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Building, Rebuilding or Renovating Contextual Sustainable Tall Buildings in a Historical European City Center: the Case of Brussels

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Biography

Architect ERIC YSEBRANT (Belgian, 1943) is Founding Partner of the ASSAR/ART & BUILD association of architects. The newly created Brussels-based firm combines the experience of ART & BUILD ARCHITECT and ASSAR ARCHITECTS of which Eric Ysebrant is also the Founding Partner in 1985. The association comprises a 250 team of architects and staff with offices in Brussels, Luxembourg and Paris and is Belgium's largest architectural group.

Architect ISIDORE ZIELONKA (Belgian, 1942) is Founding Partner of the ASSAR/ART & BUILD association of architects. The newly created Brussels-based firm combines the experience of ASSAR ARCHITECTS and ART & BUILD ARCHITECT of which Isidore Zielonka is also a Founding Partner in 1989. The association comprises a 250 team of architects and staff with offices in Brussels, Luxembourg and Paris and is Belgium's largest architectural group.

ASSAR/ART & BUILD has designed projects covering virtually all fields such as low- and high-rise projects, new and renovated buildings, mixed-use, housing, offices, retail and leisure, hospitals and research laboratories for the European Union or GSK-GlaxoSmithKline to name a few, including defence projects such as the 120,000-square-meter Belgian Military Academy or the new 200,000-square-meter NATO headquarters project under progress, the latter project is the result of an international competition designed by SOM+ASSAR, both projects being located in Brussels. The association has designed more office projects used by the European Commission than any other architect.

The projects designed by the partners of the association received numerous awards including a MIPIM Award in Cannes, France for the renovation of the 34-story Madou Plaza and the 2000 PLEA Passive and Low Energy Architecture World Award for the sustainable features implemented in the 220,000-square-meter Berlaymont Building, the European Commission Headquarters. In the last 5 years, with about 12 tall buildings built, rebuilt or renovated, Brussels has probably witnessed more tall buildings activity than any other city in Europe apart from Moscow and ASSAR/ART & BUILD has a track record of more than 50% of all these Brussels high-rise projects. Such projects include the 27-story Covent Garden and the 23-story Ellipse Building featuring a low-rise building unit and a high-rise one designed in a way to create a harmonious link to the existing urban fabric.

Many buildings designed by the association include an array of energy savings features such as active double skin façades with operable windows allowing for fresh air ventilation in all rooms located. Some projects include wastewater recovery processes using advanced biological and bacteriological purification techniques. Water is recovered at the end of the process and is stored in a pond of non drinkable water. It is recycled into the building for sanitary flushing, for building and garden maintenance.

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Abstract

Old European cities will have to consider remodelling or rebuilding existing Tall Buildings within their city centers. Brussels, Belgium is a good example of such a trend. In the 1960's, Brussels started to erect tall office buildings that were not compatible with the existing, historical urban fabric. These buildings gradually became obsolete at the turn of the millennium and will require renovating or rebuilding.

In some cases the decision is to demolish these existing Tall Buildings to make room for new low-rise buildings. In other locations the decision is to rebuild taller than the existing Tall Buildings. In both cases, the contextual urban implementation has been revised and more useable space has actually been built. As opposed to most other European cities, Brussels has concentrated its Tall Building activity on obsolete buildings or obsolete tall building zones. The architects have put much effort into urban contextualization and into implementing sustainable features. The newly built/renovated towers include an array of energy saving features, such as active double skin façades and wastewater recovery processes, which use advanced biological and bacteriological purification techniques. In recent years, Brussels has witnessed more high-rise activity than any other European city, apart from Moscow. The joint venture of ASSAR-ART & BUILD has a track record of more than 50% of these projects.

Keywords: Regeneration, Renovation, Sustainability, Contextual, Double-Skin

Introduction

Old European cities will generally have to consider remodelling, rebuilding or building Tall Buildings in their city centers and Brussels, Belgium is an interesting example of such a trend. Brussels has become one of the important administrative centers in Europe with a concentration of European institutions (European Commission, European Parliament and European Council of Ministers and NATO in addition to numerous federal and regional administrations related to the complexity of Belgium's administration).

This administrative status started in the 1960s and it required to build Tall, following the American example (see Figure 1). Building Tall has now expanded into a necessity in order to respond to economic and sustainable requirements. This is also reinforced by the limitation of its territory to 19 communes and 160 sq km.

The early 1960s saw the erection of a number of office buildings that were not compatible with Brussels's historical urban fabric, which is characterized by narrow plots of 4-story residential around mixed-use city block centers. If a few Tall Buildings were erected on a pedestrian slab as in France, most adopted the model to fill-in what used to be a lively city block on a few levels,

but with no human relation to the street.

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Figure 1 – Espace Nord area administrative quarter, Brussels, Belgium

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Among those new office developments, a series of 25- to 30-story buildings were sited in the prime locations scattered around town. These have set the image of modernity, clashing with existing surroundings, and typical of the 1960's low-quality construction. They were soon rejected and construction stopped for nearly half a century. The phenomenon was reinforced by the fact that some high quality architecture, such as the "Maison du Peuple" by Victor Horta, was razed to make way for an insignificant tower design. The general feeling at the time was to consider high-rise buildings as both megalomaniac and experimental.

This long pause in high-rise building development lead to most towers becoming obsolete in Brussels at the turn of the century. This created the urgent requirement to renovate or rebuild these existing towers or build new buildings on new plots, still following the master plans and decisions made in the late 1960s. Due to Brussels' market conditions (with low rental values for a capital city and low annual take-up) or to construction costs or to elevators serving 12 floors at a time, the 1960's building height of 100 to 120 m for approximately 25 stories has not been challenged. It is only Brussels' topography that differentiates the towers in the skyline.



Figure 2 – North Galaxy/Brussels/Belgium, 2005

Art & Build/Montois Partners/Jaspers-Eyers & Partners – Photo Detiffe

Figure 3 - Ellipse Building/Brussels/Belgium, 2006

Art & Build / Montois Partners - Photo Glavie

No new Tall Buildings have been generated for over 30 years. All recent Tall Buildings in the North district, such as the Ellipse and the North Galaxy buildings, designed by Art & Build Architect (see Figures 2 and 3), are the result of the 1967 local plan.

Quite opposite from most other European cities, Brussels recent Tall Building development occurs either with derelict Tall Building areas or with obsolete Tall Buildings. In both cases, the architects put much effort into urban contextualization and implementing sustainable features.

A loop through recent history has brought Tall Buildings back into favour. To the area of the administrative territory, we can now add the requirements to:

- Bring population back from the periphery and inverse pauperisation (life and taxes).
- Increase urban density with transport nodes to reduce the environmental impact of commuting.
- Reinforce the identity of institutional entities.
- Respond to sustainable issues.

This movement is visible in the projects designed by ART & BUILD and ASSAR.

Reconstruction - Central Plaza¹ (see Figures 4 and 5) - Brussels - Belgium

At only 15 stories, the reconstructed Central Plaza is the shortest in this series. It is the result of an interesting process to replace a former 23-story tower in a location close to the historic medieval city hall. The result of an international competition called for the renovation of the existing 23-story tower. After extensive talks with the city authorities, the process eventually led to the construction of a shorter 15-story building.



Figure 4 - Central Plaza/Brussels/Belgium, 1963 - Before reconstruction Robert Goffaux with Charles Heywang

After numerous projects were studied for this central location opposite the Central Railway Station, the final project is a better integration of the urban area and increases office space by 20%. A unique feature of this building is that it offers virtually no parking spaces, relying on the public transport interchange in its lower level for all tenants. Quality location and accessibility is reinforced by floor to ceiling views into the city center.

The city as a whole can be viewed from the top floors. Urban integration is achieved by a low-scale base, links to surrounding low-rise buildings, and closing a street.



Figure 5 - Central Plaza/Brussels/Belgium, 2006 – New construction
Art &Build / Montois Partners – Rendering Détrois

The benefit is a new definition of public spaces and a city oriented by landmarks. In addition, the passive externally ventilated façade tells a new story about energy savings and comfort to the public. Now occupied by four major international law firms, it proves that sustainability pays (see Figure 6).



Figure 6 – Central Plaza/Brussels/Belgium, 2006 – New construction
Art &Build / Montois Partners - Photo Glavie

Architectural identity

The architecture comes down to the definition of a sober and serene shape in order to calm the wide variety of volumetric interplay and thus preserves the square's present morphological features.

In the form of an ellipsis, the building echoes the circular features of 'Shell' and 'Josi' buildings, on the Place du Marché au Bois. The size of 'Central Plaza' enables the towers of St Michel and Gudule Cathedral to freely reaffirm themselves from the "Place de la Cathédrale" as from the historical district of the "Place Agora".

The glass and metal façade of the 'Central Plaza' is made up of an extremely narrow (15 cm) cold double skin. This is a first for this type of technology applied to a rental building in Brussels.

"There is an answer to every context; an answer that must be the synergistic synthesis of all the conceptual parameters 'Central Plaza' ... involved more than 40 draft models Several typological viewpoints were possible. The choice of the elliptical shape, a finished and dynamic form, finally won. At the same time, it is an answer to the curves of the buildings opposite and represents the crossroads of the Place Marché au Bois. The ellipse, a smooth and non-static form, asserts itself clearly and soberly and offers the building a reading as an urban landmark. (...) Striking & with identity, answering & integrating ... this is the paradox of today's answer to the 'historical eclecticism' of the context. The building continues this typically Brussels notion; in keeping with this pluralistic logic where Brussels is a crucible of inventiveness, experimentation and formal freedom. Brussels is neither Paris nor Amsterdam. Brussels is a stylistic directory. The secret of the singularity of its evolution resides in the sum of differences"

according to Pierre Lallemand, Art & Build Architect.

Description of the building

The building has office space arranged on the perimeter, around a central core devoted to vertical traffic, sanitary areas and adjoining technical rooms. This layout produces offices that enjoy optimum natural light. The ground floor features a vast multipurpose space that accommodates the building's reception services. This multipurpose area can be divided and has direct access to the outside, separate from the main entrance. This permits the organisation of additional events and activities (exhibitions, receptions, etc.). 'Central Plaza' has 15

levels above ground (GF+14 +mechanical roof) and 3 levels below ground. An extension (GF+8) in Rue de Loxum (32.5 m high) provides a harmonious transition between the dimensions of the Belgacom communication company complex, the surrounding buildings and the ellipse. It also creates a dialogue with the 'Marquis' building situated on the other side of Rue de Loxum.

'Central Plaza' is served by 2 blocks of 3 lifts from level -1 to +14 (one of the 6 lifts is a goods lift that also serves levels -2 and -3). A lift is provided for visitors to connect to the underground car parking with level -1 and the ground floor (see Figure 7).



Figure 7 - Central Plaza/Brussels/Belgium, 2006 - Ground floor plan

Art & Build / Montois Partners - Image Art & Build Architect

A building focused on sustainable development

The environmental qualities, which are focused on a concern for saving energy and the efficiency of the working environment, meet the ever-increasing concerns of occupants in terms of comfort and operating costs. This project offers concrete and effective solutions in these areas.

Central Plaza is particularly successful due to:

- Its special location in the heart of the city, a major crossroads in Belgium that can rely heavily on public transport facilities.
- Its volumetric concept promotes energy savings and pedestrian comfort:
 - The oval shape is the result of a quest for maximum efficiency in relation to the surface areas and volume. This shape is characterised by a positive coefficient of compactness, which allows the surface area losses to be limited while ensuring maximum internal surface areas and volumes.

- The oval shape prevents the formation of turbulence in the proximity of the building and facilitates airflow.
- An innovative and effective envelope that ensures optimum comfort (see Figure 8):
 - The building features a narrow, cold double skin facade with natural external ventilation. It is the first rental building equipped with such a façade in Brussels.
 - A cold double-skin façade ensures the feeling of thermal comfort, natural lighting, visual comfort and optimal functioning:

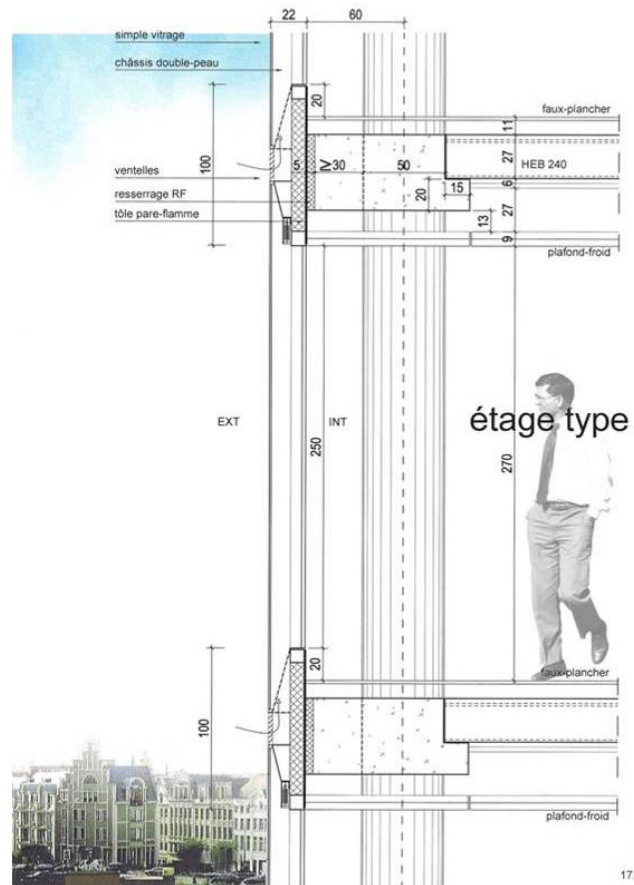


Figure 8 - Central Plaza/Brussels/Belgium, 2006 – Double-skin façade

Art & Build / Montois Partners – Rendering Art & Build Architect

- Highly effective solar protection thanks to the presence of blinds and the evacuation of overheated air captured in the double skin. The presence of blinds enhances the natural ventilation of the air between the two surfaces of the façade.
- K coefficient lower than that of a traditional façade.
- Natural ventilation possible on all levels, while guaranteeing security and optimal comfort.
- Every module features a vent with an on-off switch for operating the cold ceiling when open and thus prevents energy loss.
- Enhanced acoustical comfort.

- Solar factor lower than 20% whereas an effective single-skin façade achieves only about 30%.
- The occupants enjoy a maximum of natural light and a better quality of the perception of natural light's colours : the double-skin façade allows the use of neutral-coloured external glazing with the highest possible transmission coefficient. Light transmission with the blinds open is superior to a single-skin façade incorporating glazing with a good solar factor.

The sum total of these elements endows the building with an extremely comfortable and quiet internal climatic environment.

- Simple, economical and reliable air-conditioning solutions without mechanical cooling.
 - Silent, comfortable cold ceilings, economical in energy and surface area.
 - Two gas-fired boilers, one high output and the other condensation type.
 - Mechanical ventilation with a minimum airflow corresponding to hygienic airflow.
 - Variable airflow in the meeting rooms depending upon occupancy.
 - 'Free' frost protection in the car parking thanks to air extracted from the office floors.
 - Re start-up of the building after power interruption for the ventilation units.
 - Heat-recovery banks on the ventilation units and the cold ceilings ('free chilling' in winter and mid-season) enabling reduced use of the boilers and refrigeration units.
 - Switches on the vents enabling the cold ceilings to be switched off, therefore saving energy.
 - Optimisation of the installations' operation thanks to centralised technical management (CTM).
 - Low-energy lamps with electronic ballasts.
 - Simple, robust and long-lasting materials, easy to recycle and repair: glass, aluminium, stainless steel, stone and wood.
 - Prefabrication of structural components (beams, pillars, floor slabs, stairs, etc.) promoting sustainable development. This construction system focusing on prefabrication permits the following:
 - Improved pollution control during the manufacturing processes.
 - Reduction of waste during the manufacture of components and the on-site activities.
 - Enhanced worker safety and health.
 - Improved construction quality control, ensuring required performance characteristics.
 - Limitation on the transportation of materials and people.
 - Miscellaneous
 - Hydrocarbon scrubber and separator.
 - Storm-water tank.
- Functionality, comfort and flexibility
- Maximum flexibility of the usable surface areas:
 - Maximum number of offices enjoying light from windows thanks to the special configuration of the floors.
 - Office floors can be divided up for two different occupants.
 - Divisibility and adaptability over time thanks to the siting of utilities, module by module, ensuring high partition flexibility.
 - High flexibility for siting meeting rooms within the floors.
 - Widespread use of false ceilings enabling easy modification of connections and flexibility of layouts.
 - Easy access to technical ducts for special conversions at a later date.
 - Under-ceiling heights
 - 2.70 m in the office spaces. This height is continuous throughout the ceiling areas of the floors.
 - 2.40 m in the sanitary and service areas.
 - Adjustment of the offices
 - Façade components for creating modules for individual offices are 2.70 m wide. Optimisation of the building's modular system gives great flexibility for arranging office spaces.
 - Accessibility for persons with restricted mobility
 - The building complies with the regulations on access for persons with restricted mobility.
 - Façade maintenance
 - The building is fitted out with equipment for façade maintenance.
 - Every module of the double-skin façade is equipped with a vent facilitating window and maintenance.
 - Acoustic comfort
 - Enhanced acoustic comfort thanks to the cold double skin.
 - Acoustic false ceiling.
 - Horizontal and vertical acoustic barriers in the false ceilings that prevent the transmission of noise from one office to another.
 - Cooling
 - The cooling of rooms used as offices and meeting rooms is by means of cold ceilings. This solution is particularly comfortable, quiet and economical to run, and gives an appreciable gain in surface area.
 - Deliveries and waste
 - The building is equipped with a delivery area situated under the building and off the public highway.
 - An easily accessible waste room for triage and storing of waste is provided on level -1.
 - Fire safety
 - All office areas are equipped with a sprinkler system especially designed to maintain partitioning flexibility.

- A fire detection system is installed throughout the building.
- A smoke removal system was installed in the atriums.
- Lifts
 - A main block of six lifts for twenty-one persons serves the building from levels -1 to +14. One of the lifts can be used as a service lift and also serves levels -2 and -3.
 - An 8-person lift serves the car parking levels (-3 and -2), levels -1 and ground-floor reception.

The sum total of these architectural and technical features, together with appropriate equipment, enables high levels of energy savings and environmental performance. This approach aims to ensure the comfort and the health of the users and guarantees a significant reduction of the impact of their activities on the local and global environment. It also results in improved operating and maintenance costs. The contemporary architectural identity of 'Central Plaza', its transparency, the clear expression of its activities, its environmental qualities, its flexibility and its openness to the City of Brussels are also elements that permit the creation of a strong image. This is in harmony with the immediate surroundings and with the current and future occupants.

New Construction - Covent Garden ² (Figure 9) and Ellipse Building ³ (Figure 10) - Brussels Belgium



Figure 9 – Covent Garden/Brussels/Belgium, 2007

Art & Build / Montois Partners - Photo Art & Build Architect

The twenty-seven story Covent Garden and the twenty-three story Ellipse Building are examples of new tall buildings on two different sites that have been vacant

for many years.

Both projects are composed of two major elements; a low-rise building unit and a high-rise. Both projects are designed to create a harmonious link between a next-door park, a low-rise buildings zone and a high-rise buildings zone. Both projects are designed around an inner garden – open in one case, covered by a skylight in the other – to help create this urban link (see Figure 11). They are an attempt to build speculative high-rise projects different from what we are used to seeing. Adding flexibility and multiple tenants (one of the rare opportunity where the European Commission might share a building with others) to integrate with historical low-rise buildings, the complex links different scales via dramatic atria.



Figure 10 - Ellipse Building/Brussels/Belgium, 2006

Art & Build / Montois Partners - Photo Airprint



Figure 11 - Covent Garden/Brussels/Belgium, 2007 – Atrium

Art & Build / Montois Partners - Rendering Détroit/Art & Build Architect

This offers impressive urban rooms where biological water treatment is visible from all waste waters of the building (see Figure 12). These buffer zones offer energy savings and bring a new identity. Density is created for both projects by the transportation interchange of the railway.

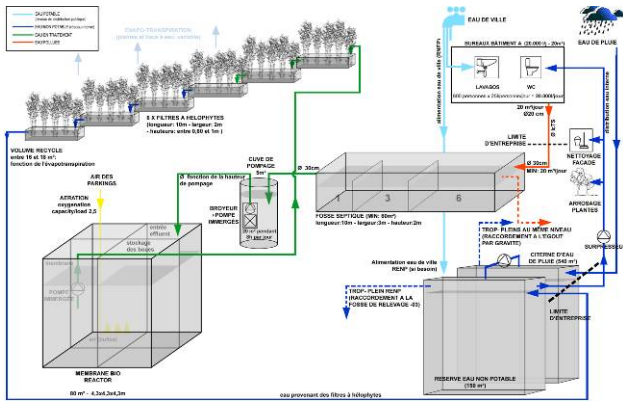


Figure 12 - Covent Garden/Brussels/Belgium, 2007 – Water treatment
Art & Build / Montois Parnters - Rendering Art & Build Architect

Renovation - Madou Plaza ⁴ (Figure 13) - Brussels - Belgium

Originally completed in 1965, Madou Plaza is the tallest building in the Brussels CBD. Its renovation is probably one of the most ambitious of its kind ever undertaken in the city. Completely rethought in respect of its function, circulation routes and relationship to its surroundings, the 34-story 120 m/394 ft high building has been entirely rebuilt around its original structure.

Some 8,000 sq m/86,111 sq ft of new construction at the base have created a podium for the existing 32,000-sq-m/344,445-sq-ft tower. This 13-story podium is organized around an atrium, the tallest in Brussels. The atrium serves as the ‘beating heart’ of the project. Madou Plaza now includes a conference center equipped with an auditorium and business service facilities.

Award-winning project

The Madou Plaza project is the result of a competition. The MIPIM-award winning project honored in Cannes (France) in 2006 is the work of architects ASSAR, as lead architect in charge of the concept and master plan, and Archi 2000. Madou Plaza is the third of ASSAR’s projects to receive a MIPIM award. Two others – Résidence Novalis and the Mondrian – have received the MIPIM Awards in 2000 and 2005, respectively.

Taking the urban fabric into account

Numerous solutions have been designed and several models were built in order to create a 13-story atrium block at the rear of the tower. The intent was to become a harmonious link with the existing urban fabric and not an intrusive body into the area (see Figure 14).

The side of the atrium facing the Chaussée de Louvain is only 7 stories high – with a 7-story recessed glazed wall above it – in order to match the height of the existing townhouses. At the Rue Scailquin side, where an existing 12-story office block stands, the atrium façade’s height matches that of the office block. On the townhouse side, the 7-story atrium façade has a recessed glazed metal curtain wall which cannot be seen from street level. However, it allows daylight to generously light the offices facing the atrium. At night, the glazed wall becomes a lantern that can be seen from distances away.

The ‘glazed promontory’, located in the façade, forms a direct prolongation of one of the wings of the atrium and underlines the design of the new entrance to the building. On two levels and placed to the left, it creates an urban link between the tower and the inner ring road. The ‘micro-climate’ of the esplanade is also improved by the inclusion of this feature and by the design of the curved façades. The promontory also enables special areas to be created (meeting rooms for example) with views overlooking the city.



Figure 13 - Madou Plaza/Brussels/Belgium, 2006 – ASSAR, lead and design architect / Archi 2000 - Photo ASSAR

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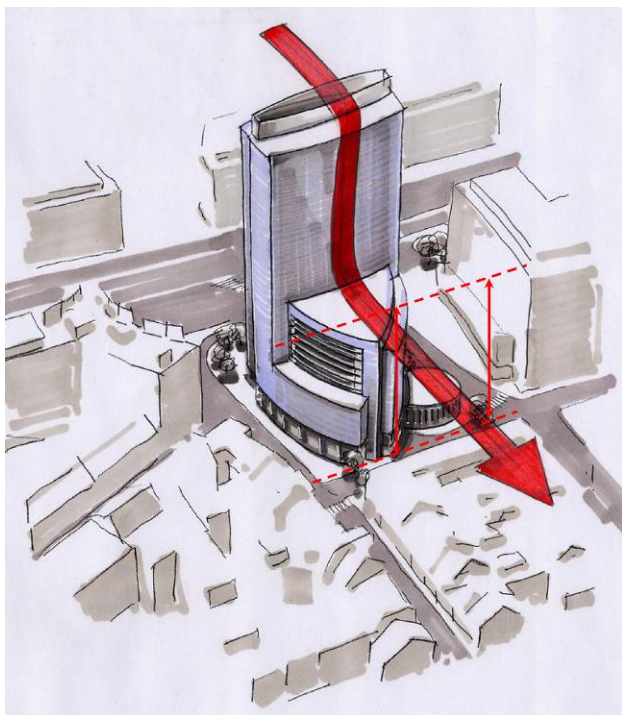


Figure 14 – Madou Plaza/Brussels/Belgium – ASSAR – Rendering showing the aerodynamic principles as well as the contextual volumetric approach – Rendering ASSAR Architects

Master plan

In 1965 the existing tower did not take into account the urban fabric within which it was located. Before its transformation, there was no plaza in front of the building. The back of the tower was adjacent to derelict townhouses and workshops left abandoned for years (see Figure 18). The concept architect, ASSAR, after having studied the implementation of an additional

8,000 sq m, advised its client to buy the adjacent site to provide for an addition of rentable space. The City of Brussels then had an idea to buy a portion of the boulevard so as to allow the creation of a real plaza in front of the tower. The problem of how to find the right value for the different pieces of land then arose. ASSAR architects suggested, to each owner, to exchange sites at no additional cost to anyone. This solution was accepted by both parties. It can now be seen that at ground level, a large area along a retail street has been allocated to shops. A new street flanked by housing has been created at the rear of the tower (and given back to the City) while an esplanade has been laid out at the front and is now part of the tower ownership (see Figure 19).

Urban renewal

Car and pedestrian circulation has been redistributed for greater efficiency and to generate increased safety for all road users. The rear of Madou Plaza has a new roadway in order to allow the tower to fit more harmoniously into the urban fabric. The tower is on one side of the roadway and a residential building is on the other. This residential building, soon to be constructed, will act as a transition between the modernity of the tower and the more classic urban fabric style of the block located between the Rue Scailquin and the Chaussée de Louvain. At street level, a series of shops will run along the Chaussée de Louvain, a shopping street leading to the heart of Saint-Josse. These shops will continue the lively retail fabric of this thoroughfare, so brutally interrupted by the entrances and exits of the car parking in the original tower design. These have now been located at the crossroads of the Rue Scailquin and the newly created roadway, behind the tower, providing greater safety.

The atrium

The atrium serves both as a welcome hall, a well of light for the offices on the lower floors, and as a communications hub for the rest of the building (see Figure 15). Facing the atrium on one side stands a 193-seat auditorium. It is also accessible from the outside so that it can be rented to the general public of the local community. On the other side of the atrium is the 150-seat cafeteria. A grand staircase leads to the 1st floor restaurant, which benefits from views overlooking the atrium on one side and from panoramic views overlooking the city on the other side.

Vertical circulation

Vertical circulation features twelve elevators located within three elevator banks serving levels +0 to +10, +10 to +21 and +21 to +31. Level 10 and level 21 allow a smooth transfer from one elevator bank to the others. The mid- and high-rise banks use existing shafts, including the former circular staircase shafts transformed into elevator shafts. The low-rise bank is new, facing the atrium. It should also be noted that levels +31 to +33 are linked by a single elevator dedicated to the penthouse

mechanical levels at the top of the tower.

A newly created bank of two elevators connects the ground floor level with the underground garage. In order to replace the obsolete circular staircases, two newly built staircases have been built in what used to be the ladies and men's rooms.



Figure 15 – Madou Plaza/Brussels/Belgium, 2006 – Atrium
ASSAR, lead and design architect / Archi 2000 – Photo Detifffe

Double-skin façade

A semi-reflective double-skin type façade and cold ceilings provide the occupants with the highest standard of comfort (see Figure 16).

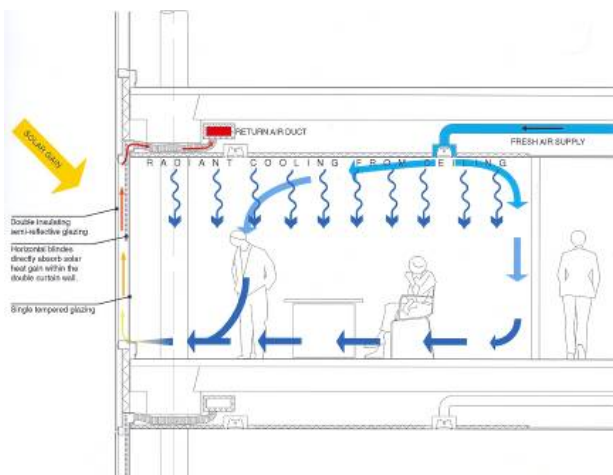


Figure 16 – Madou Plaza/Brussels/Belgium, 2006 – Double-skin façade
ASSAR Architects – Section plan ASSAR Architects

The entire ceiling surface acts as a cooling radiator thanks to the circulation of chilled water in tiny tubes behind the perforated metal panels. The modulation of the façade is 135 cm and operable windows (1 out of 2) open horizontally towards the outside.

The structure

Structurally, the renovation/transformation of Madou Plaza comprises two elements (see Figure 17):

- Extend the floors of the existing tower by means of an additional 80 cm to transform the straight existing façades into a new curved façade.
- Build a new atrium at the rear of the tower.

The first part was made possible by removing the existing covering of the floor plates and providing a lighter raised floor. In this way, the loads on the existing steel columns and beams remained similar to the existing situation, before transformation. The only columns to have received more loads are the two columns in contact with the new extension. These existing hollow-metal columns are reinforced with additional curved plates, welded on site. The raft foundation has also been extended because of the increase in loads. By removing the existing 7 cm thick covering of the floor plates, problems of fire resistance arose. All of the existing floor plates and support profiles had to be sprayed with a fire resistant product to maintain fire ratings.

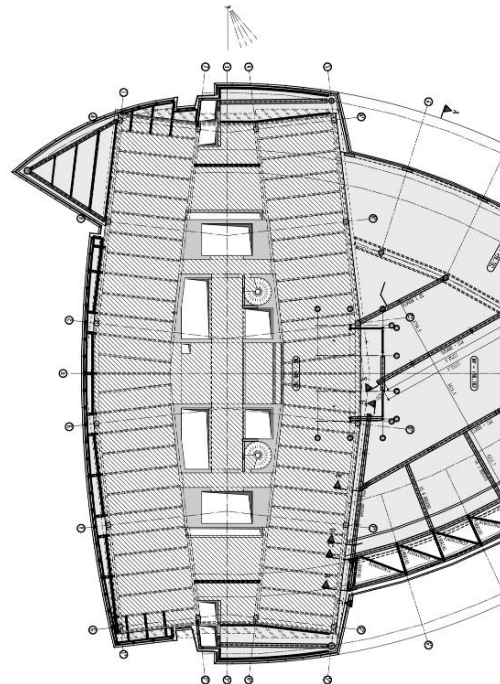


Figure 17 – Madou Plaza/Brussels/Belgium – The part with the lines indicates the existing Madou Plaza tower limits before renovation
ASSAR, Architects – Drawing ASSAR Architects/Waterman TCA

On top of the existing tower, a new steel structure has been built to support the antennas of the telecom and television companies using the roof. Due to the uninterrupted activities of these companies, it was

necessary to progressively transfer their equipment to one level below and carry out the installation so that the local reinforcements, supporting the new steel structure, could be executed with no impact on their activities. Once the work on the upper level had been completed, the antennas were transferred to the new structure and the operator was able to return to the upper level.

The second part of the renovation/transformation was the new extension. The smallest element is made of a mix of steel and concrete. This is an extension of the twenty-one floors. The typical upper floors now comprise around 1,000 sq m instead of the 865 sq m before the transformation. The new concrete column – at the tip of the promontory – has a new foundation created in the existing parking garage, below basement level -3.

The largest element (the wings around the thirteen stories) has been built using high strength concrete columns and prefabricated beams. Because the existing building imposed floor-to-floor height limits, the floors plates had to be double T sections so that the mechanical elements could pass between the plate ribs. As the general layout of these parts is curved throughout, these particular double T sections also had to enable the upper plate to be cut into, to avoid form-work for in-situ concrete. This thirteen story atrium is topped by two mechanical floors. The 28 m span metal beams supporting these two heavy load-bearing mechanical floors curve with the façade.



Figure 18 – Madou Plaza/Brussels/Belgium –
Before renovation, ground floor plan – Robert Goffaux



Figure 19 – Madou Plaza/Brussels/Belgium –
After renovation, ground floor plan – ASSAR Architects

After the renovation, office areas allowed for optimal use of the different floor plate sizes: 1,390 sq m and 1,800 sq m in the lower levels around the atrium and approximately 1,000 sq m for the tower levels. Occupied by the Commission of the European Union, Madou Plaza as a whole is one of the most secured office projects in Brussels, with access to badge holders restricted to each individual's own area. The renovated Madou Plaza is more than an architectural transformation; it is a veritable urban renewal for the lively Place Madou area (see Figures 18 and 19). Creating a square in front of the tower constitutes a genuine 'Madou Plaza', rather than in name only, as it was before the renovation.

Selected technical features

- Air conditioning via cold ceilings: a particularly silent system offering high degrees of comfort
- Reinforced air input in meeting rooms
- Double-skin façade (exterior: double glazing with thermal insulation and solar control / interior: single glazing)
- One window frame out of two opens, using the 'pentograph' system.
- Raised floor systems
- False ceilings with high acoustic performance
- Low luminescence lighting
- Minimum floor to ceiling height: 2.60 m
- Rapid smoke extraction and evacuation system in the event of fire
- Separate security control for offices and garage

Conclusion

All the above-mentioned Tall Buildings include an array of energy saving features such as active, double-skin façades with operable windows, allowing for fresh air ventilation in all rooms. The buildings are fully sun-protected while allowing for natural light and good views to the city. Some projects include wastewater recovery processes, using advanced biological and bacteriological purification techniques. Water is recovered at the end of the process and is stored in a pond of non-potable water. It is recycled into the building for sanitary flushing and for building and garden maintenance.

More than forty years ago, after having been among the first in Europe to brutally insert Tall Buildings into an historic city, Brussels has recently become a "think tank" about the way a Tall Building should be built or rebuilt within an urban context. At the same time, sustainable architecture is now part of these renovated projects, since the oil crisis has made us understand that energy matters.

ART& BUILD/ASSAR combines a 250 strong team of architects and staff. ART& BUILD/ASSAR has designed projects covering virtually all fields, including low-and high-rise projects, new and renovated buildings, mixed-use facilities, housing, offices, retail and leisure, hospitals and research laboratories. Defence projects, such as the new 200,000-sq m NATO headquarters, is the

result of an international competition. It was designed by SOM+ASSAR and is currently under construction in Brussels.

The projects designed by the joint venture of ART & BUILD/ASSAR received numerous awards, including the MIPIM Award in Cannes, France for the renovation of Madou Plaza and the 2000 PLEA Passive and Low Energy Architecture World Award for the sustainable features implemented in the 220.000-sq-m Berlaymont Building - the European Commission Headquarters. Features developed in the Tall Buildings described above keep the financial and time imperatives under control. This is the only real way to promote sustainable development on a large scale.

References

Central Plaza/Brussels/Belgium/2006 Architects: Art & Build, design architect/Montois Partners / Client: Egimo sa, (Compagnie Immobilière de Belgique) / Structural engineer: Ingénieurs Associés / Services engineer: Tractebel / General contractor: Louis De Waele / Above ground area: 25,000 sq m

Covent Garden/Brussels/Belgium 2007 Architects: Art & Build, design architect/Montois Partners / Client: Immobilière du Royal Rogier / Project manager: Buelens Real Estate nv / Structural Engineer: Bureau d'Etudes Greisch sa / Services engineer: JCD-STD jv / Acoustical engineer: Venac / Wind study: Numeca / Control-Security: Seco / Main contractors: Van Roey/Democo/Vooruitzich / Occupant: Commission of the European Union / Above ground area: 72,000 sq m / Height: 99.13 m; 27 stories / Parking spaces: 350 / Structural materials: reinforced concrete / Other materials: glass curtain wall

Ellipse Building/Brussels/Belgium/2006 Architects: Art & Build, design architect/Montois Partners / Client: Fortis Real Estate/Immomills Development / Construction manager: Fortis Real Estate Construction Management/Progex / Structural engineer: Ingénieurs Associés/B.CEC / Services engineer: Technum/Tractebel Development Engineering/Geocal / Acoustical engineer: Venac / Contractor: Cordeel / Occupant: Vlaamse Gemeenschap of België / Above ground area: 46,198 sq m / Height: 85 m, 23 stories / Structural materials: reinforced concrete / Other materials: glass curtain wall, granite

Madou Plaza/Brussels/Belgium/2006 Architects: ASSAR Architects lead architect/Archi 2000 / Concept and master plan: ASSAR Architects / (1965 Architect: Robert Goffaux)

Client: IVG Real Estate Belgium / Project coordinator: Cetim
Owner: Commission of the European Union / Structural engineer: Waterman TCA / Mechanical engineer: Tractebel Development Engineering / Acoustical engineer: D2S International / Quantity surveyor: G. Pierson et Associés /

Landscape architect: ASSAR, Archi 2000, JNC International /
Quality control: Seco / Contractors: Herpain/Strabag / Occupant: Commission of the European Union / Height today: 119.67 m/ 392.62 ft / Original height in 1965: 112 m / 367 ft / Number of above ground levels: 34 / Basements: 4 / Functions: Office, auditorium, restaurants, retail / Above ground area: 40,000 sq m / Garage: 470 underground spaces / Basic module: 1.35 m / Auditorium: 193 seats / Cafeteria: 150 seats / Restaurant: 200 seats / Structural materials: reinforced concrete, steel / Other materials: active double-skin clear glazed-wall, white metal casing, grey granite Azul Extra Madura, polished black Chinese granite