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ABOUT MULTICRITERIA ANALYSIS OF EXISTING METHODS OF CHECKING THE INTEGRITY OF CONCRETE

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Abstract:

To date, there are a number of methods of technological control of concrete strength, and no universal method suitable for precast and monolithic reinforced concrete structures has been developed. Therefore, in this dissertation all existing methods of concrete strength control are investigated and the problem of their improvement is solved taking into account the peculiarities of monolithic monolithic building construction and the most acceptable method is proposed.

Keywords: : Workplace Spirituality, Self-Empowerment, Holy Shrine Of Imam Ali.

Non-abrasive concrete strength control includes a number of methods. These include the ultrasonic pulse method, the cutting (engraving) method, the crack cutting method, the structural edge fracture method, the elastic deformation and shock pulse method, and other less traditional methods (Ultrahigh frequency method, radioisotope method, firing method, etc.).

More objective method of non-slip control from the mechanical method is the tear-off method with a break [1]. Of the disadvantages that seriously hinder its wide application, we should note the complexity of the work that is carried out for installation, separation of anchors in the concrete body and replacement of the formed cracks, the cost of equipment and work, the impossibility of automation of this process, the impossibility of control at many points in the structure and without solving the problem of the formwork.

Moreover, its application contradicts one of the basic principles of sampling control - the principle of selection probability. The I. W. Wolf method [4], based on the installation of a special loosening cone in holes [2, 3], which can be drilled or punched in a solid concrete body, slightly corrects the situation related to the probability of selection. However, it leads to further increases in labor costs and test times.

Cutting method of steel discs glued to the structure with a special glue [5, 6] has several advantages over the method of cutting with fracture, including: low labor costs, absence of cracks after application and, therefore, no need to repair defects. The disadvantages include: the inability to control the structure until it is removed from the mold; the inability to automate the control process; the fact that the obtained parameters depend only on the quality of the outer layers of structural concrete, which leads to lower accuracy of this method of control.

Even though the method of structure edge fracture [1] is characterized by much higher measurement accuracy, it requires high labor costs, impossibility to automate the measurement process, impossibility to control the unresolved structure from the formwork, specificity of the test site (violation of the principle of selection probability) significantly limits the scope of its mass application.

Other methods of mechanical tests, widely used in construction in the CIS countries, including the Republic of Uzbekistan, are very simple and inaccurate.

Particularly, the elastic impact method, the shock impulse method and the plastic deformation method depend on many factors, including the fact that they reflect only the surface layer of concrete, the type of coarse aggregate and the location of reinforcement [7, 8]. However, the serious disadvantages of these methods include the impossibility of control without removal of formwork and the inability to automate the measurement process.

Mechanical non-abrasive methods include the firing method based on the interaction of a special cap, which moves on the surface of the concrete under the influence of the energy of bullets, steel dowels or powder gases. The strength of structural concrete is determined by the depth of the furrow formed [45, 79].

The serious disadvantages of the method include the danger to the tester and others, the significant influence of the coarse filler on the depth of the groove, and the impossibility of testing thin-walled structures.

The main physical method to control the strength of concrete in the structure is the ultrasonic pulse method. In this case, for monolithic concrete and reinforced concrete, as mentioned above, only the use of bilateral sound transmission is allowed [129]. However, there are also areas in all-cast structures where it is not possible to conduct ultrasonic transducers on one axis, so that bilateral sound transmission is not possible at all (e.g., walls or enclosures without holes). Some other serious disadvantages of the ultrasonic method is the indirect control of the temperature and humidity of concrete, the direction and diameter of the reinforcement, the size of the protective layer of concrete, strength, elastic characteristics and the amount of aggregate, the curing time of concrete. concrete, type, grade and consumption of cement, amount of sand, type and consumption of additives are the influence of the quality of contact with the surface of the concrete tool modifiers.

The advantages of the method include: automation of tests and the process of their development, the ability to control the hardening process of concrete at an early stage by installing transformers on the formwork, speed and simplicity of testing, ease and convenience of equipment.

There is also a method of controlling the strength of concrete by its electrical conductivity [1, 3].

To the advantages of this method can be attributed its high sensitivity to structural changes in concrete, to the disadvantages - the dependence of the measured size on the geometric characteristics of the electrodes and the distance between them, porosity and humidity of concrete.

Also, another promising method to control the strength of concrete without collapse is the method of acoustic emission. Its essence is to register acoustic waves resulting from the local restructuring of the internal structure during the hardening of concrete, when a force or other influences are applied to it, and then these waves are processed and interpreted accordingly [4, 5] .

To the disadvantages of this method can be attributed that the influence of physical and chemical processes occurring in concrete, as well as the type and composition of concrete on the characteristics of acoustic emission signals is insufficiently studied.

Additionally, the use of radioisotope methods [7] and microwave methods [8] to control the strength of concrete has been tested. But due to their complexity and insufficient accuracy, they have not found wide application in construction practice.

The above-mentioned analysis of existing methods of monolithic cast concrete strength control makes it possible to highlight the most important criteria and to compare the main methods according to many criteria. In such a comparison, as evaluation criteria were chosen: K_1 - reliability of the method and availability of mechanical documentation; K_2 - speed and possibility of automation; K_3 - possibility of application for different structures (by shape, reinforcement, responsibility); K_4 - cost of testing, labor and safety; K_5 - adverse effect on the structure and the need to eliminate the defects occurred.

These criteria could be expressed in scores ranging from 0 to 1.0 (a mutual difference of 0.1 units). The maximum score of 1.0 means that it fully meets the quality criteria. The analysis was conducted by the grid method. The results of the analysis to choose the rational method of controlling the strength of monolithic cast-in-place concrete are presented in Table 1.2 and in Figure 1.3. It should be noted that only the methods shown in Figure 1.3 can be used for strength control at an early stage (before formwork removal).

Table 1.1.
Number of criteria for evaluating the strength control methods of monolithic cast concrete

Method №	Method name	Evaluation Criteria				
		K_1	K_2	K_3	K_4	K_5
1	Test methodology for concrete cube specimens stored next to the structure	0,9	0,2	1,0	0,4	1,0
2	Test methodology for concrete cube specimens separated from the structure by means of monolithic forms.	1,0	0,2	0,8	0,3	0,6
3	Test methodology for concrete cube specimens cut out of the structure.	0,9	0,2	0,8	0,3	0,6
4	The methodology of fracturing a structure by fracturing	0,8	0,3	1,0	0,6	0,9
5	The methodology separated from the structure	0,7	0,3	1,0	0,4	1,0
6	Structure edge fracture methodology	0,8	0,3	0,4	0,7	0,8
7	Ultrasonic Pulse methodology	0,8	1,0	1,0	0,9	1,0
8	Elastic return style	0,7	0,5	1,0	0,9	1,0
9	Plastic deformation methodology	0,7	0,3	1,0	0,9	1,0
10	Shock pulse style	0,7	0,5	1,0	0,9	1,0
11	Temperature and time factor control methodotology	0,7	1,0	1,0	1,0	1,0
12	Conductivity control methodology	0,4	1,0	0,8	0,4	1,0
13	Radioactive methodology	0,3	1,0	1,0	0,3	1,0
14	Firing methodology	0,5	0,5	0,9	0,4	0,9

Based on the analysis of methods of technological control of concrete mixture and basic parameters of concrete, Table 1.2 is formed. From the data presented in this table, we can see that the following methods of control of characteristics of concrete mixtures and concrete can be attributed to the most universal methods: ultrasonic, electromagnetic, electromechanical. However, all of them have their shortcomings, and, in our opinion, it is practically impossible to single out a method based on a single physical principle for determining all the necessary parameters.

Table 1.2.
Technological capabilities of controls depending on the physical principle of operation

Physical principles of controls	Indicator of control				
	Mobility of concrete mix	Degree of density of the concrete mix	Moisture content of cured concrete	Curing temperature of concrete	Structural concrete strength
Mechanical (manual)	+		+	+	+
Electric, electromechanical	+	+	+	+	+
Ultrasonic	+	+			+
Radiation related, radioisotope related		+	+		+
Electromagnetic wave (ultrahigh frequency)		+	+	+	+

CONCLUSION.

Thus, a multivariate analysis of existing methods of control of concrete strength showed that there are no universal methods of control that fully meet the requirements of the open construction site and allow effective determination of concrete mortar, critical, design and other strength indicators.

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