Coloring Paris

BY FRANK HOVORKA

In the City of Light, Parisians can see the vivid spectrum of light emanating from nearby Aubervilliers. EMGP 270 is not only beautiful, but also provides a comfortable office working environment and sustainability as the first private commercial building certified under the High Environmental Quality (HQE®) Offices program, a French sustainable building certification program comparable to the USGBC LEED® program.

Nights

Trapezoid Base

The 10,000 m^2 EMGP 270 occupies a key position on the main avenue near the highway, which runs diagonally from porte d'Aubervilliers, crosses the Saint-Denis canal and leads to the city's center. The building consists of a two-floor basement for the car park, a ground floor with the main entrance, services, and retail, and seven additional floors with offices. The streets around EMGP 270 create a narrow triangle.

The two-level trapezoid base of the building has a central core to house the elevators, stairs, air shaft and technical shaft. Each building face varies according to the street characteristics: a sharp prow on the avenue, a setback façade over the base on the south side, and a compressed look on the gable front. On all three faces, a brick façade pays tribute to the place and its past, and tall windows cover the full height of each floor.

The triangular shape of the building helped to optimize the workspace. With the workspace around the periphery, each office receives abundant daylight through the tall windows. Computer simulations defined the surface and dimension of glazing to achieve a daylight factor between 1.5 and 2.5 at 5 m to 6 m from the façade.

Color Glow

The building façade features a lighting design consisting of 600 windows framed with a range of 12 colors. One or several frames around each window are superimposed to vary the depth and width of each window. Vertically arranged glass cases with colors on the inner sides amplify the look. The color and light movement produces a distinct visual identification, visible from nearby Paris. By day, the windows appear to diffract light. By night, each window is colored with light in five sequences.

Nine staged electric circuits control and dim the lighting. A 16 mm diameter fluorescent tube, located in a recessed spot in the floor, lights the window frame from inside the building. The optic, asymmetrical design spreads the light 3° to 38°. The T5 fluorescent tubes are fitted to controlled electronic ballasts with 18 mm diameter glass filters. The filters, developed for this project, are recyclable. The lighting installation has a 15,000 hour lifetime.

In addition to the façade, the lobby's design features a light wall. Glass covers a 25 m long, 3 m high wall, which gives 80% useful light in the lobby through a continuous line of fluorescent tubes on the top of the wall and 19 200 m of optic fibers in a 4 cm space between the glass and wall. The 150 W metallic iodide lights with a 7,000 hour lifetime are located in a false ceiling, making them easy to maintain. Each light is equipped with a motorized color disk. Fibers change color randomly. The variation is slow, almost elusive.

BUILDING AT A GLANCE

Building Name EMGP 270

Location 45 Victor Hugo Avenue, 93300 Aubervilliers, France

Size 10 000 m^2

Started January 2004

Completed June 2005

Use Office building

Cost €16.2 million (approximately $24.9 million)

Distinctions First private commercial building certified under HQE Offices program

BUILDING TEAM

Owner ICADE
Project Manager Frank Hovorka and Caroline Delgado-Rodoz

Architect Brenac & Gonzalez
Project Manager Xavier Gonzalez and Jean-Pierre Lévèque

Mechanical
INGENI Project Manager
Patrick Bozetty and Annie Ayouch
THOR Project Manager Phillipe Cuvilliez

Maintenance Engineering Eurogem
Project Managers Alain Vattan and Benjamin Ficquet

Building Skin Van Santen
Project Manager Gontran Dufour

Structural SCYNA 4
Project Manager Francois Delbarre

Lighting 8' 18"
Project Manager François Migeon
Assistant Rozenn Le Couillard

Acoustic LASA
Project Manager Adam Devilliers

Project Management MEUNIER
Project Managers Eric Marchand, Raymond Sauvegrain, Philippe Boitelet and Eric Botturi

Environmental Solutions

The building team studied and evaluated the global impact of the building on the environment to find solutions. The project was designed to achieve indoor health, energy and water efficiency, CO_2 reduction, user comfort and control of environment, quicker leasing and better tenant retention.

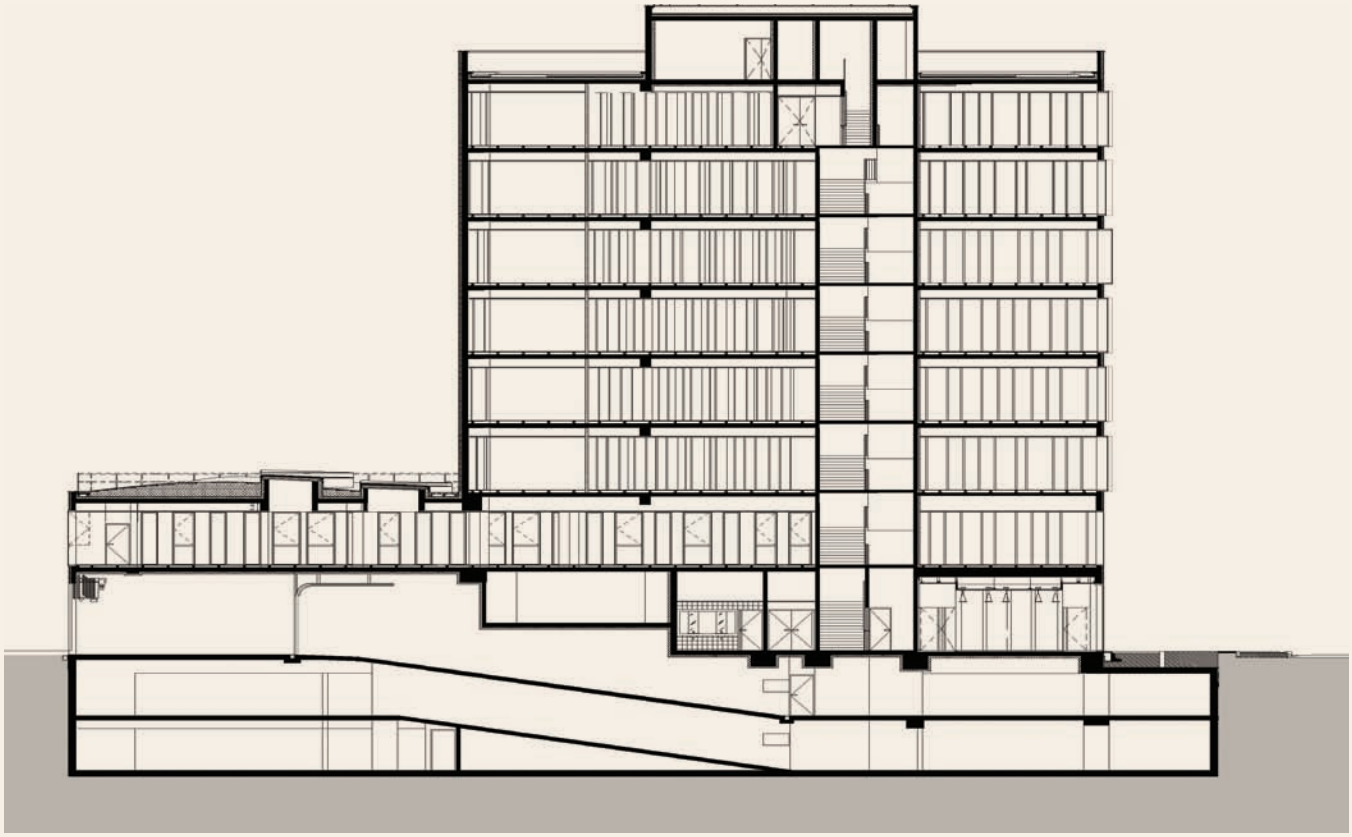
The following features achieve these goals:

- Energy-saving system regulating indoor temperature based on external climate conditions;
- Triple-glazed windows for daylighting and street noise reduction;
- North-oriented entrance for glazed side without air conditioning;
- Chilled beam air conditioning;
- Workspace with direct daylight access;
- Partitioning flexibility;
- Office space with user-adjustable air diffusers, temperature controls and artificial light dimmers;
- Motor-controlled blinds with automatic shutdown according to solar heat;
- Lavatories with light motion detectors;
- Two flow flush systems (3 L and 6 L);

Motorized blinds automatically control incoming daylight.

- Airflow recycled by triple filters in the two air-handling units before being redirected; and
- Building management system with metering by component (75 submeters for energy).

BUILDING SECTION



EMGP 270 provides a comfortable office working environment.

Motion detectors regulate lighting in the lavatories.

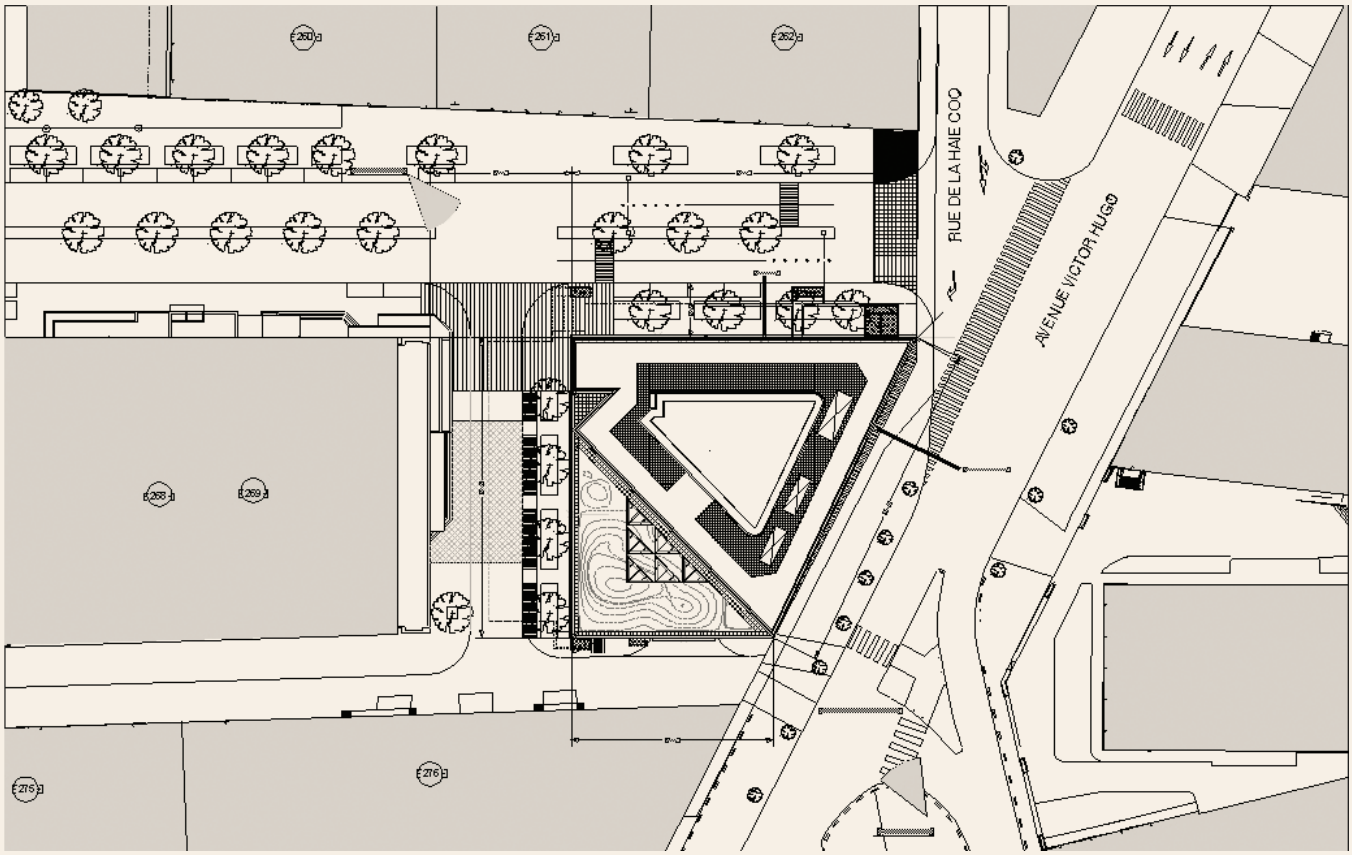
Thermal Control

In addition to excluding all glass curtain-wall type systems, external materials were chosen for their thermal control performance levels. Combining external insulation with bricks offered the dual advantage of matching the look of nearby older buildings and avoiding needing a thermal bridge with an outside insulating layer. Composed of compacted polyurethane foam and imbedded terra cotta facing, the 1 m by 1 m panels were joined on-site.

Water Management

Control and management of water will be one of the vital issues in years to come. In view of this, rainwater is caught, stored and used for watering the lawn and for flushing toilets. The consumption of the toilet flush is an average of 200 m^3 per month for 450 users. The rainwater tank of 180 m^3 is insufficient.

SITE PLAN



Limiting Impact

To limit the negative impact of the work site on the environment and the neighborhood, a green construction site chart was created for contractors and a method for achieving responsible waste management was defined. The chart showed vehicle movements on-site, hours for delivery, and noise reduction measures. Particularly, machines and tools used on-site were controlled to limit periods of noise. Furthermore, dust was limited by regular sprinkling of surfaces and cleaning of trucks using recycled rainwater.

Indoor Comfort

Two air-handling units on the roof of 5.5 m^3/s are integrated with heat pumps, electrical heater and cooling unit. The team anticipated low-mode functioning in the event of breakdown, so that resulting levels of discomfort would remain within acceptable limits. Each air-handling unit is designed to provide enough air for the whole building at a lower quantity but in accordance with French codes. Dry coolers (range 14°C to 18°C) and two electrical chillers of 350 kW each provide chilled water to the chilled beams. The main air supply is from two heat pumps of 20 000 m^3/h, each with a heat recovery system.

The team installed an efficient ventilation system to renew a volume of air four times larger than the prescribed code (55 m^3/h per chilled beam, each 1.35 m axes). To achieve skin comfort, a cooling system was chosen that diffuses slow-speed air drafts. Humidity levels are maintained between 40% and 60%.

A centralized computer system ensures occupant comfort. Sensors

A light wall in the lobby gives 80% useful lighting.

2007 ELECTRICAL CONSUMPTION ON SITE

	kWh/year	kWh/m^2/year
HVAC	1,295,236	144
Lighting	202,299	22
Individual Electrical Sockets	360,389	40
Miscellaneous*	418,286	47
Total	**2,276,210**	**253**

*Miscellaneous includes the consumption of 900 m^2 of shops and restaurant on the ground floor, four elevators, parking and façade lighting, and small equipment.

The data should be compared to the average consumption for HVAC and lighting of 380 kWh/m^2 per year for a typical office building, according to the French Environment and Energy Management Agency (ADEME). Nevertheless, the consumption of EMGP 270 is 40% higher than predicted.

Users believe that in a green building they should not feel too cold or too warm. To avoid complaints, the facility maintenance team set the temperature range between 22°C and 24°C. However, the building was designed to work properly between 20°C and 25°C.

Changing the temperature settings increases energy consumption. An indoor temperature set at 20°C to 22°C directly impacts the electrical heater in the chilled beam (196,435 kWh). An indoor temperature set to a maximum of 24°C results in the chillers running all year long. In addition, free chilling is not efficient enough when the outside temperature is higher than 11°C.

Advertisement formerly in this space.

Chilled beams allow occupants to easily change an office to a meeting area.

LESSONS LEARNED

Auditing The building team, client, architects, design office, mechanical engineers and other specialists in environment control, worked with an auditor to achieve HQE certification. The auditor, as the official body, validated each phase of the project from design to construction. Periodic verification from the auditor placed the onus on the building team to achieve eco-friendly performances.

Simulation Tools In the project's early stages, the design team worked with simple thermal dynamic simulations and computational fluid dynamics. The simulations provided data to help the investor choose the best solution or make modifications to the project plan. For example, the windows were changed from operable to nonoperable based on simulated acoustic and air pollution measurements. In addition, the investor chose less efficient insulation to increase ease of maintenance and replacement of the blinds.

Facilities Management Talks Facility management was involved early in the design process through a task from an ICADE subsidiary. The involvement helped to prevent, at no cost, problems that would have been difficult to solve after construction was completed.

Avoiding Disruptions All building management system subunits and valves for the chilled beams are placed in the corridor's operable ceiling tile for easy access. Access through the lobby to all technical shafts means no disruption for the tenants.

End User Information The team created a CD-ROM for occupants that explains building aspects such as nonoperable windows and automatic window blinds, as well as addressing best green practices. Occupant feedback for the CD-ROM has been positive.

Building Information Management Building information management is key to success because energy-efficient buildings are more sensitive. For example, changing the setpoint temperature at EMGP 270 has a greater impact on energy use than in an average building. Because the building was designed to work properly between 20°C and 25°C, changing the settings increases energy consumption. Additionally, the building is designed to run with no night or weekend stop because of thermal inertia. The managers are not used to tuning HVAC parameters according to predictions based on external parameters. Unfortunately, the building team was not efficient enough with the information transferred to the facility management team, and some misunderstandings occurred about the best possible use and fine-tuning of the building.

FLEXIBILITY WITH CHILLED BEAMS

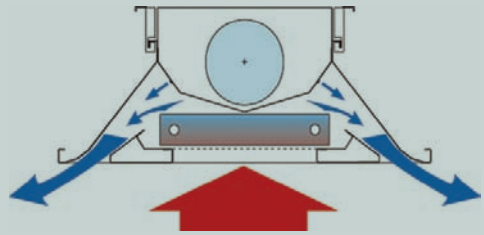
Flexibility is vital for high performance buildings. The chilled beam system offers comfort and flexibility, efficient use of space, and economical life cycle due to low airflow and low water flow rates. New, adaptable active chilled beams with a broad operation range are used in the building. Adjustable air velocity, cooling capacity and supply airflow rates make them adaptable.

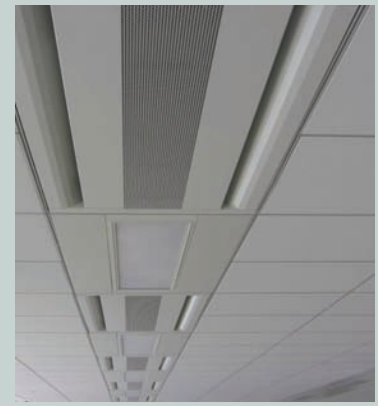
Beams are ventilating systems, integrated with or without suspended ceilings and combining ventilation, cooling and heating (supply air) and even lighting. A water coil allows the cooling and the reheating of the air. A cooling coil cools high temperatures (14°C/17°C) when there is no condensate for the system to use. Thanks to the range of water temperature, the building can run with free chilling through the dry coolers on the roof without switching on the chillers.

The whole office and meeting areas' indoor climate solution can be built on one type of product. Chilled beams are suitable for constant and demand-based ventilation applications. Using only one product and one specification benefits the building life cycle. It makes the logistics chain easy in order-delivery process and on building site, offers consistency in appearance, eases installation and simplifies maintenance.

New Range: Adaptable Active Chilled Beams

In addition to an excellent indoor climate, chilled beams offer competitive life-cycle costs. With a broad operation range, chilled beams can be simply and cost-efficiently adjusted to meet requirements of a new layout. The range enables suspended ceiling and exposed installation. Supply airflow rate is adjusted based on demand, making it easy to change an office to a meeting area or vice versa. Additionally, cooling capacity and air velocity can be adjusted when division wall locations change to create an open plan or individual preferences vary. Compared with the traditional systems, chilled beams ensure good working conditions, drastically reduce churn costs and provide adaptability.





Chilled beams generate low velocity air diffusion for user comfort.

monitor presence, temperature, air quality, lighting and activate ventilation, heating and cooling devices. The information-processing system also monitors the quality of outdoor and indoor air. However, occupants can change parameters using a remote-control. Although external heat intensity sensors on each façade automatically regulate motorized venetian blinds to help control daylight, occupants also can adjust the blinds manually. Artificial light dims automatically depending on the brightness of incoming daylight, or users can manually dim the light to suit individual taste.

Acoustic comfort was achieved by eliminating noise from the exterior. Triple glazing reduces the noise level to 40 db. The chilled beam system eliminates noise using an offset motor. Carpets and acoustic ceilings also reduce noise in offices.

Operating Cost

Construction on EMGP 270 began in January 2004 and finished in June 2005. As the average energy cost is roughly 20% to 30% of the operating cost of the building, the design included features to minimize other costs. No filters in the chilled beams means no filter replacements. Additionally, monitoring and commissioning reduce maintenance needs.

To date EMGP 270 has achieved a 30% lower than average operating cost, mainly due to lower energy consumption. According to the French association of facilities managers, the same size building costs an average of €190 000 per year (approximately $290,000) for energy. In 2007, EMGP 270 cost €130 000 (approximately $200,000). ●

ABOUT THE AUTHOR

Frank Hovorka is program director at ICADE in Paris.