Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 190 (2017) 263 – 270

Procedia Engineering

www.elsevier.com/locate/procedia

Structural and Physical Aspects of Construction Engineering

Analysis of Behavior and Carrying Capacity of Glued Timber-Timber Joints Loaded with Bending Moment

Antonin Lokaj[a], Kristyna Vavrusova[a,]*, David Mikolasek[a]

[a]*VSB-Technical University Ostrava, Faculty of Civil Engineering, Ludvika Podeste 1 875, Ostrava Poruba, 708 33, Czech Republic*

Abstract

The growth of timber use in building industry brings new trends, not only into the field of innovative wood-based materials but also into joining of the timber structures elements. Besides the already well normatively described joints with glued-in steel rods it is possible to design longitudinal joints of these structures with internal or external glued wood-based panels. For testing were chosen longitudinal joints of structural dimensions with external glued panels in beams stressed with bending moment. The content of this article is description of typical deformation of tested joints and determination of their carrying capacity and its dependence on the glued line thickness.

Peer-review under responsibility of the organizing committee of SPACE 2016

Keywords: Timber; glued; carrying capacity; adhesive

1. Introduction

The growth of timber use in the building industry brings new trends, not only to the field of innovative wood-based materials, but also to the joining of the timber structure elements. Besides already well normatively described and laboratory tested joints with steel glued-in elements, most commonly rods or plates, glued timber-timber joints, used in furniture or the building industry are created as well. In the building industry it is possible to use glued joints especially for the reconstruction of timber structure elements – for their strengthening or for the replacement of

* Corresponding author. Tel.: +420 597 321 375.
E-mail address: kristyna.vavrusova@vsb.cz

Peer-review under responsibility of the organizing committee of SPACE 2016
doi:10.1016/j.proeng.2017.05.336

damaged sections of wood. The stiffness and load bearing capacity of glued joints is influenced by several aspects (type of wood species, moisture, thickness of glued line, quality of gluing process, etc.).

Glued wood-steel joints, mainly in the form of threaded rods, are already an established practice in the construction industry with normative described values of bearing capacity [1, 2] long with and perpendicular to grains supported by many laboratory experiments and scientific works. Some specialists from all around the world [3, 4, and 5] and also from the Czech Republic [6, 7] are dedicated to the issue of carrying capacity and the performance of joints of timber structures with glued-in steel rods and plates. These joints are used both for new buildings and for restoration and redevelopment in locally damaged elements of timber structures, where there is no need of total replacement, but only the local repair of damaged parts is required.

The load bearing capacity and deformation of glued wood-wood joints is influenced by considerably more factors than in the case of steel-wood joints. They are mainly: the type of wood species, adhesive properties, glued line thickness, moisture and geometry. A number of influences affecting the behaviour therefore offer a wide range of questions that need to be answered in this issue. Worldwide, research inquiries and the testing of these joints, focusing on various influences and their combinations affecting their bearing capacity, are already in progress.

For example, [8] is devoted to the mechanical behaviour of these joints. Other works are mainly devoted to the carrying capacity of adhesives in combination with various aspects [9, 10 and 11] and the thickness of the glued lines [12].

For this work, glued joints were selected and tested, where the following aspects that may affect the bearing capacity were observed and simulated:

- parameters of the joint - testing of outside and inside plywood;
- thickness of the glued line, which mainly for timber elements with an uneven surface affects the quality of the joint – two thicknesses of 1 and 3 mm were chosen;
- the quality of longitudinally connected elements faces the simulation of the possibility of no-contact of longitudinal elements and an existing gap between them - in the first series the longitudinal members are joined without gaps, in the second series a gap of 10 mm is left between the elements.

2. Material and methods

2.1. Description of test samples

For testing, sets comprised of 10 test samples were assembled. To determine the real behaviour and carrying capacity of joints, testing samples with structural dimensions of 140×200×1400 mm were assembled. The test samples were made of solid spruce wood with a strength class of C24.

For inside and outside the glued element plywood with dimensions of 27×140×280 mm of beech veneers D40 consisting of 7 layers was used. The grains of the inner layers of plywood went parallel with the grains of the timber elements. The thicknesses of the glued lines between the timber elements and plywood were selected with values of 1 and 3 mm.

The bio component epoxy adhesive with low viscosity and high wetting power was used for gluing. The test samples were conditioned prior to destructive testing in a standard ambient temperature of 20±2°C and relative humidity of 65±5%. To determine the moisture of test samples, a moisture detector was used.

Three test sets with the following characteristics were prepared (Fig. 1):

- inside plywood;
- outside plywood, glued line thickness 1 mm, without gap between elements,
- outside plywood, glued line thickness 3 mm, without gap between elements,
- outside plywood, glued line thickness 1 mm, 10 mm gap between elements,
- outside plywood, glued line thickness 3 mm, 10 mm gap between elements.