

BATIPACK®: An Innovative and Ecologic Building Process

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Abstract. The BatiPack® process is an innovative system for the construction of load-bearing walls with controlled costs and delays. The wood brick, hollow, contains isolating within it, are maneuverable and designed to be assembled quickly and easily without any special skill and without lifting equipment. By its mechanical, ecologic characteristics, the process thus perfectly substitutes for traditional masonry materials. It can be adapted to any type of project and size of building.

Delivered on pallets, it is easily transportable and can be stored anywhere. The assembly is made by nesting and gluing in a groove. The prestressing put in place by a cable positioned on each side of each block gives the system lightness, minimal consumption of raw material and above all flexibility combined with high strength.

All types of coatings can also be placed on the BatiPack which also offers maximum thermal resistance, thanks to insulated materials which are integrated inside of the blocks. The customer has the choice between wood fiber, wool of rock, of cotton or of soil.

This process has various mechanical properties and has a high seismic resistance.

Keywords: Timber structure · Modular building · Prefabrication · Wood brick

1 Introduction

BATIPACK is an innovative load-bearing wall system. The process consists in assembling composite wood hollow bricks by nesting and gluing. The pre-stressing put in place by a cable vertically positioned on each side of each block gives the system lightness, minimal consumption of raw material and above all flexibility combined with high strength.

The 6 faces of the hollow block are made with OSB 4 panels (panels working under high stress used in humid environment). The boxes are completely filled with rock wool insulation, varying in thickness depending on the desired thermal performance. The upper side and the male side face are coated with a band of compressible rockwool. The blocks are thus highly insulating, and designed to be assembled quickly and easily.

The process is thus perfectly substituted for traditional masonry materials and is provided for the realization of bearing walls or separation wall for individual or collective housing.

2 Description

See Fig. 1.

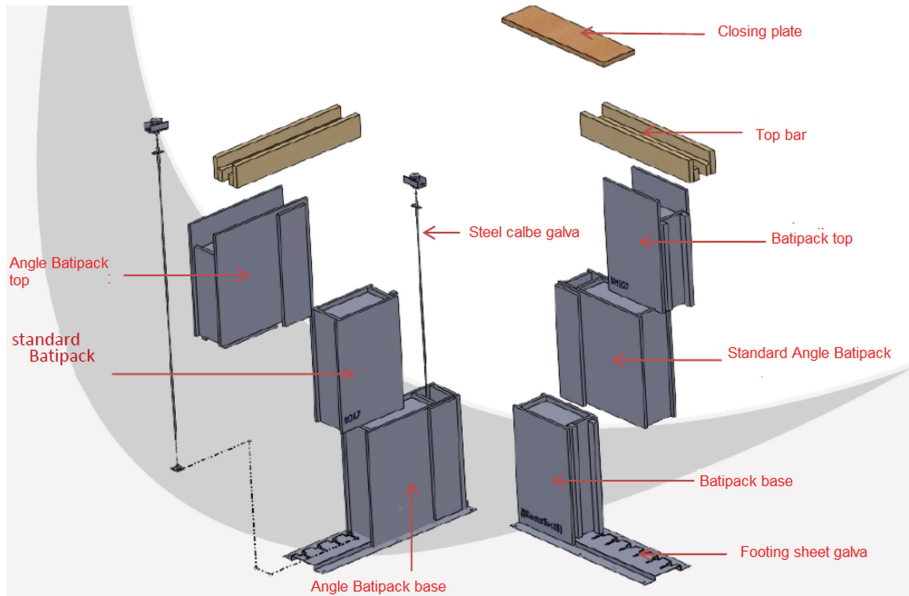


Fig. 1. Batipack conception

2.1 Composition of Batipack Block

The 6 faces of the hollow block are made of OSB 4 panels (high-stress panels used in humid environments), in respect with NF EN 300/4, label CE according to NF EN 13986 and certified by CTB-OSB 4.

The thicknesses are 15 mm for the large vertical faces, 18 mm for the small vertical faces and 9 mm for the horizontal faces.

The edges of the facings are covered with a PVC tape.

The box is completely filled with a wool insulation of density 70 kg/m and thermal conductivity 0.037 W/m.K of thickness variable according to the thickness of the box and the desired thermal performance.

The upper side and the male side face are covered with a band of ROCKMUR compressible rock wool of ROCKWOOL with a density of 50 kg/m³.

There are several types of bricks, including (Fig. 2):

- Current part bricks with a base model (BB), a standard model (B) and a top model (BH).
- The angle bricks with a base model (BAB), a standard model (BA) and a top model (BAH).



Fig. 2. Batipack blocks

The geometrical characteristics of the Batipack caissons may vary and are given below:

- Thickness: 200 to 400 mm
- Width: from 300 to 600 mm with step of 100 mm
- Height: from 350 to 600 mm with step of 50 mm.

The dimensional variations of the bricks previously described make it possible to adapt to each building project according to the facade dimensions desired by the client.

2.2 Connection to the Foundation

The Batipact base boxes are supported on a 3 mm thick metallic plate. In this metallic footing, fences are disposed to provide the fixation with the boxes of the first row as well as the positioning and the anchoring of the prestressed cable.

The metallic footing, in direct contact with the masonry, must be covered by a Z350 hot dip galvanized coating in accordance with NF EN 10346.

Other types of connection to the foundation can be considered (Fig. 3).

A specific component of footing is necessary for the building corners; it is made by reconstituting of the linear part and welding.

The protective coating of the areas affected by welding is recovered with a painting riche in zinc.

2.3 Prestressing System

The BatiPack system stability is based on the continuous vertical compression which is achieved by a prestressed cable positioned on each side of each block (Fig. 4).



Fig. 3. Connections to the foundation

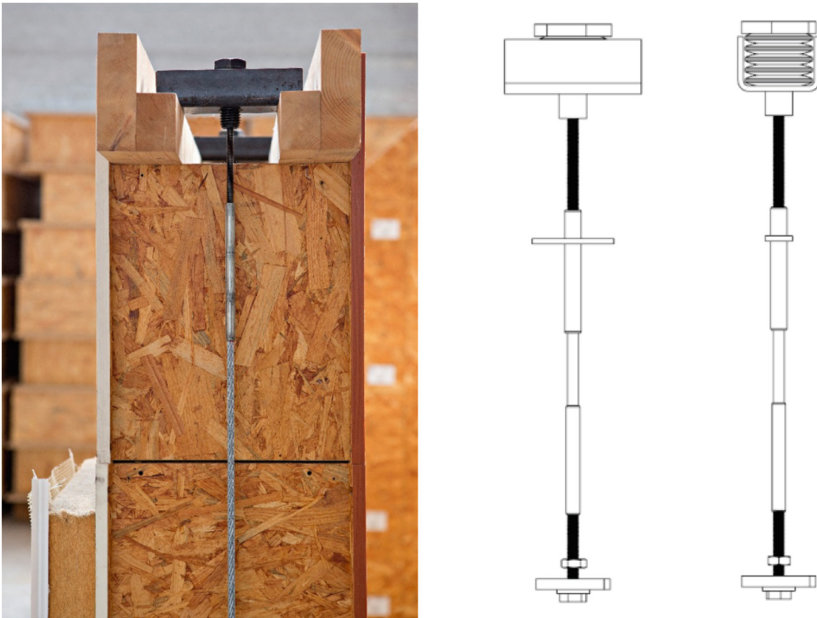


Fig. 4. Prestressing cable installation.

Each cable is made of galvanized steel with a diameter of 8 mm. It is dotted with a threaded sleeve at each end. Prestressed cables are connected in the base with the metallic footing, on the top with a double top bar in L shape.

The structures are self-stable by connecting blocks by cables, without any direct rigid connection between blocks.

The prestressing, maintaining a constant pressure from the bottom to the top of walls, gives some advantages:

- Lightness of the structure.
- Minimal consumption of raw materials.
- Flexibility combined with high solidity.

2.4 Pre-frames for Doors or Windows

The pre-frame is surmounted by a hollow block forming a lintel. This element is supplied and dimensioned in the way that no load is applied to the doors or windows carpentry.

3 Performance

3.1 Mechanical Performance

The walls of the Batipack system are used as load-bearing elements. They are then exposed in their plane by horizontal forces which are transmitted to the foundations of the structure. We can consider Batipack walls as a Bracing system which is a static system designed to ensure the overall stability of a structure with respect to horizontal effects resulting from possible actions on its plane (e.g. wind, earthquake, shock, braking, etc.). Studies carried out by the FCBA (French Institute of Technology for Forest-based and Furniture Sectors), a partner of the CSTB (Scientific and Technical Center for Buildings), determined the modification coefficient (K_{mod}), for a permanent load, equal to 0.42, for a live load, equal to 0.79 [1].

With respect to the horizontal loads perpendicular to the plane, under the wind load according to Eurocode, the Batipack system has an deflection lower than $H/500$ for $H = 3.00$ m [1].

The behavior of the walls of the Batipack system with regard to soft body shocks is satisfied. The wall elements are not damaged and retain their bearing function.

3.2 Earthquake Resistance

According to NF EN 1998-1, the walls of the Batipack system have a limited degree of ductility (class L), i.e. the seismic behavior factor “q” to be used for earthquake design is: $q = 1.5$ [1].

This seismic behavior factor “q” is defined by Eurocode 8 (Design of structures for earthquake resistance). In practice, the q-factor is used for structural design: the seismic actions are determined by an equivalent linear calculation where the elastic forces obtained are divided by q, which limits the resistance of the structure.

The studies carried out by the FCBA (French Institute of Technology for Forest-based and Furniture Sectors) validated the performance of the BatiPack under seismic loading.

3.3 Insulation Performance, Safety and Durability

The Batipack construction brick is wrapped by a vapor barrier film. This disposition offers to the product a good water vapor permeability and a satisfied humidity resistance.

The waterproof of the construction is ensured by the use of a water-tight film, according to DTU 31.2. The waterproofing is then reinforced by the installation of a traditional exterior coating defined and implemented in accordance with DTU 31.2.

The batipack system configuration composed by the assembly of the hollow blocks behaves like a double wall with connections. This shows a notable improvement in acoustic performance.

The tests with respect to the insulation to the outside air noise have been carried out. The results show that the product matches the existing norms concerning decibels reductions imposed by DTU 31.2.

Thermal insulation is ensured on the one hand by rockwool insulation, with a certified thermal conductivity of 0.037 W/(m.K), and on the other hand by the internal and external coatings. The heating measuring index can be up to 2.5 times higher than the other materials [1].

The massive wood used for the manufacture of the caissons and the assembly of the walls receive a treatment allowing classifying in Use class 2, including in termite zone, according to Eurocode 5 (Design of timber structures).

The materials used in the manufacturing of the BatiPack system (OSB 4 and rock wool) are completely free of formaldehyde, unlike most materials used in the construction field.

It is importance to note that OSB material is not attacked by common wood-boring insects such as termites, ants, bees, or wood weevils. The material is certificated Anti-termite.

The OSB 4 product is 100% PEFC (Program of the Endorsement of Forest Certification) certified by the FCBA (French Institute of Technology for Forest-based and Furniture Sectors).

4 Implementation

Batipack block is designed to be palletized and film-wrapped immediately. Easy and fast delivery thanks to the palletised-packaging processed at the factory, each Bati-pack® brick has its own serial number and is assembled in an ascending order following the erection notice that comes with the invoice.

The Batipack process provide composite wood bricks which are designed to be hand-manipulated, an assembling methodology that do not require any particular skill or special equipment. The insertion of frame during the construction period is also simplified.

5 Some Achievements with the Batipack® Brick

Apart France, the BatiPack® product has already been exported and set up in Guinea, Senegal, the Philippines, Argentina, Irak. Batipack system can be applied on many types of building project, for example [2]:

- Houses and chalets (Fig. 5)



Fig. 5. Houses and chalets.

- Extension (Fig. 6)



Fig. 6. Extension.

- Technical and industrial building (Fig. 7)
- ...



Fig. 7. Industrial building.

6 Conclusions

Due to its innovative concept, the Batipack® presents various advantages:

- Optimized logistic
- A short erection delay thanks to its hand-manipulating conception.

Its multiples performances also position it as a serious alternative to classic construction materials and technologies, mainly because of:

- Its thermic, acoustic characteristics
- Its seismic resistance
- Its mechanical performances.

References

1. FCBA (French Institute of Technology for Forest-Based and Furniture Sectors): Dossier technique, Reference 2010.347.0356 (2010)
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