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Influence of target strength in recycled aggregate concrete mix design integrated approach

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Abstract: Concrete mix design involves the process of selecting ingredients with appropriate proportions. Creates the required strength and durability of the concrete structure. Material having different properties. Not easy to create a great mix of concrete. It is Imperative all ingredients be tested determine their physical properties then prepare the mix as per guidelines. But guidelines available for fresh raw or the natural material used in the mix design. Various steps include in mix design for this paper mainly focus on Target strength of concrete (Fck) Value variation. In case of recycled concrete material used in the mixed design. For the study casting the M25 grade. Recycled aggregate used up to 30 % by weight. Compare the statistical analysis variations used for mix design.

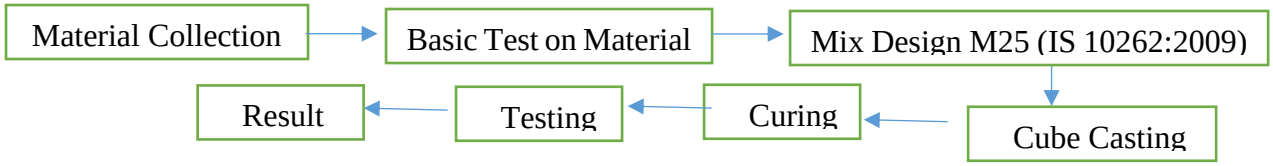
Keywords: Target Strength of Concrete, (Fck), Concrete mix Design

1. INTRODUCTION

As per the general statement of concrete mix design. The Selection of suitable ingredients with respect to appropriate proportion is called as concrete mix design. Today number of methods available for mix design. According to the grade of concrete material proportions are different this proportion also vary in place to place due to effects of physical properties of material. Even with best mix design failures occurs in concrete some of the design and quality of material equality responsible for final strength of concrete. However, most often the reason for failure are due to neglect and neglect of quality on site during construction. Concrete mix design guidelines are available for natural materials used in concrete.[1] Required qualities of aggregate for concrete as per IS 383 [2] Aggregate one of the most important constituents of concrete. Major changes in occurs in final strength of concrete due to aggregate properties [3] Large quantity natural material used in construction industry creates environmental impact. Many researchers suggested the recycled aggregate towards the sustainable material [4] using RCA as concrete may effectively minimize the C&D waste [5] Few studies have been conducted on microstructure of recycled RCA and its effects [6] suggest the quality improvement methods for recycled aggregate [7] basic properties of recycled aggregate [8] concrete need to find suitable alternatives to produce sustainable concrete [9] other researchers have also studied the possibility of using RA in concrete production [10] [11][12] Moreover RCA Can be used replacement material not only reduced disposal quantities but also support sustainable construction [13] The aim of this paper is to mainly analysed the variation in Target meant strength and standard deviation value for M25 grade of concrete with replacement of 30% recycled aggregate.

2. EXPERIMENTAL METHODS OR METHODOLOGY

Methodology: as the flow chart shows the methodology used for experimental work.



3. EXPERIMENTAL WORK:

In experimental work used PPC cement as per the specification [14] Initial and final setting time of cement according to ASTM 191 [15] Normal consistency determine according to ASTM 187 [16] Density of sand 1360 Kg/M3 Specific gravity 2.63 and water absorption 0.98% sieve analysis conducted according to ASTM 136 [17] as coarse aggregate density 1610 Kg/M3 ,Specific gravity 2.65,water absorption 0.75% and similarly Recycled aggregate density 1410 Kg/M3 Specific gravity 2.60 ,water absorption 1.05 % test conducted according to ASTM 128 [18] Concrete mix design M25 grade as IS Method [1] Prepare the mix design for one cubic meter concrete finding proportion of material for mix

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design normal case and 30% replacement of recycled aggregate as per table No.1 shows after mixing to measure the slump test according to ASTM 143 [19] next day sample kept in curing chamber for 28 days. Compressive strength test was performed as per ASTM C39-96 [20]

Table No.1

Grade of Concrete	Cement	Sand	Aggregate	W/C Ratio
Material M25	425.73 Kg	535.2 Kg	1175.9 kg	0.45

4. STATISTICAL QUALITY CONTROL:

The use of statistical method in monitoring and maintaining of the quality of product and service. Similarly in design based on an assumption that the concrete obtained will have strength equal to or greater than the specified strength. The strength of concrete obtained on site will depend on many factor and result shows considerable variability. In mix design concrete will produced an average strength greater than specified.

Code Provision: The code provision of using statistical method for finding out the concrete strength are set out in clause 9.2.4 and 16 of IS 456:2000 [21] The standard deviation for each grade of concrete shall be calculated separately.

Standard deviation based on test strength of sample

1) Number of test result of sample: The total number of test strength of sample required to constitute an acceptable record for calculation of standard deviation shall not less than 30.

2) Standard deviation to be brought up to date: The calculation of the standard deviation shall be brought up to date after every change of mix design.

3) In case of significant changes in concrete: when significant changes are made in the production of concrete batches the standard deviation value shall be separately calculated for such batch of concrete.

Economical and effective system of quality control based on stastical method. In quality control the most important activity as far as concrete concerned is the collection of the sample specimen. As per Gaussian normal distribution theory property under investigation. The distribution may be presented either using the strength variable or transformed variable called the standard normal variable. The probability function associated with standard normal variable. The definition of characteristics strength of concrete are based upon this function. According to definition 95% the specimen should possess a strength greater than the characteristics compressive strength (Fck) of concrete. From the probability density function this correspondence to a value of -1.65 for the standard normal variable according to IS the target strength of the concrete mixture is defined as.

Target strength = Fck+1.65σ where σ = Standard deviation. For mix design Value given in table standard deviation can be change as the grade of concrete is change.

5. STANDARD DEVIATION:

This is the root mean square deviation of all the result this is denoted by σ

$$\sigma = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n - 1}$$

Where, σ = Standard deviation

X = particular value of observation

$\bar{x}$ = arthmetic mean

n = number of observation

Relation between Average design strength and specified minimum strength

In design of concrete mixes the average design strength to be aimed at should be appreciable higher than the minimum strength stipulated by structural designer. The value of average deign strength to be aimed at will depend upon on the quality control exercise at the time of making concrete [22].

Table No.2

Sample No	1	2	3	4	5	6	7	8	9	10	11	12
Compressive Strength in Mpa	22.1	19.25	20.3	24.5	26.5	18.9	17.5	21.2	23.5	24.7	23.8	20.6

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Table No. 2 (Continue)

Sample No	13	14	15	16	17	18	19	20	21	22	23	24
Compressive Strength in Mpa	22.4	24.5	19.7	21.9	23.7	20.9	21.5	26.7	24.7	23.5	22.7	20.5

Table No. 2 (Continue)

Sample No	25	26	27	28	29	30
Compressive Strength in Mpa	19.0	21.5	22.6	26.0	22.8	23.4

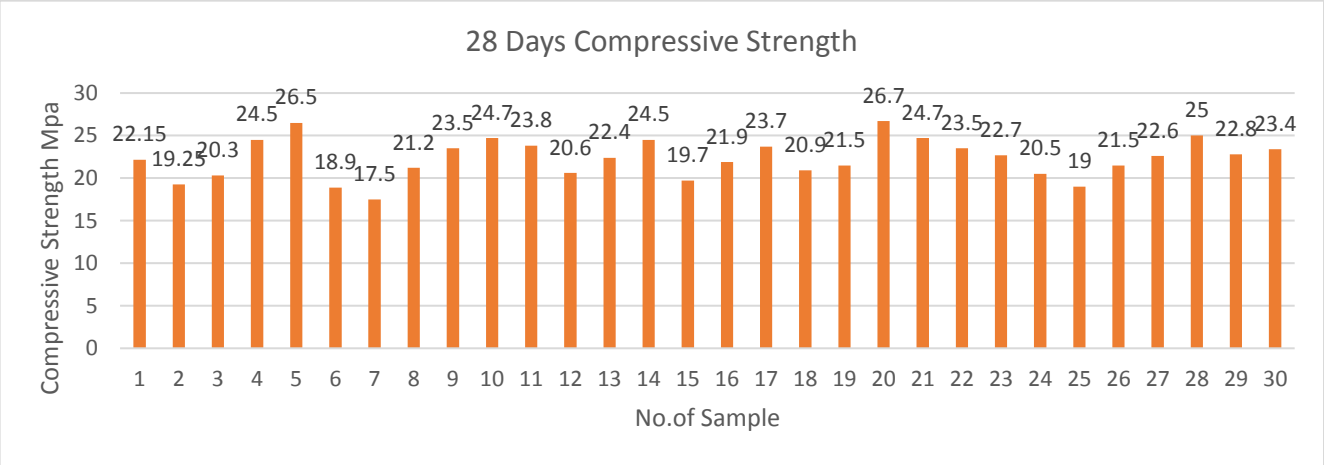
$$\sigma = \frac{\sqrt{\Sigma(150.58)^2}}{30-1}$$

$$\sigma = 2.28$$

Coefficient of Variance = Standard deviation / Average strength

Coefficient of Variance = 2.28 / 22.33 x 100

= 10.21%



Graph No.1

6. CONCLUSION

1) Standard deviation and coefficient of variance value increase with the strength of concrete.
2) As per IS Code 10262:2009 given the value of standard deviation for finding the target mean strength of concrete. For fresh material.
3) From the above observation 30% utilization of recycled aggregate in concrete affects the value of standard deviation.as per the quality standard this value nearby expected 4.0 but actually found 2.28 due the quality of aggregate.
4) Similarly provision should also be made in the code or factor value considered for recycled aggregate used in concrete. Due to factor value the target strength increases. As target strength increase final strength of concrete and quality of concrete improve
5) Factor value also varying according to the percentage of recycled aggregate used in concrete. More research also need in that filed.

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