

INNOVATIVE TECHNOLOGY AND MATERIALS IN SUSTAINABLE DESIGN OF A FACILITY FOR AGRICULTURAL PRODUCTION PURPOSE

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Впровадження інноваційних технологій і сучасних матеріалів, таких як компонований масив деревини, у процесі проектування, виготовлення та будівництва може відіграти вирішальну роль у сталому розвитку сільськогосподарських виробничих потужностей.

The integration of modern engineered materials, such as mass timber, and innovative technologies in the design, fabrication, and construction process can significantly contribute to the sustainable development of agricultural production facilities. A notable illustration of this is the construction of a goat barn situated in the town of Glion, Montreux commune, Switzerland. The challenging terrain and limited space for construction necessitated a streamlined approach to erect the structure within a relatively confined area. To meet these challenges, the decision was made to prefabricate the construction elements off-site using solid-sawn timber and glue-laminated timber (Glulam). Glulam is a type of structural engineered wood product, composed of layers of dimensional lumber bonded together with durable, moisture-resistant structural adhesives, with all the grain running parallel to the longitudinal axis. The objective of this approach was to fabricate all components and prepare them for installation upon delivery, without requiring any on-site adjustments.

The barn is a single-story timber structure, erected upon a concrete pedestal that houses an office and a shop space. The upper level has been designed to accommodate animals and machinery necessary for an automated service. Wooden trusses fashion the two-sloped roof with a total span of about 14 m. Each truss consists of Glulam top chords, while the bottom chord is a hollow steel shape (HSS), clad with timber. The web members, braces, beams and columns have been constructed from solid-sawn timber. These trusses have been bolted together through knife plates. The entire construction area is approximately 700 sq. m.

The structural design of the barn was developed through a meticulous computer-aided analysis of a 3D model. All the timber components and their corresponding connections were modeled in a virtual 3D space using specialized computer-aided design and computer-aided manufacturing (CAD/CAM) software. This process has enabled precise in-shop fabrication of parts utilizing a computer numerical controlled machine (CNC). The CNC machine is an automated and motorized tool and platform, both of which are controlled by a computer. The machine executes specific input instructions derived from the 3D file where the timber parts are modeled. This method ensures a high level of precision in the manufacture of the parts.

Timber structures offer numerous benefits over steel and concrete, including reduced weight, faster installation, and biophilic design benefits. Additionally, they contribute to reducing CO₂ emissions and therefore mitigating climate change.