A building system for duplicable hotel buildings

Ing. Giovanni Spatti
Wood Beton Spa
Iseo (Brescia), Italy

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1. Industrial building.

The world is changing and the construction sector is changing with it.
Today everyone is talking about «industrialized construction»: professionals, businesses, investors and public institutions. But, in Italy there is still much to do about the off-site building, probably because there is no real culture regarding this type of building. It is clear that the most correct way to go is precisely this one: to build in the factory and assemble on site, using industrialized production lines with automated processes, in order to increase productivity and make the sector competitive, with a technological and innovative response.

1.1. The advantages of industrialized construction.

Industrialized building is a type of building much more attractive than the traditional one.
First of all, it ensures a **high level of product quality**, because the work in the factory takes place in conditions of extreme safety and controlled temperature, protected from atmospheric agents, in contact with the design office, with continuous supervision. The construction operations done in the factory allow a **reduction of the operators on site**, which becomes a place of pure assembly: the speed and the methods of installation reduce the duration of the operations at height, where it is simply needed to carry out simple mechanical connections. This reduces the possibility of accidents on site and increases **operator safety**. Moreover, since the production of the elements is in the factory, the reduction of construction waste is almost automatic, ensuring a **clean and always tidy building site.**
The use of industrialized construction systems allows an **important reduction in assembly time**: during the production phase in the factory, complete products are made with finishes and ready to be installed, while in the building site the foundations are made. Consequently, the production on site is significantly reduced, **minimizing construction time**. Then, thanks to the design level reached before the construction phase, it is possible to obtain an **accurate estimate of the construction costs.**
Finally, making «industrialized construction» means paying attention to the environment: we minimize the use of materials and employ fewer people on site, with a significant reduction in traffic and, consequently, less pollution.

Figure 1+2: Images from the construction site: safety for operators and cleaning site.

2. The levels of industrialization.

The integration between on-site execution and industrial production favors the realization of technological systems that meet the new demands of the construction sector, responding to the needs of sustainability, speed of execution and cost control, which come from the different market demands.
Today the industrialized systems are the transposition into the constructive field of technological research in the production chain; they represent the synthesis of the possibilities of evolution of industrialization systems in construction, ensuring the adoption of the most innovative technical solutions.
It is possible to identify three different levels of building industrialization:

1. BASE: Building prefabricated components.
2. MEDIUM: Industrialized systems that facilitate the traditional construction.
3. ADVANCED: Building as an industry.

3. Level 1 of industrialization. Building prefabricated components.

In the construction world, there are new possibilities to built projects, with the intelligent use of prefabricated elements.
In this case the traditional building works together with the industrialized one: a synergy between construction companies and innovative companies, which make their technologies available to facilitate the works.
In the past, classic building materials, such as wood, steel and concrete, were brought loose to the construction site and then assembled. Today things are changed: articulated elements arrive at the construction site, made in the factory and assembled on site in a rapid and simplified way, with standardized and codified procedures that can be replicated endlessly.

3.1. Level 1: Realization of Hotel in Valle D'Aosta.

From the first patented system, the Prepanel® (a mixed wood-concrete slab), other unique and certified products were born in Wood Beton: systems pre-assembled in the factory, that have radically changed the processes on site.
With the use of prefabricated elements, we built the hotel **« Au Charmant Petit Lac - Spa & Park Hotel»** in Champoluc (AO), a three-storey tourist accommodation with 26 bedrooms.

Figure 3: Au Charmant Petit Lac - Spa & Park Hotel in Champoluc (AO).

For this hotel, the Xlam walls were prefabricated in the factory completed with mineral wool external insulation and 60 minutes fire resistance.
The main peculiarity is that all the walls were externally cladded in the factory, with solid larch wood elements, so each panel arrived at the construction site complete and ready to be laid.


Figure 4+5: Prefabrication of the wall in the factory with cladding and transport to the building site.

In addition to the walls, the balconies, the parapets, the brise soleil in laminated larch wood and the Preconnect® roof, the system signed and patented by Wood Beton, have been prefabricated in the factory.


Figure 6+7: Construction phases of hotel.

In this perspective, the Iseo company built the **«Hotel EX Majestic»** , in the heart of Courmayeur (AO), where design blends with the natural element: a multifunctional complex for hotel, residential and commercial use, entirely made of wood.

An imposing structure, where the hotel consists of seven floors while the residential one has six floors.

Figure 8: Ex Majestic Hotel in Courmayeur (AO).

All the walls are made of timber and were entirely built in the factory: in this case, the first four floors have a frame structure, while the rest are in Xlam, the main material used also for the balconies and the slabs.
The claddings are made of larch wood and the roof, even in this case, is the Preconnect® type, completely prefabricated.

Figure 9: Construction of Xlam balconies in the factory.

All the hotels are characterized by very high energy standards and combine innovation and sustainability: Wood Beton built with systems that satisfied the needs and requirements of the client and the designers.
For this reason we used timber to built the structures: it is a material that gives healthiness and pleasantness to holiday environments. We embraced the «philosophy of hospitality in a sustainable way» and we built a perfect encounter between modern construction technologies and the oldest part of tradition, the wood, one of the first materials to which architecture has turned.

4. Level 2 of industrialization. Industrialized systems that facilitate traditional building.

The building sector is constantly evolving, so it is essential to satisfy the needs of the market, sometimes even anticipating them.
«BE THREE®» was born based on this idea: a dry construction system that is able to adapt to every design request, taking advantage of the peculiarities of each individual material: wood, concrete and steel, demonstrating great architectural flexibility and respecting the seismic requirements.

At the same time, BE THREE®, pays close attention to sustainability, as it allows to create completely removable structures that are then recyclable and reusable in other areas.
This system allows to respond quickly to the market demands: the system, entirely prefabricated, ensures a speed of execution that considerably reduces assembly times, guaranteeing safety on site for operators and costs that can be exactly defined already during the design phase.

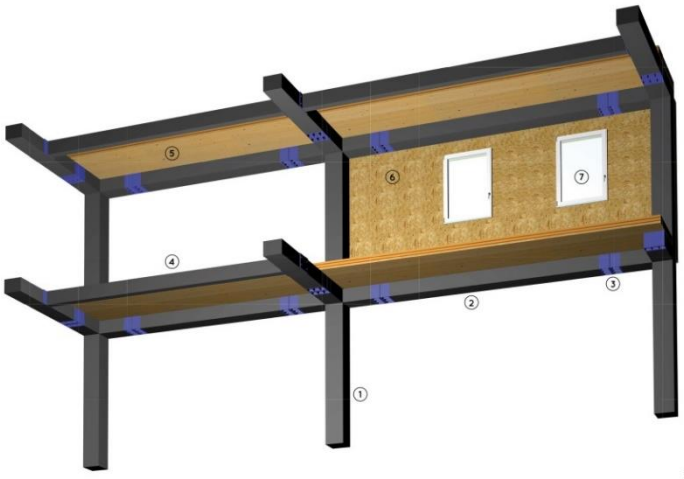

Figure 10: Render of the construction system.

BE THREE® is a system that allows to build hospitality multi-storey buildings with a frame structure composed by vibrated/prestressed concrete, with CLT slabs dry assembled to each other. The cantilever elements of the concrete column have the same dimension of the beams and a size that allows to connect them to the beams themselves with a fixed connections (outside the critical area of the column). The connection between the cantilever and the beam is made using a steel element that also works as a seismic insulation device.
The shape, size and location of the floor elements allow to create a rigid plane, without wet connections or concrete pouring.
The structure is prefabricated but it is a highly hyper static system. This characteristic together with the use of high strength concrete and steel connection, guarantees a good ductility and high seismic resistance performances. Finally, BE THREE® is an environmentally friendly system, as it minimizes the amount of concrete and timber and it allows to easily disassemble the structure.

4.1. Level 2: Construction of «Arte Bianca» building.

The BE THREE® system was applied to the construction of a new accommodation facility for Cast Alimenti, the famous training institute of Brescia.

Figure 11: Render of «Arte Bianca» project.

«Arte Bianca» is a «turnkey» project, of about 2,500 square meters, completed in less than 10 months.
For the construction of all the structures, we used a completely prefabricated system, which does not require the use of scaffolding: i.e. the BE THREE® system, which uses different materials such as wood, steel and concrete, and guarantees speed and easy assembly of the elements of the structure and maximum safety to the operators on site.
Moreover it allows to obtain a totally removable and, at the same time, light structure, which does not need any supplementary concrete pouring.

Figure 12: The correct material in the correct place: wood, concrete and steel.

In particular, we used timber for Xlam slabs and the prefabricated walls. The latter have a timber frame structure and they came out of the factory already plastered on the outside.


Figure 13+14: Wooden slabs and wooden walls.

We also built in the factory the 42 bathrooms of the rooms, with a wooden structure, complete with all finishing and all the MEP installations, insulation and plasterboard counter walls. The choice to install a completely prefabricated product, designed in detail during the production is the best technical and cost-effective solution.


Figure 15+16: Prefabricated bathroom in the factory and site positioning.

5. Level 3 of industrialization. Building as an industry.

Industrialization, repetitiveness and standardization: a new generation approach that transforms the construction sector.
«Building as an industry» or «off-site construction»: these are definitions that express the same process: the construction in the factory of three-dimensional elements, with finishes and installations already integrated, and the subsequent assembly on site.
All it is possible thanks to industrialized production lines, based on very precise automated processes.

It is a modern constructive trend oriented towards a future that focuses on optimizing time and resources, minimizing waste and increasing the operator safety and limiting the environmental impact.
Technology, innovation and modernization are the basis of new construction methods that can make the sector grows.
A type of construction where the different elements of a building can be physically built not in the construction site and later assembled on site.

5.1. Level 3: Moxy/WBFactory System.

In 2011 Vastint Hospitality, a construction multinational company, part of Inter Ikea Group, was looking for someone who could engineer an idea / concept on which to invest for several of the following years.
Wood Beton was chosen to achieve the purpose to engineer the construction of modern hospitality facilities with innovative technologic solutions, made by prefabricated three-dimensional Xlam elements, provided with finishing, electric, hydraulic and ventilation systems all installed inside the factory.
For this reason we built a new production factory that employs around 200 people: the WBFactory in Corzano (Brescia).
Wood Beton built a factory, defined the handling of the modules with automated systems, the number of workstations and the necessary human resources, the times of the individual activities and all work shifts.
Practically, we created a factory and a production line with chain processes, similar to the production chain used for the car production.
In WBFactory we built «the prefabricated rooms and bathrooms» of the Moxy Hotels, and now we make around 2,000 rooms every year.

Figure 17: WBFactory in Corzano (BS)

5.2. Moxy Hotel in Malpensa (VA).

The first opportunity to implement the new construction system was in Italy, at Malpensa airport: a «turnkey» job done in just 6 months.

Figure 18: Moxy Hotel in Malpensa (VA)

The hotel has 4 floors and an area of about 5000 square meters.
On the ground floor there is a hall, the conversation and waiting room, the breakfast room, the reception, the bar and the storage room, the services for users (info point, web point, etc.), the services guest toilets, the technical rooms for the fire sprinkler system and the changing rooms for the staff.

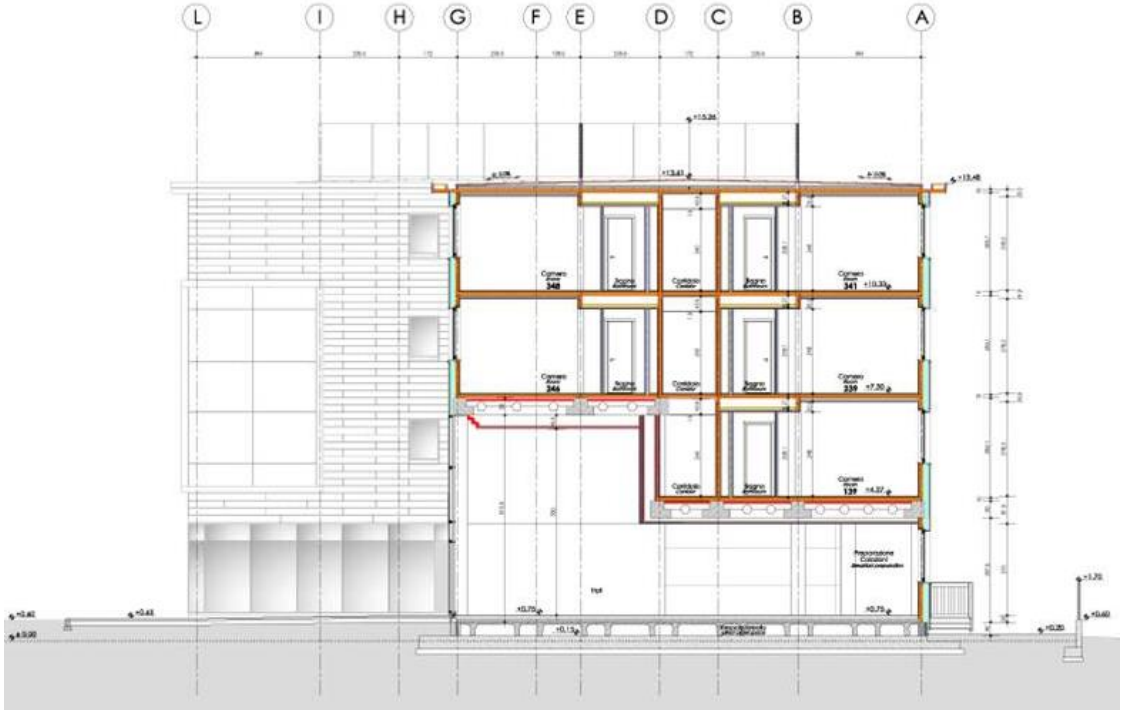

Figure 19: Section of the hotel

In the above three floors there are the guest rooms: a total of 162 bedrooms: 152 ordinary rooms and 10 Deluxe rooms.
The ordinary rooms have the same dimensions and services; they have an area of 14 square meters and can accommodate 2 people. The Deluxe rooms are more comfortable and larger: they have a surface of 26.02 square meters, and can accommodate up to 4 people. These rooms are also equipped for disabled users.
About the installations, there is a mechanical ventilation system for the air exchange in every room: it is an integrated system with an heat recovery unit.
There are three machines for air treatment that are on the roof of the hotel, while the installations shafts are located in correspondence of each room, in order to have the main ducts and pipes distribution of the networks mainly along the vertical direction.

5.3. Concrete prefabricated structure for foundations, stairwells and elevator shaft.

During the design of the project, we also decided to built portions of reinforced concrete structure to solve some specific problems: to respect the idea of a totally «dry» structure, we used reinforced concrete only in the «prefabricated» version and with innovative solutions.
The prefabricated concrete elements, built by Camuna Prefabbricati Srl were: the underground tunnel for the intallations, the prefabricated foundations, the beams and columns of the hall area, the stairwells and the elevator shafts.

Figure 20: Concrete prefabricated structure

5.4. Timber prefabricated structure.

The hotel has a CLT load bearing structure, composed of three-dimensional modules that form a box-shaped system, completely finished in the factory, «packed» , transported to the construction site, raised to its final position and connected (structure and installations) to the other boxes and installations shafts.
The module serves two rooms, as it contains two bathrooms, two entrances and a shaft for the main installations (electrical and mechanical).
The interior spaces are completely finished in the factory, both for the installations and for the finishes: tiles, sanitary ware, taps, light points, shower boxes.

Figure 21: Three-dimensional elements.

Figure 22: Two-dimensional elements.

To complete the bedrooms, bi-dimensional elements, slabs and walls, were connected on site to the modules.
The floors arrive at the construction site complete with suspended ceiling, the provision for the smoke detection system and a top dry screed, already pre-coupled to the acoustic insulation layer necessary to guarantee a good acoustic behaviour.
The façade walls and the dividing walls of the rooms are made with CLT panel walls, 100mm thick, also pre-finished in the factory.
In particular, the façade walls arrive on site with the window already pre-installed.

6. Conclusions.

To fight the crisis of the construction sector it is important to innovate and create new and unique products for the market, to become a reference point and to consolidate its own position day after day.
The design of new products and new technologies allows us to satisfy the requests of customers and the market needs: from the technological point of view, important goals can be reached with continuous research, using indiscriminately different materials and respecting the environment by choosing certified raw materials and reducing the environmental impact during the production processes.
Industrialized building is the correct way to go: to build in the factory and to assemble on site, using industrialized production lines with automated processes; to increase the productivity and make the sector competitive, through a technological and innovation response.
In this way the factory becomes a place where the activities are codified, repeated and standardized, increasing quality and reducing costs.

Figure 23: Automated production line in WBFactory – Corzano (BS)

From this point of view, Wood Beton Spa is a consolidated reality that anticipates the needs of the market, with great innovation and engineering capacity, proposing industrialized construction technologies, in the residential, commercial and hospitality sector, that are unique both at national and international level.