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Mixing of Concrete and its Testing Methodology

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ABSTRACT

We have seen various occasions where different performance characteristics of concrete in a structure are tested. In mostly cases, an estimate of strength of concrete in the structure is needed, other aspects like overall quality, uniformity etc. also becomes important in others. At present the direct test used mainly as a basis of quality control is compression testing of cubes, cylinders etc. and it represents the potential strength of the concrete used in the structure. The main parameters determining the qualities of concrete are its composition of mix, degree of compaction and curing. However, the methods of compaction and curing usually are different for the cubes and the structural members as quality control in laboratory is better that quality control in field. Due to this variation in quality control, results obtained on cubes may not truly represent the quality of concrete in the structure. Hence the use of Non-Destructive Testing on the newly constructed structure becomes necessary.

Keywords: *Reinforcement, Workability, hydration of concrete, calibration rod, Non-Destructive Testing.*

INTRODUCTION

Reinforcement

Reinforcement of Fe415 grade of steel has been used in RCC beam. Three bars of 12mm diameter have been used as tension reinforcement and two bars of 10mm diameter have been used as hanger bar. Diameter of shear stirrups was kept 8mm.

Design of Concrete Mix

Using the above physical properties of cement, fine aggregate, coarse aggregate and water mix has been designed for M25 grade of concrete.

CONTENT

Casting of Specimens

Cubes and beam specimens have been tested using cast iron moulds. These moulds were cleaned completely for any dust and loose rusted materials and after that oil was applied inside and on the edges to avoid any sticking of concrete to mould. For testing of specimens, unique code, consisting date of casting and serial number, has been written on the Income of specimens to identify it.

Mixing of Materials

Complete and thorough mixing of ingredients has been carried out for the production of concrete having uniform properties and desired strength. Mixing was done to produce a homogeneous, uniform in colour and consistency concrete. The mixing of ingredients was done in mixture. All materials were weighted on the weighing machine. These were put in mixture and mixed dry for 1 minute approximately and after that required quantity of water was discharge slowly in the mixture and it was mixed for further 1.5 to 2minute and a uniformity of mix was ensured before discharging the mix.

Workability Test

Workability of concrete is a very important parameter. If concrete is less workable then high degree of compaction is required to achieve maximum strength. This depends on many factors such as water content, mix proportions, size and shape of aggregate, surface texture and grading of aggregate, use of admixture etc. There are many methods to measure the workability such as slump test, compacting factor, flow test, Vee Bee test etc. and each of these methods has its own advantages & disadvantages. There is no single method of workability test which is applicable to all types of concrete. Slump test is one of most used workability test method and this is used for this experimental work also. Measured slump of concrete has been found to be 53mm.

Placing of Concrete in Mould

It is not enough that concrete is correctly designed, batched, mixed etc. it is also utmost importance that it is placed systematically to get optimum results. Before placing the concrete in moulds, it was ensured that moulds are tightened and there are no loose materials inside like chipping, shaving, and dust. Oil was applied inside and on edges of moulds to avoid the sticking of concrete to moulds and compacted. While placing the concrete for reinforced beam, utmost care was taken to place the reinforcement in correct position and maintain the correct effective cover to all sides. The concrete has been placed and compacted before initial setting of cement.

Compaction of Fresh Concrete

Compaction of concrete is required to expel the entrapped air from the concrete. In the process of mixing of material, transportation of green concrete and placing into mould it likely that air is entrapped in the concrete and the amount of entrapped air less for high workable concrete. This entrapped air must be removed otherwise strength of concrete will be considerably lower concrete should be thorough only compacted and worked around the reinforcement into the corners of the mould. To remove the air from concrete, specimens were vibrated for approximately 30-40 seconds on plane table vibrator.

Curing of Specimens

Hydration of cement particles starts as soon as water is mixed to cement and concrete starts gaining strength due to formation of C-S-H gel, a product of hydration of cement. Hydration of cement particle do not complete instantaneously albeit it is a continuous process for a long time. Cement generally requires water cement ratio of 0.23 for complete hydration and0.15 for filling the gel pores created due to hydration of particles. In other words, it can be said that cement requires 38% water of weight of cement for complete hydration. If concrete specimens are open to atmosphere, water would be lost by evaporation. To avoid this phenomenon and supply enough water for hydration, curing of specimens becomes mandatory. There are many ways of curing such as water curing, membrane curing, application of heat etc. but for this experiment water curing was used and all specimens were kept under water for28 days in a curing tank.

Testing Methodology

All specimens have been taken out of curing tank after 28 days and dried in sunlight to test the effect of moisture content on UPV and compressive strength by rebound hammer and for further testing. To find the effect of moisture content, testing has been done at 1, 7, 14, 21 and 28 days drying of specimens in sunlight. For testing, ultrasonic testing apparatus and rebound hammer have been used. For all measurement of present study, direct method of ultrasonic testing is used. Ultrasonic Testing apparatus of Pundit lab

Company has been used for this study. It consist a pair of transducers, display unit, BNC cables, calibration rod etc. Ultrasonic jelly has been used for good acoustical coupling between the concrete and face of the transducer. Calibration is done on regular basis using a calibration rod of calibration time of 25.4ps. Frequency of apparatus can be set any value between 24 kHz to 500 kHz. For all specimens and all measurements, direct method of ultrasonic pulse velocity measurement has been used. Before measurement of ultrasonic pulse velocity. Path length has been measured accurately using scale of accuracy of 0.5mm and entered into instrument. Standard method of measurement used is applying the jelly, position the transducers and perform the measurement Rebound hammer used for this study. A total of 10 strikes have been used and average value of rebound and compressive strength has been noted. Utmost care is taken to strike the concrete surface perfectly perpendicular and point of impact is kept at least.

CONCLUSION

- The compressive strength in the presence of moisture has been found to be decreased about 18%. However no significant change in the observations made in the presence of moisture has been observed when beam specimens were tested transversally as well as longitudinally. An increase in ultrasonic pulse velocity of about 1.59 to 1.72% due to moisture has been observed in beams as well as cubes.
- Presence of reinforcement in travel path of pulse wave causes increase in UPV and for present study it is found to be 1.20% higher when 12mm dia. Bar has been used.
- Flexural test on plain and RCC beams show that there is no significant effect of stressed and unstressed condition on UPV and RH.

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