Lab Work No. 6

Determination of the strength of heavy concrete with non-destructive method

For more complete control of the strength of concrete in products, the usual standard tests of control samples are not enough. The samples have other sizes, which affects the conditions of their molding and hardening, and therefore they evaluate the strength of concrete in the product with only a certain degree of approximation.

At present, non-destructive methods for controlling the strength of concrete are widely used, which make it possible to tentatively determine the strength in any structure or on any particular section of a structure or product without destroying them.

Non-destructive methods can be divided into two groups: mechanical or surface (methods of elastic rebound, shock impulse, plastic deformation, tearing off a section of a structure, chipping a structural rib, etc.) and physical (ultrasonic, resonance methods, free vibration method). When using non-destructive methods, the strength of concrete is determined by the calibration dependence, which relates an indirect indicator of the strength of concrete (the magnitude of the rebound of the striker, the diameter of the imprint on concrete, the speed of passage of an ultrasonic pulse through it, etc.) with the strength of concrete. The calibration dependence is established on the basis of parallel tests under a press and non-destructive method of at least fifteen series of control cubic samples. Control samples are taken from randomly selected batches. If the samples selected in this way do not provide a dispersion of the concrete strength values in the range that makes it possible to construct a calibration dependence, it is allowed to produce up to 40% of samples with deviations in the cement-water ratio up to $\pm$ 0.4.

Among the mechanical non-destructive methods, the most common in practice are: the method of plastic deformations, based on the principle of deepening a hammer (ball) into concrete upon impact and obtaining an imprint (hole) on concrete of a certain diameter, and the elastic rebound method, in which

the value of the rebound is an indirect characteristic of strength from the surface of concrete (or the drummer pressed against it).

The first concrete test method is implemented using spring devices with a specific impact energy, as well as a Kashkarov hammer with an arbitrary impact energy. In order to reduce the influence of this parameter on the measurement results, when using the last device, an indirect characteristic of concrete strength is the ratio of the diameters of the prints on concrete and the reference rod.

The reference hammer of the construction of K.P. Kashkarov is shown in Fig. 2. The method for determining the strength of concrete is that when a hammer hits the surface of a concrete structure, two prints are simultaneously formed: the first with a diameter d_C — on concrete, второй диаметром d_E — on the reference rod inserted into the hammer. For the indirect characteristic of concrete strength, the ratio d_C/d_E, is taken, which determines the strength of concrete at a given location in the structure. The reference rod is made of St3 steel with a length of 150 and a diameter of 10 mm; the end of the rod is pointed.

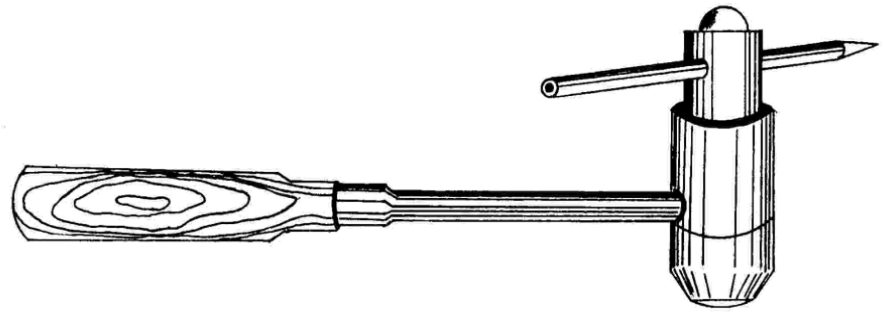

Fig. 2. Reference Hammer Design K.P. Kashkarov

At least 5 strokes are applied with a reference hammer at various points along the length or area of the structure. During the test it is necessary to ensure that the axis of the hammer head is perpendicular to the surface of the test structure. After each stroke, the reference rod is moved so that the distance between the centers of adjacent prints is at least 10 mm. Impacts on the surface of the test structure are applied so that the distance between the test sites is at least 30 mm. The diameter of the holes on the concrete surface and the reference rod is measured with an error

of up to 0.1 mm angular scale, consisting of two steel measuring rulers, riveted at an angle. To facilitate measuring the diameters of prints on concrete, impacts can be made through sheets of carbon paper and white paper.

The strength of concrete in the structure is established using the calibration curve according to the arithmetic mean value of the indirect characteristic. The strength values thus obtained are valid for concrete with a moisture content of 2-6%. In the case of increased humidity, the values of the concrete tensile strength must be multiplied by the correction moisture coefficient, which is assumed to be equal at a moisture content of 8% ─ 1.1; with a moisture content of 12% ─ 1.2.

The elastic rebound method allows you to obtain more reliable data on the strength of concrete, since the size of the elastic rebound is more affected by the inner layers of the structure. This method is carried out using Schmidt hammers, often called sclerometers. The OMS–1 sclerometer (Fig. 3) is designed to determine the compressive strength of concrete in the range 5...40 MPa in concrete and reinforced concrete structures.

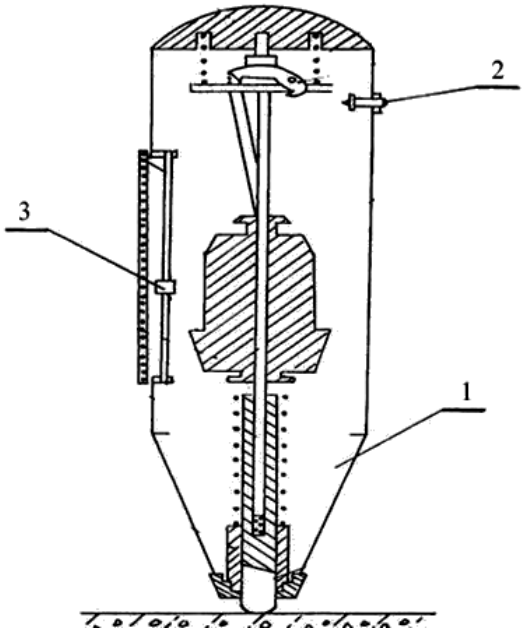

Fig. 3. Sclerometer OMS–1

Before performing the strike by pressing the palm of the hand on the spherical end of the indenter 1, the sclerometer is brought into working position. Then set the sclerometer at a selected point on the test surface perpendicular to it. Holding the sclerometer by the body with two hands so that one finger is at the stopper,

press the indenter to the concrete surface and smoothly slide the device body to it until it clicks (hit). Without taking the sclerometer away from the concrete surface, press the stop button 2 with a finger, fixing the position of the slider with arrow 3 after the impact. In this laboratory work, the OMS-1E electronic sclerometer is used, equipped with an electronic counter for the magnitude of the rebound of the striker, which gives more accurate measurements.

The test is performed at at least five points of the product. Then calculate the average value of the elastic rebound and determine the strength of concrete according to the calibration dependence, previously set by parallel testing of the control cubes of concrete with a sclerometer and the press. When testing control cubes with a sclerometer, they should be clamped in the press with an effort of (30 ± 5) kN. The position of the sclerometer relative to the test surface should be the same as when establishing the calibration dependence, that is, horizontally. If it is necessary to test horizontal or inclined surfaces, the angle of inclination between the longitudinal axis of the device and the horizontal plane should be taken into account to introduce corrections when processing the results.

The results of the experiments are entered in table.8.

Table 8

The Results of Determining the Strength of Concrete Non-Destructive Method

Type of Controlled Strength and its Required Value	Name of Non-Destructive Method, Type of Device	The Average Value of the Indirect Strength Characteristics	The Value of Concrete Strength by Calibration, MPa	Correction Factor	The Value of Concrete Strength, Taking into Account the Correction Factor, MPa	The Average Value of Concrete Strength, MPa