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SHERPA-CLT-CONNECTOR FOR CROSS LAMINATED TIMBER (CLT) ELEMENTS

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ABSTRACT: The use of cross laminated timber boards has greatly increased and substantially changed timber construction industry. The parallel development and improvement of existing conventional bonding systems has only hesitantly taken place in a few pilot projects. The use of high-quality bonding systems enables individual construction parts to turn into effective bearing construction elements [2]. Therefore a sophisticated bonding system for cross laminated timber boards was to be developed. The need for an improved and marketable bonding system for cross laminated timber boards is well known and has been expressed repeatedly by the industry. It is common practice to use partial thread screws to bond cross laminated timber elements. Due to the geometry of cross laminated timber elements, the layered structure and cross lamination (0°/90°/..), as well as the (supposed) orthotropy of wood, the use of screws for bonding in grain wood is virtually unavoidable. The building code EN 1995-1-1 [1] does not permit the use of fibre-parallel screws in professional timber construction and therefore an approval certificate is required. In the project preparation phase and project phase the conditions and requirements of the bonding system are defined in a three-strand model: manufacturing, application and calculation. In the course of the project process two bonding systems are developed: one bonding system that meets all listed model requirements, and a simplified bonding system meeting all essential points. The simplified system is not specifically designed for temporary constructions (containers etc.), as the connectors are not meant to be fixed repeatedly in the same spot. Both bonding systems allow for easy dismantling. For patent reasons only the simplified connector model is introduced. The essential benefits of this connector are its easy handling and assembling without scaffolding, its industrial prefabrication integration potential, and consequently, its short assembling time. The bonding system consists of four elements, i.e. the casing, the counter-casing, the pin, and full thread screws. The specific geometry of the connector also lends itself to being used in other timber construction systems, e.g. timber frame constructions. Bearing capacity features of the connecting device meet the requirements of a four-storey solid timber building.

KEYWORDS: Sherpa, cross laminated timber (CLT), connectors, bonding system

1 INTRODUCTION

Due to systematic processing in timber construction CNC-supported production methods are increasingly used. A high prefabrication degree shortens assembly time at the building site and at the same time it reduces costs and improves quality. The CLT building technique with large-format elements has established itself on the market for this very reason. The development of suitable bonding devices is lagging behind this growing market demand. Since individual elements require an appropriate bonding system to form a viable construction system, the market potential of the bonding device is as high as that of the CLT building system itself. The innovative input of this connector device is that it unifies the features of swift and safe high-precision assembling and adjustability. Moreover, easy dismantling and long-term air tightness are to be achieved. A specific advantage of this connector is that it doesn't require any scaffolding for assembling as the bonding system is integrated in the building interior. If the bonding system is mounted in the industrial prefabrication stage, the assembling process on site does not necessarily require skilled personnel. The implementation of the project was based on simulation models and laboratory experiments so as to realistically assess the market potential of this product.

2 PROJECT DESCRIPTION

Nowadays wood screws, partly also nails and dowels with a specific design, rod dowels and fit bolts, as well as glued threaded rods are used as connecting materials in construction joints. The use of these connection materials

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often results in the inadequate fibre parallel positioning of bonding materials on the narrow side of CLT elements (Figure 1).

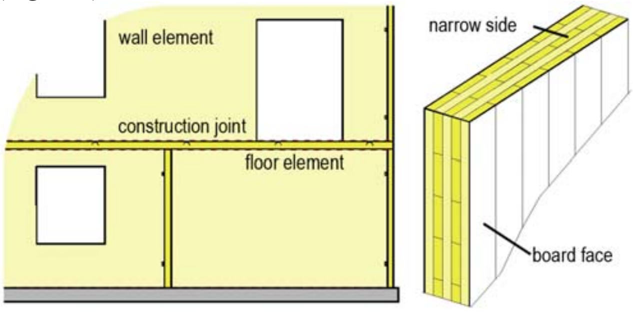

Figure 1: *CLT element, terminology*

2.1 TECHNICAL DESCRIPTION

The newly developed bonding system "Sherpa-CLT-Connector" enables the joining of big-size massive timber elements for wall, roof and floor constructions with intermittently fixed bonding materials at construction joints so that a precise, airtight fitting can be achieved. The connector consists of a casing and the corresponding counter casing (Figure 2). Both casings can be flush mounted into massive timber elements in the prefabrication stage. By fixing the full thread screws the conic pin effects the centered locking. The metal pin also transmits load in the transversal direction of the board plane. Flush mounting of connectors protects board elements and the connectors during the transportation and assembling process. This connector is designed to be used at wall-to-wall joints (longitudinal and corner joints), wall-to-floor-to-wall and floor-to-floor joints.

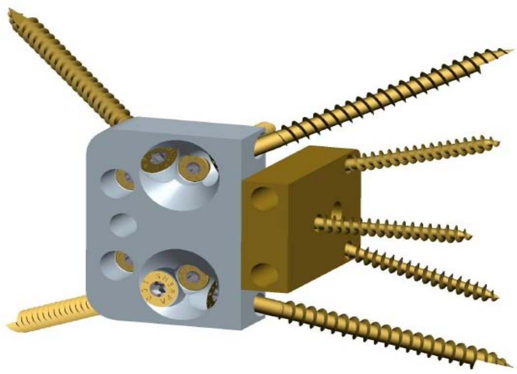

Figure 2: *Sherpa-CLT-Connector*

2.2 METHOD – LABORATORY SETUP

In the development stage the bonding system underwent FE-program simulations and laboratory experiments. The calculation is based on nonlinear material properties and the quadratic shift approach of the elements involved. For the experiments the CLT boards are fixed into a steel frame. The measuring equipment consists of 4 inductive displacement inducers and load cells. In the laboratory experiments a hydro-pulse testing frame was used to measure the tension and compression forces. The load impact was recorded according to EN 26891[6] path-control.

3 CONCLUSIONS

The essential requirements in terms of the bonding system, cost-effectiveness, safe load transmission, prefabricated flush mounting, on site adjustment potential as well as easy and flexible assembling are met. Hence the properties of the connector fulfil these structural and assembly-related conditions and expectations. The test results equal the maximum values of the specimen test load according to EN 26891 [6], and the load at a 15 mm shift respectively. The characteristic values calculation was based on EN 14358 [7]. The normal force was tested on 20 SHERPA-CLT-Connectors. Five connectors each were tested in longitudinal and corner joints with three- and five-layered CLTs. The shear force was tested on 10 connectors at five longitudinal and corner joints each. The SHERPA-CLT-Connector is being developed with a private sector partner.

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