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Concrete Mix Design Using Microsoft Excel

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ABSTRACT: The current research caters for the possibility of arriving at a system for designing concrete mixes easily using available materials locally by specified wide ranges of pre-requisites of three main prescribed properties to cover a good variety of practical mixes, which are water, water-cement ratio and total aggregate-cement ratio. Using these three properties, a tri-linear form was constructed by graphical technique manner based on absolute volume approach. This approach defines as a summation of absolute volume for each of these three materials individually water, cement and aggregate should be equal to the absolute volume of whole concrete mixture based on these altogether. A quad-form area which includes a wide range of mixes can be formed from this representation. This area should achieve all the prescribed properties aforementioned. Artificial neural network concept used in this study also to build easily and quickly system which can be translated into Excel sheet.

KEYWORDS: Concrete, Compressive strength model, Quick method, Quad-form area method, Graphical solution.

I.INTRODUCTION

Cement concrete is one of the apparently simple but complex and utmost widely used construction material in the world in this Morden days. It has the advantage of being formed into any desired shape conveniently.Due to the varying properties of the materials used in concrete, the design of concrete is not an easy task. The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability, and workability as economically as possible, is termed the concrete mix design. In the method of Concrete Mix Design means, determination of the proportion of the concrete ingredients i.e. Cement, Water, Fine Aggregate, Coarse Aggregate which would produce concrete possessing specified properties such as workability, strength and durability with maximum overall economy. The various methods of mix design are applied for determining the qualities & quantity of concrete. The extent of quality control is often an economic compromise, and depends on the size and type of job. The cost of labour depends on the workability of mix, e.g., a concrete mix of inadequate workability may result in a high cost of labour to obtain a degree of compaction with available equipment. So it is obligatory to resort to mix design for high rise/ strength structures

II.LITERATURE REVIEW

Title of Paper	Name of Journal	Concluding Remarks
Concrete Mix Design Using Neural Network [1]	International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering	In this Paper the an ANN has been developed using fineness modulus of fine and coarse aggregates, target strength of design concrete, workability of concrete and grade of cement as inputs and weight of cement, water, fine aggregate, 10 mm coarse aggregate and 20 mm coarse aggregate as outputs. The design Trials can be reduced using developed ANN. This is quite Simple and is particularly useful in saving calculation time and effort. Concrete can be made in the most economical manner using proposed approach.
Optimised Mix Design For Normal Strength and High Performance Concrete Using Practical Packing Method [2]	Archives of Civil Engineering	In this paper, optimized concrete mix is designed for normal strength and high performance concrete using particle packing method. A critical review of mix design methods using American Concrete Institute (ACI) and Bureau of Indian Standards (BIS) have been conducted highlighting the similarities and differences towards attaining a particular design compressive strength. Compression test has been carried

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		out for cubes of M30 and M40 grade concrete. Optimization of concrete mix has been carried out by adjusting the concrete ingredients to match with the modified Anderson curve. Compression test has been carried out for the adjusted proportions and it isObserved that the mixes designed by particle packing method estimates compressive strength closer to design compressive strength. Further, a mix has been designed for high performance concrete, which has a fine grained matrix and compression test has been performed to check the adequacy of desired compressive strength and found to be satisfactory.
Concrete Mix Design using Artificial Neural Network [3]	International Journal of Advanced Research in Science and Engineering	In this Paper study demonstrates that the ANN model can be very convenient tool in order to solve mix design problems. ANN can be used efficiently for most of the noisy problems. This study emphasis is given to predict strength of concrete by testing and training of ANN model of mix proportions. The accuracy of prediction depends upon number of training data and its variations. The proposed ANN was validated and outputs predicted by developed neural network were fairly accurate in a range of 90 to 95%. More reliable predictions can be made with more data and wide variations. The application of artificial intelligence in the field of mix design is very appropriate in order to preserve valuable time at reasonable cost.
SCC Mix Design using User Interface Software [4]	Research Gate	In this paper the principal consideration of the design method is to fill the paste of binders into voids of the aggregate framework piled loosely. With the proposed software program, all we need is to input material properties, packing factor and reinforcement specifications and SCC with good flow ability and segregation resistance can be obtained with self-compacting ability.
A Computer-Aided Approach to Pozzolanic Concrete Mix Design [5]	Advances in Civil Engineering	In this paper the study develops a two-step computer-aided approach for pozzolanic concrete mix design. The first step is to establish a dataset of pozzolanic concrete mixture proportioning that conforms to ACI code. In this step, ANNs are employed to establish the prediction models of compressive strength and slump of concrete. The second step is to classify the dataset of pozzolanic concrete mixture proportioning. A classification method is utilized to categorize the dataset into 360 classes based on compressive strength of concrete, pozzolanic admixture replacement rate, and material cost.
A new approach to concrete mix design using Computer Techniques [6]	Nigerian journal of technology	In this paper the project surveyed in details the existing methods of concrete mix design with the aim of finding a computer aided technique for the concrete mix design process. An applicable model was developed and consequently a computer program that can be used to evaluate mix proportions and the corresponding compressive strength of concrete for various cement content and varying water/cement ratios was developed.
Development of user Friendly Software	International Journal of Engineering Research & Technology.	The study has following conclusions: 1. The mix design packages are user friendly.

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Packages for Concrete Mix Design in Accordance to IS 10262:2009 [7]		2. It saves lot of time, energy and material incurred in trial mixes. 3. Results are very accurate and have percentage error less than 0.2. 4. It includes all the provisions of IS codes and can design all grades of concrete specified in codes. 5. Fly ash concrete is environment friendly, cost effective and corrosion resistant construction material. This study can be extended by making use of locally available and recycled materials as a partial replacement of cement by glass powder, blast furnace slag aggregates replacing coarse aggregates and copper or ferrous slag for fine aggregates which will result in a more economic concrete mix.

III.MATERIAL AND METHODS

1 Cement

Ultra Tech 53 grades Ordinary Portland Cement is used for the study. This cement is the most widely used one in the construction industry in India.

2 Fine Aggregate

Natural Sand of river bed is used confirming to grade Zone –II of table 4 of IS 383.

3 Coarse Aggregate

Coarse Aggregate of 20mm was used in this project.

4 Admixture:

EmcePlast BV (Chlorine-free concrete plasticizer and/or water reducing agent was used.

5Water:

Drinking Water is used for casting and currying of the mortar blocks.

IV.EXPERIMENTAL WORK: THE APPLIED PROCESSES

Fineness Modulus

To determine the fineness modulus of Sand and Coarse Aggregate details sieve analysis is performed. The fineness modulus ofsand and coarse aggregate is 3.02 and 5.94 respectively.
Table 1 to 2 show the fineness of sand and coarseaggregate respectively. Sand used for this work is from grading zone II.

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Table 1 Sieve Analysis of sand sample

I.S Sieve Size (mm)	Weight Retained in (kg)	Individual % Retained	Cumulative % Retained	%Passing
10.00	00.00	00.00	00.00	100
4.75	00.120	06.00	06.00	94.00
2.36	00.180	09.00	15.00	85.00
1.18	00.450	22.50	37.50	62.50
0.600	00.540	27.00	64.50	35.50
0.300	00.360	18.00	82.50	17.50
0.150	00.280	14.00	96.50	03.50
Pan	00.070	03.50	100.00	00.00
			=302	

FM =Total Cumulative percentage retained /100 = 302/100 = 3.02

Table 2 Sieve Analysis of Coarse Aggregate

I.S Sieve Size (mm)	Weight Retained in (kg)	Individual % Retained	Cumulative % Retained	%Passing
20.00	00.500	10.00	10.00	90.00
10.00	02.900	58.00	68.00	32.00
4.75	01.520	30.40	98.40	01.60
2.36	00.040	00.80	99.20	00.80
0.600	00.000	00.00	99.20	00.80
0.300	00.000	00.00	99.20	00.80
0.150	00.000	00.00	99.20	00.80
Pan	00.040	00.80	100.00	00.00
			=573.20	

FM =Total Cumulative percentage retained /100 = 573.2/100 = 5.732

Table 3 : I.S Limit For Sand For Zone I, Zone II , Zone III And Zone IV

Sieve size	Zone-1	Zone-2	Zone-3	Zone-4
10mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
0.6mm	15-34	35-59	60-79	80-100
0.3mm	5-20	8-30	12-40	15-50
0.15mm	0-10	0-10	0-10	0-15
Fineness modulus	4.0-2.71	3.37-2.1	2.78-1.71	2.25-1.35

Specific Gravity

The Specific Gravity of Sand and Coarse Aggregate is determined by using Pycnometer and Density Basket Method and found to be 1.93 and 2.28 respectively.

Table 4 Specific Gravity of Fine Aggregate (Sand)

Sr. No.	Particulates	Sample
1.	Wt. of pycnometer + Aggregate + Water (W_1)	01.813
2.	Wt. of pycnometer + Water (W_2)	01.497
3.	Wt. of Saturated Surface Dry Aggregate (W_3)	00.561
4.	Wt. of Oven Dried Aggregate (W_4)	00.475

Specific Gravity = $W_4/[W_3-(W_1-W_2)]$ = 1.938

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Table 5 Specific Gravity of Coarse Aggregate (Sand)

Sr. No.	Particulates	Sample
1.	Wt. of D. Basket + Aggregate + Water (W_1)	01.700
2.	Wt. of empty D. Basket in Water (W_2)	00.500
3.	Wt. of Saturated Surface Dry Aggregate (W_3)	02.066
4.	Wt. of Oven Dried Aggregate (W_4)	01.974

Specific Gravity = $W_4/[W_3-(W_1-W_2)]$
= 2.28

Mixing

First gravel and sand are added to an electrical mixer for one minute. The cement is then added into the mixer, followed by gradual addition of water, mixing is continued until a homogenous blend is formed.

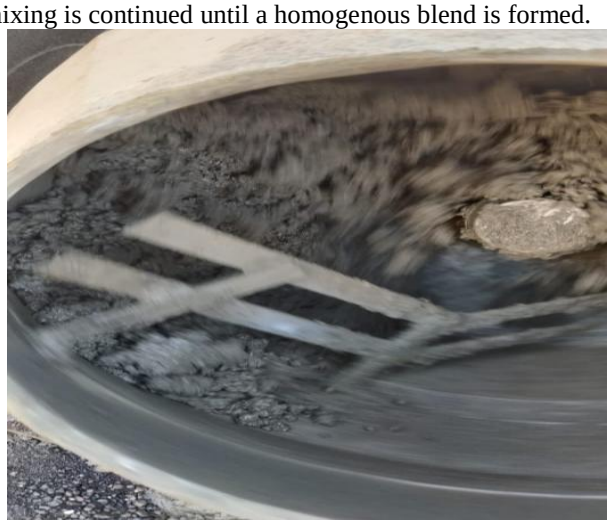

Figure 1: Mixing

Tests for fresh concrete: Slump Test

This test is used to determine the consistency of concrete. The consistency, or stiffness, indicates how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirements for the finished product quality. The slump test resulted values are within the range of 7 to 9 mm.

Figure 2 Slump Cone Test

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Casting

Moulds are cleaned and oiled before casting, and then they are put on the level area. The moulds are filled with the concrete mix of size 150mm*150mm*150mm. Concrete surface are levelled by trowel, and then marked. After casting, moulds are put on the level ground assuring no vibration or compaction, the moulds are kept in the laboratory for 24 hours.

Figure 3 Casting

Figure 3.4 Vibration of Mould

Curing

After a day of casting process, the moulds are removed, and concrete specimens are put into the curing tank for periods of 7 days.

Figure 5 Curing

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Tests for Harden of Concrete

The fifth and final process is to test the concrete hardness after
Strength and that is done after drying the samples for 30 minutes.

Compressive strength test

It is the most common of all tests on hardened concrete; in addition, compressive strength is the most important parameter in structural design.

Three standard cubes of 150mm* 150mm* 150mm are formed for each mix. Thecompressive strength test was carried out at ages of 7 days.

Figure 6 &7 Compression Testing Machine

V.RESULTS AND DISCUSSIONS

- Compressive strength at 7 days is:
- Cube 1: 18.53 N/mm^2
- Cube 2: 18.00 N/mm^2
- Cube 3: 19.15 N/mm^2

Average Compressive strength: 18.56 N/mm^2

Figure 8 &9 Failure of Mould

VI.CONCLUSION

- The project is based on mix design. The mix proportions were found out practically and the software based.
- Mix Design was performed on software bases in order to minimize error and to get accurate results.
- Software Mix Design has reduce the time of calculation and it gives the required proportions as per our strength.

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