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MAKING ARRANGEMENTS AS A SUPPLEMENT EXISTING MEASURING EQUIPMENT FOR DETERMINING MECHANICAL FEATURES OF PLYWOOD

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ABSTRACT
Mechanical properties of plywood is an important factor affecting the determination of the application range of plywood in the construction industry. Institute of Faculty of Technical engineering has a measurement equipment (Universal material tester) to measure the mechanical properties of materials in accordance with European standards. Since the dimensions of the test pieces for testing the mechanical properties of plywood, in accordance with European standards, higher than the existing measurement equipment enables it was necessary to make arrangements in addition to the existing material testing machine to allow the measurement with respect to the dimensions of the test pieces and the expected size of the force.
The paper will be presented as a way of making arrangements in addition to the existing measuring equipment for testing tensile strength waterproof plywood.
Keywords: measuring equipment, arrangements, process of making arrangements

1. INTRODUCTION

HMT.50 EM Hydraulic material testing machine manufacturers Stirolab Ltd. Sežana (Slovenia), is universal material tester - motor-operated designed to perform the following tests [8]:

- tensile test according to DIN 50125
- compression test - DIN 50106
- shear test - DIN 50110 & 52186
- bending test - DIN 50141
- HBS Brinell test - EN 10003
- deep draw test - Erichsen

Table 1. The appearance and technical characteristics of the HMT.50 EM Hydraulic material testing machine [8]

	**Machine frame**	
	Dimensions (LxWxH)	800 x 600 x 1600 mm
	Weight	240 kg
	Drive unit	
	Max. piston stroke	150 mm
	Crosshead speed range:	5 - 400 mm/min
	Sensors	
	Max. test force	50 kN
	Force transducer	load cell 50 kN / 0.5%
	Dilatation transducer	linear potentiometer
	Software	STIROLAB-HMT.50EM
	Power supply	230 V / 50 Hz

HMT.50EM tests are fully computer supported with STIROLAB-HMT.50EM software for data acquisition, processing, report generation and storage. External electronics includes a force/ deformation measurement unit with digital displays.
On the material testing machine, along with the aforementioned arrangements were meant to examine the tensile strength of three types of waterproof construction plywood manufactured in “Novi drvni kombinat“ (New wood combine) in Sremska Mitrovica (Serbia):
- Beech plywood, thickness d = 20, 25 and 30 mm;
- Poplar plywood, thickness d = 20, 25 and 30 mm and
- combined plywood (beech and poplar plywood), thickness d = 18, 25 and 32 mm.
Poplar plywood are made of veneer thickness of 2.0, 2.5 and 3.0 mm, beech plywood, veneer thickness from 2.0 to 2.5 mm and combined plywood were made of beech and poplar veneer thickness of 2.1 and 2.5 mm. So they used the following specific molding pressures:
- poplar plywood for 8 [kg/cm2] = 7.848 [bar] ≈ 8 [bar]
- for combined plywood 10 [kg/cm2] = 9.81 [bar] ≈ 10 [bar]
- the beech plywood 12 [kg/cm2] = 11.772 [bar] ≈ 12 [bar]
In preparing these plywood used to the melamine-urea formaldehyde glue (SADECOL L-1880) manufacturer Sadepan Chimica srl (Mauro Saviola Group) from Sito di Viadana (Italy). Plywood for use in construction are examined in accordance with EN 626, and mechanical properties of plywood in accordance with EN 789. According to the requirements of the standard dimensions of these test pieces for testing the tensile strength are much greater than the maximum stroke. Layout and dimensions of test pieces are given in Figure 1.

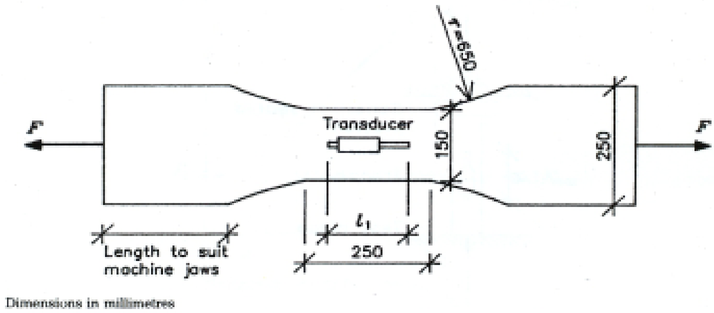

Figure 1. Arrangement for tension test according to EN 789 [7]

According to available data in the literature for some types of plywood are expected to be higher fracture force than the aforementioned testing machine can accomplish.

2. MAKING ARRANGEMENTS AS A SUPPLEMENT EXISTING MEASURING EQUIPMENT

At the beginning of the process of making arrangements testing machine it was necessary to fulfill two requirements:
- to facilitate the examination of proof in accordance with the aforementioned standards, i.e. ensure that the use of arrangements can be tested using probe dimensions 1055 x 250 x board thickness and
- to achieve the expected breaking force, which can be up to 6 times higher than the maximum force that achieves the aforementioned testing machine without arrangements.
The basic idea in making the necessary arrangements was that the action of the load-down (compression force) on the testing machine through the piston rod is achieved tensile force on the test pieces. In this way allows the testing of tensile strength of plywood with a waterproof test pieces dimensions prescribed standard, on the one hand, and achieving the necessary force - the force of fracture tests on the other side.
Test piece is placed in a pair of jaws that are purpose-built for testing. The upper jaw consists of two steel plates (dimensions 290x195x10 [mm] front and rear (back) panel dimension of 320x260x12[mm]. The lower jaw (mandible) consists of two steel plates (dimensions: front: 295x195x12 [mm], and the last: 330x225x12[mm]). The front panels of both jaws can be downloaded

and the last (back) jaw plates are fixed. On both sides of the panels were welded to the test pieces serration to increase friction between the plates and test pieces. On the face of the front panel of the jaws are welded to two steel plates measuring 200x60x8 [mm], which allows manipulation of the front jaw plates. For fixing test pieces into the jaw was used by 8 screws firmly connected M12x67 [mm] and 5 Allen screws M10x30. The upper jaw is pivotally connected to the lever and the lower jaw is pivotally connected to the base plate structure arrangements, which is firmly connected to the substrate - the laboratory. Weight of the upper jaw was 10.920 [kg].

Figure 2. Jaw arrangements

The lever is pivotally connected to the upper piston testing machine. The lever is made of INP 10 a profile that is set in a tube 80x120x7 [mm]. In order to provide the necessary rigidity of the levers on the upper side arm is welded steel plate dimensions 1250x65x15 [mm]. Total length of lever is 1590 [mm]. In order to provide the necessary tensile force at a distance of 1255 mm from the axis of the piston testing machine was set up support, pivotally attached, and the distance from the axis of joint support to the axis of the jaw joint is 270 mm. The mass lever is 61.00 [kg].

Figure 3. Photos structural arrangements and the lever

All test pieces for testing tensile strength are air conditioned in an atmosphere of temperature 20 ± 2 ° C and relative humidity 65 ± 5%. When testing the tensile strength to achieve the load speed was 2.5 [mm / sec], which is guarded to the maximum load is achieved for 300 ± 120 [sec], average 300 [sec]. All tensile strength testing of waterproof plywood with a testing machine HMT.50 EM was supported with STIROLAB-HMT.50EM software.
Placing and fixing test piece into the jaws of tensile testing machine, tensile testing machine start up and starting the program to determine the stresses on the pressure is carried out each test to determine tensile fracture force. The resulting data is a software collected, processed and stored, and generated a report which contained information on the realized value of the load force and deformation, as well as graphical display of force and deformation.

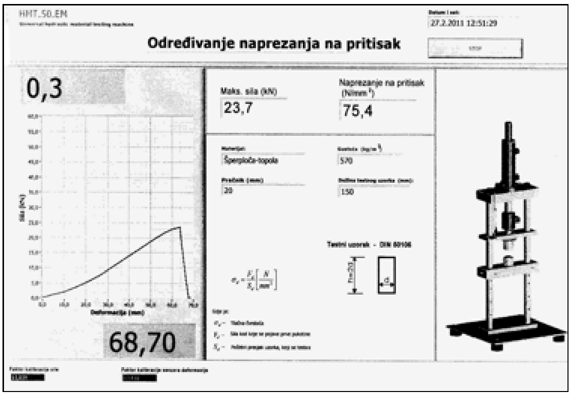

Figure 4. Example of measurement reports

Values obtained and the displacement is necessary to correct the value of the coefficients k_1 and k_2, so that the breaking force Fl is calculated from the expression:

$$F_l = k_1 + k_2 \cdot F_{measur} \qquad (1)$$

where:

F_l - the value of the breaking force of tested pieces [N]
k_1 - coefficient of influence of the mass elements of the levers and jaws,
k_2 - coefficient of influence of the length of the lever,
$F_{measur.}$ - the value obtained (measured) force [N].

For the arrangements shown in Figure 3 coefficient k_1= 0.095 and a coefficient k_2 = 4.64815.

3. CONCLUSION

Based on the above we can conclude that:

By making the appropriate arrangements as a supplement to the existing measuring equipment can expand the scope of research and measurement of certain properties into new areas of application, in this case to measure the tensile and bending stresses waterproof plywood.

When making arrangements need to define the requirements to be met. In this case, the above requirements were:

Enabling the measurement of tensile stresses on test pieces that are in accordance with standard EN 789, significantly larger dimensions than the original measurement enables the measurement of bending stresses.

To carry out specified measurements necessary to construct a jaw for gripping test pieces and increase the value of maximum force, which is required for testing the same.

When calculating the value of the actual forces is necessary to take into account all the influential factors that affect getting the actual value of tension stress and bending stresses.

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