Concrete Mix Design By IS:10262-2009 Using Computer Program

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Abstract: Today most of the calculations are done by using computer program/software. So, that the solution becomes more reliable and accurate. In the field of concrete technology, it is very difficult to judge the proportions of different ingredients.

In this work, computer program is made in Microsoft Excel, so that the solution becomes more accurate and faster. Designer can judge the proper proportion of ingredients of concrete.

Keywords: Concrete Mix, IS: 10262 -2009, IS: 456 - 2000, Compression Testing Machine (CTM)

I. INTRODUCTION

A concrete mix is a combination of six major elements in various proportions: cement, water, coarse aggregates, fine aggregates (i.e., sand), air and admixtures. A good concrete mix design creates the foundation of a sound infrastructure. Concrete mix design involves a process of preparation in which a mix of ingredients creates the required strength and durability for the concrete structure. Because every ingredient in the mix consists of different properties, it's not an easy task to create a great concrete mix. It is imperative that all ingredients be tested to determine their physical properties and the bearing capacity of the project location. The ingredients to be tested: Cement, fine aggregate (sand), coarse aggregate, Water and Admixture (If any). The values of the physical properties obtained after testing will be used as the basis for all concrete mix design considerations.

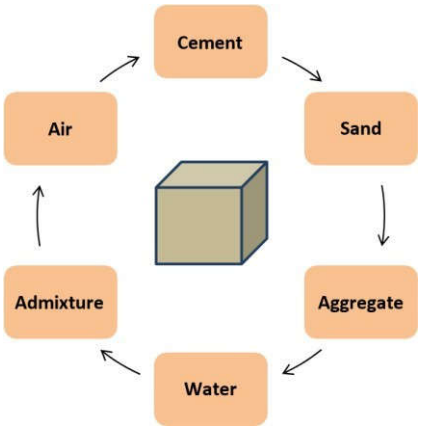

Figure 1. Concrete mix ingredients

This will ensure the structure will be sound and prevent failure of the mix. It is important to note that the ingredients for the mix might vary from one project location to another, so the physical properties must be tested for the requirements specified for each location.

II Important parameters of concrete mix design

- The grade designation giving the characteristic strength requirement of concrete.
- The type of cement influences the rate of development of compressive strength of concrete.
- Maximum nominal size of aggregates to be used in concrete may be as large as possible within the limits prescribed by IS 456:2000.
- Water/cement ratio is selected as per experience depending upon the grade of concrete.
- The cement content is to be limited from shrinkage, cracking and creep.
- The workability of concrete for satisfactory placing and compaction is related to the size and shape of section, quantity and spacing of reinforcement and technique used for transportation, placing and compaction.

III Computer Program Using IS:10262-2009

The following screenshots shows some important parameters to enter in this program:

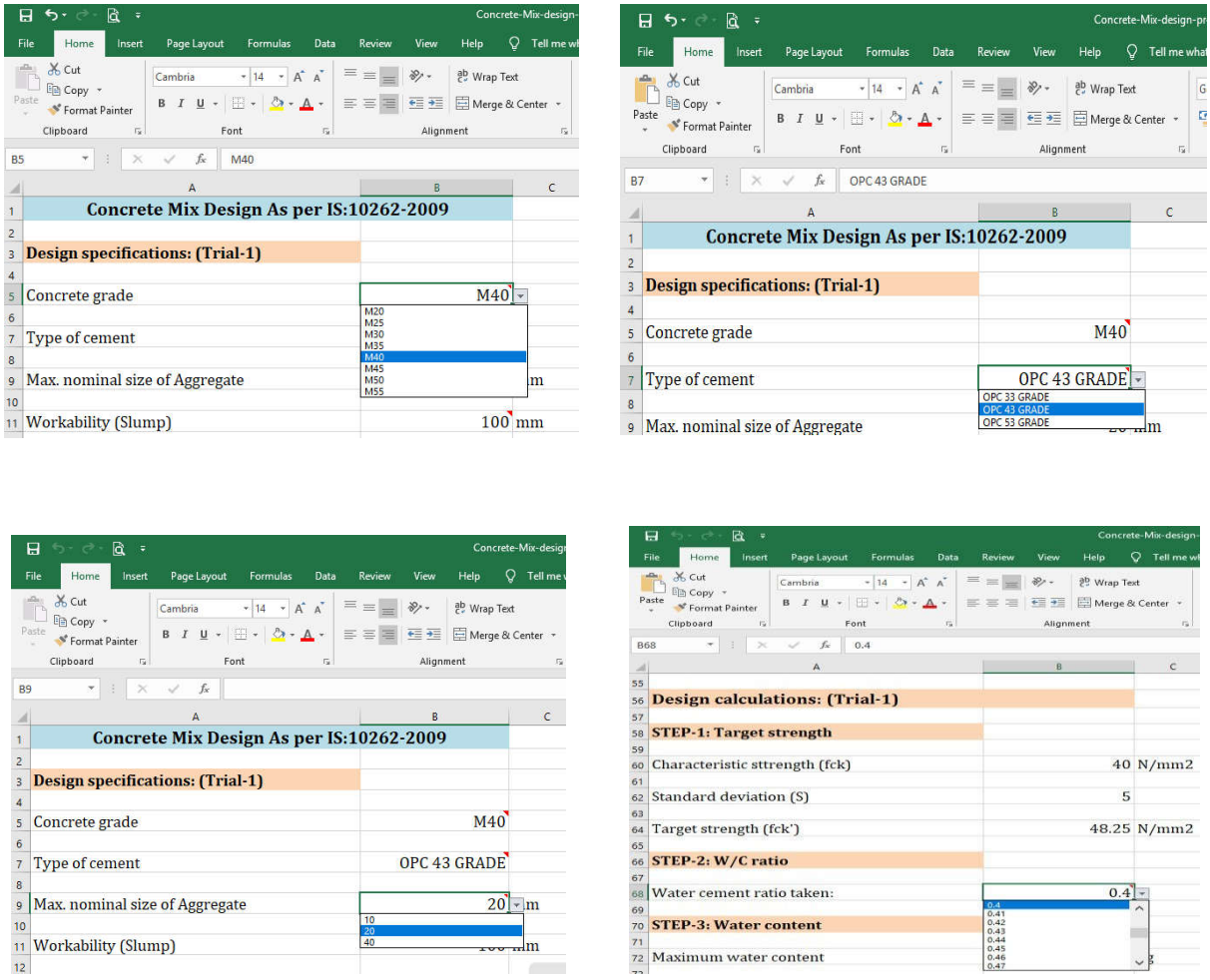

Figure 2. Concrete mix design program

IV Input data for Concrete mix design by program (Trial 1)

Concrete grade	M40
Type of cement	OPC 43 GRADE
Max. nominal size of Aggregate	20 mm
Workability (Slump)	100 mm
Exposure condition	Severe
Water cement Ratio (Max.)	0.45
Method of concrete placing	By Pump
Type of aggregate	Crushed Angular
Fine Aggregate (Zone)	Zone I
Specific gravity of Cement	3.15
Specific gravity of C.A.	2.74
Specific gravity of F.A.	2.74
Specific gravity of Water	1
Water absorption (C.A.)(-ve)	0 %
Water absorption (F.A.)(-ve)	0 %
Free moisture (C.A.)(+ve)	0 %
Free moisture (F.A.)(+ve)	0 %
Chemical admixure	Superplasticizer
Specific gravity of Admixure	1.145
Water content reducer	25 %
Volume of chemical admixure (As % by mass of cement)	2 %
Air voids	0 %
Coarse Aggregate (% contribution) 10 mm size	40 %
Coarse Aggregate (% contribution) 20 mm size	60 %
Coarse Aggregate (% contribution) 40 mm size	0 %

Table 1. Input data for Concrete mix design of M40 (Trial 1)

After entering all required data for mix design of M40, by using computer program one can see the result as per below table 2.

V Output data for Concrete mix design by program (Trial 1)

Step:1 Target Strength	**Value**	**Unit**
Characteristic strength (fck)	40	N/mm^2
Standard deviation (S)	5	
Target strength (fck')	48.25	N/mm^2
Step:2 W/C ratio		
Water cement ratio taken:	0.4	
Step:3 Water content		
Maximum water content	186	kg
Correction for type of Aggregate(-ve)	0	kg
Water content (after type of Agg.)	186	kg
Correction for slump (+ve)	11	kg
Correction for chemical admixure (-ve)	49	kg
Water content (Actual)	148	kg
Step:4 Cement content		
Minimum cement content (As per IS)	320	kg
Correction for Agg.size (Min.cement)	0	kg
Cement content (After correction)	320	kg
Cement content (Actual)	370	kg
Step:5 Volume of coarse aggregate		
Volume of C.A.	0.6	
Correction of C.A. for w/c ratio	0.02	
Volume of C.A. (After w/c correction)	0.62	
Correction of C.A. for concrete placing	10	%
Volume of C.A. (After correction)	0.56	
Step:6 Volume of F.A.		
Volume of F.A.	0.44	
Step:7 Concrete mix calculations		
Volume of concrete [a]	1.000	m^3
Volume of cement [b]	0.117	m^3
Volume of water [c]	0.148	m^3
Volume of chemical admixture [d]	0.006	m^3
Volume of total Aggregates [e]	0.728	m^3
Mass of C.A. [f]	1114	kg
Mass of F.A. [g]	882	kg

Step:8 Site corrections		
Actual moisture content (C.A.)	0	%
Actual moisture content (F.A.)	0	%
Correction for C.A.	0	kg
Correction for F.A.	0	kg
Correction for water content	0	kg
Final C.A.	1114	kg
Final F.A.	882	kg
Final water content	148	kg
Step: 9 Final mix proportions (Per m^3 of concrete)		
water	148	kg
cement	370	kg
Fine aggregate	882	kg
Coarse aggregate	1114	kg
Chemical admixture	7	kg
water cement ratio	0.40	
Coarse Aggregate: 10 mm size	445	kg
Coarse Aggregate: 20 mm size	668	kg
Coarse Aggregate:40 mm size	0	kg
Step: 10 Final mix proportions (Per m^3 of concrete)		
water	0.4	
cement	1	
Fine aggregate	2.39	
Coarse aggregate	3.01	
Chemical admixure	0.02	

Table: 2 Output of concrete mix design of M40 (Trial 1)

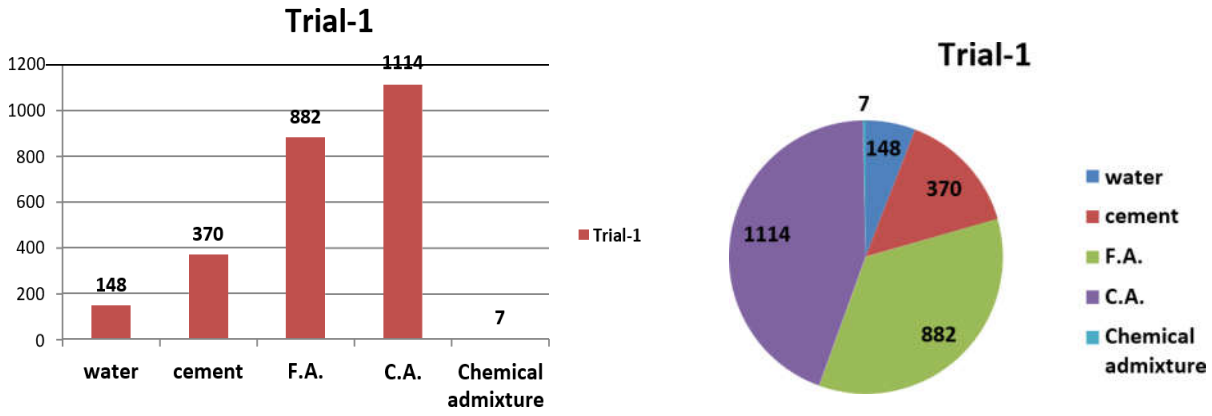

Chart: 1 Output of Trial 1

Above output shows the results obtained by computer program for Trial-1. Now, one can change the water cement ratio and keeping all other data same, the similar output can be obtained and compare the results of concrete mix design of M40 grade of concrete.

ELEMENTS	**TRIAL-1**	**TRIAL-2**	**TRIAL-3**
water	148	148	148
cement	370	361	352
F.A.	882	889	896
C.A.	1114	1115	1115
Chemical admixture	7	7	7
Water cement ratio	**0.40**	**0.41**	**0.42**

Table 3: Comparison of Results of three trials after changing the water cement ratio

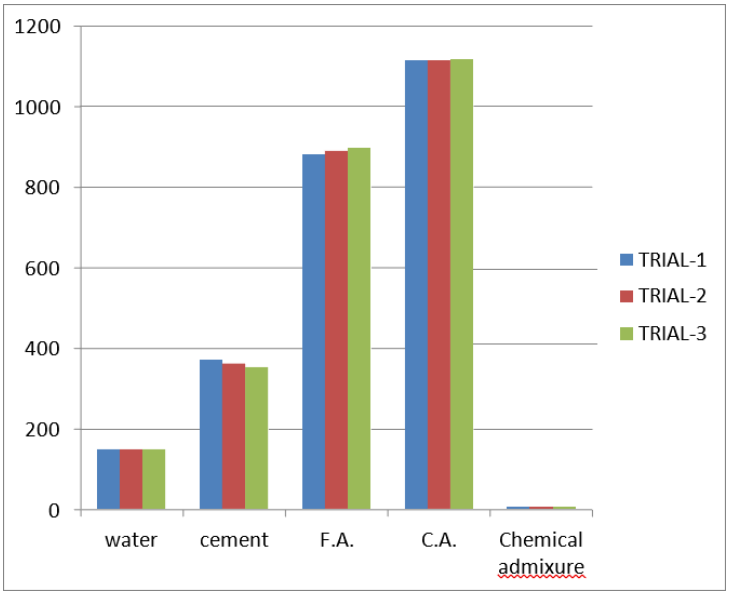

Chart 2: Comparison of Results of three trials after changing the water cement ratio

VI Experimental work

After getting results from computer program for M40 grade of concrete, experiment work for slump test is carried out for checking slump value as per concrete mix proportions.

Figure: 2 Experiment work of slump test for checking slump value

VII CONCLUSION

In this computer program, all guidelines as per IS: 10262-2009 is included and it gives reliable and accurate results. It helps to designer to judge the proper mix proportions for a concrete grade of **M20 to M55**. Moreover, instant results can be obtained by changing value of properties of each ingredient of concrete as per requirements of concrete mix design.

VIII REFERENCES

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