Timber structures have gained increasing attention in the European construction field due to their sustainability, reduced self-weight, and speed of erection, which can make them cost effective with respect to traditional reinforced concrete systems. Particularly beneficial is the low carbon footprint of wood compared to other construction materials such as concrete and steel. Wood products can achieve high mechanical performance not only at material level, but also at structural level, as proven by the efforts to design and construct tall timber buildings in Europe. Although structural timber is able to retain and even increase its strength over time, its service life is strongly affected by environmental conditions and their variations. An important issue is that the changes of moisture content inside wood can pose a risk for the safety and serviceability of timber components of buildings exposed to variable environmental conditions

CRESTIMB project aims to develop an innovative timber system suitable for multi-storey buildings with open spaces. The proposed system will include moment-resisting frames made of softwood or hardwood glue-laminated timber with innovative beam-to-column connections, and dowel cross laminated floor panels. With the objective to ensure an increased service life and the possibility of reuse, the long-term behaviour of the system components will be investigated with an advanced numerical model including the rheology of wood under variable indoor climates. The numerical analyses will be assisted by experiments on softwood and hardwood samples, as well as full size tests.

Proposed system require performant moment-resisting connections in terms of stiffness and resistance to achieve sufficient serviceability and safety. As timber is not a ductile material, the required ductility of the structure (e.g. in seismic-prone regions) should be provided by innovative beam-to-column connections. The connection is based on friction between metallic parts and utilizes threaded rods as fasteners.

In addition, CRESTIMB will build a novel rheological model that is applied to a 3D problem and rigorously describes all main rheological phenomena in softwood and hardwood, including non-linear behaviour. To deepen the understanding of the wood's long-term response, the new creep model will simultaneously include the response of the wood in all material directions. To assess the creep and mechano-sorptive parameters for softwood and hardwood species in compression, tension and shear, laboratory tests on small samples will be undertaken, in the short and long-term, in controlled and uncontrolled environments. These tests will also include assessment of the bond performance of novel bio-based adhesives for laminated elements under accelerated aging.

CRESTIMB will develop a novel methodology for the service life assessment based on the mechanical response of the structural timber. Determination of the service life or its limit based on the multi-physics simulations of the material and the consequent use of this predicted service life in the lifecycle assessment are two completely new approaches developed in the proposed project.

Increasing circularity and prolonging the service life of buildings and structural components are steps forward towards more sustainable, resource-efficient, cost-effective and environmentally-friendly construction.