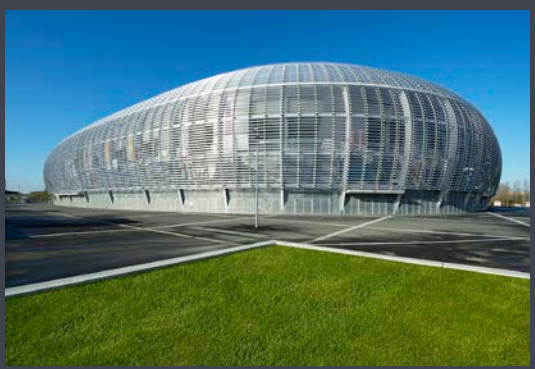
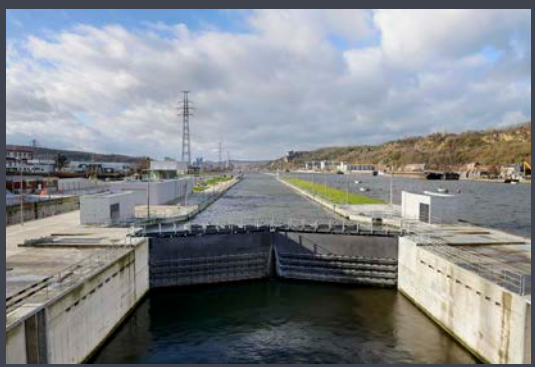




Engineering and architecture

grejsch

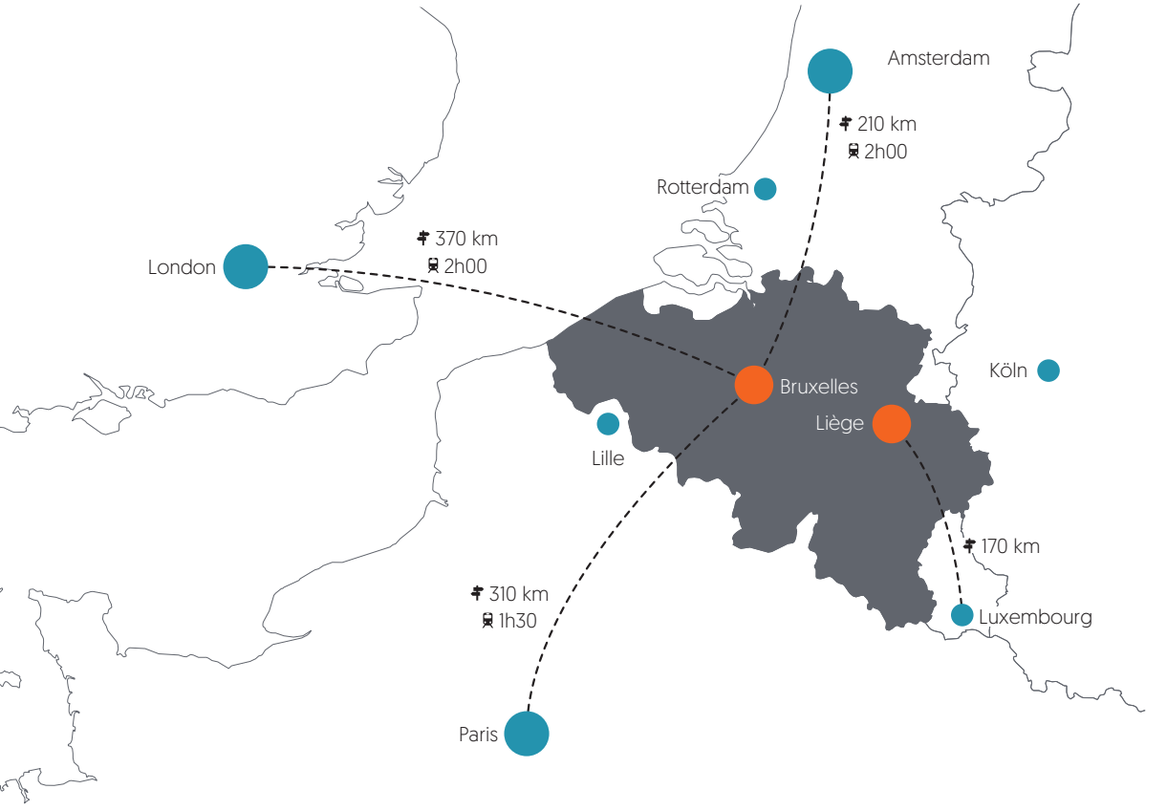
Based in Brussels and Liège, Bureau Greisch is one of the most advanced engineering and architecture firm in Europe. It was founded in 1959 by the engineer and architect René Greisch and currently has a staff of over 170 across its six companies (beg, bgroup, gi, gce, Neo-Ides and canevas). This large team is always open to collaborative ventures and carries out complex assignments in a wide variety of fields.

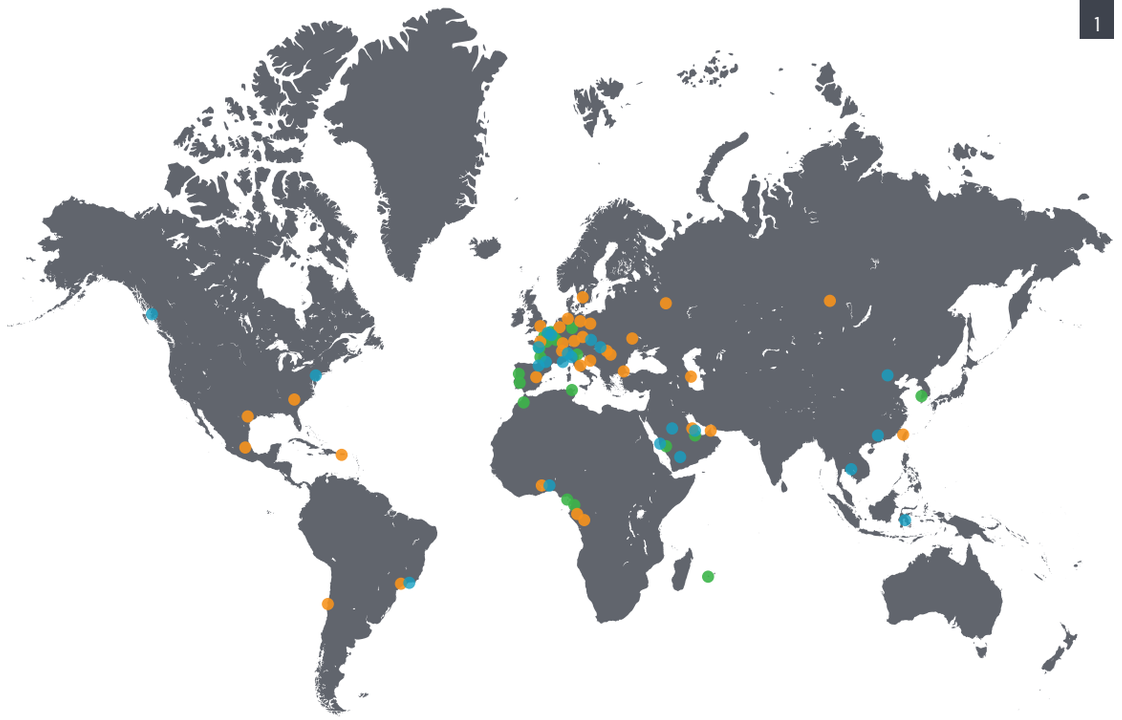
Through his interest in both architecture and the structural design of buildings, René Greisch instilled in his team the spirit of research and innovation on which its reputation among architects has been built, leading to numerous collaborative ventures with some of the top names. Bureau Greisch also has its own architectural unit (canevas) in order to create an atmosphere where engineers are constantly questioning and searching for new solutions, both formal and technical.

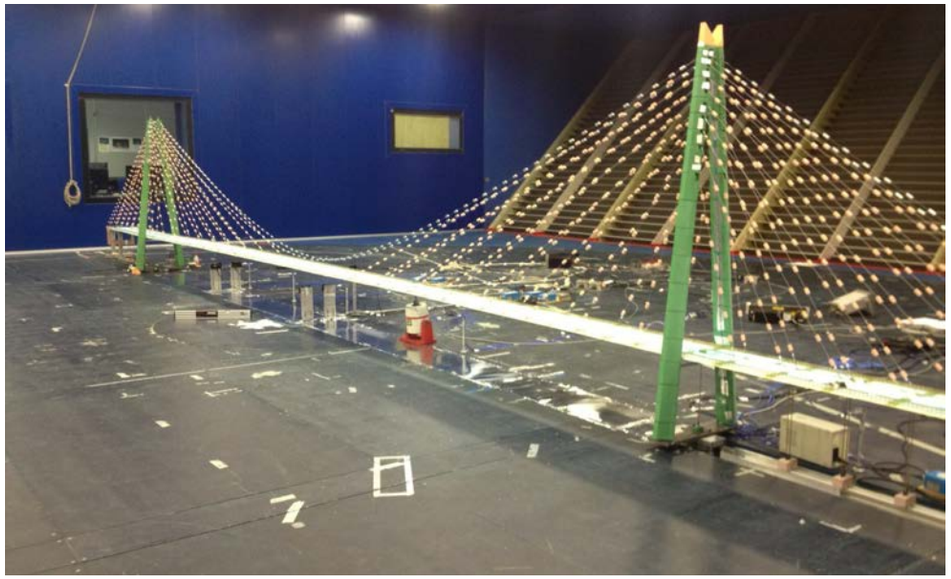
This spirit of teamwork and cooperation, a quest for synergy and collaboration, innovation allied to imagination, and a questioning and dynamic approach have become the methods and principles by which Bureau Greisch works.

René Greisch's approach is embodied in a desire for perfection, in which a work is constantly refined and polished up to the very last moment. He also believed that nothing within the finished work should betray the complexity of its execution.

The art is to conceal the effort involved in the work; it should seem to flow naturally from its source...
René Greisch







Mission :

- the global calculations of the structure during its service life ;
- proposals for construction methods ;
- the design of the steel deck in the main span ;
- the dynamic studies necessary to verify the behaviour of the global structure :
- under the wind (during the service life and the construction stages - verifications made with numerical simulations and by tests in wind tunnel laboratory),
- under the earthquake and/or the passages of trains.

Third Bosphorus bridge (BB3)

Owner :
KGM - Turkish Ministry of Transport - Head office of the roads.

Conception :
M. Virlogeux - JF. Klein.

Situation :
At the north of Istanbul to cross the Bosphorus near the Black Sea (TR).

Execution of the works :
2013 - 2016

Total cost of the works :
700 Mio € excl.vat

Suspension bridge with a 1408 m longmain span and a total length of 2 408 m, located at the north of Istanbul near the Black Sea.

As the Brooklyn bridge, the main span is partially suspended at the towers by stiffening cables and at the main cables with vertical hangers. The top of the towers, composed of 2 concrete shafts, are 320 m above sea level. The deck is 5,50 m high and 58 m wide with 4 road lanes in each direction, 2 railways tracks and 2 sidewalks.

In the central span, the steel deck is made up of an orthotropic plate (total steel weight : 45 000 tons). The side spans are made up of post-tensionned concrete.

The preliminary design is the result of a competition won by Michel Virlogeux (France) and Jean-François Klein (Switzerland). The final design is made by T-Ingénierie (Switzerland) and Greisch (Belgium) on behalf of the joint venture Içtas and Astaldi S.P.a.

The construction should be completed by the end of 2016.

Millau Viaduct

Owner :
Compagnie Eiffage du Viaduc de Millau

Architect :
Norman Foster

Situation :
Autoroute A75, on the Tarn
Near Millau - Aveyron (FR)

Execution of the works :
2001 - 2004

Cost of the works :
350 Mio € excl.vat

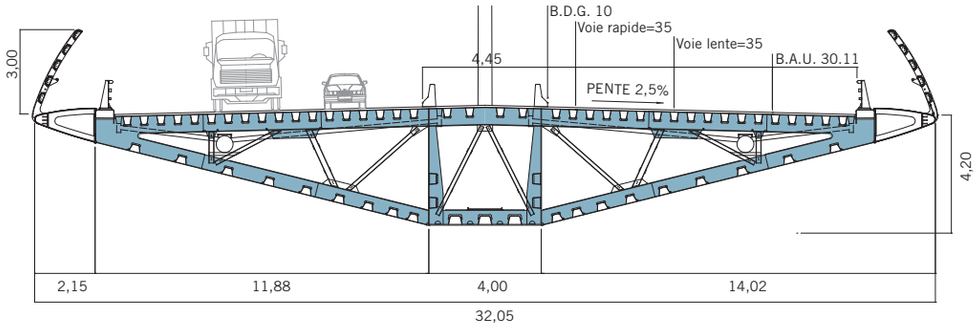
An eight-span multi-cable-stayed viaduct of overall length 2,460 metres, in a site presenting severe geographical and climatic conditions: a steep-sided valley, and strong winds with high speeds and turbulence.

The superstructure is entirely of steel – an orthotropic deck (28 m wide and 4.20 m high) and 7 pylons (90 m high). Total weight of steel: 50,000 tonnes.

The bridge was built by launching the deck from the two sides of the valley, earning a triple world record – launched in spans of 171 m, to a maximum height of 280 m (junction over the river Tarn) and with a total weight 20,000 tonnes on the last launch. The highest temporary pier stood at 175 m.

Greisch introduced a steel variant and carried out all the working calculations for the deck-pylon-cable structures.

Greisch demonstrated an innovative approach in designing the assembly of this particularly complex structure.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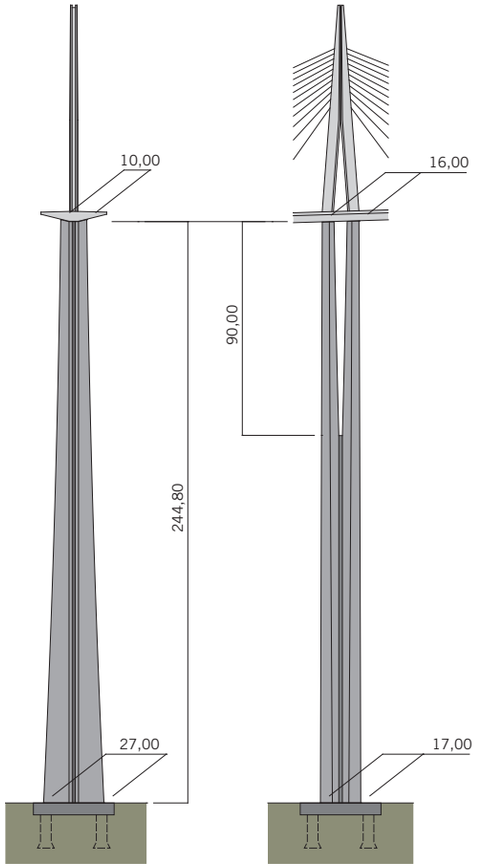
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La Haute-Colme (Saint-Omer)

HST Viaducts

Lots of high speed train viaducts are made up of steel or composite (steel and concrete) structure. The high density of such railways in France gave us the opportunity to collaborate with several contractors in the construction of them.

The first mission, in 1992, lead us to fulfill the detailed design of the longest French viaduct (Saint-Omer - La Haute Colme). It is a dual girder bridge from which we learned the technical railway bridges specifications, which include the dynamic and fatigue specific behaviours.

Later in the 90's, we were called by the SNCF, through the contractors, to make the detailed design of the four most prestigious steel bridges along the new high speed line between Lyon and Marseille : Arc, Donzère (Garde-Adhémar), Mornas and Mondragon.

The viaduct over the river Sado in Portugal, has a quite different history, as we collaborate with a Portuguese engineering office for the full design of the multiple arch bridges, up to the detail design.

More recently, we worked in a joint venture with the SNCF to make the full design of the new four tracks bridges over the river Garonne, where high speed trains are entering the Bordeaux station and on the design of the bridge "La Savoureuse" on the Rhin-Rhone railway.

Arc Viaduct

La Savoureuse

Sado

Donzère

Bridge over the 'Grande ravine' on the Réunion island

This bridge is located along the "route des Tamarins", road with 2 x 2 lanes, that was officially opened on june 2009. This road reduces the traffic on the road along the west coast of the island.

This 288-meter-long bridge spans a 170-meter-deep breach. The deck, made up of orthotropic steel plates, rests on two 20 degree tilted cantilevers, composed of post-tensioned concrete.

The cantilevers are anchored in the abutments and their summits are holded by cables located in the deck. They are built with the cantilever method. The abutments work as counterweights. The two halves of the deck have been launched from each bank and then connected the middle of the bridge.

Mission : execution study (civil engineering and steel structure) and technical assistance on the work site during the launching operations.

Bridge over the 'Ravine Fontaine' on the Réunion island

The gap is a 110-meter-deep gully at the bottom of which no support can be built. The bridge is a 200-meter-long arch bridge. The unique arch is made up of steel and has a 170 m span. It supports a composite deck (steel and concrete) by means of radiating steel columns. The foundations are composed of concrete massifs casted in two indentations made in the gully banks. The arch has been built with the cantilever method from each bank thanks to a truss made up of temporary diagonals and by anchoring the whole structure with active anchors in the ground.

Mission for the group of engineering offices greisch – tremblet – seti – coyne & bellier and the architects Zirk and Dezeuze : complete conception from the preliminary project to the definitive project, consultation with the companies, supervision of the execution studies, leading of the building execution, acceptance of the pieces of work.

Mission for greisch office : representative of the group, conception of the bridge, complete study of the bridge in use, establishment of the consultation papers, consultations. Control of the execution studies.

Viaducts

Oyala bridges in Equatorial Guinea

The construction of four new road cable-stayed bridges over the Rio Wele in Oyala fits into the development of the future city. The structures consist of a post-tensioned concrete deck, supported by two lateral plans of stay cables, hanging on four towers. The lower part of the towers is made up of reinforced concrete and the upper part, on which the stays are anchored, is metallic.

The deck section is composed of two longitudinal beams of prestressed concrete, interconnected by cross beams also of prestressed concrete. There are 2 * 2 car lanes separated by a median strip, bordered on each side by a sidewalk two meters wide on the deck. The deck is 150 m long, 23.6 m wide and 1.55 m high. The central span is 81 m long.

Access to the site is made difficult by the presence of the Rio Wele, the deck is built with moving equipments, by successive cantilever starting from the pylons.

Complete mission for the account of the contractor Besix.

Herve (BE)

Hoge Brug - Maastricht (NL)

Hoge Brug - Maastricht (NL)

Farciennes (BE)

Liège (BE)

Footbridges

The designer's approach to this type of work always involves careful thought. Bureau Greisch achieves a clear expression in its structural and architectural missions.

For each project, the context, integration into the environment and significance of the structure is considered. Only then does the form take shape and the structure emerge.

Grand stade de Lille - Footbridge (FR)

Liège (BE)

Inland Ports

Multimodal platform at Hermalle-sous-Argenteau

Stretched out over 100 hectares, this platform for harbour exploitation contains railways, tracks for portal cranes, local roads and their equipment, the collecting and draining of surface water, and an isolation zone. The project integrates the environmental and urbanistic aspects.

Complete technical and urbanistic mission : preliminary project, planning permission, definitive and execution projects, technical assistance and health-security coordination.

Multimodal Garocentre platform in La Louvière

The platform lies at the main branch of the large section of the Centrum Canal. The project comprises :

- a new quay-wall with a length of 325 m ;
- a 3 ha concrete platform with railway tracks and a craneway for a gantry crane. The works also comprise the execution of the drainage system and the executions (safety systems, lighting etc.) ;
- the access roads and the roads on site ;
- a ballast-filled railway at the rear of the site ;
- a 2-storey reception building (200 m² floor area) ;
- the technical equipment (high-voltage-, low-voltage, water and gas supplied, optical fibre network).

Canal-bridge at Houdeng-Aimeries

This 498 m long and 46 m wide bridge allows the 'canal du Centre' to overbridge the valley of the Thiriau du Sart and a major roadway interchange at the entrance of La Louvière. It is a post-tensioned concrete bridge. The cross section has 2 inclined sidewalls that support the transversal fish-belly-shaped girders. They support the bottomplate every 4.50 m and 4.20 m of watercharge.

The longitudinal and transversal post-tensroning leads to a bidirectional compression of the concrete in contact with the water.

The deck rests every 36 m on circular piles that bring the important load to a poor-quality ground that needed special foundation piles to handle with the expected.

The deck has a total weight of 65 000 tons and was incrementally launched bringing a world record on the subject.

Complete mission : preliminary, definitive and execution projects and supervision during the building.

New lock at Ivoz-Ramet

Construction of a lock (length: 225 m, width: 25 m and a 4.5 m lift) whose characteristics are the following :

- located at the same place as an existing lock (to be demolished) with difficulties of access to the building site ;
- set up between a 136 m x 16 m lock that has to go on working and a movable dam.

The road access to the new lock and to the new control building is made possible by way of a 32 m long movable bridge.

Complete mission : architecture, stability, special techniques, electromechanical engineering and landscaping : preliminary design, basic design, tender documentation, detailed design, site supervision.

New lock at Ampsin (BE)

The 5 m high Ampsin dam, located on the river Meuse upstream of Liège, is to be equipped with two new sluices, with respective horizontal dimensions of 225 m x 25 m (class VIb) and 225 m x 12.5 m (class Vb).

The project includes new quay walls, a 500m-length footbridge and complementary works (roadworks, technical buildings, fish passage, environmental measures,...) within a global budget of 80 million euros.

Locks

Owner :
SOFICO

Owner delegate :
Public service of Wallonia, direction of waterways of Liège (SPW - DGO2 - DVHL).

Situation :
Between the Albert canal and the Juliana canal, Lanaye (BE)

Execution of the works :
2011 - 2016

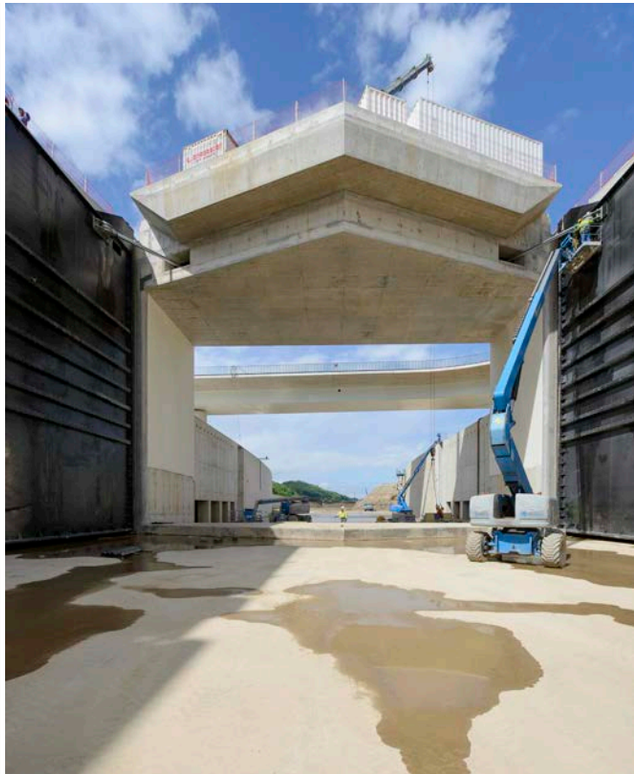
Cost of the civil engineering works and surroundings :
98 Mio € excl.vat

Fourth lock at Lanaye

Construction of a lock (225 m - 25 m - 13,7 m) with its ancillary structures and a pumping station/hydroelectric power plant, to the east of the existing complex of locks at Lanaye.

Tourist development of the site through its landscape designing and the construction of service infrastructures for the public benefit. Studies in association with a landscape architect, a sculptor, and a painter.

Mission : civil engineering and architecture studies (Greisch/Canevas) and electromechanical equipment studies (SNC Lavalin).

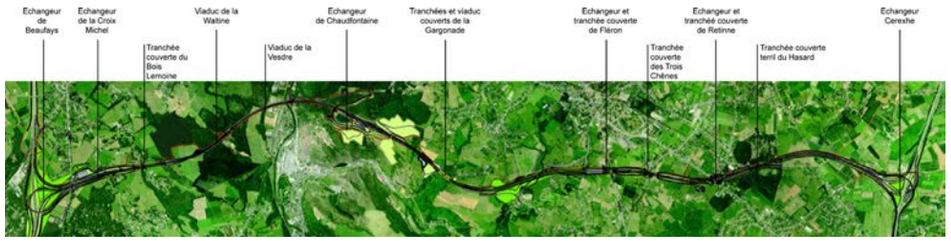


Overall view of Liege Airport - Main studies carried out by Bureau Greisch

Linear projects

This 12.5 km long highway connects the existing E40 (Brussels-Aachen) to the North and the E25 (Liège-Luxemburg) to the South. This huge project includes 6 junctions, 7 cut and cover tunnels (total length 1800 m), 6 upper bridges, 1 viaduct over the Vesdre Valley (length 1600 m, height 80m), 1 viaduct over the Waltine Valley (length 340 m, height 50m) and 1 covered viaduct (acoustical and environmental considerations) over the Gargonade Valley (length 200 m, height 50m).

The project takes into account the protection of the underground water and supposes a large landscape and environmental approach.



A 605 - Cerexhe-Heuseux- Beaufays highway

Airports

Bureau Greisch has been involved since the early nineties in the most significant infrastructures and building developments at Liege Airport. This includes the construction or the renewal of aprons and tracks (various pavement materials), new buildings (airport terminal, logistic hubs), ancillary roads and parking areas, complete drainage systems, ...

Metro in Brussels

Bureau Greisch, especially its Brussels branch Bgroup-Greisch, has been involved in the construction, the expansion and the renewal of the metro network in Brussels ever since its creation in the early seventies. The deep knowledge of the metropolitan context and the whole infrastructure combined with accurate design methods leads to useful and convenient transportation infrastructures.

Constitution station in Brussels, designed with Systra (Paris) and Sum Project (Brussels)

Recently, Bureau Greisch has managed the study of the rehabilitation of various stations (Arts-Loi, De Brouckère, Montgomery,...) and the project of the new Constitution station, near Brussels South railway station.

De Brouckère Station, designed with Sum Project (Brussels)

New tramline in Liège

Owner :
Regional transport service of Wallonia (SRWT)

Conception :
SM Liège-Tram: Bureau Greisch, atelier d'architecture du Sart-Tilman, cabinet Richez, Transamo and STIB.

Partners :
Transitec ingénieurs-conseils and Semaco

Situation :
City of Liège (BE)

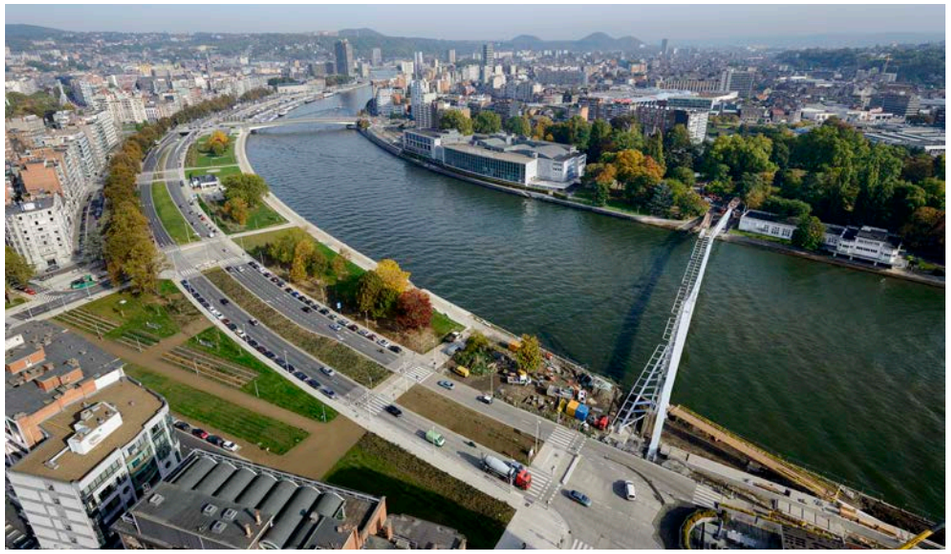
Execution of the works :
2018 - 2022

Approximate cost of the works :
366 Mio € excl.vat

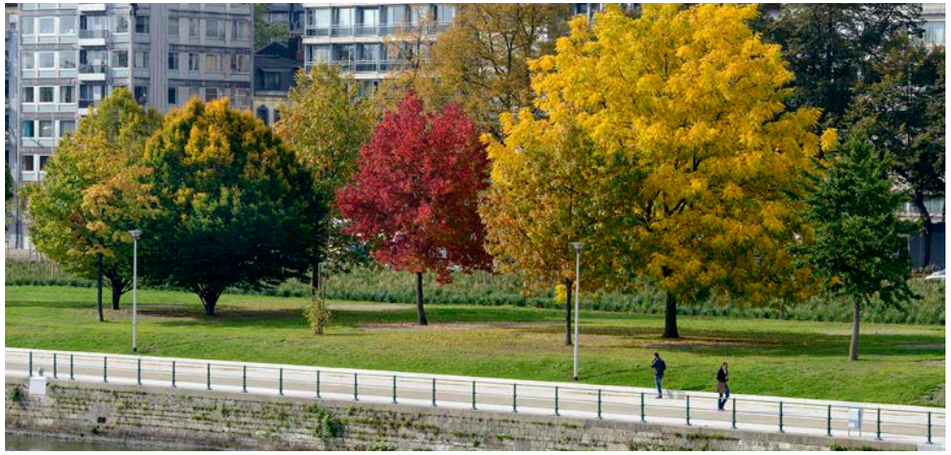
Town planning and technical studies for the creation of the first tramline across the heart of Liège and its close neighborhoods (12 km long).

This project, which is planned to become the backbone of all public transportation throughout the city, includes about 20 stations, a series of exchange points (bus/tram, car/tram), a maintenance and storage building, all power supply buildings and equipment as well as all the architectural, technical and aesthetic implementation of the infrastructure inside a living city.

The project applicant called “LiegeTram”, an association of private study offices led by Bureau Greisch, is in charge of providing all the preliminary studies, accompanying the public administration during the tender procedures (DBFM) and supervising all the studies and the works executed by the contractor.



New "quais de Meuse" in Liège, designed with Atelier Corajoud (Paris)



The widening of the right bank of river Meuse, in Dinant (Belgium), known as "la Croisette", designed by Bureau Greisch.

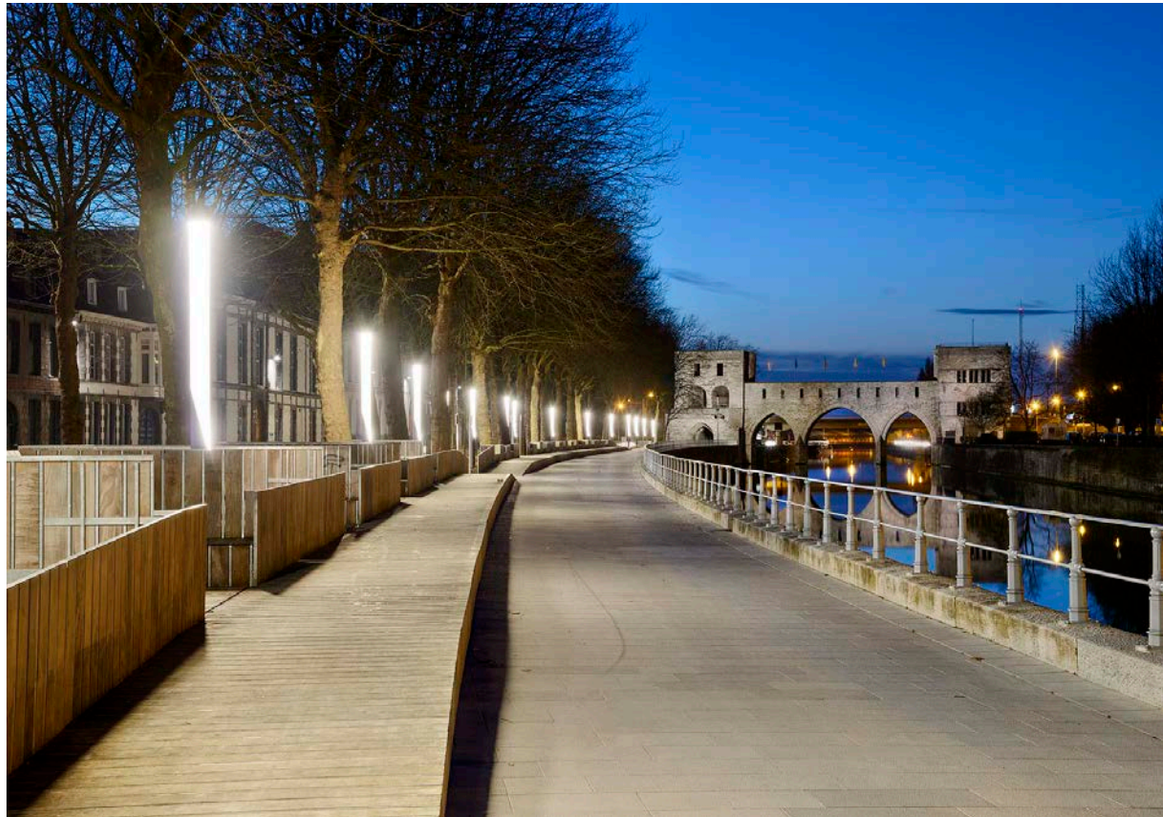
The "Boulevards du Centre" in Brussels, known as "le Piétonnier", designed with Sum Project (Brussels)

Town planning

Great urban projects, in conjunction with all the new ways of thinking the "city", require fully integrated teams where town planners, landscape architects and engineers merge their inputs into consolidated developments. Bureau Greisch is keen on collaborating on such projects, from the very beginning of the studies up to the direction of the works, by sharing its experience and its knowledge within open-minded exchanges.

Specific tools such as ground modelling softwares or 3-dimensionnal viewers are commonly used therefore.

The conversion of the "Salines Quay" (Tournai, Belgium), designed by French architect Nicolas Michelin, supposes the construction of a new road and parking areas, a stony cycling lane and a wooden footwalk along the river Escaut.



Liège-Guillemins railway station

Owner :
Euro Liège TGV

Architect :
Santiago Calatrava

Situation :
Place des Guillemins - Liège (BE)

Execution of the works :
2000 - 2009

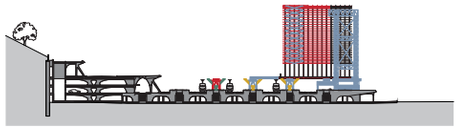
Cost of the works :
200 Mio € excl.vat

Designed by the architect Santiago Calatrava and standing like a latter-day cathedral, the new Guillemins station has a monumental glass and steel dome extending 200 m over the tracks. The new, partially pre-fabricated building is of white concrete.

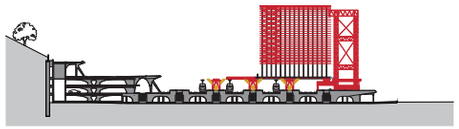
Greisch provided the project planning, construction designs and all assembly-related studies.

This particularly complex structure was constructed in sections and pushed out across the platforms to minimise the number of tracks out of service at any one time.

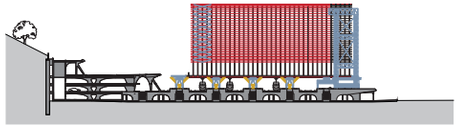
Plate-forme de montage



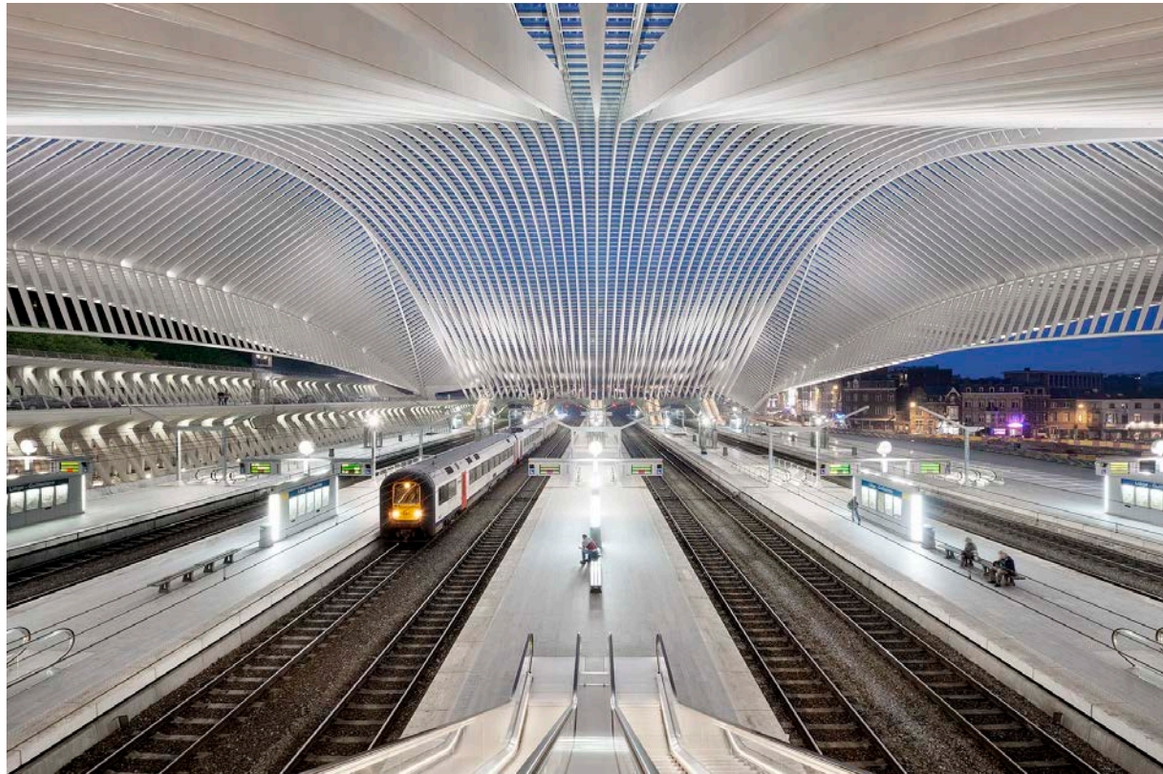
Assemblage de 5 arcs pour le poussage n°3

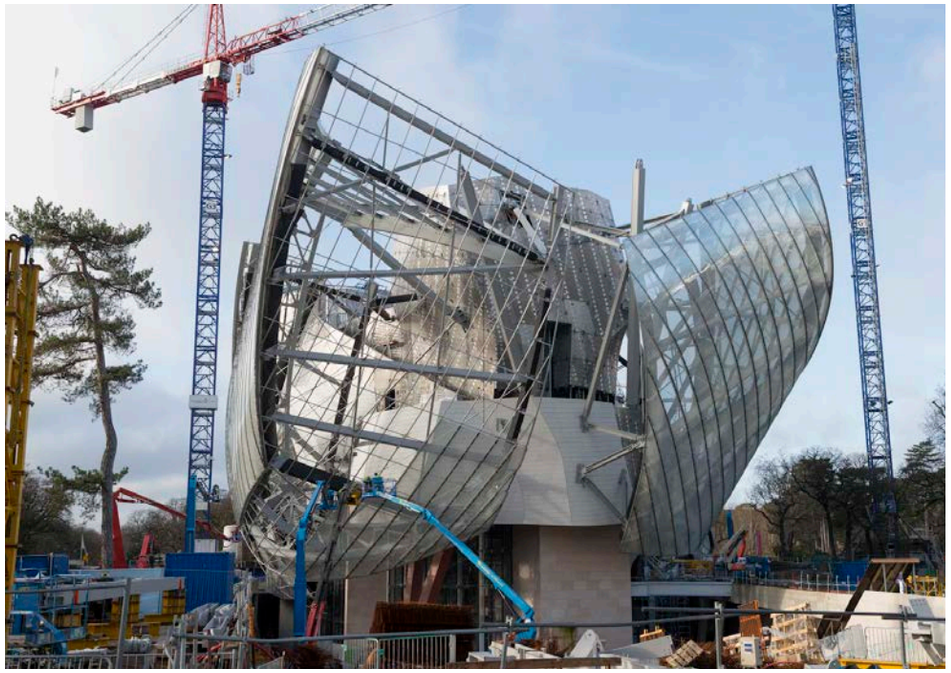


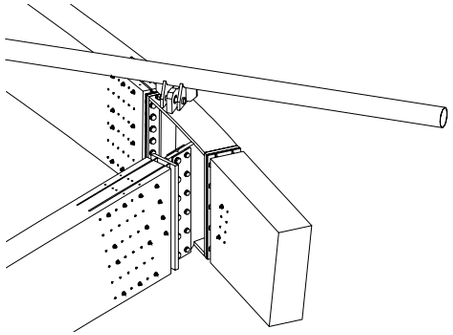
Poussage n°3



Assemblage de 5 arcs pour le poussage n°7







Louis Vuitton Foundation

Owner :
Fondation Louis Vuitton pour la Création

Architect :
Gehry Partners

Situation :
Jardin d'acclimatation, avenue du Mahatma Gandhi - Paris (FR)

Execution of the works :
2009 - 2013

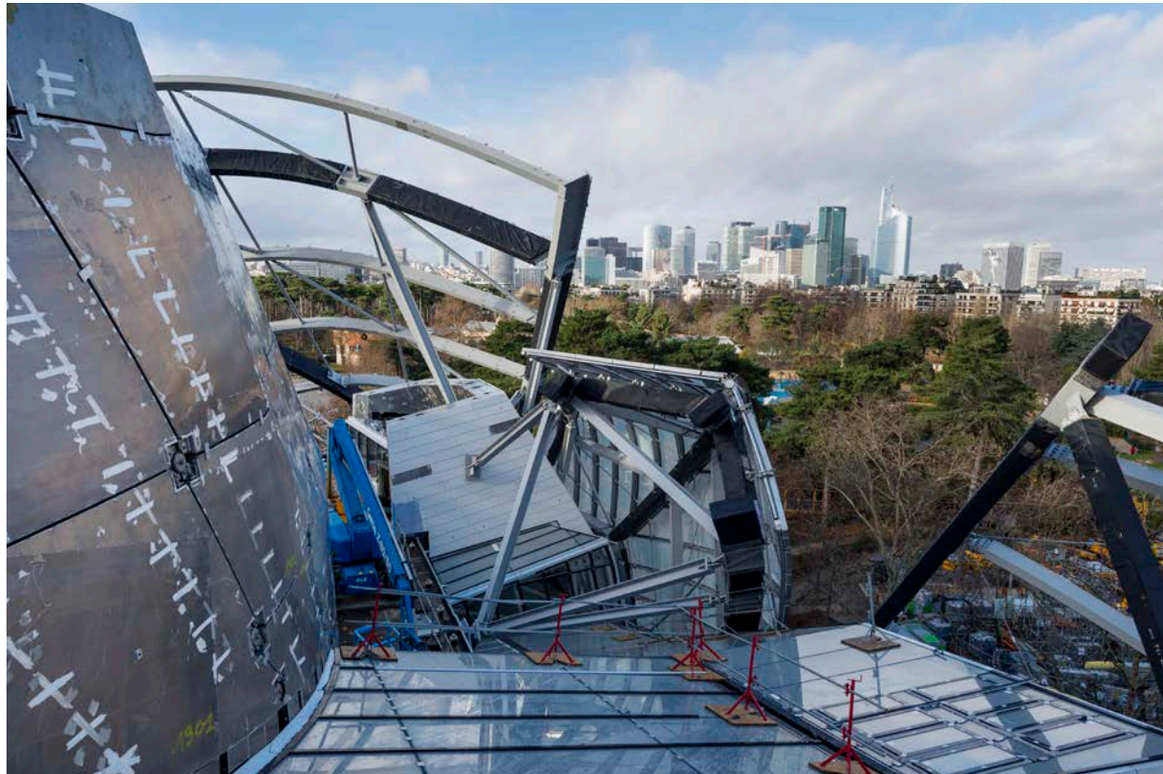
Cost of the works :
Confidential

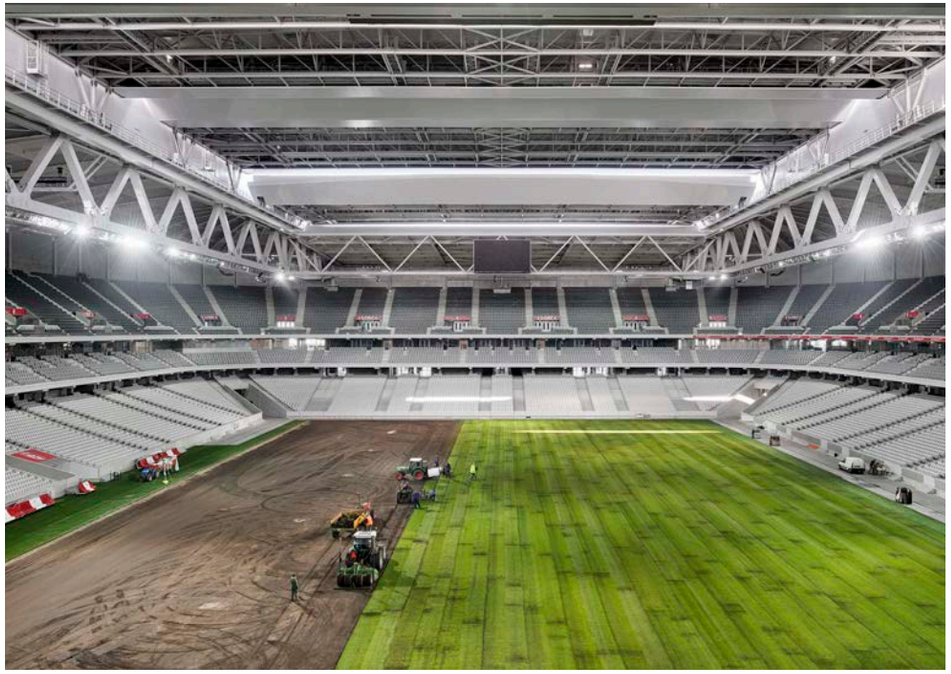
Construction of a museum. This building housing the Louis Vuitton Foundation is an exceptional design and one of the iconic contemporary buildings in Paris. It mainly houses exhibition galleries, an auditorium and associated services.

The building is enveloped in a set of glass «sails» (canopies), each one of a different shape and curvature, with a total area of 13,700 m², giving the building its distinctive architectural appearance.

The structure of these canopies comprises a combination of glue-laminated timber beams and metal profiles. The glazed covering of these sails is made up of quadrilateral curved panels, each geometrically unique.

Greisch assisted with the completion of the project, carried out the studies for construction and assembly of all the sails and canopies, from the glass-frame complex to the structures and their supports.





Lille Stadium

Owner :
Lille Métropole Communauté urbaine

Architect :
Valode & Pistre, Pierre Ferret

Situation :
Boulevard du Breucq - Villeneuve d'Ascq (FR)

Execution of the works :
2009 - 2012

Cost of the works :
50 Mio € excl.vat (stdium, parking and buildings) with 45 Mio € for the roof.

The metal roof of the Grand Stade in Lille, with a total surface area of almost 50,000 m² is made up of simple cylindrical and spherical forms. The north and south ends of the roof are recessed to accommodate the retractable roof sections. These are supported by two lattice mega-girders with a 200 m span and an initial height of 20 m. As a result of Bureau Greisch's work on the «re-design» of the structure, the height of these girders was reduced to 16 m (pre-stressed frame) thus improving the overall visibility for spectators in the stadium. In its final configuration, the stadium can stage fully-indoor events or semi-outdoor events with the opening of the 120 x 80 m² roof.

All the main structures were assembled on the ground and then hoisted into place. Our studies for construction phasing and methods meant it was possible to do away almost completely with welding on site and so reduce the time and risks associated with assembly.

Hospitals

Hospital buildings often have a large internal area that has to be used as efficiently as possible - the structure has to make way for the technical services. The structural design has to adapt to this constraint while optimising construction costs.

This approach leads to a completely different structural typology between the reception and distribution spaces, operational areas, operating theatres and laboratories, wards and treatment units.

Hôpital de Knokke [BE] - Arch. Aaprog - Broeckx et partners - Buro II

Hôpital Montlégia [BE] - Arch. Assar et Artau architectures

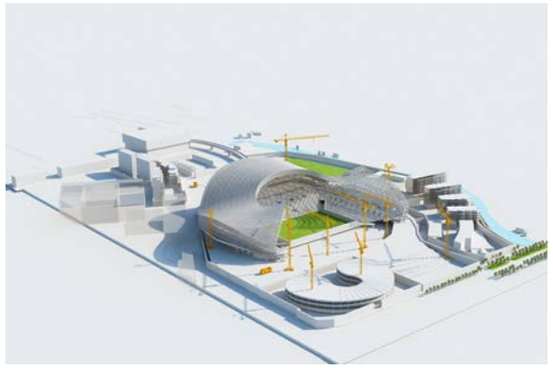
Centre hospitalier Delta à Bruxelles [BE] - Arch. Assar

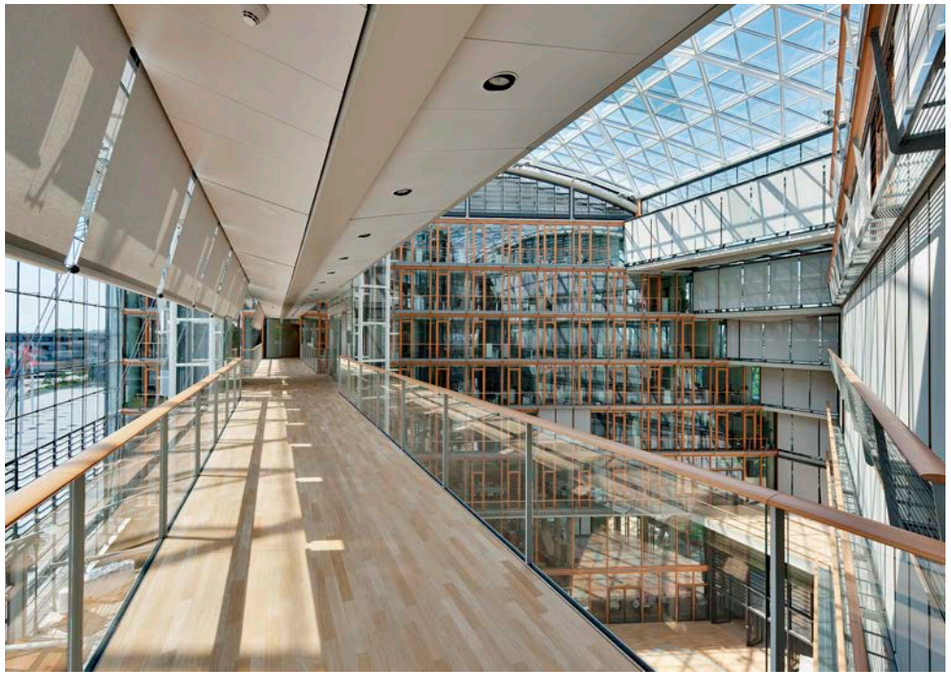
Vélodrome Stadium - Marseille (FR)

Bureau Greisch was brought into this project to optimise the preliminary design and was able to rationalise the design through its experience of structural behaviour.

Without changing the initial typology, we optimised the distribution and dimensioning of the elements to achieve a significant gain in the materials and elements for assembly.

By controlling the behaviour and directing the stresses, we were able to simplify the foundations and the main load-bearing elements.





EIB - Luxembourg

Owner :
European investment bank

Architect :
Ingenhoven

Situation :
Boulevard Konrad Adenauer - Luxembourg (LU)

Execution of the works :
2005 - 2008

Cost of the works :
135 Mio € excl.vat - 24 Mio € for the civil works

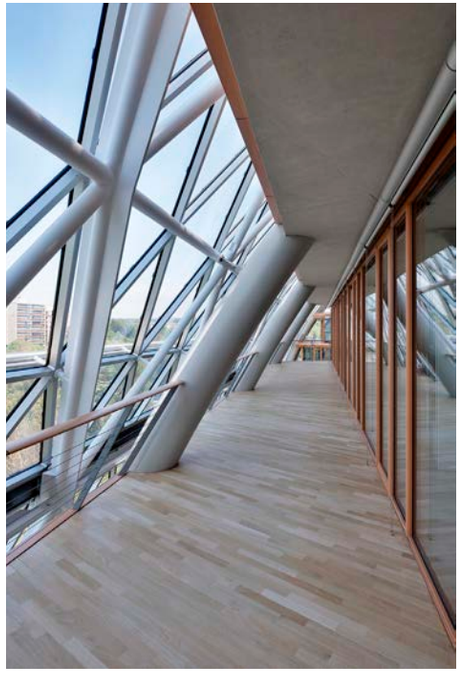
This extension to the European Investment Bank headquarters is located on the Kirchberg Plateau and contains three underground parking levels and ten levels of offices.

A particular feature of the building is that it has no expansion joints despite its 150 m length. This results in high restraining efforts leading to high stress in all the component members (columns, walls, cores, floors).

The exposed concrete internal structure has a mainly mushroom slab construction. The composite columns along the edges are curved and support both the floors and the glazed roof that wraps around the building.

The total floor space is 72,000 m² and the glazed roof 15,000 m².

Bureau Greisch provided the constructions designs.



Tour des Finances - Liège

Owner :
Fedimmo

Architect :
M. & J-M. Jaspers - J. Eyers & Partners/
Bureau d'Architecture Greisch

Situation :
Quartier des Guillemins - Liège (BE)

Execution of the works :
2012 - 2014

Cost of the works :
+/-50 Mio € excl.vat

The Tour des Finances in Liège is a 120-metre high building almost entirely pre-fabricated in high-performance concrete (C80/95). Only the core, the building's backbone, was built on site using climbing formwork.

This reference is one of a number of projects that Bureau Greisch has designed in recent years. These buildings, mainly located in Belgium, come in at under 150 metres high. While they cannot be considered very high buildings on a global scale, they nevertheless share certain features from the point of view of design and dimensioning – spatial and cost optimisation, metal or concrete structure, contribution of the external structure to lateral stability, use of dampers, earthquake resistance, control of differential settlement, etc.

Several examples of these projects appear on the following pages.

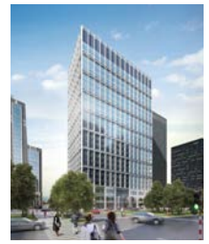
High rise buildings

VAC
(Gent - BE)

Tour Paradis
(Liège - BE)

Silver Tower
(Bruxelles - BE)

Realex
(Bruxelles - BE)

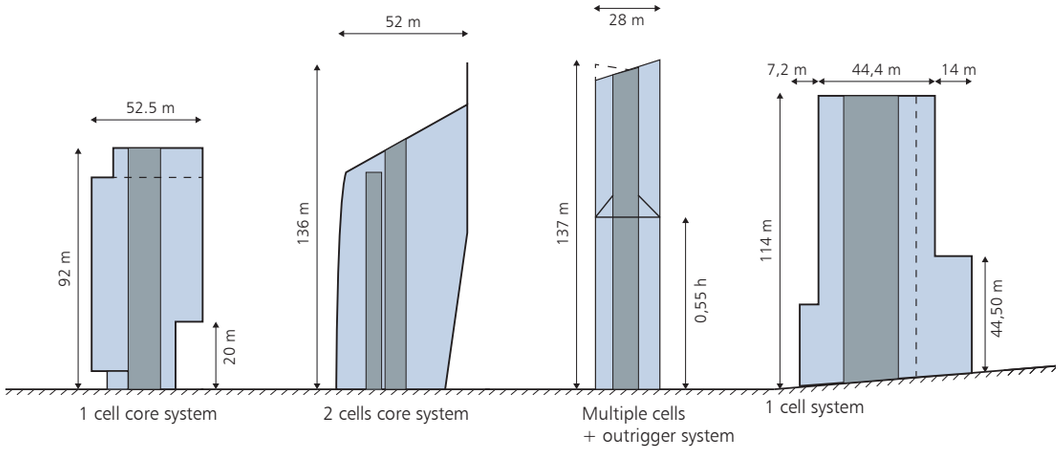


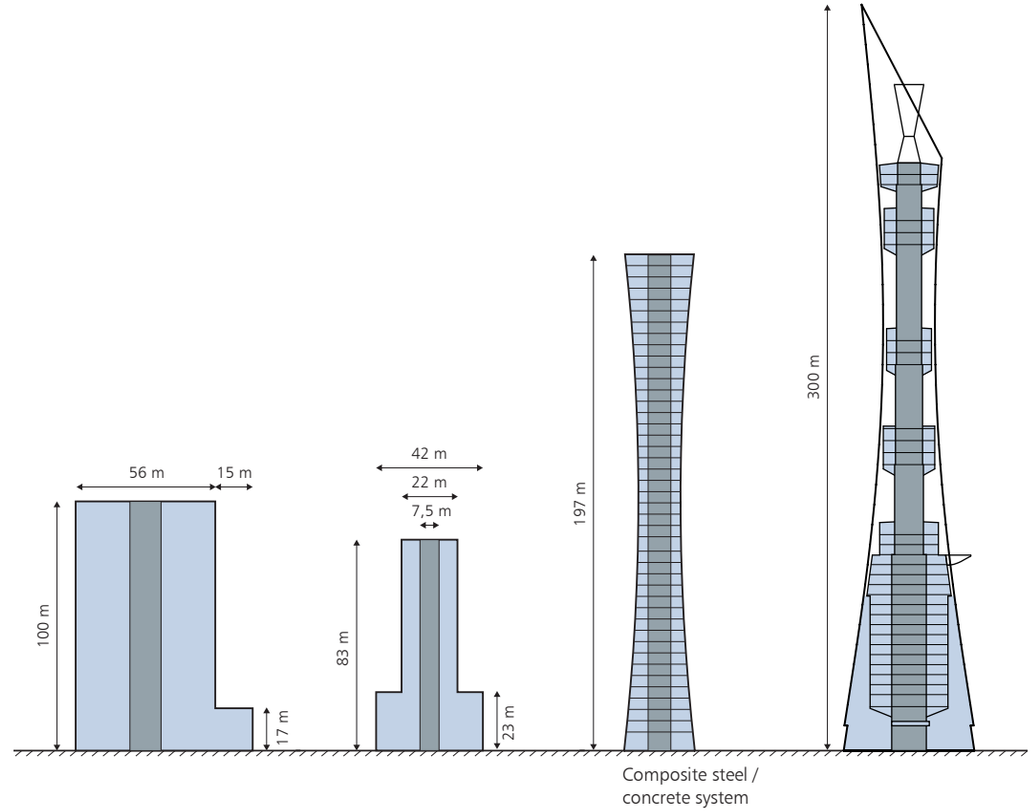
WTC IV
(Bruxelles - BE)

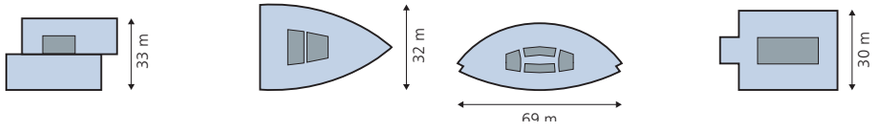
Delta Ouest
(Bruxelles - BE)

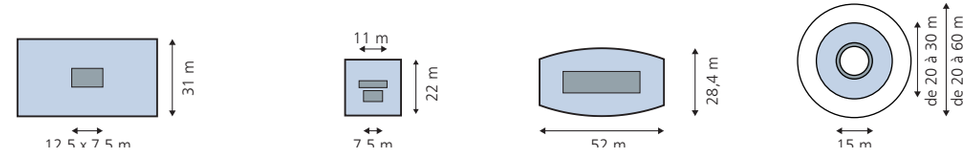
Iconic Tower II
(Lagos - Nigeria)

Aspire Tower
(Doha - Qatar)









CIAC - Liège (BE)

The 1905 Palais des Expositions has undergone a thorough refurbishment – lowering the semi-basement level, replacing all the floors and installing an auditorium – which has increased the museum space, notably with the addition of a contemporary extension on the Meuse Canal side.

The whole structure is of pre-stressed reinforced concrete and all the elements designed to remain visible have been prefabricated, including the 8 m high cruciform columns and the elements of the huge pre-stressed roof slab with a span of 17 m. Bureau Greisch carried out the stability and fluids studies.

Architects: Rudy Ricciotti & Cabinet pHD.

Hemicycle of the European Parliament in Brussels (BE)

Following major damage to the wooden roof frame of the European Parliament, Bureau Greisch devised a metal reinforcing structure to be inserted inside the existing framework. This allowed the loads to be transferred without dismantling the roof. The metal structure was adjusted by prestressing cables for effecting the transfer.

Blankenberge Pier (BE)

Owner :
Ville de Blankenberge (en leasing via Dexia banque)

Architect :
Groep Planning

Situation :
Blankenberge seaside (BE)

Execution of the works :
1999 - 2003

Cost of the works :
20 Mio € excl.vat

Blankenberge Pier, a unique example on the North Sea, has undergone major renovation/refurbishment to provide new facilities.

The extremely complex works, including underpinning of part of the existing building and the creation of new spaces in the tidal zone, were carried out within a temporary enclosure designed to withstand the vagaries of the sea. Concrete elements were restored using cathodic protection.

All structural studies (design, plans, construction and assembly) were conducted by Bureau Greisch.

Sculptures

In addition to conventional construction projects, Bureau Greisch often provides assistance for art installations requiring special studies.

These collaborations, for example with Bernar Venet and Arne Quinze, always take place in a spirit of complete symbiosis with the artistic vision.

← *Sculpture of Bernar Venet - Versailles (FR)*
Passenger of Arne Quinze « Mons 2015 » (BE) ↑

Water Tower - Ghlin (BE)

This 40 m high water tower with a capacity of 2,000 m³ was designed as a landmark structure.

Right from its inception, the client wanted an artistic approach to the design.

Nevertheless, the loadings and functional requirements, combined with the seismic context, called for some very specific studies.

↑↓ *View from outside the office and indoor ambience at Bureau Greisch in Liège*

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