

# BULLETIN OF LESSONS LEARNED

## CENNI DI CAMBIAMENTO, MILAN, ITALY

This bulletin presents the lessons learned and experiences gathered from stakeholders who responded to an online questionnaire and/or participated in interviews.

### OWNER/DEVELOPER

Polaris Real Estate SGR SpA

### DESIGN TEAM

ARCHITECT: ROSSIPRODI ASSOCIATI Srl.  
STRUCTURAL ENGINEER: Borlini & Zanini SA

### AUTHORITY HAVING JURISDICTION

Ministry of Infrastructure and Transport

### CONSTRUCTION TEAM

GENERAL CONTRACTOR: Carron  
TIMBER SUPPLIER: MakHolz  
TIMBER FABRICATOR: StoraEnso  
TIMBER ERECTOR: Service Legno



Photo Credit: Riccardo Ronchi

Cenni di cambiamento is a social housing apartment complex with four 9-storey towers and 2-storey connector buildings between towers. The complex contains 124 units, common amenity and social spaces, gardens and some commercial office and retail units to accommodate social services.

All buildings in the complex are timber structure using cross laminated timber (CLT) for floors, walls, elevator cores, stair cores and balconies. Two complex connection systems are employed at the joints of the CLT panels to ensure seismic stability.

The complex offers high quality housing to low-income families within three lease options including a lease-to-own option resulting in ownership after only 8 years. It is currently the largest completed residential project in Europe constructed with a mass timber structure and was the catalyst for a revised approvals process in Italy that now allows structural timber solutions for new construction over 3 storeys.



## PROJECT VITALS

LOCATION: 15 - 17 Via Gabetti, Milan, Italy  
COMPLETION DATE: November 2013  
OCCUPANCY TYPE: Commercial / Residential  
CONSTRUCTION COST: €1,000/m<sup>2</sup> (~ \$1,525/m<sup>2</sup> CAD)  
TOTAL FLOOR AREA: 17,000 m<sup>2</sup> gross built floor area  
NUMBER OF LEVELS: 9

### TECHNICAL RESOURCES + LINKS

Technical details of the building systems can be accessed through the following resources:

**Bernasconi, Andrea. (June 2012) Timber construction in the city of Milan - 4 residential buildings with 9 storey.**  
<http://www.traeblog.dk/wp-content/uploads/2012/07/Via-Cenni.pdf>

**Rossi Prodi, Fabrizio. (2012) Abitare Sociale. Peasaggio Urbano, 5-6 bis.2012, pg 20-39** <http://www.periodicimaggioli.it/promo/2013/paesaggio-urbano/index.htm>

# LESSONS LEARNED

## OWNER/DEVELOPER

- Work with an experienced design team committed to innovation from the start of the project.
- Spend additional time during project planning and design phase to create robust detailed drawings that are well integrated with the construction and logistics plan.
- Apply a holistic approach to innovation, rather than a focusing only on innovating with wood.
- Construction time is very short and requires focused oversight to ensure details are executed as planned.
- Prioritize quality over all other objectives to ensure the project is appreciated and maintained with care by its occupants.

## DESIGN TEAM

- Create a project specific design approach that supports innovation within the constraints of the project, rather than applying established practices and procedures.
- Design that facilitates varied and flexible floor plans over fixed layouts is more appealing and durable over time.
- Flexible floor plans must be part of the design strategy from project conception to be successful.
- Planning for systems integration early in design is essential to avoid costly and impractical changes during construction.
- Installation of services in a timber structure is easier, cleaner and more economical than working with concrete.

## AUTHORITY HAVING JURISDICTION

- Work closely with the design team early in the project to ensure solutions respond to the unique aspects of the local jurisdiction.

## CONSTRUCTION TEAM

- Strong site management and organization are key to ensuring logistics and details are properly executed.



Photo Credit: Riccardo Ronchi

## THE OWNER / DEVELOPER

### POLARIS REAL ESTATE SGR SpA

The project was built by Polaris Real Estate SGR SpA in collaboration with Social Housing Foundation (FHS). Polaris managed all aspects of the development from design, to construction and property management, leasing and operation.

#### RATIONALE

- Provide high quality, affordable public housing with all the amenities and qualities of market housing for half the cost.
- Create energy efficient, comfortable and healthy housing that is durable and inexpensive to operate.
- Benefit from improved resource and energy efficiency, and reduction of embodied energy and carbon emissions associated with wood construction.

#### PROCESS

- The project was funded by Polaris Real Estate SGR SpA.
- A design competition was held to select an architectural team.
- A rigorous due diligence phase focused on the local seismic, fire, energy and acoustics implications of a 9 storey structural timber building.
- A lifecycle cost analysis was applied to ensure long term management and durability was prioritized equally with capital costs.
- The cost of fire protection was one of the most significant capital costs.
- Cost of timber structure was evaluated to be about the same as a similar concrete structure, not including the cost of fire protection.
- Structural design was considered the most significant risk; this was the first instance of timber used for structure in Italy.
- The initial structural design considered concrete stair and elevator cores, but the team opted for a mass timber core based on an evaluation of the difficult interaction between the different structural systems.

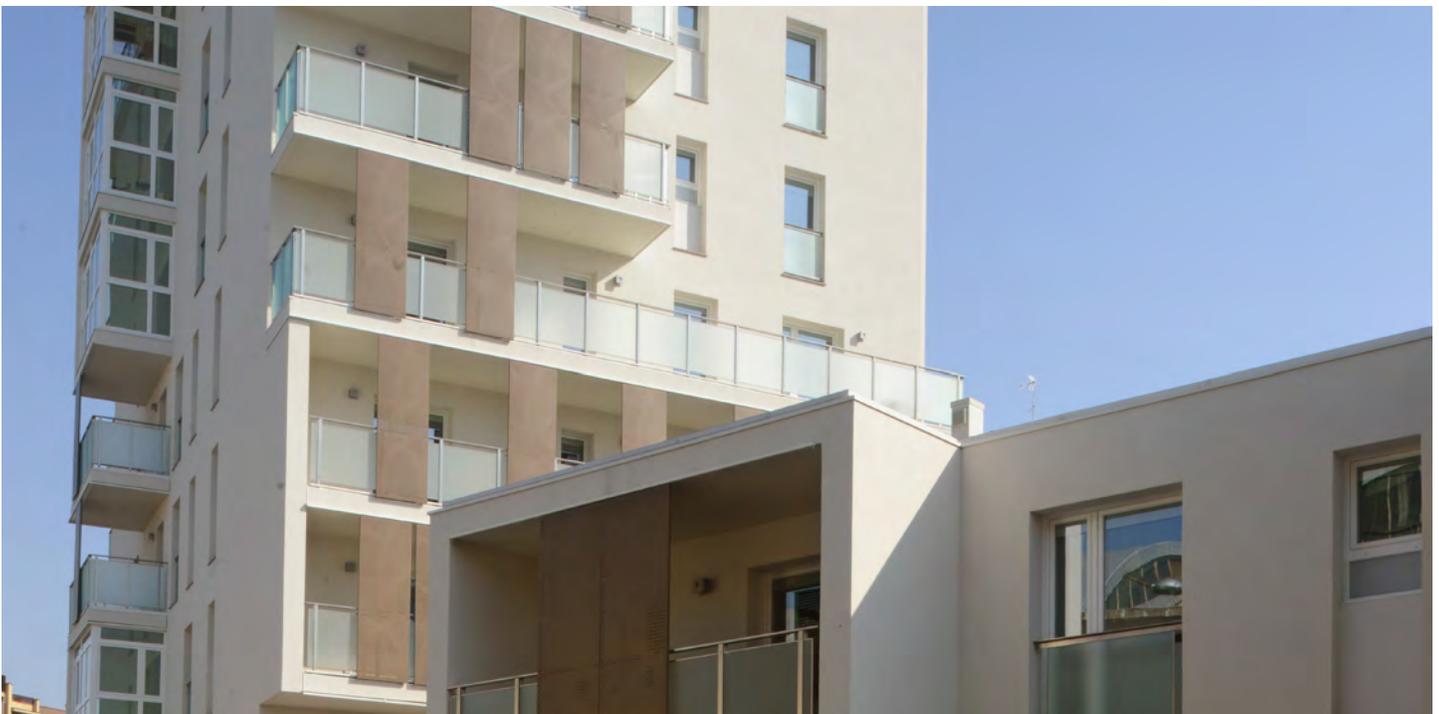


Photo Credit: Riccardo Ronchi

## CHALLENGES

- Maintaining the project schedule.
- Keeping costs within the budget; specifically the cost of fire protection strategy.
- Keeping the focus on high quality results while working in the context of social housing.

## SUCCESSSES

- Low income public housing occupants were offered high quality, healthy, beautiful and affordable homes, of which they can be proud.
- Exceptional example of innovation in the context of a social housing development.
- Completed within the expected time frame, with a savings of four months construction time compared to a concrete structure.
- Very efficient and flexible floor plans and building program.



Photo Credit: Riccardo Ronchi

## THE DESIGN TEAM

ROSSIPRODI ASSOCIATI srl., BORLINI & ZANINI SA

ROSSIPRODI ASSOCIATI srl. completed the architectural design and Borlini & Zanini SA were the structural engineers.

### RATIONALE

- Design a high quality residential project based on the principles of sustainable design.
- A commitment to the principles of sustainable design and realizing the embodied energy and carbon savings associated with mass timber construction.
- Promote ongoing experimentation and innovation in social housing.

### DESIGN PROCESS

- Design emphasis was on quality, durability and long term maintenance.
- Obtaining project approvals was challenging given timber construction is not common in Italy and the characteristics of structural timber are not well understood locally.
- Special permission was obtained during the design phase from the authority having jurisdiction to build in timber over three stories.
- Approvals took place during the design process over six months, and this was the first project to earn permission to proceed with a structural timber approach.
- Despite a relatively low earthquake risk in Milan compared to other parts of Italy, the authority placed special emphasis on seismic risk given the new structural timber typology. The most stringent seismic code in Italy (K-1) was required by the authority to ensure the best outcome for this first example of a tall timber building in the region.
- 3D modeling software was used for design.
- Design process was approximately two months longer compared to a conventional structural approach.
- The team considered the LEED rating system, incorporating sustainable design principles, but did not pursue formal certification.
- A platform timber frame structure and a steel structure were considered without detailed calculation and design, before selecting a CLT solution.
- CLT panel prefabrication included window and door openings only, penetrations for system and other finishes were cut on site.

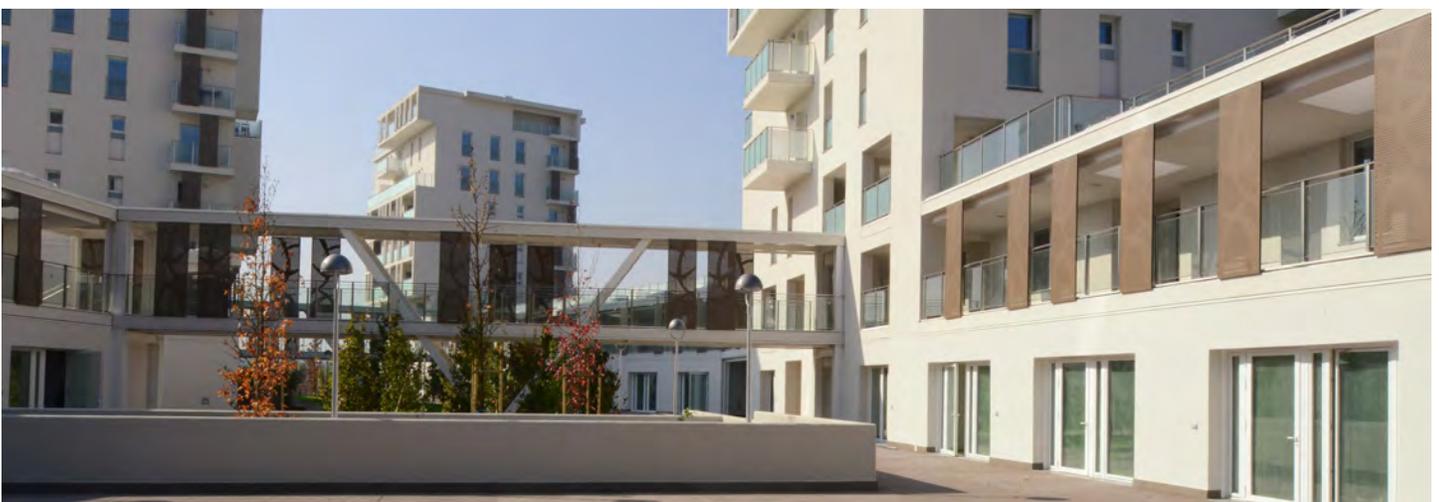


Photo Credit: Riccardo Ronchi

## DESIGN SOLUTIONS



### STRUCTURE

- Cast-in-place reinforced concrete basement.
- CLT panels for walls and floors from ground level to 9th storey.
- The CLT panels used for the walls decrease in thickness from 200mm on the first floor to 120mm on the 9th floor.
- The CLT walls are interrupted at each level by the floor panels to simplify production, transportation and construction; this creates a greater need for accurately designed and executed connection details.
- Floor element maximum span is 6.7m, using 230mm thick 7-ply CLT panels.



### LATERAL STABILITY

- Connections between CLT elements use two strategies to achieve “continuous stitching” to ensure high performance load transfer during a seismic event:
  - Steel plates and screws to connect CLT panels together.
  - High performance self-tapping screws at joints of floor and wall panels.



### FIRE PROTECTION

- Fire testing was done by the CLT fabricator.
- Gypsum board encapsulates all exposed timber on the interior with the exception of some ceilings in common areas.
- Doors are specialized fire protection doors.
- Exterior façade is non-combustible stucco cladding.



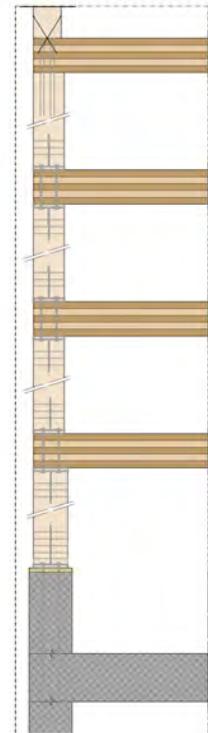
### MOISTURE PROTECTION + DURABILITY

- Vapour barrier installed on the inside of exterior walls.
- All suites have continuous ventilation systems with anti-pollution features and automatic humidity control.
- The building is designed for a service life of at least 70 years with very low maintenance.



### SYSTEMS INTEGRATION

- Penetrations for systems were cut on-site after panels were installed.



Schematic of Floor and Wall panels.  
Detail Credit: ROSSIPRODI ASSOCIATI srl.



Steel plates  
Photo Credit: ROSSIPRODI ASSOCIATI srl.



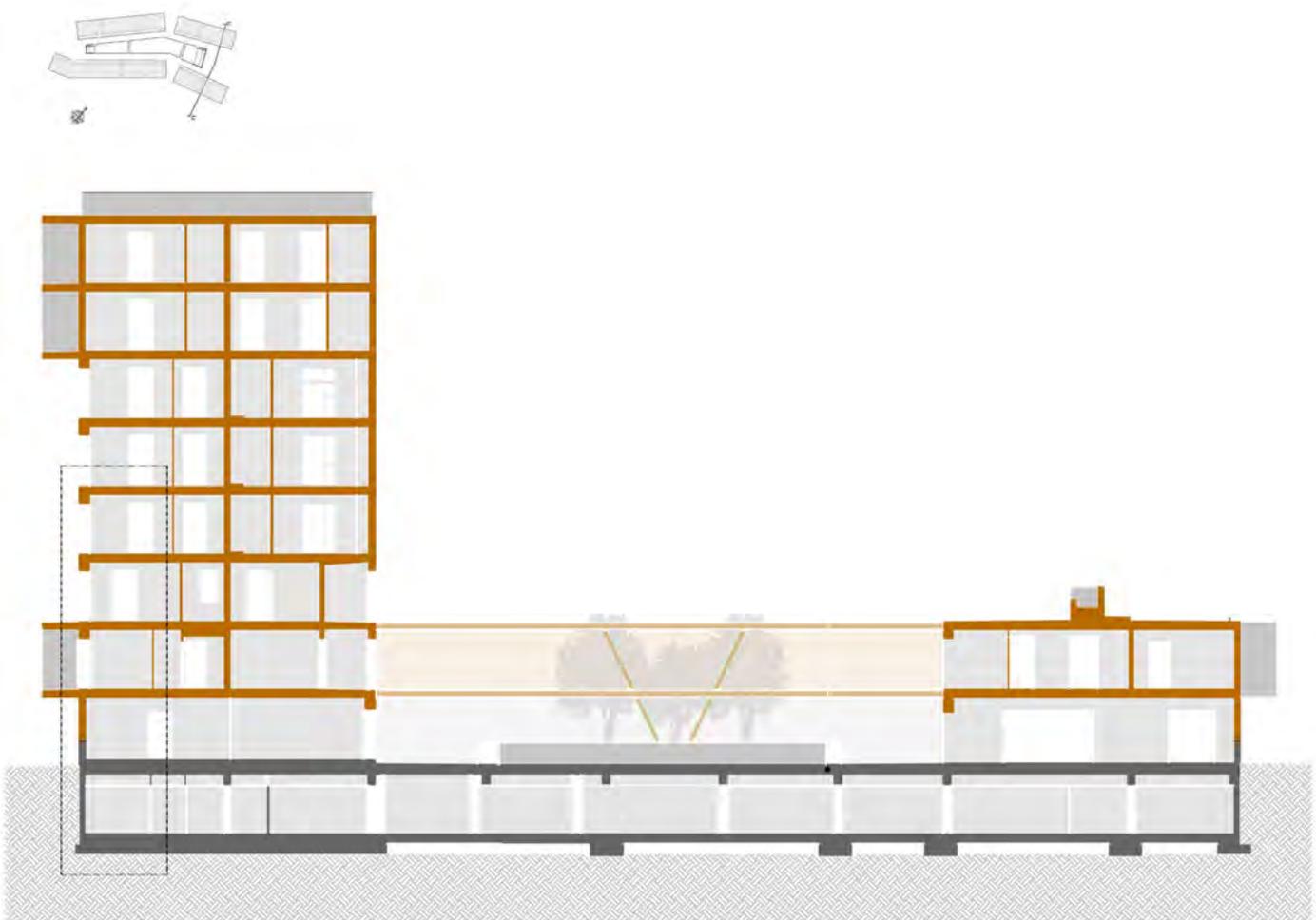
Self-tapping screws  
Photo Credit: Riccardo Ronchi

## CHALLENGES

- Maintaining a holistic approach to design, in line with the desired architectural language, structural considerations and important social considerations of the project.
- Evaluating options for the façade to ensure the appearance best reflected the goals of the social housing project, required special consideration and effort.
- Resolving structural design to accommodate unique floor plans for each level, while maintaining a flexible and easily customized layout for each suite.
- Developing the structural connection strategies to meet the stringent seismic requirements.
- Although seismic risk is relatively low in Milan compared to other parts of Italy, the Authority's perception of risk was heightened in this first instance of a tall timber structure, necessitating adherence to the most stringent seismic requirements.
- The cost of encapsulating exposed timber with gypsum to meet the fire protection requirements.

## SUCCESSES

- Residents reported that they are happy with, and proud of their space.
- Demonstrated that building high quality, healthy, state of the art residential projects was possible within a social housing context.
- Planning and logistics were very well incorporated into design documents.
- All risks were successfully mitigated and approvals obtained, setting the precedent for more mass timber projects in Italy.



Elevation view.  
Detail Credit: ROSSIPRODI ASSOCIATI srl.

## THE AUTHORITY HAVING JURISDICTION

### MINISTRY OF INFRASTRUCTURE AND TRANSPORT

Authority representatives were not available to provide their perspectives, however the information presented here reflects feedback from other project stakeholders on the permissions and approvals process for Cenni di cambiamento.

Prior to Cenni di cambiamento the local building code in Milan did not allow timber buildings above 3 storeys. The design team worked with the Authorities over six months to gain permission to construct with timber up to 9 storeys. This was a significant change to the approvals process in Italy, considering the industry's unfamiliarity with mass timber.

Although seismic risk is relatively low in Milan compared to other parts of Italy, the Authority's perception of risk was heightened in the context of a timber structure. The most stringent seismic code in Italy (K-1) was required by the Authority to ensure the best outcome for this first example of a tall timber building in the region. During design, the Authority evaluated various strategies proposed by the design team over a six month period.

Significant attention was also given to fire testing which was completed by the timber supplier.



Photo Credit: Riccardo Ronchi

## THE CONSTRUCTION TEAM

CARRON, SERVICE LEGNO, STORA ENSO, MAKHOLZ

Carron managed construction, Stora Enso were responsible for the fabrication, MakHolz supplied the timber and Service Legno were the timber erectors.

### RATIONALE

- Prove a strong, profitable business case for the use of mass timber products in construction.
- Expand expertise and develop industry capacity for mass timber projects.

### PROCESS

- Panel delivery logistics followed a continuous delivery schedule according to the assembly plan.
- The delivery schedule kept only two containers of panels on-site at all times, reducing site storage space required and the risk of exposing panels to weather. Panels were delivered to the site in containers.
- The construction team was hand selected, but skilled workers were readily available in the region.
- Scaffolding was used to improve building site safety and to assist with façade installation.
- The timber structure was completed in five months.



Photo Credit: Riccardo Ronchi.

## CONSTRUCTION SOLUTIONS



### SYSTEMS INTEGRATION

- Making penetrations for systems was relatively easy compared to working with a concrete structure.



### MOISTURE PROTECTION + DURABILITY

- All CLT panels were delivered covered with a PVC film, but after the first month of construction, the film was removed to allow the wood to breathe.
- Panel end grains were protected before installation.
- Panels were stored on-site in the delivery containers until installation.
- A nylon cover was used to protect the structure initially, but abandoned to better allow the wood to breathe. Standing water was removed immediately.

## CHALLENGES

- Addressing weather protection and standing water and snow removal.
- Achieving innovation and handling the pressure of scrutiny that comes with doing something new.
- Maintaining the project schedule.
- Maintaining construction costs.

## SUCCESSSES

- Construction process and project planning were well organized.
- Speed of construction was four months faster than a conventional construction process.
- Noise and dust during the construction were reduced as a result of timber materials and prefabricated elements.



Photo Credit: ROSSIPRODI ASSOCIATI srl.



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