Experimental investigation of rigid pavement using demolished waste

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ABSTRACT - There is a large amount of demolished waste generated every year in India and other developing countries. Since very small amount of this waste is recycled or reused. So, disposing this waste is a very serious problem because it requires a large amount of space. This project is experimented to reduce the cost of concrete. Aimed at the study, design mix of grade M25 was prepared using IS10262-2009. Thereafter, the replacement of different constituents of concrete, one at a time was carried out by replacing these with the different sieved fractions of crushed demolition waste. The demolished concrete was mixed with the concrete in 10%, 15%, 20%. Cubes were casted with concrete mixes and subjected to curing for 7 days, 14 days, 28 days and their strength is determined. Test result shows that the strength of the concrete increase when the demolished waste is replaced, as the demolished concrete percentage increased the strength of the concrete also increase. For reducing the cost and natural aggregate we can replace with the demolished concrete, so that the strength of the concrete increase.

Keywords: coarse aggregate, demolished concrete

INTRODUCTION

Due to rapid development of industries and urban areas waste generation is also increases, which is unfavorably carrying out the environment. At present, in India 27.8% of the total population living in cities, which is 13.8% more than the year of 1947. There is a shortage of about 55,000 million m 3 due to the construction of new infrastructure which shows that the demand of the aggregates in future increases. 750 million m 3 additional aggregate is required to fulfill the demand of the road sector. There is a huge gap between the demand and the supply of the aggregates because giant amount of aggregates is required in the housing and transportation nowadays. During construction waste generated is about 40 kg per m 2 to 60 kg per m^2. Similarly, during renovation, repair and maintenance work 40 kg/m 2 to 50 kg/m 2 waste is generated. The waste generated due to demolition of the building is highest among all the wastes. If we demolish permanent building about 300kg/m^2 waste is generated and in case of demolition of semi-permanent building 500kg/m^2 waste is generated. At present, demolished material are dumped on land or treated as waste, which means they cannot be utilized for any purpose. If we put the demolished waste on land then the fertility of the soil get decreases. 23.75 million tons of waste is generated annually in India in the year of 2007 according to Hindu Online. According to CPCB (Central Pollution Control Board) Delhi, 48 million waste is generated from the construction waste from which only 3% is utilized in the construction of the embankment. In 100 parts of the construction waste 40 parts are of concrete, 30parts of ceramics, 5 parts of plastics, 10parts of wood, 5 parts of metal and 10 parts of some other mixed compounds. There is a huge demand of construction aggregate which is more than 26.8 billion in all over the world. There is a quiet increment in the utilization and demand of the natural aggregates in India due to housing, road, construction and infrastructure development. Cement versatility, durability, sustainability and economy have made it the world's most widely used construction material. The term concrete refers to a mixture of aggregate, usually sand and either gravel or crushing stone, held together by a binder of cementitious paste. The paste is typically made up of Portland cement. Demolished concrete aggregate (DCA) is generally produced by the crushing of concrete rubble, then screening and removal of contaminants such as plaster, paper, reinforcements, wood, plastics. Concrete made with this type of recycled demolished concrete aggregate is called Demolished aggregate concrete (DAC). The main purpose of this work is to determine the basic properties of DAC made of coarse recycled demolished concrete aggregate then to compare them with the properties of concrete made with natural aggregates concrete.

As the demolished aggregate is lighter than the natural aggregate so the concrete made from such aggregate possesses low density but the water absorption of the demolished aggregate is higher than the natural aggregate and the strength of the demolished aggregates is somehow lesser than the natural aggregates. So concrete made from these demolished aggregate can be utilized where more strength is not required. e.g. Pavements, sidewalls, etc.,

MATERIALS AND METHODOLOGY

Raw materials required for the concreting operations of present work are cement, fine aggregate, coarse aggregate, demolished concrete and water.

CEMENT

Cement is used as a binding material where the strength and durability are significantly important. Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the

different construction that forms the compacts assembly. The chief chemical composition of Ordinary Portland Cement is calcium, silica, alumina and iron and the raw materials used for the manufacturing of cement .

FIG 1 MIXING OF CONCRETE

The Ordinary Portland Cement of 53 grade calcareous & argillaceous materials along with conforming to IS: 12269-1987 is used in the manufacture of concrete. Also some tests were conducted such as consistency test, setting time test and specific gravity test. Ordinary Portland cement of 53 grades is used and on batch is utilized throughout the work. This ordinary cement consists of two materials namely argillaceous and calcareous.

Property	IS Code (IS8112:1989)
Specific gravity	3.12
Consistency	33
Initial setting time	Not less than 30 minutes
Final setting time	Not greater than 600 minutes

COURSE AGGREGATE

Aggregates are the important constituents of concrete. They play a major role in the body of the concrete, reduce shrinkage and effect economy. Aggregates occupy 70-80 percentage of the volume of concrete and hence their impact on various characteristics and properties of concrete is undoubtedly considered. Here, in this project we have used 20mm size aggregate in the casting of the beams. The Specific gravity, Finess modulus, Water absorption and Impact tests on coarse aggregate were performed.

FINE AGGREGATE

Fine aggregates are basically sands won from the land or the marine environment. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through 9.5mm sieve. Sand can also be referred as the naturally occurring granular material composed of finely divided rock and mineral particles. The composition of sand varies according to the local rock source and conditions, but the most important constituent is silica usually in the form of quartz. Sand is a non-renewable resource over human timescales, and sand suitable for making concrete is in high demand.

WATER

Water plays an important role in mixing, laying, and compaction, setting and hardening of concrete. Water influences the strength development and durability of concrete. Ordinary potable water with p H not less than 6 and conforming to the requirements to IS456:2000 was used. Guidance to examine the suitability of water for different constructions can be obtained from the above code. Water cement ratio of 0.45 was used in the recycled concrete and for this purpose normal water was used for mixing and curing purpose.

SPECIFIC GRAVITY

The specific gravity in saturated surface dry condition of demolished concrete aggregate was found from 2.5 which is less but satisfying the results. If specific gravity is less than 2.4, it may cause segregation; honeycombing & also yield of concrete may get reduced.

WATER ABSORPTION

The DCA from demolished concrete be made of crushed stone aggregate with old mortar adhering to it, the water absorption ranges from 0.32%, which is comparatively more than that of the natural aggregates. Thus the water absorption results are satisfactory.

BULK DENSITY

The bulk density of demolished aggregate is lower than that of natural aggregate, thus results are not satisfactory; due to low Bulk Density the mix proportion gets affected.

EXPERIMENTAL INVESTIGATION

Replacement proportions for various Concrete

TABLE 1

S. No.	Concrete type	coarse aggregate replacement with demolished waste
1	C1	Standard concrete
2	C2	10% replacement
3	C3	15% replacement
4	C4	20% replacement

MECHANICAL PROPERTIES

Compressive strength test:

The compressive strength of cubes and cylinders are tested by using the compressive testing machine by applying the load at the rate of 30N/mm2 per minute. The average test result values are tabulated and comparative studies were made on the both normal and partially replaced concrete cubes of 10%, 15%, 20%

TABLE 2

Specimen Type	Compressive strength in N/mm2 (Cube)		
	7 Days	14 Days	28 Days
C1	21.25	23.61	26.18
C2	21.98	24.65	29.14
C3	23.12	26.12	31.20
C4	25.36	26.91	34.26

GRAPH

Compressive strength on concrete

GRAPH 1

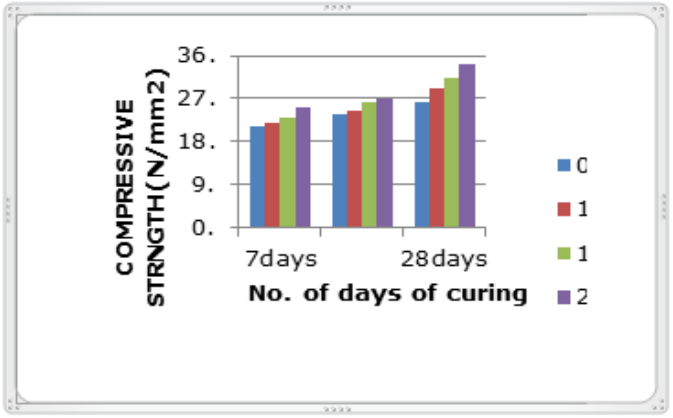

FIG 2 - 20% REPLACED MATERIALS

CONCLUSION

- The result shows that, strength of the concrete increase when the demolished waste is replaced with the coarse aggregate.

- As the demolished concrete percentage is increased the strength of the concrete also increase.
- For reduce the cost and natural aggregate we can replace with the demolished concrete, so that the strength of the concrete increase.

REFERENCE

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