Engineering Properties of Ready Mix Concrete
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Abstract— Any type of construction works requires concrete as a basic material. The concrete mixture is made up of different ingredients like cement, sand, water, aggregates and admixtures. In the Indian countries, the use of RMC (Ready Mix Concrete) is increased due to its advantages in comparison with traditional concrete mixture. It is type of concrete which is produced under controlled conditions using consistent quality of raw materials. The advantage of RMC like speed of construction can be very fast, reduction in cement consumption by 10 to 12 percent due to better handling and proper mixing, versatility in using and methods of placing of concrete, it uses bulk cement instead of bagged cement so dust pollution will be less and reduced and with better durability of structure their overall service life is increased and there is saving in life cycle cost it is mostly used at the construction site. In this paper, the main focus is to check various engineering properties of materials which are used in the preparation of RMC. The tests are conducted in laboratories and results and its comparison is checked.

Key words: RMC (Ready Mix Concrete), Specific Gravity, Materials used in the Preparation of RMC at Plant

I. INTRODUCTION

Ready mix concrete is a concrete that is manufactured in a factory or in a batching plant according to a set recipe, and then delivered to a work site by truck mounted in transit mixtures. This results in precise mixtures, allowing concrete mixtures to be developed and implemented on a construction sites. The ready mix concrete is often preferred over on site concrete mixing because of the precision of the mixture and reduced work site confusion. RMC is specifically manufactured for delivery to the customer’s construction site in a freshly mixed and plastic or unhardened state. Concrete itself is a mixture of Portland cement, water and aggregates comprising sand and gravels or crushed stones. Ready mix concrete is bought and sold by volume—usually expressed in cubic meters. It is manufactured under controlled operations and transported and placed at site using sophisticated equipment’s and methods.

Ready Mix Concrete (RMC) is a specialized material in which the cement aggregates and other ingredients are weigh-batched at a plant in a central mixer or truck mixer, before delivery to the construction site in a condition ready for placing by the builder. Thus, ‘fresh’ concrete is manufactured in a plant away from the construction site and transported within the requisite journey time. The RMC supplier provides two services, firstly one of processing the materials for making fresh concrete and secondly, of transporting a product within a short time.

II. MATERIALS REQUIREMENT FOR PREPARING RMC MIX

- Aggregates: Aggregates are basic ingredients of any concrete mixture. It makes roughly 60 to 75 percent of Ready mix concrete volume, and obtained from aggregate quarries and aggregate banks.
- Additives: Additives are solid or liquid substances that can be added to ready mix concrete before or during preparation. Most commonly used additives either improve a hardened concrete’s durability or reduces water content in an effort to shorten setting time.
- Water: This is the mix’s vital fluid, which sets of a chemical reaction when it comes into contact with cement.
- Cement: No other material rivals cement’s importance in the mix, it is the ingredient that gives concrete its resistance.
- Concrete Mixing: During the mixing phase the different components comes to produce a uniform mass of concrete. Mixing time is registered from the moment material and water are poured into the cement mixer and it begins rotating. In the following figure 1 schematic diagram of RMC plant is given.

![Fig. 1: RMC Plant](image)

To check the engineering properties like strength, hardness, specific gravity, flakiness index, elongation index, dry bulk density and slump value of concrete mixture the following tests are performed on selected sample of concrete having M 20 grade, OPC 43 grade (as per IS 8112). Here the field condition is normal and no chemicals are used as additives. The tests are conducted under supervision.

III. TESTS ON MATERIALS

A. Test on Fine Aggregates

Sieve analysis test is performed on sample of fine aggregates. A gradation test is performed on a sample of aggregate in a laboratory. A typical sieve analysis involves a nested column of sieves with wire mesh cloth (screen). A representative weighed sample is poured into the top sieve which has the largest screen openings. Each lower sieve in the column has smaller openings than the one above. At the base is a round pan, called the receiver. The column is typically placed in a...
mechanical shaker. The following table 1 includes results of sieve analysis test.

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Retained (grams)</th>
<th>% Retained</th>
<th>Cumulative %</th>
<th>% finer</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.75</td>
<td>17.5</td>
<td>17.5</td>
<td>1.75</td>
<td>98.25</td>
</tr>
<tr>
<td>2.36</td>
<td>59</td>
<td>5.9</td>
<td>7.65</td>
<td>92.35</td>
</tr>
<tr>
<td>1.18</td>
<td>283</td>
<td>28.3</td>
<td>35.95</td>
<td>64.05</td>
</tr>
<tr>
<td>600mic.</td>
<td>198</td>
<td>19.8</td>
<td>55.75</td>
<td>44.25</td>
</tr>
<tr>
<td>300mic.</td>
<td>194</td>
<td>19.4</td>
<td>75.15</td>
<td>24.85</td>
</tr>
<tr>
<td>150mic.</td>
<td>111.5</td>
<td>11.5</td>
<td>86.25</td>
<td>13.75</td>
</tr>
<tr>
<td>Pan</td>
<td>137.5</td>
<td>13.8</td>
<td>100</td>
<td>00</td>
</tr>
</tbody>
</table>

Table 1: Sieve Analysis Test Results
- Result: From Table 2 of IS 383 the sample is from grading zone II

B. Test on Coarse Aggregates
Similarly sieve analysis test is performed on coarse aggregates sample. The following table 2 indicates results of coarse aggregates test.

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Retained (grams)</th>
<th>% Retained</th>
<th>Cumulative %</th>
<th>% finer</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 mm</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20 mm</td>
<td>569</td>
<td>11.38</td>
<td>11.38</td>
<td>88.62</td>
</tr>
<tr>
<td>12.5 mm</td>
<td>3661</td>
<td>73.22</td>
<td>84.6</td>
<td>15.4</td>
</tr>
<tr>
<td>10 mm</td>
<td>619</td>
<td>12.38</td>
<td>96.98</td>
<td>3.02</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>130</td>
<td>2.6</td>
<td>99.58</td>
<td>0.42</td>
</tr>
<tr>
<td>Pan</td>
<td>21</td>
<td>0.42</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2: Sieve Analysis Test Result for Coarse Aggregates
- Result: From Table 2, of IS 383 the sample is the single sized nominal aggregate

C. Specific Gravity Test on Coarse Aggregates
The following results are for specific gravity test on coarse aggregates. The specific gravity of any material is calculated to find the strength of material.

D. Experiment Result
- Saturated surface dry (SSD) sample weight (A) = 500.00 gm.
- Pycnometer + water + SSD sample (B) = 1847.00 gm.
- Pycnometer + water + SSD sample (C) = 1539.00 gm.
- Oven dry Sample (D) = 498.00 gm.
- Specific gravity = 2.5937 gm/cc

E. Aggregate Impact Value Test
This test is done to determine the aggregate impact value of coarse aggregates as per IS: 2386 (Part IV) – 1963. The apparatus used for determining aggregate impact value of coarse aggregates is Impact testing machine conforming to IS: 2386 (Part IV)-1963.IS Sieves of sizes – 12.5mm, 10mm and 2.36mm, A cylindrical metal measure of 75mm dia. and 50mm depth, A tamping rod of 10mm circular cross section and 230mm length, rounded at one end and Oven. From the test the AIV is calculated as 23.69 %.
- The dry loose bulk density of sample is calculated as 1248 gm/lit.
- The dry compacted bulk density is calculated as 1402 gm/lit.
- The following table3 indicates calculation of flakiness index for selected sample of coarse aggregates.

Table 3: Experiment Result for Flakiness Index
- The obtained value for flakiness index is 19.54 %.

The elongation index on an aggregate is the percentage by weight of particles whose greatest dimension (length) is greater than 1.8 times their mean dimension. The elongation index is not applicable to sizes smaller than 6.3 mm. The following Table 4 includes results of elongation test.

<table>
<thead>
<tr>
<th>Passing through IS sieve</th>
<th>Retained on IS sieve</th>
<th>Weight of Sample retained</th>
<th>Weight of Sample passed</th>
<th>Total weight of the sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>20</td>
<td>1947</td>
<td>361</td>
<td>2308</td>
</tr>
<tr>
<td>20</td>
<td>16</td>
<td>1278</td>
<td>246</td>
<td>1524</td>
</tr>
<tr>
<td>16</td>
<td>12.5</td>
<td>501</td>
<td>276</td>
<td>777</td>
</tr>
<tr>
<td>12.5</td>
<td>10</td>
<td>283</td>
<td>75</td>
<td>356</td>
</tr>
<tr>
<td>10</td>
<td>6.3</td>
<td>104</td>
<td>41</td>
<td>145</td>
</tr>
</tbody>
</table>

Table 4: Elongation index of coarse aggregates
- The obtained value of elongation index is 6.96%.

IV. Tests on Fresh RMC
After the fresh concrete is prepared Slump test is performed on concrete. Slump test is the most commonly used method of measuring workability of concrete which can be employed either in laboratory or at site of work. It is not a suitable method for very wet or very dry concrete.

![Fig. 2: Slump test apparatus](image)
V. ADVANTAGES OF USING RMC IN CONSTRUCTION WORK

- Better quality concrete is produced
- Elimination of storage space for basic materials at site
- Elimination of Procurement / Hiring of plant and machinery
- Wastage of basic materials is avoided
- Labor associated with production of concrete is eliminated
- Time required is greatly reduced
- Noise and dust pollution at site is reduced
- Organization at site is more streamlined
- Durable & Affordable
- No storage space required either for raw materials or for the mix
- No wastage at site.
- Environment friendly

REFERENCES

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