Department of Building Engineering

EXERCISE NR 5

Cement
- preparation of cement mortar
and the execution of beams
to determine strength characteristics

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

5.1 . Preparation of mortar and production of beams for strength tests (according to PN-EN 196-1)

The collection and preparation of cement samples for testing should be performed based on PN-EN 196-7. The following accuracy is required when measuring the components: weighing - to 1 g; measuring water - to 1.0 cm ^{3} (ml). The average laboratory sample should be weighed before the test, the mass should be recorded and sieved through a square mesh sieve 1 mm. Any lumps of cement should be rubbed between the fingers. The residue on the sieve should be weighed, the mass recorded and the residue calculated in percent. The sieved cement, which should be placed in a tightly closed container, is tested . **The water** for testing is taken from the water supply network.

Testing conditions. The tests should be performed in rooms with a temperature of 20± 2°Cand relative humidity of at least 50. The instruments and raw materials used (cement, water, sand) should be at room temperature. For marking, vessels and instruments made of materials that do not react with cement, cement paste and mortar should be used.

Required devices and instruments. The laboratory should be equipped with appropriate measuring and research equipment. The devices and instruments used for testing will be briefly described. These are:

- **mixer laboratory** with a program attachment and a device for automatic or manual control of the rotation speed; the basic elements of the mixer are: a stainless steel bowl with a capacity of approx.; 5 la rotating bronze stirrer, adapted in shape to the bowl (the distance of the stirrer edge from the side wall of the bowl should be in the range of 3 ±1 ÷8± 1 mm); device housing with built-in sand tank (automatically emptied) and adjustable speed motor;
- **shaker** with a steel plate (table) for mounting the mold; shaking frequency: 1 shake per second; plate lifting height: 15± 0,3 mm; after rising to the required height, the table should fall freely; total weight of the plate, empty form and overlay: 20 ±0.5 kg; it is advisable to install a counter on the shaker; the total number of shakes should be 60 (the device should switch off automatically);
- **a mould** (*Fig. 1*) made of stainless steel with a minimum hardness of 200 HV, ground inside, dismantled, creating 3 horizontal partitions for forming bars with a cross-section of 40 x ×40 mm and a length 160 mm; the angles between all adjacent mould surfaces should be close to 90°; the partitions should be thick 10 mm; all mould elements should fit tightly together;
- **an air-conditioned room** (or a large container for storing the mortar molds) to ensure that the big humidity air (above 90%) and a temperature of 20.0 ± 1.0 °C ;
- **a container with water** for storing the unmoulded bars; a stainless steel grate should be placed on the bottom; the approximate capacity of the container should be such that there are four volumes of water for each volume of product samples.

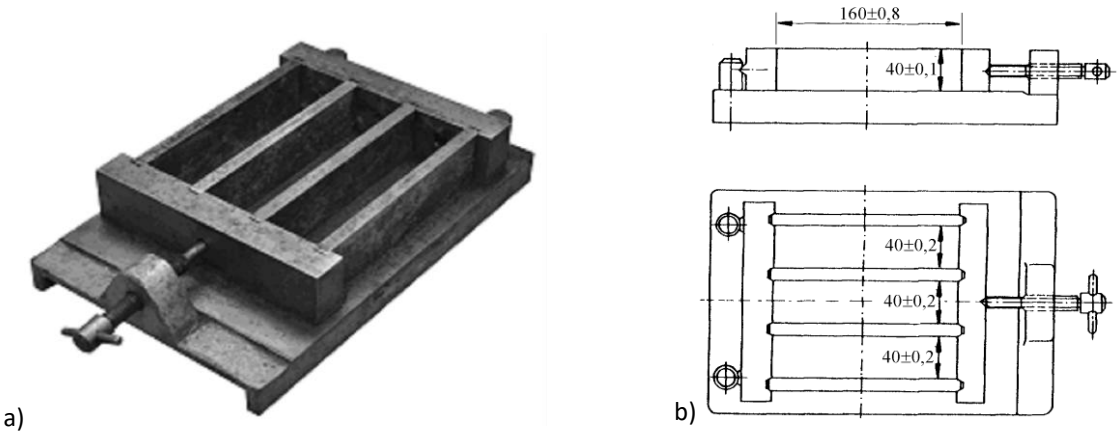

Fig. 1. Form for making standard beams: a) general view; b) diagram and dimensions

The preparation of the form is carried out before each subsequent forming of the beams. The individual parts of the form should be thoroughly cleaned, then mounted on the base and screwed together. When screwing together, a sealant should be used to seal the corners (e.g. a hot mixture of rosin and paraffin in a ratio of 1:3). The internal surfaces of the form should be slightly moistened with mineral oil. The form prepared in this way can be filled with mortar.

Standard mortar for preparing beams is prepared according to the following proportions: 1 part cement, 3 parts standard sand and half a part water (water-cement ratio W/C = 0.5).

Standard sand is usually packed in bags of 1350 g(this is enough to make a mixture for three beams). Therefore, the standard mortar for making three beams (1 form) consists of:

- 450 ± 2 gcement;
- 1350 ± 5 gstandard sand;
- 225 ± 1 cm ^{3} water.

The sequence of operations is as follows: water is poured into the mixing bowl, then cement is poured in, and after mixing, sand is gradually added. These operations, their duration and the speed of the mixer rotation are listed in Table 1.

Table 1. Activities and their time during mortar mixing

Name of activity	Mixer speed	Duration of activity, s
Mixing cement with water	small	30 ±2
Sand dosing	small	30 ±2
Mixing the mortar	big	30 ±2
Removing the mortar stuck to the walls of the bowl using a scraper inside the bowl	without mixing	90 ±5
Mixing the mortar	big	60 ±5

Preparation of the beams. The mold prepared according to this description should be attached to the shaker plate using handles. The first of two portions (approx. 300 g) of the prepared mortar is taken and the individual mold compartments are filled with it. To facilitate filling the mold, special spatulas should be used. The laid first layer is spread with a spatula and compacted on the shaker. After stopping the shaker (60 shakes), you can start filling the mold compartments with the second layer of mortar, and then start the shaker again. After completing these activities, remove the mold with the overlay from the shaker and remove excess mortar with a sharp metal ruler (steel

plate), moved slowly in a cutting motion along the mold (perpendicular to the beams), making a movement in both directions. Then the mortar surface is leveled with the same ruler, held flat.

Curing of the bars. The molds with fresh mortar should be placed in an air-conditioned cabinet. The mold with mortar should be stored horizontally so that moist air has free access to the bars. The mold should be covered from above with a glass or steel plate (preventing drying).

The stripping of the bars depends on the time of the examination. Bars intended for examination after 24 h (which happens relatively rarely) should be stripped 20 minutes before the examination. Bars intended for examination at other times should be stripped after 20 ÷24 h.

The demolded products must be permanently marked on the upper surface and placed in a water bath at a temperature of 20± 1°Cin the prepared container. The bars should be placed on the grid and at a certain distance from each other to ensure free access of water (the distances between the bars, the vessel wall and the water surface should be greater than 5 mm). The bars should remain in the water until the test.