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Experiment procedure with semi-rigid timber connectors

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Abstract. The paper deals with the preparation of an experiment of semi-rigid timber connections using modern timber connectors Rothoblaas Alumidi. The experiment consists of the loading of a timber bracket of structural wood. This bracket is attached to the glue laminated beam using Alumidi connector. There are a few specimens, which will be examined. Each specimen differs in the number of connectors and measurements of timber beams. The deformations of the connection itself, as well as the deformation of the timber bracket will be measured on the specimens. Subsequently, it will be possible to calculate the rotational stiffness of the connection from the measured deformations. The aim of the experiment is to verify the correctness of the numerical analysis of the connection and subsequently to prepare recommendations for engineering practice.

1 Introduction

Numerical analysis was done as an input for the experimental testing of connectors. Based on designed connections, the rotational stiffness values of each specimen have been calculated. For that purpose, a calculation method according to [9] is used.

Table 1. Rotational stiffness of the dowel part of connection.

Specimen number	Number of dowels	I_p (mm^2)	K_{ser} (N/mm)	$C_{\psi MSP}$ (MNm/rad)	$C_{\psi MSÚ}$ (MNm/rad)
1.	2	3528	4303.7	0.0304	0.0202
2.	3	3866	4303.7	0.0333	0.0222
3.	4	4328	4303.7	0.0373	0.0248
4.	4	4328	4303.7	0.0373	0.0248

Where:

- I_p – polar moment of inertia [mm^2],
- K_{ser} – middle value of slip modulus [N*mm^{-1}] according to [1],
- $C_{\psi,MSP}$, $C_{\psi,MSÚ}$ – stiffness [MNm/rad].

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Table 2. Rotational stiffness of the annular ring nail part of connection.

Specimen number	Number of nails	I_p (mm^2)	K_{ser} (N/mm)	$C_{\psi MSP}$ (MNm/rad)	$C_{\psi MSÚ}$ (MNm/rad)
1.	6	46848	2999.2	0.1405	0.0937
2.	10	63488	2999.2	0.1904	0.1269
3.	14	78336	2999.2	0.2349	0.1566
4.	18	91904	2999.2	0.2756	0,ň.1838

The stiffness value for the serviceability limit state is obtained by calculation. The stiffness value of ultimate limit state is given by 2/3 of serviceability limit state stiffness value. The results are verified by the method of deformation of the connector – dowel/nail. The specimen is loaded with a bending moment of 1Nm. Subsequently, it is possible to determine the deformation of the connector and to calculate the stiffness of the connection.

2 Experiment

2.1 Connection properties

It is necessary to divide the connection into two parts. Timber bracket is connected to T-connector Alumidi through self-drilling steel dowels SBD with the diameter of 7,5 mm and the length of 75 mm. Alumidi is connected to the glulam beam through the annular ring shank nails LBA with the diameter of 4 mm and the length of 100 mm.

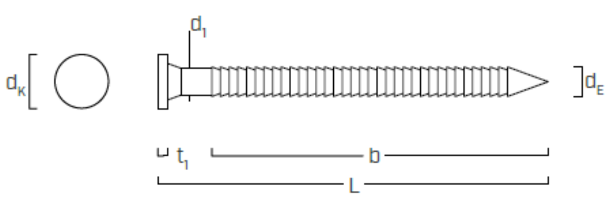

Fig. 1. Annular ring shank nail Rothoblaas LBA.

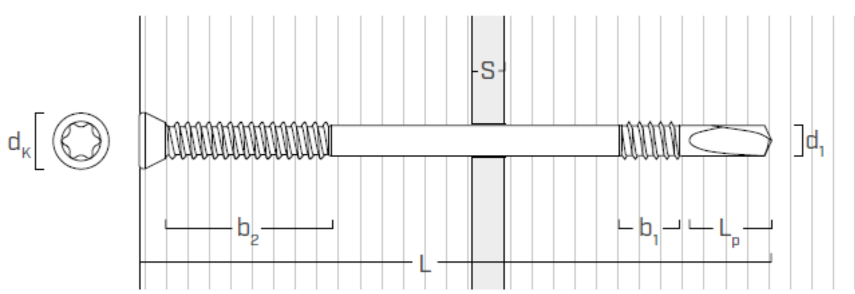

Fig. 2. Self-drilling steel dowel Rothoblaas SBD 7,5/75.

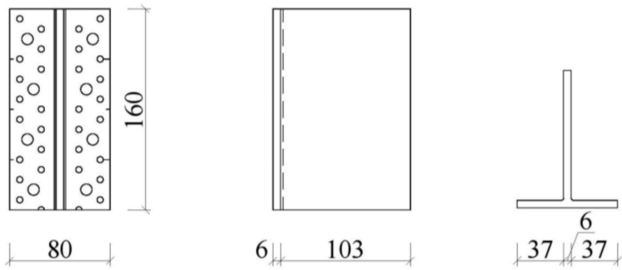

Fig. 3. Rothoblaas Alumidi 160.

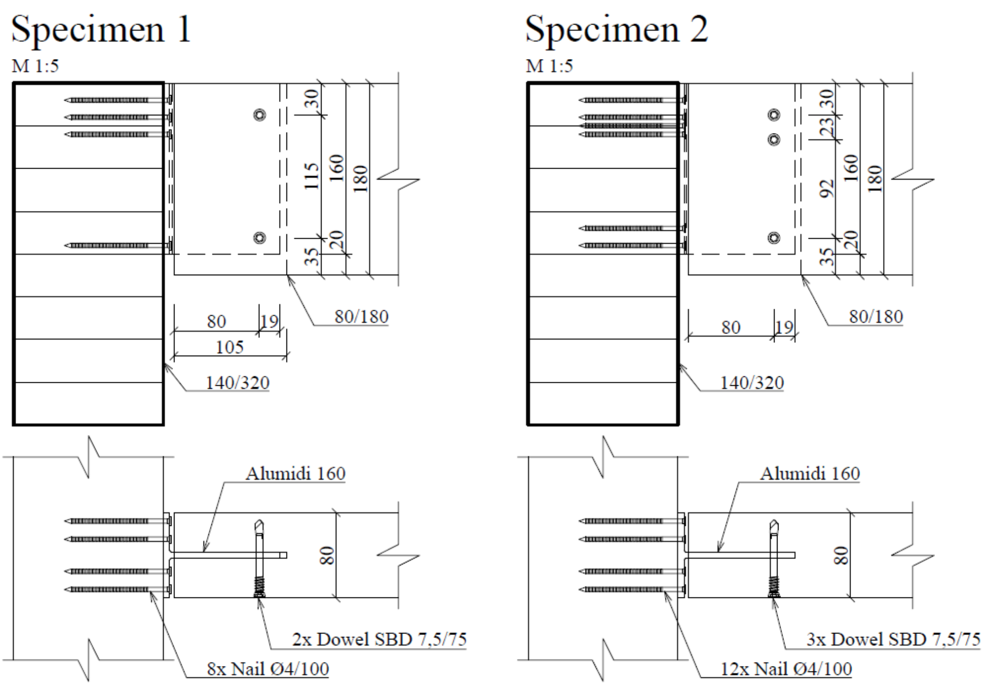

Fig. 4. Cross section of structural connection.

2.2 Experiment set-up

Due to the assembly limitations, it is not possible to load the specimen from above. For that reason, the entire connection will be horizontally mirrored, and the timber bracket will be loaded from the bottom. For loading of the bracket is used the hydraulic press ENERPAC RC756. The press will be controlled by the hydraulic hand pump ENERPAC P-80. The bracket will be loaded at the distance of 750 mm from the inner surface of the glulam beam. Deformations of the timber bracket and deformations of Alumidi connector will be measured on the specimen. HBM WA-T deformation sensors will be used for that purpose.

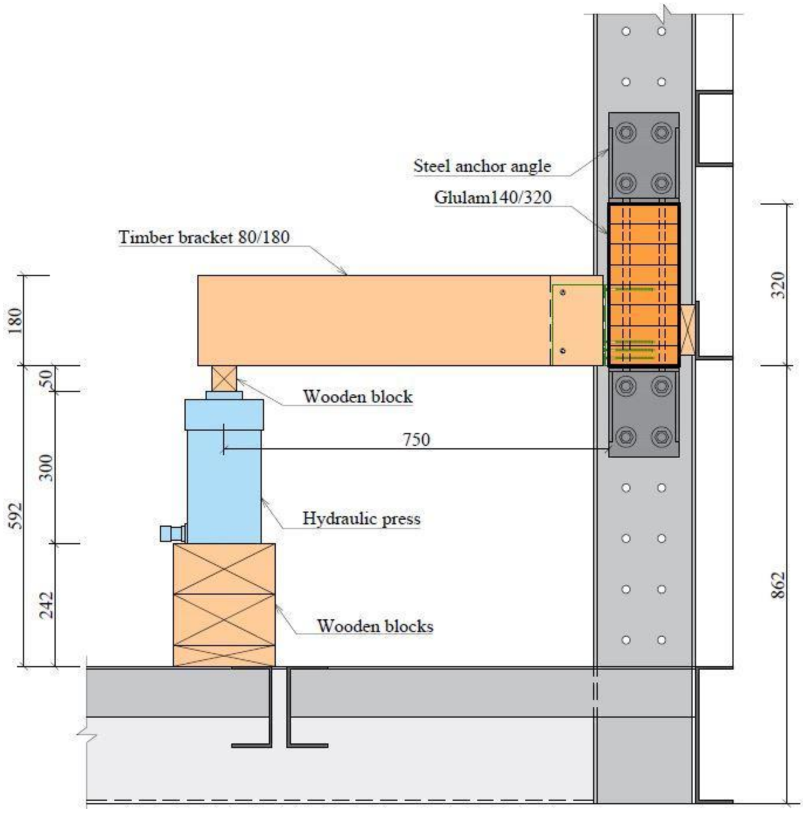

Fig. 5. Experiment set-up – loading.

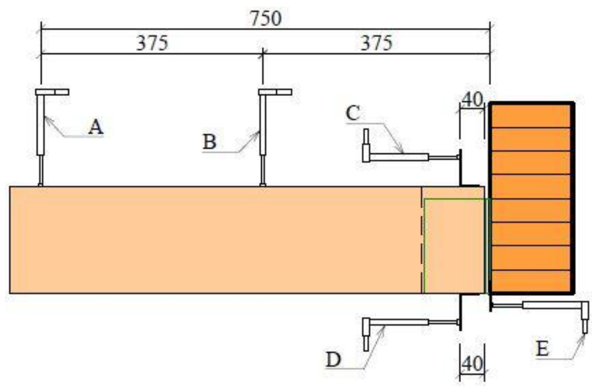

Fig. 6. Position of deformation sensors.

Deformation measuring position:

- "A" – the end of the timber bracket – vertical direction,
- "B" – the middle of the timber bracket – vertical direction,
- "C, D" – the timber bracket nearby Alumidi connector – horizontal direction,
- "E" – rotation of Alumidi bracket – horizontal direction.

3 Goals and theses

When modelling the structure, we have utilized the real stiffness values of the connection in question. The detailed calculation better explains the behaviour of the structure connection and the overall allocation of the forces in the load-bearing structure. The results of considering the connection as a semi-rigid will become evident not only in the area of safety but using more connections will also be more economical.
The aim of the experiment is to verify the outcomes of the numerical analysis. Moreover, the outcomes will be confronted with a 3D model in the FE computer software RFEM. One of the goals is to simplify the design procedure of semi-rigid timber connections in engineering practice.

Acknowledgement

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