

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.

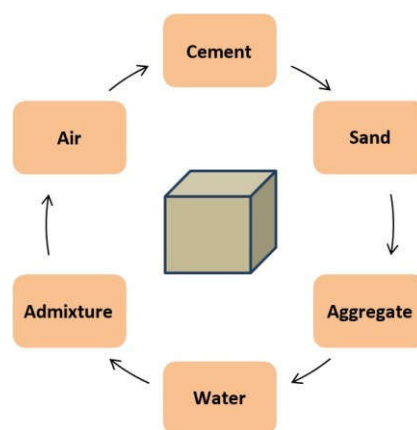


Figure 1. Concrete mix ingredients

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:

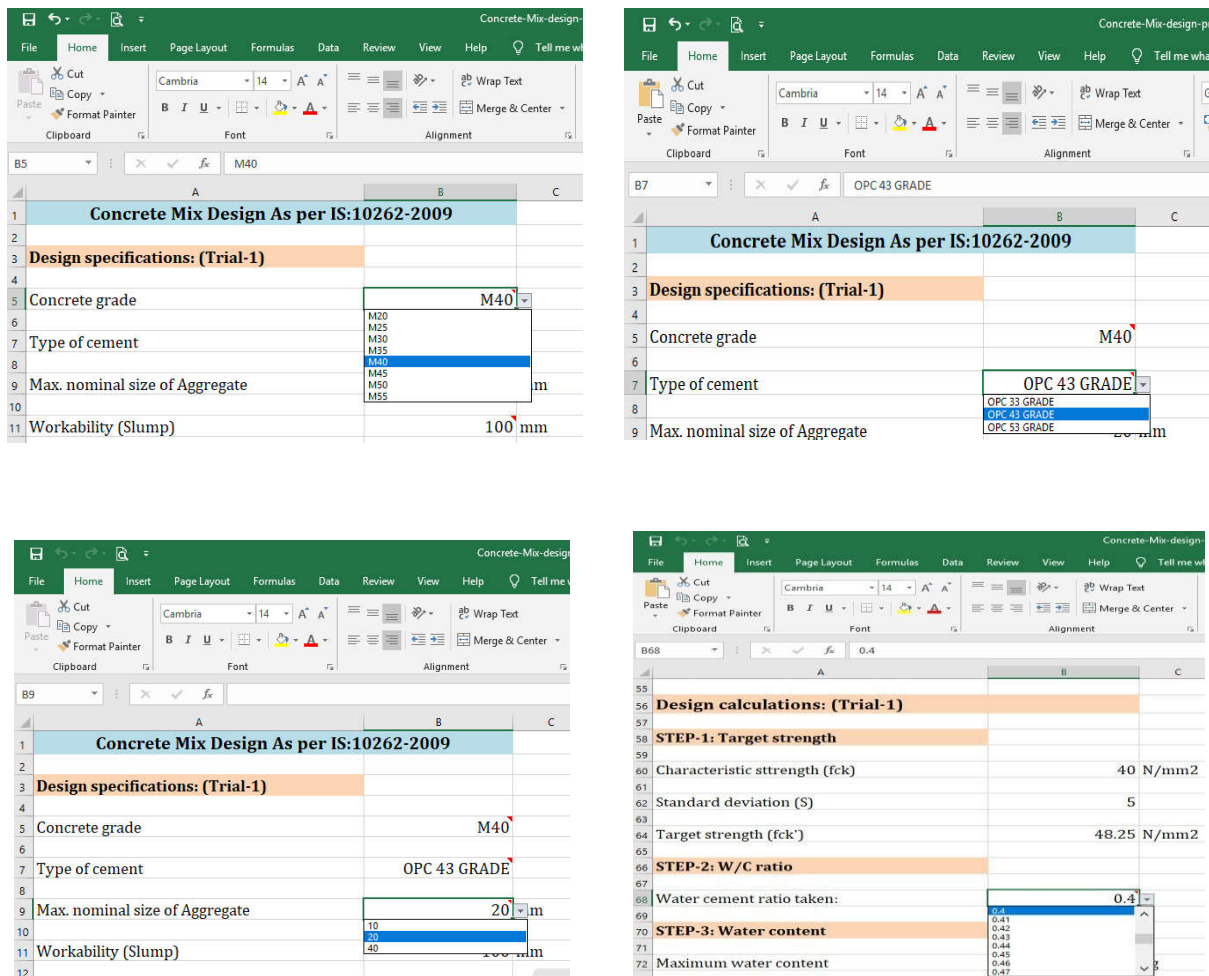


Figure 2. Concrete mix design program

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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 admixture | Superplasticizer |
| Specific gravity of Admixture | 1.145 |
| Water content reducer | 25 % |
| Volume of chemical admixture (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 admixture (-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 m³ 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 m³ of concrete) | | |
| water | 0.4 | |
| cement | 1 | |
| Fine aggregate | 2.39 | |
| Coarse aggregate | 3.01 | |
| Chemical admixture | 0.02 | |

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

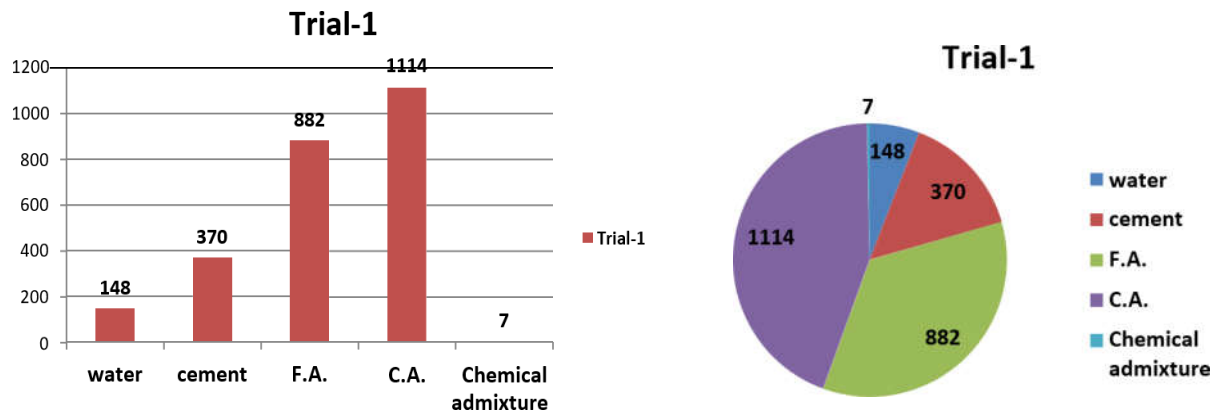


Chart: 1 Output of Trial 1

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

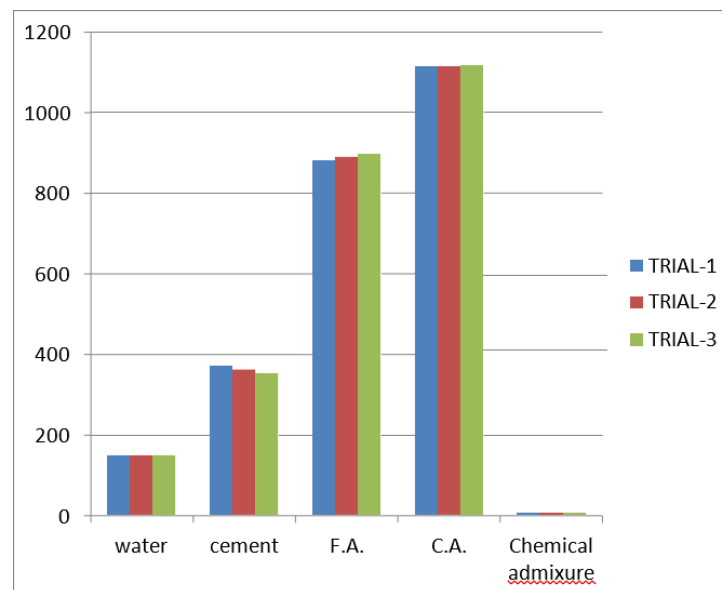


Chart 2: Comparison of Results of three trials after changing the water cement ratio

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

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