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Study of Strength of Demolished Concrete in Construction

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Abstract: Huge quantities of construction and demolished waste are generated every year in developing countries likes India . the disposal of this waste concrete requires a large area to get disposed, recycle allow to utilize that area for other meaningful purposes. Reuse of waste concrete involves breaking, crushing and removing contaminated & irrelevant materials from existing concrete, the target of the present thesis work is to determine the strength characteristics recycled aggregate for the application in concrete pavement construction. The scope of the thesis is to determine and compare the compressive strength, flexure strength and sulphate resistance of concrete by using different percentages of recycled aggregate .
Keyword: Demolished, Contaminated, Irrelevent, Pavement, Utilize.

I. INTRODUCTION

Concrete is the most widely used man-made construction material in the world .It is obtained by mixing materials, water aggregate and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape hardens into a rock –like mass known as concrete. The hardening is because of chemical reaction between water and cement, which continues for long period leading to strong with age. Concrete have two type ingredients namely active and inactive. The active group consists of water and cement. The inactive part consists of sand and coarse aggregates. Concrete have high compressive strength and low tensile strength. To overcome this shortcoming, steel reinforcements are used along with the concrete. This type of concrete is called reinforced cement concrete (RCC).

II. OBJECTIVE OF THIS STUDY

The study on use of demolished concrete in pavement construction consists of conducting laboratory investigations on cement concrete prepared by using demolished concrete to estimate its suitability for pavement construction. The main objectives of study are:

A. To prepare mix design for M40 concrete with varying proportions of recycled aggregates.
B. To determine the compressive strength of the samples at the end of 7, 28, 56 and 90 days.
C. To determine the flexural strength of the samples at the end of 7,28, and 90 days.

III. LITERATURE REVIEW

Kumar, Satish, 2002 Recycled aggregates are used as base, sub base course and sometimes for foundation purpose also. In USA, the use of recycling technology in a number of full scale pavement rehabilitation projects has been accomplished since 1976 .
Kumar, Satish, 2002 recycled concrete was first used in 1976 for the production of new concrete where a 41 years old pavement was crushed and demolished concrete was used In other construction of 17 mile long and 20 cm thick highway pavement, crushed concrete was used in Lowa in 1978.
Shayan 2003 to resist compression loads is called Compressive strength. It is found that the use of RCA in the concrete mix decreases compressive strength compared to natural aggregate. But it is also found that, at 28 days, all mix designs usually exceed 50MPa compressive strength.
Shing Chai NGO, 2004 Initially recycled aggregates were used as landfills but now a day they are also used for constructions for building and roads. Recycled aggregates have been used as concrete kerb and gutter mix in Australia.
Shing Chai NGO, 2004 doing Market development study for recycled aggregates products stated that recycled aggregates can be used in embankment fill. The embankment site is on the wet sub grade areas, recycled aggregates can stabilize the base and provide an improved working surface for the remaining work.

IV. MIX DESIGN

As per design of concrete mix M40, the ratio of cement, fine aggregate and coarse aggregate was taken as 1:1.23:2.52 respectively.

A. *Mix design M40 Grade*

Mix design is the process of finding the proportion of concrete mix in terms of ratios of cement, sand and coarse aggregates.
Parameters for mix design – M40 :- Grade Designation M40 Grade of cement =43grade Fine aggregate =Zone II
Max. Size of crushed aggregate =20mm Value of statistical coeff. (K) =1.65 Value of standard deviation (S) =5
Sp. Gravity of cement = 3.26
Sp. Gravity of Fine Aggregate =2.79
Sp. Gravity of Coarse Aggregate (10mm) =2.59 Sp. Gravity of Coarse Aggregate (20mm) =2.73

B. *Mix Calculation*

1) Target Mean Strength = fck + (1.65S) = 40 + (1.65×5S) =48.25
2) *Selection Of Water Cement Ratio;* Max w/c specified by durability=0.5(Refer IS 456:2000) Hence adopt water cement ratio=.38
3) *Calculation Of Water Content:* Approximate water content for 20mm max .size of aggregate =186kg/m^3 (as per IS :10262) Now water cement =186kg/m^3
4) *Calculation Of Cement Content:* Water cement ratio=.38 Cement content per m^3 of cement = 186/.38=489 Cement content =(as per design minimum cement content 400/m^3) Hence ok. Admixture 0.65% by wt.of cement =489×.65/100=3.18 kg
5) *Aggregate;* Volume of concrete=1m^3
   Volume of cement =489/(3.26×1000)=0.15m^3 Volume of water=186/(1×1000)=.1860 kg/m^3 Volume of admixture 3.18/(1.15×1000)=.002765m^3

Total wt. of other material except aggregate=.15+.1860+.002765=.3387m^3 Volume of coarse & fine aggregate=1-.3387=.6613m^3 Volume of fine aggregate=.6613×.38=0.2513m^3 (Assume 40%by volume of total aggregate) Volume of coarse aggregate .6613-.2513=0.41m^3
As per design of concrete mix , the ratio of cement, fine aggregate and coarse aggregate was taken as1:1.6:2.35 respectively.

V. CASTING OF SPECIMENS

As discussed in section 4.1, five batches of mixes were prepared as per the mix design of M40. First mix named m0 was taken as control mix. The ratio is 1:1.6:2.35 for cement, fine aggregates and coarse aggregates respectively. Water cement ratio was taken as 0.38 with the super plasticizer (0.65%of cement). Five batches of concrete mix were prepared with varying proportion of recycled coarse aggregates as discussed earlier . After preparing the batches, workability of concrete was measured by slump test and compaction factor test. The test samples were 150mm×150mm× 150mm cube for compressive strength, 100mm×100mm×500mm beam for flexural strength and 150mm×150mm×150mm cube for sulfate resistance. The samples were cast according to IS: 516-1959.

VI. TESTING PROCEDURE

After casting samples were kept in water for curing for specified period. In case of sulphate resistance testing, cubes were kept in sulphate solution after keeping them in water for 28 days. Sulphate solution curing was done for specified time period.

1) Compressive strength of cubes at the age of 7 & 28 days.
2) Flexural strength of beams at the age of 7 & 28 days.
3) Sulphate resistance of cubes at the age of 7, 28 and 56 days.

A. *Compressive Strength*

The dried cubes were tested at the age of 7& 28 days. The cubes were tested on compression testing machine (CTM) after drying at room temperature as per IS: 516-1959 as shown in Figure 6.1. The load was applied at rate of 350MPa/minute in a uniform and continuous manner. Impacts were prevented during the application of load. Application of load was kept continued until the sample failed and maximum load carried by the sample was recorded. Three samples for each test reading were tested. Final value of test is taken as an average of three samples.

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Figure 6.1 Test for Compression Strength In CTM.

B. Flexural Strength

The dried beams were tested on flexural testing machine using two points loading. The transverse bending test was employed. Flexural strength was calculated as per equation 6.1 for a rectangular sample under a load in a two-point bending setup (as shown in Figure 6.2) where the loading span was one-third of the support span:

$$\sigma = \frac{FL}{bd^2}$$

Figure 6.2 Test For Flexural Strength

The tests were conducted at the age of 7,28 and 90 days. Three test samples were tested for each final value. The average value of three samples was taken as the final flexural strength.

C. Sulphate Resistance

Test cubes were cured in water for 28 days before submerging to sulphate solution ($MgSO_4$). Cubes were tested in CTM machine after 7,28 and 56 days for checking the compressive strength. 2 samples were tested for each final value of compressive strength.

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