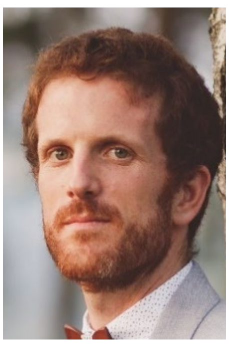
Eco Campus Arboretum – Europas größte Bürocampus aus Holz – Nanterre (Fr)

Antoine Fouchier
MATHIS
Muttersholtz, France



Arboretum

1. Introduction

Arboretum is an office complex built in Nanterre (France) on the edge of the Paris-la-Défense business district. The complex comprises 5 new office buildings and 2 refurbished buildings for restaurants and other services.

It is the largest timber-frame office campus in Europe with a minimal carbon footprint. It is the largest tertiary complex in France to be awarded the BBCA (Bâtiment Bas Carbone) label of excellence and the E+C label at the E2C2 level.

For this project, MATHIS was responsible for the design studies, the manufacture and assembly of the glulam and steel structures and the installation of the CLT floors. The size of the project and the volumes involved presented an industrial and logistical challenge.

Figure 1: Project visualisation – © WO2 – Arboretum

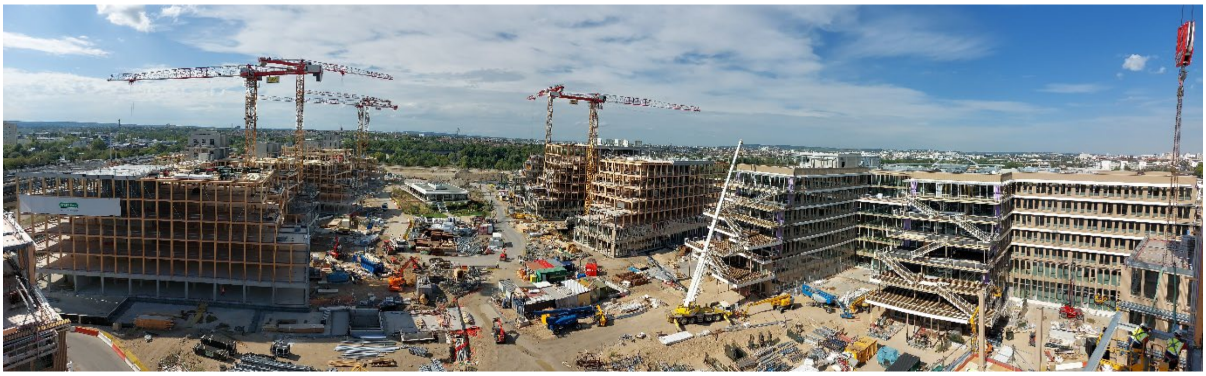


Figure 2: site overview – © MATHIS

2. The project and its constraints

2.1. Data

The project is located on a former paper mill site, 2 buildings of which have been preserved and converted into leisure and restaurant areas. Each building got the name of a tree species: *Amandier (Almond), Biloba, Cèdre (Cedar), Douglas, Epicéa (Spruce).*

Location: *Nanterre – La Défense, former paper mill district, on the banks of the Seine*
Total built surface: *31,400m²*
Office and restaurant floor area: 126,000m

Green spaces: *9 hectares of parkland, including 6 hectares of green spaces (more than 1,000 trees planted and 3,200m² of open-ground vegetable garden and orchard) 17,000 m² of green terraces.*

Timer structures:
- *32,400m^3 of wood used, from sustainably managed forests*

Including *5,800 m^3 of structural timber (glued laminated timber) and 20,500m^3 of CLT (supplied by StoraEnso, timber sourced and processed in Austria)*
- *1100 Tons of steel structure*
- *18 tons of materials recovered and reused*

2.2. Static system

Each building is made up of parallel bars linked by circulation spaces and terraces.
From a static point of view, the foundations, basements, and ground floors are made of reinforced concrete. A concrete core ensures horizontal stability. A glulam (GL24h, GL28h) beams and columns structure and CLT floors are fitted above the base. Steel beams are used to cross certain large spans or to carry extended terraces at the end of the bars. As the bracing cores are eccentric in the plane of the levels, steel portals had to be added at the end of the longest bars to limit the horizontal deformations and torsion of the floors around the cores.

The green roof terraces are supported on concrete slabs, covering the last level. The non-planted terraces are supported on zero-slope CLT floors, a process for which WO02 has filed an ATEx (experimental technical assessment).

The client wanted to retain as much visible timber as possible, limiting false ceilings to the central circulation areas of the office floors. This constraint meant that the connections and joints had to be designed so that they were not visible, while still allowing for adjustment and assembly clearances. The connections were designed as far as possible so that they could be assembled on the floor on the timber elements, saving time on crane rotations and limiting work at height.

The connections between the columns and beams were designed to be as easy as possible to make in our workshops in Alsace. We opted for a system of folded and welded plates, dowelled to the beams and columns. The CLTs are notched at the edge and then L-shaped angles are screwed to join them to the beams. These connections are invisible from the office areas. A threaded rod adjustment system in our lift fittings was developed to control the precision of the floor installation.

Figure 3: construction in progress – MAHTIS © Patrick Raffin

Figure 4: column-beam-CLT connection – MAHTIS © Patrick Raffin

2.3. Fire protection and BIM synthesis

During the execution studies, the complexity of the project was further increased by the integration of active (sprinkler) or passive (gypsum board protection) protection for the wooden buildings, providing R60 resistance in addition to the R60 or R90 fire resistance required for the structure itself. Internal vertical circulation (lifts and staircases) is embedded in the concrete cores.

The integration of this new constraint and all the associated networks demonstrated the need for a perfect BIM connection between the models of all the companies and the usefulness of a well-coordinated synthesis between lots. The synthesis issues had to be addressed sufficiently far in advance of the project to enable the framework to be manufactured on schedule.

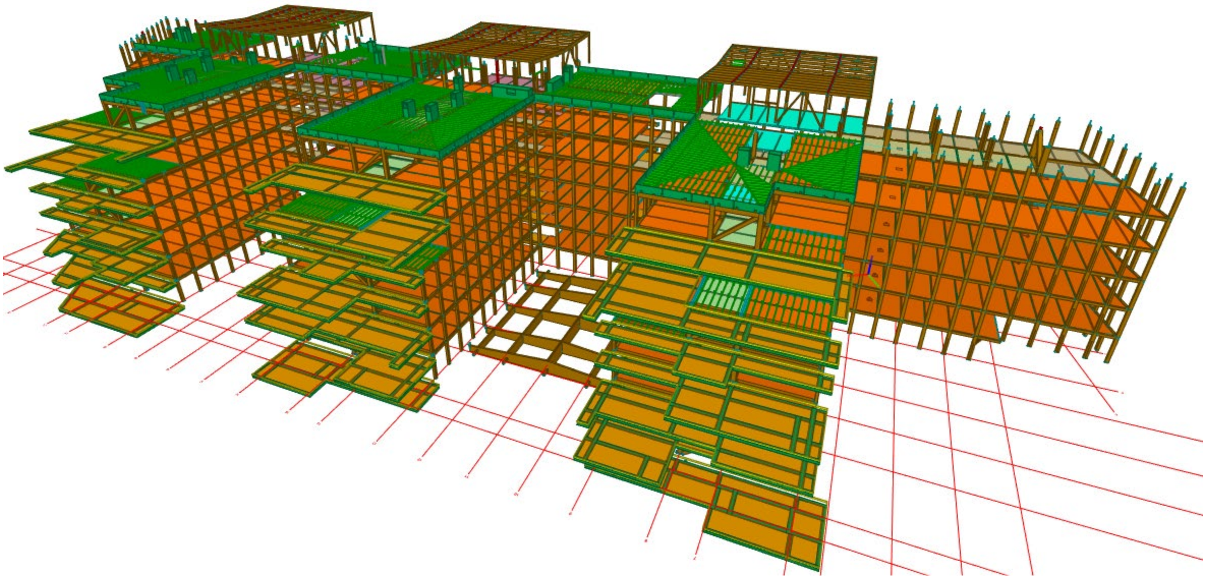


Figure 5: overview of the timber structure 3D model – MAHTIS

3. Construction constraints

3.1. Production and logistics

The glulam elements were manufactured in our factory in Alsace. This project mobilized up to 50% of the factory's activity for 20 months. The cross-sections used were simplified in order to come as close as possible to those of glulam and to reduce the volume of wood to be planed.

The logistics of such a project require perfect organization throughout the process. MATHIS uses a staking plan to monitor the progress of projects in the design, industrial and site delivery phases (gluing, machining and finishing of elements to be shipped). The project is divided into phases corresponding to a transport unit or a lifting sequence. For each of these phases, the staging plan defines the main stages of the project (milestones) and the dates on which they must be validated in order to guarantee the site acceptance dates. In the design phase, the milestones concern the validation of the plans and notes for the phase in coordination with the other lots. At the same time, they allow raw materials and hardware to be ordered in time for production and semi-finished products to be ordered for installation as work progresses. They then oversee the manufacture of the timber structures, their packing and delivery to site.

This staking enables lean management to monitor the entire process. It facilitates the coordination of production between the various projects in progress and limits the need for storage in the factory or, worse still, on site. As it is quicker to install components on site than to manufacture them in the factory, logistical platform storage facilities had to be found close to the site to ensure uninterrupted installation.

The supply of hardware (more than 1.8 million screws were used on the site) was another challenge, at a time when logistical flows were very tight during the post-Covid economic recovery.

Figure 6: lifting of columns and pre-assembled beams – MAHTIS © Patrick Raffin

3.2. Moisture control on site

A moisture management plan was required for these large structures. As part of the construction phase, the timber elements were exposed to the rain, atmospheric humidity and temperature variations for several months, often during the rainy season. Given the horizontal cantilever of over 55m, the floors are not constrained in plan and the longitudinal deformation caused by the increase in humidity in the wood would have been too great for the installation of the facades. In response to this problem, temporary protection was installed.

The aim of this protection was to allow the wood to dry out between rain showers, while at the same time preventing water from stagnating in the joints and running down to the lower levels where the technical equipment was installed. The solution adopted was to install watertight joints at all floor junctions and watertight membranes over the beams. Standing water must be drained regularly. To protect the upper floors from direct rainfall, protective tarpaulins were installed on the facades, while allowing good light levels. Hygrometry sensors have been fitted to the columns and beams so that they can be monitored directly.

4. Conclusion

From a technical, production organisation and logistical point of view, this ambitious project was a challenge.

Delegated project manager: WO2

Architect: Leclercq Associés, Nicolas Laisné Architectes, DREAM Dimitri Roussel, Hubert & Roy Architectes et Antoine Monnet

Structural Engineering Office: TERRELL

Control: APAVE

Co-contractor: GCC