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UNION OF ENGINEERS AND TECHNICIANS OF SERBIA

BACKGROUND

The roots of Serbian technical civilization date as early as the time of the Nemanjics. Beginnings of engineering activities were associated to the mining and metallurgical undertakings (Novo Brdo) and to building of magnificent medieval sacral structures of the Serbian state.

After the First (1804) and second Serbian Uprising (1815) the technical tradition was renewed and Serbian joined the then current European trends. First educated engineers came in Serbia from Austro-Hungarian Empire in 1830s. At that time, the main preoccupations of engineers were railway construction, town planning, construction of sewage disposal and water supply systems, as well as creating of national defense system. At that time 1834/35 from Austrian Empire arrived first schooled engineers France Janke and Franz Baron Kordon who served as so called "drzavni indzilirin" or state engineers.

In Serbia in the 19th century there were a total number of about 6000 engineers engaged in various activities. In an eighty–year period from 1834-1914 the State Construction Administration (which from 1880 also included railways) employed one third of these engineers. However other ministries were also competent for some engineering affaires like, for example the Ministry of Finance was responsible for mining, or the Ministry of Education and Church Affaires was responsible for education of technical stuff. From 1838 this primarily referred to the Licej: according to "Establishment of public institutions of learning" of 1844, the Department for Philosophy included also subjects such as Pure and Practical Geometry and Higher Mathematics, and Architecture, while in 1853 a separate Natural Sciences and Technical Department was introduced in the Licej and in 1863 the Great School with Technical Faculty started operating. The first classes held at the Technical Faculty of the Great School in 1863 marked turning point in schooling of Serbian engineers.

Out of some 600 engineers, approximately one third were schooled in Serbia and one fifth of them studied abroad as "state grants students", while about one fourth were foreigners and Serbs from "across the Danube".

In 1868 one of preconditions which might have contributed to professional associating of engineers was the numerosity of professionals and models from abroad established half a century earlier (engineering associations in Great Britain, Germany and America) had influence on establishing professional associations in Serbia.

The Founding Assembly of the Technicians` Society was held on the 3rd February 1868 in the premises of Great School. Engineer Emilijan Josimovic was elected for the first President of the Society. It is important to mention that this happened only a year after Turkish commander in Belgrade Ali -Riza pasha gave the town and the fortress keys to duke Mihailo Obrenovic. Shortly afterward in 1869 was established Society for Agrarian Economy that is the Serbian Agricultural Society. Association of Serbian Engineers was established in 1890 while in 1896 was established the Association of Serbian Engineers and Architects.

The first scientific magazine published by this Association in 1890 was "Srpski tehnicki list" The "Srpski tehnicki list" besides professional articles also published detailed information related to the work of the Association. The members at that time, who numbered around one hundred of them, initiated a whole series of issues and demand the same to be solved by the competent bodies. During the First World War, two volumes of "Srpski tehnicki list" were published in Thessaloniki. The magazine was initiated by the engineers and architects who were in Thessloniki as members of the Serbian Army. In Thessaloniki was held the General Assembly of the Association in 1918 attended by 463 engineers.

During his short stay in Belgrade, in 1892, famous scientist Nikola Tesla was elected for the first honorary member of the Association of Serbian Engineers.

Providing assets from its own incomes, bank loans, gifts and donations of its organizations-members and its individual members Association built the House of Engineers in Belgrade, Kneza Milosa 7 str in 1932/35. The House of Engineers "Nikola Tesla" in Belgrade Kneza Milosa 9-11 str was built between 1962 and 1969. In the premises of these two Houses of Engineers besides the Union of Engineers and Technicians of Serbia today perform their activities 26 republic`s professional and multidisciplinary engineering-technicians` associations out of 41 collective members of UETS.

Besides **Emilijan Josimovic** who was first President of the Technicians` Society, prominent figure of that time, Rector of Licej and Great School and honorary member of the Serbian Royal Academy, to work of our Union contributed as well: **Kosta Alkovic**, professor at the Great School, Minister of Construction and member of Serbian Learned Society and Serbian Royal Academy, **Dimitrije Stojanovic** professor at the Technical Faculty, first Director of Serbian State Railways, and member of Serbian Learned Society and Serbian Royal Academy, **Milos Savcic**, Minister of Construction and President of Belgrade Municipality, famous businessman who gave the greatest donation for the construction of House of Engineers in 1932, as well as presidents of the Serbian Academy of Sciences and Arts **Josif Pancic, Jovan Zujovic, Simo Lozanic, Kirilo Savic, Aleksandar Despic, Nikola Hajdin** and other famous scientists.

ACTIVITIES

The Union of Engineers and Technicians of Serbia - Savez inženjera i tehnicara Srbije is a voluntary, non-governmental, non-profit, scientific, interest, professional, non-party organization of engineers and technicians, and their organizations in the Republic of Serbia, open for cooperation with other scientific, commercial and other organizations, on the basis of mutual recognition, mutual respect and independence in work.

Union of Engineers and Technicians of Serbia and its collective member finance their own activities from their own assets.

Purposes and tasks of UETS are:

- Assembling and organizing of engineers and technicians of Serbia for the purpose of increase of their expert knowledge, providing appropriate status in the community, on the basis of their contribution to the, scientific-technological and economic and development in general of Republic of Serbia;
- Joining, strengthening and massification of basic engineering-technicians' organizations of Serbia, development of mutual cooperation as well as the cooperation with appropriate international organizations of engineers and technicians;
- Improvement of order-interest, reputation and protection of members of the engineering-technicians' organization of Serbia;
- Providing help to engineers and technicians in scientific, expert improvement and organization of appropriate forms of permanent education;
- Monitoring contemporary development of engineering and technology and pointing out the currents of events and changes in this area and providing opinions on optimality of engineering and technological solutions in investment and other enterprises;
- Caring for and development of ethics of engineering-technician profession, human rights and liberties;
- Stimulating, organization and publishing of scientific and expert papers, magazines and other publications of interest for engineering-technician organization and technical intelligence;
- Work on technical regulations (laws, regulations and standards), providing its modernity, adequacy, actuality and functionality;
- Consideration and providing expert opinions on plans, programs, analysis and other acts, which are important for the development of engineering, technology and production in the Republic of Serbia;
- Stimulating and helping the activities and initiatives, aiming to preserve the human environment and area organization, saving and rationalization of spending of all sorts of energy;
- Preparation and maintenance of the meetings with purpose of permanent education of engineers and technicians;
- Providing help in development of technology and economy whose purposes are similar to the purposes of engineering-technicians` organization;
- Organization of multidisciplinary meetings and meetings of wider social importance;
- Cooperation with appropriate expert, commercial organizations and other organizations and organs at the realization of tasks of mutual interest;

- Management of Houses of Engineers and other property of Union of Engineers and Technicians of Serbia.

Union of Engineers and Technicians of Serbia has developed cooperation with organs of local government, state ministries, Serbian Academy of Sciences and Arts, Serbian, Chamber of Engineers, Engineering Academy of Serbia, Chamber of Commerce and Industry of Serbia, with numerous companies, professional associations, faculties and universities and other institutions. UETS also has developer international cooperation.

In accordance with the Law and Contract with republic ministries in the framework of UETS are organized and performed specialist` exams for several engineering branches.

Union of Engineers and Technicians of Serbia has several thousand individual members and 41 collective members in the Republic of Serbia: 19 republic`s professional associations (associations of architects, town planners, mechanical engineers, electrical engineers, mining and geological engineers, surveyors, agricultural engineers, chemical engineers etc) 7 republic`s multidisciplinary engineering-technicians` associations (ecology, standardization and quality, material protection and corrosion, informatics etc) 1 provincial engineering-technicians` association, 14 municipal and regional engineering-technicians` associations.

Union of Engineers and Technicians of Serbia is founder of the Engineering Academy of Serbia, and collective member of the Chamber of Commerce and Industry of Serbia.

Union of Engineers and Technicians of Serbia, in a cooperation with faculties, universities, enterprises, economic and professional associations organizes various scientific meetings, professional reunions, congresses, seminars, conferences. UETS members publish their expert magazines; “KGH”; “Procesna tehnika”, “Ecologica”, “Tekstilna industrija”, “Forum”, “Sumarska industrija”, “Zastita materijala” and maintain professional reunions, seminars, conferences and congresses in branches of architecture, mechanical engineering, chemistry, electrical engineering, agriculture, forestry etc.

All activities of the Union are performed in accordance with the procedures and standards of **QMS - Quality Management System**.

Union of Engineers and Technicians of Serbia is National member of **FEANI – European Federation of National Engineering Associations** from Serbia. FEANI is a federation of professional engineers that unites national engineering associations from 32 European countries. Thus, FEANI represents the interests of over 3,5 million professional engineers in Europe. FEANI is striving for a single voice for the engineering profession in Europe and wants to affirm and develop the professional identity of engineers. Through its activities and services, especially with the attribution of the EUR ING professional title, FEANI aims to facilitate the mutual recognition of engineering qualifications in Europe and to strengthen the position, role and responsibility of engineers in society.

Union of Engineers and Technicians of Serbia is member of COPISSE – Permanent Conference of the Engineers of Southeast Europe.

Collective members of UETS are members of international professional associations and have developed international cooperation.

With all that has been done and with accomplished results, objectively solid conditions have been provided for further and more successful work, business operation and development of the Union of Engineers and Technicians of Serbia.

CONTENTS – TECHNICS 2014

ISSN 0350-2619

TECHNICS

OUR CIVIL ENGINEERING

Our Civil Engineering - Notre génie civil - Unser Bauwesen – Наше строительство

YEAR 68 - 2014

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Experimental Determination of Load Bearing Capacity of Connections Realized by Punched Metal Plate Fastener

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This paper demonstrates the results of experimental determination of load bearing capacity of structural timber member connections realized by WOLF and LKVC metal connector plates. Considering the complexity of the connections realized by these modern mechanical fasteners, this paper deals only with plate anchorage capacity (stress in the metal-wood contact). The aim of the conducted experimental study was to determine the metal connector plate anchorage capacity in accordance with the provisions of Eurocode 5 and also to analyze the ratio of the load bearing capacities of these two types of connectors in terms of their geometry. Experimental testing was conducted by loading of multiple samples up to the limit plate anchorage capacity. Discussion of the test results included the analysis of the connection deformation for different levels of load, as well as the mode of reaching the limit plate anchorage capacity. Review of the determined limit plate anchorage capacities, for the determined displacements of connection, was given in the conclusion, together with the comment on test results.

Key words: *metal connector plate, tooth, joint, limit bearing capacity, displacement*

1. INTRODUCTION

Metal connector plates are modern mechanical fasteners, which are used in contemporary timber structures. The emergence of these fasteners was aimed to improve the level of production, in terms of simplicity of the connections of structural elements, namely, construction of the connections which will be of high-quality and safe, in terms of transferring the load [1].

In the world and in our country there are several standard types of metal connectors which are produced by perforating metal sheet and positioning the teeth perpendicular to a sheet plane. These type of connectors have been successfully used for the realization of connections between members of the timber trusses. The geometry of the standard types of metal connectors differ from manufacturer to manufacturer, in relation to the sheet thickness, the shape and the length and position of the teeth and the number of teeth per unit area.

These parameters, as well as the production technology of standard types of metal connectors, affect the load bearing capacity of connections in timber structures.

Load bearing capacity of metal connectors can be experimentally determined in accordance with Eurocode 5 and it is used as a parameter for dimensioning of connections formed by metal connector plates.

For experimental determination of the load bearing capacity of connections formed by punced metal plate, the LKVC plate type is chosen, whose manufacturer is LKV Center from Serbia [2], so as the WOLF 15N plate type, whose manufacturer is WOLF from Austria [3] (Figure 1).

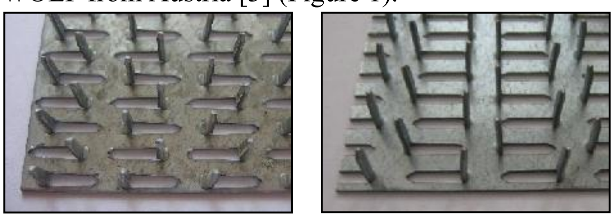

Figure 1 - Punched metal plate fastener LKVC (on the left) and WOLF (on the right)

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Metal connectors are manufactured in accordance with the provisions of EN 10147 [4]. Both have same thickness of the sheet of 1.5 mm, which is important in order to make certain comparison in terms of load bearing capacity of realized connections. Presented connectors have different geometry of teeth, their arrangement and number per unit area. Distance between the teeth in the two orthogonal directions is shown in Table 1, from which we can find the corresponding tooth surface of 169 mm^2 for LKVC plate and 215 mm^2 for WOLF plate.

Table 1. LKVC and WOLF plate geometry

	LKVC (mm)	WOLF (mm)
Distance between teeth in X direction	22.50	25.40
Distance between teeth in Y direction	7.50	8.46
Length of teeth	13.50	15.00

2. DIMENSIONING ANCHORAGE CAPACITY OF THE CONNECTIONS FORMED BY METAL CONNECTORS

Plate anchorage capacity (which includes analysis of stresses in the metal-wood contact) is determined on the basis of laboratory tests, loading the test samples to the limit bearing capacity, for different positions of the longitudinal connector axis, in relation to the direction of the force and direction of the wood fibres. Typical values of stresses in the metal-wood contact, are expressed per unit area of the metal connector plate, for specific angles α and β [5], where α is angle between the direction of force and the direction of the longitudinal connector axis, and is β angle between the direction of force and the direction of the longitudinal axis of the timber member. Longitudinal connector axis is direction of the sheet rolling, namely, direction of the teeth pulling out of the sheet plane. The longitudinal axis of the timber member is defined by the direction of the fibres.

Limit metal connector plate anchorage capacity is defined by the provisions of EN 1075 [6] and EN 28970 [7], in function of the limit load, effective connector area and wood density, and it is expressed in N/mm^2:

$$f_{a,\alpha,\beta} = \frac{F_{\alpha,\beta,\max}}{2 \cdot A_{ef}} \cdot \left(\frac{\rho_k}{\rho}\right)^c \qquad (1)$$

where:

$f_{a,\alpha,\beta}$ - limit plate anchorage capacity for given angles α and β (for one connector in connection)

$F_{a,\alpha,\beta,\max}$ - maximum (limit) load,

A_{ef} - effective connector area,

ρ_k - characteristic density of wood, for certain class of wood,

ρ - density of wood, for the test sample,

c - dimensionless coefficient.

3. SAMPLES FOR EXPERIMENTAL TESTING

Experimental testing of plate anchorage capacity was conducted for the angle values of α=90º and β=0º. For determination of the limit metal connector plate anchorage capacity, in accordance with the provisions of EN 14545 [8], standard samples were tested, with 5 samples in one series, for the connector LKVC and the same for the connector WOLF (Figure 2 and Figure 3).

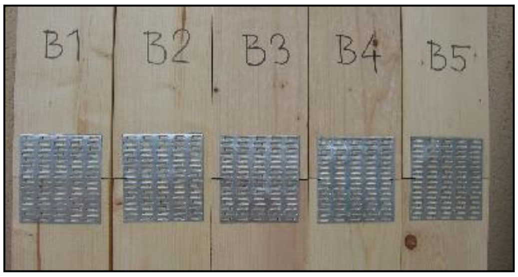

Figure 2 - Types of samples of series B (LKVC)

Figure 3 - Types of samples of series D (WOLF)

The geometry of the samples was derived according to EN 1075. Connector dimensions were chosen in way that approximately the same effective area for each connector type could be obtained, and at the same time that there is no fracture in the cross-section of connector, but only in the metal-wood contact zone. This is achieved by the ratio of connector length L and connector width B, where L>B/2. Wood that is used for samples is from class II conifers, with humidity of 15%. The geometry of all the samples that were subjected to the test is shown in

Figure 4 and Figure 5, noting that the width of the cross section of the wood element was b=44 mm.

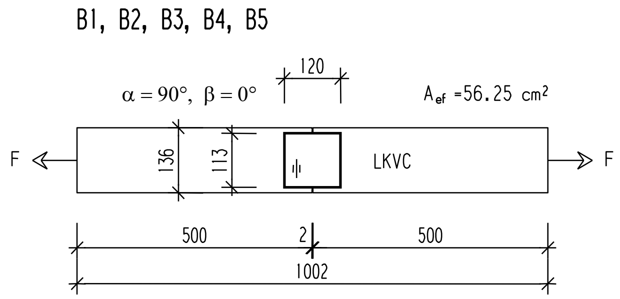

Figure 4 - Types of samples of series B (LKVC)

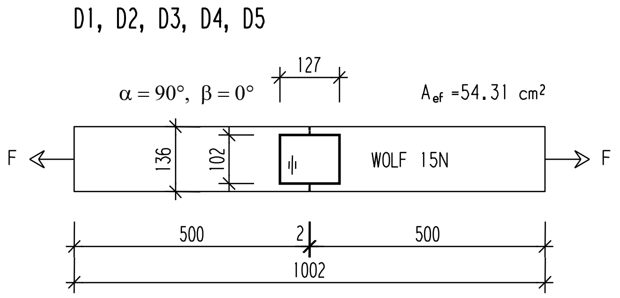

Figure 5 - Types of samples of series D (WOLF)

4. EXPERIMENTAL TESTING PROCEDURE

The experimental determination of load bearing capacity of connection of timber elements requires implementation of specific tests in laboratories, which are equipped for this purpose, in order to obtain specific information on the strength of these connections. Preparation of test samples included conditioning of the wooden elements, prior to the construction of the joints, and then the conditioning of the finished samples, after the connection was formed. According to ISO 554 standard, atmosphere for the preparation of samples is 20/65, which means the air temperature of 20° and humidity of 65%. By respecting these rules, load bearing capacity of the tested connections can be compared, including the comparison of the test results from different laboratories.

Testing of the load bearing capacity of realized connections was performed in the Institute of Materials and Structures, at Faculty of Civil Engineering in Belgrade, on the hydraulic tensile testing machine, made by Amsler. During the application of particular force, deformations were registered with mechanical deformation indicators, with 0.01 mm accuracy, which were positioned in joint area in order to obtain relevant values of deformations in the connection (Figure 6). Two of these mechanical deformation gauges were positioned on each sample, in order to record the deformation of connection on the both sides of the sample.

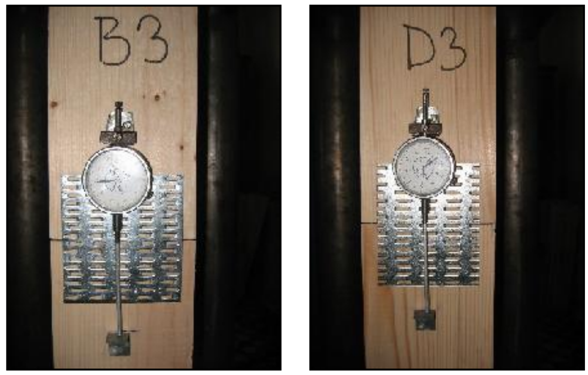

Figure 6 - Samples of series B (LKVC) and series D (WOLF)

Testing procedure was conducted according to EN 26891 [9]. Load was applied in value of 40% of the estimated maximum load ($0.4{\cdot}F_{est}$) and retained for 30 seconds. After that, the deformation was read, as well as load that caused that deformation. Then the load is reduced to a value of $0.1{\cdot}F_{est}$ and retained for 30 seconds, whereupon reading was carried out. The load was then raised until limit load or sliding was attained. Loads up to the value of $0.7{\cdot}F_{est}$ were approximately $0.2{\cdot}F_{est}$ per minute, while for the values above $0.7{\cdot}F_{est}$ limit load or sliding was attained for about 3 to 5 minutes. Total test time of one sample was between 10 and 15 minutes. Application of tensile force was carried out through certain mechanical additions (Figure 7), with an increment of 2.0 kN, and it was in line with loading procedure, in function of estimated maximal load. Destruction of connections came in two ways: due to the extraction of teeth from the timber, before reaching allowable displacement and due to exceeding the allowable displacement in connection. Testing of each sample was discontinued after the destruction of connections, when it was visually ascertained that teeth started pulling out of wood, or the strain in the connection reached the value of about 2.0 mm.

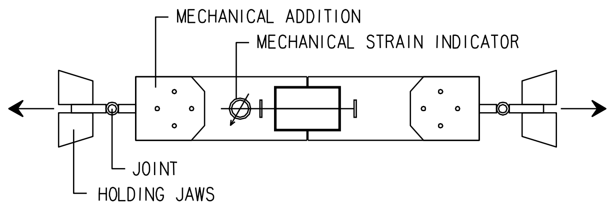

Figure 7 - Samples of series B and series D (axial tension - a schematic representation)

5. RESULTS OF THE EXPERIMENTAL TESTING

Results of the experimental testing, for both plate types, are shown in Tables 2, 3 and 4 and in force-strain diagrams (Figure 8), Tables and diagrams are showing the individual values of connection displacement and the mean average value. Characteristic parameters in accordance to EN 26891 are shown in Table 3 and Table 4 (F_{est} - estimated maximum load, F_{max} - maximum load for the adopted allowable displacements of connection, v_{01} - displacement for the value of 10% of estimated maximal load, v_{04} - displacement for the value of 40% of estimated maximum load i v_{max} - maximum displacement of connection during testing). Load F_{est} was estimated for the allowable displacements of 1.5 mm [10]. In the discussion of the test results, ratio of the value of applied load and the measured displacement of connection was analyzed, respectively, the limit bearing capacity of connections in function of defined allowable displacement are given.

Table 2. Test results (individual and mean value displacement)

	Load (kN)									
Sample	0.0	10.0	2.0	6.0	10.0	14.0	18.0	22.0	26.0	30.0
	Displacement (mm)									
B1	0.0	0.055	0.020	0.035	0.065	0.115	0.200	0.325	0.535	0.985
B2	0.0	0.060	0.010	0.040	0.070	0.110	0.180	0.280	0.405	0.640
B3	0.0	0.085	0.030	0.065	0.090	0.135	0.195	0.285	0.415	0.715
B4	0.0	0.075	0.020	0.060	0.085	0.130	0.205	0.310	0.515	0.835
B5	0.0	0.085	0.035	0.065	0.095	0.150	0.225	0.355	0.535	0.940
Mean value displacement (mm)	0.0	0.072	0.023	0.053	0.081	0.128	0.201	0.311	0.481	0.823
D1	0.0	0.120	0.060	0.105	0.135	0.245	0.460	0.850	2.140	
D2	0.0	0.115	0.045	0.090	0.120	0.215	0.385	0.770	1.765	
D3	0.0	0.110	0.045	0.085	0.120	0.210	0.385	0.775	1.795	
D4	0.0	0.120	0.055	0.100	0.125	0.225	0.435	0.920	2.320	
D5	0.0	0.105	0.060	0.085	0.115	0.220	0.405	0.790	2.035	
Mean value displacement (mm)	0.0	0.114	0.053	0.093	0.123	0.223	0.414	0.821	2.011	

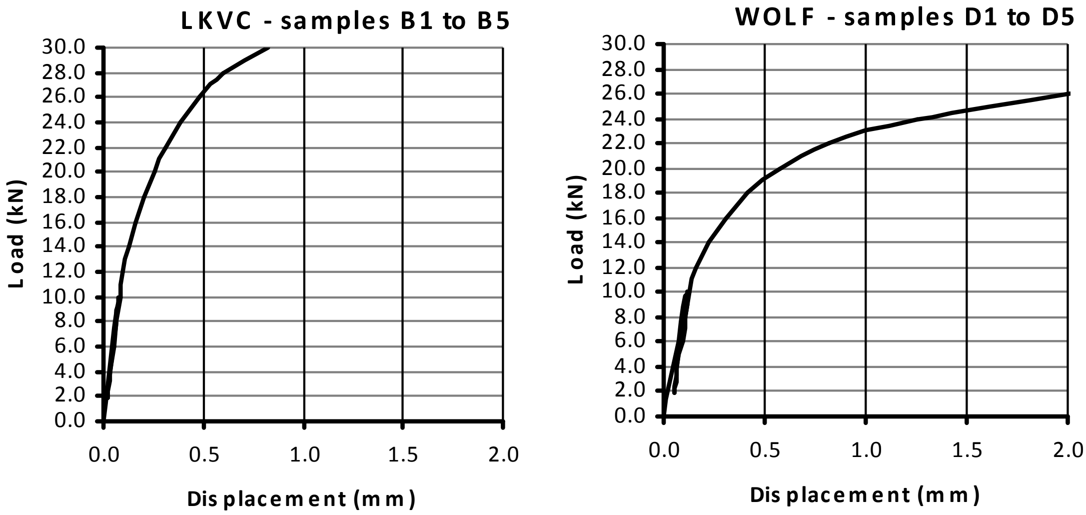

Figure 8 - Force-displacement diagram (mean value displacement)

Table 3. Test results (individual value displacement)

		Load		Displacement		
Series	Sample	F_{est} (kN)	F_{max} (kN)	v_{01} (mm)	v_{04} (mm)	v_{max} (mm)
B	B1	26.0	30.00	0.020	0.065	0.985
	B2	26.0	30.00	0.010	0.070	0.640
	B3	26.0	30.00	0.030	0.090	0.715
	B4	26.0	30.00	0.020	0.085	0.835
	B5	26.0	30.00	0.035	0.095	0.940
D	D1	26.0	24.51	0.060	0.135	2.140
	D2	26.0	25.20	0.045	0.120	1.765
	D3	26.0	25.11	0.045	0.120	1.795
	D4	26.0	23.93	0.055	0.125	2.320
	D5	26.0	24.69	0.060	0.115	2.035

Table 4. Test results (mean value displacement)

		Load		Displacement		
Series		F_{est} (kN)	F_{max} (kN)	v_{01} (mm)	v_{04} (mm)	v_{max} (mm)
B	LKVC	26.00	30.00	0.023	0.081	0.823
D	WOLF	26.00	24.69	0.053	0.123	2.011

6. DISCUSSION OF THE TEST RESULTS

Based on the test results, there are evident differences in the strain of connections realized by plates made by diferent manufacturers, for the same value of applied load. For all samples, and both plate manufacturers (LKVC and WOLF), it can be distinguished only a slight difference in the sample strain to the extent of 40% of the maximum estimated load (about 10.0 kN), after which the increment in deformation is larger for WOLF plate, comparing to LKVC plate and for the same value of applied load. Since the effective area of LKVC plate is only 3.57% higher than the WOLF plate, for the same value of displacement, it can be concluded that LKVC plate has a higher load bearing capacity per unit area, compared to WOLF plate, for the applicable load. If we analyze the behavior of connections in relation to the boundary displacement of 1.5 mm, certain differences in the achievement of ultimate bearing capacity of connections for both plate types can be identified. The LKVC plate never reaches the boundary displacement of 1.5 mm, since at a significantly lower amount of displacement the extraction of teeth from the timber began and in that point further testing was stopped. The point in wich teeth start pulling out of the timber represents a physical destruction of the connection, which practically defines the breaking force, which in this case corresponds to the shift of only 0.823 mm, taking into account the average value of five samples tested. In the other hand, the WOLF plate reached the border displacement of 1.5 mm, but at lower load applied compared to LKVC plate, which eventually resulted in a smaller load bearing capacity per a unit area for a WOLF plate. Testing of load bearing capacity of connections realized by WOLF metal plates was stopped at an average shift of about 2.0 mm, since it was visually ascertained extraction of teeth from the timber.

Having in mind that testing was conducted in accordance with standard ISO 554, and the fact that a same class of wood, with a same density, was used for all samples, value of c=0 is taken for dimensionless coefficient c (1), from the provisions of EN 1075 and EN 28970. In this way the effect of ratio of characteristic and real wood density on the load bearing capacity of connection is excluded. Accordingly, limit plate anchorage capacities are determined for both plate types, as well as the ratio between limit plate anchorage capacities of LKVC and WOLF plates (Table 5).

Table 5. Limit plate anchorage capacity

Plate type	Plate anchorage capacity $f_{a,90,0}$
LKVC	2.67 N/mm^2
WOLF	2.27 N/mm^2
LKVC / WOLF	17.62 %

If we analyze the spacing between teeth in two orthogonal directions, and i another words we take into account the number of teeth per unit area, the lo-adbering capacity of one teeth can be identified. The corresponding surface for one tooth of LKVC plate is 169 mm^2, and 215 mm^2 for WOLF plate, and so we can conclude that the capacity of a single tooth of WOLF plate by about 8.20% higher than the capacity of a single tooth of LKVC plate (Table 6). This data is not relevant for load bearing capacity of connections, in terms of dimensioning of the connection, because bearing capacity of connector is expressed per unit of surface area and not by bearing capacity of one tooth. This data can be useful during the designing of connector's geometry and geometry of tooth, in order to increase the connector load bearing capacity.

Table 6. Limit bearing capacity of one tooth

Connector	Capacity of one tooth
LKVC	451.0 N
WOLF	488.0 N
WOLF / LKVC	8.20 %

Figure 9 is showing samples of B and D series in the phase of testing, as well as the plate position relative to the timber, in a moment when testing was stopped.

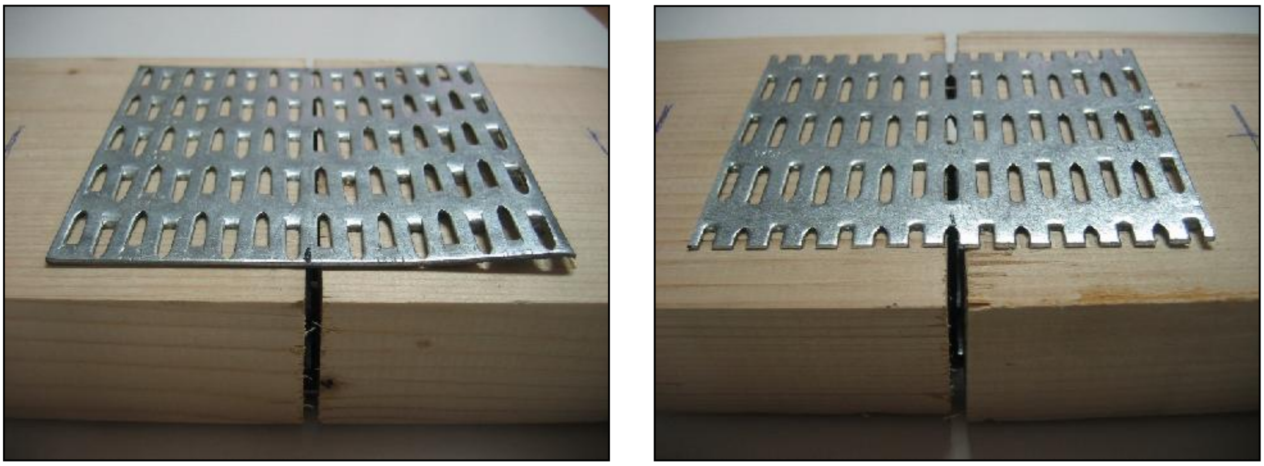

Figure 9 - Samples of series B (LKVC) and series D (WOLF)

7. CONCLUSION

Experimental testing of punced metal plate fasteners anchorage capacity were carried out on samples made of timber connected by plates of two diferent types: LKVC and WOLF 15N. Samples were subjected to axial tension, in accordance with EN 1075, in order to determine the behavior of these two types of plates in connections, where the behavior of connection is analyzed in a linear and the non-linear part of the strain diagram. The results gave a picture about the relation between carrying capacity of these two types of plates, in terms of their geometry, for various levels of load of timber connections, and the values of angles α=90° and β=0°.

Ultimate anchorage capacity of connections is determined by the adopted permissible displacement of connection of 1.5 mm, which proved to be a key criterion for conections executed by WOLF plates, unlike the connections executed by LKVC plates, where the failure occurred before reaching permissible displacement of 1.5 mm. For both plate types only small differences in capacity were evident in the area of of elasticity, where the amount of strain was approximately 0.1 mm, while in the area of plastic deformation LKVC plate performed better, as it was noted in ratio of ancorage capacity of these two type of plates which is about 18% in favor of LKVC plate.

Higher capacity of one tooth for WOLF plate, by about 8% compared to the one tooth of LKVC plate may be partially explained by greater length of WOLF plate teeth by 2.0 mm compared to the LKVC plate teeth, but it is not the only parameter which determines the anchorage capacity of plates. Number of teeth per unit area of plate proved to be an important parameter in the function of the anchorage capacity. The corresponding surface of a single tooth of WOLF plate is 27% higher compared to that of the LKVC plate, which is evident in determining the ratios of limit load carying capacity per unit area, in favor of LKVC plate, despite a greater capacity of single teeth of WOLF plate.

For the final comparative assessment of the quality of these two types of plates, in terms of anchorage capacity, it is necessary to acquire data on the anchorage capacity for other combinations of angles α and β. Also, the distance of the farthest row of teeth to the line of splice may be of importance to limit anchorage capacity, or to teeth beginning extracting out of wood. Therefore, new experimental tests of anchorage capacity of metal plates, should analyse the impact of plate size to a limit anchorage capacity.

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REZIME

EKSPERIMENTALNO ODREĐIVANJE NOSIVOSTI VEZA OSTVARENIH METALNIM KONEKTERIMA

U radu je prikazano eksperimentalno određivanje nosivosti veza ostvarenih metalnim konekterima tipa WOLF i LKVC. S obzirom na kompleksnost veza ostvarenih ovim savremenim mehaničkim spojnim sredstvima, predmet rada obuhvata samo nosivost bočne veze (naprezanje u spoju metal-drvo). Cilj sprovedenih eksperimentalnih ispitivanja je bio da se utvrdi nosivost bočne veze ostvarene metalnim konekterima, u skladu sa odredbama Evrokoda 5 i da se paralelno sa tim analizira odnos nosivosti ova dva tipa konektera, sa aspekta njihove geometrije. Eksperimentalno ispitivanje je sprovedeno na više uzoraka, opterećivanjem uzoraka do dostizanja granične nosivosti bočne veze. Diskusija rezultata ispitivanja je obuhvatila analizu pomerljivosti veza za različite nivoe opterećenja, kao i način dostizanja granične nosivosti bočne veze. U zaključku je dat komentar o utvrđenim graničnim nosivostima bočne veze, za određena pomeranja veze, i zauzet je stav po pitanju dobijenih rezultata.

Ključne reči: *metalni konekter, zubac, čvorna veza, granična nosivost, pomeranje*