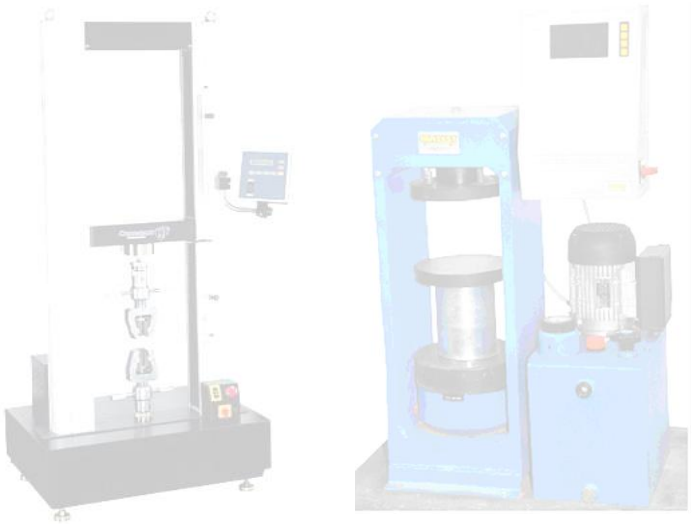
Department of Building Engineering



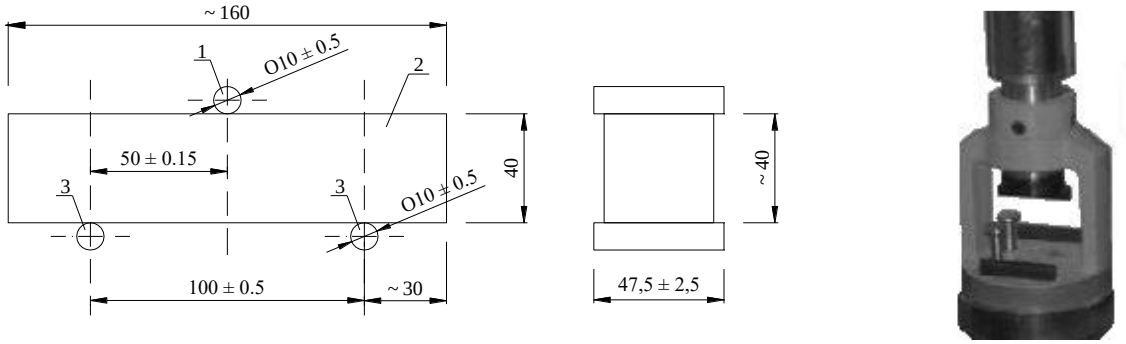
EXERCISE NR 6

Cement:
- determination of bending and compression strength cement bars

Instructions from the lab:
"Building engineering and building materials"

6.1. Determination of the bending strength of cement beams (according to PN-EN 196-1)

Any device can be used to determine the bending strength, provided that it has a breaking system identical to that shown in Fig. 6.1. The tested beam is placed on two lower supports (rollers), while a load is applied to the upper support, which causes the beam to break. The device for determining the bending strength should have a maximum load of 10 kN and a force measurement accuracy ±of 1 and a load increase of (50 ± 10) N/s.



a) b)

Fig.6.1. a) Schematic diagram of the breaking system for testing the flexural strength of cement: 1 - load roller; 2 - sample; 3 - supports
b) Attachment for bending bars 40x40x160mm, compliant with PN-EN 196

Figure 6.2 shows a device that meets the above requirements.

Prepared bars, after being removed from the bath, should be dried with a cloth and placed in the device with the side surface (the plane of the bar resulting from the leveling of the upper surface should be vertical) on the support rollers, so that its longitudinal axis is perpendicular to the support rollers. Then, using a loading roller, transfer the vertical load to the opposite side surface of the bar. The pressure (50 ± 10 N/s) should be increased evenly until the bar breaks.

The bending strength (R_f) is calculated according to formula (1):

Rys. 6.2. Universal flexural testing machine.

$$R_f = \frac{1{,}5 \times F_f \times l}{b^3}, [MPa], \quad (1)$$

Where: b – lateral length of the trabecular cross-section, mm;
F_f – breaking load in the middle of the beam, N;
l – distance between supports, mm.

Final result. From the three measurement results obtained, the arithmetic mean should be calculated with an accuracy of 0.1 MPa .

6.2. Determination of compressive strength of cement beams (according to PN-EN 196-1)

The compressive strength test is performed on halves of the beam. These halves are obtained by previously conducting a bending strength test or by halving the beams in such a way that their structure is not damaged.

Rys. 6.3. Prasa hydrauliczna do badania wytrzymałości na ściskanie.

Measurement in a hydraulic press. The beams taken out of the water bath and dried with a cloth should be placed between the compression plates of the press insert, in the longitudinal direction, so that the front surfaces of the beam protrude approximately 10 mmbeyond the plates. The upper surface of the beam, resulting from leveling with a steel ruler, should be set vertically. Then the load increase should be set to 2.4 ± 0.2 kN/s, the press drive should be switched on and the samples destroyed.

$F_{c)}$ is read on the manometer using a passive pointer (maximum force value). In the case of a digital indicator, the device's memory is used.

Manually operated devices may be used, but they must be equipped with a load increment control regulation. Both manual and automatic devices should provide force measurement with a margin of error of no more than 1 %.

Similarly, the remaining beam halves should be tested. The compressive strength R_C is calculated according to the relationship:

$$R_C = \frac{F_c}{A}, \text{ [MPa]} \qquad (2)$$

where: F_c - pressure force causing the destruction of the trabecular mesh, N;

A = 1600 mm ^{2} - area of pressure plates (compressed surface), mm ^{2} .

Final result. The result of the determination is the arithmetic mean of the six measurement values obtained on a set of three bars. If one of the six values differs from the mean by more than 10%, it should be rejected, and the arithmetic mean should be recalculated from the remaining five. If another single value of these five differs by more than 10%, the entire test result should be rejected (the measurement should be repeated).

Individual results and the final strength value are given with an accuracy of 0.1 MPa .

Note on units. In EN and PN-EN standards (European standards and Polish standards consistent with European standards) the unit of strength used is 1 N/mm ^{2}, while in Poland the basic unit is 1 MPa. The conversion factor is as follows: 1 N/mm ^{2} = 1 MPa .

Group -……/team …… Date……..……

1. ……

2. ……

3. ……

4. ……

Exercise 6

DETERMINATION OF THE BENDING AND COMPRESSION STRENGTH OF CEMENT BEAMS

BENDING STRENGTH TEST			
Sample No.	Breaking load at the center of the beam	Bending strength	Average value
	N	MPa	MPa
1			……
2			
3			

COMPRESSIVE STRENGTH TEST				
Sample No.	Compressed surface	Value of destructive force	Compressive strength	Average value
	mm2	kN	MPa	MPa
1				1……
2				
3				
4				2……
5				
6				

Conclusions:

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