BOUYGUES CONSTRUCTION Shared **innovation**

linkcity OpenUP

Trend Memo #11

#Bio-based and geo-based materials

December 2022

#Bio-based and geo-based materials

THE BASICS

Bio-based materials are derived from renewable organic matter (biomass) of plant or animal origin, whereas geo-based materials are derived from mineral resources. They can be used as a construction material in the building sector.

Bio-based and geo-based materials

Bio-based materials:
wood, hemp, straw, flax, cork, cellulose wadding, sheep's wool, recycled textiles

Geo-based materials:
dry stone, raw earth

Bio-based and geo-based materials are derived from:

The agricultural sector (plant fibres)

Forestry (wood)

Recycling (recycled textiles, cardboard, cellulose wadding)

Recovery of waste (excavated soil)

Is there a risk of competition of use between bio-based materials and agricultural products?

No = Bio-resources used for building are generally by-products derived from existing crops (for food needs)

- **In the case of rice or wheat,** we refer to agricultural by-products, in other words, the stalk, which has little or no use for food purposes, is used. This stalk will be used as an aggregate because it is a very good insulator.
- **Hemp and flax are used as crop rotation heads,** in other words, they enable the improvement of soil in the spring before it is cultivated. They provide additional income for farmers, and also avoid the need to weed before cereals are planted.

#Bio-based and geo-based materials

CHALLENGES

Reduction of the environmental impact

In France, the building sector accounts for 43% of national energy consumption and 23% of GHG emissions[1]**.** Bio-based materials help **reduce the carbon footprint** in a context of climate change and help meet challenges such as France's National Low Carbon Strategy, which aims for carbon neutrality by 2050.
Bio-based materials in the building industry enable effective long-term carbon storage. Moreover, the processingof bio-based materials requires little energy and their local production potential limits transport needs.

Materials derived from biomass (wood, hemp, straw and all other plants) naturally capture CO_2 and store carbon through photosynthesis.

These materials are renewable, present in abundance and reversible, which makes it possible **to save resources** in a context of increasing scarcity (e.g. shortages of sand for the manufacture of cement concrete).

10% of the wheat straw produced annually would be enough to insulate all new housing units built each year in France[2]**.**

Non-denatured material such as raw earth can be returned to its cycle ad infinitum, which offers prospects for the demolition of buildings. Raw earth also makes use of construction waste from excavated earth from building or public works sites.

Saint-Gobain develops innovative solutions based on excavated earth

Its mixture of excavated earth and plant-based fibres and a low carbon hydraulic binder is in the process of being certified by the CSTB (Centre Scientifique et Technique du Bâtiment), with the aim of obtaining ATEx[3] certification in 2023.

In France, net carbon sequestration in forest biomass was estimated at around

53 Mt CO_2 eq

for the year 2017, in other words, about 15% of national CO_2 emissions excluding land use, change and forestry[4]

1 m^3
of wood captures an average of
850 kg of CO_2
during its growth and stores about
230 kg of carbon

The way bio-based materials are used has an impact on their carbon footprint. In the case of raw earth, for example, mechanised installation doubles the carbon footprint and transportation can also increase it considerably, since earth is a heavy material. **Therefore, the use of local and minimally processed materials should be encouraged.**

[1] Source: ecologie.gouv.fr - [2] Source: Collect'IF Paille - [3] The Appréciation Technique d'Expérimentation (ATEx) procedure is an assessment for innovative construction products, processes or techniques, conducted by experts under the aegis of the CSTB, at the request of parties interested in obtaining a rapid technical assessment - [4] Source: French Ministry of Ecological Transition and Solidarity and I4CE - The Institute of Climate Economics, Datalab. Key climate figures. France, Europe and world, 2020 edition

#Bio-based and geo-based materials

CHALLENGES

Healthy and comfortable buildings for users

- Bio-based materials contribute to the overall comfort of building users thanks to their **positive health properties** (low emissions of volatile organic compounds, anti-polluting products such as sheep's wool insulation) **and their biophilic qualities,** creating a stronger sense of connection with nature.

- Their hygrothermal characteristics ensure good **moisture regulation** and offer greater **comfort in summer:** the inertia of these materials gives them excellent phase shift properties (heat takes longer to enter the building).

Support for local economic activity

- The sectors represent a significant source of local employment, from the production of resources to construction and product manufacturing. They contribute to the **relocation of employment and the development of local know-how.**

- The use of these materials also supports farmers and foresters by helping to diversify and increase their income.


© Nicolas Grosmond

Paris Nation Residence

Paris (75) - Creation of a natural biodiversity environment in a dense urban area

Construction of a two-storey wood structure building accommodating 13 rental housing units from one-room to three-room units

Project owner: GECINA
Main contractor: Mars Architectes
General contractor: Bouygues Bâtiment Île-de-France
Delivery: 2020

Wood indicators

m3 of wood: 170 m^3
Tonnes of CO2 saved: 108
Project surface area: 700 m^2
Wood-framed surface area: 800m^2

Note: All values of tonnes of CO_2 saved given in this trend memo are indicative and not the final results of the LCA of projects.

#Bio-based and geo-based materials

CHANGE FACTORS

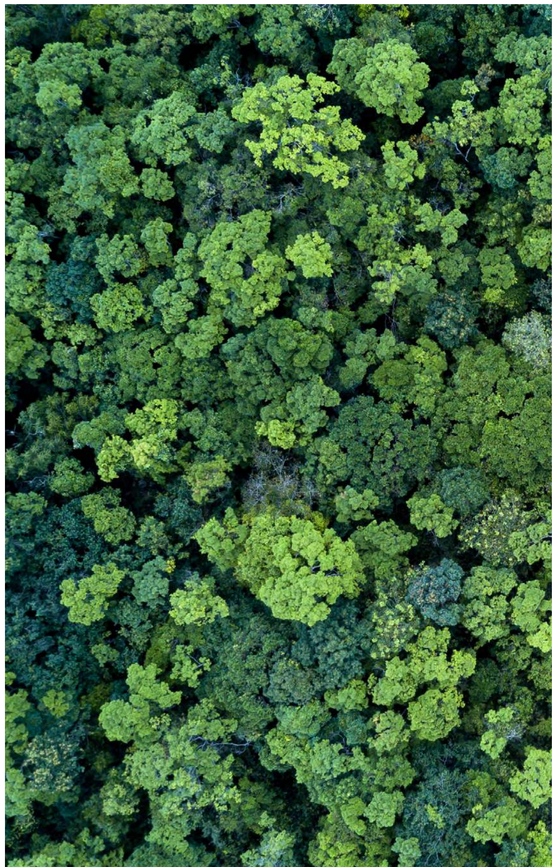
The use of bio-based materials in the building industry is not only supervised but also encouraged by various measures and regulations.

RE2020

Applicable since 1 January 2022 for housing units and progressively applied to all buildings, this uses dynamic life cycle analysis (LCA) to calculate the environmental impact of buildings.

This applies a weighting factor according to the year of CO2 emission: carbon emissions produced at the beginning of the cycle (production) are increased, while those produced at the end of the life cycle are reduced.

Bio-based materials can store carbon for decades in the building and only release it at end of life, unlike materials such as concrete, where the production phase generates the most emissions. Bio-based materials are therefore the most effective in achieving the greenhouse gas emission thresholds set by RE2020.



LABELS

Bâtiment BIOSOURCÉ

The “Bâtiment biosourcé” government label, defined in 2012, is a French regulatory label that certifies that all or part of a building includes a significant proportion of materials obtained from plant or animal biomass. It distinguishes three levels according to the total mass of bio-based materials per m² of floor surface area, but does not impose minimum thresholds to be reached to define bio-based material in the building.

Produit Biosourcés Label Produit Biosourcé

The “Produits Biosourcés” private label introduces thresholds by product type. Set up by the KARIBATI social utility solidarity company, it provides transparency with respect to the quantities of bio-based materials used in products. A new “Produit biosourcé +” label was created in 2021 to promote products with a bio-based content of over 80%.

BÂTIMENT BBCA BAS CARBONE

The BBCA (Low Carbon Building) label recognises a building’s commitment to low carbon transition. It measures the greenhouse gas emissions of buildings avoided throughout their life cycle, from construction to operation to end of life.
It proposes a reduction in the threshold to be reached to obtain it, depending on the volume of bio-based material used.

#Bio-based and geo-based materials

CHANGE FACTORS

Sectors are becoming more structured

Associations representing all bio-based sectors are being set up:

- **Created in 2019, the mission of the liaison committee for bio-based materials is to raise awareness and support public authorities and the construction industry in the use of bio-based materials.** (Members: l'Ordre des architectes en Île-de-France, the Chambre d'Agriculture, l'Union des Industriels de la Construction Bois (UICB), l'Association des Industriels de la Construction Biosourcée (AICB), Interchanvre, Construire en Chanvre, Accord paille, Collect'if paille and Francilbois).
- **The Association des Industriels de la Construction Biosourcée** (AICB) represents its members in dealings with public authorities and promotes the quality of the products they offer. However, it does not cover all sectors (straw is not represented).

Sectors are joining forces in pursuit of a common objective of developing renewable materials.

- **2017:** The Association des Industriels de la Construction Biosourcée (AICB) joined the Union des Industriels et Constructeurs Bois (UICB).
- **2018:** Partnership between the wood and hemp sectors through the joint commitment of the UICB and InterChanvre (hemp inter-branch organisation).
- **Since 2020:** wood bio-based pacts have been developed at the initiative of regional forestry-wood sector (FIBOIS) inter-branch organisations in order to provide technical support to construction players for the introduction of a significant proportion of bio-based materials in their projects.

The bio-based sector is very positively perceived by the general public:

87% **of French people have a positive image of bio-based products**

38% **associate bio-based materials with the building and construction sector**

(IFOP survey for the Association Chimie du Végétal, April 2020)

The Forestry-Wood sector has strengthened its dynamics through several flagship actions:

- **The Plan Ambition Bois Construction 2030** showcases the ability of the wood-construction sector to respond to the increase in the use of wood and bio-based materials. It includes 10 commitments to support all construction professionals in this transition.
- **The France Bois 2024 collective action,** led by CODIFAB (Comité Professionnel de Développement des Industries Françaises de l'Ameublement et du Bois) and France Bois Forêt (national inter-branch organisation)[1], aims to promote the use of wood construction and development solutions, particularly French, in the production of 2024 Olympic and Paralympic Games' structures.
- **The State supports the development of the sector:** the Forestry-Wood sector has received investment of €200 million as part of the recovery plan, including €150 million for forestry renewal and €50 million for the modernisation of wood processing industries.

The Forestry-Wood sector accounts for

12.5%

of manufacturing jobs in France, and represents

€26 billion

in added value, representing €60 billion per year

The hemp concrete sector is experiencing strong growth: three new hemp mills are being created in France, in addition to the six existing ones.

France is the European leade in hemp production, with

34,300

tonnes of hurds per year

[1]France Bois Forêt represents 24 professional organisations from the seed, forestry and primary wood processing sectors, and a large part of the secondary wood processing sector.

#Bio-based and geo-based materials

CHANGE FACTORS

A dynamic market

According to the National Wood Construction Survey 2021, **the market for new wood construction is growing in all construction segments** (housing and non-residential buildings). The average turnover per company in the wood construction sector is much higher than in the building sector, and productivity is also 10% higher for wood construction companies.

The building and public works industry is taking up the challenge: developers, promoters, housing providers and builders are committing themselves to wood construction.

This dynamic is driven by new market standards based on the **green value of buildings,** defined as “the additional net value of a property generated by improved environmental performance.”

Players

WeWood

This is the name given to Bouygues Bâtiment France’s goal of building 30% of its buildings in wood by 2030. The company also supports the French wood industry by committing to using 30% French structural wood in its projects from 2021, with a target of 50% by 2025.

Players

EpaMarne

EpaMarne, a developer in eastern Paris, is one of the pioneering developers and project owners in wood bio-based construction, with more than 4,500 housing units built using wood construction in its operating area since 2015. Since 2018, its wood strategy has accelerated, with a target of 50% of housing units built of wood and a diversification in its recommendations towards other bio-based materials (hemp concrete, straw, raw earth). It is also a partner in the Booster Bois Biosourcés invitation to tender launched in 2019 in the Île-de-France region to promote innovative projects in this sector.

Survey

A survey of 237 Swiss institutional real estate investors conducted by Wüest Partner in 2021 reveals that investors are paying more attention to grey energy during construction when acquiring new projects under construction. They are beginning to want to minimise the grey energy of project acquisitions in order to meet their certification or portfolio targets. However, the willingness of these investors to pay more for low greenhouse gas emissions during construction is still modest compared to the willingness to pay more for low CO_2 emissions during operation.

Project

As part of the Quai 22 operation in the north-west of Lille, the Linkcity and Nhood developers have sold a 7,620 m² office asset to the German investor KanAm Grund. This building, whose structure (excluding the concrete base) and framework are made of wood, is aiming for BREEAM “very good” and BBCA Standard Level certification. This is part of KanAm Grund’s strategy, via its Leading Cities Invest fund, for which more than 57% of assets are already certified or undergoing certification. The building will be fully leased to Dalkia (a subsidiary of EDF) for a period of twelve years from delivery in mid-2023.

Project owner: LinkCity, Nhood
Main contractor: GBL Architects
General contractor: Bouygues Bâtiment Nord-Est

Wood indicators

m³ wood: 400 m³
Tonnes of CO_2 saved: 1,220
Project surface area: 7,815 m²
Wood-framed surface area: 2,500m²

CONSTRUCTION TECHNIQUES AND PRACTICES

The applications of bio-based materials in the building sector are numerous, whether for new build, renovation or elevated construction operations, and from structural work through to finishing work:

- **Structure**
- **Cladding**
- **Coatings**
- **Partitions**
- **Insulation**
- **Flooring, false ceilings, wall cladding, joinery**

Bio-based and geo-based materials can be used in a wide range of applications: individual and collective housing, service sector buildings, etc.

Straw is mainly used in building insulation with filling techniques (filling a wooden frame with straw bales), prefabrication (filling caissons with straw bales), external insulation (fixing straw bales to the wall or inserted in a secondary frame fixed to the existing wall). It can also be used as a load-bearing structure.

5,000
tonnes of straw are currently used every year in construction.


© ASP Architecture

The Jules Ferry residence of the social housing provider Le Toit Vosgien in Saint-Dié-les-Vosges (88) is currently the highest straw-insulated building (7 floors). Seven hundred prefabricated caissons filled with straw were used on the site.

Different construction systems are possible in wood construction: wooden frame walls, joist floors, CLT solid wood floors or walls, solid wood or cross-laminated posts and beams.

CONSTRUCTION TECHNIQUES AND PRACTICES

© SCAU Architecture, Chaix & Morel et Associés, ArtBuild Architectes, Base paysagiste. © Image Kreaction

ENGIE Campus

La Garenne-Colombes (92)
New build/Offices Wood structure

One of the largest office developments in recent years, with 37,500 m² of wood structure and 100% renewable energy for heating and cooling.

Project owner: Nexity
Main contractors: SCAU Architecture, Chaix & Morel et Associés, ArtBuild Architects, Base Paysagiste
Main execution contractor: Artelia
General contractor: Bouygues Bâtiment Île-de-France
Delivery: mid-2024

Wood indicators

m³ wood: 7,130 (certified BOIS DE FRANCE)
Tonnes of CO_2 saved: 6,917
Project surface area: 187,000 m²

Secondary school

Pithiviers (45)
New build/School building/Bio-based materials

The new secondary school in Pithiviers is a showcase for bio-based materials: hemp, flax and cotton are used for the interior lining and the filling of the school's wooden frame walls. A truss frame is used throughout the school, and the attic is insulated with cellulose wadding.

Project owner: Loiret Departmental Council
Architects: Vincent Bourgoin/Blatter Dauphine/Atelier Poinville
General contractor: Bouygues Bâtiment Centre Sud-Ouest
Delivery date: August 2021

Wood indicators

m³ wood: 130 m³
Tonnes of CO_2 saved: 192
Project surface area: 7,452 m²
Wood-framed surface area: 1,600m²

© Ludovic Letot

© AlexisToureau

Bertelotte Residence

Paris 15th arrondissement
Renovation / Student residence/Straw insulation

Major renovation work including the transformation of an office building into a 146-bed student residence with co-working and co-living spaces (five-storey residence). The existing facades are made up of wooden frame caissons including insulation made of straw bales from a short supply chain.

Project owner: Paris Habitat OPH
Main contractors: NZI Architects
General contractor: Bouygues Bâtiment Île-de-France
Delivery: October 2019

Wood indicators

Wood-framed surface area: 3,125m²
Tonnes of CO_2 saved: 125
Project surface area: 4,400 m²

CONSTRUCTION TECHNIQUES AND PRACTICES


© Le Foyer Rémois

First French social residence built of sprayed hemp concrete

Résidence Botanic

Trilport (77) – New build/Collective housing/Hemp concrete

First French social residence made of sprayed hemp concrete. This is the first time that a three-storey apartment block of this size has been built in France using the sprayed hemp concrete technique, which is usually used for low-rise buildings and for insulation during renovation. For the exterior Botanic walls, Foyer Rémois opted for a hemp/lime sprayed coating for the middle and upper floors, and wood cladding for the interior of the loggias and the stairwells on the garden side.
More than 2,000 m² of surface area to be sprayed and coated. 680 m³ of lime-hurd mixture was mechanically sprayed in thicknesses ranging from 38 to 46 cm. The reduction in primary energy consumption for the heating of housing units is estimated at 40% compared to insulated reinforced concrete walls. The 70 tonnes of hurds used came from locally-grown hemp, and were processed in a factory less than 15 km from the site.

Project owner: Le Foyer Rémois
Main contractor and architect: Zetta Green – Voulangis (77)
General contractor: Thouraud (Groupe Fayat-Reims)
Hemp spraying: AKTA


© Association Terre - Communauté Emmaüs

Experimentation

New build/Collective housing/Raw earth

Near Rennes, the Coop de Construction developer, the Néotoa housing provider, the town of Cesson-Sévigné and researchers from the Institut d'Aménagement et d'Urbanisme de Rennes are planning to build a two-storey building made of load-bearing raw earth, without relying on a concrete or wooden structure. This project aims to change regulations for earth-based construction, create a new sector and develop building techniques that can be replicated on a large scale.

OVERCOMING BARRIERS

The development of bio-based and geo-based materials faces several types of obstacles:

Cultural barriers and misconceptions about these materials

Insurance and regulatory barriers

Lack of professionals trained in design and implementation

Supply shortages

Technical barriers

Cultural barriers and preconceptions

Bio-based and geo-based materials are sometimes subject to preconceived ideas; for example, regarding fire safety, pests or moisture sensitivity. In reality, they are subject to regulation, like all other building materials.

To ensure their fire resistance, for example, bio-based materials must comply with fire risk regulations. If they do not meet these criteria, they must be chemically treated or include a protective firewall screen.

Some materials have very good natural fire resistance, without treatment. This is the case with plant-based concretes such as hemp concrete and wood concrete.

Many industrial applications use a hydraulic binder (cement or lime) to stabilise raw earth, but these practices degrade the carbon footprint and the recyclability of earth.

When preconceived ideas make the use of bio-based materials counter-productive

Preconceptions concerning bio-based materials sometimes lead to practices that may reduce the environmental benefits of using bio-based materials.

© Saint-Gobain

Best practice

Saint Gobain is conducting research into the use of new, less carbon-intensive binders to stabilise raw earth. This stabilised earth can be recycled as aggregate to recreate stabilised earth concrete.

New techniques are being developed using a hydraulic binder:

- **Poured earth:** based on a formulation relatively close to that of rammed earth (a method of building walls made of raw earth, compacted in successive layers in formwork), the earth is made sufficiently liquid to be poured with a little hydraulic binder between two watertight panels and to be formed without compaction, like cement concrete.
- **To reduce costs, rammed earth is also replaced by large compressed raw earth blocks (CEBs) with the addition of some cement.**

OVERCOMING BARRIERS

Insurance and regulatory barriers

Bio-based materials must meet the same requirements as other building materials: suitability for use, technical control, standards, technical opinions, insurance, certification.

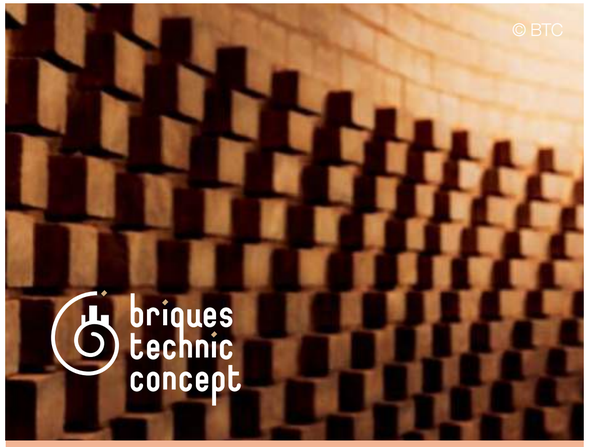
Bio-based materials and French ten-year guarantee

Insurers rely on the C2P (Commission Prévention Produits) classification of the AQC (Agence Qualité Construction), which brings together building professions and construction insurance. This classification distinguishes between “standard techniques” and “non-standard techniques”.

The ability of a company using bio-based materials to obtain a ten-year insurance policy[1] is based on the assumption that the use of these materials falls within the scope of **“standard techniques”.**

There are several ways of obtaining a “standard techniques” qualification: standardisation, technical opinions and professional rules. These documents attest to the technical qualities of the materials (reaction to fire, durability, mechanical resistance).

For example, bio-based and geo-based materials have standards (wood, cellulose wadding), **technical opinions and ATEx**[2] (flax, recycled textile, raw earth, dry stone), Unified Technical Documents (wood) or professional rules (straw, hemp).



Brique Technic Concept makes compressed earth bricks

The ATEx, issued for a period of two years, allows for the construction of load-bearing raw earth buildings of up to four storeys, of which a maximum of three are stacked in earth bricks.

Fire policy and bio-based materials in construction / Fire regulations

On 20 July 2021, the Paris Préfecture de Police published a policy on the protection of buildings incorporating bio-based and combustible materials against fire. Although this document does not have regulatory status, it puts forward a series of particularly demanding recommendations regarding wood, which could be requested in the requirements of a building permit. The construction industry is waiting for new fire regulations (expected in early 2023), which will clarify expectations concerning wood used in structures.

Straw construction and hemp concrete are governed by professional rules whose latest revisions date from 2012 and 2018 respectively.

Raw earth construction processes are currently classified as “non-standard techniques” by the CQA and therefore do not automatically benefit from the necessary insurance. They are subject to technical control, but their implementation can be facilitated by the use of an ATEx. In 2021 and 2022, the sector took a major step forward with the award of four ATExs at the initiative of Brique Technic Concept and Cycle Terre.

[1] The Spinetta law governing construction insurance stipulates that the builder must be covered by a ten-year civil liability policy at the time of starting a construction project. This covers any damage that may occur during the 10 years following acceptance of the work by the project owner. - [2] See page 2

OVERCOMING BARRIERS

Training and employment challenges

With the entry into force of the RE2020, which focuses on bio-based materials, the sector expects an explosion in demand and anticipates the development of production capacities, employment and professional training. This makes training the first strategic commitment of the “Plan Ambition Bois Construction 2030” wood construction plan.

In the construction sector, the transition implies the acquisition of new skills for the entire sector, from craftsmen to major building and public works companies. It also requires more structural and thermal design offices with expertise in bio-based and geo-based materials.

“We are committed to supporting operators in the construction family in their work as builders, in conjunction with training organisations. We are also committed to the continuous training of our professionals, from upstream to downstream.”

“Training” commitment in the Plan Ambition Bois Construction 2030

In 2021, the wood industry employed

370,000

people, including

140,000

in industrial activities, all sectors combined (forestry, construction, trade, etc.)

Did you know?

New wood, bio-based and mixed construction methods encourage a reduction in physical labour intensity on building sites and constitute an opportunity to accelerate female involvement in building trades.

As part of its WeWood initiative, Bouygues Bâtiment France has chosen to develop its internal skills in wood construction.

At the end of 2020, a unit of 30 technical experts was created to change the entire Group’s existing culture and spread best professional practices.

With the support of the Centre Gustave Eiffel and in partnership with integration specialist Humando, the Gustave Eiffel high school in Massy and the FCBA wood Technology Institute, they created the Académie du Bois et de la Mixité des Matériaux (Academy of Wood and Mixed Materials). This is the first French training programme whose objective is to develop a range of courses from low level to postgraduate level, combining skills in wood and bio-based materials, concrete and steel. Discussions are also underway with the Compagnons du Devoir and the Tour de France with a view to training teams of journeymen, technicians and site supervisors.

This training course is designed to support the development of the skills of journeymen in traditional concrete trades towards new wood, bio-based and mixed construction methods.

Target of 500 employees trained in 2 years

Three work-study training levels:

- Wooden structure and mixed materials assembler
- Wood construction technician professional baccalaureate
- BTS vocational training certificate in wood construction and housing (supplemented by a professional licence in the long term)

Bouygues Bâtiment France initiated the same approach in 2022 for the collective development of skills in bio-based and geo-based materials.

OVERCOMING BARRIERS

Supply shortages

Wood and bio-based materials are naturally abundant resources. Nevertheless, supply is sometimes subject to periods of shortage.

Upstream, the health of forests is threatened by climate change and its effects: increased frequency and intensity of storms, health crises among certain species (e.g. spruce) and fires. Forests must also adapt to enable them to continue producing quality wood while preserving biodiversity and storing carbon. The sector has thus embarked on a policy of adapting settlements in order to anticipate climate change.

Downstream, French sawmills have experienced long periods of supply shortages due to the increase in world wood consumption and export restrictions imposed by certain countries (for example, Russia). At the same time, France continues to export a large proportion of its raw wood. These situations create a risk of higher costs and longer lead times in the wood market. In response, the sector is taking action to ensure that the production of French forests supplies French sawmills wherever possible.

PIVETEAUBOIS
L'INNOVATION AU CŒUR DU BOIS

In 2021, Bouygues Bâtiment France signed a framework agreement with Piveteaubois, a cross-laminated wood specialist, to secure supplies.

It provides for the supply of 25,000 m² of CLT[1] per year for 2 years and enables the company to ensure that 30% of its operations are supplied with French wood.

[1] Cross-Laminated Timber: solid wood panels produced by gluing several layers of wood together.

OVERCOMING BARRIERS

Technical barriers

Technical progress could support growth in the use of bio-based materials.

Hardwoods (oak, ash, poplar, beech, etc.) now account for 75% of France's forests.

However, these species are under-exploited, since 85% of the wood used by the construction sector is softwood (Douglas fir, spruce, larch, etc.). Softwoods are used for carpentry, framing and interior joinery, while hardwoods are currently used more for interior fittings, for reasons of cost and the more advanced structure of the sector. However, the characteristics of hardwoods make them suitable for other uses. Their use in structural work has been growing over the last ten years.

Since 2007, a regulatory framework has enabled poplar to be used in structures, in the same way as softwoods.

PROBOIS Project

The PROBOIS partnership project, involving the Normandy and Ile-de-France regions, has made it possible to remove the normative and technical obstacles to the use of beech in structural work. This means that beech can be used for cross-laminated construction products.

L'Éveil de Flaubert

Rouen – New build/Mixed operation/Use of hardwoods in structures

On a 1.6 hectare site near Rouen city centre, this urban regeneration project involves the creation of 256 housing units, 9,000 m² of offices, 300 m² of shops and 600 m² of inter-company restaurants, organised around landscaped areas. Thanks to an innovative cross-laminated beech solution designed by the Manubois company, 70 posts, equating to 36m³ of cross-laminated beech, were installed in the seven-storey service sector building.

Project owner: LinkCity
Main contractors: VK, AZ Architects, OLM Paysages
General contractor: Bouygues Bâtiment Grand Ouest
Delivery: October 2019

Wood indicators

m³ wood: 366
Tonnes of CO_2 saved: 355
Project surface area: 16,700 m²

©TVK et AZ Architectes

SUPPORTING ALTERNATIVE CONSTRUCTION APPROACHES

The challenges related to the use of wood and bio-based and geo-based materials are not limited to replacing concrete. These materials can also act as an accelerator to support alternative ways of building and support the cultural transformation of the building and public works sector. This is necessary in order to meet the many challenges specific to the sector: shortage of work site labour, low productivity, widespread introduction of energy renovation for buildings, etc.

Wood construction, for example, is well suited to off-site construction, which allows building components to be manufactured and pre-assembled in factories and encourages the industrialisation of processes. This industrialisation of manufacturing processes, in turn, encourages growth in the market by enabling larger volumes.

One of the target markets identified for achieving carbon neutrality by 2050, and meeting societal challenges, is the rehabilitation and thermal renovation of housing units. Wood construction combined with bio-based materials makes it possible to carry out elevated construction and light renovations with almost zero emissions.

The “Industrialisation of wood and other bio-based products and construction systems” invitation to tender

Launched in 2021 and 2022 at the initiative of the French government aims to support the widespread introduction of wood construction and renovation and to anticipate a rise in wood and bio-based construction.

The Treet

Bergen (Norway) – New build/Housing/ Prefabrication of CLT panels

With its 14 floors, this tower is one of the largest wooden towers in the world. Its construction relied heavily on prefabrication in order to reduce the number of on-site operations and the duration of the work site.

3D wooden modules, prefabricated by the Estonian company Kodumaja and delivered by boat directly to the work site, were stacked on four levels. The next five levels are made up of a post and beam structure prefabricated by the Norwegian company Moelven, with a central location for the lift and stairwells, made of CLT modules. Prefabricated caissons are inserted between the beams, and on the fifth level, floor-high cross-laminated beams ensure the strength of this first five-storey structure. The assembly procedure is then repeated identically: 3D modules on four levels, cross-laminated post/beam structure, floor-level beams on the tenth level. These serve as a support for the top four levels, built on the same principle.

Project owner: Bergen and Omega Building Society
Main contractor: Artec
Delivery: 2015


© Artec


© Groupe Arcane Architectes


© Iago Corazza

Les Toits de Belleville

Paris (75) – wooden elevated construction and thermal renovation

Design and construction for the creation of 47 wooden elevated construction housing units and thermal renovation of 364 housing units on an occupied site.

Project owner: CDC HABITAT
Main contractor: Groupe Arcane Architectes
General contractor: Bouygues Bâtiment Île-de-France
Delivery: 2023

Wood indicators
m^3 wood: 39 m^3
Tonnes of CO_2 saved: 451
Project surface area: 3,500 m^2
Wood-framed surface area: 7,200m^2

Tecla House

Massa Lombarda (Italy) - House/Raw earth 3D printing

In Massa Lombarda, near Ravenna, Italy, architect Mario Cucinella created Tecla in conjunction with the Italian company WASP, a 3D printing specialist. This 60 m^2 bioclimatic habitat prototype was created from locally collected clay, mixed with water and then poured using Crane Wasp technology: two digitally controlled cranes with synchronised printing arms lay down the earth in layers to form two conical volumes. With a volume of 60 m^3 of earth and 200 hours of printing, the construction of this house requires little labour.

RESEARCH AND INNOVATION: PROMOTING A GREATER MIX OF MATERIALS

Hybrid construction systems

The use of hybrid construction systems, i.e. combining the advantages of different materials (wood, concrete, steel), provides not only a cost-effective and sustainable solution for buildings and structures, but also options for improving their performance, design and execution. There is therefore no competition between materials, but rather a synergy to be found between them. CLT (cross-laminated timber) is the best example of this.

Research and Innovation approaches

For many years, several initiatives in bio-based and geo-based materials have been carried out by **Bouygues Construction's Research and Innovation Department,** in association with many other entities. Wood-concrete slabs, with CLT on the underside and concrete on the top, are an approach initiated several years ago by Bouygues Construction. Further research on bio-based building materials and processes will be initiated in line with the National Low Carbon Strategy (NLCS).

As the culmination of this research and innovation approach, **Bouygues Construction and the Ecole Supérieure du Bois created an industrial chair** in June 2022 dedicated to promoting the use of wood and bio-based materials in the building industry. Its aim is to support Bouygues Construction's Wewood initiative, whose objective is to build 30% of its structures in wood by 2030. The chair will also strengthen the ability of the ESB to generate knowledge on the subject of bio-based materials. The group and the school hope that this activity will help to support skills development in the wood and building sectors.

Hybrid wood-concrete slab

BOUYGUES CONSTRUCTION Shared **innovation**

linkcity

TO GO FURTHER...

Surveys and research bodies

National Wood Construction Survey 2021

Sixth survey concerning the wood construction sector launched by CODIFAB and France Bois Forêt under the aegis of France's Observatoire National de la Construction Bois research body.

Associations promoting bio-based and geo-based construction

AICB: Association des Industriels de la Construction Biosourcée

BBCA: Association pour le développement du bâtiment Bas Carbone

Bouygues Bâtiment France's "Construire Autrement" (Build Different) division

WeWood

Bio-based and Geo-based division

Engineering and Technical Studies

Karibati: a bio-based materials expert for the building industry

Portals and newsletters

Biosourçons !

Cerema's newsletter on bio-based and geo-based materials and products

Bâtiment biosourcé

Information portal on bio-based construction, published by the AICB (Association des Industriels de la Construction Biosourcée)

Trend memo #11
December 2022

Strategic Foresight & Marketing Department – Bouygues Construction – prospective@bouygues-construction.com
Editorial committee: Virginie Alonzi, Christelle Atié, Tristan Cabocel, Elsa Favreau, Mathilde Fras, Claire Meunier