zařízení pro technologické provozy.

Na projektu pracujeme od r. 2009 až dodnes, kdy jsme zpracovali postupně všechny stupně projektové dokumentace statiky. Práce na stavbě začaly v prosinci 2011 a hrubá stavba monolitického skeletu byla dokončena v únoru 2013 (celkem cca 5.000 m^3 betonu, 750 t betonářské oceli a 4,4 t předpínací oceli).

Nosné konstrukce stavby objektu SO 01 jsou navrženy jako železobetonové monolitické. Uspořádání svislých nosných konstrukcí spodní a horní stavby je zachováno převážně v základní modulové osnově 3 až 6,6 m.

Spodní stavba má přibližně obdélníkový půdorys, přičemž od úrovně terénu nahoru lze objekt popsat jako dvě samostatně stojící budovy s půdorysem kruhové úseče svírající mezi sebou víceúčelový sál tvaru rotačního elipsoidu s podélnou osou délky 24,6 m, a shodnými příčnými osami (vodorovná a svislá) délky 17,6 m. Podélný řez sálem (vodorovný i svislý) je elipsa, příčný řez sálem je kružnice. Nosnou konstrukci víceúčelového sálu tvoří železobetonová skořepina tloušťky 300 mm. V místech, kde je víceúčelový sál dispozičně propojen se dvěma podporujícími budovami, je skořepina sálu přerušena. Víceúčelový sál je navíc podporován čtveřicí masivních šikmých železobetonových sloupů. V úrovni stropních desek po obou stranách přiléhajících budov jsou uvnitř sálu po obvodu vetknuté galerie (sloužící k sezení pro diváky), které jsou konzolovitě vyloženy ze skořepiny sálu na délku cca 3 m. Galerie mají zakřivený půdorys v závislosti na zakřivení sálů (rotační elipsoid - viz výše) a jsou lokálně propojeny se stropními deskami budov obepínajících sál (stropní desky nad 2.NP a 3.NP). V úrovni stropní desky nad 4.NP je v příčném směru v sálu navržená železobetonová předpjatá lávka pro sezení diváků.

Při navrhování nosných konstrukcí stavby bylo vyvinuto maximální úsilí co nejvíc dodržet architektonický záměr betonového rotačního elipsoidu zaklíněného mezi 2 budovy půlkruhového půdorysu, přičemž pod elipsoidem musí zůstat volný prostor bez svislých nosných konstrukcí. Tato snaha nesla s sebou řadu statických komplikací a relativně složité a náročné provedení na stavbě. Už při návrhu konstrukcí muselo být zohledněno rozdělení stavby na jednotlivé etapy vyplývající z geometrické komplikovanosti stavby a technologických přestávek plynoucích z předpětí jednotlivých konstrukcí. V místě styčníku elipsoidu a podporujících sloupů jsou navržené masivní tuhé ocelové vložky zabezpečující bezpečný přenos sil z elipsoidu do sloupů.

Spodní část elipsoidu, část stropní desky nad 1.NP, galerie konzolovitě vyložené uvnitř elipsoidu a lávka jsou dodatečně předepnuté kabely se soudržností. Předpětí bylo modelováno v celkovém 3D modelu konstrukce jak prostřednictvím ekvivalentního zatížení, tak s využitím modulu dodatečného předpětí. Na jednotlivé konstrukce byly rovněž zpracovány zjednodušené 2D modely výseků konstrukce, v kterých bylo předpětí analyzováno s využitím modulu fáze výstavby a provozu (TDA). Spodní stavba byla dimenzována odděleně v samostatných 2D modelech, přičemž účinky zatížení na piloty byly sčítány.

Software: Scia Engineer

Hladík a Chalivopulos s.r.o

Contact Pavel Hladík, Martin Lukšo, Miloš Zich
Address Pekařská 398/4
60200 Brno, Czech Republic
Phone +420 539 085 600
Email hladik@hch.cz, lukso@hch.cz
Website www.hch.cz

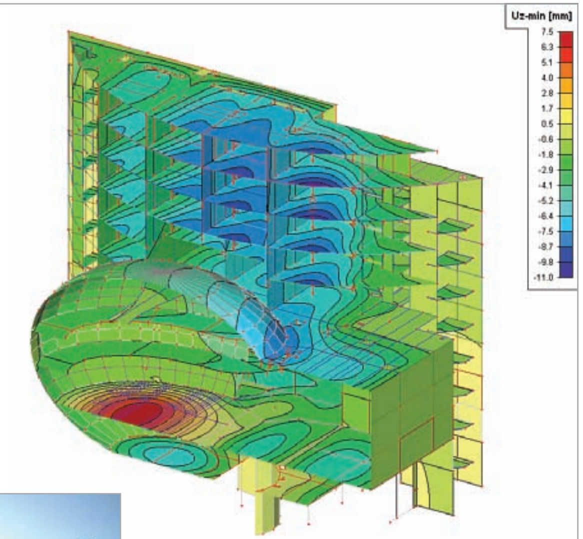
Firma Hladík a Chalivopulos s.r.o. vznikla v roce 2006 jako pokračující organizace firmy Ing. Pavel Hladík zabývající se projekční činnosti od roku 1997.
Specializujeme se na statiku nosných konstrukcí pozemních staveb, především železobetonových a předpjatých – jak monolitických tak prefabrikovaných. Zabýváme se také návrhem nosných dřevěných a ocelových konstrukcí, a zakládáním staveb včetně speciálního hlubinného založení. Vypracováváme projektové dokumentace statiky všech stupňů projektové dokumentace (od územního řízení, stavebního povolení, prováděcí a tendrové dokumentace až po dílenskou dokumentaci), statické posudky, vykonáváme odborný autorský dozor na prováděných stavbách a v neposlední řadě nabízíme poradenství širokého spektra v oblasti statiky a řešení eliminace tepelných mostů v nosných konstrukcích.
Pracovní tým tvoří v současnosti cca 25 osob (18 inženýrů a dalších externích spolupracovníků).

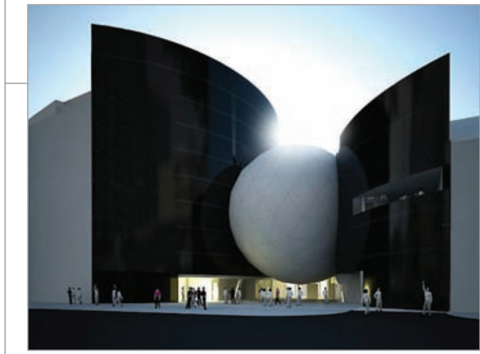
Project information

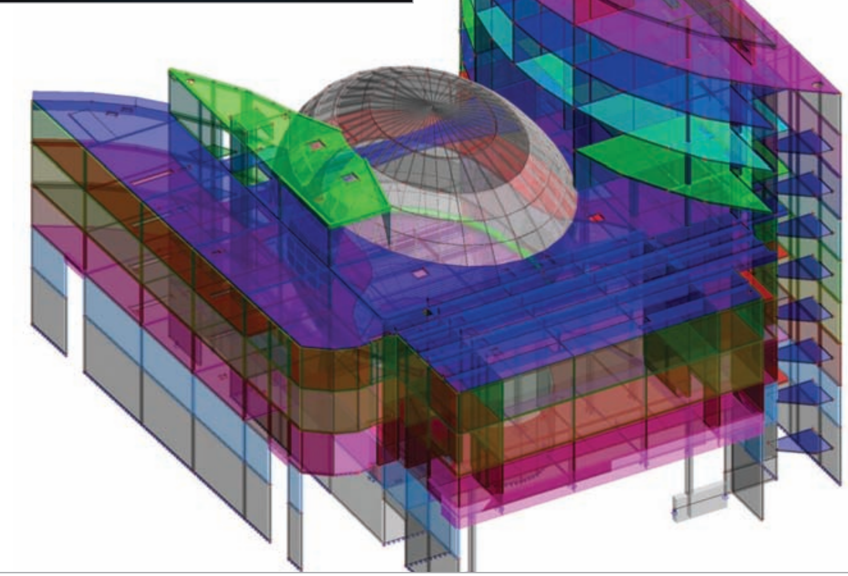
Owner	SONO Records, s.r.o., Atriová 27, 621 00 Brno
Architect	Ing.arch. František Šmédek, Smedek, s.r.o.
General Contractor	BRESTT, s.r.o.
Engineering Office	Hladík a Chalivopulos s.r.o.
Location:	Brno, Czech Republic
Construction Period	12/2011 to 02/2013

Short description | SONOCENTRUM

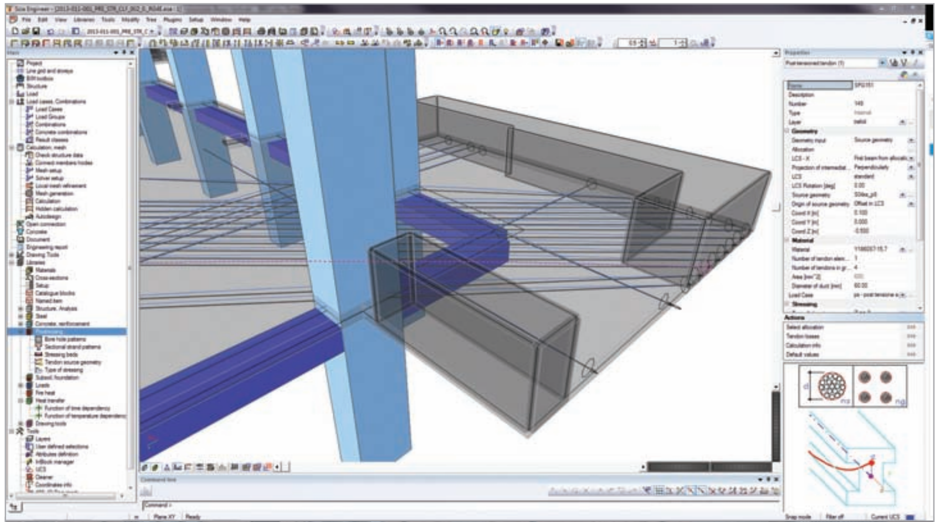
A multifunctional building with 4 basements and 9 storeys. The aboveground part of the object can be described as 2 stand-alone buildings clutching a multipurpose hall-shaped rotation ellipsoid between them with the free disposition under the hall (no vertical load-bearing structures). The ellipsoid has a reinforced concrete shell thickness of 300 mm. The ellipsoid is also supported by four massive inclined columns. There are console galleries lined along the perimeter and a lateral footbridge for seating spectators inside the hall.
The lower part of the ellipsoid and some other structures are post-tensioned with bonded tendons.







Porta Nuova Isola “Bosco Verticale” - Milano, Italy



Einleitung

Der erste „Bosco Verticale“ besteht aus zwei Türmen zu 110 und 76 Metern und zwei Gebäudeblocks für Büros und Wohnungen im Zentrum von Mailand, als Teil des Projektes „Porta Nuova Isola“. Die auskragenden Balkone der zwei Türme tragen ca. 900 Bäume und Sträucher, welche eine Höhe bis zu 9 Metern erreichen können.

Holzner & Bertagnolli Engineering ist für die Ausarbeitung des Projektes in der Ausführungsphase engagiert worden. Aufgabe des Studios war dabei die Koordination der verschiedenen Disziplinen untereinander (Architektur, Tragwerksplanung, Bauablauf). Ziel war es dabei einen kontinuierlichen und effizienten Bauablauf zu gewährleisten.

Interaktion Metro

Besonderes Augenmerk musste auf die Interaktion zwischen Metro und Gebäude gelegt werden, da die U-Bahnlinie M2 direkt unter dem Gebäude B, in unmittelbarer Nähe des Gebäudes D und C verläuft. Um die Übertragung von störenden Vibrationen zu unterbinden, wurden die Bauwerke mittels Isolatoren entkoppelt.

Dynamik

Um die Kräfte aus der Erdbebenbeanspruchung und zufolge der Windlast zu ermitteln, wurden die verschiedenen Gebäude dreidimensional in Scia Engineer modelliert.
Die dynamische Erdbeben Bemessung erfolgte nach den Antwortspektren.
Zusätzlich wurden die Eigenformen der Regeldecken berechnet und nachträglich mittels Messungen kontrolliert, da die „schweren“ Balkone niederfrequent schwingen und dies genauer untersucht werden musste.

Untergeschosse

Das Untergeschoss besteht aus drei Ebenen, welche größtenteils als Parkflächen verwendet werden.
Die Decken wurden als verbundlos vorgespannte Massivdecken ausgeführt. Dabei wurde für die Vorspannung die freie Spanngliedlage verwendet. Dies ermöglichte kurze Ausschalfristen und einen schnellen Bauablauf.

Gebäude B und C

Die Fundamente dieser Gebäude konnten als gewöhnliche Oberflächengründungen ausgeführt werden (jedoch entkoppelt mittels Isolatoren).
Die Decken wurden als verbundlos vorgespannte Massivdecken mit Hohlkörpern ausgeführt, um das Gewicht zu reduzieren und eine wirtschaftliche und schlanke Bauweise zu ermöglichen.

Gebäude D und E

Die Gründung des Gebäudes D wurde, wie zuvor erwähnt, komplett schwingungsentkoppelt. Dabei wurden die Isolatoren zwischen zwei Fundamentplatten positioniert, sodass ein Austausch zu einem späteren Zeitpunkt möglich ist.
Die Fundierung des Gebäudes E hingegen, wurde als Fundamentplatte mit einer Stärke von 2,0 Metern ausgeführt.
Die horizontale Aussteifung der Bauwerke wird durch den Kern aus Stahlbeton gewährleistet.

Die besondere Herausforderung für Holzner&Bertagnolli war die Optimierung der Regelgeschossdecken mit den bis zu 4 Metern auskragenden Decken und den großen Lasten aus dem Eigengewicht der Bäume. Auch musste die dynamische Beanspruchung durch Wind und Erdbeben untersucht werden sowie ihr Einfluss auf den Inneren Bereich der Decken.

Die Decken wurden als nachträglich mit Verbund vorgespannte Massivdecken ausgeführt, welche im Randbereich auf verbundlos vorgespannte Träger aufliegen. Die Vorspannung erfolgte mit Verbund, um die Dauerhaftigkeit und Sicherheit der gewählten Lösung zu verbessern. Maßgebend für die Dimensionierung der Regelgeschossdecken, war die Langzeitverformung der Balkone. Diese bestimmte den Vorspannungsgrad und den Verlauf der Spannglieder.

Software: Scia Engineer

Holzner & Bertagnolli Engineering GmbH/Srl

Contact Claudio Bertagnolli, Oswald Holzner
Address Bozner Straße 15/11
39011 Lana, Italy
Phone +39 473 56 15 26
Email info@h-b.it
Website www.h-b.it

Das Ingenieurbüro Holzner & Bertagnolli Engineering GmbH hat sich auf die Weiterentwicklung der Tragwerksplanung von Industrie-, Zivil- und Dienstleistungsbauten, der Projektierung von Infrastrukturen, der Bauberatung und Sicherheitskoordination, der Geotechnik sowie dem Seilbahnbau spezialisiert.

Dank eines stetigen Wachstums und der kontinuierlichen Erweiterung unseres Mitarbeiterteams verfügt das Ingenieurbüro Holzner & Bertagnolli Engineering GmbH über ein umfangreiches Know-How in der Projektierung und Bauleitung von Bauwerken aus Stahlbeton, vorgespanntem Stahlbeton, im Seilbahnbau und der Geotechnik.

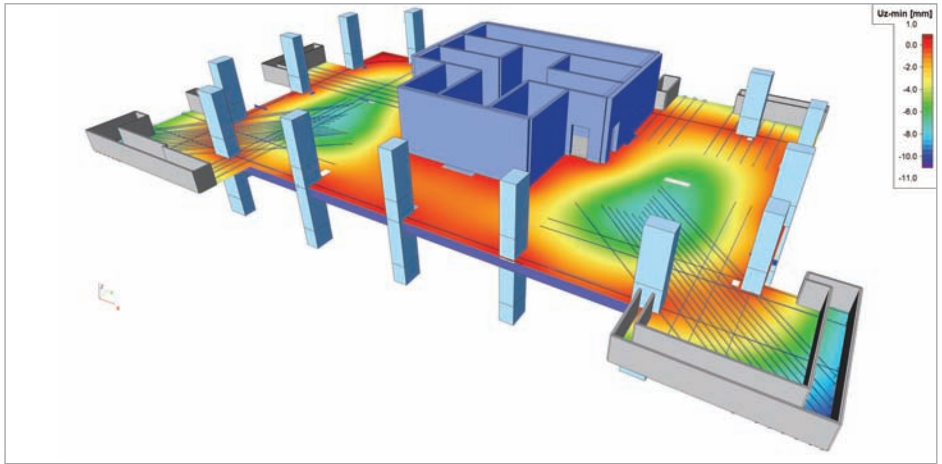
Im Jahre 2010 wurde das Ingenieurbüro Dr. Ing. Oswald Holzner in die Gesellschaft Holzner & Bertagnolli Engineering GmbH umgewandelt. Dr. Ing. Claudio Bertagnolli, langjähriger Mitarbeiter des Ingenieurstudio Ing. Oswald Holzner, ist als neuer Geschäftspartner in das Unternehmen eingetreten.

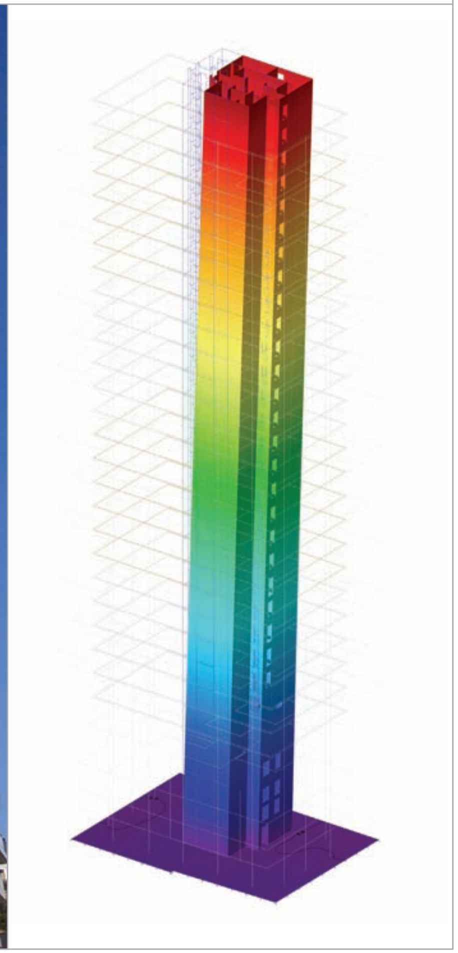
Project information

Owner	HINES ITALIA SGR S.p.A.
Architect	Stefano Boeri Architetti
General Contractor	ZH General Construction Company S.p.A.
Engineering Office	Holzner & Bertagnolli Engineering GmbH/Srl
Location	Milano, Italy
Construction Period	01/2010 to 07/2013

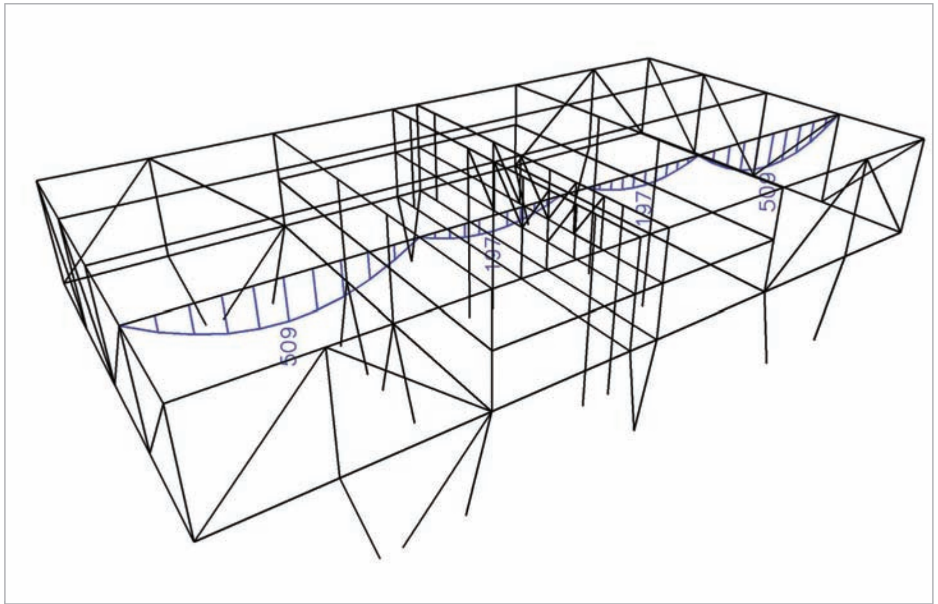
Short description | Porta Nuova Isola “Bosco Verticale”

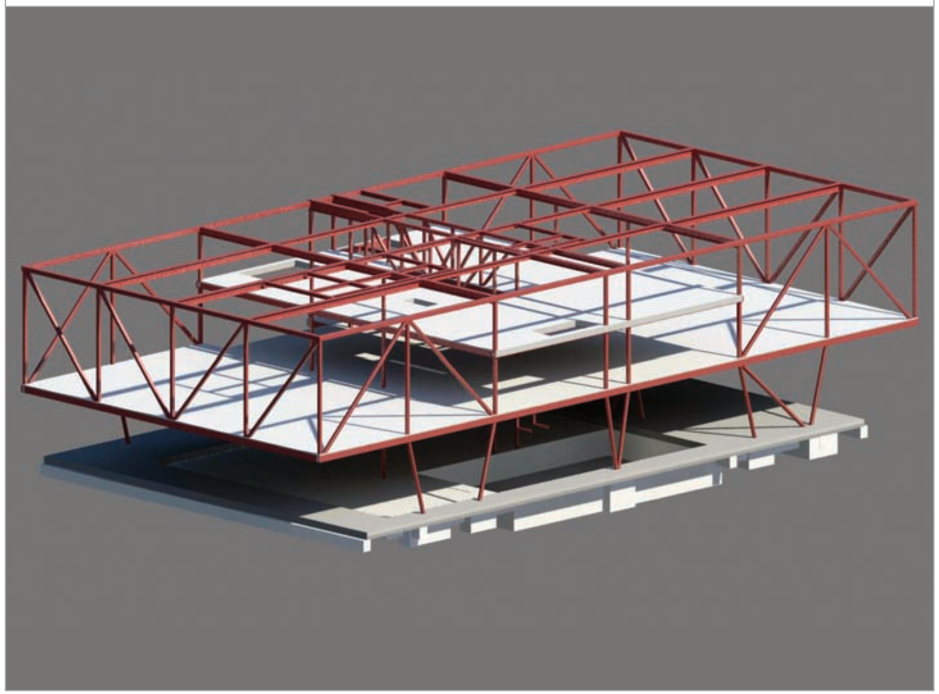
The project comprises 2 towers of respectively 110 and 76 m, and another two residential and office blocks. The buildings are located in the centre of Milan and are part of the “Porta Nuova Isola” project. There are 3 basement floors underneath the whole area, mainly used for parking purposes. The name “Bosco Verticale” - “Vertical Forest” comes from the approx. 900 trees placed on the balconies all around the 2 towers.
The main structural system of the towers is a central reinforced concrete core with flat slabs. The balconies with an up to 4 m cantilever where realised with bonded post tensioned slabs, the basement floors with unbonded post tensioned slabs.
A major issue was the interaction of the underground railway passing beneath this area. The vertical structure was disconnected with isolators (viscous damper) on the basement level to prevent a vibration transfer to the upper floors.





New Community “Brede” School - Utrecht, The Netherlands





Project

A new community school along Duurstedelaan in the suburb of Hoograven in Utrecht will be occupied halfway through 2013. The plan, designed by VVKH architecten, offers space to three schools (the Ariëns School, the Da Costa School and De Hoge Raven), as well as out-of-school care facilities and a ‘sports box’ with two gym halls.

The three schools and the out-of-school care facilities are individual free-standing buildings that surround a sports box. This sports box has been designed as a kind of box on legs above the central entrance area (the village square) and its particular structure is explained in this entry in more detail.

Design

Both of the end walls of the sports box project over the set back fronts of the village square, whereas the end walls, as the longitudinal sides of the gym halls, must be floor-bearing. It was therefore obvious that these end walls had to be implemented in a façade-high steel lattice girder (with the span of more than 21 m), in which the lattice girder also bends around the corner thus creating the verge.

The upper floor of the gym hall has a clear span of approximately 12.5 m and is made up of a hollow-core beam floor 320 mm thick and a structural compression layer of 60 mm. Because of the restricted height, for the inside of the sports box the choice was made for integrated steel Top Hat Q (THQ) beams, supported by Ø219.1 mm round steel pipe columns. At the positioning of a single internal bearing line with a span of approximately 10 m, a floor-to-ceiling steel lattice girder was also applied, onto which the 1st floor has been suspended using a suspension column.

The roof comprises a steel structure with perforated profiled steel roof sheets. The stability is guaranteed by a number of wind bracings with columns placed at an angle.

Subsequent to the call for tender and at the request of the building contractor, the method of construction was changed from steel to prefab concrete, in which the floor-to-ceiling steel lattice girders of the sports box were altered to be constituted prefab concrete wall beams. In addition, the integrated steel THQ beams on the steel columns, at the place of the four internal bearing lines, had to be replaced with prefab concrete wall beams with various large openings. For this purpose, these walls have been subdivided and connected to each other by means of ridge and joggle pieces so that they can transfer the load from the upper-level floors to the steel columns. The lintels above the various openings ensured an adequate coherence.

Construction

For the first design of the sports box in steel, use was made of Scia Engineer to produce a 3D calculation model in order to obtain a sound perception about the transfer of force. To achieve this, all the data of the vertical and horizontal loads on the structure were entered into the model. When the transition was made to prefab concrete, the same calculation model was used to determine the greater column forces because of its increased own weight.

The individual prefab concrete wall beams were then calculated as a 2D slab in which the reinforcement was determined on the basis of the sectional forces.

Software: Scia Engineer

IMd Raadgevende Ingenieurs

Contact	Heleen van den Berge
Address	Piekstraat 77
	3071 EL Rotterdam, The Netherlands
Phone	+31 10 2012360
Email	h.vandenberge@imdbv.nl
Website	www.imdbv.nl

Since its inception in 1960 IMd Raadgevende Ingenieurs [consulting engineers] has remained totally independent and has had no commercial ties with manufacturers, subcontractors, contractors or developers who could influence the making of unbiased and unrestrained recommendations. The company dedicates its activities to making recommendations in the field of structural engineering.

The company has experience in working on projects in which the structural engineer is expected to do more than merely make calculations and drawings. An active input of the structural design in the design phase specifically leads to an economically feasible plan. IMd's aspiration is to ensure that the client gets a functional and beautiful building, the architect can realise 'his design', all the consultants achieve their best performances and the contractor can build quickly and easily.

Project information

Owner	Gemeente Utrecht
Architect	VVKH architecten Leiden
General Contractor	Slingerland Bouw Nijkerk
Engineering Office	IMd Raadgevende Ingenieurs B.V. Rotterdam
Location	Utrecht, The Netherlands
Construction Period	09/2011 to 05/2013

Short description | New Community "Brede" School

A new community school along Duurstedelaan in the suburb of Hoograven in Utrecht will be occupied halfway through 2013. The plan, designed by VVKH architecten, offers space to three schools (the Ariëns School, the Da Costa School and De Hoge Raven), as well as out-of-school care facilities and a 'sports box' with two gym halls.

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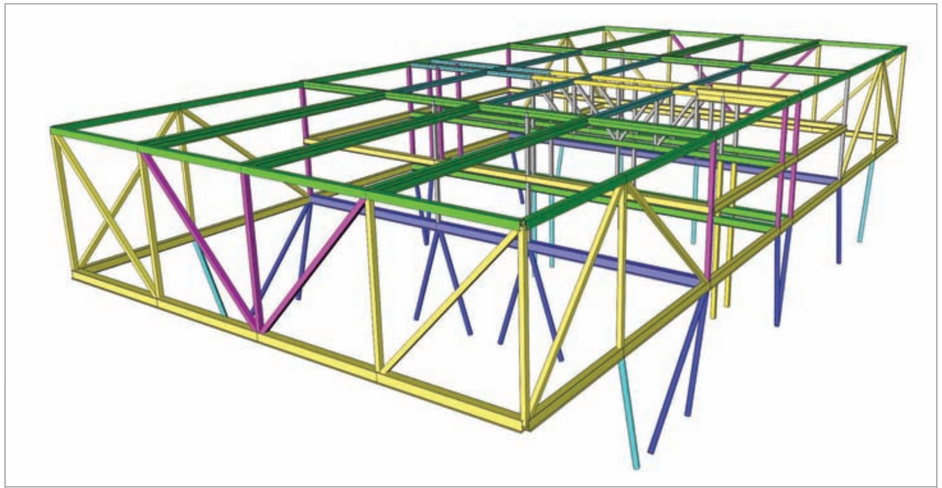
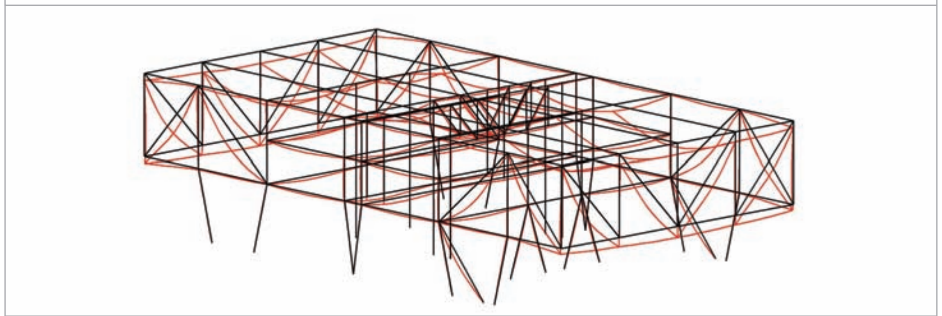
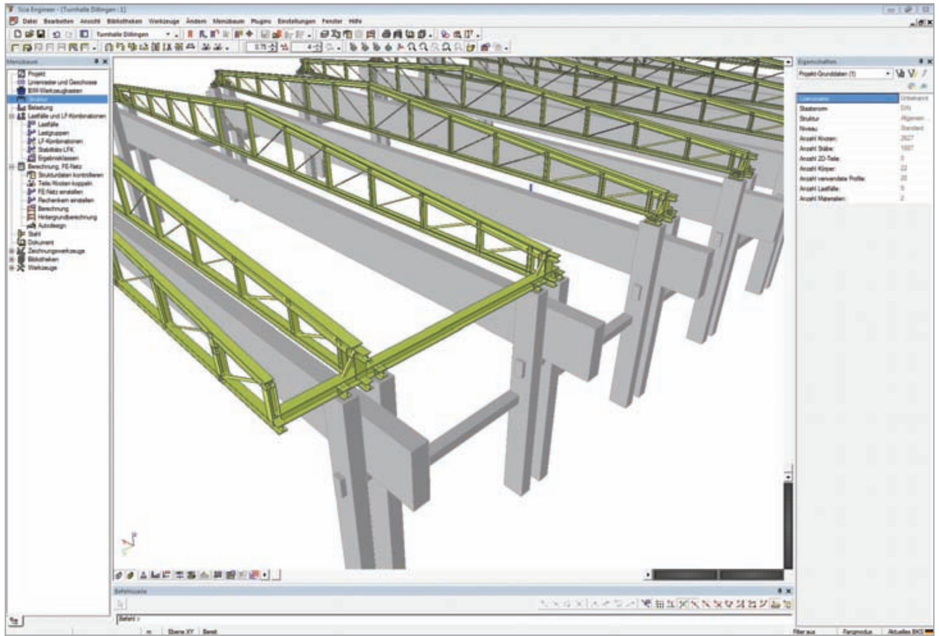




Generalsanierung Turnhalle Mittelschule - Dillingen, Deutschland



Aufgrund einer nicht ausreichend tragfähigen Trapezblechdacheindeckung wurde eine umfangreiche Sanierung einer Dreifachturnhalle (Baujahr 1974) notwendig, wobei zusätzlich eine Verbesserung der energetischen Hülle sowie der Architektur durchgeführt werden sollte.

Da die vorhandenen Spannbetonbinder, mit einer Spannweite über ca. 29 m bei einem Achsabstand von 6 m, eine neue Dacheindeckung einschließlich Unterkonstruktion nicht aufnehmen können, werden diese durch eine neue Stahlkonstruktion überbaut.

Diese neue Tragkonstruktion wird auf die Köpfe der vorhandenen und noch nicht voll ausgenutzten Doppelstahlbetonstützen aufgesetzt. Hierbei muss aber eine zentrische Vertikallasteinleitung der möglichst leichten neuen Konstruktion sichergestellt werden.

Zu den zusätzlichen vertikalen Lasten kommen noch erhöhte horizontale Lasten aus einem höheren Aufbau, welche aus der umlaufenden Lamellenattikakonstruktion sowie der vergrößerten Dachneigung und den zusätzlichen Lichtbändern resultiert. Diese Horizontallasten dürfen hierbei nur an entsprechend ausgelegte Bestandstützen abgeleitet werden. Die Auflagerung auf den anderen Stahlbetonstützen hat horizontal verschieblich zu erfolgen.

Da die Abstützung der ca. 2 m von der Binderachse abgesetzten Giebelwände des ca. 45,9 x 28,6 m großen Gebäudes an die Spannbetonbinder ebenfalls nicht mehr brauchbar war und keine eingespannten Giebelstützen vorhanden sind, muss die gesamte Giebelwand mitsamt der dortigen Lamellenkonstruktion in die neue Tragkonstruktion eingebunden werden. Dies bedeutet die Randgiebelbinder ohne vertikale Zwischenunterstützung an den jeweils ersten Stahlfachwerkbinder der Stützen anzuschließen.

Um die Gesamthöhe der umlaufenden Lamellenkonstruktion bei einer Dachneigung von 5 Grad möglichst gering zu halten wurde die Systemhöhe der Stahlfachwerkbinder auf ca. 2 m festgelegt. An den Randpfosten der Innenbinder sowie den Pfosten der Giebelbinder wurden die Pfosten der Lamellenunterkonstruktion mittels SCHÖCK-Isokorb angeschlossen.

Diese ca. 3,2 m hohe umlaufende Lamellenunterkonstruktion besteht aus 4 umlaufenden Hohlprofilriegeln, wobei die oberste Reihe das Gewicht der Alulamellen trägt und daher mit Kopfbändern abgestützt wird. An diesen horizontal verlaufenden Hohlprofilen werden die vertikalen Aluhohlprofile mit den Haltern für die Lamellen angeschraubt.

Durch die umlaufende hohe Attikakonstruktion sowie die Oberlichtbänder ergab sich ein aufwendiger Ansatz der Schneeanhäufungen. Da die Konstruktion schon als 3D-Modell für Vorentwürfe vorhanden war, konnte mittels DWG-Schnittstelle das Scia Engineer Berechnungsmodell und die Lasteingabe zügig erstellt werden und eine möglichst wirtschaftliche Konstruktion ermittelt werden.

Hierbei war es besonders wichtig, das komplizierte Tragverhalten des Gesamtsystems möglichst realistisch abzubilden um für den Bestand keine zu hohen Lasten zu erhalten und die Verformungen und Schnittgrößen der angehängten Giebel- und Lamellenkonstruktion ausreichend genau beurteilen zu können. Zur besseren Übersichtlichkeit und Kontrolle, insbesondere bei der Ergebnisdarstellung, wurde das Gesamttragwerk mittels Layern bauteilweise strukturiert.

Software: Scia Engineer

Ingenieurbüro für Stahlbau Dipl.-Ing. (FH) Jürgen Mark

Contact Jürgen Mark
Address Gräfin-Euphemia-Str. 5a
89264 Weißenhorn, Germany
Phone +49 7309 929699
Email ib-mark@email.de

Das “Ingenieurbüro für Tragwerksplanung” Dipl.-Ing. (FH) Jürgen Mark wurde 1998 gegründet und ging 2003 im Rahmen einer Konzentration seines Tätigkeitsbereiches in das “Ingenieurbüro für Stahlbau” über. Die Spezialisierung auf die Bereiche Stahlbau, Stahlleichtbau, Fassade, Aluminium- und Glasbau und die damit verbundene hohe Fachkompetenz sichern dem Ingenieurbüro seitdem jederzeit eine hohe Auslastung. Bereits 2003 wurden die vielfältigen Konstruktionen im 3D-CAD erfasst und entworfen. Nach Einstellung der Weiterentwicklung der vorhandene Statiksoftware wurde 2008 auf die moderne 3D-Statik-Software von Scia umgestellt. Da sich die Aktivitäten aber nicht nur auf die Statik, sondern auch auf die Ausführungsplanung beziehen, steht zunächst eine vernünftige und wirtschaftliche Konstruktion und anschließend erst die effektive statische Berechnung im Mittelpunkt.
Durch innovative und problemorientierte Projektbearbeitung mit sinnvoller und effektiver Nutzung neuerster Technologien sowie ständiger Fortbildung und Weiterentwicklung ergeben sich erhebliche Wettbewerbsvorteile für das Büro und entsprechende wirtschaftliche Vorteile für die Auftraggeber. Dieses umfangreiche Fachwissen wird auch zunehmend von größeren allgemein tätigen Ingenieurbüro’s im Rahmen einer Kooperation genutzt.

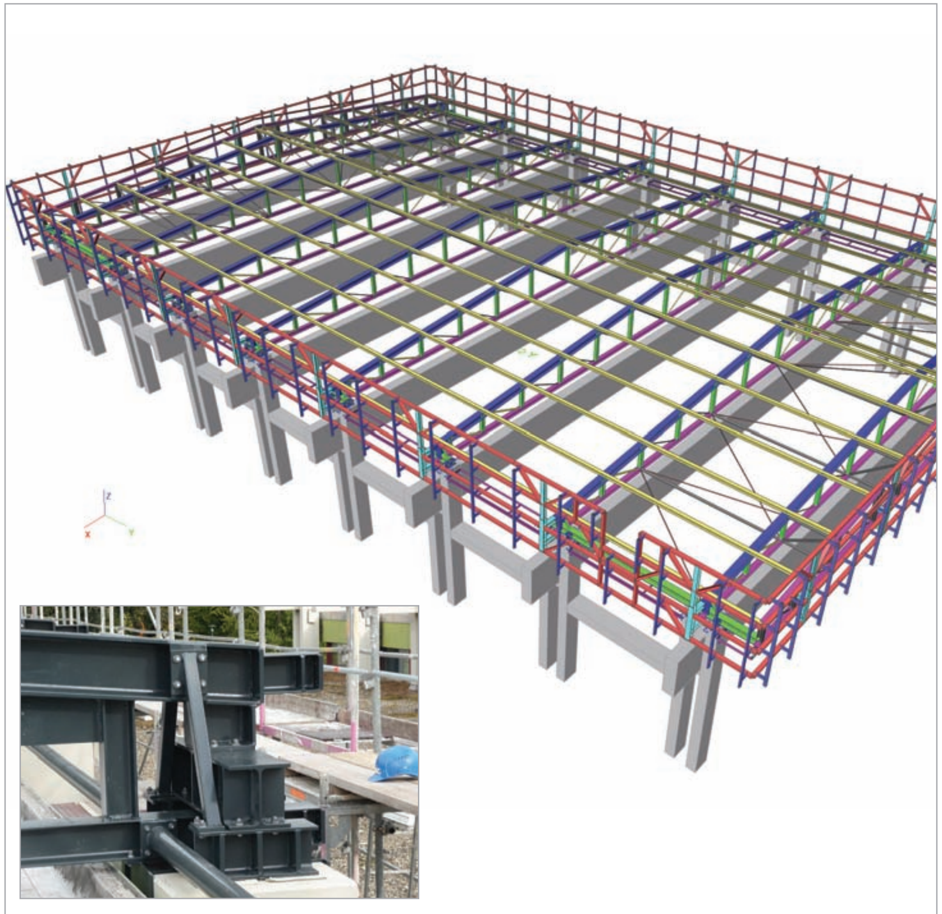
Project information

Owner	Große Kreisstadt Dillingen a.d. Donau
Architect	Freier Architekt VDA Thomas Riesenegger Dipl.-Ing. (FH)
General Contractor	Große Kreisstadt Dillingen a.d. Donau
Engineering Office	Ingenieurbüro Klaus Riegg und Ingenieurbüro für Stahlbau Dipl.-Ing. (FH) SFI Jürgen Mark
Location	Dillingen, Germany

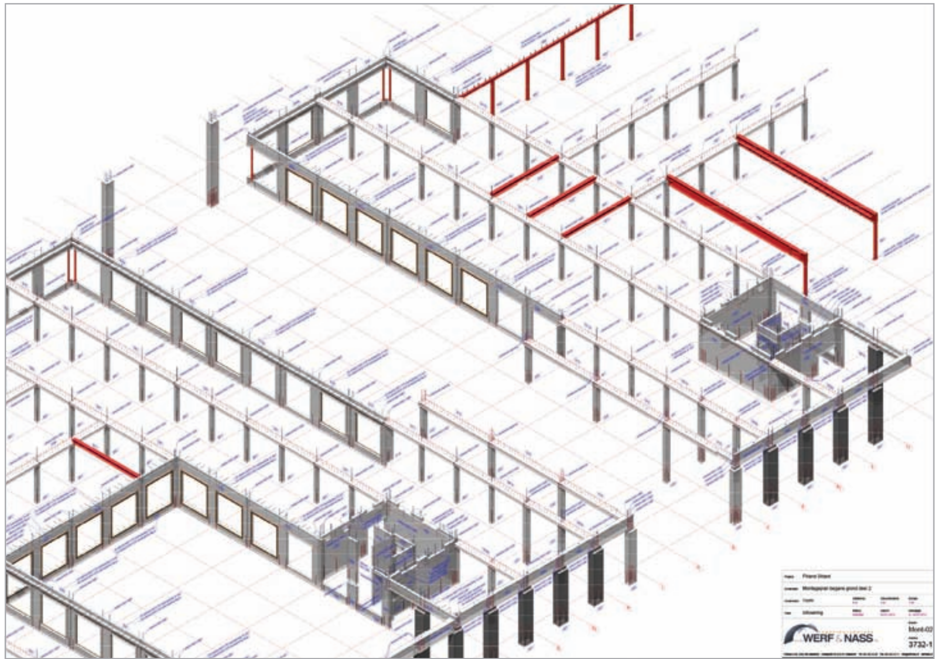
Short description | Refurbishment Middle School Gym

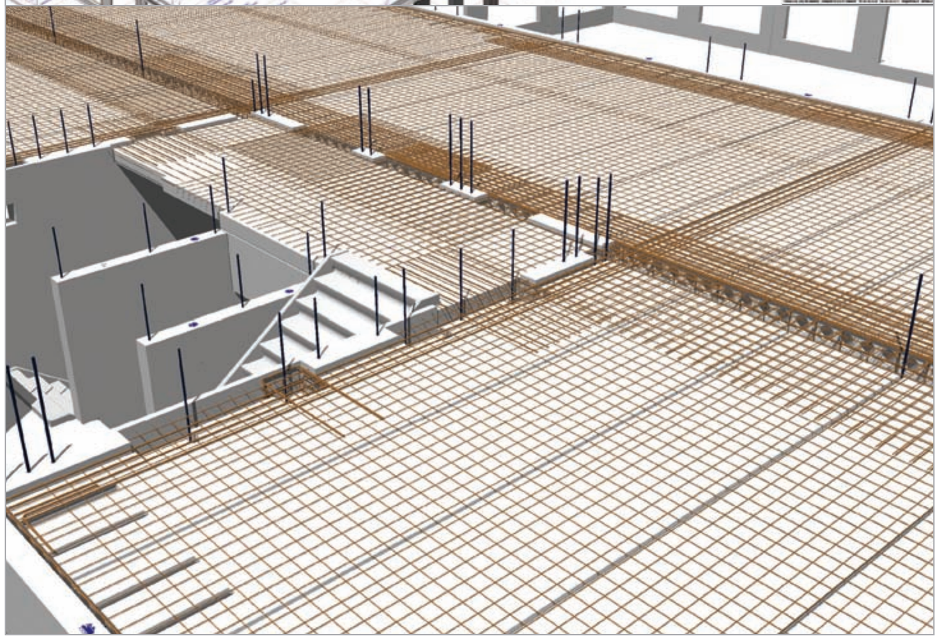
In a triple sports hall dating from 1974, the insufficiently trapezoidal sheet roofing is replaced by a new independent steel structure because the highly utilised prestressed concrete members should not be so overloaded.

The loads are carried by the static reserves of the reinforced concrete columns. In addition, the unfavourable flat roof is replaced by a saddle roof with the gradient of 5 degrees. The attica is supplemented with an aluminium lamella. The substructure of the new steel structure is attached thermally separated.



Fitland - Sittard, Nederland





Sportzone

Het Fitland-gebouw vormt het hart van de te realiseren “sportzone” te Sittard. In de Sportzone Limburg worden sporten & studeren en sporten & werken optimaal op elkaar afgestemd. Dat biedt maatwerk voor mensen die sportieve ambities willen combineren met hun studie of maatschappelijke carrière. De excellerende (sport)omgeving is het resultaat van de krachtenbundeling van sport, onderwijs, zorg, bedrijfsleven en overheid. Dat leidt tot betere (top) sportprestaties, optimale talentontwikkeling en nieuwe kennis.

Accommodaties

Het Fitland gebouw, gelegen tussen het stadion en de atletiekbanen, biedt onderdak aan 3 scholen die de opleidingen uiterlijke verzorging, horeca en sport aanbieden (Leeuwenborgh, DaCapo en Arcus). Daarnaast zal er in hetzelfde gebouw een topsporthal gerealiseerd worden. Rondom de sporthal zullen diverse sportfuncties voorzien worden, denk hierbij aan een klimwand, squash- en bowlingbalen, budozalen, wellness-voorzieningen e.d.

Het gebouw is ruim 23.000 m² groot en wordt middels een loopbrug verbonden met het ernaast gelegen stadion. In het stadion worden 72 hotelkamers gerealiseerd waarvan de centrale voorzieningen en de ontvangst in het Fitland-gebouw gesitueerd worden.

In het af te bouwen stadion worden naast het genoemde hotel 3 sportzaken, een speelhal, een horecagedeelte en kantoren gevestigd. Het betreft hier een eerste fase groot 15.000 m², de tweede fase eveneens groot 15.000 m² wordt bij de verdere doorontwikkeling van de sportzone afgebouwd. Voor het stadion (zijde huidige entree parkeergarage) komt een grote Decathlon sportretailer van 3.000 m² en een fastfood restaurant.

Constructie

Het schoolgebouw bestaat uit een volledig prefab betonnen casco (kolommen, balkbodems, wanden, trappen en bordessen) met kanaalplaatvloeren. De plint op begane grond-niveau is in gekleurd prefab beton uitgevoerd. Naast het hoofdconstructeursschap hebben wij in dit project de prefab engineering ter hand genomen.

Het sportgedeelte kent een ter plaatse gestort betonnen casco. Ook dit gedeelte van het gebouw is voorzien van een gekleurde prefab betonnen plint. Het dak bestaat uit een grote staalconstructie; Het staal is door ons in model uitgewerkt en in 3D doorgegeven aan de staalleverancier. Deze manier van informatieoverdracht (zonder gebruik te maken van 2D tekeningen) is uiterst geslaagd te noemen gezien de foutloze uitvoer.

Planning en productie

De productie, montage en bouw ter plaatse zijn binnen de gestelde termijn en ruim binnen het budget gerealiseerd. Eén en ander is zeker te danken aan de efficiënte Allplan-werkmethodiek welke wij inmiddels ontwikkeld hebben.

Software: Allplan Engineering

Ingenieursbureau van der Werf en Nass BV

Contact Ramòn Steins
Address Oranjeplein 98
6224 KV Maastricht, The Netherlands
Phone +31 433625229
Email ramon.steins@werfnass.nl
Website www.werfnass.nl

Sinds 1965 heeft Ingenieursbureau van der Werf en Nass BV uit Maastricht duizenden bouwconstructies voor woningen, utiliteitsprojecten en de industrie ontworpen en berekend. Hoe groot de verschillen in uiterlijk, draagkracht en materialen ook zijn, alle constructies zijn ontworpen vanuit de filosofie dat bouwen meer is dan techniek. In dat licht bezien, zijn constructies voor ons meer dan een optelsom van berekeningen en denken we graag vanaf het begin van het bouwproces mee over onderwerpen als milieu, gezondheid en veiligheid. Alleen zo kan een ontwerp optimaal tot ontwikkeling komen. De creativiteit van Ingenieursbureau van der Werf en Nass rust op een solide basis. Onze ingenieurs zijn getrainde technici die beschikken over een gedegen kennis van materialen en rekentechnieken en een schat aan praktijkervaring. Voor het uitvoeren van hun werkzaamheden maken ze gebruik van de modernste software, waardoor ze in staat zijn ingewikkelde modellen en alternatieven snel en verantwoord door te rekenen. De tekenkamer werkt sinds 2009 louter nog in Allplan, in 3D.

Project information

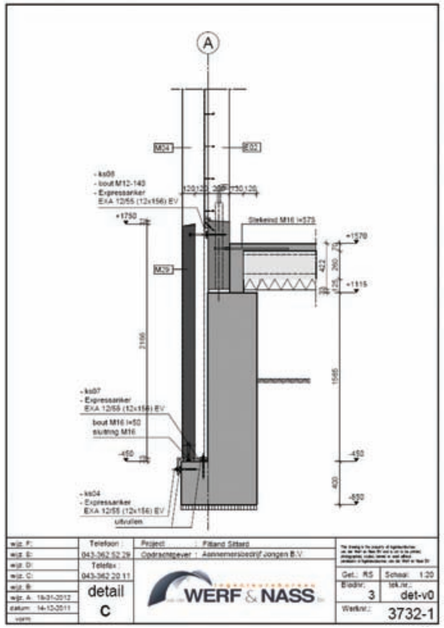
Owner	Ingenieursbureau van der Werf en Nass BV
Architect	Povse Timmermans architecten
General Contractor	Jongen Landgraaf
Engineering Office	Ingenieursbureau van der Werf en Nass BV
Location	Sittard, The Netherlands
Construction Period	01/2012 to 12/2013

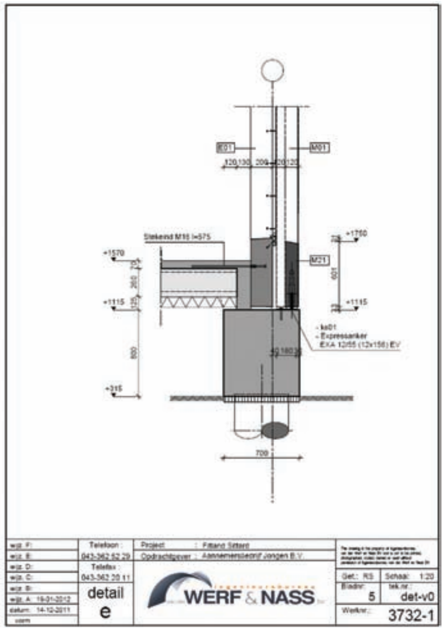
Short description | Fitland

Together with the company Fitland and the educational institutes Leeuwenborgh and DaCapo, our client, Bouwontwikkeling Jongen, came up with a new concept regarding education. Within this concept, education, work and recreation are brought together in one multi-functional building.

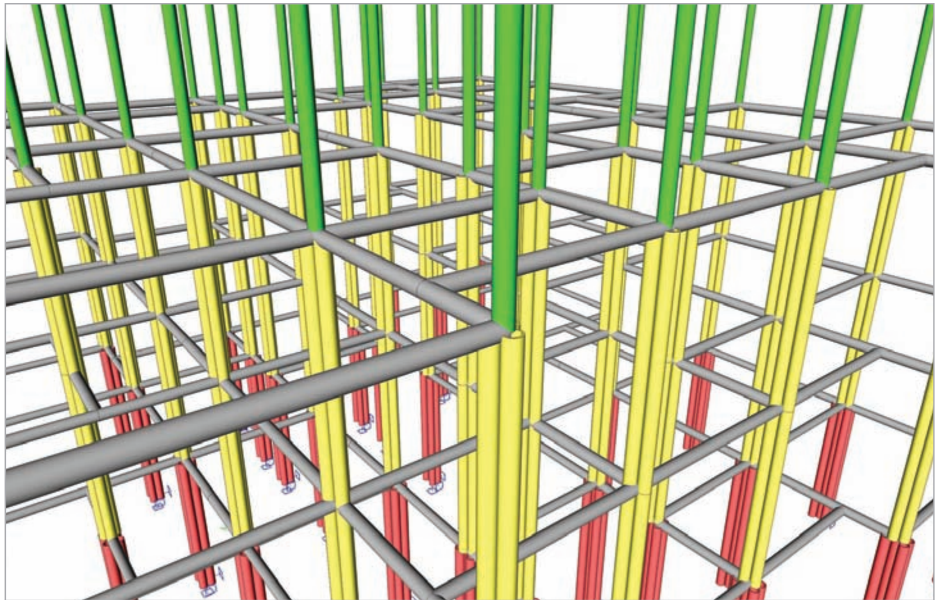
The schools are located on one side of the building, the sports and wellness areas are situated on the other side. The building will be connected with the soccer stadium of Fortuna Sittard. The Fitland building will be the heart of the Sittard Sportzone.

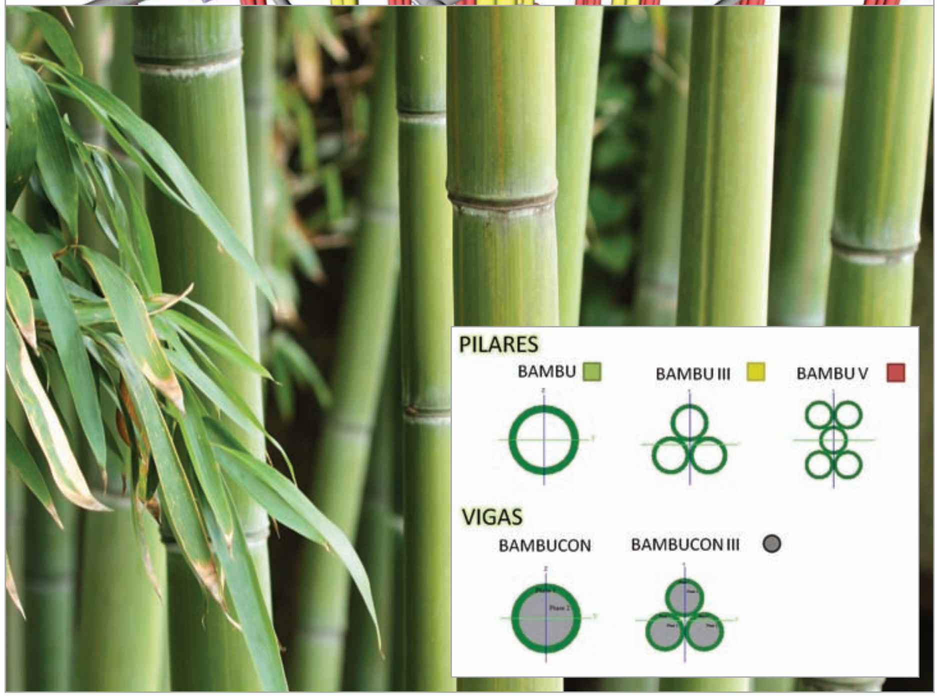
The project was modelled in 3D using Allplan, all steel reinforcement data were transmitted digitally to the steel bending company without 2D drawings.





Structural Analysis of a Bamboo Building - Brazil





With the aim of ensuring environmental sustainability in construction, a mixed material was developed, composed of bamboo and filled with concrete, combining the advantages of both materials in a single element.

In general, the bamboo constructs are still made empirically based on the results of the field load test. These buildings tend to conform more to traditions, beliefs and criteria established by professionals than to standards calculation or mathematical models for structural analysis. Therefore, in order to simulate the behaviour of these structures we chose to model a building of four floors in Scia Engineer structural analysis software developed by the Nemetschek Scia.

The performance of experimental research was essential for defining the characteristics of bamboo filled with concrete. By means of tests in the laboratory of the “Instituto Mauá de Tecnologia”, we studied the mechanical behaviour of the composite to bending, compression and shear, adjusting the physical and mechanical properties together with parameters of the input for Scia Engineer.

Materials

C25/C30 concrete was used with the physical and mechanical characteristics stipulated by the European standard Eurocode (EN 1992).
To simulate the characteristics of bamboo the woods were chosen as the base material, once the bamboo had different behaviour in relation to the position of the material fibres. Through literature and testing developed by the authors, the physical and mechanical properties of bamboo were stipulated.

Cross Section

The default values adopted for the bamboo poles were 15 cm in diameter and 1.50 cm thickness.

Structural Model

The model includes a 3D portico, with four floors composed of bamboo stick pillars, and bamboo beams filled with C25/C30 concrete.

Loads

The usual design procedures were followed, respecting the precepts of technical standard NBR 6120: “Loads for the calculation of structures”, aimed at simulating the loads of dead weight of the slabs, closing masonry, dry-wall and overhead of utilisation. Loading due to wind was not considered, as it is a structure with high rigidity, low overall height and a great number of pillar rows. The self-weight load was applied automatically by Scia Engineer, taking into account the specific weight of the materials used. All the loads, both permanent and accidental, were increased by 1.40, according to NBR 6118.

Theoretical Verification

Through the internal forces in the bars, from the structural analysis developed in Scia Engineer, the bars more requested were verified by applying criteria of strength of materials to normal stresses and shear stresses.

Conclusion

All bars met the verification criteria, making it possible to state that a four-floor building made of bamboo is technically feasible.

The bamboo has good compressive strength, enough to be used in the columns of the building. However, the beams require sections of bamboo filled with concrete. The bamboo is efficient in normal forces, both traction and compression, hence its use in truss structures provides better utilisation of its resistance, but does not exclude other structural models, such as those presented in this work.

It has been proven throughout the development of the research that bamboo is an alternative material for the construction industry and besides having good physical and mechanical characteristics it is a material that enhances sustainability.

Software: Scia Engineer

Instituto Mauá de Tecnologia

Contact Débora Coting Braga
Address Praça Mauá 1
09580 900 São Caetano do Sul, Brazil
Phone +55 11 42393 000 / 0800 019 31 00
Email ceun@maua.br
Website www.maua.br

Instituto Mauá de Tecnologia - IMT is a private, non-profit organization.Its main objective is to promote technical-scientific education, technological research and development aiming to provide highly qualified human resources to contribute to the socioeconomic development of Brazil.

IMT was founded on December 11, 1961 its headquarters is located at Rua Pedro de Toledo, 1071 in São Paulo city. The institute maintains two units: the Centro Universitário and the Technical Services and Tests Center and two campi: one in São Paulo city and the other in São Caetano do Sul.

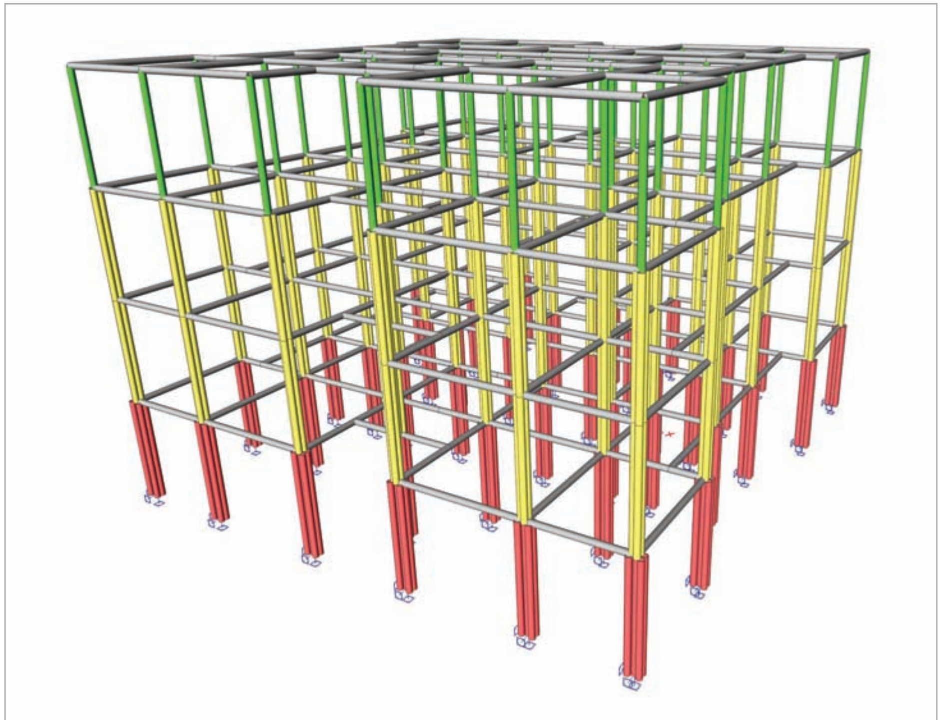
The headquarter of the two units is located at IMT campus in São Caetano do Sul at Praça Maua, 1 with a constricted area of 130,000 m², 12 km from São Paulo city center. In this campus the Centro Universitário offers undergraduate courses in Engineering, Design, Administrations and Higher Education Certificate.

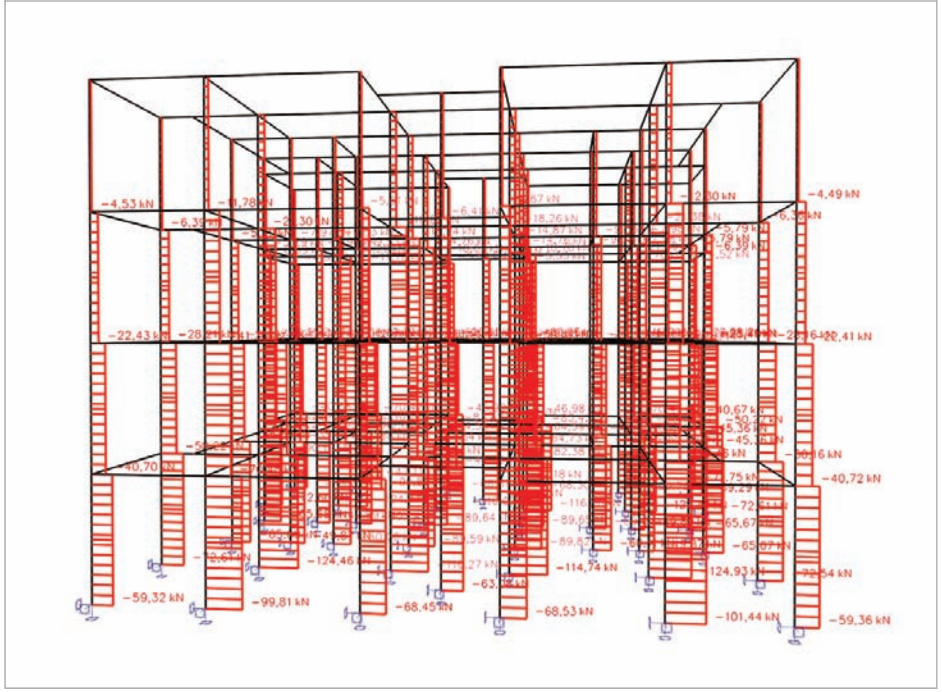
Project information

Owner	Instituto Maua de Tecnologia - IMT” (Maua Institute of Technology
Architect	Débora Coting Braga
General Contractor	Débora Coting Braga
Engineering Office	Débora Coting Braga
Location	Brazil
Construction Period	01/2011 to 12/2011

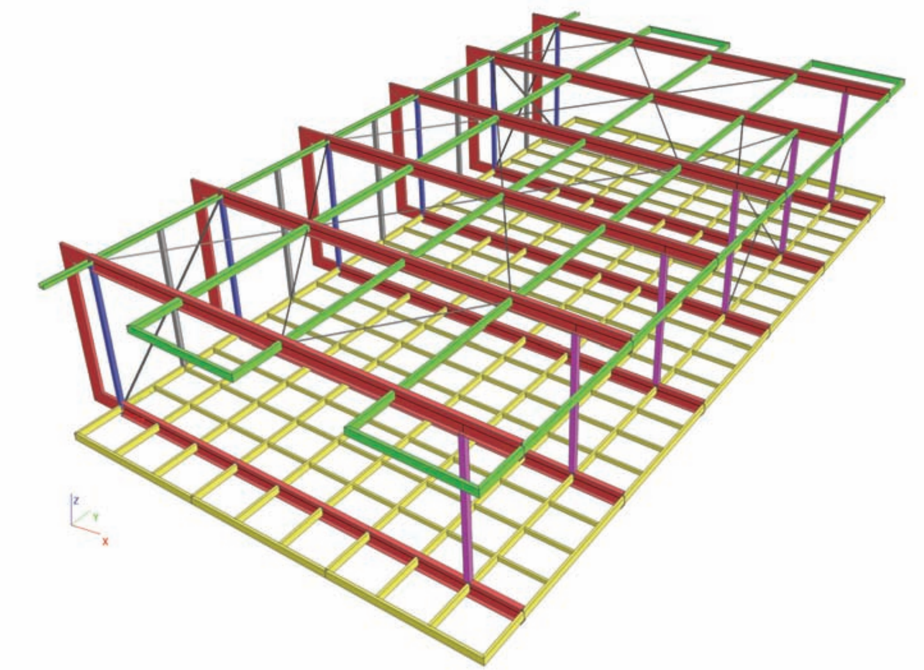
Short description | Structural Analysis of a Bamboo Building

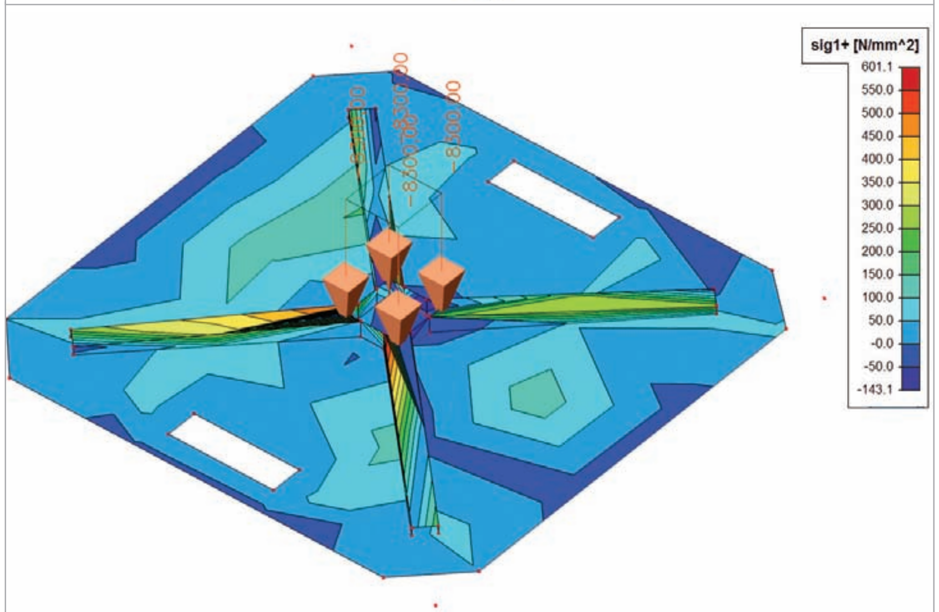
Currently, constructions of bamboo are still made empirically, based on the results of load tests on test pieces. In this research, the technical feasibility of constructing a four-floor buliding with bamboo as the main material of the self-supporting structure was verified. Tests confirmed the good resistance of bamboo's compression parallel to the fibres, enough to be used as columns. However, bending tests and compression perpendicular to the fibres showed the inadequacy of the material when subjected to these efforts. The idea was developed of a composite material of bamboo filled with concrete, which after the results from the laboratory was allowed to be used as the beams of the building. It has been proven throughout the development of research that bamboo is an alternative material for construction and besides having good physical and mechanical characteristics it is a material that enhances sustainability.





Demontabel Paviljoen - Worldwide





Inleiding

Het paviljoen is een multifunctioneel gebouw, waarin bezoekers een tentoonstelling kunnen bijwonen.

Het uitgangspunt tijdens het ontwerp van de constructie was dat het paviljoen overal ter wereld moet kunnen worden opgebouwd.

Om het doel tijdens de uitwerking te bewaken is een programma van eisen opgesteld m.b.t. de constructie.

1. De constructie moet demontabel en in zee-containers verscheepbaar zijn.
2. De constructie moet in een kort tijdsbestek door enkele personen in elkaar gezet kunnen worden, zonder zwaar materieel.
3. De constructie moet in verschillende breedtes uitgevoerd kunnen worden.
4. De constructie moet overal ter wereld geplaatst kunnen worden, uitzonderingen daargelaten.

Gebruik

De opdrachtgever wil het paviljoen overal ter wereld kunnen opbouwen. Gezien het architectonische ontwerp was dit alleen mogelijk als een zo licht mogelijke constructie werd toegepast. Door de constructie demontabel te maken bleven de liggerlengtes beperkt, waardoor het geheel in een zeecontainer verscheept kan worden. Daarnaast mochten de onderdelen niet meer wegen dan 50 kg/stuk om het noodzakelijk gebruik van groot materieel te voorkomen. Gezien de aanwezige overspanningen en optredende belastingen was dit alleen mogelijk als de hoofddraagconstructie in aluminium uitgevoerd werd.

Het paviljoen moet overal ter wereld kunnen staan. Dit houdt in dat met verschillende (weer)omstandigheden rekening gehouden dient te worden. Met behulp van de Eurocode is gezocht naar maximale belastingen m.b.t. sneeuw en wind. Om de constructie niet extreem zwaar te maken zijn er grenzen gesteld aan de optredende belastingen en is aangegeven in welke gebieden de belastingen overschreden mogen worden.

Bij het plaatsen van het paviljoen nabij een open wateroppervlak zoals een zee of groot meer dienen er m.b.t. de wind extra maatregelen getroffen te worden.

In het geval van sneeuw is de standaard sneeuwbelasting in Zweden en Finland gehanteerd. In landen als Noorwegen, IJsland en de grootste delen van Zweden, Finland en de Alpen zijn i.v.m. extreme lasten ook extra maatregelen nodig.

Een andere eis was de mogelijkheid om te kunnen variëren in grootte. Het paviljoen is ontworpen als modulair system waardoor er flexibiliteit in gebruik van de oppervlakte ontstaat. De mogelijkheden zijn 75 m² en 150 m². De afbeeldingen zijn veelal van de variant van 75 m² die als eerste geproduceerd is.

Constructie

De hoofddraagconstructie van het paviljoen bestaat uit frames uit demontabele aluminium I-liggers. Het frame wordt ondersteund door verstijfde stalen platen. De vloer- en dakconstructie is opgebouwd uit een raamwerk van aluminium kokers. Deze dragen de optredende belasting af aan de frames. Tevens zijn er windverbanden toegepast om de constructie te stabiliseren.

Bovenaan worden de aluminium frames voorzien van kappen die geen constructieve waarde hebben. Het dak is aangebracht tussen de liggers en waterdicht gemaakt.

Engineering

Scia Engineer bevat 2 functies die de doorslag gaven om het project als een 3D rekenmodel uit te werken. De eerste was de mogelijkheid om zelf samengestelde aluminium profielen in te voeren, waardoor er met de juiste stijfheden gerekend kon worden. Verplaatsingen en krachtsverdelingen konden op deze wijze goed in kaart gebracht worden bij de verschillende omstandigheden. Een andere functie was het rekenen met niet-lineaire steunpunten. Het paviljoen wordt in principe niet bevestigd aan de ondergrond, uplifting kan bij zware windbelasting een rol spelen. Met ‘steunpunten enkel druk’ was dit effect goed te modelleren.

Software: Scia Engineer

Konstruktieburo Snetselaar BV

Contact Richard Bettink
Address Galileïlaan 36
6716 BP Ede, The Netherlands
Phone +31 318 62 71 62
Email rbettink@snetselaar.nl
Website www.snetselaar.nl

Konstruktieburo Snetselaar BV is een landelijk opererend onafhankelijk en zelfstandig adviesbureau voor bouwconstructies. Onze activiteiten bestaan uit het ontwerpen, berekenen en tekenen van bouwkundige en civiele constructies van gewapend/voorgespannen beton, staal en hout. De bouwsectoren waar wij ons op richten zijn de utiliteits- en woningbouw als ook de industriële bouw en de droge infrastructuur. Met ons team van ruim 20 adviseurs, (register)-constructeurs en tekenaars bieden wij de volgende diensten aan:

- Alle werkzaamheden als hoofdconstructeur voor bouwconstructies (volledig 3D-BIM)
- Sterkteberekeningen en detailberekeningen incl. ontwerp-, detail- en wapeningstekeningen
- Werktekeningen staal- en prefab betonconstructies voor productie en montage (BIM)
- Grondmechanisch onderzoek (sonderingen), Funderingsberekeningen en Funderingsadviezen

Onze praktijkgerichte aanpak is gebaseerd op de betrokkenheid van onze medewerkers bij ook de uitvoering van projecten. Het meedenken tijdens het bouwen staat voorop. Ons bureau kenmerkt zich door snelle prijsbewuste adviezen met korte lijnen naar de opdrachtgever.

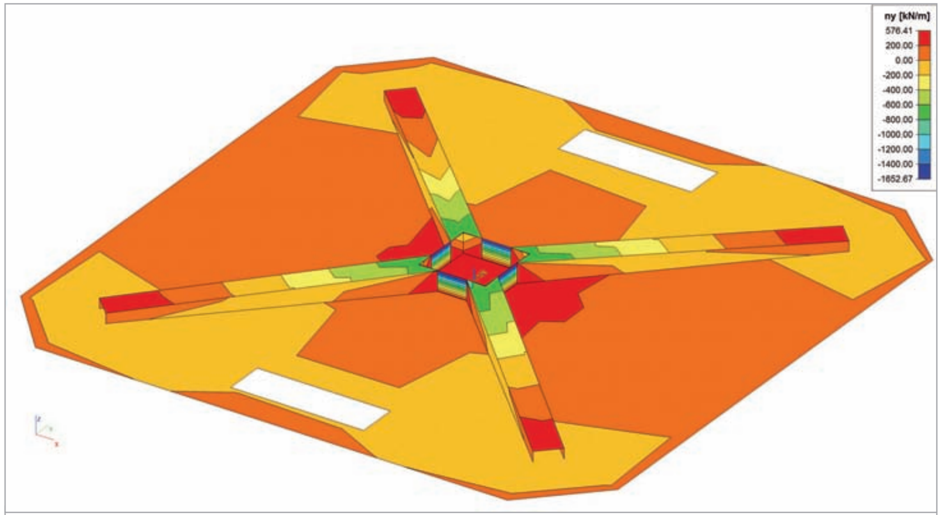
Project information

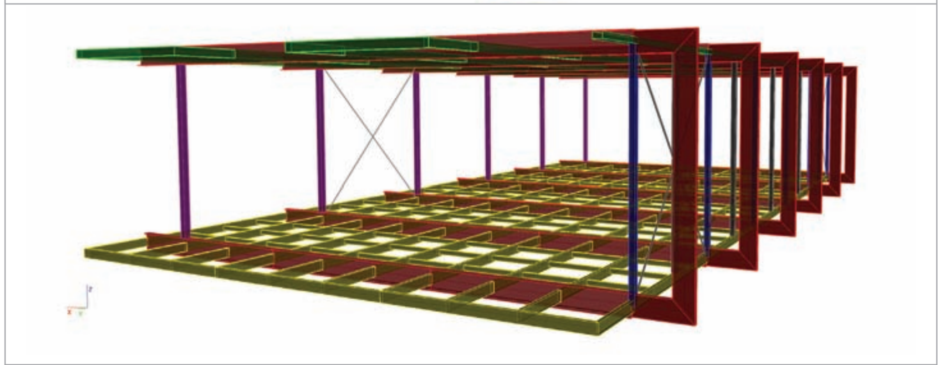
Owner	G-Star International B.V.
Architect	G-Star International B.V.
General Contractor	Fiction Factory
Engineering Office	Konstruktieburo Snetselaar BV
Location	Worldwide
Construction Start	2007

Short description | Demontabel Pavilion

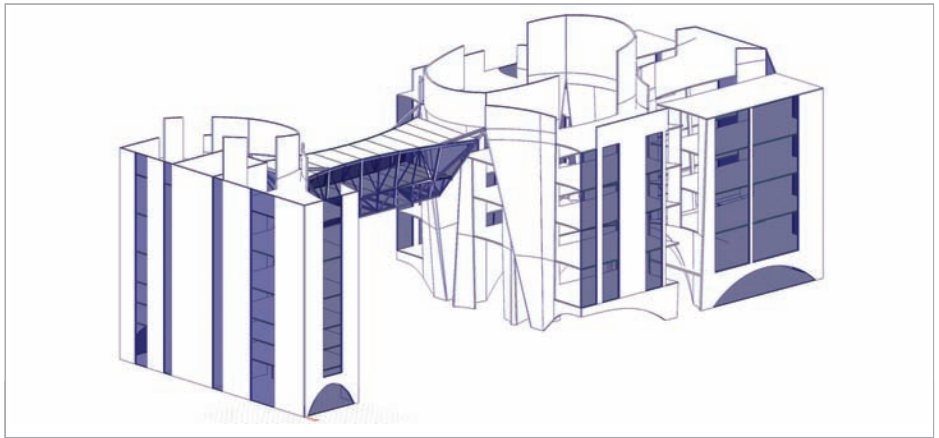
This exhibition pavilion is manufactured in an aluminium support structure. The weight of the aluminium elements is no more than 50 kg, so the pavilion can be put together by two persons. It is intended that this pavilion travels to various exhibitions around the world. Therefore, the construction by Konstruktieburo Snetselaar BV has also been designed with the possibility to transport the pavilion with a container. In addition, there are various wind and snow loads in the different parts of the world which must be calculated. The overall structural impact of the aluminium support structure and the drawings were developed by Konstruktieburo Snetselaar BV.

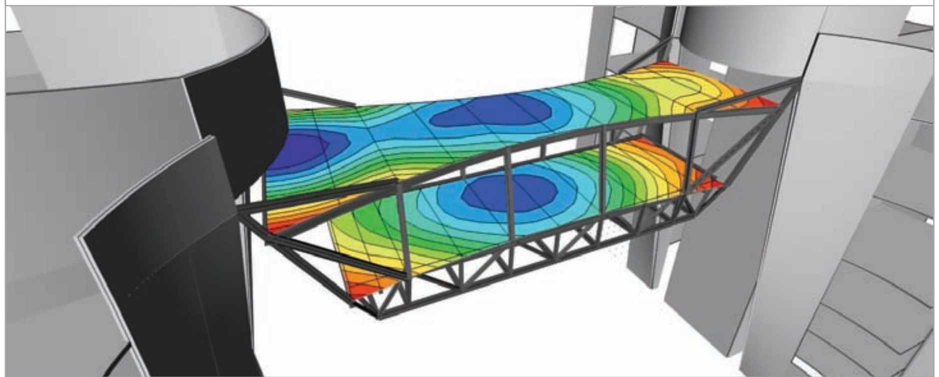
Scia Engineer enabled to model composed aluminium sections and nonlinear support conditions.

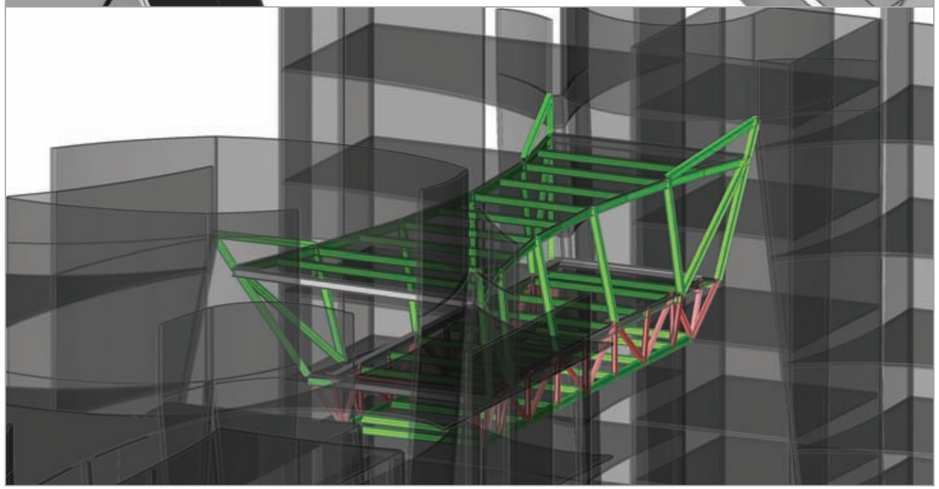




National Music Centre - Calgary, Alberta, Canada







Project Description

An international design competition sought to identify a unique design for Canada's National Music Centre that would link the historic past of Calgary's East Village with the innovations of the future.

As a result, the National Music Centre is an entirely new cultural institution dedicated to the music of Canada in all of its forms. It is at once museum, performance hall, interactive music education center, recording studio and broadcast center. Sited opposite the Stampede Grounds in Calgary's historic East Village, the new National Music Centre, along with the restored King Eddy Hotel, will catalyze the future redevelopment of the district.

Key Structural Design Features

- Free form, 5 story concrete structure that utilizes nine towers to form the body. The towers serve as cores to resist the lateral load.
- Contemporary look features concrete walls clad in terra cotta rising in subtle curves. These curves merge, separate and interlace. Smaller concrete structures lean on each other and form understated arches, many of which don't touch the ground.
- Majority of exterior was architecturally exposed concrete, making concrete appearance and the reduction of cracking paramount.
- Combination of mat foundation and spread footings.
- Bridge spanning over 4th Street SE connecting the structure designed as a full story steel truss and included no similar connections.

Project Challenges

The scale of the National Music Centre project and the intricacy of the architecture could have made it difficult and expensive to complete using traditional engineering workflows and software. Because of the scale of the project, complex architecture and mix of materials, KPFF encountered various design, analysis and workflow challenges.

One such design challenge was the requirement for the structure to not only perform adequately for strength, but also for the unique functional needs related to the acoustics of specific spaces. In addition, other spaces held requirements for interior climate control in relation to the preservation of the museum's collections. These design challenges made direct collaboration with the architectural and interior design teams vital, in order to ensure that the structure performs effectively in all aspects of the design.

Also, in an attempt to streamline the project workflow, KPFF decided to utilize Scia Engineer because it allowed the engineers to directly leverage the architects Rhino 3D model into analysis. Within this process, Rhino 3D files were imported into Scia Engineer as VRML files.

After importing as VRML files, KPFF was able to choose to have Scia Engineer convert the VRML geometry into 1D or 2D members automatically, or bring the model in as reference geometry. In this case, because of the many doubly curved shell elements in the design, the model was brought in as a reference model. KPFF was able use the tools in Scia Engineer's BIM toolbox to trace around and convert the Rhino3D model into a proper analytical model that was ready for loading, meshing and analysis.

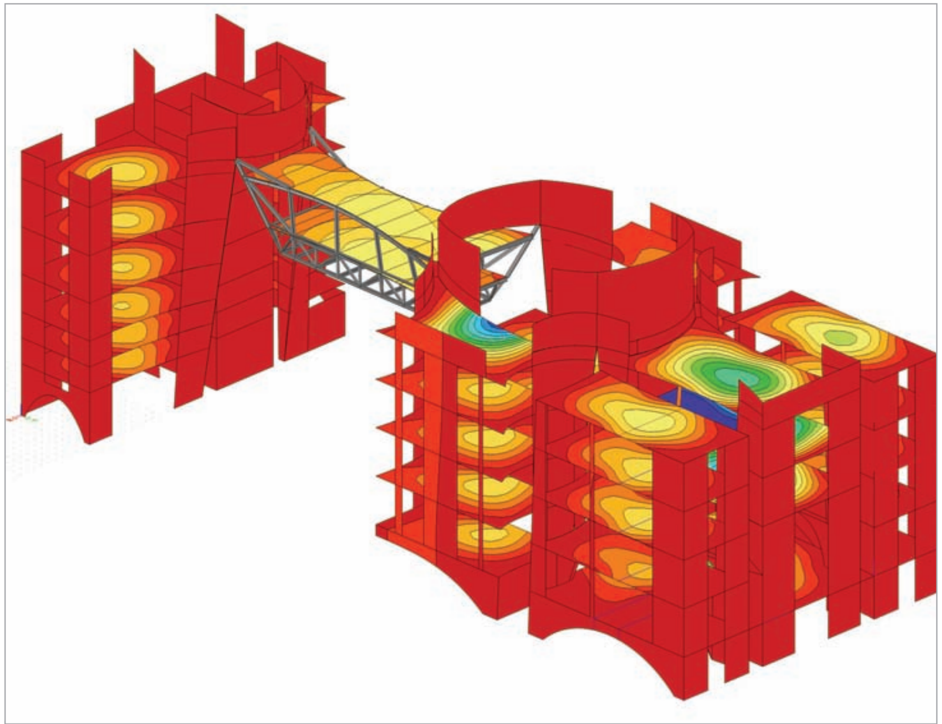
Ultimately, the ability to leverage the architect's model into analysis saved KPFF tremendous time. The biggest advantage was the ability to make changes and turn the design back to the architect within a day. Without the quick turnaround that Scia Engineer allowed, the project design phase would have greatly extended and could have caused for difficulty in coordination.

Software: Scia Engineer

KPFF Consulting Engineers

Contact	Andrea Hektor
Address	111 SW Fifth Avenue, Suite 2500 Portland, Oregon 97204, America
Phone	+1 503-227-3251
Email	andrea.hektor@kpff.com
Website	www.kpff.com

KPFF was founded in Seattle, Washington, in 1960 and since that time, the firm has grown in both size and stature. In addition, we have built a reputation as creative and innovative engineers who are focused on a high level of client service and excellence in everything we undertake. This strong tradition of client service and excellence is the primary reason that we have experienced significant growth in our professional practice over the last 50 years.
Today, KPFF Consulting Engineers is a multi-office, multi-discipline engineering firm that provides a wide variety of engineering services to the design and construction industry both in the United States and abroad. Services which are provided include structural engineering, civil engineering, construction management, project management, surveying and a variety of specialty engineering services.
This significant broad-based experience provides us with the ability to solve the most difficult and challenging problems.



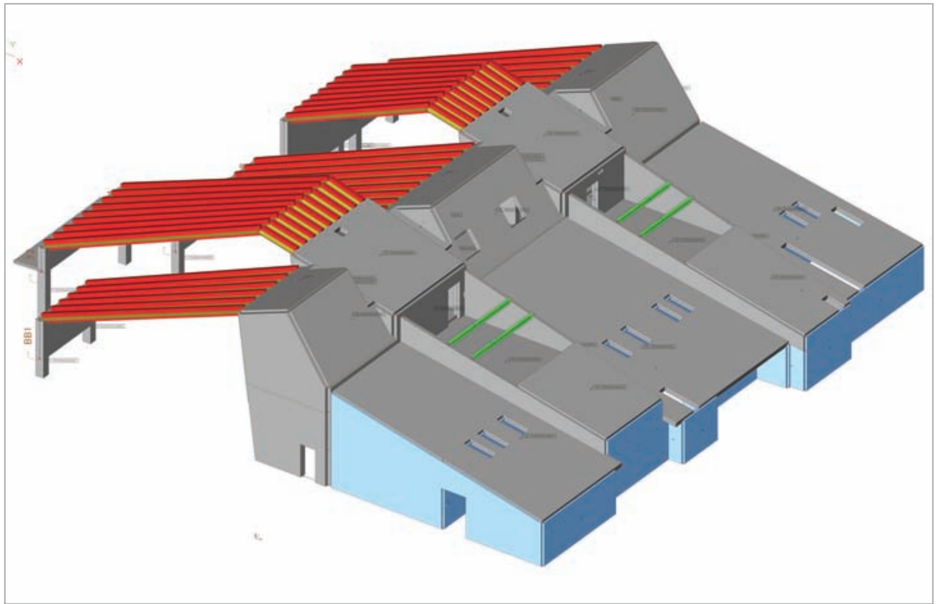
Project information

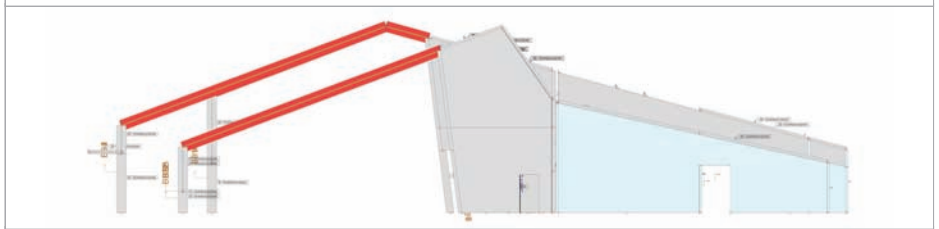
Owner	Cantos Music Foundation
Architect	Allied Works Architecture, Portland, Ore
General Contractor	CANA Construction
Engineering Office	KPFF Consulting Engineers, Portland and Read Jones Christoffersen Consulting Engineers, Calgary
Location	Calgary, Alberta, Canada
Construction Period	02/2013 to 06/2015

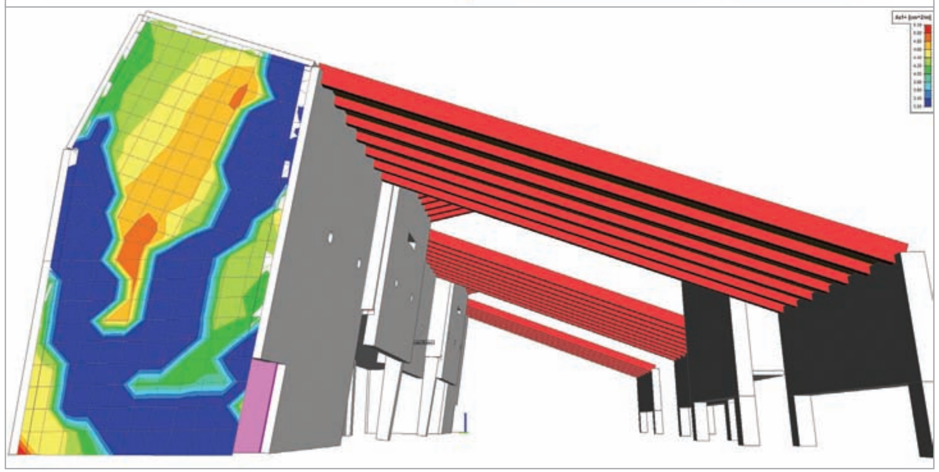
Short description | National Music Centre of Canada

The National Music Centre of Canada is a 135,000-square foot cultural institution dedicated to the music of Canada and located in Calgary's historic East Village. The design itself is free-form, using 9 towers to form the structures body. Additionally, the structure is built around the historical and condemned King Edward Hotel, which will be refurbished and reopened as part of the project.
As a result of the project's scale and intricate architecture, Scia Engineer was utilized for its 3D modelling capability, advanced analysis and, most importantly, the software's ability to leverage the architect's model into analysis, allowing for streamlined collaboration between the architect and structural engineer.

Construction of a New Student Dining Hall - Haßloch, Pfalz, Germany







Stipulations

The objective was to construct a joint yet separate building made of reinforced concrete, timber and brickwork, with the entire building to be divided into a hall and a food preparation area.

Specifications

The hall functions as the actual dining hall where the food is distributed to the students. In order to accomplish this, a widely spanned timber construction of laminated timber trusses was chosen for the roof. In the front area, reinforced concrete panels on steel posts are used as supports for the laminated timber trusses. In the rear area, a stable and rigid core of reinforced concrete was constructed for bracing purposes. It also contains all the technical facilities. The structure is shifted and arranged in an offset pattern in the floor plan as well as in the elevation. Altogether, there are five adjacent buildings, which, although they differ in height, dimension and inclination, have been united to form one single hall. Adjoining the rear part of the hall, the food preparation area is built in the conventional way, while the individual houses are shifted and arranged in an offset pattern as well.

Basic dimensions

- Length: 35.00 m
- Minimum width: 35.50 m
- Maximum width: 38.00 m
- Minimum height: 2.70 m
- Maximum height: 10.20 m
- Roof pitches: 12.5°, 15°, 20°, 55°

Programmes used

- Scia Engineer
- Frilo Statics
- GLASER -isb cad-

Structural calculation

To realise the structural system, the whole building was modelled in Scia Engineer in 3D. This process enabled the determination of the various intersection points of walls, ceilings and roof constructions. As almost no wall is parallel to its adjacent wall, and the roof constructions have different pitches, too, all the resulting intersection points had to be described and recorded exactly. This was the prerequisite for construction planning. Detailed modelling of the whole system in 3D provided the basis for the complex formwork and reinforcement drawings. By using Frilo along with Scia and GLASER -isb cad-, this project was successfully planned and concluded.

Thoughts on the building

Starting with the strip foundations and the 25 cm thick floor plate that runs at two levels, the reinforced concrete disks that are 50 cm thick were initially erected on the 50 cm x 50 cm stanchions at the start of the construction site. Through the roof construction that is inclined and reduces the load, as it is horizontally made of laminated timber trusses, these disks and stanchions had to be supported with sufficient rigidness to be able to greatly limit deformations and to ensure usability. Following this, the rigid reinforced concrete section with walls that are 40 cm thick and ceilings that are 30 cm thick rose towards the sky from the centre of the base plate. It was possible to achieve a high level of rigidity due to the thicknesses used in order to realise the rigid core on the one hand, and to be able to withstand the seismic loads placed upon the entire system on the other. Right from the start, all the openings of the entire technology had to be jointly taken into account for this reinforced concrete structure. This could only be achieved through the extremely good cooperation between the heating planner, the ventilation planner, the designer of the sanitary facilities, the electric planner and ourselves. The preparatory building was constructed in a solid brick construction in the rear section with a slight time delay. In this process, reinforced concrete ceilings that are 30 cm thick were placed on lime-sand bricks which joined with the reinforced concrete core in terms of their incline and orientation. Finally, the hall had a crown placed upon it, using the laminated timber trusses that are 24 cm x 56 cm thick. These were placed upon them by means of a frictional coupling on steel mounting parts that we specially developed and set in concrete for this purpose.

Software: Frilo Statics, GLASER -isb cad-, Scia Engineer

Kreidemacher Ingenieure

Contact Lothar Kreidemacher
Address Fritz-Lederle-Straße 6a
67071 Ludwigshafen, Germany
Phone +49 621 57 25 323
Email ing@kreidemacher.de
Website www.kreidemacher.de

K | ING kreidemacher ingenieure

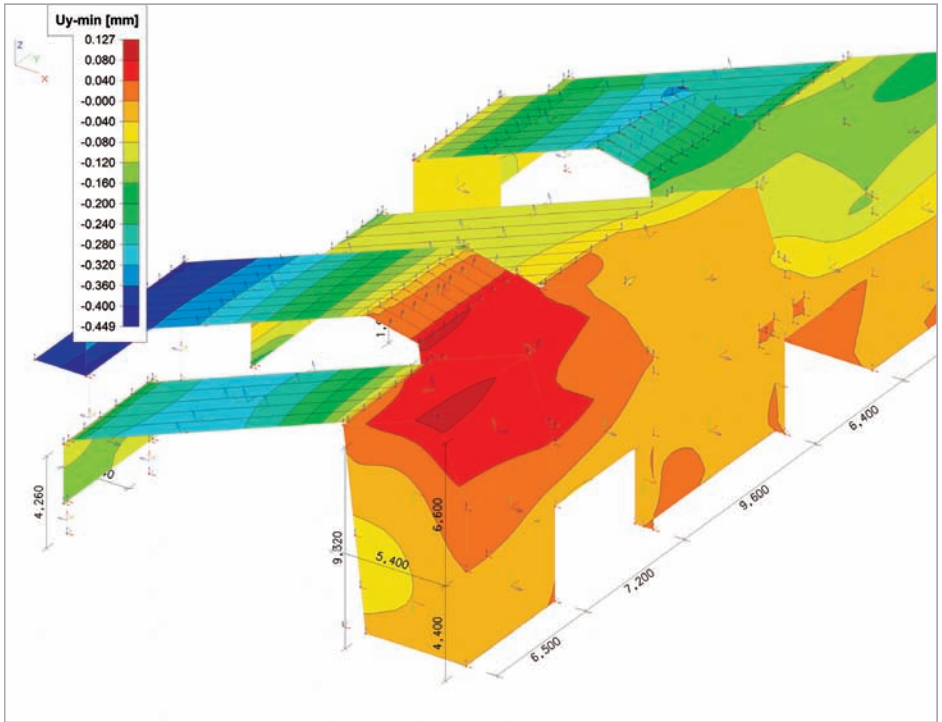
Vita of Kreidemacher Engineering Consultants: 1964 - Founded by Friedrich Kreidemacher; 2007 - Succession of Lothar Kreidemacher; 2014 - 50th anniversary of the engineering consultants.
Bio of Dipl.-Ing. (FH) Lothar Kreidemacher: 1971 - Born in Neustadt an der Weinstraße in Germany; 1992-1997 - Studies at the Fachhochschule in Kaiserslautern (University of Applied Sciences); 1997-2007 - Structural engineer in various engineering offices; 2002 - Training as a health and safety coordinator; 2007 - Took over the engineering office.
Services: Preparation of structural calculations for building construction, civil engineering and bridge construction as well as formwork and reinforcement drawings, construction and shop drawings. Technical processing in the field of reinforced concrete construction, steel construction, timber construction, masonry and earthwork. Inspection of construction works in compliance with the German Standard DIN 1076. Planning, technical processing, tendering and site management of the restoration of all types of bridge constructions. Preparation of files containing the essential data of engineering structures pursuant to DIN 1076 (“Bauwerksbücher”).

Project information

Owner	Kreisverwaltung Bad Dürkheim
Architect	CBA
General Contractor	Rohbau: Philipp & Wahl GmbH & Co. KG, Ludwigshafen
Engineering Office	Kreidemacher Ingenieure
Location	Haßloch, Pfalz, Germany
Construction Period	07/2011 to 03/2013

Short description | Construction of a New Student Dining Hall

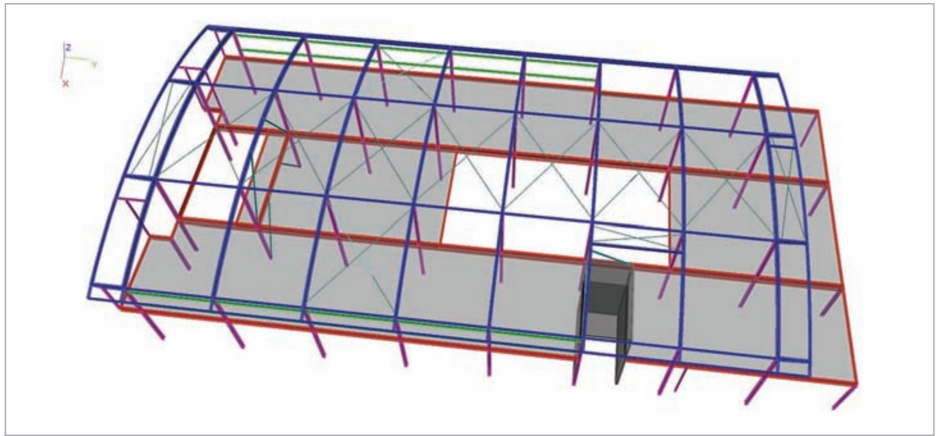
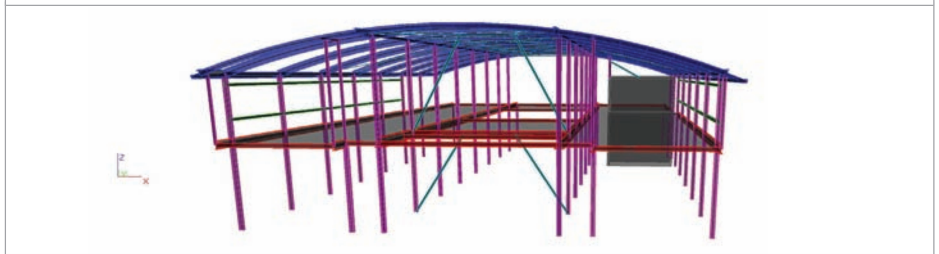
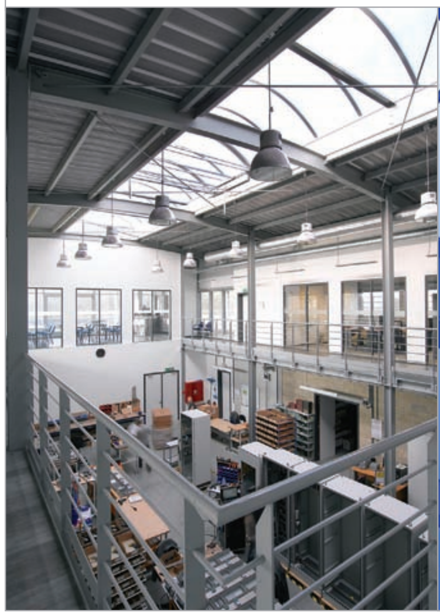
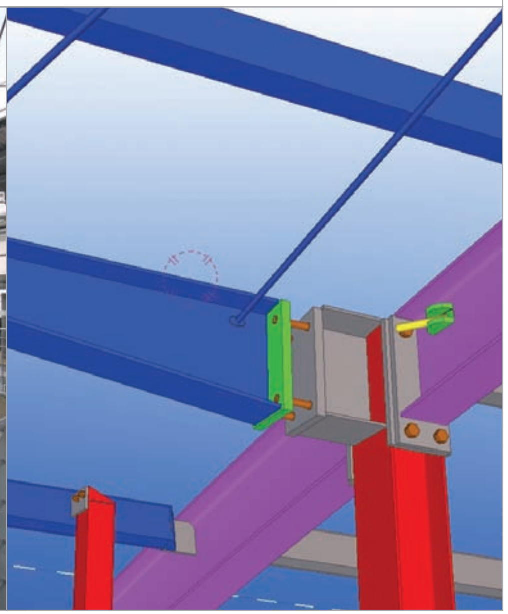
For this project, different materials such as timber, reinforced concrete and masonry have been used to reflect the interplay of various materials in modern architecture and the art of engineering. To realise the new dining hall, five adjacent “houses“ were united into one building. A 3D modelling was the only way to realise and accomplish this construction. All corners and edges have different inclinations and directions, which draws special attention to the interplay of the roof construction of laminated timber trusses and the neighbouring reinforced concrete panels and walls. The core of reinforced concrete in the middle forms the bracing heart of the construction and the connection to the adjacent masonry.



Category 1: Buildings

1

“Small is beautiful too” - Louvain-la-Neuve, Belgique

Ce nom de projet se veut un clin d’œil au pavillon luxembourgeois de l’Exposition universelle de Shanghai placée sous le thème “Small is beautiful too”.

La société Steel est spécialisée dans le comptage et la gestion de l’énergie depuis 1982 à Louvain-la-Neuve, en Belgique. Avec ses 21 personnes et une croissance régulière, Steel a pris la décision de construire un nouveau siège social plus vaste et plus représentatif tout en mettant en valeur l’image positive et dynamique de la société, en accord avec son champ d’activité technique et novateur.

Le bâtiment se compose de bureaux (730 m²), d’un atelier de montage et d’un espace de stockage de composants électriques (660 m²). Il est articulé autour d’un atrium de la hauteur de l’immeuble permettant d’amener une lumière de type zénithal pour les ateliers du rez-de-chaussée.

Le choix de l’acier s’imposait compte tenu du nom de l’entreprise “Steel” mais aussi parce que ce matériau répondait pleinement aux demandes de l’architecte qui souhaitait une grande liberté architecturale, ainsi que des matières légères et transparentes et prendre en compte des paramètres de confort tels que lumière, convivialité et chauffage.

Souhaitant respecter les engagements environnementaux ISO14001, Steel opta pour une construction “basse énergie”, un réel défi compte tenu du choix architectural de colonnes extérieures avec en bardage des panneaux sandwich fixés par l’intérieur. Pour relever ce défi technique le bureau d’études Lindab a mis en place une solution innovante avec des éléments “Schöck” faisant office de coupures de pont thermique sur les profils principaux, ceci complété par des pannes en tube rectangle remplies d’isolation. Les façades sont réalisées en panneaux sandwichs métalliques de chez Kingspan (KS 1000 TL) avec une finition extérieure légèrement ondulée (Trime Line). L’âme de ce panneau est constituée d’un isolant PIR de 100 mm d’épaisseur. Les dimensions des panneaux ont été choisies en fonction de la modulation du bâtiment (éléments de 6.000 mm de long (trame structurelle) sur 1.000 mm de haut (modulation en façade).

Lindab a su apporter les réponses techniques adaptées pour assurer la tenue au feu de cette réalisation dont la structure est entièrement apparente à l’intérieur du bâtiment. Pour cela, une peinture intumescente destinée à la protection des charpentes métalliques a été appliquée au rez-de-chaussée permettant d’obtenir une stabilité au feu d’1 heure tout en respectant l’harmonie de la structure. A l’étage la structure a été calculée pour une résistance au feu de 30 minutes sans protection. Un calcul effectué suivant la méthode graphique de calcul de la résistance au feu des structures acier, selon EN 1993-1-2 : 2005 avec l’annexe national belge.

Par sa conception évolutive, ce bâtiment a été conçu pour répondre aux demandes croissantes des clients : accueil plus convivial, espace de production optimisé et plus confortable, stock mieux adapté, organisation des espaces favorisant une communication et une logistique professionnalisées. Tout a été fait pour que cette réalisation inscrive le client dans la modernité. Les lignes épurées, la toiture courbe avec, pour encadrer le bâtiment, un bandeau débordant d’une grande finesse, les espaces associés à une utilisation généreuse du verre, contribuent à créer une atmosphère confortable et plaisante.

Ce bâtiment “basse consommation” a remporté le 2ème prix dans la catégorie “meilleur développement industriel et logistique” au MIPIM 2013 (Marché International des Professionnels de l’IMmobilier).

Modélisation

Pour ce bâtiment nous avons modélisé tous les éléments qui participent à la stabilité du bâtiment. La stabilité horizontale est garantie par l’effet diaphragme du plancher et en toiture par les pannes en tube rectangulaire. La stabilité verticale est assurée par la cage d’escalier en béton. Les différents éléments de la structure sont vérifiés et optimisés par le programme Scia Engineer.

Software: Scia Engineer

Lindab Buildings (Astron)

Contact Erny Hendrickx
Address Route d'Ettlebruck
B.P.152
L-9202 Diekirch, Luxembourg
Phone +352 80.2911
Email e.hendrickx@astron.biz
Website www.astron.biz

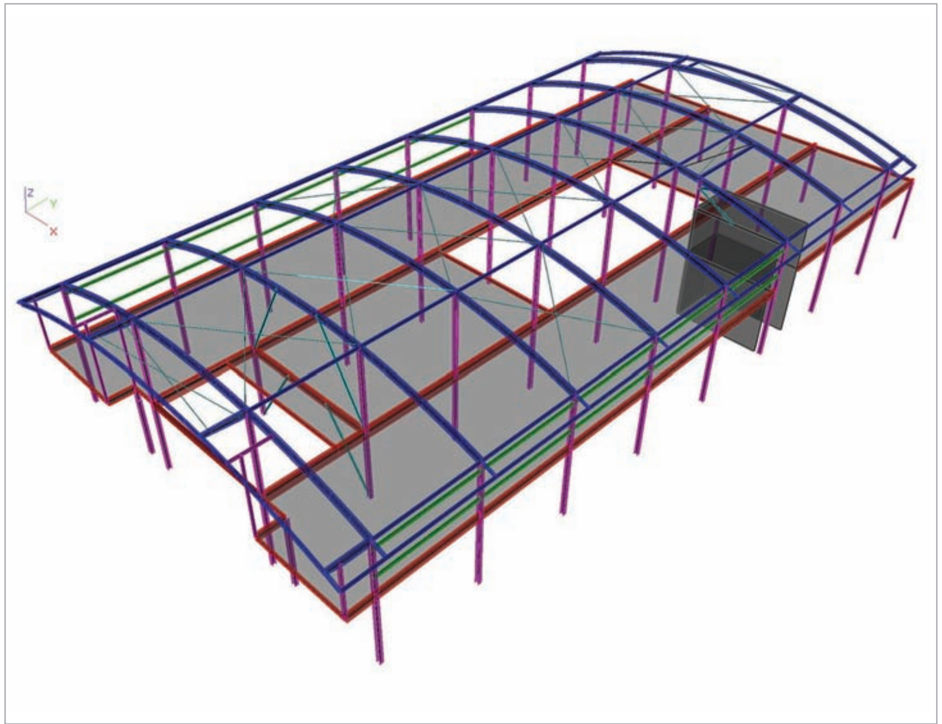
Lindab avec sa marque Astron est le leader européen des solutions de construction en acier, allant de la conception à la production de tous les principaux composants d'un bâtiment en acier. Une approche fiable pour une construction rapide et clé en main, pour des bâtiments essentiellement de type non résidentiel (usines de production, entrepôts, commerces, centres sportifs, bureaux, compagnies de transport, garages et hangars d'avions) en Europe et au-delà. Les bâtiments Astron offrent des possibilités de construction pratiquement infinies et permettent de personnaliser et architecturer le bâtiment. Lindab s'appuie sur les compétences d'un réseau européen de Bâtisseurs locaux agréés chargés de la promotion, de la vente, du montage et de la mise en œuvre de ses différents procédés et produits Astron.

Project information

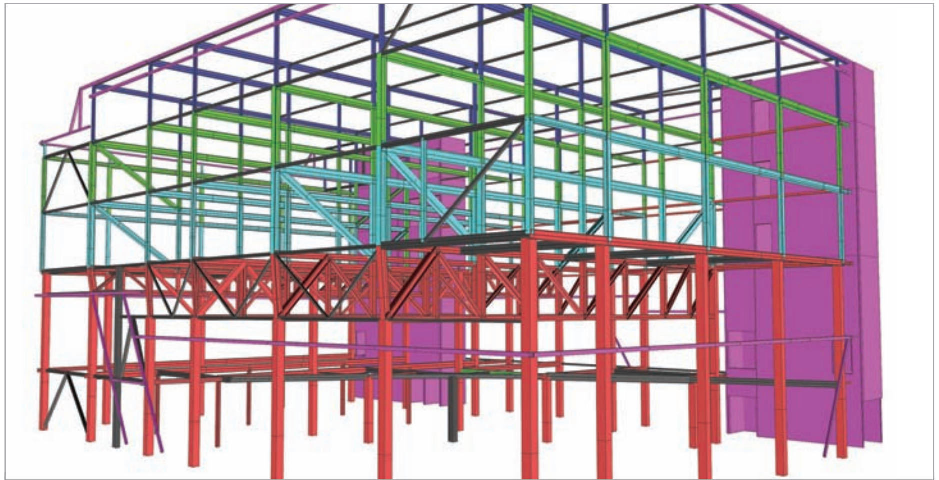
Owner	STEEL S.A., Louvain-la-Neuve, Belgique
Architect	Assar Architects
General Contractor	Jean Wust
Engineering Office	Lindab S.A. (Astron), Diekirch, Luxembourg
Location	Louvain-la-Neuve, Belgium
Construction Period	03/2011 to 08/2011

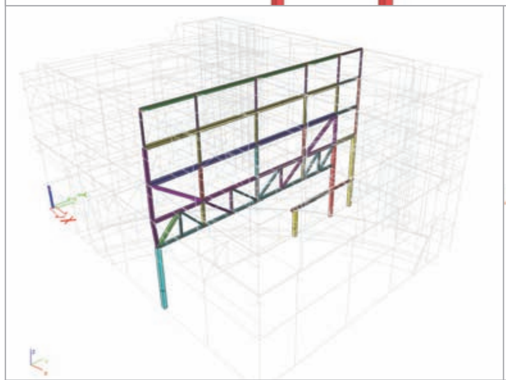
Short description | "Small is beautiful too"

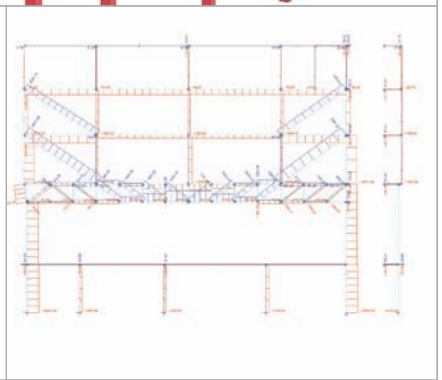
The Belgian company "Steel", specialised in energy management, has just moved into its new 1,500 m² office building completed by Astron Builder Wust SA. The choice of steel was naturally driven by the company's name, "Steel", but it was also chosen because the material fully meets the architect's requirements: great architectural freedom ensured by a light steel structure as well as transparent materials. The customer wanted a low-energy building in order to comply with ISO 14001 Environmental Management, a real challenge when taking into account the choice of exterior columns with architectural sandwich panels fixed from inside. To meet this challenge, the Astron engineering office has implemented an innovative solution with "Schöck" elements to avoid the thermal bridges on the main profiles. This was completed by rectangular tubular purlins filled with insulation. Clear lines, a curved roof and generous use of glass create a pleasant atmosphere.



Delorge Business Park - Hasselt, België







Projectomschrijving

Mathieu Gijbels bouwt in opdracht van klant Groep Delorge het project Delorge Business Park, in samenwerking met Ma°Mu architecten. Architectenbureau Ma°Mu zorgde voor het ontwerpconcept, nv Mathieu Gijbels is aangesteld als hoofdaannemer en staat samen met Ma°Mu Architecten in voor de algemene coördinatie van het project. Encon doet de coördinatie van de technieken.

Concreet worden er twee gebouwen geconstrueerd langs de Herkenrodesingel te Hasselt. Bovendien is het Delorge Business Park een multifunctioneel gebouwencomplex. Het herbergt 1.400 m² showroom voor 2 automerken (Audi en Volkswagen) en heeft 3 etages met polyvalente kantoorruimtes.

De Audi showroom werd volgens het Terminalconcept ontwerpen; dit oogt met zijn gebogen vormen en geperforeerde en geanodiseerde aluminium gevelbekleding dynamisch en futuristisch. De combinatie van Audi en Volkswagen toonzalen met bovenliggende kantoren is uniek, want het is de eerste keer in Europa dat Audi dit toestaat. Ook de gemeenschappelijke parkeerkelder met een totale oppervlakte van 4.600 m² is uniek, want eigenlijk vormen de twee gebouwen elkaars tegenpolen.

Challenge en projectaanpak

Mathieu Gijbels stond garant voor het stabiliteitsconcept van het gebouw. De bouwheer Groep Delorge had de wens om zo weinig mogelijk kolommen te gebruiken in de showrooms. Dit vormde samen met de verdiepingen van de kantoortoren boven de showroom van VW het meest uitdagende stabiliteitspunt. Deze verdiepingen versprongen telkens ten opzichte van elkaar in twee richtingen, waardoor er uitkragingen van telkens 3 m ontstonden.

In de showroom van Audi is nv Mathieu Gijbels erin geslaagd om geen enkele kolom in de toonzaal aanwezig te hebben. Hiervoor zijn er speciale vakwerken ontworpen die de overspanning van de showroom in één keer kunnen overspannen. Deze overspanning loopt over een afstand van 27 m, en draagt de bovenliggende kantoorruimtes. De uitkragingen van Volkswagen zijn gerealiseerd binnen de aangegeven slanke maten die door de architect zijn opgelegd.

Het structurele concept moest wel aangepast worden. De oorspronkelijke structuur van het concept voor beide showrooms was namelijk eerst voorzien in beton, maar deze is nadien vervangen door een staalstructuur.

Technische details over project Delorge Business Park

- 1.400 m² voor 2 showrooms
- Showroom Audi van +/- 400 m²
- Showroom Volkswagen van circa 1.000 m²
- 800 ton constructiestaal gebruikt
- 4.600 m² gemeenschappelijke parkeerkelder
- 2.500 m² kantoorruimtes

Software: Scia Engineer

Mathieu Gijbels

Contact Gert Janssen
Address Industrieweg Noord 1161
3660 Opglabbeek, Belgium
Phone +32 89 819100
Email gert.janssen@gijbels.be
Website www.gijbels.be

MATHIEU GIJBELS
Bedrijfs- en Kantoorbouw
DE VOORDENKERS

Mathieu Gijbels is een Limburgs aannemersbedrijf uit Opglabbeek, gespecialiseerd in de realisatie van bedrijfs- en kantoorbouw. Nieuwbouw, renovatie, vastgoedadvies en bouwkundige service en onderhoud zijn de kernactiviteiten van de bouwfirma. Klantentevredenheid en een levenslange relatie met de klant staan centraal in onze visie. Dit realiseren we door altijd een stap verder te denken en de lat hoger te leggen, met de juiste kennis en een hart voor bouwen.

De missie van nv Mathieu Gijbels bestaat eruit de bouwzorgen van haar klanten over te nemen, zodat zij zich volledig kunnen concentreren op hun eigen werk. De bouwgroep is B2B georiënteerd.

In maart 2013 ontving nv Mathieu Gijbels de GreenLight Award van de Europese Commissie. Via deze award probeert men het energieverbruik en de aanwezigheid van schadelijke producten in de verlichting te verminderen in Europa.

Project information

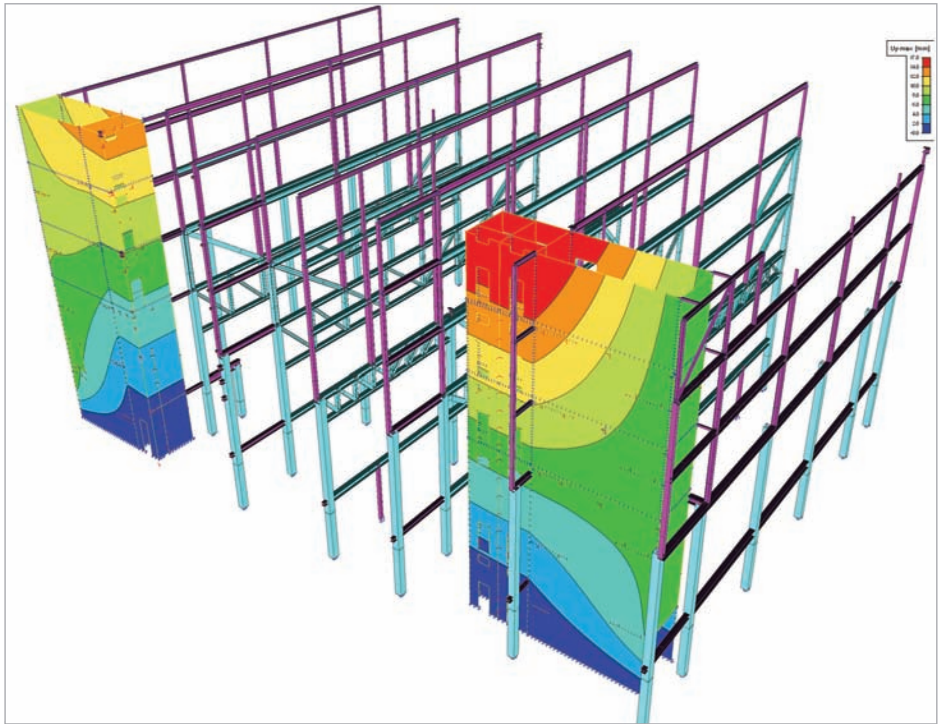
Owner	PGC Immo
Architect	Ma°Mu Architecten
General Contractor	Mathieu Gijbels
Engineering Office	Mathieu Gijbels
Location	Hasselt, Belgium
Construction Period	09/2012 to 08/2013

Short description | Delorge Business Park

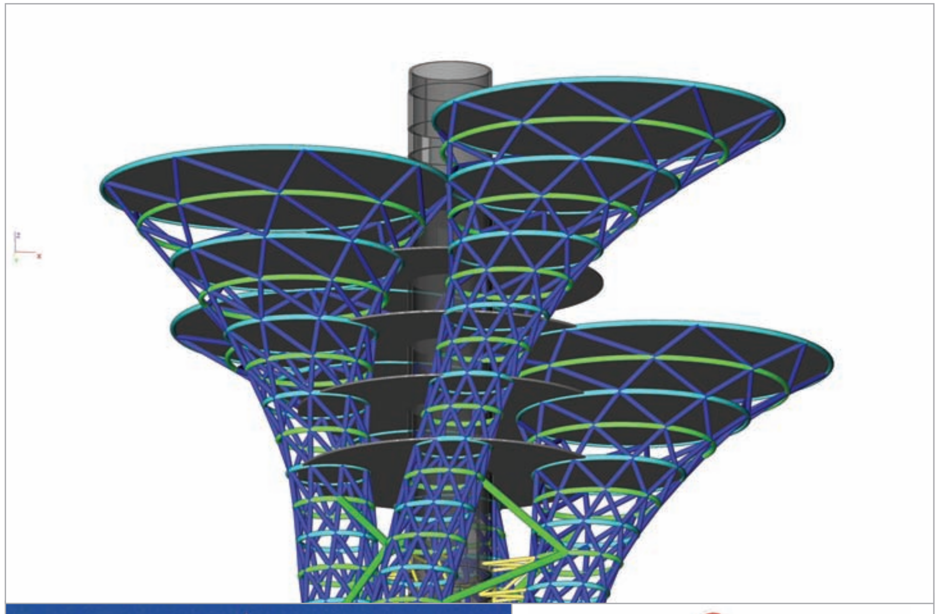
Mathieu Gijbels is building for its client Groep Delorge the Delorge Business Park project, in collaboration with Ma°Mu Architects. Ma°Mu Architects provided the design concept, NV Mathieu Gijbels has been appointed the main contractor and along with Ma°Mu Architects is responsible for the overall coordination of the project. Encon sees to the coordination of techniques.

The Delorge Business Park is a multifunctional building complex. It contains a showroom for Audi and VW and has 3 floors with offices that are unique, since it is the first time that Audi & VW have built a showroom with office rooms in Europe.

Scia Engineer was used to design the free span of 27 m for the showroom; also a concrete shaft was modelled.



Taiwan Tower - Taichung City, Taiwan



Project Description

The Taiwan Tower in Taichung City, Taiwan, is a direct result of the Taiwan Tower International Design Competition. The project guidelines included a construction budget of $220 million, as well as specific required architectural features, such as a base level city museum and observation decks, a restaurant and an environmental monitoring station at the top levels. In addition, the tower was required to be the tallest building in central Taiwan, with a minimum height requirement of 300 m.

Primary Structural System

The primary structural system for the tower consists of 4 steel framed tubes 7 m in diameter which spiral around an 8 m circular concrete core. Each tube is composed of round steel pipes in a diagrid pattern that rotates around the core, completing a full 360 degrees of rotation over 240 m of rise in elevation.

At both the top and base of the structure the 4 tubes flare out to allow for occupied space. The base contains 5 occupied floors, while the top contains 7 occupied floors. Both the top and bottom are designed using composite slabs on a steel beam and girder system with large spans which accommodate open areas below.

Lateral System

As a result of the building's height, the lateral system was required to resist typhoon level winds of +499.2 kg/m^2 and -748.8 kg/m^2 at the top of the tower. Under this lateral loading, the central concrete core transfers forces to the exterior tubes through a series of small outrigger trusses which are placed at a 12 m vertical interval for the full height of the tower. These outrigger trusses allow the structural system to utilize the exterior tubes to their full potential under all loading conditions and greatly increase the lateral stiffness of the structure as compared to a core only system. The torsion induced on the core was offset by a continuous truss which connects the tubes to each other and allows the four individual tubes to work as a single unit.

Foundation System

All vertical and lateral load resisting elements will terminate at a mat slab on a drilled pier foundation system.

Repetitive & Modular Design

Although in geometrical terms the tower is complex and unusual, the majority of the structural system is repetitive and designed to be modular. The spiraling tubes are designed to be fabricated in 3- or 6-meter sections, either on or off site and lifted into place. The tower core lends itself to a common climbing form work system. These characteristics allow for a more easily constructed structure.

Design Approach & Scia Engineer

Because of the tight project schedule (completed submission in 4 weeks) and the complexity of the exposed steel structure, the design team chose to utilize Scia Engineer. Scia Engineer's flexibility in 3D modeling allowed for the structure to be modeled, analyzed and designed for gravity loads, seismic loads, including dynamic analysis and winds loads, all within Scia Engineer. After the model was optimized, it was then exported to the architect via IFC (Industry Foundation Class). Using this OpenBIM workflow enabled the design team to create a unique and collaborative 3D workflow that integrated the architecture and engineering. Ultimately, this workflow allowed the team to manage design changes and work iteratively towards the final design, while also abiding by the project's tight deadlines.

Software: Scia Engineer

M.I. Flamer & Associates

Contact Mark Flamer P.E.
Address 45 W. Mendocino Ave
Willits CA 95490 - United States
Phone +1 707-456-9023
Email mark@flamerassoc.com

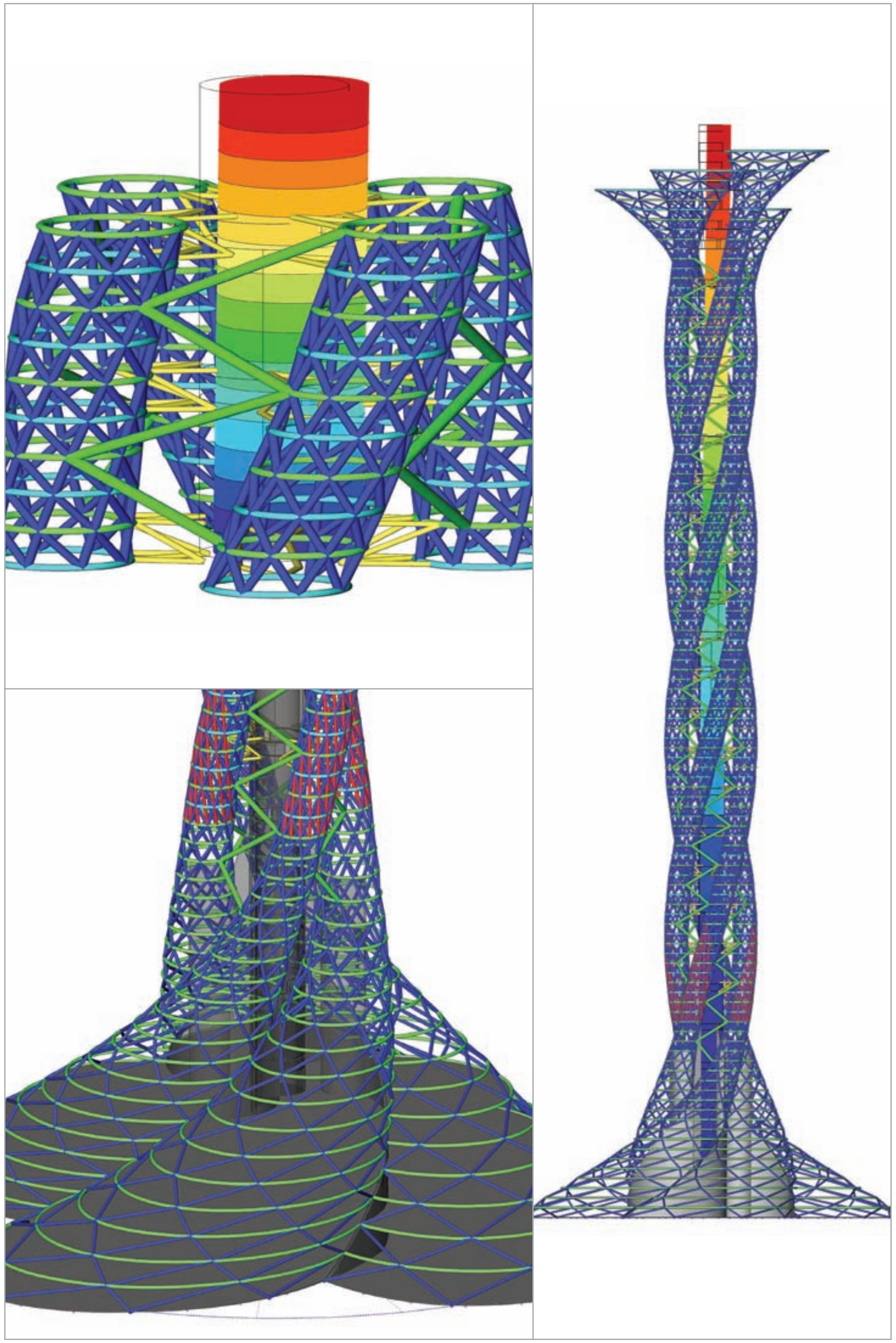
M.I. Flamer & Associates is primarily involved in consulting work that provides firms with assistance in the modeling and analysis of complex or unusual structural systems using state-of-the-art finite element analysis software, including Scia Engineer. M.I. Flamer & Associates has over 15 years of experience in the design and construction industry and has worked on many projects throughout the United States. The company has recently increased its efforts in the software engineering market, with the goal of leveraging its AEC experience to create software for the design of smarter, more efficient buildings.

Project information

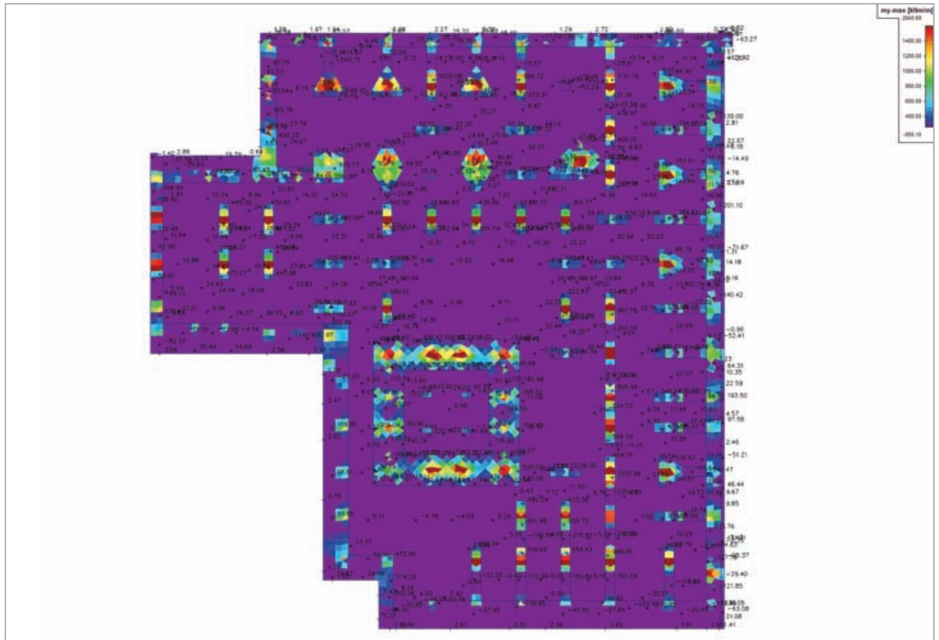
Owner	Taichung City Government
Architect	Douglas Muir, RA BArch, NCARB
General Contractor	TBD
Engineering Office	M.I. Flamer & Associates
Location	Taichung City, Taiwan
Construction Period	01/2014 to 12/2016 (project is in bidding phase)

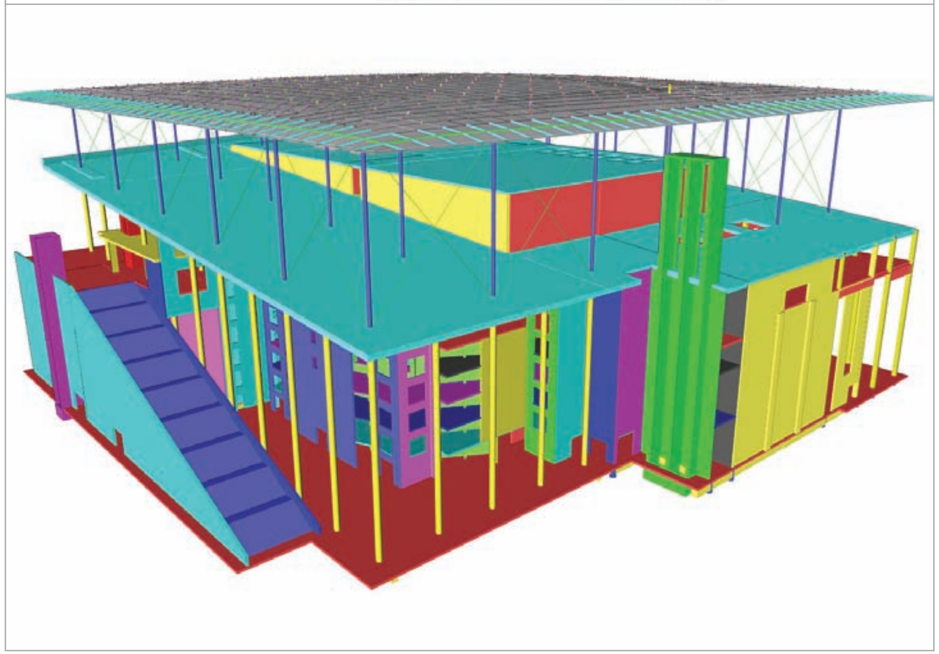
Short description | Taiwan Tower

The Taiwan Tower is a new landmark structure in Taichung City, Taiwan, that includes a street level museum and observation decks, a restaurant and an environmental monitoring station at the top levels of the 366 m tower. The primary structural system for the tower consists of 4 steel framed tubes 7 m in diameter which spiral around an 8 m circular concrete core and are designed to be fabricated in 3 or 6 meter sections. The circular concrete core transfers lateral load to the exterior tubes through a series of small outrigger trusses. These outrigger trusses allow the structural system to utilize the exterior tubes to their full potential, while increasing the structures lateral stiffness. The design team utilized Scia Engineer for modeling and advanced analysis such as dynamics. The software was also used as the hub for the team's OpenBIM design approach which utilized the IFC model exchange in order to create an iterative and collaborate design process.



Stavros Niarchos Cultural Centre - Athens, Greece





Project History

In 2006, the Stavros Niarchos Foundation (SNF) announced its intention to fund the creation of the Stavros Niarchos Foundation Cultural Centre (SNFCC), a project that includes the construction and complete outfitting of new premises for the National Library of Greece (NLG) and the Greek National Opera (GNO), as well as the development of the 170,000 m² educational and cultural Stavros Niarchos Park. The project has a budget of €566 million.

General Design Team

- Design Architect: RENZO PIANO BUILDING WORKSHOP
- Executive Architect: BETAPLAN
- Landscape Design: DEBORAH NEVINS and Associates, Inc. in collaboration with Helli Pangalou
- Structural Engineer: EXPEDITION in collaboration with OMETE
- MEP Engineer: ARUP in collaboration with LDK
- Theatre Design Consultant: THEATRE PROJECTS CONSULTANTS
- Acoustic Design: ARUP Acoustics
- Library Consultant: AMA Alexi Marmot Associates
- Façade Consultant: FRONT
- Signage Design: C&G PARTNERS
- Food Service Consultant: SefronHornWinch
- Traffic Consultant: DENCO
- Irrigation Design: SOTIRIOS MAVRAGANIS
- Environmental Studies: HPC - PASECO
- Project manager / Cost Consultant: FAITHFUL+GOULD

Contractor

The Joint Venture of Impregilo-Terna has been appointed as the general contractor for the project

Design Verification

Penelis Consulting Engineers is the sole structural and seismic consultant on behalf of the contractor, the Joint Venture of Impregilo-Terna.
Part of the scope was the verification of the main two seismically isolated buildings: the Opera House and the National Library buildings.

The original analysis has been performed using Etabs, while for the verification Scia Engineer and ECtools were chosen.

Opera House

It is an R/C structure with seismic isolation in the basement. The building is 100 x 100 m in plan and has the height of 32 m for the R/C part. On top of the building rests a ferrocement canopy which is supported by steel columns, spring dampers and post-tensioned X bracing on the R/C structure below.

Library

It is an R/C structure with seismic isolation in the basement. The building is 95 x 95 m in plan and has the height of 30 m for the R/C part

The design verification for both buildings consisted of at least the following tasks:

- Selection of inverted pendulum isolators
- Checking the capacity of R/C walls and cores
- Checking the capacity of large beams (200 cm x 200 cm) and waffle slabs with wide spans
- Checking deflections
- Checking temperature effects
- Checking creep effects

All those tasks were executed using Scia Engineer and ECtools.

Software: Scia Engineer

Penelis Consulting Engineers sa

Contact Grigorios Penelis
Address Hagias Sofias 48
54622 Thessaloniki, Greece
Phone +30 2310332032
Email penelis@penelis.com
Website www.penelis.com

Penelis Consulting Engineers sa was founded in 2002 and provides the following services:

- Technical advice for the development of buildings
- Technical advice for the restoration-upgrading of existing buildings and monuments
- Structural design of new buildings
- Structural design and assessment of existing buildings and monuments
- Structural design of technical works and bridges
- Supervision of civil engineering works
- Project Management and Construction Management
- Software Development

In 2006 a subsidiary called “3pi- Penelis Software Ltd” was founded in order to separate the software development, with ECtools as its main product. The company has projects in Greece, Bulgaria, Romania, Croatia, Serbia and Egypt.

Project information

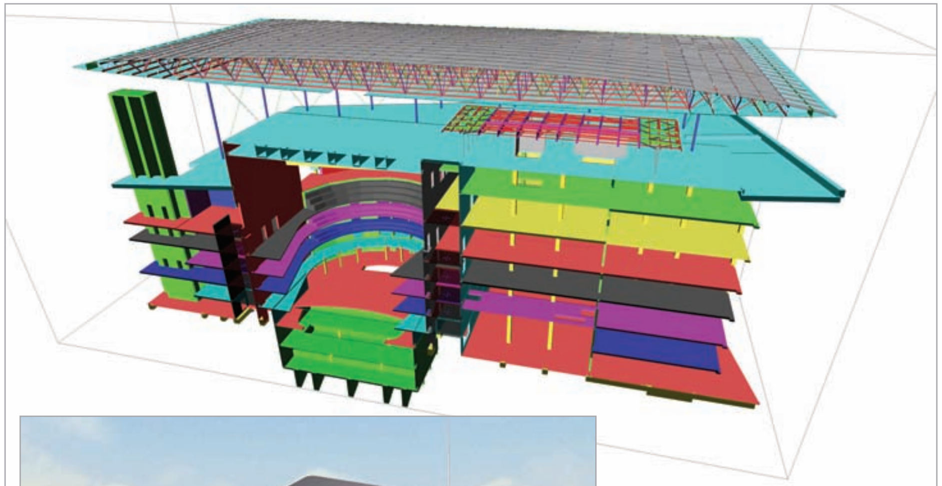
Owner	Stavros Niarchos Foundation
Architect	Renzo Piano Building Workshop & Betaplan
General Contractor	Joint Venture Impregilo SPA- Terna SA
Engineering Office	Expedition & Omete/ Penelis Consulting Engineers Sa
Location	Athens, Greece
Construction Period	09/2012 to 10/2016

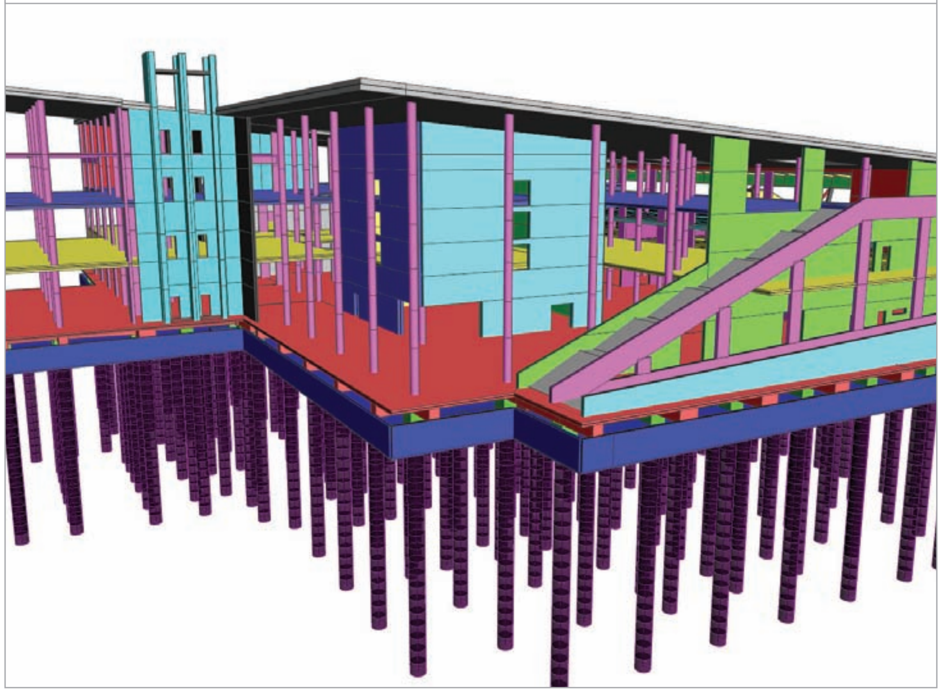
Short description | Stavros Niarchos Cultural Centre

The Stavros Niarchos Foundation Cultural Centre (SNFCC) is a project that includes the construction and complete outfitting of new premises for the National Library of Greece (NLG) and the Greek National Opera (GNO), as well as the development of the 170,000 m² educational and cultural Stavros Niarchos Park. The project has a budget of €566 million.

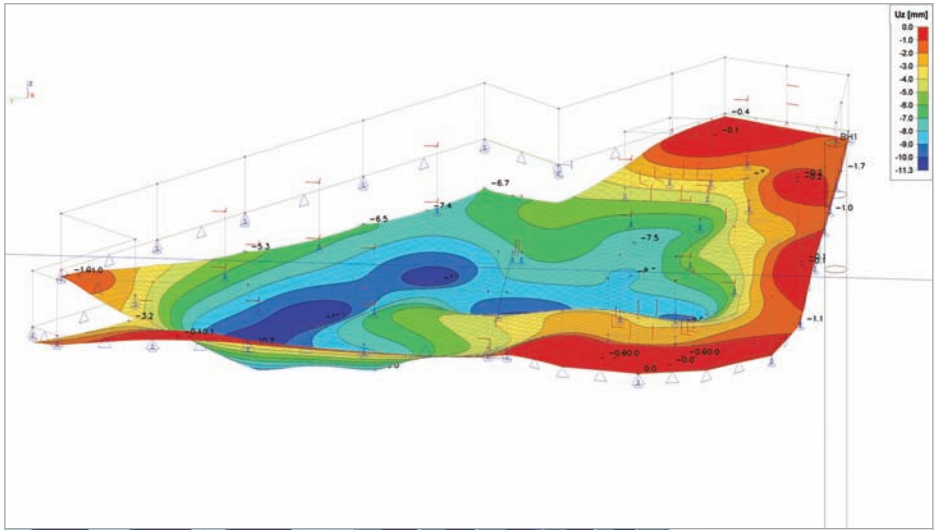
Penelis Consulting Engineers SA has been appointed by the general contractor, the Joint Venture of Impregilo-Terna, to execute the design structural verification of the two main buildings, the GNO and NLG.

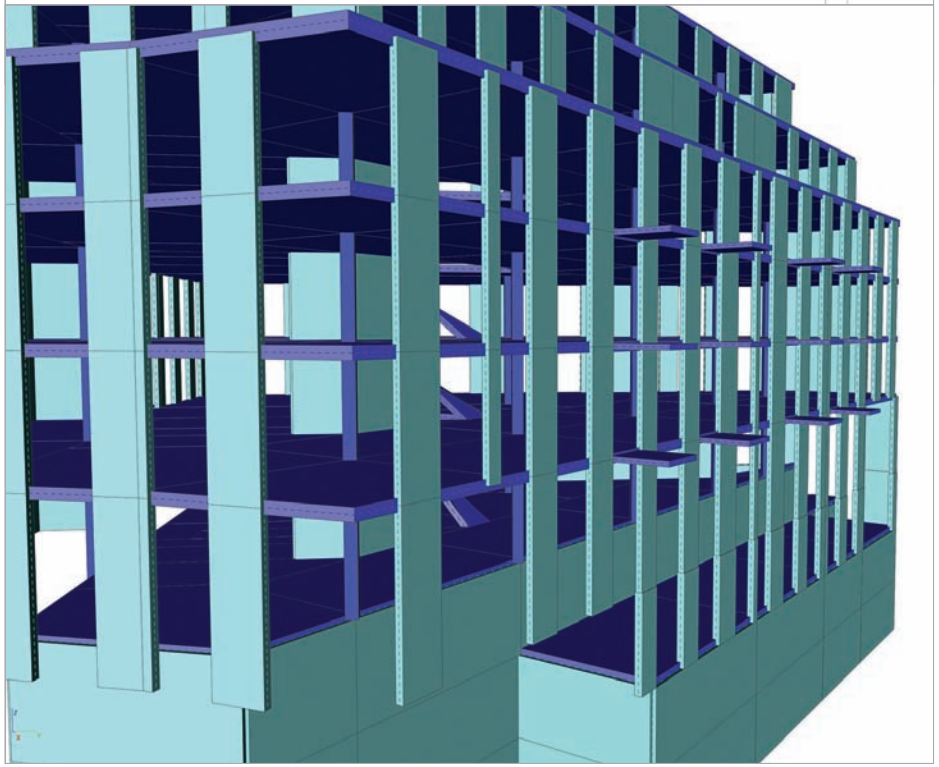
All the structural and seismic analyses and checks have been executed using Scia Engineer and ECtools.





Residential Building “Na Santince” - Prague, Czech Republic





Building geometry and structural system

- Building period: 2012
- Height dimension: 25 m
- Overall length: 40 m
- Overall width: 47 m

Design software

The structural analysis was prepared using a 3D model with Scia Engineer software.

Excavation

The site is situated within a residential area. The excavation was designed with steel shoring embedment due to the bedrock.

Foundations

The foundations combine 900 mm- and 1,200 mm-diameter bored piles embedded into the bedrock and a foundation slab 350 mm thick. A “white tank” waterproof concrete system designed to resist hydro pressure from ground water is used in the basement.

Load

The design loads conform to EC and National Annex: Apartments 1.5 kN/m^2, staircase 3.0 kN/m^2, commercial area 2.5 kN/m^2, parking 2.5 kN/m^2

Structure and design process

Assessing the real behaviour of a load bearing structure, including its response to variable soil properties, requires several successive calculations with different modifications of input data. It is not convenient to create the structural model in one step including the different properties of the load bearing structure, subsoil, materials and methods of founding. However, such a solution is possible by using the Additional Module “Soilin” with an analysis of the upper structure and subsoil.

The basic principle of structural calculation consists of two steps. The structure is primarily supported with fixed supports without the influence of geological conditions. The results of the first step of the structural analysis were only comprised of the reactions in the supports. The subsequent step determines the stiffness of the point supports (piles) for cases of a pre-defined settlement with the flexible supports. The geological layers according to the geological survey were assigned for the shallow support of the base slab. The actual calculation introduces iteration. Starting iteration is for the default input parameters C1x, C1y, C1Z, C2x, C2y. The number of iterations depends on the compensation contact stress under the base slab for the specific properties of soil. It usually requires about 10 iterations and several iteration cycles. The results of the calculation are the internal forces in the base plate that are needed for the design of the reinforcement and the distributed reactions to the piles.

Structure

The main bearing structure is contained with reinforced concrete columns and walls. The class of concrete is C30/37 XC1. Border walls with a thickness of 200 mm and elevator walls were designed for the rigidity of the buildings. The floor slab was designed with a reinforced concrete slab with a thickness of 280 mm, locally supported by columns.
A significant interior radial concrete column with dimensions of 450 mm x 450 mm was designed for the interior staircase. The storey landing was designed with a cantilever slab.

Conclusion

Scia Engineer also allowed for the preparation of several structural alternatives. There were more designs in the process of the work according to the client’s and the architect’s demands and Scia Engineer made it possible to alter the structure very easily.
The real deflections of the structure were measured on-site, and the results were very near to the calculated deflections.

Software: Scia Engineer

P-H-A

Contact Hana Gattermayerova
Address Gabcikova 15
Praha 8
18200 Praha, Czech Republic
Phone +420 284685882
Email statika@p-h-a.cz
Website www.atelierpha.cz

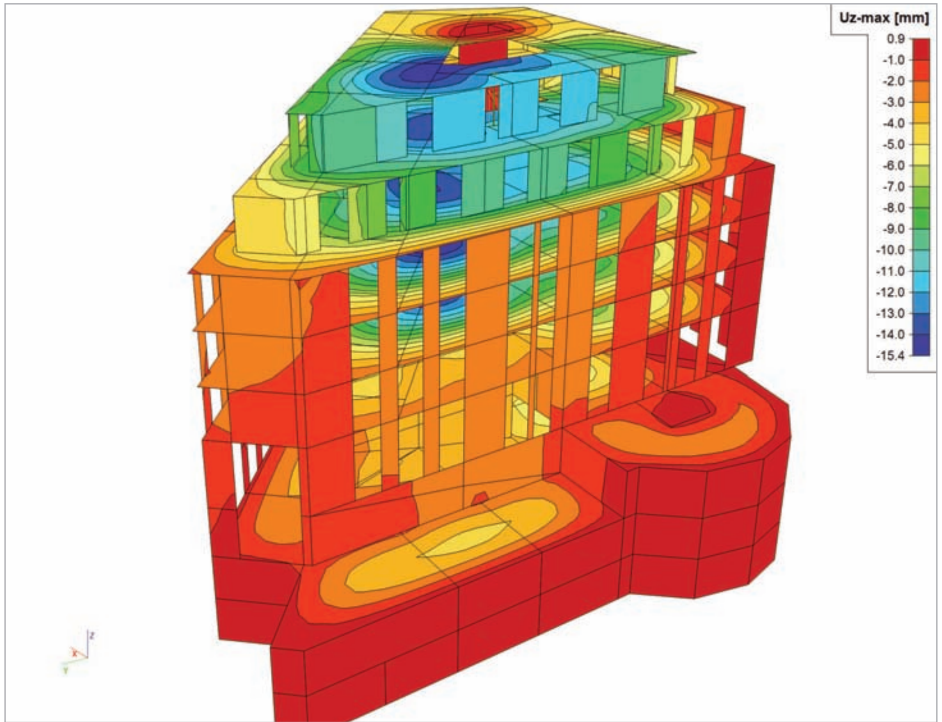
Atelier P.H.A. was founded in 1990.
P.H.A. deals with design tasks, preparation and implementation of investment projects and engineering activities, and is an expert in the field of construction and real estate investments. P.H.A. participates in opinions carried out on structures after the 2002 flood, opinions on the condition and measures taken on load-bearing structures in industrial, high-rise apartment buildings and apartment building regeneration, opinions on the impact of emergency situations - like fires and flooding - on load-bearing structures, and in building passports during reconstruction etc.
PHA can follow up on international projects in accordance with most standard codes: Eurocode, Fema-350, UBC97, СНИП and other specific national codes. Structure designers participate in professional seminars, as well as structural engineering meetings and conferences, and lectures, and their contributions are published in professional newspapers.

Project information

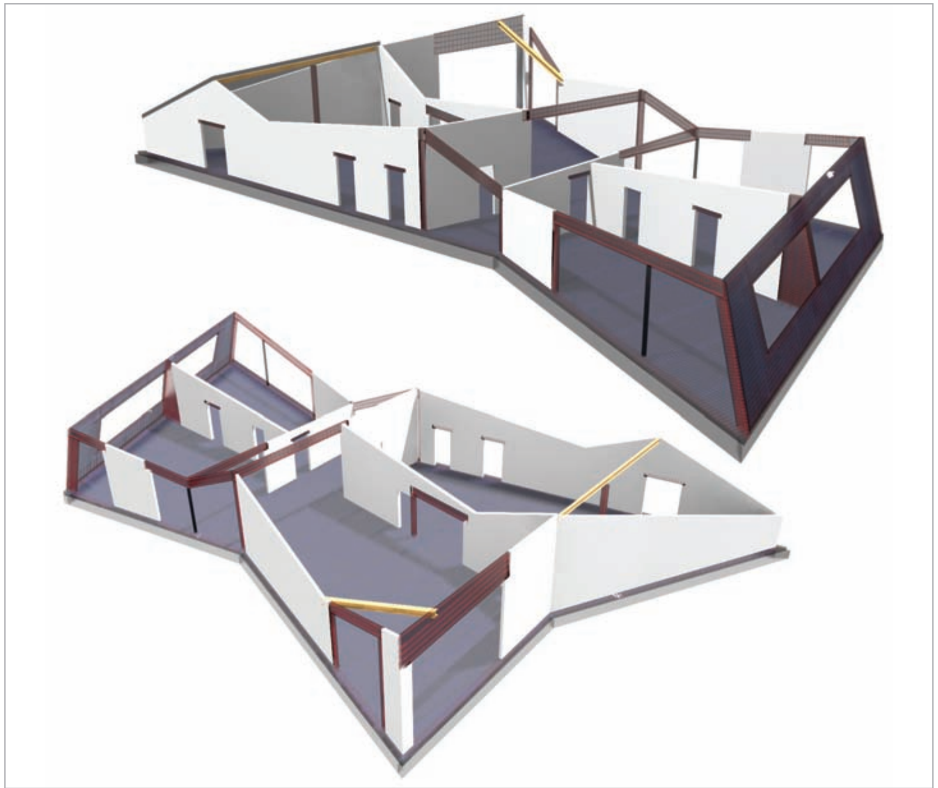
Owner	Atelier P.H.A. Ltd.
Architect	Ing. arch. Ondřej Gattermayer
General Contractor	P.H.A. Inc.
Engineering Office	Atelier P.H.A. Ltd.
Location	Prague, Czech Republic
Construction Period	05/2012 to 02/2013

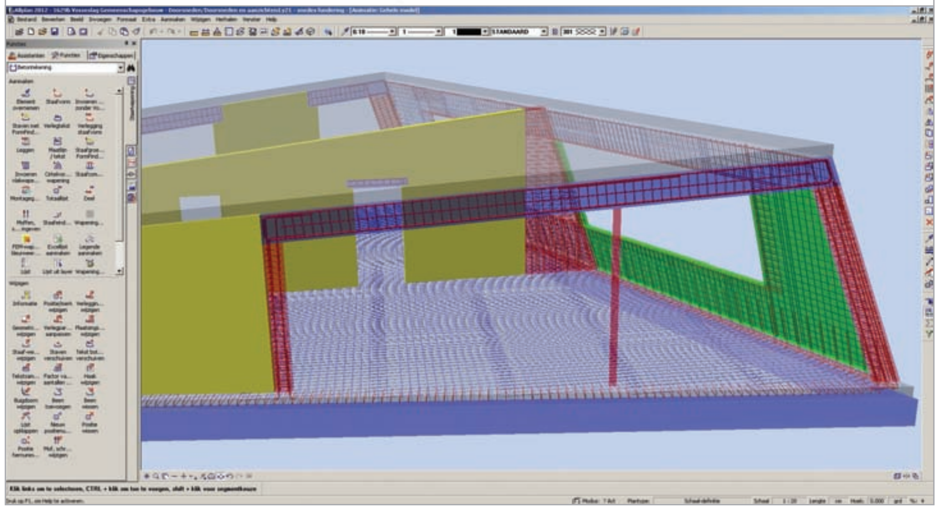
Short description | Residential Building "Na Santince"

The residential building "Na Santince" is a proposed new development of P.H.A., a.s. The building consists of 6 storeys above grade and 3 storeys below grade.
The above grade part of the building includes 25 residential flats and two commercial suites. The access is through an arbour, which emphasises (or delineates, defines) the building's street facade. The two top storeys are unique due to the indented facade that enables the construction of spacious terraces with a unique view of the historic part of Prague and the residential area Hanspaulka. The parking and technical services are situated in the underground.



Community Service Building Vosseslag - De Haan, Belgium





The project is situated on the ‘Kennedyplein’ in De Haan, a coastal city in West Flanders, Belgium. The community service building has to play an important role in the social revival of the neighbourhood. The strong lines and shapes of the building have to attract people from every direction.

Allplan Engineering

This project is an engineering design with Allplan Engineering 2012 software. The strong shapes and different heights called for a 3D approach. With the help of Allplan Engineering, we succeeded in lightening up every detail of the construction, where a 2D approach would rather leave you in the dark.

We started working with the Allplan Engineering software in August 2011. We had four days of basic training and with the help of the helpdesk we started to elaborate our new projects with Allplan Engineering. Despite our basic knowledge of the program software, the building up of the design in 3D was not too complex. On the contrary, the modelling process was very user friendly and satisfying results were obtained rather quickly.

Working Method in Allplan

The 3D model was built up with 3D-objects without any intelligence. These objects were given all the right architectural attributes afterwards. In this way you have absolute freedom in the designing, but you can still keep the right presentation and visualisation of beams, columns, walls, etc....

We worked with the following simple colour codes

- Red: Concrete/Steel Column
- Blue: Concrete Beam
- Orange: Steel Beam
- Yellow: Masonry Wall
- Green: Concrete Wall
- Grey: Concrete plate

The floor above the ground floor is on different planes and consists of prestressed vaults. This floor level determines all the levels of the bearing objects such as walls, columns and beams.

The Use of a 3D model

Working in 3D gives you a much better summary of the project in total and it allows you to check every detail without losing valuable time. Once the 3D model is built, it’s a rather easy to create any view or section of any part of the building. Instead of limiting the building information to prevent errors, additional plans and views were made to clarify the design. Even a 3D-pdf was sent to the contractor; this way he loses less time and he can start working with a complete and clear engineering design.

Reinforced objects

The difficult shapes were no threshold for the design of the reinforced objects. With the collision detection tool you can always check the practicability of the reinforced design. Allplan Engineering 2012 has shown itself to be a powerful tool with lots of potential. We look forward to working with the new Allplan Engineering 2013 software, especially with the new smartparts.

Software: Allplan Engineering

Plantec nv

Contact Carl Pertz
Address Nieuwpoortsesteenweg 399
8400 Oostende, Belgium
Phone +32 59 561010
Email info@plantec.be
Website www.plantec.be

Engineering Office Plantec nv was founded in 1986 and is specialised in the design of infrastructure, architecture, urban design, topography and structural engineering. The firm currently operates from Ostend with approximately 28 employees and works throughout West and East Flanders.

Our vision and working method:
Everything around us has a determinant influence on the quality of life. Our creativity has its source in the comprehension of the environment. With a multifunctional team of designers and engineers, we try to enhance the quality of life itself.

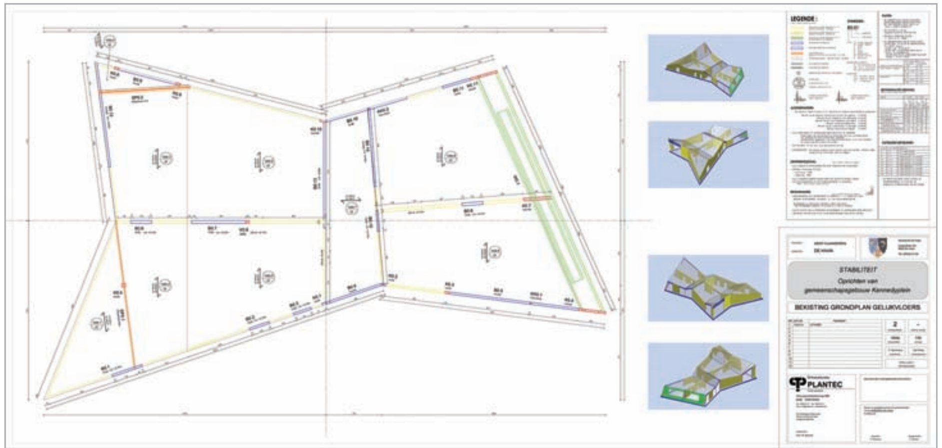
An ISO9001 Quality Management System is in operation in our office and is externally audited by BQA.

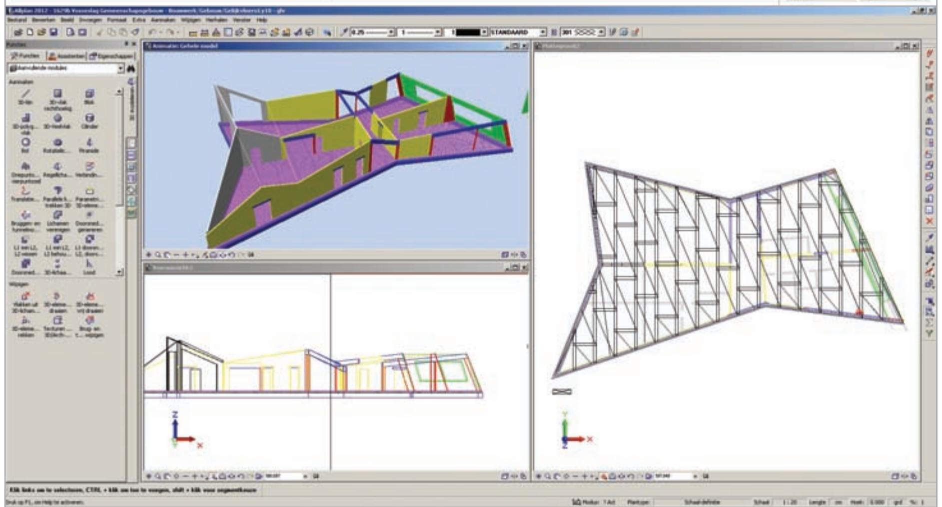
Project information

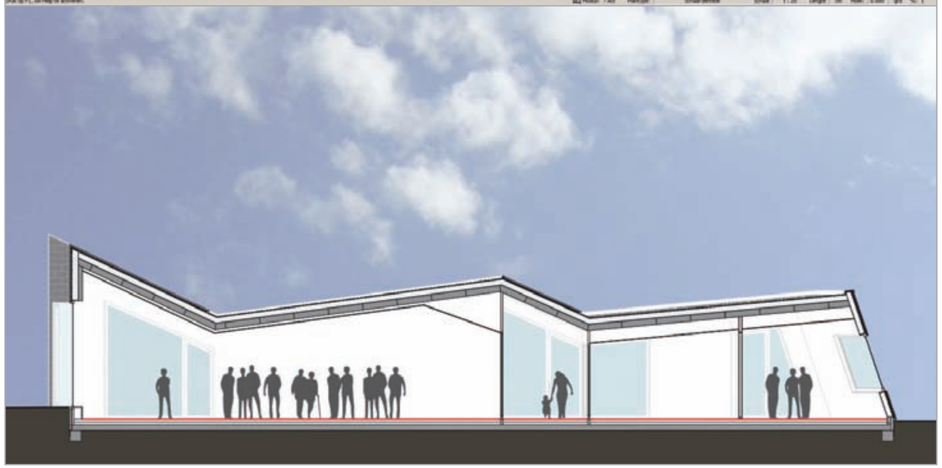
Owner	Gemeente De Haan
Architect	Ontwerpbureau Plantec nv
General Contractor	Detrac
Engineering Office	Ontwerpbureau Plantec nv
Location	De Haan, Belgium
Construction Period	04/2013 to 12/2013

Short description | Community Service Building Vosseslag

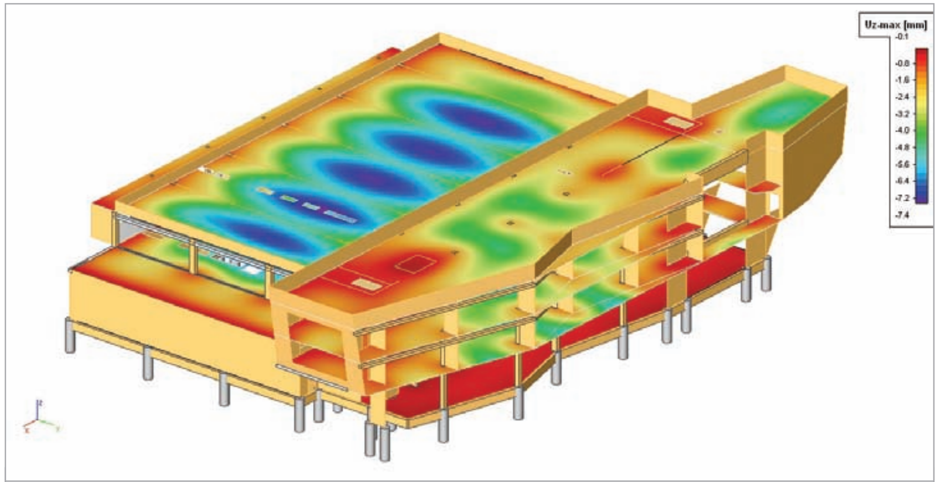
This building is part of the redesign of the ‘Kennedyplein’ and is located in the south of the square. The strong lines and shapes are designed to attract attention from every direction, like a beacon in the sea. Every side of the building has to link up with the surrounding infrastructure. The building is designed to play a significant role in the feeling of safety and social control on this renewed site. The functional use of the building has to enhance the social revival of the square and its environment.

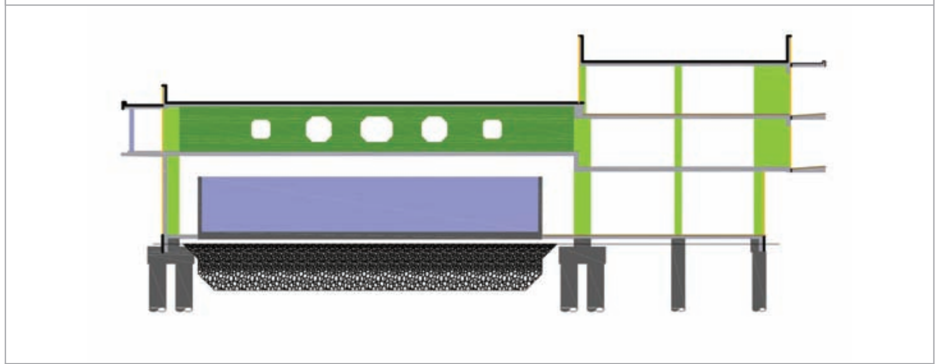


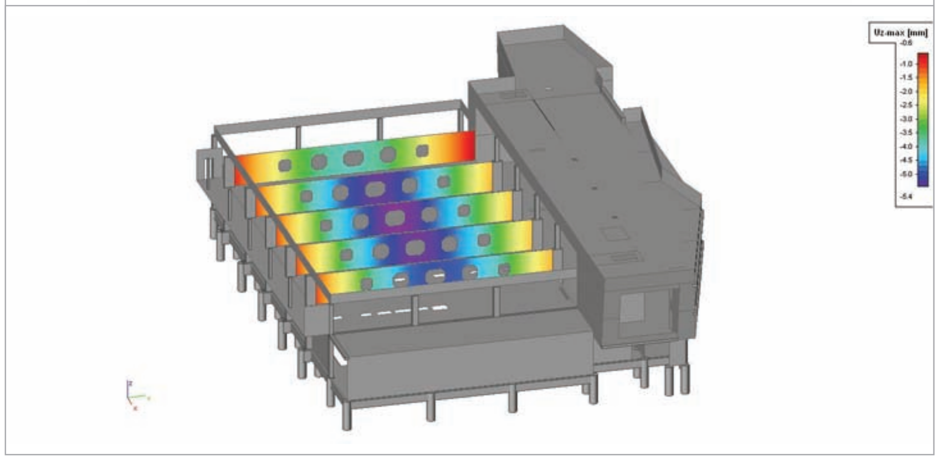




HILASE, New Lasers for Industry and Research - Prague, Czech Republic







Description

The main objective of presented project “HILASE” is to develop laser technology with breakthrough technical parameters. In offering these parameters, Laser Centre “HILASE” will be unique, not only in the Czech Republic but also in Europe. The “HILASE” object is divided into two parts; a monolithic two-storey laser hall and a three-storey administrative section. The dimensions of the laser hall are 25.9 m x 49.9 m, with a height of 8.9 m. The ceiling above the 1st floor and the roof above the 2nd floor have a common beam formed in the 2nd floor. The beam is broken by a number of large holes for wiring technology lasers. The beam has a span of 25.9 m and was designed as monolithic-reinforced. The administrative building has the dimensions of 14.7 m x 60.0 m and a height of 11.85 m. The structure is designed as a monolithic skeleton, while the building edge sections are cantilevered on the second and third storeys. The building foundation is designed on piles. The foundation of the laser plate, located on the 1st floor of the hall, is designed with a 420 mm thickness. The dynamic filter is designed under the laser plate in order to reduce the transmission of vibrations from the subsoil into the building.

Conceptual design and structural analysis

The building was designed according to strict technological requirements for the operation of the laser. Especially strict are the limits for the dynamic behaviour of the laser foundation slabs from subsoil vibration. These vibrations are propagated from the subsoil environment to the building structure.

The first natural frequency of the laser slabs must be greater than 25Hz. The limit deflection of any point structure is $<\Delta uz,rqr = 0.2$ micron in 5-50Hz, and the maximum $\Delta uz,rqr = 0.02$ micron in 50-100Hz. These values are very stringent and are difficult to achieve in the design of the foundation slabs. The foundation plate is located in the hall of the building and it is laid in bad geological layers. To reduce vibrations transferred from the subsoil to the foundation structure, the dynamic filter was designed, at the boundary of both systems. The layered structure is composed with a high and very low bulk density and also a high and low speed of vibration through strata. Filter efficiency was determined at a value of 30%. The own response to dynamic exciting (loading) was performed with the use of the spectral analysis computing system with Scia Engineer on the 3D model. Control calculations were carried out in the reference software. The foundation of the laser plate was modelled as a 3D (wall-plate) structure supported by a flexible “Winkler - Pasternak subsoil”. The values of the soil were modelled using envelope subsoil with regard to the fact that the control-verification was made with the system Soilin. The vibration load was considered as 0.00008 m/s^2 and was an expert estimate compiled from experiences of other sites and from vibration measurements in the locality. The ceiling above the 1st floor (the laser hall) and the roof above the 2nd floor have a common beam formed in the 2nd floor. The beam is broken by a number of large holes for wiring technology lasers. The beam has a span of 25.9 m and was designed as monolithic-reinforced. For global analysis several nonlinear 2D and 3D models were created in Scia Engineer. A controlling calculation was performed on the beam element. Crucial to the design of the reinforcement was the “strut and tie” model, which served for the design and control of global reinforcement and reinforcement around the holes. It was confirmed that this method achieved good agreement with the nonlinear calculation made with Scia Engineer.

Conclusion

The design of the laser hall - in particular the foundation of the laser plate - required the linking together of deep expertise in the geotechnical and dynamic sides of structures. Calculations that are made for structures exposed to subsoil environment vibrations are very complicated and require high theoretical and practical experience. In this case, to achieve very strict limits in regard to the dynamic responses of the foundation of the laser plate, the dynamic filter was used at the boundary of both systems to reduce the transmission of vibrations from the ground to the construction. The checking of calculations for the trusses was performed with the “strut and tie” method. It was confirmed that this method achieved good agreement with the nonlinear calculation made with Scia Engineer.

Software: Scia Engineer, Allplan Engineering

STATIKA s.r.o.

Contact Emanuel Novák
Address Rochovská 765, Praha 9
19000 Prague, Czech Republic
Phone +420 26 1211675
Email novak@statika.cz
Website www.statika.cz

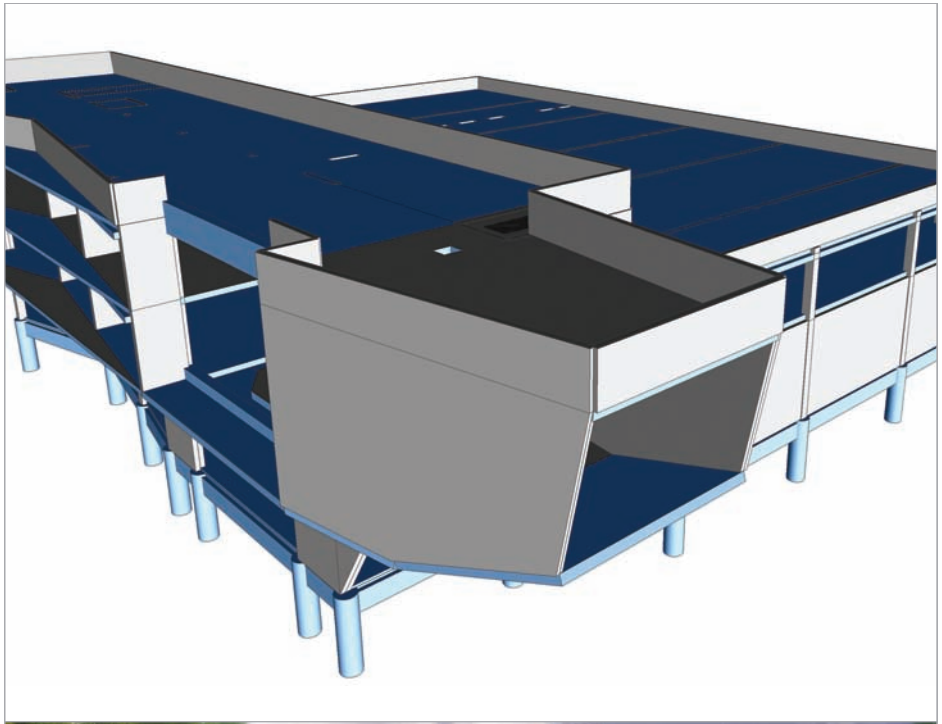
STATIKA Company Ltd. was founded in 1998. Today the firm is one of the leading engineering companies engaged in the design and assessment of load-bearing construction works, engineering and bridge constructions in all material variants. We use the latest computational method designs. In addition, we provide forensic engineering services for construction with the focus on statics and structure dynamics. This activity provides us with feedback in the design of structures. Some of our professional staff work as lecturers at professional conferences. The company is divided into various departments: concrete structures, steel structures, foundations, bridges and engineering design. This approach allows us to design structures in all material variants. Each section works under the leadership of experienced structural engineers, the creators of many interesting structures. We design a construction from conceptual design to the working design and the delivery of construction documents. Our designs meet the required economic, aesthetic and utility parameters.

Project information

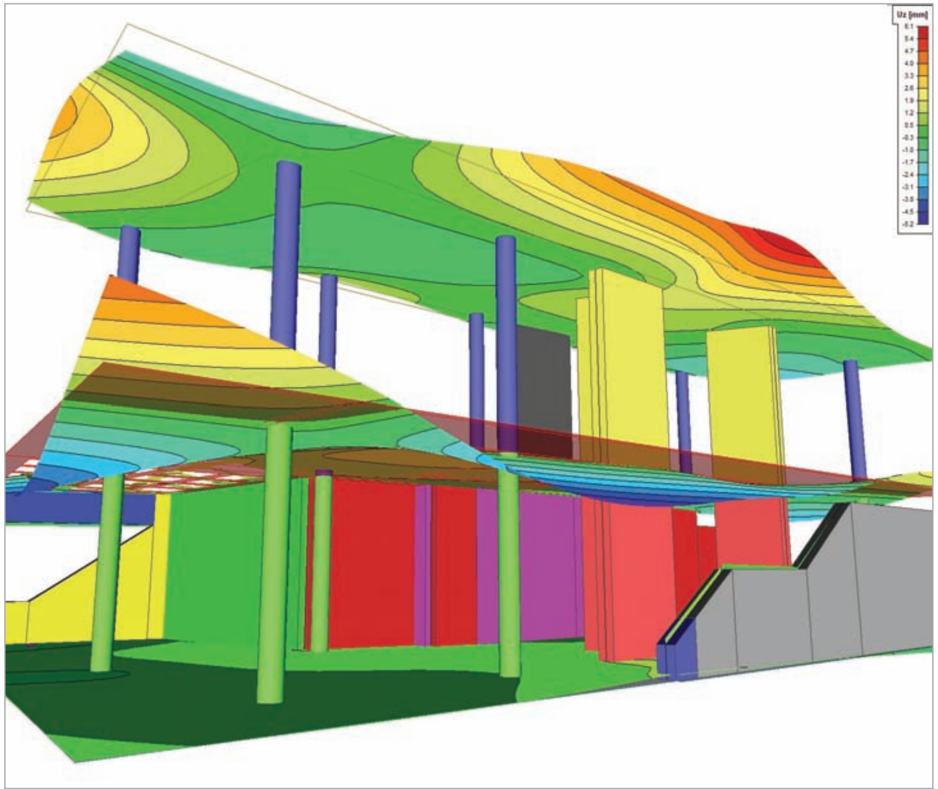
Owner	Academy of sciences of Czech Republic
Architect	Len+k architekti s.r.o., Prague
General Contractor	OHL ŽS, a.s., Prague
Engineering Office	STATIKA s.r.o., Prague
Location	Prague, Czech Republic
Construction Period	09/2012 to 02/2014

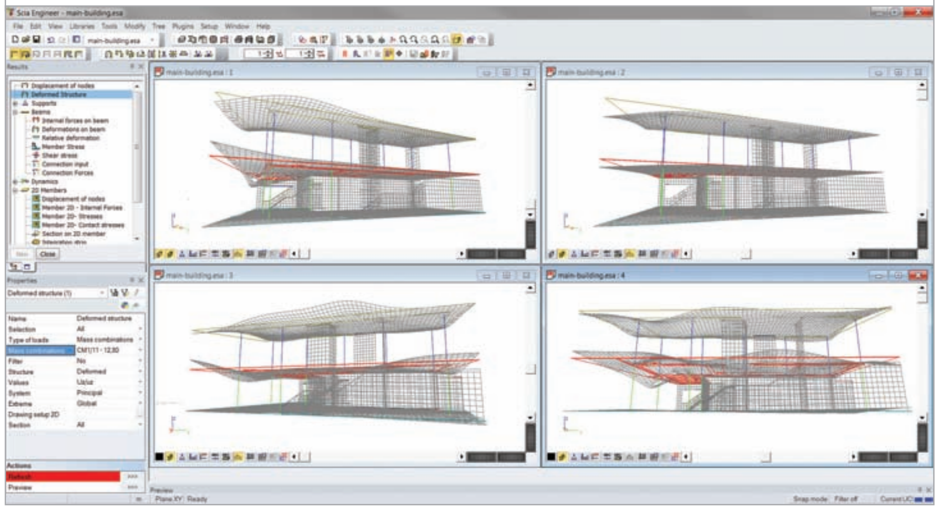
Short description | HILASE, New Lasers for Industry and Research

The main objective of presented project "HILASE" is to develop laser technology with breakthrough technical parameters. Generally said, the involved lasers are much stronger, while they are also more efficient, compact and stable. The lasers are also easier to maintain than currently available technology. The project specifically focuses on lasers based on diode pumping and on the development of related technologies. With the given parameters, Laser Centre "HILASE" will be unique not only in the Czech Republic, but also in Europe. The project has great application potential in the commercial sphere. The outputs of this project will be used for technologies in the areas of micro-shaping, testing the resistance of optical materials, cutting, welding, coatings removal and laser hammering.
The building "HILASE" consists of a monolithic two-storey laser hall and a three-storey administrative building.



Summer House - Vourvourou-Halkidiki, Greece





Project Description

The project centres on a two-storey summer house, located in the professors' quarter of the Aristotle University of Thessaloniki in Vourvourou, Halkidiki, Greece. The house is built on a hill right at the sea front, in the middle of a pine forest, and just a few steps from an almost-private magnificent beach.

The structural members consist of reinforced concrete. The vertical elements are walls and circular columns. The plates are rigid, having an area of about 180 m^2 and a thickness of 28 cm. The roof is inclined, while the middle plate is expanded as a cantilever outside the perimeter, creating the balconies and the external passageways. The mat foundation serves as the ground floor slab, with concrete walls along the longitudinal direction. Two secondary structures are attached to the main building; a pergola composed of concrete beams and a small underground warehouse (about 50 m^2).

Basic characteristics

The house has been built in an area with a high risk of substantial seismic activity. The strongest earthquake of the 20th century in the area was Ierissos earthquake in 1932, which had a magnitude of 7.0 on the Richter scale. On the other hand, the architectural concept demanded few columns, with the minimal dimensions possible, and no beams at all, so that the wonderful view could be enjoyed unhindered. Only some concrete walls were allowed, mainly in the middle and the rear side of the house. This type of construction is very common in non-seismic areas, but it is not recommended in general for areas with high seismicity, mainly because of the difficulty of having a credible calculation model for the transfer of the shearing forces directly from the plate to the concrete walls.

Using Scia Engineer & ECTools for modelling and structural design

The structure was modelled with Scia Engineer as a whole, including the surface elements (plates, walls, foundation, etc.) and the linear elements (mainly the columns). The foundation plate is considered to be supported on the elastic ground through unilateral contact conditions, in order to deal with the soil structure interaction.

For the design of the structural elements of the building, including the EC8 general checks (second order effects, seismic joint width, infills, torsional sensitivity, the exception of joint capacity design etc.) ECtools software was used. ECtools has the ability to distinguish complex wall sections (cores) and treat them as one section, recognising automatically the vertical walls that have been entered on Scia as 2D surface elements, and designing them as seismic walls, as required by EC8.

Shear punching on the plates and the foundation was resolved with the appropriate Scia algorithm which recognises the position of the column (inside, in the perimeter or in the corner position), and the possible existence of holes in the vicinity. The underground structure was modelled using 2D surface elements as well.

Conclusion

Although the presented building is rather small in size, the overall configuration of the structural members required the use of Finite Elements, in order to build a reliable model. Although this type of analysis is usually a laborious and complicated task, Scia Engineer, being a next generation program, brings the Finite Element technology to a level of convenience that allows the engineer to use it in all cases with the minimum effort, namely in cases ranging from simple conventional buildings to advanced cases with complex geometry, non-linear analyses etc.

Software: Scia Engineer

statika.gr, Consultant Civil Engineers

Contact P. Zervas, I. Lavassas, M. Stefanouri, G. Nikolaidis
Address P.P. Germanou 21
54622 Thessaloniki, Greece
Phone +30 2310257572
Email zenik@statika.gr
Website www.statika.gr

Having more than 30 years of experience in the analysis and design of civil engineering projects, we offer advanced solutions in structural analysis, design, and the supervision of the construction of special structures like Steel structures (steel buildings, industrial silos, oil tanks, wind turbines, etc.), Concrete structures (industrial buildings, parking facilities, multi-storey buildings, hotels, etc.) and site restoration projects.

Some of our customers are: Hellenic Petroleum, ALUMIL, FIBRAN, Port of Thessaloniki, Tate & Lyle, Bank of Greece, Municipality of Thessaloniki, Aluminium of Greece etc.

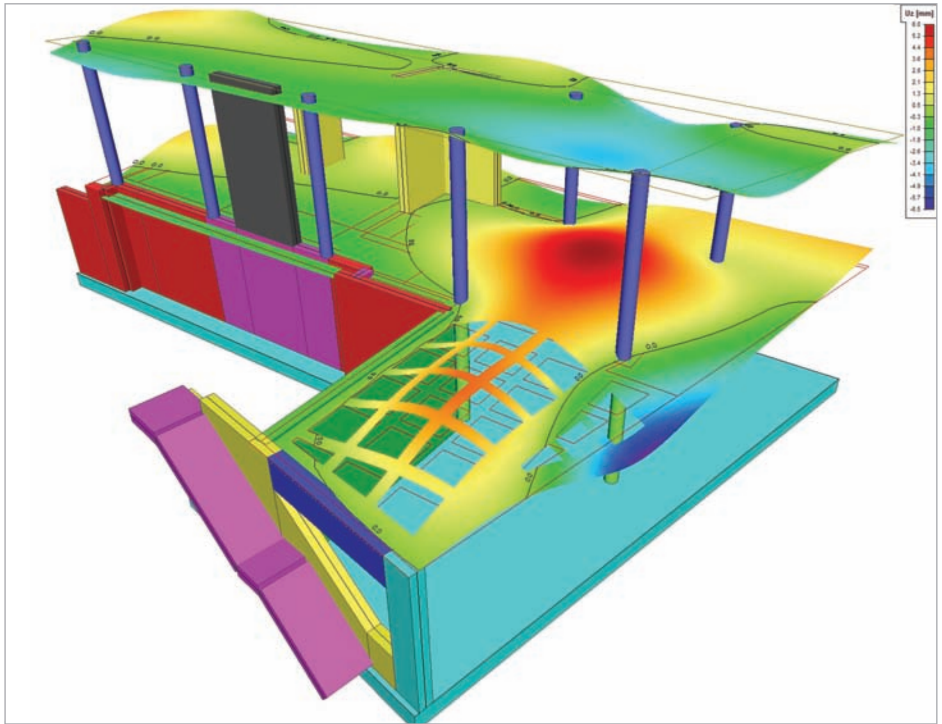
Our office is also active in the research area, producing scientific papers and participating in conferences and research programmes. The recent EU research programme HISTWIN (High-strength Steel Towers for WINd turbines) is one programme we have participated in.

Project information

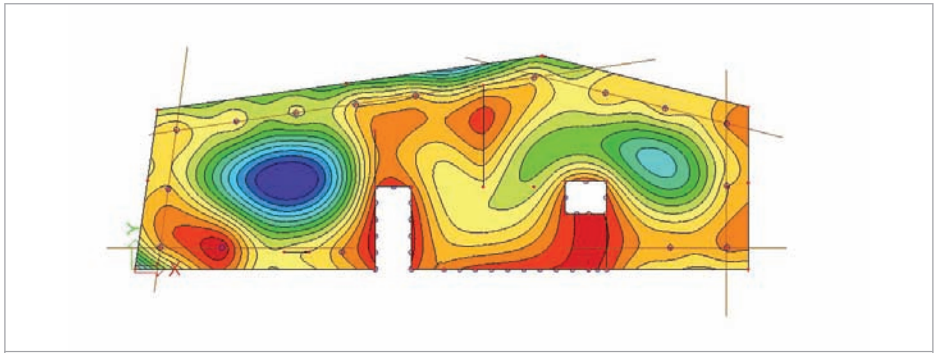
Owner	Nicolas Mousiopoulos
Architect	A.Kotsiopoulos, E.Zoumboulidou, A.Panou
General Contractor	Domia SA - Chris Seroglou
Engineering Office	statika.gr, Consultant Civil Engineers
Location	Vourvourou-Halkidiki, Greece
Construction Period	04/2011 to 10/2011

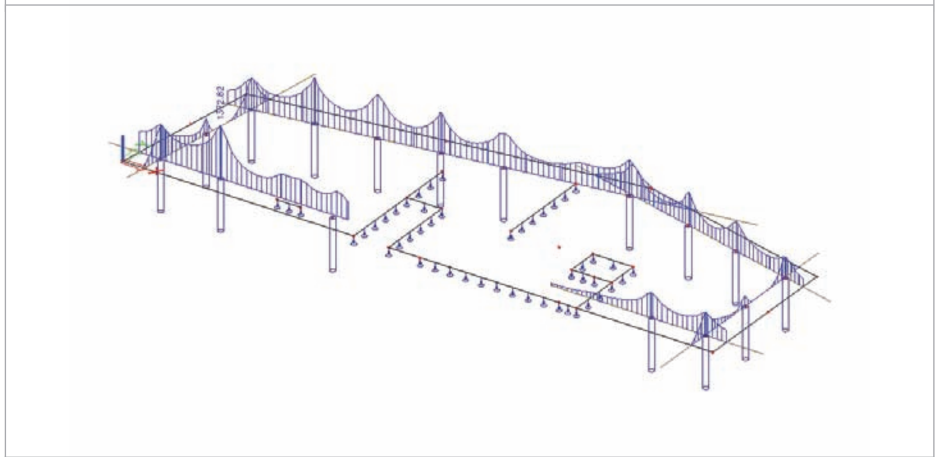
Short description | Summer house in Halkidiki

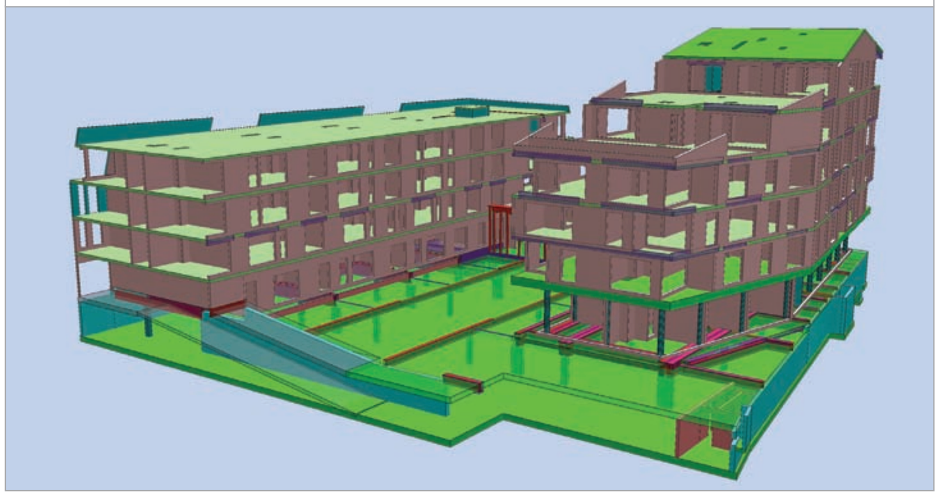
The project concerns a summer house in Halkidiki. It is a two-storey building located just a few metres from the Aegean sea. The location is actually within an area prone to hazardous seismic activity. The strongest earthquake of the 20th century in this area was the Ierissos earthquake that struck in 1932, with a magnitude of 7.0 on the Richter scale. The building is concrete, with plates that are adjusted directly to the columns and walls without beams. For specifying the transfer of the horizontal seismic forces from the plates to the vertical elements, without the existence of beams, an FE modelisation was necessary. The structure was analysed and designed using Scia Engineer and ECTools software in order to describe the whole structure using surface and linear finite elements.



Annonciaden - Wijnegem, België







Software: Allplan Engineering, Scia Engineer

In de voormalige normaalschool van de zusters Annonciaden wordt een nieuw gemengd zorg- en woonproject gerealiseerd.

Hedendaagse serviceflats (89), commerciële ruimtes, een ondergrondse parking, een fietsenstalling, een openbaar park én een kinderdagverblijf zijn voorzien in het woonproject. Ze geven het centrum van Wijnegem een nieuw uitzicht.

Nieuwbouw

Het totale project is opgedeeld in 6 delen. Het Parkvolume met service flats, commerciële ruimtes en een dokterspraktijk heeft 5 bovengrondse niveaus en is daarmee het hoogste gebouw in het project.
Het Straatvolume heeft 4 niveaus maar is het grootste in oppervlak. Ook hierin zijn commerciële ruimtes en serviceflats ondergebracht.
Tussen het Park- en Straatvolume is een gelijkvloerse inkom- ontvangst - en circulatieruimte voorzien.
Onder deze volumes en een groot deel van het park bevindt zich de ondergrondse parking voor 95 parkeerplaatsen en de bergingen voor de serviceflats en commerciële ruimtes.
Het binnenpark dat ontstaat door de omsluiting van de omliggende gebouwen wordt ingericht als park en bevindt zich boven de ondergrondse parking. Na voltooiing van de werken wordt het park overgedragen aan het gemeentebestuur.

Verbouwing

Naast het nieuwbouwgedeelte dat wordt gebouwd op de plaats van het af te breken schoolgebouw, blijven er enkele waardevolle delen behouden.
Het vroegere tuinpaviljoen wordt grondig verbouwd zodat hierin het kinderdagverblijf en een appartement kan worden ondergebracht.
Langs de Turnhoutsebaan staan twee gebouwen met onder andere een kapel en de vroegere verblijfplaatsen van de zusters. Deze gebouwen, huis Meeus en huis d'Arripe, worden verbouwd tot commerciële ruimtes, kantoren en appartementen. Het karakter van deze gebouwen, zowel gevels als de inrichting, blijft zo veel als mogelijk bewaard.

Allplan

De structurele elementen zijn getekend in Allplan. Hierbij vormden de wanden in beton van de tweede en derde verdieping van het Parkvolume de grootste moeilijkheid.
Deze wanden staan licht hellend ten opzichte van het verticale vlak. Bijkomend wordt deze helling gecombineerd met een hellende breuklijn tussen de verticale gevel van de lagere verdiepingen en het schuine deel van de bovenste verdiepingen.
Voor het verkrijgen van een brandweerstand van R120 voor het balkenrooster boven de parkeerkelder, werd geopteerd om stalen liggers te omstorten met beton. Om dit te realiseren werden in Allplan eerst alle elementen in staal met hun verbindingen getekend. Daarna werd het omhullende beton met zijn wapening uitgewerkt.

Scia Engineer

De plaat boven de gelijkvloerse verdieping van het hoogste volume en het balkenrooster boven de parkeergarage werd berekend met Scia Engineer.
Deze plaat brengt alle lasten uit de bovenbouw naar de inspringende kolommen en enkele dragende wanden. Ze wordt ter plaatse gestort en heeft een dikte van 600 mm.

Omwille van de opgelegde locatie van de kolommen en de niet overeenkomende bovenliggende structuur wordt er een zwaar en dicht balkenrooster voorzien. Al deze balken worden omgestort met beton omwille van de opgelegde brandweerstand van 2 uur.

Studie10 Ingenieursbureau bvba

Contact Bart Bruyns
Address Mechelsesteenweg 193
2500 Lier, Belgium
Phone +32 3 293 03 15
Email bart.bruyns@studie10.be
Website www.studie10.be

Studie10 profileert zich als een dynamisch ingenieursbureau in de bouw met gespecialiseerde diensten op het vlak van:

- Stabiliteit: ontwerp van funderingen, grondkerende constructies, staal-, beton- en houtconstructies
- Technieken: ontwerp van installaties HVAC, sanitair, brandbestrijding en elektriciteit
- Infrastructuur: ontwerp van omgevingswerken voor bedrijfsterreinen
- Veiligheid: veiligheidscoördinatie tijdens ontwerp én uitvoering van het project
- Energie: advies voor optimalisatie van energiegebruik in gebouwen

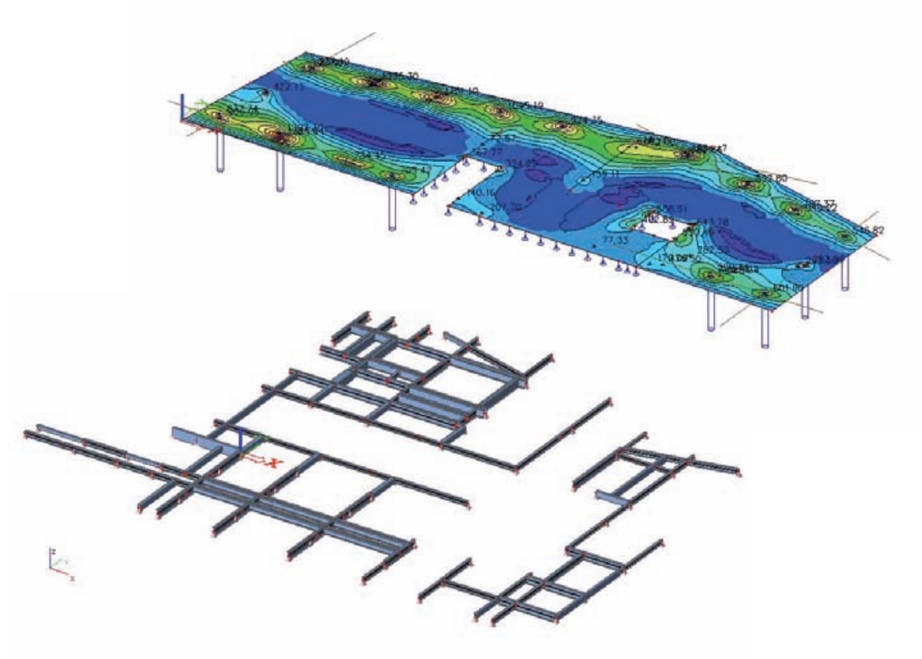
Deze activiteiten situeren zich voornamelijk in de domeinen van appartementsbouw, seniorenhuisvesting, kantoor- en industriebouw, openbare gebouwen, burgerlijke bouwkunde en civiele constructies bij industriële installaties.

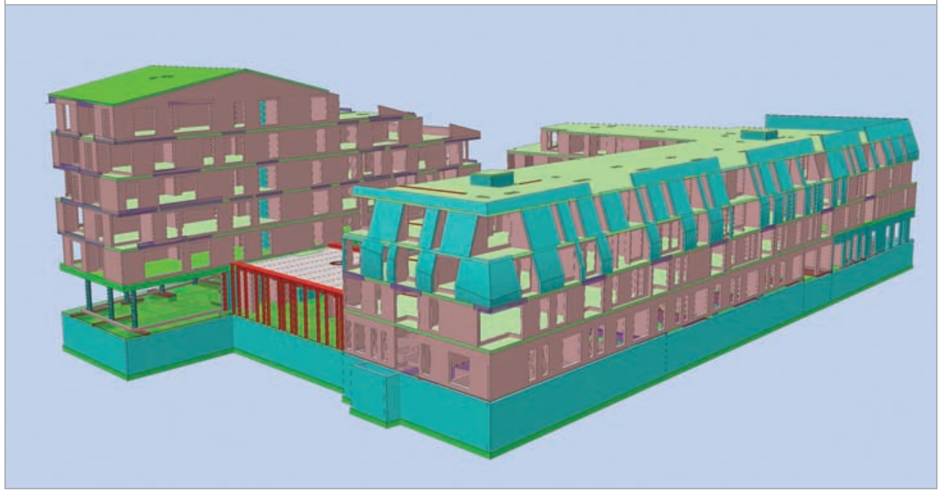
Project information

Owner	Costermans Projecten
Architect	Veelaert Architecten
Engineering Office	Studie10 Ingenieursbureau bvba
Location	Wijnegem, Belgium
Construction Period	08/2013 to 12/2014

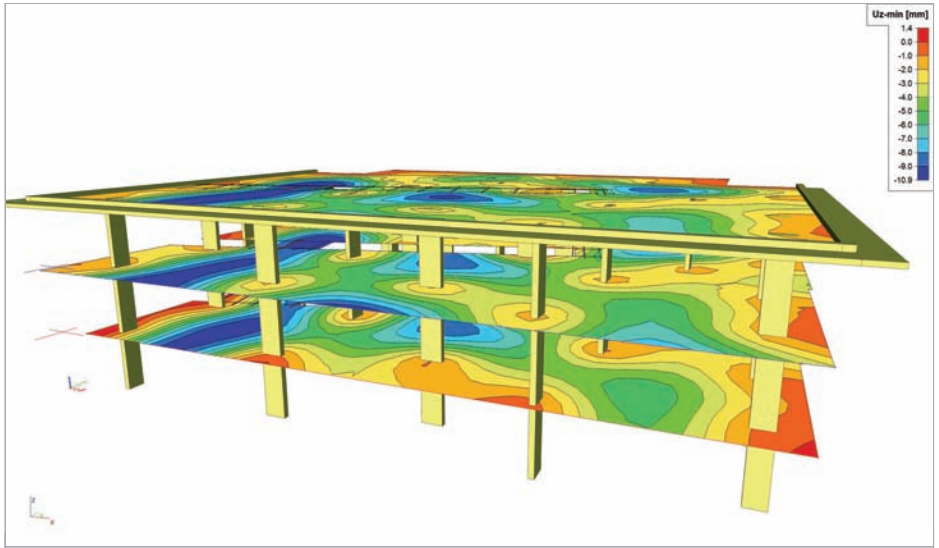
Short description | Annonciaden

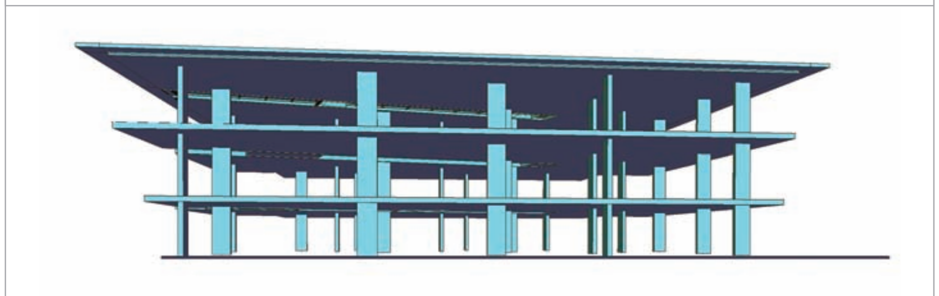
At the former site in Wijnegem (B) of the Teachers College of the Sisters of the Annonciaden, a mixed project for care and residential housing will be built.
The project provides 89 present-day service flats for the elderly, commercial spaces, underground parking, bicycle sheds, a public park and a day-care centre for children. This project will give the town centre of Wijnegem a new look.

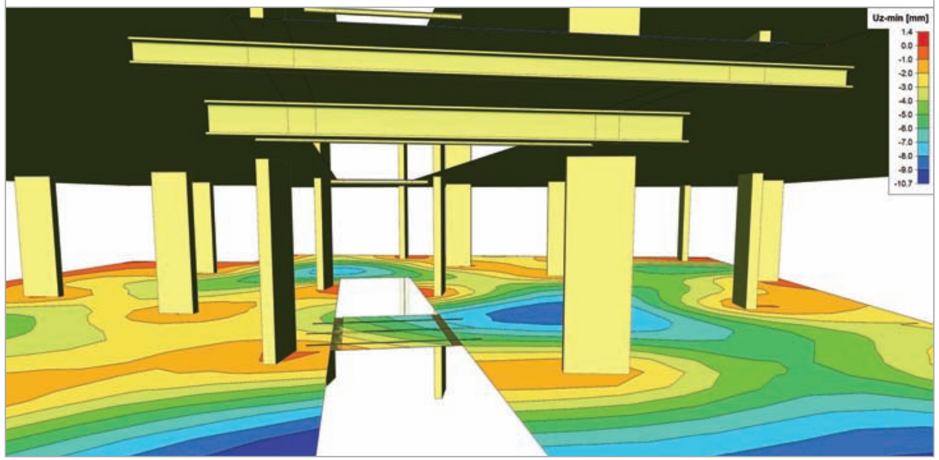




Car Assistance Company - Turnhout, België







Het project omvat het uitbreiden van een bestaande garage met een nieuwe showroom gespreid over 3 verdiepingen.
Het architecturaal ontwerp is opgesteld door Architects in Motion te Turnhout
Daar het gebouw gelegen is aan één van de drukste invalswegen naar Turnhout en omdat het gebouw dienst doet als uithangbord van Mercedes-Benz, heeft de architect alles in het werk gesteld om van het gebouw een echte eye catcher te maken.

Structuur

Het gebouw telt 3 niveaus en ook de dakplaat doet dienst als parkeerdak. De verdiepingsvloeren zijn opgevat als vlakke paddestoelvloeren dewelke afdragen op een kolomstructuur zonder doorhangende balken.
De kolommen werden niet volgens een vast stramien in het gebouw ingeplant waardoor het gebouw een speels karakter krijgt.
De horizontale stabiliteit van de structuur is verzekerd door een combinatie van langwerpige kolommen en twee betonkernen. Daar de langwerpige kolommen niet steeds in dezelfde richting gepositioneerd zijn, is er een variatie in opname van krachten naargelang de wind frontaal of lateraal aangrijpt.
Hier en daar werden elementen geprefabriceerd, doch omwille van de “random” inplanting van de steunpunten van de vloerplaat en omwille van het esthetische karakter werd er voor gekozen om de vloerplaten ter plaatse te storten.

Uitdagingen

Omwille van de speelse inplanting van de kolommen werd er voor geopteerd om de vloerplaat te berekenen met behulp van de Scia software. Daar het een showroom voor wagens betreft, werd tevens de nodige plaats gelaten tussen de kolommen teneinde circulatie van de wagens mogelijk te maken. Hierdoor loopt de tussenafstand tussen de kolommen op tot ongeveer 8,00 m.

Elk niveau kraagt wat meer uit ten opzichte van het onderliggend niveau hetgeen een verschuiving van de momentenlijnen en spanningen met zich meebrengt.

In het midden van het gebouw bevindt zich een atrium welke de trap naar de verdiepingen huisvest. Om het gebouw te kunnen compartimenteren bij brand, werden er rookschermen voorzien rondom het atrium die ingewerkt werden in de betonplaat. Hierdoor werd de dikte van de plaat ter hoogte van de aansluiting met het trapgat en in de dakplaat lokaal teruggebracht van 32 cm naar 10 cm. Beide platen werden onderling verdeuveld met staalprofielen. De samenwerking tussen staalprofielen en betonplaat werd eveneens gesimuleerd aan de hand van de Scia software.

Daar elk niveau steeds iets meer uitkraagt t.o.v. het onderliggend niveau loopt de afstand tussen het uiteinde van de overkraging en de kolommen op bepaalde plaatsen op tot ca. 4,50 m.

Omdat op de bovenste dakplaat de overkraging zou kunnen leiden tot te grote vervormingen werd er voor gekozen om nuttig gebruik te maken van de randbalk rond het parkeerdak teneinde de differentiële zettingen van de luifels zoveel mogelijk te beperken.

Voor de verwarming van de showroom werd gekozen voor een systeem van betonkernactivering. De vloerverwarmingsleidingen werden derhalve in ruwbouwfase reeds in de betonplaat ingestort. De inplanting gebeurde in nauw overleg tussen installateur en studiebureau teneinde ervoor te zorgen dat op plaatsen met maximale spanning en hoge ponskrachten de plaat niet verzwakt wordt door secundaire leidingen.

Software: Scia Engineer

Studiebureau Van hoorickx

Contact Bernard Van hoorickx
Address Deken Adamsstraat 14
2300 Turnhout, Belgium
Phone +32 14 428569
Email studiebureau@van-hoorickx.be
Website www.van-hoorickx.be

Studiebureau Van hoorickx werd in 1992 opgericht en is in de loop der jaren uitgegroeid tot een van de toonaangevende studiebureaus van de Kempen. Het studiebureau spitst zich toe op stabiliteitsstudies van allerlei soorten gebouwen, gaande van appartementsgebouwen, schoolgebouwen, rusthuizen tot industriële gebouwen en kunstwerken van burgerlijke bouwkunde.

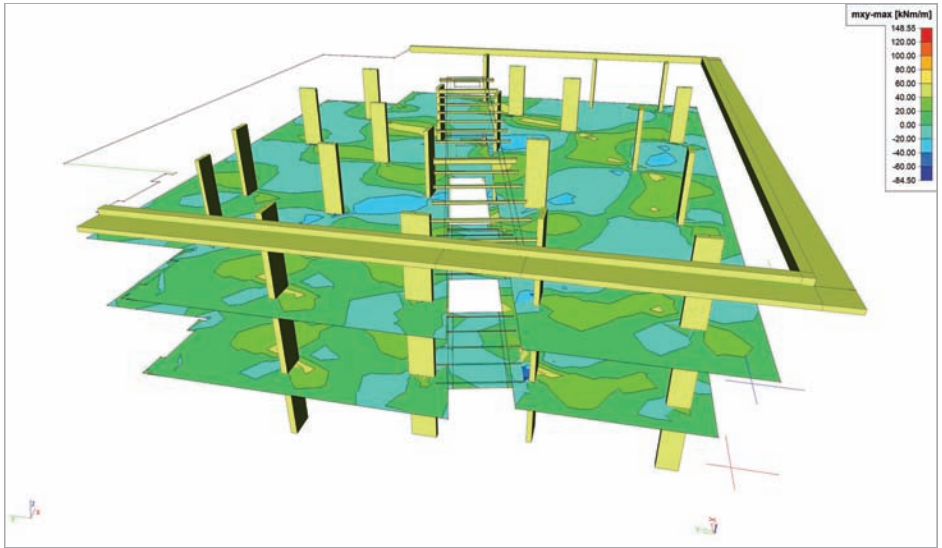
In haar 20-jarig bestaan heeft het studiebureau reeds heel wat know-how en ervaring opgedaan op gebied van stabiliteitsberekeningen. Het komt uiteraard de klant ten goede dat deze ervaring zich weespiegelt in stabiliteitstechnische oplossingen die tegelijkertijd prijsbewust en duurzaam zijn. Dankzij investeringen in onder meer de Scia Software is het in staat de meest complexe 3D-structuren te becijferen. Tevens staat het studiebureau open voor nieuwe technologieën en bouwmethodieken en zal ze deze steeds afwegen om zo getrouw mogelijk de gewenste architecturale effecten te bekomen zonder de duurzaamheid en prijsconsequenties uit het oog te verliezen.

Project information

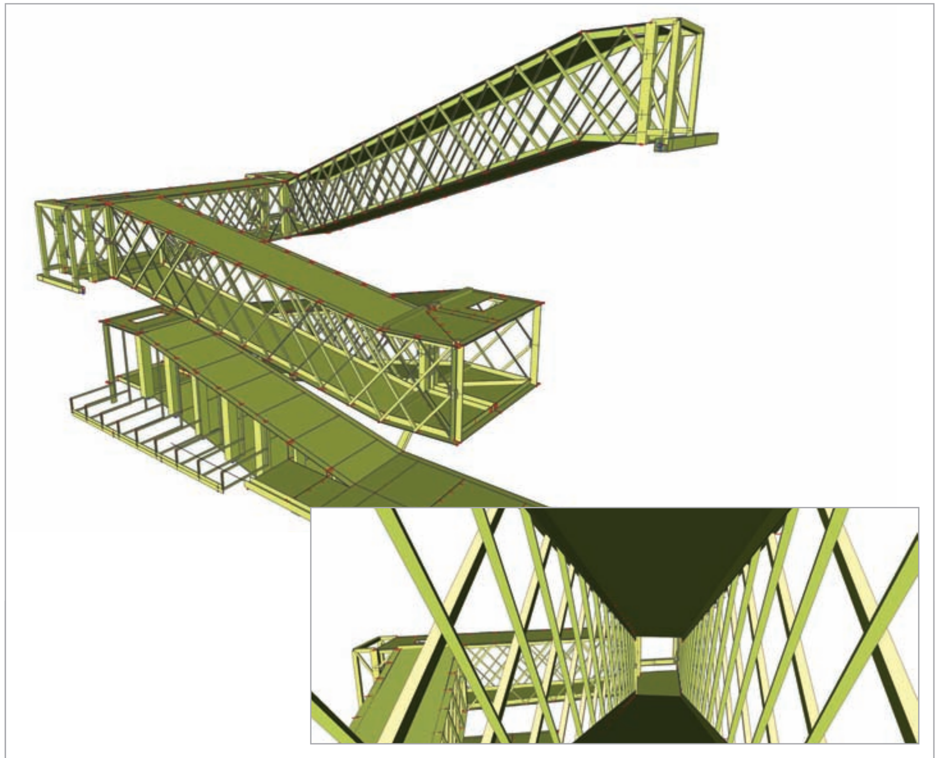
Owner	Car Assistance Company
Architect	Architects in Motion
General Contractor	Vanhout.Pro / Bouwonderneming Huybreckx
Engineering Office	Studiebureau Van hoorickx
Location	Turnhout, Belgium
Construction Period	05/2012 to 07/2013

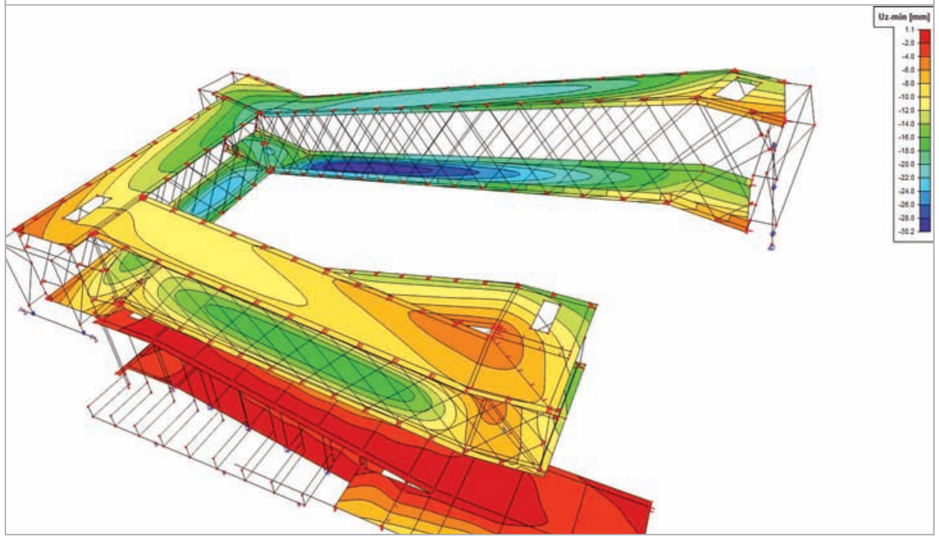
Short description | Car Assistance Company

The project consists of an extension of the car showroom of a company in Turnhout, Belgium.
The building is situated on one of the main access roads of the town. Therefore, the architect wanted to have an eye-catching design.
The columns have a random position in the space in order to obtain a space with a casual character.
The beamless mushroom slabs are supported by elongated columns.
As these elongated columns are positioned in both directions, the wind stability is guaranteed by different columns depending on the wind direction. Every slab enlarges in comparison with the subjacent slab, therefore the internal forces differ from slab to slab.
The heating of the building is ensured by thermal activation of the concrete core. The central atrium with the longitudinal stairs had to be reinforced with steel beams in the thickness of the slab in order to allow for the necessary recesses for the fire screens and other technical installations.



Tubes at the 'De Grote Post' Cultural Centre - Oostende, Belgium





The listed post office, designed by Gaston Eysselinck in 1953, is being converted into a dynamic cultural centre. Situated between the old building (1953) and the new rear edifice, 25 m-long transparent tubes guide the public into the various rooms in the buildings and animate the outside space, an amphitheatre beyond which the tubes are suspended. The tubes allow the original structure of the building to be as visible as possible. They are constructed from a single material: the floor and roof slabs in solid steel plate appear to be stitched together with a fine steel thread. The solid steel is also the surface finish so that the tubes look the same from every side.

By choosing a dense mesh work of diagonal elements, the thickness of the steel plates and posts could be reduced to a minimum.

At the points of junction between the diagonals and the plates, tight Vierendeel cells transfer the transversal forces of the trusses.

The sewing stitches form oblique elements which, together with the floor slabs and roof sheeting, form the horizontal compression and tension components of a one-storey-high structural frame. The oblique posts are separated into two crisscross layers and give the façades a checkered pattern. The posts evolve from thick square tubes on each layer into thin steel plates which clearly demonstrate the forces at work over the length of the posts. When in one layer the posts are in tension, the cross posts in the other layer are in compression. The transition from tension to compression allows the thickness of the stitching, the steel thread, to vary in the two layers. Through smaller stitches, the size of the steel posts can be reduced to form a close-knit pattern that is used architecturally.

At the connections of the tubes to the existing buildings slide bearings avoid forces created by thermal expansion, to pass on the existing buildings.

The tubes were compiled as four bridges to one entire unit. Each tube was prefabricated in a steel atelier and lifted as one piece over the buildings. Despite the total weight of 40 tonnes per tube and its manageable sizes, the assembly had to be done with great precision. Because of the height of the surrounding buildings and the small street from where the operation took place, it was no easy feat. Therefore, the assembly could not take place with wind speeds of more than 25 km/h.

The added value of Scia in this project was the possibility to create a global 3D model of the entire construction. An accurate determination of the section models resulted in a very precise dimensioning of the steel elements. We used the steel control function to check the stability of the posts.

Software: Scia Engineer

Studieburo Mouton bvba

Contact Anne Botte
Address Koningin Astridlaan 225
9000 Gent, België
Phone +32 9 2214965
Email anne@studieburomouton.be
Website www.studieburomouton.be

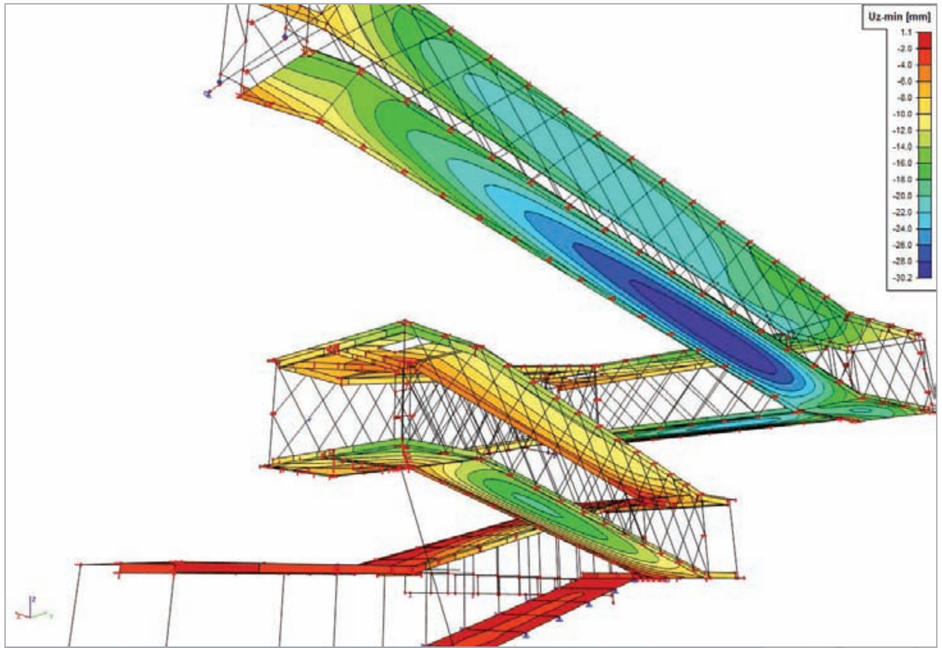
Studieburo Mouton was founded in mid-2002 and created through the independent practice of architect-engineer Guy Mouton. Studieburo Mouton is a structural design office that has acquired a special position within the Flemish architectural landscape. Conducting a stability study for a design goes much further than simply calculating a given situation. The office is ready to be involved in the architect’s very earliest design stage. Its main aim is to provide a stability study in which the interaction with the architect strengthens the design. The main endeavour of Studieburo Mouton is to arrive together with the designers at an intrinsically superior design process and structure. Studieburo Mouton does not envisage architecture and stability as separate entities but as a powerfully expressed consolidation among partners that creates a superior final project.

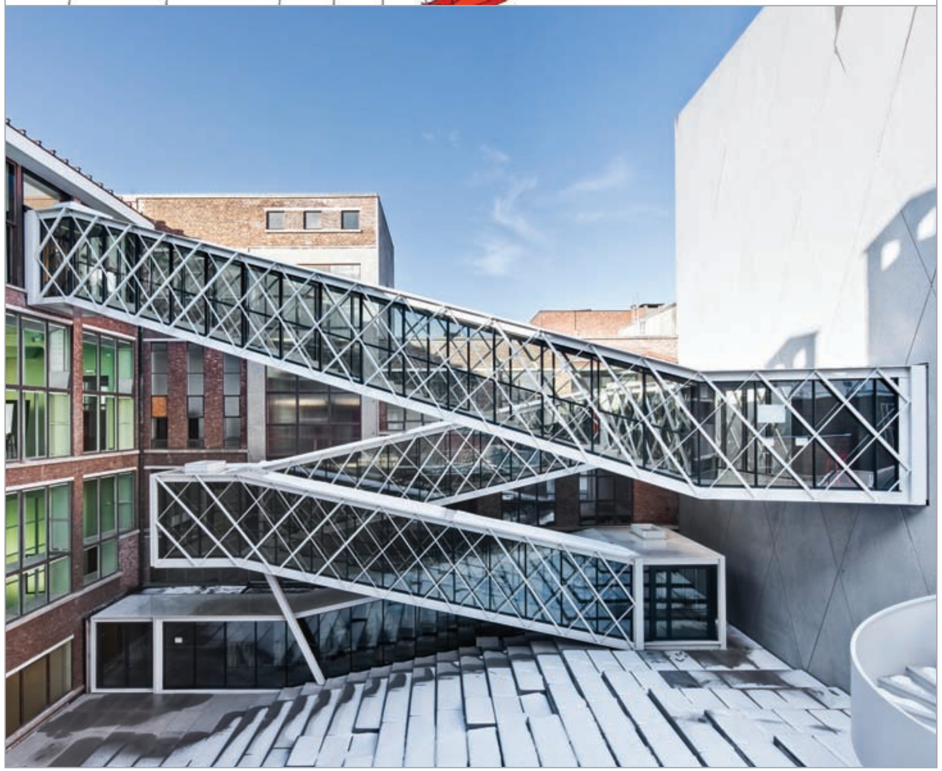
Project information

Owner	City of Ostend
Architect	B-architecten
General Contractor	MBG-Strabag
Engineering Office	Studieburo Mouton
Location	Oostende, Belgium
Construction Period	12/2010 to 12/2012

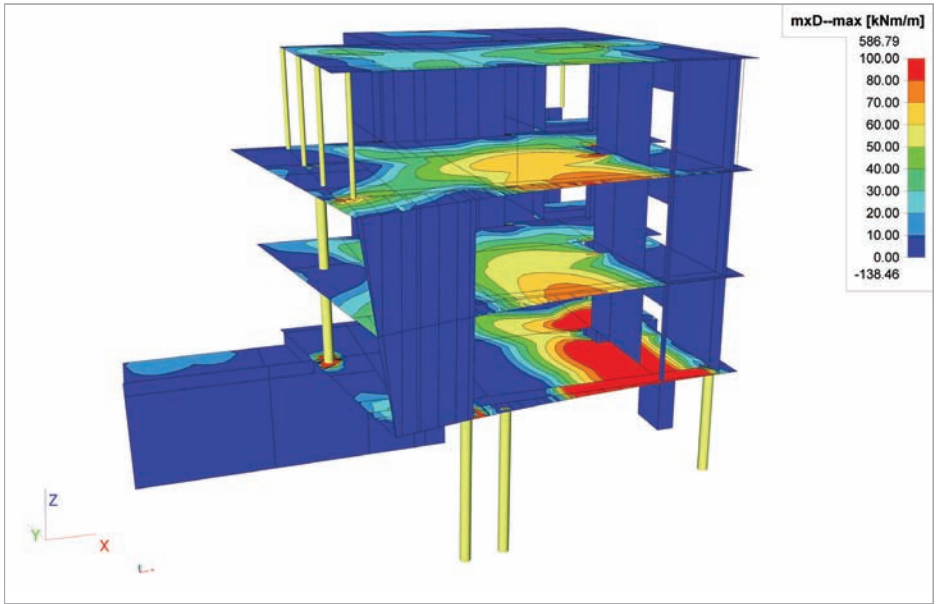
Short description | Tubes at the ‘De Grote Post’ Cultural Centre

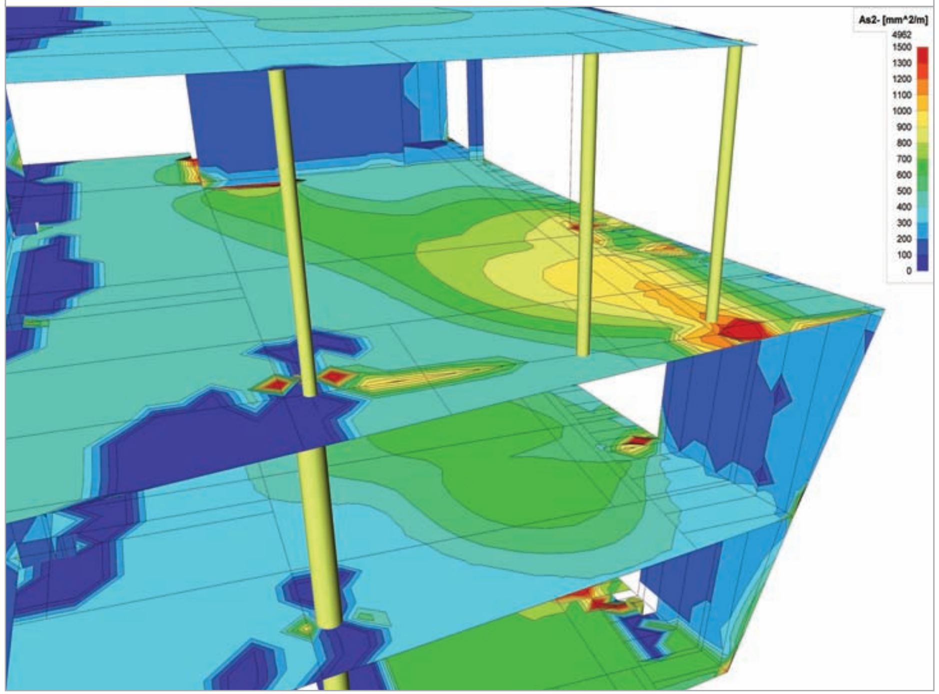
In the beating heart of the former post office transparent tubes link the old building with the new rear building. The tubes are constructed from a single material: the floor and roof slabs in solid steel plate appear to be stitched together with a fine steel thread. The stitches form together with the floor slabs and roof sheeting the horizontal compression and tension components of a one-storey-high structural frame. The posts, evolved from thick square tubes on each layer into thin steel plates, clearly demonstrate the forces at work over the length of the posts.





Rest and Nursing Home “Rustenhove” - Ledegem, Belgium





Software: Scia Engineer

Project description

The Rustenhove rest and nursing home is located in the rural municipality of Ledegem, Belgium. After completion, the project will provide residence to 126 seniors.

The existing part of the retreat consists of three main wings of three floors which come together under an angle of 120°.
The building project embraces, on the one hand, a thorough renovation of two wings of the existing building and, on the other hand, the construction of a new wing as well as the construction of an additional level above the existing building. The total project comprises approximately 8,360 sqm. The new wing also has a basement in order to provide space for technical services.

The new wing has a twisted façade which folds open towards the street – it gives the façade a dynamic emanation to emphasise the innovative nature of the provided health care. The closed twisted façade of the 1st and 2nd levels is accompanied by a sloped curtain wall at the head of the building. Behind this façade one finds the living rooms. This way the residents may experience the special façade also from the inside and above this they can obtain an overview of the activity on the car park, the inner garden and the main reception area. The entrance is situated on the ground floor, under the curtain wall. It is an open space working as a crossroads: it provides the entrance to the new wings but at the same time also offers access to the existing wings via an existing connection tunnel.

Structural description

The slabs of the ground floor and 1st and 2nd floor cantilever in relation to each other follow three arcs of circles. These circles meet each other at the transition between the living room and bed wing and their radius decreases with the level (46.85 m for the ground floor and 30.80 m for the second floor). The edge of each floor is supported by a concrete wall with the form of the envelope of a cone. To make sure that the analyses of the internal loads of the wall were correct, the wall surface was divided into a regulating structure. This way it was also possible to make a shell model as well as a model made up of columns. The increase of the internal loads caused by global imperfection was analysed by means of a second order calculation; thereby, reduced stiffness was applied to take into account the effects of cracked concrete.

The in situ poured slab above the ground floor with a thickness of 35 cm supports this concrete bracing wall as well as the superjacent masonry corridor wall while spanning 7.20 x 9.50 sqm. At the back, the new construction cantilevers 3 m over the existing connection tunnel by means of a slab with a thickness of 61 cm. And at the front and side, the slab is 50 cm thick to take the loads of the column of the superstructure and to transfer them to two sloped round columns in the façade and the load bearing wall of the tunnel. Punching reinforcement was therefore required.
The slab above the first floor is an in situ poured slab with a thickness of 35 cm based on the span of 8 m x 9 m, the back side cantilevering by 3 m and the long-term deflections. The slab above the 2nd floor – spanning 8 m by 10 m – serves as a transfer level for the recessing load bearing façade of the 3rd level.

Due to the fact that the glass façade is a delicate finish as regards deflections, an accurate study of the deformations was made by mean of a CDD calculation. The influence of the cumulated deflections of the two transfer levels as well as the influence of the different stages of construction were thereby taken into account. The maximum additional deflection was limited to L/500.

VK Engineering

Contact	Frederique Noë
Address	Zevenbergenlaan 2a 8200 Brugge, Belgium
Phone	+ 32 50 390553
Email	frederique.n@vkgroup.be
Website	www.vkgroup.be

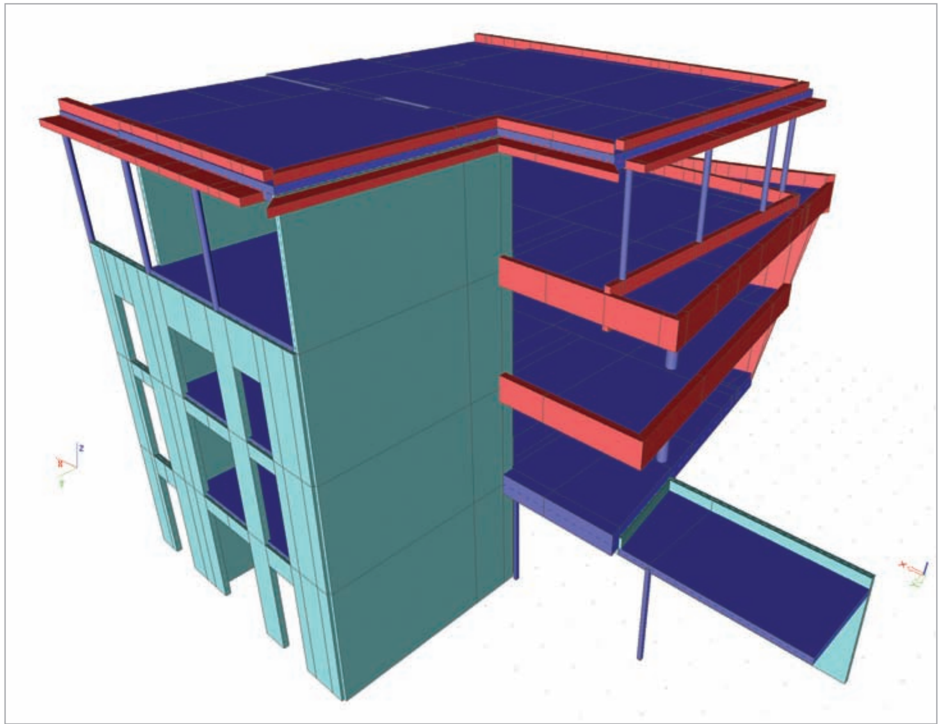
VK offers its services in four market segments: Healthcare, Buildings, Industry and Infrastructure. Our multi-disciplinary consulting engineers undertake studies in building services and civil & structural engineering, ranging from mechanical engineering, electrical engineering and plumbing, to data communication, security and fire engineering, to concrete and structural studies.
VK keeps track of advanced technologies and studies in architecture and construction management and puts together the best team for the client's project.
Having a proven track record with many renowned architects, VK proudly looks back on the building of a portfolio that features many challenging and large-scale projects, including new constructions, as well as renovations of (classified) monuments, expert assessments and management. The new NATO-headquarters, the Antwerp law courts, the Astana National Library, and the VinMedicare Hospital in Hanoi are but a few examples.

Project information

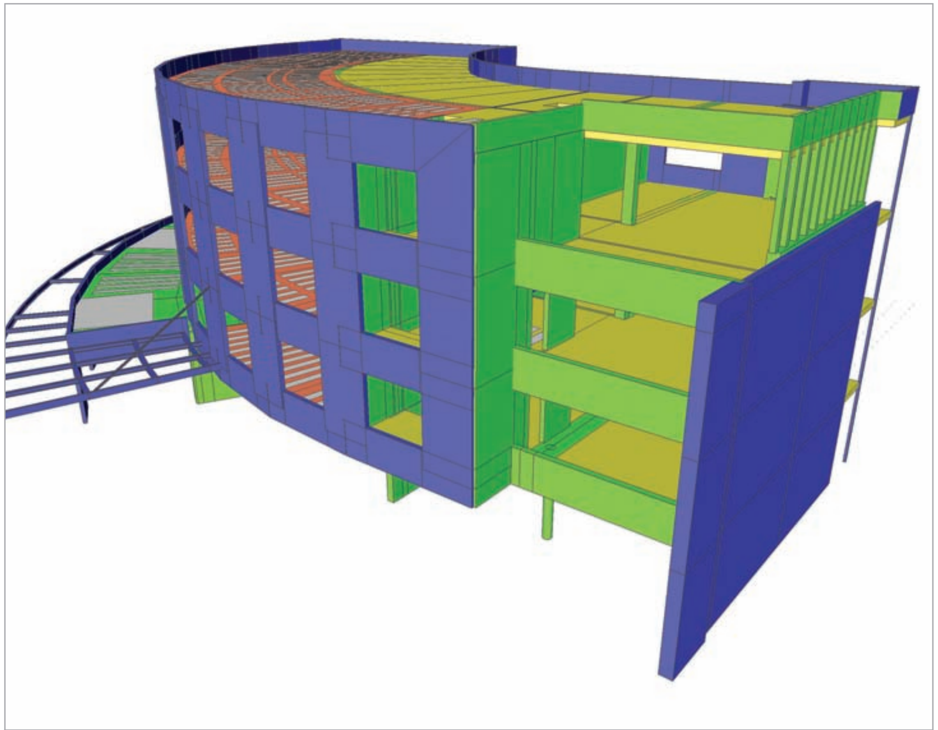
Owner	Woon- en Zorgcentrum Rustenhove vzw
Architect	architektenburo Johan Ketele bvba
General Contractor	Algemene Ondernemingen Himpe
Engineering Office	VK Engineering
Location	Ledegem, Belgium
Construction Period	2007 to 2015

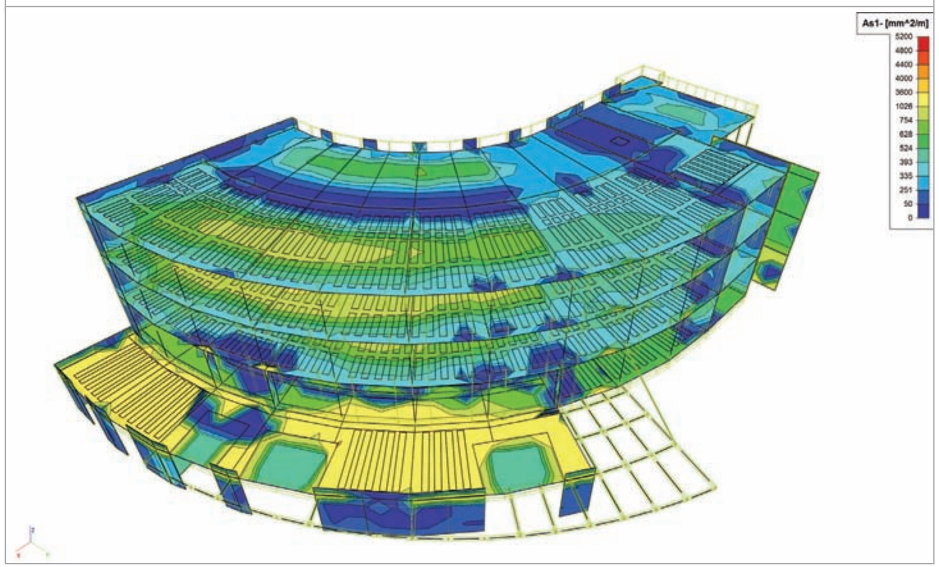
Short description | Rest and Nursing Home "Rustenhove"

After completion, the Rustenhove rest and nursing home will comprise of approximately 8,360 sqm. The main technical challenges of this project concerned the entrance building, which contains a supporting concrete wall with the form of a cone envelope. The increase of the internal loads caused by global imperfection was analysed by means of a second order calculation. In addition, a study of the deformations was made. The influence of the cumulated deflections of the two transfer levels as well as the influence of the different stages of construction were thereby taken into account.



Sacred Heart Hospital - Menen, Belgium





Project description

In 2001, the S. Heart Hospital of Roeselare and the GH Menen merged into the S. Heart Hospital Roeselare-Menen. The management immediately decided to reassemble the dispersed locations of the GH Menen on one campus. The existing hospital part to be replaced consists of connected buildings with different architectural styles and floor levels. Furthermore, the present infrastructure is outdated and is not adapted to the demands placed on a contemporary hospital.
VK will provide the building complex with an extension, with, among other things, a radiology department, a medical imaging unit, an emergency admissions centre, intensive care facilities, an operating room, nursing units and a day hospital. Moreover, the extension will combine all components in a smooth way. Through internal shifting of services, it was also possible to plan the reconditioning of certain areas. The final hospital will contain 175 hospital beds and 25 day hospital beds. The modernisation and expansion of the hospital will be carried out while the hospital operations continue. A very advanced phasing of the work will be necessary in order to achieve this renewed 14,500 sqm hospital. A number of existing units have already been addressed in preparatory projects. The delivery room, for example, had to make way for an interim emergency admissions unit, and was moved to a new wing. An additional operating room had to accommodate the increased activity. The Kloosterpand, a part of the monastery that centuries ago laid the foundation for the current hospital, will become a new wing with rehabilitation, haemodialysis, and administration departments and a pharmacy.

Architectural challenges

The basic idea for the different floor levels draws on flexibility as the most important requirement; therefore each floor was designed as an open space of 12.6 m with only one row of columns in the middle and load-bearing outer walls. In addition there are two transfer levels in order to create the necessary space for the operational cooperation of the hospital with, for instance, the reception area, the emergency unit and the intensive care unit on the ground floor and operating rooms and medical-technical areas in the basement.

Structural challenges

Due to the arc-shaped ground plan and the limited structural height (40 cm for the slabs; beams included), several traditional precast floor systems were not an option. In addition, specific demands were set in the form of big spans up to 8.2 m as well as the need for future flexibility (change of functions) of the floor system. As a result, the choice was for predalle flooring with weight-saving elements and a cast-in-place compression layer. Thanks to the incorporation of the light-weight elements, the loads on the transfer levels were limited. The load-bearing façade above the ground floor is captured by a concrete slab spanning 7.75 m; for this slab a higher concrete quality for the compression layer was applied (C40/50). The façade spans the reception area over 13 m and simultaneously cantilevers of 2 m to 3.75 m. Therefore the façade was designed as a concrete arc-shaped 'vierendeel' beam. The cantilever stiffener walls were taken into account in the model to take up the restraining and torsional loads. Some of the stability walls are not centrically positioned onto the supporting columns for the sake of the integration of building services and architectural aims. In this case there are no equilibrium beams, but punching reinforcement was applied.

Modelling and calculation challenges

The 3D model was schematically prepared by the engineer with the intention to create a model as flexible as possible. This scheme was translated by the cad-operator into an analytical Scia Engineer model. The model is easily adaptable for the simple optimisation of the structure and can be divided into several smaller parts for more detailed calculations. Above this, one can create several load take-down models of the transfer levels, of the foundation and for the evaluation of the prefabrication of structural concrete elements.
Scia Engineer made it possible to analyse the global 3D action of loads as well as to analyse the influence of the deformations of the lower structure onto the deformation of the upper structure. On-site performed measurements of the deflections have confirmed the correctness of the model (2 à 3 mm deflection of the façade after finalising the concrete structure is in accordance with the calculated values).

Software: Scia Engineer

VK Engineering

Contact Frederique Noë
Address Zevenbergenlaan 2a
8200 Brugge, Belgium
Phone + 32 50 390553
Email frederique.n@vkgroup.be
Website www.vkgroup.be

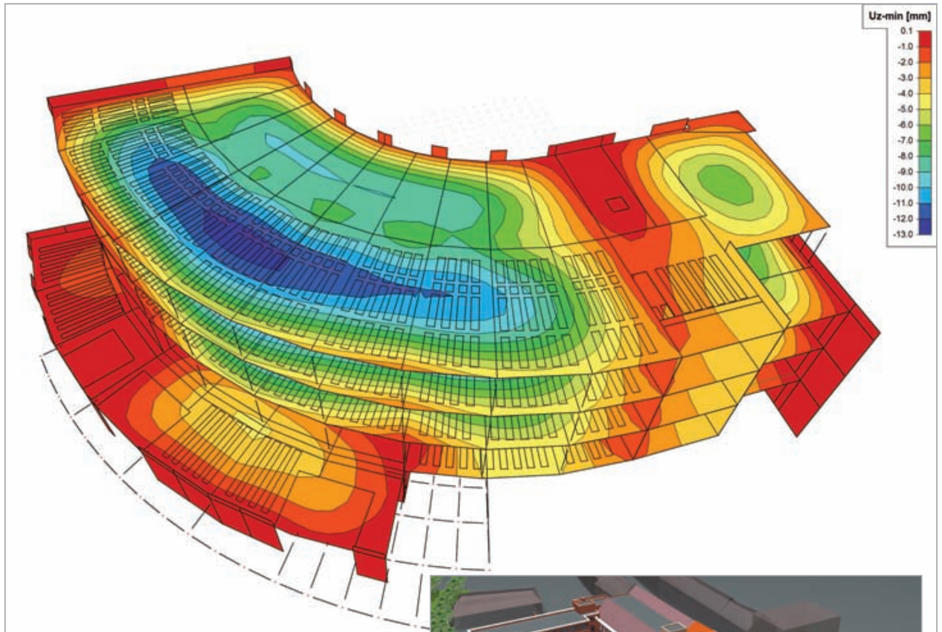
VK offers its services in four market segments: Healthcare, Buildings, Industry and Infrastructure.
Our multi-disciplinary consulting engineers undertake studies in building services and civil & structural engineering, ranging from mechanical engineering, electrical engineering and plumbing, to data communication, security and fire engineering, to concrete and structural studies.
VK keeps track of advanced technologies and studies in architecture and construction management and puts together the best team for the client's project.
Having a proven track record with many renowned architects, VK proudly looks back on the building of a portfolio that features many challenging and large-scale projects, including new constructions, as well as renovations of (classified) monuments, expert assessments and management. The new NATO-headquarters, the Antwerp law courts, the Astana National Library, and the VinMedicare Hospital in Hanoi are but a few examples.

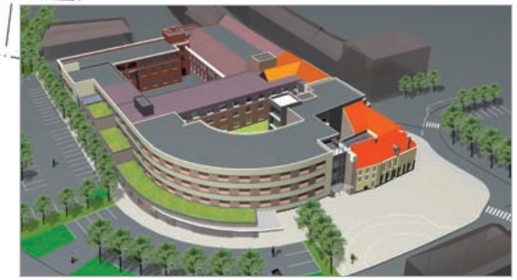
Project information

Owner	Sacred Heart Hospital Roeselare-Menen
Architect	VK
General Contractor	Artes Depret
Engineering Office	VK Engineering
Location	Menen, Belgium
Construction Period	2002 to 2015

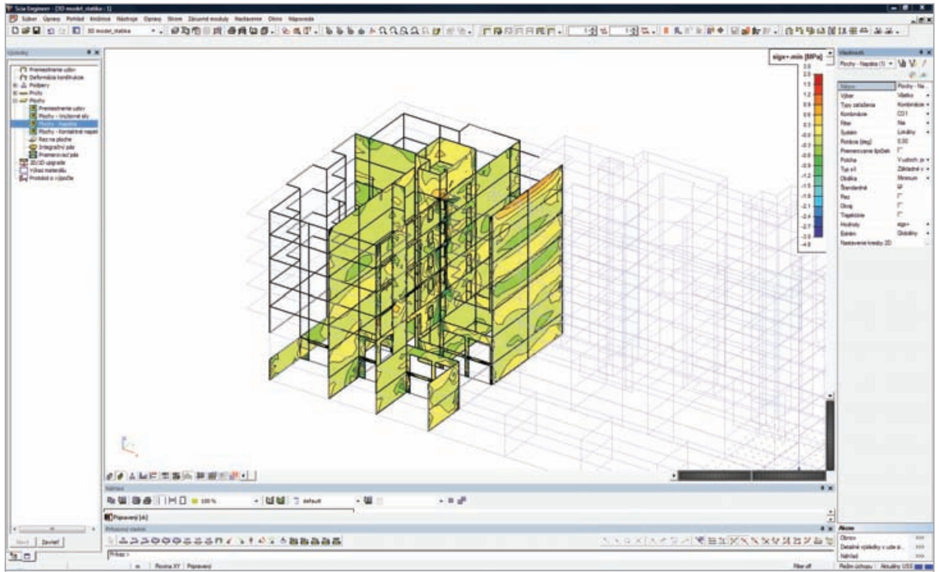
Short description | Sacred Heart Hospital

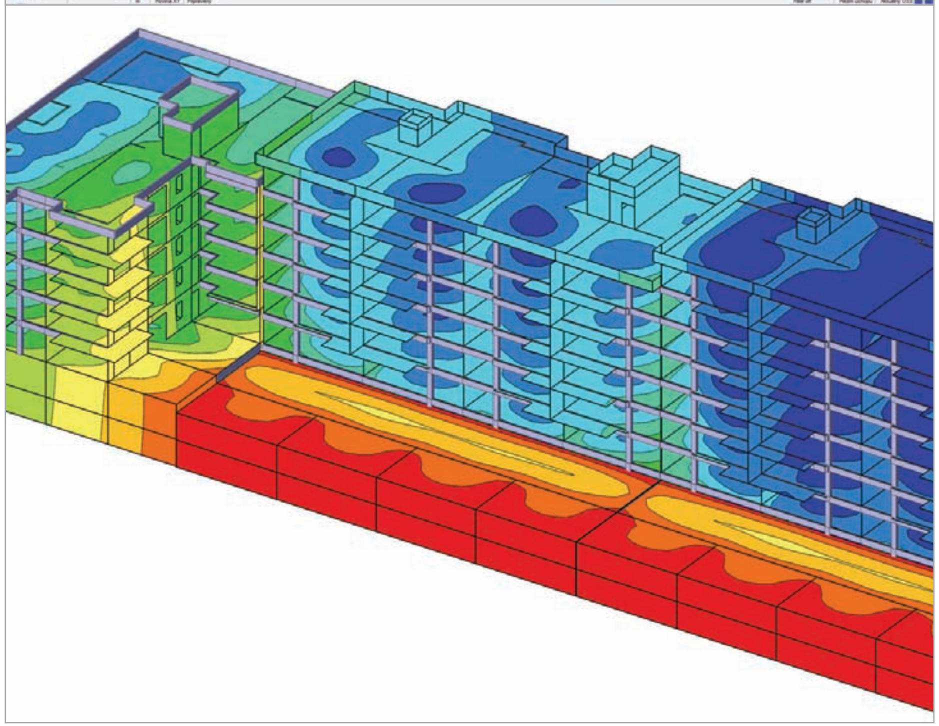
The renewed S. Heart Hospital Menen will contain 200 hospital beds. The last phase is a new arc-shaped wing which will bring the ground floor up to its final 14,500 sqm and will be finished in 2015. The façade spans the reception area over 13 m and simultaneously cantilevers of 2 m to 3.75 m. Therefore the façade was designed as a concrete arc-shaped 'Vierendeel' beam. Scia Engineer made it possible to analyse the global 3D action of loads as well as to analyse the influence of the deformations of the lower structure onto the deformation of the upper structure.





Polyfunctional Building - Bratislava, Slovakia





Introduction

This project is a continuation of an existing home-building initiative in a Bratislava location. The building is divided into three parts, with each having a different number of storeys. The ground plan dimensions of the whole object are 96 m x 25 m and it is divided into five dilatation units. The maximal height of the building is 28.8 m.

There are projected flats (third-storey and higher), offices (second-storey), shops (first-storey) and a car parking facility (two sub-levels) within this object.

The motivation for this project is to have all the roofs designed as “greenery” so that the roof layers’ weight generates the load case on the roofs’ reinforced concrete slab.

Geological conditions

According to the results of the geological examination of the foundation’s soil, the following points were determined: the surface layer is created by dirt-sand with a clay addition, underneath which there is a gravel layer, and then at a depth of 13 m is a layer of neogen clay. Underground water was found at a 2.5 - 3.0 m depth during the geological examination. The water is in direct relation to the Danube river.

Load bearing system

The main load bearing system is a combination of reinforced concrete walls, columns, communication cores and slabs. The car parking facility has two underground storeys comprising reinforced concrete box with a foundation slab. The thickness of the reinforced concrete walls is 200 mm. There are various types of column dimensions. The thickness of the typical slabs is 200 mm, while for the roof slabs it is 250 mm. The foundation slab has three different thicknesses – 900 mm, 800 mm and 700 mm.

Use of Scia Engineer software

The calculation consists of static analysis regarding the vertical load, wind load and dynamic loads. For the static and dynamic (seismic) solutions for the structure, a 3D model was created for the whole object with Scia Engineer software using finite element method calculations. The loads were calculated according to Eurocode 1.

The seismic load is considered as a standard designed spectrum of seismic response according to Eurocode 8. The seismic response of the structure was calculated using modal analysis, which consists of the eigen vectors solution and then the internal forces solution for each load case.

Scia module Soilin was used for the calculation of the interaction of the foundation soil and reinforced concrete structure.

Separate calculations were performed for the typical floor slabs. A particular model was created for each slab, while the internal forces and deflections with creep were calculated.

Scia software helped us to decide on the foundation. In just a short time it is possible to make adjustments and to calculate the response of the concrete structure.

Software: Scia Engineer

Vodotika a.s.

Contact Miroslav Malast, Ján Cigánek
Address Bosákova 7
85104 Bratislava, Slovakia
Phone +421 2 624 10 376
Email vodotika@vodotika.sk
Website www.vodotika.sk, www.vodotika-mg.sk

Vodotika a.s. is an engineering company established in May 1990. At present, we employ more than 20 people who variously specialise in civil and structural engineering as architects, civil engineers, structural engineers and hydraulic engineers.
The main company activities are divided into two parts that cover all design stages:

- Design of building constructions (apartment blocks, multifunctional buildings, dwelling units, blocks of flats)
- Design of water and environmental constructions (hydropower plants, dams, hydraulic complex facilities, polders)

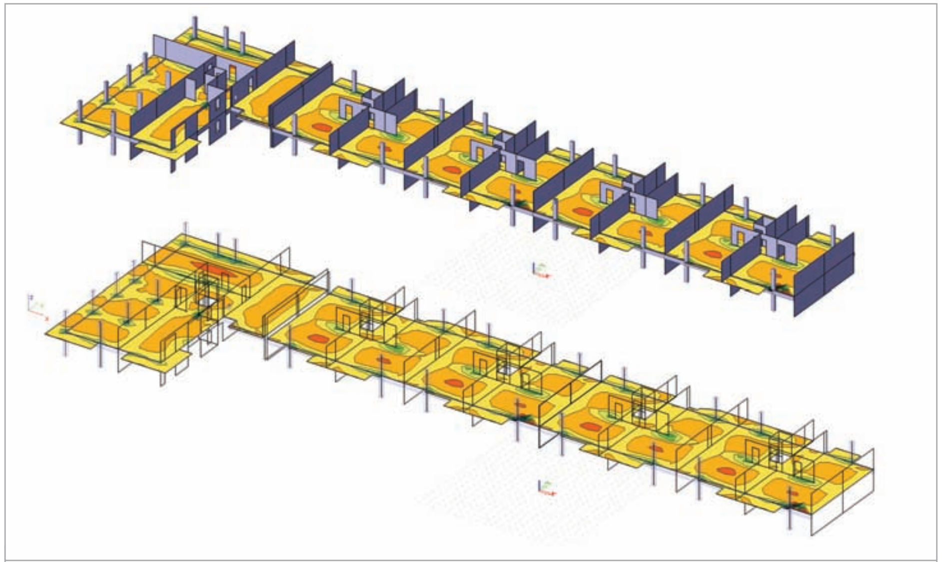
Our company has been the chief designer of multifunctional buildings in Bratislava-Petržalka (Šustekova-Bosákova streets) since 2002. One of the most significant reference cases in our design of building constructions can be seen in Scia User Contest 2009, p.102 - "High-rise building Vodotika". Vodotika company has held an EN ISO 9001 certificate since 2003.

Project information

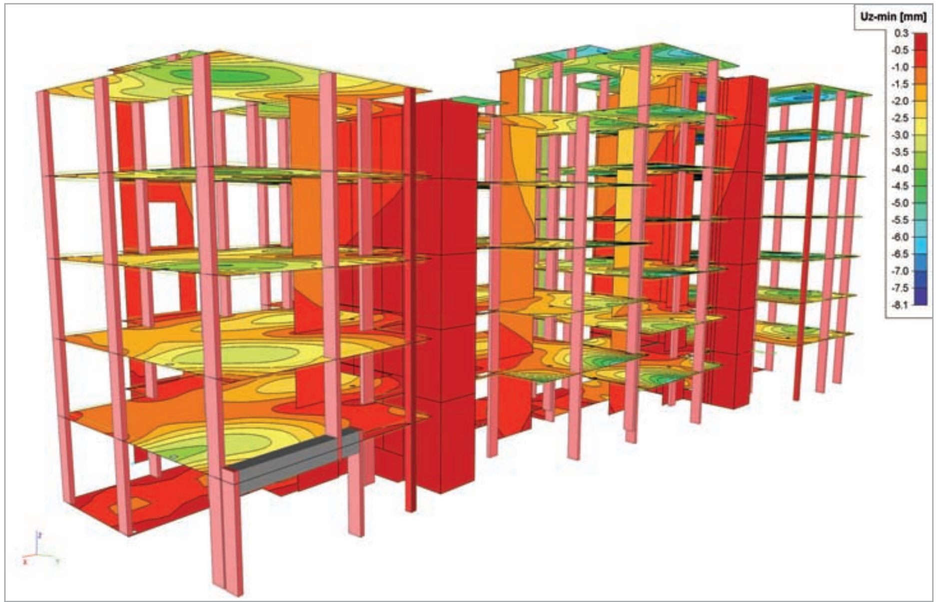
Owner	Vodotika-MG, spol. s.r.o.
Architect	Vodotika a.s.
Engineering Office	Vodotika a.s.
Location	Bratislava, Slovakia
Construction Start	11/2013

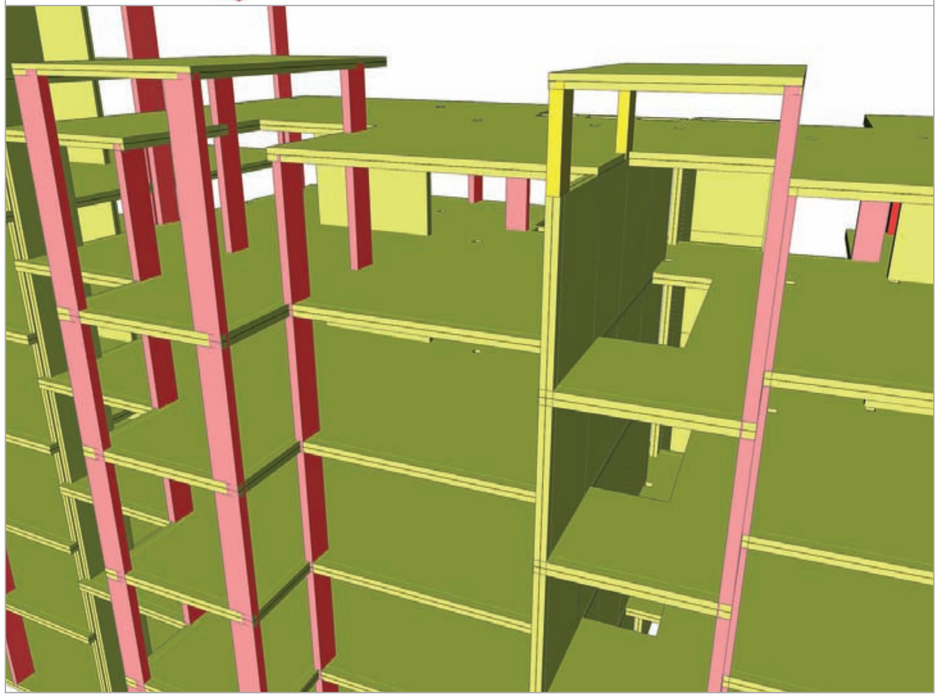
Short description | Polyfunctional Building

The polyfunctional building project is situated in Bratislava-Petržalka's Lužná street. It is the next phase and the continuation of home-building in this location. The project comprises of a complex of three buildings, each with a different number of storeys, which include flats, offices, shops and two sub-levels of car parking. The construction is divided into five dilatation units. The load bearing system is a combination of reinforced concrete walls, columns, communication cores and slabs. For the static and dynamic analysis of the structure and for the foundation concept, the 3D model was created using Scia Engineer software.



Allen Court Block 2 - Ealing, United Kingdom





Allen Court Block 2, is a relatively straightforward RC framed building. Up to 8 storeys high with 250 mm thick reinforced concrete flat slabs and generally 600 x 200 mm columns. The bottom levels of columns, up from foundations to underside of 1st, have to be designed to cater for impact loading, as some of the lower level is to be accessed by vehicles, therefore we increased the thickness of these columns by 50 mm for increased cover. The size and shape of the building is long and narrow, we therefore had to ensure there were enough shear walls for stability and to counteract any wind loadings that may occur. There are several concrete balconies at each level, these are supported using a thermal break system, and the design of these balconies has also been carried out on Scia Engineer.

We used Scia Engineer to design the flat slabs, column loads, slab moments, areas of steel and stability in the core walls. This gave us enough information to design the foundation loadings, to which we had a tight deadline to enable the client to procure the site.

Block 2 is 1 of 3 blocks, Block 1 is similar in construction to Block 2 and Block 3 is a loadbearing masonry construction, based on traditional build and piled ground beams for the foundations.

We use the Scia Engineer program to enable us to mark up the steel areas for reinforcement, we get our reinforcement drawings for larger projects done out of house, to enable us to concentrate closer on the design. We use the steel areas combined with the slab moments to give us the required reinforcement to the slab area. The column loads help us to determine the amount of punching shear required. The column loads can easily be differentiated into serviceability loads for foundation design and ultimate loads for column and punching shear designs.

We have worked very closely with the architect and main client on this project, to enable us to forward our design principles with accuracy and speed, whilst still ensuring correct design procedures. We schemed up and tendered for this project several months ago, and used the Scia program to back up our tendered estimates at the early stages, and implement any changes, client or architectural, for the construction issue.

This project has not been started on site currently, and a start on site date for May 2013 has been imposed. We are preparing any necessary design and detailed information to ensure that the start on site date is achievable and that any delays that may occur are kept to a minimum.

Software: Scia Engineer

Walker Associates Consulting Limited

Contact Thomas Huggins
Address 13 Capricorn Centre, Cranes Farm Road
SS14 3JJ Basildon, Essex, United Kingdom
Phone +44 1268530500
Email tom.huggins@walker-associates.co.uk
Website www.walker-associates.co.uk

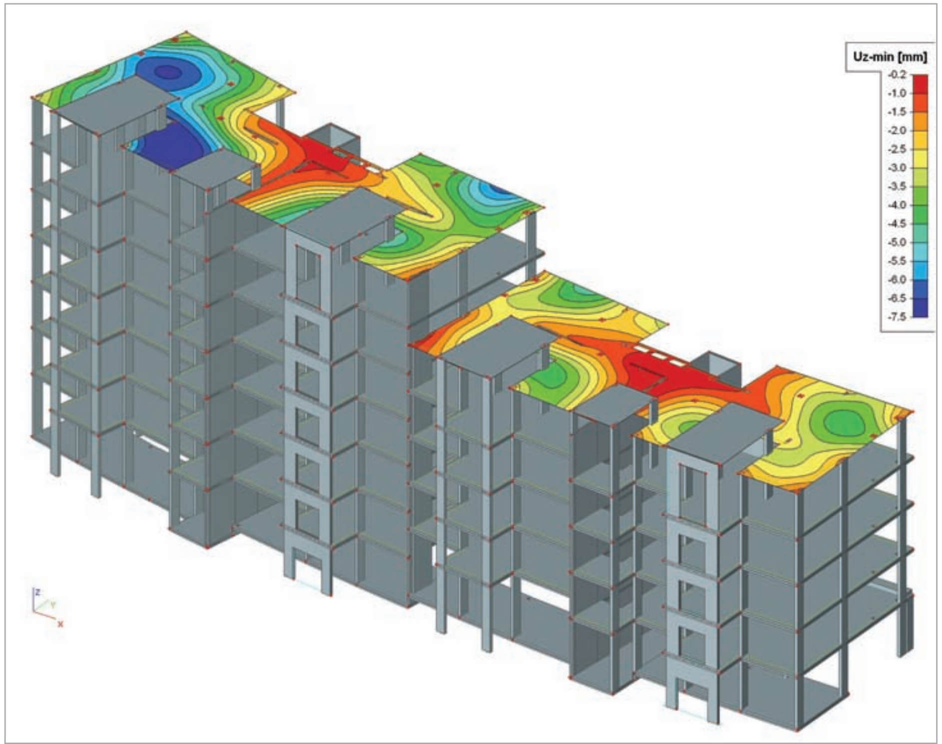
We are a structural and civil engineering consultants based in Basildon, Essex. Our projects range from small housing estates to multi-storey RC framed buildings. We also design in the other structural disciplines, such as timber, steel and masonry. We have a very good client base and we ensure all our projects run as smoothly as possible.

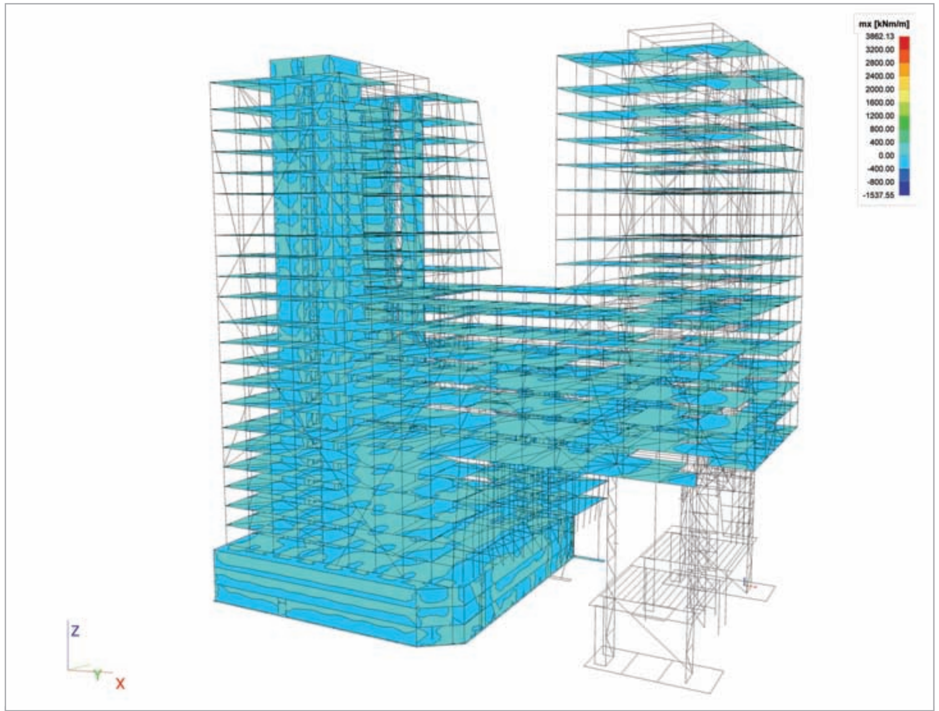
Project information

Owner	Linden Homes
Architect	HTA
General Contractor	Linden Homes
Engineering Office	Linden Homes
Location	Ealing, United Kingdom
Construction Start	05/2013

Short description | Allen Court Block 2

Allen Court is an RC framed building, consisting of 250 mm thick floor slabs and generally 600 x 200 mm columns. The core walls provide the stability of the building. The foundations are piles and pile caps to support the structure at columns and shear wall locations. There is a masonry external leaf and a lightweight inner leaf. There are several balconies at all levels which are connected to the slab using a thermal break system.





The new City Hall in Utrecht, the Netherlands, is currently under construction immediately next to and partly above the new Central Station terminal in Utrecht. Since Utrecht Central Station is the busiest train station in the Netherlands, it is a unique and complex location. The south tower of the building is situated directly above the new public transportation terminal, which is also currently under construction. It is supported by 5 main columns, which run through the bus terminal area on ground level and run through the Central Station on raised ground level.
The northern part of the building starts on ground level but the main entrance is situated on raised ground level. The north tower has a large void over 6 storeys, which borders a large curved glass facade on the south side. This curved facade is connected to the floors with a lattice girder, spanning approx. 26 m. Vertically, the entrance façade is fully suspended from the walkway construction on level 6/7.
The offices start from the 1st floor upwards. Throughout the building there are a large number of voids and inner areas. A parking basement of 3 levels will be situated underneath the north tower.

The main bearing structure consists of 3 concrete cores, a steel structure and structural exterior walls (steel structure). Above ground level, there are no dilatations and the superstructure is a single whole ‘unit’. Therefore, the entire construction provides the stability for the building.
The core walls and basement walls will be poured in situ. From the ground floor upwards, the exterior walls will be built as a steel construction. These exterior walls consist of columns, girders and diagonals. Together, these elements provide stability in the exterior walls.

The floors consist of hollow core plates, of which most have a reinforced compression slab. This slab works as a diaphragm, which divides the horizontal forces within the floor between the different stability elements (concrete cores and steel structure). The reinforcement in the compression slab is therefore oriented in 2 directions. Through the use of starters connected to the steel (girders) and the openings in the hollow core plates and the reinforcement, a structural connection is created between the steel structure and the floors.
In the places where the compression slab does not have sufficient capacity, openings for dowels will be made in the hollow core slab.
In the places where it is not possible to make a compression slab (locally), steel tie elements will be used to obtain sufficient structural cohesion.
The diagonals and lattice girders which transfer the loads are characteristic of the building’s architecture. The detailing of the nodes (column-girder-diagonal) must be done within the framework as drawn by the architect.
The foundation floor is 300 mm thick and has been poured in situ. Underneath the columns of the north tower, the footings are 1,500 mm. There are also footings at the location of the 5 main columns of the south tower, with an average thickness of 2,500 mm. The piles for the foundation are round Fundex grout injection piles with the dimensions of 520/670 mm and round Tubex grout injection piles with the dimensions of 762/950 mm. The level of the base of the piles varies between 26 m –NAP and 31 m –NAP.

Use of Scia Engineer

The entire main bearing structure has been designed with the finite element program Scia Engineer.
The concrete walls and floors have been entered as 2D elements. The concrete beams and the steel structure have been designed with 1D bar elements. The foundation piles have been entered as springs.
With the calculation model, the entire force distribution of the main bearing structure has been analysed and the forces have been determined for the following engineering process.
The 3D model was also the basis of the calculations for the construction phase of the project.
The entrance facade was designed with a 3D Scia Engineer calculation model. This model helped analyse how this facade would behave with different load cases compared to the main bearing structure and how detailing should be adapted accordingly.

Software: Scia Engineer

Zonneveld Ingenieurs b.v.

Contact Harm Hoorn
Address Delftseplein 27
3013 AA Rotterdam, The Netherlands
Phone +31 10 452 88 88
Email info@zonneveld.com
Website www.zonneveld.com

Zonneveld ingenieurs b.v. was founded in 1981 as an office specialised in structural engineering. Over the past thirty years, the company has gained a lot of experience in a wide variety of projects. The management consists of five very experienced consulting engineers. All (approx. 30) employees are highly qualified and have extensive experience.
Nowadays, Zonneveld ingenieurs is a specialist in high-rise and inner-city redevelopment.
Zonneveld ingenieurs is a precursor in the field of sustainability and when it comes to using BIM.
A few of the most significant reference projects are:

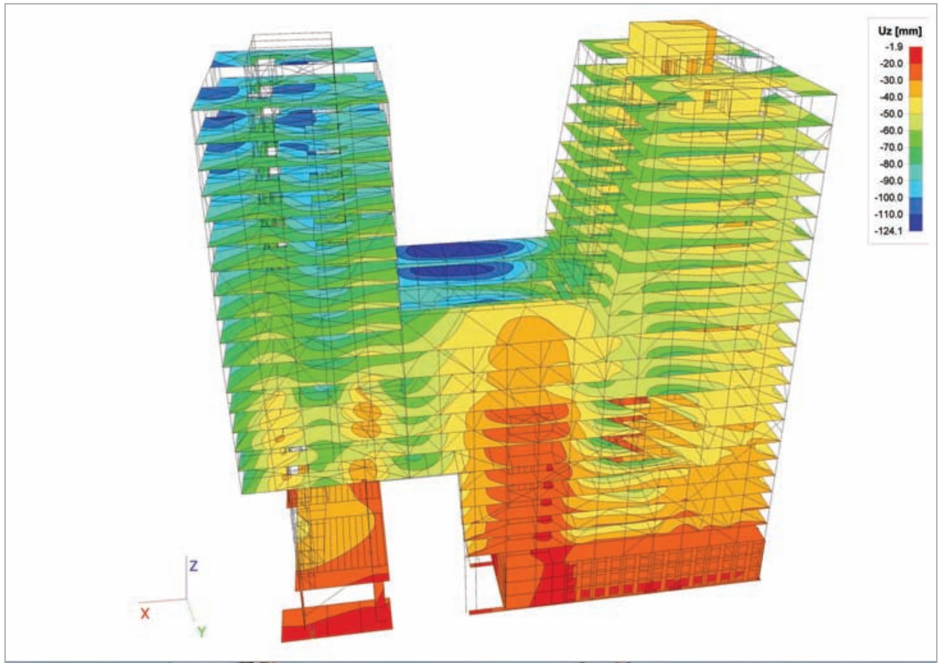
- Ministries of Justice and the Interior, The Hague
- City Hall, Utrecht
- PGGM Bulding, Zeist
- Music Palace, Utrecht
- City Hall, Nieuwegein

Project information

Owner	Municipality of Utrecht
Architect	Kraaijvanger bv, Rotterdam, Netherlands
General Contractor	Boele & Van Eesteren, Rijswijk, The Netherlands
Engineering Office	Zonneveld ingenieurs bv, Rotterdam, The Netherlands
Location	Utrecht, The Netherlands
Construction Period	09/2010 to 2014

Short description | City Hall

The new City Hall in Utrecht is currently under construction immediately next to and partly above the new Central Station terminal in Utrecht, the Netherlands.
The south tower of the building is supported by 5 main columns, which run through the bus terminal area on ground level and through the Central Station on raised ground level.
The north tower has a large void over 6 storeys' high, which borders a large curved glass facade on the south side.
The entire main bearing structure has been designed with the finite element program Scia Engineer. The Engineer model has been used to analyse the entire force distribution of the main bearing structure and determine the forces for the following engineering process. It was also the basis of the calculations for the construction phase of the project. The entrance facade was designed with a 3D Scia Engineer calculation model, to analyse its behaviour and adapt details accordingly.



Maastower - Rotterdam, The Netherlands

With the height of 165 m, the Maastower in Rotterdam, the Netherlands, is currently the tallest building in Benelux. The roof level is at +157.65 m.
The Maastower is situated IN the Maas river. A part of the river has been specially dammed up to make room for the tower.
The Maastower has two underground parking layers. On the ground floor and first floor levels there are the main entrance, the entrances to the parking garages, the distribution area, a grand café, meeting facilities and a restaurant. An access ramp runs through the restaurant and the main entrance hall to provide access to the 10-level parking garage for public use above first floor level.
The office area starts from level 12, and level 12 itself has an archive area and fitness area. The entire floor area of the Maastower is approximately 65,000 m².

Stability is provided by a facade tube, which is formed by the bearing prefab facade elements. This facade tube collaborates with the in situ core, which houses 4 elevators for low-rise (up to the 30th floor) and 3 elevators for high-rise (30th up to 44th floor).

The high foundation pressure compresses the compressible soil layers between NAP -35 m and NAP 50 m, which causes a dish-like settlement of approx. 140 mm underneath the building. The interaction between the structure of the building and deformation of the subsoil has been analysed and predicted meticulously.

It is important to investigate the dynamic behaviour for high-rise projects. The Maastower easily meets the demands as set in NEN6720. It is not sufficient, however, to just meet NEN6720. Zonneveld ingenieurs also analysed the twist vibrations and superposed these on the translation vibrations.
Subsequently, the predictions for the vibration comfort were calculated with the Eurocode and ISO4352.
Both methods of calculating showed that the dynamic behaviour is well within the set limits.
The predicted accelerations do not exceed 0.15 m/s2, which is sufficient for an office building.

Wind played an important role in the design of the canopy above the main entrance at the front of the building. An Scia Engineer model of the canopy was made in close cooperation with the architect. The final design of the canopy in steel and glass was also largely based on this Scia Engineer model.

The facade elements have been assembled in half-brick bond. This caused less complex connections and offers great advantages in the structural binding.
An alternative load path for a potential calamity could therefore fairly easily be shown.
The facade also transfers a large part of the vertical load. Combined with wind load and settlement of the subsoil, this leads to large internal pressure in the lowest building layers.
The thickness of the walls has been based on this internal pressure.

Use of Scia Engineer

The entire main bearing structure has been designed with the finite element program Scia Engineer.
The concrete walls and floors have been entered as 2D elements. The concrete beams and the steel structure have been designed with 1D bar elements. The foundation piles have been entered as springs.
With the calculation model, the entire force distribution of the main bearing structure has been analysed and the forces have been determined for the following engineering process. The reinforcement of the prefabricated elements was checked with the results of the Scia Engineer model.
The 3D model was also the basis of the calculations for the construction phase of the project. The 3D Scia Engineer model also analysed and calculated the influence of the settlement in the deeper soil layers (“laag van Kedichem”) on the forces in the main bearing structure.
For the canopy in steel and glass, a separate Scia Engineer model was made to analyse the influence of wind and accordingly adjust the final design/shape of the canopy.

Software: Scia Engineer

Zonneveld Ingenieurs b.v.

Contact	Harm Hoorn
Address	Delftseplein 27
	3013 AA Rotterdam, The Netherlands
Phone	+31 10 452 88 88
Email	info@zonneveld.com
Website	www.zonneveld.com

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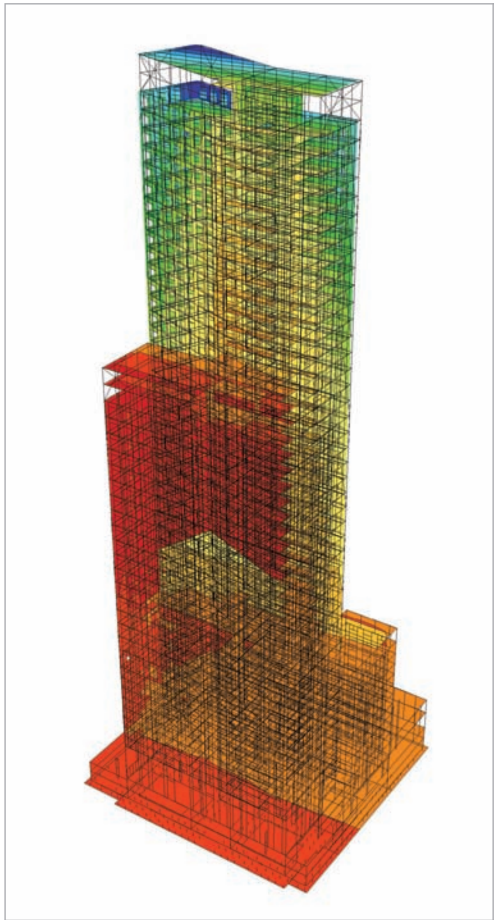
- Ministries of Justice and the Interior, The Hague
- City Hall, Utrecht
- PGGM Bulding, Zeist
- Music Palace, Utrecht
- City Hall, Nieuwegein

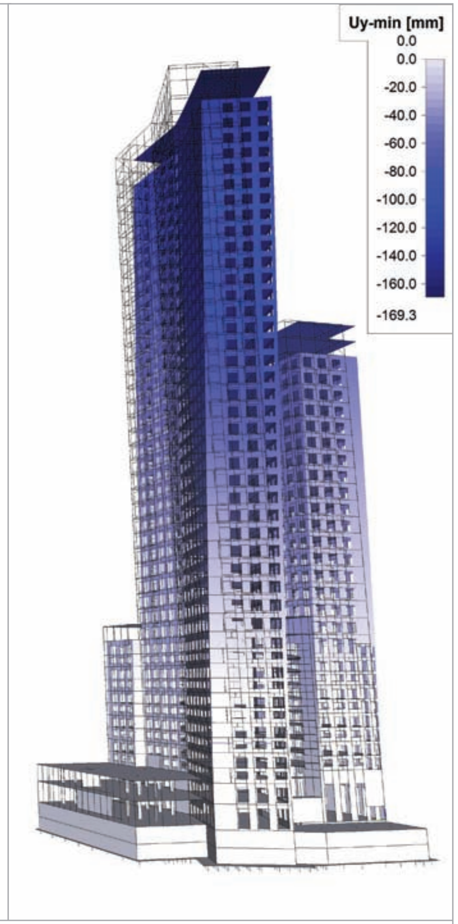
Project information

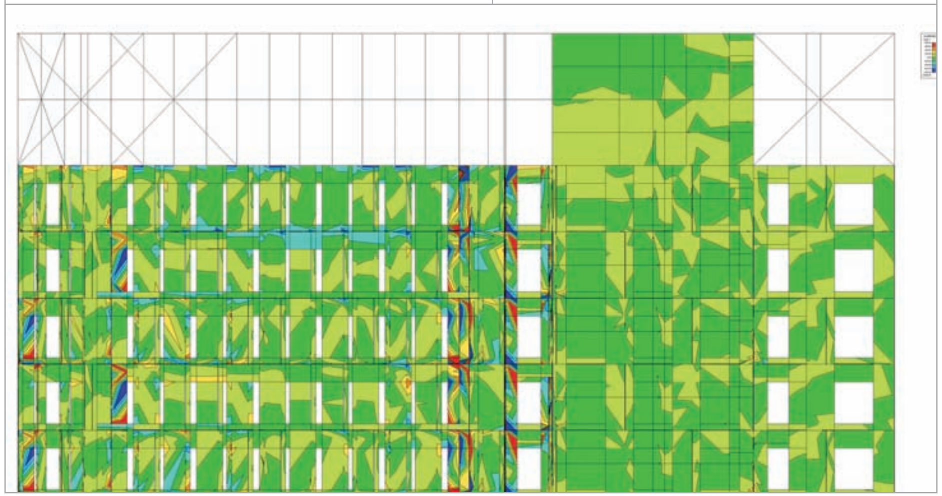
Owner	Skandinaviska Enskilda Banken (SEB)
Architect	Odile Decq Benoit Cornette, Paris - France with Dam & Partners Architecten, Amsterdam - The Netherlands
General Contractor	Besix Nederland Branch, Barendrecht - The Netherlands
Engineering Office	Zonneveld ingenieurs bv, Rotterdam - The Netherlands
Location	Rotterdam, The Netherlands
Construction Period	04/2007 to 12/2009

Short description | Maastower

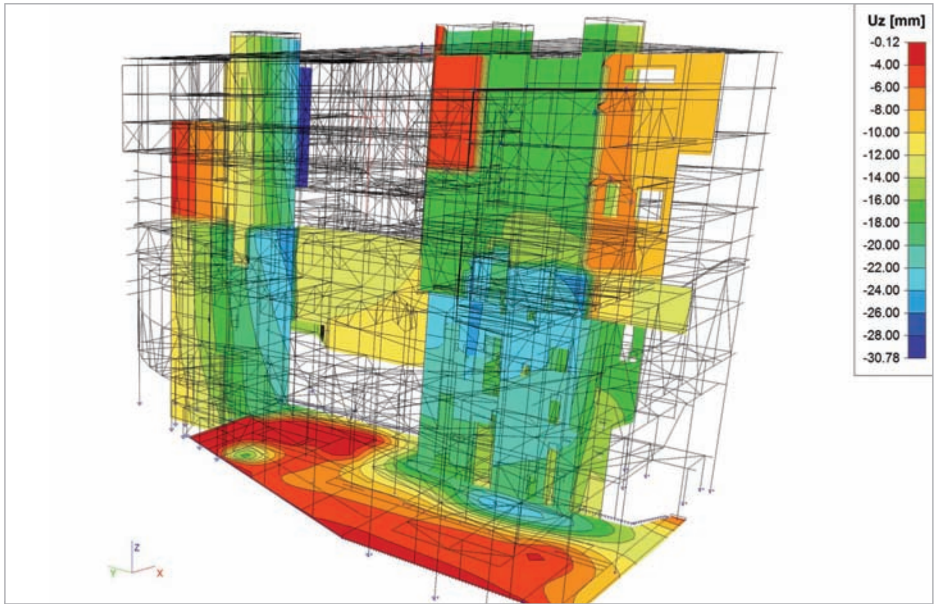
The Maastower (165 m) is currently the tallest building in the Netherlands. Part of the Maas river was 'reclaimed' to make room for the Maastower. One of the issues the construction had to deal with was settlement of the subsoil. The 3D Scia Engineer model was used to analyse and calculate the influence of the settlement in the deeper soil layers ("laag van Kedichem") on the forces in the main bearing structure.
Another special feature is the canopy over the main entrance. The Scia Engineer model helped shape and design the canopy.
Stability is provided by a facade tube, which is formed by the bearing prefab facade elements. This facade tube collaborates with the in situ core. The facade elements have been assembled in half-brick bond. This caused less complex connections and offers great advantages in the structural binding.

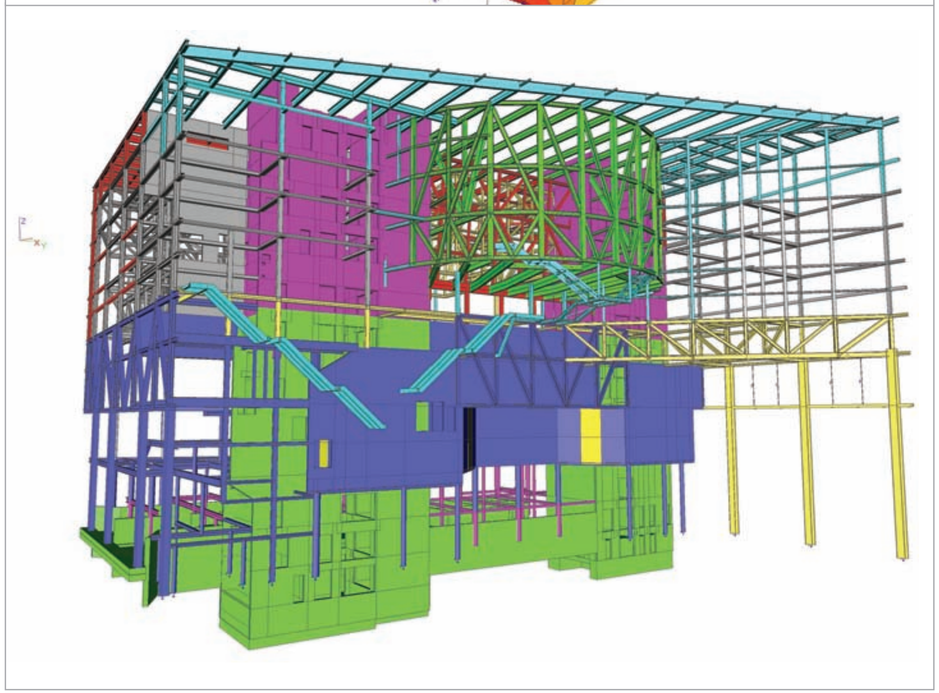






Music Palace - Utrecht, The Netherlands





The existing Vredenburgnusic music centre in Utrecht, the Netherlands, will be extended with 4 new music halls. The new music theatre will house different music biotopes, classical, jazz and pop music. The jazz and pop biotopes in other locations in Utrecht are outdated and no longer live up to the modern demands.

Above the new “Pop Hall”, the “Crossover Hall” and the “Jazz Hall” will be situated. The new (round) “Chamber Music Hall” will be built as a cantilever above the existing “Symphony Hall”.

Because of the large spans, the new halls will be built of steel. The steel structures will be supported by two connected concrete cores, which form the backbone of the building. The foyers, restaurants and plaza functions are situated between the halls as a public area.

Owing to the demands regarding noise, the halls will be made with a box-in-box structure. The Jazz Hall and the Crossover Hall are suspended on top of the building and span approx. 20 m from core to façade. Heavy columns have been integrated into the façade to support these halls. The span has been constructed with trusses, which are part of the outer box.

The Chamber Music Hall has been suspended from the concrete core as a cantilevering element, which places it above the existing Symphony Hall without coming into contact with it. Therefore, these two halls are completely separated and structure-borne sound cannot occur.

Since both concrete cores have halls which cantilever 16 m, horizontal deformations occur in the building. As a result of the cantilevers, the cores bend approx. 40 mm. This deformation has been calculated and the final outfitting will take this deformation into account.

A lot of attention has also been paid to the dynamic behaviour of the floors of the halls.

For the expedition zone on level -1, a 6.5 m-deep building pit has been made. The building pit was built from steel sheet piles and underwater concrete.

At the location of the cores, the high foundation pressure is absorbed by grout injection piles, fitted with a permanent steel tube with a large bearing capacity.

The chosen building method ensures that the ground water outside the building pit is not influenced, in order to meet all the demands set for the vicinity.

Use of Scia Engineer

The entire main bearing structure has been designed with the finite element program Scia Engineer.
The concrete walls and floors have been entered as 2D elements. The concrete beams and the steel structure have been designed with 1D bar elements. The foundation piles have been entered as springs.
With the calculation model, the entire force distribution of the main bearing structure has been analysed and the forces have been determined for the following engineering process.

The 3D model was also the basis of the calculations for the construction phase of the project.

Software: Scia Engineer

Zonneveld Ingenieurs b.v.

Contact Harm Hoorn
Address Delftseplein 27
3013 AA Rotterdam, The Netherlands
Phone +31 10 452 88 88
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Zonneveld ingenieurs is a precursor in the field of sustainability and when it comes to using BIM.
A few of the most significant reference projects are:

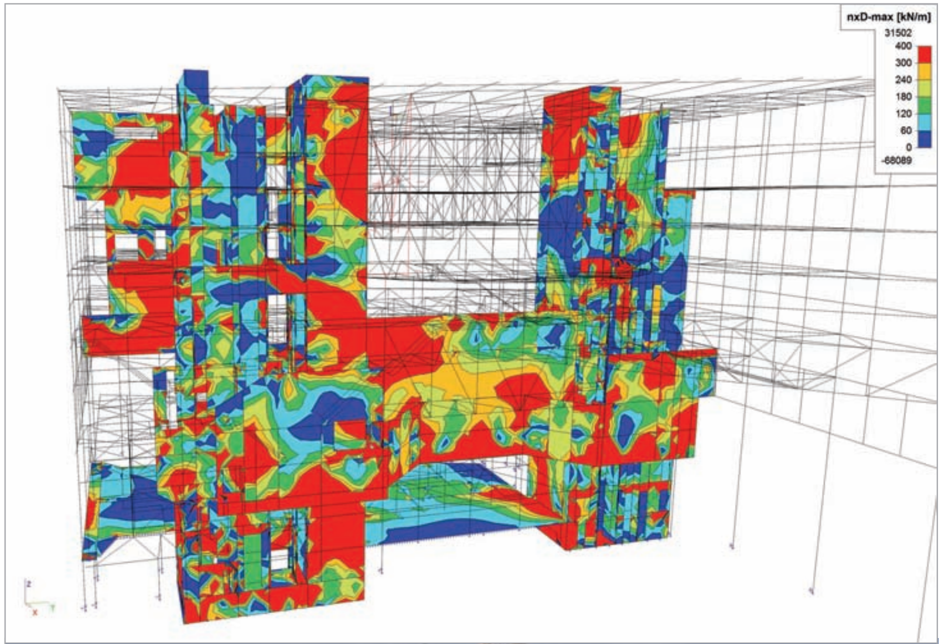
- Ministries of Justice and the Interior, The Hague
- City Hall, Utrecht
- PGGM Bulding, Zeist
- Music Palace, Utrecht
- City Hall, Nieuwegein

Project information

Owner	Municipality of Utrecht
Architect	Main architect: Architectuurstudio HH, Amsterdam, The Netherlands
General Contractor	Heijmans Bouw bv, Rosmalen, The Netherlands
Engineering Office	Zonneveld ingenieurs bv, Rotterdam, The Netherlands
Location	Utrecht, The Netherlands
Construction Period	03/2010 to 2014

Short description | Music Palace

The existing Vredenburg music centre will be extended with 4 new music halls, built of steel.
The steel structures will be supported by two connected cores, which form the backbone of the building. The foyers, restaurants and plaza functions are situated between the halls as a public area.
Because of the demands regarding noise, the halls will be made with a box-in-box structure.
The entire main bearing structure has been designed with the finite element program Scia Engineer.
With the calculation model, the entire force distribution of the main bearing structure has been analysed and the forces have been determined for the following engineering process.
The 3D model was also the basis of the calculations for the construction phase of the project.



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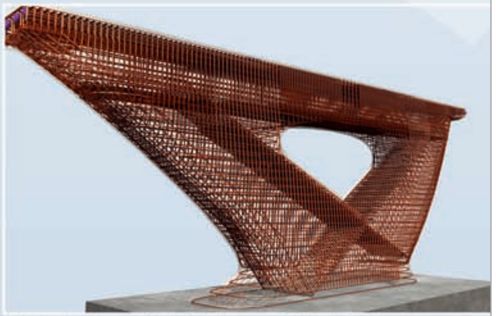

Fly-Over Haarlem, Iv-Infra bv, Nieuwegein, The Netherlands

Railway Bridge, Jürgen Wolf Construction, Berlin, Germany

Fly-Over Krensheide, Movares, Utrecht, The Netherlands

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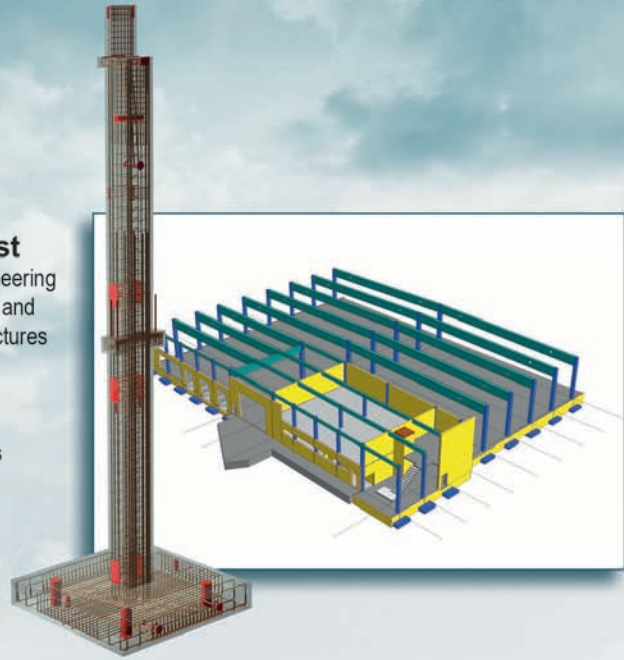

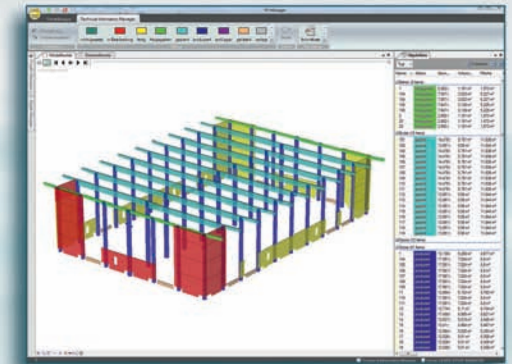

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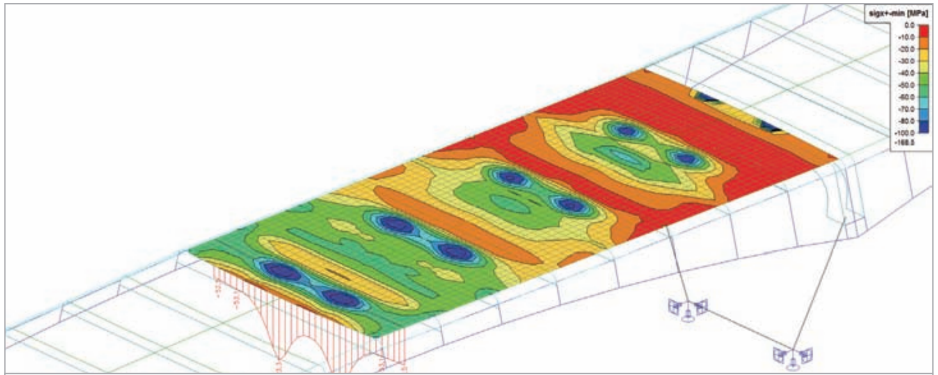
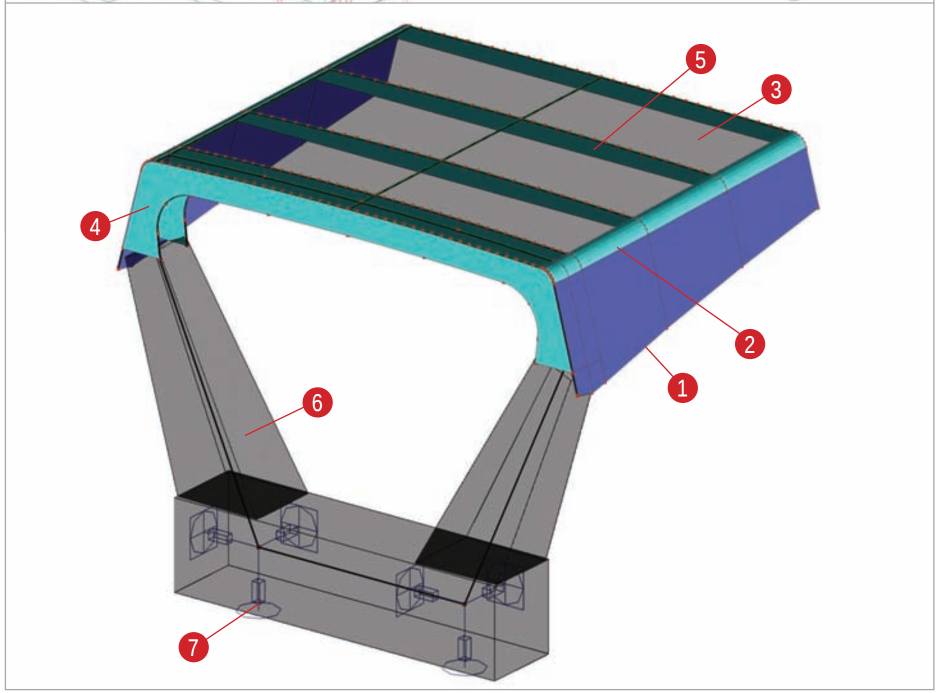
2

Winner Category 2: Civil Structures

Quote of the Jury: *“The jury nominated this project because of the combination of its original design and its functionality. The moveable part of the bridge is totally integrated in the deck and is barely visible in the closed state. The bridge fits well in its surroundings. The structural system consists of a single curved plate merging several functions together, and of concrete foundation piles without extra supports.”*





Programme
Architectural and stability study

Concept
The design for the Vluchthaven footbridge provides for an object that stands out for its graciousness and oneness. In a departure from classical engineering, our concept was to limit the hierarchy of the elements by merging several functions together into one whole. The Vluchthaven bridge is an example of integral design: the deck, cross members, main beam and the finishing are one. The bridge is conceived as a single curved and cutout plate.

Inspired by the elegant movement of a heron’s wing during flight, the plate is slightly torsed around its axis, representing the backbone of the bridge. As a result, the form of the bridge evolves: the cross-section at mid-span is concave while the opposite happens above the supports, with the cross-section convex. This way the necessary constructive height is achieved on supports. It gives the Vluchthaven bridge its wave shape, admittedly modest, but sufficient to provide a visual experience and rhythm.

The bridge’s light wave shape, referring to the light waves on the IJ lake, is structurally optimally used, and is continued in the design of the railing. This consists of a series of vertical elements following the wave. The absence of horizontal lines in the railing, additionally accentuates the shape of the bridge deck. This gives the entire bridge a calm and moderate rhythm. LED lights are embedded into the railing.

The mobile part of the bridge has been designed integrally with the bridge. While closed it is hardly visible.

Structural analysis
Scia Engineer has been used to create an analytical model of the entire bridge out of 3D plates. There are mainly seven different types of elements that can be distinguished in the model:
1. The side, as 3D plates
2. The curved corner plates, as 3D plates
3. The light curved plates for the deck, as 3D plates
4. The U-shaped stiffeners above the abutments, as 2D plates
5. The flat stiffeners under the deck, as 2D plates
6. The concrete support structures as beams
7. The supports with the stiffnesses of the present foundation piles

Through the use of the ‘import dxf/dwg’ function, the 3D contour lines of the geometry have been uploaded. While tracing the imported lines and nodes, the curved plates were generated in the model.

Making use of a custom XML-tool we modeled the 98 load cases for the traffic loads.

The specific form of the stiffeners above the abutments could be modeled with the use of the ‘cut-out’ function. Also the flat stiffeners follow the geometry determined by the wave of the deck plate above.

Because it is a mobile bridge, along with the closed situation three open versions have also been modeled to calculate the effects of the wind on the structure during the opening and closing.

With the ‘Productivity toolbox’ the entire plate geometry has been exported in table form into the calculation note along with all the results of the linear calculations. The ‘stability analysis’ was used to estimate the buckling behaviour near the support on the complete 3D model.

To investigate the vibratory behaviour of the bridge, the permanent part of the bridge was analysed with the use of the ‘Dynamics analysis’ function, using the full 3D model.

Software: Scia Engineer

Ney & Partners

Contact Oswald Verbergt
Address Terhulpsesteenweg 181
1170 Brussels, Belgium
Phone +32 2 6432180
Email ove@ney.be
Website www.ney.be

Ney & Partners is a structural engineering consultancy, established in Brussels. Since its creation in 1997, the office has worked with a pro-active view on the art of engineering through the integration of the different civil works disciplines.

This integration and optimisation of structural elements aims to overcome the classic hierarchic assembly of constructive solutions. Innovative bridges, roof structures and works of art developed by our office most clearly express this vision.

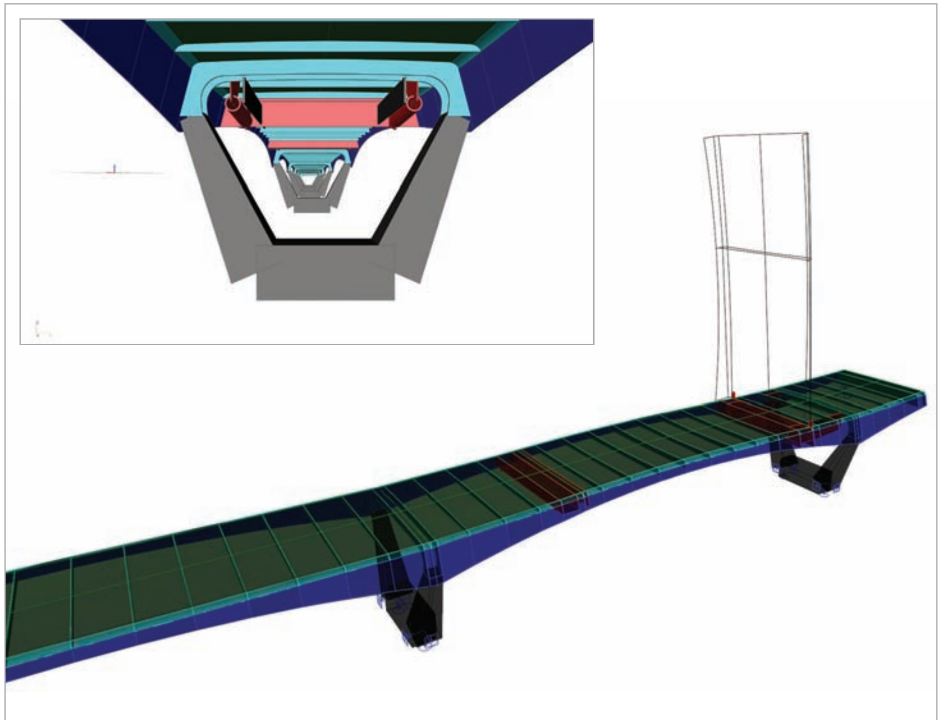
The construction project quality lies in the synthesis of specific design constraints. The structural aspect is of primary importance to this synthesis. From the very beginning of the design process, Ney & Partners conducts constant research for advanced engineering integration. In doing so, our position as an engineering consultancy goes beyond the standardised dimensioning of predefined technical solutions. Ney & Partners currently employs more than 45 civil engineers, architects and draughtsmen.

Project information

Owner	Gemeente Amsterdam
Architect	Ney & Partners
General Contractor	Vandermade bv
Engineering Office	Ney & Partners
Location	Amsterdam, The Netherlands
Construction Period	05/2012 to 10/2012

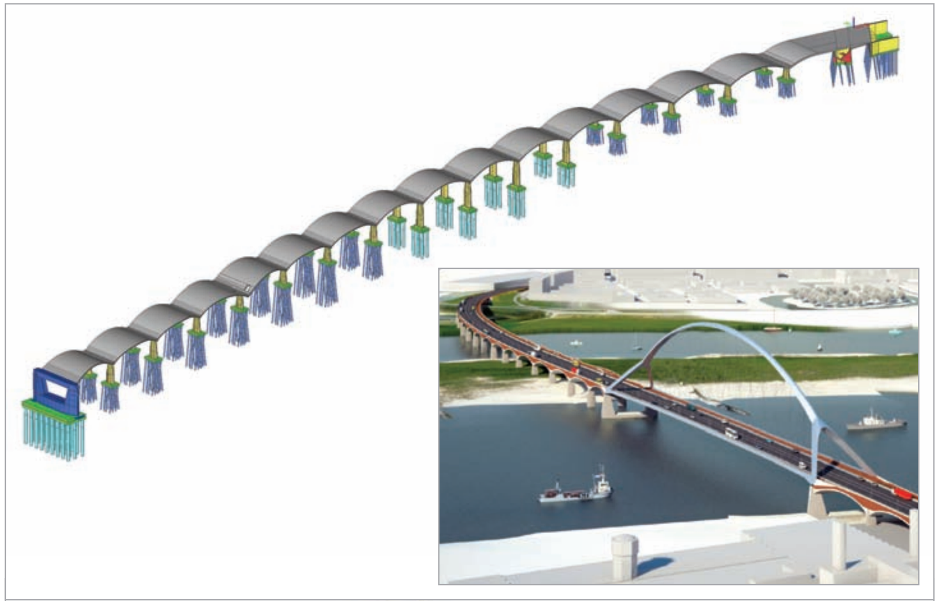
Short description | "Vluchthaven" Footbridge

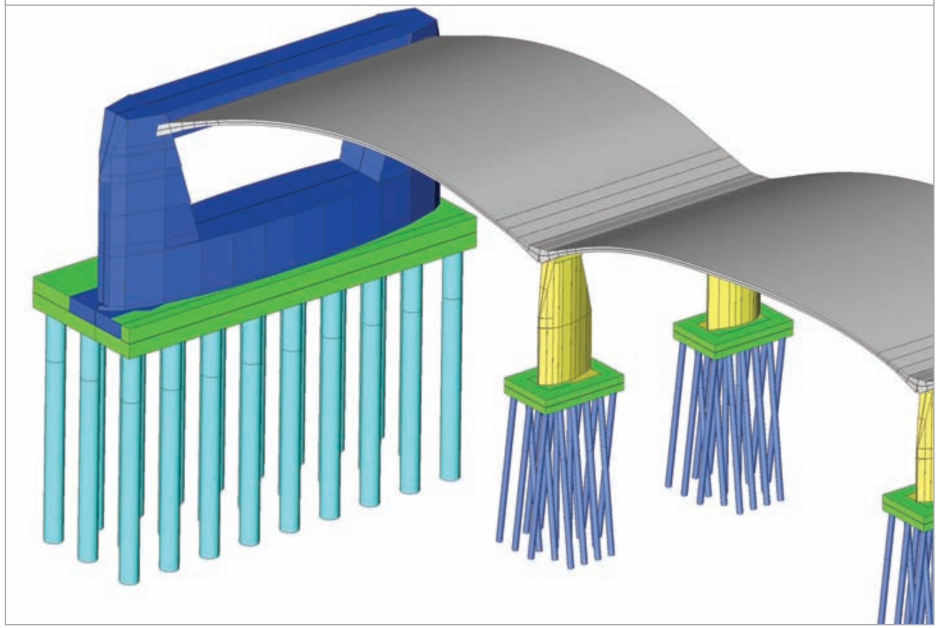
The moveable Vluchthaven footbridge connects the IJdock peninsula with the Westerdoksdijk, over a length of 105 m, while also providing access to the IJDock marina. The concept consists of a thick folded and shaped sheet of steel. The form of the deck is inspired by the elegant movement of a heron's wings during flight. This also gives the deck, with a width of 4 m, its needed stiffness. The deck shape allows for better water management in regard to a series of openings on both sides of the bridge. Those perforations make a subtle reference to the water present underneath the bridge and enforce the relation between the passer-by and the bridge. The perforations also allow for subtle lighting integrated in the railing of the bridge. At a height of 15 cm, LEDs are embedded in resin at the base of each of the +1,000 posts.



City Bridge - Nijmegen, The Netherlands

Nomination Category 2: Civil Structures





Introduction

The city of Nijmegen is building a new bridge across the river Waal to improve the accessibility to the city and traffic flow. The bridge will be built at the historical location known as “De Oversteek” (“The Crossing”), where American soldiers crossed the river to secure the existing Waal bridge during Operation Market Garden. The existing Waal bridge, dating from 1936, was at the time of completion the biggest arch bridge in Europe with a span of 244 m.

The contract to design, build and maintain the new bridge crossing the River Waal at Nijmegen was awarded to a consortium after a design competition in 2009.

The bridge has the total length of 1,400 m. The southern approach bridge on the Nijmegen side lies in a curvature with the radius of 500 m. The main span, with the length of 285 m, consists of a single tied arch structure and crosses the river Waal in a straight line, while the northern approach bridge is in a horizontal curvature of 2,000 m.

Design of the approach bridges

The approach bridges consist of a succession of concrete arches. The spans of these arches are 42.5 m. The thickness of the arches at the columns is just under 1.5 m and in the centre of the span 0.5 m. The void above the arches is filled with foam concrete to reduce the weight on the arches and covered with mixed aggregates and asphalt layers.

The total continuous length of the approach bridge at the north side equals 703 m, including the abutment at the Oosterhoutsedijk. The length at the south side equals 275 m. The concrete arches of the northern and southern approach bridges are rigidly connected to the bridge columns and have no expansion joints.

Modelling with Scia Engineer

The approach bridges were modelled in Scia Engineer using a 2D beam model for the preliminary and final design stages.

Geometrical non-linear calculations were carried out with the 2D beam model. With this model the buckling shapes of the arches were investigated and the second order moments were calculated.

To keep the bridge stable during the construction stages, a prestressed tensioning system of bars and beams, spanning between two arch crests, was set in place to take over the thrust force from the arch, which came into action as the falsework was removed. A second 2D beam model was set up to determine the force distribution during the various construction stages.

For the detailed design stage, a 3D model has been created consisting of shells, beams and plates. The horizontal curvature of the bridge, the changing angle to every support axis and the varying width of the in plane curved arches has been taken into account. Also, the complex shapes of the columns and river pier have been modelled. The piles with different lengths and horizontal and vertical spring stiffnesses for every axis were also modelled in the model.

The loads and load combinations according to the NEN-EN codes were applied. These loads included dead loads, creep and shrinkage loads, traffic loads, temperature loads, wind loads, support settlements, accidental loads and earthquake loads.

With the 3D model the internal force distribution was determined in order to design the required reinforcement. Moreover, the pile design has been carried out using the results of the 3D model.

Software: Scia Engineer

BAM Infraconsult bv

Contact: Tristan Wolvekamp M.Sc., ir. Mark Keijzers, ing. Kees Jan den Exter
Address: H.J.Nederhorststraat 1, 2801 SC Gouda, The Netherlands
Phone: +31 180590602
Email: t.wolvekamp@baminfraconsult.nl
Website: www.baminfraconsult.nl

BAM Infraconsult is the consultancy and engineering firm for the Civil Engineering section of the Royal BAM Group. The company manages the design relating to urban infrastructure, large-scale line infrastructure, ports and coastal engineering. It is involved in the tender, design, construction and management stages of projects, incorporating both design and other services, including risk management, systems engineering, environmental management and licence management.

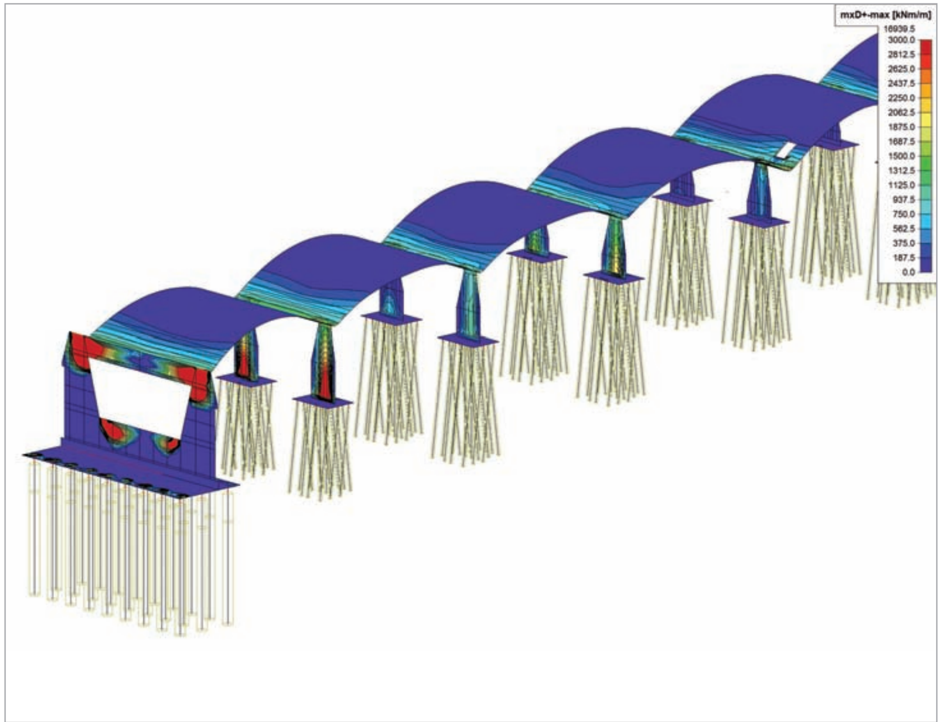
BAM Infraconsult has 267 employees and is headquartered in Gouda. BAM Infraconsult also has sites in Apeldoorn, Breda, The Hague, Utrecht, Jakarta and Singapore, along with support offices in Amsterdam, Ravenstein and Zuidbroek.

Project information

Owner	Gemeente Nijmegen
Architect	Ney Poulissen Architects and Engineers
General Contractor	BAM Civiel bv and Max Boegl
Engineering Office	BAM Infraconsult bv
Location	Nijmegen, The Netherlands
Construction Period	02/2011 to 11/2013

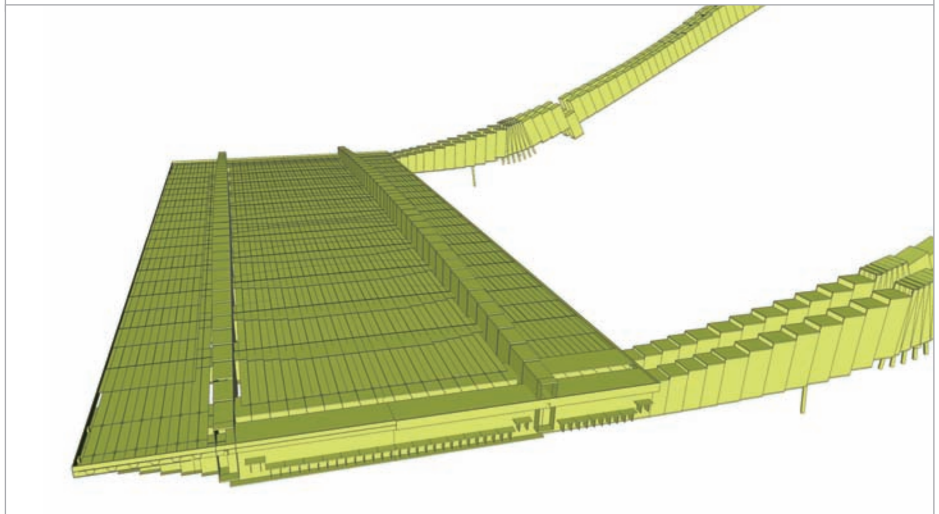
Short description | City Bridge

This project describes a new city by-pass in Nijmegen, which is currently under construction, including a new bridge over the river Waal. The city requested a City Bridge, which will allow for a five-lane crossing, a two-lane cycle path at the east side of the bridge and a 1 m-wide inspection lane at the west side of the bridge. In the architectural ambition document from the city, the client also requested a convenient adjournment on and under the bridge. The main bridge over the river had to span at least 240 m, had to fit perfectly within the landscape and join the bridge family of the city. Completion of the bridge is scheduled for the end of 2013.



“Scheepsdalebrug” Movable Road Bridge - Brugge, Belgium

Nomination Category 2: Civil Structures



Introduction

The movable road bridge at Brugge is built to cross over the Brugge-Oostende channel. The new bridge replaces an old movable metallic bridge of the “Vierendeel” type.

The bridge has the width of 19 m and is a rolling bascule bridge with a movable pivot point. The pivot point has a radius that rolls over the concrete understructure. The bridge is powered by two jacks and the rolling movement of the bridge occurs according to the longitudinal axis of the bridge.
The weight of the bridge (725 tonnes) is balanced by ballast that is positioned in two 15 m-high arms of the bridge. The span of the bridge is 40 m and the bridge has three traffic lanes with two separate lanes for pedestrians and cyclists.

The bridge deck is transported in one piece to the site together with the two arms. On the site the arms are welded to the bridge deck and the bridge is ballasted.

Description of technical questions to be resolved with Scia Engineer

Scia Engineer was used both for the dimensioning of the bridge in the traffic situation and the erection engineering of the bridge.

The complete 3D model was formed with bars, even the orthotropic deck plate, divided into longitudinal and cross girders with an equivalent stiffness and adopted mass. Correct modellisation of the mass was very important because of the balancing of the bridge.

From the engineering point of view this project has several challenges.

First, there were the different states of the bridge to be studied.
The possibility of creating different states of the bridge in one model was a big advantage in terms of calculation of the bridge. With the automatic steel code check (EC) of Scia Engineer it was possible to check all members in all states in one calculation model. This gave an important gain in calculation / optimisation of the structure in the different states.

Second, there was a second order calculation needed for the check of the arms based on a stability calculation.

Third, the use of graphical sections with different material properties so as to model the exact weight of the bridge into the different states of the bridge.

Fourth, the calculation of eigenvalues / frequencies of the bridge in order to check if there were risks of vibration under wind loads.

Fifth, for the erection engineering the different construction stages had to be examined to determine the right camber of the bridge so that the arms could be welded correctly to the bridge deck on site.

Description of how our experience with Scia Engineer proved its completeness

- Dimensioning a 3D structure in different states.
- The possibility of using and combining the results of Scia Engineer in a flexible way.
- The use of graphical sections with different section properties.
- Stability calculation and second order calculations.
- Calculation of eigenvalues.

This project proves the great diversity of Scia Engineer in checking the structure and the use of materials.

Modules used:
- Base
- 3D frame
- Steel code check (EC)
- Stability
- Dynamics

Software: Scia Engineer

Ingenieursbureau Stendess N.V.

Contact Jurn De Vleeschauwer
Address Grote Baan 18
9920 Lovendegem, Belgium
Phone +32 9 370 71 25
Email jurn.devleeschauwer@stendess.be
Website www.stendess.com

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Managing complex projects with care.
Recent references demonstrate the multidisciplinary knowledge and ability of our engineers and designers in the market of bridges, industry, utility and other projects located all over the world.

Project information

Owner	Waterwegen en Zeekanaal afd. Bovenschelde
Architect	Bureau Eggermont - Gent
General Contractor	THV Victor Buyck Steel Construction - Depret - Egemin
Engineering Office	Ingenieursbureau Stendess N.V.
Location	Brugge, Belgium
Construction Period	11/2009 to 05/2011

Short description | "Scheepsdalebrug" Movable Road Bridge

The movable road bridge at Brugge is built to cross over the Brugge-Oostende channel. The new bridge replaces an old movable metallic bridge of the "Vierendeel" type.

The bridge has the width of 19 m and is a rolling bascule bridge with a movable pivot point. The pivot point has a radius that rolls over the concrete understructure. The bridge is powered by two jacks and the rolling movement of the bridge occurs according to the longitudinal axis of the bridge.
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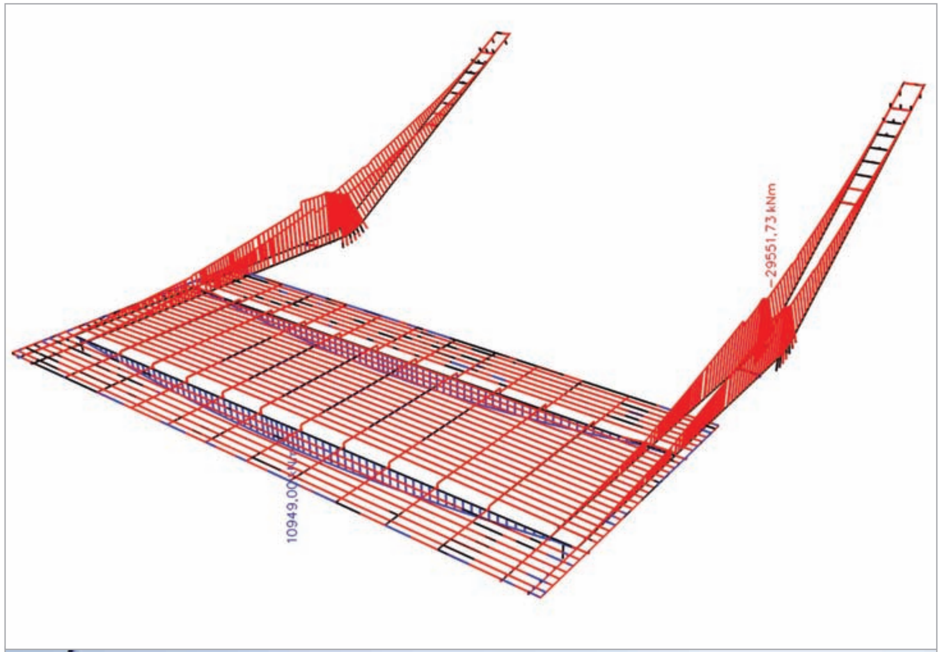
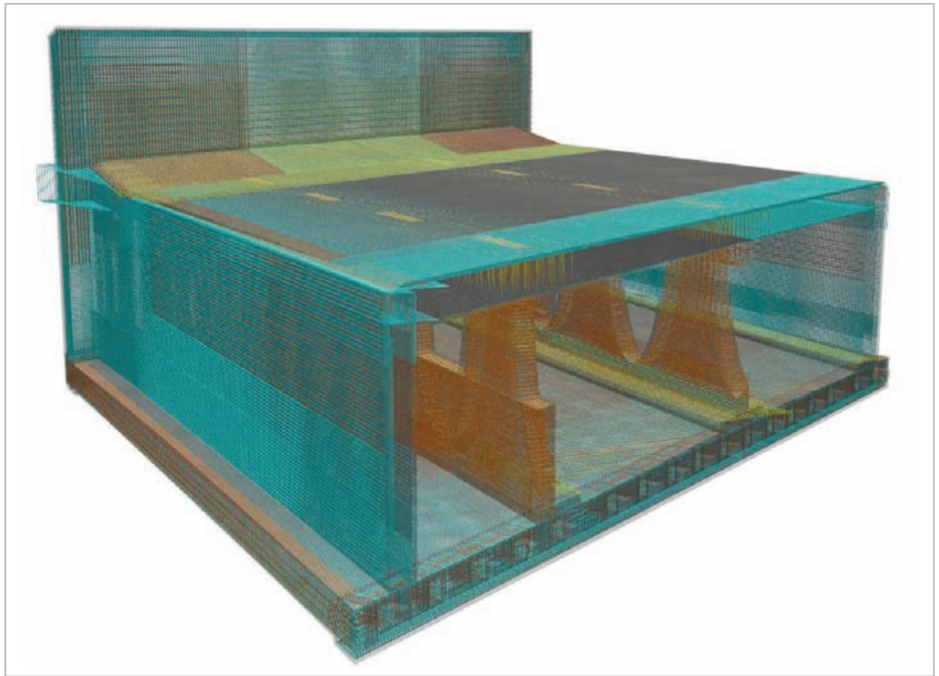
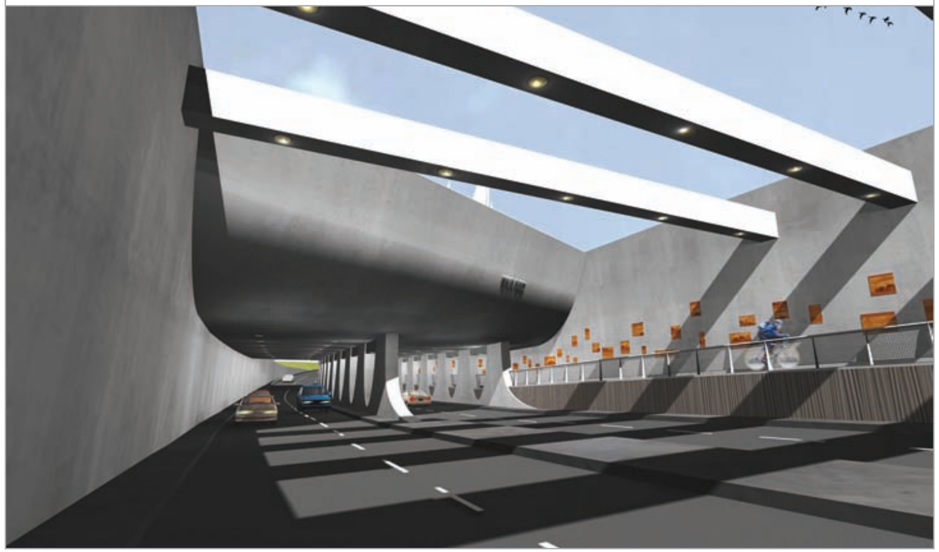


Aqueduct, Part of the “Westelijke Invalsweg” Project - Leeuwarden, The Netherlands

Nomination Category 2: Civil Structures





Detail engineering, Aqueduct Westelijke Invalsweg

Based on the architectural requirements, the front wall of the aqueduct at the East and West entrance should have a rounded shape with the radius of 5 m. There were two different structural options available.
The first option was a complex round shape with in-situ concrete. This option would lead to very large dimensions and complex formwork.
The second option was a simpler rectangular aqueduct with prefab concrete shell parts. The extra space on the surface level can be used for the service path.
The second option was chosen since from the design point of view it was less complex and easier to construct.
For the dividing walls beneath the aqueduct, the architect had the design requirement that 60% of the area be “gaps”. So the choice was made to make the dividing walls upside down ellipsoid shapes. This was meant to evoke the image of Roman-era aqueducts.

Pergola construction

The horizontal struts near the East Entrance should be made in concrete and create a lamella roof impression according to the architectural requirements.
With the presence of the permanent struts in the deepest part of the access ramp, the choice for a pergola construction was obvious.
The struts are made from pre-cast pre-tensioned girders with the dimensions of 800 mm width and 1,350 mm height.
Centre-to-centre: 5,000 mm.
Because of the regularity of the supports, a slim deck slab with the thickness of 400 mm could be made.

Ingenious poldering

The West Entrance should be made with an open green character. In the preliminary design an artificial polder containing a geomembrane was foreseen.
After the soil and geotechnical research had been carried out, a strong water-resistant loam layer was identified at the West Entrance. Based on this layer, the design was optimised.

The project in Allplan Engineering

We started from scratch with three MX-axes.
One for the cycle path and one for each carriageway.
With the design constraints in mind, the model was generated using the Bridge and Tunnel Modeler.

After its completion, the model was checked thoroughly by examining the design constraints one by one.

When the main model was finished, the aqueduct casing, water cellar and the horizontal struts were modelled separately.

We chose a separate design option because the last 3 parts of the model where not curved design-wise. For the main tunnel the segmentation was 2.5 m. This was chosen as it was the segmentation by which the building tolerance was within prescribed measures.

When the model was ready, dimension drawings were made. For this the model had to be divided into separate tunnel sections, each section as a separate dimension drawing.
After completing the calculation, the rebar modelling could start.
All rebar was modelled in 3D.

Summary

- Total sections: 19
- Length of concrete sections 2-20: approx. 390 m
- Length of polder section, west side: approx. 195 m
- Closed part: approx. 55 m (sections 6-7)
- Internal height, closed sections: 5.3 m
- Internal width: 22.6 m
- Number of drawings: approx. 120

Software: Allplan Engineering

Witteveen+Bos

Contact Tim Neurink
Address Leeuwenbrug 27
Postbus 233
7400 AE Deventer, The Netherlands
Phone +31 570-697151
Email t.neurink@witteveenbos.nl
Website www.witteveenbos.nl

Witteveen+Bos offers its clients value-added consultancy and top-quality designs for water, infrastructure, spatial development, environmental and construction projects. We deliver reliable solutions based on the knowledge, experience, social insight and intellect of our employees. At Witteveen+Bos we maintain an inspiring working environment from where we tackle the fascinating challenges that the future holds. Professionalism, respect and integrity are our core values.
A multidisciplinary project approach characterises our way of working.

Infrastructure

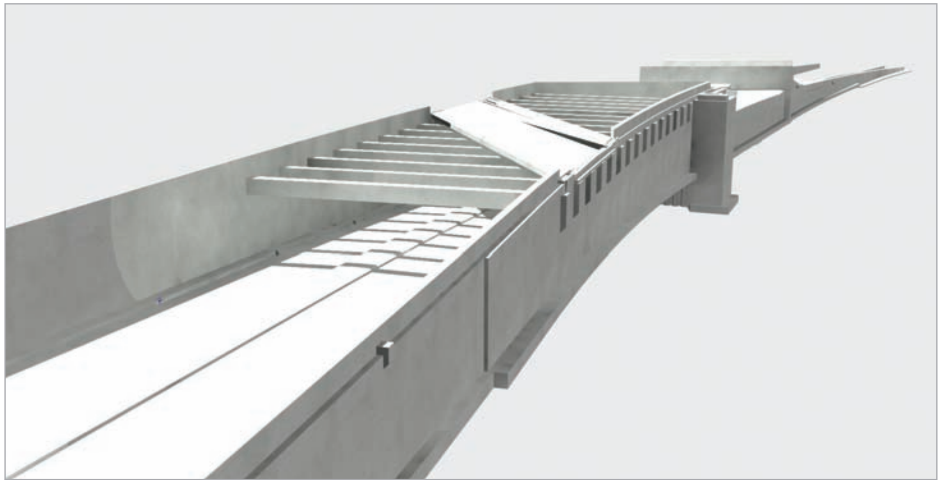
Over the years, road, rail and hydraulic engineering have created national and international infrastructures characterised by their large scale on the one hand and their sophistication on the other. Witteveen+Bos has contributed to this development at numerous levels.

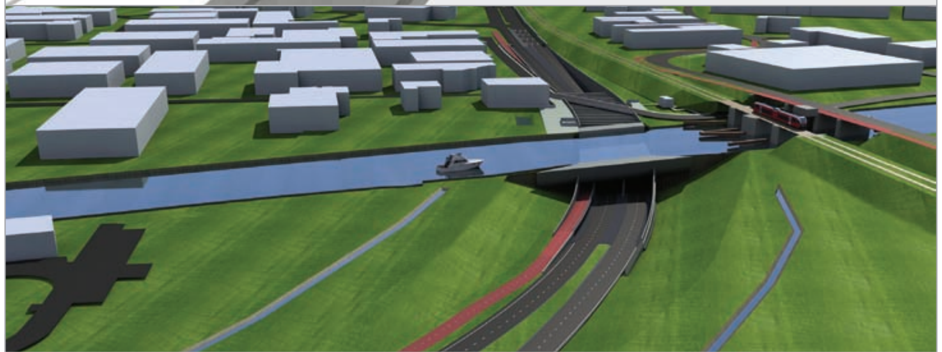
Project information

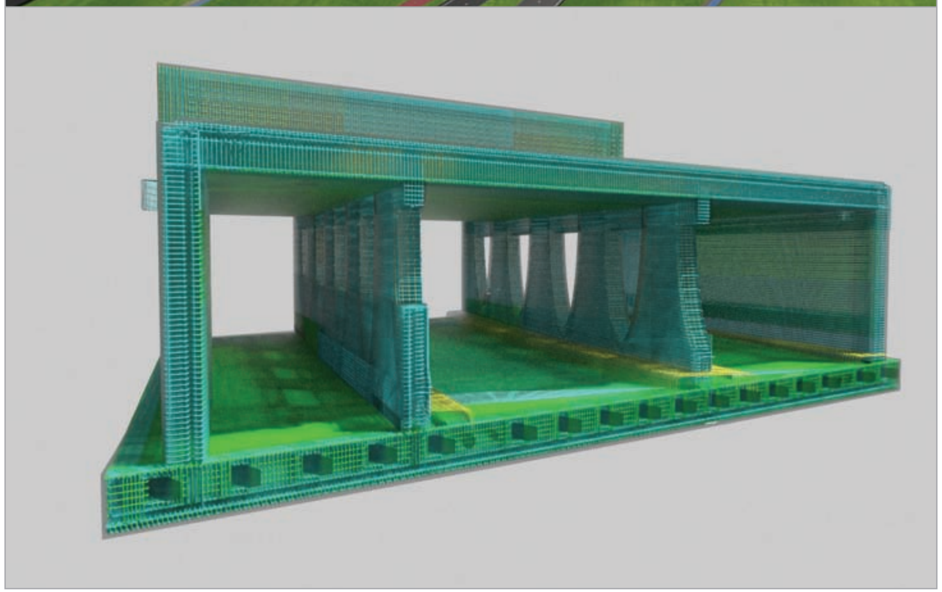
Owner	Provincie Friesland
Architect	Penta Architecten
General Contractor	Ballast Nedam
Engineering Office	Witteveen+Bos & Grontmij
Location	Leeuwarden, The Netherlands
Construction Period	03/2012 to 05/2013

Short description | Aqueduct, Part of the “Westelijke Invalsweg” Project

The Westelijke invalsweg has 2 x 2 lanes between the highway (A31, “Haak om Leeuwarden”) and the city of Leeuwarden. At the Westelijke Invalsweg junction with the “van Harinxmakanaal” an aqueduct is foreseen with a lower level road over about 600 metres.
There are structural challenges and also design requirements. Because of the overall scale of the project, design requirements (also known as “beeldambitie document”) were set up.
Within this document, the requirements for the architecture and finishing of the aqueduct are determined, such as the surface and look of the walls, the appearance of the horizontal struts in the East Entrance, and also the requirements concerning the “Green Entrance” at the west side.

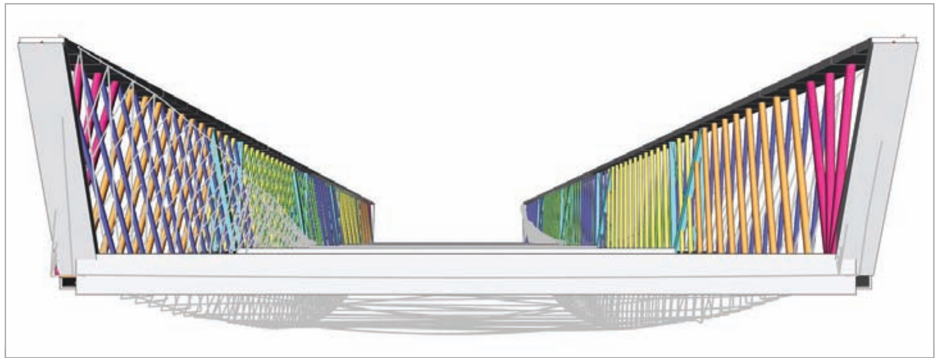


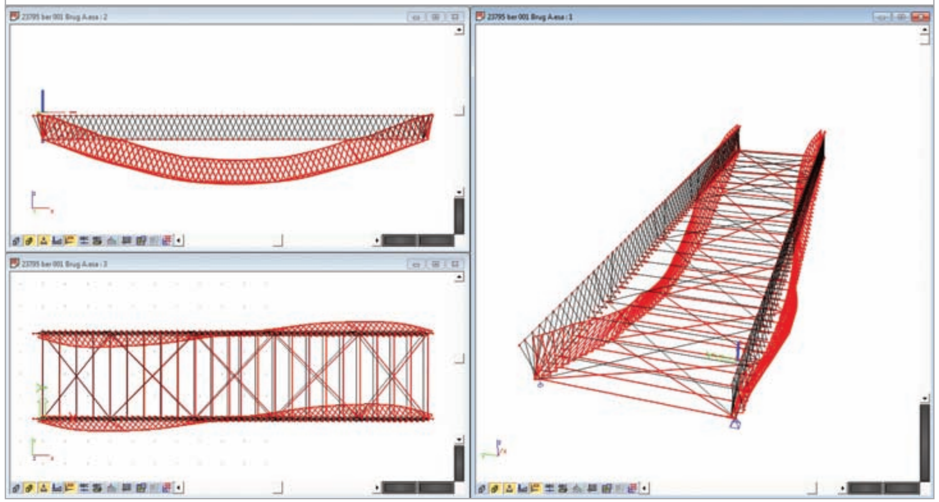




Vakwerkbruggen Park Randenbroek - Amersfoort, Nederland

Nomination Category 2: Civil Structures





Inleiding

In het park Randenbroek te Amersfoort worden momenteel drie vakwerkbruggen gebouwd. Deze fiets-/ voetgangersbruggen zijn ontworpen door ipv-Delft, ingenieursbureau voor productvormgeving B.V. De opdrachtgever van het werk is de Gemeente Amersfoort.

Om het brugdek slank te houden is gekozen voor het principe van de vakwerkbrug. Het betreft echter geen standaard. Deze vakwerken bestaan uit een boven- en onderregel met daartussen een groot aantal ronde staven met geringe diameter. Het vakwerk is volledig geoptimaliseerd naar staafkracht en diameter. Om het geheel stijf te maken zijn op 4 posities forsere V-steunen toegevoegd. De stalen bovenbouw is gefundeerd op betonnen landhoofden en palen.

Geometrie

De grootste brug heeft een overspanning van 17 m en is 4 m breed. De onderregel van het vakwerk is een koker met een dikte van 0,2 m. Dit is tevens de dikte van het brugdek. De brug wordt gedragen door twee vakwerken die tevens dienst doen als hekwerk.

De bovenregel bestaat uit een massieve rechthoekige doorsnede van 200 x 40 mm. Per vakwerk worden twee rijen diagonaalstaven toegepast welke uitwaaieren naar onder toe. Deze twee rijen lopen in twee verschillende richtingen. Hierdoor ontstaan trek- en drukstaven. De twee rijen staven zijn identiek en gespiegeld aan elkaar. Per rij slaat de kracht in het midden van het dek om van trek naar druk en andersom.

Afhankelijk van de optredende drukkrachten neemt de diameter toe. Nabij de oplegging treden in de diagonaalstaven de grootste trek- en drukkrachten op. Dit heeft geleid tot een maximale staafdiameter van rond 45 voor de drukstaaf en rond 25 voor de trekstaaf. De kleinste staafafmeting bedraagt 20 mm en wordt toegepast voor de trekstaven in het midden van het dek. Overige staafafmetingen die zijn toegepast zijn r40, r35.

De bovenregel van een vakwerk wordt verend gesteund door de vele staven. De constructie bleek echter teveel te vervormen ten gevolge van de belasting. Om deze reden is het vakwerk op vier posities verstevigd. Hiervoor zijn 4 V-steunen toegevoegd. Deze bestaan ieder uit 4 vierkante massieve staven vk 45 mm.

Uitdaging in de berekening

Wij hebben Scia Engineer gebruikt om een compleet 3D-model van de brug te maken. Hierdoor kregen wij direct inzicht in de optredende krachten en vervormingen. De grootste uitdaging lag in het optimaliseren van de vakwerken. De wens vanuit de ontwerper was uiteraard het behalen van een zo groot mogelijke slankheid. Met Scia Engineer kun je in het model snel en efficiënt de staven aanpassen. De staven zijn vervolgens apart gecontroleerd.

De stabiliteit van de bovenregel is eveneens met behulp van Scia Engineer inzichtelijk gemaakt. Doordat er twee rijen staven verbonden zijn aan de bovenregel met afwisselend trek- en drukkrachten, is er sprake van een 1e orde horizontale vervorming van de bovenregel. Van bovenaf gezien geeft dit een sinus die halverwege de overspanning zijn nulpunt heeft. Vervolgens is de brug ook met een 2e orde berekening beschouwd. De gedragingen van een dergelijke constructie kunnen alleen inzichtelijk worden gemaakt met een 3D-model.

Software: Scia Engineer

Adams Bouwadviesbureau

Contact Rob Arts
Address Van Heemstraweg123f
6651 KH Druten, The Netherlands
Phone +31 487 588 280
Email rar@adamsbouwadvies.nl
Website www.adamsbouwadviesbureau.nl

adams
bouwadviesbureau

Adams Bouwadviesbureau is een raadgevend ingenieursbureau op het gebied van bouwkunde, draagconstructies en civiele bouwwerken, gebaseerd op heldere ontwerpkeuzes en duidelijke afspraken. Veiligheid, innovatie en kwaliteit staan hoog in het vaandel. Onze uitgebreide ervaring ligt op het terrein van woning- en utiliteitsbouw en bruggen, zowel individuele projecten als grootschalige stadsvernieuwing. Sinds de oprichting is het bureau uitgegroeid tot een bedrijf van 15 medewerkers met de flexibiliteit van een klein bedrijf en het kennisniveau van een grote organisatie.

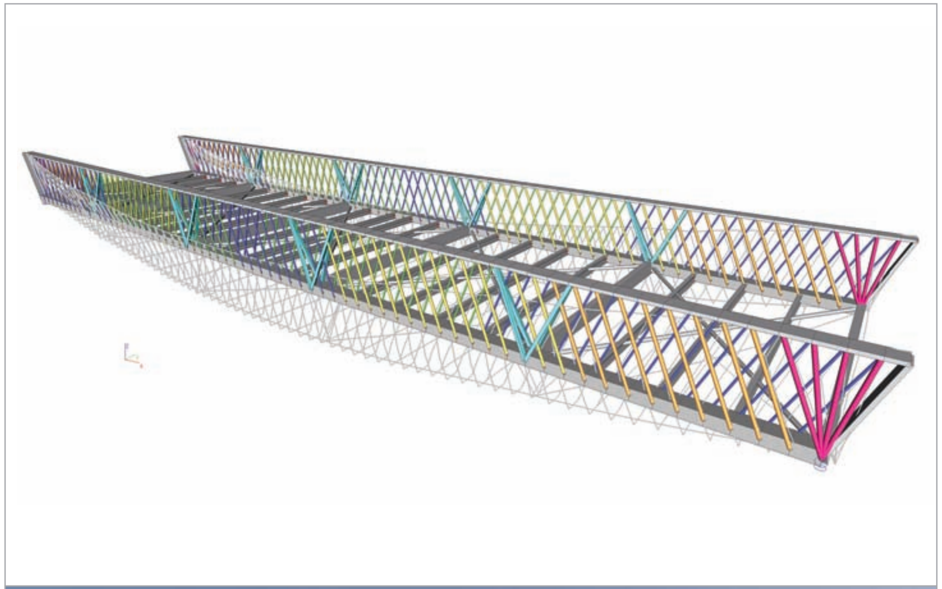
Integrale projecten waarin bouwkunde, constructie en installatie worden gecombineerd, worden uitgewerkt in 3D door middel van Allplan. Het rekenwerk wordt ondersteund door software van Scia en zelf ontwikkelde rekenprogramma's.

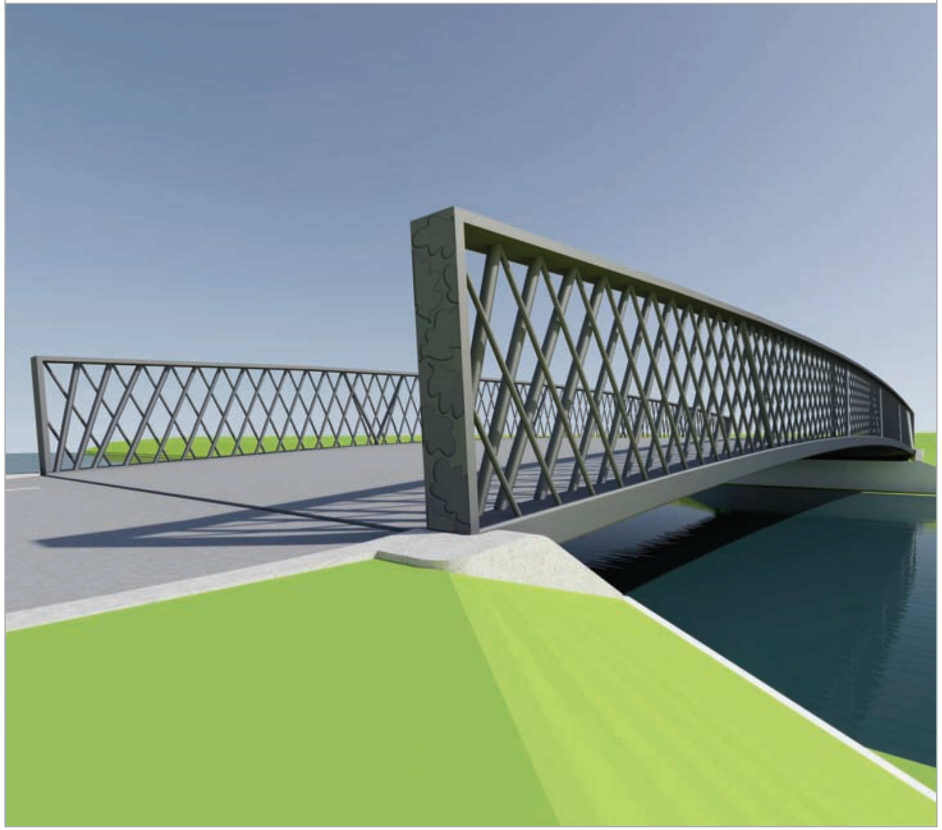
Project information

Owner	Gemeente Amersfoort
Architect	ipv-Delft
General Contractor	Wallaard Noordeloos bv
Engineering Office	Adams Bouwadviesbureau bv
Location	Amersfoort, The Netherlands
Construction Period	03/2013 to 09/2103

Short description | Steel Truss Bridges "Park Randenbroek"

The City of Amersfoort is currently implementing three footbridges in the Randenbroek park. The park will be a meeting place where all the people of Amersfoort can pursue numerous activities. These steel truss bridges have a very high number of bars. For this reason, a 3D model was needed to analyse the construction. Scia Engineer was used for the calculation and dimensioning of the steelwork.





Tuikabelbrug over de Ringvaart - Gent, België

Beschrijving van de constructie

De Pyloon heeft de vorm van een driehoek zonder onderlinge koppeling tussen beide benen van de pyloon. De pyloon wordt aan de onderzijde met bolscharnieren aangezet op de funderingszool.
De bovenbouw voor het wegverkeer wordt uitgevoerd in beton (betonnen hoofdliggers ca 130 m waarvan de eerste 68 m centrisch voorgespannen wordt met nagerekt staal, betonnen dwarsdragers elke 3 m en betonnen brugdekplaat met breedte 8 m). De betonnen hoofdliggers steken deels boven de rijweg uit.
Fietspaden en dienstpaden worden uitgevoerd als een staalstructuur. Deze paden bestaan uit roostervloerelementen die opgelegd worden op stalen consoles. Deze consoles worden verankerd in de betonnen hoofdliggers.
De bovenbouw wordt aan de stadzijde (zijde werfzone) verankerd en ingeklemd in een ankermassief.
De bovenbouw wordt aan de zijde van het sintelstort op een landhoofd opgelegd op een glijdende oplegging.
De bovenbouw wordt volledig opgehangen aan de pyloon. In definitieve toestand is er geen enkele vaste verbinding tussen de bovenbouw van de brug en de pyloon

Bouwfasering

Het brugdek wordt gebouwd op een tijdelijke werfzone welke zich bevindt in het verlengde van de brug achter het ankermassief. Dit houdt in het betonneren van de hoofdliggers, dwarsdragers en brugdekplaat, het voorspannen van de hoofdliggers en het uitvoeren van het tussenblok aan het uiteinde van de brug welke als tegengewicht dienst doet.
De pyloon wordt in het atelier samengelast en over het water, via de Ringvaart, getransporteerd naar de werfzone. Deze wordt recht gezet en op een tijdelijke fundering geplaatst. De pyloon krijgt dan een tijdelijke schoring aan de achterzijde via een systeem van buisprofielen.
Eens het beton voldoende verhard is (en de eerste 68 m voorgespannen is), worden de tuikabels 3 tot en met 13 gemonteerd en op spanning gebracht om de structuur van de bekisting op te tillen. In de transportconfiguratie is de brug enkel nog verticaal ondersteund onder de hoofdligger op 12 m van het uiteinde zijde sintelstort en op 4 tijdelijke consoles aan de pyloonbenen (twee per been), vlak onder het brugdek bevestigt. Beide pyloonbenen worden verbonden via een tijdelijke trekker, welke gemonteerd is tussen de consoles.
In tussentijd worden de funderingen gemonteerd en wordt het landhoofd zuid opgetrokken. Het landhoofd noord (zijde werfzone) kan pas gebouwd worden nadat de brug verplaatst is over de ringvaart naar zijn definitieve positie.
Voor het verplaatsen van de brugstructuur worden de voorste steunen op een rijdend platform geplaatst en worden de consoles aan de pyloon voorzien van glijschoenen welke in rails kunnen schuiven.

De stabiliteit van de constructie tijdens de bouwfasering wordt verzekerd met een langse en dwarse blokkering van de langsliggers via twee tijdelijke nokken, gemonteerd juist voor de pyloonbenen. Bij een achterwaartse en/of dwarse beweging van het brugdek maken de nokken contact met de pyloonbenen.
Voor het transport over de ringvaart worden pontons voorzien waarop de transportplatforms zullen gereden worden om vervolgens overgevaren te worden.
Na het transport van de brug naar zijn definitieve positie wordt de pyloon afgezet op zijn funderingszool.
Hierna kan de bouw van het ankermassief beginnen. In tussentijd wordt het brugdek horizontaal vastgehouden aan het landhoofd sintelstort, via tijdelijke trekankers.
Hierna kan de brug worden afgewerkt. Dit houdt in: het spanningsloos maken van alle tijdelijke verbindingen om deze vervolgens te verwijderen.
Het afwerken van het brugdek, nl. het aanbrengen van een waterdichte rok op de brugdekplaat en het aanbrengen van de afwerkingslagen van het wegdek.
Montage van tuikabels 1 en 2 en definitieve tuiregeling.
Het momentvast verbinden van de brugconstructie met het ankermassief waarna de brug klaar is voor ingebruikname.

Software: Scia Engineer

ARCADIS Belgium NV

Contact	Bart Van Zegbroeck
Address	Koningsstraat 80 1000 Brussel, Belgium
Phone	+32 2 505 75 00
Email	b.vanzegbroeck@arcadisbelgium.be
Website	www.arcadisbelgium.be

ARCADIS

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ARCADIS is een internationale onderneming die advies-, ontwerp-, ingenieurs- en managementdiensten levert in de vakdomeinen infrastructuur, water, milieu en gebouwen. Door de jaren heen hebben we ons ingezet om onze kernwaarden te handhaven en onszelf de moeilijke vraag gesteld wie we willen zijn als vertrouwensadviseur, werkgever en maatschappelijk verantwoordelijke onderneming.

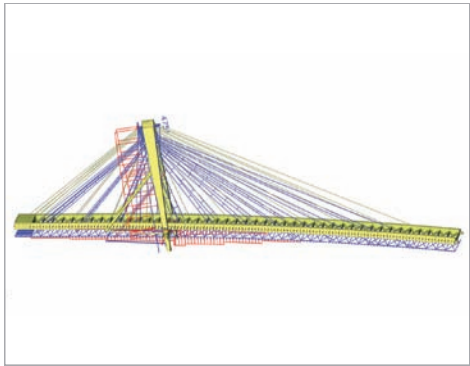
Met 778 medewerkers (FTE) en een omzet van EUR 80 miljoen, is ARCADIS in België uitgegroeid tot referentiebureau in zijn vakgebied.
Wereldwijd telt ARCADIS ruim 21.000 medewerkers, goed voor een omzet van EUR 2,4 miljard. De onderneming heeft een uitgebreid internationaal netwerk dat steunt op sterke lokale marktposities.

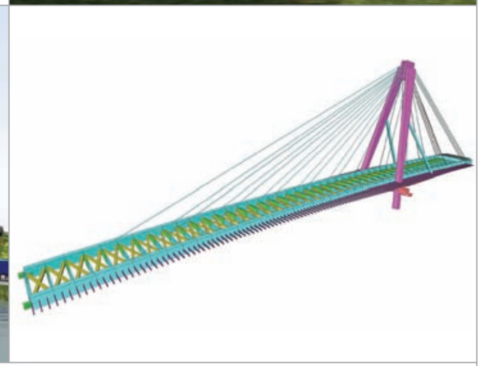
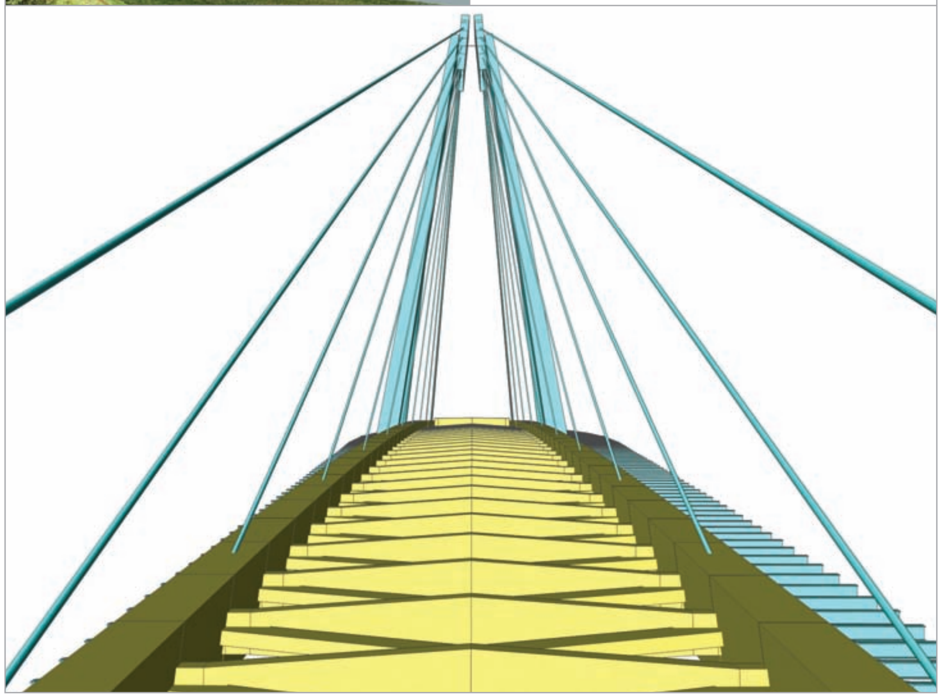
Project information

Owner	Agentschap wegen en verkeer - AWV
Architect	Zwart en Jansma Architecten
General Contractor	THV R4, gebouwd door de THV KW, zijnde Besix en Antwerpse Bouwwerken
Engineering Office	ARCADIS België
Location	Gent, Belgium
Construction Period	09/2012 to 06/2013

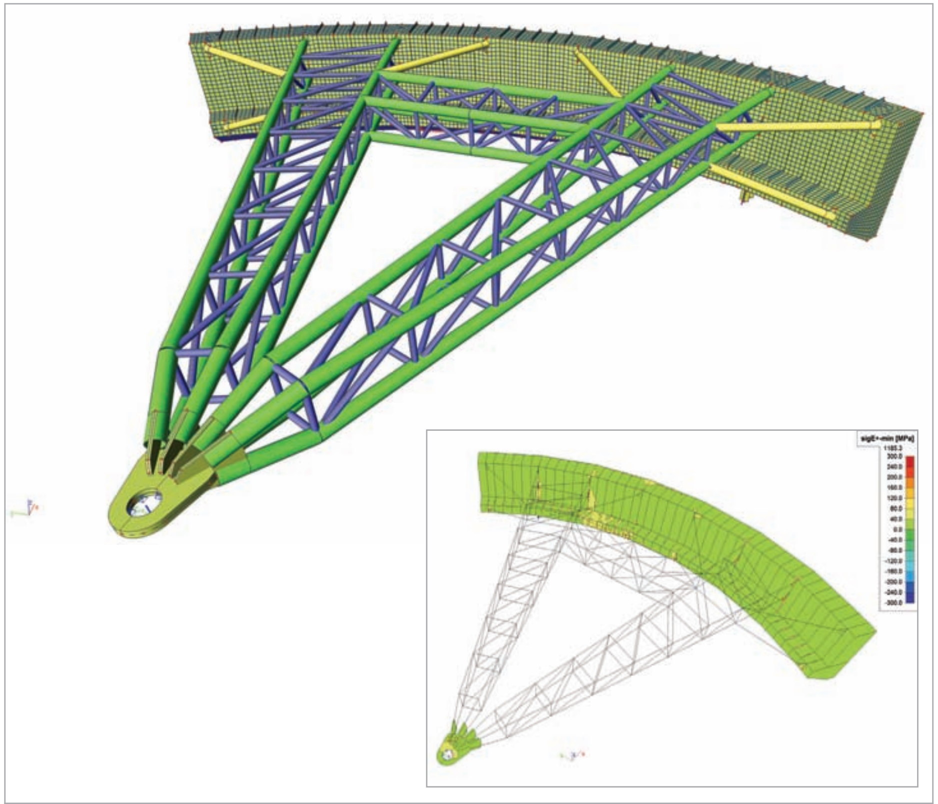
Short description | Cable-Stayed Bridge over the Canal in Gent

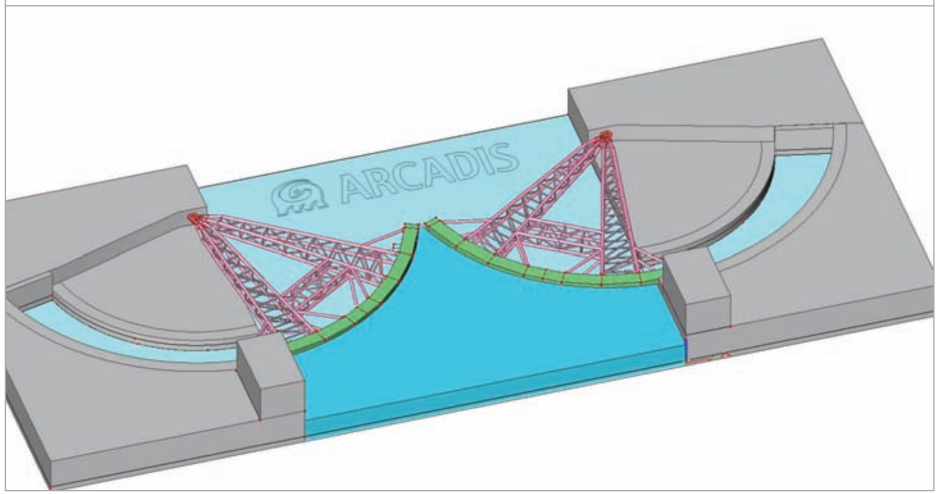
The bridge has a single pylon erected between the canal and the inner ring (R4). The pylon is made of steel and has two legs. The superstructure of the bridge is suspended by two cable surfaces. This superstructure is made entirely of concrete (concrete main girders + crossbars with a concrete deck slab). The cycle paths are designed as steel grid floor elements applied on steel brackets, which are anchored in the concrete main girders of the bridge. The bridge is built up in the extension of the longitudinal axis of the bridge. Barges are provided for transport over the canal. The abutment north side has not been built during the preparatory phase because the bridge will be moved in the longitudinal direction over the location. Once the bridge is in its final position, the structure will be finished and the cable forces adjusted.



Engineering Study - Yeongam River, Korea





The project concerns the conceptual design and calculation advice for the Yeongam floating sector gate in South Korea.

A new navigable channel is being built between the lower reaches of the Yeongsan and Yeongam rivers in South Korea as part of an extensive regeneration scheme.
For the water control of this channel, two types of weirs are used. In a bypass a series of vertical lifting doors and for the navigable channel a floating sector gate similar to the “Maeslantkering” sector gate in the Netherlands.
The Yeongam Floating sector gate in Korea is the first weir of this type in South-East Asia.

The navigable channel is 60 m wide. The weight of the gate is approximately 250 tonnes each and it revolves around a spherical bearing to adjust to the varying water levels and buoyancy situations. Each gate is opened and closed by a set of winches. The winch operating wires are guided on the outside face of the gate leaf.

For the engineering company EPS Solutions Co. Ltd., ARCADIS has provided conceptual design and calculation advice for the Yeongam floating sector gate during the detailed design phase. Advice was also given on the engineering items which related to the hydraulic behaviour and the mechanical parts, such as the winch system, the hinge connection and the buoyancy/ballast tank system.

Structure

For the conceptual design, a model in Scia Engineer has been made. The structure can be divided into the pair of arms and the floating body. The arms come together at the hinge and are connected at two-thirds with an intermediate structure.
The arms decrease in width towards the hinge and are built up out of circular hollow sections. The main outside sections are CHS 508 x 12. The diagonals are CHS 216 with various wall thicknesses. At the connection with the intermediate truss, CHSs are also connected with the floating body. At these locations the main sections have the increased wall thickness of 25 mm.

The weir itself, the floating body, is built as a stiffened plate structure with the height of 7 m. The floating body is divided into 7 segments. The separation between the segments is watertight. Each segment has an upper and bottom part. The bottom part is used for buoyancy and every bottom segment can be individually filled for perfect trim.
For the upper part, only the front plate is the actual separation between the different water levels. In these segments the water can freely come in at the rear side. This also provides stability.
The plate thickness of 16 mm is used for the front plates, most of the other plates in the structure are 12 mm. The stiffeners, bulb-flats, are vertical placed in the front and rear plates. The stiffeners in the top plate are trough shaped.
For the wire of the winch at the top, additional reinforcements are provided.
The housing of the bearing is also built up out of plates.

Scia Engineer has been used for a verification of the forces in the elements.

Out of the box

New is that Scia Engineer has been used for a 3D visualisation. By making a screenshot from approx. 175 situations, an animation is created.

ARCADIS Nederland BV

Contact Anton van Kooij
Address Lichtenauerlaan 100
3062 ME Rotterdam, The Netherlands
Phone +31 10 2532 222
Email anton.vankooij@arcadis.nl
Website www.arcadis.nl

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ARCADIS is an international company that provides consultancy, design, engineering and management services in the fields of Infrastructure, Water, Environment and Buildings.
Our mission is to improve quality of life around the world by creating places of distinction and providing sustainable solutions that enhance the built and natural environments. In doing so, we produce exceptional value for our clients, employees and shareholders.

Our innovative structural engineering professionals strive to overcome the physical limitations of sites while also meeting the requirements of each project. The teams work with our in-house architects, as well as with clients directly, to develop solutions to the full range of structural needs, in many cases paving the way for the creation of new opportunities for the architect and project owner.

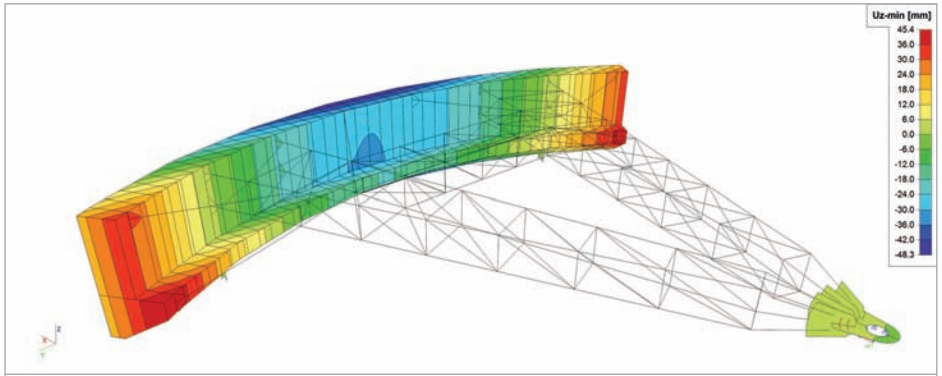
Project information

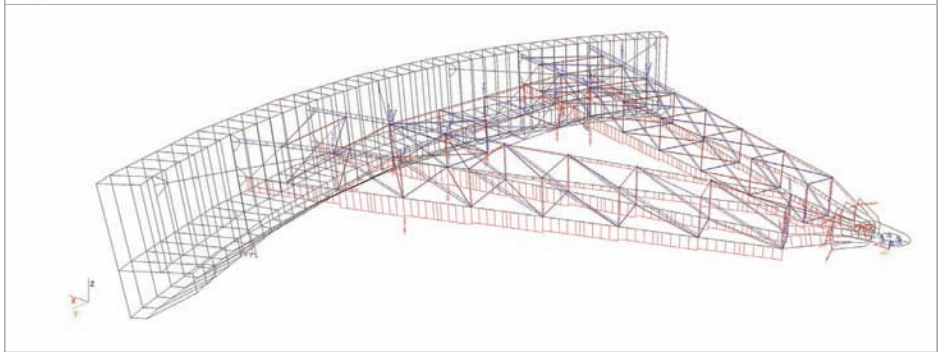
Owner	South Korea state
General Contractor	Keum Jeon Industrial Company Ltd
Engineering Office	EPS Solutions co ltd
Location	Yeongam River, Korea
Construction Start	2012

Short description | Engineering Study - Yeongam River

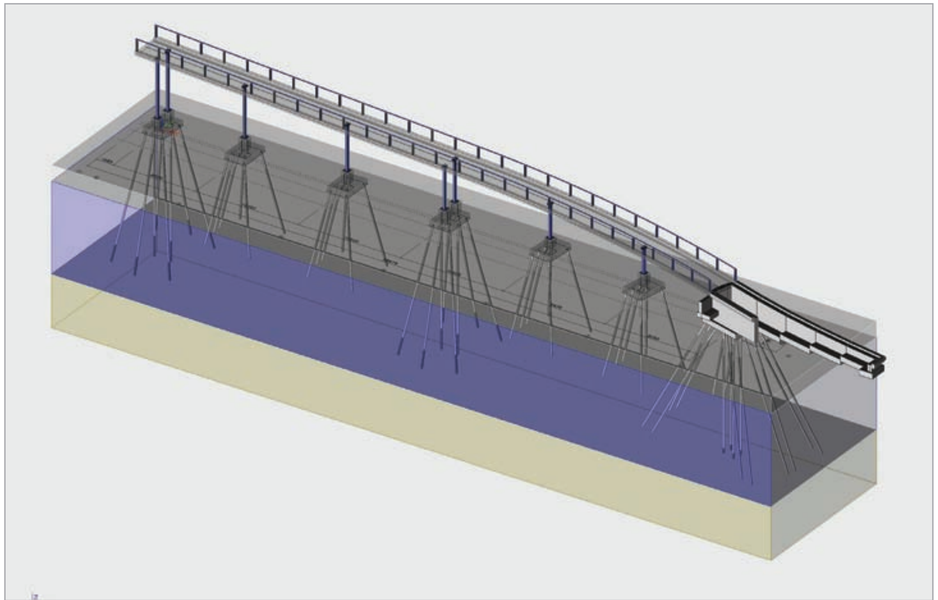
Korea Yeongsan river Estuary Embankment, development section 3. It concerns flood prevention by means of distributing flood discharge from Yeongsan Lake to Yeongam Lake.

A new navigable channel is being built between the lower reaches of the Yeongsan and Yeongam rivers in South Korea as part of an extensive regeneration scheme. The northern lake (Yeongsan Lake) contains fresh water and the southern lake (Yeongam Lake) contains brackish (slightly salty) water. Water from Yeongam Lake is being used for irrigation purposes. To control the water flow a number of weirs are built in this new channel.





Barrier Free Pedestrian Connection - Mannheim, Germany



Client

Mannheim is a city in south-western Germany. With approximately 315,000 inhabitants, Mannheim is the second-largest city in the Bundesland of Baden-Württemberg, following the capital city of Stuttgart. The name of the city was first recorded as Mannenheim in connection with a legal transaction in the year 766, surviving in a twelfth-century copy in the Codex Laureshamensis from Lorsch Abbey. The name is interpreted as “the home of Manno”, where Manno is a short form of a Germanic name such as Hartmann or Hermann. Mannheim remained a mere village throughout the Middle Ages.
Mannheim lies on the junction of the river Neckar by the river Rhine and it contains a lot of traffic- and pedestrian bridges.

The Order

After the reconstruction of the Friedrich-Ebert Bridge across the river Neckar in 2007, the Mannheim City Government decided to improve the traffic situation and build a barrier free connection from Neckar Bank Way to the bridge allowing handicapped people in wheelchairs or cyclists to get on to the bridge directly without any help. The architectural design of the new part should conform with the old structure.

Technical data

The connection is about 70 m long and 2.5 m wide and it lies about 6.0% in grade. In the ground view the structure line is half bended to get far away from the Neckar Bank Way. It consists of the solid beam (120 m^3 of concrete, 21 t of reinforcement) based on the slim steel columns (24 t of steel) with supporting walls at the entry with deep injection piles foundation (altogether about 600 m long). The bad soil conditions were responsible for the deep piles foundation by the existing bridge structure too.

Software and Model

Scia Engineer was used for design and optimisation. The planned new structure was built up as a 3D model, including the supporting walls and foundation with deep injection piles. The appropriate loads and combination were implemented in line with the current DIN rules. Due to the width of 2.5 m, additional evacuation vehicle loads had to be considered.

Calculation

Calculation of the structure was processed according to Theory IId Order.
Dynamic calculation due to Earthquake Zone I was considered too.
The required optimised length of the injection piles was settled due to the piles’ reactions regarding the given appropriate soil conditions.
Design and optimisation of the solid beam was done with required reinforcement regarding concrete creeping.

Execution

The planning began in February 2010.
The opening of the structure took place on 21.11.2011.
The building costs of the structure are about 600,000 euros.

Software: Scia Engineer

Dipl. - Ing. S. Ryklin STATIK

Contact Sergej Ryklin
Address Liselottestrasse 17,
D-69123 Heidelberg, Germany
Phone +49 6221 830973
Email statik@ryklin.de
Website www.ryklin.eu

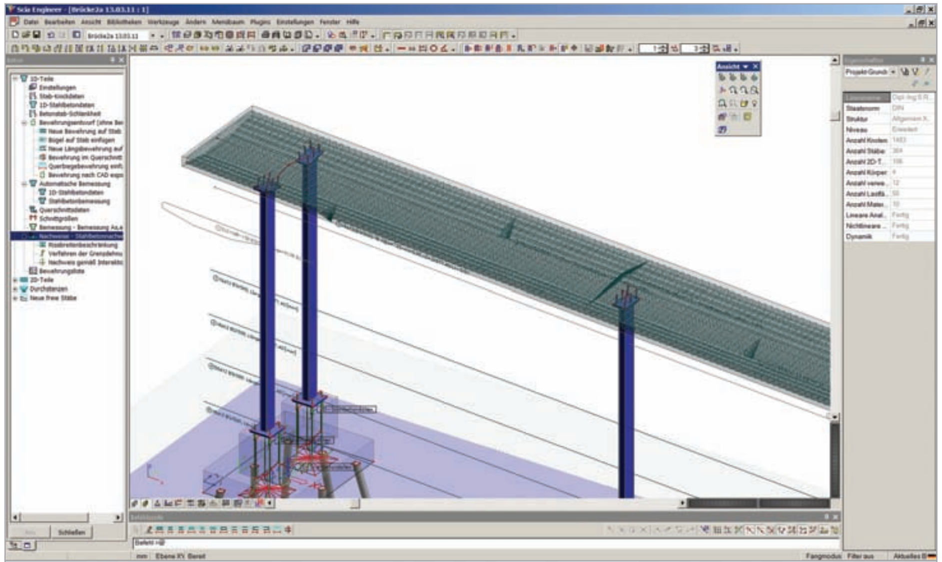
Sergej Ryklin - Born in 1963 in Moscow
1981-1985: Civil Engineering; “Bridges/Tunnels”; Since 1993: Structural designer and verifier at “Römhild & Hecker” Consulting Engineers in Landau, Germany; Since 1997: Structural designer; 2008-2009: Master’s Study at the Institute for Membrane and Shell Technologies, Anhalt University of Applied Sciences, Germany.
Range of Capacity: Planning and optimisation of steel, aluminium, solid, composite, timber and membrane structures; Project consultancy; Building physics calculations; Dynamics calculations, Project verification.
Philosophy: Flexibility in planning due to integral 3D design with the ability to find feasible and low-cost solutions from the draft stage on.
Experience: Residential and industrial buildings, parking spaces, pedestrian bridges, swimming pools, silos, membranes…
References: Daimler, John Deere, SAP, DB...

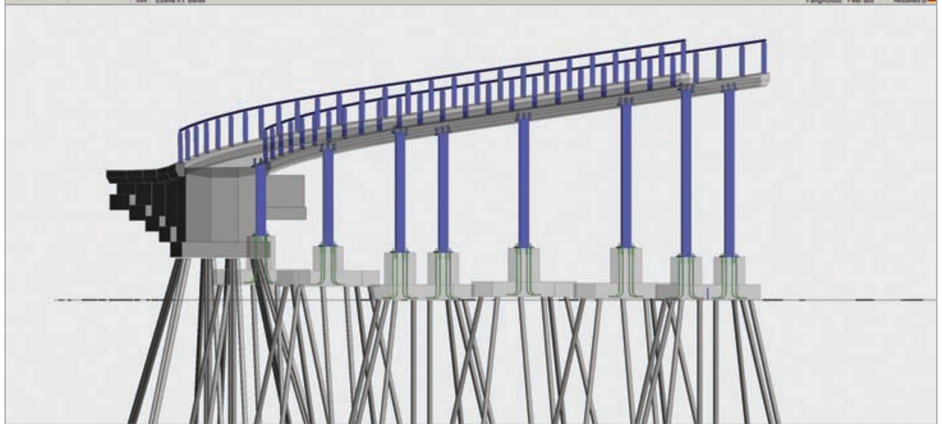
Project information

Owner	Mannheim City
Architect	Mannheim City Planing Department
General Contractor	King Ingenieure Ludwigshafen, Germany
Engineering Office	Dipl. - Ing. S. Ryklin STATIK
Location	Mannheim, Germany
Construction Period	02/2011 to 11/2011

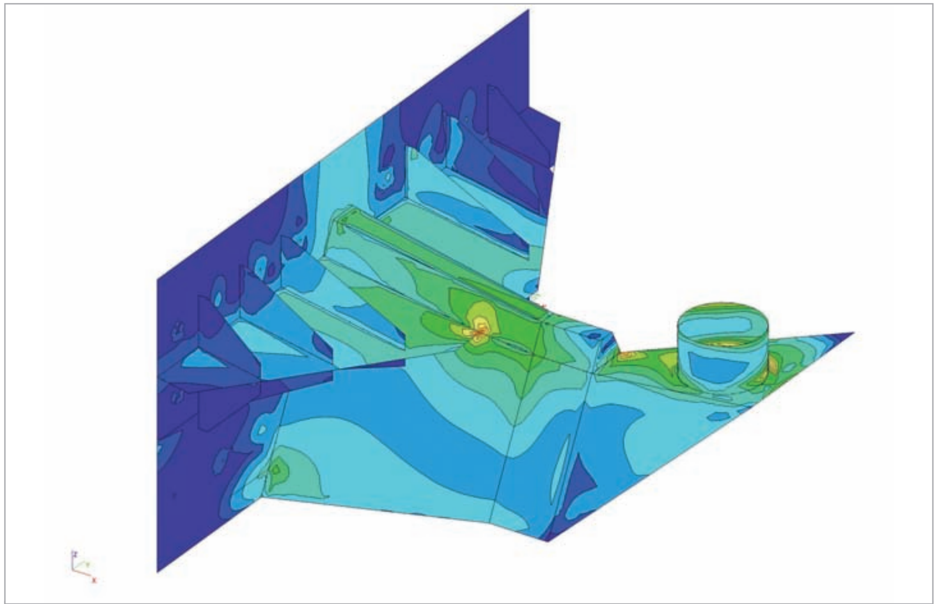
Short description | Barrier Free Pedestrian Connection

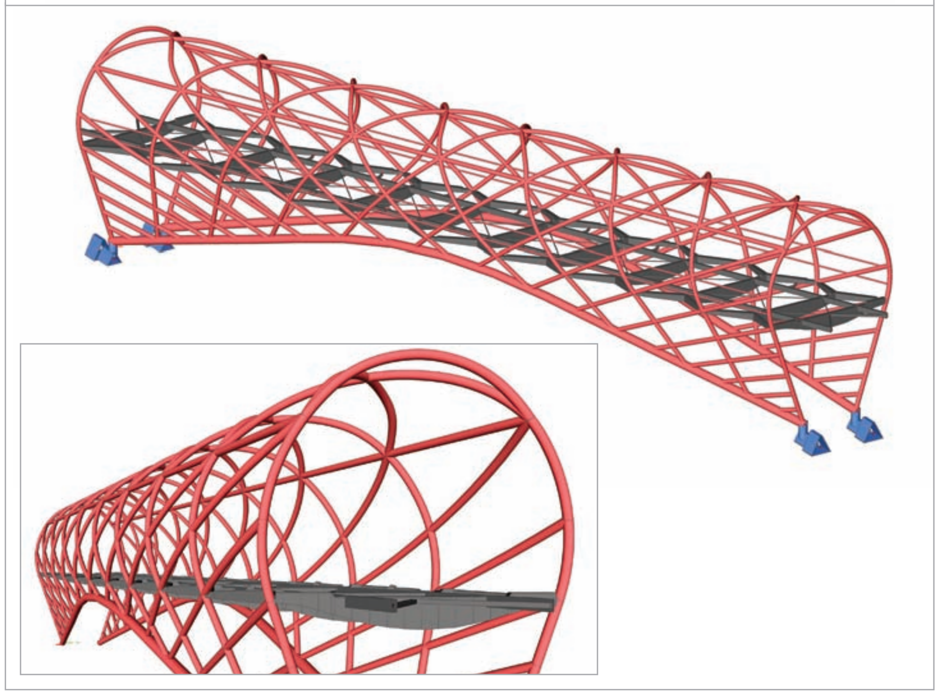
The City Mannheim lies on the junction of the river Neckar by the river Rhine and contains a lot of traffic- and pedestrian bridges. After the reconstruction of the Friedrich-Ebert Bridge across the river Neckar in 2007, the Mannheim City Government decided to improve the traffic situation and build a barrier free connection from Neckar Bank Way to the bridge. The connection, implemented in 2011, is about 70 m long and 2.5 m wide and it lies about 6.0% in grade. The structure consists of the solid beam based on the slim steel columns with supporting walls at the entry and deep injection piles foundation. The very bad soil conditions were responsible for the deep piles foundation by the old bridge structure too. The new structure was built up as a 3D model in Scia Engineer, including the supporting walls and foundation with deep injection piles. Calculation of the structure was processed according to Theory IId Order. The required dynamic calculations due to Earthquake Zone I were considered too. The building costs of the structure are about 600,000 euros.





Statische und dynamische Berechnung einer Fußgängerbrücke - Paris, France





Überblick

Die Fußgängerbrücke des neu errichteten Einkaufszentrum Centre Commercial Beaugrenelle in Paris verbindet zwei voneinander getrennte Bauwerke dieser Shopping Mall. Dem Besucher wird durch die Brücke ermöglicht, die stark befahrene Rue Linois in bequemer Art und Weise zu überqueren. Das Centre Commercial Beaugrenelle liegt im Zentrum von Paris, direkt an der Seine und nur wenige hundert Meter vom weltberühmten Eifelturm entfernt. 2,80 Millionen Menschen erreichen den Standort in weniger als 30 Minuten.

Der Entwurf der Fußgängerbrücke stammt von den Architekten Valode & Pistre. Wobei die Brücke dem Einkaufszentrum ihren Wiedererkennungswert gibt. Die Eröffnung des Einkaufzentrums erfolgt im zweiten Halbjahr 2013.

Projektbeschreibung

Die Fußgängerbrücke besteht im Wesentlichen aus zwei verschiedenen Teilen, zum einen die außen liegende tragende Stahlkonstruktion und zum anderen der innen liegende Glastunnel. Die Stahlkonstruktion spannt sich wie ein räumliches Netz um den Glastunnel. Das statisch tragende Netz wird durch gebogene Stahlrundrohre realisiert. Die Brücke schließt nicht im rechten Winkel an die Gebäude an, sondern ist ca. 25 Grad gegenüber den Gebäuden verdreht. Dies macht die Geometrie der Brückenkonstruktion noch komplexer. Das tragende Stahlformrohr-Netz wird an vier Auflagerpunkten aufgesetzt, welche den Hauptteil der Lasten abtragen. Die Gehwegplatte wird an vier Punkten noch horizontal gehalten. Die Lagerung des tragenden Netzes erfolgt wie bei einem Einfeldträger. Die Anbindung der Brücke an das Gebäude erfolgt über vier Stahlkonsolen, welche als ca. 1,10 m lange Kragträger ausgeführt sind.
Die groben Abmessungen der Konstruktion sind:

- Spannweite. ca. 31 m
- Max. Höhe der Rohrkonstruktion: ca. 8,30 m
- Max. Breite der Rohrkonstruktion: ca. 5,30 m

Bei der Realisierung wesentlich war die strikte Begrenzung der maximalen vertikalen Verformung der Brücke (max. L/500, die sehr geringe Verformung ist auf Grund der innen liegenden Verglasung notwendig). Die Prüfung der Schwingungsanfälligkeit der Brücke auf Grund von Fußgängerverkehr war ebenso ein bedeutender Teil unserer Arbeiten. Bei dieser Konstruktion war besonders die Nachweisführung für die Vielzahl an Knotenverbindungen der Rundrohre (nach EN1993-1-8) aufwendig.

Montage

Die Stahlkonstruktion wurde vor ihrem Transport, einmal komplett zusammengeschweißt und im Anschluss wieder auf transportierbare Einzelteile getrennt. Vor Ort wurden die Einzelteile wieder zusammengeschweißt. Zu diesem Zwecke musste die Rue Linois mehrere Wochen für den Straßenverkehr gesperrt werden. Die komplette Stahlkonstruktion der Brücke wurde im August 2012 mittels zweier Hebekräne millimetergenau eingehoben und auf den zuvor montierten Stahlkonsolen fixiert.

Verwendung von Scia Engineer

In Scia Engineer wurde die komplette Stahlkonstruktion als räumliches Stabtragwerk berechnet. Wobei die Brücke auch schon im statischen Modell auf ihren vier Stahl-Auflagerkonsolen/Stahlkragträgern lagert. Die Berechnung der Konstruktion erfolgte nach Theorie II.Ordnung. Zusätzlich zur eigentlichen Brückenstatik wurde Scia Engineer genutzt, um das dynamische Verhalten der Brücke unter Fußgängerverkehr entsprechend französischen Richtlinien zu berechnen. Die geometrisch sehr komplexen Auflagerkonsolen wurden mittels FEM-Berechnung nachgewiesen. Ebenso wurde der Montagelastfall untersucht, bei dem die Struktur beim Anheben durch die Kräne nachgewiesen wurde.

Ausführende Firmen

Bouygues Batiment (Frankreich)
GIG Fassaden GmbH (Österreich)
Grömer Stahl GmbH (Österreich)
Stallinger & Partner ZT-GmbH (Österreich)

Software: Scia Engineer

Dipl. Ing. Stallinger & Partner ZT-GmbH

Contact Johann Stallinger
Address Haselbachstraße 16
4873 Frankenburg, Austria
Phone +43 7676 6571-0
Email j.stallinger@zt-stallinger.at
Website www-zt-stallinger.at

Dipl. Ing. Stallinger & Partner
Ziviltechniker - GmbH

Die Firma Stallinger & Partner ZT-GmbH wurde 1997 von Herrn DI Johann Stallinger gegründet und erstellt statische Berechnungen für alle Bereiche des Bauwesens. Die Kernkompetenz liegt im Stahlbau (Hallenbau, Industriebau, Bogendächer), jedoch zählen auch Massivbau, Holzbau, Fassadenbau und Sonderkonstruktionen zu unserem Leistungsspektrum.

Wir sind nicht nur in Österreich tätig! Neben einer Vielzahl an Projekten in Deutschland, sind wir auch im restlichen Mitteleuropa, Skandinavien und auf den britischen Inseln vertreten. Weiters konnten auch in Südamerika, Afrika und Asien Projekte erfolgreich umgesetzt werden.

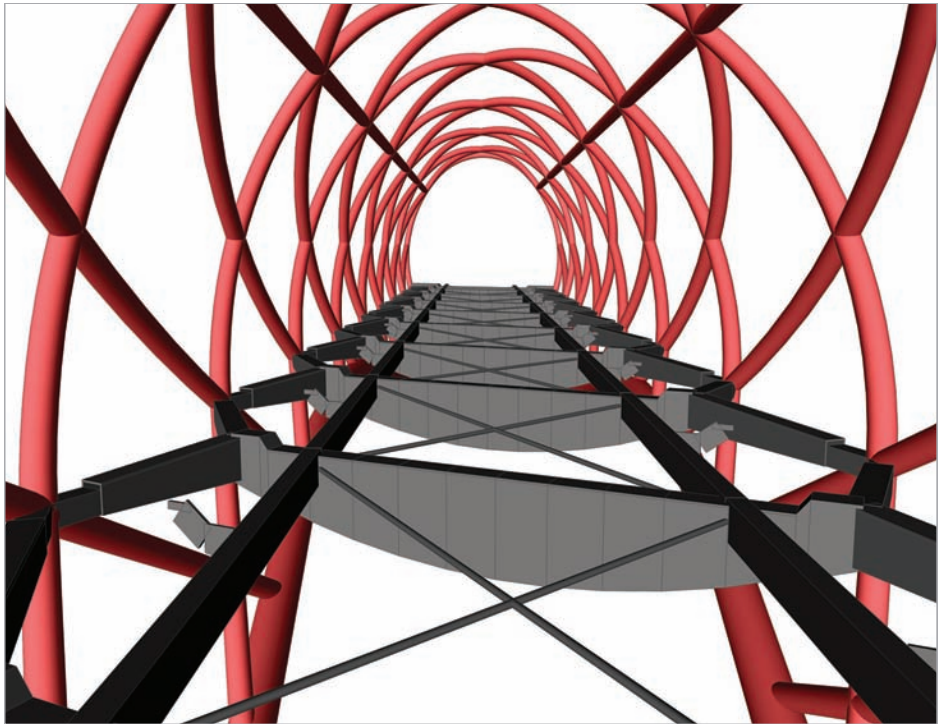
Die Firma Stallinger & Partner ZT-GmbH entwickelt für ihre Kunden auf Wirtschaftlichkeit bedachte, den technischen Regeln entsprechende, an den Kundenwünschen orientierte optimale Lösungen von einfachen bis zu komplexen Tragwerksstrukturen.

Project information

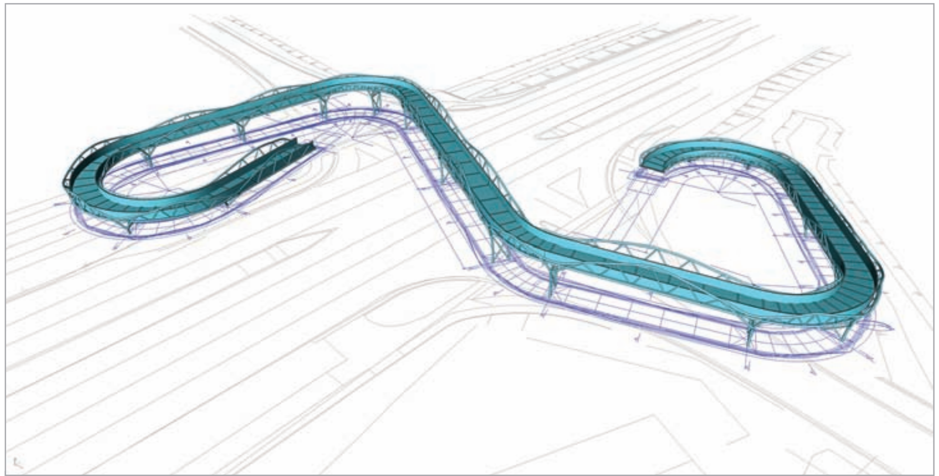
Owner	Gecina, Apsys, Foncière Euris, Paris Orléans
Architect	Valode & Pistre Architectes
General Contractor	Bouygues Batiment, GIG Fassaden GmbH
Engineering Office	Grömer Stahl GmbH
Location	Paris, France
Construction Period	06/2009 to 08/2012

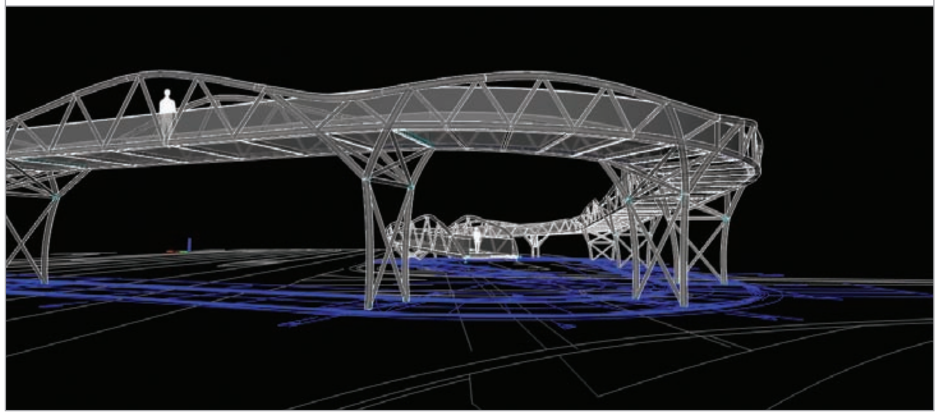
Short description | Static and Dynamic Analysis of a Footbridge

Static and dynamic analysis of the net-like steel bearing structure of the footbridge at the Centre Commercial Beaugrenelle in Paris (close to the Seine and Eiffel Tower).
This steel and glass structure is particularly characterised by its complex geometry. The exterior steel structure bears the interior glass tunnel. The footbridge is borne by 4 projecting steel brackets of approx. 1.10 m. During the project, deformation boundaries, verification of the oscillation susceptibility due to pedestrians, verification of the numerous shaped pipe connections, the load transfer within the two buildings and the assembly were just some of the major challenges facing the companies involved. The static and dynamic analysis was carried out in Scia Engineer. Furthermore, the process of lifting the steel structure during assembly was also calculated using Scia.



Fietsersbrug over de Westerring - Genk, België





Enkele jaren geleden is de Vlaamse overheid met een uitgebreide campagne gestart om de zogenaamde ‘zwarte punten’ in haar wegennetwerk te herontwerpen en veiliger te maken. Één van de onderdelen van deze campagne was het ontwerp van een fietsers- en voetgangersbrug over de Westerring te Genk. Deze brug verbindt het buitengebied Winterslag met het centrum van de stad. Het oorspronkelijk ontwerp betrof een fietserstunnel, maar door de aanwezigheid van verschillende ondergrondse constructies bleek dit geen haalbare kaart. De opdrachtgever heeft toen de keuze gemaakt om op deze locatie een ‘eyecatcher’ in de regionale infrastructuur te implementeren met een hoge architecturale kwaliteit. Dit vormde de aanleiding voor een constante samenwerking tussen architect en ingenieur vanaf het begin van het ontwerpdossier.

De randvoorwaarden van het project zijn complex: aan beide zijden van de weg bevinden zich waterlopen; twee van de vier hoeken rond het kruispunt zijn eigendom van particulieren en de ruimtes tussen de bossen en de gewestweg zijn zeer beperkt.
Dit leidde tot het ontwerp van een tracé waarin optimaal gebruik wordt gemaakt van de beperkte ruimte, maar waarin eveneens aandacht is voor interessante zichten en bewegingen door de groene omgeving van Winterslag.

Concept

De staalstructuur is een hybridevorm van een vakwerk en een bowstring, met een brugdek in gewapend beton. Deze is met stiftdeuvels verbonden aan de staalstructuur en zorgt voor een grote stijfheid in transversale richting. Bij slanke staalstructuren die onderhevig zijn aan voetgangersverkeer, is het dynamisch gedrag van de structuur van cruciaal belang. Deze module werd dan ook veelvuldig gebruikt om de eigenfrequenties van de brug te bepalen en te toetsen aan de normen.

De uitlijning van de bovenste randligger van de brug is op parametrische wijze vastgelegd: de totale hoogte van de ligger staat in lineair verband met de lengte van de overspanning. Op rechte gedeeltes van het tracé zijn beide liggers symmetrisch, in de bochten zijn de binnenste liggers lager omwille van de kleinere radius. Ook in het horizontale vlak werd speciale aandacht gegeven aan de uitlijning van deze koker. Dit alles geeft de structuur een elegant, dynamisch karakter, waarbij de beleving van de brug en de omgeving constant verandert als fietsers en voetgangers de oversteek maken.

Gebruik van Scia Engineer

Vanaf de eerste ontwerpschetsen werd gebruik gemaakt van Scia Engineer om de haalbaarheid van de concepten te toetsen. De grafische interface liet bovendien toe om de esthetische kwaliteiten van het ontwerp te bekijken en waar nodig, aan te passen.

Het grondplan van het tracé werd als dwg geïmporteerd in de software, waarna de punten in verticale zin getransleerd werden tot de gewenste positie. Aan de lijnen werden vervolgens profielen toegekend. De pylonen en funderingen werden in Scia ontworpen, in functie van het dynamisch gedrag van de structuur. Op deze wijze werden eveneens de posities van de dilatatievoegen in het betonnen brugdek onderzocht.

De mate van detail in het model is functie van de studieopdracht. Het doel was om tot een ontwerp te komen waarvan de uitvoeringsstudie mee in de aanbesteding zit. Hierdoor zijn de hoofdprofielen en de uitlijning in detail bestudeerd, maar werden van de details enkel korte haalbaarheidsberekeningen gedaan.

Resultaten

De performante structuur van Scia liet toe om op eenvoudige wijze de effecten van verschillende ingrepen te onderzoeken. Zeker bij de dynamische analyses kon - door het plaatsen van eenheidslasten op kritische punten en interpretatie van de resulterende vervormingen - het rendement van verzwaring van de profielen, het plaatsen van schoren of het verhogen van de graad van inklemming vergeleken worden. Dit heeft geleid tot een optimalisatie van de structuur, waardoor er binnen de grenzen van het krappe budget werd gebleven.

Software: Scia Engineer

Grontmij Belgium

Contact Ronny Engelen, Jules Frère
Address Herckenrodesingel 101
3500 Hasselt, Belgium
Phone +32 11 260870
Email ronny.engelen@grontmij.be
Website www.grontmij.be

Grontmij is een multidisciplinair advies- en ingenieursbureau voor duurzame infrastructuur en mobiliteit; industrie, water en energie en planning en ontwerp. Vanuit een toekomstgerichte visie geven wij kwalitatief advies en realiseren we creatieve ontwerpen en projecten. Samen met en dicht bij onze klanten uit het bedrijfsleven en de overheid, willen we waarde creëren en werken we aan totaaloplossingen. Wij doen dat met respect voor onze klanten, onze omgeving en het milieu.

Onze visie: Grontmij creëert waarde voor haar klanten, haar medewerkers en haar aandeelhouders. Wij realiseren projecten met bijzondere aandacht voor economische aspecten, innovatie en duurzaamheid.

Onze missie: We willen het beste duurzame advies- en ingenieursbureau zijn in Europa. We plannen een duurzame toekomst voor en met onze klanten.

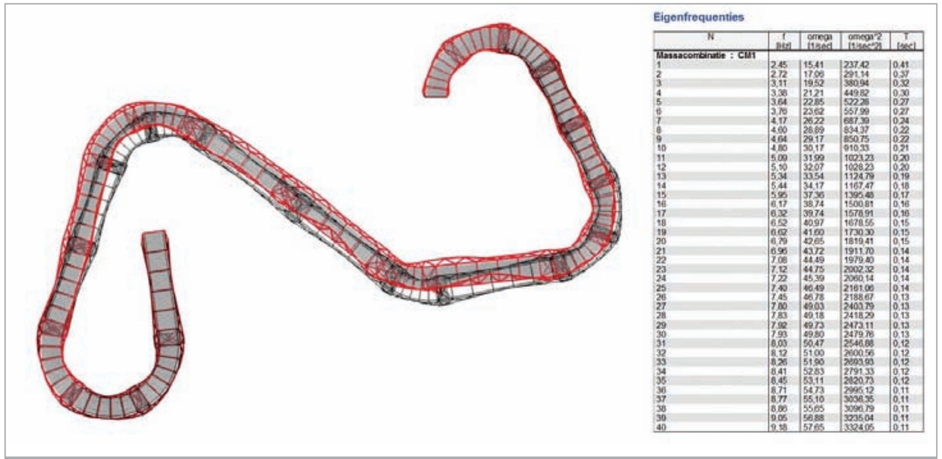
Project information

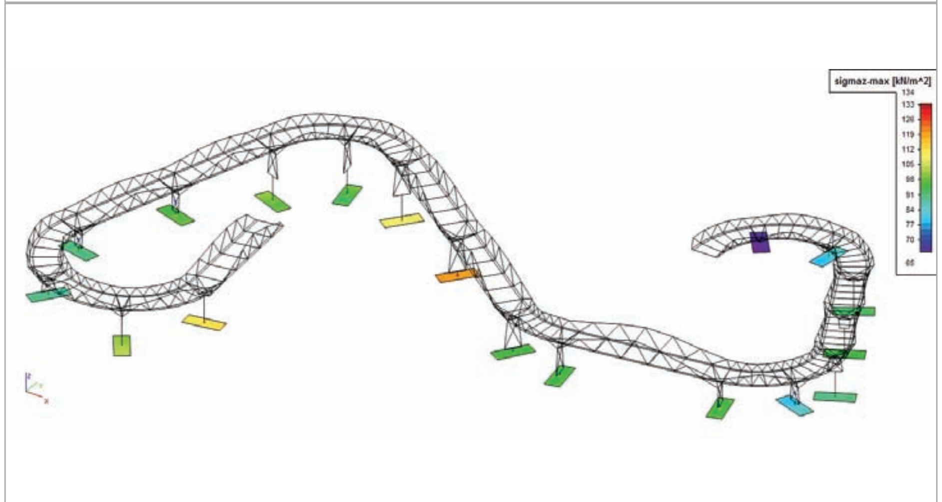
Owner	Vlaamse Overheid - Agentschap Wegen en Verkeer
Architect	Grontmij Belgium NV
General Contractor	VBG
Engineering Office	Grontmij Belgium NV
Location	Genk, Belgium
Construction Period	08/2013 to 2014

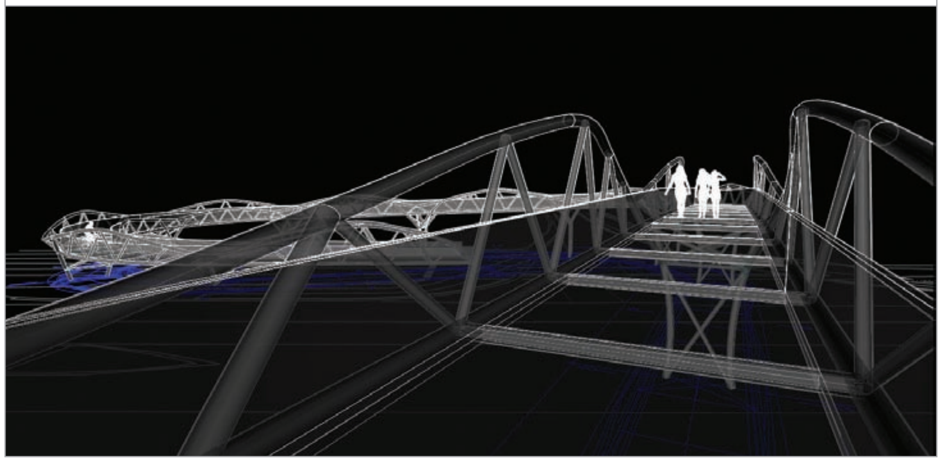
Short description | Pedestrian and Cyclists' Bridge over the "Westerring"

Several years ago, the Flemish government started a campaign to redesign so-called 'black spots' in its infrastructure. One of the projects in this campaign was the design of a pedestrian and cyclists' bridge over the circular road around the city of Genk.

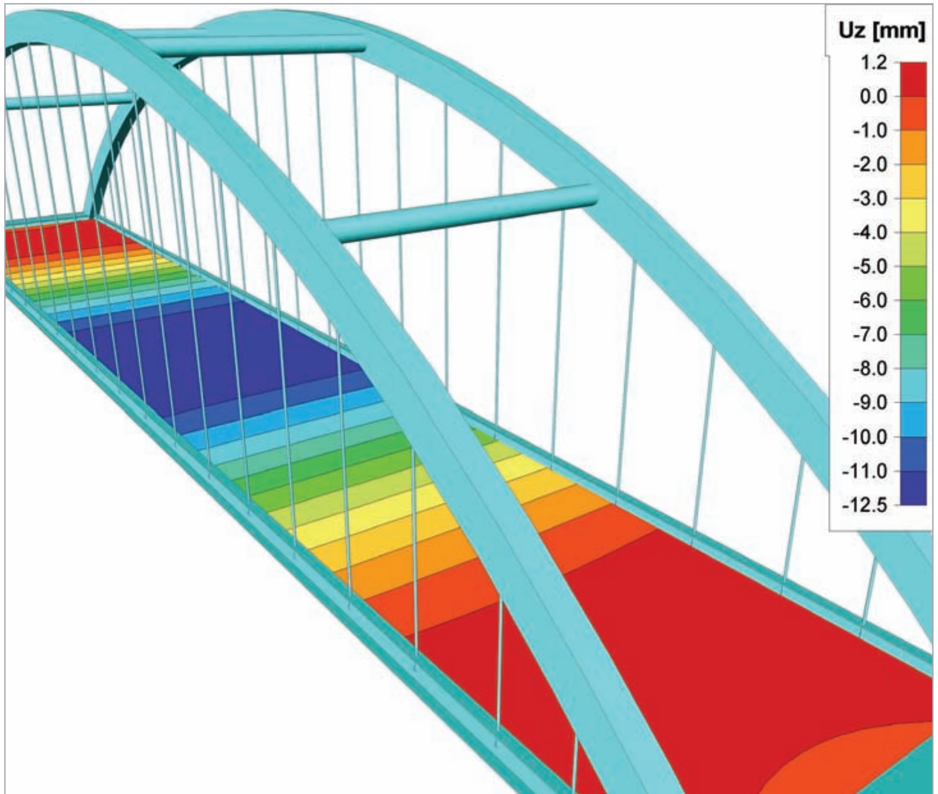
The steel structure is a mixture between a truss and a bowstring bridge, with a concrete deck. This deck is connected to the steel structure through shear connector studs, making it rigid in the transverse direction. The alignment of the upper hollow section beam was defined by means of parametric design: the total height is linearly related to the width of the span. Also in the horizontal direction, special attention was paid to the alignment of this beam. This gives the structure an elegant and dynamic character, changing the perception of the bridge when pedestrians and cyclists are passing by. A dynamic analysis of the structure ascertained satisfactory dynamic behaviour.

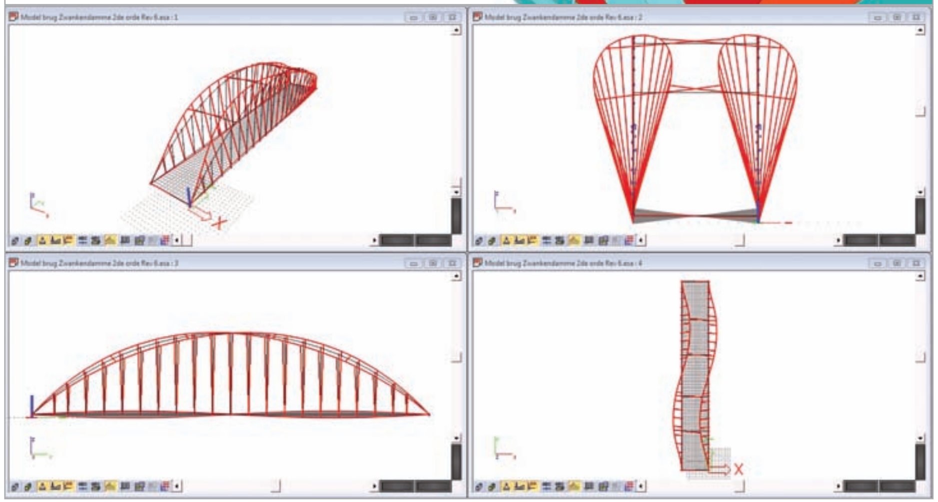






Bowstring Bridge - Zwankendamme, Belgium





Description of the bridge type and its characteristics

In order to respond to the expansion of the Port of Zeebrugge and the need for more capacity in container traffic, the number of tracks of the "Bundel Zwankendamme" has to be increased. Simultaneously, the safety will be increased by replacing the level crossing situated at Wulfsberge with a road bridge crossing the railway tracks.
The solution of a large single-span bridge was chosen: a bowstring bridge in steel with tie rods and prestressed concrete decks. The abutments are in concrete and founded on piles.

The characteristics of the bridge are:

- A single span of 87.98 m.
- Steel grade S355J2G3.
- The cross-sectional view.
- 2 lanes for vehicles, each 3.5 m wide.
- An emergency lane, 1 m wide.
- A cycling path, 3 m wide: two-way traffic, also intended for occasional pedestrians.
- A high safety barrier (type IVB) and safety kerb (type IVA) will be installed for road traffic safety.
- Four pot bearings will support the bridge.
- Each abutment is supported by 60 concrete screw piles with a 60 cm diameter: 48 are vertical and 12 at a 1/10th angle. All have the length of 18 m.
- The bridge is made of 560 tonnes of steel.

The bridge concept

As there will be a set of railway tracks under the bridge, it is not possible to build intermediate pillars. They would restrict the options of the track layout and they would have a minimum distance to the railway tracks.
In addition, they would need to be dimensioned to cope with the considerable accidental collision forces.
For the 88 m span the arch bridge is the best option from a financial point of view. The construction height (distance between the upper side of the road and the bottom of the main girder) is very small for this kind of span, only 85 cm.
The bridge has to be able to carry extraordinary loads of 360 tonnes, hence 12 axles of 30 tonnes.

The choice was made to provide one mixed cycling path rather than two single paths + footpath because all the cycling routes are on the south side of the bridge. The north side contains nothing but industrial sites. Intense usage by pedestrians is not expected.
Finally, the bowstring bridge is to be welded and assembled in place with minimal interference with the railway traffic.
The bridge will be put in place during a weekend when railway traffic is interrupted, so with minimal disturbance.

Calculation techniques, technical specifics

3D modelling of the bridge was carried out in Scia Engineer 2011 to ensure the most accurate tension calculations.
A global model has been built to calculate the strength, stiffness and fatigue of the main steel structure and the prestressed concrete decks.
Geometry, material properties, preconditions and loads were all uploaded into the program.
A second-order check was also carried out in Scia Engineer.
Everything has been dimensioned and checked according to the Eurocodes.
This includes the following elements:

- Bearings
- Profiles
- Second-order check
- Prestressed decks
- Steel joints
- Several connections
- Abutment
- Girders between the arcs

Used modules

- Steel code check (EC)
- Stability
- Physical non-linear conditions

Software: Scia Engineer

Infrabel

Contact Alex Lefevre
Address Frankrijkstraat 85
1060 Brussel, Belgium
Phone +32 2 525.23.59
Email alex.lefevre@infrabel.be
Website www.infrabel.be

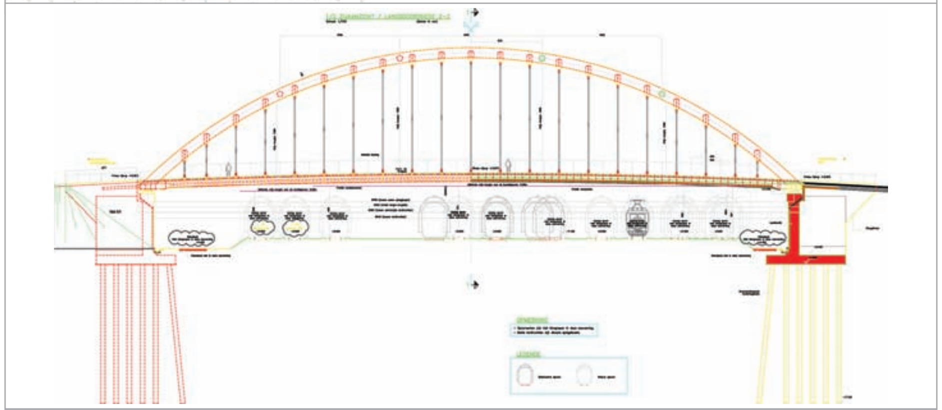
Infrabel is responsible for the Belgian railway network. Every day, 12,364 employees ensure optimum performance of our equipment: railways, catenaries, switches, signals, crossings, etc. Mobility and accessibility in Belgium are our primary tasks, which is why we keep expanding our railway infrastructure. Our mission: to develop a safe and high-quality railway network for all the trains of the future. In our role as infrastructure manager and operator of the Belgian railway network we distribute the available capacity on the railway lines and coordinate all the trains running on Belgian territory. In our endeavour to create optimum opportunities for train traffic we are expanding the railway network so as to make it a strong link within a sustainable transport system. The central location of our railway network within Europe offers plenty of opportunities for the socio-economic development of our country. Infrabel makes good use of these opportunities and through numerous projects continues to turn the Belgian railways into an indispensible means of transportation.

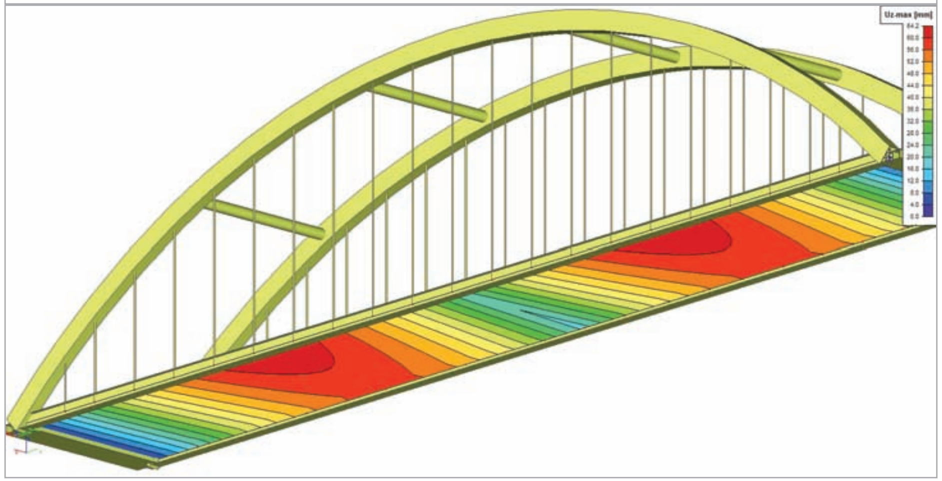
Project information

Owner	Infrabel
Architect	Infrabel I-I.53
General Contractor	West Construct: Besix, Aelterman
Engineering Office	Infrabel I-I.53
Location	Zwankendamme, Belgium
Construction Period	10/2012 to 02/2014

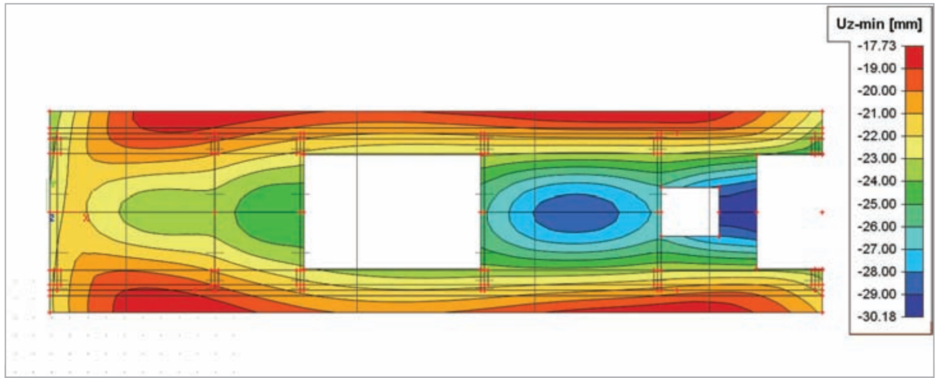
Short description | Bowstring Bridge

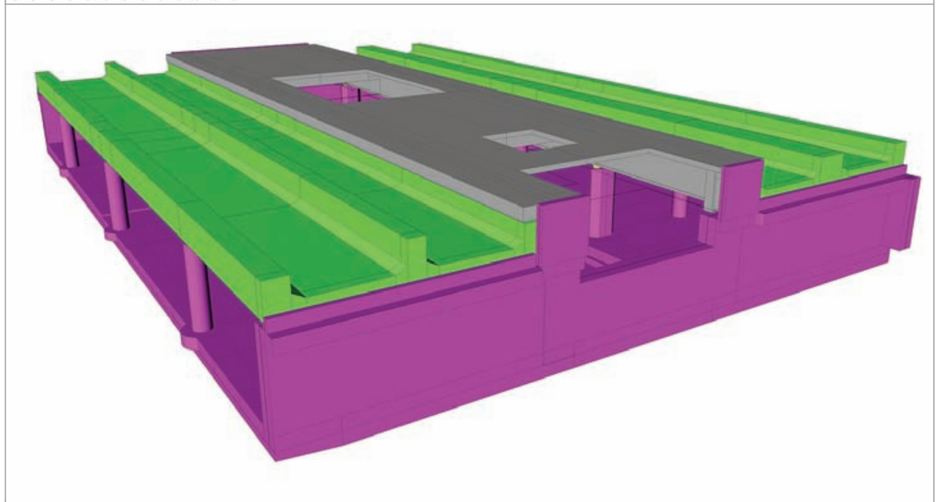
For the container traffic in the Port of Zeebrugge there was a big need for an extra set of tracks. The new set of tracks would disconnect the village of Zwankendamme from the N 31 road. To maintain the connection there was the need to build the bridge. We chose a bowstring bridge because there is a span of 88 m and for this range a bowstring is the most economical solution. As there will be a set of railway tracks under the bridge, it is not possible to build intermediate pillars. They would restrict the options of the track layout.





New Passage / Arcade at Tilburg Railway Station - Tilburg, The Netherlands





Description of Structure

The structure of the passage/arcade consists of a U-shaped tunnel covered with two double-track railway bridges with a platform in between. The U-shaped tunnel (floor, walls and columns) is made of reinforced concrete. The railway bridges and the platform are constructed from pre-stressed concrete. In order to reduce the height of the construction (top of rail - bottom of deck), the railway bridges are constructed as trough bridges. A further reduction of the height is obtained by reducing the thickness of the ballast bed (with authorisation from ProRail). The platform between the two double-track trough bridges is constructed as a double T-deck. Although an integral construction was briefly investigated and seemed possible, the client preferred a more proven method of construction. Therefore, it was decided to keep the superstructure separated from the substructure by the use of elastomeric/spherical bearings.

Method of Construction

In order to reduce the number and duration of the 'out-of-operation' periods for the rail tracks, the following considerations were made:

- Use of natural foundation instead of pile foundation;
- Pre-construction of the complete structure at the site north of Tilburg Central Station (the former Nedtrain facility).

The use of a natural foundation results in differential settlements between the supports. These differential settlements do not fulfil the requirements of the client (ProRail) and result in too high stresses in the girders of the trough bridges and also in tension forces at the end supports of the trough bridges and platform.
In order to meet the requirements regarding the differential settlements and stresses, jacking of the bridges and platform is necessary immediately after positioning of the structure and a second time (1 year after positioning). For the end supports, spherical uplift load bearings are used.

By pre-constructing the entire structure, the hindrance to the rail traffic is reduced to a minimum. For the positioning of the structure in its final position, several options have been considered. The definitive design and the tender specification are based upon the method of 'tunnel pressing in an open construction pit'.

Structural Model in Scia Engineer

The entire structure, the U-shaped tunnel, the two double-track trough bridges and the platform are modelled in Scia Engineer using Plate and Shell elements. The girders of the trough bridges are defined as subregions, with a different thickness, within the main slab. The girders of the double T-deck (platform) are modelled by using a standard ribbed plate element. Working with one overall model instead of several separate models for the individual structures, it is necessary to make sure that interaction between the different structures and structures with the subsoil is implemented correctly in the calculations.

Modelling of the natural foundation is done by using an individual surface support on the bottom slab of the U-shaped tunnel. The subgrade reaction modulus (C1z parameter) is determined by Plaxis calculations. With Scia Engineer an analysis is performed to determine the sensitivity of the structure for the range of the subgrade reaction modulus. It is concluded that the lower limit for the modulus is critical for all the main structural elements.

Using an overall model means that the bearings between the trough bridges/platform and the wall of the tunnel have to be modelled with beam elements because the use of spring elements between structural elements is not possible. The beam elements that represent the bearings were rigidly connected to the wall elements. The connection to the superstructure is modelled as a joint. Because the stiffness of the bearings in all three directions is different, a study is performed to determine the size, length and modulus of elasticity of the beam elements so they would represent the stiffness of the bearings in all directions.

The use of Scia Engineer made it possible to design this complex structure within the requirement specifications of the client.

Software: Scia Engineer

Ingenieursbureau Oranjewoud BV

Contact	Vincent Dols
Address	Beneluxweg 7
	4904 SJ Oosterhout NB, The Netherlands
Phone	+31 162 487000
Email	vincent.dols@oranjewoud.nl
Website	www.oranjewoud.nl

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Oranjewoud aims to be a leading partner in the development and application of sustainable and integral solutions relating to all aspects of our living environment, such as home, work, recreation, mobility and the environment.

Core values

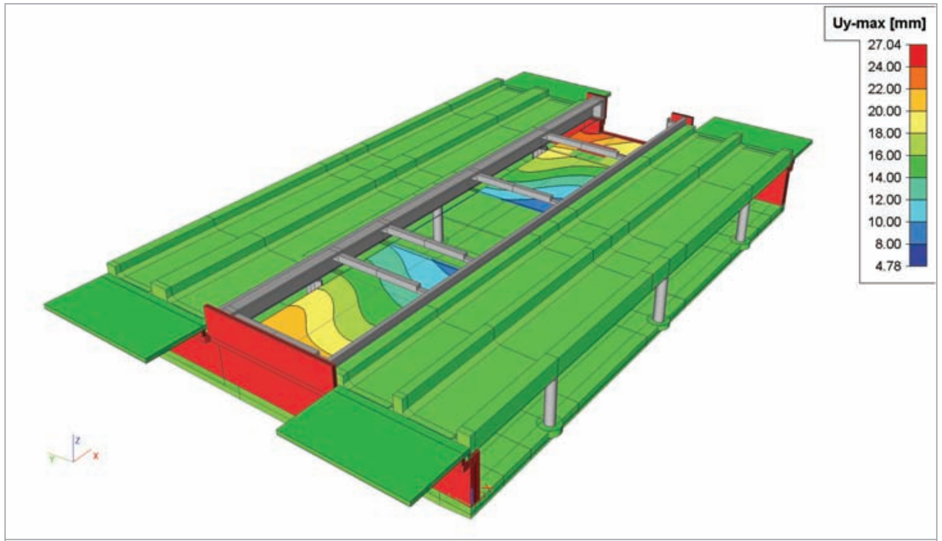
Enterprising, People-oriented, Development, and Character.

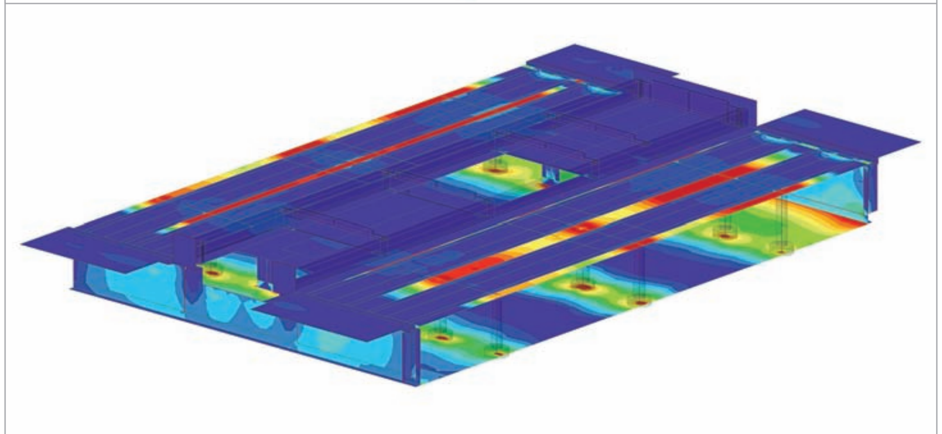
Project information

Owner	ProRail
Architect	architectenbureau cepezed b.v.
Engineering Office	Ingenieursbureau Oranjewoud BV
Location	Tilburg, The Netherlands
Construction Period	05/2013 to 09/2015

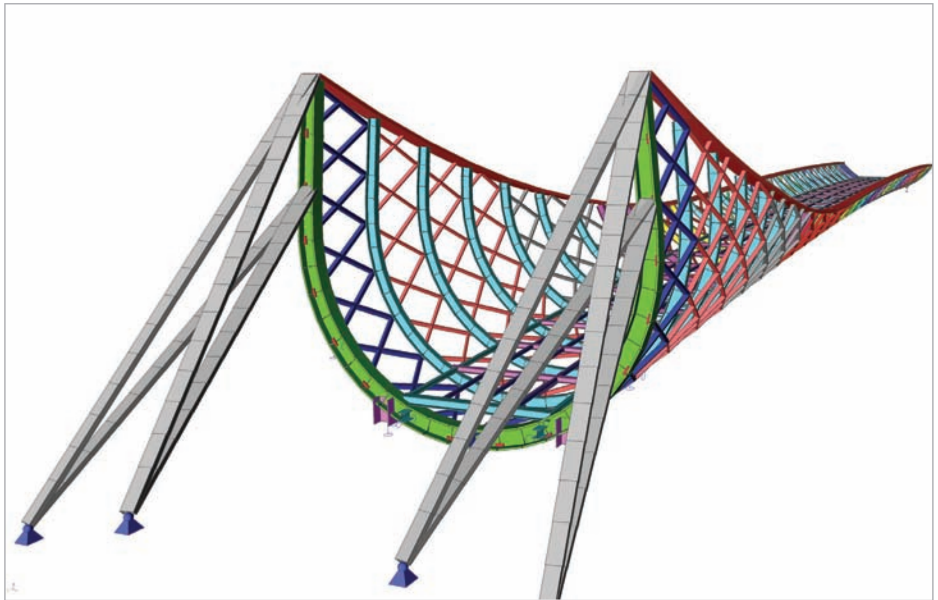
Short description | New Passage / Arcade at Tilburg Railway Station

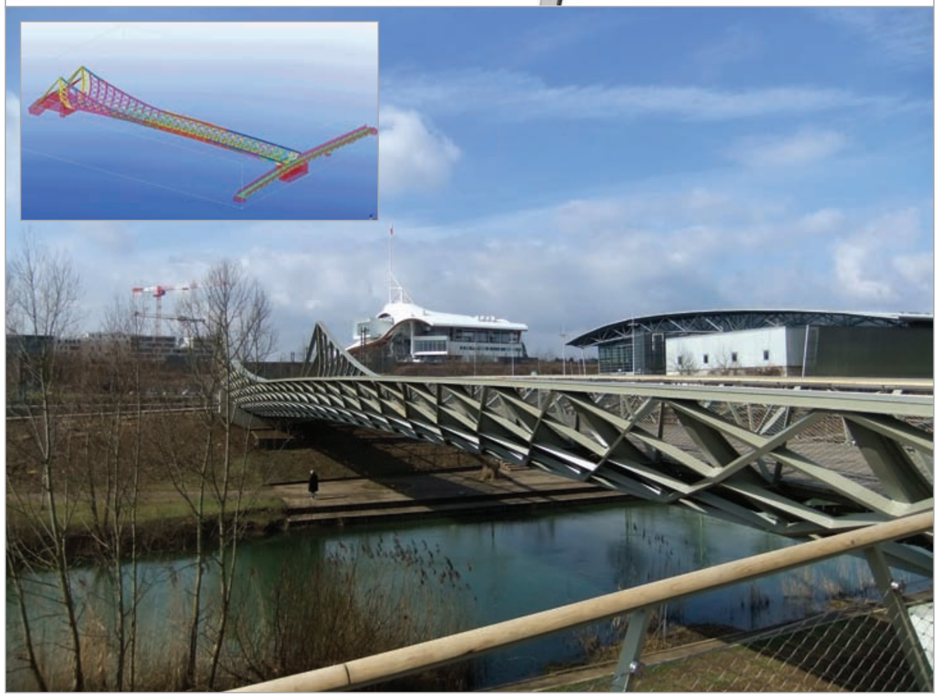
Studies show that in the coming decennia Tilburg Central Station will have to deal with a growing number of passengers and trains. In order to handle this increasing mobility, the complete station, except from the monumental covering of the station with hyperbolic shells, will be subject to a facelift. With this facelift, Tilburg will get a central station with a front and back entrance, as well as an easily accessible platform due to wide stairways, elevators and escalators. A major part in this project is the construction of a new 40 m-wide passage/arcade. The lack of space, the presence of many cables and pipes, the pollution of soil and ground water and, not least, the client's requirement that the disruption of the train traffic should be kept to an absolute minimum made this a very complex project. Oranjewoud conducted a study of possible structural concept and building methods which led to a preliminary design. After the definitive design Oranjewoud also completed the specifications for this project in December 2012. The open tender started in January 2013.





Cyclist- and Pedestrian Bridge - Metz, France





Introduction

The cyclist- and pedestrian bridge in the centre of Metz crosses the river Seille in the contemporary Parc de la Seille. The bridge is officially known as the passerelle de Graoully. The name refers to the mythical animal that is the symbol of Metz: the dragon.

The 64-metre-long bridge has a changing width from 8.7 m to 8.4 m and a changing height from 7.5 m to 6.8 m.The total weight of the bridge is 100 tonnes. The bridge has several cross girders in the form of a "U". These cross girders are connected by crossing rectangular diagonals. The net of diagonals is in equilibrium with a box-formed top girder that is anchored on 1 side of the bridge to limit the deformation of the bridge. The bridge is placed in one piece in its final place.

Description of technical questions to be resolved with Scia Engineer

ESA-Prima Win was used both for the dimensioning of the bridge in the traffic situation and the erection engineering of the bridge.

The complex 3D structure was modelled in Scia Engineer with bars. The possibility of input of 2D dxf files in Scia Engineer was a big advantage so as to form the 3D structure in Scia Engineer exactly. Sufficient points were created in the bars to form the curved cross girders by linear bars.

From the engineering point of view this project has several challenges.
First, there was the complex form of the bridge. The possibility of user-friendly input by Scia Engineer was a big advantage. The use of 2D dxf files made it possible to compose the 3D structure in Scia Engineer in a rapid manner.

Second, there was the dynamic analysis of the bridge. Because of the light and slender character of the bridge there was the need to calculate the eigenvalues / frequencies of the bridge in order to check if there were risks of vibration under pedestrian load or wind actions. The possibility of calculation of accelerations due to passing pedestrians in Scia Engineer was a big advantage.

Third, there was the second order calculation needed for the check of the box-formed top girder based on a stability calculation. The twisting form of the girder (referring to the dragon) and the elastic support of the cross girders gave a complex stability form that was used as input for the second order calculation.

Fourth, the evaluation of deformations during the construction phase. The bridge was lifted in one piece to its final position. The choice of the position of the lifting lugs was important in order to evaluate the deformation of the bridge during positioning.

Description of how our experience with Scia Engineer proved its completeness

- Dimensioning a complex 3D structure in Scia Engineer by input of 2D dxf files.
- The possibility of using and combining the results of Scia Engineer in a flexible way.
- Stability calculation and second order calculations based on a complex stability form.
- Checking the dynamic behaviour of the structure by calculating the eigenvalues and the accelerations of the structure.

This project proves the great diversity of Scia Engineer in checking the structure.

Modules used:
- Base
- 3D frame
- Dynamics
- Steel code check (EC)
- Stability

Software: Scia Engineer

Ingenieursbureau Stendess N.V.

Contact Jurn De Vleeschauwer
Address Grote Baan 18
9920 Lovendegem, Belgium
Phone +32 9 370 71 25
Email jurn.devleeschauwer@stendess.be
Website www.stendess.com

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Stendess calculates and draws complex steel constructions in a high quality and efficient manner while seeking economically responsible and sustainable solutions for specific technical stability issues. Thanks to the integral service, whereby the design of the metal superstructure and the concrete substructure are calculated and drawn by experts in the same office. The building owner and principal contractor retain 100% control over the complete structure.

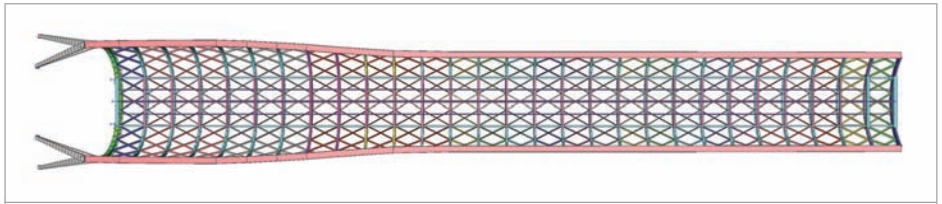
Managing complex projects with care.
Recent references demonstrate the multidisciplinary knowledge and ability of our engineers and designers in the market of bridges, industry, utility and other projects located all over the world.

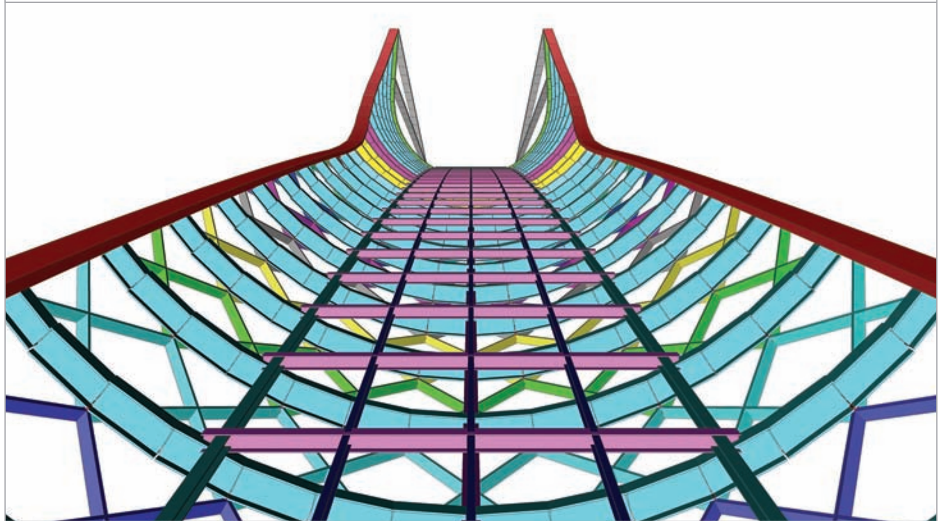
Project information

Owner	Ville de Metz
Architect	Brigit de Kosmi
General Contractor	Anmeco N.V.
Engineering Office	Terrell S.A.S. / Ingenieursbureau Stendess N.V.
Location	Metz, France
Construction Period	2010 to 2012

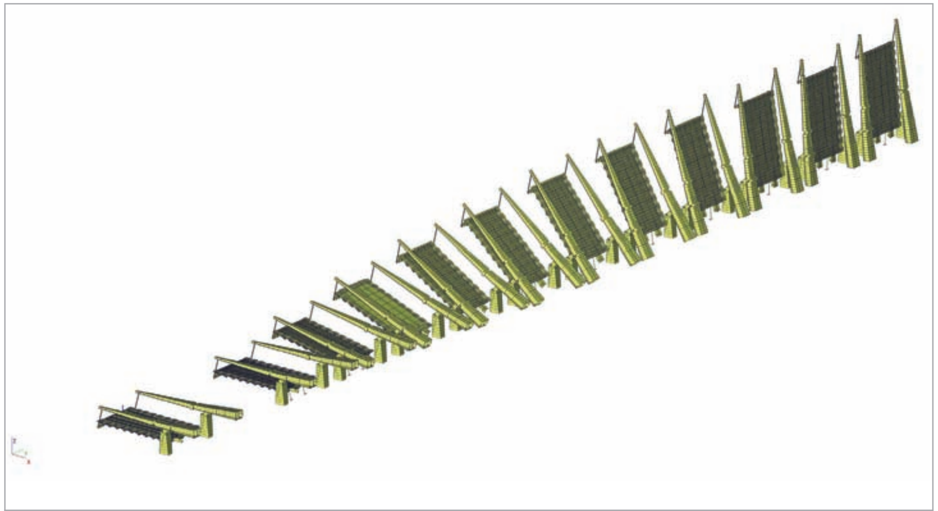
Short description | Cyclist- and Pedestrian Bridge

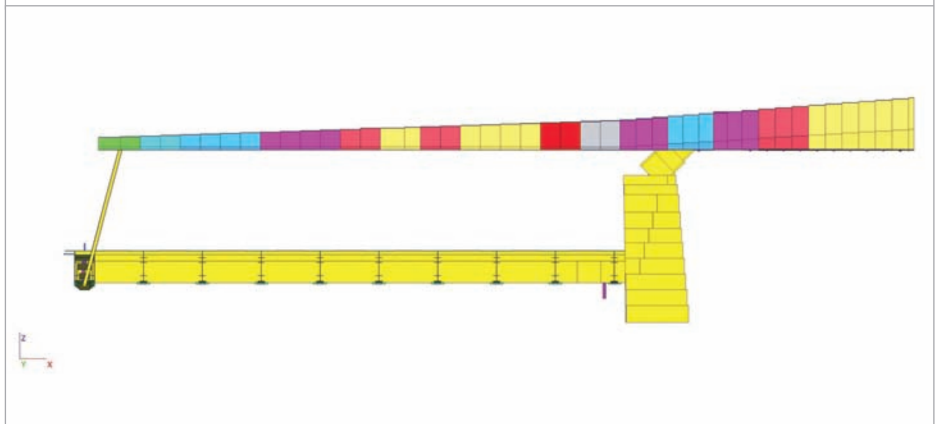
The cyclist- and pedestrian bridge in the centre of Metz crosses the river Seille in the contemporary Parc de la Seille. The bridge is officially known as the passerelle de Graoully. The name refers to the mythical animal that is the symbol of Metz: the dragon.
The 64-metre-long bridge has a changing width from 8.7 m to 8.4 m and a changing height from 7.5 m to 6.8 m.The total weight of the bridge is 100 tonnes.
The bridge has several cross girders in the form of a “U”. These cross girders are connected by crossing rectangular diagonals. The net of diagonals is in equilibrium with a box-formed top girder that is anchored on 1 side of the bridge to limit the deformation of the bridge.
The bridge is placed in one piece in its final place.





“Gouderakse Brug” Movable Road Bridge - Krimpenerwaard Gouda, The Netherlands





Introduction

The movable road bridge at Gouda is built to cross over the Hollandsche Ijssel. The bridge is a part of the project ‘construction of the south-east ring road”, aimed at achieving a better and easier road to Krimpenerwaard and decreasing the traffic in the centre of Gouda. The bridge is also called the ‘Gouderakse brug’.

The bridge has the span of 30 m and is of the drawbridge type. The bridge is powered by two heavy jacks situated under the bridge deck. The bridge is balanced by ballast situated in the back of 2 peak arms, each supported by 1 tower. The bridge deck is hung up on the end of the arms by a tension bar. The arms have the total length of 40 m and are characterised by their peak and sharp forms.
The total weight of the bridge is 400 tonnes. That weight is balanced by 480-tonne ballast.

The bridge deck is built upside down. A special lifting procedure was foreseen to turn the 230-tonne heavy bridge deck afterwards.

Description of technical questions to be resolved with Scia Engineer

Scia Engineer was used both for the dimensioning of the bridge in the traffic situation and the erection engineering of the bridge.

The complete 3D model was formed with bars, even the orthotropic deck plate, divided into longitudinal and cross girders with an equivalent stiffness and adopted mass. Correct modellisation of the mass was very important because of the balancing of the bridge.

From the engineering point of view, this project has several challenges.
First, there were the different states of the bridge to be studied. The possibility of creating different states of the bridge in one model was a big advantage towards calculation of the bridge. With the automatic steel code check (EC) of Scia Engineer it was possible to check all members in all states in one calculation model. This gave an important gain in calculation / optimisation of the structure in the different states.
Third, the use of graphical sections with different material properties to model the exact weight of the bridge into the different states of the bridge. The input of complex forms for the arms and towers was possible thanks to the use of graphical sections.
Fourth, the calculation of eigenvalues / frequencies of the bridge in order to check if there were risks of vibration under wind loads.
Fifth, for the erection engineering the different construction stages had to be examined.

Description of how our experience with Scia Engineer proved its completeness

- Dimensioning a 3D structure in different states.
- The possibility of using and combining the results of Scia Engineer in a flexible way.
- The use of graphical sections with different section properties.
- Stability calculation and second order calculations.
- Calculation of eigenvalues.

This project proves the great diversity of Scia Engineer in checking the structure and the use of materials.

Modules used:

- Base
- 3D frame
- Steel code check (EC)
- Stability
- Dynamics

Software: Scia Engineer

Ingenieursbureau Stendess N.V.

Contact Jurn De Vleeschauwer
Address Grote Baan 18
9920 Lovendegem, Belgium
Phone +32 9 370 71 25
Email jurn.devleeschauwer@stendess.be
Website www.stendess.com

Integral quality is our top priority

Stendess calculates and draws complex steel constructions in a high quality and efficient manner while seeking economically responsible and sustainable solutions for specific technical stability issues. Thanks to the integral service, whereby the design of the metal superstructure and the concrete substructure are calculated and drawn by experts in the same office. The building owner and principal contractor retain 100% control over the complete structure.

Managing complex projects with care.
Recent references demonstrate the multidisciplinary knowledge and ability of our engineers and designers in the market of bridges, industry, utility and other projects located all over the world.

Project information

Owner	Provincie Zuid Holland
Architect	Hollandia B.V.
General Contractor	Combinatie Van Hattum en Blankevoort / KWS Infa / Boskalis / Hollandia
Engineering Office	Ingenieursbureau Stendess N.V.
Location	Krimpenerwaard Gouda, The Netherlands
Construction Period	09/2010 to 03/2012

Short description | "Gouderakse Brug" Movable Road Bridge

The movable road bridge at Gouda is built to cross over the Hollandsche Ijssel. The bridge is a part of the project 'construction of the south-east ring road", aimed at achieving a better and easier road to Krimpenerwaard and decreasing the traffic in the centre of Gouda. The bridge is also called the 'Gouderakse brug'.
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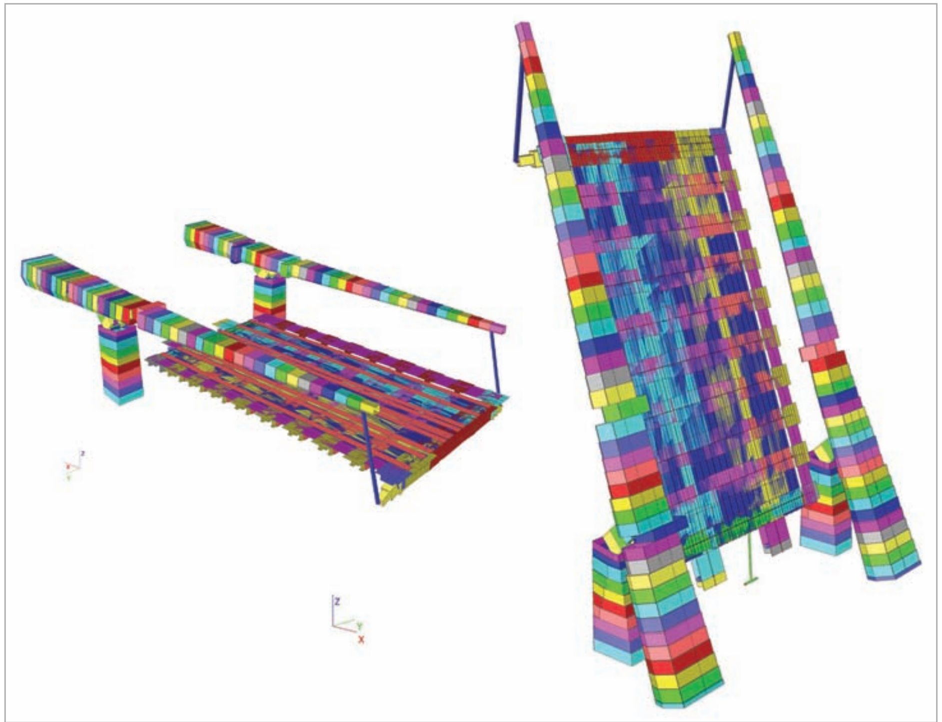
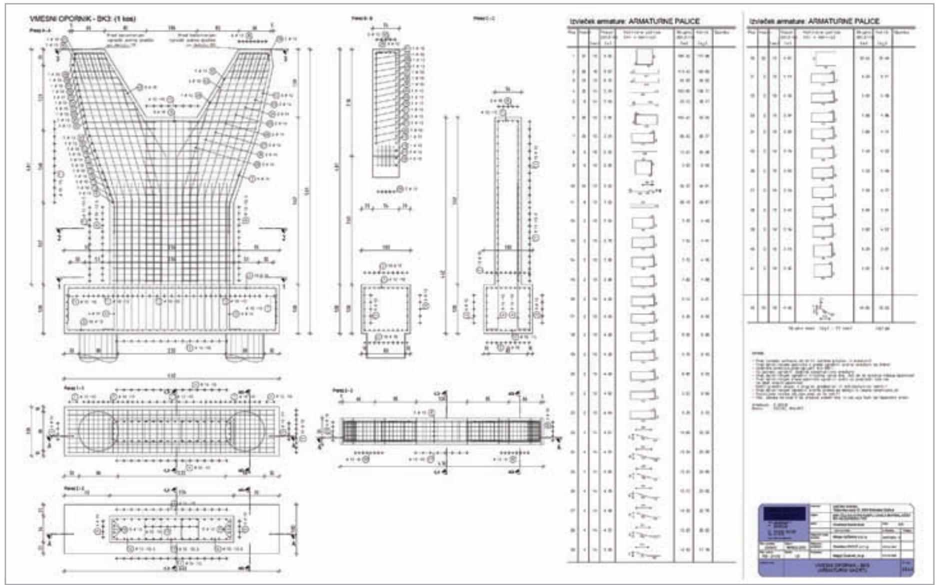
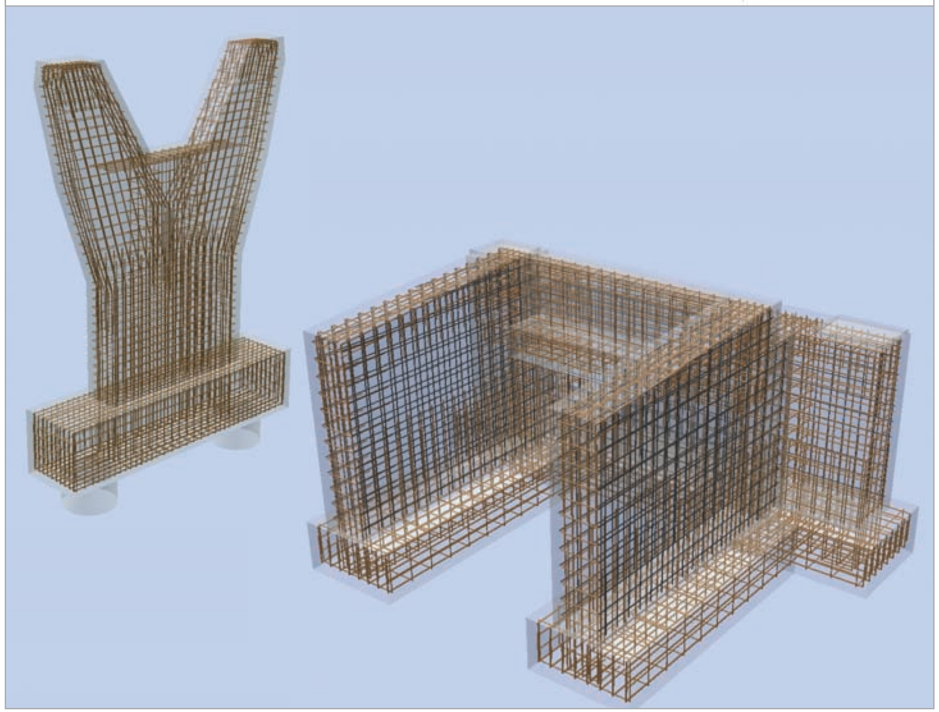


Wooden Footbridge with a Cycling Track Across the River “Sava” - Bohinjska Bistrica, Slovenia





The footbridge is composed of three different structural materials. The main bearing structure and secondary bearing structure are designed as glue-laminated timber beams. Connecting members, anchoring seats and stability bracings are designed with structural steel. The complete supporting structure with foundations and pilots are designed as massive concrete structures.

Architectural design

The architectural design is based on a smooth curved structure with a natural look to fit in a natural environment. Terrain at each end will be raised to prevent the flooding of the cycling track and pedestrian walkway. Both end foundation blocks will be partially filled with earth to form a new embankment raised to a new flood protection height. The main span is divided into three smaller spans with two middle support pillars. These pillars will be placed beyond the main river stream on dry river bed. The bridge structure is designed as a U-type channel with two large main beams connected with smaller cross beams at the bottom and longitudinal secondary beams for attaching walking boards.

Design of the structure and technical data

Timber bearing structure

Two main beams are used to bridge across all three spans. The cross-section dimensions of these beams are 24 x 160 cm. The middle span beams are curved beams because of the curved bridge design. Span sections are connected together with steel plates and a large number of bolts to assure a rigid connection. Hinge connections are used to attach the beams to concrete supports and steel sockets will be used because of the large height of the cross-sections, in order to gain stability and prevent overturning.

The main beams are connected with smaller cross-beam dimensions of 20 x 22 cm and are placed approximately every 5.0 m. The connections of these beams are rigid. This is achieved with the usage of steel plates and a large number of bolts in each connection. These beams also provide stability that counters overturning. Secondary beams with dimensions of 16 x 16 cm are then placed on top of the cross beams at an 83 - 84 cm distance to ensure the bearing of the final walking surface. The secondary beams are attached with hinge connections. All the beams are made as glue-laminated beams with Gl28h grade quality.

Steel elements of the structure

Besides the steel plates for all the connections and anchoring seats, steel bracing diagonals were used to achieve the global stability of the structure. These diagonal bracings are placed in intersections of cross beams and main beams and are attached through steel plates on the socket connections of the cross beams. All the diagonals have a strain link to gain the correct tension of the elements. Some diagonal bracing elements must be anchored to concrete supports to assure the global stability of the structure.

Concrete foundations and pillars

Both end foundation blocks are designed as concrete U-wall element blocks on strip foundations. The walls of the foundation blocks are 50 - 60 cm thick. On each front wall there are two raised concrete seats for the timber beams of the main bearing structure. Both rebar and mesh reinforcement were used for the adequate reinforcement of cross-sections. The middle pillars are slightly different, being made as walls with two inclined arms. Each inclined arm has a seat for the main timber beam on top. The walls of the middle pillars are anchored to a massive concrete girder on two pilots, which are drilled 5 - 6 m deep in bedrock.

Software and calculation model

Scia Engineer 2012 was chosen for the complete 3D-Modeling and for the calculation because there were three different structural materials in interaction. Some calculations were also “handmade”, such as for the timber section design because of complex vertical and horizontal frequencies that had to be calculated to prevent uncomfortable vibrations.

The concrete design and reinforcement was carried out in cooperation with another engineering bureau with Nemetschek Allplan software. Some details for connections were also “handmade” and transferred into the computer design.

Software: Allplan Engineering, Scia Engineer

LoGing d.o.o., PE Ljubljana

Contact Matjaž Žabkar
Address Letališka cesta 5
1000 Ljubljana, Slovenia
Phone +386 59059020
Email matjaz.zabkar@siol.net
Website www.loging.si

LoGing NOVO MESTO www.loging.si

Personal information: Matjaž Žabkar was born in 1979 in Novo mesto, Slovenia. From 1997-2002, he attended to a Diploma study of Civil Engineering at the University of Ljubljana, specialising in "Steel structures". In the period 2002-2007, he worked on Architectural and Civil Structure projects, and in 2008 he became a certified engineer in the Slovenian Chamber of Engineers, IZS. Since 2007, he has worked on planning and the optimisation of steel and membrane structures, foundations and other concrete structures, and earthquake resistant structures.

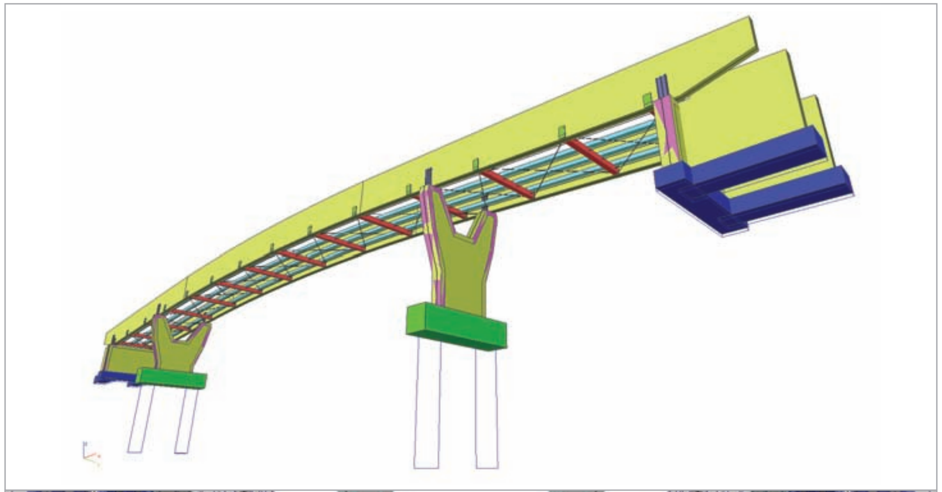
Company information: The company develops, manufactures and erects Office and Manufacturing facilities, Storage halls, Functional constructions, Sports facilities and Mobile halls, Canopies and other structures. The firm cooperates with many Slovenian and foreign partners, developing new products and improving existing programmes and services. In Slovenia, LoGing is one of the leading companies in the field of buildings with inflatable thermal membrane roofs with ETFE, PTFE or LOWE coatings. The production capacity for steel structures is limited to 500 t per month.

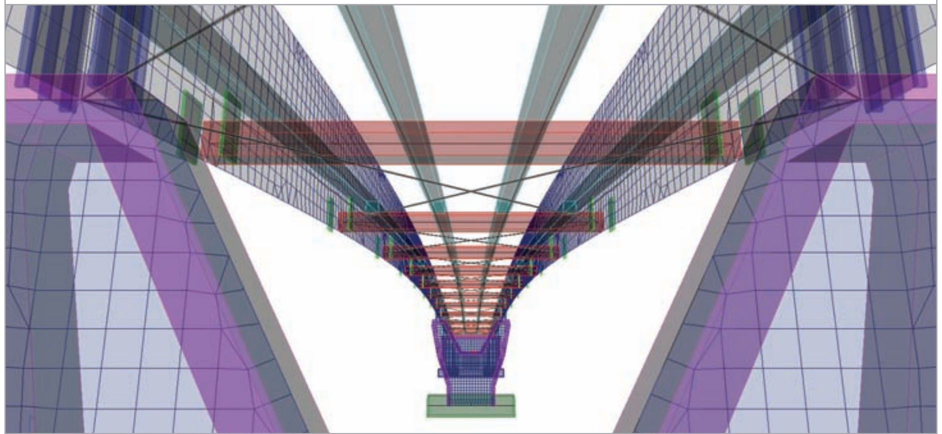
Project information

Owner	Dipl.-Ing. Matjaž Žabkar
Architect	Dans arhitects
General Contractor	ProTehno d.o.o. Ulica pod Gozdom 19, 4264 Bohinjska Bistrica
Engineering Office	Loging d.o.o., Biro Udovč s.p.
Location	Bohinjska Bistrica, Slovenia
Construction Period	04/2013 to 07/2013

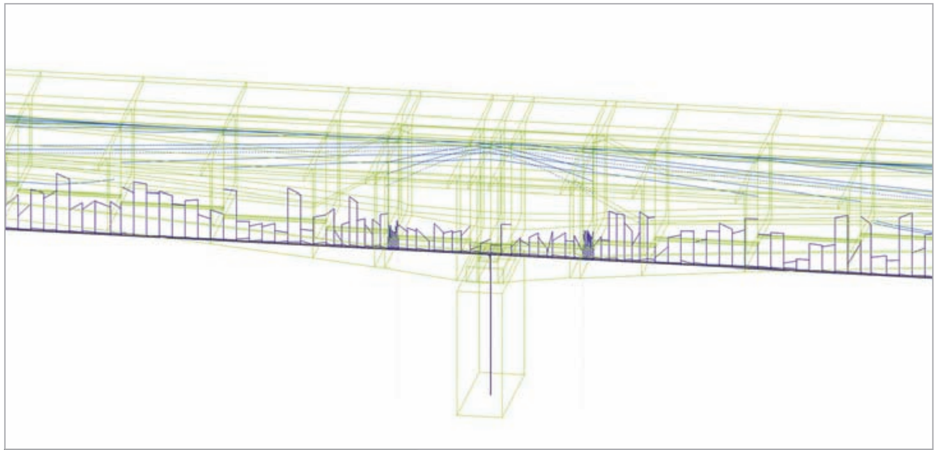
Short description | Wooden Footbridge with a Cycling Track

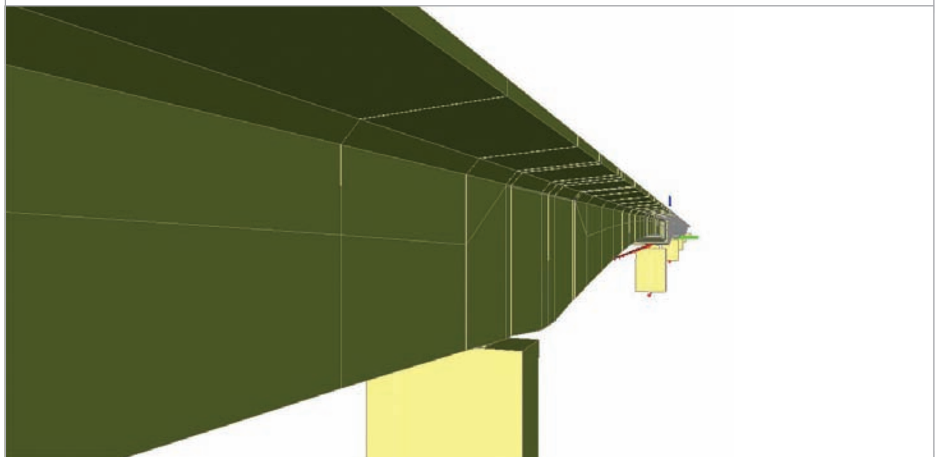
The wooden footbridge with a cycling track is a future project in terms of offering safety to cyclists and pedestrians as the cycling track on the other side of the river is currently accessed with difficultly from the main road. The wooden bridge will be 53.6 m long and 3.40 m wide with a curved vertical course. The vertical radius of curvature is ~181.6 m in the middle span. Both ends of the bridge are linear and ~12.35 m in length. The highest point of the walking surface is ~1.56 m higher than the surface at the beginning or end.
The bearing wooden structure sits on two end foundation blocks and two middle supporting pillars with pile foundations. The complete wooden structure is connected with steel plate sockets and bolts. Many connections are strengthened with steel plate ribs. The structure stability is based on diagonal steel bracings which are anchored to concrete supports. Both fences are part of the bearing structure. From the aesthetic point of view, the complete fence is decorated with shingle plates.





Bridge over Koberný Pond and a Wildlife Corridor at km 87,500 of D3 Motorway - Soběslav, Czech Republic





The Bridge over Koberný lake and a wildlife corridor at the 87,500 km point of the D3 motorway section running from Tábor to Veselí nad Lužnicí, with a total length of 552.8 m (58.4 + 4 x 109.0 + 58.4), is located in a non-built-up area, within the meliorative area of Koberný lake, about 15.4 m above the terrain surface. It is located approximately two kilometres south-east of the town of Planá nad Lužnicí, and about one and half kilometres north of the village of Košice. The valley which is traversed by the bridge is used for agricultural and breeding purposes.

The D 27.5/120 width configuration motorway bridge is set to a right-hand horizontal curve with the radius R = 1,750 m and in vertical alignment is on a vertical curve with the radius R = 35,000 m. Transversally, the roadway on the bridge is superelevated at 3.5 %.
The C 30/37 XF4 concrete grade pillars, with the cross-section of 8.0 x 2.5 m, are founded on 19 thirty-metre piles 1.2 m in diameter. The piles are keyed into R3 and R4 paragneiss to the depth of about 1.5 m. Under abutments and in the transition area, the ground is reinforced with gravel piles, allowing for the effect of the settlement of adjacent embankments with the average height of 12 m. According to calculations, the aggregate settlement of the adjacent embankments reaches up to 0.6 m. The abutments are founded on 10 deep piles. Water encountered during drilling for the piles was pumped to settling tanks behind the abutment to be liquidated in an environmentally friendly way.

Two pairs of casting carriages were used for the free-cantilever-method construction of the load-bearing structure of the box girder with the variable depth ranging from 2.69 m to 5.89 m. Casting of the girder proceeded symmetrically from 16-metre long balance arms. The stub was cast at two stages, on a scaffold provided by PIŽMO supports. Four temporary reinforced concrete supports with the cross-sections of 1.3 x 1.3 m were tied for stabilising the balanced cantilevers on each foundation. The stub in the assembling condition was with the foundation for each temporary support in relation to a pair of pre-stressing rods 47 mm in diameter. After the joints of the neighbouring stubs were made monolithic, all the temporary supports were deactivated.

Several mathematical models for apposite computational analysis of the structure during all the stages of the construction process were created in Scia Engineer. Calculations were realised with a global and local finite elements model using beam and (or) plate elements. Because of a great computational demand, or sometimes the poor relevancy of global models, some details of the structure and some phases of the construction have been modelled and calculated in separate models. Two global models were created. The first one - a 3D model, which consists of 1D members in proposed geometry - was made for clarification of the torque, for the assessment of inner forces from support settlement, the superimposed dead load and climatic effects, and for determination of the bearings load. The second one is a 2D flattened model which consists of 1D members. It was made for time dependent analysis. The model reflects the rheology and loading history for the assessment of inner forces and deformations in specific time. For the shape modelling, the 1D member modeller was used with a Variable cross-section, General cross-section and Planar 2D members. Concrete designer modules were used for better time dependent behaviour understanding e.g. Post-tensioned tendons, a Prestress check and Time dependent analysis. The global analysis model is a 3D frame TDA model with beam elements respecting the proposed geometry. Cross-sections that are 1D member are defined as general cross-sections with a linear-variable connection. The piers are 1D members with a constant cross-section. The foundation details are calculated separately and in the global model are represented as an elastic support. The tendons are modelled using a Post-tensioned tendons module aid. Cantilever tendons in the upper plate of the deck and continuous tendons are applied as 1D member in real proposed geometry or in a flattened shape in a TDA model. The bearings are simulated as short 1D member with joints with specific material characteristics. In TDA a relevant displacement is released in a specific time. Temporary supports are rigidly connected to a balanced cantilever and in TDA they are also removed in specific time. The computation of inner forces is carried out with a standard linear calculation.

Software: Scia Engineer

Metrostav a.s. Division 4

Contact Martin Kulhavý
Address U Elektry 830/2b
19800 Prague 9, Czech Republic
Phone +420 266708503
Email kulhavy@metrostav.cz
Website www.metrostav.cz

Metrostav a.s. is a universal construction company, which commands a leading position in key segments of the Czech construction market and also in market expanses of foreign countries. The company traditionally holds a strong position in underground construction, public and residential buildings, industrial construction and transportation construction. It is a member of the multinational DDM Group.

Division 4 of Metrostav a.s. was founded in 2001 for the purpose of carrying out transport-related construction projects, particularly roads, motorways and railways including associated structures. Since 2003, the division has been collaborating with a bridge production plant owned by Metrostav a.s. on steel bridge structures and steel-composite bridges. An important technological advance took place in 2004, when Metrostav a.s. started delivering highway structures using its own capacities. Since 2006, the free cantilever technique has been developed in collaboration with the world's leading companies in the area of the development of casting carriages.

Project information

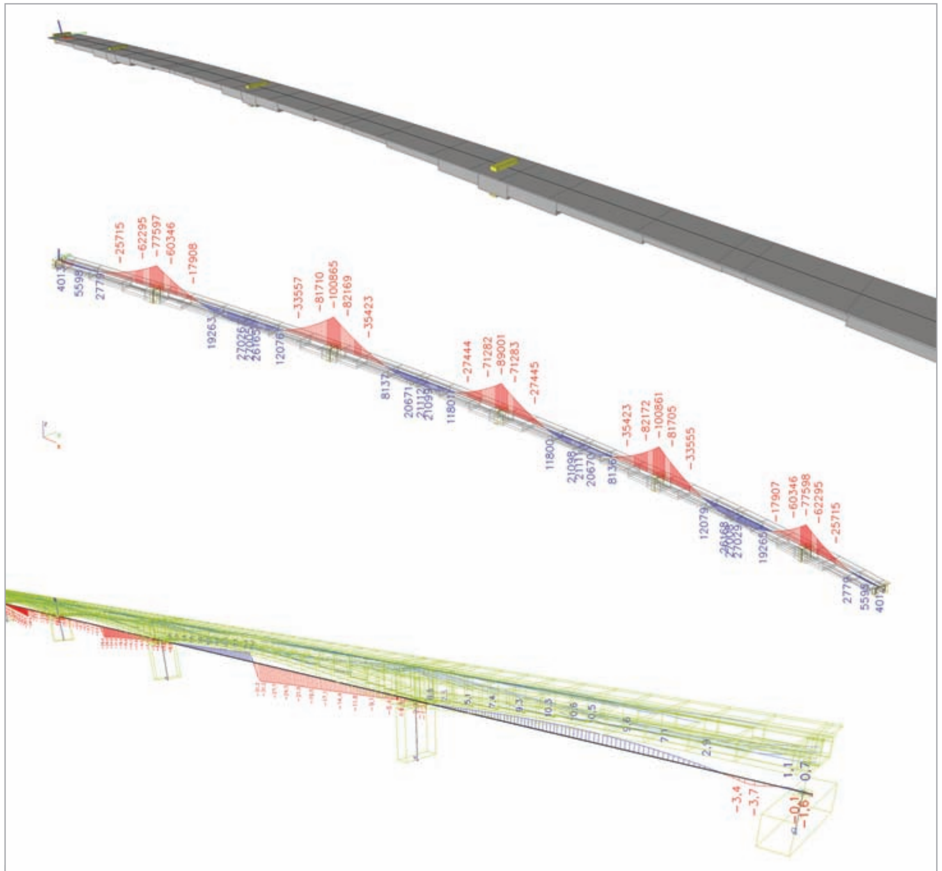
Owner	The Road and Motorway Directorate of the CR
Architect	Novák & Partner, s.r.o.
General Contractor	Metrostav a.s. Division 4
Engineering Office	Novák & Partner, s.r.o.
Location	Soběslav, Czech Republic
Construction Period	09/2008 to 08/2013

Short description | Bridge over Koberný Pond and a Wildlife Corridor

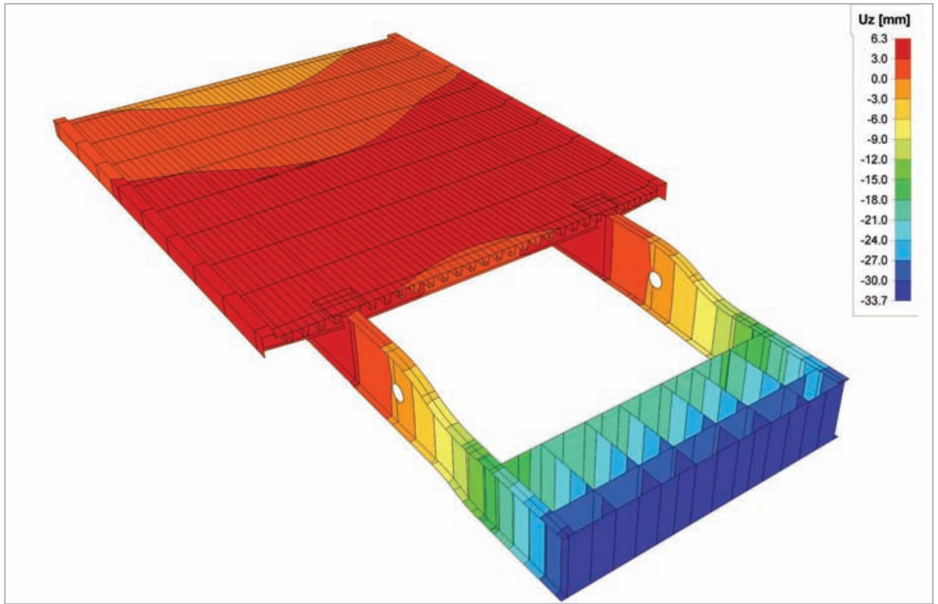
The Bridge over Koberný lake and a wildlife corridor at the 87,500 km point of the D3 motorway section running from Tábor to Veselí nad Lužnicí, with a total length of 552.8 m, is located in a non-built-up area which is used for agricultural and breeding purposes.

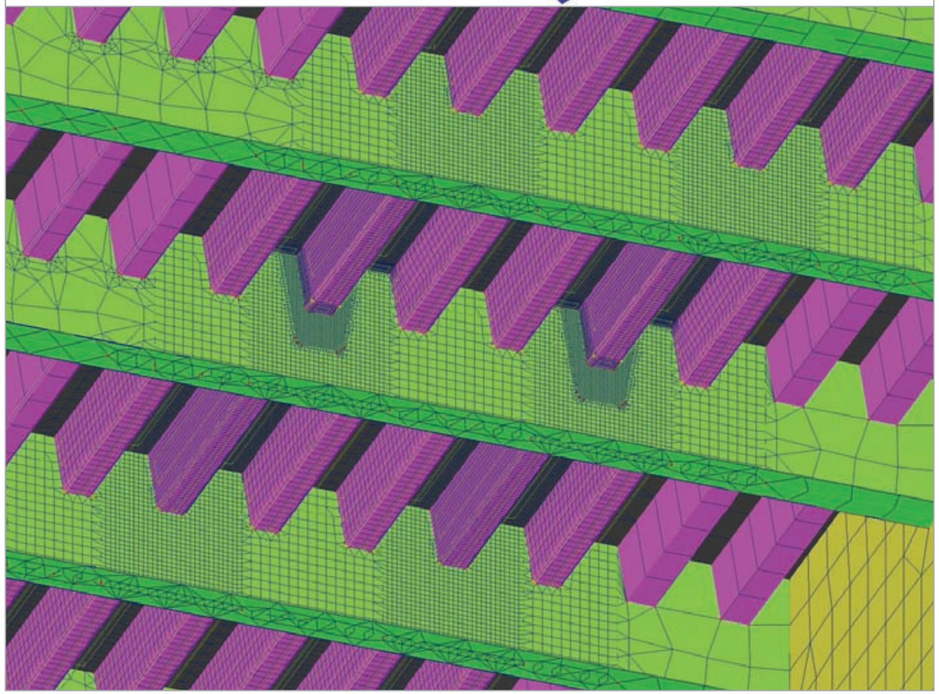
The motorway corresponds to the category D 27.5/120. The concrete pillars, with the cross-sections of 8.0 x 2.5 m, are founded on 19 30-metre piles 1.2 m in diameter.

Two pairs of casting carriages were used for the free-cantilever-method construction of the load-bearing structure of the box girder with the variable depth ranging from 2.69 m to 5.89 m. Casting of the girder proceeded symmetrically from 16-metre long balance arms.



“Ketelbrug” Movable Bridge - Ketelmeer, The Netherlands





Introduction to the Ketelbrug

The Ketelbrug is located at the A6 motorway crossing Ketelmeer between Lelystad and Urk in the Netherlands. The bridge has the total span of 800 m. A bascule bridge is incorporated.

The bridge consists of 2 carriageways, both on separate bridge decks, with 2 traffic lanes. On the east side there is also a connection for slow traffic. The height of the bridge is 13.1 m and it has a movable part on the south side.

The Ketelbrug is the property of Rijkswaterstaat (national road authority) and is one of the fourteen steel bridges which must be strengthened before 2018.

Since being put into service in 1970, the traffic has increased and the trucks become heavier. This increase is more than could have been provided for at that time. The heavier load has caused fatigue in the steel structure of the bridge. The renovation is intended to ensure the safety of the bridge deck.

The renovation of the Ketelbrug entails the replacement of the two moveable bridge decks and both accessory driving mechanisms, including the electrical systems. The renovation is in order to continue to guarantee smooth and safe flow on water and road. The goal of Rijkswaterstaat is to cause the least possible disruption for the traffic on the road and waterway. The replacement of the bridge deck must take place within a weekend.

The project

The steel structural part of the project consists of creating a new design for the existing bridge deck. The new design of the bridge deck must be equal to the existing one, hence a minimum of modifications was required to the existing sub-structure. This requirement leads to a new design within the existing situation. The new design must be in accordance with the current regulations (EuroCode).

The deck of the Ketelbrug is an orthotropic steel deck where the troughs are welded between the girders. The cross girders span approximately 8 m between the two main beams. The main girders span approximately 23 m between the main bearing and the front supports.

The use of Scia Engineer

The design of a bridge with a steel bridge deck is dominated by the fatigue assessment. For a good fatigue assessment, a very detailed model is needed. For this reason, the whole deck, including the counter weight, is modelled in Scia Engineer. The model is constructed entirely of plates. Locally, a very fine mesh is used to get detailed information.

To carry out a good fatigue assessment influence lines are needed. The influence lines are created with Scia Engineer by placing an axle load every 40 cm. This is done by using the function Traffic Loads (Lane Loads Manager). Furthermore, the result per load (axle load location) could be exported to a spreadsheet by using the detailed results in the mesh node. Finally, the fatigue assessment is realised.

Software: Scia Engineer

Movares

Contact Arjen Steenbrink
Address Postbus 2855
3500 GW Utrecht, The Netherlands
Phone +31 30 2655555
Email arjen.steenbrink@movares.nl
Website www.movares.nl

Movares
adviseurs & ingenieurs

From concept to completion

Movares is an engineering consultancy providing solutions in the fields of mobility, infrastructure, building and spatial planning. Usability, future value and sustainability play a major role in the designs we produce and the advice we give. We contribute to accessibility through our unique combination of expertise. With some 1,400 members of professional staff, Movares operates throughout Europe and has offices in the Netherlands, Germany and Poland.

Giving shape to mobility

Infrastructure is the backbone of development, both for society and the economy. From the initial studies and the earliest planning phases to the design and execution of projects through to management and maintenance, Movares plays an active role throughout the entire consulting and engineering process. Our combination of knowledge, expertise and innovativeness is summed up in our motto: 'Giving shape to mobility'.

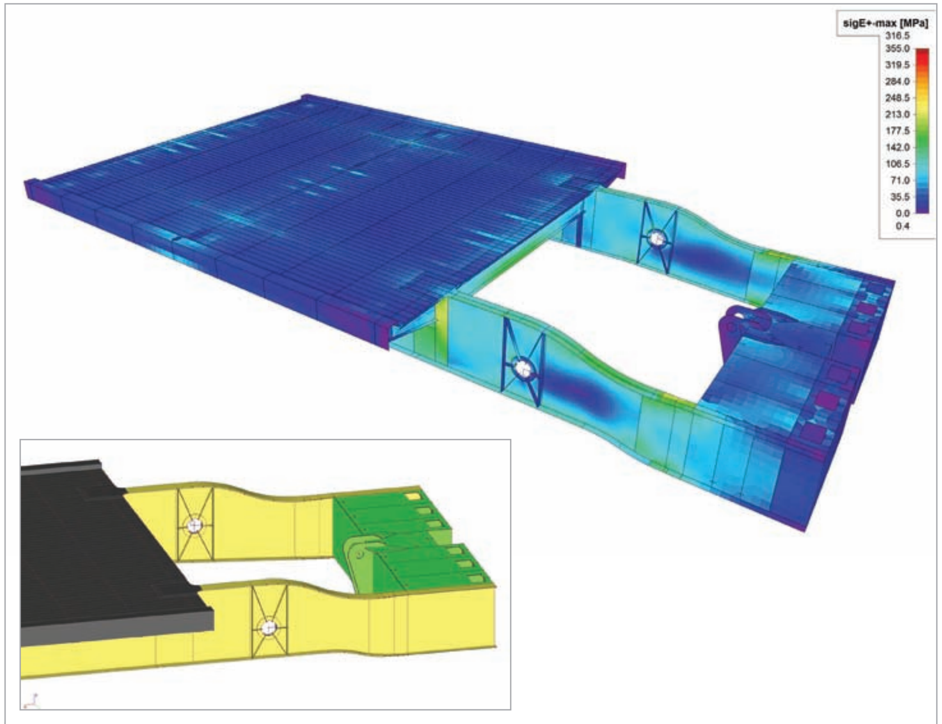
Project information

Owner	Rijkswaterstaat
General Contractor	BSB Staalbouw
Engineering Office	Movares Nederland
Location	Ketelmeer, The Netherlands
Construction Period	10/2012 to 03/2013

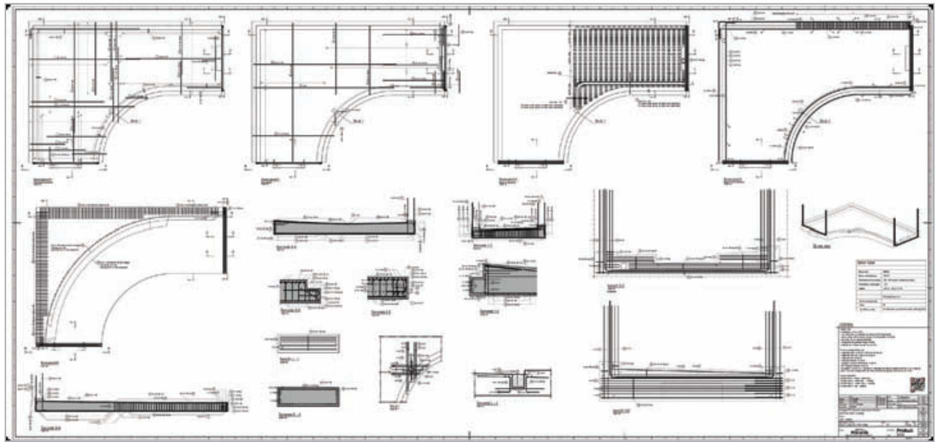
Short description | "Ketelbrug" Movable Bridge

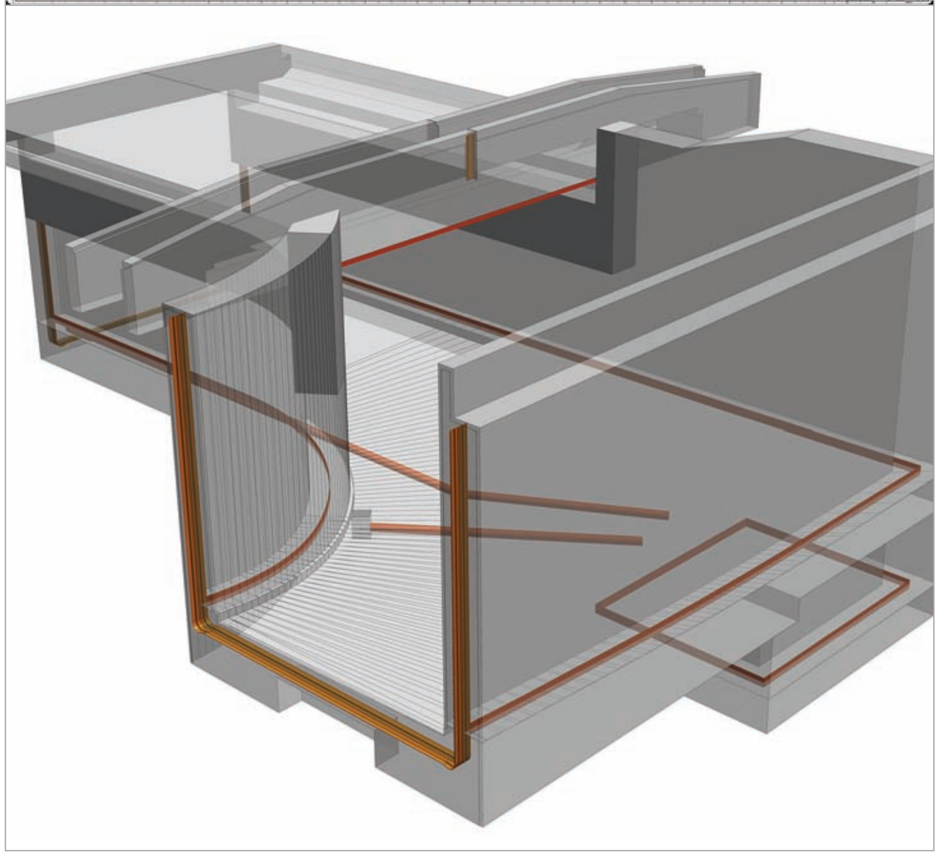
The Ketelbrug is a bridge with a bascule bridge incorporated. The existing bascule bridge has fatigue damage and needs to be replaced. In this project a new design for the existing bridge deck must be made. The design is an orthotropic steel deck and steel main girders with a span of 23 m. The replacement of the bridge deck must take place within a weekend.

The design of a bridge with a steel bridge deck is dominated by the fatigue assessment. This means a very detailed model, with a fine mesh, and a model made with only plate elements. From this model, influence lines could be exported and a fatigue assessment made.



Service Tunnel Station - Utrecht, The Netherlands





Background

The project Doorstroom (Thoroughfare) Station Utrecht (DSSU) includes optimising the current railway infrastructure on the site of Utrecht Central Station. Part of this plan is a service tunnel, which connects the public road with the southern rail yard. This underpass crosses four tracks and is built with minimum disturbance to normal train traffic.

On behalf of ProRail, the DSSU project is designed by Movares and will be executed by the contractors combination U-Central (BAM Rail and Volker Rail). The design phase includes the preliminary design, the final design and the implementation design.

Implementation

The service tunnel is made up of 8 segments. The tunnel ramps consist of 6 open tunnel segments parallel to the tracks. The junction with the train tracks consists of 2 partially closed segments. The partially closed segments include a section in which the road turns the corner at 90 degrees. Under segment 4 there is a pump basin for rainwater.

Due to the high water table a sheet pile pit is needed since lowering of the groundwater level is not permitted. After unearthing of the pit and the pouring of the underwater concrete the pit is drained. For driving the sheet pile along the tracks there is 1 train-free period of 52 hours available. To build segment 5 in its final location there will be approximately 7 months when 2 of the 4 tracks will be out of service. This segment can be built relatively simply without disturbing the rail traffic. On the other hand, segment 4 must be built during a train-free period. To that end, the deck west of the railway tracks will be built on top of the sheet piles and during a 52-hour train-free-period slid on to its final place. The deck is located temporarily on the sheet pile walls, which are part of the building pit. Afterwards, the pit under the deck is unearthed. Then underwater concrete is poured and drained after the concrete has been sufficiently cured and the finishing work can begin. This phase consists of building the pump basin, building the concrete walls and floor underneath the deck, when once again a train-free period in needed.

Finally, the sheet piling is disconnected from the newly built segment to ensure that all external forces will be distributed to the new segment.

Design

During the entire design phase engineering programs such as Allplan (drafting) and Scia (design) were used. The final design consists of a model where fabrication and reinforcement drawings can be generated. It is intended that this data can be transferred completely to the contractors combination U-Central so that information loss in the digital chain is reduced to a minimum.

The tunnel floor has both a longitudinal and transverse slope and goes through a bend in the tunnel. The floor reinforcement is orthogonal and follows the upper surface of the floor.

The project is designed in accordance with the latest European standards (EC2) and, where possible, the use of standard lengths of rebar.

Software: Allplan Engineering, Scia Engineer

Movares

Contact Gerrit van Kekem
Address Postbus 2855
3500 GW Utrecht, The Netherlands
Phone +31 6 2278 2213
Email gerrit.van.kekem@movares.nl
Website www.movares.nl

From concept to completion

Movares is an engineering consultancy providing solutions in the fields of mobility, infrastructure, building and spatial planning. Usability, future value and sustainability play a major role in the designs we produce and the advice we give. We contribute to accessibility through our unique combination of expertise. With some 1,400 members of professional staff, Movares operates throughout Europe and has offices in the Netherlands, Germany and Poland.

Giving shape to mobility

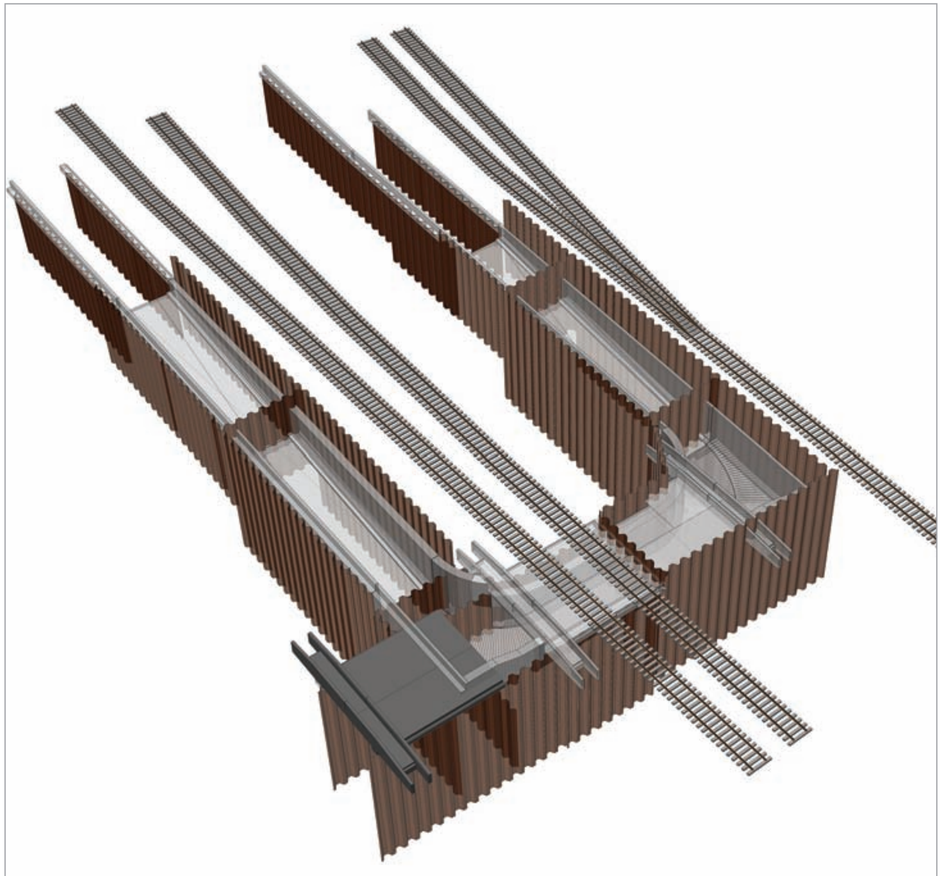
Infrastructure is the backbone of development, both for society and the economy. From the initial studies and the earliest planning phases to the design and execution of projects through to management and maintenance, Movares plays an active role throughout the entire consulting and engineering process. Our combination of knowledge, expertise and innovativeness is summed up in our motto: 'Giving shape to mobility'.

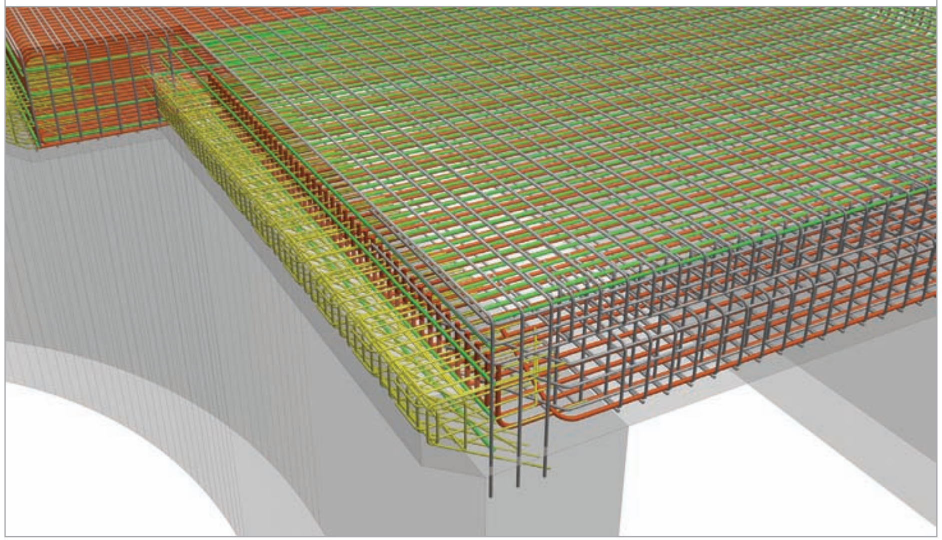
Project information

Owner	ProRail
General Contractor	Movares Nederland
Engineering Office	Movares Nederland
Location	Utrecht, The Netherlands
Construction Period	09/2013 to 10/2014

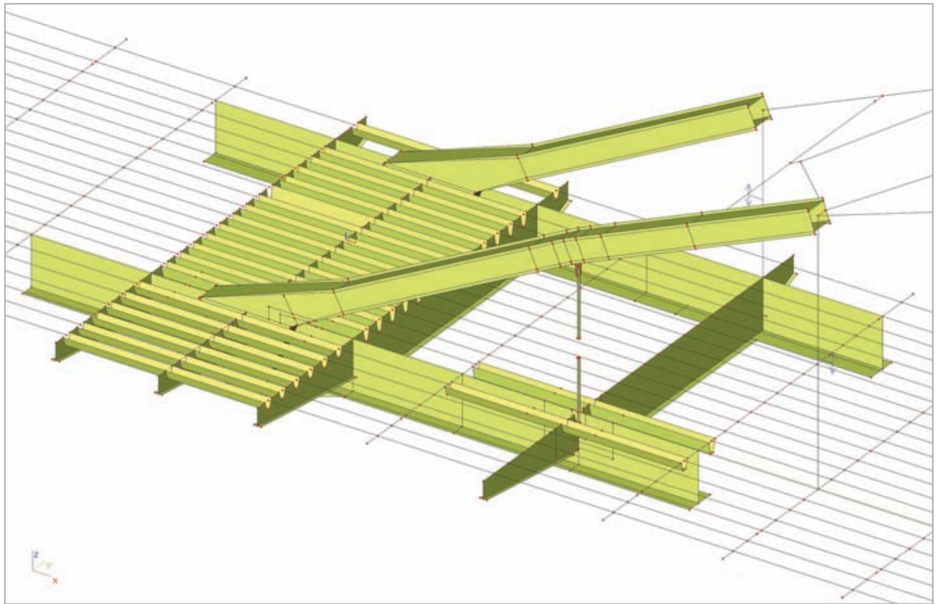
Short description | Service Tunnel Station

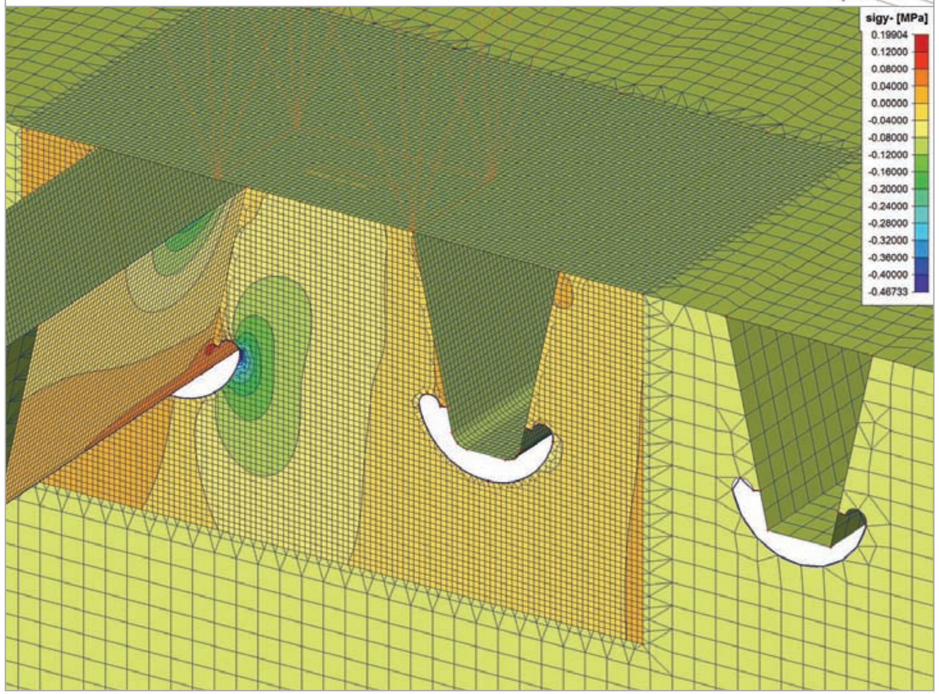
A part of the "DoorStroom Station Utrecht" (DSSU) project concerns a new free crossing between the railway and the area to the south of "Centraal Station Utrecht" and the public road. During the design process of "Diensttunnel", the BIM concept was applied to attain savings in costs and time in the building phase. This implementation consisted of the engineer, contractor and rebar company coming together and reaching agreement on what information was needed and how that information can be exchanged. In practice, this resulted in reusing design information and speeding up the process.





“Weesperbrug” Arch Bridge - Weesp, The Netherlands





The Weesperbrug is located south-east of Amsterdam and dates back to 1937. The bridge has the total length of 144 m, with a main span of 96 m. The bridge crosses the Amsterdam-Rhine Canal. The Amsterdam-Rhine Canal is one of the main waterways in the Netherlands. The canal is an important connection between the port of Amsterdam and the Ruhr in Germany, making it one of the busiest inland canals in the world. Rijkswaterstaat, the administrator of the canal, put out a request for a tender for the major maintenance and strengthening of its steel arch bridges, to guarantee a residual life of 30 years. The contractor decided to replace the old bridge with a new one, instead of pursuing lengthy and risky maintenance and reinforcement activities. The new bridge will have an orthotropic steel deck, whereas the old bridge has a concrete deck. Therefore, the new bridge weighs considerably less than the old bridge, so the concrete foundation can be reused.

The Weesperbrug is one of eight bridges in the maintenance project which will be replaced by the contractor. The method of exchanging the old for the new bridge will minimise the nuisance to shipping on the Amsterdam-Rhine Canal and the environment. The new Weesperbrug will be constructed at the works of the contractor in Gorinchem, located at the river Merwede. This location has an advantage for transportation because the bridge can be transported across the river, over the North Sea and through the North Sea Canal to its final location on the Amsterdam-Rhine Canal.

The use of Scia Engineer

The calculations for the design of the new Weesperbrug are made using Scia Engineer. Furthermore, the temporary situations of removing the old bridge and placing the new one have been analysed.

Different types of models have been made for different types of verifications. At first a main model has been made. This model consists of the steel deck in 2D elements and all the other elements in 1D members. This basic model is used for:

- Elaboration of forces in the main structure;
- Assessment of the main structure on the strength;
- Assessment of the main girders, arch and pendants on fatigue;
- Assessment of the (arch) stability;
- Assessment of dynamic (wind) effects on the pendants.

The arch stability is checked by finding the lowest buckling mode with corresponding n-value. These are used to calculate the critical buckling load and the buckling length, which were used in a buckling check in accordance with the Eurocode. For the dynamic wind effects on the pendants, a geometric nonlinear calculation was made for a realistic value of the stresses in the pendant at a certain amplitude.

The Weesperbrug has an orthotropic deck structure consisting of a steel deck plate with troughs as stiffeners. A sub-model consisting completely of fine-meshed 2D elements was integrated into the main model to analyse the fatigue life. To carry out a good fatigue assessment, influence lines are needed. These are created with Scia Engineer by placing an axle load every 40 cm. This is realised by using the function Traffic Loads (Lane Loads Manager). Furthermore, the result per load (axle load location) could be exported to a spreadsheet by using the detailed results in the mesh node. Finally, the fatigue assessment is realised in the spreadsheet.

In another sub-model the most important connections are modelled using 2D elements with a fine mesh. In this model the strength of these connections is assessed. Again, the sub-model is integrated into the main model for realistic preconditions and forces. The connections checked by using this model are:

- Arch - Pendant
- Pendant - Main girder
- Arch spring - Main girder

Since there is only a couple of hours’ time available to place the new bridge, it is placed in one piece from a pontoon on the canal. For some parts of the main girder this situation gives the largest stresses. In the main model the supports and loads are changed to verify all temporary situations.

Software: Scia Engineer

Movares

Contact Anne Blom
Address Postbus 2855
3500 GW Utrecht, The Netherlands
Phone +31 30 2655555
Email anne.blom@movares.nl
Website www.movares.nl

Movares
adviseurs & ingenieurs

From concept to completion

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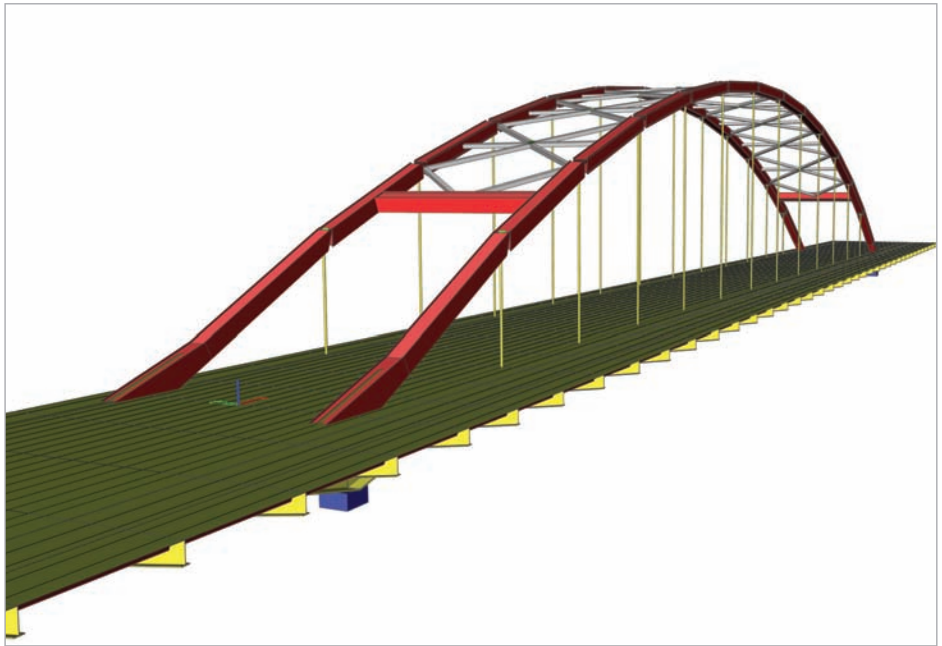
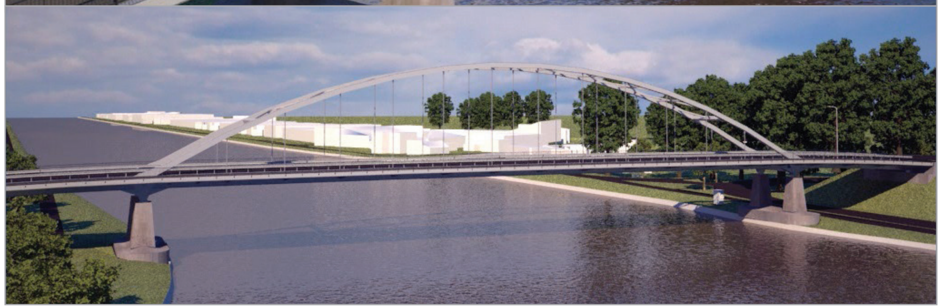
Project information

Owner	Rijkswaterstaat
Architect	Studio SK
General Contractor	Mercon Steel Structures
Engineering Office	Movares Nederland
Location	Weesp, The Netherlands
Construction Period	10/2012 to 06/2013

Short description | “Weesperbrug” Arch Bridge

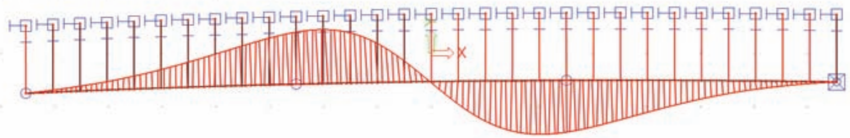
The Weesperbrug is located east of Amsterdam and dates back to 1937. The bridge has the total length of 144 m, with a main span of 96 m. The bridge crosses the Amsterdam-Rhine Canal. The contractor decided to replace the old bridge with a new one, instead of pursuing lengthy and risky maintenance and reinforcement activities. The new bridge will have an orthotropic steel deck, whereas the old bridge has a concrete deck. Therefore, the new bridge weighs considerably less than the old bridge, so the concrete foundation can be reused. Scia Engineer has been used throughout the project. A main model is used for strength verifications and fatigue calculations of the main bearing structure. This model is also used for the stability calculations of the arch. Detailed models have been implemented in the main models for verifications of strength of connections and the fatigue life of the orthotropic steel deck.



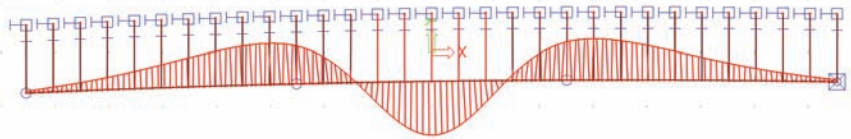


Footbridges of the “Smedenpoort” - Brugge, Belgium

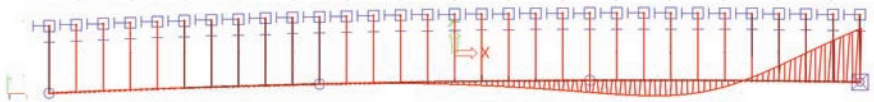
Stability combination S1, Buckling mode 1

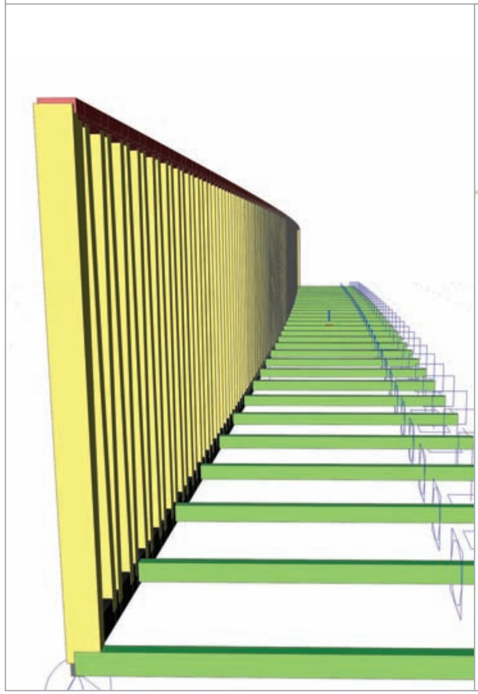


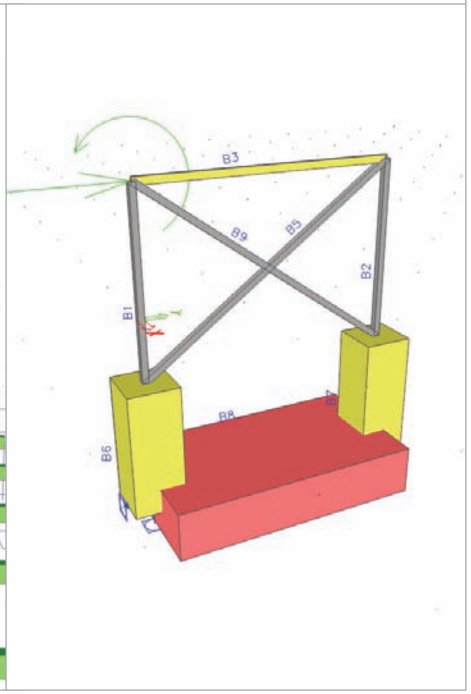
Stability combination S1, Buckling mode 2



Stability combination S5, Buckling mode 1







Programme

Architectural project and stability study.

Context

The Smedenpoort (“The Gateway of the Blacksmiths”), one of the four remaining heritage-listed gateways of the City of Bruges, and built in the 13th century, became a bottleneck. The gateway was too narrow to allow for a fluid traffic of cars, pedestrians and cyclists. The City of Bruges decided, under the supervision of the Commission for Monuments and Landscapes, to add new footbridges on both sides of the existing heritage monument.

Project description

The two footbridges have a width of 2.5 m. The overall lengths are 62.6 m for the southern footbridge and 57.2 m for the northern footbridge, with the radius being 253.5 m. Except for the position of the abutments and bracings, the two bridges are identical. The effective spans are reduced to 5 m between each supporting column, which corresponds with the spans of the existing bridge across the fortification canal.

The new footbridges had to respect the strong historic presence of the surroundings. The path has been conceived as an element that embraces the existing bridge and gateway, offering respect to the old monument.

The structure is constructed with weathering steel and the walking surface is made of prefabricated concrete tiles. The use of steel bars instead of hollow sections and the used details refer to handcraft.
The structural elements have a reduced dimension due to the large number of supports and the structural use of the railing. This results in a filigree structural design, with the railing a mix of a Warren truss and a Vierendeel truss. The pattern of the vertical bars of the railing is developed according to the internal forces in the truss, optimising the material use. The horizontal stiffness is provided by the bridge deck forming an arched lattice, with the concrete tile work as compression struts.

Structural analysis

For the bridge calculation, the choice was to split the three-dimensional structure into two-dimensional pieces, on the one hand to simplify the modelling, and on the other hand to maximise the direct insight into the results. This split was made possible by the structural concept and the connection between the different elements.

A first model consisted of three spans of the structural railing. In addition to this, models were made for an individual column, the abutments with bracings, the cross-beam and the concrete tile. To enable the checking for instability of the structural railing, the first 2D-model was extended to 3D with half of the crossbeams and other supporting conditions applied. Finally, another 2D-model to check the horizontal stability of the bridge deck structure was made with the bridge deck consisting of cross-beams and concrete tiles.

Modelling with different small calculation models allows for a good insight but requires a good exchange of reaction forces and supporting conditions. The ‘Productivity toolbox’ functionality proved to be very useful for this project. Calculation results (such as internal forces) for the different models were exported in numerical values, so that they could be combined to make a global envelope or imported afterwards as loads in the other models. ‘General Cross Section’ was used to model the steel handle with the reservation for the integrated Led-line.

Due to the slenderness of the whole structure, the railing had to be checked for buckling and the bridge deck (an arch in the horizontal plan) for pedestrian-induced vibrations. Therefore, the stability was analysed with the ‘Stability analysis’ functionality. A modal analysis was carried out using the ‘Dynamics’ functionality. A good estimation of the supporting stiffnesses was essential.

Software: Scia Engineer

Ney & Partners

Contact Bart Bols
Address Terhulpsesteenweg 181
1170 Brussels, Belgium
Phone +32 2 6432180
Email bbo@ney.be
Website www.ney.be

Ney & Partners is a structural engineering consultancy, established in Brussels. Since its creation in 1997, the office has worked with a pro-active view on the art of engineering through the integration of the different civil works disciplines.

This integration and optimisation of structural elements aims to overcome the classic hierarchic assembly of constructive solutions. Innovative bridges, roof structures and works of art developed by our office most clearly express this vision.

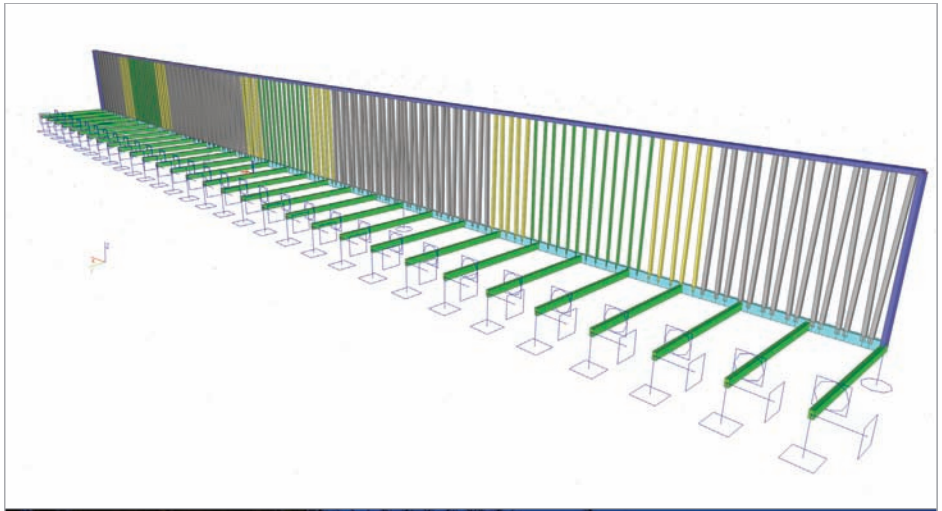
The construction project quality lies in the synthesis of specific design constraints. The structural aspect is of primary importance to this synthesis. From the very beginning of the design process, Ney & Partners conducts constant research for advanced engineering integration. In doing so, our position as an engineering consultancy goes beyond the standardised dimensioning of predefined technical solutions. Ney & Partners currently employs more than 45 civil engineers, architects and draughtsmen.

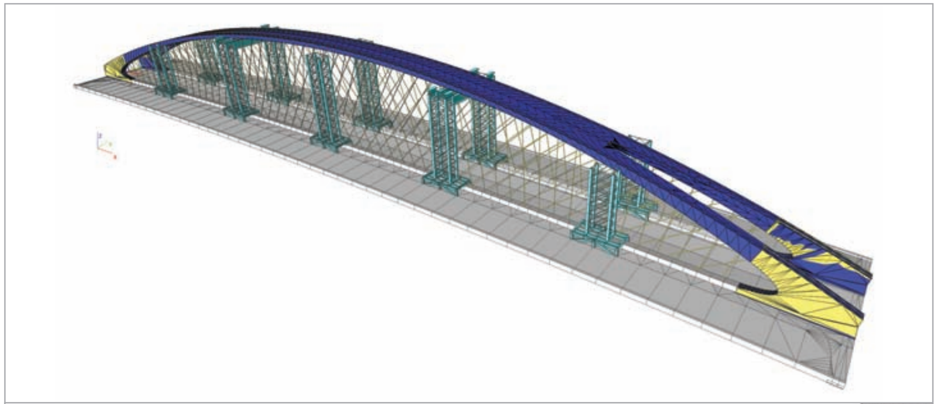
Project information

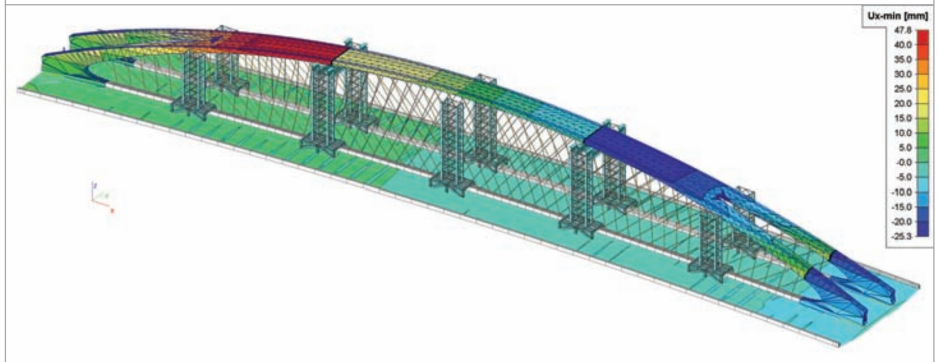
Owner	City of Bruges
Architect	Ney & Partners
General Contractor	Depret nv
Engineering Office	Ney & Partners
Location	Brugge, Belgium
Construction Period	06/2011 to 07/2012

Short description | Footbridges of the “Smedenpoort”

With total lengths of 62.5 m and 57.2 m, respectively, the footbridges at the Smedenpoort in Bruges provide a safe passage for pedestrians embracing the listed gateway. Weathering steel is used for the main structure; concrete tiles form a bridge deck that is 2 m wide. To minimise the dimensions of the structural elements and maximise the transparency of the structure, the railing and bridge deck become structural and the spans are reduced. The position and dimension of the railing bars is determined by a pattern. Each 5 m section of the bridge is supported by a small column. The footbridges embrace the gateway with their curved trajectory and, at night, with light-emitting diodes integrated into the handrail of the outer railing.







Introduction and description of the bridge

The client, the City of Prague, announced the architectural competition in 2006. The winning project was submitted by the Mott MacDonald company together with the Roman Koucký architectural office. The construction process for this structure began in the summer of 2010. The general contractor for the bridge was Metrostav a.s., while the designer of the steel structure was Excon a.s. Novák & Partner Ltd. company was the designer of the incremental launching of the construction process and the temporary structures used for the construction process. Under the terms of the project supervision for the contractor, we also performed a lot of computational analysis of the structure with respect to all the construction stages.

The structure of the new Troja Bridge crosses the Vltava River in a northern part of Prague city centre. It connects the central part of the city with the city ring road. The bridge has two spans. The main span, 200.4 m in length, crosses the river, while there is a side span of 40.4 m in length. The bridge should open in 2013. The main span is crossed by a steel network arch, which is extremely flat (the rise/span ratio is 1/10), and by the suspended tied concrete deck. The bridge carries two tram tracks, four road lanes and two pedestrian lanes. The steel arch has a multiple box section at the midspan. The section splits into two legs close to the supports. The arch footings are fixed to the concrete deck and to the last massive in situ cast transversal beam. Due to the extreme load, the footings are filled with self-compacting concrete. The main span concrete deck is composed of a thin in situ cast slab, with a typical thickness of 280 mm. The deck is stiffened by precast prestressed transversal beams, which are only 500 mm wide and almost 30 m long, with a weight of 50 tonnes. They are suspended by tied network hangers. In the longitudinal direction, the deck is only stiffened by two arch ties with a composite cross section. The inclined hangers are in the diameter range of 76-105 mm. They have a pin and fork connection at the ends to the tie and to the arch. Each transversal precast beam is prestressed by two cables with nine strands. The concrete bridge deck is heavily prestressed. The transversal prestressing tendons are composed of four strands (15.7 mm) in flat ducts. The longitudinal prestressing is rather complex. Six cables with 37 strands are located in each composite tie. The slab is prestressed by a number of cables with 7 to 22 strands. The pedestrian stripes are located on the steel cantilevers, which will be attached to the edge stiffening concrete beam of the bridge deck.

The side span is a single span completely in situ cast prestressed concrete structure.

Construction stage analysis and global supervision analysis

For the understanding of the response of the structure during the construction process several mathematical models were compiled. The simplest 2D beam model, where all the structure parts were modelled by the beam elements, was primarily used for TDA module analysis of the construction process, taking into account the effect of creep and shrinkage. The other models were rather more complex. In the case of the main 3D model, it was mainly planar 2D elements that were used; only for hangers and the temporary truss beam elements were used. For this model, 11,569 planar elements, 4,719 beam elements with 107 cross sections, 19,089 nodes, 7 materials and 107 load cases were defined. This model was used for the global static, dynamic, non-linear (geometric and material non-linearity) and non-linear stability analysis. The model served also as the basis for the detailed design of the structure's aerodynamic stability. In the calculations of geometric nonlinearity, a solution was considered according to the theory of the second order. The nonlinear solution of suspension elements with an axial tensile force was made with respect to the tension stiffening theory. All the results were compared with simplified calculations on models for which exact analytical solutions are known. Bridge hangers were modelled as nonlinear beam elements with sag able to only transmit tensile axial forces. The main 3D mathematical model of the bridge structure was also used for the analysis of the dynamic effects of moving loads.

Software: Scia Engineer

Novak & Partner, Ltd.

Contact Lukáš Vráblík
Address Perucka 2481/5
12000 Prague 2, Czech Republic
Phone +420 221592053
Email vrablik@novak-partner.cz
Website www.novak-partner.cz

Novák & Partner Ltd. was founded in July 1992 and initially dealt with bridge design only. Later on, the company expanded its engineering activities with general and special structural analysis, the design of road structures and environmental studies. The company provides full design and engineering services from conceptual preparation up to the provision of implementing documentation, the author's supervision, engineering activities, negotiation with public authorities, and expert consulting and bridge inspection services. We provide services to customers from the Czech Republic, Slovakia, Germany, Denmark, the Netherlands, Austria, the USA and Russia. Since 2003, the company has operated as part of the VALBEK Design group. At present, more than 30 employees work for the company as well as a number of permanent external specialists and students from CTU in Prague, including those specialised in foundation engineering, general engineering activities and budgeting. The company has won many awards, e.g. "The Dancing House of Prague", "Tramway Bridge Hlubocepy - Barrandov, Prague", "Bridge over Berounka valley, Prague".

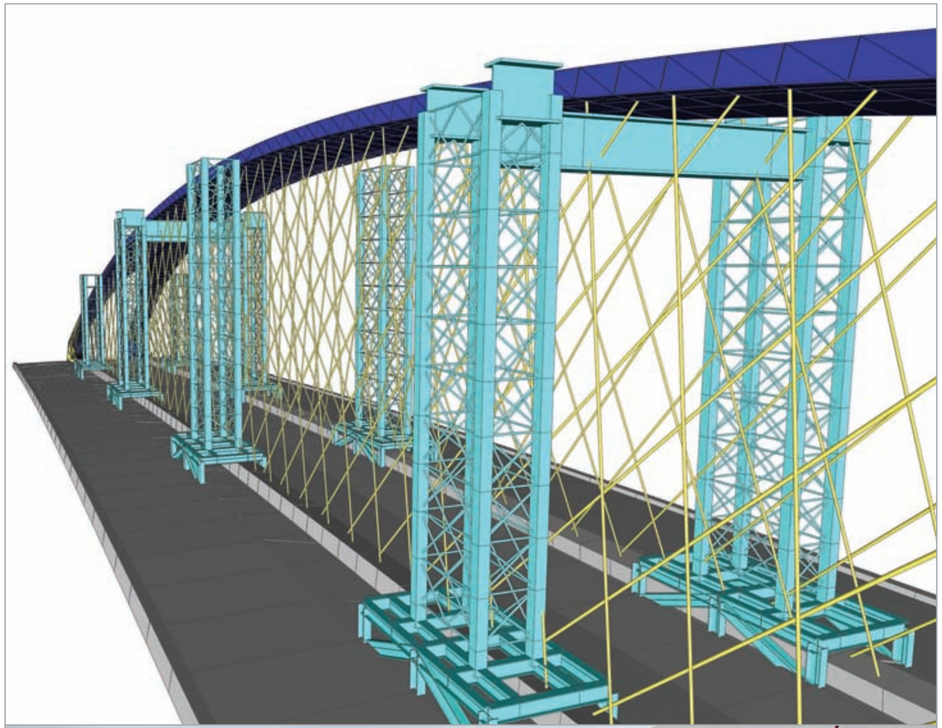
Project information

Owner	Capital City Prague
Architect	Roman Koucky, Libor Kabrt
General Contractor	Metrostav a.s.
Engineering Office	Mott MacDonald a.s.; Excon a.s.; Novak&Partner Ltd.
Location	Prague, Czech Republic
Construction Period	09/2010 to 12/2013

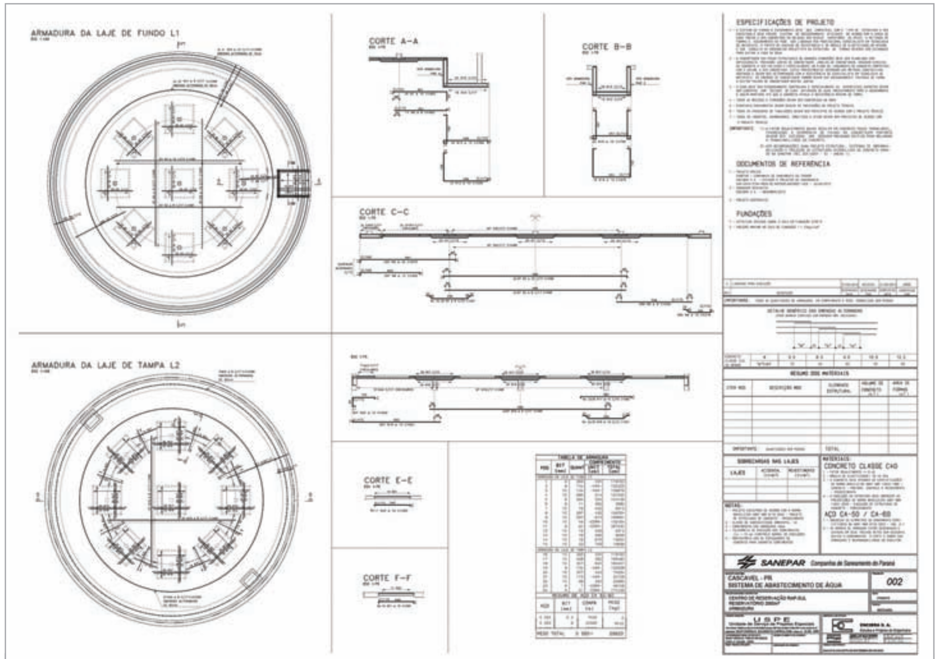
Short description | New Troja Bridge over Vltava River

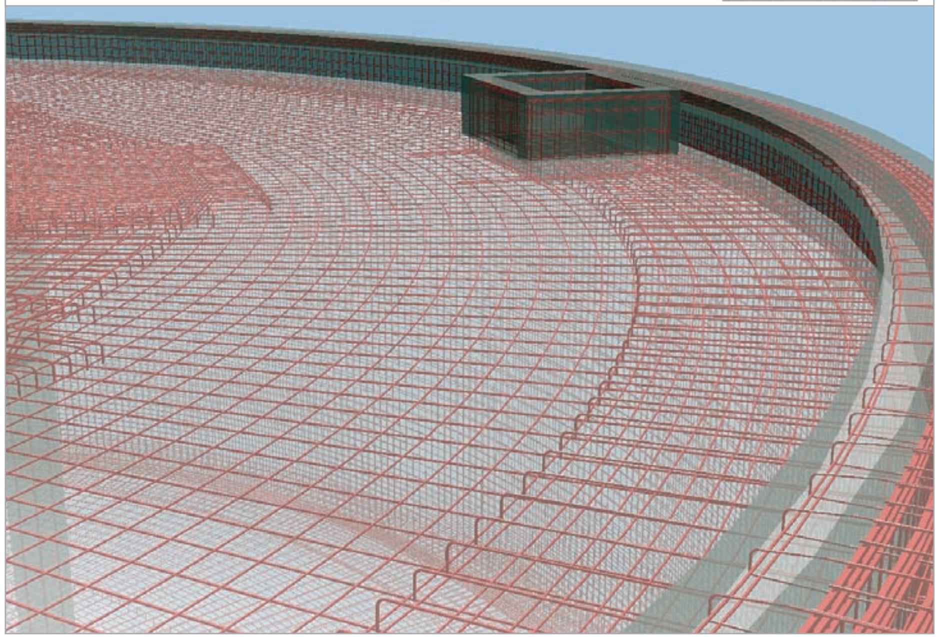
The structure of the new Troja Bridge crosses the Vltava River in the northern part of the city centre. The bridge has two spans - the main span that crosses the river is 200.4 m in length and the side span is 40.4 m in length. The main span is crossed by a steel network arch, which is extremely flat (the rise/span ratio is 1/10), and by a suspended tied concrete deck. The side span is a single span completely in situ cast prestressed concrete structure.

The conclusive structural behaviour and construction process of the bridge is very complex and difficult. It was necessary to deploy many computational models for simulation and the prediction of structural behaviour. The results from mathematical simulations were continuously compared with the results of measurements and computational models were continuously updated.



Supported Tank 2,000 m³ Cascavel - Paraná, Brazil





The tank is a monolithic structure in reinforced concrete, supported directly on the ground, for the storage of treated water. Its capacity is 2,000 m³. As the water is treated with chlorine, the internal environment of the tank is extremely aggressive due to the presence of chlorine gas in the air cushion between the water surface and the lower face of the tank lid. Due to the presence of the chlorine gas, a flat slab with capitals was chosen as the tank lid to avoid the formation of a gas retention chamber under the lid with the enhancement of the aggressive effect on the structure. Another design challenge was to adapt the tank to ground conditions to obtain a more economical solution in the direct foundation (raft), within the limits of the admissible soil tension.

Structure Description

The tank has an inner diameter of 22.00 m and a height of 5.37 m. The bottom slab, which acts as a raft, has a thickness of 20 cm, with the capitals thickness of 30 cm and dimensions of 2.40 m x 2.40 m under the columns. Along the outer circumferential wall, the bottom slab thickness is increased to 30 cm, with a width of 1.00 m. This forms an outer flange cantilevered projection 50 cm beyond the outer face of the wall. This flange has the function of reducing the contact pressure between the structure and the foundation soil beneath the exterior walls. The nine columns have internal dimensions of 30 cm x 30 cm, with eight of them radially distributed and one central column. The tank lid is 20 cm thick, supported by columns via capitals with a thickness of 30 cm and dimensions of 2.40 m x 2.40 m. The entire structure has been designed in reinforced concrete.

Standard Codes Applied

Eurocode (Scia), NBR-6118:2003 - Design of concrete structures, NBR-6120 - Loads for calculation of edification structures and other Brazilian norms.

Exposure Class, Materials and Concrete Cover

According to Table 6.1 of NBR-6118, the structure is classified as aggressive with a very strong risk of structural deterioration, Class IV Environmental Aggression. According to Table 7.1 of the same norm, Class C40 concrete with a water/cement ratio mass ≤ 0.45 was adopted. According to Table 7.2 and specifications of the contractor, all of the adopted concrete covers are 45 mm. The used steel was CA-50.

Loads considered

The loads applied to the bottom slab were 5.37 tf/m², equivalent to a height of 5.37 m of water and a constant load of 0.25 tf/m² for adjustment and trims. A permanent load of 0.25 tf/m² for the settlement and trims and an accidental load of 0.15 tf/m² were applied to the tank lid.

Modeling and Analysis

The structure was modelled in 3D Scia. Various stress diagrams, areas of rebar and contact stresses of the model were obtained. After some adjustments to the dimensions of the structure and soil parameters, the final model was settled and it provided parameters for the design and detailing of the structure. According to the diagrams of the contact stresses, the maximum tension in the soil reached a value of around 1.00 kgf/cm².

Design and Detailing

From the information obtained from Scia, the design of the reinforced concrete members conducted by the Eurocode program were checked using the criteria and requirements of the Brazilian standard for critical sections, making sure of the compatibility between standard norms. After the definition of the design of the structural parts, the detailing of the most important pieces was made and the general criteria of drawings from other parts were established. This information was relayed to the engineer responsible for the use of Allplan, who developed all the detailing of all the reinforcement in the program. Scia proved a powerful tool that caters for issues such as the reliability of results and productivity gains. There is great ease in the creation and display of input data as well as results obtained by the settable graphical user choice. The interpretation of results is quite intuitive and interactive.

Drawing and final presentation

With all the reinforcement detailed in Allplan 3D, specific drawings were developed for each structural piece as forms and reinforcements.

Software: Allplan Engineering, Scia Engineer

proCalc Associated Engineers

Contact Jorge Silka
Address Rua Grã Nicco, 113, Conjunto 504, Bloco A
81200-200 Curitiba, Brazil
Phone +55 11 3285 2001
Email silka@procalc.com.br
Website www.procalc.com.br

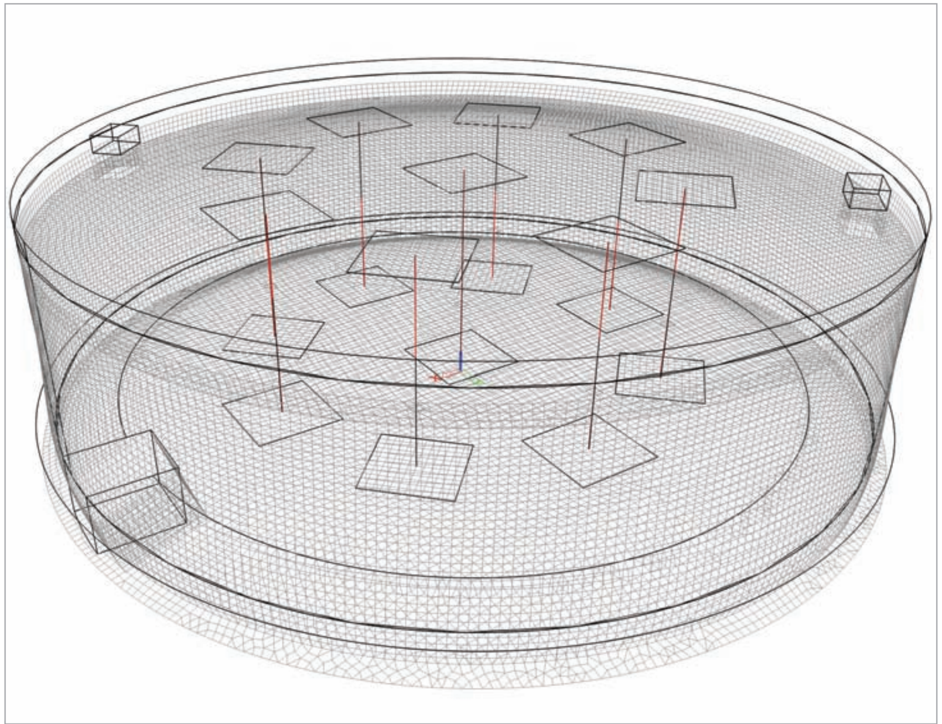
Origin: The company proCalc Associated Engineers was founded in August 1989, in Curitiba, Paraná, Brazil, as proCalc Structures Ltd.
Objective: Project development of structures in reinforced concrete and prestressed in general; prefabricated structures and structural masonry projects.
Quality: We apply the extensive experience of our professionals, in tandem with technological resources, for the careful study of structural solutions. We always seek the best technique, economy and ease of execution. We always look for and adopt the most modern resources of an international level in programmes for structures.
Products: We operate in the following areas: residential, commercial and corporate projects, high-rise buildings, industrial, sanitation and buildings for public works, reports, investigations, structural reinforcement projects and project reviews.
Collection: We have designed more than 2,500,000 m² of building structures, over 400,000 m³ of reservation capacity in sanitation and more than 500,000 m² of industrial structures.

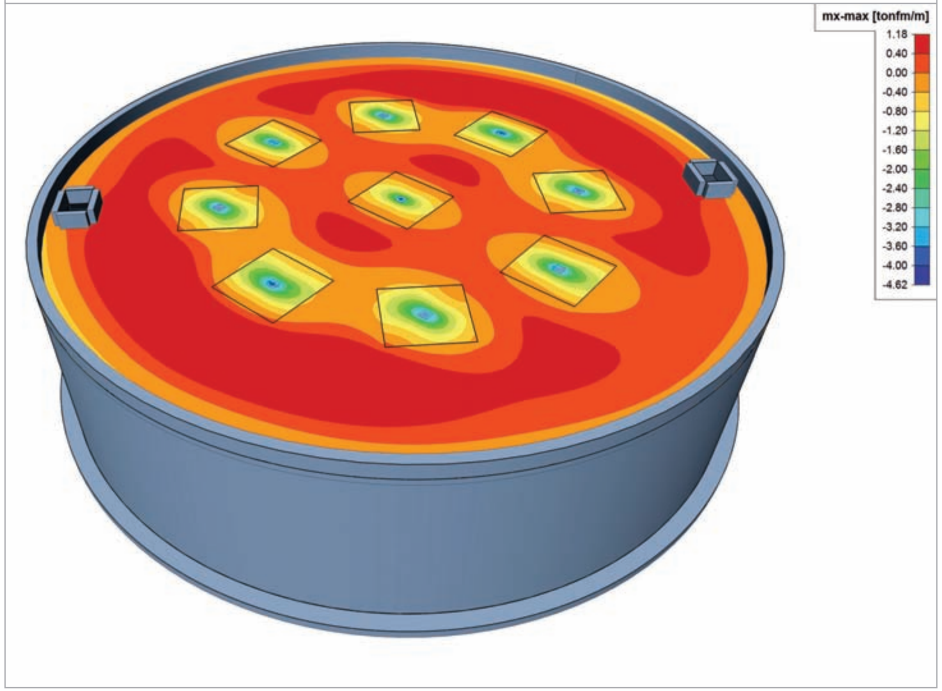
Project information

Owner	Companhia de Saneamento do Paraná - SANEPAR
Architect	Companhia de Saneamento do Paraná - SANEPAR
General Contractor	Encibra S.A. - Estudos e Projetos de Engenharia
Engineering Office	proCalc Engenheiros Associados S/S
Location	Paraná, Brazil
Construction Period	01/2014 to 01/2016

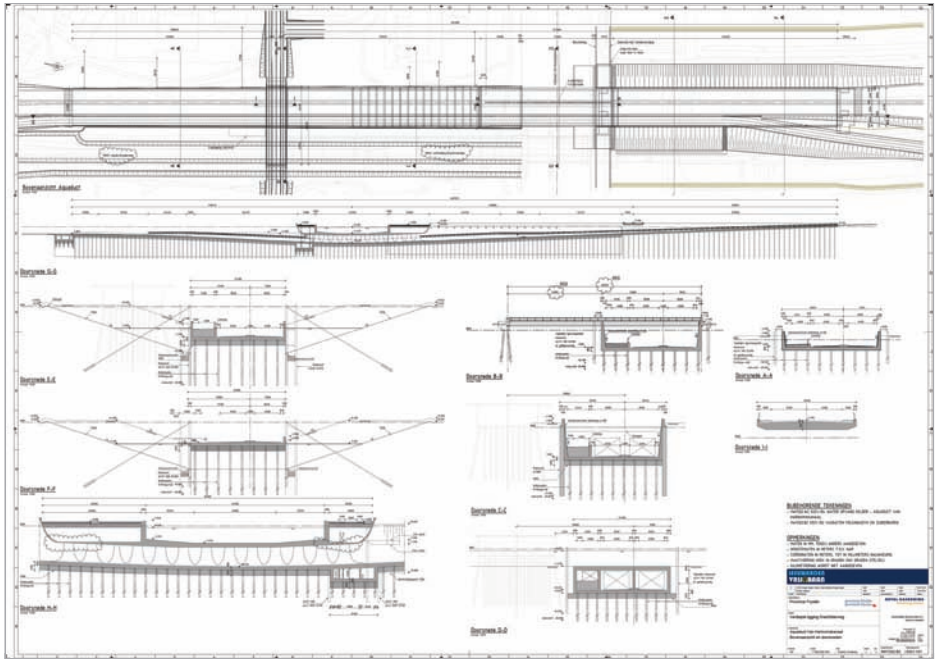
Short description | Supported Tank 2,000 m³ Cascavel

The tank is a monolithic structure in reinforced concrete, supported directly on the ground, for the storage of treated water. Its capacity is 2,000 m³. As the water is treated with chlorine, the internal environment of the tank is extremely aggressive due to the presence of chlorine gas in the air cushion between the water surface and the lower face of the tank lid. Due to the presence of chlorine gas, a flat slab with capitals was chosen as the tank lid to avoid the formation of a gas retention chamber under the lid, wit the enhancement of the aggressive effect on the structure. Another design challenge was to adapt the tank to the ground conditions to obtain a more economical solution in the direct foundation (raft), within the limits of the admissible soil tension. In association with a team of geotechnical professionals, the solution found was to replace and improve the soil layers to obtain the admissible tension from the tank model within the economic viability of its execution.





Verdiepte Ligging Drachtsterweg Inclusief Aquaduct - Leeuwarden, Nederland



Het project

De Drachtsterweg aan de zuidkant van Leeuwarden is een belangrijke invalsweg voor verkeer vanuit de richting Drachten en Groningen. Momenteel kruist de weg het Van Harinxmakanaal via een beweegbare brug. De weg ligt op of boven maaiveld, is grotendeels omgeven door bebouwing en wordt gekruist door enkele lokale wegen.

Met het project Drachtsterweg, dat wordt uitgevoerd in opdracht van de provincie Fryslân, wordt de weg over circa 1 kilometer lengte verdiept aangelegd. De weg kruist het kanaal straks via een aquaduct en alle kruisingen met lokale wegen en fietspaden worden ongelijkvloers. Bovendien worden er twee sloepenroutes gerealiseerd. De bestaande Drachtsterbrug over het Van Harinxmakanaal zal worden gesloopt.

In opdracht van de provincie Fryslân heeft Royal HaskoningDHV het contract en referentieontwerp opgesteld en de aanbesteding van het werk verzorgd. Eind januari 2013 is het werk gegund aan Heijmans, waarmee voor Royal HaskoningDHV de contractbeheersfase is gestart. De uitvoering van het project loopt tot begin 2016. Het ingezonden model is het referentieontwerp, het uitvoeringsontwerp wordt door Heijmans uitgewerkt.

Multidisciplinair ontwerpproces

Het ontwerp voor dit project betreft een multidisciplinair ontwerp, waarbij het ontwerp van de weg, omgeving, civiele constructies en grondbalans met behulp van systems engineering worden uitgewerkt. Bij het opstellen van het referentieontwerp is er met verschillende softwarepakketten samengewerkt, om zo alle facetten van het ontwerp zo inzichtelijk mogelijk te krijgen. De ontwerpinformatie (objecten) vanuit Allplan en MX worden gedeeld met GIS en gelinkt dmv Relatics aan de proces- en projectinformatie (eisen, functies, risico's etc.). Ook is deze informatie gedeeld met vormgevers voor het maken van visualisaties.

Aquaduct

Eén van de kunstwerken binnen dit project is het aquaduct, waarmee de Drachtsterweg het Van Harinxmakanaal kruist. De Drachtsterweg bestaat uit 2 x 2 rijstroken, een fietspad en een voetpad. De toerit aan de noordzijde begint vanaf het Drachtsterplein met een open bak en na het kruisen van het viaduct Weideflora wordt de open bak ondersteund door stempels. Vóór het kruisen van het kanaal is een groenzone ter hoogte van het maaiveld gecreëerd "groene overkluizing". Na het kruisen van het kanaal, en het ten zuiden daarvan gelegen fietspad, begint de zuidelijke toerit. Het eerste, diepe deel van deze toerit bestaat uit een combinatie van opstaande wanden en daarboven een groen talud, met een folieconstructie onder de taluds. Meer naar het zuiden gaat deze constructie over in een volledige folieconstructie, welke doorloopt tot voorbij het knooppunt Himpenserdyk.
In dit deel worden twee fietsviaducten en het viaduct Himpenserdyk onderlangs gekruist.

Software: Allplan Engineering

Contact Anne Slomp
Address Entrada 301
1096 ED Amsterdam, The Netherlands
Phone +31 205697700
Email anne.slomp@rhdhv.com
Website www.royalhaskoningdhv.com

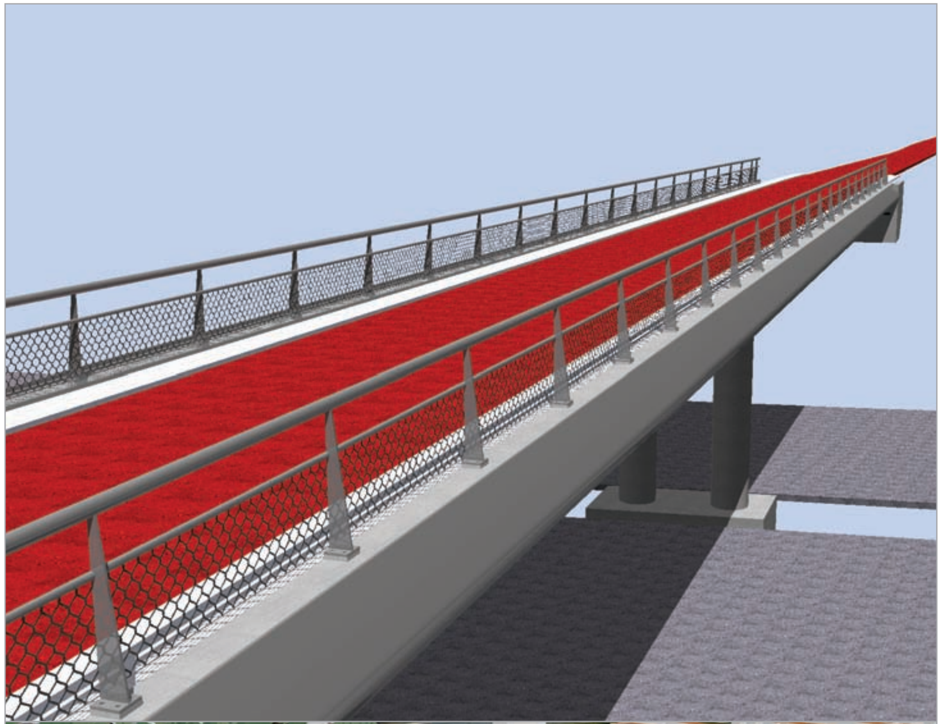
Royal HaskoningDHV is een vooraanstaande, onafhankelijke en internationale dienstverlener op het gebied van projectmanagement en engineering consultancy. Per jaar werken haar specialisten aan zo'n 30.000 projecten op het gebied van planning en transport, infrastructuur, water en watermanagement, maritiem, luchtvaart, industrie, energie, mijnbouw en gebouwen. Samen met haar internationale netwerk aan kantoren levert Royal HaskoningDHV lokaal eersteklas oplossingen voor klanten over de hele wereld, in zowel de publieke als de private sector.
Met 8.000 werknemers werkt Royal HaskoningDHV in meer dan 30 landen aan uitdagende projecten. Daarbij zit de meerwaarde met name in kennis van de lokale markt en de daar geldende omstandigheden: Royal HaskoningDHV levert regionale, professionele diensten via het gezamenlijke, volledig geïntegreerde internationale kantorennetwerk.

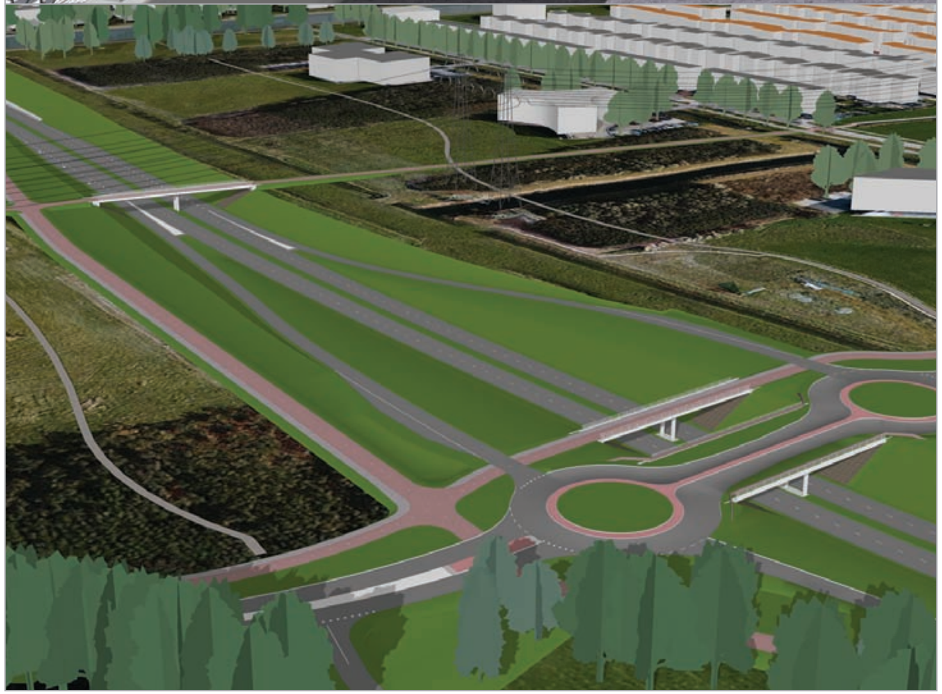
Project information

Owner	Provincie Fryslân
Architect	My BackYard Landschapsarchitectuur
General Contractor	Heijmans
Engineering Office	Royal HaskoningDHV
Location	Leeuwarden, The Netherlands
Construction Period	01/2013 to 01/2016

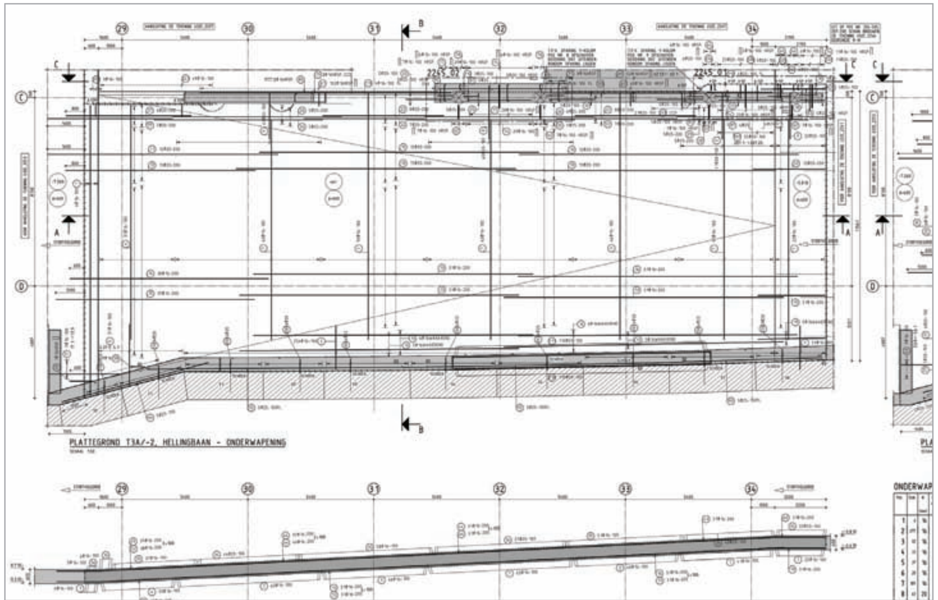
Short description | Deepened Location Drachtsterweg Including Aqueduct

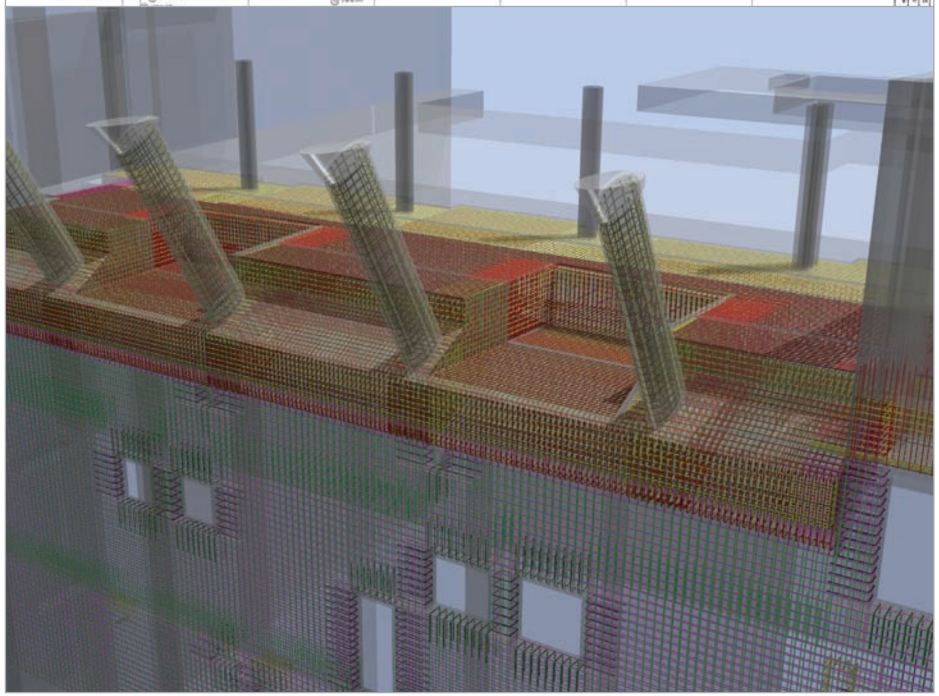
The Drachtsterweg on the south side of Leeuwarden is an important access road for traffic flowing from Drachten and Groningen. Currently, the road crosses the Van Harinxmakanaal via a movable bridge. The project Drachtsterweg implies that the road, measuring approximately more than 1 kilometre in length, will be subject to a deepened construction. In future, the road will cross the canal via an aqueduct and all the junctions of local roads and pathways will be at various levels. In addition, two routes for sloops will be realised. Commissioned by the Province of Friesland, Royal HaskoningDHV drew up the contract, drew the reference design and prepared the project tender. In late January 2013, the work was awarded to Heijmans, which meant the start of the contract management phase for Royal HaskoningDHV. The implementation of the project will run until early 2016.





Reinforcement Optimisation Rokin Metro Station North-South Line - Amsterdam, The Netherlands





Rokin station is part of the North-South metro line in Amsterdam, the Netherlands. It is one of three deep underground stations realised to date in the historic city centre of Amsterdam . The project is characterised by difficult soft soil conditions with high ground water tables, very close to vulnerable historic buildings. Therefore the limitation of deformations is the top priority, resulting in a robust design with diaphragm walls and a grout strut in the deep clay layer. The station box Rokin is approximately 200 m long and 25 m wide, with a maximum excavation depth of 26 m. Royal HaskoningDHV, part of "Adviesbureau Noord/Zuidlijn", is responsible for the detailed engineering of Rokin.

Together with our client "Dienst Metro" (Metro Department of the Municipality of Amsterdam) and the contractor Max Bögl we are constantly looking for optimisations within the project. To get a better grip on the interaction between the execution and design, it was decided two years ago to make a 3D model of the station including all the necessary temporary works. In the following process of time and cost optimisation, several changes were made that required the re-calculation of several parts of the structure. As a result, existing drawings that were made with regular 2D CAD software had to be changed. However, there were several advantages in using the now available 3D model to make completely new formwork and reinforcement drawings. The 3D model was made in Revit Structure and it was therefore decided to produce the formwork drawings with the same software. To make detailed reinforcement drawings, 3D Allplan was used. Elements from the 3D model were exported to 3D Allplan with the use of IFC files.

As already mentioned, the 3D model enables us to get a better insight into the interaction between the design of the structure, the execution of the work and the temporary works, such as struts and supporting frames. Another advantage is that optimisations in formwork and reinforcement can be revised directly in the model and all corresponding drawings will be automatically changed. Due to the 3-dimensional animation and collision control functions, possible conflicts in areas with high reinforcement quantities are more easily identified during the design. This increases the quality of the drawings and reduces the amount of problems during execution. The more realistic overview of the reinforcement thereby helps to design the necessary support reinforcement that is also included on the drawings. The direct availability of the bar bending schedules on the drawings increases the work speed for the contractor.

3D Allplan enables us to draw complicated reinforcement lay-outs with the help of intelligent functions within the program. Besides existing functionalities, some other methods are used to speed up the process. When possible, due to repetition in the structure, reinforcement is copied. The model is set up in coordinates and therefore the labels and dimension lines are lost when an element is copied and moved. As labeling is a relatively time-consuming activity in the process of making a reinforcement drawing, this is a disadvantage. Royal HaskoningDHV developed a "trick" that made it possible to copy and move an element without the loss of the labels and dimension lines (see [1]).

The 3D model also creates a solid base for the as-built drawings that have to be made in the near future. Deviations during execution can be adjusted directly in the model. This enables, for example, the use of the model for the technical installations design in an early stage.

To date, approximately 70% of the drawings have been delivered to the satisfaction of both the client and the contractor. The use of 3D Allplan enables us to implement optimisations in a short period of time. The aforementioned advantages contribute to a more efficient execution of the work and thereby help in realising earlier project completion.

[1] *Van Baal, M. - "Verschuiven met behoud van wapeningsmaatvoering en –labels "- CAD Magazine 2013-01*

Software: Allplan Engineering

Royal HaskoningDHV

Contact Sjaak van 't Verlaat
Address George Hintzenweg 85
3068 AX Rotterdam, The Netherlands
Phone +31 88 348 20 00
Email sjaak.van.t.verlaat@rhdhv.com
Website www.royalhaskoningdhv.com

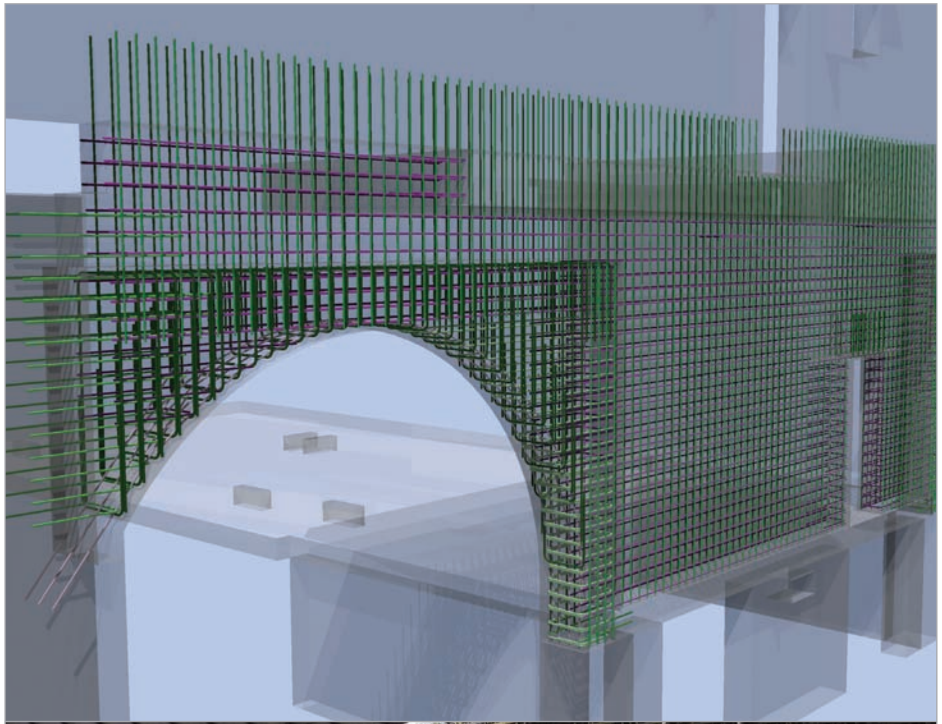
Royal HaskoningDHV is a leading independent, international engineering consultancy service provider with roots established in the Netherlands, the United Kingdom and South Africa. We specialise in aviation, buildings, industry, energy and mining, infrastructure, maritime and waterways, planning and strategy, rivers, deltas and coasts, transport and asset management, and water technology. A first choice consultancy for major world challenges, our experts provide sustainable and pragmatic solutions.
Working together, we can achieve more. This is the philosophy we embrace at Royal HaskoningDHV. With the overarching aim of enhancing society together, we work closely with clients, stakeholders, industry, and academic leaders, to ensure projects are delivered on time and within budget, while providing a better, brighter, sustainable future.
Royal HaskoningDHV is part of "Adviesbureau Noord/Zuidlijn".

Project information

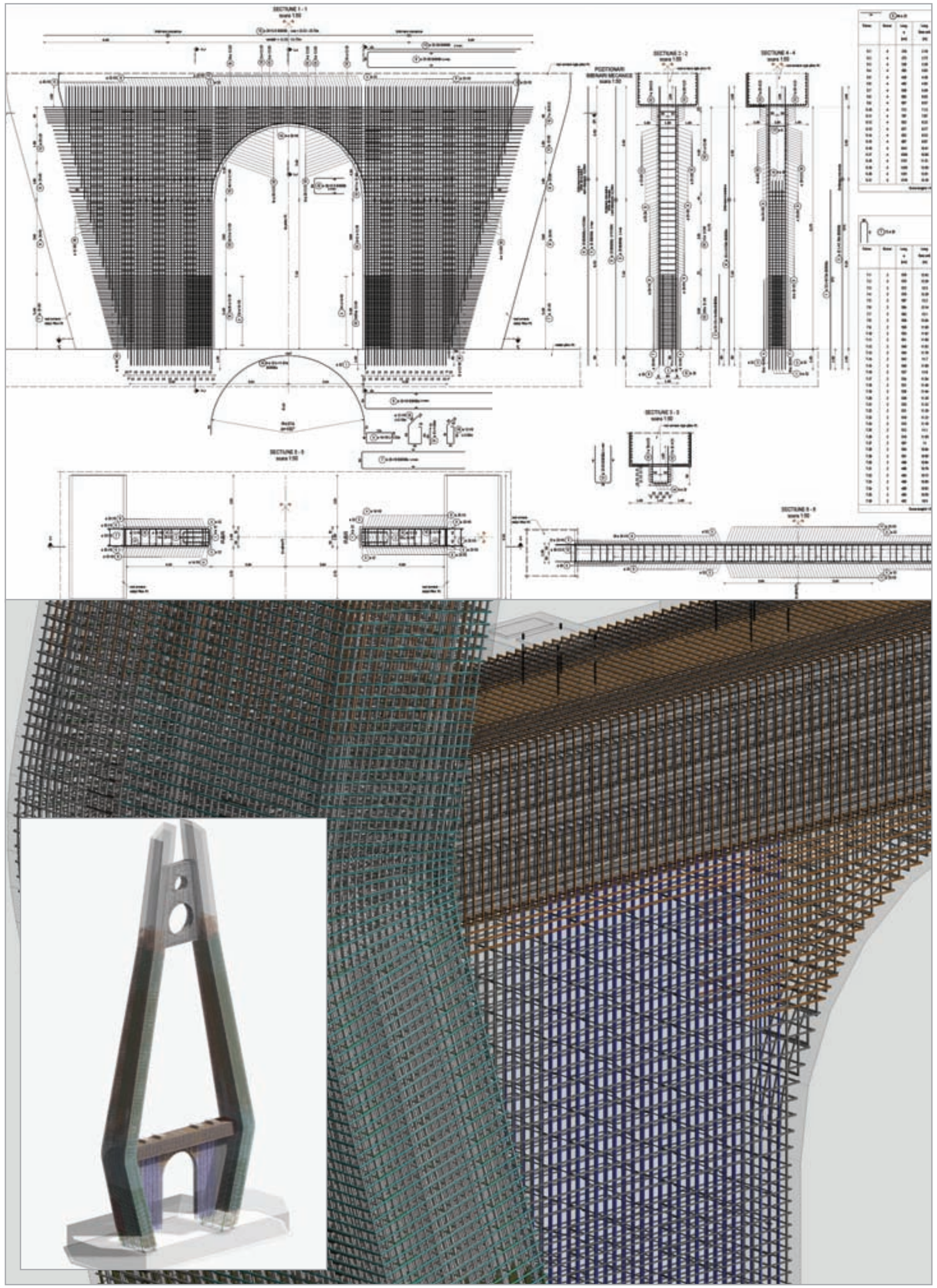
Owner	Dienst Metro (Metro Department Municipality of Amsterdam)
Architect	Benthem Crouwel Architects
General Contractor	Max Bögl
Engineering Office	Royal HaskoningDHV
Location	Amsterdam, The Netherlands
Construction Period	2002 to 2017

Short description | Reinforcement Optimisation Rokin Metro Station

Royal HaskoningDHV is responsible for the detailed engineering of Rokin station. A 3D model of the station is made, which includes all temporary works. In order to make detailed reinforcement drawings, elements from the model are exported to 3D Allplan. The realistic 3D overview increases the quality of the reinforcement drawings, thus reducing the error rate. Whenever possible, intelligent copy and move tricks are used. Bar bending schedules, including support reinforcement, are directly available to the contractor. In general, the use of 3D Allplan contributes to a more efficient execution of the project.



Bridge over the Danube - Agigea Constanta, Romania



The bridge over the Danube-Black Sea Channel from Agigea - km 0 + 540 - is located at the confluence of the Black Sea and the Channel, near Constanta seaport. The bridge ensures the connection between the Northern and Southern zones of the harbour, now separated by the Danube-Black Sea navigable canal. The structural engineers from Search Corporation SRL are using Allplan Engineering to carry out this special project.

The bridge and access viaducts have a total length of 906.82 m, with 362.00 m for the bridge and 544.82 m for the viaducts.
The overpass of the Danube-Black Channel is carried out with a cable-stayed bridge which has three spans of 81.40 m and 200.00 m + 81.40 m; the superstructure has a total length of 362.80 m.
The deck of the cable-stayed bridge is made from a composite structure (steel + concrete), partly made of prestressed concrete on the lateral spans, and metal, partly in collaboration with the flooring from the reinforced concrete of the bridge superstructure. The access viaduct decks are made from prestressed, precast, reinforced concrete beams, which works through a monolithic plate and prestressed concrete cross pieces.
Above the anchorage area, the pillars are made from composite sections: steel box (where the anchorages of the cables are positioned) embedded in concrete. The cooperation is achieved with flexible connectors welded to the steel box of the anchorages. The total height of these pillars is 62.00 m.
The design elements for the bridge over the canal and viaducts, as required by the specifications and project are:

- The clear height under the bridge should be equal to the railway bridge from the lock, which is 17.70 m and provides the navigation gauge required for the Danube-Black Sea Channel which has a height of 17.50 m, a width of 35.00 m in the middle of the waterway and 10.00 m on the remaining width.
  This is required by both technical and economic conditions and also for ensuring the safety zones, protection and stability of the channel section;
- The bridge is equipped with a roadway width of 14.80 m, which provides four lanes: two lanes for traffic and two lateral pedestrian sidewalks with a minimum width of 75 cm;
- A life-time of at least 50 years, designed according to norm AND 554-2002;
- The structural strength of the bridge over the canal and the access viaducts is designed for live loads according to STAS 3221-86 “Bridges Road. Convoy type and class loading”;
- In terms of the seismic design, the work is placed according to norm SR-EN 1998-2:2006 and National Annex SR-EN 1998-2: 2006/NA: 2010.

In the cross-section, the bridge superstructure is made from two steel box coffered girders in collaboration with reinforced concrete flooring, respectively from two prestressed concrete coffered beams.
The solution adopted for the execution of the bridge is characterised by the modern design structure, which presents a number of technical and economic advantages such as:

- Combination of relatively simple structural components with known technologies in a unitary complex structure;
- Reducing the duration of construction, with all the benefits arising from achieving this goal;
- Achieving a work with a particular architectural aspect;
- Achieving a work with a height of reduced construction, of only 3.05 m, representing approximately L / 70 of the central span of the bridge, L = 200 m.

Workflow with Allplan Engineer
The design started with the generation of the digital model of the terrain using the specific functions from Allplan (Digital Terrain model).
The road and the deck elements were created using the Bridge/Civil Engineering module.
The general arrangement drawing files were realised directly from 3D using the Associative Views module.
Because of the reinforcement complexity, the reinforcement model had to be checked for every inserted placement of bars. Using the function Collision check and displaying bars with different surface colours, the structural engineers did this more efficiently.
Special 3D objects and textures were used for obtaining a realistic presentation.

Software: Allplan Engineering

SC Search Corporation LTD

Contact Viorel Bucur
Address 48 Iancu de Hunedoara Bvd, Crystal Towe
Bucharest - district 1
010613 Bucharest, Romania
Phone +4 21 316 4018
Email viorel.bucur@searchltd.ro
Website www.searchltd.ro

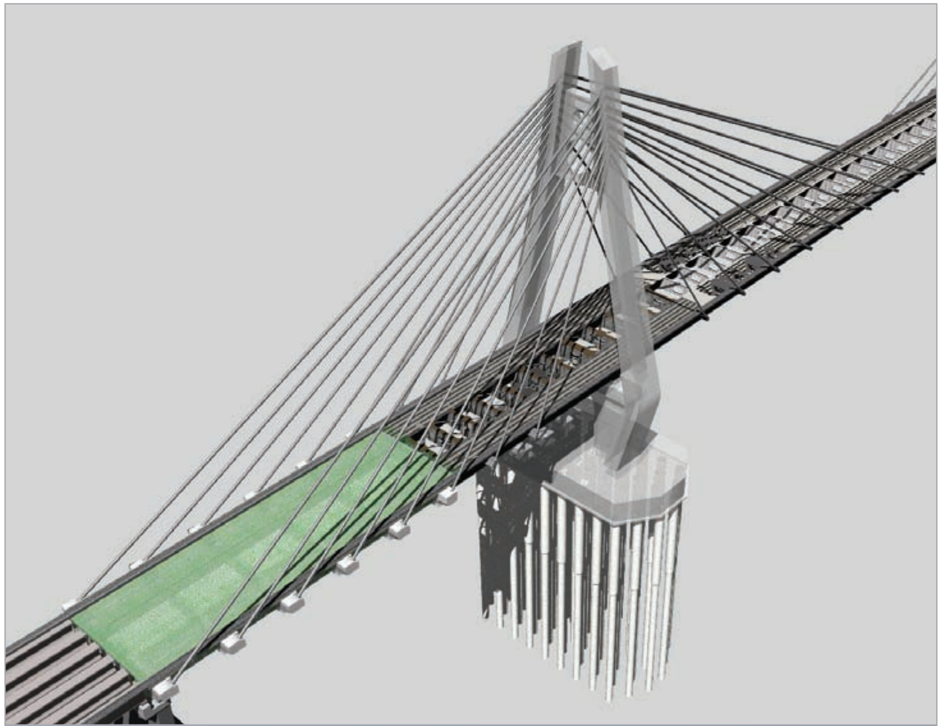
Search Corporation is one of the most important companies in Romania specialised in planning road transportation networks. With four offices, it is located in the most important cities of Romania: Bucharest, Cluj, Timisoara, and Iasi. Founded in 1991, our company was built on the idea of creating a strong professional organisation that operates according to international standards with competitive prices. Valuing teamwork, quality and perseverance, the company seeks to meet the needs of its clients, whether they are governmental agencies, municipalities or private entities. In the past, Search Corporation has contributed in the preparation of the national strategy for road network development, alongside the Ministry of Transport, the Romanian National Company for Motorways and National Roads, and local authorities. Due to its values, Search Corporation has become a strong and reliable resource for the road and airport administrators in Romania, in the planning, designing and construction management required for road infrastructure projects and airport development.

Project information

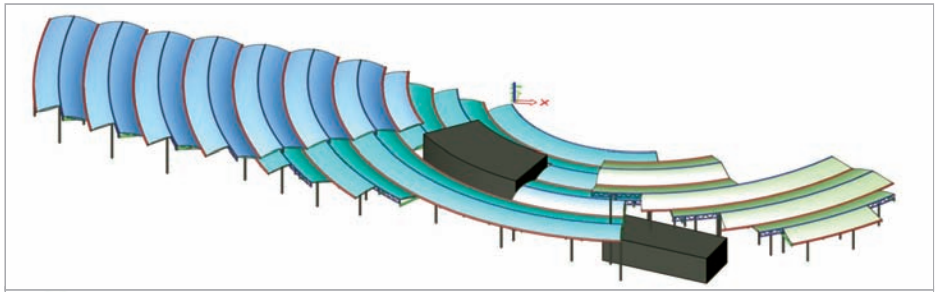
Owner	Compania Nationala Administratia Porturilor Maritime S.A
Architect	Search Corporation S.R.L
General Contractor	Ministerul Transporturilor, Constructiilor si Turismului
Engineering Office	Search Corporation S.R.L
Location	Agigea - Constanta, Romania
Construction Period	06/2010 to 12/2013

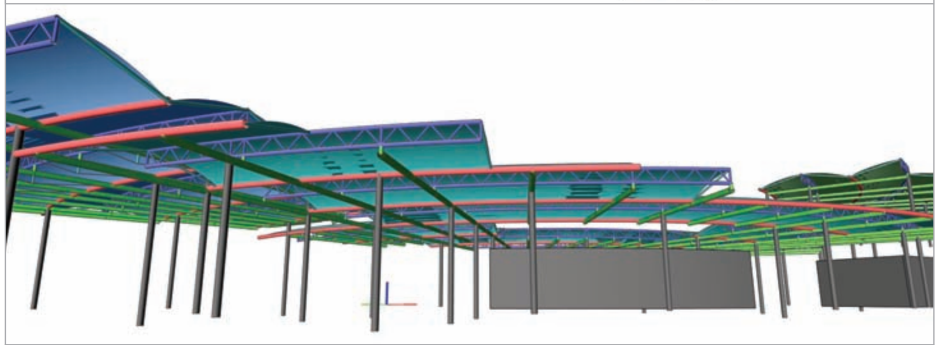
Short description | Bridge over the Danube

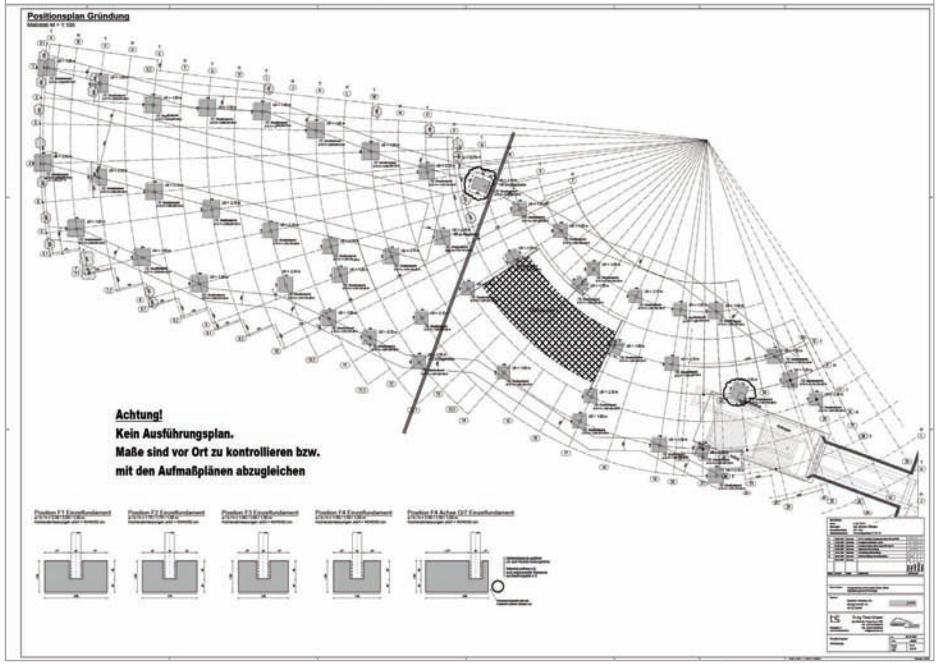
The bridge over the Danube-Black Sea Channel from Agigea - km 0 + 540 - is located at the confluence of the Black Sea Channel, near Constanta seaport. The bridge ensures the connection between the Northern and Southern zones of the harbour, now separated by the Danube-Black Sea navigable canal. The bridge and access viaducts have a total length of 906.82 m, with 362.00 m for the bridge and 544.82 m for the viaducts.



Redesign of a Traffic Center - Essen, Germany







The 1970s saw the construction of the traffic court in Essen-Steele. It forms one of Essen's main hubs. The concept, developed during the 1970s, to transport 20,000 passengers per day on buses to the central control traffic court, and from there to further destinations by S-train or tram in the city centre, remains valid today. However, after more than 30 years, it was decided that the traffic court should have a makeover. The construction project was planned by the architects of Essen Transport Ltd. (EVAG). It is designed to provide more comfort with modernisation and more accessibility for the disabled. The construction project was started at the end of 2008. The budget was set at 9 million euros. After a year and a half of construction, the revamped facility was launched in August 2010.

Around 20,000 passengers now use the daily continuous entry and exit at all levels to trams, buses and commuter trains. Arrival and departure locations for the trams were designed so that the buses can be reached easily. A generous canopy for the traffic centre, traffic routes and waiting areas was made to ensure a comfortable transition.

Twelve modern breakpoints are now accessible and can be reached in bad weather with dry feet thanks to the new light-flooded roof. The new 3,256 sqm roof construction is made with a vandal-proof and self-cleaning film that has already been utilised in the "Allianz Arena" of FC Bayern Munich. ETFE (ethylene-tetrafluoroethylene) film, first deployed more than 25 years ago, was the best alternative to expensive glass roofing for this project. The roof structure is built at three different heights to allow the use of different means of transport. Thus, the tram area is built to +5.61 m and the bus area is built to +4.50 m reaching to the bottom of the sheet roofing, while the construction reaches to +8.50 m over the existing staircase to the access bridge and the transition to the S-Bahn.

The design is described by concentric curves with sawtooth-shaped transparent foil panels consisting of pneumatically biased, ultra-thin membrane-cushions made of ETFE with a span of 3.5 m. The cushions were calculated using wire-theory and calculations in the third order for large deformations. There are up to 19 cushions in a row, all supported by radial steel substructures made of circular hollow sections with long trusses in the high points and continuous beams in the low points. The longest truss is 49 m long and 65 cm high with crossbars. The longest support beam is 58 m long. Orthogonal to the radial support elements is an arrangement of crossbeams with partial wire-reinforcement. The crossbeams are supported by steel columns in a non-systematic order to meet the demand for required space for the trams and buses. The columns are grounded on foundations with quivers to absorb the resulting moments.

The entire roof was built around a new massive building containing a ticket sale facility and a kiosk. It was therefore necessary to interrupt the concentric curves of the cushion roof.

Photo material: Fotodesign Andreas Braun, Hameln

Software: Allplan Engineering, Frilo Statics, Scia Engineer

TSS

Contact Bo Sørensen
Address Neuer Markt 4
49393 Lohne, Germany
Phone +49 444292380
Email soerensen@tss-ingenieure.de

INGENIEURGEMEINSCHAFT
Thor - Schipper - Schween
Beratende Ingenieure VBI
Prüfingenieure für Baustatik

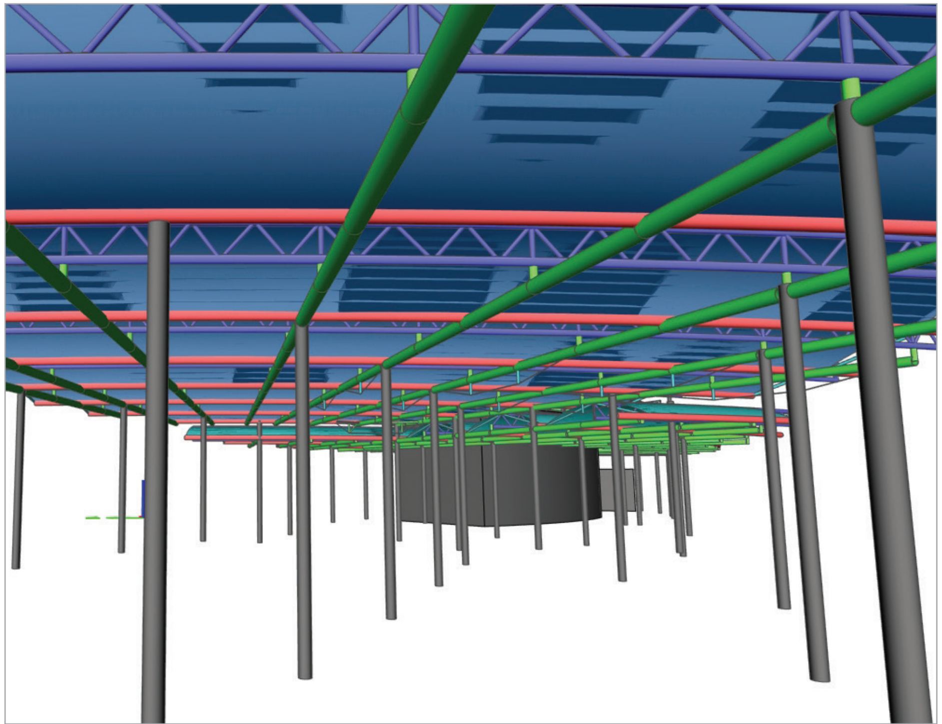
Robert Thor founded his engineering company in Lohne in the north-west of Germany in 1985. It was a reward for his endeavours as an inspection engineer. Building on his experience gained from several years as a senior partner in Bremer, he and his staff planned various major engineering structures and special civil engineering structures.
In 2006, Robert Thor was looking for a partnership to secure the future of his company. Eventually, in 2007, he linked up with Manfred Schipper, an engineer from Oldenburg. Schipper, also an inspection engineer, pursued his profession in Lower Saxony and Mecklenburg-Vorpommern.
Robert Thor was still engaged in a search for a successor for his company in Lohne as Manfred Schipper was to stay as the office head in Oldenburg. Thor and Schipper proceeded to enter into an agreement with 48-year-old inspection engineer Tobias Schween in 2009, forming the firm Thor-Schipper-Schween.

Project information

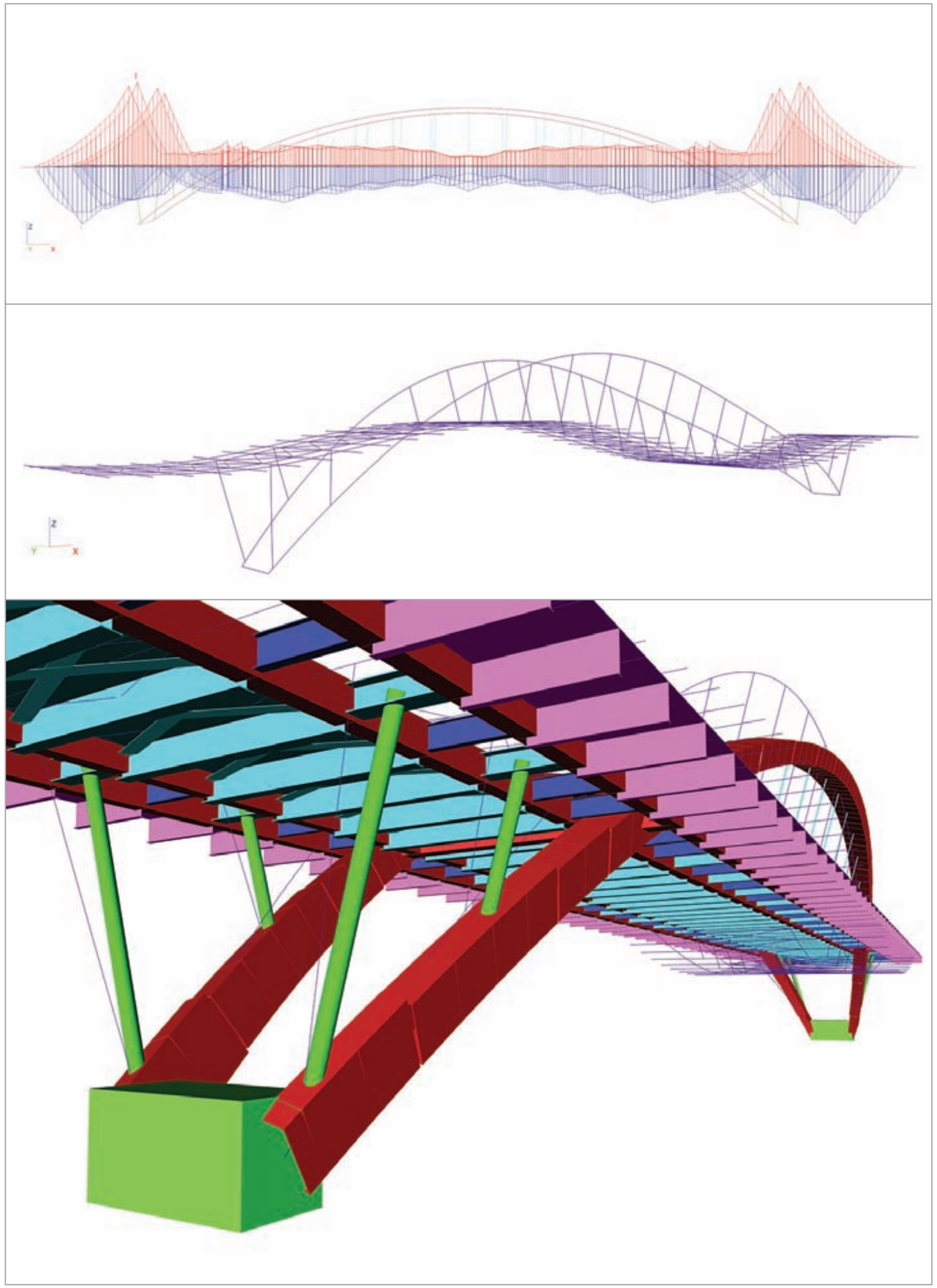
Owner	Essener Verkehrs AG
Architect	Essener Verkehrs AG
General Contractor	Spiekermann
Engineering Office	Thor-Schipper-Schween
Location	Essen, Germany
Construction Period	2009 to 2010

Short description | **Redesign of a Traffic Center**

The 3,256 sqm light-flooded roof construction is made with a vandal-proof and self-cleaning ETFE-film similar to that utilised at the “Allianz Arena” of FC Bayern Munich. ETFE-film was first deployed more than 25 years ago and it was the best alternative to expensive glass roofing. The roof structure is built at three different heights describing concentric curves with sawtooth-shaped foil panels consisting of pneumatically biased, ultra-thin membranes made of ETFE on radial steel substructures comprised of circular hollow sections with trusses in the high points and a continuous beam in the low points. Orthogonal to the radial support elements, an arrangement of crossbeams on steel columns supports the construction with foundation quivers.



Boogbrug over het Albertkanaal - Briegden, België



De oude betonnen boogbrug over het Albertkanaal in Briegden is gebouwd bij het graven van het kanaal in de jaren '30, werd opgeblazen in 1940 en is in haar oorspronkelijke staat hersteld na de Tweede Wereldoorlog. De bouw van een nieuwe brug op dezelfde plaats was noodzakelijk om een vlot en veilig scheepvaartverkeer te verzekeren omdat de oude brug slechts een doorvaartbreedte had van 48 m. De doorvaartbreedte van de nieuwe brug bedraagt 100 m en de doorvaarthoogte beantwoordt aan de Europese norm van 9,10 m, zodat binnenschepen geladen met vier lagen containers er moeiteloos onderdoor kunnen varen.

Concept

Het basisidee voor het ontwerp was die van een stalen boogbrug, waarbij de twee bogen niet met elkaar verbonden zijn boven het brugdek en waarbij het rijwegverkeer gescheiden werd van het fiets- en voetgangersverkeer:

- Totale lengte van het brugdek: 161 m,
- Overspanning van de 2 bogen: 127 m,
- Hoogte van de bogen: 22,8 m,
- Totale breedte van het brugdek: 22,4 m (een centraal rijweggedeelte met 2 rijstroken van 4,5 m, een open zone van 3 m aan beide zijden voor de doorgang van de 2 bogen en de esthetische uitwerking van het brugdek en 2 uitkragende fiets- en voetpaden van 3,7 m buiten de bogen),
- Scheefstand van de bogen: 15° gekanteld naar buiten toe (om esthetische redenen).

Structuur

- 2 stalen bogen bestaande uit kokerprofielen met variabele breedte en hoogte,
- Volledig stalen brugdek bestaande uit een klassieke orthotrope plaat, ondersteund door dwarsdragers om de 3,4 m en 4 kokervormige hoofdliggers,
- De verbinding tussen het brugdek en de 2 bogen bestaat uit 2 kokervormige dwarsdragers ter hoogte van het brugdek en 22 hangers en 8 pijlers die gelegen zijn in de schuine vlakken van de bogen,
- De afdichting van het brugdek bestaat uit een asfaltbedekking voor het rijweggedeelte en een epoxybekleding voor het fiets- en voetpadgedeelte,
- Gewicht van de brug: 1600 ton (exclusief afwerking).

Complexiteit

- Studie van de boogstabiliteit door het niet aanwezig zijn van een windverband,
- Studie van de stabiliteit van de brug door het kantelen van de 2 bogen ten opzichte van het verticale vlak,
- Studie van de globale krachtswerking van de brug: door de mengvorm van een boogbrug (~ opname van de horizontale spatkrachten door de booggeboortes) en een bowstringbrug (~ opname van de horizontale spatkrachten door het brugdek),
- Studie van de impact op de globale krachtswerking van de brug t.g.v. eventuele horizontale zettingen van de 2 betonnen boogfunderingen (~ interactie tussen de optredende horizontale reacties op de funderingen, de horizontale zettingen en de krachtswerking in brug),
- De uitvoering van 2de-ordeberekeningen en niet-lineaire berekeningen was noodzakelijk.

Gebruik van Scia Engineer

Scia Engineer diende voor het opstellen van een 3D-berekeningsmodel van de brug. De brug werd volledig gesimuleerd met een staafmodel. Het rekenmodel werd gebruikt voor het voorontwerp van de brug. In een latere fase moest de aannemer nog een volledige controlestudie uitvoeren. Uiteindelijk werd de brug volledig gerealiseerd volgens het oorspronkelijk voorontwerp: dit toont aan dat het - eenvoudig - rekenmodel efficiënt was.

Uitvoering

De aannemer is op 1 april 2012 ter plaatse gestart met de voorbereidende werken; de nieuwe brug is amper 6 maanden later op 1 oktober 2012 in gebruik genomen.

Software: Scia Engineer

Vlaamse Overheid - Afdeling Expertise Beton en Staal

Contact Jody De Winter
Address Koning Albert II-laan 20 bus 6
1000 Brussel, Belgium
Phone +32 2 553 73 46
Email jody.dewinter@mow.vlaanderen.be
Website www.vlaanderen.be

departement Mobiliteit en Openbare Werken

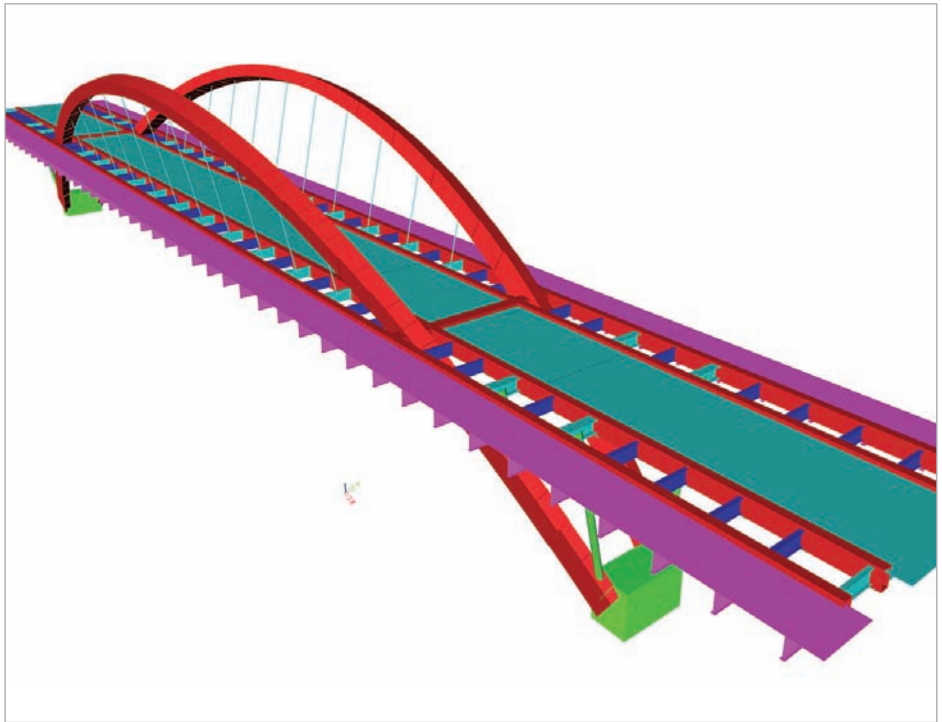
De afdeling Expertise Beton en Staal (vestiging Brussel) is het studie- en controlebureau van de Vlaamse overheid op het gebied van constructies van burgerlijke bouwkunde.
Een relatief jong team van meer dan 20 studie-ingenieurs (stabiliteit) staat samen met tekenaars in voor de opmaak van berekeningen, technische voorschriften, ontwerptekeningen en aanbestedingsdossiers voor de nieuwbouw en renovatie van complexe openbare bouwkundige infrastructuurwerken in Vlaanderen zoals bruggen, tunnels, sluizen, stuwen en kaaimuren. EBS treedt ook op als technisch adviesbureau bij ontwerpen die opgemaakt zijn door externe studiebureaus. EBS treedt op als beheercentrum voor de kunstwerken in Vlaanderen en adviseert bijzondere inspecties die op deze kunstwerken uitgevoerd worden en geeft daarbij beoordeling en advies voor onderhoud en herstelling.
Er wordt zeer nauw samengewerkt met de diensten van de Vlaamse Overheid die deze kunstwerken bouwen en onderhouden.

Project information

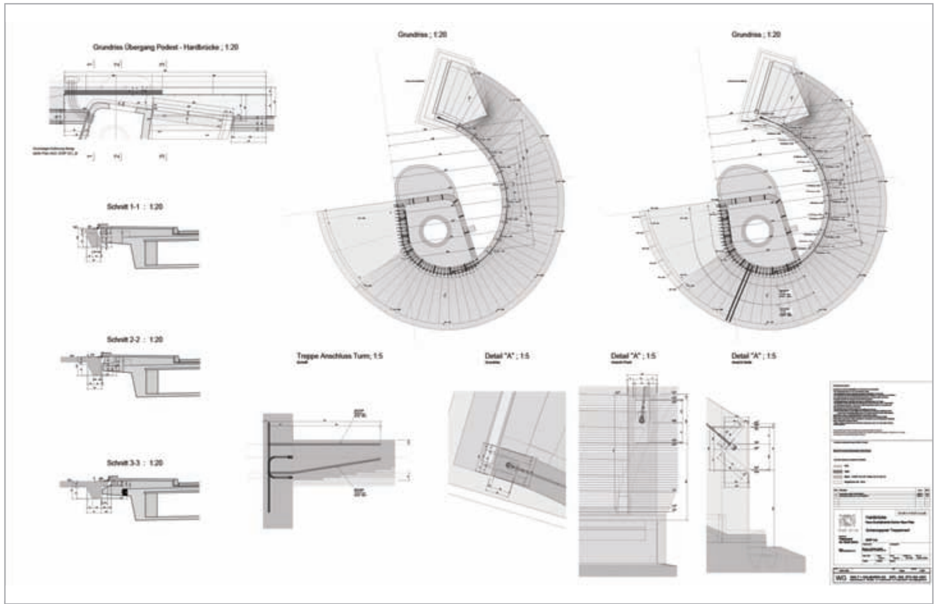
Owner	NV De Scheepvaart - Afdeling Waterbouwkunde
Architect	Vlaamse Overheid - Afdeling Expertise Beton en Staal
General Contractor	Roegiers NV + Aelterman
Engineering Office	Vlaamse Overheid - Afdeling Expertise Beton en Staal
Location	Briegden, Belgium
Construction Period	10/2011 to 10/2012

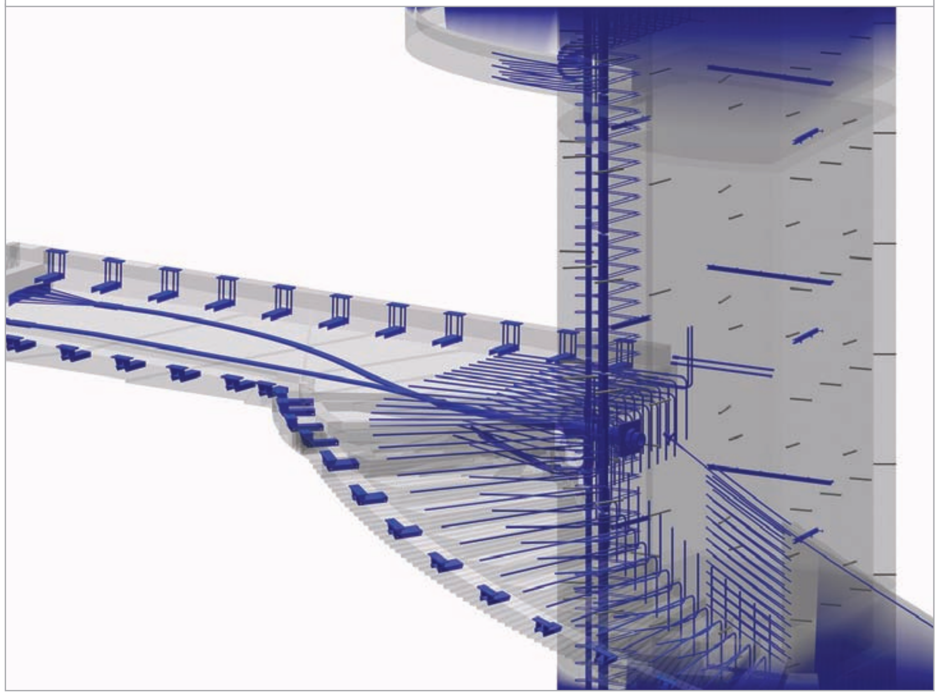
Short description | Arch Bridge over the Albert Canal

NV De Scheepvaart intended to replace the old concrete arch bridge across the Albert Canal in Briegden with a new steel bridge with a larger passage width for vessels.
The new arch bridge has a total length of 161 m. The arches span a length of 127 m. The arches have a rectangularly shaped cross section with varying height and width. Each arch is tilted 15 degrees outward. The arches are transversally connected at the bridge deck level only by 2 transverse box beams. The orthotropic steel bridge deck is supported by 22 rods (100 mm) and 8 piers.
Scia Engineer software was used for preliminary studies of the bridge (stability calculations, non-linear calculations and steel-code checking in accordance with Eurocode 3 standards).



Neubau Treppenaufgänge Hardbrücke - Zürich, Schweiz





Örtliche Verhältnisse

Auf der Hardbrücke in Zürich wurden im Bereich Cinemax / Schiffbauhalle eine neue Haltestelle für die Buslinien 33 und 72 gebaut. Der Bau der neuen Haltestelle war sehr eng mit der Sanierung der Hardbrücke verknüpft, musste also terminlich und inhaltlich auf die Sanierung abgestimmt werden.
Die neue Bushaltestelle soll den Bereich Cinemax / Schiffbauhalle erschliessen und eine optimale Umsteige-möglichkeit zum inzwischen realisierten Tram Zürich-West bringen. Gestalterisch fügen sich die Aufgänge zur Haltestelle ins Gestaltungskonzept der Hardbrücke ein und passen zum ebenfalls durchgeführten Umsetzung des Plan Lumière.
Eine weitere Prämisse war die “Verwandtschaft” zu den im Zuge des Escher-Wyss-Platz-Umbaus geplanten neuen Aufgängen zur Bushaltestelle Escher-Wyss-Platz auf der Hardbrücke und einem noch nicht realisierten westseitigen Aufgang nahe beim Bahnhof Hardbrücke. Diese “Verwandtschaft” besteht in der Form, in der Materialisierung und in der Dimensionierung.
Da die Aufgänge in der Hardstrasse wegen Industrie-gleis und Freihaltebereich für die MAN-Spezialtransporte nicht direkt an der Brücke anliegen können, werden hier zusätzlich Passerellen nötig.
Die Treppen am Escher-Wyss-Platz verbleiben mit ihrem Ausgangspunkt unter der Brücke und schwingen sich in einem Bogen nach aussen und hinauf auf die Brücke, einmal im Uhrzeigersinn, einmal im Gegenuhrzeigersinn. In der Hardstrasse hingegen schwingen sich beide Treppen im Uhrzeigersinn hinauf auf die Brücke, verhalten sich zueinander also punktsymmetrisch. Sowohl auf Platzebene als auch auf der Ankunftsebene auf Höhe Brücke besteht eine enge räumliche Beziehung zwischen Treppe und Lift, die auch konstruktiv ausgenutzt wird, indem sich die tragende Innenwange aus dem Liftkern heraus entwickelt.

Die geschwungenen Form gibt den Treppen eine plastische, zeichenhafte Wirkung. Die Treppen-geometrie, aufgebaut auf den Gesetzmässigkeiten einer logarithmischen Spirale, vereint oberseitig die Anforderungen an Sicherheit und Festlegung einer einfachen Wendelgeometrie zum Bau der Schalung.
Die Passerelle als Verbindung zur Buswartehalle auf der Hardbrücke spannt als weit auskragende Platte vom Liftturm zum Brückenrand, ohne auf diesen Lasten abzugeben.

Materialisierung:

Über das Material verbinden sich die neuen Aufgänge mit der Hardbrücke: Treppe und Liftschacht sind in Ortbeton mit einer Bretterschalung konstruiert. Die Innenwange der Treppe ist als tragende Betonbrüstung mit einem aufgesetzten Handlauf ausgebildet, während ein Staketengeländer aus Metall die schlanke Aussenkante der sich hinaufschwingenden Treppe betont. 5 cm dicke Granitplatten bilden den Gehbelag auf den Stufen. Die Passerelle hingegen erhält einen Schwarzbelag, verwandt mit dem Bodenbelag der Buswartehalle und der Trottoirs. Bei den Personenliften sind die Kabinentüren und Schachttüren verglast, das Kabineninnere ist in robustem Chromstahl ausgeführt.

Tragwerk

Die Treppenaufgänge als L-förmige Läufe mit Brüstung in Form einer helixartigen logarithmischen Spirale, die in einen Liftkern eingespannt sind. Da der Standort des Turmes infolge der Randbedingungen nicht unmittelbar bei der Haltestelle an der neu verbreiterten Brücke sein kann wird ein quasi 7 m auskragender Übergang als Passarellen benötigt. Als Anschluss zur bestehenden Brücke muss infolge sehr grosser horizontaler Verschiebungen der Brücke eine Speziallager-konstruktion entwickelt werden und soll möglichst k(l)eine Auflagerkräfte an diese abgeben. Treppen-brüstung und Passarellen sind wegen Gebrauchs- und Dauerhaftigkeitsanforderungen vorgespannt. Die Fundation erfolgt infolge beengter Platzverhältnisse mittels quasi als verlängertem Turmschaft ausgebildeten Pfählen die gleichzeitig mit Betonausfachung als Rühlwand Baugrubenabschluss sind.

Software: Allplan Engineering

Walt+Galmarini AG

Contact Lukas Schmid
Address Drahtzugstrasse 18
8008 Zürich, Switzerland
Phone +41 43 222 66 66
Email lukas.schmid@waltgalmarini.ch
Website www.waltgalmarini.ch

Walt+Galmarini AG
dipl. Ing. ETH SIA USIC

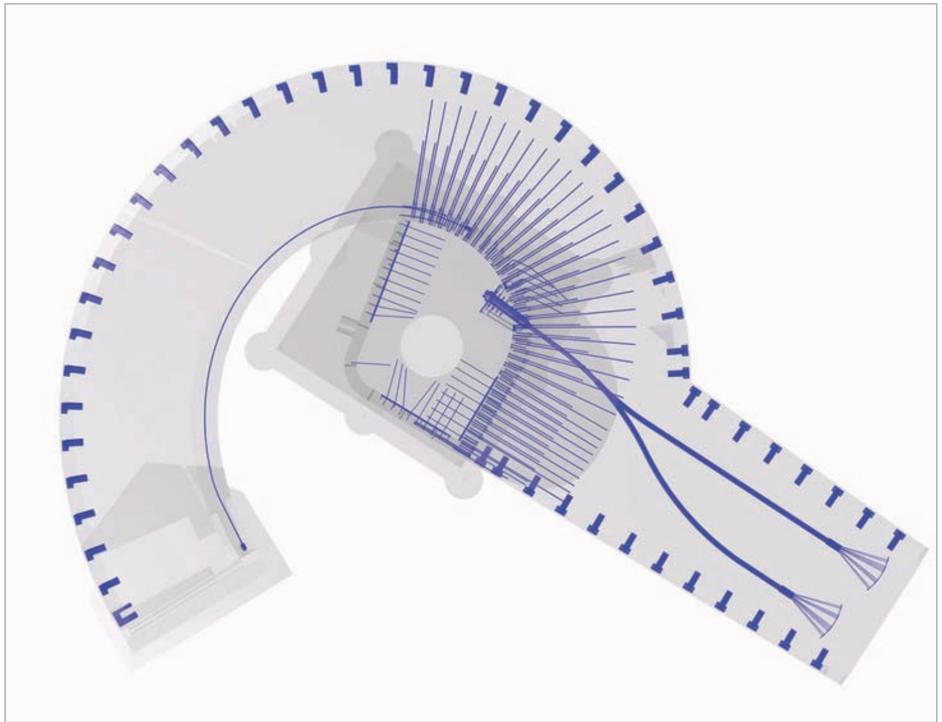
Unser Ingenieurbüro wurde im Jahr 1956 gegründet. Derzeit beschäftigen wir in Zürich 35 Mittarbeiter. Die Konzentration auf wenige Tätigkeitsgebiete des Bauingenieurwesens erlaubt uns, als führende Firmen unsere Kunden optimal zu bedienen und auch bei
Projekten jeder Größe die erforderlichen Kapazitäten bereitstellen zu können.
Wir befassen uns vor allem mit Planung, Projektierung, Projekt- und Bauleitung in den Bereichen der Hochbeanspruchten, weitgespannten Tragkonstruktionen in Stahl, Stahlbeton und Spannbeton, Holz und Faserverbundwerkstoffen. Unsere Aktivitäten beinhalten auch Baugruben- und Hangsicherungen und Spezialfundationen.
Wir kennen die neusten Methoden und wenden diese konsequent und unter Einsatz aktuellster Hilfsmittel an. Durch Teilnahme an Seminaren und Kongressen und Beteiligungen an weltweiten Forschungsprojekten leisten wir einen Beitrag zur eigenen Innovationsfähigkeit und Ausbildung und zum Fortschritt auf dem Bausektor.

Project information

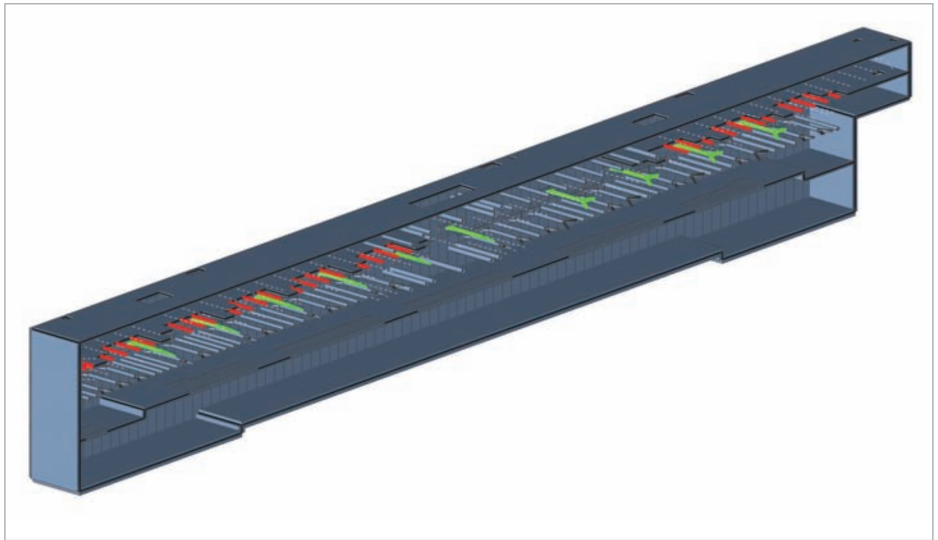
Owner	Stadt Zürich
Architect	Boesch Architekten
General Contractor	Helbling Beratung + Bauplanung AG
Engineering Office	Walt und Galmarini AG
Location	Zürich, Switzerland
Construction Period	02/2009 to 11/2011

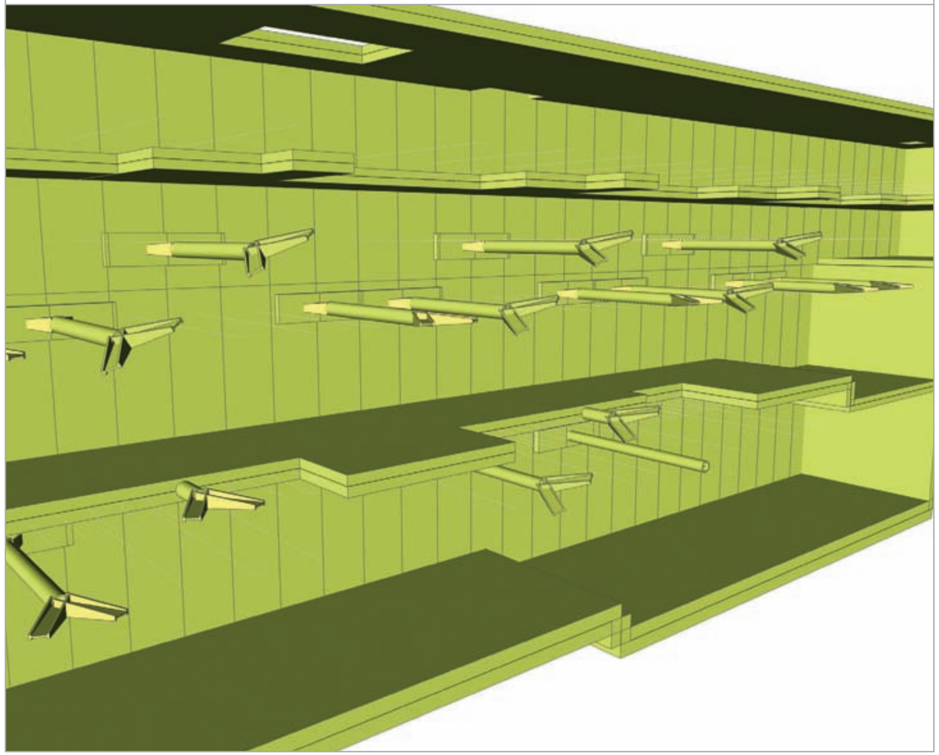
Short description | New Stair Tower Bridge

The design intent of the stair tower is symbolically emphasised by the chosen curved shape.
The stairways, derived from a logarithmic spiral, combine functional and safety requirements by means of a simple spiral geometry to facilitate formwork and construction.
The L-shaped stair flights with parapets monolithically integrated are helically cantilevered from the concrete elevator shaft.
In order to provide clearance for the adjacent bus stop, the widened bridge has to be serviced from the stair tower by a 7 m cantilever connection deck.



Ceintuurbaan Station, North/South Metro Line - Amsterdam, The Netherlands





Project description

Ceintuurbaan Station is part of the North/South line project, situated in the historic centre of Amsterdam. The scope of the project contains eight stations and connects the northern and southern districts with the city centre.

The metro line measures approximately 10 km in length, divided into an underground section of 7 km and a bored tunnel of 3 km long. The metro line runs from the above-ground Buikslotermeerplein Station via a semi-sunken route and is connected with the Central Station by an immersed tunnel below the IJmeer. From the Central Station, the metro line continues its route via the stations Rokin, Vijzelgracht and Ceintuurbaan. These stations are all constructed at an average depth of 30 m below the surface and are connected by a bored tunnel. At Europaplein Station the metro arrives above the ground and is connected to the existing metro network at Zuid/WTC Station.

Structure and building method

Ceintuurbaan Station is 230 m long and has an average width of 11 m. Due to the limited space available between the buildings at street level, the station is designed for two bored tunnels, which are located above each other. The station has two main entrances through which passengers can enter the station at NAP +0.6 m.
From the concourse level at NAP -6.8 m, passengers (approximately 42,500 a day) are divided over the two lower platforms by an escalator or elevator.

To minimise the duration of the impact on traffic and the surroundings, the station is built by using the cut & cover method. First, the diaphragm walls, 1.2 m thick, and the roof were made. Below the roof structure more excavation took place, while constructing several floors and metro platforms. To guarantee the vertical stability of the deepest section, the last couple of metres were excavated under compressed air, starting from the intermediate floor at NAP -18.8 m. After the completion of the foundation slab, the concrete structure was ready to be connected with the bored tunnels.

Horizontal stability of the structure

During the excavation process, the diaphragm walls were supported by temporary steel struts at different levels to secure horizontal stability. Due to its great depth and the presence of several openings in the floor slabs, the combination of diaphragm and retention walls also has to be supported by additional struts in the final phase. These struts are applied at five different levels.

The permanent steel struts are installed and prestressed in the presence of the temporary steel struts and floor slabs. The temporary steel struts are removed in different phases. During removal, the deflection of the steel struts is monitored by strain gauges and extensometers. With the information obtained from these measuring instruments, the forces per construction stage can be determined.

Use of Scia Engineer

To verify these results, a 3D model of the station is created in Scia Engineer. With the use of the module ‘construction stages’, the influence of the several construction phases could be predicted. This gave the opportunity to verify the retrieved information from the monitoring. Furthermore, the model made it possible to anticipate critical situations and to prevent the forces from exceeding the design values in the consecutive stages.

Software: Scia Engineer

Witteveen+Bos

Contact Nick Waterman
Address Hoogoorddreef 56F
1101 BE Amsterdam, The Netherlands
Phone +31 203125555
Email n.waterman@witteveenbos.nl
Website www.witteveenbos.nl

Witteveen+Bos was founded in 1946 by the engineers G.S. Bos and W.G. Witteveen. At the present time, the company comprises eight offices in the Netherlands and eight international offices and has more than 900 employees. Today, Witteveen+Bos is among the top 10 engineering firms in the Netherlands.

The company offers clients value-added consultancy and top-quality designs for water, infrastructure, environmental and construction projects. We deliver reliable solutions based on knowledge, experience and social insight. In an inspiring working environment, we take on fascinating challenges, while ensuring our core values of expertise, reliability and commitment.

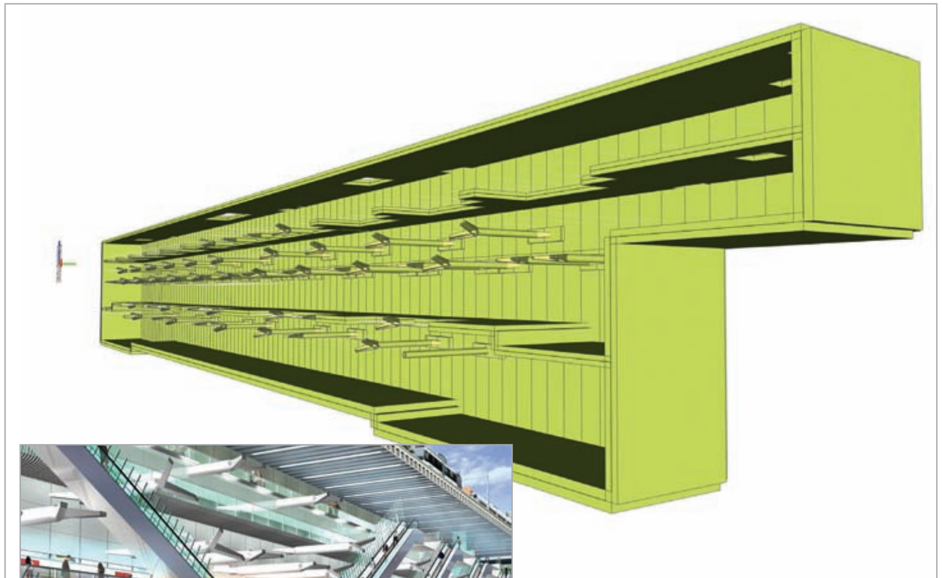
Besides the offices in the Netherlands, Witteveen+Bos is also located in Indonesia, Kazakhstan, Latvia, Russia, Belgium, and Vietnam. Furthermore, the company is a member of the Strategic European Expertise Network (SEEN) and takes part in several strategic alliances.

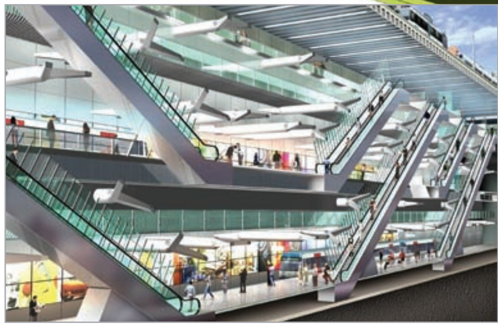
Project information

Owner	The city of Amsterdam
Architect	Benthem Crouwel Architects, Amsterdam
General Contractor	The city of Amsterdam
Engineering Office	Consulting firm Noord-/Zuidlijn
Location	Amsterdam, The Netherlands
Construction Period	2003 to 2017

Short description | Ceintuurbaan Station, North/South Metro Line

With its length of 230 m, depth of 30 m and average width of 11 m, Ceintuurbaan is the narrowest station of the North/South line. Its great depth made it necessary to support the combination of diaphragm and retention walls in both the construction and final phases. Therefore, permanent steel struts are installed and prestressed. These struts are designed to bear the horizontal loads and minimise the deflection of the walls during the operational phase. The 3D model made it possible to analyse the behavior of the structure in the construction stages and to anticipate critical situations.



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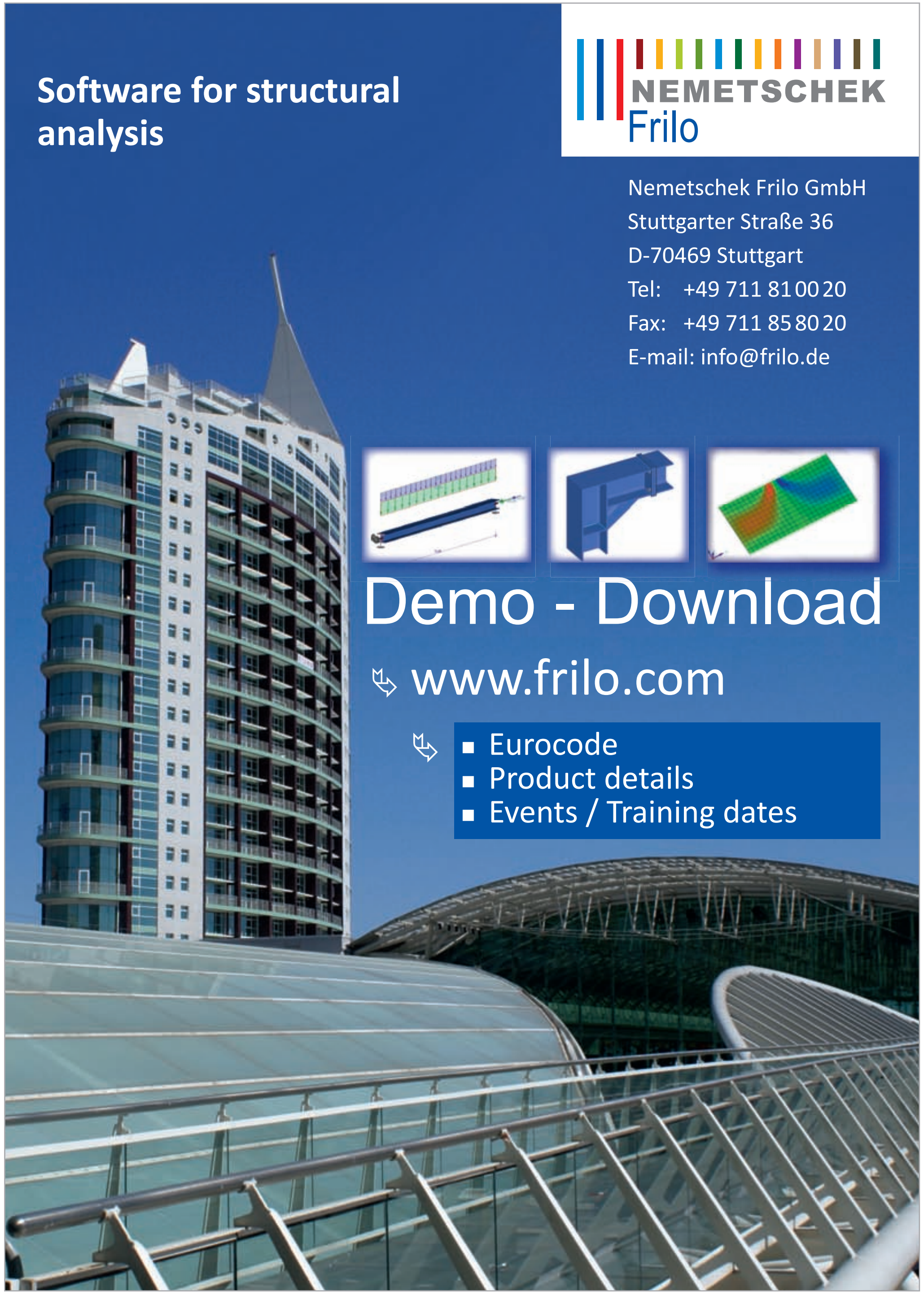
www.isbcad.de
GLASER -isb cad- Programmsysteme GmbH
Am Waldwinkel 21 · D-30974 Wennigsen
Tel. +49 5105 58920 · Fax +49 5105 82942
info@isbcad.de · www.isbcad.de


Software for structural
analysis
NEMETSCHEK
Frilo
Nemetschek Frilo GmbH
Stuttgarter Straße 36
D-70469 Stuttgart
Tel: +49 711 81 00 20
Fax: +49 711 85 80 20
E-mail: info@frilo.de
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Category 3: Industrial Buildings and Plants

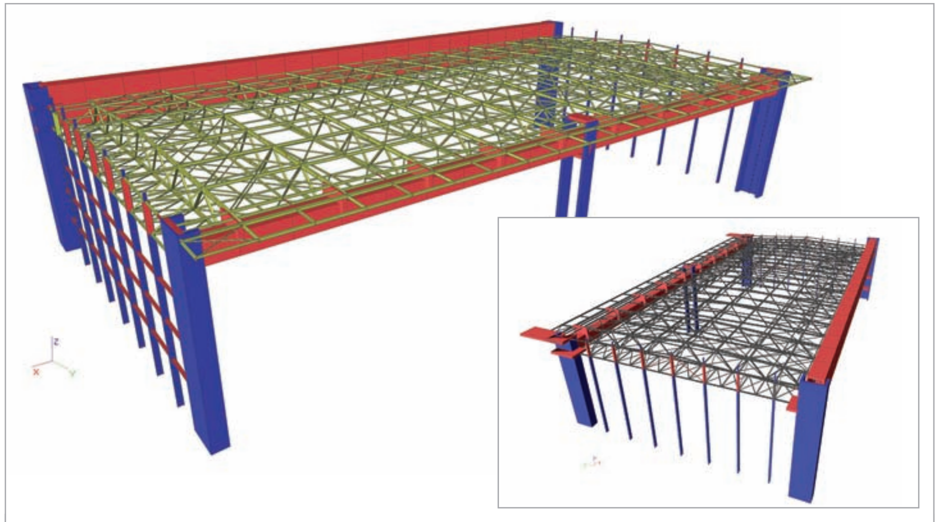
Design of general steel or concrete structures, power plants, frame structures, large span halls and hangars, pre-engineered buildings… for which Nemetschek design and or detailing software has been used.

3

Onderhoudsloods voor Vliegtuigen met Kantoren Tui Travel - Zaventem, België

Winner Category 3: Industrial Buildings and Plants

Quote of the Jury: *"The project is nominated because of several innovative features including a long 112 m free span, and the combination of post-tensioned concrete and steel for the roof structure. The execution of the roof is very impressive: the entire 3,000 ton roof structure was prefabricated and assembled on the ground, then lifted to the final stage. It is supported by only 5 columns, so stability was an important consideration."*



Software: Scia Engineer

Algemene beschrijving van het project

Op de luchthaven van Zaventem, waar de vroegere loods 40 stond, wordt een nieuw TUI Travel Belgium gebouw, genaamd "Jetairport" opgericht. Dit nieuwe supermoderne onderhoudsgebouw omvat een loods met een grondoppervlakte van 10.000 m² en in totaal nog eens 11.500 m² kantoorruimte. Teneinde verschillende vliegtuigtypes tegelijkertijd binnen te laten, waaronder de gloednieuwe Boeing 747 Dreamliner, werd een maximale overspanning boven de poorten opgelegd.
De hangar heeft een vrije overspanning van 112 m en een vrije hoogte van 20 m onder de dakspanten.
Het kantoorgebouw omvat een kelderverdieping,6 bovengrondse verdiepingen en een technisch verdiep.
Het biedt plaats aan 1.000 personen.

Concept stabiliteit

De loods heeft een breedte van 117 m en een diepte van 55 m. Aangezien geen kolommen werden toegelaten ter hoogte van de poorten diende een overspanning van 112 m gerealiseerd te worden. Om dit te bereiken werd geopteerd voor een kokerligger in nagespannen beton met een breedte van 3 m en een hoogte van 6,5 m. Aan de achterzijde van de loods werd wel een tussenkolom toegelaten. Hier werd gekozen voor een hyperstatische kokerligger op 3 steunpunten in nagespannen beton met een breedte van 2,5 m op een hoogte van 2,5 m. Loodrecht op beide hoofdliggers rust een stalen dakstructuur bestaande uit 10 vakwerkliggers (type Warren Truss) met een variabele hoogte. Deze bedraagt in het midden van de overspanning 5 m.
Tussen de diverse vakwerkliggers zijn de nodige gordingen en knikverbanden voorzien.
De ganse dakstructuur steunt af op 5 betonnen U-kolommen met een hoogte van 26 m.

Het kantoor heeft een lengte van 112 m en een breedte van 21 m. Aangezien de snelheid van uitvoering van primordiaal belang was, is het ganse gebouw volledig als prefab geconcipieerd. De kolommen werden in 2 delen geprefabriceerd met een lengte van 14 m, en omvatten zo in één fase 3 verdiepingshoogtes. Ze zijn allen voorzien van consoles aan 2 of 3 zijden. Hierop worden prefab-balken gelegd dewelke zelfdragend zijn en de ondersteuning vormen voor welfsels in voorgespannen beton.
Na het aangieten van de gewapende druklaag wordt de horizontale schijfwerking verzekerd naar de centrale kernen. Het kantoor is afgescheiden van de loods door middel van een brandmuur van 2 uur.

Speciaal aandachtspunt

De montage van het dak van de loods vereist enige verdere aandacht. De beide betonnen hoofdliggers werden op de grond ter plaatse gestort. Na voldoende uitharding werden naspanstrengen ingebracht en het geheel nagespannen. Omwille van timing werd tegelijkertijd de staalstructuur eveneens op de grond tussen de beide liggers gemonteerd.
Ondertussen werden de 5 hoofdkolommen verder op hoogte gebetonneerd.
Vervolgens werd het ganse dak, met een totaal gewicht van 3.000 ton, 'gelift' tot een hoogte van 20 m door middel van hydraulische strandjacks en dit in een tijdspanne van enkele uren.
Een korte video van het liftproces kan men vinden op http://youtu.be/eSb9CsIuMvI.

ARCADIS Belgium NV

Contact Dirk Inghelbrecht
Address Koningsstraat 80
1000 Brussel, Belgium
Phone +32 2 505 75 00
Email d.inghelbrecht@arcadisbelgium.be
Website www.arcadisbelgium.be

ARCADIS is een internationale onderneming die advies-, ontwerp-, ingenieurs- en managementdiensten levert in de vakdomeinen infrastructuur, water, milieu en gebouwen. Door de jaren heen hebben we ons ingezet om onze kernwaarden te handhaven en onszelf de moeilijke vraag gesteld wie we willen zijn als vertrouwensadviseur, werkgever en maatschappelijk verantwoordelijke onderneming.

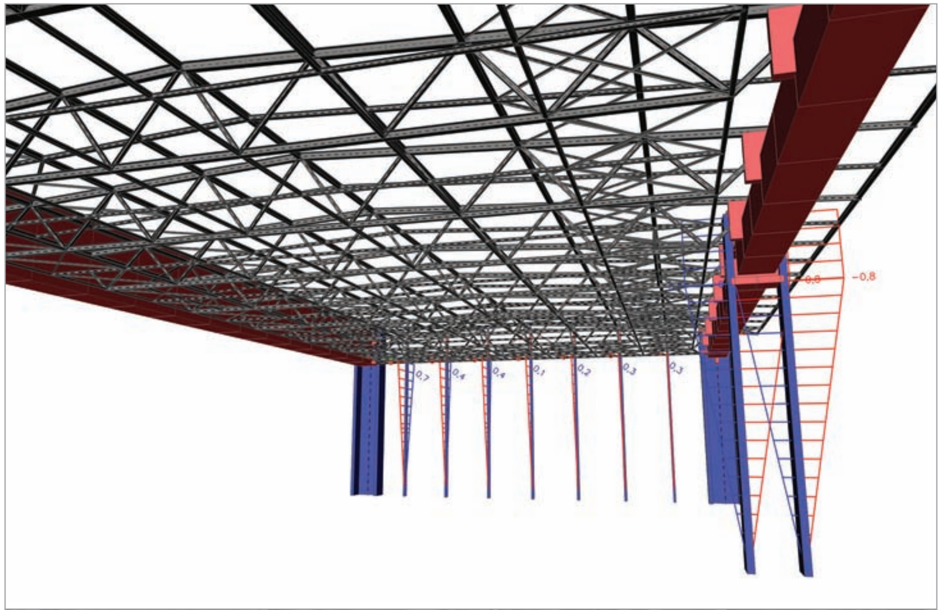
Met 778 medewerkers (FTE) en een omzet van EUR 80 miljoen, is ARCADIS in België uitgegroeid tot referentiebureau in zijn vakgebied.
Wereldwijd telt ARCADIS ruim 21.000 medewerkers, goed voor een omzet van EUR 2,4 miljard. De onderneming heeft een uitgebreid internationaal netwerk dat steunt op sterke lokale marktposities.

Project information

Owner	TUI Travel Belgium
Architect	Jaspers-Eyers & Partners
General Contractor	Van Laere NV
Engineering Office	Arcadis Belgium, Ghent
Location	Brussels Airport Zaventem, Belgium
Construction Period	02/2012 to 03/2013

Short description | **Maintenance Hangar with Office Spaces TUI Travel**

At Zaventem airport the new “Jetairport” business complex is being built. The concept is remarkable owing to the combination of office space on the one hand and aircraft maintenance hangar facilities on the other. The hangar will accommodate 3 aircraft that can be serviced simultaneously. A special feature was the building of the roof of the hangar. The roof consists of 2 main beams of post-stressed concrete with a free span of 112 m and a secondary steel structure with a span of 55 m. It was assembled on the ground, weighs approximately 3,000,000 kg and is 7,200 square metres. After assemblage it was lifted by hydraulic strandjacks in a few hours to a height of 20 m.
A video of the lifting of the roof was made (http://youtu.be/eSb9CsIuMvI).



Nomination Category 3: Industrial Buildings and Plants

Project withdrawn by the customer

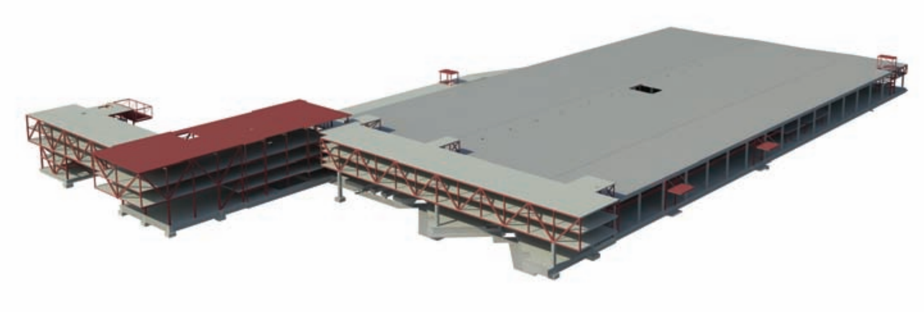
Project information

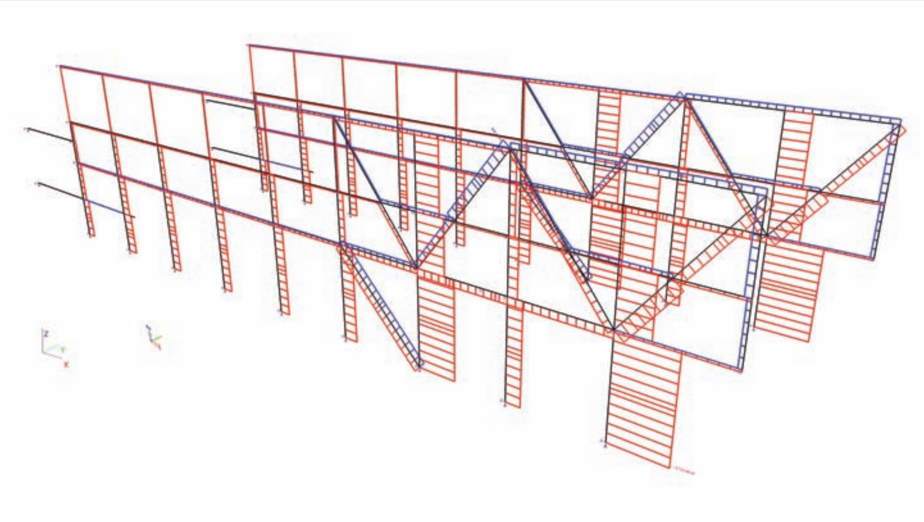
Owner
Architect
General Contractor
Engineering Office
Location
Construction Period

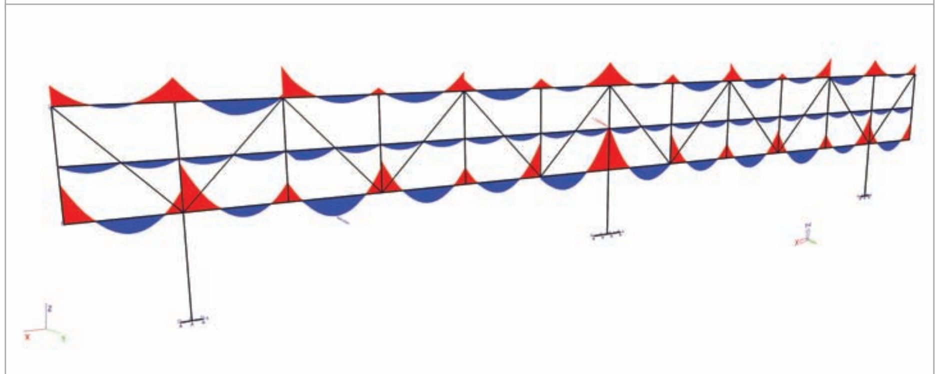
Short description

Industrial Hall and Offices Lely - Maassluis, The Netherlands

Nomination Category 3: Industrial Buildings and Plants







Project

Along the A20 highway at Maassluis in the Netherlands a new innovative international head office, R&D centre and production hall for the Lely group has been implemented. Lely is a Dutch family business that offers robotic products and services to the agricultural sector.

The new building, designed by Consort Architects, is expected to be completed by mid-2013. The project includes a warehouse with parking space on the roof and three connecting office buildings with showrooms, conference rooms and a company restaurant.

The project illustrates the power of integrated design in a special way. From the crawl space up to the parking deck, at every level of the building it is evident that the various disciplines in the design and construction team have worked together closely for the best, most durable and fastest results.

Lely has high sustainability ambitions for this project, ranging from the integration of the total complex into the existing area to putting up bat- and bird-nest housings on the factory hall. The far-reaching commitment to sustainability was awarded by the DGBC with the highest BREEAM certificate ('Outstanding', the maximum 5 stars) for the design of the production hall. This level has not previously been achieved on the European mainland by a building with an industrial function. The Office buildings achieved the designation 'Excellent' (4 stars).

Design

The warehouse (22,500 m^2) was designed as a "platform building", eliminating the need for expensive lowered loading docks with a pile supported concrete floor. The elevated business floor, consisting of hollow core slabs, was completely prefabricated, just like the rest of the building. This enabled a very high construction rate which can be phased "horizontally". While on one side the pilecaps were still being placed, the roof sheets were already being mounted on the other side of the building.
The prefabricated pilecaps were carefully engineered with simple connections of the cap to the foundation piles, foundation beams, hollow core slabs and columns. The pilecap dimensions of 2.4 m by 2.4 m were not just determined by the structural considerations, they are also a multiple of the width of the connecting hollow core slabs. This design has led to a quick assembly process.

The grid distances of the concrete columns in the industrial building were tailored to the wishes of the client. After an extensive study of roof variants, a structure with TT-slabs spanning 20 m was chosen. With a shorter span (10.8 m) of the prestressed roofbeams the number of columns on the production floor was sufficiently minimised. The columns are sandwiched into the prefabricated pilecaps at the bottom. Each column plays a part in the stability of the hall; there is no bracing.

The office building adjacent to the warehouse is made up of a steel main supporting structure with hollow core slabs in between. The steel trusses are raised above ground level so that the freight cars can pass under the building. The diagonals, columns and connections in the trusses were designed with close consultation between the architect and the structural engineer. The trusses, along with the steel staircases, provide the stability of the buildings. A saving of the total amount of material used was obtained through the use of trusses as the main supporting structure.

Calculations

Scia Engineer software was used for the main calculations of the structure. With Scia Engineer it is possible to create fantastic 3D models. However, we have chosen to make the calculations of this project in such a way that the full structure could be represented with simple 2D models of the structural components. The power of Scia Engineer is that it is possible to calculate the entire building with a few 2D models of the trusses and beams. With this, we were able to present the structure in a clear and concise manner in the calculations.

Software: Scia Engineer

IMd Raadgevende Ingenieurs

Contact	Heleen van den Berge
Address	Piekstraat 77 3071 EL Rotterdam, The Netherlands
Phone	+31 10 2012360
Email	h.vandenberge@imdbv.nl
Website	www.imdbv.nl

IMd Raadgevende Ingenieurs

Since its inception in 1960 IMd Raadgevende Ingenieurs [consulting engineers] has remained totally independent and has had no commercial ties with manufacturers, subcontractors, contractors or developers who could influence the making of unbiased and unrestrained recommendations. The company dedicates its activities to making recommendations in the field of structural engineering.

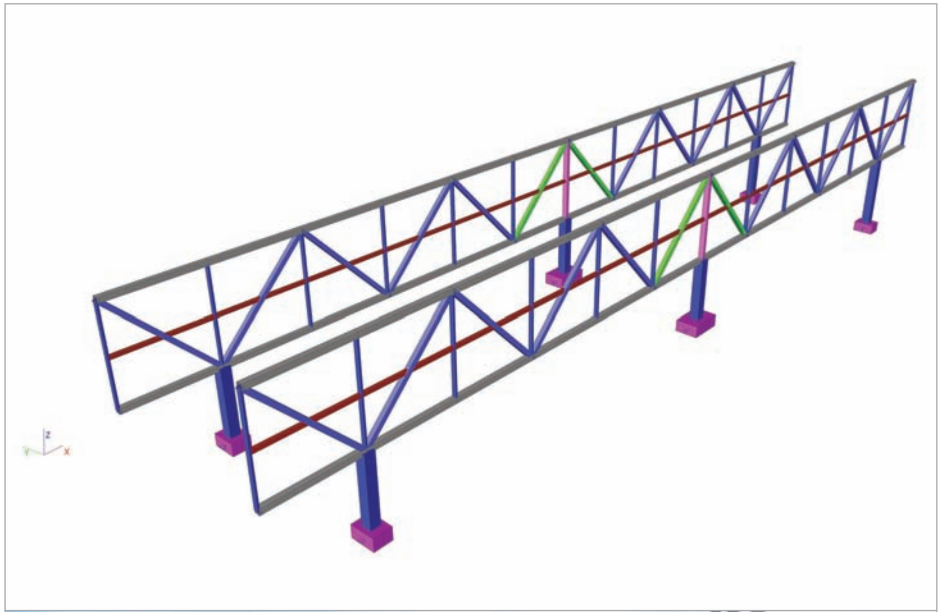
The company has experience in working on projects in which the structural engineer is expected to do more than merely make calculations and drawings. An active input of the structural design in the design phase specifically leads to an economically feasible plan. IMd's aspiration is to ensure that the client gets a functional and beautiful building, the architect can realise 'his design', all the consultants achieve their best performances and the contractor can build quickly and easily.

Project information

Owner	Lely Holding, Maassluis
Architect	ConsortArchitects, Rotterdam
General Contractor	Dura Vermeer Bouw Zuid West, Rotterdam
Engineering Office	IMd Raadgevende Ingenieurs, Rotterdam
Location	Maassluis, The Netherlands
Construction Period	07/2011 to 03/2013

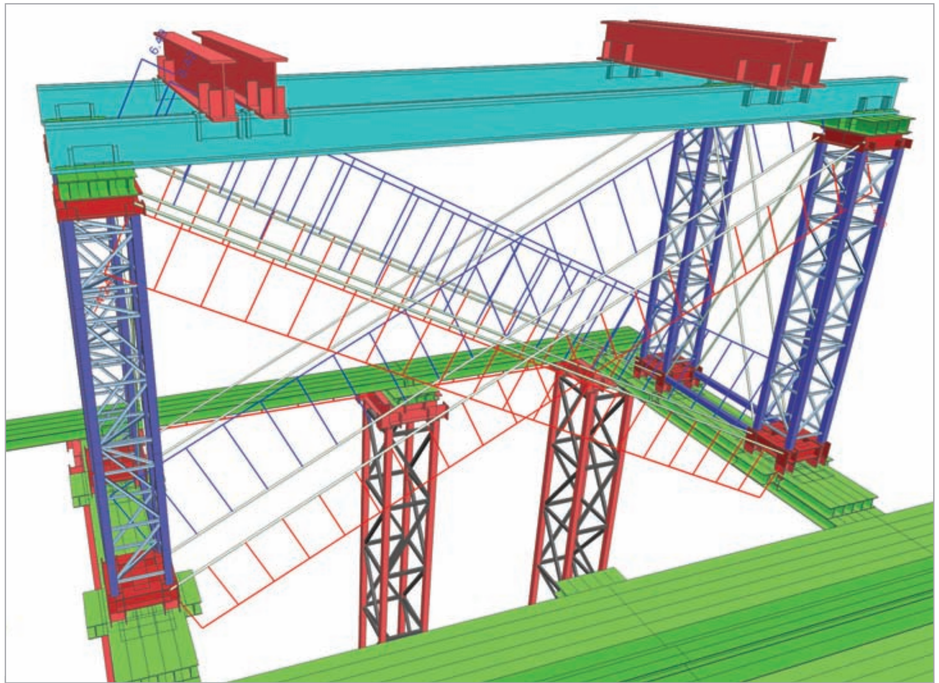
Short description | **Industrial Hall and Offices Lely Maassluis**

Along the A20 highway at Maassluis in the Netherlands a new innovative international head office, R&D centre and production hall for the Lely group has been implemented. The new building, designed by Consort Architects, is expected to be completed by mid-2013. The project includes a warehouse with parking space on the roof and three connecting office buildings with showrooms, conference rooms and a company restaurant.
The project illustrates the power of integrated design in a special way. From the crawl space up to the parking deck, at every level of the building it is evident that the various disciplines in the design and construction team have worked together closely for the best, most durable and fastest results.



Extraction and Replacement of a Large Stator Assembly - Collahuasi Copper Mine, Chile

Nomination Category 3: Industrial Buildings and Plants



Project Description

Mammoet was contracted to perform the heavy lift and replacement of one complete stator section. This stator is part of one of the large mills which reduce the size of the incoming raw unprocessed earth before it enters a second mill which reduces the particle size for final processing. The large stator section is assembled from four quarter sections. Each of the quarter sections had to be lifted and moved to the waiting system. The system was then used to move the pieces out of the building and lower to ground elevation approx. 42' below. One of the primary challenges in replacing the stator section is the location of a conveyor belt and separator tower that is part of the operating plant. It was requested that impact to the conveyor be minimal during installation of Mammoet's equipment to keep the plant operational until the shutdown started. Mammoet's system was designed and installed months before the actual shutdown of operation and replacement of the components started. Once the replacement of the 4 components is complete, plant operations can continue while Mammoet's equipment is removed.

Structural System

The gantry on this project, like most Mammoet structures, is assembled from a mix of proprietary parts and custom components. The lattice towers, strand jacks and beams were transported in from the Mammoet yard in Rosharon, Texas. The foundations were constructed of poured in place concrete and installed by a local contractor.

Seismic Design

Chile is of special interest to the earthquake engineering community, as it is one of the most seismically active regions on earth. The main seismic source in Chile is the Nazca subduction zone. In this area, the Nazca tectonic plate subducts with a relatively high velocity (80 mm/year) to the South America tectonic plate. As a consequence of this collision, the models of the seismic source which affects Chile can be described as: subduction interface, intra-slab and crustal fault. All these lead to shallow crustal earthquakes, which are typical for this area.

For these reasons, Mammoet US chose to collaborate with Mark Flamer P.E., an expert in seismic design using Scia Engineer, for the analysis of the gantry system. The results were also peer reviewed by an industry expert in Chile.

The present seismic design code in Chile is titled NCh 433.Of96 and is based on the 1995 Uniform Building Code (U.S.). The code offers both static and dynamic methods for analysis of structures. Due to the size and geometrical irregularity of the structure, the design team chose to use the linear dynamic procedure (Modal Response Spectrum) over the simpler linear static (Equivalent Lateral Force) method. The design acceleration values in Chile vary based on seismic zone. The Collahuasi Copper Mine is located in the second of 3 zones. The response spectrum analysis was run with several models simulating the various positions the gantry and load would be in throughout the project. The critical load position found was with the stator at the highest lift point tying the fundamental period of the gantry and stator together, resulting in the most mass being mobilized under seismic excitation. The critical reactions were sent to a Chilean design team who then specified the foundation system.

Scia Engineer

- The ease and simplicity of Scia's graphical interface allowed for time-efficient modeling especially in the repeating tower structures.
- Load modeling was easily able to account for multiple load scenarios, ranging from environmental survival cases to the stator section's dynamic position on the system.
- Report generation vastly reduced the amount of time required for compiling and revising engineering reports. Graphical outputs and pictures also greatly aided in communication between Mammoet and the client as there was often a language barrier.

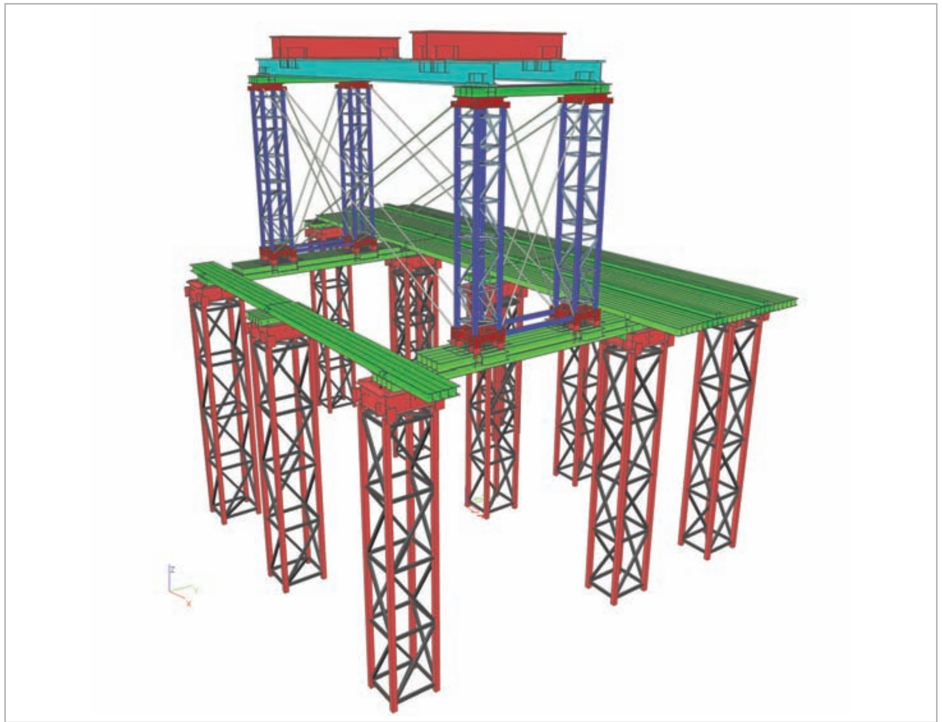
Software: Scia Engineer

Mammoet US

Contact Joseph Lawless
Address FM 521 20525
77583 Rosharon, Texas, United States
Phone +1 281 369 2200
Email Joseph.Lawless@mammoet.com
Website www.mammoet.com

Mammoet US: Mammoet is the world's leading tailor-made heavy lifting and multimodal transport solutions specialist. Our core business is the transport, shipping, installation (including horizontal and vertical positioning) and removal of heavy or large objects, to and from any location, onshore and offshore.

Mammoet's mission statement is: "to be the best full service provider in the global market for engineered heavy lifting and multi-modal transport for the benefit of our customers, shareholders and employees."



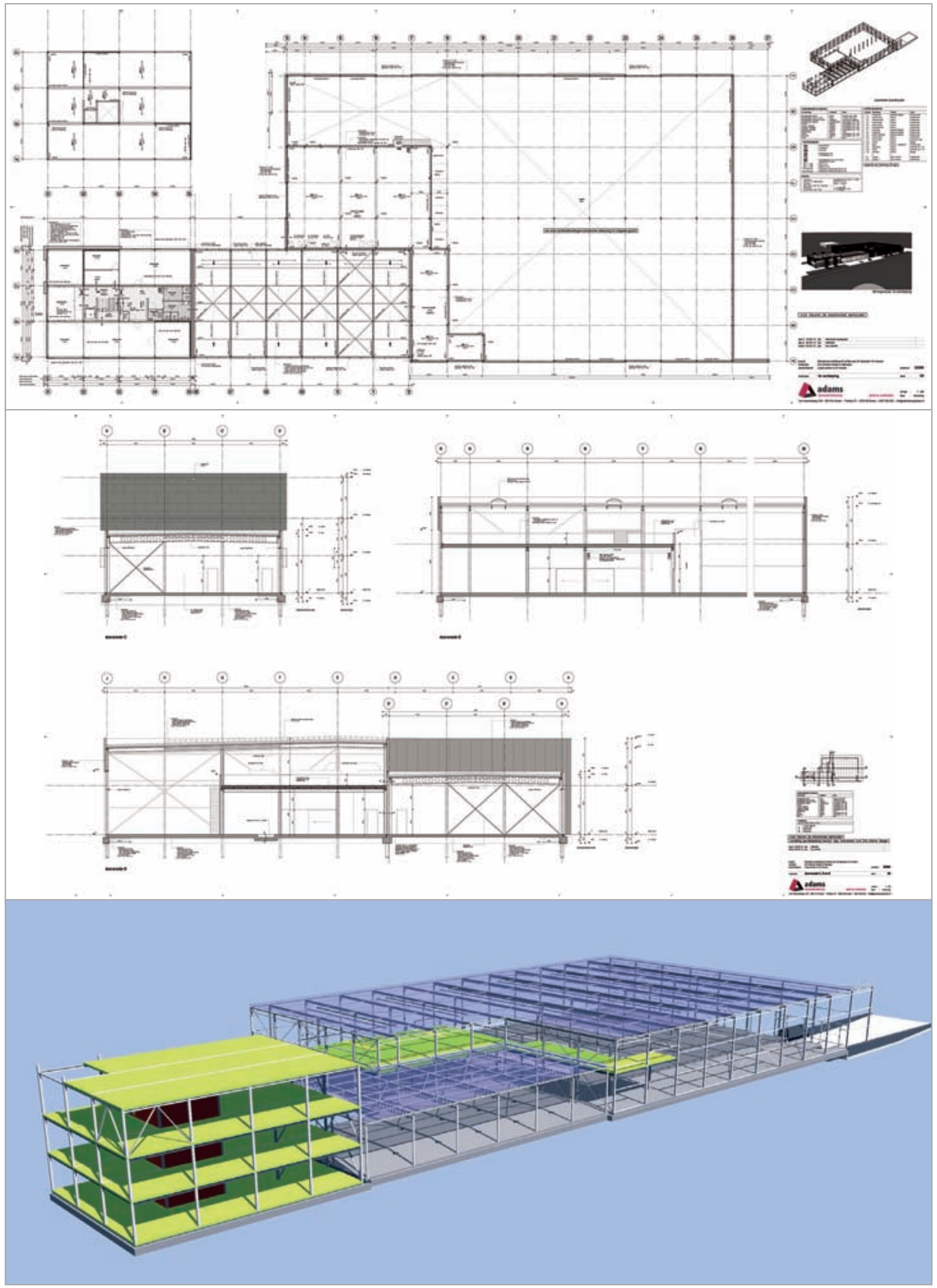
Project information

Owner	ABB
General Contractor	Mammoet Chile
Engineering Office	Mammoet USA
Location	Collahuasi Copper Mine, Chile
Construction Period	01/2013 to 01/2013

Short description | **Extraction and Replacement of a Large Stator Assembly**

The project objective was the extraction and replacement of a large stator assembly at the Collahuasi Copper Mine in Chile. The stator assembly was composed of 4 quadrants with the heaviest weighing 118.5 US tons. This process required the design and construction of a temporary gantry system to lift the stators over the existing conveyor systems at the plant. The project was very challenging due to extremely tight working conditions, the sheer size and mass of the components and the intense seismic forces the gantry system had to be designed for. 3D models of every component involved in the process were created and a 4D simulation was prepared to guide the crews on site.

Bedrijfspand "Certilas" - Huissen, Nederland



Vijf dimensies en drie disciplines, allemaal gecombineerd in een 3D model: Virtueel Bouwen. Het virtuele gebouw is meer dan een impressie alleen. Het vormt de basis voor tekeningen, calculatie, planning en onderhoud. Door de integrale combinatie van de disciplines ontstaat een efficiënte werkwijze in tijd, afstemming en kosten. Bij de realisatie van dit project hebben we gebruikt gemaakt van het concept Virtueel Bouwen met onze software.

Het project

Het bedrijfspand bestaat uit drie delen: een kantoorgedeelte, een demoruimte en een magazijn. Het kantoorgedeelte bestaat uit drie bouwlagen. Op de begane grond en de eerste verdieping bevinden zich de kantoren van de afdeling in- en verkoop en de directie. Op de tweede verdieping is een grote ruimte op te delen in verschillende afzonderlijke ruimten, die gebruikt kunnen worden voor presentaties.

De demoruimte bestaat uit een grote open ruimte waarin verschillende lastechnieken gedemonstreerd worden. De staalconstructie en de installaties zijn volledig in het zicht gelaten, waardoor een industriële look wordt gecreëerd. Door de open structuur in de gevels wordt deze ruimte het visitekaartje van het bedrijf.

In het magazijn komen stellingen te staan met de voorraad van alle lasmaterialen. Een gedeelte van de negen meter hoge hal wordt gescheiden door een tussenvloer. In een onderhoudsruimte in het magazijn worden ook reparaties uitgevoerd en lastechnieken getest.

BIM proces

Het gebouw is uitgewerkt met Allplan. In het 3D model zijn de drie disciplines bouwkunde, constructie en installatietechniek uitgewerkt van de ontwerp tot uitvoeringsfase. Met een simpele handeling kan geschakeld worden tussen de disciplines.

Het is onze ambitie om niet alleen de disciplines te combineren in het 3D model, maar ook op de afdruk. Doordat een element, zoals een wand, in elke discipline één en hetzelfde element is ontstaan er nooit afstemmingsproblemen tussen de bouwkunde, constructie en installatie. Daarnaast hoeft er ook maar één model getekend te worden in plaats van drie, wat een hoop tijd scheelt.

Doordat één persoon over de kennis beschikt van deze drie disciplines, ontstaat er een nauwe afstemming.

5D model

Aan de elementen in het 3D model hebben we informatie toegevoegd, die gebruikt kan worden voor calculatie en planning. Met gebruik van de rapportfunctie in Allplan zijn die gegevens in een document samengevat, die voor het proces een meerwaarde hadden. Het gaat om algemene informatie zoals leverancier, materiaal, levertijd, aanschafprijs en elementspecifieke informatie, zoals hang- en sluitwerk, glassoort, RAL kleur, betonkwaliteit en milieuklasse. Deze gegevens zijn later tevens van waarde bij het onderhoud van het pand.

De opdrachtgever heeft deze gegevens vervolgens gebruikt om een elementenbegroting te maken en de aannemer kan deze gegevens gebruiken voor zijn inkoop en planning.

Omdat Allplan de uitwisseling via IFC ondersteunt kan de opdrachtgever het IFC model in een onafhankelijke viewer openen, een element aanklikken en informatie uitlezen over de hoeveelheden en de leverancier.

Software: Allplan Engineering

Adams Bouwadviesbureau bv

Contact Paul Bier
Address van Heemstraweg 123f
6651 KH Druten, The Netherlands
Phone +31 487588280
Email pbi@adamsbouwadvies.nl
Website www.adamsbouwadvies.nl

adams
bouwadviesbureau

Adams Bouwadviesbureau is een raadgevend ingenieursbureau op het gebied van bouwkunde, draagconstructies en civiele bouwwerken, gebaseerd op heldere ontwerpkeuzes en duidelijke afspraken. Veiligheid, innovatie en kwaliteit staan hoog in het vaandel. Onze uitgebreide ervaring ligt op het terrein van woning- en utiliteitsbouw en bruggen, zowel individuele projecten als grootschalige stadsvernieuwing. Sinds de oprichting is het bureau uitgegroeid tot een bedrijf van 15 medewerkers met de flexibiliteit van een klein bedrijf en het kennisniveau van een grote organisatie.

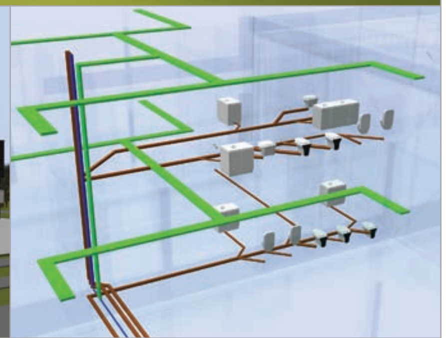
Integrale projecten waarin bouwkunde, constructie en installatie worden gecombineerd, worden uitgewerkt in 3D door middel van Allplan. Het rekenwerk wordt ondersteund door software van Scia en zelf ontwikkelde rekenprogramma's.

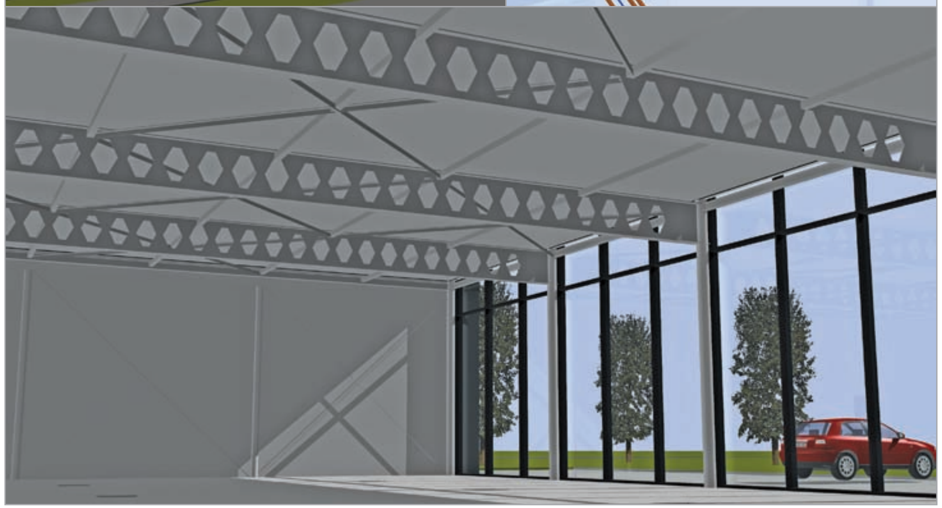
Project information

Owner	Laspa BV
Architect	Eric Interior Design
General Contractor	Klomps aannemersbedrijf
Engineering Office	Adams Bouwadviesbureau bv
Location	Huissen, The Netherlands
Construction Period	05/2013 to 12/2013

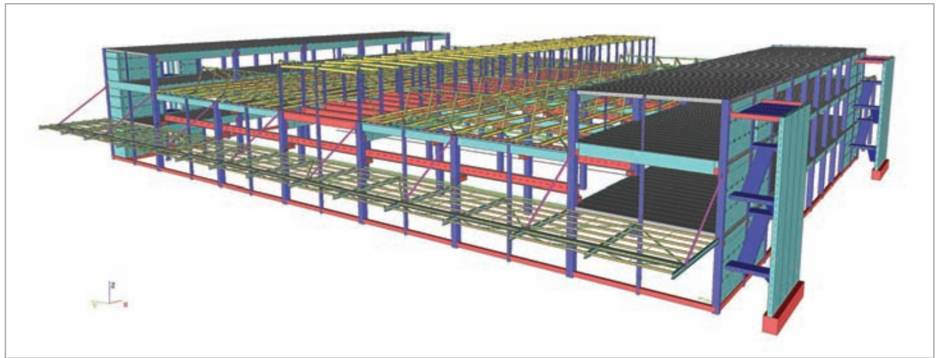
Short description | Company Building "Certilas"

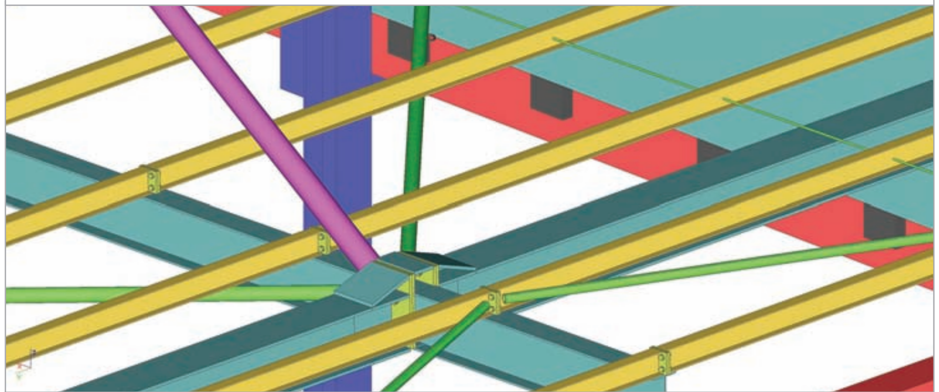
Five dimensions and three disciplines, all combined in one 3D model: Virtual Engineering. The virtual building is more than a mere impression. It forms the basis for drawings, calculation, planning and maintenance. By the integral combination of the disciplines, an efficient method is created, in time coordination and cost. During the implementation of this project we have used the Virtual Engineering concept with our BIM software.

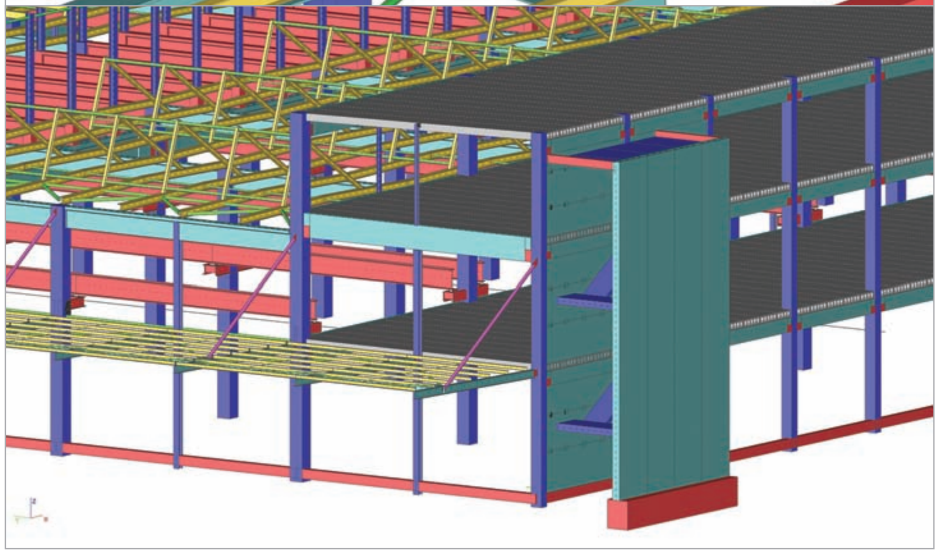




Production Hall 090b - České Budejovice, Czech Republic







Bj090b is a continuation of the existing factory building Bj090a at the company R. Bosch spol. s.r.o.
The new factory building with the ground plan parameters of 5 x 12 + 13.5 + 12 = 85.5 m / 5 x 12 = 60 m is based on the large-diameter piles heads and cups for the restraint of concrete columns.

The building consists of 2 three-storey annexes which formed the western and eastern facade and of single-storey shop between them, which has a penthouse for the machine room in the middle module. The first floor with level +/-0.000 consists of the production shop and warehouse handling. The second and third floors of the annexes on levels +5.250 and +10.500 with the utility load of 4.5 kN/m^2 are areas of social and administrative facilities building. The total height of the outbuilding is +14.87 m. The production shop has the height of 9.6 m to the upper level of girders. The machine room floor in the centre of the shop, a 12 m ship located at +9.750 with a useful load of 7.5 kN/m^2, has a steel structure covered by the metallic roof and facade. The internal prefabricated staircase is located at the eastern facade. Two outside prefabricated stairs, located at the western façade, leave the outer contour of the building.

The prefabricated concrete structure consists of:

- Prefabricated columns
- Prefabricated girders of the machine room under the roof superstructure
- Prefabricated beams of the machine room under the roof superstructure
- Precast roof girders of the shop
- The prefabricated ceiling- and roof beams of the annexes
- Circumferential bracing of both annexes
- Ceiling panels (Spiroll), thickness 320 mm
- Wall panels of staircases
- An intermediate landing platforms and
- Staircase shoulders
- Roof panels of the outside staircases
- Roof trims of the staircases
- Reinforcing membrane of ceilings and roofs on the panels (Spiroll)

The steel structure creates of the following parts of the building:

- The roof superstructure machine room +9.750
- Roof purlins of the shop including supporting structure of skylights
- The steel staircase in the eastern annex
- Gable columns in the façade - row 40
- Supporting roof sheets of the shop and of the penthouse/superstructure machine room
- Special profiled roof sheets for the watering concrete floor slabs of the machine room
- The north shelter suspended from the concrete facade columns
- Internal columns of annexes
- Lining trapezoidal sheets

Based on experience with similar big-box structures, we resolved the problem of cladding shear deformation, which occurred due to long-term deformation of concrete structures. We came to the solution that consists of an indirect anchorage facade profiled on concrete columns through auxiliary C profiles of bent sheet metal. Thus, we have eliminated solid connections of the facade to the supporting concrete structure and thereby prevented unwanted deformation of the facade.
Inside the building we also implemented a structure for the design of the future building clean room.
The supporting structure consists of steel frames in the transverse axial distances of 3 m. The outer steel frames have the axial distance of 2.42 m. The overall external dimensions of the structure are 38 x 9.8 x 4.24 m. The joints of the structure of the area are welded in order to maintain cleanliness in the area. The frame corners are designed to be welded with tapered columns and mullions. Other connections have been designed using hidden welded brackets, which will be fitted with supporting elements. The structural elements of the hidden brackets will be welded to the bottom flange for attachment on the bracket. In order to facilitate the assembly of steel frame mounting, frame joints are designed. Mounting connections are positioned with regard to the bending moment diagram at the zero bending moment.

Software: Allplan Engineering, Scia Engineer

APP Projekt s.r.o.

Contact Jan Šinogl
Address Jírovcova 24a, České Budějovice
370 01 České Budějovice, Czech Republic
Phone +420 387002149
Email sinogl@app-projekt.cz
Website www.app-projekt.cz

APP Projekt s.r.o., a comprehensive design and engineering company with headquarters in České Budejovice, Czech Republic, was established in April 1992 as a private company. APP Projekt s.r.o. has a team of well-educated, skilled and flexible specialists with long-time branch experience in the construction of industrial buildings. The team itself, or in cooperation with partners, offers an integral architectural and engineering service system in project preparation and construction management at a respected level of European quality. Thanks to this professional structure, APP Projekt s.r.o. has become a well-equipped engineering company that is able to satisfy a wide spectrum of clients' requests within deadlines, at reasonable cost and in high quality.

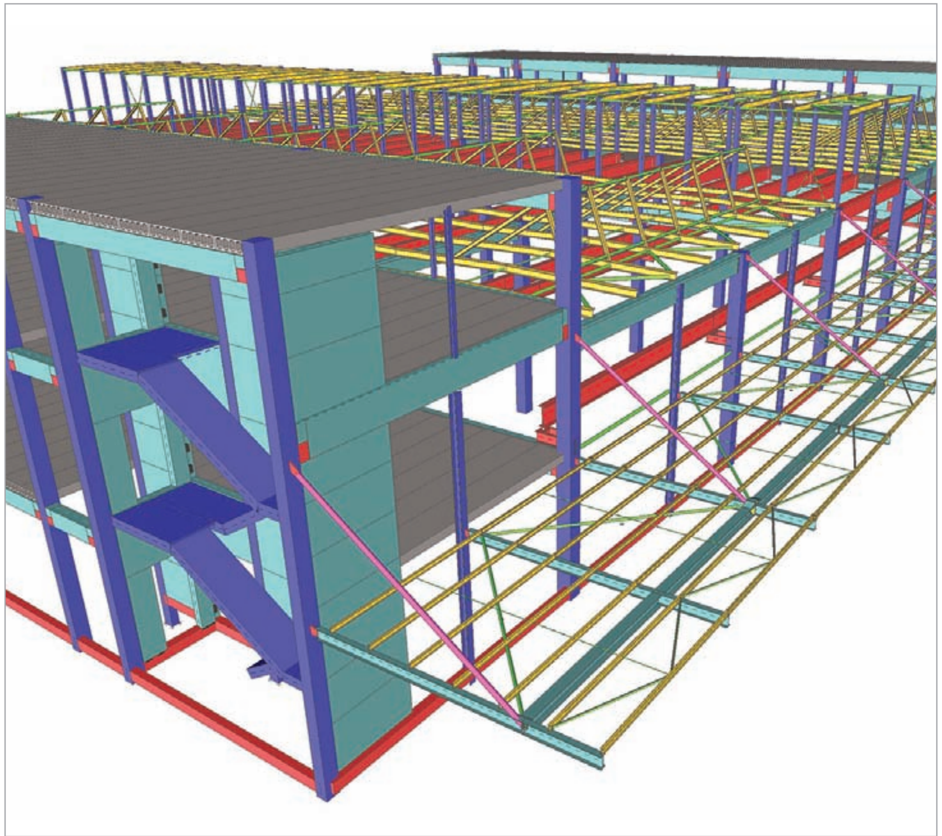
References: Bosch, A.Pöttinger, Engel, Kern-Liebers, Umdasch...
More at: www.app-projekt.cz

Project information

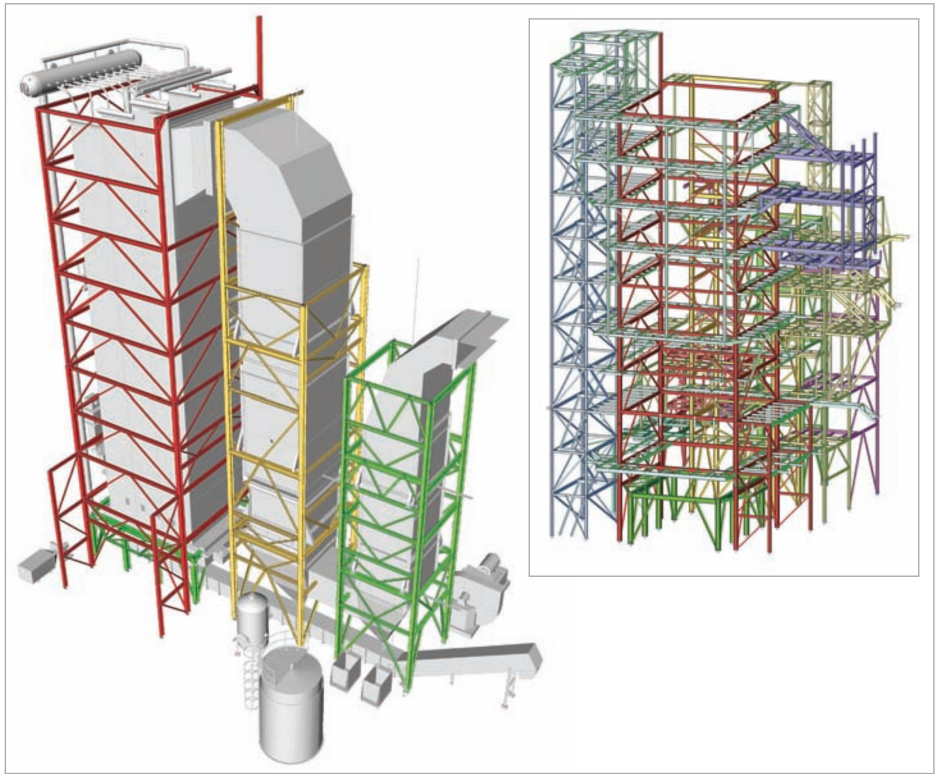
Owner	Robert Bosch s.r.o.
Architect	Bosch CRE department in cooperation with APP Projekt
General Contractor	Berger Bohemia
Engineering Office	APP Projekt s.r.o.
Location	České Budejovice, Czech Republic
Construction Period	09/2011 to 09/2012

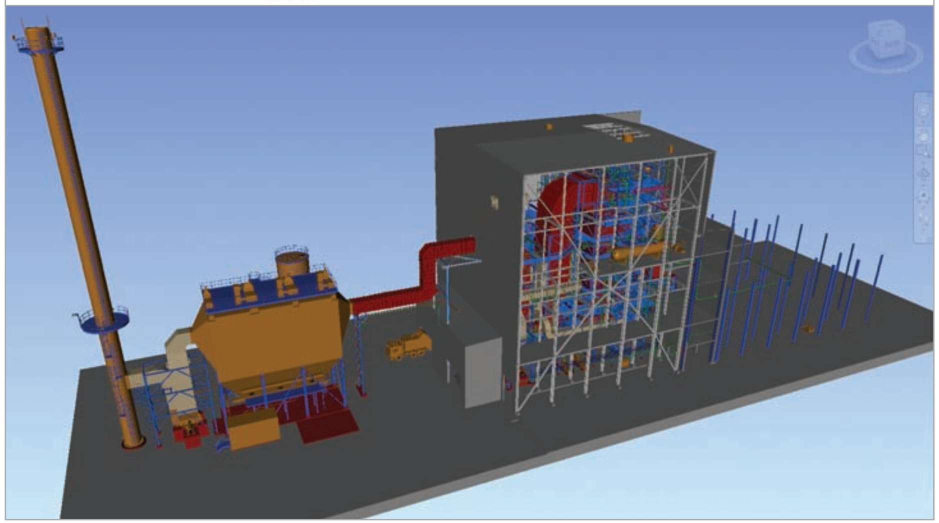
Short description | Production Hall 090b

The architectural design was prepared on the basis of the assignment from the client and the future user with regard to the parameters of the technological use. The current proven concept, i e. the concept of an open-plan hall with administrative and social built-in rooms separated from the production shop by open galleries, was observed during the building of new production shop extension 090b.
APP Projekt s.r.o. provided complete design work in all stages of documentation, engineering, creative and technical supervision, including cooperation in final acceptance and putting the building into use.



Steel Structure for Biomass Boiler and Service Platforms - Elblag, Poland





General Description of the Structure and Supported Devices

- Overall dimensions of the structure envelope: 21 x 24 x 33 m
- Structure Weight: 215 tonnes
- Number of bars in the structure: 2,254
- Number of joints: 1,254
- Weight of supported technology: 625 tonnes

The presented steel structure serves to secure the operation of the steam three-draught boiler for biomass combustion. The first draught of the boiler is formed by a combustion chamber of the boiler with membrane walls and a membrane top wall, on which there are suspended systems of ribbed tubes. The combustion chamber, with dimensions of 8 x 8 x 25 m and a weight of 295 tonnes, is mounted to slide on a bearing steel structure. Friction bearings along with a guideway in appropriate directions enable the chamber to transform its shape due to considerable heat dilatation. Dilatation movements are enabled from the fixed point on the substructure outwards and upwards in the guideway directions. The bottom of the combustion chamber is formed by a vibration resonance grid, which has been placed on a separate steel concrete structure. The bearing structure of the second and third draught has been designed as a multistage spatial frame. The interconnecting of the structures of the individual draughts has been solved in a way which enables misalignments of the assembly to be compensated. Duct systems supported by this structure are divided into several dilatation units, which are always mounted to slide on the steel structure with the guideway. Another structure serves to support sheet metal ducts and pipelines for water and steam, and to secure the access to technological devices by means of platforms. The whole structure is situated inside the boiler house, to which it is connected on several levels. The method for interconnecting the boiler structure to the boiler house has been chosen so as to hinder the transfer of horizontal forces between individual structures.

Software and Model

The whole structure has been solved as a 3D-framed structure. The greater part of the joints has been modelled as hinged with negligence of the rotary stiffness of the connection. Frame joints have been designed in joints of spar pieces of main structures, where the stability of the structure could not be secured by means of vertical bracing. The influence of the second order has been examined by means of the “Stability” module, with which the maximum critical number of the structure has been determined. As results from the stability assessment, influences of the second order have to be considered. These influences have been implemented into the model in the form of horizontal forces acting to columns within the independent loading cases.

Particular attention has been paid to the structure below the combustion chamber and the structure below the vibration grid. The structure below the chamber was interesting especially in the field of solving details of the chamber’s friction bearing. These details have been made without the usage of bearings, with the application of sliding lacquers and appropriate friction coefficients for the determination of horizontal forces.

The structure below the vibration grid was examined dynamically by means of a modal analysis with the development to natural shapes.

Following the execution of the linear static, dynamic and stability analysis, the Scia Engineer program was applied. In this program, we successfully achieved an optimised design structure design. We also managed all the design phases thanks to the application of the transfer of geometry into the Scia program from the AdvanceSteel program by means of the IFC- and XML-Export.

Software: Scia Engineer

Bilfinger Babcock CZ s.r.o.

Contact Jiří Protivínský
Address Křižíkova 72
61200 Brno, Czech Republic
Phone +420 545 104 059
Email jiri.protivinsky@bbs-cz.bilfinger.com
Website www.babcock-cz.bilfinger.com

BiLFINGER

Bilfinger Babcock CZ s.r.o. is an important provider of steam generators and power plant equipment. The company provides comprehensive solutions for applications using a wide range of fuels and/or waste heat utilisation, having environmental friendly technologies in focus. In detail, the product portfolio consists of Heat Recovery Steam Generators, Clean Biomass Fired Boilers, Coal Fired Boilers, Special Boilers, Turnkey Plants, Modernization and Repairs of such equipment and newly also 3D Laser Scanning services. The scope of works and services ranges from technical feasibility study up to final assembly, as well as plant operations and lifetime services.

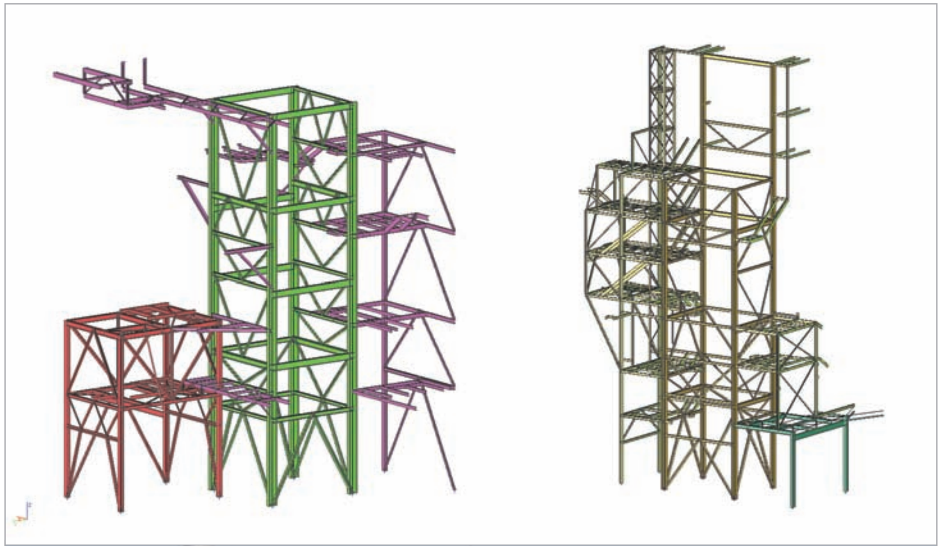
The design of pressure parts and bearing structures of boilers is secured within the company by the Stress Analysis Department managed by Ing. J. Jelínek CSc. This department processes the complete stress design of the pressure pipeline, pressure tanks, flat elements of duct systems and the whole range of dynamic calculations. Steel structures are processed here from the design phases up to the basic design documentation and design of joints.

Project information

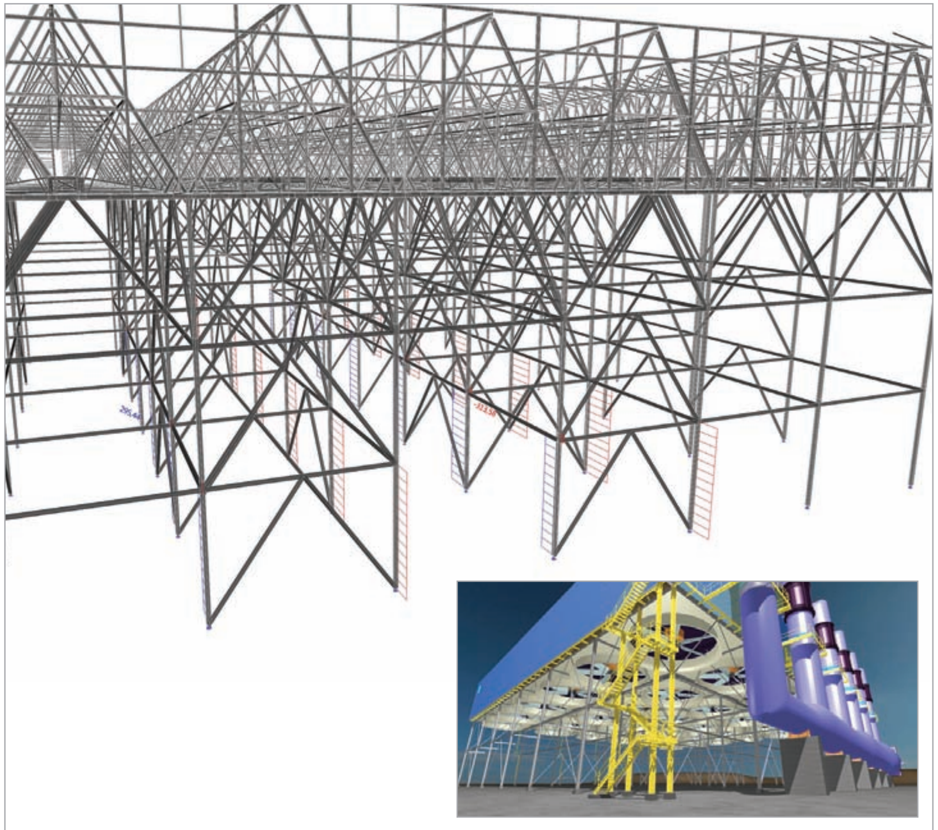
Owner	Energa Kogeneracja, Elblag, Poland
Architect	BPiR Protech, Lodz, Poland
General Contractor	Mostostal Warszawa S. A., Warszawa, Poland
Engineering Office	Bilfinger Babcock CZ, Brno, Czech Republic
Location	Elblag, Poland
Construction Period	12/2011 to 03/2013

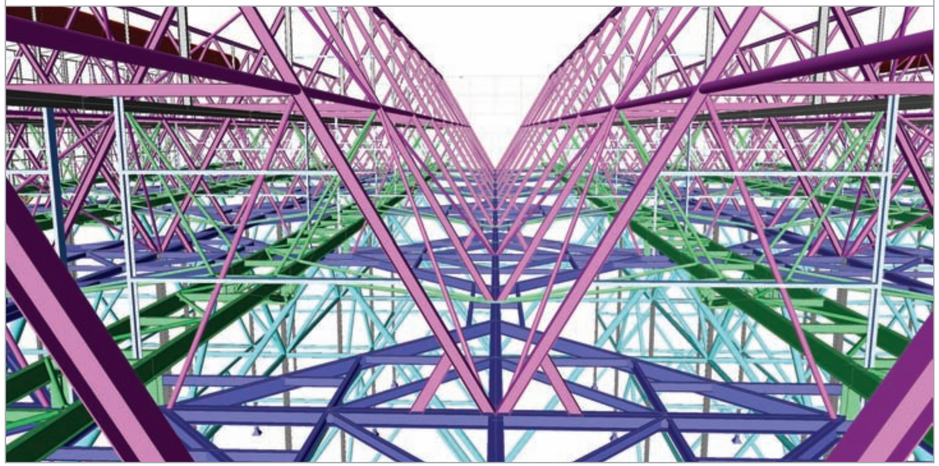
Short description | Steel Structure for Biomass Boiler and Service Platforms

The project subject was the building of the Biomass boiler for combustion of straw and wooden pellets. The device outputs 90 tonnes of steam per hour with the pressure of 95 bar and the temperature of 525°C. The fuel is delivered to the boiler by means of a combination of worm conveyors and pneumatic tossing devices from the daily silo. In individual boiler draughts, the heating of the primary and secondary air, the heating of water and the additional heating of steam takes place.
The bearing structure serves as a supporting structure for three boiler draughts, the duct system, and the pipeline for air, water and steam. On the bearing structure, fixed points of the steam piping and the friction bearing of heated boiler parts have been made. At the same time, the structure is used to provide access to individual technological devices. The total weight of the steel structure is 215 tonnes. The total weight of the supported technology is 625 tonnes.



Construction d'un aérocondenseur - Riyadh, Arabie Saoudite





Introduction

La société Saudi Electric Company a décidé de construire une nouvelle unité de production d'énergie à 140 km à l'ouest de Riyadh en Arabie Saoudite. Cette unité de production est composée de turbines à gaz, d'un générateur de vapeur à récupération de chaleur, d'un générateur à turbine vapeur et de 2 aérocondenseurs identiques. Nous avons étudié la structure métallique de ces aérocondenseurs.

L'aérocondenseur est composé de 42 cellules réparties en « rues ». La structure a une dimension de 92 x 95 m et une hauteur de 41 m.

Modélisation

La structure est composée d'environ 8.400 éléments barres. Toutes ces barres sont issues de la bibliothèque de profilés américains incluse dans Scia Engineer. De plus, nous avons dû utiliser les qualités d'acier suivant les normes américaines.

La sous-structure entièrement contreventée par des tubes supporte le plancher des ventilateurs, la passerelle, le support du collecteur et les façades protégeant les échangeurs du vent. Une passerelle périphérique en porte-à-faux permet d'accéder à toutes les « rues ». Enfin, une cage d'escalier et une cage d'ascenseur viennent compléter l'ensemble. Celles-ci ont été étudiées séparément.

Aspect particuliers du projet

- La structure étant construite en Arabie Saoudite, nous avons dû nous conformer aux cahiers des charges de la Saudi Electric Company. Pour ce faire, la norme ASCE/SEI 7-10 (IBC) et, en complément, la norme Saudi Building Code SBC-302 Structural Loading and Forces-2007, ont dû être utilisées afin de définir les charges d'exploitations et climatiques à appliquer à la structure.
- Le marché local des aciers de construction est majoritairement composé de profilés américains. De plus, nous avons dû nous adapter aux disponibilités des profilés sur le marché qui devait fournir 2.500 tonnes d'aciers pour les deux aérocondenseurs.
- Le calcul de la structure a été effectué en utilisant le contrôle acier suivant le code AISC – LRDF issue de la norme américaine.
- Nous avons dû effectuer le calcul dynamique de la structure soumise aux vibrations des ventilateurs en fonctionnement mais également dans le cas où une des palles d'un ventilateur se briserait. En effet, le bris d'une palle induit des efforts dynamiques importants.

Conclusion

Le logiciel de calcul Scia Engineer a fourni un outil de modélisation exceptionnel de par sa facilité d'utilisation, de modélisation et d'optimisation.

Nous avons pu effectuer ces calculs grâce aux bibliothèques de normes et de profilés complètes ainsi que grâce aux modules dynamiques.

Software: Scia Engineer

Bureau d'Etudes Lemaire sa

Contact Agostino Giordano
Address Route du Condroz 404
4031 Angleur, Belgium
Phone +32 4 366 60 40
Email a.giordano@belemaire.be
Website www.belemaire.be

Engineers and Consultants for People and Nature

Créée en 2000 sous l'impulsion d'un jeune ingénieur, le Bureau d'études Lemaire s.a. réalise des études techniques dans les domaines de l'industrie, du génie civil, du bâtiment et des infrastructures. Il se distingue par son dynamisme, son savoir-faire et ses compétences.

Le Bureau d'études Lemaire s.a. est composé d'une équipe solide de 30 personnes, comprenant de jeunes ingénieurs et dessinateurs DAO hautement qualifiés, vouant une passion à la construction et participant activement à la conception, au développement et à la réalisation des projets.

Dès la naissance d'un projet, le Bureau d'Etudes Lemaire s.a. s'efforce de dégager des solutions techniques créatives et originales respectant la dimension architecturale souhaitée par son concepteur. Avec des outils informatiques performants, le Bureau d'études Lemaire s.a. offre à sa clientèle un service moderne, innovant et d'excellente qualité.

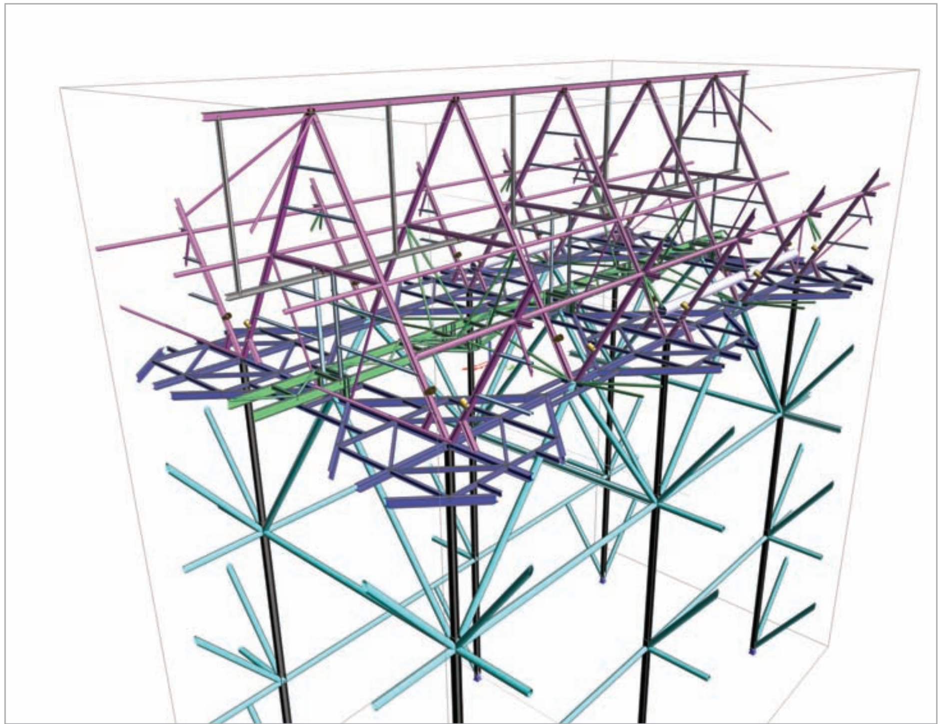
Project information

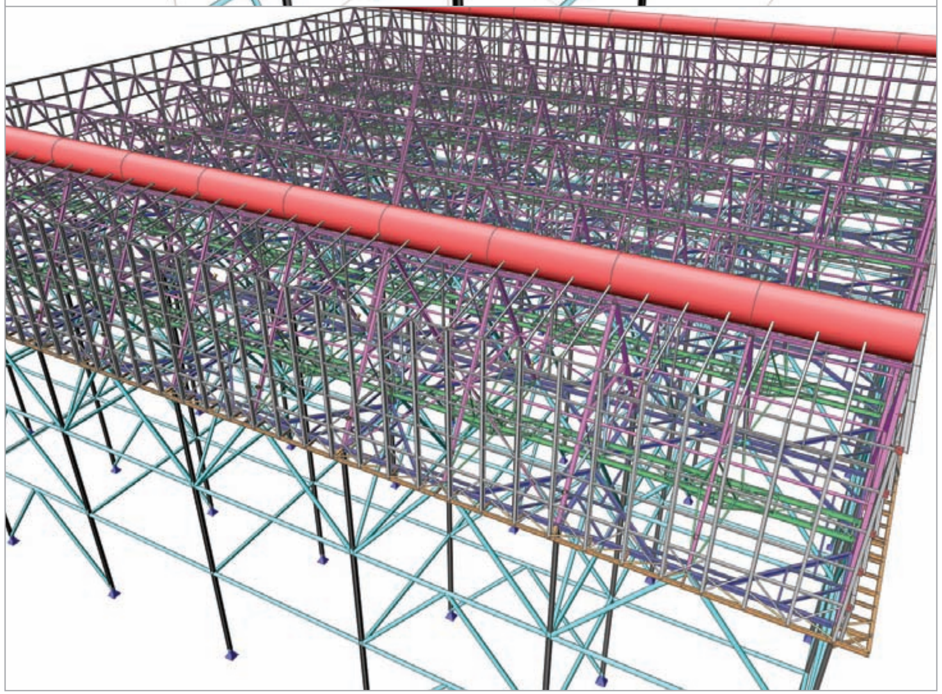
Owner	Saudi Electricity Company
Architect	Research-Cottrell Dry Cooling - A Division of Hamon Group
General Contractor	Bemco - GS Joint Venture
Engineering Office	Bureau d'Etudes Lemaire
Location	Riyadh, Kingdom of Saudi Arabia
Construction Period	01/2013 to 07/2013

Short description | Construction of an Air Cooled Condenser

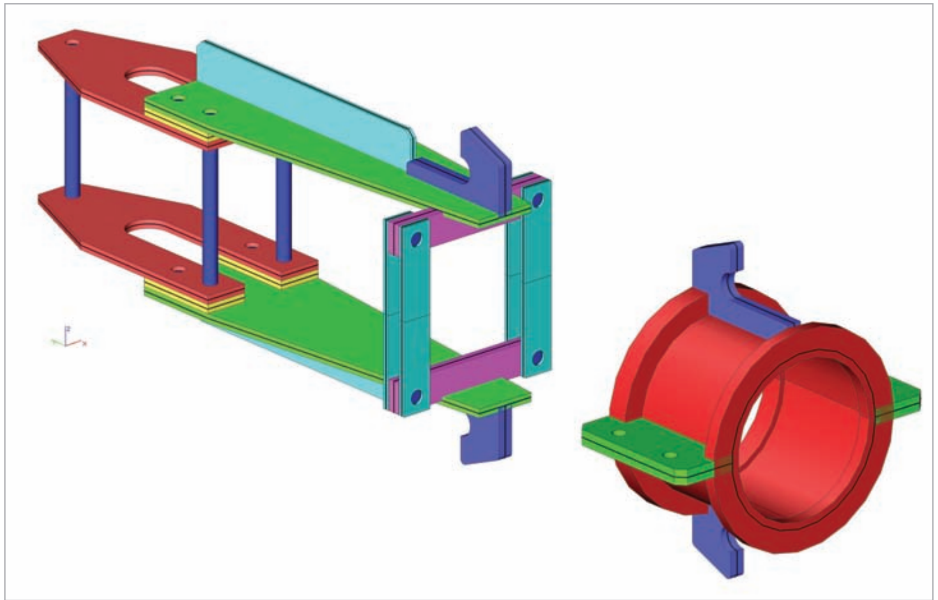
This project concerns the construction of a new power plant comprising four gas turbines, four horizontal heat recovery steam generators, one steam turbine generator and air-cooled condensers. We design the structure for these ACCs. The ACCs are composed of 42 cells which are divided into 7 "streets". The dimensions are 92 x 95 x 41 m.

Scia Engineer provided a software that allowed us to design the structure according to the American codes and using American sections. We also had to use the dynamics functionalities. The structure was easy to model with the software.





Lifting of Heavy Loads and Construction Stages - América do Norte, Central e Sul, Brazil



Introduction

The team of Odebrecht Industrial Plants is responsible for internal consulting and technical support on engineering solutions for all Odebrecht's contracts.

The main effort is to analyse the different stages of the assembling of huge equipment through designing specific accesses or a group of accessories that allow the required movements, which means the manipulation of heavy loads until the end of the installation process. These accessories and/or accesses are normally not considered during the conception of the equipment design, but are fundamental to their installation.

About our work

The workflow is based on simple client information regarding the equipment, and the first decision is to define the machines (the cranes) that will make the movement. Subsequently, the equipment itself is analysed in order to check if it supports the lifting loads in the different construction stages. The analysis will define if reinforcement is necessary for the installation process or even for the equipment operation. The accessories are defined based on global and local analyses of the introduction of loads. Scia results define the material and components, with the information flowing to the customer and the internal Odebrecht S.A. team.

The analysis is based on American Standard Code AISC 89, but in some cases, for a refined analysis, Eurocode is used.

Use of Scia Engineer

Scia Engineer has been used since 2011. The biggest discovered benefit was the shells study. The tools used previously did not allow easy modeling with a refined analysis that considered heavy loads manipulation.

The projects are distributed across different parts of the world, including Brazil, Mexico, Houston, Argentina and Italy. The main challenge in these contracts is the deadline, which demands an agile analysis, a quick dialogue with the support team, and fast and reliable results, since maintenance stops for important equipment are involved.

In citing some main examples of the use of Scia Engineer, we refer to some projects where advancements in the field of analysis and accurate calculation were possible. The Scia Engineer response is very close to the real structure behaviour.

In conclusion, the use of Scia Engineer means, for us, Practicality for Consulting Engineering through a user friendly interface and large gains in modelling.

Project 1: Chimney
Client: YPF Ensenada Industrial Complex
Description: Continuous Regeneration Process Reactor.
Equipment: 200 tonnes.
Location: Argentina

Project 2: Chimney
Client: CSN - Companhia Siderúrgica Nacional
Description: Reheat Furnace Chimney. Ten sections, four vertical points, critical section: 70 tonnes.
Location: Rio de Janeiro - Brazil

Project 3: Pernambuco Arena
Description: Load Measuring Device. Hydraulic Equipment for loads acting in the coverage rods.
Maximum load extent: 60 tonnes.
Location: Pernambuco - Brazil

Project 4: Aquapolo Project
Description: Cylindrical Tank, with a 12 m diameter and a 12 m height. Chimney of Balance: 30 tonnes.
Location: São Paulo - Brazil

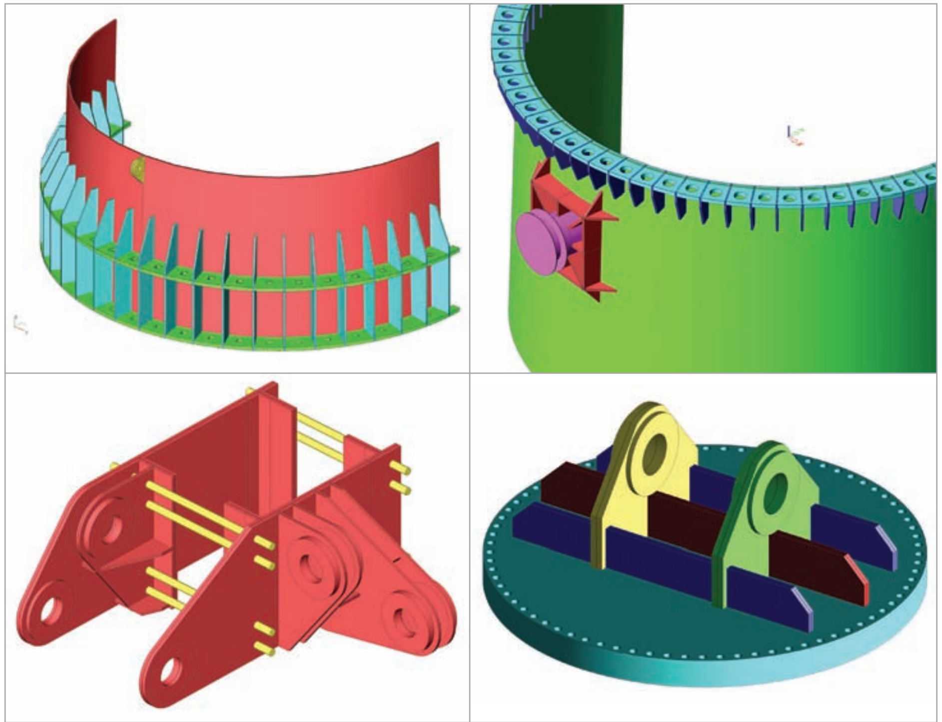
Software: Scia Engineer

Construtora Norberto Odebrecht S.A.

Contact André Mansur
Address Av. das Nações Unidas, 8501 - 27º andar
05425-070 São Paulo, Brazil
Phone +55 11 30968000
Email andremansur@odebrecht.com
Website www.odebrecht.com.br

Odebrecht is a Brazilian organisation composed of diverse businesses with global operations and quality standards. Through its leading companies, Odebrecht serves the following industries: Engineering and Construction, Investment in Infrastructure and Energy, Industry and Auxiliary Institutions. Founded in 1981, Odebrecht SA, the organisation holding, is responsible for strategic direction and the preservation of philosophical unity, ensured by the practice of the Odebrecht Entrepreneurial Technology (OET).

Odebrecht Industrial Plants: The team of Odebrecht Industrial Plants is responsible for internal consulting and technical support with engineering solutions on all Odebrecht's contracts.



Project information

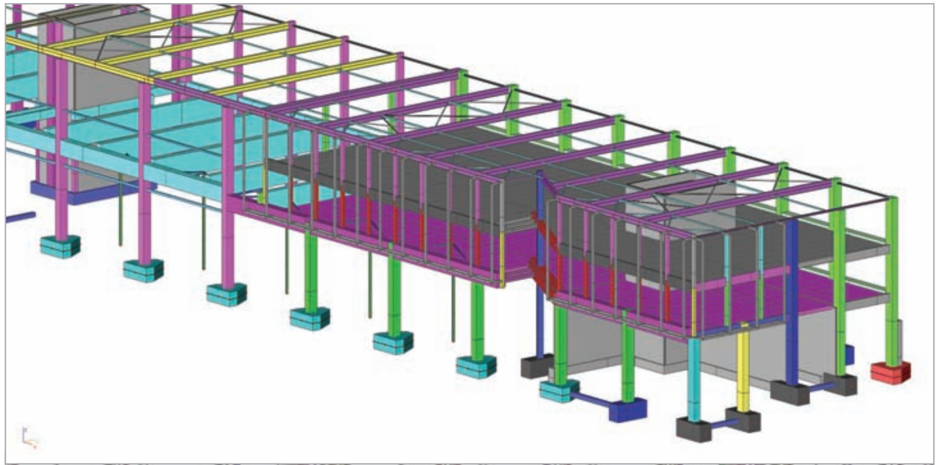
Owner	Construtora Norberto Odebrecht S.A.
Architect	Odebrecht Plantas Industriais
General Contractor	Construtora Norberto Odebrecht S.A.
Engineering Office	Odebrecht Plantas Industriais
Location	América do Norte, Central e Sul, Brazil
Construction Period	01/2011 to 04/2013

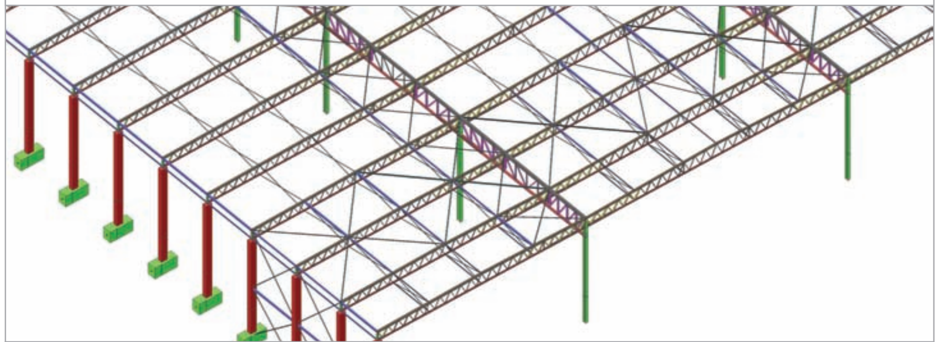
Short description | **Lifting of Heavy Loads and Construction Stages**

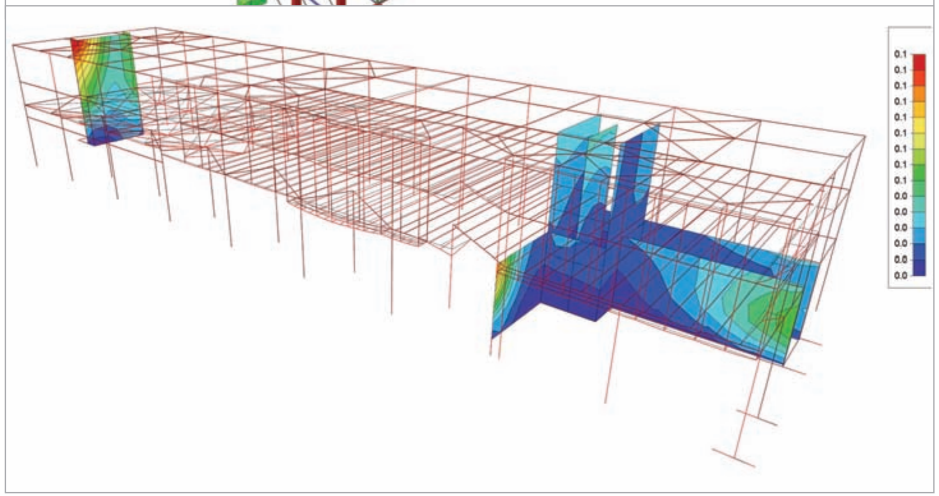
The key focus for Odebrecht Industrial Plants is to analyse the different stages of huge equipment assembling through designing specific accesses or a group of accessories that allow the required movements, meaning the manipulation of heavy loads until the end of the installation process. These accessories and/or accesses are not normally considered during the conception of the equipment design, but are fundamental to their installation.

In citing some main examples of the use of Scia Engineer, we refer to some projects where advancements in the field of analysis and accurate calculation were possible. The Scia Engineer response is very close to the real structure behavior.

Aveve Gebouw - Wilsele, België







Structurele berekening

Staal en beton

Het gebouw heeft een oppervlakte van 36.000 m² waarbij de voorbouw in beton wordt geprefabriceerd, en ook de nieuwe hallen uit staal worden geprefabriceerd.

Fundering

De stalen hal wordt geplaatst op sokkels die op hun beurt op grindkernen staan.
De voorbouw uit beton wordt geplaatst op sokkels die op schroefpalen worden gefundeerd. Het project bevat schroefpalen die tot 1.250 kN belasting moeten kunnen opvangen. Deze krachten per schroefpaal zijn zo hoog omwille van de aanwezigheid van een tussenvloer met een zeer grote overlast (1.500 kg/m²).

Ontwerpeisen

Voorbouw: de moeilijkheid van het project bestond uit zowel de zware belasting van de tussenvloer, als de grote overspanning en de benodigde brandweerstand. Hierdoor was men genoodzaakt over te stappen op een prefab betonstructuur.
Hal: de grote overspanningen die moesten gerealiseerd worden, opdat er zo weinig mogelijk kolommen in het gebouw geplaatst dienden te worden.
Lift: in de voorbouw is een lift voorzien die een last van 15 ton moet kunnen verplaatsen in verticale richting. Dit zorgt voor de nodige krachten in de x-,y- en z-richting.
Sprinklertank: de stalen hallen worden door middel van sprinklerinstallaties voorzien van de nodige brandpreventie. De sprinklertank wordt geplaatst op een funderingsplaat van 50 cm dikte.

Structurele berekening

Het programma Scia Engineer is uitvoerig gebruikt tijdens de ontwerpfase van het project. Aan de hand van Scia hebben we het staal gedimensioneerd, de funderingen, de betonwanden, paalfunderingen en betonkolommen.
Aan de hand van de krachten die door het programma zijn berekend konden we samen met de betonleverancier de betonelementen dimensioneren.

De hal is een staalconstructie bestaande uit vakwerken. De vakwerken zijn zowel tweedimensionaal als driedimensionaal doorgerekend. De meest courante en standaard verbindingen zijn met Scia doorgerekend; de complexere knopen zijn in detail door ons studiebureau bekeken.

De betonstructuur werd volledig driedimensionaal doorgerekend. Dit zodoende dat de krachten in de paalfunderingen eenvoudig konden bepaald worden. Indien er aanpassingen werden gemaakt aan het concept kon er dus ook gemakkelijk een nieuwe berekening worden voorgelegd ter goedkeuring. Het driedimensionaal ingeven van de structuur gaf een duidelijk beeld van de verloop van alle krachten. Dit geeft naar ontwerp toe altijd een bepaald voordeel.

De liftschacht werd volledig gedimensioneerd met Scia Engineer. Dit gedeelte van de structuur werd afzonderlijk doorgerekend. Dit zodoende dat de rekentijd niet te hoog zou oplopen.

Technische gegevens van de hal in staal:
Maximale overspanning: 30 m
Maximale hoogte: 12 m

Technische gegevens van het magazijn in beton:
Overlast tussenvloer magazijn = 1500 kg/m²
Overspanning liggers = 18 m
Overspanning welfsels = 6 m

Technische gegevens van het kantoor in beton:
Overlast tussenvloer kantoor = 350 kg/m²
Overspanning TT elementen = 18 m

Besluit

Door gebruik te maken van de 3D-module van Scia Engineer is het mogelijk om alle lasten afzonderlijk in te geven.
Scia Engineer geeft een duidelijk krachtenverloop weer per element, hierdoor werd het gemakkelijk om de resultaten te interpreteren.

Software: Scia Engineer

Edibo nv

Contact Jan Caelen
Address Maatheide 1302
3920 Lommel, Belgium
Phone +32 11 54.11.59
Email jan.caelen@edibo.be
Website www.edibo.be

De firma Edibo, gevestigd in Lommel, is gespecialiseerd in het bouwen van bedrijfsgebouwen en kantoren. Edibo bouwt zowel nieuwbouw-, uitbreidings- als renovatieprojecten "sleutel-op-de-deur" en dit zowel in staal, beton als hout. Reeds meer dan 25 jaar bouwt Edibo schitterende referentieprojecten in diverse sectoren: multifunctionele distributiecentra voor de logistieke sector, productie- en bedrijfsruimten voor industrie (oa voedingsindustrie), KMO en multinationals, kantoorcomplexen en showrooms voor handel en dienstverlening. Edibo onderscheidt zich door zijn toegevoegde waarde. Vanaf de ontwerp en studiefase wordt er meegedacht met de bouwheer. De interne studiedienst staat garant voor stabiliteitsstudies, fire safety engineering en bouwtechnische optimalisatie. Een oordeelkundige projectuitvoering en kwalitatieve afwerking wordt ondersteund door de ISO 9001 kwaliteitslabel en ISO 3834, evenals de OHSAS 18001 veiligheidscertificering.
Tenslotte tracht Edibo steeds bedrijfsgebouwen met "onderscheidend karakter en uitstraling" af te leveren. Het realiseren van een stimulerende werkomgeving binnen het programma en het budget van de bouwheer ligt vervat in het motto "Building dreams on facts".

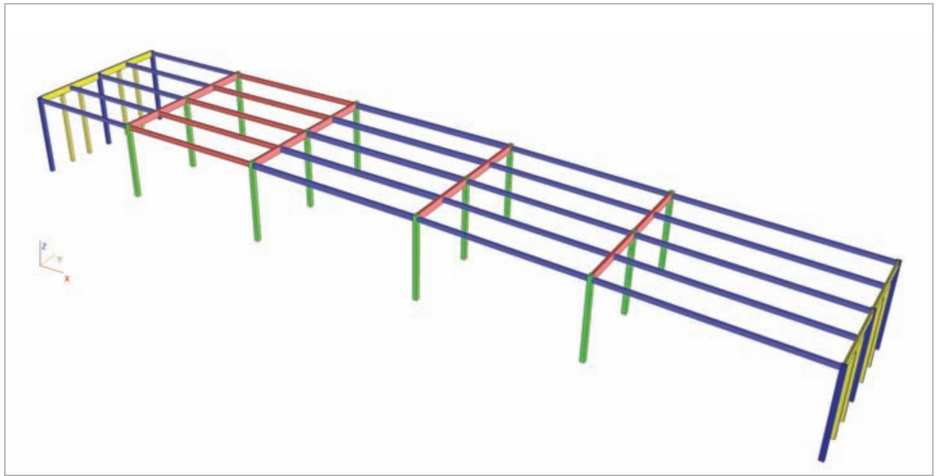
Project information

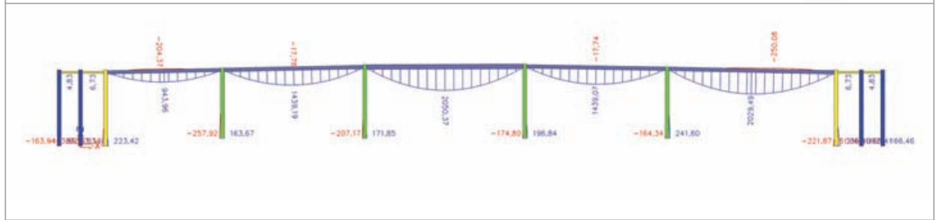
Owner	Aveve NV
Architect	Aveve NV
General Contractor	Edibo nv
Engineering Office	Edibo nv
Location	Wilsele, Belgium
Construction Period	08/2012 tot 07/2013

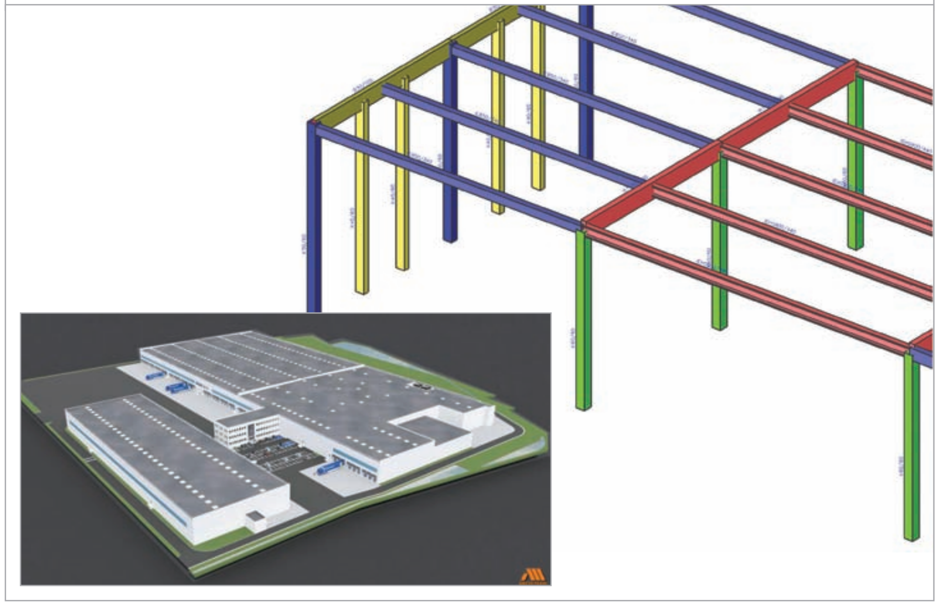
Short description | Aveve Building

This project concerns a warehouse and an office building. The 36,000 m² building consists of steel structure elements as concrete elements. The steel structure weighs 1,200 tonnes.
Owing to the high loads on the floor in combination with the fire resistance, the decision was taken to construct the front building in precast concrete.
The great difficulty in this project is the time pressure imposed by the client.

Sint-Niklaas Logistics Lidl - Sint-Niklaas, België







Project

Het betreft de bouw van een nieuw distributiecentrum voor het opslaan en verdelen van goederen voor de Lidl in Sint-Niklaas. Hierbij is er een gedeelte voorzien voor enkel opslag van voedsel (food) en een apart gedeelte voor andere goederen (non-food). Het food-gedeelte bestaat uit 2 compartimenten gescheiden door een brandwand. Ter plaatse van deze brandwand is eveneens een uitzettingsvoeg voorzien.
De draagstructuur is opgebouwd uit beton met een steeldeck dak. Daarnaast zijn er een aantal technische lokalen aanwezig voor de vele technieken en een apart kantoorgebouw dat volledig uit beton is opgebouwd.

Ontwerp

Bij het ontwerp van het distributiecentrum moest rekening worden gehouden met enkele uitzonderlijke parameters :

1. De lengte van het food-gebouw bedraagt bijna 300 m. Hierdoor is het noodzakelijk om een uitzettingsvoeg te voorzien om de nodige verplaatsingen ten gevolge van de wind en krimp/kruip te kunnen opvangen. Doordat er met voorgespannen dakliggers gewerkt wordt, moet er rekening gehouden worden met de krimp en kruip bij het uitharden van deze dakliggers. Deze zorgen namelijk voor niet te verwaarlozen verplaatsingen en bijgevolg extra momenten in de kolommen en de funderingen.
2. Er moet rekening gehouden worden met een aantal extra belastingen op het dak ten gevolge van sprinklerinstallaties, elektro en zonnepanelen. Ter plaatse van de koelcellen komen hier nog belastingen bij ten gevolge van verlaagde plafonds, luchtkoelers en extra sprinklers.
3. Ter plaatse van de brandwanden moet een brandweerstand van 2u behaald worden voor de structurele elementen.
4. Er moet rekening gehouden worden met uitbreidingsmogelijkheden.

Scia

De dimensionering van de betonnen draagstructuur werd volledig bepaald in Scia Engineer. Aan de hand van de interne krachten in de kolommen werd een 2de orde berekening uitgevoerd om voor deze elementen de dimensies en de wapening te bepalen. Hierbij werd rekening gehouden met de krimp en kruip door de prefab voorgespannen dakliggers. Deze liggers verkorten ongeveer 0,33 mm per lopende meter. De portieken zijn 120 m breed, dit zorgt dus voor een totale verkorting van 4 cm op 1 portiek. Er wordt gerekend dat 1 cm verkorting ongeveer overeenkomt met een temperatuurverschil van 10°. In Scia Engineer werd bijgevolg een (negatieve) thermische lijnlast van 4 x 10° = 40° ingegeven. Deze simuleert bijgevolg de verkorting van het portiek en geeft extra momenten die meegenomen worden in de berekening van de kolommen en funderingen.

Software: Scia Engineer

Establis Group nv

Contact	Jurgen Vantornout
Address	Beversesteenweg 612 8800 Roeselare, Belgium
Phone	+32 51 431200
Email	jvantornout@establis.eu

Establis garandeert creatieve berekeningen en optimale oplossingen voor uw bouwkundige structuren, met een bewust gevoel voor realiteit.

Ons team in Antwerpen en Roeselare bestaat uit 20 hooggekwalificeerde medewerkers met diverse specialiteiten, ondermeer op het vlak van beton, staal, prefab, funderingstechnieken en seïsme. Wij allemaal staan klaar om uw unieke bouwproject van a tot z te begeleiden op basis van een vlotte communicatie en degelijke technische know-how.

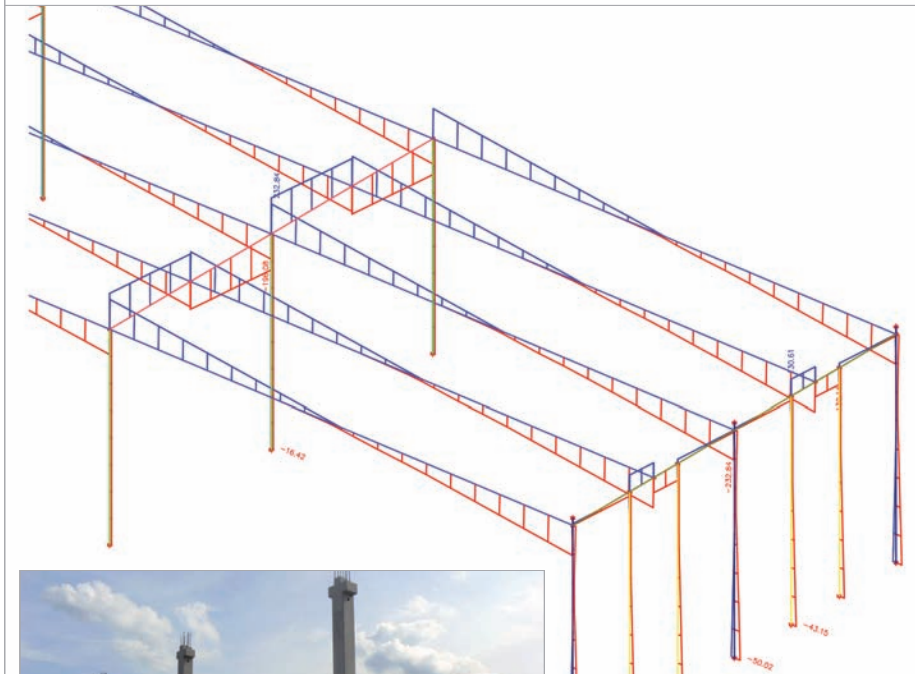
Een beroep doen op Establis betekent voor u het binnenhalen van stabiliteit op lange termijn.

Project information

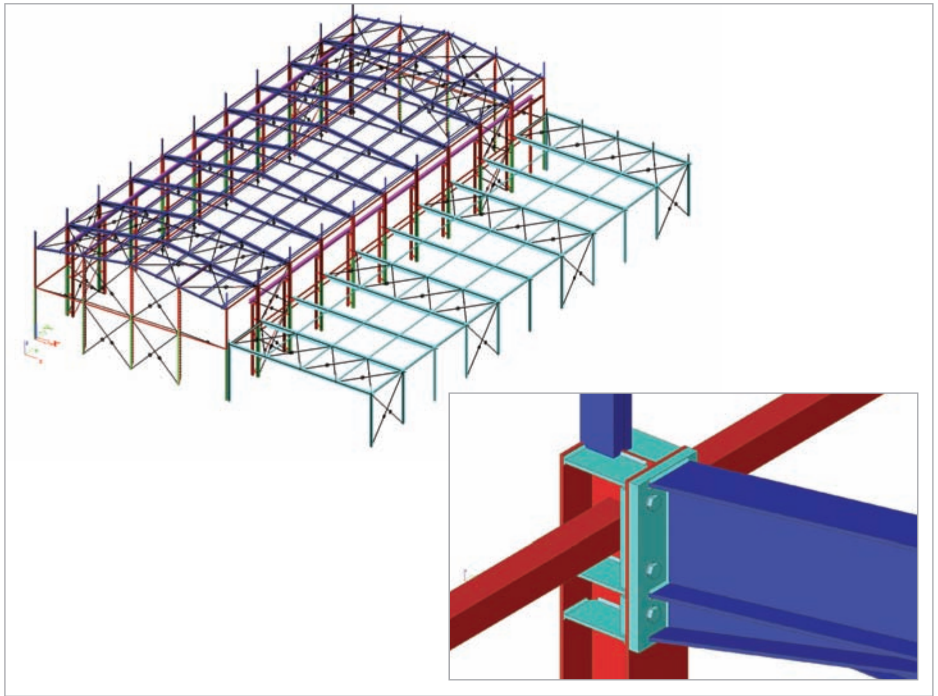
Owner	Lidl
Architect	Architeam
General Contractor	Cordeel
Engineering Office	Establis Group
Location	Sint-Niklaas, Belgium
Construction Period	02/2012 to 02/2013

Short description | **Sint-Niklaas Logistics Lidl**

A completely new site for logistics for the Lidl store in Sint-Niklaas. The site contains a food and non-food building, an office completely built of concrete and several technical rooms. The food part has 2 compartments and is divided by a fire wall. There is also a dilatation joint foreseen next to the fire wall. The structure was designed by Establis and built by Cordeel.



Reconstruction of Existing Industrial Building MOBITEX - Lendava, Slovenia



The existing building is currently used for storage activities. A development process demands changes which will allow the company to use the existing building for other purposes. After a redevelopment programme, the reconstructed building will be mostly used as a "Steel structures manufacturing plant". Along one side of the reconstructed facility there will be a new canopy for storage and handling purposes.

Architectural design

The new design is based on the existing structure with a rectangular floor plan of 1,015 m^2 and a double pitched roof with a parapet wall around the perimeter. Along one whole side of the facility there will be a new canopy of 788 m^2, attached to the main columns of the structure with openings on the front and rear sides. Inside the main facility there will be a crane girder with a crane track along the length of the building. The girder is intended for an overhead travelling crane with a hoist that has a 10 t bearing capacity.
The main goal of the design is to modify and strengthen the existing steel structure with minimal additional structural interventions in reconstruction. The crane and the crane girder will be relocated from their current location in another industrial building.

Steel structure design and technical data

Basic steel structure

The main bearing structure consists of double pitched planar steel frames with a span of 20.0 m and a ~5.0 m eaves height. Frame columns are anchored into foundation buckets. The secondary structure consists of roof beams and stability beams with cross diagonal bracings. Both end frames have three facade columns which are also supporting roof columns and wall diagonal bracings.

Modified steel structure

The main structure frames are upgraded to a new eaves height of ~9.0 m with identical steel column sections. On the inner side of the frame, new column strengthening profiles are added parallel to the existing columns with a 0.5 m axial distance and height of 7.4 m. These columns have two functions. Firstly, they are to strengthen the existing structure, and secondly, they are to carry crane loads directly from the crane rail beams which are mounted on top of new columns. The stability of these columns is provided by angular bracing elements in the same fields as the main stability elements of the building and link beam elements to main columns.
Both end frames were raised to a new eaves height and modified to assure the required bearing strength. The roof beams of the end frames were strengthened with a rectangular hollow steel section on the bottom side of the main section while facade columns were strengthened by adding a rectangular hollow steel section parallel to the main column with a 0.30 m axial distance provided by steel plates. Some additional stability beams were also added because of larger buckling lengths.
In total, ~29,993t or 29.5 kg/m^2 of additional steel was needed for the reconstruction of the main facility without consideration of the crane-rail beams.

Crane rail track

The installed crane rail track extends from the second axis and ends 1.2 m from the end of the building. The total length of the track is 43.8 m. No additional steel was added for the crane rail track.

Canopy

The canopy roof structure consists of main roof beams and columns on one side. The roof beams are coped at each end and strengthened with steel plates. Both end frames were designed to sit on two columns, because no additional loads were allowed on the corner columns of the main facility. Stability beams and diagonal bracings were used for global stability. The canopy structure weighs ~23,855 t or 30.3 kg/m^2.

Software and calculation model

Scia Engineer 2012 was used for 3D-Modeling and calculation. The general idea was to achieve the complete use of the existing structure with minimal reconstruction costs, which was provided with optimisation of the structure for at least 16.4 kg/m^2 or ~20% in comparison with a similar structure type and loads on other buildings calculated with other software. With the Scia software, all EC and National standards were also used.

Software: Scia Engineer

LoGing d.o.o., PE Ljubljana

Contact	Matjaž Žabkar
Address	Letališka cesta 5
	1000 Ljubljana, Slovenia
Phone	+386 59059020
Email	matjaz.zabkar@siol.net
Website	www.loging.si

Personal information: Matjaž Žabkar was born in 1979 in Novo mesto, Slovenia. From 1997-2002, he attended to a Diploma study of Civil Engineering at the University of Ljubljana, specialising in “Steel structures”. In the period 2002-2007, he worked on Architectural and Civil Structure projects, and in 2008 he became a certified engineer in the Slovenian Chamber of Engineers, IZS. Since 2007, he has worked on planning and the optimisation of steel and membrane structures, foundations and other concrete structures, and earthquake resistant structures.

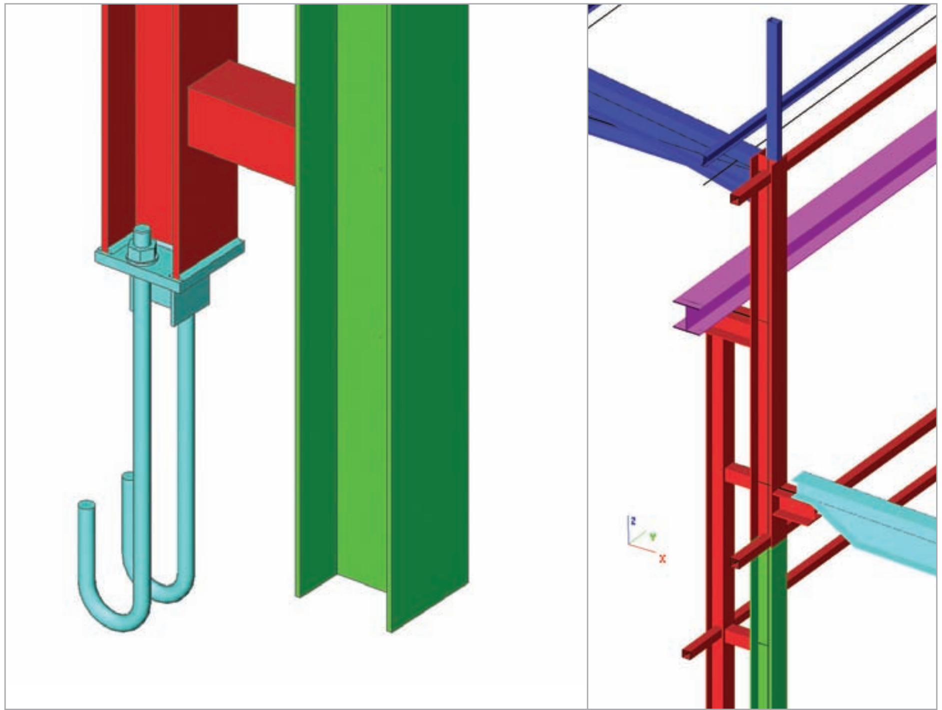
Company information: The company develops, manufactures and erects Office and Manufacturing facilities, Storage halls, Functional constructions, Sports facilities and Mobile halls, Canopies and other structures. The firm cooperates with many Slovenian and foreign partners, developing new products and improving existing programmes and services. In Slovenia, LoGing is one of the leading companies in the field of buildings with inflatable thermal membrane roofs with ETFE, PTFE or LOWE coatings. The production capacity for steel structures is limited to 500 t per month.

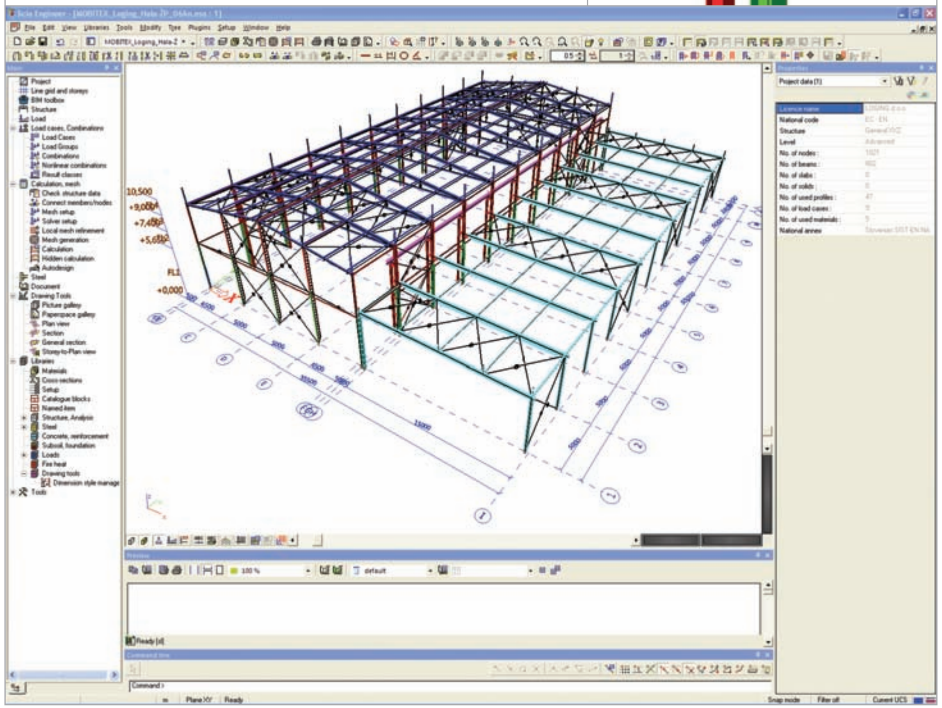
Project information

Owner	Dipl.-Ing. Matjaž Žabkar
General Contractor	LoGing, d.o.o. Slovenia
Engineering Office	LoGing, d.o.o. Slovenia
Location	Lendava, Slovenia
Construction Period	05/2013 to 08/2013

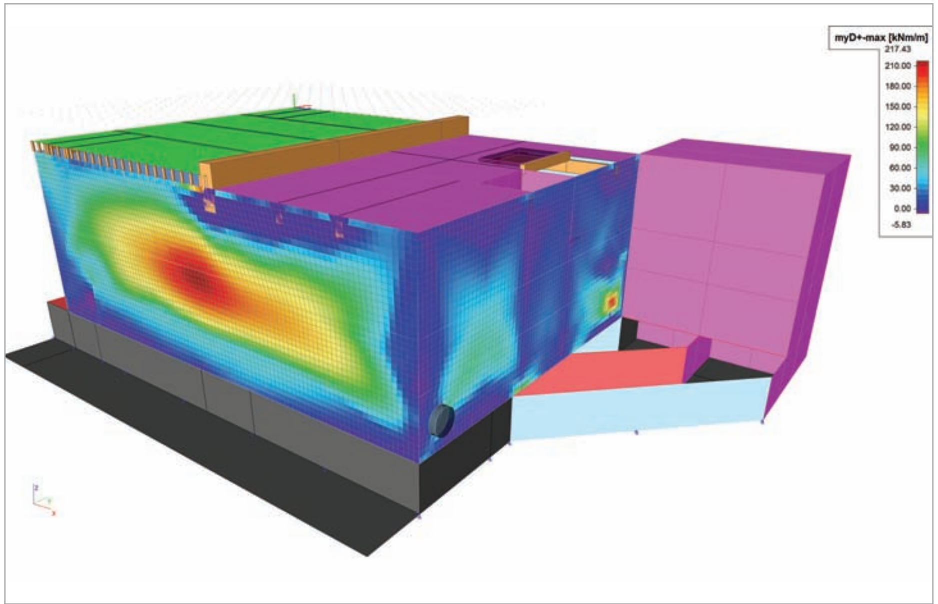
Short description | Reconstruction of Existing Industrial Building MOBITEX

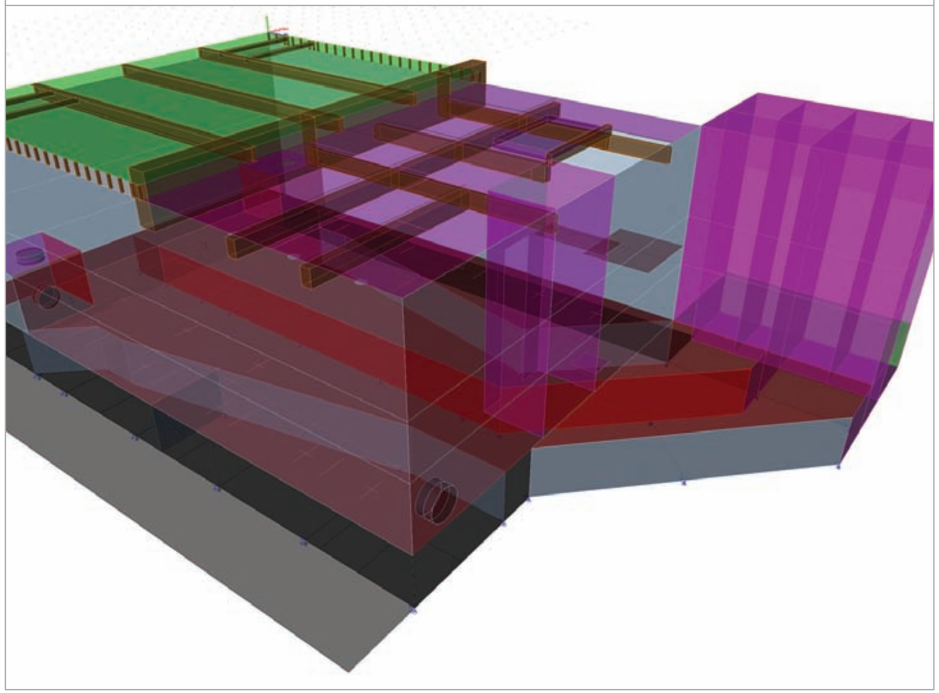
The basic purpose of the project is to transform the existing storage hall into a new “Steel structures manufacturing plant” including an overhead double girder crane with a bearing capacity of 10 t. The basic dimensions of the existing building are a width of 20.0 m, a length of 50.0 m and ~5.0/5.6 m in height at the eaves/ridge. The overall weight of steel for the existing structure was 36,864 t or 36.3 kg/m^2.
The reconstruction includes a change of elevation for 4.0 m with the strengthening of bearing steel structure elements, the installing of a crane rail girder moved from another location and the construction of a new canopy alongside the whole length of the building. The new dimensions of the reconstructed building show no change except for the height of the building at the eaves/ridge which measures ~9.0/9.6 m. The canopy span measures ~15.0 m with an eaves height of ~5.2 m. The new weight of steel for the reconstructed structure is 74,695 t or 73.6 kg/m^2 which means 37.3 kg/m^2 of new steel structure. The weight of the canopy structure is 23,854 t or ~30.3 kg/m^2.





Pompstation Walem III - Rumst, België





Kader

Het pompstation kadert in het geheel van ‘Aquaduct’, een project van AWW-TMVW-VMW voor onderlinge waterleveringen. Dit project omvat het aanleggen van een groot aantal leidingen, de vernieuwing van een verouderde drinkwaterproductielijn en de bouw van een aantal nieuwe pompstations. Walem 3 is één van de nieuwe pompstations.

Walem 3 dient aangesloten te worden aan het pompstation Walem 2 om de capaciteit van dit laatste pompstation te vergroten. Tijdens de werken moet de bestaande productie en verpomping van drinkwater in dienst blijven.

Projectomschrijving

Walem 3 dient ondergronds aangesloten te worden op Walem 2. Voor de aanvoer van het drinkwater worden er twee afzonderlijke kelders gebouwd. Uit deze kelders wordt het water opgepompt. De vorm van de kelder moet ervoor zorgen dat er zo weinig mogelijk wervelstroming optreedt. Eveneens dienen er nog extra geleiders geplaatst te worden ter hoogte van de aanzuigmonden. Op het bovenliggend niveau staan de verschillende pompen die het water uit de aanzuigkelders zuigen. In deze pompenzaal komen er verschillende waterleidingen DN1000 toe en vertrekken weer. De volledige kelder dient perfect waterdicht te zijn om menging van grondwater en drinkwater te vermijden.

Op het dak van de pompenzaal ligt er aan één zijde een steeldeck opgelegd op stalen liggers. Aan de andere zijde komt er bovengronds nog een elektrisch kabine waarbij de vloeren op verschillende niveaus liggen. In de wanden en het dak van deze kabine dienen er verschillende openingen gemaakt te worden voor verluchting, doorvoer van leidingen en dergelijke.

Bouwkundige informatie

Doordat het pompstation zich aan de oevers van een rivier bevindt, dient men rekening te houden met mogelijke overstromingen. Bijgevolg diende men het opdrijven van de constructie na te gaan en hoge waterniveaus in rekening te brengen bij de structuurberekening.

De constructie zelf zit voor 2/3 onder de grond. In de toekomst is het mogelijk dat de grond nog aangevuld wordt tot het niveau van het steeldeck. De gronddruk op de wanden en op het dak van de kelder is dus zeker een belangrijke belasting. In de pompenzaal zijn de betonnen wanden 7 m hoog en 0,5 m dik. De bovengrondse elektrische kabine bestaat uit metselwerk. Het dak van de kabine bestaat uit voorgespannen welfsels. De rest van de constructie bestaat uit ter plaatse gestort gewapend beton. Het elektrisch lokaal steunt op een balkenrooster waarvan de grootste overspanning 14,4 m bedraagt.

In Scia Engineer werd de volledige constructie met uitzondering van het gemetselde lokaal gemodelleerd. De hele constructie wordt gefundeerd op palen. Met Scia Engineer werden de interne krachtswerking en de reactiekrachten op de palen bepaald.

Software: Scia Engineer

SBE

Contact Lies Scheerlinck
Address Slachthuisstraat 71
9100 Sint-Niklaas, Belgium
Phone +32 3 7779519
Email lies.scheerlinck@sbe.be
Website www.sbe.be

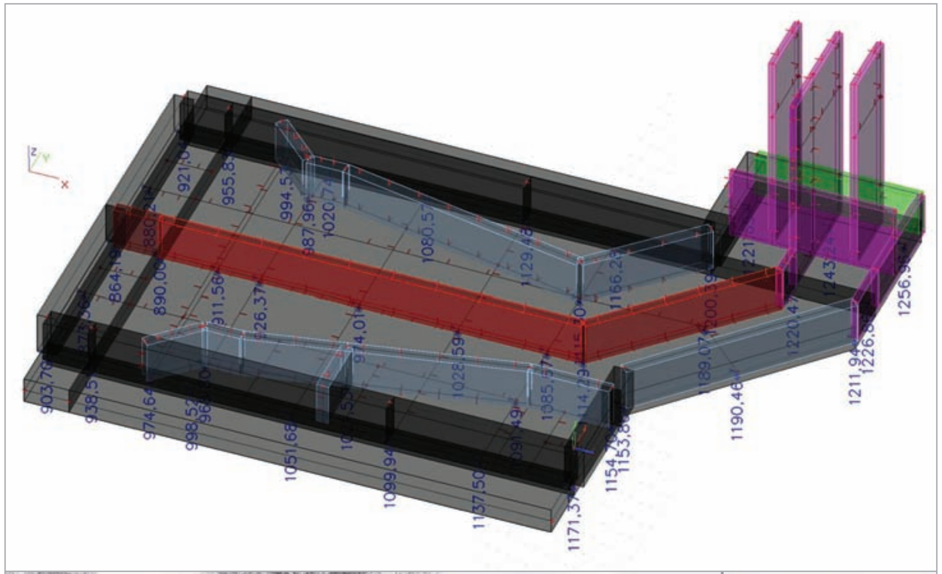
SBE nv is een vitaal en dynamisch studie-, teken- en ingenieursbureau, gevestigd te Sint-Niklaas nabij de Antwerpse haven.
Het bureau heeft zich gedurende de laatste 30 jaar geprofileerd als een studie- en adviesbureau gespecialiseerd in havenconstructies, burgerlijk bouwkunde, geotechnische problemen, staalstructuren en funderingstechnieken
Met meer dan 30 jaar ervaring in de verschillende domeinen van de bouwkunde, en vooral dan op het gebied van grote infrastructurele projecten, zijn de projectingenieurs de leidende kracht voor een jong en dynamisch team dat met een grote gedrevenheid de meest uiteenlopende opdrachten aanpakt.
De studieopdrachten worden uitgewerkt met de nadruk op kwaliteit en uitvoerbaarheid, doch steeds rekening houdend met de financiële en economische haalbaarheid, met referenties in Europa, Oekraïne, Korea, Nigeria, Panama, etc.

Project information

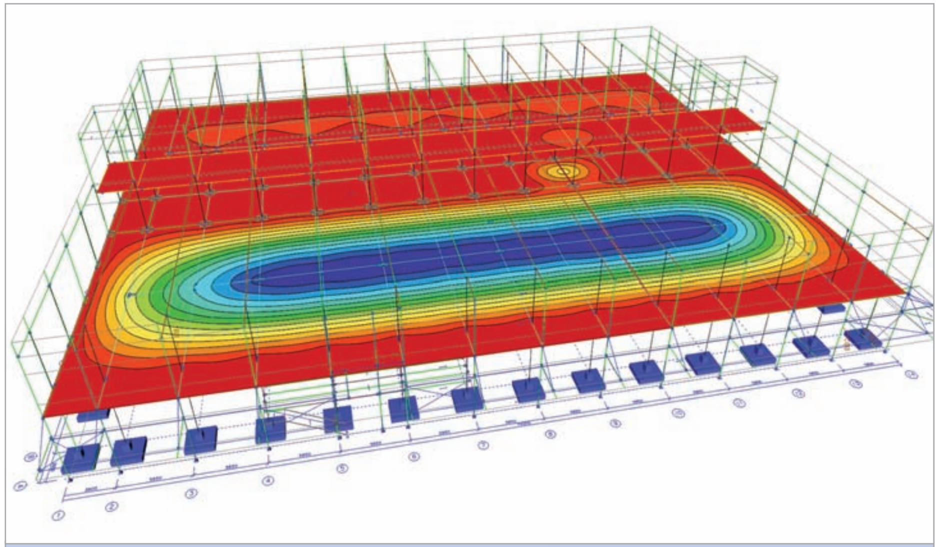
Owner	Waterlink
Architect	Waterlink
General Contractor	Mourik
Engineering Office	SBE
Location	Rumst, Belgium
Construction Period	09/2012 to 06/2013

Short description | Walem III Pumping Station

The Walem III pumping station was built to enlarge the capacity of the neighbouring Walem II pumping station. The pumping station consists of various water reservoirs and an electrical building. Since the station is located on the banks of a river, we had to consider high water levels for the structural design. The electrical building is constructed in masonry and sits on a grid of concrete beams, cast in situ, with a maximum span of 14.4 m. The pumping station is constructed with in situ concrete. The whole structure sits on a piled foundation. The equilibrium of forces and the forces acting on the piles were designed using Scia Engineer.



Neubau eines Produktions- und Logistikgebäudes, Teekanne GmbH & Co.KG - Düsseldorf, Deutschland



Die Marke Teekanne ist seit 130 Jahren für qualitativ hochwertige Produkte rund um den Teegenuss bekannt. Um diese hohen Qualitätsansprüche auch in Zukunft sicherzustellen wird auf dem Werksgelände in Düsseldorf ein hochmodernes Fertigungsgebäude erstellt, dass in seinen Anforderungen den hohen Ansprüchen und Werten der Teekanne genügen muss.

Sicherstellung der Produktqualität

Das Produktionsgebäude muss einen optimalen Produktionsablauf von der Rohware zum fertig verpackten Produkt gewährleisten. Große Deckenspannweiten bei gleichzeitigen hohen Nutzlasten führen zu einer optimalen Produktionsanordnung ohne signifikante Einschränkungen durch Stützen oder erforderliche Wände.

Sicherstellung der Hygienestandards

In einem Lebensmittel verarbeitenden Betrieb ist die Hygiene das oberste aller Gebote. Die Umsetzung von Hygienestandards bei der Material- und Oberflächenwahl, aber auch bei der Gebäudekonstruktion ist daher selbstverständlich.

Nachhaltigkeit

Die Nachhaltigkeit spielte auch beim neuen Produktionsgebäude eine Rolle. So war nicht nur eine energieeffiziente Gebäudehülle gefragt, sondern ein sinnvoller und effizienter Einsatz der erforderlichen Energie zur Gebäudeklimatisierung. Ein großer Anteil spielt darin die Rückgewinnung der zum Produktionsprozess erforderlichen Energie und die sinnvolle Wiederverwendung um die hohen klimatischen Produktionsbedingungen zu erfüllen. Entstanden ist ein zweischiffiges Produktions- und Logistikgebäude mit einer dreigeschossigen Mittelspange. Die Seitenschiffe sind zweigeschossig ausgeführt, im Erdgeschoss wurde die Anzahl der Stützen auf ein Minimum reduziert, im Obergeschoss wurden aufgrund eines weitgespannten Dachtragwerkes keine Stützen benötigt. Aufgrund des freitragenden, modularen Aufbaus ist eine flexible Raumgestaltung möglich. Das Herzstück der schmalen Mittelspange ist die sich im Obergeschoss befindende Technikzentrale. Hier sind u. a. die raumlufttechnischen Anlagen zur Sicherstellung der klimatischen Bedingungen untergebracht. Die Anordnung direkt über der Produktion führt zu kurzen Erschließungswegen und somit auch geringen Raumverbrauch.

Aufgrund der hohen Planungsanforderungen durch Produktion, technischer Gebäudeausrüstung und Tragwerk, lag es nahe, das Bauwerk anhand eines dreidimensionalen Gebäudemodells mit Nemetschek Allplan zu planen. Durch die programminterne Bauwerksstruktur in Verbindung mit dem Workgroupmanager konnte eine parallele Teamarbeit von Architekten, Ingenieuren und Haustechnikplanern gewährleistet werden. Ein weiterer Vorteil ist die Planerstellung durch Ableitung des Gebäudemodells, das jeder Fachdisziplin zur Verfügung stand. Dadurch ist das fehlerhafte und zeitaufwendige führen und pflegen von parallelen Datenständen nicht mehr notwendig. Diskrepanzen zwischen Gebäude- und Fachplänen werden automatisch vermieden.

Der Standort in Düsseldorf liegt im westlichen Rheinbecken und ist somit Erdbeben gefährdet. Da das Gebäude aufgrund seiner komplexen Struktur nicht mit vereinfachten Methoden nachgewiesen werden kann, musste das Gebäudemodell dreidimensional berechnet werden. Nemetschek Scia ist in der Lage, die Horizontallasten aus Stabilisierung, Wind und Erdbeben direkt im 3D-Modell zu ermitteln. Die Bemessung der Stb.-Stützen konnte somit optimiert nach Th. I O. oder wahlweise mit den iterativ ermittelten Steifigkeiten im Zustand II erfolgen. Dadurch war es möglich, die großen Deckenspannweiten unter hohen Nutzlasten zu realisieren. Da die tragende Struktur des Gebäudes zusätzlich aus feuerschutztechnischen Gründen in F-90 ausgeführt werden musste, konnten die entsprechenden Nachweise der Stützen ohne großen Mehraufwand mit durchgeführt werden.

Mit dem neuen Produktions- und Logistikgebäude erhält die Teekanne einen Produktionskomplex der nicht nur den hohen Ansprüchen an Qualität, Hygiene und Nachhaltigkeit gerecht wird, sondern durch optimierte Planungsprozesse und dem effizienten Einsatz von Gebäudetechnik ein hochmodernes, flexibles Gebäude mit dem die Herausforderungen der hoffentlich nächsten 130 Jahre gemeistert werden können.

Software: Allplan Engineering, Scia Engineer

SHI-Planungsgesellschaft mbH

Contact Sascha Speckmann
Address Am Patentbusch 2
26125 Oldenburg, Germany
Phone +49 441/9700-970
Email s.speckmann@shi-ol.de
Website www.shi-ol.de

SHI Planungsgesellschaft für Städte-, Hoch- und Ingenieurbau mbH

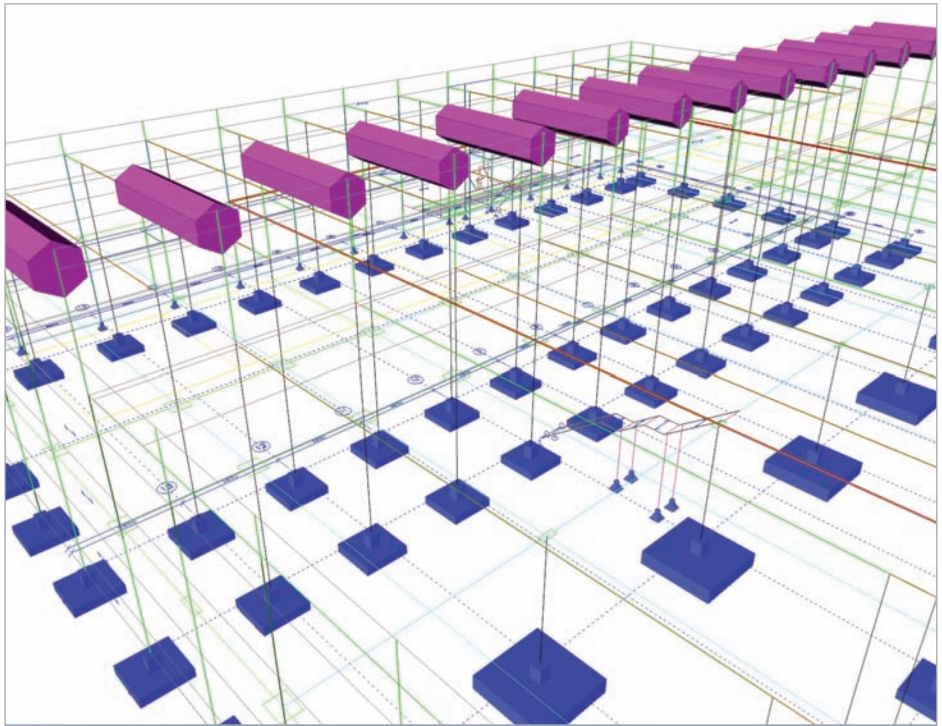
SHI Planungsgesellschaft mbH ist eine Gesellschaft unabhängig beratender Ingenieure und Architekten und seit 1976 für öffentliche und private Auftraggeber tätig.
SHI arbeitet schwerpunktmäßig auf den Gebieten Industriebau, Hoch- und Tiefbaubau und Ingenieurbau.
SHI bietet einen qualifizierten Stab erfahrener Architekten, Bauingenieure und Umweltingenieure für Beratungs-, Planungs- und Bauleitungsaufgaben.
Durch die umfassende, interdisziplinäre Projektbearbeitung beginnend bei der Beratung bis zur Baufertigstellung entstehen fachgerechte Bauwerke unter Beachtung der Wirtschaftlichkeit mit optimalem Nutzwert sowie hoher Qualität und ausgereiftem technischen Standard.
Die Bearbeitung erfolgt durch ein Team von z. Zt. ca. 65 Mitarbeitern.

Project information

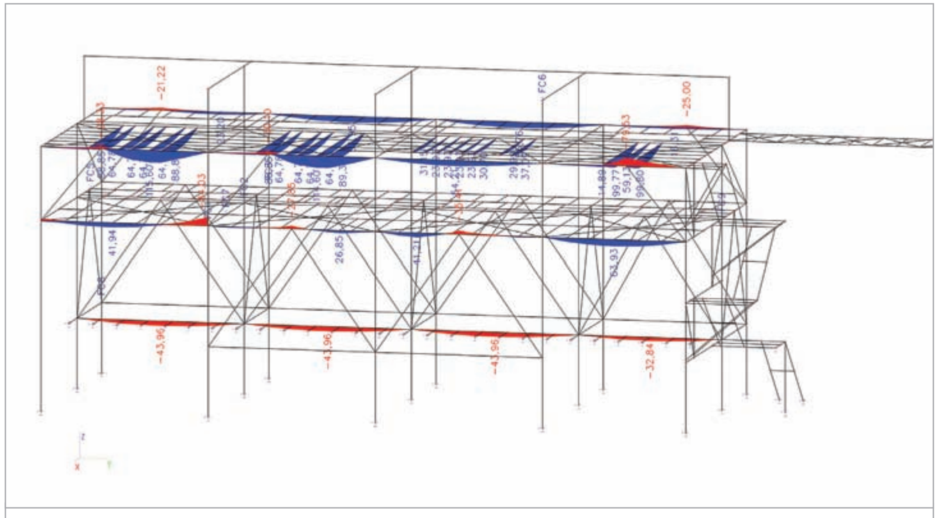
Owner	Teekanne GmbH & Co. KG, Düsseldorf, Germany
Architect	SHI Planungsgesellschaft mbH
Engineering Office	SHI Planungsgesellschaft mbH
Location	Düsseldorf, Germany
Construction Period	07/2012 to 07/2013

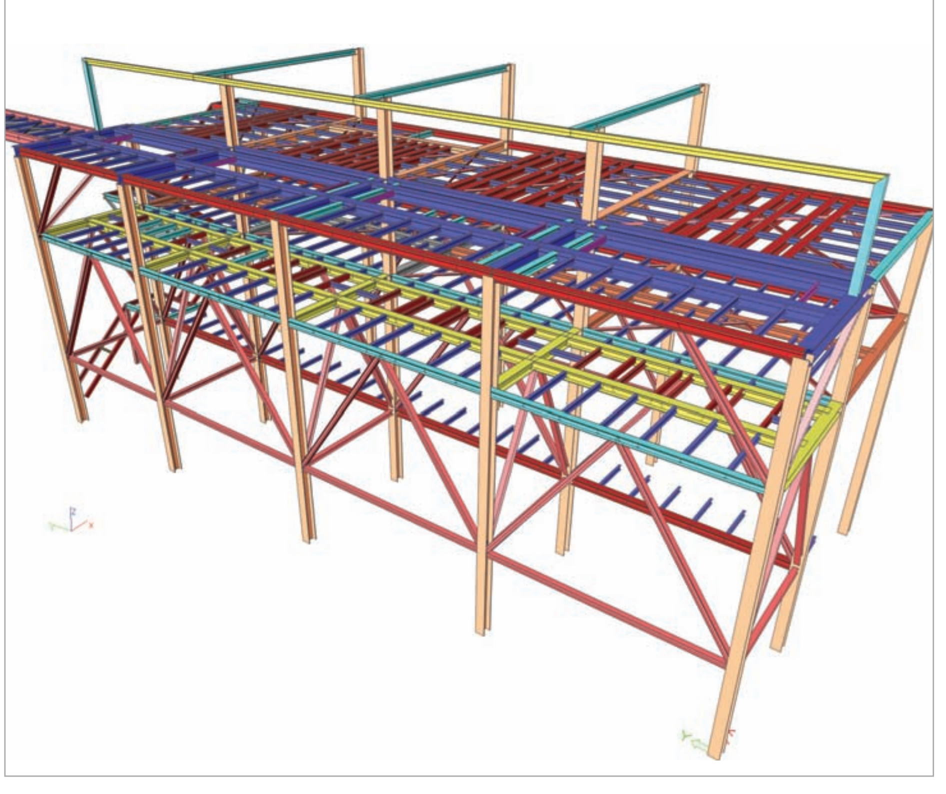
Short description | **Construction of a new Production and Logistics Building**

Since 1882, Teekanne has been playing a significant role in the tea industry and has developed into one of the foremost manufacturers and purveyors of tea worldwide. To guarantee the company values in future times, a new production site is being built at the company headquarters in Düsseldorf, Germany. This building has to meet high standards in product quality, food regulations and sustainability. For planning a 3D BIM process was chosen, using Nemetschek Allplan to fulfil the requirements of design, structure and building equipment for energy and the air-conditioning system. Due to seismic loads, high span ceilings with heavy loads and only using pillars for building stiffening a full 3D calculation was necessary using Scia Engineer.



Steel Extrusion Structure - Usak, Turkey





The project

This project concerns the construction of a steel structure consisting of five spinning machines.
Spinning machines are machines that process plastic granules into yarn.
This construction consists of three floors: the ground floor, the first floor and the top floor.
The top floor, the extrusion floor, is the floor where the extruders are located, together with the silo with the granules and the spinning beams.
There are different configurations of the spinning beams; for example, one spinning beam with three extruders or one spinning beam with two extruders.
On the first floor there are cabinets which cool down the wires.
On the ground floor the yarn is textured and here you will find the final product.

The assignment

The assignment was to reconstruct the existing installation identically at another location in a seismic area.
The new structure cannot be an exact copy of the existing structure because the existing structure was a building with concrete elevations.
Because of the tight time schedule, the client chose a steel structure instead of a concrete one.
The floor elevations are crucial for the construction and setup of the machine.
The spinning beam, which is provided on the top floor, is placed on a bottom flange of the steel beam.
The top floor has the heaviest load, with the spinning beam, the extruders and the preheating furnace. All floors are covered with checker plate.

Structural system

The design was based on Eurocode standards. The static system of the structure is in the transverse and longitudinal direction stabilised by bracing.

Design software

The static analysis was calculated using a 3D model in Scia Engineer software with linear, non-linear and steel modules.

Foundations

The structural design of the basements was made by a local company based on the outputs of our analysis.

Equipment loads

The equipment load was given by the client.

Structural 3D modelling

The design of the process has been worked out in Scia Engineer. The structure has been completely modelled with 1D beam elements in 3D.
Live, dead and equipment loads have been applied to the load-bearing structure.

The calculation included several steps:

1. A linear calculation using a 3D frame model for the gravity loads (self-weight, dead load, live load, equipment loads.
2. A non-linear calculation using a 3D frame model for the bracings.
3. A check of steel elements using steel module EC 3.

The parameters of the structure were modified step by step according to the technological demands.
The static system of the building is formed by frames with diagonal bracing in transverse and longitudinal bracing and horizontal bracings in the floors.

The system of bracing was active tension diagonal bracings, in which the horizontal forces can be resisted by the tension of diagonals only, neglecting the compression ones.

Conclusion

The project has been successfully completed and will become operational in June 2013.

Software: Scia Engineer

SPIE - Controlec Engineering

Contact Geert D'Hollander
Address Handelspoort 1
4538 BN Terneuzen, The Netherlands
Phone +31 115 670100
Email g.dhollander@spie.com
Website www.spie-nl.com

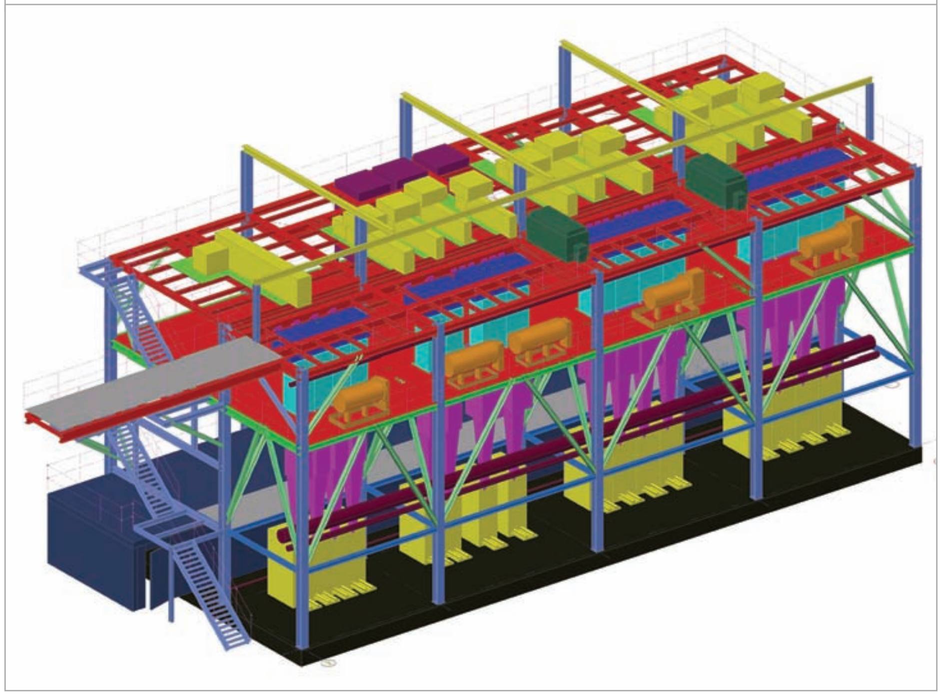
SPIE-Controlec Engineering is an independent, multidisciplinary engineering and consultancy office specialised in front-end, basic and detail engineering, procurement, project and construction management and a member of the SPIE group.
Established in 1971, throughout the years the company has developed into a renowned EPC contractor for the process industry and energy companies that are familiar with numerous technical disciplines.
From start to finish, we support our clients' implementation of their projects by applying state-of-the-art know-how, years of experience and a flexible approach to projects.
We have specialised engineers in the following fields: process, piping, mechanical, civil/structural, electrical, instrumentation and process control.
Together with other SPIE divisions, we can provide the complete trajectory from conceptual design to building, operationalising and maintenance of E&I and automation.

Project information

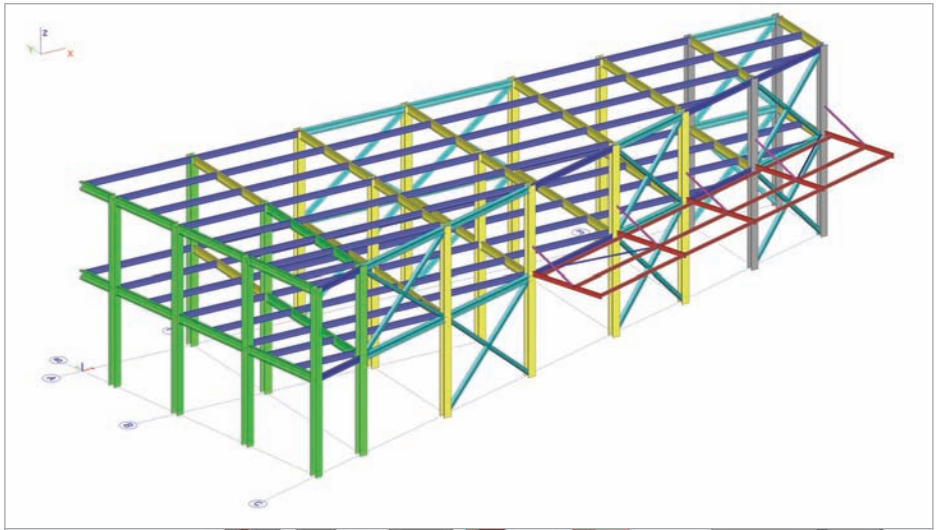
Owner	Balta Group
General Contractor	SPIE Belgium
Engineering Office	SPIE-Controlec Engineering
Location	Usak, Turkey
Construction Period	01/2013 to 05/2013

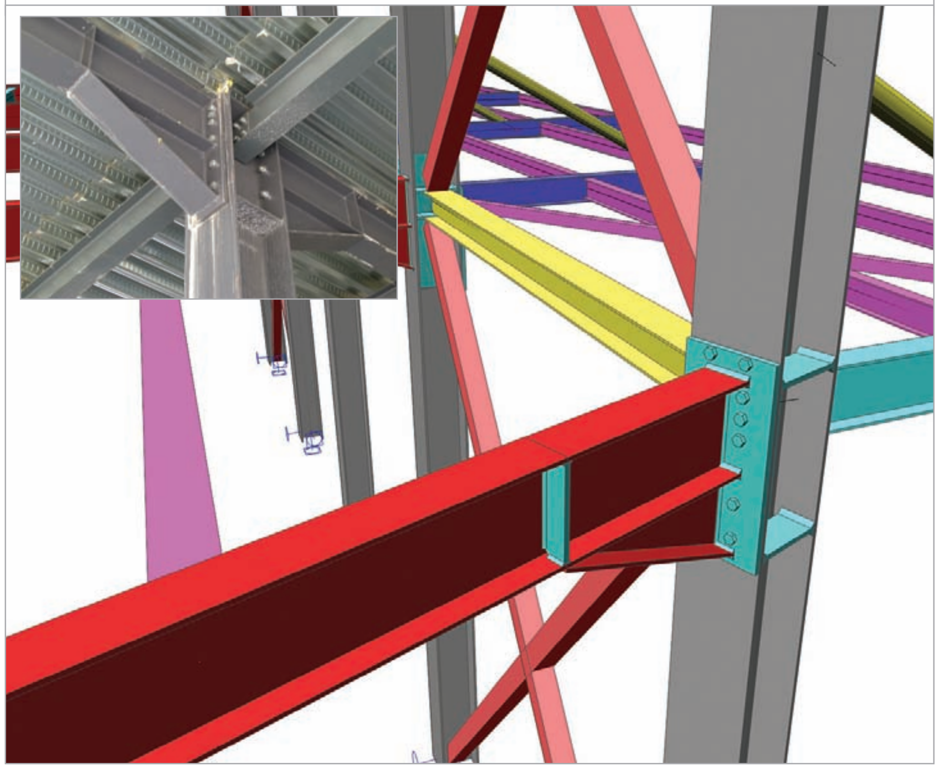
Short description | Steel Extrusion Structure

The project is a design of a new steel structure for an existing spinning machine for Baltagroup. The construction is built at the beginning of 2013 in Turkey.
The structure contains five new spinning machines.
The total weight of the structure is about 100 tonnes of steel.
The steel structure should be seismic resistant and the ground floor must be cleared of all obstacles, such as bracings, to generate the texture machine and to handle the finished product.



Extension of Two-Floor Industrial Baking Plant - Crete, Greece





Introduction to the project

This project includes the extension of an existing industrial baking plant founded in 2004 in Chania, the second largest city of Crete.
The existing part of the plant is a two-floor building with a basement, made from reinforced concrete.
The extension includes a two-floor composite structure of steel and concrete. The total area of the plant is about 1,600 sqm. This year we are designing a new extension, of about 200 sqm.

Description of the project

The whole structure comprises of three separate buildings. The existing building is made from reinforced concrete and the extension is made from steel and concrete. Due to the geometry of the extension, we decided to design it as two separate buildings matched together with a seismic joint.

Approach

Extension Part A

The distances between the columns of each frame are from 3 m to 6 m. The distances between the frames are from 4 m to 6 m. The dimensions of the building are 28 m x 13 m and the height about 7.50 m. We used HEA for the columns, IPE for the main and secondary beams and an SHS cross-section for the roof bracing.

Extension Part B

The distance between the columns of each frame is about 6 m. The distances between the frames are about 3 m. The dimensions of the building are 15 m x 6 m and the height is about 7.50 m. We used HEA for the columns, IPE for the main and secondary beams and an SHS cross-section for the roof bracing.

For both parts of the extension, the secondary beams were designed using the composite beam module in order to reduce the total weight of steel.
To simulate the diaphragm of the concrete slab, HEA1000 was used for the roof bracing, without weight and mass, using property modifiers.

The use of Scia Engineer in this project

We designed the 3D Model, using the Line Grid option. The next step was to make all the load cases, load groups and load combinations.

Load groups:
1. G : permanent
2. S : snow
3. W : wind
4. E : seismic
5. Q : variable

Load cases:
1. LC1 : self-weight
2. LC2 : permanent
3. LC3 : variable
4. LC4 : snow
5. LC5 : seismic X
6. LC6 : seismic Y
7. LC7 - LC22 : 3D Wind Load Cases

Load Combinations:
1. EN-ULS
2. EN-SLS
3. EN-seismic X
4. EN-seismic Y

For the wind loads we used the 3D wind option to calculate with accuracy all the zones according to EN1991-1-4.
For the permanent loads and snow, we used line forces on beams.The seismic design followed EN1998.
After the linear and the modal analysis, we conducted section and unity checks for all the members. We also proceeded to a serviceability check for the main beams.

Software: Scia Engineer

TE, Consulting Engineer

Contact Tsolakis Eleftherios
Address Soudas Av. 23, Crete, Chania
73200 Chania, Greece
Phone +30 2821081846
Email etsolakis@hotmail.com
Website www.etsolakis.gr

TSOLAKIS N. ELEFTHERIOS
Civil Engineer, M.Sc. NTUA
CONSULTING ENGINEER

TE, Consulting Engineer was founded in 2007 to provide the following civil engineering services:

- Technical advice for the development of new buildings.
- Technical advice for the restoration/upgrading of existing buildings.
- Structural design of new buildings (concrete, steel, composite, timber and masonry structures).
- Structural design and assessment of existing buildings.
- Supervision of civil engineering works.

Due to our experience and our knowledge, we can accomplish even the most exacting projects.

TE, Consulting Engineer has managed over 60 projects in Greece.

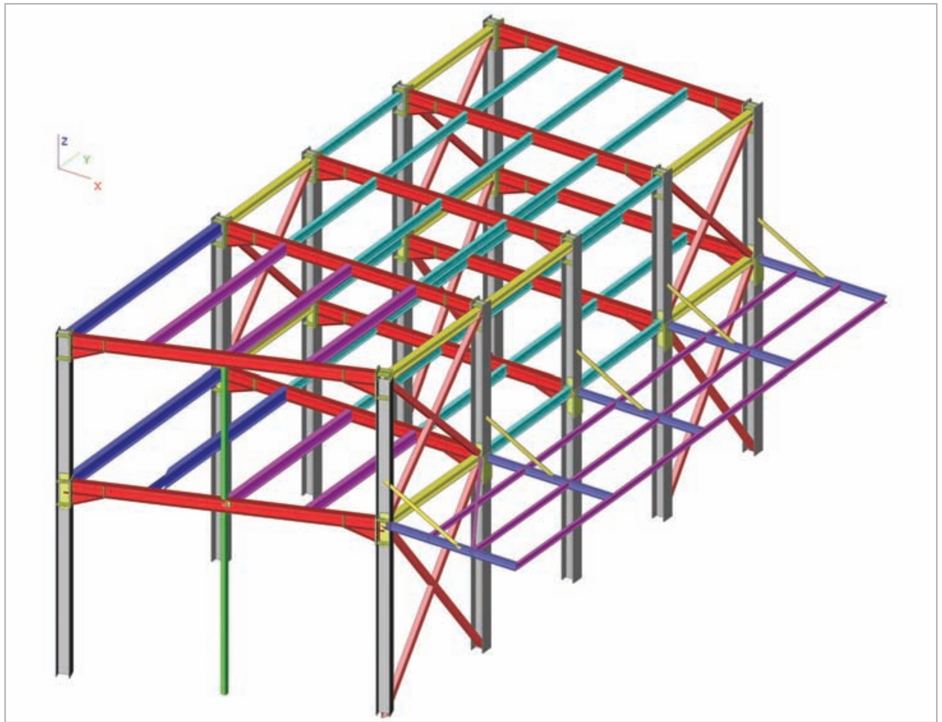
Project information

Owner	M. Koundouraki
Architect	Konstantina Lakiotaki, Tsolakis Eleftherios
General Contractor	Morfometal
Engineering Office	TE, Consulting Engineer
Location	Crete, Greece
Construction Period	12/2011 to 03/2013

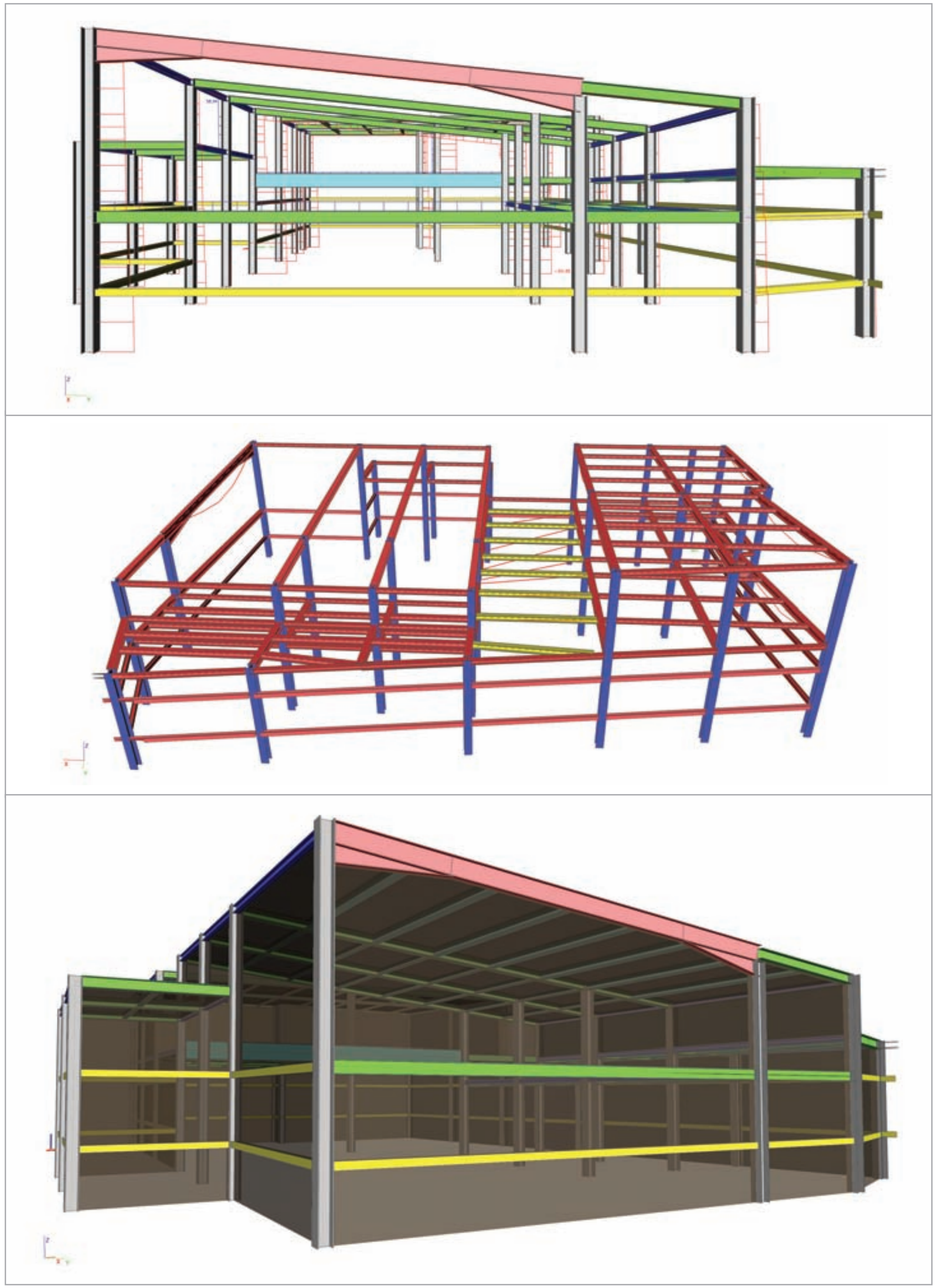
Short description | Extension of Two-Floor Industrial Baking Plant

This project includes the extension of an existing industrial baking plant that was founded in 2004 in Chania, the second largest city of Crete. The plant produces many different products using the best-quality raw materials. Specifically, it produces different types of pies for a traditional snack, called "souvlaki".

The existing part of the plant is a two-floor building with a basement, made from reinforced concrete. The extension includes a two-floor composite structure of steel and concrete. The total area of the plant is about 1,600 sqm. This year, we are designing a new extension, of about 200 sqm.



Fresh & Frozen Seafood, Packaging Industry - Crete, Greece



Introduction to the project

This project includes a new structure for an industrial enterprise that supplies fresh seafood and packages the produce prior to sale. The enterprise also has the means to freeze seafood.

The new structure consists of a two-floor building with a basement. On the first floor, the seafood will be delivered for all the necessary processing prior to the final packaging phase. On the first floor will sit the offices of the enterprise, while the basement will be used for stocking frozen products.

The location of the structure is very close to the larger port in the area. Therefore, the seafood can be delivered very quickly and the frozen products can be sent on to other places or countries.

The total area the industrial enterprise will cover is approximately 900 sqm.

Description of the project

The structure was designed from steel members and concrete slabs. Due to the complicated architectural view, a 3D model was designed.

Approach

We used HEB for the columns, HEA for the main beams, IPE for the secondary beams and an SHS cross-section for the wall bracing.

The secondary beams were designed using the composite beam module in order to reduce the total weight of steel.

To simulate the diaphragm of the concrete slab, HEA1000 for roof bracing was used, without weight and mass, using property modifiers.

The use of Scia Engineer in this project

We designed the 3D model using the Line Grid option. The next step was to make all the load cases, load groups and load combinations.

Load groups:
1. G : permanent
2. S : snow
3. W : wind
4. E : seismic
5. Q : variable

Load cases:
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6. LC6 : seismic Y
7. LC7 - LC22 : 3D Wind Load Cases

Load Combinations:
1. EN-ULS
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For the wind loads, we used the 3D wind option to calculate with accuracy all zones according to EN1991-1-4. For the permanent and the snow loads, we used line forces on beams. The seismic design followed EN1998.

After the linear and the modal analysis, we conducted section and unity checks for all the members. We also proceeded to a serviceability check for the main and secondary beams.

Software: Scia Engineer

TE, Consulting Engineer

Contact Tsolakis Eleftherios, Stefanaki Kaliopi
Address Soudas Av. 23, Crete, Chania
73200 Chania, Greece
Phone +30 2821081846
Email etsolakis@hotmail.com
Website www.etsolakis.gr

TSOLAKIS N. ELEFTHERIOS
Civil Engineer, M.Sc. NTUA
CONSULTING ENGINEER

TE, Consulting Engineer was founded in 2007 to provide the following civil engineering services:

- Technical advice for the development of new buildings.
- Technical advice for the restoration/upgrading of existing buildings.
- Structural design of new buildings (concrete, steel, composite, timber and masonry structures).
- Structural design and assessment of existing buildings.
- Supervision of civil engineering works.

Due to our experience and our knowledge, we can accomplish even the most exacting projects.

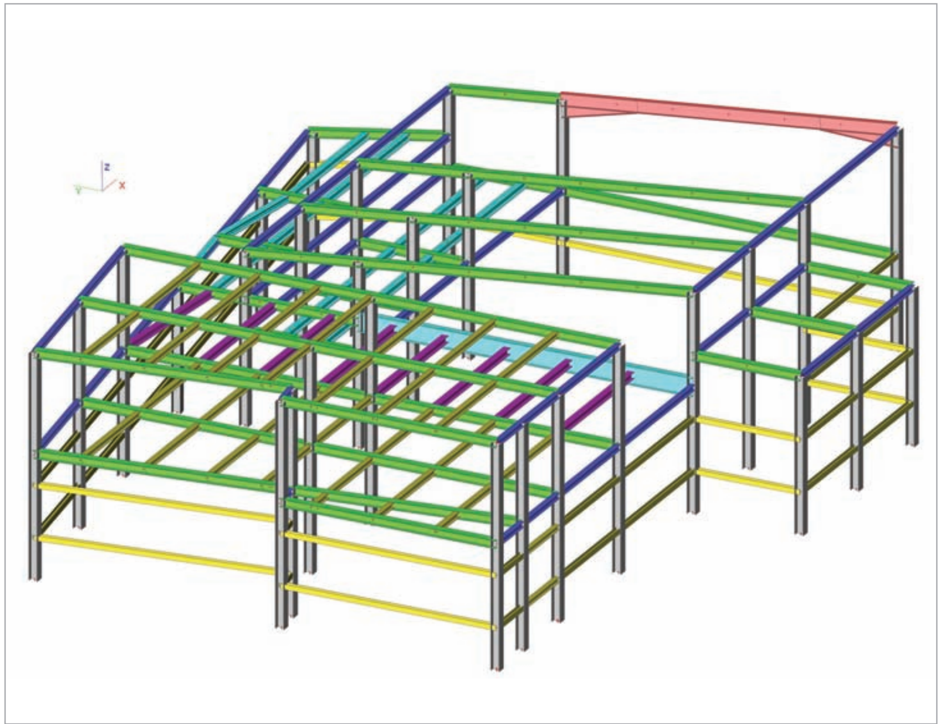
TE, Consulting Engineer has managed over 60 projects in Greece.

Project information

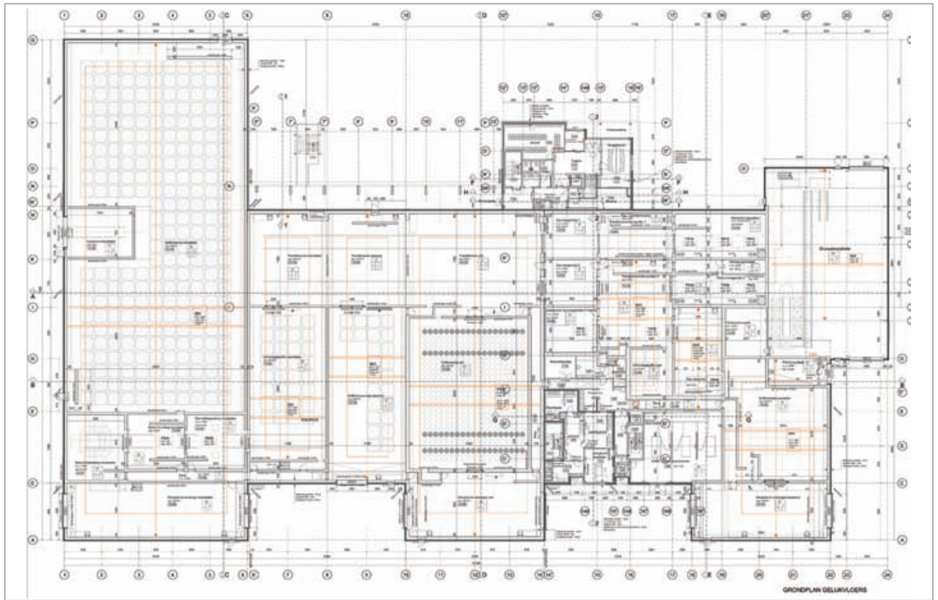
Owner	Rokakis Ioannis, Antonios & Georgios CRETEFISH ENT. COMPANY
Architect	Kolokotronis George
Engineering Office	TE, Consulting Engineer
Location	Crete, Greece
Construction Period	09/2013 to 06/2014

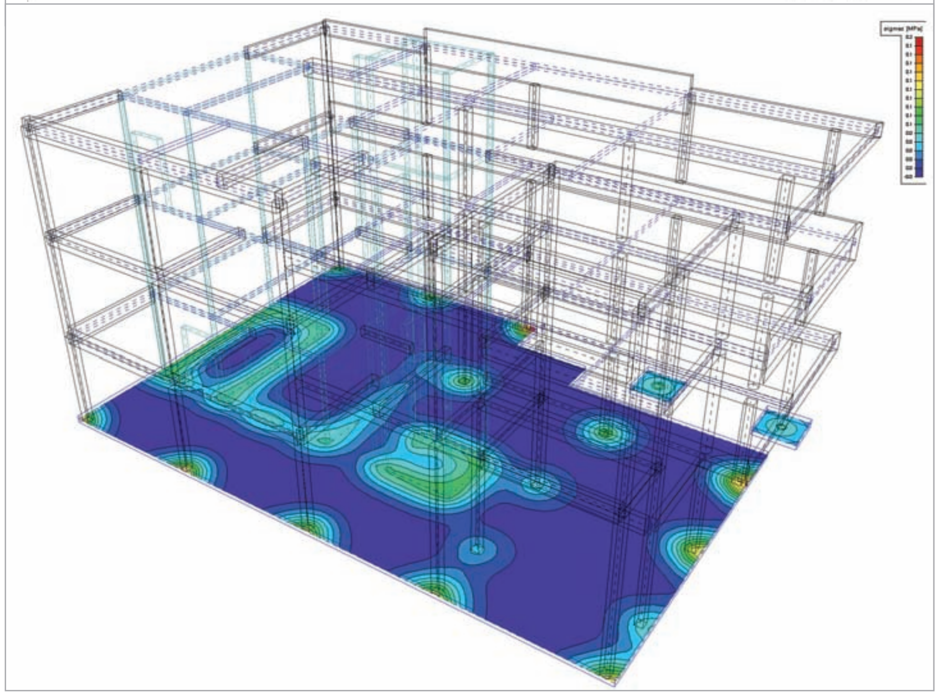
Short description | **Fresh & Frozen Seafood, Packaging Industry**

This project includes a new structure for an industrial enterprise that supplies fresh seafood and packages the produce prior to sale. The enterprise also has the means to freeze seafood.
On the first floor, the seafood will be delivered for all the necessary processing prior to the final packaging phase. On the first floor will sit the offices of the enterprise, while the basement will be used for stocking frozen products.
The total area the industrial enterprise will cover is approximately 900 sqm.



Installatie voor de Productie van Monolieten - Dessel, België





Op 23 juni 2006 heeft NIRAS (de Nationale instelling voor radioactief Afval en verrijkte splijtstoffen), via de beslissing van de Ministerraad, de opdracht gekregen om het geïntegreerd project voor oppervlakteberging van radioactief afval van categorie A in de gemeente Dessel verder uit te werken. Bij oppervlakteberging wordt het radioactief afval op zo'n manier ingesloten en afgezonderd dat mens en milieu optimaal beschermd worden. Dit zowel gedurende de 300 jaar waarin er actief toezicht van de berging is, als daarna.
Het concept wordt al op verschillende plaatsen ter wereld toegepast, onder meer in Frankrijk, Spanje en Japan. De totale hoeveelheid categorie A-afval die in de installatie in Dessel zal geborgen worden, rekening houdend met een verdere levensduur van de kerninstallaties van 40 jaar, werd geraamd op 70.500 m³.

Eén van de belangrijke deelprojecten van de oppervlakteberging is de installatie voor de productie van monolieten (verder IPM genoemd).
In de IPM zal het laag- en middelactief kortlevend afval in een betonnen caisson geplaatst worden en zullen de resterende ruimtes binnen deze caisson opgevuld worden met een immobilisatiemortel. Zo'n monoliet houdt de radioactieve straling tegen en sluit de radioactieve stoffen in. Een typisch monoliet heeft afmetingen van 1,95 m x 1,95 m x 1,62 m en heeft een massa van 20 ton. Het eindproduct van de IPM is een betonnen monoliet die vanaf de IPM naar de bergingsmodules kan getransporteerd worden. De wijze waarop een monoliet geproduceerd zal worden, is uiteenlopend en afhankelijk van de aard van het afval dat in een monoliet geïmmobiliseerd wordt.

Structuur

Naast de installatie zelf voor de productie van monolieten bestaat een deel van het productiegebouw uit een aantal buffers. Daarnaast is er nog het kantoorgebouw en de cementeerinstallatie. Deze gebouwen bezetten samen een oppervlakte van 6.650 m² en hebben een gemiddelde hoogte van 17 m. Voor elk van deze structuren wordt een 3D dynamisch rekenmodel opgesteld in Scia Engineer.

Het volledige productiegebouw wordt opgetrokken in gewapend beton. Zowel wanden als vloeren zullen geconstrueerd worden als massieve betonnen elementen die ter plaatse bekist en gestort worden. De dakplaat wordt opgebouwd uit voorgespannen welfsels met druklaag en een aanvullende betonlaag als stralingsschild. Bij grotere overspanningen is er een bijkomende primaire draagstructuur voorzien van prefab voorgespannen betonnen IV-liggers. In alle buffers worden kraanbanen voorzien, welke geplaatst zullen worden op doorlopende betonnen consoles.
Vanwege de grote overlasten door stapeling van monolieten (tot 210 kN/m²) op de vloerplaat, is speciale aandacht vereist voor de fundering. Hier wordt geopteerd voor een algemene funderingsplaat. Het terrein dient voorbelast te worden om zettingen van de definitieve constructie te minimaliseren. Voor een correcte simulatie van de grondkarakteristieken werd een voorafgaandelijke zettingsproef uitgevoerd.

Het kantoorgebouw wordt opgebouwd uit een betonnen skeletstructuur. De cementeerinstallatie wordt uitgevoerdals een stalen draagconstructie.

Gebruik van Scia Engineer

Een van de grote uitdagingen, waarbij Scia Engineer een antwoord biedt, is het implementeren van een grote reeks van belastingsgevallen en combinaties volgens de Eurocode: gebruiksbelastingen in functie van de bestemming van de ruimte, overlasten in de bufferruimtes waarbij opslag volgens een willekeurig patroon mogelijk dient te zijn, tal van kraanbanen en rails voor manipulatie van de monolieten.
Daarenboven dient er, vanwege het nucleaire karakter van het gebouw, gerekend te worden met tal van extreme omstandigheden zoals extreme sneeuwval, tornado's en in het bijzonder aardbeving. Voor de aardbevingsbelastingen zijn er met name belastingspectra opgesteld door Technum die via Scia geïmplementeerd werden.

Software: Scia Engineer

Technum - Kantoor Hasselt

Contact Kurt Swennen
Address Ilgatlaan 23
3500 Hasselt, Belgium
Phone +32 11 28 86 00
Email kurt.swennen@technum-tractebel.be
Website www.technum.be

Technum is de entiteit van Tractebel Engineering gespecialiseerd in "Smart & Sustainable Infrastructure" en heeft verschillende kantoren in België.
Tractebel Engineering is een studie- en adviesbureau met meer dan 100 jaar expertise in energie- en infrastructuurprojecten, vestigingen in twaalf landen (hoofdzetel in Brussel) en projecten in meer dan 80 landen. Het stelt het meer dan 3300 mensen te werk en heeft een omzet van ongeveer 500 M€. Samen met Tractebel Engineering beheersen we de volledige levenscyclus van energie- en infrastructuurprojecten, gaande van haalbaarheidsstudies tot de ontmanteling.

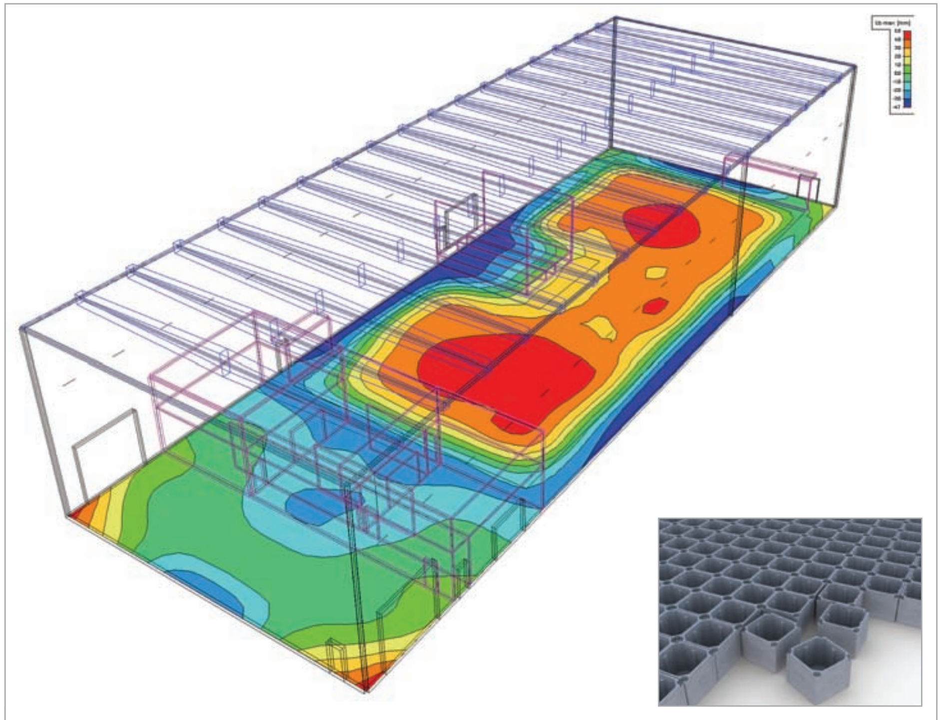
Smart & Sustainable Infrastructure is ons motto. We zorgen voor kwaliteitsvolle, duurzame oplossingen via een intelligente integratie van infrastructuur, gebouwen, mobiliteit en energie efficiëntie. We combineren op een creatieve wijze al onze competenties en spelen op die manier een sleutelrol in de ontwikkeling van de steden en de leefomgeving van de toekomst.

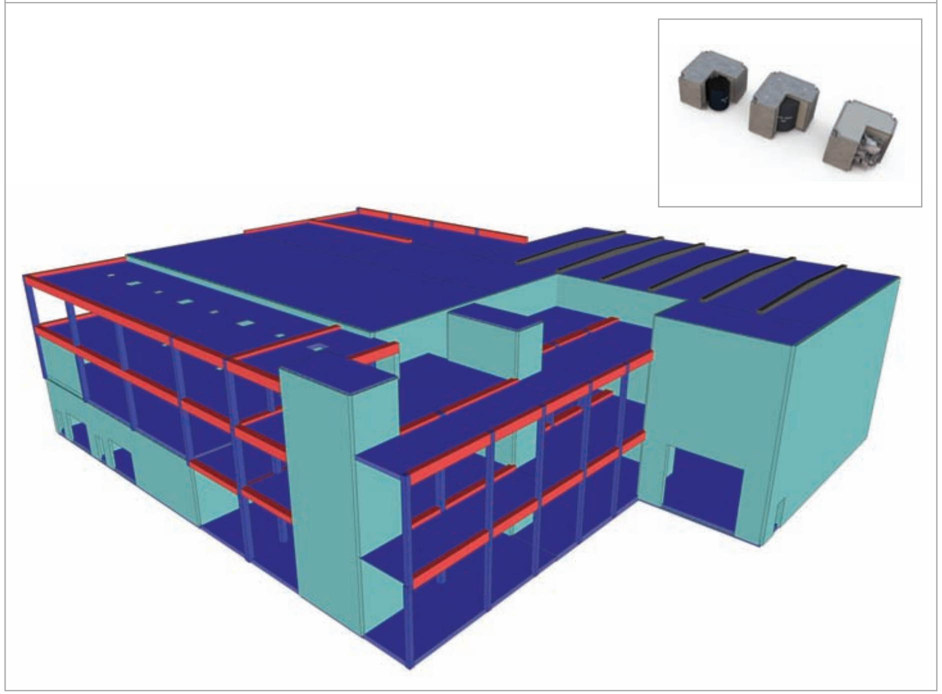
Project information

Owner	NIRAS
Architect	Signum+ Architects, Gent
Engineering Office	Technum, Hasselt
Location	Dessel, Belgium
Construction Period	02/2014 to 10/2016

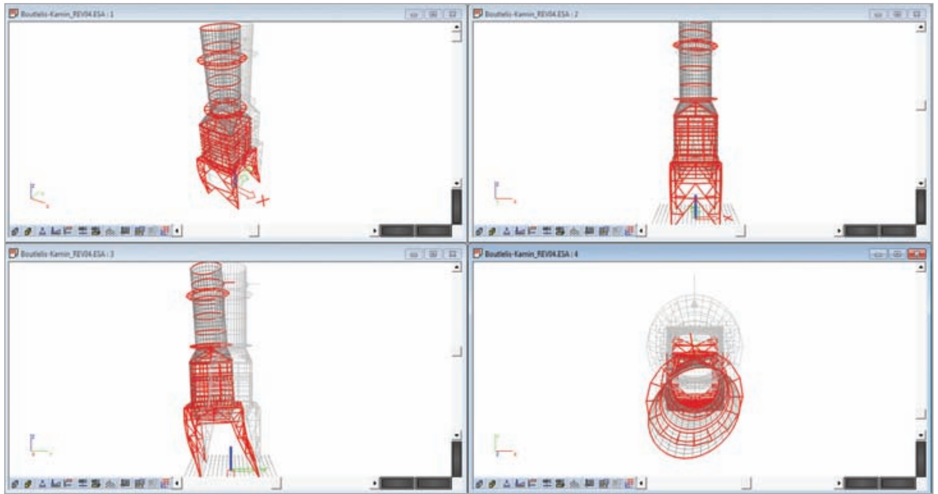
Short description | Monolith Production Facility

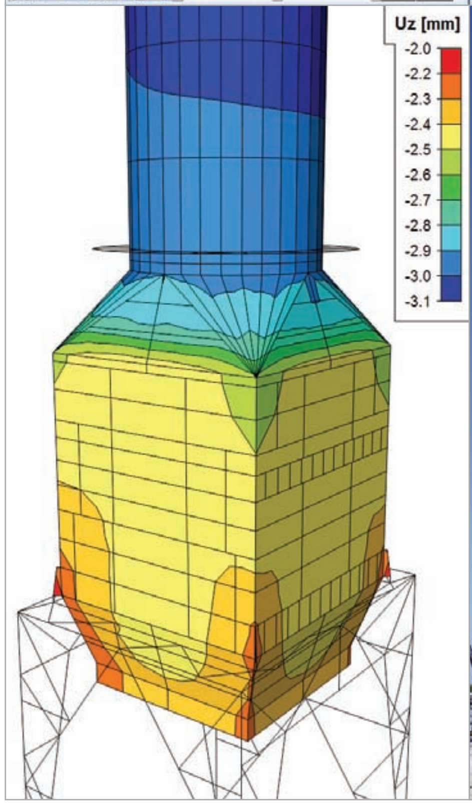
The cAt project of ONDRAF/NIRAS offers a solution for the disposal of low-level and medium-level radioactive short-lived waste (category A waste) in Belgium.
The cAt project is unique in terms of the way in which the repository in the municipality of Dessel will be integrated into a social, value-added project for the region over the long term.
At the Monolith Production Facility, the waste is placed in a caisson and filled with mortar to form concrete monoliths. The monoliths will be stored at the MPF until they can be transported to the disposal modules by rail.
Information and video: www.niras-cat.be





Abgaskamin für ein Gas- und Dampfkraftwerk - Bou Tlelis, Algeria





Das Projekt
Standort ist Bou Tlelis (Algerien), 35 km westlich von Oran.
Gesamtvolumen 228 Mio €
Maße: 10 x 12 x 46 m
Gewicht: ca. 200 t

Der Endkunde ist Sonelgaz, Algeriens nationaler Stromproduzent. Dieser hat den Auftrag an ein Konsortium bestehend aus General Electric und Cegelec Energy (VINCI Energies GSS) vergeben. Es handelt sich um ein Kraftwerk zur Stromproduktion. Es werden 2 Gasturbinen betrieben mit einer Gesamtleistung von 445 MW. Die Turbinen stammen von GE.

Bei diesem Projekt handelt es sich um den Abgaskamin eines Gas- und Dampfkraftwerkes.

Software
Der Kamin wurde vollständig in Scia Engineer berechnet.
- Der Konventionelle Stahlbau des Kaminstuhls
- Die Schalen und Bleche der einzelnen Kaminschalen

Das Gesamtmodell beträgt 743 strukturelle Träger und 555 strukturelle Schalen. 24 Lastfälle ergaben rund 850 Lastfallkombinationen, nach welchen die Elemente bemessen wurden.

Modellierung
Besonders wichtig ist das perfekte Zusammenspiel von Stabwerken und finiten Elementen (Platten und Schalen).

Das einfache und schnelle Modellieren ermöglichte die rasche Erstellung von komplexen Schalentragwerken. Geometrische Besonderheiten wie Berechnungen von Durchdringungen, Übergänge von rechteckig auf rund oder auch Verschneidungen von Schalenelementen wurden dank der eingebauten Funktionen mühelos bewältigt.

Weitere benötigte Funktionen
Frequenzanalyse
Mit den Dynamikmodulen wurden Eigenfrequenzberechnungen zur Schwingungsuntersuchung durchgeführt.

BIM
Über die IFC Schnittstelle wurde die Konstruktion an das CAD Programm Tekla Structures zur Erstellung der Stahlbauzeichnungen übergeben.
Während des Projektverlaufes diente dies auch zur Kontrolle und Abgleich zwischen dem CAD-Modell und dem Statikmodell.

Bemessung
Die Berechnung war nach US-amerikanischen Bestimmungen durchzuführen. Daher mussten die entsprechenden Landesnormen verwendet werden.

Ausgabe
Obwohl die Programmoberfläche auf Deutsch war, konnte die Ausgabe in englischer Sprache erfolgen.

Besondere Herausforderungen
Besondere Herausforderungen waren letztlich die schmetterlingsförmige Winddruckverteilung, welche auf die Kaminröhre detailliert eingegeben werden mussten, die Auflagerung des Kamins auf den Kaminstuhl, sowie die Optimierung der Transport- und Montageeinheiten.

Software: Scia Engineer

Voss u. Kamb und Partner GmbH

Contact Lino Caiazzo
Address Europaallee 11-13
67657 Kaiserslautern, Germany
Phone +49 631/36215-0
Email caiazzo@voka-kl.de
Website www.voka-kl.de

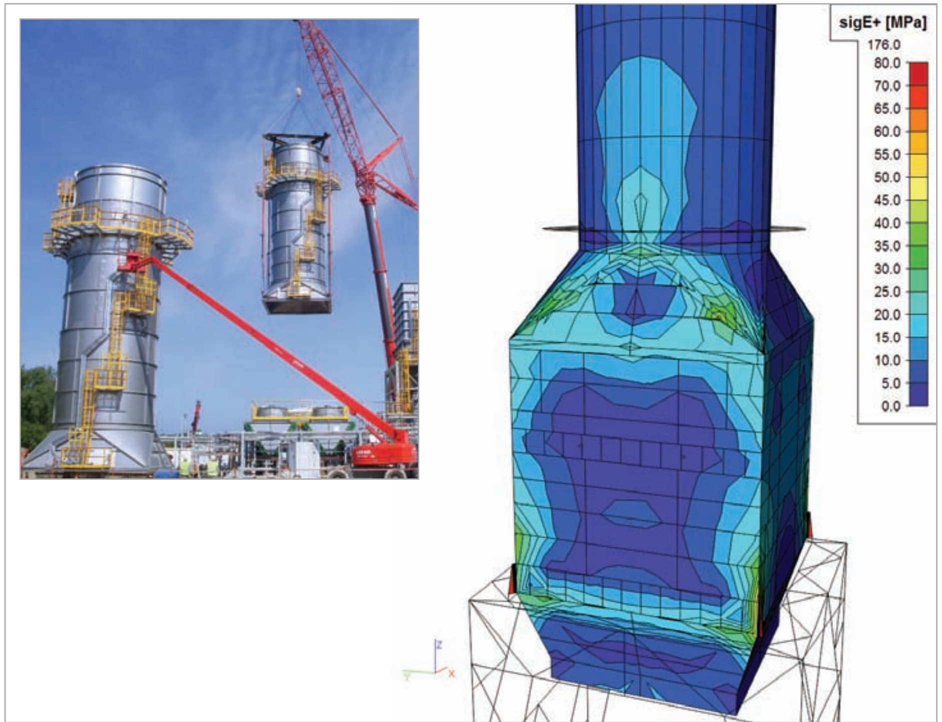
Wir planen und realisieren Ingenieurbauwerke, Produktionsanlagen, Gewerbe- und Bürogebäude. Unsere Schwerpunkte liegen im Kraftwerks-, Industrie-, Anlagenbau und Produktionsanlagen für die Großchemie. Wir zeichnen uns durch technische Kompetenz, Kreativität und jahrzehntelange Erfahrung aus.
Um unser Leistungsbild abzurunden, stehen wir unseren Kunden auch beratend zur Verfügung. Mit der Zeit haben wir unser Leistungsspektrum erweitert vom Stahlbau bis hin zum kompletten Hochbau, wie zum Beispiel Bürogebäude, Schulen und Verwaltungsgebäude. Wir verfügen über 35 qualifizierte Mitarbeiter.
Wir halten verschiedene Software-Systeme vor, um den Wünschen unserer Kunden gerecht zu werden.

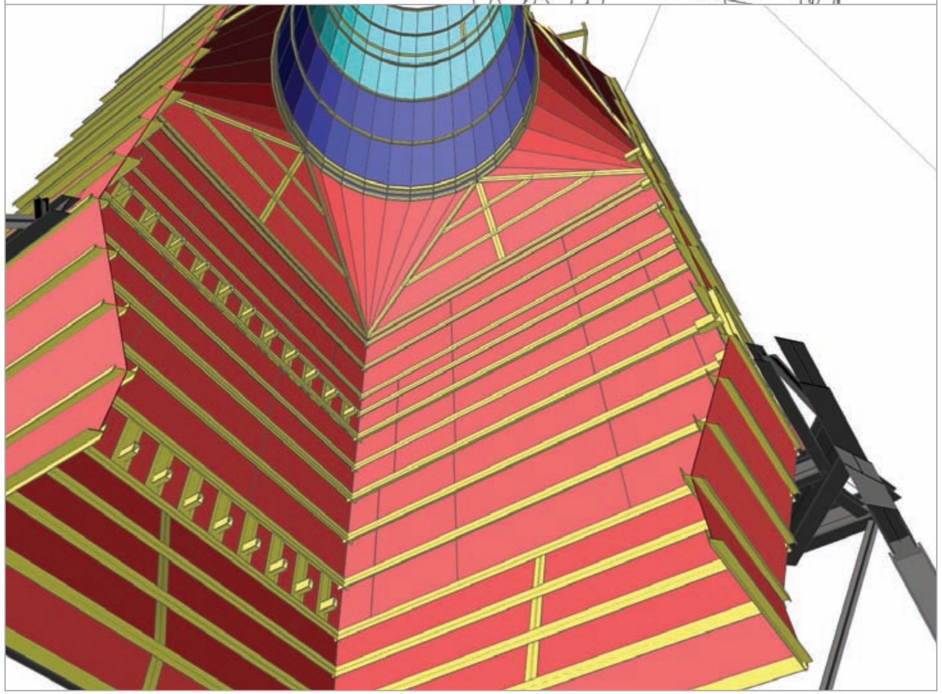
Project information

Owner	G+H Montage
General Contractor	GE Power Generation
Engineering Office	Voss & Kamb und Partner GmbH
Location	Bou Tlelis, Algeria
Construction Period	05/2012 to 02/2013

Short description | Exhaust Stack of a Gas Turbine Power Plant

In a project for Sonelgaz, Algeria's national electricity utility, two gas turbines from GE with a combined power of 445 MW were installed near Oran.
The exhaust stack was entirely analysed with Scia Engineer, in regard to both the supporting structural steel and the steel plates and shells.
The modelling tools of Scia Engineer made it possible to easily input the very complex geometry.
Next to the dynamic analysis and the possibility of designing to American standards and to report in French and English, a particular point of interest was the good export of the Scia Engineer model to Tekla Structures through IFC.





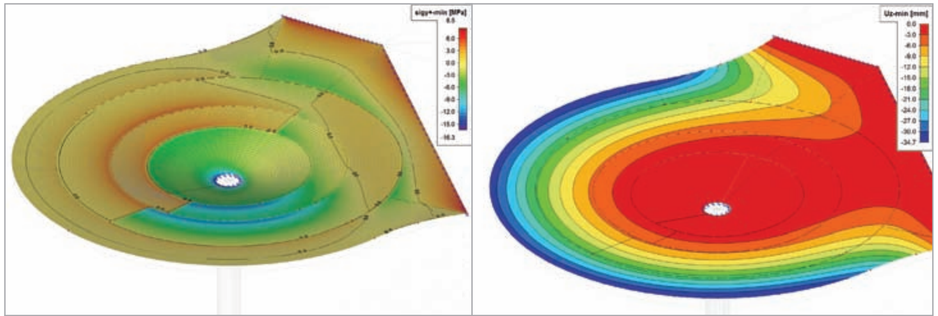
Sustainable, Ecological and Green Structures - Scaffolding - Works of art - Mechanical equipment - … Larger projects (storage tanks, conveyer belts, cold store installations, supporting structures), playground equipment, scaffolds, works of art, cranes, tubular connections, … at which the analysis/design software has been used. To this category also belong stadiums, spectacular roofs.

4

Prestrešenie Čerpacej Stanice GAS - Matúškovo, Slovak Republic

Winner Category 4: Special Projects

Quote of the Jury: *"This complex project could not have been calculated by hand, advanced software like Scia Engineer is essential to do this job. The three hollow columns in combination with the thin concrete diaphragm roof (average 150mm thickness) achieve the overall stability of this nice slender structure. The hollow columns are functional and transfer the rainwater from the roof to the sewer. The connections between column and foundation, and column and roof were especially complex to calculate and execute. The nice use of illumination completes this original architectural design."*



Software: Scia Engineer

Základy

Základové konštrukcie objektu sa navrhujú ako plošné, tvorené železobetónovými základovými pätkami, v dvoch prípadoch doplnené o základový pás pod stojanom s čerpadlom pohonných hmôt. Základové pätky sú vzhľadom na stĺpy navrhnuté ako centrické, s rozmermi 2.300 x 2.300 mm, resp. 2.150 x 2.150 mm. Šírka základových pásov je 700 mm. Základová škára pätiek je umiestnená na výškovej kóte -2,5 m pod úrovňou terénu, základová škára pásov potom na kóte -1,8 m pod úrovňou okolitého terénu. Horná hrana všetkých základových konštrukcií je na výškovej kóte -1,0 m, čo je zároveň i spodná hrana nosných stĺpov. Základy sú vystužené KARI sieťovinou s priemerom drôtu 6 mm, veľkosť oka 100 mm, doplnenou v potrebných miestach prútovou výstužou s priemerom 12 mm. Zo základov je nad hornú hranu vyvedená čakacia výstuž určená ku napojeniu výstuže stĺpov.

Zvislé nosné konštrukcie

Zvislé nosné konštrukcie tvoria tri kruhové stĺpy s vonkajším priemerom 550 mm, vnútorný priemer je 200 mm. V dutine stĺpa sú vedené dažďové zvody strechy. V hornej časti stĺp pomocou kónického tvaru plynule prechádza do škrupinovej dosky prestrešenia. V zakrivenej časti sú v hmote stĺpa vynechané drážky pre osvetlenie a ostatné potrebné rozvody profesií. Armovanie stĺpov je navrhnuté pri vonkajšom i vnútornom povrchu prútovými vložkami priemeru 10 mm, doplnenými strmeňmi - skrutkovnica tvaru considere, vloženou taktiež k obom povrchom.

Vodorovné nosné konštrukcie

Vodorovné nosné konštrukcie sú tvorené zakrivenou škrupinovou doskou hrúbky 140 mm. V mieste nábehov na nosné stĺpy je hrúbka závislá na tvare kónusu, ktorý plynule prechádza do nosných stĺpov. Armovanie stropnej dosky je pri oboch povrchoch riešené pomocou KARI sieťoviny s priemerom drôtu 6 mm, veľkosť oka 100 mm - v miestach s minimálnym zakrivením plochy. V miestach nábehov na stĺpy je hmota vystužená prútovými vložkami priemeru 12 mm v prípade hlavnej výstuže, priemeru 6 mm v prípade rozdeľovacej výstuže. Hlavná výstuž je prestykovaná s hlavnou výstužou stĺpov. V miestach drážok pre osvetlenie sú v armovaní vyhotovené výmeny pomocou prútovej výstuže priemeru 8 mm.

Popis realizácie

Realizácia objektu začala výkopovými prácami na začiatku marca 2011 výkopovými prácami. Nasledovalo debnenie a armovanie základových pätiek a pásov, po ktorom nasledovala betonáž - ukončenie približne v polovici marca 2011. Na hornej hrane základových konštrukcií bola vytvorená pracovná škára (výšková kóta -1.000 m), nad ktorou bolo potrebné nechať vyvedenú výstuž pre napojenie stĺpov konštrukcie. Od tejto pracovnej škáry nasledovalo použitie pohľadového betónu. Samotná betonáž stĺpov bola pomocou ďalších dvoch pracovných škár (výškové kóty +3.060 m a +4.922 m - nábeh stĺpa) rozdelená na celky, ktorými sa plynule prešlo do betonáže škrupinovej dosky (výšková kóta +5.457 m a vyššie) - koniec apríla 2011. Debnenie bolo použité systémové, spolu so špeciálnym debniacim dielcom nábehu dielca, ktorý bol na každý stĺp použitý v rámci rotačného systému. Konštrukcia bola podstojkovaná počas betonáže a nasledujúcich 14 dní, pokiaľ sa skúškou Schmidtovým kladivkom nestanovila dostatočná pevnosť konštrukcie - koniec mája 2011. Nasledovalo oddebnenie konštrukcie, čím sa skompletizovala hrubá stavba konštrukcie. Celá výstavba nosnej konštrukcie bola bezproblémová a prebehla v súlade s časovým harmonogramom. Odovzdanie stavby do užívania prebehlo v auguste 2011.

Použité materiály

- Betón základových konštrukcií STN EN 206-1 VC25/30 XC1 (SK) - C1 0,4 - Dmax 16-32 - S3, prísada SILIKATE 2%
- Betón hornej stavby STN EN 206-1 C30/37 XC1 (SK) - C1 0,4 - Dmax 16 - S3, prísada SILIKATE 2%
- KARI sieťovina 6/100 (W)
- Betonárska oceľ 10 505 (R)

VISIA s.r.o.

Contact Ladislav Chatrnúch
Address Sládkovičova 2052/50
92701 Šaľa, Slovakia
Phone +421 948139090
Email atelier@visia.sk
Website www.visia.sk

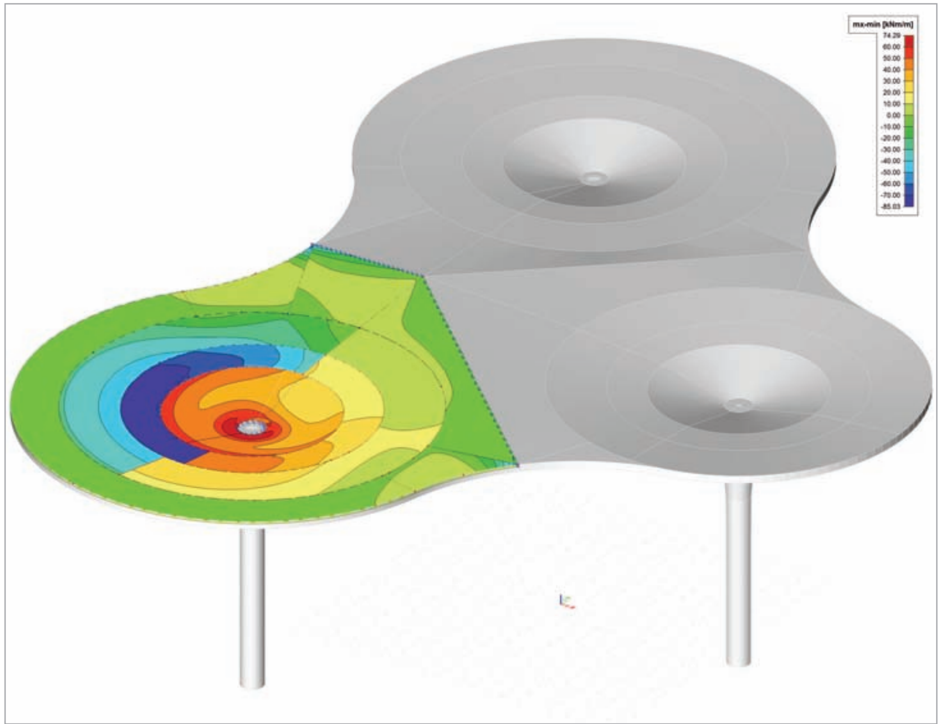
Sme tím architektov, stavebných inžinierov a statikov z juho-západného Slovenska v meste Šaľa.
Spájame kreatívnu časť projektu s technickými vedomosťami v jednom ateliéri.
Máme veľa skúseností s monolitickým betónom, oceľou a drevenými konštrukciami.
Riešili sme mnoho nízkonákladových stavieb.
Urobili sme niekoľko projektov pasívnych domov.
Navrhujeme 3D modely zo statiky v programe Tekla.
Pre statické výpočty používame programy Scia Engineer - Nemetschek Scia
Náš komunikačný jazyk je slovenčina a angličtina

Project information

Owner	GAS s. r. o., Bratislava
Architect	MgA. Adam Jirkal & MgA. Jerry Koza
General Contractor	C-PARTNERS, s.r.o.
Engineering Office	VISIA s.r.o.
Location	Matúškovo, Slovak Republic
Construction Period	03/2011 to 08/2011

Short description | **Roofing Gas Station GAS**

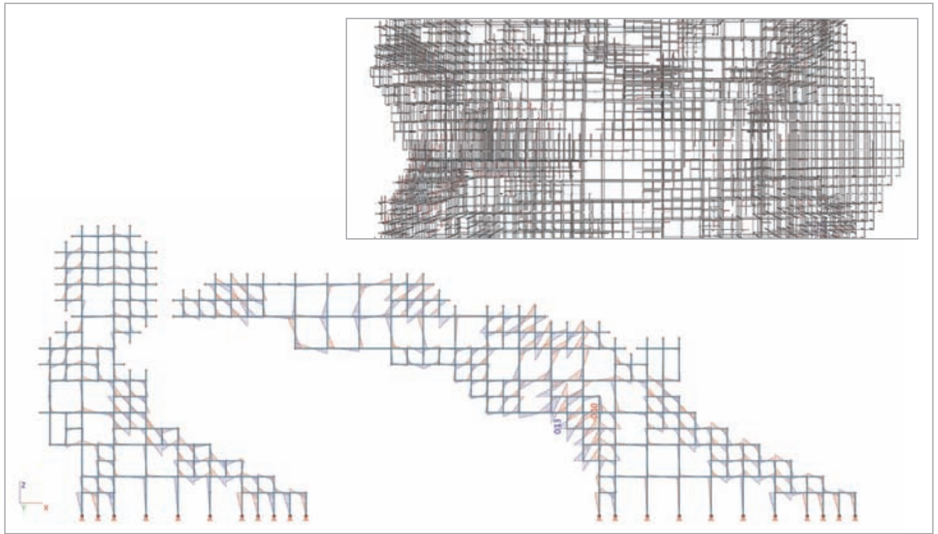
The concrete roofing is designed as the intersection of three circle-shell slabs with thicknesses ranging from 140 mm to 200 mm. Each shell slab is at its centre supported by a cone-shaped column. In order to drain rain water, the columns are tubular. On the bottom side of the shell-slab is a small groove for the lighting. The steel reinforcement is made of bars, with diameters of 8 mm and 12 mm. Waterproof concrete (Class C30/37) was used to provide protection against rainwater. The foundation is a combination of foot flange and foundation straps. The external column diameter is 550 mm, the internal 200 mm. The circle shell slab diameters are 10 m and 8 m. The total construction height is 8 m (5,500 mm above the ground level; the foundation is 2,500 mm high).



Serpentine Gallery Pavilion 2013 - London, United Kingdom

Winner Special Prize for Fabrication and Execution

Quote of the Jury: *"The concept of this reusable structure was drawn up using Rhino and bespoke scripts were used to transfer the geometry to Scia Engineer for structural analysis and design. The 3D model was also used for computer aided manufacturing (CAM), as well as for better visualization and optimization of the size of the fabrication modules for onsite delivery and erection. The geometry was transferred from Scia Engineer to Revit for producing the structural drawings. Due to the different partners involved and the short project time, the use of Building Information Modeling (BIM) was essential to make this project a success."*



Each year, the Serpentine Gallery commissions an international architect to design their summer pavilion. The 2013 Pavilion was designed by Japanese architect Sou Fujimoto, with AECOM carrying out the structural design from concept stage in January 2013 to completion in time for the press launch on 4th June 2013. The Pavilion exemplifies contemporary architecture and the engineering challenge is to mask the complexity of the structure behind simple design and intelligent detailing.

Concept

The concept is built around a three dimensional 400 mm grid, with 20 mm square hollow sections forming a vierendeel space frame which provides areas of shelter, formed by the addition of circular polycarbonate discs, as well as areas where guests are invited to climb over the structure.

Design

The complex nature of the structure meant that a three dimensional analysis model was essential as the structure relies on all 27,000 members for global stability. In the areas where guests are permitted access onto the structure, locally high loading was imposed to allow for the weight of the glass infill panels and the weight of a crowd gathered on the structure. This was combined with accidental load combinations which accounted for unwanted access onto the roof, member removal and settlement of the footings.

Testing

From the outset it was clear that the detailing of the nodes was vital; they needed to be simple to fabricate, allow easy construction of larger modules for delivery to site as well as on site, connections, and they needed to be able to transfer the full moment capacity of the section across the joint.

Several concepts were drawn up and design sessions with the fabricator (Stage One) allowed a detail to be developed which allowed the structure to be constructed in the available timescales. Separate details were needed for the site connections.

It was necessary to ensure that the joint could mobilise the full moment capacity of the steel section as this was fundamental to the stability of the structure, which relied on vierendeel action of the frames and the corresponding high moments at node points. To ensure that the capacity of the joints was sufficient, several test pieces were created and tested to destruction. This included small scale single nodes as well as large scale mock ups of portions of the structure.

Parametric design process

The success of the scheme relied upon electronic collaboration between the design team members. From the outset of the project the design concept was conveyed using 3D models, as the complex structure has very little meaning when expressed as two dimensional sections. The architectural scheme was drawn up using Rhino and bespoke scripts were used to transfer the geometry to Scia Engineer. Fundamental to the success was the ability to make this a complete round trip process, allowing rapid design development with the architect and iteration of the design to a final solution which embodied the architect's dream as well as functioning structurally.

The 3D model was also shared with the fabricator allowing integration with their computer aided manufacturing processes, as well as better visualisation of the structure and optimisation of the size of the fabrication modules for delivery to site and erection within the short construction period on site.

Structural design drawings were produced in AutoDesk Revit. The geometry was transferred to Revit using the Revit-Scia Engineer link.

Software: Scia Engineer

AECOM

Contact Harriet Eldred
Address MidCity Place, 71 High Holborn
WC1v 6QS London, United Kingdom
Phone +44 1727535339
Email harriet.eldred@aecom.com
Website www.aecom.com

AECOM is a global provider of professional, technical and management support services to a broad range of construction and infrastructure markets. With approximately 45,000 employees around the world, AECOM is a leader in all of the key markets that it serves, providing a blend of global reach, local knowledge, innovation and technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments.

From major road and rail projects to energy generation, water management systems and creating beautiful and successful buildings and places, AECOM in Europe works closely with clients across all areas of the built and natural environment. Our teams of award-winning engineers, designers, planners and project managers ensure that our solutions outperform convention. Combining global resources with local expertise provides exceptional, high-quality, cost-effective professional and technical solutions.

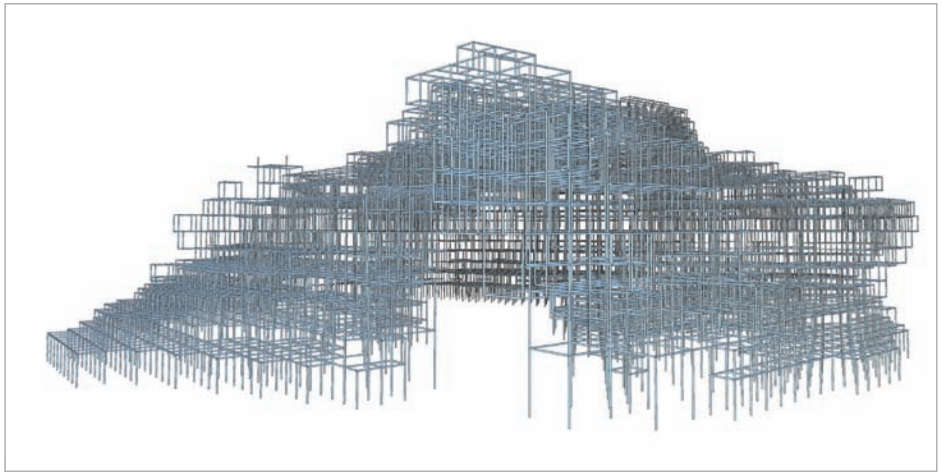
Project information

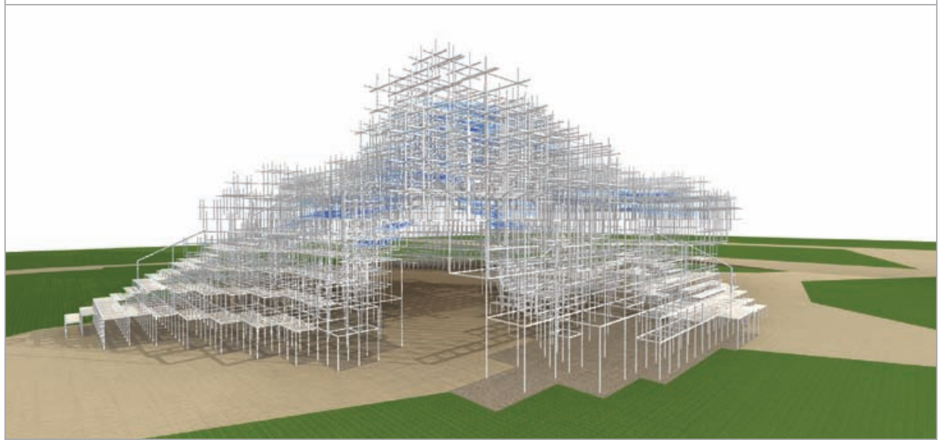
Owner	Serpentine Gallery
Architect	Sou Fujimoto Architects
General Contractor	Stage One
Engineering Office	AECOM
Location	London, United Kingdom
Construction Period	03/2013 to 05/2013

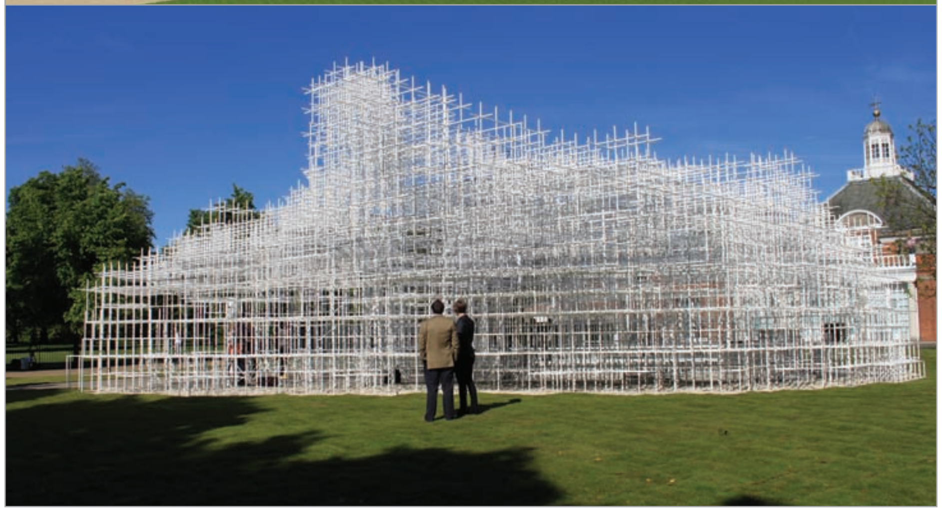
Short description | **Serpentine Gallery Pavilion 2013**

The Serpentine Gallery's annual Pavilion is an opportunity for an international architect to showcase their expertise in the UK. Each pavilion is intended to be an example of contemporary architecture and cutting edge engineering which aims to inspire and intrigue everyone who has the opportunity to visit the venue during its four month lifespan.

The 2013 Pavilion is no exception - the structure is a vierendeel space frame constructed from members with almost negligible moment capacity. The design and fabrication of this structure has to be completed within four months, adding additional pressure to the design and fabrication teams. Collaboration and exchange of electronic design information was vital to the success of the project.

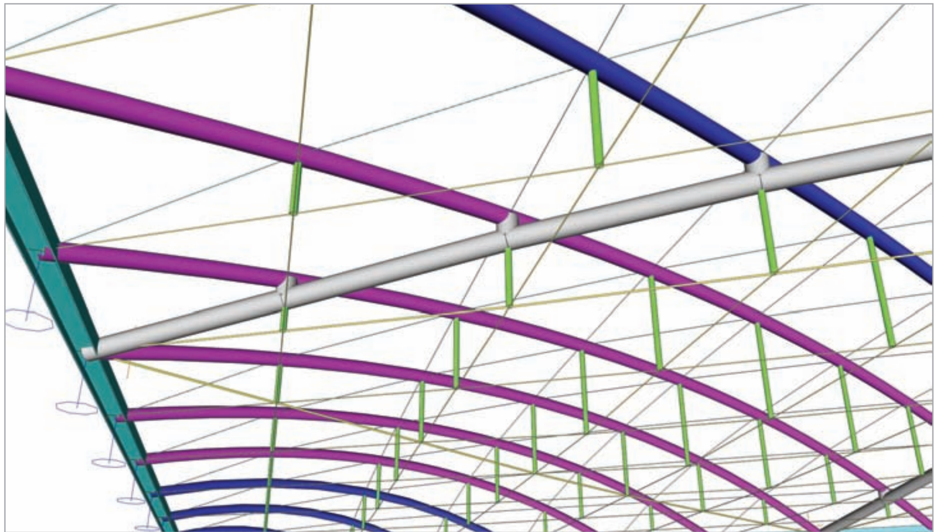






Couverture de l'atrium, Bâtiment Helios - St Jean de Braye, France

Nomination Category 4: Special Projects



Software: Scia Engineer

Depuis 2012, le groupe LVMH fait construire un nouveau centre de recherche, le programme Hélios II, sur le site des parfums Christian DIOR, dans la banlieue d'Orléans, à Saint Jean de Braye (Loiret).

Ce projet comporte six bâtiments qui s'assemblent en triangle. L'intérieur de ce triangle est aménagé en jardin ouvert, l'Atrium.

Baudin Châteauneuf s'est vu confier la réalisation de l'ossature métallique de la couverture, en coussins gonflables, de cet atrium.

L'ouvrage
Le défi : couvrir, par une structure « légère » et sans point porteur intermédiaire, un triangle équilatéral de 56 mètres de coté.
La solution : 12 pannes cintrées en tubes circulaires, reposant, par l'intermédiaire de montants verticaux, sur une nappe de câbles inox croisés.

Un cadre périphérique en HEB500, 2 poutres principales sous tendues, en tube Φ 406,4 mm, et une panne cintrée en tube Φ 323,9 mm sous tendue elle aussi, assurent la rigidité de la structure.
Les pannes cintrées, en tube Φ 323,9 mm, portent directement d'un coté à l'autre pour celles situées vers la pointe du triangle. Celles situées vers sa base, s'appuient aussi sur les 2 poutres principales.

L'ordre de pose des différentes pannes a fait l'objet d'une étude attentive. En effet, les câbles de sous tension ne sont pas dans le plan vertical des pannes, mais forment une nappe croisée à 60° avec celles-ci.
Ainsi, lors de la mise en place d'une panne, tous les câbles la soutenant ne sont pas encore en place et la tension prévue ne peut pas être appliquée.
Pendant le montage de l'ossature, les poutres et la panne principales ont été chacune soutenues par un appui provisoire pour éviter des déformations excessives.

Le modèle de calcul
Tous les éléments de l'ossature sont modélisés, aussi bien chacun des tronçons de câbles que les pannes cintrées.

Les cas de charges étudiés correspondent, pour les uns, aux actions habituelles sur toute structure : le poids des matériaux, les actions de la neige et du vent ; alors que d'autres actions sont beaucoup moins fréquentes : effet de la pression interne des coussins et cas accidentels dus à la « crevaison » d'un coussin.

Une analyse non linéaire est exécutée prenant en compte l'incapacité des câbles à reprendre un effort de compression.
La fonctionnalité « contrainte initiale » est aussi utilisée pour introduire une tension dans ces éléments.

Enfin un calcul de stabilité a permis de prendre en compte correctement les effets liés au flambement des tubes comprimés.

Seulement 70 tonnes
1.200 mètres de câbles inox et seulement 70 tonnes de structure métallique ont permis au Département Charpentes Métalliques de Baudin Châteauneuf la réalisation de cette structure.

Encore une fois, Baudin Châteauneuf a su faire preuve de son savoir faire, depuis la phase de « conception-études » jusqu'au montage sur le chantier, en passant par la fabrication des pièces par notre atelier, pour mener à bien la réalisation d'un nouvel ouvrage hors normes.

Baudin Châteauneuf

Contact Cédric Ricaud
Address BP 30019
60 rue de la brosse
45110 Chateauneuf sur Loire, France
Phone +33 238463846
Email cedric.ricaud@baudinchateauneuf.com
Website www.baudinchateauneuf.com

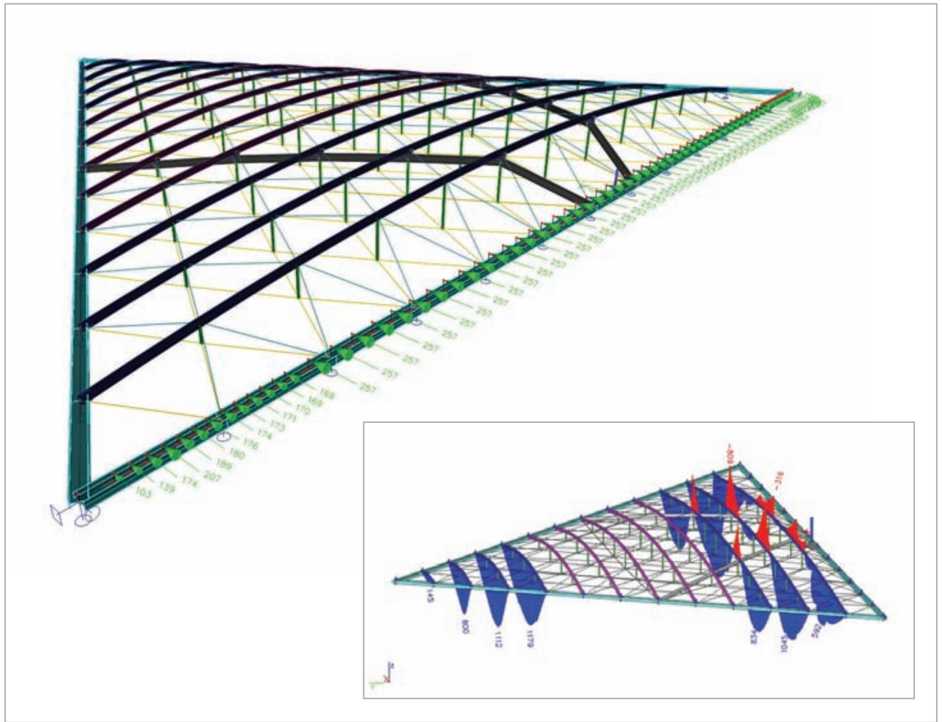
Fondée en 1919 à Châteauneuf sur Loire, la société SNC Baudin est baptisée Baudin Châteauneuf en 1952. Née de la production de pylônes électriques et de hangars agricoles, l’entreprise s’oriente vers la construction de ponts métalliques. Après 1945, BC participe activement à la reconstruction des ponts en France. Ces nombreux chantiers valorisent son expérience et enrichissent sa connaissance des ponts suspendus.
Baudin Châteauneuf s’est développée grâce à la maîtrise de la réalisation des ponts suspendus et a étendu son savoir-faire dans les domaines variés de la construction.
Aujourd’hui, BC propose une gamme complète de prestations aussi bien en construction et rénovation d’ouvrages d’art, en charpentes métalliques, en génie mécanique, en génie civil, en entreprise générale ou en transport exceptionnel.
Elle a récemment étendu ses activités à la couverture et au bardage, au traitement de l’eau et de l’air, aux câbles offshore et à l’éolien.

Project information

Owner	LVMH
Architect	ARTE Charpentier
General Contractor	Eiffage Construction Centre
Engineering Office	LVMH R&D
Location	St Jean de Braye, France
Construction Period	05/2012 to 06/2012

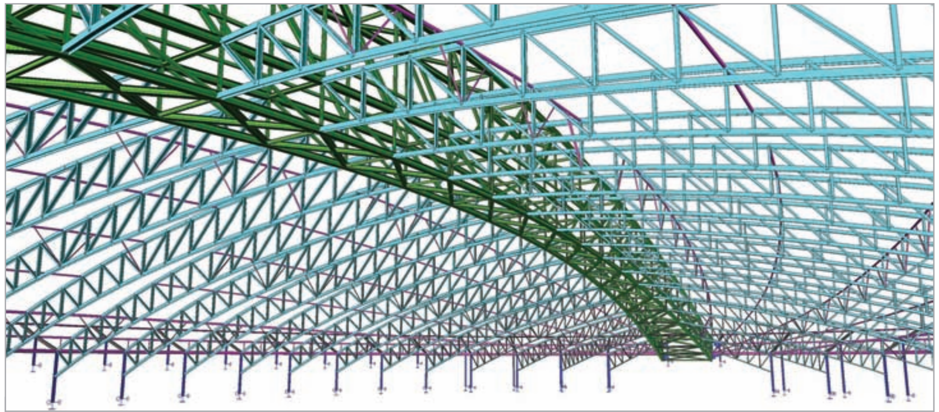
Short description | **Coverage of the atrium**, **Helios Building**

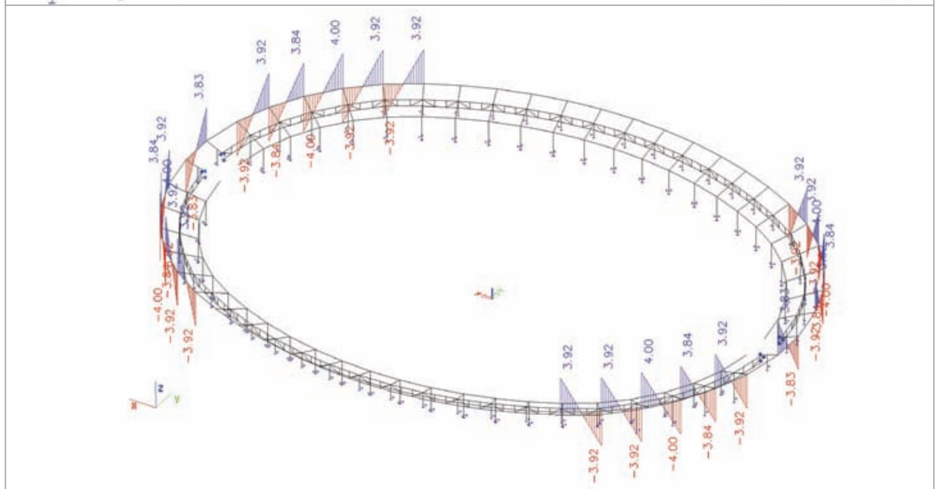
The project consists of the creation of the roof structure, in inflatable cushions, of the Atrium, the interior garden of the new research centre for LVMH R&D.
A “light” steel structure, without intermediate supports, makes it possible to cover the triangular free space of the 56 m span above the Atrium.
The frame structure is made of 12 curved purlins with a circular tube section, subtended by a stainless steel cable mesh.
The functionalities “tension-only” and “initial stress” of Scia Engineer were applied on this project. A global stability analysis allowed for a deeper insight into the buckling modes of this structure.
Finally, Baudin Châteauneuf implemented this unique work using merely 1,200 m of stainless steel cables and 70 t of structural steel.

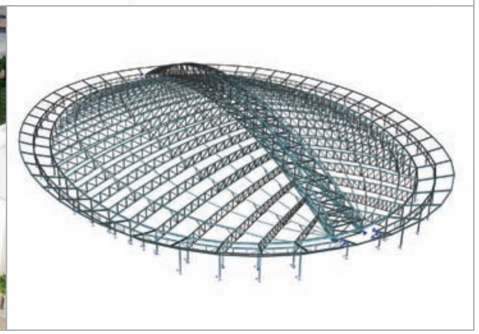


KSU Sports Campus - Riyad, Saudi Arabia

Nomination Category 4: Special Projects







The arena roof is part of the King Saud University Sport Campus in Riyadh (Saudi Arabia) and it is the main feature of the sport campus. The building is for indoor athletics and also has the ability to hold conferences. The basic form of this building consists of a large single span roof with a central arch truss supporting secondary trusses.
The steel structure covers an independently stabilised reinforced concrete frame.

Steel roof

The roof structure can be summarised as follows:

- A steel arched truss with cords in HISTAR profiles spanning 145 m between reinforced concrete buttresses.
- Buttresses are formed from a series of interconnecting shear walls with a thrust block above and thick foundation below to underlying rock.
- Secondary arched trusses supported by the main truss and parametrical columns.
- A perimeter flat ring connected to the end of the arched truss and to the concrete buttress.
- The roof cladding is a light-weight complex with steel sheets, insulation and water-tightness.
- The roof bracing has been divided into two parts in order to avoid lock-in stresses.

The overall stability is provided mainly by the buttresses. The main arch transfers the lateral loads back to the buttresses through a combination of axial thrust, minor axis and major axis bending and torsion. The external part of the perimeter ring floats over the concrete structure via pin-ended columns with free displacement support made with Teflon.

Vertical loads from the main arch truss are transferred back to the buttresses via axial thrust and major axis bending.
Vertical loads acting on the perimeter ring are transferred to the reinforced concrete structure via axial loads in the parametrical columns.

Use of Scia Engineer

The model geometry was imported from a dxf file provided by the client. The beams, hinges, support and loads were then introduced. The layers manager was really useful in this project for analysing the project part by part. 3D exportation in dxf and pdf was used for transmitting the sketch of the results, as column displacement and reactions.
The predefined load library allowed for a quick introduction of the loads. The wind loads curve tool was used to model the evolution of the wind pressure all along the height of the building.
For the analysis of the behaviour of the structure, we used the deformed structure results. In fact, by using a relative big scale factor, this tool shows how the structure deflects and allows for locating the critical points and also detecting if there is a non-symmetry (the model is double symmetric, so its behaviour should also be symmetric).
The very large document possibilities allowed for the production of the calculation sheet and transmission of information between the project actors.

The key numbers of the project

- 3,912 nodes
- 3,139 beams
- Numbers of profiles used: 80
- 820 tonnes of steel (S460, S460HISTAR, S355, S235)

Software: Scia Engineer

Schroeder & Associés

Contact Faiza Benyahia
Address 8, rue des Girondins
1626 Luxembourg, Luxembourg
Phone +352 44.31.31.1
Email faiza.955@hotmail.fr
Website www.schroeder.lu

The engineering office Schroeder & Associés operates in four fundamental departments: building engineering, structural engineering, road-system - networks, urban and landscape design. Relying on its 50 years of experience and 230 employees, as well as on foreign specialised partners, the engineering office offers its services, experience and know-how to its customers.

Our challenge consists of proposing activities answering the demands of our customers and increasing their satisfaction by completing our missions in an effective way.

General information about the company

- Foundation of the office in 1961.
- Co-founder of Luxconsult S.A, SDC SA, Dahlem, Schroeder sarl and RW-Consult.
- Collaboration with specialised offices in Germany, Belgium, France and Switzerland.

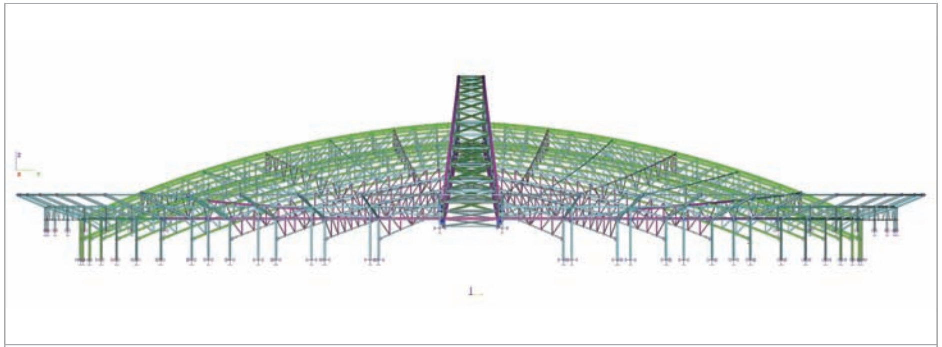
Project information

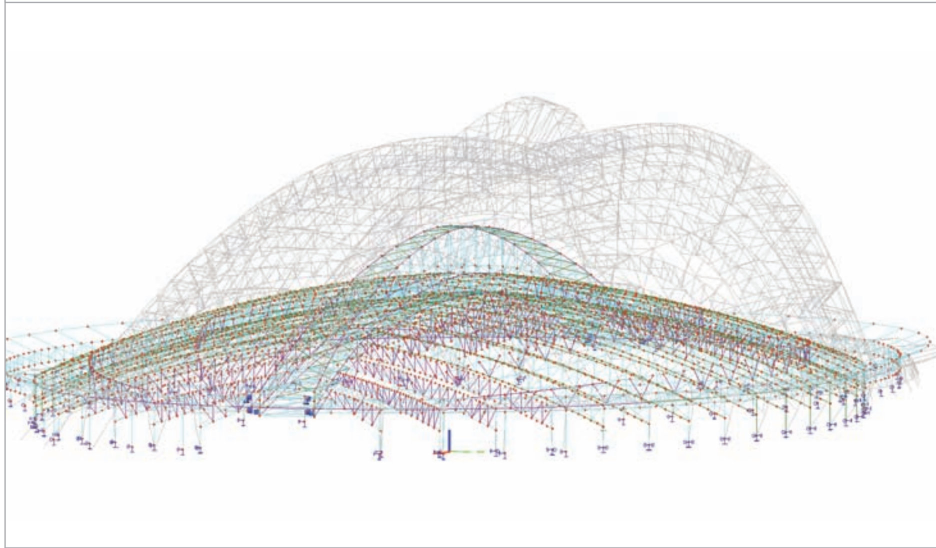
Owner	King Saud University
Architect	STW
General Contractor	Saudi Binladen Group / INMA
Engineering Office	Schroeder Et Associes (Arena Steel structure)
Location	Riyad, Saudi Arabia
Construction Period	01/2012 to 10/2014

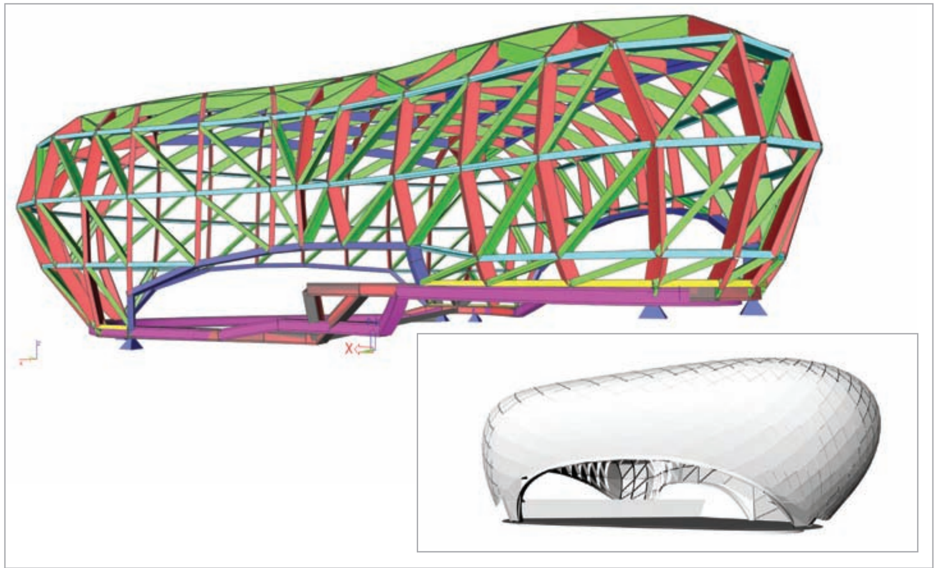
Short description | **KSU Sports Campus**

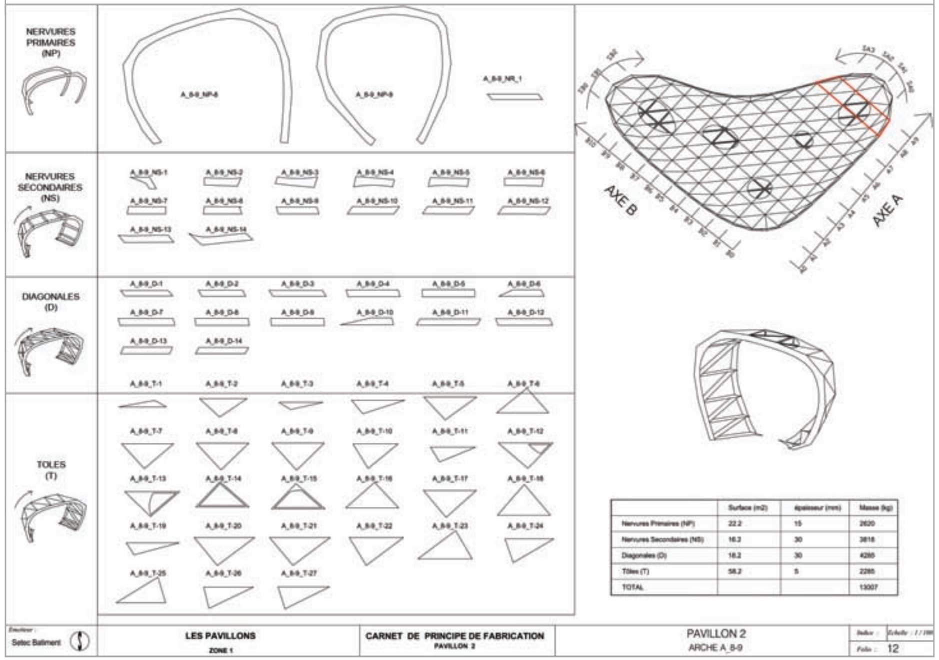
The KSU Sports Campus project is to provide an extensive addition to the sports facilities at the King Saud University, Riyadh, in the Kingdom of Saudi Arabia. The aim is to develop a Sports Campus with both teaching facilities and technical areas for sport. There is also a requirement to accommodate Conferrings (Graduation Ceremonies) and the ability to hold large sports events to National Standard - this includes the provision for events to be televised.

The Athletics Arena is a stand-alone building with a 200 m running track and facilities for high jump, long jump, shot put and pole vaulting, all in compliance with IAAF requirements. There is permanent spectator seating for approx. 6,700 around the running track, and for conferrings temporary seating of 2,700 is placed in the centre of the building, facing a stage. Spectator facilities are being provided on the concourses. VIP, family and spectator entrances are provided. Athletes' and media facilities are provided to allow for national events.









	Surface (m2)	épaisseur (mm)	Masse (kg)
Nervures Primaires (NP)	22.2	15	2620
Nervures Secondaires (NS)	16.2	30	3818
Diagonales (D)	18.2	30	4285
Tôles (T)	58.2	5	2285
TOTAL			13007

Pavillons

Le projet consiste à implanter 5 pavillons aux formes contemporaines qui jalonneront la promenade depuis la place jusqu'au bassin supérieur. Ces pavillons hébergeront des commerces haut de gamme.
Chaque pavillon a une forme unique déterminée par le tracé de la perspective au sol. Il s'agit d'une architecture aux formes libres. Les pavillons s'ouvriront par de larges vitrines sur la promenade intérieure. La structure des pavillons est constituée de coques métalliques nervurées qui peuvent être facilement montées sur place et démontées ultérieurement pour être réutilisées. Cette méthode de construction assure un chantier propre et rapide, parfaitement adaptée aux contraintes toutes particulières de ce site très sensible. L'ossature ainsi réalisée sera laissée apparente, constituant un élément intéressant de lecture de l'architecture à l'intérieur.

Setec Bâtiment a été missionnée pour réaliser :

- La conception géométrique (recherche et optimisation)
- La faisabilité du projet sur l'existant
- La conception de la superstructure

Un accompagnement de la genèse du projet

Dès l'esquisse nous sommes intervenus sur la conception géométrique et structurelle du projet. Nous avons utilisé Scia Engineer pour nous assister dans cette recherche d'options structurelles. La géométrie était générée avec Grasshopper et importée en élément poutres ou macro 2D dans Scia Engineer, ce qui a grandement contribué à la rapidité de modélisation. Une fois le système structurel choisi nous avons travaillé sur l'optimisation de la forme et du dessin géométrique des pavillons par rapport aux contraintes structurelles. Les efforts dans la structure sont très sensibles aux variations de courbures des pavillons. La maitrise de la descente de charge était primordiale pour ne pas apporter des surcharges ponctuelles non admissibles sur le parking existant.

Une géométrie complexe facilement modélisée

La géométrie de la structure a été conçue et rationalisée en utilisant Grasshopper de façon à faciliter la fabrication des coques et en réduire ainsi le coût. Toutes les nervures sont planes, seule leur découpe est courbe. Les différents modèles 3D ont été réalisés en important dans Scia Engineer les différents calques du fichier 3D.

Le calcul en zone sismique

Le projet se situe en zone de sismicité moyenne. Une étude du comportement de la structure sous sollicitation sismique a ainsi été menée. L'étude des fréquences propres de l'ouvrage montre que la réticulation de l'ossature assure une bonne raideur à la structure.

Une analyse de stabilité de l'ouvrage

La structure ayant une géométrie complexe, un calcul au flambement généralisé (linaire puis non linéaire) a été réalisé afin de valider la conception et optimiser la géométrie. Ainsi, l'analyse a été menée avec la prise en compte des déplacements des nœuds, de la déformée des barres ainsi qu'une imperfection globale imposée à la structure.

Une structure facilitant le montage et démontage

Les pavillons étant des ouvrages temporaires, il est prévu que la structure soit démontable puis re-montable sur un site différent, ce qui impose que la structure soit montée par blocs et assemblée par des boulons. Les coques en arches prévues continues dans la conception, sont amenées sur le chantier en 3 modules. L'encastrement entre ces modules étant caractérisé comme semi-rigide par l'Eurocode, des rotules flexibles ont été insérées dans le modèle de calcul.

Une conception indissociable de l'existant

L'interface avec l'infrastructure servant de fondations au pavillon nous a contraint à maitriser la descente de charges sur l'existant en adaptant judicieusement les conditions d'appuis de l'ouvrage. La flexibilité du logiciel a permis de tester facilement un grand nombre de disposition d'appuis ce qui nous a conduit à :

- Implanter un nombre limité d'appuis avec une rigidité élastique modélisant le comportement de l'infrastructure
- Définir le relâchement de certains degrés de liberté aux appuis sous charge permanente)
- Imposer un phasage dans le montage de la structure

Setec Bâtiment

Contact Victoire Saby, Carlos Noumedem, Clément Frecenon

Address 42-52 quai de la rapée CS71230
Immueble centrale Seine
75012 Paris, France

Phone +33 182516199

Email victoire.saby@batiment.setec.fr

Website www.batiment.setec.fr

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Setec Bâtiment : multidisciplinaire et innovant

Setec Bâtiment, qui compte environ 230 collaborateurs, dispose de compétences techniques fortes dans tous les domaines du bâtiment : de la structure, à la conception environnementale. Une intense collaboration dès le début des projets entre les différents services techniques en interne et aussi avec les acteurs extérieurs permettent la naissance de solutions intégrées et innovantes.

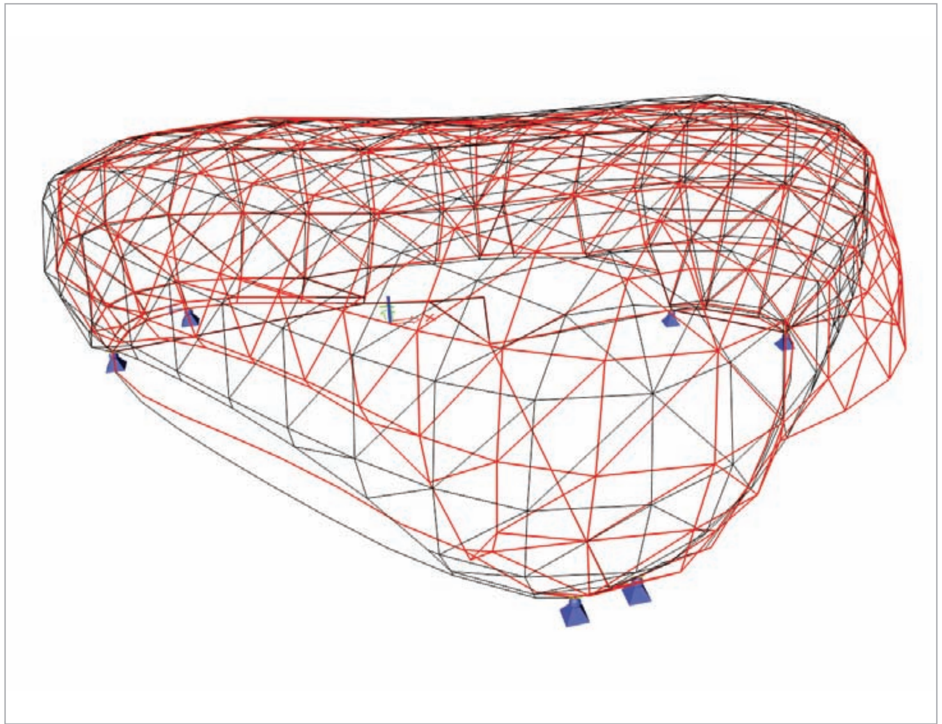
Project information

Owner	Confidential
Architect	Affine Design - Richard Martinet Architects
Engineering Office	Setec Batiment
Location	Europe
Construction Period	08/2013 to 09/2014

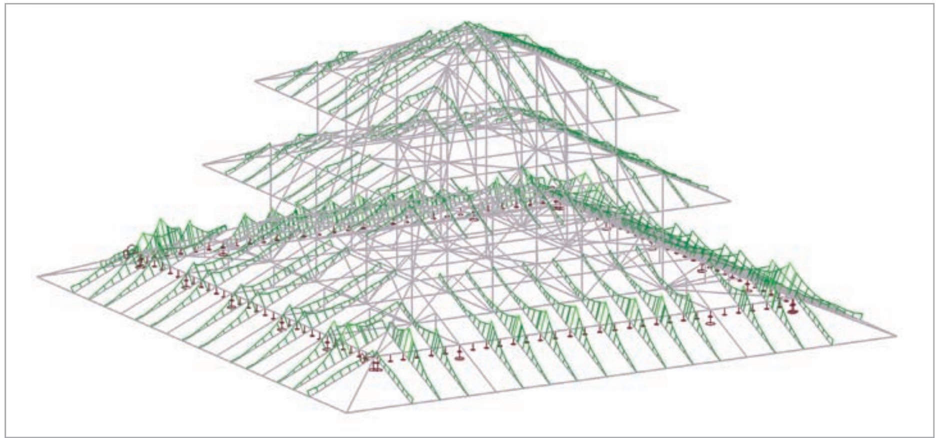
Short description | **Pavilions**

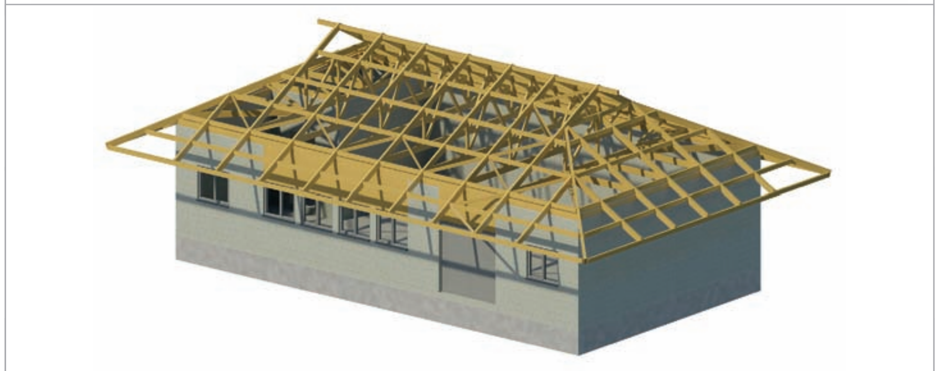
The project consists in the set up of 5 free-formed contemporary pavilions. They will punctuate the promenade that goes from the plaza to the upper pond. Each pavilion has a unique form deduced from the available ground perimeter. It is free from architecture (which abstracts from notions of wall and roof). The pavilions open up to the promenade through wide glazed facades.

The pavilions' structure is made of steel ribbed shells that can be easily assembled on site and then disassembled to be reused later on. This construction choice ensures a clean and dry construction site, which is perfectly adapted to the particular constraints of this very sensitive site. The achieved skeletal structure will remain visible, creating an interesting key to read the architecture from the inside. A similar geometry family is used for the construction of the pavilions' outer skin.



Chester Zoo “Islands” - Chester, United Kingdom





Project background
Chester Zoo is located in the north of England and is the most visited wildlife attraction in Britain, with around 1.4 million visitors per year. As part of the zoo’s Natural Vision Masterplan, it is in the process of creating one of the largest zoo developments in Europe. The new attraction, known as ‘Islands’, will showcase the zoo’s international conservation work and take visitors on a journey to the south-east Asian islands of the Phillippines, Papua New Guinea, Bali, Sumatra, Sumba and Sulawesi, immersing them in the sights, sounds and smells of these diverse and exotic cultures. Work on site is expected to begin in 2013 and be completed ahead of the 2015 summer season.

Structural design brief
The project required the design of a number of themed animal and visitor facilities, each reflecting the vernacular architecture of the island from which they originated. The main challenge of this project was therefore to devise cost-effective structural forms which retained the appearance and character of the traditional buildings (typically constructed using relatively primitive techniques) whilst satisfying the requirements of modern structural design codes and building regulations.

The intricate roof structures found on the islands of south-east Asia have been replicated using pitched timber roofs clad with artificial thatch or corrugated metal sheeting, with the walls of each structure typically featuring a co-ordinated palette of bamboo or timber rainscreen cladding. Since the design brief required that the internal space of each building be column-free where possible, a series of timber trusses have been integrated into the roof structures, allowing loads to be distributed to the supporting perimeter blockwork walls.

Use of Scia Engineer
The primary advantage of using Scia Engineer for this project was that it allowed the modelling, analysis and design of complex three-dimensional roof geometries which would have been difficult and time-consuming to assess by hand calculation. The roof structures were modelled as three-dimensional frames formed of one-dimensional beam elements, and assessed for a variety of permanent and variable loads, making use of Scia Engineer’s ability to generate relevant load combinations according to BS EN 1990 (Eurocode 0) and BS EN 1991 (Eurocode 1).

The design process also made extensive use of the new timber module in Scia Engineer, which allowed the rapid sizing and checking of members at both the ultimate and serviceability limit state according to BS EN 1995 (Eurocode 5). The ability to easily extract support reactions from the roof models saved considerable calculation effort and time when designing other aspects of the structures outside Scia Engineer, such as the supporting walls and foundations.

Finally, by exporting the analytical models from Scia Engineer to Autodesk Revit, the design intent for each structure could be clearly communicated to AECOM’s CAD technicians and provided a basis from which they could construct physical models of the buildings.

Software: Scia Engineer

AECOM

Contact Alan Carter, Joe Clifton, Steve Seddon
Address 1 New York Street
Manchester, United Kingdom, M1 4HD
Phone +44 1616011700
Email alan.carter@aecom.com
Website www.aecom.com

AECOM is a global provider of professional, technical and management support services to a broad range of construction and infrastructure markets. With approximately 45,000 employees around the world, AECOM is a leader in all of the key markets that it serves, providing a blend of global reach, local knowledge, innovation and technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments.

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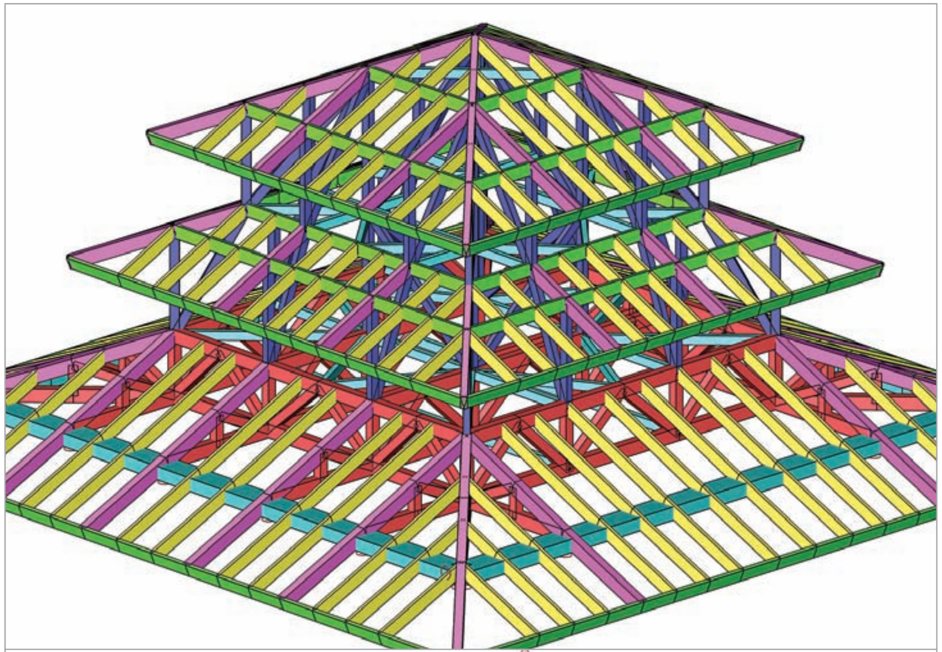
Project information

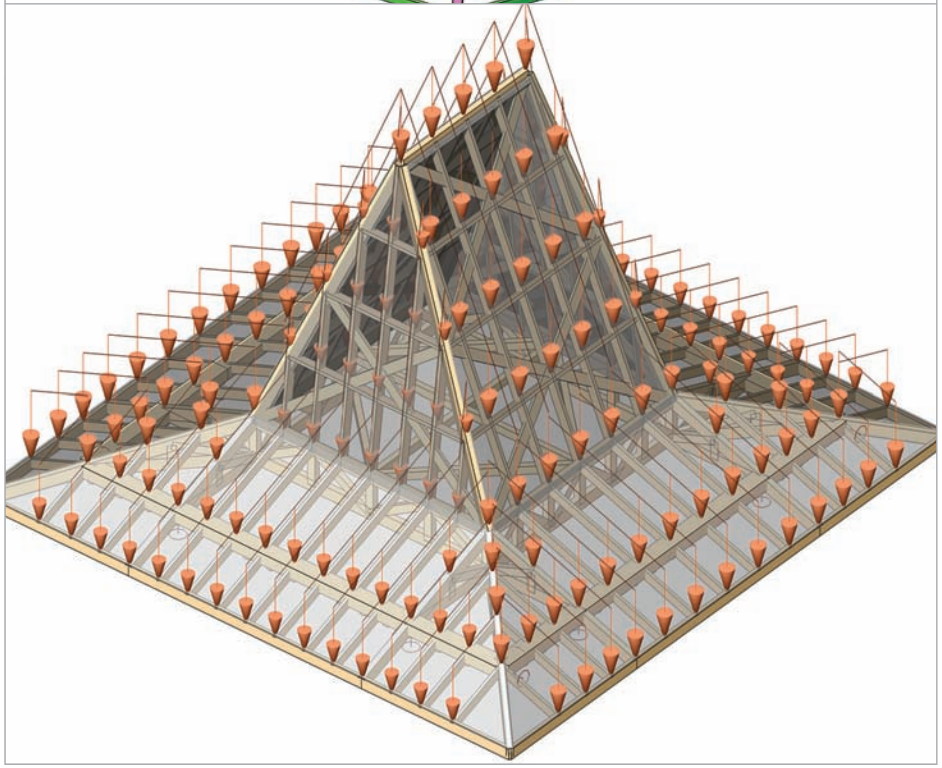
Owner	Chester Zoological Gardens
Architect	Dan Pearlman
Engineering Office	AECOM
Location	Chester, United Kingdom
Construction Period	06/2013 to 04/2015

Short description | Chester Zoo "Islands"

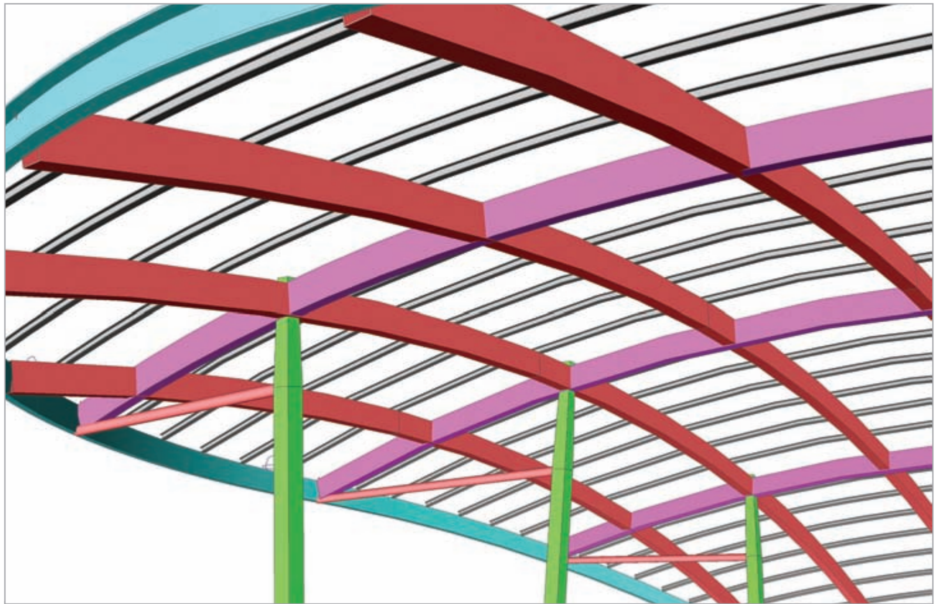
AECOM were appointed by Chester Zoo to provide the structural design for a number of themed animal enclosures and visitor facilities as part of their 'Islands' development. The new attraction will showcase the zoo's international conservation work and take visitors on a journey to the islands of south-east Asia.

As part of the design process, a number of complex roof structures have been modelled, analysed and designed as three-dimensional frames in Scia Engineer, making extensive use of the new timber module for sizing and checking members according to Eurocode 5.





Roof Structure Noorderpark Subway Station - Amsterdam, The Netherlands



Introduction

In the city of Amsterdam a new subway line is being created that connects the Northern part of Amsterdam with the Southern part. The line runs underneath the city centre, the central railway station and the waterway known as 'het IJ'.
One of the newly built stations is Noorderpark, located north of 'het IJ', where the subway emerges from underground. The station will be fitted with a glass roof structure supported by steel beams and girders.

Architectural Design

The design is provided by Benthem Crouwel Architects and consists of a transparent smooth roof surface of cold-bent glass. The bend line of the roof edge is characteristic. The vertical and horizontal curvatures follow the spatial structure of the station.

Stuctural Lay-out

The structural lay-out consists of main beams in the transversal direction, supported by slanted columns. The slanted columns provide the stability of the roof structure. The purlins supporting the glass, of which the spacing is adjusted to the size of the bent glass panels, are supported by long curved beams in the longitudinal direction.

Challenges

The complexity of the project mainly lies in the geometry. The roof is constructed by assembling different spherical shapes and intersection surfaces to create a completely smoothly curved surface in all directions. All this is done by an analytical approach to parameterise the design in such a way that the constraints given by the maximum size and repetition of the glass panels are always satisfied.

Another complicating factor was the substructure of the platforms and entrance plateau, already built and designed for the totally different former design of the roof structure.
Finally, considering the bended geometry in all directions, it was a tedious job to determine and input all the different windloads on the structure. Wind suction as well as wind pressure had to be taken into account for different wind directions and different parts of the structure.

Modelling approach

The shape of the roof was modelled with the modelling tools available in Scia Engineer to create spherical bodies. The final shape was then intersected by surfaces. In the intersections the steel beams and girders were modelled.
Finally, since many different combinations of forces at the supports were generated, a governing part of the already built substructure was modelled to check if any reinforcements were needed.

Optimisation

Since the structural design was parameterised from the offset and modelled in Scia Engineer, different variants for the geometrical shape as well as the used steel profiles could be analysed and compared quickly. Thus an optimal design in terms of shape, steel usage and ease of erection is reached, all tailor-made to the cost-effective usage of cold-bent glass.

Software: Scia Engineer

ARCADIS Nederland BV

Contact Meint Smith
Address Lichtenauerlaan 100
Postbus 4205
3006AE Rotterdam, Netherlands
Phone +31 10 2532 136
Email m.smith@arcadis.nl
Website www.arcadis.nl

ARCADIS is an international company that provides consultancy, design, engineering and management services in the fields of Infrastructure, Water, Environment and Buildings.
Our mission is to improve quality of life around the world by creating places of distinction and providing sustainable solutions that enhance the built and natural environments. In doing so, we produce exceptional value for our clients, employees and shareholders.

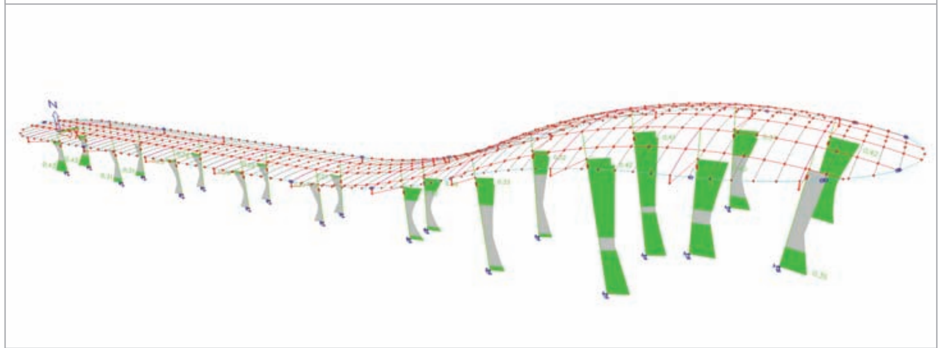
Our innovative structural engineering professionals strive to overcome the physical limitations of sites while also meeting the requirements of each project. The teams work with our in-house architects, as well as with clients directly, to develop solutions to the full range of structural needs, in many cases paving the way for the creation of new opportunities for the architect and project owner.

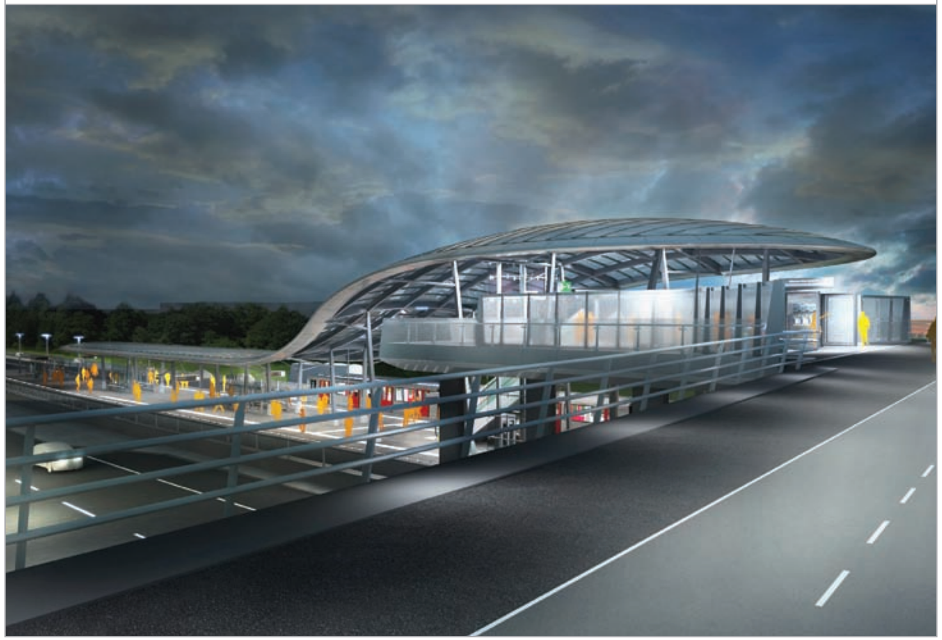
Project information

Owner	Municipality Amsterdam
Architect	Benthem Crouwel Architects
General Contractor	VolkerWessels Visser en Smit Bouw bv
Engineering Office	ARCADIS Nederland BV
Location	Amsterdam, The Netherlands
Construction Period	09/2013 to 12/2013

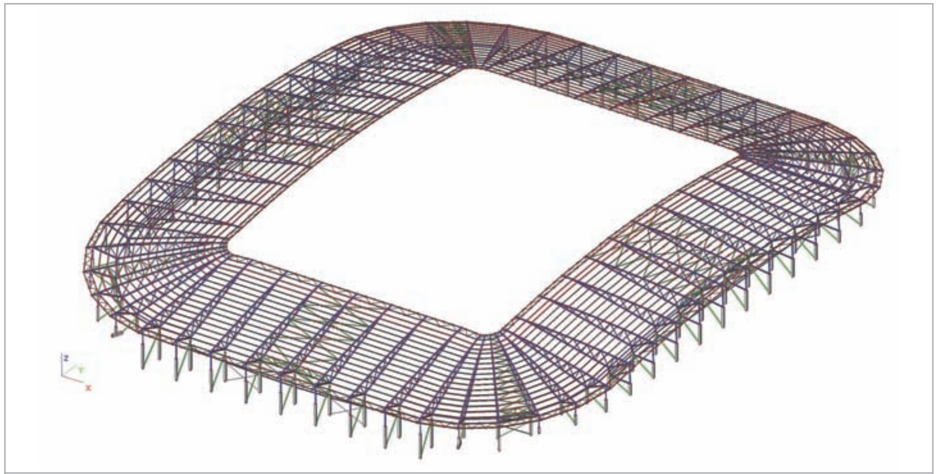
Short description | **Roof Structure Noorderpark Subway Station**

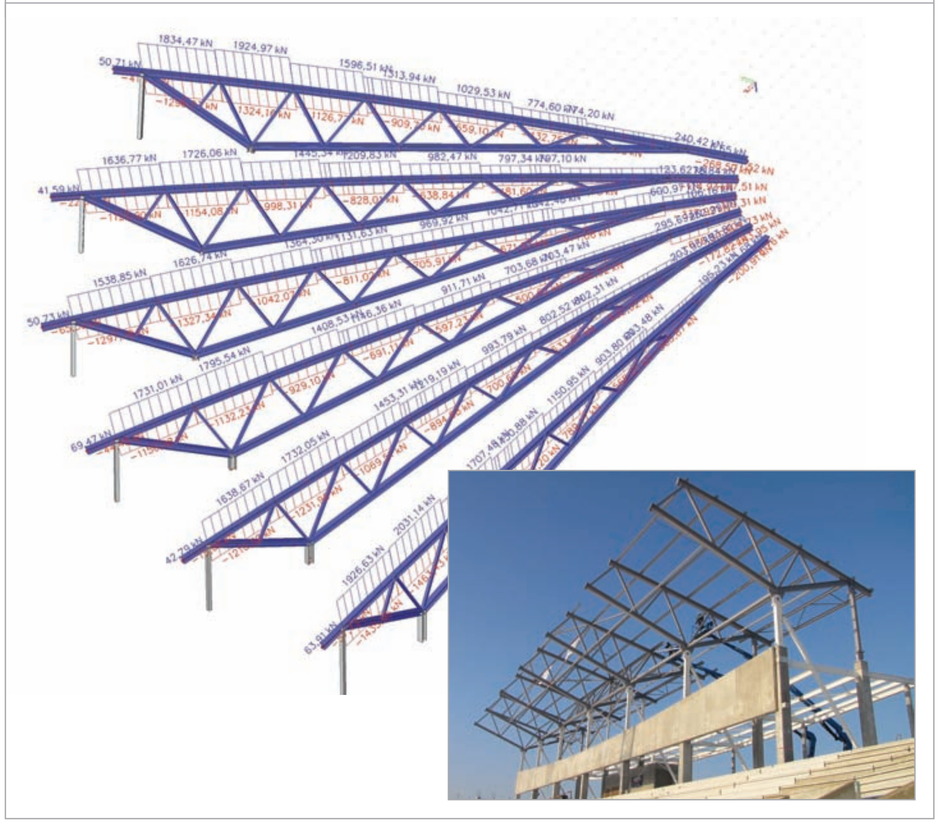
This project concerns the roof structure covering the newly built ‘Noorderpark’ subway station in the city of Amsterdam.
The main complexity of the project lies in the geometry, with the roof being constructed by assembling different spherical shapes and intersection surfaces to create a smooth curved surface in all directions.
The modelling tools of Scia Engineer were used to create the sperical bodies, intersect them with surfaces and to model the steel beams in the intersections.
A parameterised design of the roof structure made it possible to create an optimal cost-effective structure suited to the usage of bent glass, yet with a very attractive, transparent doubly curved smooth appearance.





Luifelconstructie Arteveldestadion - Gent, België





Voetbalclub KAA Gent bouwt het eerste stadion van de nieuwe generatie in België. Het Arteveldestadion is gelegen langs de Ottergemsesteenweg in Gent, strategisch op het kruispunt van snelwegen E40 en E17 en langs de R4 ringweg. Het stadion is het hart van een volledig nieuwe site, met een hotel, kantoorgebouwen en retail.

De nieuwe thuishaven van KAA Gent zal plaats bieden aan 20.000 toeschouwers en voldoen aan de recentste UEFA- en FIFA-normen. Een unieke wandelpromenade zal omheen het volledige stadion lopen, met toegang tot drank- en eetgelegenheden voor alle supporters.

Verder zijn ook de kantoren van de club geïntegreerd in het stadion, samen met de fanshop, skyboxen, business seats en lounge. Een groot gedeelte van het stadion zal ruimte bieden aan commerciële activiteiten en kantoren.

ASK Romein verwierf de opdracht om de stalen luifelconstructie boven de nieuwe tribunes te produceren en ter plaatse te monteren.

De eerste taak bestond erin de reeds ontworpen constructie verder te optimaliseren, binnen de randvoorwaarden gesteld door de architect en het studiebureau. Daarnaast dienden ook verschillende verbindingsdetails te worden uitgewerkt en berekend.

De luifel is opgebouwd uit 58 stalen vakwerkspanten verbonden door warmgewalste gordingen. Elk vakwerkspant rust via slechts twee steunpunten op de onderliggende prefab betonstructuur, waardoor een overkraging van 29 meter gerealiseerd wordt. De vakwerken worden gekenmerkt door een specifieke vorm, die het gevolg is van de architecturale vormgeving. De luifel volgt de tribunes volledig rondom het stadion, met een golvende beweging op de langste zijdes.

De belangrijkste belastingen op de luifel bestaan uit het gewicht van de dakbedekking, onderhoudslasten, sneeuw en wind. Bovendien is de luifelconstructie ontworpen voor een temperatuurbereik van -24°C tot +37°C. Hiervoor zijn uitzettingsvoegen voorzien in de vier hoeken van het stadion. De stabiliteit van het geheel wordt verzekerd door windverbanden in het dakvlak en verticale verbanden in de gevelvlakken.

In een eerste fase is een optimalisatie van het vakwerkspant uitgevoerd in een 2D-rekenmodel. Dit basismodel liet ook toe om een eerste inschatting te maken van de reactiekrachten die de luifel overdraagt op de onderliggende betonstructuur.

In een volgende stap is een volledig 3D-model opgebouwd, wat toeliet de gordingen verder te optimaliseren en de windverbanden te ontwerpen. De gebruiksvriendelijkheid van Scia Engineer maakte het mogelijk om op korte termijn een compleet rekenmodel op te bouwen. Ook de gebogen vorm van de dakstructuur kon met voldoende nauwkeurigheid gesimuleerd worden in de software.

Uit de resultaten kon een beter inzicht verkregen worden in de vervorming en doorbuiging van de luifel, waardoor de gepaste ontwerpmaatregelen konden genomen worden. De intuïtieve invoer van kniklengten in de software liet toe de knikcontroles van zowel de vakwerkspanten als de gordingen efficiënt en conform de Eurocodes uit te voeren.

Een belangrijk deel van de verbindingsdetails zijn ontworpen met behulp van externe rekentoepassingen. Hiervoor was het belangrijk om interne krachten en verbindingskrachten eenvoudig en correct te kunnen exporteren uit het model.

Een performante uitvoer van reactiekrachten maakte het uiteindelijk mogelijk om de steunpunten en verankeringen in de betonstructuur te dimensioneren.

Software: Scia Engineer

ASK Romein Malle NV

Contact Jeroen Van Minnebruggen
Address Ambachtsstraat 33
2390 Malle, Belgium
Phone +32 3 320 24 00
Email j.vanminnebruggen@ask-romein.com
Website www.ask-romein.com

ASK Romein gaat als gerenommeerde staal- en totaalbouwer geen uitdaging uit de weg. Van bedrijfsruimten tot uiterst complexe bouwwerken. ASK Romein ontwikkelt en realiseert graag ambitieuze projecten. Vanuit vestigingen in Malle (België), Roosendaal en Vlissingen (Nederland) bedenkt, ontwikkelt, ontwerpt, optimaliseert en realiseert ASK Romein projecten voor haar klanten.

ASK Romein is voor deze activiteiten werkzaam in volgende marktsegmenten:

- KMO (bedrijfspanden en kantoren)
- Logistiek en distributie, havenbedrijven
- Sport- en recreatiecomplexen
- Zware industrie (silo-ondersteuningen…)
- Productie- en procesgebouwen voor food en non-food
- Specials: parkeergarages, showrooms, koel- en vrieshuizen

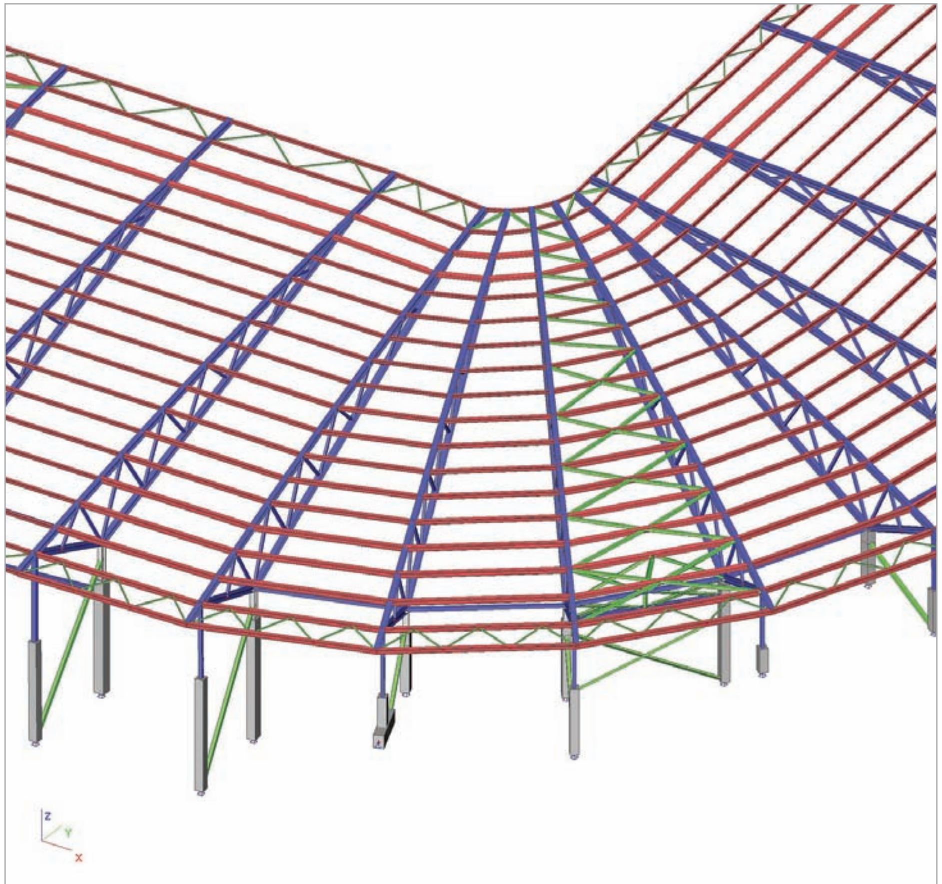
Project information

Owner	cvba Artevelde
Architect	Bontinck Architecture and Engineering
General Contractor	Ghelamco
Engineering Office	VK Engineering
Location	Gent, Belgium
Construction Period	01/2013 to 06/2013

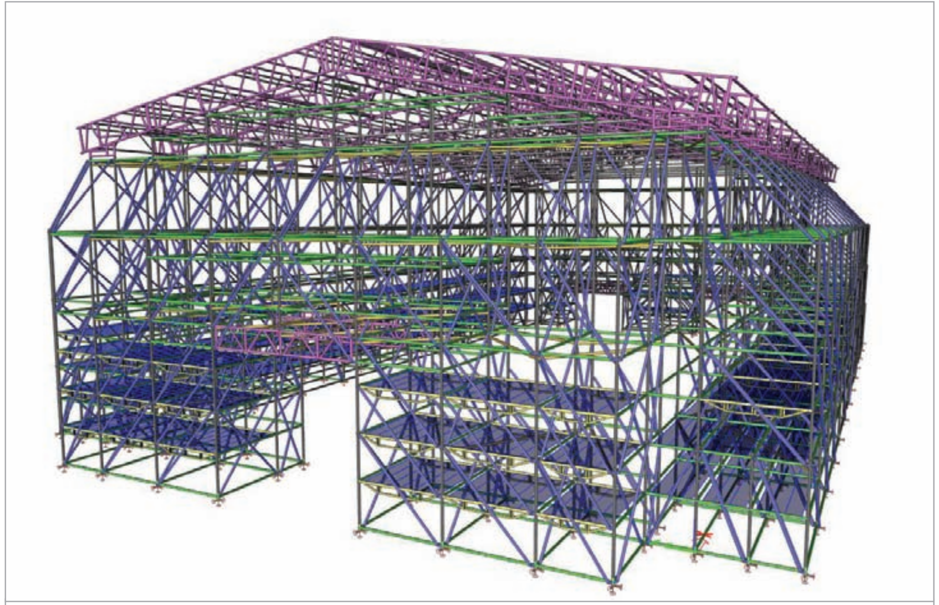
Short description | **Steel Roof Structure Artevelde Stadium**

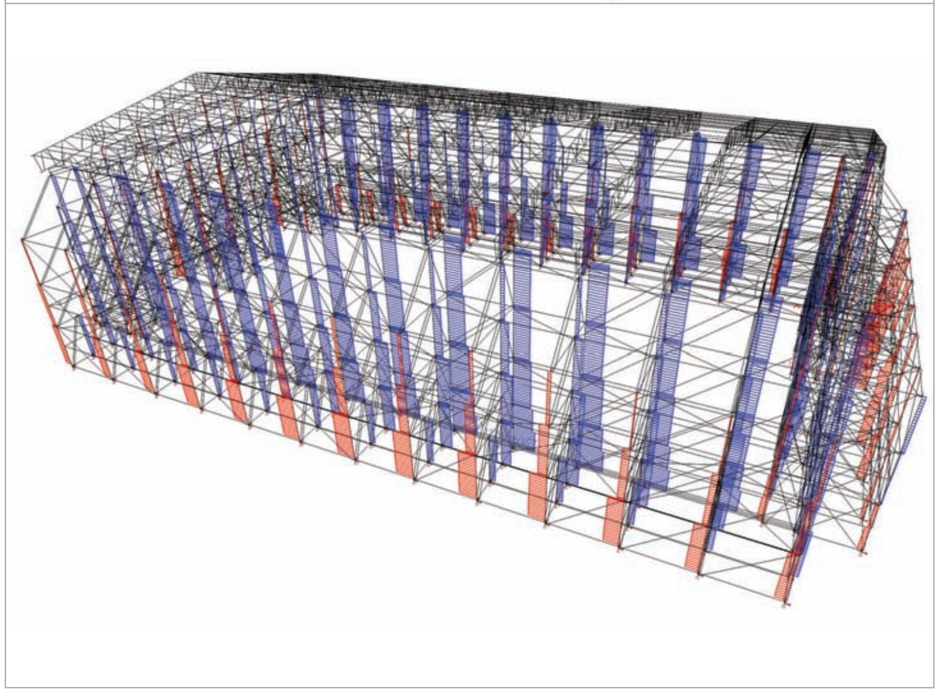
The Artevelde Stadium is the new state-of-the-art home stadium for KAA Gent. The steel roof structure consists of 58 trusses, with a cantilever span of 29 metres. ASK Romein was entrusted with the fabrication and mounting of the complete roof structure, including trusses, purlins and bracings. This task started with an optimisation of the roof structure.

Modelling and calculation of the roof structure was performed using Scia Engineer software. Straightforward input of loads and buckling settings were important key features. Deformation of the complex geometry was analysed and thermal effects were assessed. For the design of the steel detail connections, internal forces and connection forces were exported from the software to external calculation sheets.



Abris CEA Marcoule - Bagnol sur Ceze, France





Définition du besoin
Il s'agit d'une étude de faisabilité pour le CEA de Marcoule qui doit pouvoir effectuer des travaux sans répercussions sur l'environnement.

Des cuves enterrées doivent être sorties à la grue puis déposées sur un camion plateau qui devra pouvoir pénétrer dans l'abri. Les dimensions intérieures de l'abri sont donc conditionnées en fonction du plateau, des cuves et de la grue. Les dimensions extérieures sont quant à elles définies par l'emplacement des bâtiments voisins. L'abri doit donc faire 29 m x 13,5 m intérieur pour 34 m x 21 m extérieur avec une hauteur au faitage de 10,5 m.

Cet abri en structure d'échafaudage se situe sur un sol inaltérable et doit être en mesure de résister aux conditions climatiques du site sans aucun dispositif de fondation ou d'amarrage.

Modélisation et calcul
Scia Engineer nous permet de calculer la structure d'échafaudage selon les normes NF 12810 et NF 12811 ainsi que les Eurocodes mais également de déterminer la quantité de lest nécessaire à la tenue de la structure sous l'effet du vent.

Pour la modélisation, nous utilisons des rotules non-linéaires pour les connecteurs d'échafaudage ainsi que des appuis à frottement, déterminés par la nature du sol. Ces appuis sont également définis en compression seule car aucun dispositif ne les retient au sol.

La structure est calculée dans son ensemble afin de tenir compte de toutes les déformations pouvant engendrer des efforts dans les porteurs voisins.

Cela permet également d'affiner la répartition du lest sur l'ensemble de la structure.

Le modèle comporte 7.651 barres et 12.583 nœuds.
18 profils différents ont été utilisés.
Le calcul comporte 11 cas de charge combinés en 48 combinaisons non-linéaires.

La difficulté première repose sur l'uniformité des profils d'échafaudage, en effet nous sommes dans l'impossibilité d'avoir recours à des profils adaptés aux charges.
Les problèmes doivent obligatoirement trouver une solution géométrique qui permette la diffusion des charges pour les adapter aux profils et non l'inverse.

Il a donc fallu doubler un certain nombre de diagonales dans des directions bien définies et laisser certains pieds extérieurs se soulever lors des coups de vent afin de limiter les efforts dans les barres en retirant le surplus de lest.

Conclusion
COMI SERVICE, de par son expertise, son expérience et des outils adaptés tel que Scia Engineer, a su encore une fois relever un défi industriel pour lequel seul l'échafaudage peut convenir.

Avec la volonté de répondre selon les dernières normes en vigueur avec un calcul non-linéaire au plus proche de la réalité, COMI SERVICE prouve que le monde de l'échafaudage fait partie intégrante de l'ingénierie industrielle.

Software: Scia Engineer

COMI SERVICE

Contact Rémi MARTIN
Address Batiment A6 Europarc de Pichaury
13856 Aix les Milles, France
Phone +33 488783800
Email remi.martin@comi-service.fr
Website www.comi-service.com

Fondées en 1979, les COnstructions Métalliques de l'Isere lancent un département échafaudage en 1984 pour les besoins de la centrale nucléaire de Bugey. Puis en 1993, le fabricant de matériel d'échafaudage LAYHER rachète COMI qui devient COMI SERVICE.
En 2001 LAYHER cède COMI SERVICE au groupe POUJAUD qui devient ainsi leader français de l'échafaudage.
En 2012 le groupe ALTRAD entre dans le capital pour créer le groupe POUJAUD-ALTRAD puis rachète la totalité du groupe en 2013.

COMI SERVICE en quelques chiffres :

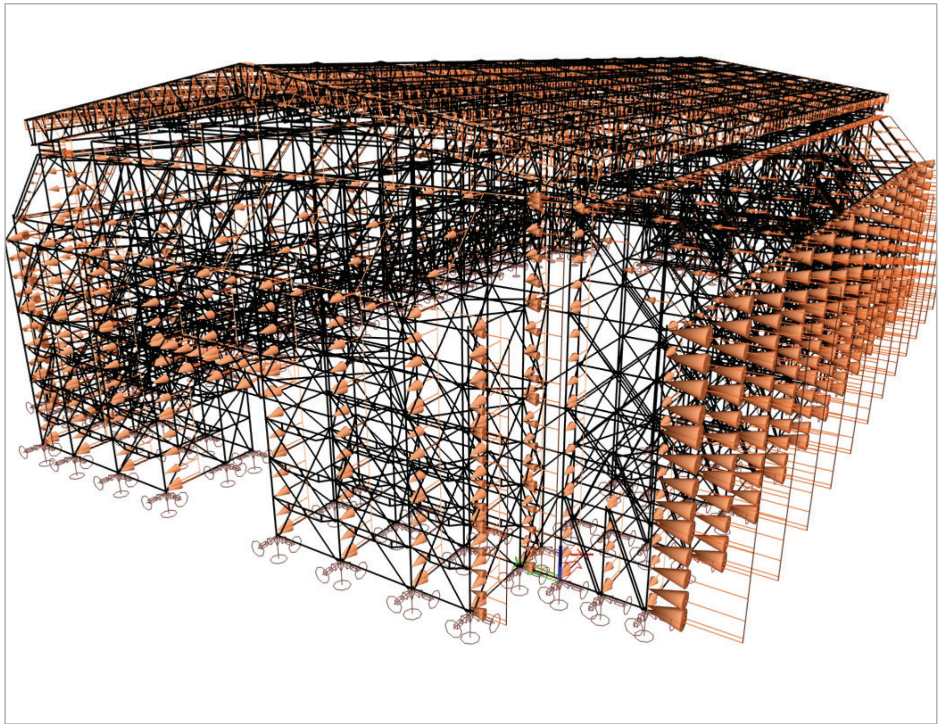
- 320 salariés en CDI.
- 50 M€ de CA en 2011.
- 7 agences opérationnelles réparties sur tout le territoire.
- Un parc de 10.000 tonnes de matériel.

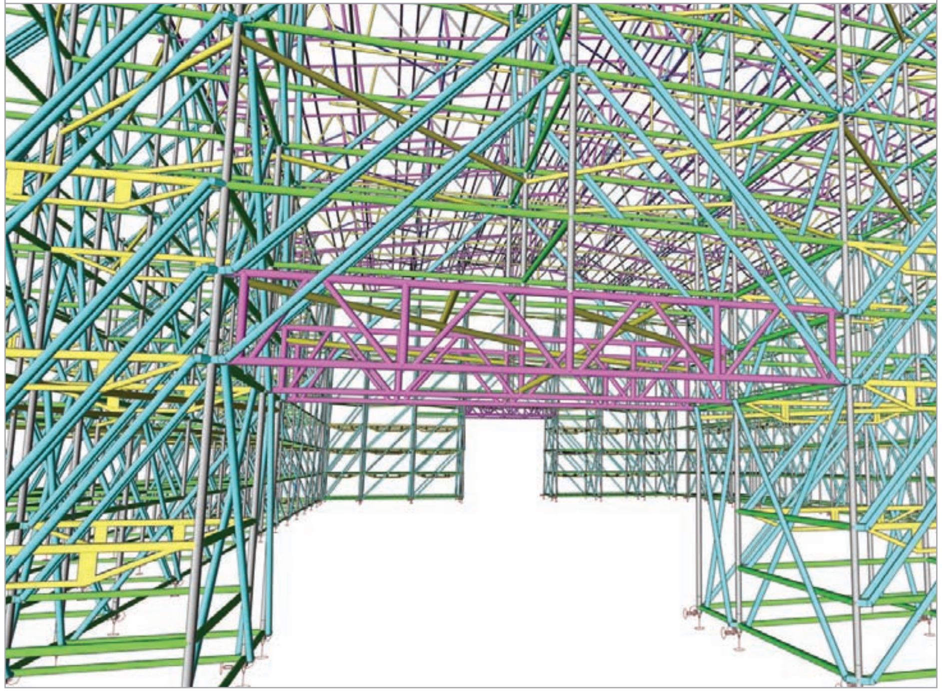
Project information

Owner	Onet Technologies Nuclear Decommissioning
General Contractor	EDF
Engineering Office	COMI SERVICE
Location	Bagnol sur Ceze, France
Construction Start	01/2014

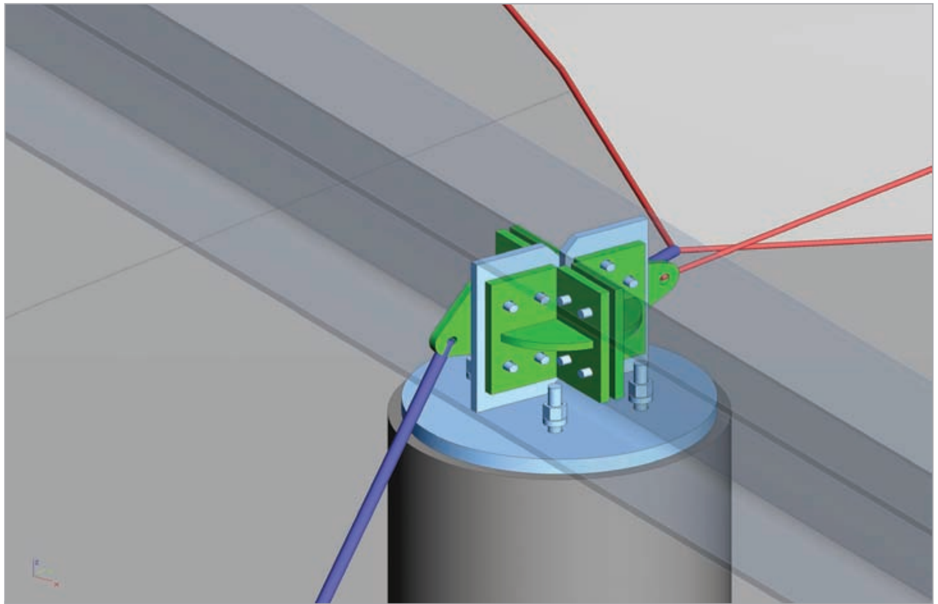
Short description | **Scaffold above a Nuclear Power Plant of Marcoule**

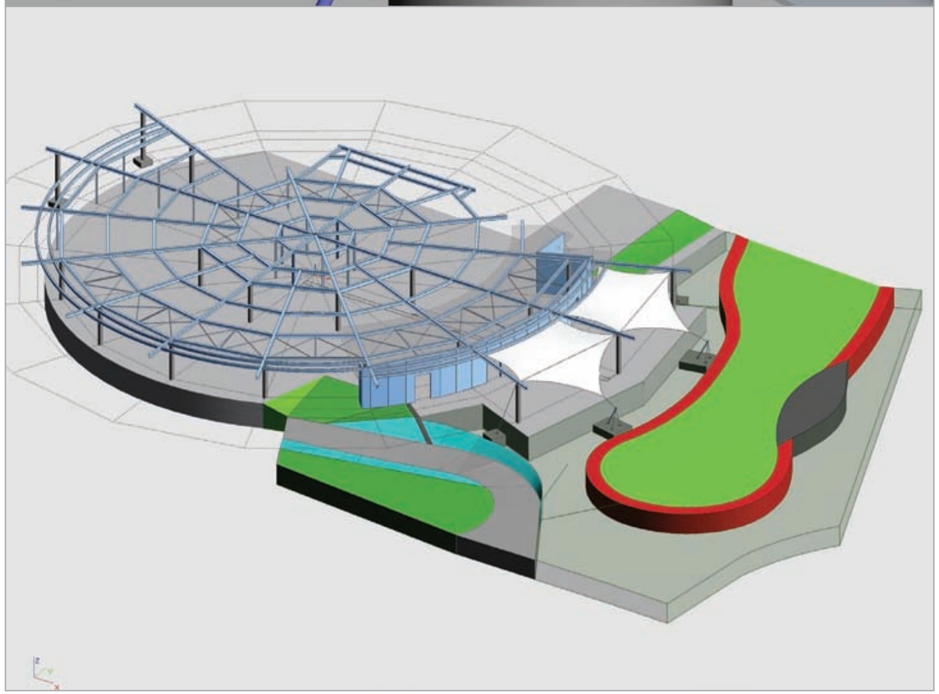
The project presents a shelter scaffold above a nuclear power plant of Marcoule in France.
During maintenance works on the power plant the underground tanks must be dug out and simultaneously the environment must be protected.
The internal dimensions of this huge shelter, consisting of about 7,600 structural members, are 29 m x 13.5 m and its stability is ensured solely by its self weight, no external anchorage is allowed.
Significant wind loads forced us to use ballast on the structure and to find suitable geometrical solutions for favourable distribution of stresses in the steel tubes.
The design was performed according to the Eurocodes and specific scaffolding codes.





Cafe Open Space Membrane Covering, BASF - Ludwigshafen, Germany





Client

BASF SE, the largest chemical company in the world, is headquartered in Ludwigshafen, Germany. The BASF Group comprises subsidiaries and joint ventures in more than 80 countries and operates six integrated production sites and 390 other production sites in Europe, Asia, Australia, the Americas and Africa. BASF has customers in over 200 countries and supplies products to a wide variety of industries.

BASF was founded on 6 April 1865 in Mannheim, in the German-speaking country of Baden, by Friedrich Engelhorn. He had been responsible for setting up a gasworks and street lighting for the town council in 1861. The gasworks produced tar as a byproduct, and Engelhorn used this for the production of dyes. BASF was set up in 1865 to produce other chemicals necessary for dye production, notably soda and acids. The plant, however, was erected on the other side of the river Rhine at Ludwigshafen because the town council of Mannheim was afraid that the air pollution of the chemical plant could bother the inhabitants of the town. In 1866 the dye production processes were also moved to the BASF site.

Order

It was planned to renew the environment around the plant cafe building in Ludwigshafen and the open space in front of the cafe with many tables and seats that had to be protected from the summer sun.

Two variants of membrane covering - permanent as a cone and temporary as five-point anticlastic sail - were developed, integrated into the environment with the existing buildings and presented.

The temporary five-point sail solution - only for the summer time - was chosen.

Software and modelling:

The given surroundings with the existing cafe structure were built up in Scia Engineer with the Structure and 3D-Free-Modelling tools. The environment with the appropriate part of the site structure was exported as DWG/DXF to the form finding software - Formfinder - to find and adjust the required form and then to Forten Software for the membrane design.

The results of the formfinding and membrane calculations were imported back in Scia Engineer to design the support steel structure, anchors, edge/corner details and foundation. All membrane reactions on the existing steel beams and regular loads were set in Scia too so that the additional load for the site building could be verified. The fully detailed structure was developed in one 3D model to be able to consider every distance and height in 3D-Space precisely.

All the overviews, elevation, execution and detail drawings were processed and created in Scia Engineer with the help of the appropriate modelling and drawing tools.

Execution

The covered area of the two anticlastic twin membrane parts amounts to approx. 320 sq m and gives sufficient sun protection for all the open space cafe places. Soltis86 from Ferrari, Italy, was used for the covering.

The steel beams of the existing structure received newly designed anchor details. Four new foundation blocks - two with tension rods and two with steel bracing units - were created. Additional tension rope was spanned between the tops of the columns to achieve sufficient stability during assembly. The planning was completed by April 2011. The first assembly took place at the end of May and lasted about 4 hours.

The production and execution were managed by the company Planex Technik in Textil GmbH LU, Germany.

Software: Scia Engineer

Dipl. - Ing. S. Ryklin STATIK

Contact Sergej Ryklin
Address Liselottestrasse 17,
D-69123 Heidelberg, Germany
Phone +49 6221 830973
Email statik@ryklin.de
Website www.ryklin.eu

STATIK
Dipl.Ing. S.Ryklin

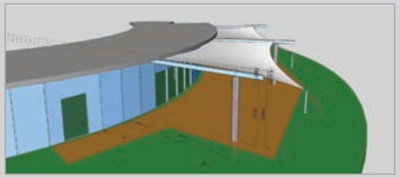
Sergej Ryklin - Born in 1963 in Moscow
1981-1985: Civil Engineering; “Bridges/Tunnels”; Since 1993: Structural designer and verifier at “Römhild & Hecker” Consulting Engineers in Landau, Germany; Since 1997: Structural designer; 2008-2009: Master’s Study at the Institute for Membrane and Shell Technologies, Anhalt University of Applied Sciences, Germany
Range of Capacity: Planning and optimisation of steel, aluminium, solid, composite, timber and membrane structures; Project consultancy; Building physics calculations; Dynamics calculations, Project verification
Philosophy: Flexibility in planning due to integral 3D design with the ability to find feasible and low-cost solutions from the draft stage on.
Experience: Residential and industrial buildings, parking spaces, pedestrian bridges, swimming pools, silos, membranes...
References: Daimler, John Deere, SAP, DB...

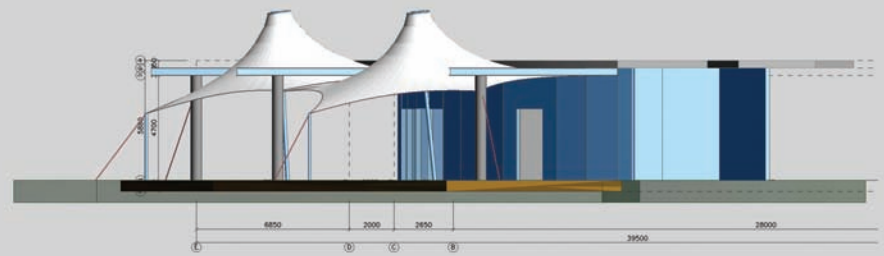
Project information

Owner	BASF Ludwigshafen
Architect	Dipl. - Ing. S. Ryklin STATIK
General Contractor	Planex Technik in Textil GmbH
Engineering Office	Dipl. - Ing. S. Ryklin STATIK
Location	Ludwigshafen, Germany
Construction Period	10/2010 to 05/2011

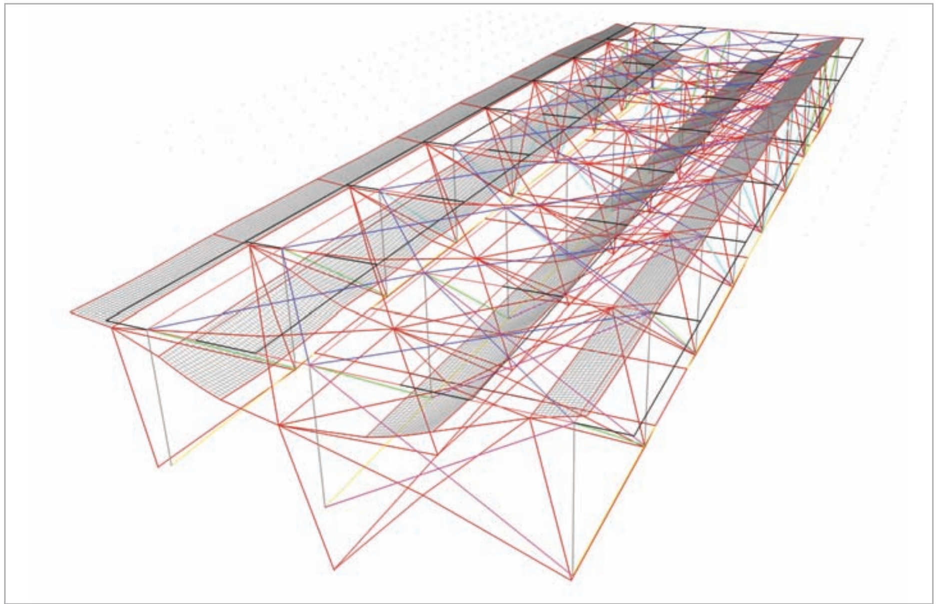
Short description | **Cafe Open Space Membrane Covering, BASF**

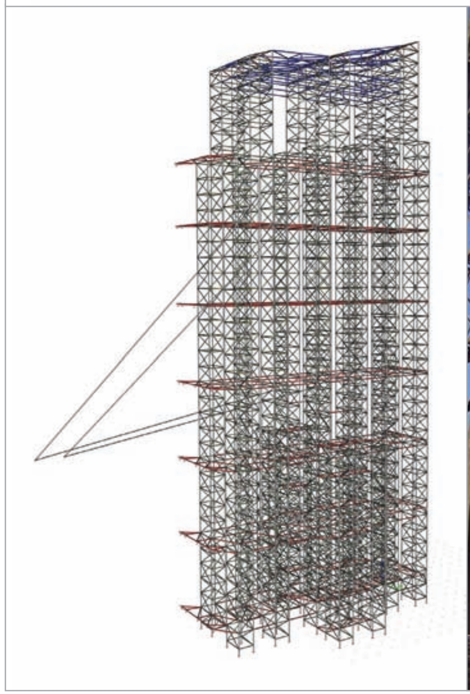
According to the renovation of the environment around the plant cafe building by the BASF chemical company in Ludwigshafen Germany, the open space in front of the cafe with many tables and seats had to be sun protected. The temporary solution with two twin five-point sails - only for the summer time - was chosen. The given surroundings with the existing cafe structure were built up in Scia Engineer using Structure and 3D-Free-Modelling tools. The environment with appropriate parts of the site structure was exported as DWG/DXF to the form finding software - Formfinder - to find and adjust the required form and then to Forten software for the membrane design. The results of the formfinding and membrane calculations were imported back in Scia to design the support steel structure, anchors, edge/corner details and foundation. The fully detailed structure was developed in one 3D model to be able to consider every distance and height in 3D-Space precisely. The production and execution were managed by the company Planex Technik in Textil GmbH LU, Germany.





Shoring Structure for a Cement Transportation System - Nordeste, Brazil





Characterisation
In this project an exceptional structure was used: a 40-m-high tubular tower, 48 mm diameter posts, diagonals and bars, stiffened by spatial tubular trusses with the diameter of 48 mm coupled with the towers by braces; composed of eight stayed cables with the diameter of 12.7 mm.

Modelling technique and analysis
For the first phase of the analysis, a model of the transporter structure was made using finite elements of bars and plates simulating the frames of the steel and carrier base. The model was loaded with self-weight, wind and live load, and then submitted to a linear static analysis. The support of the first structure was defined between this structure and adjacent steel columns - the support could be changed if necessary, depending on the transporter maintenance needs, as well as the beam support that makes the transition between the transporter and the shoring towers.

The reactions of this first model were then transferred to a second numerical model that simulated the behaviour of the shoring structure, composed of tubular towers, frames and stayed cables. This model was loaded with self-weight and wind. The geometric imperfections derived from the assembly phase were considered on the model according to the national standard code.

The second numerical model was submitted to a static analysis, geometric non-linear, using the Newton-Raphson method for the solution to the equations.

About Scia Engineer
Scia Engineer was the best solution found to attend to our focus: scaffolding structures connected with infrastructure and industrial projects. The main benefit was accurate results and fast and easy modelling. Scia Engineer ensured a new level of quality and precision of scaffolding projects, which allowed for efficient and cheaper projects.

References:

NBR 15696 - Formas e escoramentos para estruturas de concreto; ABNT.

NBR 6123 - Forças devido ao vento em edificações; ABNT.

NBR 8800 - Projeto de estrutura de aço e de estrutura mista de aço e concreto de edifícios; ABNT.

NBR 14762 - Dimensionamento de estruturas constituídas por perfis formados a frio; ABNT.

ESTUB NE12/142; Projeto de montagem; autores: Ronaldo Cisneiros e Josemar Carlos; Estub Sistemas Construtivos, filial Recife.

Análise Numérica e Experimental da Estabilidade de Torres Tubulares de Escoramentos; Dissertação de mestrado; autor: Celuos Alves; Estub Sistemas Construtivos Ltda, filial Rio de Janeiro.

Software: Scia Engineer

Estub Grupo João Mendes

Contact	Celuos Alves
Address	Av. Brazil, 20.101 Coelho Neto 21515-000 Rio de Janiero, Brazil
Phone	+55 21 2472-7200
Email	celuos@estub.com.br
Website	www.estub.com.br

In 1969, the engineer João Ricardo Mendes returned from France to revolutionise the way to design and build tubular structures. The engineering concepts acquired during the years of study, combined with work experience in the largest company in the French sector, were essential to transform his office into one of the most respected companies in the industry.

Founded in Recife in October 1969, Estub was a pioneer in the development of tubular structures. In 1975 a partnership with Entrepose started that lasted about 12 years and allowed to bring to Brazil a bit of European technology, which has been carefully adapted to the reality of the internal market.

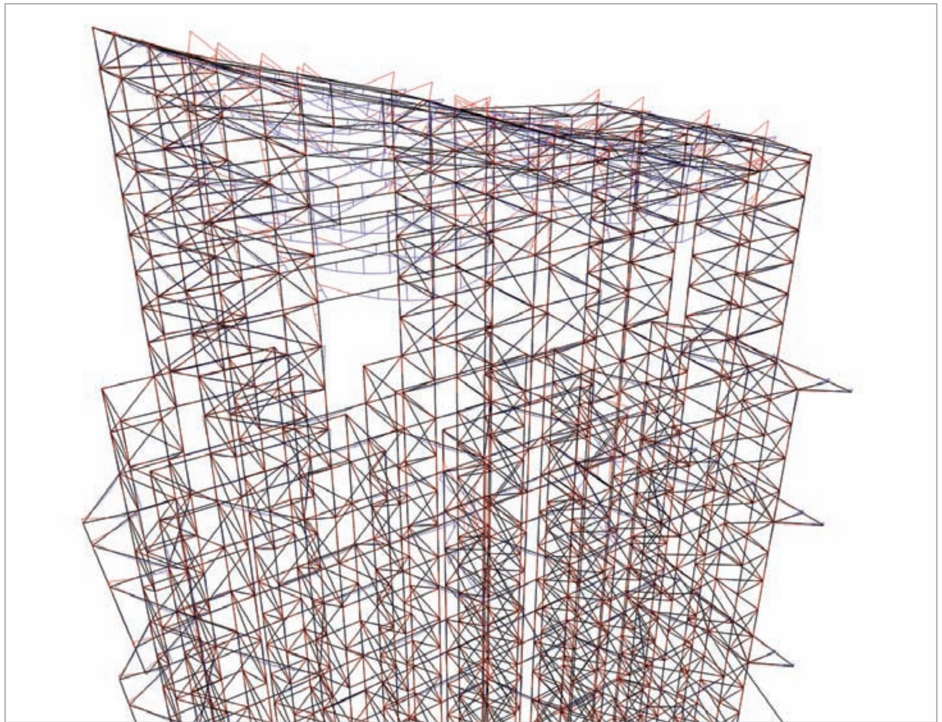
Through large projects such as subways, dams and bridges, the brand could be consolidated by demonstrating technical and executive competence.

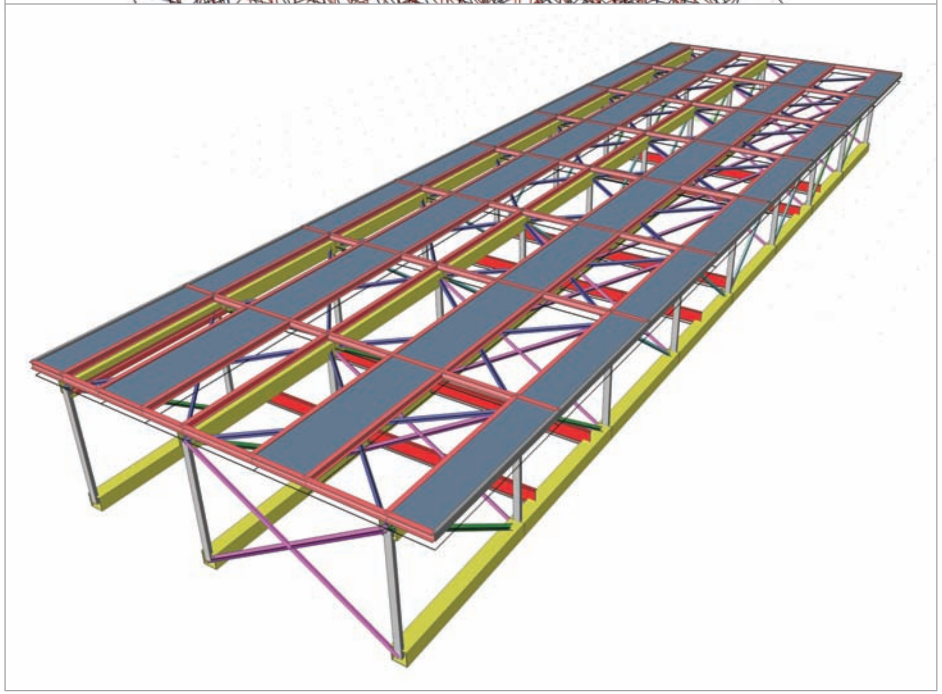
Project information

Owner	Cement Manufacturer Company
Architect	Estub Sistemas Construtivos
General Contractor	Cement Manufacturer Company
Engineering Office	Estub Sistemas Construtivos
Location	Nordeste, Brazil
Construction Period	10/2012 to 02/2013

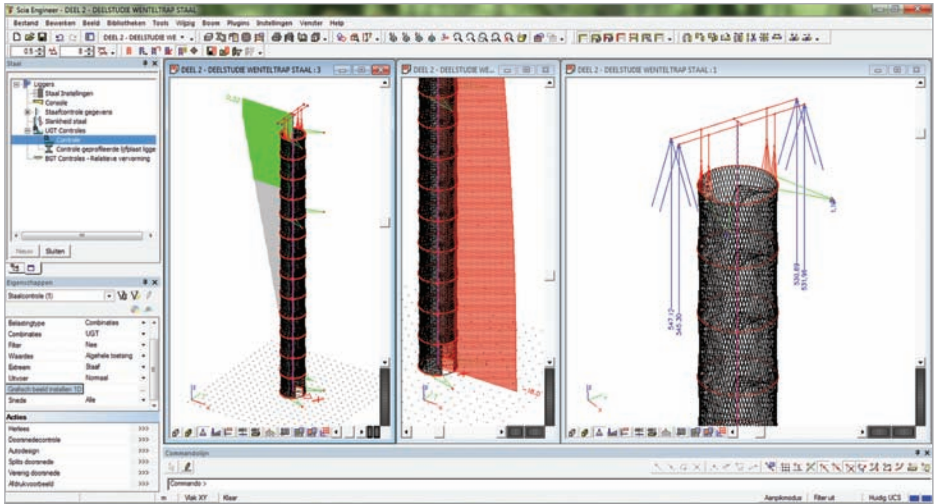
Short description | Shoring Structure for a Cement Transportation System

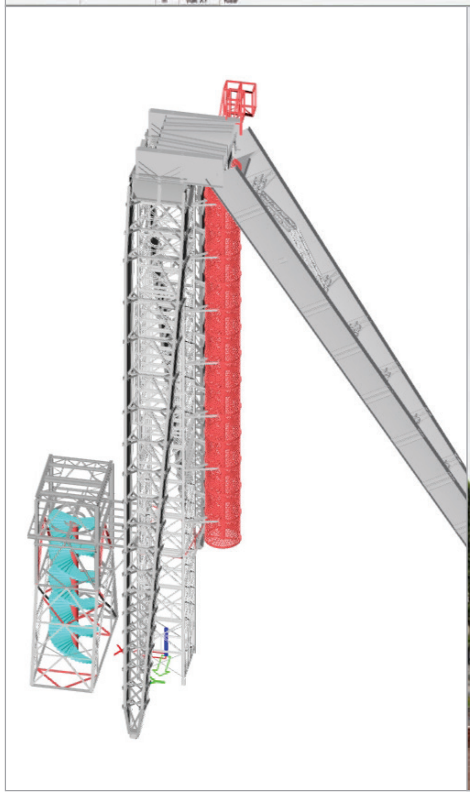
In this project an exceptional structure was used: a 40 m-high tubular tower, 48 mm diameter posts, diagonals and bars, stiffened by spatial tubular trusses with the diameter of 48 mm coupled with the towers by braces; composed of eight stayed cables with the diameter of 12.7 mm.
Scia Engineer was the best solution found to attend to our focus: scaffolding structures connected with infrastructure and industrial projects. The main benefit was accurate results and fast and easy modelling. Scia Engineer ensured a new level of quality and precision of scaffolding projects, which allowed for efficient and cheaper projects.





C-Mine Expedition - Genk, België





De reconversie van de mijnsite van Winterslag moet de gehele site nieuw leven inblazen. C-mine, het cultuurcentrum in de oude machinezalen is tegelijk het vertrekpunt om de gehele omgeving te gaan verkennen.

Vanuit C-mine vertrekt ook C-Mine Expeditie. Dit avontuurlijk belevingsparcours laat de bezoeker onderweg kennismaken met elementen uit het mijnverleden, en de ervaringswereld van het ondergrondse. Via o.a. de ventilatietunnels, en de gangen waarlangs de kompels naar de lift liepen, wordt de jongste en hoogste schachtbok van Vlaanderen beklommen. Het weidse uitzicht staat sterk in contrast met de beleving van het ondergrondse.

Na de afdaling duikt de wandeling opnieuw de grond in, om via een nieuwe verbindingstunnel de bezoeker weer tot bij het vertrekpunt in het machinegebouw te brengen.

Door C-Mine Expeditie krijgt de schachtbok een nieuw leven en een nieuwe betekenis. De uitdaging van het ontwerpteam lag erin om nieuwe structuurelementen met de oude te verweven, met maximaal behoud van het geklasseerde bouwwerk.

Om de beklimming van de schachtbok mogelijk te maken, is een eerste deel tot 15 m boven de grond, uitgevoerd in beton. Door balkvormige prefabelementen telkens 9° geroteerd te stapelen en finaal na te spannen, werd een draaitrap bekomen die langs twee zijden gebruikt kan worden. De ene kant wordt voor de stijgende bezoekers gebruikt. Op de terugweg gebruikt men de andere kant.

Om het tweede deel van 15 tot 60 m te beklimmen, werd een stalen wenteltrap opgehangen aan de schachtbok. Stalen modules van tussenbordes tot tussenbordes, werden stuk voor stuk, van bovenaf naar beneden gemonteerd. Voor de verticale lasten werkt de centrale as. De horizontale en torsiestijfheid werden bekomen door een raster van profielen aan de buitenzijde. Het uitzicht van een visfuik was het resultaat.

Het ontwerpteam

- NU Architectuuratelier: ontwerp
- L-Groep Architectenbureau: uitvoering
- Grontmij Belgium nv: engineering

Gebruik van Scia Engineer

De studie verliep gefaseerd. In een eerste fase werd op zoek gegaan naar een basismodel van de bestaande structuur. Op basis van de originele bouwplannen van omstreeks 1960, werd profiel per profiel gemodelleerd. Verscheidene gebruikte profieltypes horen niet meer tot de hedendaagse standaard, wat een extra uitdaging vormde om toch tot een zo waarheidsgetrouw mogelijk startmodel te komen.

Vervolgens werd het ontwerp van de nieuwe structuren hieraan toegevoegd, om de globale effecten van de nieuwe belastingen, zoals de personenbelasting, maar ook de gewijzigde windbelasting, te onderzoeken.

De speciale modules die hierbij gebruikt werden, waren:

- Geom. niet-lineair (2-de orde) raamwerken
- Niet-lineariteit
- Initiële vervormingen en kromming
- Stabiliteit (algemene knikvorm)

Vervolgens werden de nieuwe stalen elementen in afzonderlijke modellen bestudeerd ter optimalisatie van geometrie, profielkeuzes en detaillering. Voor de betonnen trap werd de module “Gewapend beton balken en kolommen” aangewend.

Conclusie

Scia Engineer heeft het mogelijk gemaakt om in het ontwerpproces vanuit een gedetailleerd basismodel van de bestaande constructie, de effecten (zowel visueel als technisch) van verschillende variante concepten op een relatief snelle manier te kunnen beoordelen.

Foto’s: Stijn Bollaert

Software: Scia Engineer

Grontmij Belgium

Contact Ronny Engelen
Address Herckenrodesingel 101
3500 Hasselt, Belgium
Phone +32 11 260870
Email ronny.engelen@grontmij.be
Website www.grontmij.be

Grontmij is een multidisciplinair advies- en ingenieursbureau voor duurzame infrastructuur en mobiliteit; industrie, water en energie en planning en ontwerp. Vanuit een toekomstgerichte visie geven wij kwalitatief advies en realiseren we creatieve ontwerpen en projecten. Samen met en dicht bij onze klanten uit het bedrijfsleven en de overheid, willen we waarde creëren en werken we aan totaaloplossingen. Wij doen dat met respect voor onze klanten, onze omgeving en het milieu.

Onze visie: Grontmij creëert waarde voor haar klanten, haar medewerkers en haar aandeelhouders. Wij realiseren projecten met bijzondere aandacht voor economische aspecten, innovatie en duurzaamheid.

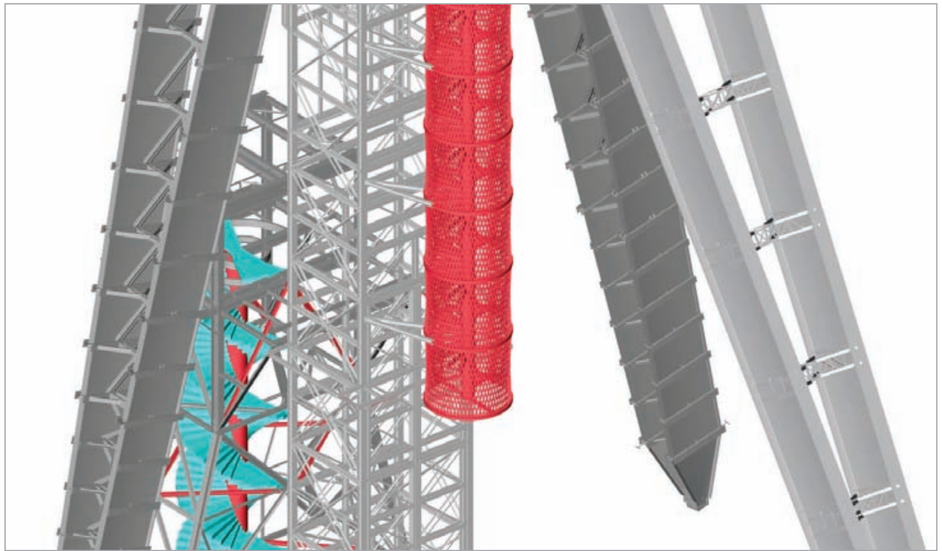
Onze missie: We willen het beste duurzame advies- en ingenieursbureau zijn in Europa. We plannen een duurzame toekomst voor en met onze klanten.

Project information

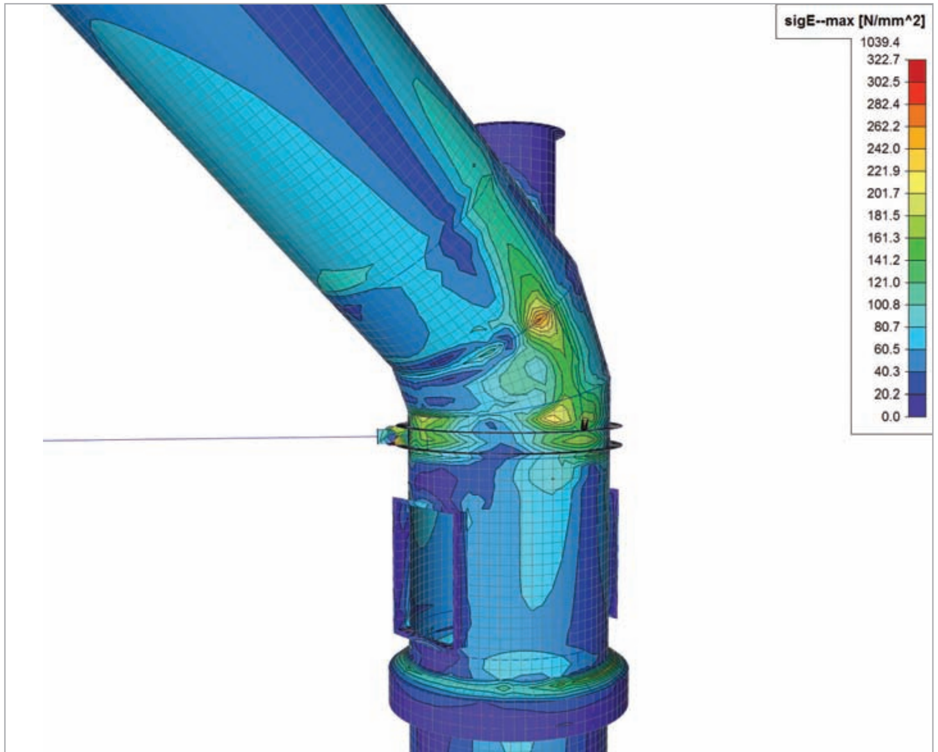
Owner	Stad Genk (B)
Architect	NU Architectuuratelier, Gent (B)
General Contractor	Algemene Onderneming Driesen nv, Overpelt (B)
Engineering Office	Grontmij Belgium nv
Location	Genk, Belgium
Construction Period	08/2009 to 03/2012

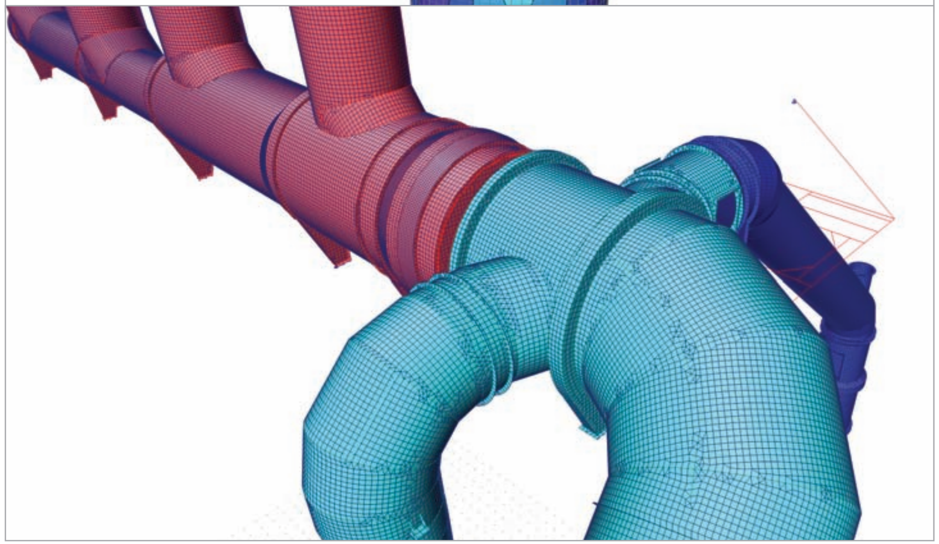
Short description | **C-Mine Expedition**

As part of C-Mine Expedition, a new life for the shaft tower on the mining site of Winterslag (Genk, Belgium) has been created by designing winding staircases.
Scia Engineer made it possible in the design process, starting from a detailed model of the existing historical structure, to analyse the effects from different concept ideas for the new elements so as to ultimately reach the ideal balance between modern architecture and monumental value.



Instandsetzung und Überarbeitung der Entstaubungsleitung - Georgmarienhütte, Deutschland





Projektbeschreibung
Das vorhandene Entstaubungssystem wurde 1994 im Zuge des Gleichstrom-Lichtbogenofens herge-stellt und soll in Teilbereichen im Sommer 2013 modernisiert werden. Die Anlage besteht im ersten Teil aus einer Direktabsaugung, bestehend aus den dampfgekühlten Bauteilen:

- Klappstück
- 135° Bogen
- Konus
- Brennkammer mit Nachbrennkammer und halbautomatischem Staubaustrag mittels Schieber
- Schräge
- Bogen R 4.500 mm mit Spülöffnung
- Waagerechte mit Revisionsöffnungen
- Bogen R 2.000 mit Spülöffnung
- Schiebemuffe auf dem Verdampfungskühler stehend

An diese Bauteile schließt der Verdampfungskühler und die Entstaubungsleitung DN 2000 mit Drallkörper an. Die Entstaubungsleitung DN 2000 wird nach dem Dachdurchtritt außerhalb der Ferti-gungshalle bis an das Kopfstück herangeführt. Unter dem Verdampfungskühler befindet sich ein Staubaustrag in eine Mulde.

Der zweite Teil der Anlage dient zur Entstaubung der Fertigungshalle (Rauchschiff) und besteht aus einem 3-fach abgestuften Rohr.

Der dritte Teil der Anlage ist die Kaltluftzufuhr, diese dient zur Stabilisierung des Entstaubungsprozesses und dem Schutz der Filterschläuche.

Im ersten Teil des Entstaubungssystems befindet sich eine Messbühne um Temperatur und die Zusammensetzung des Abgasstromes zu ermitteln. Diese Messwerte werden an den Leitstand übermittelt und die Stellung der Regelklappen angepasst. Die Messbühne ist an der Giebelwand des Gebäudes befestigt und hat keine Verbindung mit der Entstaubungsleitung, hierdurch werden schädigende Einflüsse auf die Entstaubungsleitung vermieden.

Gleichzeitig werden die Lagerungsbedingungen des ersten Teils des Entstaubungssystems geändert. Infolge der Temperaturausdehnung der Entstaubungsleitung, es treten maximale Temperaturen von 250°C auf, wird oberhalb des Daches eine zusätzliche horizontale Abstützung vorgesehen. Das Kopflager der Entstaubungsleitung DN 2000 ist in Längsrichtung verschieblich und wird durch Knaggen in Querrichtung stabilisiert. Zur Aufnahme der Verformungen in Längsrichtung der Entstaubungsleitung befindet sich hinter dem Kopflager ein Kompensator.

Am Ende der drei Leitungen befinden sich Regelklappen um den Querschnitt über Stellmotore in un-terschiedliche Öffnungspositionen fahren zu können. Im Kopfstück werden die drei Leitungen zur Entstaubungsleitung DN 4000 zusammengefasst und über den Hof zur Entstaubungsanlage geführt.

Im ersten Teil des Entstaubungssystems befindet sich zur Druckentlastung direkt hinter dem Drallkörper eine Druckentlastungsklappe. Zur Abgasführung außerhalb des Hallenbereiches wird ein zusätzlicher Kanal als Gasleitsystem vorgesehen. Jeweils zwei weitere Druckentlastungsklappen befinden sich im senkrechten Bereich oberhalb des Daches und im waagerechten Kopfbereich der Entstaubungsleitung DN 2000.
Die Entstaubungsleitung DN 2000 und die Rauchschiffabsaugung DN 4000 erhalten im Bereich des Kopfstückes zusätzliche Mannlöcher zur Revision der Regelklappen und des Kompensators. Um einen Absturz von Personen zu verhindern, werden vor den schrägen Bereichen der Entstaubungsleitung DN 2000 und DN 4000 Absturzsicherungen vorgesehen.

Unterschiedliche Abgastemperaturen, Unterdruck und äußere Belastungen aus Wind und Schnee bilden die hauptsächlichen äußeren Belastungen, Abrasion und Abgasstrom die inneren Belastungen. Die statische Berechnung soll eine Modernisierung mit Regel- und Druckentlastungsklappen herbeiführen und das Lagerungskonzept optimieren. Alle im Außenbereich befindlichen Komponenten werden im Sommer 2013 erneuert. Hinzu kommt noch ein Kanal als Gasleitsystem mit Druckentlastungklappe direkt nach dem Drallkörper, die Messbühne, Horizontalabstützung und die Anpassung der Kopfbühne an die geänderten Lagerungsbedingungen der Entstaubungsleitung.

Software: Scia Engineer

GSG Georgsmarienhütte Service Gesellschaft mbH

Contact Reinhard Mesker
Address Neue Hüttenstr. 1
49124 Georgsmarienhütte, Germany
Phone +49 5401/394808
Email reinhard.mesker@gmh.de
Website www.gmh-holding.de, www.gmh.de

Georgsmarienhütte
GmbH · seit 1856 · Edelstahl

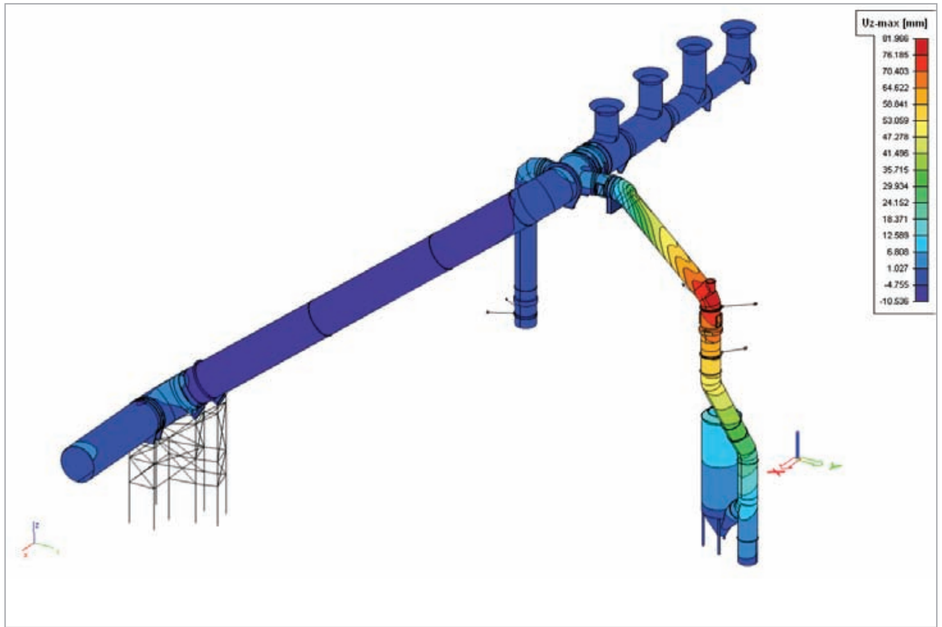
Die Georgsmarienhütte GmbH zählt zu den führenden europäischen Anbietern für Stabstahl, Halbzeug, Rohstahl und Blankstahl aus Qualitätsstahl und Edelbaustahl. Bei der Stahlerzeugung im Gleichstrom-Elektrolichtbogenofen kommt ausschließlich aufbereiteter, sortierter Stahlschrott zum Einsatz.
Stahl aus der Georgsmarienhütte wird überall dort eingesetzt, wo die Belastung am größten ist, wo Kraft erzeugt oder übertragen wird und wo Sicherheit eine Rolle spielt. Unser Stahl hält ein Auto in Bewegung: Unsere Kunden fertigen Kurbelwellen, Pleuel, Nockenwellen, Antriebswellen, Getriebeteile, Fahrwerksteile und vieles mehr. Neben der Automobilindustrie und deren Zulieferern liefern wir Stahl für Ketten, Maschinenbauteile und Hydraulikkomponenten sowie Rohblöcke für Freiformschmieden. Umfangreiche Informationen können der Internet-Seite der Georgsmarienhütte GmbH (www.gmh.de) entnommen werden.

Project information

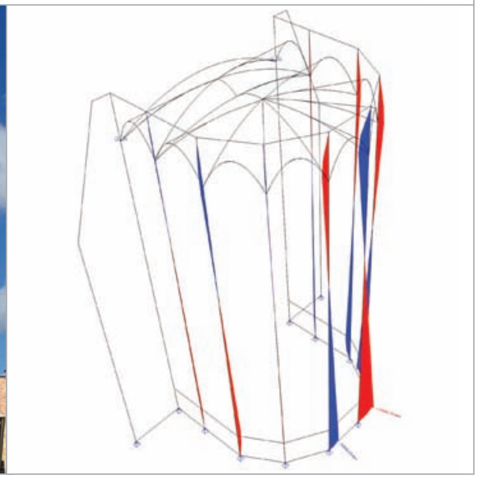
Owner	Georgsmarienhütte GmbH
Architect	Georgsmarienhütte GmbH
General Contractor	Georgsmarienhütte GmbH
Engineering Office	GSG - Georgsmarienhütte Service GmbH
Location	Georgmarienhütte, Germany

Short description | **Repair and Revise of Dust Collection Line**

The main reason for the static calculation for the dust removal duct was the modernisation of the shutting and depressurising flap and the renewal of the concept of supports. The three suction lines (electric arc furnace, roof converter and cold line) fused to a cross and the 4,000 mm duct. Every line can be closed by a shutting flap. Several compensators absorb the temperature lengthening and movements of the duct. All outside parts of the duct will be renewed in summer 2014.



Etude de Stabilité du Choeur de la Collégiale Saint-Denis - Liège, Belgique



Dans le cadre d'un projet de construction, il a été demandé aux étudiants d'étudier la stabilité du chœur de la collégiale, c'est-à-dire des fondations, des colonnes et des voûtes car des désordres structurels ont été constatés (fissures, chutes de morceaux de stucs, déplacements importants de parties de la charpente ...).

Examen des désordres

Un élément de décoration en stuc appartenant à la rosace du chœur est récemment tombé. Ce type d'élément était un témoin placé par les bâtisseurs de cathédrales pour signaler tout mouvement structurel, il était donc important d'identifier si le système structurel présentait un risque de ruine ou non.

Les autres désordres visibles dans les voutes ou colonnes étaient :

- La présence de fissures dans les voûtes ;
- Le mauvais état de certains plombs maintenant les vitraux ;
- La présence d'une fissure horizontale dans deux colonnes.

Au niveau de la charpente du toit, les désordres suivants ont été constatés :

- Des chevilles sorties de leurs gonds ;
- Une rupture au niveau des fixations tenon- mortaise de la croix de Saint-André coté droit ;
- Un jour du côté droit et aucun jour du côté gauche, à l'endroit de la jonction avec la nef.

Hypothèse

L'examen de l'historique des transformations subies par l'édifice a permis d'identifier un problème possible : lors de la transformation du chœur d'origine romane en chœur gothique, deux colonnes ont été positionnées hors des fondations d'origine. La fondation d'origine ayant tassé pendant 300 ans, un tassement différentiel au niveau de ces deux colonnes était une hypothèse à vérifier.

Etude

La partie la plus hardue du travail a consisté à modéliser la géométrie des voutes situées au dessus du chœur par des éléments coques.

Les colonnes ont été modélisées par des éléments 1D de type poutre. Les murs et contreforts ont été modélisés par des voiles 2D. Les appuis ont été considérés comme des rotules en pied de colonne, excepté sous les deux colonnes suspectées d'avoir tassé où des appuis à ressort ont été placés pour permettre un déplacement imposé.

L'analyse des résultats après tassement des deux colonnes montre qu'effectivement le moment est maximum dans les colonnes là où les fissures sont constatées et que les contraintes dans les voutes sont maximales là où le témoin de stuc s'est détaché.

Conclusion

Cette étude reste bien sûr un travail d'étudiants, réalisé pendant un temps très court (l'équivalent de 2 jours de travail) et les résultats mériteraient d'être vérifiés ou confirmés par des professionnels, mais l'utilisation de Scia Engineer a cependant permis de simuler un comportement qui pourrait expliquer certains désordres constatés sur la structure réelle et a permis aux étudiants de se rendre compte de l'utilité d'un tel outil.

Software: Scia Engineer

HELMo Gramme

Contact Philippe Boeraeve
Address 28, quai du Condroz
4031 Angleur, Belgium
Phone +32 4 340 34 30
Email p.boeraeve@helmo.be
Website www.helmo.be

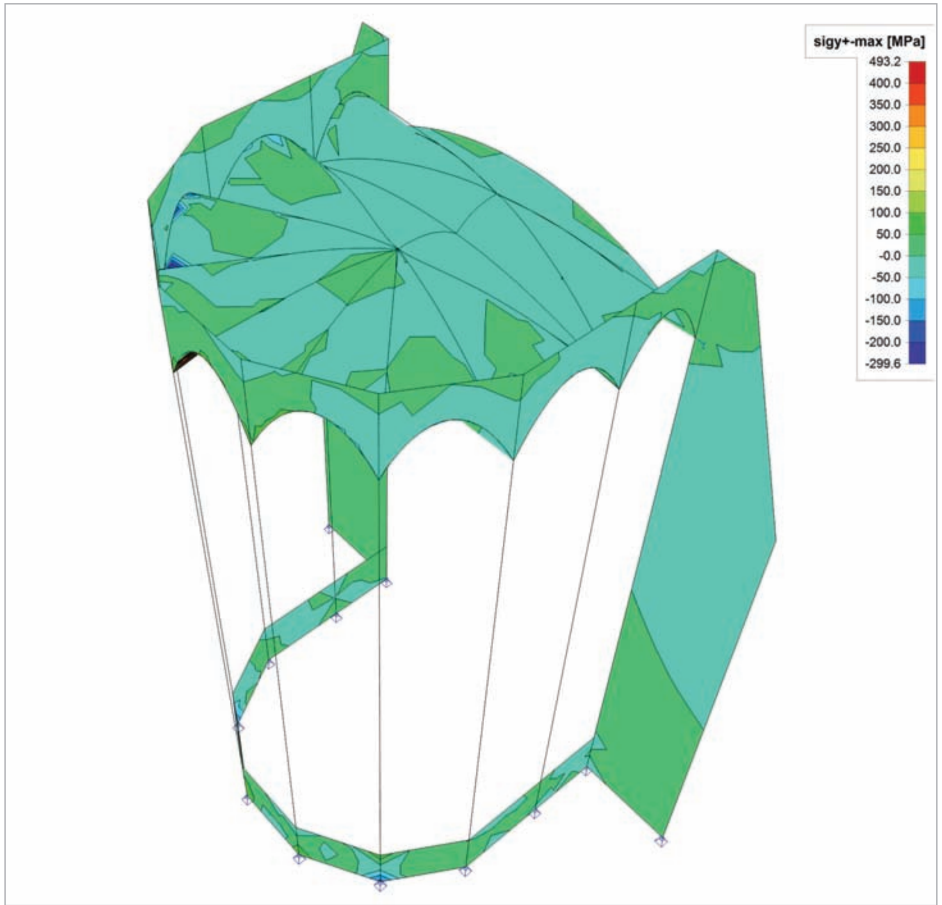
HELMo Gramme propose des études de type long débouchant, au terme des 5 ans, sur le diplôme de master en sciences de l' ingénieur industriel .
Ces études d'ingénieur industriel sont un audacieux mélange de sciences de l'ingénieur (mathématique, physique, chimie), de sciences appliquées (mécanique, électricité, thermodynamique, …), de cours techniques (informatique, dessin, technologie, …) et de cours généraux (anglais, économie, philosophie, …). De cet étonnant cocktail naît un ingénieur industriel rationnel et polyvalent, apte à résoudre de multiples problèmes dans l'industrie dans laquelle il ne tarde pas à apporter sa plus-value. Mais cette polyvalence est surtout pour l'ingénieur de HELMo Gramme un atout incontournable qui lui permet, le cas échéant, de réorienter plus facilement sa carrière dans un autre secteur de l'industrie

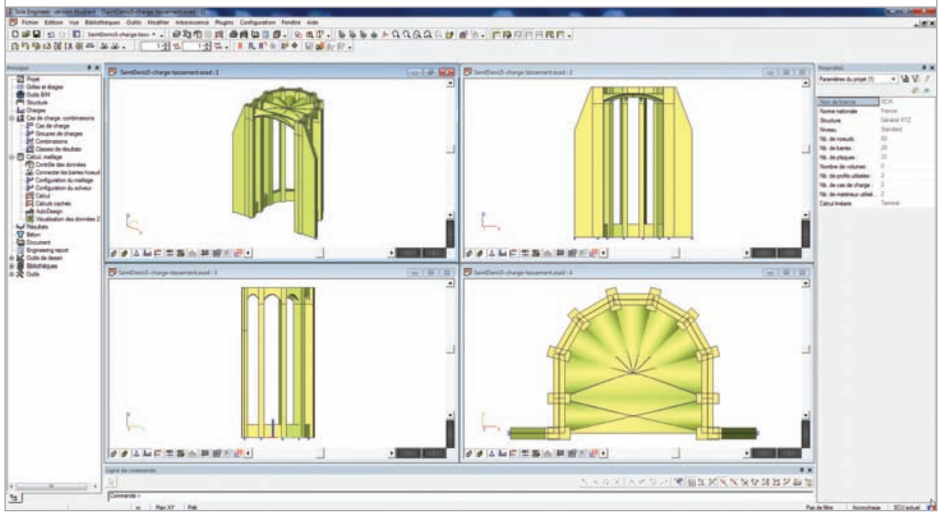
Project information

Owner	Fabrique d'église Saint-Denis
Engineering Office	None (Schoolwork done by students)
Location	Liège, Belgium
Construction Period	01/2013 to 01/2014

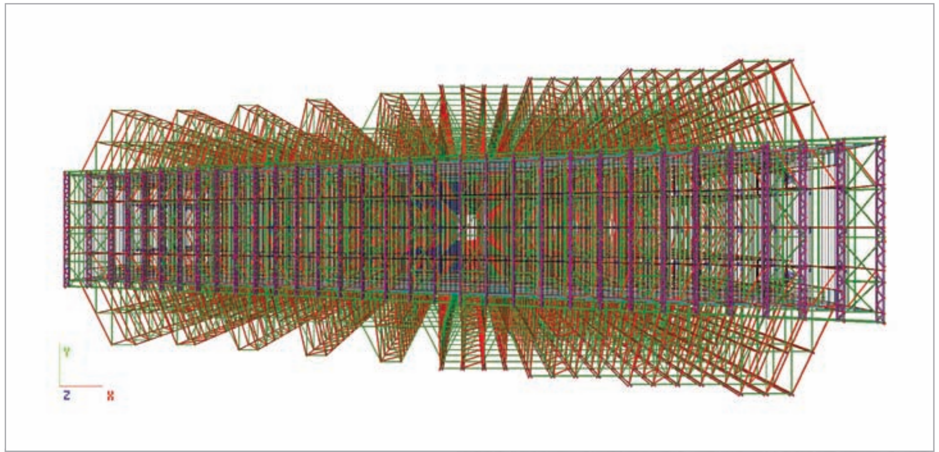
Short description | Stability Study of the Gothic Choir of the St-Denis Church

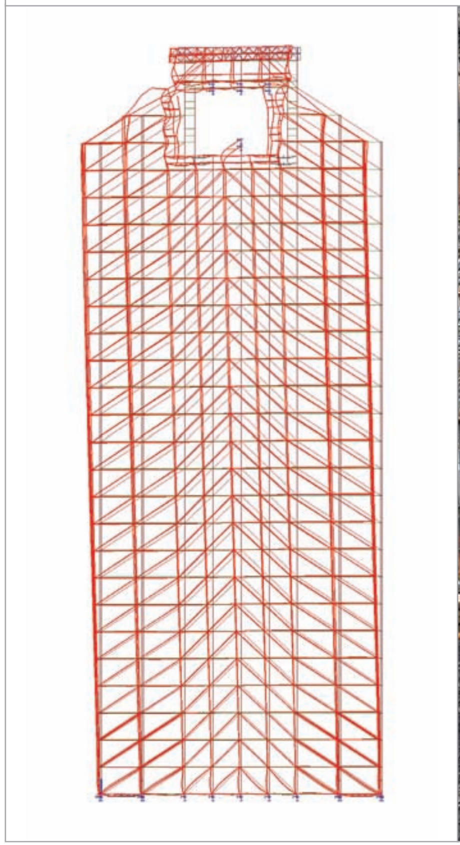
The work was carried out by 4 engineering students who wanted to explain some visible disorders (cracks, fallen stucco, abormal displacements in the roof frame…) in the gothic choir of the St-Denis church in Liège. They tried to find out the reasons for these disorders and used Scia Engineer to verify their hypothesis. Their study showed that their hypothesis of a differential settlement at the base of two columns could explain the disorders. This settlement could have been caused when the Romanesque choir was changed into a Gothic choir and the two mentioned columns were built aside the original Romanesque foundation.

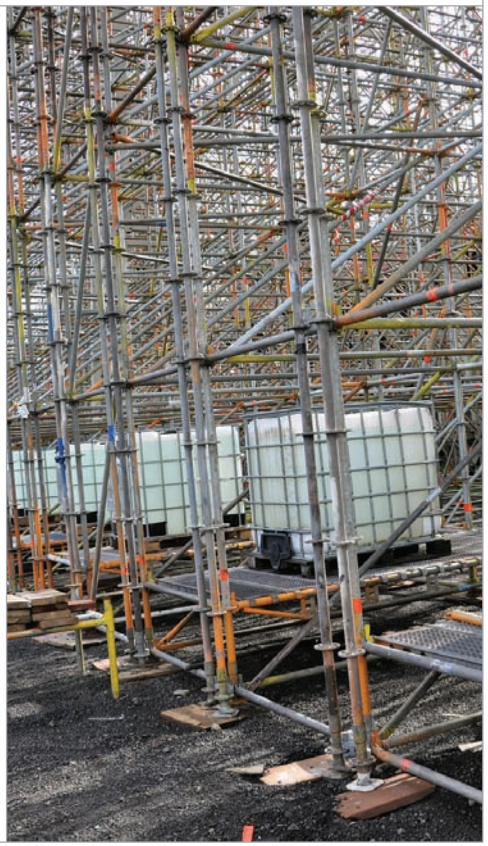




Vrijstaande Stelling (65 m) voor Renovatie Transportband - Gent, België







In 2011 deed Arcelormittal beroep op Hertel om een tijdelijke constructie te bouwen die het mogelijk maakt de noodzakelijke onderhoudswerken uit te voeren aan de transportband Kooks V42 te Gent.
Al snel bleek dat de beperkte beschikbare ruimte op de grond en de grote hoogte die moesten bereikt worden een gedegen studie vereiste, waarbij de wind de hoofdrol speelt.

Langs één zijde beperkt door een muur en aan de andere zijde beperkt door de eis van vrije doorgang zorgden ervoor dat de basis slechts 20 m mocht bedragen. De variërende hoogte van de stelling gaat van 40 m in het begin waar kan verankerd worden aan een stalen pyloon, tot 65 m op een onverankerbare plaats en dit over een totaal lengte van 40 m. Halverwege staat nog één stalen pyloon waaraan ook kan verankerd worden, waardoor de helft van de stelling, het gedeelte met de grootste hoogte, een vrijstaande stelling is. Verankeren aan de transportband zelf is niet toegestaan omdat de transportband niet gedimensioneerd is op zulke zijdelingse belastingen en bovendien ook niet mogelijk omdat de transportband en stelling grote (ontoelaatbare) vervormingen zouden ondergaan.

De uit te voeren onderhoudswerkzaamheden vereisten een winddichte folie van 8 m hoogte ter hoogte van de transportband, waar de stelling bovendien nog uitgerust moest zijn met 2 vloerniveau's.
Omdat de 20 m breedte niet symmetrisch is t.o.v. de langsas van de stelling, werd de uitdaging nog groter en werd de zijde met de kortste breedte duidelijk het kritieke pad van het ontwerp.
Een vuistregel in de stellingbouw is dat een stelling zonder zeilen moet voldoen aan een verhouding van 1:3 voor de breedte:hoogte verhouding. In dit project gaat het om een stelling met een gedeelte sheeting en dit aan een verhouding van 1:3,25.

Het belangrijkste werk bestond erin om de wind zo exact mogelijk te modelleren zonder af te glijden in vereenvoudigingen die aanleiding kunnen geven tot het verklaren van de status 'mission impossible' aan dit project.

Wetende dat er voor wind op stellingbouw niet veel wetenschappelijk onderzoek is gedaan, werden verschillende scenario's geëvalueerd.
Deze vrijstaande stelling dweept met een gevaarlijk lage alpha kritisch en een dreigend gevaar van instorten door de 2de orde effecten. (d.i. extra buigmomenten die ontstaan omdat de verticale last op een zijdelings vervormde, scheefstaande stelling staat.)
Het grote aantal staven en de vele te controleren niet-lineaire combinaties maken dat dit project bovendien niet voor elke PC geschikt was. Met geduld en inzicht om de structuur niet instabiel te maken, werd berekening na berekening het model geoptimaliseerd met steeds meer staven op kritieke plaatsen en steeds minder staven op de plaatsen waar de winst aan stijfheid niet opweegt tegen het extra vangen van wind. Zo eindigde het optimalisatie werk met drievoudige staanders in de buitenste staanderrijen, dubbele staanders in de meer binnen gelegen staanderrijen en zo hol mogelijk in het middelste gedeelte. Uiteraard werden ballasten geplaatst in de buitenste vakken.

Niet alleen het rekenwerk, maar ook de montage was geen sinecure. Omdat de montage ook binnen scherpe termijnen moest opgezet worden, werd er gewerkt met 7 mensen gelijktijdig. Vanaf 20 m hoogte werd het materiaal met een Mammoet kraan aangeleverd. Monteren van een slanke structuur op die hoogte met de daarbij aanwezige windkrachten geeft een niet alledaags gevoel van 'in den bouw' te zitten.

Software: Scia Engineer

Hertel Services nv

Contact Rudy De Smedt
Address Bijkhoevelaan 14
2110 Wijnegem, Belgium
Phone +32 3 360 6100
Email rudy.desmedt@hertel.be
Website www.hertel.com

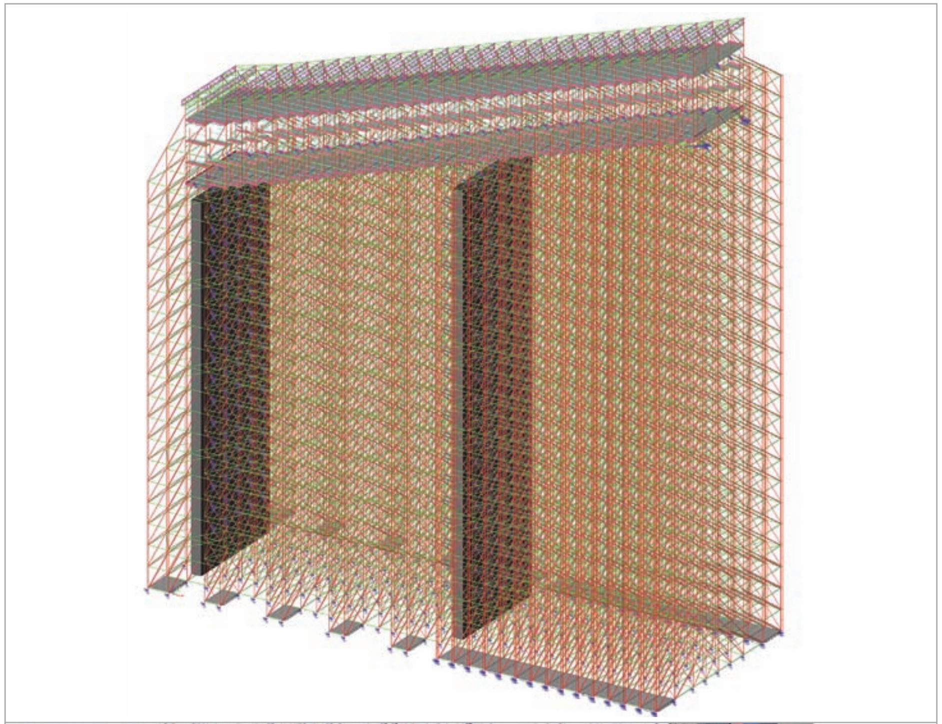
Hertel is een verlener van industriële diensten met europese roots. Hertel heeft strategische locaties over de gehele wereld zoals Midden Oosten, Noord West Europa, Oost Europa, Azië en Australië. Met meer dan 13.000 medewerkers wereldwijd is het hoofdkwartier in Rotterdam (NL) en hoofdvestigingen in Baharain en Singapore.
Onze missie is om het werldwijde merk te zijn dat de standaard zet voor industriële constructies en onderhoudsdiensten. We richten ons om te werken in veiligheid, betrouwbaarheid en sterkte om te presteren.
Met een focus op 4 belangrijke business segmenten (Offshore, Oil&Gas, Process, Power&Utility), bieden we onze klanten een brede varieteit van diensten aan, aangevuld met enkele specialismen.
Hertel Services nv, afdeling stellingbouw biedt diensten aan voor al deze disciplines.

Project information

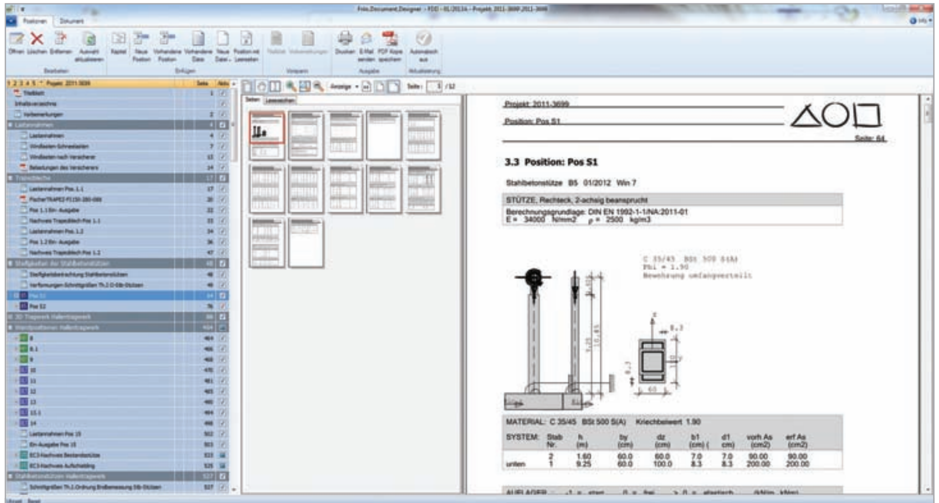
Owner	ArcelorMittal Gent
Architect	Hertel Services nv
General Contractor	Hertel Services nv
Engineering Office	Hertel Services nv
Location	Gent, Belgium
Construction Period	06/2011 to 08/2011

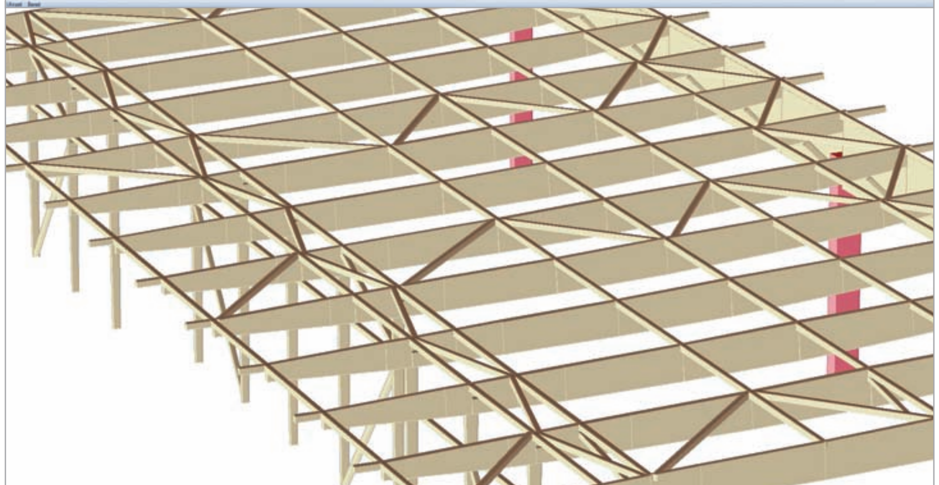
Short description | **Free Standing (65 m) Scaffold for Renovation of Conveyor Belt**

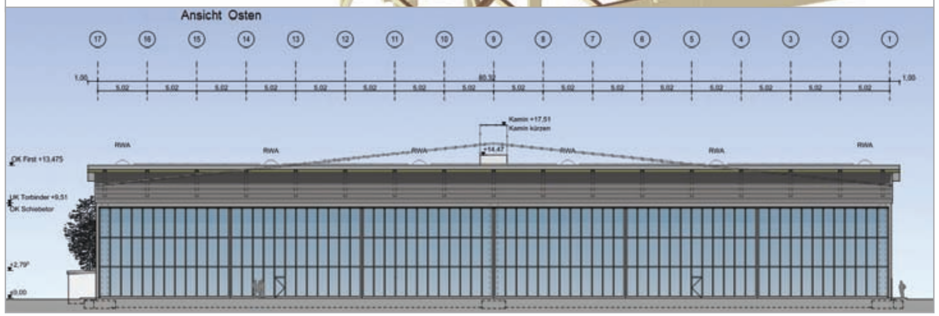
A temporary scaffolding construction was erected on the site of Arcelormittal (Gent, Belgium) in order to execute an important maintenance job on a digital ascending conveyor belt up to the height of 60 m. The lack of space at the base of the scaffolding, the limited possibilities for anchorages and important wind loads made this design a tough job for the engineer as well as for the Scia Engineer software. Rows with triple standards on the outside and important ballasted stabilisations were needed to resist to the maximum wind loads on the scaffolding and the netting with the height of 8 m over 2 floors. The construction was also checked for the important 2nd order effects, causing the deformations to diverge to structural instability.
Nevertheless, and thanks to the use of a crane and the sheer hard work of experienced and fearless builders, we implemented an impressive scaffolding construction.



Sanierung der Hallendächer - Düsseldorf, Deutschland







Hallenbeschreibung

- Projektdaten: Flugzeughangar Halle 2
- Bauherr: Flughafen Düsseldorf GmbH
- Baukosten: ca. 2,5 Mio. Euro
- Leistungsprofil: HOAI §49, Leistungsphasen 1 bis 6 sowie Bauleitung
- Nutzfläche: 2.800 m²
- Bruttorauminhalt: 33.600 m³

Projektbeschreibung

Die 80 x 35 x 12 m große Halle 2 diente dem Mieter des Flughafens Düsseldorf bislang für die Unterstellung von Privatflugzeugen.
Des weitern sind innerhalb der Halle Büros sowie Lager- und Logistikbereiche in zweigeschossiger Bauweise untergebracht.
Bei den Sanierungs- und Modernisierungsarbeiten wird die Halle zu einer Halle mit Wartungsarbeiten umgebaut, bei dem das komplette Stahldachfachwerk gegen ein neues Holztragwerk ersetzt wird. Die Seitenwände bleiben bis zu einer Höhe von 7,5 m erhalten, da der Betrieb der inneren Gebäude während der Sanierungsarbeiten weiter geht.
Des Weiteren werden die Hangartore, sowie der nun erforderliche Betonboden in WHG-Qualität erneuert.
Die neuen Wand und Dachflächen werden den heutigen erforderlichen energetischen Qualitäten angepasst. Das Dachtragwerk besteht aus zwei Leimholz Hauptträgern (GL32c, h = 3,20 m) mit jeweils einer Spannweite von ca. 40 m. Die Nebenträger (GL32c, b/h = 0,24/1,58 (0,90) m), werden ebenfalls aus Leimbindern hergestellt, die als Fischbauträger gefertigt werden. Infolge der Entfernung des alten Dachtragwerks wurden für den Weiterbetrieb der inneren Büros Sicherungsmaßnahmen der Außenwände und Büros erforderlich, die ebenfalls mit bei der statischen Berechnung des neuen Tragwerks berücksichtigt wurden. Die Aussteifung des neuen Dachtragwerks übernehmen drei Stahlbetonstützen sowie die neuen Wanddiagonalen. Die alten Wandstützen werden an das neue Holzbautragwerk entsprechend angebunden, so das im Endzustand die Standsicherheit ohne die Sicherungsmaßnahmen für die Wände wieder gewährleistet ist.

Als Besonderheit ist das neue Dach so ausgelegt, dass eine Photovoltaikanlage installiert werden kann.

Brettschichtholz BS-Holz Allgemeines

Bauteile aus Brettschichtholz (BS-Holz) sind statisch tragende und sorgfältig hergestellte, hochwertige Konstruktionselemente aus einem vergüteten Werkstoff.

BS-Holz darf nur von Firmen hergestellt werden, die einen entsprechenden Nachweis über die Eignung zum Leimen von tragenden Holzbauteilen nach DIN 1052 bzw. DIN EN 1995 besitzen.

Brettschichtholz BS-Holz Festigkeitsklassen

BS-Holz wird entsprechend DIN EN 1995 produziert und in Festigkeitsklassen eingeteilt.
Für dieses Bauwerk werden die folgenden Brettschichtleimbinder genutzt:

- Hauptbinder: GL 32c
- Nebenbinder: GL 32c
- Stützen, Riegel und Verbände: GL 28c

Die Zahlenwerte der GL-Klassen stehen für den charakteristischen Wert der Biegefestigkeit (für BS-Holz gemäß DIN EN 1995) in N/mm². Das “h” bzw. “c” bei den Benennungen steht für homogenes bzw. kombiniert aufgebautes BS-Holz.

Software: Frilo Statics, GLASER -isb cad-

InTraKon GmbH

Contact Marco Kolloczek
Address Tiroler Straße 6
45659 Recklinghausen, Germany
Phone +49 2361 41926
Email thorsten.husert@intrakon.de
Website www.intrakon.de

InTraKon GmbH

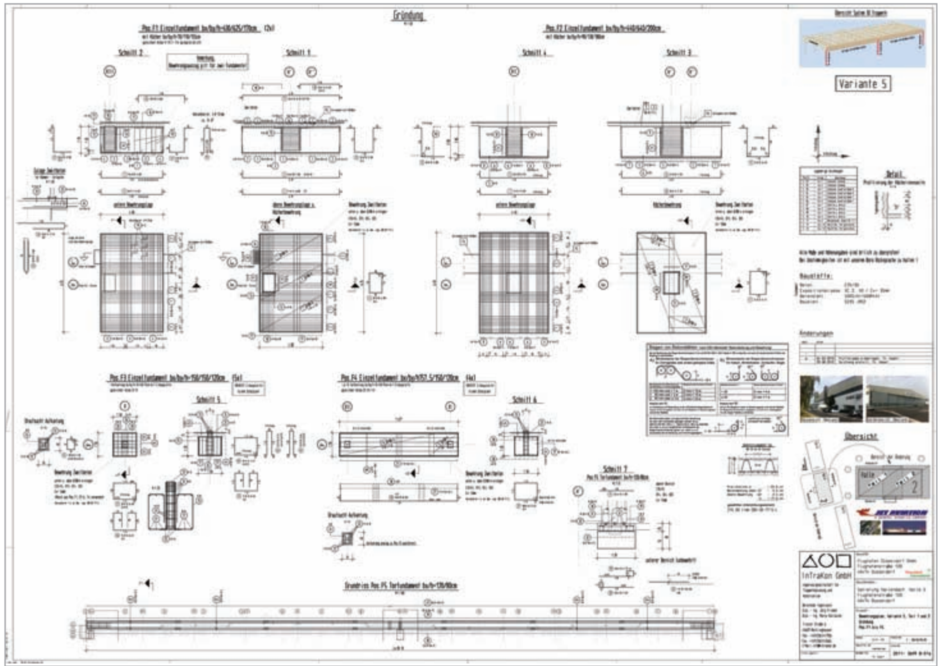
Die Ingenieurgesellschaft für Tragwerksplanung und Konstruktion -InTraKon- wurde im Januar 2001 durch die Geschäftführer Herr Dipl.-Ing. Jörg Friemel und Herrn Dipl.-Ing. Marco Kolloczek gegründet. Im Jahr 2008 wurde die Gesellschaft in InTraKon GmbH überführt.
Als Hauptaufgabengebiet ist die Tragwerksplanung sowie die bauphysikalischen Nachweise für Neubauten und Sanierungen von Gebäuden zu nennen. Das Spektrum der Aufgabenfelder umfasst hierbei den klassischen Hochbau wie auch den Anlagenbau in der Industrie. Des Weiteren werden Werkstattzeichnungen für den Stahlbau angeboten. Als Ziel wurde definiert, dass es bei jeder Planung eine maßgeschneiderte und individuelle Lösung für unseren Auftraggeber zu finden gilt, bei der die Einflüsse aus den bauphysikalischen Nachweisen und der Tragwerksplanung sowie die Kosten des Bauwerks berücksichtigt werden. Unsere Mitarbeiter werden durch moderne EDV-Lösungen unterstützt. Durch intensive und vor allem persönliche Beratung und Betreuung durch Herrn Friemel sowie Herrn Kolloczek können wir den hohen Anforderungen unserer Auftraggeber gerecht werden.

Project information

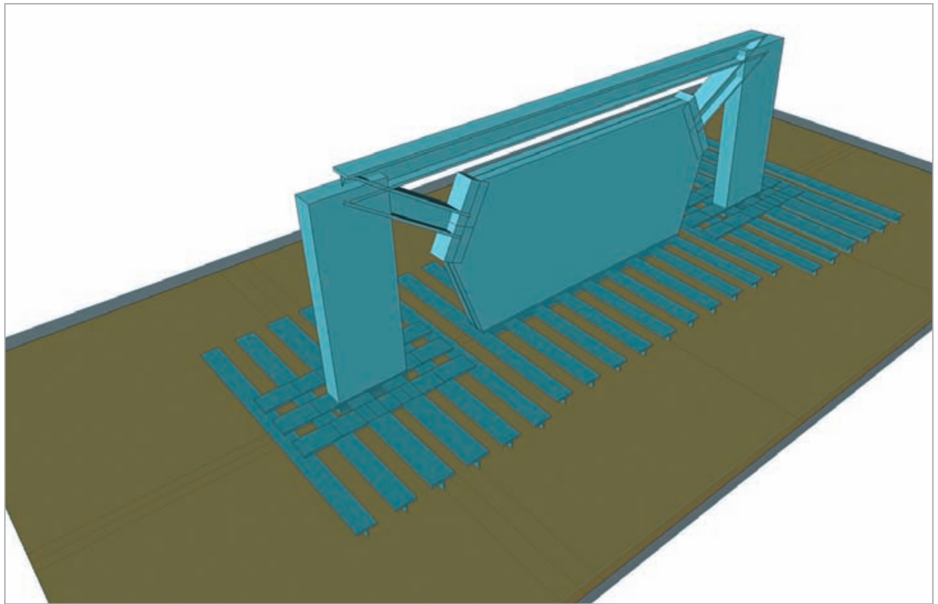
Owner	Flughafen Düsseldorf GmbH
Architect	kg5 Architekten
General Contractor	kg5 Architekten
Engineering Office	InTraKon GmbH
Location	Düsseldorf, Germany
Construction Period	02/2012 to 01/2014

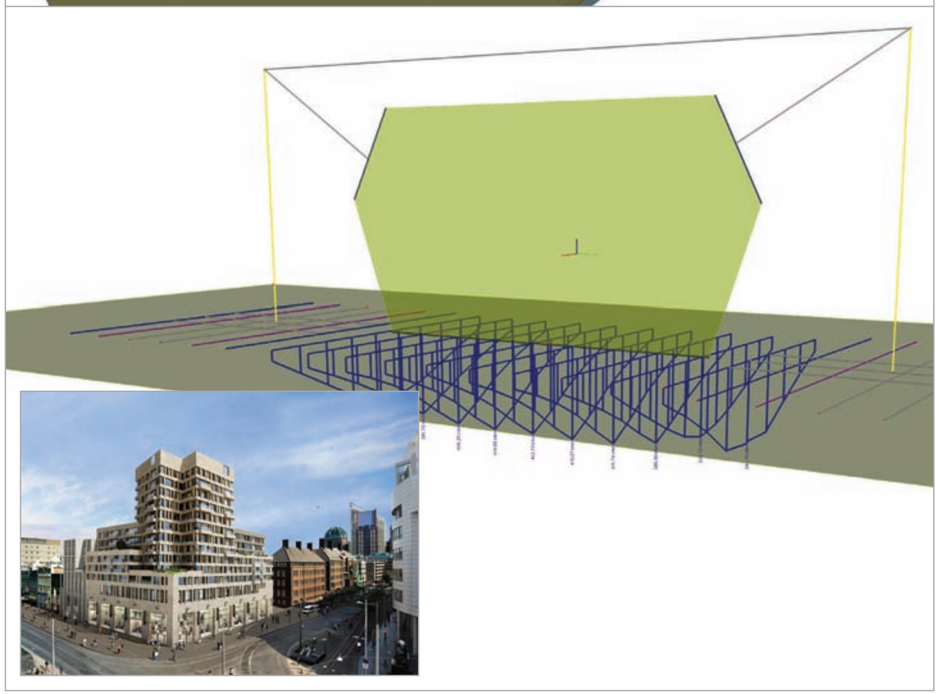
Short description | **Renovation of an Aircarft Hangar**

The dimensions of the aircraft-hangar hall 2 (80 x 35 x 12 m) previously served the tenant of Dusseldorf airport for the subordination of private aircraft. In the hangar there are offices and warehouse and logistics sectors in integrated two-storey structures. With the renovation and modernisation work, the hangar was converted into a hangar with maintenance in which the complete steel roof truss was replaced with a new timber structure. The side walls are preserved to the height of 7.5 m, since the operation of the internal building during the renovation work continues. The new wall and roof surfaces are adapted to today's necessary energy qualities. The roof structure consists of two main beams, each with the span of 40 m. The secondary beams are also made of laminated beams. The bracing of the new roof structure is provided by three reinforced concrete columns and the diagonals of the new wall. A special feature of the new roof is designed so that a PV system can be installed.



Amadeus Kalvermarkt - Den Haag, The Netherlands





Introduction

The project concerns the realisation of a new building in the centre of The Hague. It consists of a parking area in the basement, a shopping area on the first 3 floors, and 6 and 12 floors with apartments. Figure 1 gives an artist's impression.

The building has been designed by the architectural firm Bedaux de Brouwer in conjunction with IMd Raadgevend Ingenieurs, and was commissioned by the development company Kalvermarkt. It is currently (March 2013) under construction and is being built by Züblin Nederland, part of the construction group STRABAG.

Design

One of the main characteristics of the design is the fact that the new building is constructed on top of an existing foundation. A large part of the building site consisted of a 60-year-old building. This building has been completely demolished with the exception of its basement foundation.

The new complex is much larger than the previous structure. To be able to withstand the much heavier loads on the foundation on top of the floor slab of the old basement structure a new raft foundation has been designed.

The basis of the raft foundation consists of a 400 mm reinforced concrete slab that is continuous over the base of the structure. The raft is able to span any area of weaker soil and it spreads the loads over a wide area.

An exceptional part of the structure is the foundation of the very heavy loaded steel-concrete composite columns. The columns stand on top of walls which are located in the basement. Each wall carries 2 columns which are located at the outer ends.

What makes it special is that a large part of the reinforced concrete wall structure has been replaced by a steel frame. This appeared to be necessary because of the very high compression stresses that occur. Furthermore, it was required to strengthen the concrete slabs underneath the walls by steel HEM beam frames to form a ribbed construction.

For the design of this atypical complex structural element a 3D Scia Engineer model has been made. The heavy point loads from the columns are transferred and spread by the walls into a uniform load on the basement slab. In return the steel floor frames spread the uniform loads per m1 from the walls into a uniform distribution soil pressure across the foundation. The structure has been designed on basis of the assumption that the soil has the maximum allowable bearing value of 500 kN/m^2.

In the Scia Engineer model, the steel parts of the construction are modelled by 1D bar members. The reinforcement wall and floor sections are included by use of 2D wall and plate elements.

Construction

The main advantage of using the existing basement was the enormous reduction of the building costs. On the other hand, it also required a relatively complex building process. First of all, the placement of the aforementioned steel frames is a relatively unique operation and requires an experienced and skilled building team.

Furthermore, the possible uplift of the basement during construction due to the groundwater pressure on the structure has to be prevented. To avoid this, the basement has to be temporarily filled with sand bags.

The presence of a tunnel for public transport nearby the building site has also placed additional requirements on the building operation.

Software: Scia Engineer

IMd Raadgevende Ingenieurs

Contact Heleen van den Berge
Address Piekstraat 77
3071 EL Rotterdam, The Netherlands
Phone +31 10 2012360
Email h.vandenberge@imdbv.nl
Website www.imdbv.nl

Since its inception in 1960 IMd Raadgevende Ingenieurs [consulting engineers] has remained totally independent and has had no commercial ties with manufacturers, subcontractors, contractors or developers who could influence the making of unbiased and unrestrained recommendations. The company dedicates its activities to making recommendations in the field of structural engineering.

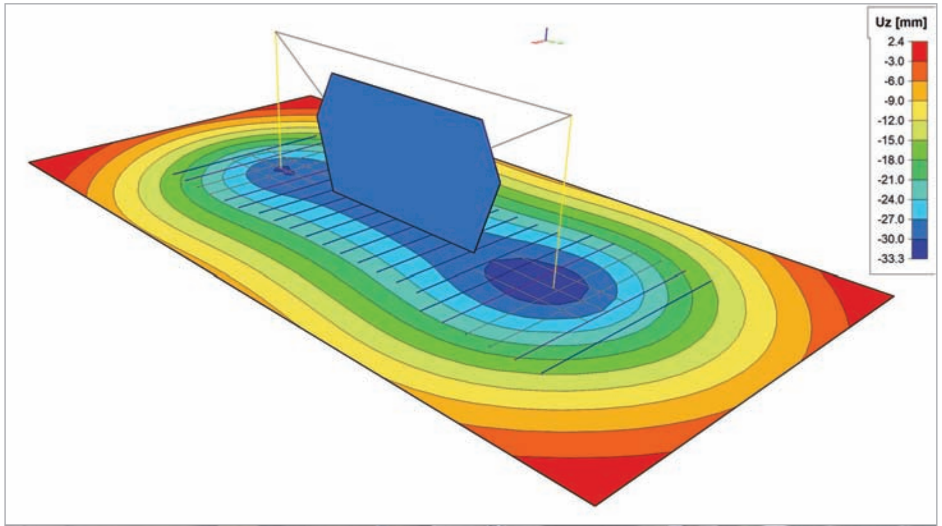
The company has experience in working on projects in which the structural engineer is expected to do more than merely make calculations and drawings. An active input of the structural design in the design phase specifically leads to an economically feasible plan. IMd's aspiration is to ensure that the client gets a functional and beautiful building, the architect can realise 'his design', all the consultants achieve their best performances and the contractor can build quickly and easily.

Project information

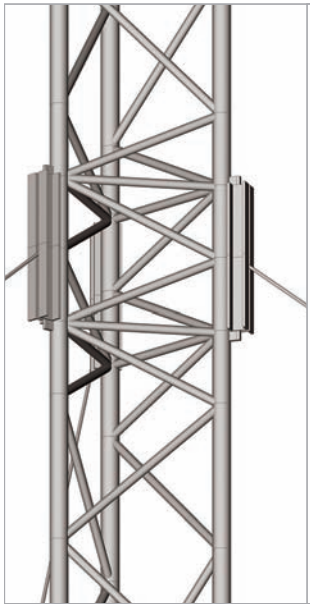
Owner	Development Company Kalvermarkt, Den Haag
Architect	Bedaux de Brouwer Architecten, Goirle
General Contractor	Strabag Züblin, Vlaardingen
Engineering Office	IMd Raadgevende Ingenieurs, Rotterdam
Location	Den Haag, The Netherlands
Construction Period	08/2012 to 07/2014

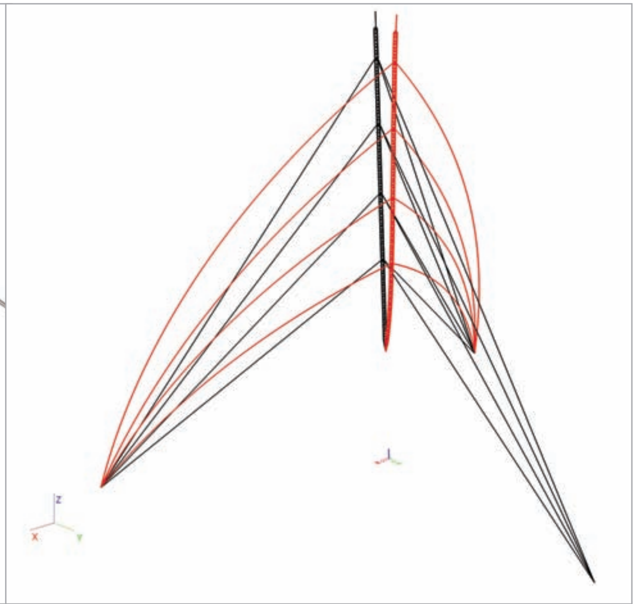
Short description | **Amadeus Kalvermarkt**

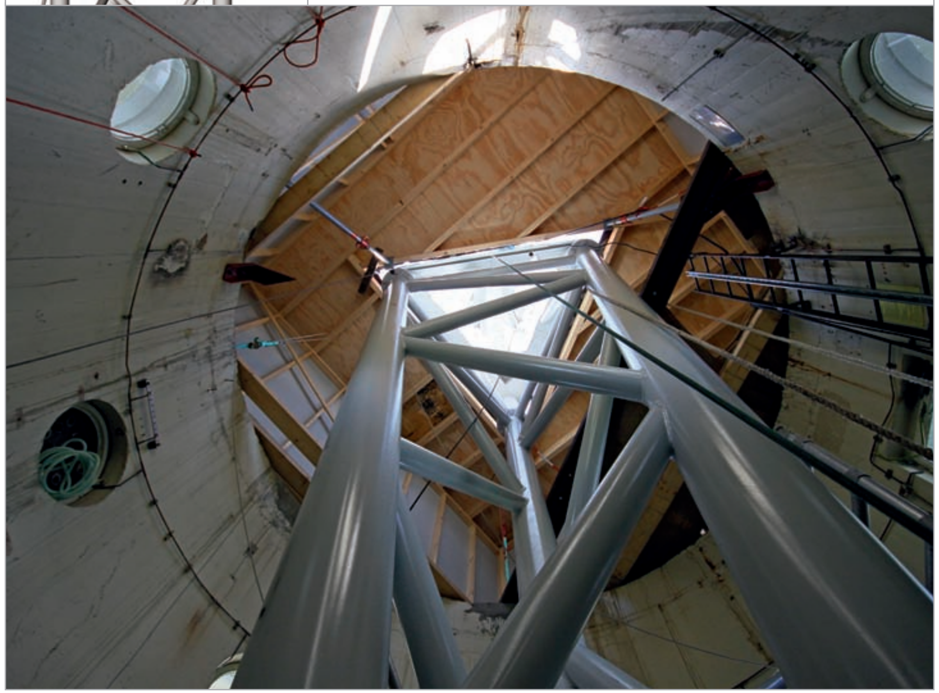
The project concerns the implementation of a new building in the centre of The Hague. It consists of a parking area in the basement, a shopping area on the first 3 floors, and 6 and 12 floors with apartments.
One of the main characteristics of the design is the fact that the new building is constructed on top of an existing foundation. To be able to withstand the much heavier loads at the foundation on top of the floor slab of the old basement structure a new raft foundation has been designed. An exceptional part of the structure is the foundation of the very heavy loaded steel-concrete composite columns. These stand on top of walls which are located in the basement. What makes it special is that a large part of the reinforced concrete wall structure has been replaced by a steel frame. For the design of this atypical complex structural element a 3D Scia Engineer model has been used.



New Antenna Mast Smilde - Hoogersmilde,The Netherlands







The television and radio transmitter mast in Hoogersmilde provides coverage in the northern part of the Netherlands. After its failure in 2011 due to a blaze, Iv-Consult contributed to the design process for the new mast using Scia Engineer as FE software.
This project was carried out to a very tight schedule and in close cooperation with client Omroepmasten B.V. and contractor VolkerWessels Telecom, and together with Iv-Bouw. This joint effort resulted in a new design and appearance for the Hoogersmilde antenna mast.

Description of the structure

The original tubular section with a diameter of two metres has been replaced in the new project by an open lattice structure in a triangular section. The steel lattice mast is built above the existing concrete tower, starting from the level +80 m and reaching the height of 303 m.
The three CHS 244.5 x 25 vertical columns running from the bottom to the top of the shaft are braced alternately every 2,000 mm by diagonals CHS 114.3 x 5.0 lying in the three sides of the shaft. The base of the mast consists of a nine metre high pyramidal module aimed at conveying the forces from the three vertical chords to the rocker bearing at the top of the concrete tower. The lateral support is provided by three groups of pre-tensioned cables which connect, at four levels, the shaft to the anchor blocks on the ground. Subdividing the plane in three angles of 120°, the cables departing from each of the three corners of the triangular section restrain the shaft against the wind forces in every direction.
The erection of the mast was completed in two weeks by a specialised helicopter installation company. Special tools and procedures were designed by VolkerWessels to ensure the success of the delicate operation, which included the installation of more than fifty modules and the guy wires that were flown into position and hooked up in special devices. Feeder cables were finally installed to provide transmitting signals to the antennas fixed to the shaft. Ladders and platforms were installed for service and maintenance purposes.

Design with Scia Engineer

Guy-wired masts are a relatively slender and fragile type of structure since they only need to provide height and resist wind. Nevertheless, guy-wired masts of this scale are classified by code as one of the most complex structures in structural engineering. Due to its national importance, the mast was designed for consequence class 3 in accordance with Eurocodes. This requirement, together with the tight deadline of only a few months from design to the start of the fabrication, made the analysis of the structure a real challenge.
In order to allow for the high displacements of the structure, a geometrically nonlinear analysis was performed and Scia Engineer proved to be a useful tool for this purpose.

The model consists of approximately 700 elements. The “cable nonlinearity” and the “initial pre-stress” functionalities offered by the software have been used to accurately represent the behaviour of the guys. With the use of specific modules, wind and ice loads have been applied to all the guy wires and all structural members. Wind, ice and permanent loads have been combined in several nonlinear combinations and the governing results were determined using the results classes. To control and analyse the enormous amount of results, the “active document” feature was used, allowing for an overview of the results, updated whenever necessary.

The resistance and stability check of the members composing the structure has been assessed by means of a Scia Engineer module which incorporates the provisions of EN1993-1-3.

The flexibility in the arrangement of the results as well as the several exporting options were beneficial in order to determine the effects related to the event of a rupture of one of the guys. For this purpose multiple analyses on different copies of the model were carried out according to the “conservative procedure” and the “simplified analytical model” (EN1993-3-1).

A modal analysis has moreover been executed to determine the natural frequencies of the structure. The software allows the user to easily transform the applied loads in the correspondent mass attributes which are used as input by the dynamic solver. With the knowledge of the eigenmodes of the structure, its sensibility to the wind frequencies can be evaluated.

Software: Scia Engineer

Iv-Consult

Contact W.M. Visser
Address Noordhoek 37
3351 LD Papendrecht, The Netherlands
Phone +31 78-6448555
Email w.m.visser@iv-consult.nl
Website www.iv-consult.nl

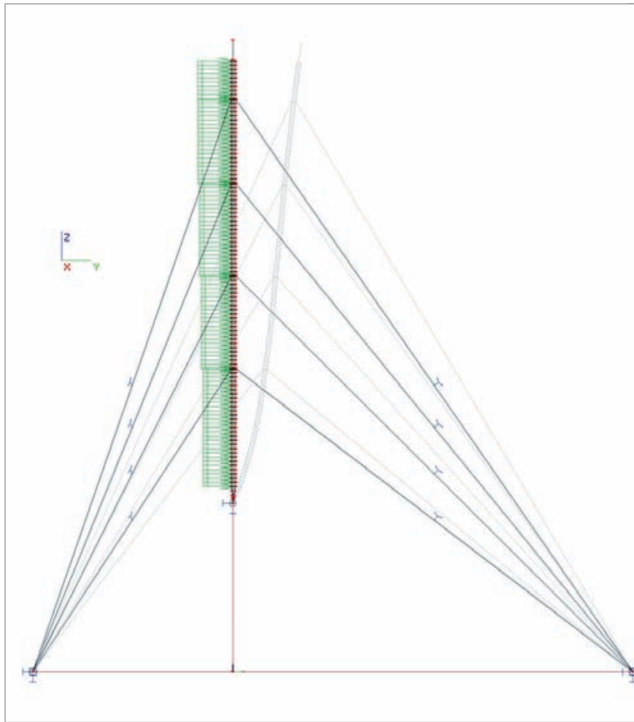
Iv-Consult is a division of Iv-Groep, a group of professional engineering companies. Through the years, the company has developed itself into a highly qualified engineering company and sparring partner for clients who need independent advice or a constructive solution.
Services are provided from preliminary design up to detail design. Iv-Consult is a market leader for the design of steel and mechanical structures. The main office is located in Papendrecht, the Netherlands. Iv-Consult also has offices in Almere, the Netherlands and Kuala Lumpur, Malaysia.
As an engineering company, Iv-Consult focuses on the challenging design and engineering of complex structural and mechanical projects. The company has the know-how and experience to realise large-scale projects like power plants, ports and yard developments. Our clients can vary from end-users to developers, architects and contractors. We provide engineering services with a creative mind setting and a high focus on cost effective design. Quality through cooperation is our selling point.

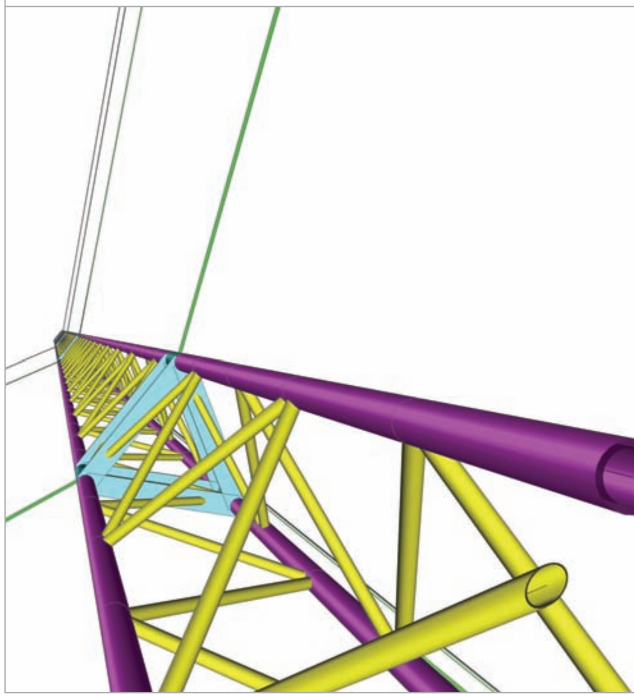
Project information

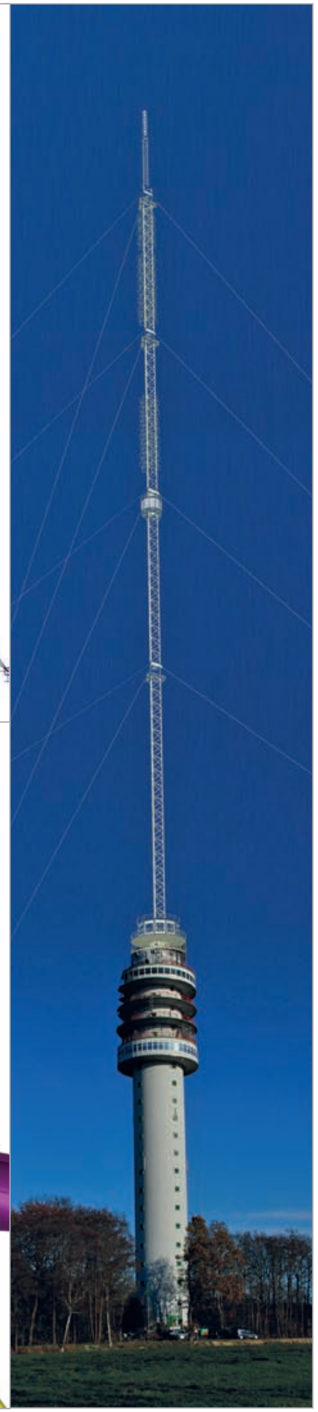
Owner	Omroepmasten B.V.
Architect	Omroepmasten B.V.
General Contractor	VolkerWessels Telecom
Engineering Office	Iv-Consult
Location	Hoogersmilde,The Netherlands
Construction Period	01/2012 to 09/2012

Short description | **New Antenna Mast Smilde**

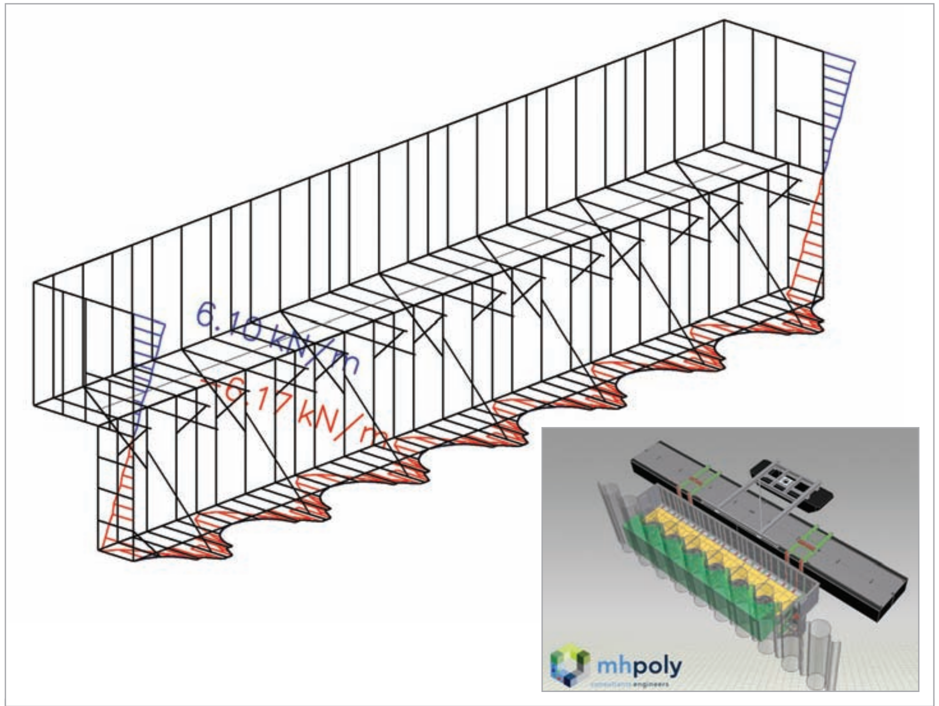
On 15 July, 2011 a blaze in one of the feeder cables caused the Hoogersmilde guy-wired antenna mast to collapse, causing service disruption to the region and damage to part of the concrete tower. The goal of the client Omroepmasten B.V. was to minimise the disruption by installing a new mast on the concrete tower by August 2012. To mitigate the tight deadline, Iv-Consult and contractor VolkerWessels Telecom completed a parallel fast-track design that would meet the scheduled mast erection date.
Scia Engineer was deployed to carry out the analysis of the new guy-wired lattice mast. A geometrically nonlinear analysis of the structure was chosen in order to allow for the high slenderness of the structure and to better represent the behaviour of the cables. A modal analysis has moreover been executed to evaluate the natural frequencies in comparison with the wind actions.

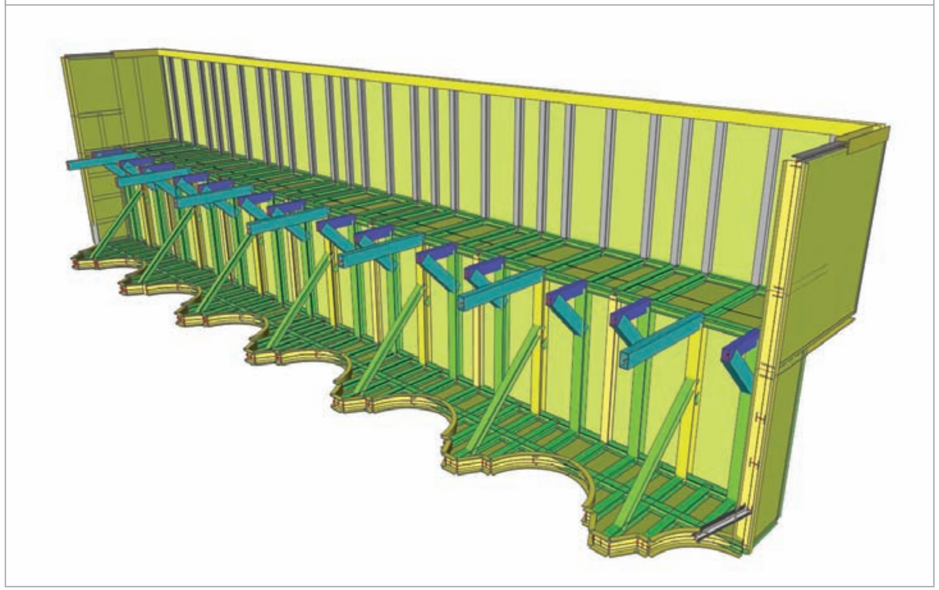






Aqua Shell - Antwerpen, Belgium





The capping beam system special technique for the construction of quay wall capping beams
A recurrent problem in building quay walls in offshore conditions is the construction of the concrete capping beam. These capping beams usually reach below the water surface and hence must be cast below the water level. An unconventional shuttering technique is applied in the construction of a quay wall in the Port of Antwerp.

The quay wall is situated alongside the Westquay of the Canaldock B2. The design and engineering of the aqua-shell is done by MH Poly Consultants & Engineers. The construction is entrusted to Van Laere General Contracting n.v.

Construction of the Quay Wall

The new quay wall has the length of approx. 860 m and is built up from sections of 20.10 m each. Each section consists of a combi-wall with 6 tubular piles, sheet piles in between, and a capping beam 4.36 m wide and 3.52 m high. This construction is then anchored by means of 31 m-long MV-tension piles.

Some indicators for the construction:

- 267 steel tubular piles, diameter 2,032 mm, thickness 22 mm, length 26.8 m.
- 262 MV-piles HP360x174 (HISTAR 460), length 31 m.
- 268 double sheetpiles AZ26 (S355GP), length 20.8 m.
- 4,000 m^3 colloidal concrete and 18,000 m^3 reinforced concrete.
- 1,500 tonnes rebar steel and 13,000 m^2 formwork.

During the tendering phase, the contractor was required to submit a clear step-by-step plan including drawings and descriptions, showing how he intended to build the capping of the quay wall considering the preconditions, such as the water. The quality of this plan also counted for the final assessment of the tender subscriptions. Van Laere n.v. was the only company tendering with this exceptional technique based on a steel, watertight limpet structure which is mounted on to the combi-wall (front wall with tubular piles) and subsequently pumped out completely.

Basics of the Aqua-Shell
After building the front wall and the tension piles, a partial backfill up to the level of +3.40 (TAW) will be carried out behind the combi-wall at shore side. This level coincides with the bottom of the concrete capping beam. A caisson (steel limpet construction) is subsequently placed against the combi-wall alongside the dock side. The particularity of this method is that the concrete capping beam is cast from atop the water in a watertight caisson that is mounted to the combi-wall. Furthermore, this caisson can support the full weight of the cast concrete and thus simultaneously serves as bottom formwork. The concrete sections will be placed in alternating order, skipping a section each time. Next, using an adapted caisson, the remaining intermediate sections are completed. In view of the tight time schedule, two caissons will be made which can be used simultaneously.

The Aqua-Shell will be shifted to the next section by means of a single floating pontoon (catamaran type). An ingenious forklift system holds the limpet construction in the pontoon, which can thus float to the next position and also ensures attachment of the caisson to the combi-wall. After temporary attachment to the front wall, large pumps lower the water level inside the caisson as fast as possible, so that the rubber profiles around it are compressed and ensure a safe and watertight connection.
The design of the rubber profile was one of the challenges during this project: The caisson had to be watertight at all times considering a drive tolerance of 80 mm on the steel tubular piles.
The upward forces on the Aqua-Shell due to the water pressure are passed on the quay wall by use of a specially designed connection which can be re-used during the project.

Software: Scia Engineer

MH Poly Consultants & Engineers bv

Contact Wilco Bruijs
Address P. Vineloolaan 46b
4611 AN Bergen op Zoom, The Netherlands
Phone +31 164-245566
Email wbr@mhpoly.nl
Website www.mhpoly.nl

MH Poly Consultants & Engineers BV is an independent, multidisciplinary and reliable consultancy with over 25 years of experience.
We are mainly active in the field of environment, infrastructure, civil and mechanical engineering. The way we work: professional, creative and practical; the result comes first.

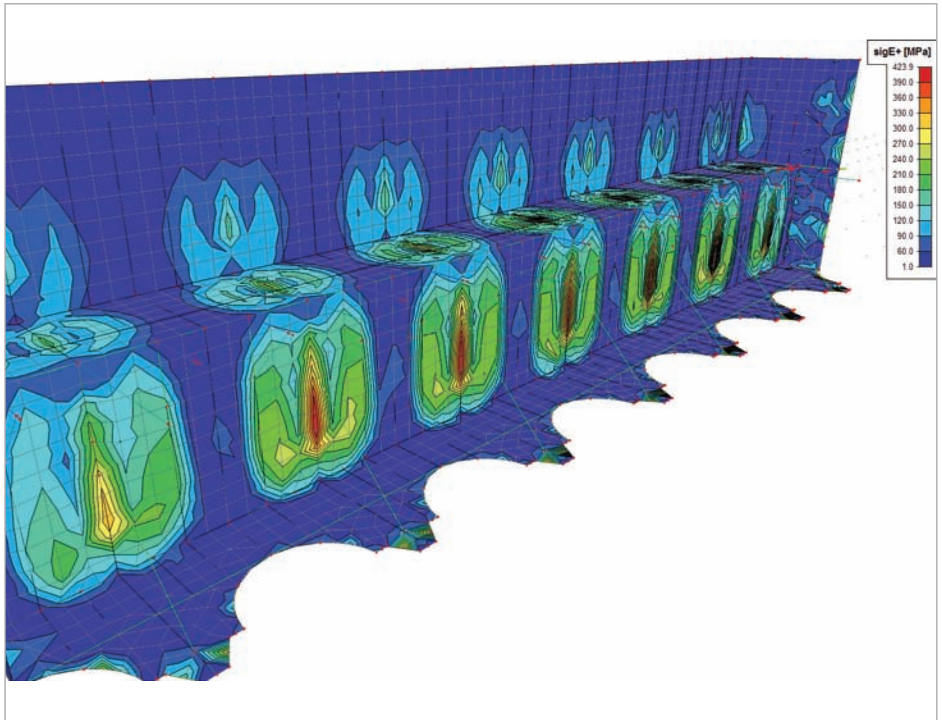
Main activities
Civil Engineering & Infrastructure: Design and engineering of civil structures such as harbours, quays, jetties, habitats for diving activities, slipways, etc.
Industry & Structural Design: Design and engineering for industrial plants, factories, piping, processes, etc.
Environmental & Planning: The execution and expertises of environmental studies, for roads, tunnels, and industrial areas.

Project information

Owner	Van Laere nv
Architect	MH Poly Consultants & Engineers bv
General Contractor	Van Laere nv
Engineering Office	MH Poly Consultants & Engineers bv
Location	Antwerpen, Belgium
Construction Period	06/2009 to 11/2009

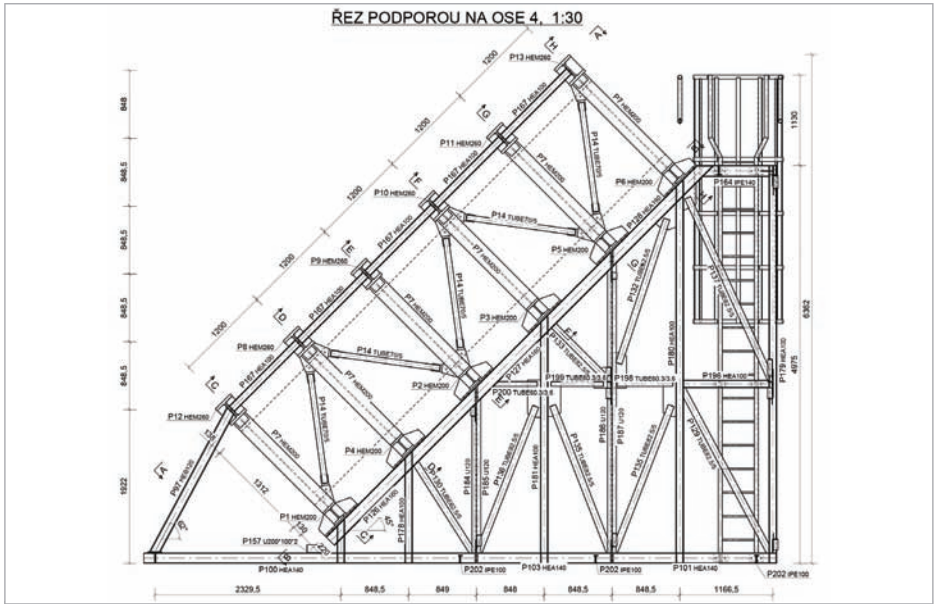
Short description | **Aqua Shell**

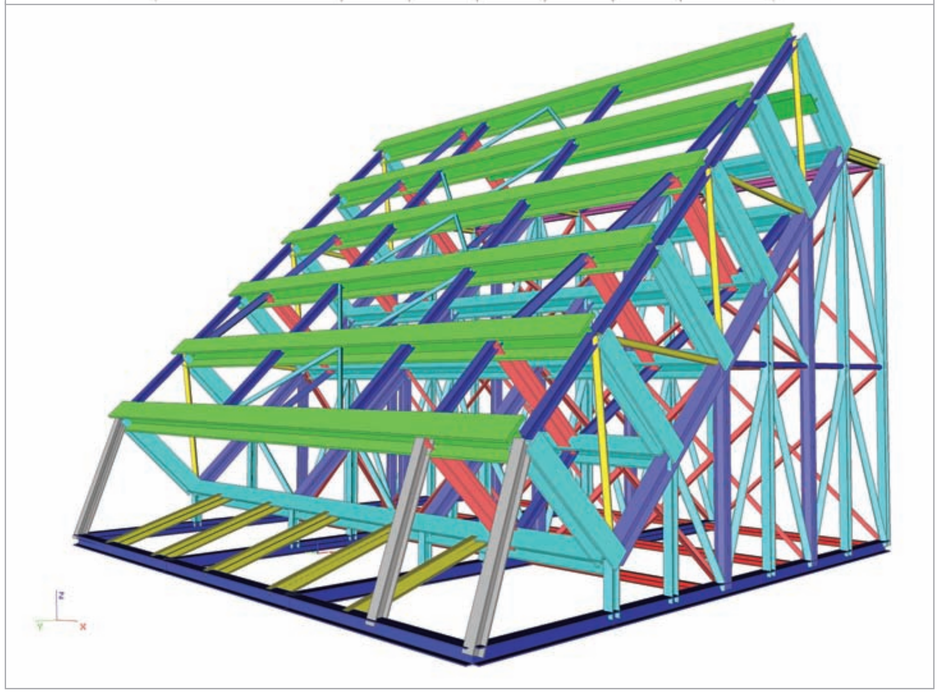
The Aqua-Shell is used to create a dry environment to pour the capping beam of a quay wall.
After the Aqua-Shell is placed against the quay wall it is pumped dry so it will pressed up against the quay wall just by the use of water pressure on the outside of the Aqua-Shell.
The upward forces on the Aqua-Shell due to the water pressure are passed on the quay wall by use of a specially designed connection which can be re-used during the project.
The rubber profile for the watertight sealing was tested in a compression test and modelled as non-linear spring supports in Scia Engineer.
Furthermore, the Aqua-Shell was optimised in Scia Engineer for weight reduction of the steel structure.
To make the Aqua-Shell transportable by road it can be dismounted into two parts.



Category 4: Special Projects
4

Training Module for Roof Supports Ostroj - Opava, Czech Republic





Geometry and structural system

- Total steel weight: 25.2 t
- Height dimension: 6.4 m
- Overall length: 7.7 m
- Overall width: 7.5 m

Introduction

PHA company, situated in Prague, received an order to calculate the steel training module for Roof supports from the contractor Ostroj Inc. A Roof support is a hydraulic unit used in the mining industry.
The steel training frame is designed for the presentation of units for inclined and steep seams extraction. The module is also intended for a miner training programme.

The newest types of the Roof supports are intended for the seams endangered by rock bursts. Therefore, the legs in the units are equipped with rock burst valves. Roof supports have a unit width of up to 2.05 m, with a hydraulic leg diameter of up to 400 mm that provide the load bearing capacity of up to 1,150 t and a section resistance of 140 kN/m^2.

The Roof support units are designed for shearer or plough Longwall systems. They are equipped with various types of bases, legs and control systems, and/or with accessories for inclined seams and for seams endangered by rock bursts.

Design software

The structural analysis was calculated using a 3D model in Scia Engineer software.

Design

The basic structural design was prepared in two models. The first model was with resistant forces supplied by Ostroj Inc. Company. The training frame was designed to bear resistant forces which show functionality and practical use of the Roof support machines.
The second model was designed according to Eurocode standards EC3 in the transverse and longitudinal directions, with stabilisation by bracing.
The Roof supports steel module is independent in regard to anchoring and is a self-bearing structure.

The minimum floor slab load bearing capacity of 10kN m^2 was required.
There were also requirements for a frame mount and demount according to the global container dimension and weight.
All connections required the demountable (bolted) type of joints. The structure can be mounted anywhere in the world within five days.

Load

Design loads conform to the contractor's requirement. The point force from hydraulic cylinders is 203 kN x 2 in a line.
The training module is designed for interior exhibition without wind and snow loads.

Design process

The training module was calculate in the Scia Engineer program and exported to the Tekla program with Module Scia 2 Tekla. The designer used the perfect combination for the design and fabrication of steel constructions.
For a fast feedback, the designer used 3D export from Tekla to the browser. With this export the contractor took influence in his project.

Conclusion

Scia Engineer has been used for an unusual mechanical structure design. The designer used the advantage of programs for a cooperation between the contractor, designer and different software.

Software: Scia Engineer

P-H-A

Contact Hana Gattermayerova
Address Gabcikova 15
Praha 8
18200 Praha, Czech Republic
Phone +420 284685882
Email statika@p-h-a.cz
Website www.atelierpha.cz

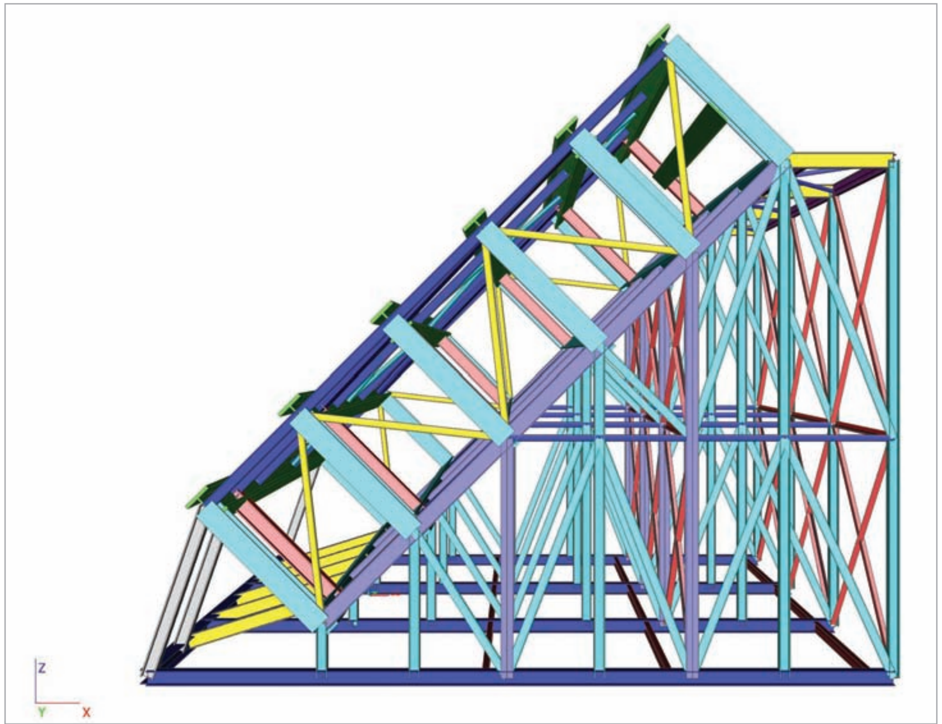
Atelier P.H.A. was founded in 1990.
P.H.A. deals with design tasks, preparation and implementation of investment projects and engineering activities, and is an expert in the field of construction and real estate investments. P.H.A. participates in opinions carried out on structures after the 2002 flood, opinions on the condition and measures taken on load-bearing structures in industrial, high-rise apartment buildings and apartment building regeneration, opinions on the impact of emergency situations - like fires and flooding - on load-bearing structures, and in building passports during reconstruction etc.
PHA can follow up on international projects in accordance with most standard codes: Eurocode, Fema-350, UBC97, СНИП and other specific national codes. Structure designers participate in professional seminars, as well as structural engineering meetings and conferences, and lectures, and their contributions are published in professional newspapers.

Project information

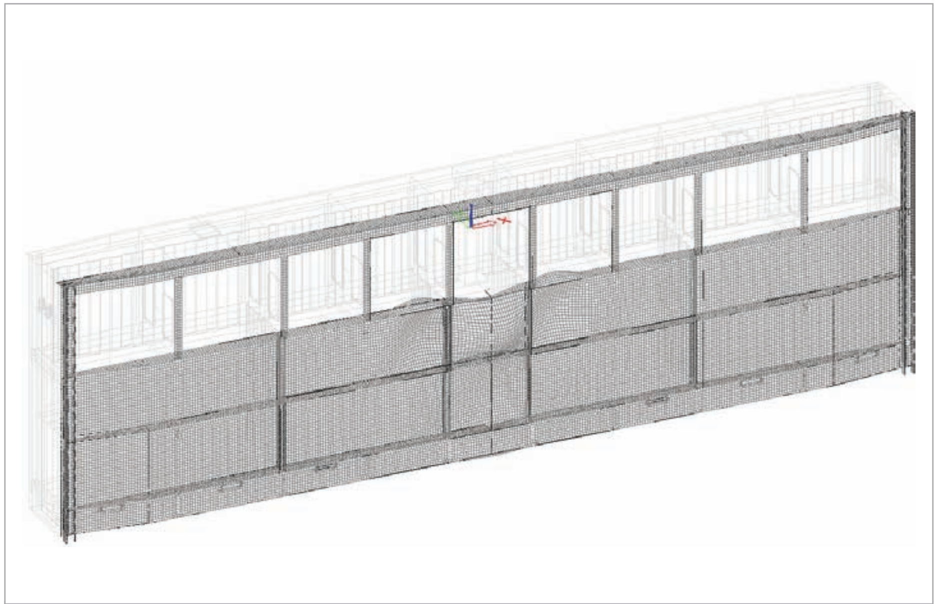
Owner	Ostroj a.s.
General Contractor	Ostroj a.s.
Engineering Office	P.H.A. Atelier
Location	Opava, Czech Republic
Construction Period	09/2012 to 11/20112

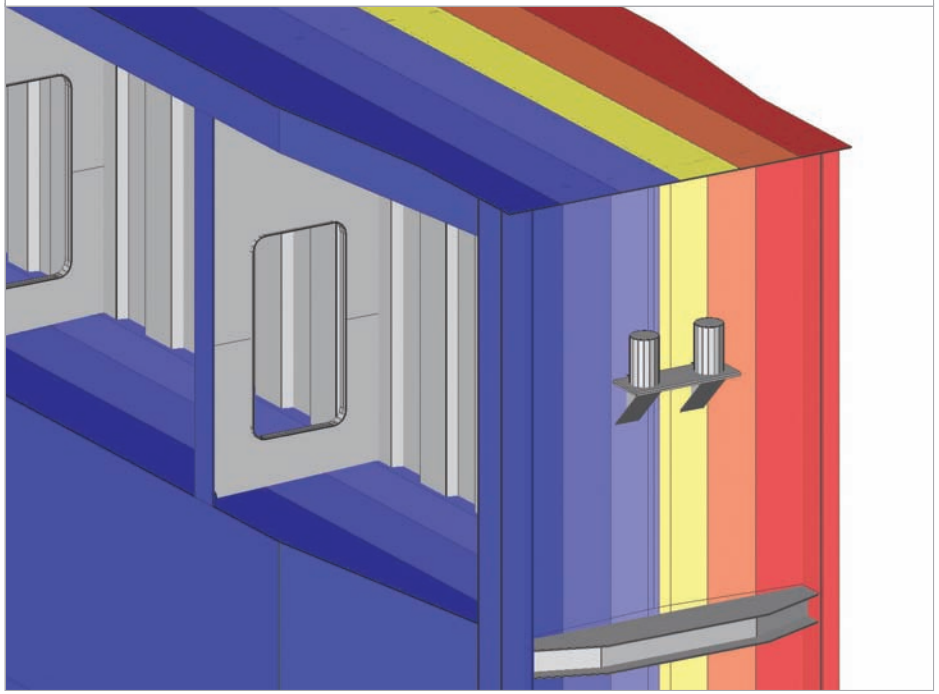
Short description | **Training Module for Roof Supports Ostroj**

This project represents the steel training module (Roof supports) designed for the presentation of units used in inclined and steep seams extraction. The structure is composed of a steel frame with a combination of timber slabs. The timber slabs ensure the functionality of the Roof support and position, which only with friction resistance behaves inside inclined seams. The angle for the training module was set to 45° but in real seams the Roof support can work independently of the seam inclination. The customer was satisfied with the designer's work, and named the training module after the designer name, IDA.



Docktor - Emden, Deutschland





Die Emder Werft und Dockbetriebe GmbH - hervorgegangen aus den Emder Nordseewerken - führen seit über hundert Jahren den bestehenden Schiffsreparaturbetrieb der Werft in bewährter Weise aus. Mit erfolgreichen Abwicklungen anspruchsvoller Aufträge im Marine-, Zivil- und Offshore- Bereich beweisen sie seit Jahrzehnten ihre Leistungsfähigkeit und Vielseitigkeit.

Der Standort in Emden gewährleistet hierbei einen uneingeschränkten Zugang zu den am stärksten frequentierten Schifffahrtsrouten der Nordsee. In zwei Schwimmdocks und einem Trockendock ist Platz für Schiffe von bis zu 55.000 tdw.

Der in die Jahre gekommene alte genietete Verschlusskörper des Trockendocks (Baujahr 1953), das sog. Docktor, war so stark sanierungsbedürftig, dass man sich 2011 für einen Neubau entschied. Das neue Docktor sollte hierbei die Belange einer konservierungsgerechten Konstruktion sowie einer benutzerfreundlichen Bedienung und Wartung erfüllen.

Die Hauptabmessungen des Tores betragen H x B x T = 9,50 m x 32,25 m x 3,20 m, bei einem Stahlgesamtgewicht von ca. 240 t.
Hinzu kommen ca. 246 t. Ballastwasser, welches sich dauerhaft im unteren Drittel des Tores befindet.

Um das Docktor aus der Schwimmlage in die Stauposition abzusenken, werden weitere ca. 100 t. Ballastwasser mittels zwei leistungsfähiger SPS gesteuerten Kreiselpumpen in die sog. Tauchzellen gefüllt.

Zum Trockenlegen des Docks wird das Docktor mit leeren Tauchtanks mit Schleppern oder Seilwinden in die dafür vorgesehenen Nischen am Dock eingeschwommen.

Durch Öffnen von Absperrklappen mit elektrischem Schwenkantrieb füllen sich die Tauchtanks mit Hafenwasser und das Tor beginnt sich abzusenken. Dabei werden die Pumpen “rückwärts durchströmt”. Nach etwa zehn Minuten setzt das Tor auf der Docksohle auf und dichtet somit an der Unterkante ab. Erst wenn die Tauchzellen vollständig gefüllt sind werden die Absperrklappen geschlossen. Die Befüllzustände werden hierbei permanent mittels einer SPS geregelt und überwacht.

Im Anschluss beginnt das Lenzen des Docks. Durch die steigende Pegeldifferenz zwischen der Dock- und Hafenwasserseite, wird das Tor in die seitlichen Dichtnischen gepresst (es entstehen dabei ca. 1.170 t Wasserdruck). Der dockseitig fehlende Auftrieb erhöht die Sohlpressung zusätzlich.

Soll das trockengelegte Dock wieder freigegeben werden, wird zunächst das Dock über Umlaufkanäle geflutet, bis die Pegeldifferenz zwischen Hafenseite und Dockseite ausgeglichen ist.

Die Absperrklappen werden geöffnet und die installierten Pumpen lenzen nun die Tauchzellen, bis sich das Tor durch den erhöhten Auftrieb von der Docksohle löst und eine ausreichende Schwimmhöhe (entspricht etwa einer Eintauchtiefe von 6 m) zum Ausschwimmen des Tores erreicht wurde.

Der benötigte Förderstrom beträgt etwa 200 m³/h bei einer Förderhöhe von mindestens 6 m. Das entspricht einer hydraulischen Leistung von ca. 3,3 kW.

Die Berechnung der Tragkonstruktion erfolgte nach der Finiten-Elemente-Methode.

Das statische Modell wurde hierbei direkt aus dem CAD- Modell generiert. Mit der Import- Funktion von Scia Engineer war dieses in kürzester Zeit möglich. Die Genauigkeit bei der Systemeingabe war somit sehr hoch.

Aufgrund der rippenlosen Bauweise des Docktores war eine Untersuchung von möglichen Beulformen außerordentlich wichtig. Auch dieses konnte mit dem entsprechenden Statikmodul von Scia Engineer problemlos und zeitsparend durchgeführt werden.

Software: Scia Engineer

SEE - Ingenieure GmbH & Co. KG

Contact Ingo Gräfe
Address Auricher Straße 283
26721 Emden, Germany
Phone +49 21 899118
Email graefe@klaas-siemens.de
Website www.see-ingenieure.de

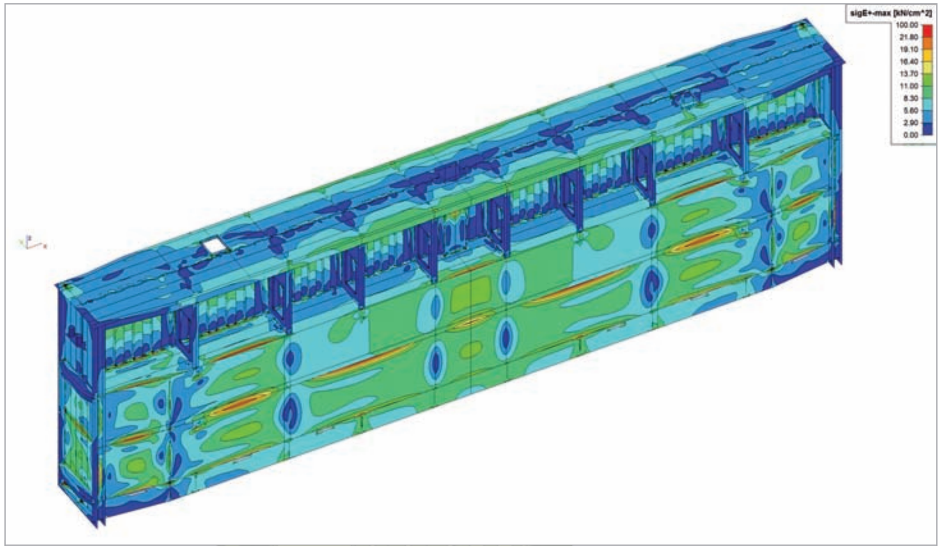
Die SEE-Ingenieure GmbH & Co. KG ist für kompetente Beratung, Planung und Durchführung von Projekten in den Bereichen Stahlwasserbau, Schleusenbau, Brückenbau sowie industriellem Stahl- und Anlagenbau bekannt.
Eine enge Verbindung zu einem Stahlbaufertigungsbetrieb hat die Entwurfs- und Ausführungsplanungen stets beeinflusst - Belange der Fertigung werden seit je her in der Konstruktionsarbeit beachtet. Dieses verleiht den fertigen Unterlagen (wie z.B. den prüffähigen Statiken und Zeichnungen) gegenüber dem Kunden u.a. eine hohe Qualität im Sinne der Wirtschaftlichkeit in Bezug auf Fertigung und Montage.
Die Entwicklungen von neuartigen Konstruktionen sind ein steter Begleiter in der täglichen Arbeit. Zwischenzeitlich wurden Gebrauchsmuster und ein technisches Patent angemeldet.

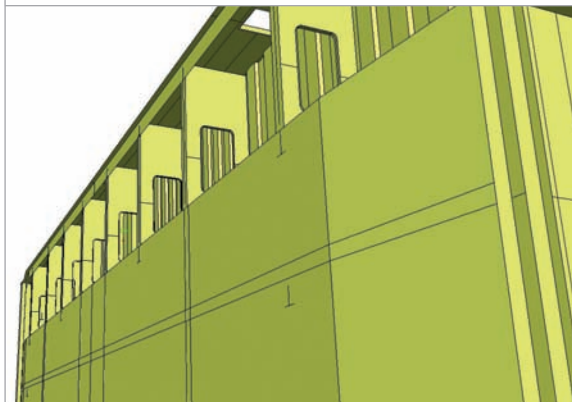
Project information

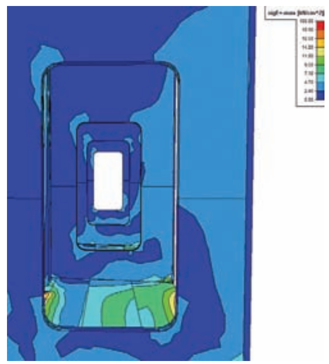
Owner	Emder Werft und Dockbetriebe GmbH
Engineering Office	SEE - Ingenieure GmbH & Co. KG
Location	Emden, Germany
Construction Period	07/2011 tot 10/2011

Short description | **Ship's Soor for a Drying-Dock**

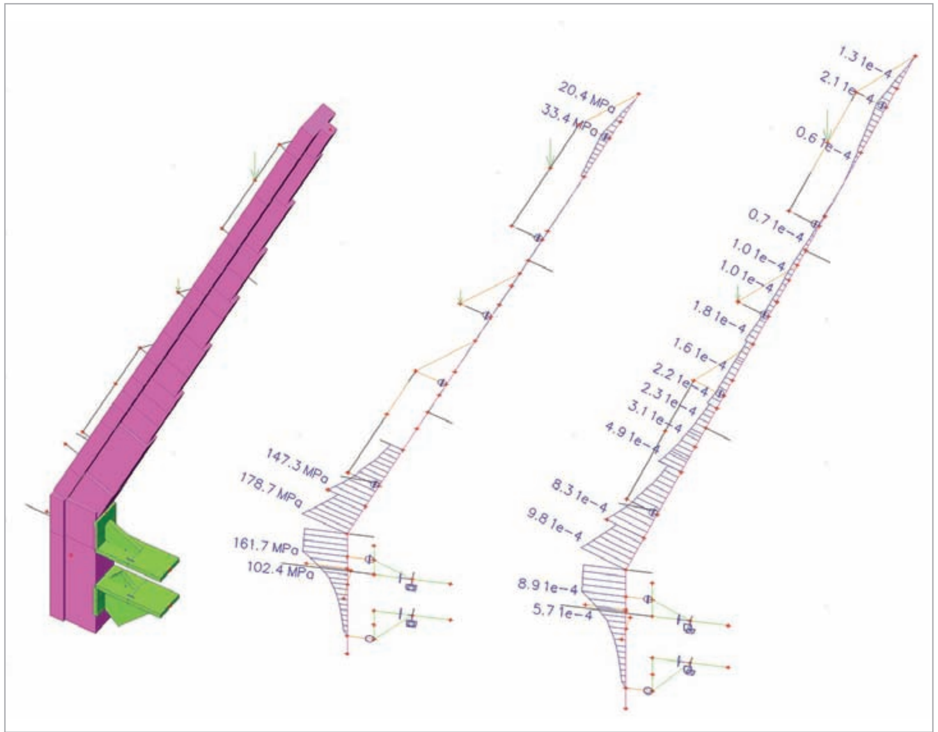
The aim of this project was to replace the old rivetted ship's door built in 1953 for the drying dock on the site of "Emder Werft und Dockbetriebe" with a new welded steel construction. The impact of corrosion and user-friendly handling were in focus.
The whole construction has the height of 9.50 m, the length of 32.25 m, the width of 3.20 m and weighs 240 t. It contains 246 t of ballast water, which is located permanently in the bottom part.
There are two additional reservoirs containing up to 100 t of ballast water, which allows for lowering of the ship's door from floating position to store position. Two centrifugal pumps are used to lift the door up again.







Couverture et Façade BFUP du Stade Jean Bouin - Paris, France



Introduction

Le projet de Rudy Ricciotti a été remporté le 8 novembre 2007 suite à un concours international. Ce stade accueillant l'équipe de rugby du Stade Français est situé à Paris dans le 16ème arrondissement, à proximité du Parc des Princes. Au terme de l'appel d'offres tenu en 2010, le gros œuvre, la charpente métallique et la couverture en Béton Fibré Ultra Performant ont été attribués à Léon Grosse qui posa le dernier panneau BFUP en janvier 2013. Bonna Sabla, le sous-traitant de l'entreprise a réalisé la façade et la couverture constituées de panneaux triangulaires en BFUP (Ductal de Lafarge). La maitrise d'œuvre est menée par l'architecte Rudy Ricciotti, assisté de Christophe Kayser (Gros œuvre / Corps d'états techniques et architecturaux) et Attila Varga (Charpente métallique, façade et couverture).

Description du stade

Ce lieu vétuste ne répondant plus aux exigences du sport de haut niveau a complétement été détruit pour laisser place à une nouvelle enceinte d'une capacité de 20.000 places couvertes qui comprendra un gymnase de 800 m², des espaces réservés aux partenaires (60 loges) et aux médias, un parking souterrain de 500 places de stationnement ainsi que des bureaux et locaux commerciaux ouverts directement sur la Ville. Tous les panneaux préfabriqués en BFUP sont triangulaires, afin d'épouser les courbures de l'enveloppe ne répondant pas à une logique géométrique imposée par les directives urbanistiques du plan local d'urbanisme de la Ville de Paris.
L'enveloppe en BFUP répond à deux caractéristiques, l'une en couverture et l'autre en façade. Les éléments de couverture de 8 m de large environ possèdent deux nervures et une plaque de 35 mm ajourées par des éléments verriers incorporés au coulage des panneaux BFUP, assurant ainsi une protection des spectateurs aux intempéries et des riverains aux nuisances acoustiques du public. Ces nervures ayant une forme en U permettent de récupérer les eaux de pluies et assurer l'arrosage de la pelouse.
En bout de fléau, un champ photovoltaïque de 2.800 m^2 environ est installé afin de subvenir aux besoins de l'équipement en termes d'éclairage.
La résille de façade est formée de panneaux en brins de BFUP, fixés sur les fléaux métalliques. Ces éléments préfabriqués, triangulaires et tous différents, ont été préfabriqués avec des angles variables de 8° ou 16°. Un brin métallique, fixé par des douilles en inox intégrées au coulage, constitue la base du triangle du panneau dont les plus grands ont une portée de 9,40 m maximum
Afin de créer des accès pompier à travers la façade, une béquille en BFUP servant d'appui a été mise en œuvre en nez de dalle pour supporter les panneaux coupés. Ces ouvrages de 1,70 à 3,60 m de haut et d'une inclinaison sur l'horizontale variables de 66° à 97°, peuvent reprendre jusqu'à 3 panneaux de 1,8 t. Sa section est en forme de T à inertie variable de 130 mm à 260 mm. Afin de combler ces ouvertures dans la façade en résille, des portes reprenant le motif des triangles voisins sont fixées à ces béquilles.

Calculs réalisés avec Scia Engineer

Le logiciel a été utilisé pour les études suivantes :

- L'exécution des panneaux de résille d'angle au sommet 8° et 16°
- La conception et l'exécution d'une variante de la béquille posée et suspendue
- L'exécution des résilles d'ouvrants pompiers ainsi que celles des linteaux et allèges
- Le dimensionnement du ferraillage des nervures des panneaux de couverture

Les calculs sont menés en isolant chaque élément. Les principales charges sont le poids propre, le vent, les charges d'entretien et de vandalisme. Le logiciel a permis de prendre en compte la non linéarité physique du BFUP (loi de comportement) ainsi que la non linéarité pour le calcul des efforts.
Pour les éléments de résille, le modèle est constitué de BFUP et de métal. Dans les zones renforcées par des armatures passives, ces dernières ont été positionnées dans la section BFUP et prises en compte par Scia Engineer pour le calcul des contraintes.
La phase de démoulage du panneau a été étudiée avec des caractéristiques différentes du BFUP.

Software: Scia Engineer

SICA an Assystem Company

Contact Jacques Portelatine
Address 152 Avenue Jules Cantini
13272 MARSEILLE, France
Phone +33 496208260
Email oetienne@sica-bet.com
Website www.sica-marseille.com

Les différents collaborateurs de SICA, non cités ci-dessus, qui ont travaillé sur le projet du MuCEM sont : Marc Asencio, Pascal Baudry, Daniel Camarena, Norbert Chocron, Jean Marie Cochet, Christine Elisabeth, François Xavier Gazagnes, Karine Guendouz, Alain Laupies, Bruno Massat et Thierry Robinson.

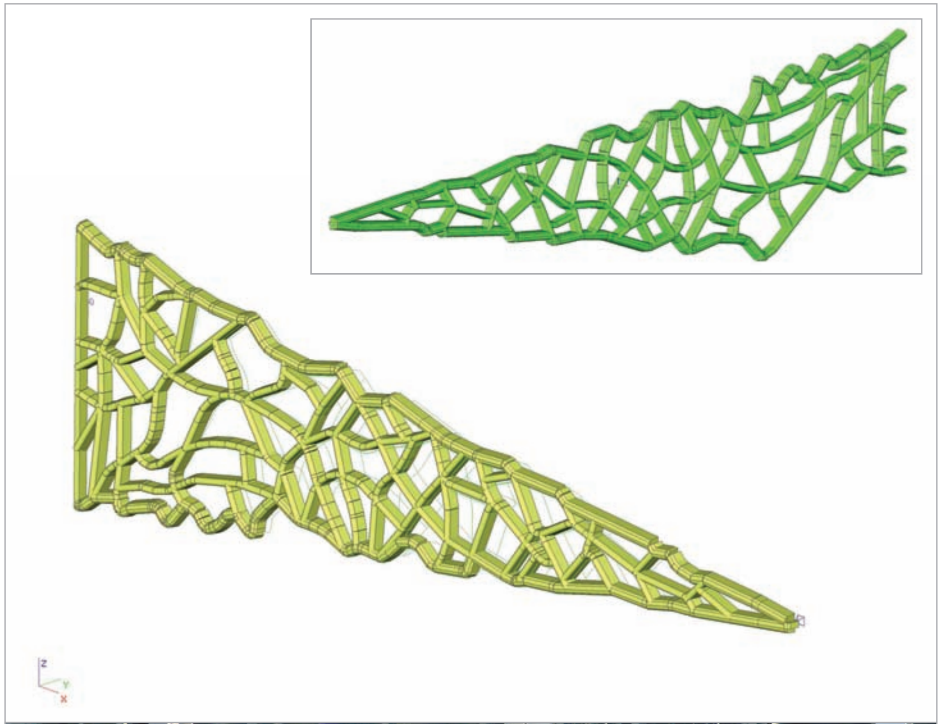
Notre bureau a à son actif des études de conception et d'exécution des structures d'ouvrages très diversifiés. Nous participons aussi au développement des nouveaux matériaux, comme nous le faisons actuellement avec les BFUP (Bétons Fibrés à Ultra hautes Performances).
SICA participe à d'autres projets d'envergures :
L'exécution de la partie G.O du Stade Vélodrome à Marseille en 1998
L'exécution de la façade et la couverture BFUP du Stade Jean Bouin en 2013
La maîtrise d'œuvre des SILO d'Arenc à Marseille en 2011 : Restructuration en bureaux et salle de spectacle.

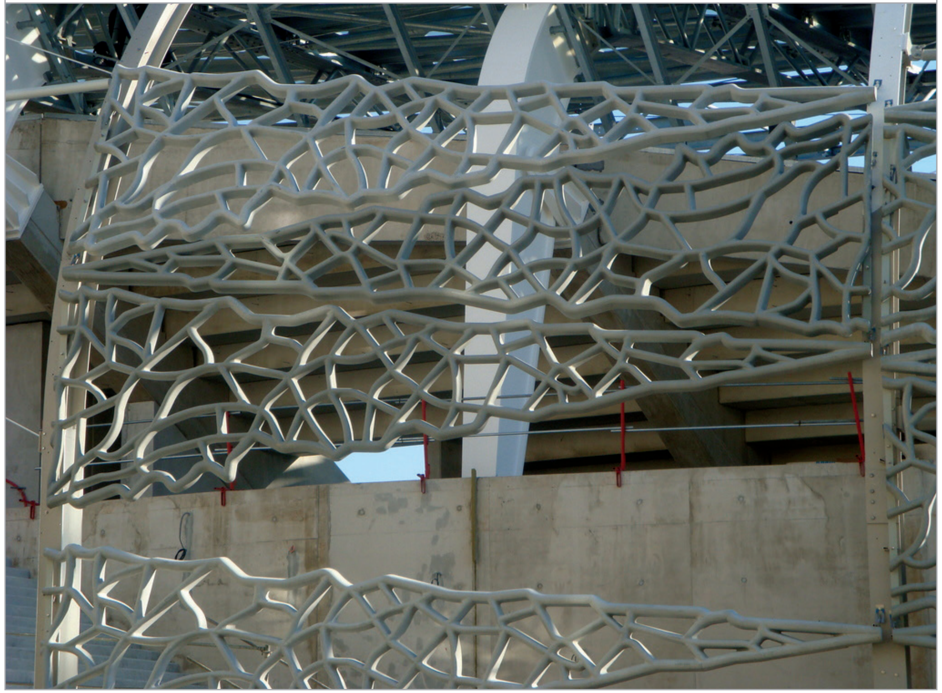
Project information

Owner	Mairie de Paris
Architect	Rudy Ricciotti
General Contractor	Leon Grosse, Bonna Sabla (préfabriquant des panneaux BFUP)
Engineering Office	Lamoureux & Ricciotti ingénierie (BFUP)
Location	Paris, France
Construction Period	10/2010 to 06/2013

Short description | **Roof and Facade BFUP Jean Bouin Stadium**

The Jean Bouin Stadium is located in front of the ''Parc des Princes''. The stadium's external surface is composed of 11,500 m² of waterproof roofing and a 95,000 m² frontage.
The roofing, designed by the architect Rudy Ricciotti and "Thrust in Design", creates lighting effects by means of a glass pierced slab. The transition between the roofing and the hairnet facade is realised by openwork panels of 35 mm thickness.
The Jean Bouin Stadium is a smart arrangement of several materials (concrete, steel, UHPFC and glass).

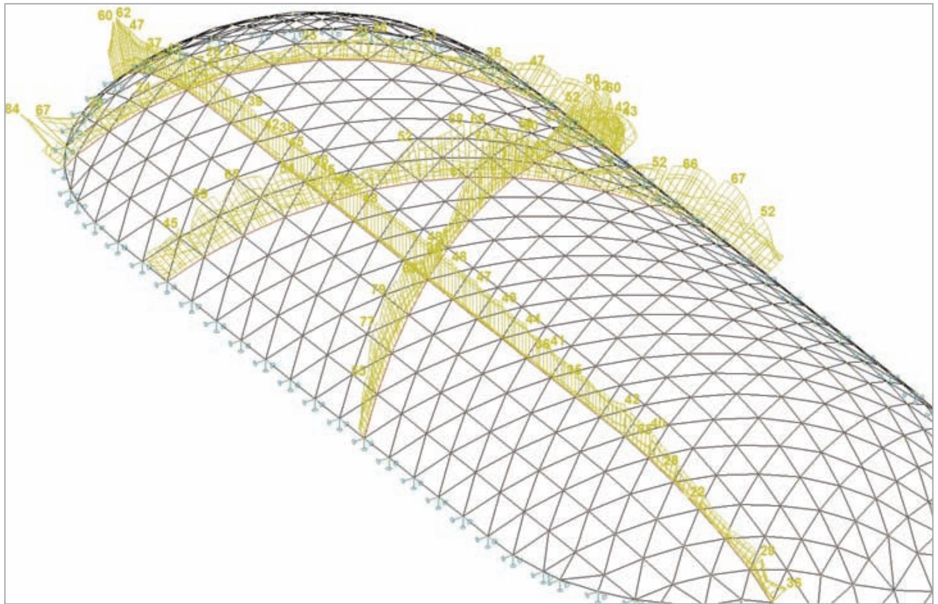




Category 4: Special Projects

4

Bank of Moscow - Moscow, Russia



Introduction

The Bank of Moscow desires a building in Moscow with a complete glass skylight and a big glass façade above a concrete structure.
The skylight measures approximately 16 m x 38 m, while the height of the façade is +/-25 m. The structure has to be very transparent, thus minimising it. The glass of the roof is heated to prevent any snow from settling. The glass of the façade is fire-resistant glass.

Task

We were asked to calculate the design for a very thin structure with glass panels on top for the skylight and the façade.
We designed a structure with square tubes as beams. In order to fit the cables of the heating system for the glass panels, we designed holes in the square tubes. The crossings of the beams are round tubes, so the tubes could be connected by welding.
In collaboration with Pauwels Glassprojects and our Russian client, the contractor Poits, we designed a system that works like meccano. The idea was that there would be no (or much less) measuring on-site and in the production factory to avoid mistakes and to speed up the production time as well as the time for the erection.
So we made the tubes with small protrusions and the round tubes with cut-outs to fit into each other. We designed this system in a way that meant the orientation of the beam could not be mistaken. If turned around, the beam would not fit into the cut-outs of the tube. The cut-outs of the tube were also designed so that they could not be turned. When some elements are assembled together, the next beam has to glide in from the top. To ensure they could glide in from the top, some beams had protrusions on top that fit into the cutouts on top of the tubes. This way the beams and the tubes could be put together without mistake. Since we made the construction drawings ourselves, and the tubes and beams were cut by laser-cutting, we gained full control of this and there was a perfect fit.
That was the initial part. In the second part, we designed for each section that was transportable (half of the width of the skylight and about 3 m in its expanse) a caliber so that when the elements were put together the position and the angles were 100% correct without any required measuring.
In the main section (a metric tonne), the calibers could be used for several parts, at the edges, and for the façade the calibers could be used for just for one part.
To avoid measuring (and mistakes in measuring) during the process of assembling and welding, the calibers were also made with cut-outs and protrusions.
The whole system worked perfectly and the precision and the erection time on-site were fabulous.
Both the glass panels and the aluminium and rubber parts were designed together with the drawings.
This rendered the taking of measurements on-site unnecessary. Exactitude in the sizes of the glass panels was achieved by drawing.

Application Scia Engineer

The calculation of the stresses in the profiles and the displacements were carried out with Scia Engineer. As the shape of the skylight is a circular part that comes close to a reverse cable line, the forces in the beams are mainly normal forces. But because a circular part is not a cable line, and because of the asymmetric wind loads, there are moments in the beams and crossings. This requires a 3D-model, for which Scia Engineer was very useful.
We also used a separate 3D model in Scia Engineer to calculate the stresses and deformations of the pre-welded parts when hung on the crane during the erection and to define the points of leverage.
The calculation of the glass panels was also performed with Scia Engineer with the plate-module.

Software: Scia Engineer

Stabilogics

Contact Eddy Hermans
Address Stationsstraat 162
3150 Haacht, Belgium
Phone +32 16 60.99.92
Email eddy@stabilogics.be
Website www.stabilogics.eu

STABILOGICS

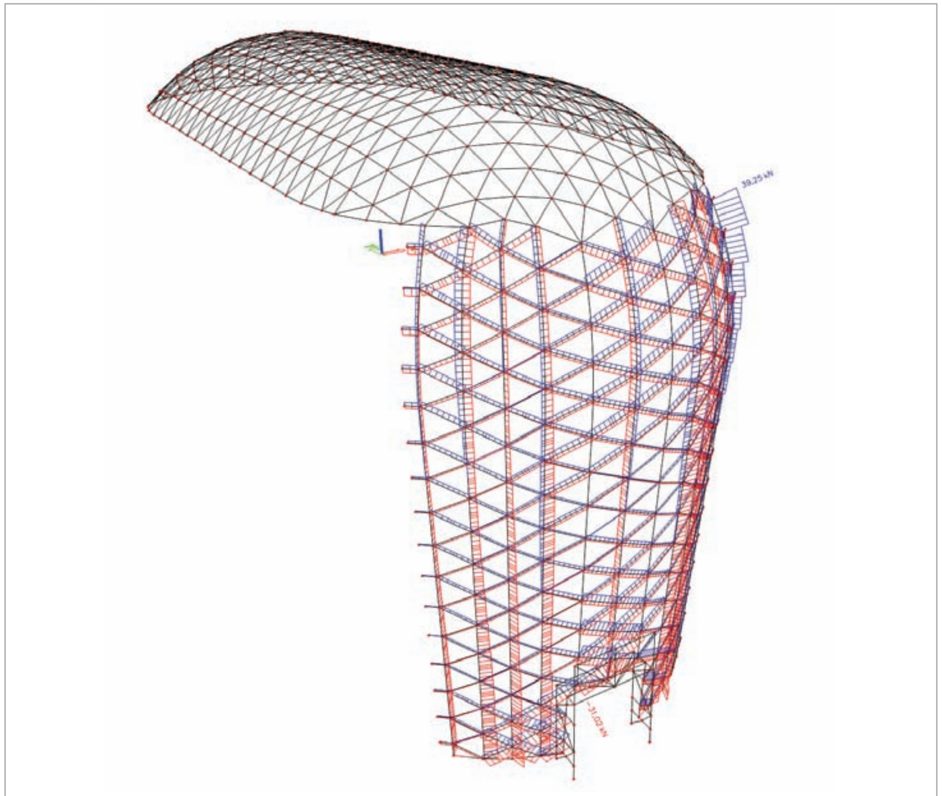
Stabilogics is an engineering bureau with great experience in stability-calculations.
Since its foundation in 2000 we are growing and are now a team of 13 people. This makes us very flexible and able to anticipate very fast what the best solution for requested projects is. With this team of experts we are also able to design and calculate very big projects. We have experience all over the world and are able to produce designs in accordance with most standards and codes: Eurocode, with all European national annexes, British standards and others. We have always put the execution of the building as the top priority. We work from design to execution, producing workshop-drawings of steel- and concrete-structures. To avoid problems on the building-site we ensure that the structure can be assembled and erected as we have designed. The strict preparation and further processing along with the great eye for details lead to efficient and smooth execution on site.
With the help of Scia Engineer (all modules), complemented with self-written calculation-programs, our calculations are supported with accuracy and speed.

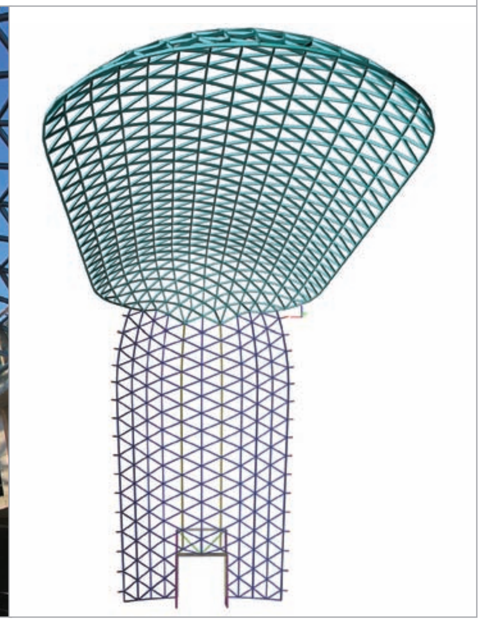
Project information

Owner	Banc of Moscow
General Contractor	POITS
Engineering Office	Stabilogics
Location	Moscow, Russia
Construction Period	04/2012 to 01/2013

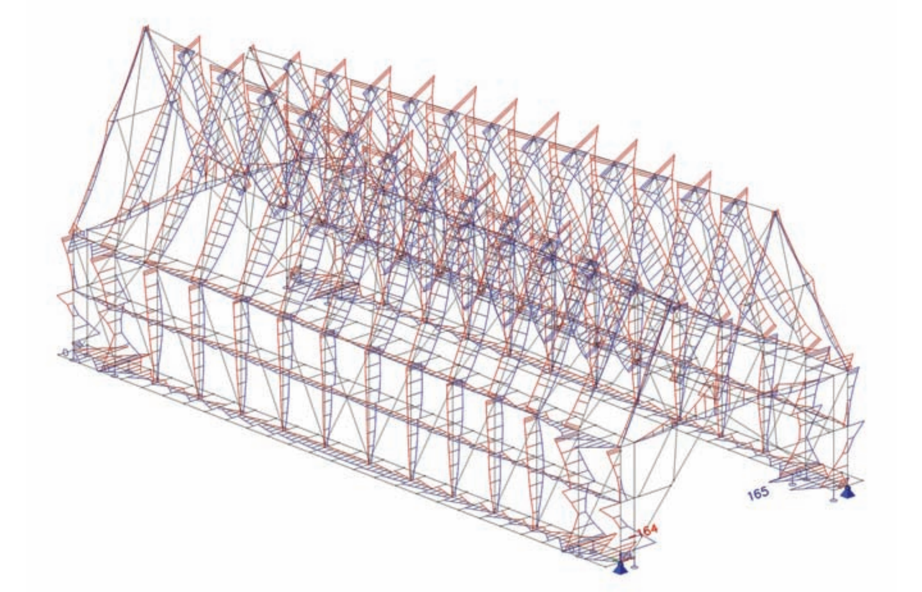
Short description | **Bank of Moscow**

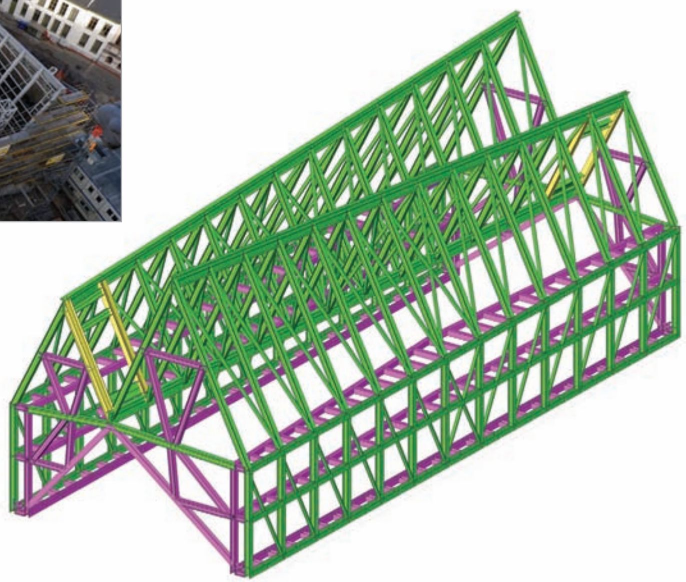
The project comprises of a concrete building with an impressive skylight and glass façade. The building will be situated in the centre of Moscow and will be an eye-catcher from the street perspective.
Stabilogics calculated the steel structure for the skylight, façade and glass panels. The company also made the production drawings for the steel, rubber, aluminium and glass panels.
Moreover, Stabilogics designed an assembling system that ranged from its drawings for the laser-cutting to its drawings of the glass panels. This was achieved in a way that meant no dimension had to be measured on-site nor during the production.





City Hall “Kobra” - Gent, Belgium





Introduction

In the redesign of the central squares “Korenmarkt” and “Emile Braunplein” and nearby streets in Ghent, a City Hall had to be designed. The hall is the central, eye-catching feature of the masterplan.A steel structure of about 40 m x 15 m, the hall is set on top of four concrete pylons at the corners. The façade and roof are covered with wood both externally and internally. The roofs and the long façades have been given an extra cover of glass panels above the wood.
The roof consists of two ridges and a gutter in the middle, but it is slightly diagonal, so the façades at the front and the back have two asymmetrical tops. This asymmetry refers to the façade of the City Hall and has a proportion that is close to the golden ratio of Da Vinci. Since both of the façades are identical (not mirrored but rotated), the building has achieved a symmetrical shape which feels very asymmetrical. This accentuates the strictness.
Through the wooden surface, small rectangular windows give out, making for a very strong effect especially on the inside.

Assignment

Our mission was to calculate the steel structure and design it through to execution. The mission was later enlarged to include the calculation of the wood, the inox glass supports and the glass panels.

When calculating the steel structure, the “fun” lay in the fact that the asymmetrical structure generated certain forces that had to be controlled to maintain the straight line of the long façades.
The ridge-beams and the gutter-beam were a help, but the frame-working of profiles over the two ridges and the scupper were essential in the stability of the structure. The frames are supported by frames in the long façades containing adjustable cables. The side forces on the façades were taken by the horizontal Vierendeel-frames. The front façades were designed as a close web of profiles, as a solid structure.Given that the façades are open, there were a lot of cases of wind in which each had an influence on another part of the structure.

On the steel structure, on top of steel purlins, wooden girders were assembled. A multiplex with cutouts for the 1,550 little square windows was placed on these wooden girders. On the multiplex, on top of a waterproof layer, twills in tropical hardwood (afrormosia) were fixed with afrormosia planks in between, to create a smooth wooden surface. The calculation of the wood and the connections was another engineering challenge.
On the afrormosia twills, inox supports were fixed. These support the glass panels. In the interior of the hall, oak planks were assembled on wooden girders. One challenge was to create the bottom of the gutter like a straight sharp knife. Another was to design the fixations in a way that achieved fire-resistance.
For all the individual parts - the steel structure, multiplex, afrormosia, oak, inox supports, and the glass panels and square windows - we made the stability calculations, while we also made the production drawings. By working this way, we were able to adjust each component to each other.
The fire-resistance of the structure was another important consideration.

Application of Scia Engineer

A structure like this can only be calculated by a complete 3D-model. In this way the total influence of all external loads can be considered and the global stability can be calculated, with the accompanying deformations, as also the details of connections.
Because of the very specific and strict architectural design the freedom in stability-design was very limited and one of the main challenges was to make the structure possible to assemble.

The module in Scia Engineer was also very useful to determine which profiles has to be treated with fire-resistant paint.

Software: Scia Engineer

Stabilogics

Contact Eddy Hermans
Address Stationsstraat 162
3150 Haacht, Belgium
Phone +32 16 60.99.92
Email eddy@stabilogics.be
Website www.stabilogics.eu

STABILOGICS

Stabilogics is an engineering bureau with great experience in stability-calculations.
Since its foundation in 2000 we are growing and are now a team of 13 people. This makes us very flexible and able to anticipate very fast what the best solution for requested projects is. With this team of experts we are also able to design and calculate very big projects. We have experience all over the world and are able to produce designs in accordance with most standards and codes: Eurocode, with all European national annexes, British standards and others. We have always put the execution of the building as the top priority. We work from design to execution, producing workshop-drawings of steel- and concrete-structures. To avoid problems on the building-site we ensure that the structure can be assembled and erected as we have designed. The strict preparation and further processing along with the great eye for details lead to efficient and smooth execution on site.
With the help of Scia Engineer (all modules), complemented with self-written calculation-programs, our calculations are supported with accuracy and speed.

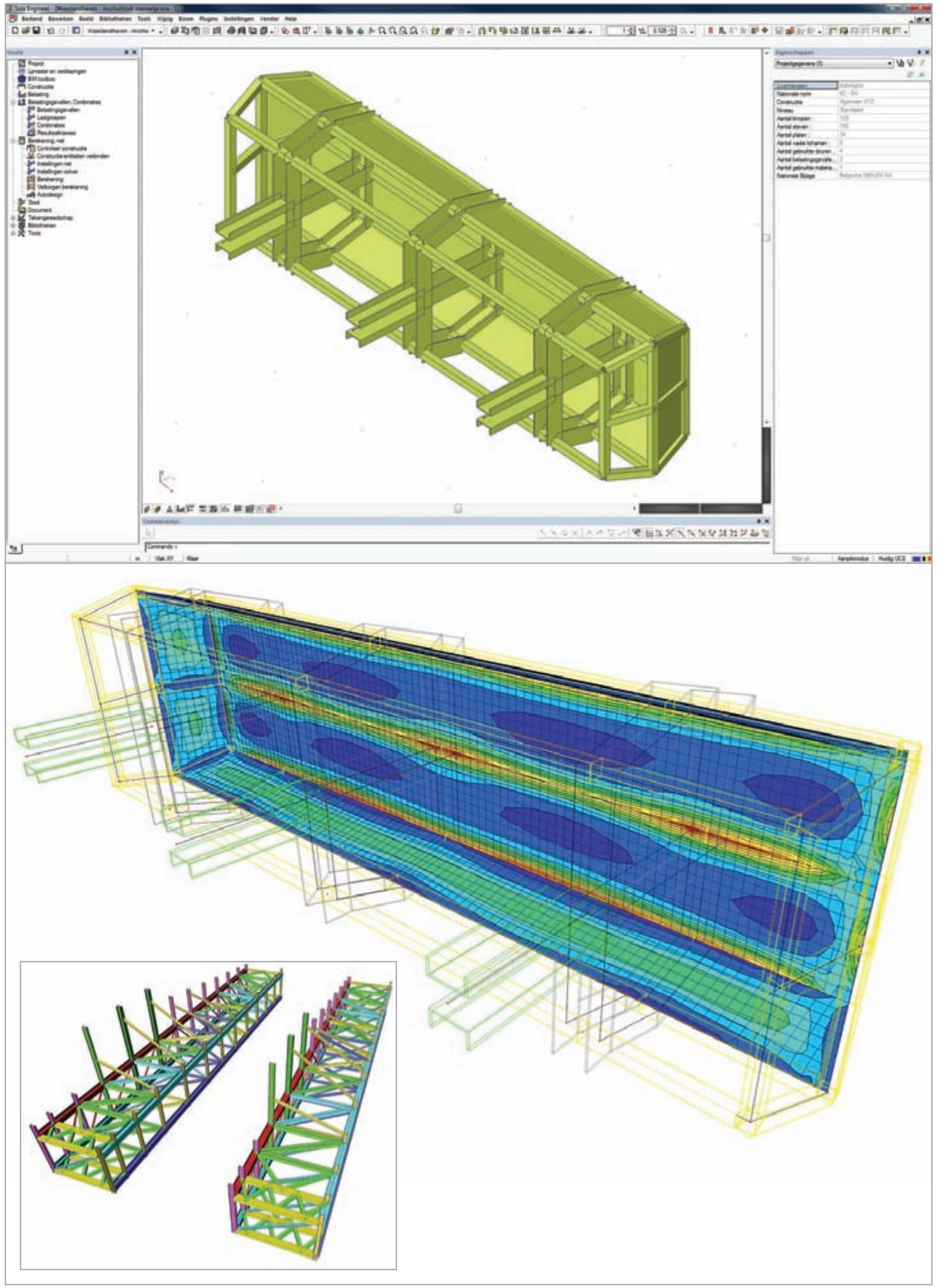
Project information

Owner	Stad Gent
Architect	Robbrecht & Daem / Van Hee
General Contractor	Besix
Engineering Office	Stabilogics
Location	Gent, Belgium
Construction Period	12/2010 to 09/2012

Short description | **City Hall "Kobra"**

The project fits the masterplan for the redesign of the central squares in the city centre of Ghent.
The building is the eye-catching centrepiece of the project. It will be used for several events organised by the City of Ghent. Under the building, there is commercial space occupied by businesses such as cafés and restaurants.
The design is strongly symmetrical with two ridges and asymmetrical front-façades.
The hall is formed with a steel structure on concrete pylons and is covered with wood and glass.
Stabilogics conducted the calculation for the complete structure through to execution. This included the processing of the drawings for the production of steel, wood, inox and glass.

Sea Lock Waasland-Port - Antwerpen, Belgium



Introduction
With the expansion of the port of Antwerp, a second sea lock is being constructed in the Waasland-port. This is the complex of docks on the left bank of the river Scheldt. The works started on 24 October 2011, with the finishing date scheduled for 2016. The “Deurganckdoksluis” is 500 m long and 68 m wide. It is a huge undertaking. The construction involves an enormous number of excavations, and huge amounts of concrete and reinforcement steel.

Assignment
For the building of the concrete retaining walls, we were asked to design a reusable steel formwork for the bottom-part of the L-shaped retaining walls.

For the retaining walls on the side of the “Deurganckdok”, the formwork needed to be 26.5 m long, for the “saskolk” 25.5 m long and for the retaining walls on the other side of the Waasland-port, 16.5 m long.
Furthermore, for each formwork-length there had to be 3 formworks available, while each had to be easily transformable from a female formwork into a male formwork. Since the concrete of the retaining walls had to be made in parts of 20 m, the individual parts could not move, so they were designed with male and female parts that fit to each other.

Its clear that a classic formwork could not be used because of the huge pressure of the concrete. To fulfill the assignment as economically as possible, only three formworks were made. These were assembled with steel profiles and steel plates on the concrete side.
The formworks were assembled as female formworks and in the cutouts “male fitting parts” were inserted and firmly fixed. Each formwork is a 3D-frame of 16.5 m (Waasland-port), onto which on one side a 3D-frame of 9 m (for Saskolk) and on the other side a 3D-frame of 1 m can be assembled (to become the longest formwork for the “Deurganckdok”).

Moreover, on top of the formwork the necessary platforms and stairs needed to be installed in order to enable work on the reinforcement and the concrete.

Furthermore there was a limitation on the horizontal displacements of a maximal 30 mm on the total formwork of 26.5 m and we had to consider that the steel formwork was supported on the sheet piling by jacks and that the position of these jacks had to be adjustable at random.

Application of Scia Engineer
The specific construction of these steel formworks taught us that a complete 3D-model in Scia Engineer was necessary. Scia Engineer made it possible to calculate the 3D-frames in a global way in detail. The exact positions of the jacks on the sheet pilings and the side-profiles of the steel formwork had a significant influence on the horizontal displacement in the middle of the formwork under the hydrostatic pressure of the fresh concrete. The 3D-modelling ensured that this influence was monitored in detail, which made it possible to design the side of the 3D-frame in an efficient way.
We had some freedom to design the frame behind the steel plates of the formwork and because it was important to tune the design to the position of the working-platforms and stairs, it was a good thing that we could easily adjust the geometry of the frame in the Scia-model to evaluate the consequences.
Scia Engineer proved to be a high-performance tool in addressing this.

Software: Scia Engineer

Stabilogics

Contact Eddy Hermans
Address Stationsstraat 162
3150 Haacht, Belgium
Phone +32 16 60.99.92
Email eddy@stabilogics.be
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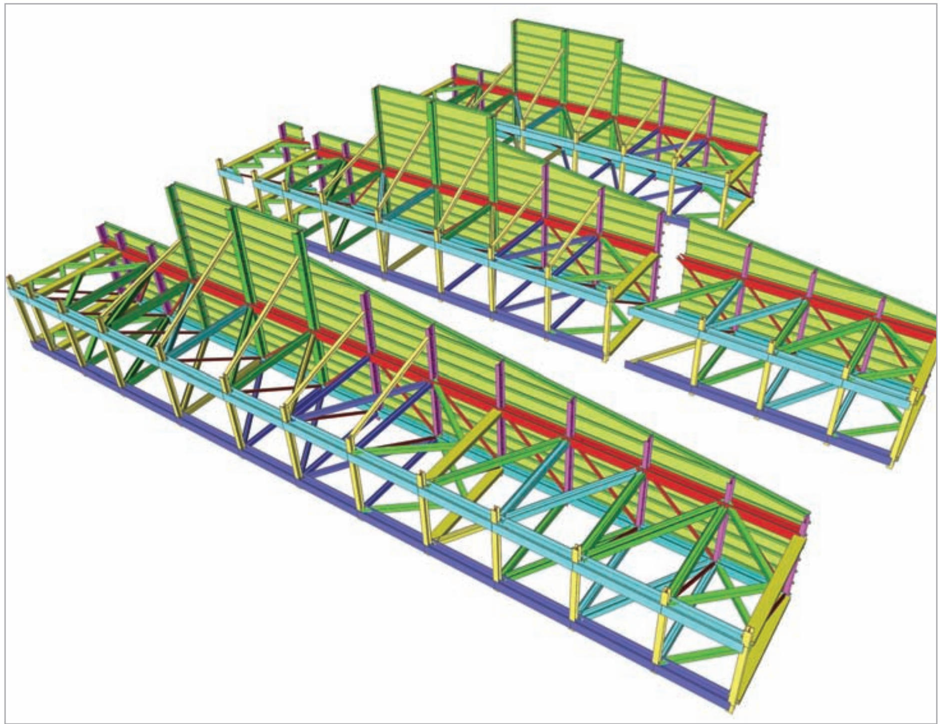
With the help of Scia Engineer (all modules), complemented with self-written calculation-programs, our calculations are supported with accuracy and speed.

Project information

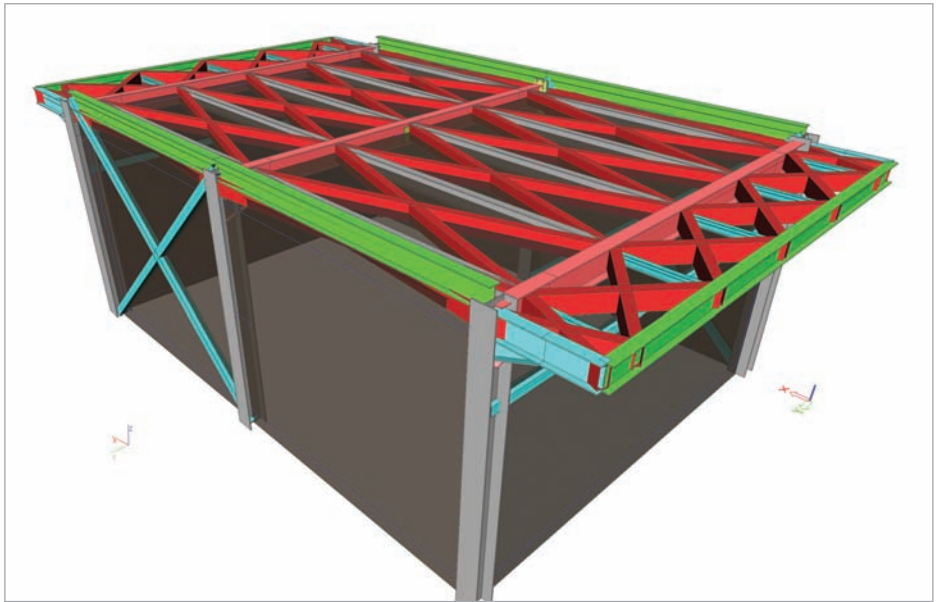
Owner	Vlaamse overheid
General Contractor	THV Waaslandsluis
Engineering Office	Stabilogics
Location	Antwerpen, Belgium
Construction Period	10/2011 to 12/2016

Short description | **Sea Lock Waasland-Port**

The construction of a second sea lock in Waasland-port was indispensable to the expansion of the port of Antwerp. The “Deurganckdoksluis” is a huge project with a length of 500 m and a width of 68 m. For the construction of the L-shaped side walls of the lock, a formwork had to be designed. This formwork had to meet a number of specific requirements. Three different lengths of formwork were needed for the different parts of the sea lock (16.5 m, 25.5 m and 26.5 m), and for each of these lengths a ‘male’ as well as a ‘female’ form was needed. Another requirement was a maximal horizontal displacement of 30 mm for the longest part, while the position of the jacks had to be adjustable at random for adequate horizontal support to the sheet piling.
Scia Engineer 3D models proved to be high-performance calculation models for this task and very clear control models for the construction consortium THV Waaslandsluis.



Sports Club with Two Tennis Courts - Crete, Greece



Introduction to the project
This small composite structure of steel and concrete is part of a larger concept that includes two tennis courts set amid a beautiful landscape full of trees and plants. The tennis courts were designed according to international rules and specifications.
The building will accommodate a small café and the locker room for the tennis players. It was designed with the provision for a roof garden in the future.

Description of the project
The main structure was designed with steel members and concrete slabs.
The composite beam module was used in order to design the secondary beams to reduce the weight of these members.

Approach
The distances between the columns of each frame were about 5.80 m. The distances between the frames were set at 3.90 m. The dimensions of the building were 10.25 m x 5.80 m and the height was approximately 3.50 m. We used HEA260 for the columns, IPE300 for the main beams, IPE220 and IPE100 for the secondary beams and an SHS cross-section for the roof bracing. To simulate the diaphragm of the slab, HEA1000 for the roof bracing was used, without weight and mass, using property modifiers.

The use of Scia Engineer in this project
We designed the 3D model, using the Line Grid option. The next step was to make all the load cases, load groups and load combinations.

Load groups:
1. G : permanent
2. S : snow
3. W : wind
4. E : seismic
5. Q : variable
6. T : temperature

Load cases:
1. LC1 : self-weight
2. LC2 : permanent
3. LC3 : variable
4. LC4 : snow
5. LC5 : seismic X
6. LC6 : seismic Y
7. LC7 : thermal +
8. LC8 : thermal -
9. LC9 - LC24 : 3D Wind Load Cases

Load combinations:
1. EN-ULS
2. EN-SLS
3. EN-seismic X
4. EN-seismic Y

For the wind loads we used the 3D wind option to calculate with accuracy all the zones according to EN1991-1-4.
For the permanent and the snow loads we used line forces on beams.
We used thermal loads (+/-20 degrees) for columns and the round beams. These members will be outside the building.
The seismic design followed EN1998.
After the linear and the modal analysis, we conducted section and unity checks for all the members. We also proceeded to a serviceability check for the main beams.

Software: Scia Engineer

TE, Consulting Engineer

Contact Tsolakis Eleftherios
Address Soudas Av. 23, Crete, Chania
73200 Chania, Greece
Phone +30 2821081846
Email etsolakis@hotmail.com
Website www.etsolakis.gr

TSOLAKIS N. ELEFTHERIOS
Civil Engineer, M.Sc. NTUA
CONSULTING ENGINEER

TE, Consulting Engineer was founded in 2007 to provide the following civil engineering services:

- Technical advice for the development of new buildings.
- Technical advice for the restoration/upgrading of existing buildings.
- Structural design of new buildings (concrete, steel, composite, timber and masonry structures).
- Structural design and assessment of existing buildings.
- Supervision of civil engineering works.

Due to our experience and our knowledge, we can accomplish even the most exacting projects.

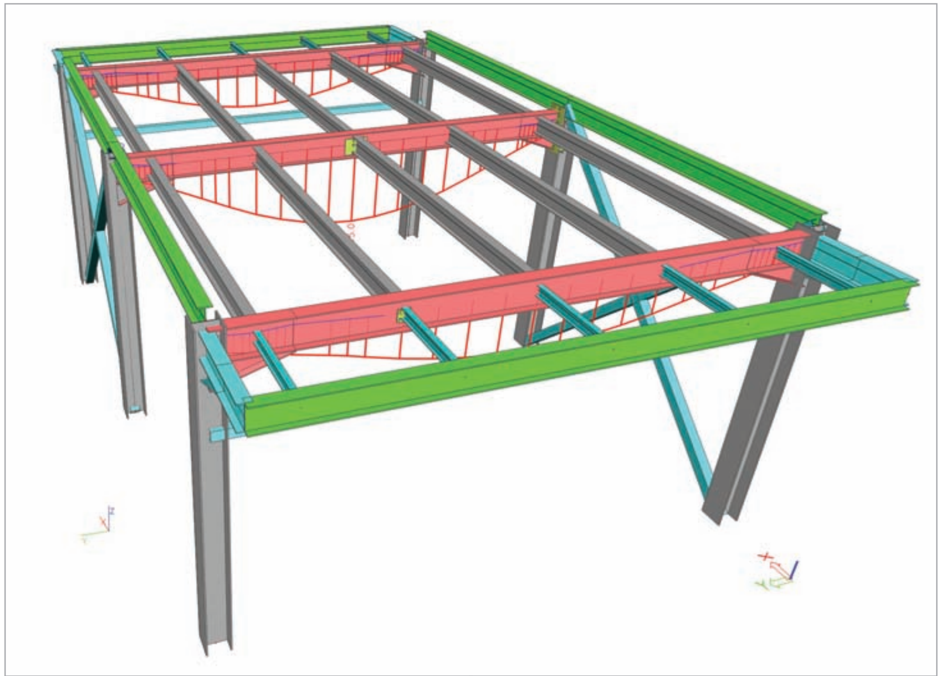
TE, Consulting Engineer has managed over 60 projects in Greece.

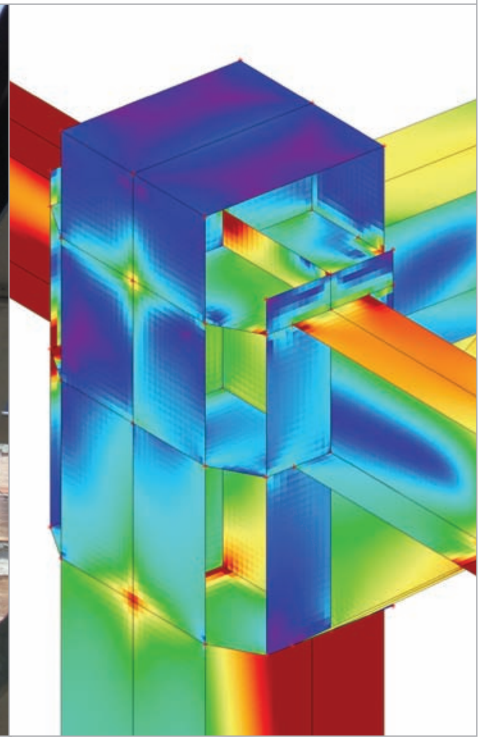
Project information

Owner	M. Thymianou & SIA
Architect	Tsolakis Eleftherios
General Contractor	Morfometal
Engineering Office	TE, Consulting Engineer
Location	Crete, Greece
Construction Period	08/2011 to 09/2011

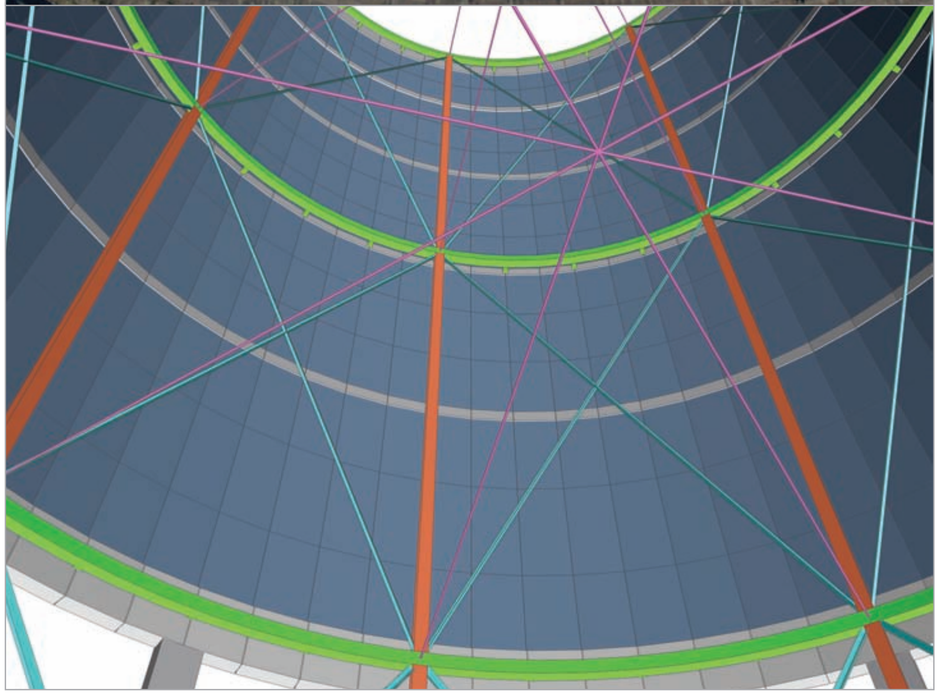
Short description | **Sports Club with Two Tennis Courts**

This small composite structure of steel and concrete is part of a larger concept that includes two tennis courts set amid a beautiful landscape full of trees and plants.
The tennis courts were designed according to international rules and specifications.
The building will accommodate a small café and the locker room for the tennis players. It was designed with the provision for a roof garden in the future.





Instandhouding Koeltorens Beringen Mijn - Beringen, België



Introductie

De voormalige steenkoolmijnsite in Beringen wordt getypeerd door drie cilindervormige koeltorens welke heden ten dage niet meer in gebruik zijn. De oudste dateert van 1923 en de meest recente van 1942. Sinds 1993 zijn ze alle drie opgenomen in de lijst van beschermde monumenten en zijn daarmee, samen met een vierde helicoïdale koeltoren op dezelfde site, de enige beschermde koeltorens van Vlaanderen. Naar aanleiding van het herbestemmingsproject be-MINE en het aangrenzend in aanleg zijnde zwembad, werd een stabiliteitsstudie uitgevoerd om een bijkomende levensduur te garanderen.

In-situ onderzoek en een stabiliteitstudie van de bestaande toestand voor de drie cilindrische koeltorens wezen uit dat het stabiliseren en restaureren van de structuur noodzakelijk is. Vooral de horizontale stabiliteit onder windbelasting bleek ontoereikend. Een oplossing werd gevonden in het aanbrengen van een nieuwe staalstructuur aan de binnenzijde van de torens die voldoende rigide is om weerstand te bieden tegen horizontale vervormingen van de bestaande constructie. Hierdoor zal tevens de visuele impact aan de buitenkant beperkt blijven.

Technische gegevens

De drie koeltorens zijn gebouwd volgens het Monneyer principe, waarbij de cilindrische mantel is opgebouwd uit prefab betonpanelen, waarbij op verschillende hoogtes ringbalken zijn voorzien. Het geheel zet aan op een massieve onderste ringbalk welke ondersteund wordt door een aantal kolommen op funderingszolen. De diameter van de torens varieert van 12 tot 21 m en de hoogte van 24 tot 38 m.

De nieuwe staalstructuur die aan de binnenzijde van iedere structuur wordt geplaatst, bestaat uit acht verticale kolommen waartussen drie cirkelvormige ringen worden gemonteerd. Deze ringen worden door middel van acht trekstaven vormvast gehouden zoals een fietswiel. Het geheel wordt voorzien van windverbanden in de zijvlakken en wordt aangezet op een nieuwe funderingsbalk.

Sofware en model

Voor de berekening van zowel de bestaande betonstructuur als de nieuwe staalstructuur is gebruik gemaakt van het softwareprogramma Scia Engineer 2012.

Hierin zijn beide structuren in 3D gemodelleerd om een correct beeld te krijgen van de krachtsafdracht op de mantel en op het vervormingsgedrag.

Na het modelleren van de staalstructuur in het model van de bestaande toestand werd duidelijk hoe beide structuren samenwerken en kon de positieve impact, rekening houdend met de werkelijke stijfheid van beide entiteiten correct begroot worden.

Software: Scia Engineer

Technum Hasselt

Contact Wim Van Audenhove
Address Ilgatlaan 23
3500 Hasselt, Belgium
Phone +32 11 28 86 00
Email wim.vanaudenhove@technum-tractebel.be
Website www.technum.be

TECHNUM
SMART & SUSTAINABLE INFRASTRUCTURE

Technum is de entiteit van Tractebel Engineering gespecialiseerd in “Smart & Sustainable Infrastructure” en heeft verschillende kantoren in België.
Tractebel Engineering is een studie- en adviesbureau met meer dan 100 jaar expertise in energie- en infrastructuurprojecten, vestigingen in twaalf landen (hoofdzetel in Brussel) en projecten in meer dan 80 landen. Het stelt het meer dan 3.300 mensen te werk en heeft een omzet van ongeveer 500 M€. Samen met Tractebel Engineering beheersen we de volledige levenscyclus van energie- en infrastructuurprojecten, gaande van haalbaarheidsstudies tot de ontmanteling.

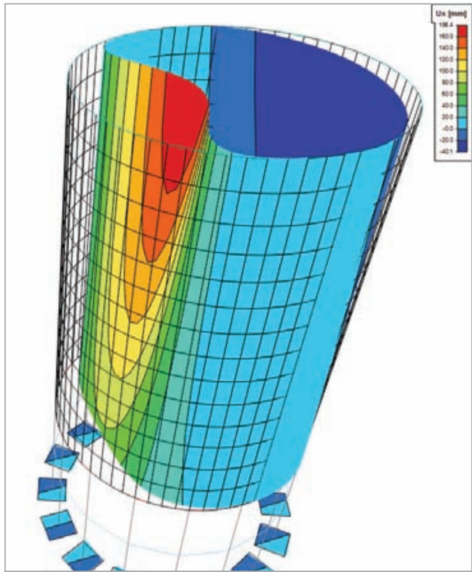
Smart & Sustainable Infrastructure is ons motto. We zorgen voor kwaliteitsvolle, duurzame oplossingen via een intelligente integratie van infrastructuur, gebouwen, mobiliteit en energie efficiëntie. We combineren op een creatieve wijze al onze competenties en spelen op die manier een sleutelrol in de ontwikkeling van de steden en de leefomgeving van de toekomst.

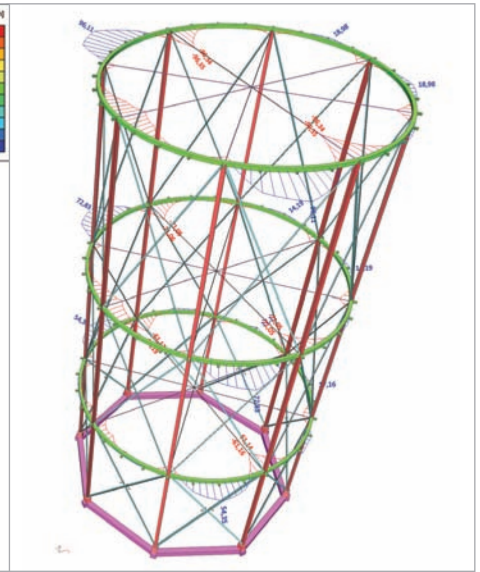
Project information

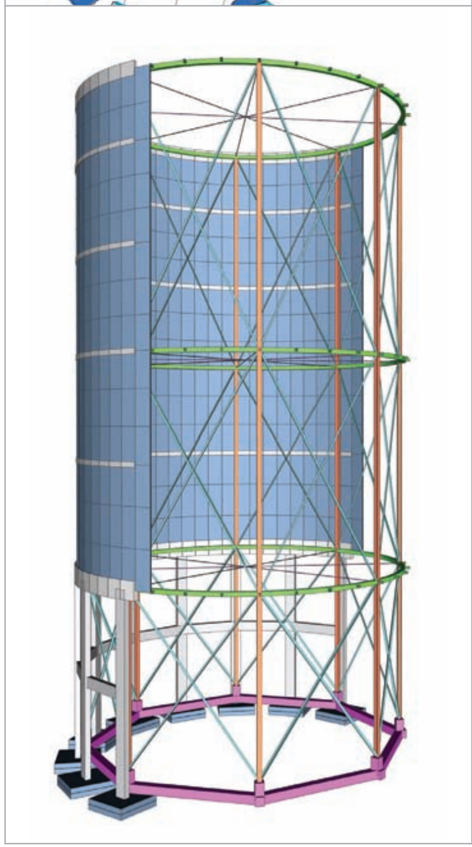
Owner	be-MINE nv
Architect	Bernard Lambert - Koplamp
General Contractor	THV Mijnbouw
Engineering Office	Technum Hasselt
Location	Beringen, Belgium
Construction Period	06/2012 to 12/2012

Short description | **Conservation Cooling Towers Beringen Mine Site**

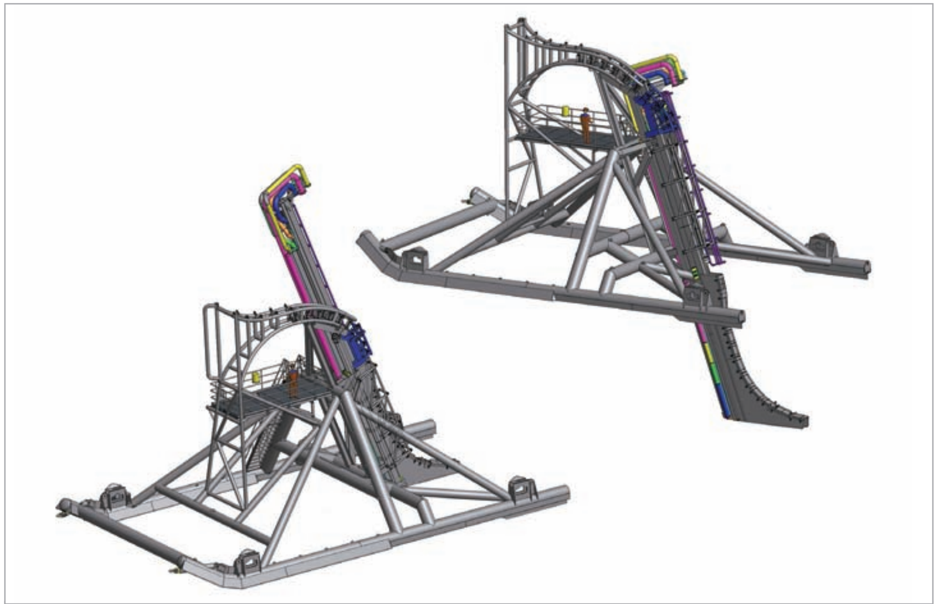
In 1989, the last ‘coal chariot’ emerged from the mineshaft of the Beringen Mine site. It signalled the end of coal mining in the Kempisch area, an activity that had left its mark over half a century. Since the end of the mining, the buildings at the site have been neglected and time has taken its toll on them. In the context of the redevelopment project be-MINE, three cylindrical cooling towers at the site must be preserved. These cooling towers thus need to be reinforced with an internal steel structure to ensure their stability. The Scia Engineer software was used to check the stability of both the existing and new structures.

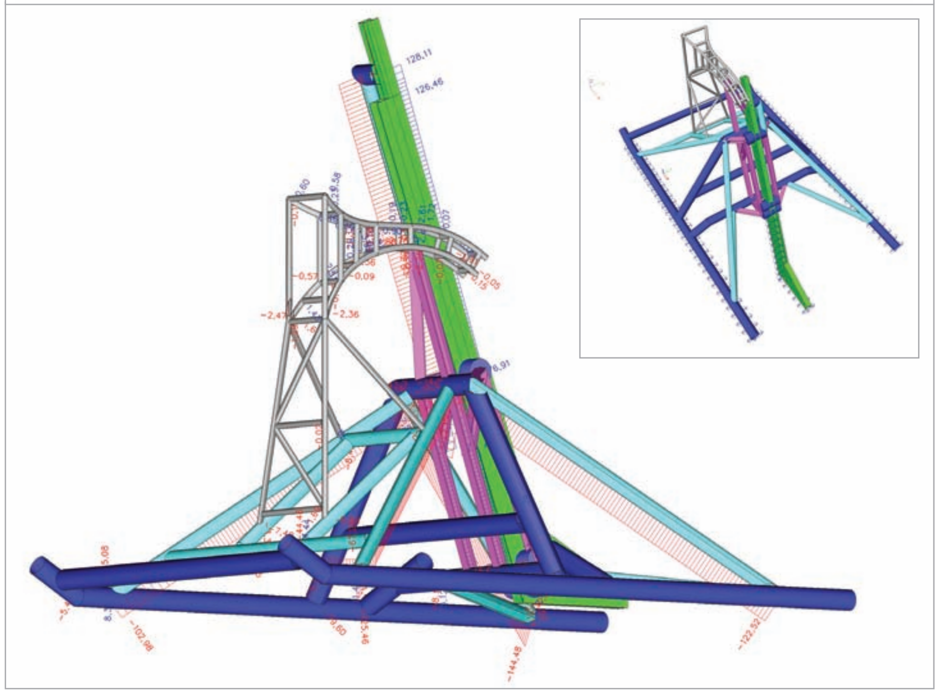






Burial Sledge System II - Rotterdam, The Netherlands





Project description

When offshore windfarms are built, offshore cables have to be installed to transfer the energy to the shore. These cable routes frequently cross shipping lanes and for reasons of protection these submarine cables often have to be buried. Due to seabed migration, cable owners installing new cables more often demand an increase of the burial depth in order to reduce the risk of exposure to, and eventual damage and failure of, the submarine cable. Deeper burial depths are potentially problematic since there are few tools available to realise such burial depths. The Burial Sledge System II (BSS-II) is a system that can realise burial depths of up to 6 m under the seabed.

The submarine cable that has to be installed under the seabed is deployed from a cable-laying barge to the lance mounted on the sledge. Fluidising in front of the lance makes the soil weak enabling the lance to install the cable at the agreed depth. Because the jetting lance is mounted on a sledge which rests on the seabed, the cable burial operation is a lot less dependent on the actual sea state which makes the operations safer for the cable as well as the personnel.

Geometry

- Height: 18 m
- Length: 20 m
- Beam: 12 m

Specifications

- Max. pulling force: 100 t
- Burial depth: Max. 6 m under the seabed
- Weight of sledge: 50 t
- Weight of lance: 20 t
- Water depth: 0-30 m

Loads on the sledge

- Wave forces
- Current forces
- Soil reaction forces during burying
- Pulling forces on the sledge, while moving

Software used for this project

- Scia Engineer: structural analysis and design according to the Eurocodes.
- Autodesk inventor: 3D Mechanical Design Software.
- Orcaflex: dynamic analysis of offshore marine systems.

The use of Scia Engineer

The whole structure of the sledge, combined with the lance, was modelled with Scia Engineer.
The calculation included several aspects:

- The modelling of the complex BSS II structure.
- The modelling of the sledge soil foundation at the seabed-level with non-linear springs to schematise the soil.
- The modelling of the environmental forces (like waves and current forces, depending on the water depth) into static load cases (the dynamic calculation was performed with ‘orcaflex’).
- A non-linear calculation of different load cases and situations (different water depths, different lance depths under the seabed).
- A Eurocode check of the steel structure.

Challenges with Scia Engineer

- The complex structure.
- The modelling of the non-linear soil at the seabed level.
- The modelling of the non-linear soil under the seabed.
- The modelling of the environmental forces.

Visser & Smit Hanab bv

Contact Bertus Span
Address Rietgorsweg 6
3356 LJ Papendrecht, The Netherlands
Phone +31 78 6417222
Email b.span@vshanab.nl
Website www.vshanab.nl

Visser & Smit Hanab

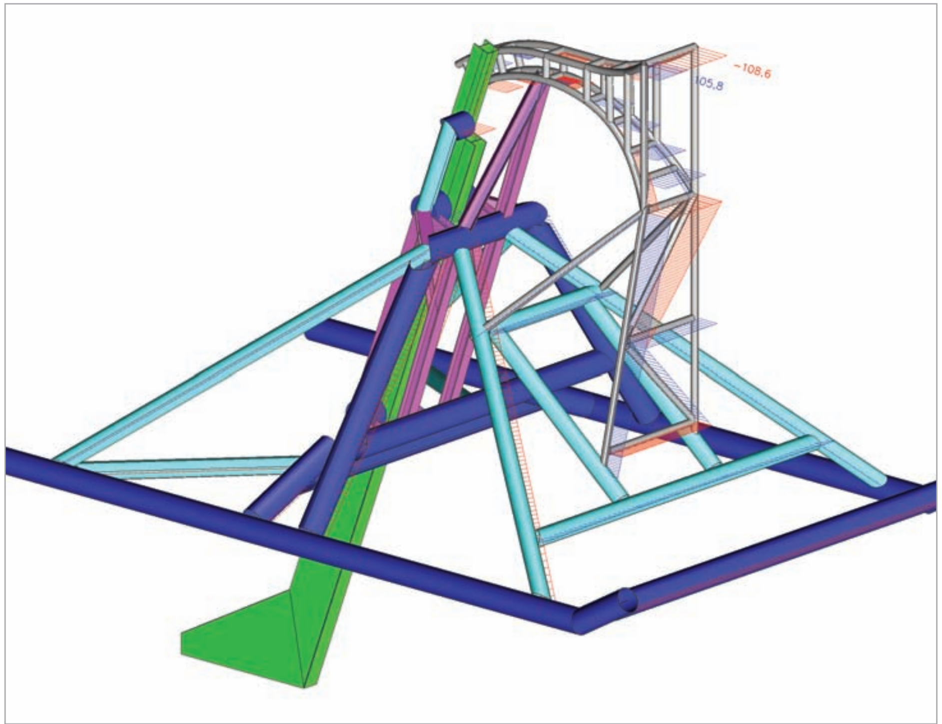
Visser & Smit Hanab is a contractor which develops, builds and maintains connections, networks and installations for water and energy. Safety is a top priority. Our goal is to expand our position in the total building process, and to be the best in our professional field. Thanks to our staff, our advanced techniques and our customer-oriented approach, we are able to provide our customers with the optimum support to meet their needs. Together with our customers, we are making a contribution to a sustainable society. In everything we do, we are customer-oriented, progressive, honourable and professional.

Project information

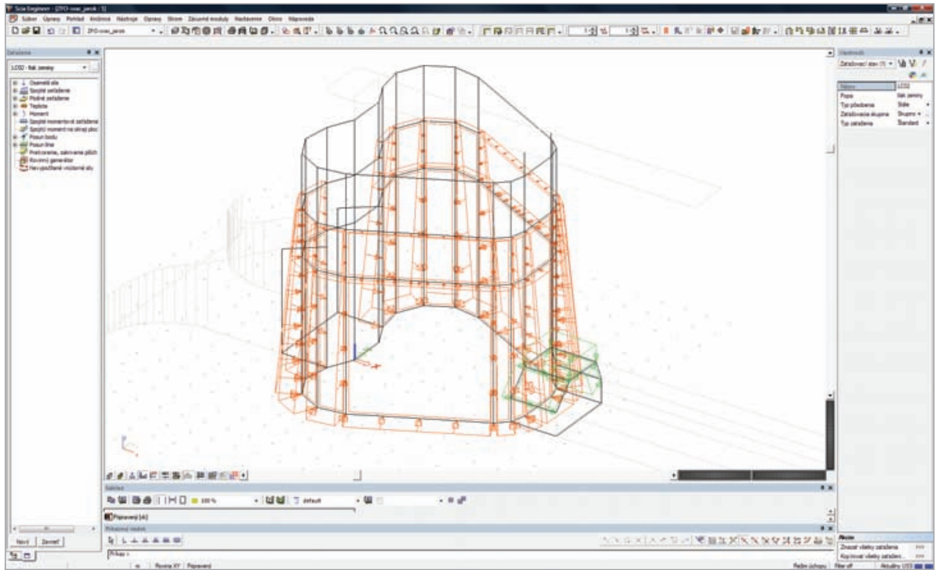
Owner	VSMC
Architect	Visser & Smit Hanab
General Contractor	VSMC
Engineering Office	Visser & Smit Hanab
Location	Rotterdam, The Netherlands
Construction Period	03/2012 to 03/2013

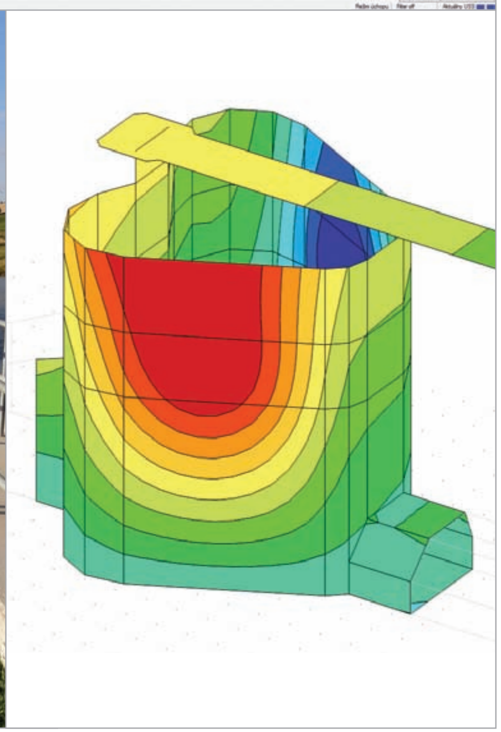
Short description | **Burial Sledge System II**

When offshore windfarms are built, offshore cables have to be installed to transfer the energy to the shore. These cable routes frequently cross shipping lanes and for reasons of protection these submarine cables often have to be buried. Due to seabed migration, cable owners installing new cables more often demand an increase of the burial depth in order to reduce the risk of exposure to, and eventual damage and failure of, the submarine cable. Larger burial depths are potentially problematic since there are few tools available to realise such burial depths. The Burial Sledge System II (BSS-II) is a system that can realise burial depths of up to 6 m under the seabed.



Protipovodňová nádrž - Turá Lúka, Myjava, Slovensko





Úvod
Združený objekt slúži na odvádzanie vôd z nádrže poldra do toku pod hrádzou. Je tvorený z piatich železobetónových blokov dĺžok 7,0 m., 11,30 m., 14,8 m., 14,8 m. a 9,0 m. Z návodnej strany je objekt tvorený vežou, v ktorej sú osadené dve dnové výpuste, hradené kanalizačnými zasúvadlami DN400, otvorom na neregulované prepúšťanie bežných prietokov toku DN200 a bezpečnostným priepadom. Nad bezpečnostným priepadom je obslužná lávka ústiaca na korunu hrádze, z ktorej je možné regulovať uzávery dnových výpustí. Za odbernou vežou je navrhnutá odpadová štôlňa. Štôlňa je ukončená vývarom. Na vtoku a na vývare sú krídla, ktoré sledujú tvar hrádze.

Geologické podmienky
Pre tento projekt bol vypracovaný orientačný inžinierskogeologický prieskum. Geologické pomery sú charakterizované dvoma vrtmi. Základová škára sa nachádza približne 2,5 m pod terénom vo vrstve štrku ílovitého až hlinito kamenitej sute.

Výpočtový model
Objekt veže má srdcovitý pôdorysný tvar v korune rozmerov 8,7 x 9,6 m. Z vtokovej strany má napojenie na krídla a z výtokovej je napojenie na odpadovú štôlňu. Základová doska je hrúbky 800 mm. Steny sú pri päte hrubé 1.200 mm a do výšky 6,2 m sa zužujú na hrúbku 400 mm. Potom až po bezpečnostný priepad sú konštantnej hrúbky 400 mm. Priepadová hrana je zaoblená. V stenách sú otvory 2 x 400 mm – dnové výpuste a 200 mm na prepúšťanie bežných prietokov. Nad bezpečnostným priepadom je obslužná lávka šírky 1,4 m a hrúbky 250 mm. Lávka pokračuje na korunu hrádze a je uložená na železobetónovú stenu, na dva piliere 0,2 x 0,4 m a na korune hrádze na základový prah.
Tvar veže bol modelovaný ako priestorová dosko-stenová konštrukcia. Oblúkové steny boli nahradené lomenými stenami. Podložie bolo zadefinované podľa inžiniersko-geologického prieskumu pomocou modulu Soilin, ktorý iteračnou metódou vypočítal pružné podopretie objektu. Výpočet vnútorných síl a premiestnení daného objektu konštrukcie bol urobený programom Scia engineer – metódou konečných prvkov.
Odpadová štôlňa má vnútorný svetlý rozmer 3,0 x 2,1 m. Hrúbka základovej dosky je 800 mm. Steny sú hrúbky od 700 po 450 mm. Stropná doska je v najhrubšom mieste hrúbky 800 mm. Vonkajšie hrany sú skosené v troch lomoch.
Zasypané zvislé konštrukcie sú zaťažené zemným tlakom v pokoji. Strop odpadovej štôlne je zaťažený plným zemným tlakom na výšku od 2,0 po 8,0 m. Zemný tlak v pokoji je vypočítaný pomocou programu Geo – 5.
Lávka je zaťažená užitočným náhodilým zaťažením p = 5 kN/m^2.Na korune hrádze je uvažované s pohybom vozidiel o náhradnom rovnomernom zaťažení 19 kN/m^2. Steny sú zaťažené vodným tlakom.

Software: Scia Engineer

Vodotika a.s.

Contact Miroslav Malast, Ján Cigánek
Address Bosákova 7
85104 Bratislava, Slovakia
Phone +421 2 624 10 376
Email vodotika@vodotika.sk
Website www.vodotika.sk

Vodotika a.s. je projektovo–inžiniersky ateliér, ktorý bol založený v roku 1990. V súčastnosti je v spoločnosti zamestnaných viac ako 20 ľudí rôznych špecializácii ako napr. architekti, statici, projektanti TZB a hydrotechnici.

Projektová činnosť je rozdelená na dve časti a zahŕňa všetky stupne projektovej dokumentácie a prípravy:

- Projektovanie pozemných stavieb (bytové domy, polyfunkčné domy, rodinné domy)
- Projektovanie vodohospodárskych stavieb (malé vodné elektrárne, priehrady, poldre, ochranné nádrže)

Jednou z najvýznamnejších referencií v projektovaní vodohospodárskych stavieb je návrh malej vodnej elektrárne v Dobrohošti (inštalovaný výkon 1,8 MW), ktorá bola postavená minulý rok a naša spoločnosť bola hlavným projektantom stavby, Vodotika má EN ISO 9001 certifikát od roku 2003.

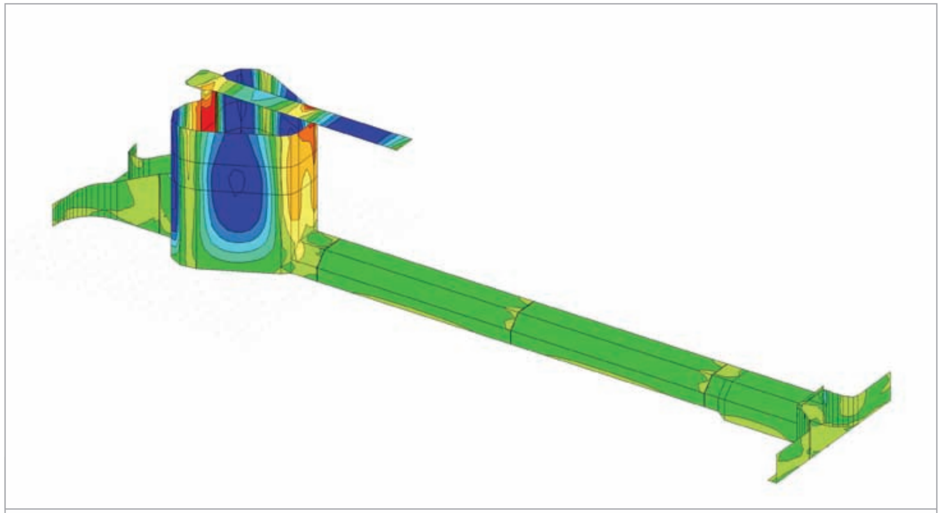
Project information

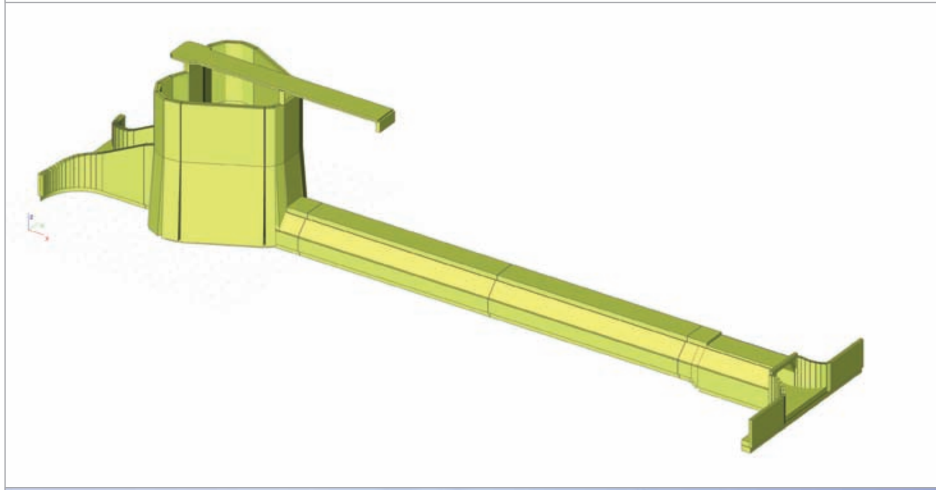
Owner	Mesto Myjava
Architect	Vodotika a.s.
General Contractor	Vahostav-SK, a.s.
Engineering Office	Vodotika a.s.
Location	Turá Lúka, Myjava, Slovakia
Construction Period	05/2010 to 09/2010

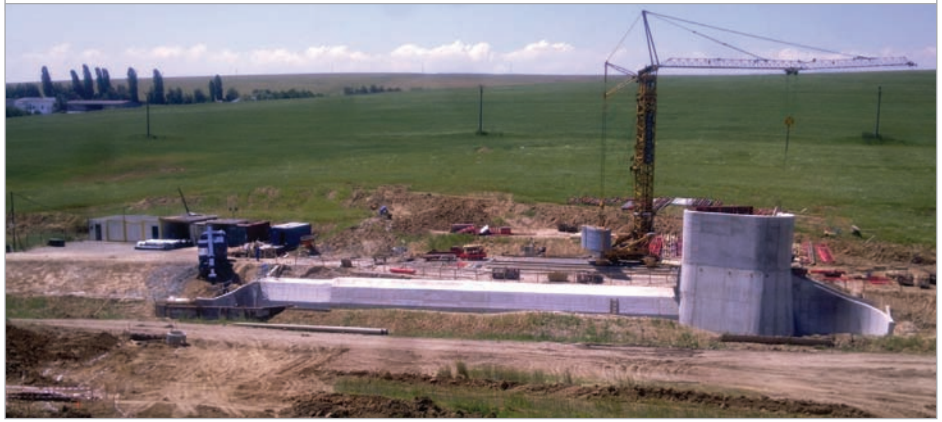
Short description | **Flood-Control Reservoir**

The Flood–control reservoir “Svacenický jarok” was built in Turá Lúka (Myjava). A complex hydraulic facility, it is designed in four parts: the intake structure, the intake tower, the outlet tunnel under the dam and the inlet facility. The service catwalk is designed for the top of the intake tower.

The construction is divided into five dilatation units and the load bearing system of the complex hydraulic facility is comprised of reinforced concrete walls and created slabs. The thickness of the concrete constructions was designed according to the solution for relevant load cases (the water pressure and the soil strain). For the static analysis of the reinforced concrete structure, the 3D model was created using Scia Engineer.



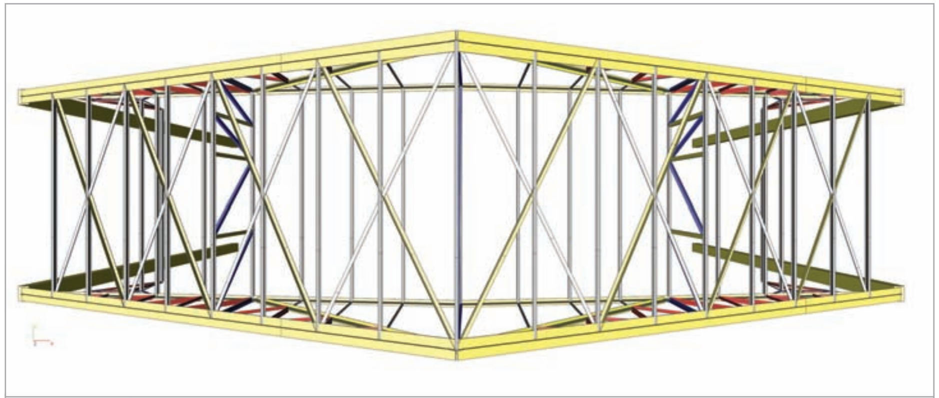


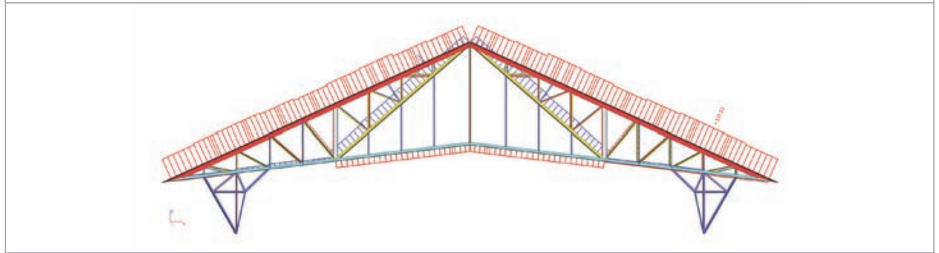


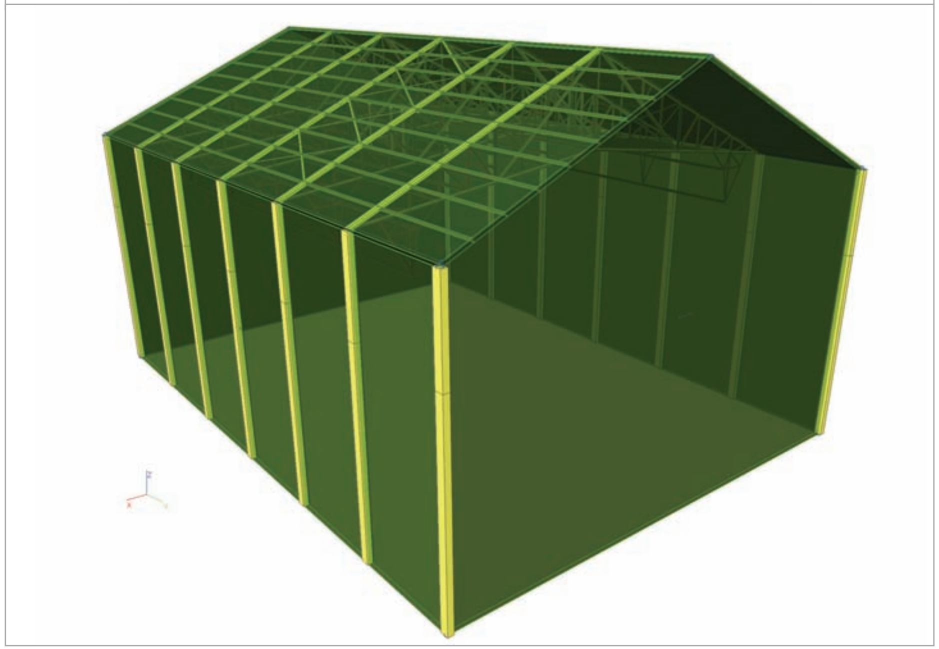
Category 4: Special Projects

4

Restoration Study Roof Trusses Cinema Roma - Antwerpen, Belgium







General information

Cinema theatre 'Roma' is a social monument from 1928, constructed in a typical Art Deco style by Alfons Pauwels. Its hall has a capacity of over 2,000 seats and is suitable for multifunctional use. During the venue's first decades (1930-1955), its captivating architecture achieved great popularity and put Antwerp on the European map as 'the place to be' for film lovers.
After the theatre's closure in 1982, the building became subject to decay and vandalism with the result that it became a real eyesore in the neighbourhood.
In 2002, after 20 years of inactivity, local association Rataplan decided to restore the building to its former glory. Following the help and efforts of hundreds of volunteers and material support from local companies, cinema theatre Roma reopened in 2003.

However, in order to meet the current standards and comfort requirements of a modern cinema theatre, it has become necessary to make a few adjustments. The roof covering has to be renewed with the integration of heavier safety glass, while the stucco ceiling needs an insulation layer, and a theatre bridge (for fixing spotlights) has to be positioned beneath the truss structure. Moreover, there is an interesting challenge where the use of renewable energy sources, in particular the installation of solar panels, is concerned. The adjustments will require additional loads on the historic roof structure.

Based upon the outcome of the recalculation, it will be clear if the original truss structure is suitable to bear the increased load. If this is not the case, an appropriate renovation proposal will be necessary.

Structural concept

The building is designed as a reinforced concrete skeleton structure with bracing brick masonry. The span of the hall (25 m) is realised with a series of steel trusses, which are embedded with their endpoints in the concrete columns. With a length of about 27.5 m, this steel structure consists of 5 Polonceau trusses with a distance between each truss of approximately 5.5 m. Each single truss is composed of combined profiles (rectangular, L or I-section) which are interconnected with bolts or rivets. One single rivet connection can be considered as an internal hinge, but whenever multiple rivets are applied in one node, they are modelled as a rigid connection. In the longitudinal direction, I-beams are embedded into a brick wall. It is hard to tell whether the support is a hinge or a fixed connection. We chose a hinge as boundary condition because this is a safe assumption.

Loading scheme

Eurocode 1 determines the permanent loads:

- Self weight of the steel structure
- Self weight of roof finishes
- Self weight of windows
- Self weight of the white stucco ceiling
- Self weight of theatre bridges

Eurocode 1 was used to determine the variable loads:

- Snow
- Wind
- Service loads

The complete analysis was carried out according to current European standards: Eurocodes EN1990, EN1991 and EN1993.

Results

Using the most unfavourable load combination, the compression forces in the upper and lower rafters become too large, with buckling as a result. As a consequence, the steel structure will fail. However, the roof trusses remain intact. Presumably, this is due to the strict safety factors of Eurocode 1 or the fact that the most unfavourable load combination has never occurred.

After a recalculation of the additional loads, it is obvious that the structure has to be reinforced. According to our restoration philosophy, it is essential to preserve the maximum amount of authentic material and to maintain the original geometry. By adding mass to the intermediate sections, the outer rafters will no longer be subject to buckling.

Master Thesis student: Yves Govaerts

Software: Scia Engineer

Vrije Universiteit Brussel

Contact Johan Blom
Address Pleinlaan 2
1050 Brussel, Belgium
Phone +32 2 629 29 55
Email johan.blom@vub.ac.be
Website www.vub.ac.be

Vrije Universiteit Brussel is a dynamic and modern university with two parkland campuses in the Brussels Capital Region. We offer a quality education to more than 11,000 students.

Thanks to the expertise of more than 150 research teams and its strategic location, VUB is your ideal partner for prestigious research and education with an outlook on Europe and the world.

In the Architectural Engineering (ARCH) department, the research is focused on “the use of engineering tools to create architecture”. This approach is applied in three topics that ask for interdisciplinary studies: the design of lightweight structures, the issue of re-use, and the incorporation of 4D design.

Within the Re-Use group, the main objective is to reconcile the authenticity of the architectural heritage with the modern standards that require more comfort and safety.

Project information

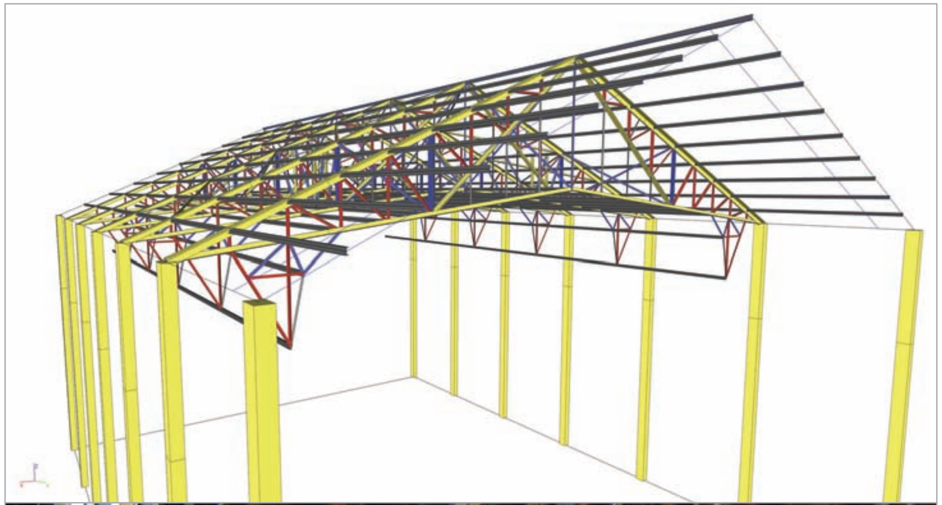
Owner	Maurice De Busser
Architect	Alfons Pauwels
Location	Borgerhout, Antwerpen, Belgium
Construction Period	11/1927 to 11/1928

Short description | **Restoration Study Roof Trusses Cinema Roma**

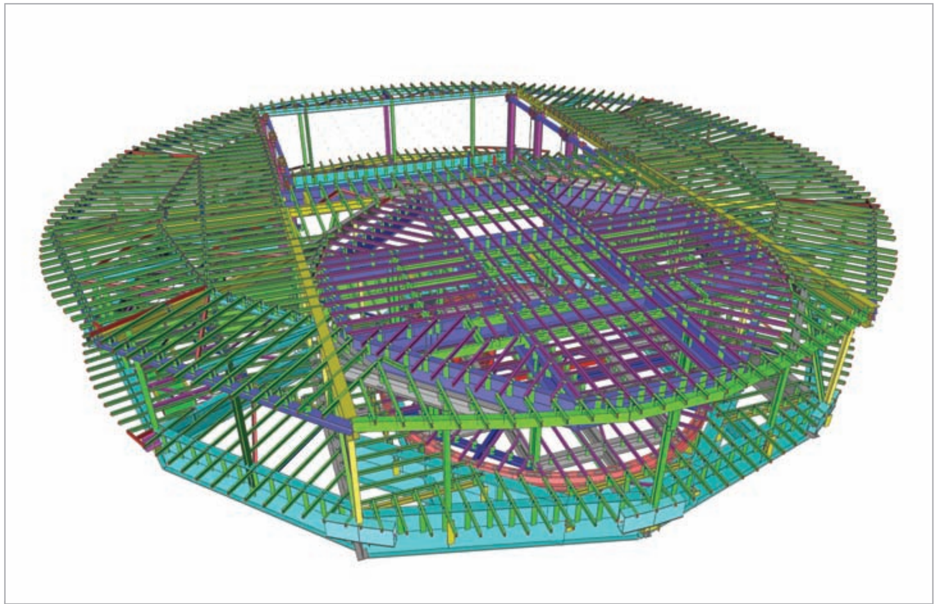
This project concerns a structural restoration study of the roof trusses of cinema theatre ‘Roma’ (1928) in Antwerp, Belgium. This extract is derived from a student report which was prepared for the course ‘Stability of structures 3: finite elements’. A 3-dimensional computational structural analysis is carried out which allows for the verification of the current structural state.

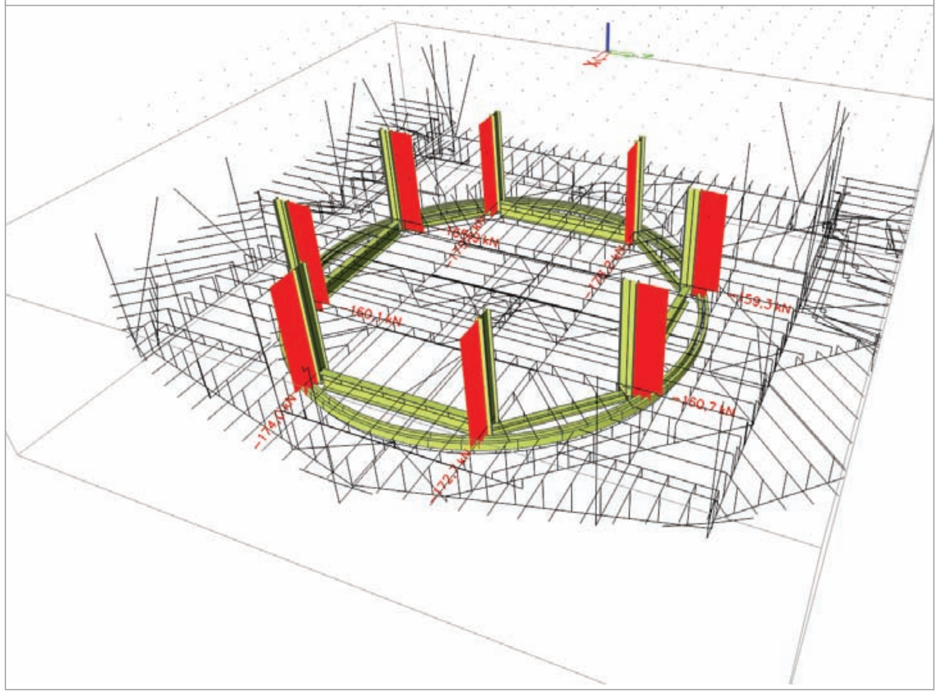
Moreover, in order to meet the current standards and comfort requirements of a modern cinema theatre, it is necessary to place additional loads on the historic structure.

The study includes the determination of the symmetrical and asymmetrical load cases and the evaluation of efficiency under all load combinations. The complete analysis is carried out according to current European standards: Eurocodes EN1990, EN1991 and EN1993.



Revolving stage, New Music Theatre - Linz, Austria





The revolving stage in the new Music Theatre Linz is a two-storey steel construction with an outer diameter of 32 m. The height of the two storeys is 3.95 m and is adapted to the surrounding building. The space underneath the revolving stage is used as an underground parking garage.

The upper storey forms the floor of the main stage and is mounted onto the lower storey by lean columns. The lower storey provides the primary supporting structure for the revolving stage. 36 crane rail wheels are mounted to the outer diameter of the lower storey and run on a crane rail, 100 m in length. The centre of the revolving stage is formed by a ball bearing slewing ring with a diameter of 2.55 m, which ensures the exact rotary movement and provides additional vertical support.

In addition to supporting the steel structure of the revolving stage, the ball bearing slewing ring at its centre also provides rotary feedthroughs for electricity, data connections and the sprinkler system.

Stage wagons which are positioned with an accuracy of 1 mm can drive onto the upper storey of the revolving stage. The revolving stage itself thus requires a 1 mm accuracy of positioning under any predefined operating condition. Furthermore, this poses the requirement of minimal deformations of the steel structure. In combination with a limited overall height of only 5.9 m, this leads to a massive steel construction of the lower storey.

The large revolving stage has a built-in smaller revolving stage with an outer diameter of 15 m which can be used during performances. Furthermore, three lifting platforms that cover the total area of 15 m x 12 m are located on the large revolving stage.

The drive components for the rotation of both revolving stages as well as for the lifting movement of the platforms are positioned in between the main girders of the lower storey. The available space is thus used in an optimal way. However, the accessibility of the drives is rather complicated. Due to the limited space, the construction of the lower storey proved to be very complex.

The large revolving stage is rotated by eight friction wheel drives which run on the crane rail's concrete base. The maximum circumferential speed is 1.0 m/s. The small revolving stage is supported by 66 plastic reels which ensure a very smooth revolving movement. Eight reels are powered directly and provide a maximum circumferential speed of 1.0 m/s. In order to lift the three platforms, 12 rope winches are mounted to the large revolving stage.

The weight of the revolving stage - including the installed equipment - amounts to approximately 502 t. The dynamic payload for rotary movement is 158 t, while the static payload is 493 t.

Revolving stages provide a fast and easy way to transform the scenery in theatres. Alternatively, many theatres have installed lifting platforms for the same purpose. Both methods have their specific advantages which usually cannot be combined. However, the solution designed for the Musiktheater Linz enables it to alternately use the benefits of the small revolving stage or the lifting platforms simply by rotating the large revolving stage.

The design of the provisional draft started in 2010. In 2011, the structural design of the revolving stage was completed. The assembly and putting into operation was finished in 2012.

The structural analysis of the revolving stage was performed with Scia Engineer. The model consisted of almost 5,000 single beams and 42 load cases which were used in 29 load combinations to provide the necessary structural certification.

Software: Scia Engineer

Waagner-Biro Austria Stage Systems AG

Contact Florian Oberlehner
Address Leonard-Bernstein-Strasse 10
1220 Wien, Austria
Phone +43 1 28844-533
Email florian.oberlehner@waagner-biro.com
Website www.waagner-biro.com

Waagner-Biro Stage Systems is one of the leading stage machinery companies worldwide. The company offers the complete spectrum of stage equipment for full and medium sized theatres, as well as mobile building equipment for arenas, stadiums and multi-purpose halls.

As a supplier of complete solutions, Waagner-Biro Stage Systems designs and implements complex stage facilities in opera houses, theatres, concert halls, event centres, multi-purpose and exhibition halls, congress centres, stadiums and arenas.

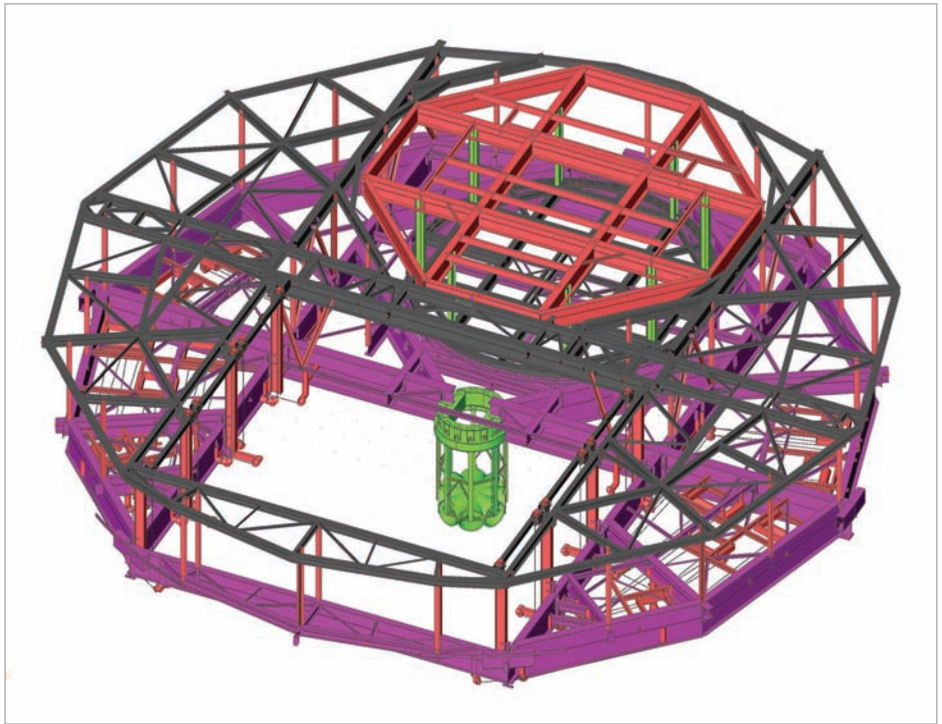
Special stage equipment for cruise liners, computer-aided stage control systems, mobile building equipment (e.g. automated telescopic stands for the highest technical demands), telescopic soundproof walls, mobile air cushion seating systems, soundproof board systems as well as special lifting platforms and stage wagon systems round off the delivery spectrum of Waagner-Biro Stage Systems.

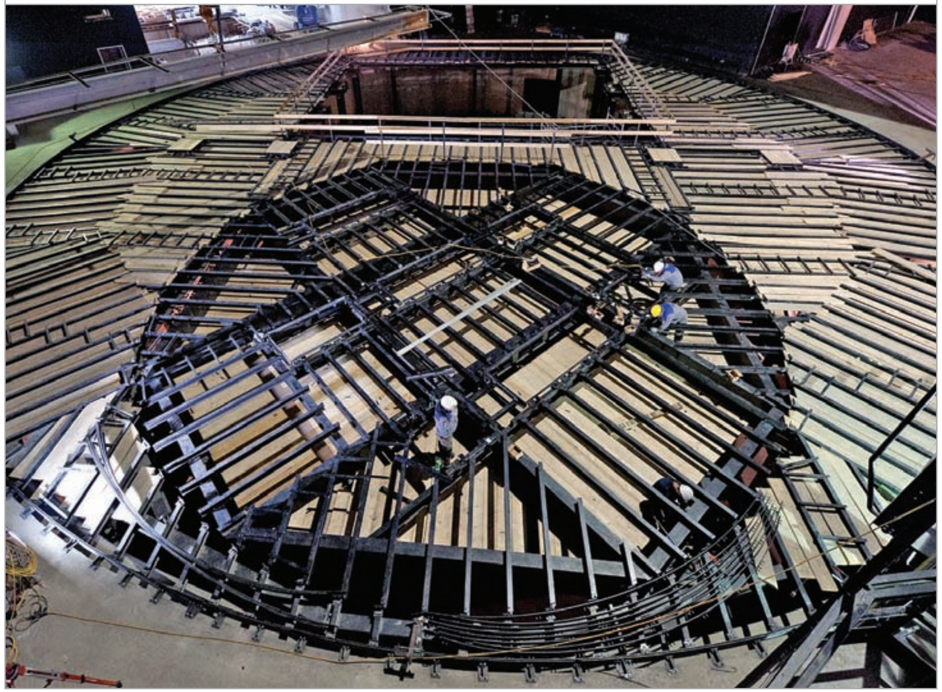
Project information

Owner	Musiktheater Linz GmbH (M.T.G.)
Architect	Terry Pawson Architects, London
Engineering Office	Waagner-Biro Stage Systems
Location	Linz, Austria
Construction Period	12/2009 to 04/2013

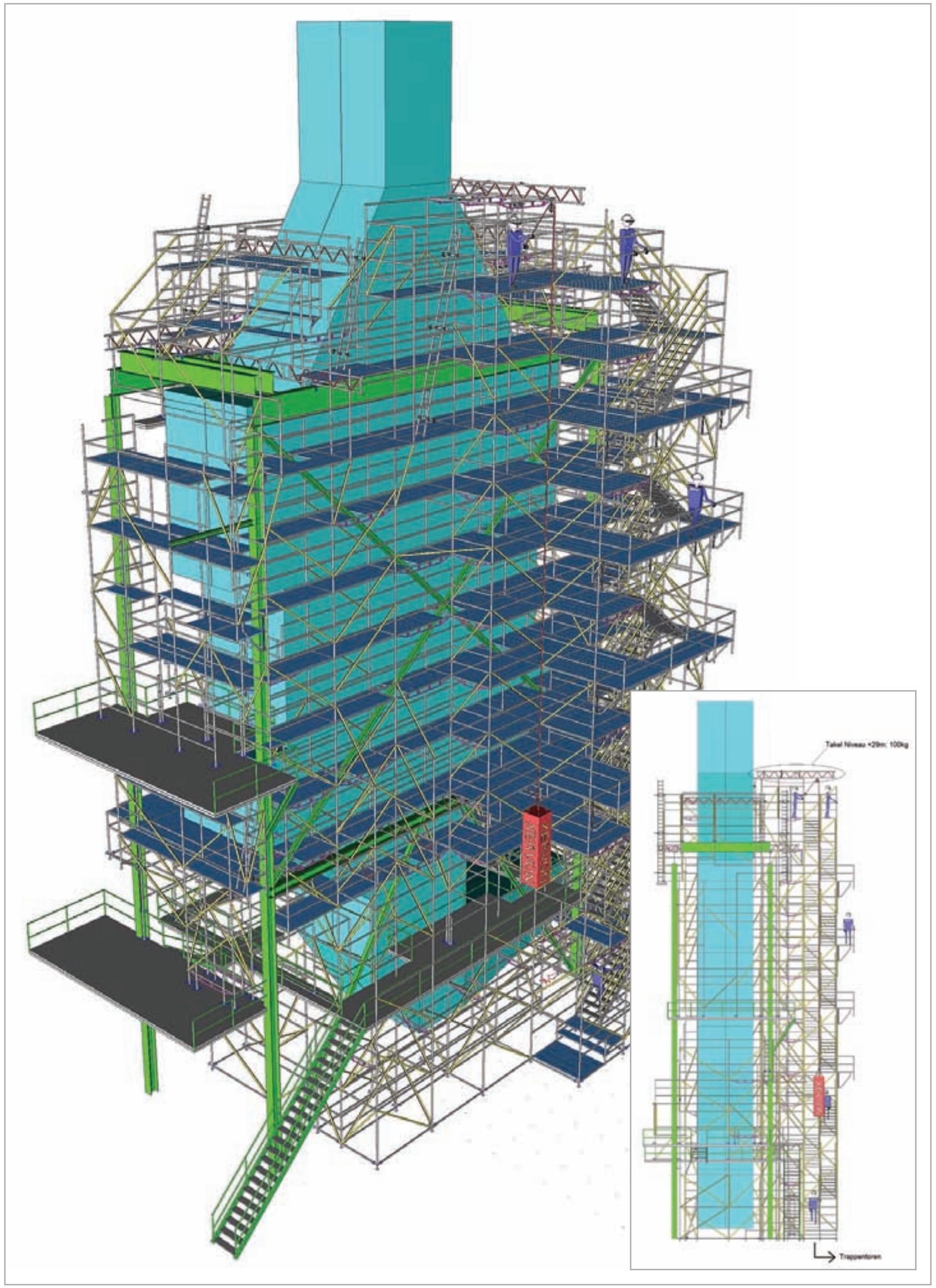
Short description | **Revolving stage, New Music Theatre**

The construction work for the new Musiktheater Linz began in 2009 after decades of discussions, planning and re-planning, and was finished with the gala opening in April 2013. The main hall of the Musiktheater provides a seating capacity for 1,000 people. The central element of the stage machinery is a large revolving stage for transport purposes with a diameter of 32 m. Located within this revolving stage is a smaller revolving stage for scenic transformations with a diameter of 15 m as well as three lifting platforms which cover the total area of 15 m x 12 m. Depending on the requirements of the performed show, either of the two parts of the large revolving stage can be rotated into the playing area of the main stage. Furthermore, the lifting platforms can pick up stage wagons which are driven onto the main stage from one of the side stages. This leads to extremely high requirements regarding the precision of the revolving stage's rotary movement.





Electrabel WKK Installatie - Antwerpen, België



Dit project betreft een WKK installatie (warmte-krachtkoppeling) van Electrabel op de terreinen van Bayer te Antwerpen. De isolatiepanelen van de installatie begonnen slijtage te vertonen waardoor lekkages ontstonden. Hierdoor begon het staal onder de isolatie te roesten en werd besloten om de beschadigde gevelbekleding en isolatie te vervangen en meteen ook enkele algemene onderhoudswerken uit te voeren. Hierbij werden onder andere de lasnaden van de installatie ter plaatse van de met roest aangetaste zones gecontroleerd.

Er werd beroep gedaan op de diensten van Xervon om een stelling te bouwen rondom de volledige installatie. Om de onderhoudswerken efficiënt en veilig te laten verlopen werd er een trappentoren toegevoegd en eveneens een takel voorzien aan de stelling om transport van materiaal optimaal te laten verlopen.

Omdat er geen gedetailleerde plannen van de installatie voorhanden waren, werd de stelling steeds opgebouwd in fasen na overleg tussen enerzijds de studiedienst en anderzijds de verantwoordelijke brigadier en plaatselijke werfleider. Op deze manier kon er tijdig ingegrepen worden bij meningsverschillen in verband met de constructie of bij belangrijke punten op vlak van stabiliteit.

Bovendien werd de verwachte overgedragen belasting van de stelling op de omliggende staalbouw van de installatie steeds doorgegeven aan het aangewezen controlebureau om zo de stabiliteit van de installatie zelf niet in het gedrang te brengen.

Binnenin dit project kwamen verschillende types van stellingen aan bod:

- Gevelstelling (vooraan): Hier was het belangrijk om voldoende ankerpunten te vinden aan de staalbouw zonder deze te overbelasten.
- Ruimtestelling (zijkanten): Op de bordessen van de installatie werden steeds extra stellingen voorzien die op hun beurt verbonden werden met de gevelstelling om de stabiliteit te garanderen. Hierbij werd steeds rekening gehouden met de capaciteit van onderliggende roosters of traanplaten. Daar waar nodig werden verstevigingen aangebracht.
- Takelstelling (bvb. op niveau +29 m): Er werd een takel voorzien aan de stelling om efficiënt transport van materiaal mogelijk te maken. Hierbij werd een maximale hijslast opgegeven door Xervon (100 kg).
- Hangstelling (achteraan): Daar waar de stelling maar deels op het aanwezige bordes kon steunen werd een stabiele hangstelling voorzien.

Afmetingen stelling

- Lengte: 16,51 m
- Breedte: 9,52 m
- Hoogte: 29,00 m

Extra gegevens project

- Lopende meter staander: +/- 1.380 m
- Lopende meter ligger: +/- 3.520 m
- Lopende meter vlonders: +/- 1.580 m
- Lopende meter vakwerkliggers: +/- 75 m
- Totale massa gebruikt materiaal: +/- 40.000 kg

De diversiteit aan stellingtypes maakte van deze constructie een interessant project om alle facetten van de stellingbouw te leren kennen.

De stelling werd zonder problemen opgeleverd binnen de vooropgestelde termijn en voldeed zowel aan de wensen van de klant als aan die van het controlebureau.

Software: Scia Engineer

Xervon

Contact Jeroen Herremans
Address Leo Baekelandstraat 5
2950 Kapellen, Belgium
Phone +32 3 660 15 30
Email jeroen.herremans@xervon.com
Website www.xervon.com

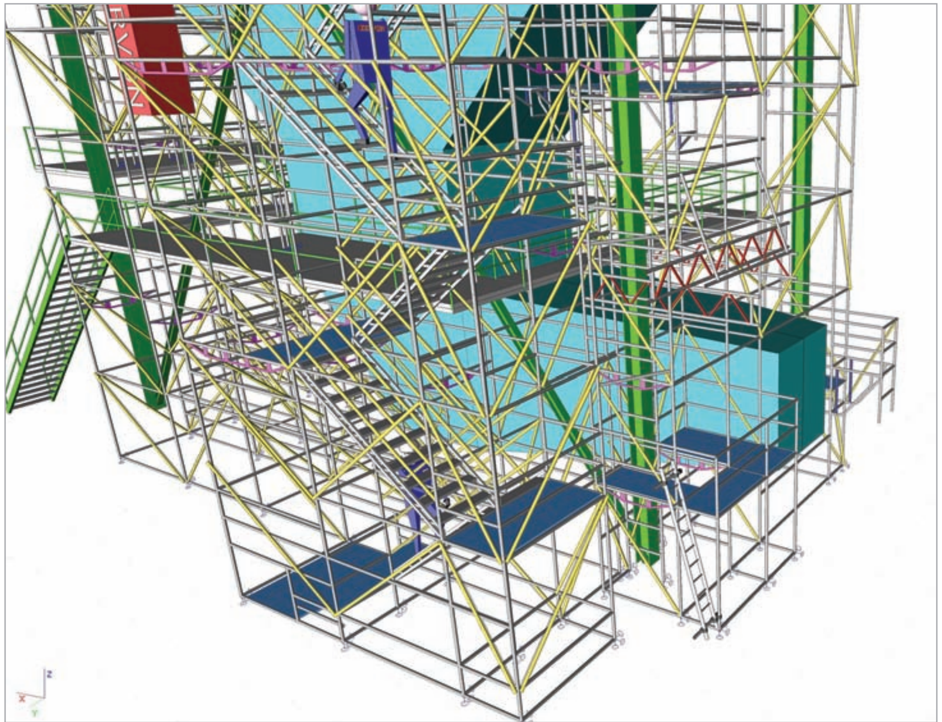
Xervon Benelux maakt deel uit van de groep XERVON GmbH, Düsseldorf, dewelke een dochteronderneming is van REMONDIS AG 1 Co KG.
Het aangeboden dienstenpakket omvat oa stellingbouw, industriële isolatie, conservering/corrosiebestrijding en schilderwerken.
Om dit pakket optimaal aan te bieden aan de klant beschikt Xervon Benelux over circa 350 medewerkers waaronder +/- 150 stellingbouwers, 50 isoleerders en 150 schilders. Dankzij het uitgebreid takenpakket is Xervon erin geslaagd een belangrijke speler te worden in de petrochemische sector met in het bijzonder de multiservice projecten. De afdeling stellingbouw specialiseert zich steeds verder in het ontwerpen, berekenen van complexe stellingen door efficiënt gebruik te maken van rekenpakketten als Scia Engineer. Montage van de stellingen gebeurt steeds in nauw overleg met de (assistent-)werfleiders ter plaatse om zo elk project, hoe klein ook, tot een goed en vooral veilig einde te brengen.

Project information

Owner	Xervon
Architect	J. Herremans
General Contractor	Xervon
Engineering Office	Xervon
Location	Antwerpen, Belgium
Construction Period	09/2012 to 12/2012

Short description | **Electrabel WKK Installation**

After years of service, the energy plant owned by Electrabel on the site of Bayer in Antwerp showed some signs of decay. The insulation panels were damaged, which allowed water to seep behind them, causing the steel of the installation to rust. Electrabel decided to replace all the damaged insulation panels and perform some general maintenance work at the same time; for example, a thorough check of all the welds. Xervon was chosen to build a scaffold around the complete installation enabling the workers to do their job safely and according to the required standards.
The scaffold was built in different stages so the stability of each stage could be checked by the engineering department using Scia Engineer software. On-site meetings between engineers and project managers were frequently organised to discuss any doubts or differences in opinion. As a result, the scaffold was built as safely as possible.



We would like to thank and congratulate each participant for making this 8th edition of the Nemetschek Structural User Contest the most impressive ever.

The Nemetschek Structural Marketing Team

Nemetschek Structural Group

Allplan Scia Frilo Glaser

Nemetschek Allplan
Konrad-Zuse-Platz 1 - D-81829 München
Tel: +49 89 92793-0 - Fax: +49 89 92793-5200
info@allplan.com
www.allplan.com

Nemetschek Engineering (Allplan Precast)
Stadionstrasse 6 - A-5071 Wals-Siezenheim
Tel: +43 662 854111 - Fax: +43 662 854111610
info@nemetschek-engineering.com
www.nemetschek-engineering.com

Nemetschek Scia
Industrieweg 1007 - B-3540 Herk-de-Stad
Tel: +32 13 55 17 75 - Fax: +32 13 55 41 75
info@scia-online.com
www.nemetschek-scia.com

Nemetschek Frilo
Stuttgarter Straße 36 - D-70469 Stuttgart
Tel: +49 711 81002-0 - Fax: +49 711 858020
info@frilo.de
www.frilo.de

GLASER -isb cad-
Am Waldwinkel 21 - D-30974 Wennigsen
Tel: +49 5105 5892-0 - Fax: +49 5105 82943
info@isbcad.de
www.isbcad.de