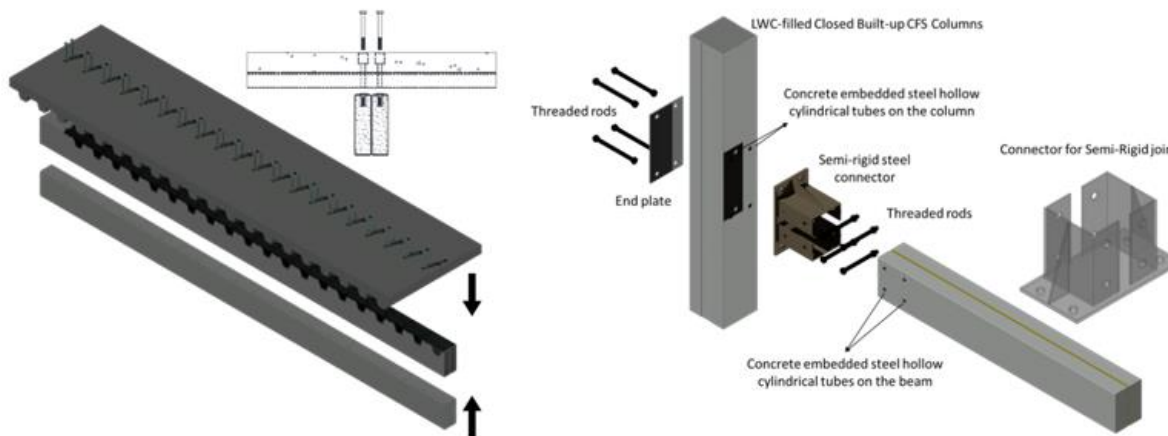


Prefabricated and demountable composite structural system combining cold-formed steel, lightweight concrete and/or timber



DESCRIPTION:

2050 Circular and Zero Carbon Sustainable Construction demands the adoption of new strategies and solutions that contribute effectively to significantly change the consumption patterns of natural resources (consumption of 40% of the global materials), waste management and treatment.

The need to reduce environmental impacts in the construction sector requires the broad implementation of modular prefabricated solutions, combining sustainable and reusable materials and technical solutions (targeting disassembly) must be introduced in the market, directing the construction sector towards a sustainable future.

The developed solution is an innovative composite structural system gathering several innovative characteristics, namely the combination of cold-formed steel products, lightweight concrete and/or timber, targeting prefabrication, modularity, and ease of erection and demountability.

The functional performance of the new hybrid structural solution, in both ultimate limit state and accidental fire conditions, was assessed using experimental tests and advanced calculation methods, namely the finite element method.

The structural system aims to explore the versatility of cold-formed steel products, combining efficiently different individual configurations to fabricate built-up elements that can be combined with lightweight concrete and/or timber. For the joints, innovative connectors were designed and tested, targeting ease of assembly and disassembly (design for disassembly) ensuring future reuse or relocation of the building or parts of the building. Since it has the potential to be an industrialized prefabricated structural system all members and elements can be tagged and monitored throughout their initial life cycle using innovative technologies such as Building Information Modelling (BIM – documentation, identification, and traceability for reuse).

For the floor systems, both composite slabs with lightweight concrete and Cross-Laminated Timber panels may be used depending on the desired level of prefabrication. The use of composite slabs with lightweight concrete and profiled steel decking may require on-site concreting, whereas the CLT panel ensures an easy and fast assembly. For both scenarios tailored connecting solutions/devices were developed to ensure adequate composite action between the composite beam and slab. Ease of assembly and disassembly was always a key requirement for the developed system, minimizing destructive operations in the disassembly process.

The developed structural system enables fast-track construction with high-quality products, optimizing on-site operations, reducing waste, improving safety, and ensuring efficient structural performance.

ADVANTAGES:

- Multi-material structural solution exploring the key mechanical properties of each material to develop an hybrid system.
- Prefabricated and industrialized solution, with minimum on-site operations.
- Modularity (2d and 3d) and ease of transportation.
- Versatility of the solution with a greater level of optimization.
- Reducing construction waste and improving safety conditions for workers.
- Ease of assembly and disassembly using tailored connecting solutions. Reuse of part or full structure.
- Improved fire resistance.

APPLICATIONS:

- New buildings, especially targeting low to mid-rise residential and office buildings;
- Retrofitting existing buildings, using, for instance, the new solutions for prefabricated structural members.
- Prefabricated and modular buildings.
- Reuse of parts/components or entire buildings in multiple life cycles.

IPR LEGAL STATUS:

Patent Cooperation Treaty (PCT) n.º PCT/IB2022/056376.

STAGE OF DEVELOPMENT:

TRL 4

KEY- WORDS

Cold-formed steel, lightweight concrete, cross-laminated timber (CLT), hybrid structures, prefabrication, modularity, ease of assembly, reuse, plug-and-play joints

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