# Philharmonie de Paris

**Engineering working**
**for an exceptional concert hall which stands out**
**through its artistic, social, architectural and environmental ambitions**

## The project

The Philharmonie de Paris, an association supported by the State and the City of Paris, has undertaken the construction of a musical facility built around a large concert hall of about 2,400 seats, in the La Villette Park in Paris.

This facility, situated at the north-eastern entrance to the capital, in a rapidly changing district, is part of a cultural park visible from the periphery of Paris and has an innovative architectural design. In acoustic terms, the concert hall meets the most demanding international standards. It stands out from the strictly front-on models and has opted to have the audience surround the stage to enhance a sense of intimacy between them and the performers.

**Concept of “floating cloud” balcony**

The Philharmonie de Paris is a true home for orchestras and the cradle of a strong educational and cultural project. It will house a number of musical formations in permanent or temporary residence. The facility is being developed over an area of 20,000 m2. In addition to the large concert hall, it includes foyers and rehearsal spaces, administrative premises for several orchestras, an educational centre, exhibition spaces, a restaurant and the infrastructures required for logistics, for technical equipment and for car parking.

## The team

| | |
|---|---|
| Customer: | Philharmonie de Paris |
| Architect: | Ateliers Jean Nouvel |
| Engineering Structure Fluids Electricity: | EGIS |

## Multi-disciplinary teamwork

EGIS was involved as of the upstream phases of the project, in the field of Engineering, Structures, fluids and electricity.

Egis structural engineering produced the design studies as of the initial phases and then supervised all the structural studies from preliminary design up to construction.

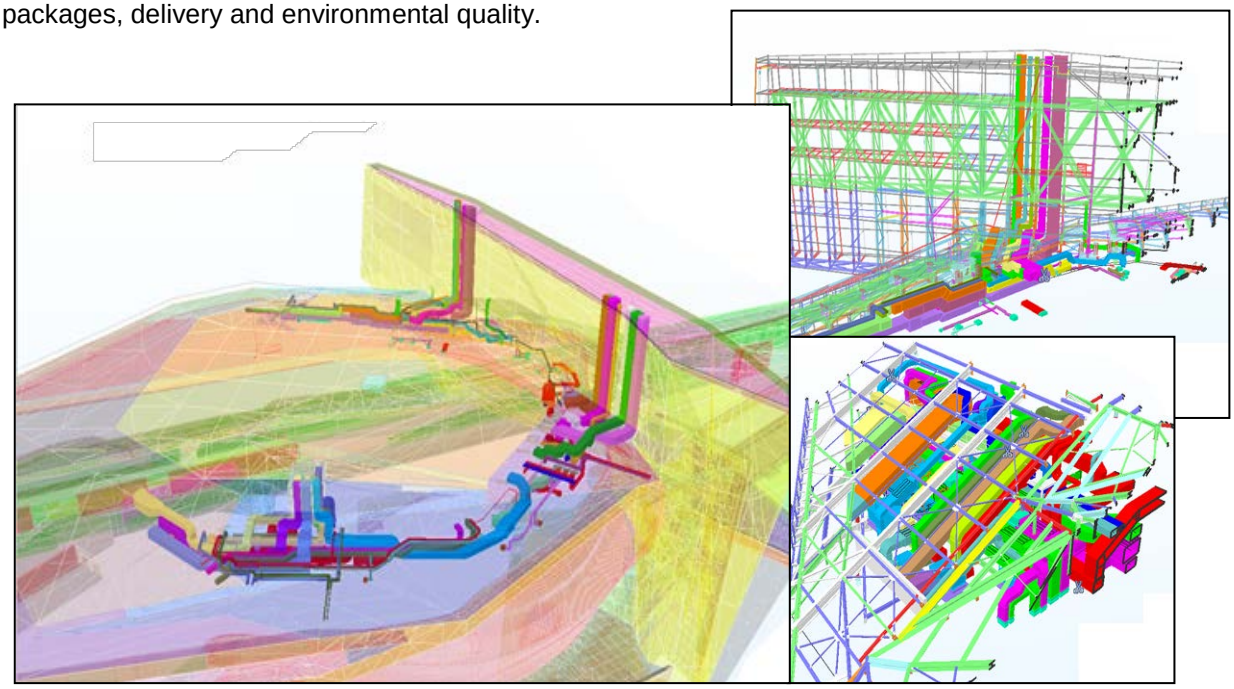
Engineering work was particularly required in the design of the prototype structures, the dynamic modelling and the definition of the testing work to qualify the vibration performance of these lightweight structures.

Those involved in fluids engineering proposed the technical solutions compatible with the architectural project and the structural constraints. EGIS thus coordinated the design of the Climatic Engineering and Energy Management installations.

EGIS then coordinated the various models and simulations used to confirm the suitability of the designs. Throughout the project, EGIS guaranteed compliance with the objectives, despite the numerous and significant changes to the project during the works phase.

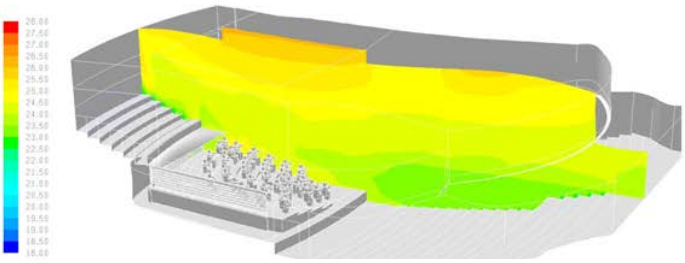
# Engineering challenges

During the design studies for this facility, which is exceptional in both its size and its shape, the engineering team was able to demonstrate the project's technical feasibility and then produce the complete definition of the project that was compatible with all the parameters at stake: architecture, structures, fluids, acoustics, technical work packages, delivery and environmental quality.

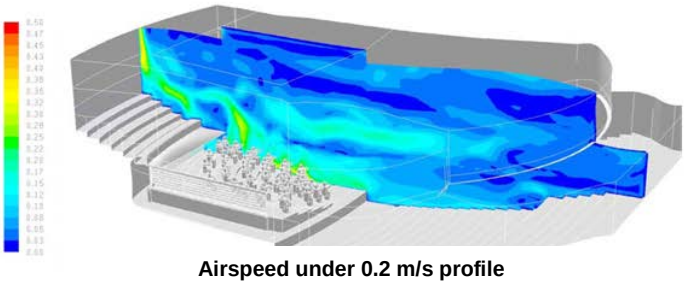


**Air flows**

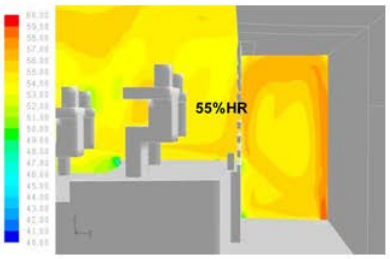
## Comfort and Energy management

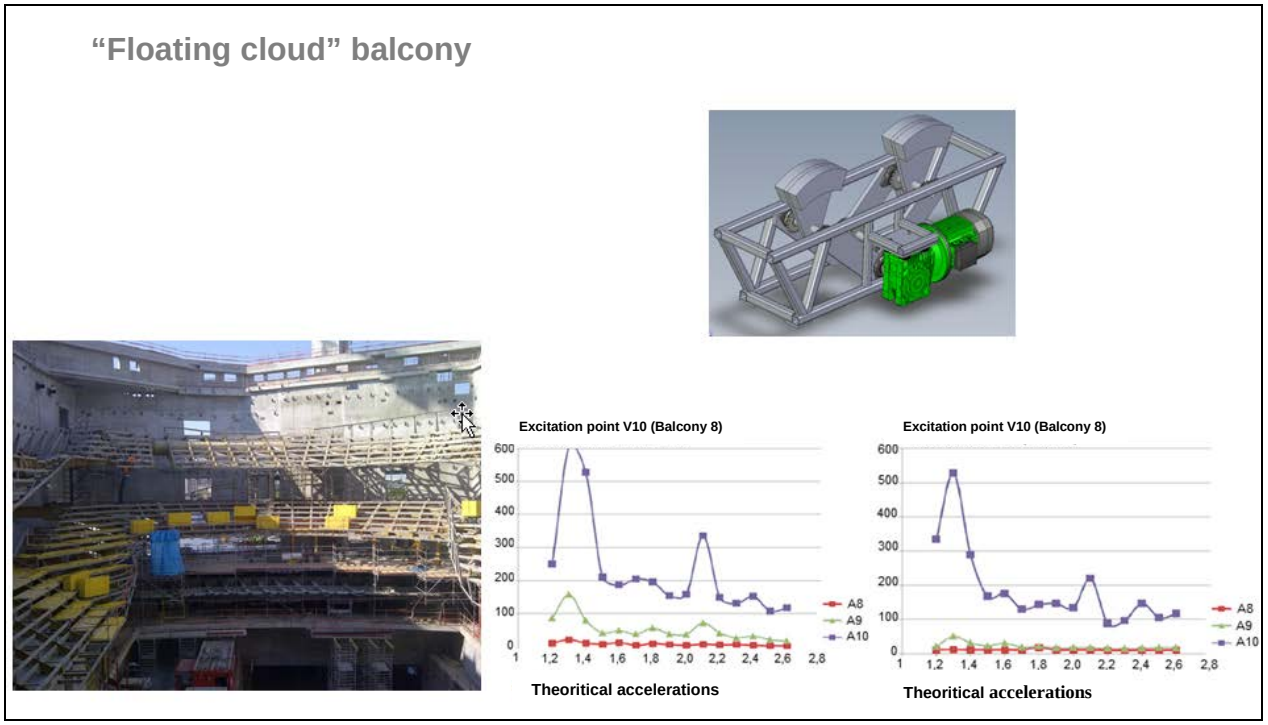


**« Perceived » temperature 23.5 to 25.5°C profile**



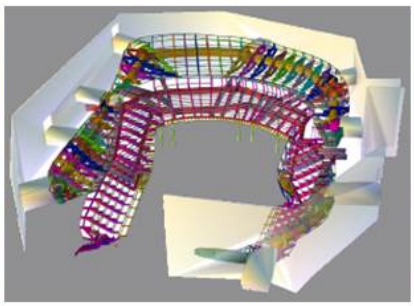
**Airspeed under 0.2 m/s profile**






**Imagination**

**Mastery**

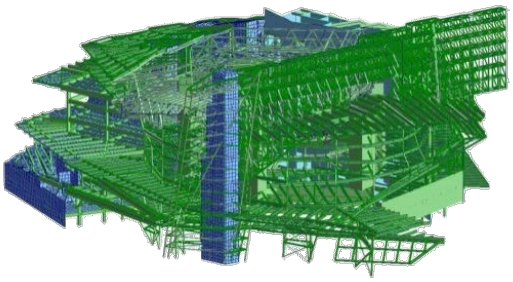


**Implementation**

## Technological innovation

This monumental structure was designed by breaking the whole down into sub-assemblies and simple but unique components, in particular:

- the "cloud balconies" which float in the hall and are only connected by a few discrete points
- the outside emblematic, giant vertical screen, 100 m long and standing more than 50 m high
- the building's roof which acts as an acoustic barrier as well as a public viewing platform and rainwater collection system



**Structural definition and design model**

**Structural execution model**

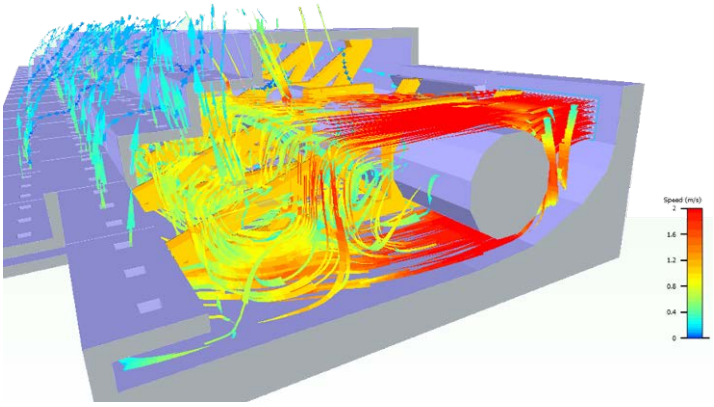
**Structures construction work**

For the fluids, air treatment in particular, the constraints were numerous and some even initially appeared to be pure fantasy:

- meet the NR10 acoustic level (15dBa) which cannot be measured with standard sound level meters
- ensure compatibility between the architectural design and the structure and the supply of numerous air distribution networks, in particular to the “levitating” balconies
- invisibly integrate the installations into the architectural structure, including those concerning fire safety

These objectives were conceived, managed and implemented as early as 2007 using computing resources which paved the way for the development of the digital mock-up.

This latter enabled the partners to define the structures together using successive iterations, with digital means such as 3D models, both for the structure and for the fluids, CFD (Computational Fluid Dynamics) for analysis of the ambient conditions in the Grande Salle (main concert hall) and air transfers in the balconies, plus DTS (Dynamic Thermal Simulations) used to determine the energy signature.



**CFD of balcony flows**

## Summary

The success of this project, which is exceptional in more than one respect, lies in the cross-cutting nature of the studies conducted by the partners as of the initial design phases.

All of the criteria to be met were analysed methodically, with no preconceptions, in order to confirm the feasibility of the project and achieve an iterative optimum by means of exceptional computing resources.

The sustainable development approach goes beyond the strictly technical side, with engineering working for the project through the integration of social, economic and environmental aspects and enhancing the La Villette Park with the addition of a facility that is quite remarkable.