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Comparison of traits pine timber used in skeletal constructions.

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Abstract: *Comparison of traits pine timber used in skeletal constructions.* The physical and mechanical properties with respect to the relevant standards were defined and large samples with the application of three different adhesives were obtained. Physical examination included figured, density and moisture content of normative samples obtained from samples of large size. The study of mechanical properties of the samples included the determination of elasticity of the average large-size module.

Keywords: wood, pine timber, construction

INTRODUCTION

Pine timber mechanical and physical properties are among the principal parameters affecting suitability of timber material for its application, especially in building industry. The term 'wood defect' refers to any wood irregularity found in timber whose presence may reduce its functional or use value. Some timber defects violate its structure and reduce its strength, e.g. holes left by insects , decay, while others such as surface colour changes of timber like blue stain, are less dangerous.

Attempts are being made to achieve maximal quantitative efficiency of full-value elements as the most desirable, as confirmed by numerous investigations in the field of timber quality and its suitability for further processing, for example the study by Pachelski, Żytecki, Iskra (1966), Buchholz, Hruzik (1970), Cegiel, Hruzik (1974), Hruzik (1979) and co-workers. This approach has become the basis for defining technological optimisation of timber processing.

The aim of the study was to determine physical and mechanical properties of harvested timber and glued timber assortments intended for building industry. The performed investigation made it possible to obtaining data about strength parameters and suitability of harvested sawn materials upgraded for production purposes by defect elimination and gluing.

METHODOLOGY AND RESEARCH RESULTS

A total of 75 glue pine samples were prepared for purposes of this experiment. They were allocated into groups which differed regarding the applied glue and cross-section. The experimental samples were obtained using three different glues employed in the production of building glued materials.

- The samples were glued using the following glue JOWACOLL 102 20 – pine A
- The samples were glued using the following glue AKZO NOBEL EPI 8055 - pine B

The investigations of the elasticity modulus were carried out in accordance with the PN-63/D-04117 standard.

During the performed experiments, in order to determine basic features of pine wood for purposes of experiments, such physical properties as: annual increment, proportion of late and early wood in annual increments, density as well as absolute moisture were determined.

Tables 1 and 2 illustrate high width variability of annual wood increments from which sample were obtained. This may have exerted some influence on the observed negative strain

distribution in the course of mechanical loading and may have caused wood warping following different desorption strains in the neighbouring layers of the element. The minimal measured annual width increment in pine wood amounted to 0.30 mm, whereas the maximal one – up to 5,30 mm.

Table 1.

Characteristic values of annual increment widths for whole samples "A"

Cross section blank (mm)					
40x72		**40x100**		**40x120**	
element	mm	element	mm	element	mm
1(G)	1,95	1(G)	1,51	1(G)	1,85
2	2,09	2	2,51	2	1,74
3(D)	1,76	3	1,57	3	1,82
		4(D)	2,03	4	2,33
				5(D)	2,05
average	**1,93**		**1,90**		**1,96**

Table 2.

Characteristic values of annual increment widths for whole samples "B"

Cross section blank (mm)					
40x72		**40x96**		**40x120**	
element	mm	element	mm	element	mm
1(G)	1,62	1(G)	1,90	1(G)	1,73
2	1,85	2	2,26	2	1,83
3(D)	1,57	3	1,84	3	1,86
		4(D)	2,03	4	2,41
				5(D)	1,71
average	**1,68**		**2,01**		**1,91**

The obtained research results confirmed significant variations in widths of annual increments in neighbouring layers. Increment widths in relation to the layer of sample origin and averaged results of all samples from a given batch were itemised and the difference in ring distribution/graining was apparent. So, in the case of glued pine timber, the mean width of annual increments ranged from 1,90 mm to 1,96 mm in group "A" and from 1,68 mm to 2,01 mm in group "B".

The results of absolute moisture content investigations of large-sized timber samples revealed that the differences between adjacent batten layers in samples did not exceed 2,5%, so they fell within the acceptable interval of 5%.

The results obtained in the course of the performed experiments revealed that the material obtained from glued pine timber was characterised by the density of 520 kg/m^3. Layers of glued pine samples were characterised by densities in the range of 490 kg/m^3 to 557 kg/m^3. When interpreting density results in relation to the position of the examined samples in the large-sized sample it can be concluded that the timber material used to manufacture glued elements did not have similar properties.

Table 3 collates characteristic values of the elasticity modulus for individual sample batches.

Table 3.

Values of the elasticity modulus at 12% moisture content

Sample symbol	elasticity module [N/mm^2]					
	40x72(A)	**40x100(A)**	**40x120(A)**	**40x72(B)**	**40x96(B)**	**40x120(B)**
1	8595	8141	10926	11523	10244	10441
2	12484	10483	9738	10360	10889	9704
3	10572	10900	10959	9814	12036	9923
4	9098	9328	10012	12415	11676	9080
5	12471	9249	11494	9967	10554	10749
6	12007	9340	10909	8651	11701	10982
7	9718	11415	9797	12356	13288	9687
8	9319	9586	10847	10625	12573	8731
9	9560	10173	9883	11499	11370	10381
10	10621	7845	10851	12104	12142	9013
11				11488	10418	9496
12				11434	12341	9732
13				10411	11988	10533
14				11863	11326	10090
15				12145	9752	9623
average	**10444**	**9646**	**10541**	**11110**	**11486**	**9878**

It can be concluded from the research results on large-sized timber samples that timber gluing reduced the spread of the elasticity modulus.

In addition, when large-sized timber samples were bent, the elasticity modulus (Figure 1.)decreased with the increase of sample cross section. The obtained mean values for solid timber were found to be at the level of 9 600 N/mm^2. When the above values were compared with the results given by Krzysik (1974) E=12 000 N/mm^2, it was found that the elasticity modulus of the examined solid wood was 27% lower. Glued pine samples exhibited smaller spread of results than solid samples but even so they were 20% lower than literature data.

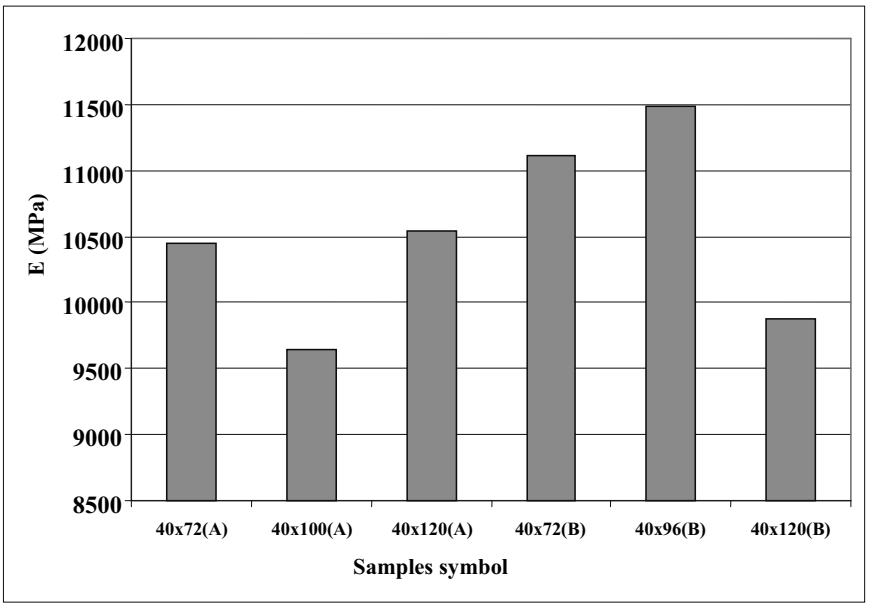

Figure 1. Values of the modulus of elasticity at 12% moisture content

In addition, the elastic modulus in the course of bending of large-sized samples decreased together with the increase of the sample cross section. Mean values for pine glued samples reached 10518 N/mm^2 and those for minimum and maximum – 7845 - 12573N/mm^2.

RECAPITULATION

The following conclusions were drawn on the basis of the performed investigations and measurements and the obtained results:

1. Basic physical properties for the examined raw material were determined. Mean ring annual increment of pine elements was found to be at the level of 2 mm. The examined raw material was narrow-ringed. Mean absolute moisture content at the time of measurement was 10%. Mean timber density of glued pine samples was determined at 520-542 kg/m^3. The obtained mean results were similar to those found in literature on the subject.
2. The elastic modulus of the examined large-sized samples was as follows: solid, glued pine samples – 10518 N/mm^2. The above results were lower than literature data.
3. Part of large-sized samples was damaged in the course of investigations of the modulus of elasticity. The most frequent cause of the damage was splitting of the multi-spline glue bond along the length in tensile layers (bottom strip). It was, therefore, concluded that the technology of joining of coniferous semi-finished products along the length in a system of multi-spline joints affects, to a significant extent, the strength of the obtained beams.

LITERATURE

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Streszczenie: *Porównanie cech drewna sosnowego stosowanego w konstrukcjach szkieletowych.* Określono właściwości fizyczne i mechaniczne w odniesieniu do właściwych norm przedmiotowych. Właściwości fizyczne obejmowały badania słoistości, gęstości i wilgotności normatywnych próbek laboratoryjnych pozyskanych z próbek wielkogabarytowych. Badanie właściwości mechanicznych próbek wielkogabarytowych obejmowało określenie średniego modułu sprężystości.

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