ARCADIS Belgium nv

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ARCADIS
Infrastructure, environment, buildings

ARCADIS – Re-shaping the future

ARCADIS delivers consulting, design, engineering, urban planning and project management services for infrastructure, environment and buildings. Our experts are focused on improving mobility, enhancing sustainability and raising the quality of life around the world. We define our success by both surpassing our clients' expectations and making a positive and lasting impact on the environments, people and places we touch. From feasibility studies through implementation and maintenance, ARCADIS is all about balance: of the creative and the functional, of possibility and reality, of the local and the global, of present needs and future legacy. ARCADIS imagines the results and re-shapes the future.

ARCADIS worldwide

With 13.500 employees, ARCADIS ranks third in Europe and ninth in the world. Because of our home market positions in Europe, the United States and South America, we combine a deep knowledge of the local conditions where we work with fresh global perspectives for unique, integrated solutions.

ARCADIS Belgium

With more than 750 employees and an annual turnover of € 73 million in Belgium, ARCADIS has earned a leading position in its field. This evolution is the result of innovation, flexibility and agility. Facts and figures not only highlight our financial success, but tell quite a bit about our reputation and our solid client relationships.

Brief overview of company activities

At ARCADIS, we divide our services into three distinct segments in an effort to distinguish our lines of business. That said, in today's complex world, we are increasingly exploring the benefits of working across these segments and across geographies to improve the human condition by establishing a balance between the natural and built environment.

Infrastructure
Consultancy, engineering, follow-up and project management for the sustainable development of:

- Transport infrastructure and ports
- Utilities, sewerage and water treatment infrastructure
- Urban zone development and company premises
- Open space and mining

Environment

- Strategic environmental consultancy for private companies and authorities
- Environmental Impact Assessment (EIA)
- Global product stewardship – REACH consultancy
- Remediation of contaminated soil and groundwater
- Waste management and reduction of energy and water consumption
- Ecology and nature development

Buildings

- Engineering and project management of plants and utilities in the industrial market
- Engineering and project management of offices and data centres for the workplace market
- Consultancy, design and supervision of building projects in the public and commercial market

And including Project Sourcing

- On site staff members for the optimization of the clients' engineering- or facility engineering department: project managers, project and site team leaders, project engineers, designers and draftsmen…

Short Description

The Monovolume, University of Ghent

The Monovolume, designed by SBXDG and engineered by Arcadis, features a contemporary and clean combination of steel, concrete and glass to create a modern landmark in the heart of the University of Ghent. The building - comprised of concrete floors, beams, walls and stairs, steel columns and roof structure - houses offices, classrooms, patios, parking and a large auditorium. The auditorium can accommodate a total of 1000 people or be subdivided into two classroom spaces by lowering a giant "guillotine-wall" from the ceiling to accommodate 600 and 400 people respectively. Because of the complexities of the design, several 3D-models were made to accurately evaluate forces, displacements, mutual influences of different construction elements. The Scia Engineer software provided optimal results and was essential for the success of the project.

Project Information

Owner: UGent (University of Ghent)
Architect: S. Beel - X.De Geyter
General Contractor: Antwerpse Bouwwerken
Engineering Office: ARCADIS Belgium nv

Construction Start: 03/2007
Construction End: 09/2009
Location: Gent, Belgium

University Design Competition

The University of Ghent is a rapidly growing university of high international status. Realizing the need for more auditoria, classrooms, offices, parking spots… UGent issued a design competition for two multifunctional buildings in the heart of the campus, adjacent to the Vice-Chancellor's Office. Architects Beel & De Geyter, in association with the engineers of ARCADIS, have won this competition and commenced design and development for the project's two landmark structures. The construction of the larger building, the Monovolume, started in 2007 and is scheduled to reach completion in fall 2009.

The Monovolume

The building's jewel-box design is contemporary and clean, featuring a combination of steel, concrete and glass. Housing offices, meeting rooms, classrooms, outdoor patio space and a large auditorium, the Monovolume not only meets the functional needs of the university but also serves as dynamic addition to the campus fabric, creating an active student-oriented space for work and leisure. The building's main auditorium can accommodate a total of 1000 people or be subdivided into two classrooms of 600 and 400 people by lowering the giant 30 ton "guillotine-wall" hanging on top of the building. A massive 380-SM glass-mosaic screen wall enables students from the adjacent "student square" to view movies and presentations being projected large-scale. Beneath the auditorium and offices, a 3,000-SM foyer welcomes visitors. Below, two underground floors house parking spaces and mechanical functions. The team's use of Scia Engineer, a software program enabling 1-, 2- and 3-dimensional modeling capabilities, proved crucial to the success of the project. The program provides analysis, design and detailing for any type of structure.

Scia Engineer-calculations

The calculations were partly 1D or 2D concrete calculations in Scia Engineer for the design of typical beams, floor slabs and walls and steel calculations for the columns of the building. However, because of the complex design, elaborate 3D-models were developed to evaluate the influence of individual elements on the structure and improve the accuracy of the results.

Auditorium

One aspect of the project modeled in 3D was the auditorium. The space is partly supported by a mushroom floor and partly by traditional floor beams. This auditorium has to resist by example the wind acting on the 400-SM double exterior walls, as well as the 3 m-wide cantilever stairwells hanging on the

Used software: Scia Engineer

interior walls. Also, the forces of the 'Guillotine Wall' had to be taken into account. To calculate the horizontal displacements of the walls and the bending moments of the hybrid floor, the team created a 3D model, offering the most accurate evaluation.
The decision to add big box floor lights to the auditorium late in the development process, created additional challenges for the team. Scia Engineer software enabled them to evaluate and adjust their design with minimal disruption to the rest of the space.
The roof of the auditorium was designed with steel 3D framework in order to house and maneuver the large 30ton 'Guillotine Wall'. ARCADIS used the 3D modeling capabilities to make accurate first estimations of the profiles.

Displacement

Throughout the design process, the team confronted several structural and architectural challenges. The special glasswork used around the building allows little room for movement, only about 3 to 4 mm, between floors. To correctly evaluate this fluctuation, the design team created one model to show the elastic connections between columns and beams, and a second model for the stiff core. Because hinges would be too flabby and movements too overestimated (and to big for the glass) as measured in other analysis tools, the stiff connection was evaluated using the 'ESASD.02 Raamwerken – star'-module of Scia Engineer and put into another 3D-model.

Also the stiff core itself required a more complex design solution, because it doesn't run up in one movement. A strengthened zone of 10 HEM-550 beams placed close to each other supports the part of the core not running down to the foundation.

Other design challenges

In addition to the obstacles listed above, the Monovolume faced other design and structural challenges. For example:

1. The auditorium floor and entrance stair were constructed in two phases, requiring the team to reinforce the area with additional concrete to ensure proper connectivity between phases.
2. The concrete delivered for the columns in the parking structure proved to be of lesser quality (fck 25 mpa for a requested C35/45) than anticipated, requiring the team to recalculate the integrity of the structure and reevaluate potential consequences. The use of 3D models enabled precise determination of these acting forces, ensuring more accurate design.
3. The steel columns on the second and third floor, which are HD 400, needed special calculations for their connections to the rest of the structure. For example, the team calculated the stiffness of the provided connection using the esasd.02-module.
4. One of the building's floor plates 'hangs' on the floor plate above it by a single steel tube. To ensure the integrity of the connection, the team created a 3D model in Scia Engineer to provide a more accurate estimation of the acting forces, allowing for more accurate calculations and evaluations.
5. Scia Engineer was also used to calculate the behavior of the featured waffle and mushroom flooring.
6. On the south wall, a double wall is hung onto the two adjacent walls. On these walls, wind loads are acting together with temperature loads and loads coming from the different connected floors. Using a 3D Scia Engineer model with temperature loads, the influence of all these acting loads could be accurately calculated.

The Grand Opening

At this time (end 2008) the construction work is almost finished as the steel roof structure of the auditorium and the housing of the Guillotine Wall are being installed. Technical installations, inner wooden walls and furniture are arriving and will continue to arrive the first half of 2009. The goal is set to have a Grand Opening in September 2009, at the start of a new academic year.

Technical data

- Width: 30.5 m
- Length: 99.15 m
- Height: 24.15 m (roof) – 30.12 m (housing 'Guillotine Wall')
- Total Floor Area: +- 13.500 m²
- Reinforcement: +- 1.200.000kg
- Concrete: +- 11.000 m³
- Steel Columns and beams: +- 480.000kg