

Quality Control Of Construction Testing Of Reinforced Cement Concrete Cubes

Mr. Chhabi Lal Singh¹ Jitendra Singh² Lavdeep Singh Patel³

¹Assistant Professor, Department of Civil Engineering, J S University, Shikohabad

^{2,3}M.Tech, Department of Civil Engineering, J S University, Shikohabad

Submitted: 25-07-2021

Revised: 04-08-2021

Accepted: 06-08-2021

ABSTRACT— The acceptance criteria of quality of concrete is laid-down in IS: 456-2000. The criteria is mandatory and various provision of the code have to complied before the quality of concrete is accepted. In all the case, the 28-days compressive strength shall alone be the criterions for acceptance or rejection of the concrete. In order to get a relatively quicker idea of the qualities of concrete, the test for 7 days compressive strength of concrete be carried out. Six concrete cubes of 150 x 150 x 150 mm sizes (the nominal sizes of aggregate does not be exceed 38 mm), 3 for 7-days testing and 3 for 28-days testing. A set of 3 cubes average strength will be a sample. The individual variation of the set of 3 cubes should not more than $\pm 15\%$ of the average. If more, the test result of samples are invalid.

Note:- For aggregates larger more than 38 mm, bigger than 150 mm moulds are to be used. See IS: 10086-1982

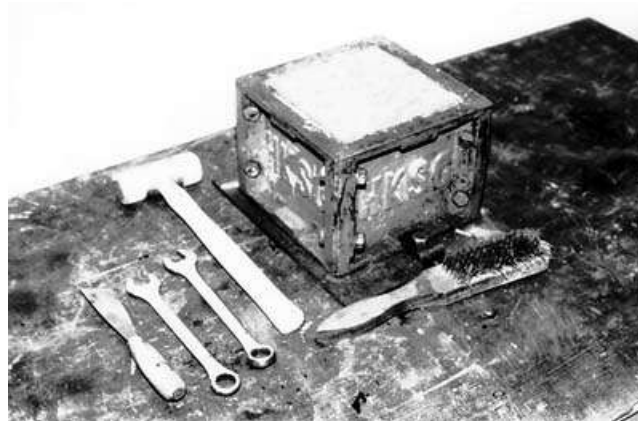
Key Words: Cube Moulds, Tamping Rod, Compression Testing Machine, Sample of Concrete, Casting of Cubes, Compaction By Hand, Compaction By Vibration, Curing, Testing of Concrete Cubes.

I. CUBE MOULD

The cube moulds of required size (150 mm for nominal size of aggregate not exceeding 38 mm) should be made in such a manner as facilities of the separations into two parts. Cube moulds should be provided with the base plates and they should be as per IS: 10086-1982. The dimension and materials of cube moulds should be as the given in **table-1**.

TABLE-1: DIMENSION, TOLERANCE AND MATERIALS OF 150 MM CUBE MOULD.

S.NO.	Description	Requirements
1	Distance between opposite faces, mm	150 ± 0.2
2	Height of mould, mm	150 ± 0.2
3	Thickness of wall plate, mm	8
4	Angle between adjacent interior faces and between interior faces and top and bottom plates of mold.	90 ± 0.5^0
5	Length of baseplate, mm	280
6	Width of baseplate, mm	215
7	Thickness of baseplate, mm	8
8	Permissible variation in the planeness of interior faces :	0.03
9	for moulds in use, mm	0.05
10	Permissible variation in the planeness of base plate, mm	0,03
11	Materials	
	a) Side plate	Cast iron
	b) Base plate	Cast iron



II. TAMPING ROD

As per IS: 10086-1982, the tamping rods shall be 16 ± 0.5 mm dia and 600 ± 2 mm long with the rounded working end and shall to be made of mild steel.

III. COMPRESSION TESTING MACHINE

The compression testing machine shall be as per IS:14858-2000. The machine shall be capables of applying the loads at specified rate, uniformly without shocks using the manual or automatic controls. The percentages of errors shall not be exceed ± 1.0 % of the indicates load.

On the basis, machine should be calibrated with the periods not exceeding 12 months from previous verifications. The machines are required to be calibrated on the installation or relocation, subjects to major repairs or adjustment and whenever there is reason to doubt the accuracy of the results, without regard to the time interval since the last verifications.

The accuracy of the testing machines shall be verified by applying 5 test loads in 4 approximately equal increments in the ascending orders. The difference between any two successive loads shall not be exceed one-third of the difference between a maximum and minimum test load. The load as the indicate by the testing machines and the applied load computed from the reading of the verifications devices shall be recording at each test

points. And calculating the error, E, and the percentage of errors, E_p for each points from these data as follows:

$$E = A - B$$

$$E_p = [E/B] \times 100$$

A= load in N indicated by the machine being certified and

B= applied load in N as determined by the calibrating device (such as verifying ring, load cell, calibrating cylinder etc.)

For checking accuracy of testing machine concrete cubes of the same grades, age in SSD condition should be testing on the machine being checked and already calibrated standard compression testing machine and finding the differences. Proper calibration of testing machine is essential.

IV. SAMPLE OF CONCRETE

The samples of concrete for the testing specimen should be making at the mixer or in the case of ready mixed concrete from the transportation vehicle discharge. Such as sample should be obtained by repeatedly passing a scoop and pail throughing the discharging of the stream of concrete. The samples thus obtained should be mixed on the non absorbent bases with shovel until it is uniformly in appearance. Sample should be spread over the entires period of the concreting and the frequency of sampling of concrete of each grades should be as following:

Quantity of concrete in the work (m^3)	Number of samples
1-5	1
6-15	2
16-30	3
31-50	4

51 and above	4 plus one additional sample for each additional 50 m ³ or part thereof.
--------------	---

Note:- Frequency of sampling could also be prescribed internally by supplier and purchaser.

V. CASTING OF CUBES

The cube mould plates should be removed and properly cleaned assembled and all the bolts should be fully tight of cube mould. The thin layers of oil side then should be applying on all the faces of the cube moulds. It is important the cube side faces must be taking parallels.

After taking the concretinng samples and mixing them the cubes shall be casting as soon possible. The concrete sample should be filled into the cube moulds in layers approximately 5 cm deep. In replacing each scoop full of the concrete the scoop should be removed arounding the top edges of the mould as the concrete slides from it, in order to ensure the symmetrical distributions of the concrete with in the mould. Each layers should be compacted either then by hand or by the vibrating as described below.

VI. COMPACTION BY HAND

Each layers of the concrete filled in the mould should be compacted by not less than 35 strokes by tamping rod. The strokes should be penetrate into the understanding layer and the bottom

layer shall be rodded throught its depth. Where the air-voids are left by the tamping rod all the sides of the mould shall be tapped to close the air-voids.

VII. COMPACTION BY VIBRATION

When compacting by vibration each all layers should be vibrated by means of an electric or paneumatic hammer or vibrator or by means of a suitable vibrating tables until the specifying condition is attained.

VIII. CURING

The casted cubes should be stored under the shaid at the place free from the vibration at a temperature 220C to 330C for 24 hours covered with the wet straw or gunny sacking.

The cube should be removed from the moulds at the end of 24 hours and the immersing in clean water at the temperature 240C to 300C till the 7 or 28-days age of testing. The cubes should be tested in the saturated and surface is dry condition.

For the true representation of actual strength of concrete in the structure, extra cubes should be cast, stored and curded as per the identically conditions of that structure, and tested at requirement of the age.



IX. TESTING OF CONCRETE CUBES

The dimensions of the specified to the nearest of 0.2 mm and their weight should be noted before testing. The bearing surfaces of the testing machine should be wiped cleaning and any loose sand or other materials are removing from the surface of

the specifying which are to be in contact with the compression plates. The cubes should be taking place in the machine in such a manner that these loads should be applied to opposite sides of the cubes as cast that is not to the top and bottom. The axis of the

specifying should be carefully aligned with the centre of the thrust of the spherically seated platens.

No packing should be used between the faces of the test specifying and the steel platen of the testing machine. As the spherically seated blocks are brought to bear on the specifying, the movable portion should be rotating gently by hand so that uniform seating may be obtained. The load should be applied without shocking and increased continuously at a rate of approximately 140 kg/sq cm/min until the resistance of the specifying to the increasing load of breaks down and no greater load can be sustained. The maximum load applied to the specifying should be there recorded and the appearance of the concrete and any unusual features in the types of failure shall

be noted. The compressive strength of concrete should be calculating from : Maximum load/Cross-Sectional area of cube to be reporting the nearest of 0.5N/mm^2

X. ACCEPTANCE

For the acceptance, both the conditions should be met with:

- The mean strength determined from any group of four-non overlapping consecutive test results should be completely with the appropriate limits as given in table.
- Any individual test result competitive with in the appropriate limit as given in table.

TABLE-2 : CHARACTERISTIC COMPRESSIVE STRENGTH COMPLIANCE REQUIREMENT:

SPECIFIED GRADE	MEAN OF THE GROUP OF 4 NON-OVERLAPPING CONSECUTIVE TEST RESULTS IN N/MM^2	INDIVIDUAL TEST RESULTS IN N/MM^2
M-15	$\geq \text{FCK} + 0.825 \times$ ESTABLISHED STANDARD DEVIATION (rounded off to nearest 0.5 N/mm^2) Or $\text{fck} + 3 \text{ N/mm}^2$ whichever is greater	$\geq \text{FCK} - 3 \text{ N/mm}^2$
M-20 OR ABOVE	$\geq \text{FCK} + 0.825 \times$ ESTABLISHED STANDARD DEVIATION (rounded off to nearest 0.5 N/mm^2) Or $\text{fck} + 4 \text{ N/mm}^2$ whichever is bigger	$\geq \text{FCK} - 4 \text{ N/mm}^2$

XI. INTERPRETATIONS-EXAMPLE FOR M-25 GRADE OF CONCRETE

For a pour of $31\text{-}50 \text{ m}^3$ 3 samples (each sample having 3 cubes) are mandatory.

- The average value of three cube sets (one sample) should be strength with the limits of $\pm 15\%$ of the average value. And otherwise the result of that sample will be invalid.
- The mean value of 3 samples (3 average values obtaining from each sample of 3 cubes) should be meet the criteria as given in table. For M-25 grade of concrete the mean value of these 3 samples should not be less than either 29 N/mm^2

or 25 N/mm^2 plus 0.825 times the standard deviation whichever is the greater.

- Any individual test result of a cube out of the above should not taking the value of cubes less than 21 N/mm^3 .

In case of doubt regarding the grade of concrete used either due to poor workmanship, or based on results of cube strength testing further tests should be conducting such as non-destructive test by Concrete Test Hammer, Ultrasonic Concrete Tester etc. Partial destructive test by drilling cores and testing them in compressed. In no case fewer than 3

cores should be tested. The final testing include the load testing on structure.

XII. DURABILITY OF CONCRETE

For the cube testing alone is not the criteria for the durability of concrete structure. A durable concrete is one that perform satisfactorily in the working environment during its anticipated exposure conditions induring service. The materials and mix proportions specimen and used should be such as to maintain its integrity and if applicable, to protect embedded metallic from corrosion.

It is essential that every concrete structure should be continuously to perform its intended functions, that is maintaining its required strength and serviceability, during the specimen or traditionally expected service life. It follows that concrete must be able to withstand the processes of determine to which it can be expected to be exposed. Such as concrete is said to be durable conditions.

Both strength and sturdiness should need to be considered explicitly at the designing stage. The emphasis is on the word both because it would be a mistake to replace overemphasis on strength by overemphasis on durability condition.

XIII. CONCLUSIONS

The present paper has discussed some of the new considerations involved in concrete cube test. The concepts discussed in this paper are expected to give reliable performance as well relative economy in construction. The criteria is mandatory and various provision of the code have to complied before the quality of concrete is accepted. In all the case, the 28-

days compressive strength shall alone be the criterions for acceptance or rejection of the concrete. In order to get a relatively quicker idea of the qualities of concrete, the test for 7 days compressive strength of concrete be carried out. The samples of concrete for the testing specimen should be making at the mixer or in the case of ready mixed concrete from the transportation vehicle discharge. The casted cubes should be stored under the shaid at the place free from the vibration at a temperature 220C to 330C for 24 hours covered with the wet straw or gunny sacking. The cube should be removed from the moulds at the end of 24 hours and the immersing in clean water at the temperature 240C to 300C till the 7 or 28-days age of testing. The cubes should be tested in the saturated and surface is dry condition.

REFERENCES:-

- [1]. IS: 456- 2000 Plain and Reinforced Concrete – Code of Practice. BIS, New Delhi
- [2]. IS: 10086- 1982 Specification for Moulds for use in Testing of Cement and Concrete, BIS, New Delhi
- [3]. IS: 14858- 2000 Compression Testing Machine used for testing of Concrete and Mortar Requirements, BIS, New Delhi
- [4]. IS: 516- 1959 Method of Tests for Strength of Concrete, BIS, New Delhi
- [5]. “Concrete Cube Testing” Civil Engineering and Construction
- [6]. “28-days Strength of Concrete in 15 Minutes” Civil Engineering and Construction