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Utilization of Demolish Brick and Marble Waste in Concrete For Partial Replacement of Coarse Aggregate

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Abstract: ***The demand for construction material is increasing every day. Concrete is widely used in construction. In this research waste, Brick & Marble is used as coarse aggregate produced from the demolition of the building which is waste material. We can use this waste material as coarse aggregate. Waste Brick and marble are economic as compared to natural aggregate & reduce the waste generated by the demolition of the building. This study aimed to investigate the suitability of using brick ballast and marble waste in concrete. Three replacement levels 10%, 20% and 30%, were compared with the conventional concrete. The tests on concrete showed that the mechanical properties (compressive and splitting tensile strengths) of concrete containing waste brick ballast and marble ballast were well comparable to those of the concrete without brick ballast. The production of normal aggregates and building stones through quarrying is an expensive process. Quarrying involves deep excavation and blasting of rocks. This has created an unpleasant environment by leaving scars on the land. Brick ballast and marble waste products chips when crushed to the required nominal sizes such as 10mm, 14mm, 20mm, etc. provide a rough and irregular surface which aids in the bonding of cement paste and the aggregate. Therefore the bond strength of concrete is likely to be increased when these aggregates are used. Careful consideration of the water absorption of brick ballast aggregates will be taken in the mix design to ensure that the workability of the mix is achieved.***

Keyword: Demolished Brick & Marble Waste1, Slump Test2, Compressive & Split Tensile Strength3.

1 INTRODUCTION

Concrete is produced by mixing cement, sand, coarse aggregate and water to produce material that can be molded into almost any shape. The major volume concrete is filled with aggregate. The inclusion of aggregate in concrete reduces its drying shrinkage properties and improves many other properties such as compressive strength etc. But it is costly to transport, so local sources are needed to reduce the cost of transport, but due to geographical constraints this is not available at all places, therefore it necessitates finding other sources and alternative from local sources. The many materials are used as an alternative source of natural coarse aggregate such as recycled low quality crushed brick, recycled coarse aggregate, coconut shell, recycled plastic aggregate, well-burnt brick, marble waste etc. For this work select a demolish brick and marble waste as an alternative source of coarse aggregate. This material was chosen because of the demolition of the building, a large number of bricks and marble are rejected.

These rejected bricks can also be a potential source of coarse aggregate. There is a shortage of about 55,000 million m3 due to the construction of new infrastructure which shows that the demand for the aggregates in future increases. 750 million m3 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 the giant amount of aggregates is required in the housing and transportation nowadays. During construction waste generated is about 40 kg per m2 to 60 kg per m2. Similarly, during renovation, repair and maintenance work 40 kg/m2 to 50 kg/m2 waste is generated. The waste generated due to the demolition of the building is highest among all the wastes. If we demolish permanent building about 300kg/m2 waste is generated and in the case of Demolition of semi-permanent building 500kg/m2 waste is generated. In 100 parts of the

construction waste 40 parts are of concrete, 30parts of ceramics, 5 parts of plastics, 10 parts 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. During the time of Second World War, the use of demolished concrete waste was started, it was utilized in the construction of the pavements. According to Union Environment Ministry, 12 million tons of the construction and demolition waste is generated in the year of 2013 but the current method adopted for the management of this waste is landfill mainly which causes a giant amount of the construction and demolished waste deposition and such huge amount affect the environment adversely. In India concrete, bricks, sand, mortar, and tile residues are the main materials found in the demolished waste of buildings. This waste can be recycled or process into the recycled demolished aggregates which can be utilized in the concrete mixes. The main purpose of this work is to determine the basic properties of concrete made of coarse recycled demolished brick and marble aggregate than to compare them with the properties of concrete made with natural aggregate concrete.

Objective

The aim of this study is to investigate the use of demolished brick and marble ballast aggregate in concrete Production.

- To investigate the mechanical and physical properties of brick & marble waste in concrete.
- To compare the performance of concrete with brick & marble waste as coarse aggregate partial replacement and conventional concrete.
- To study the utilization of demolished waste as a replacement of natural coarse aggregate.

2 METHODOLOGY

In this experimental methodology was followed. Firstly study material collected & studied carefully and materials are collected and the preliminary tests are conducted on materials. Based on the preliminary tests concrete mix was designed and for particular grade concrete the specimens were cast, tested and the results were concluded. The methodology adopted for this study is as shown in Figure below.

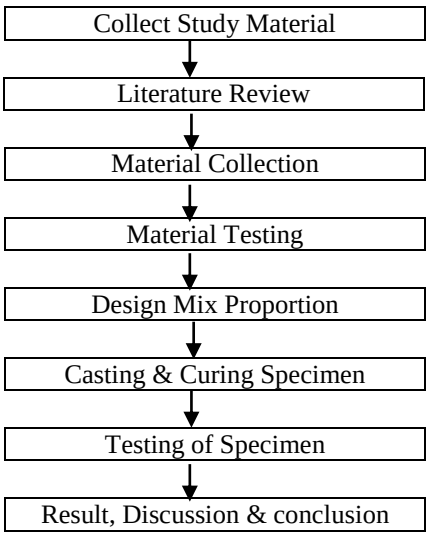

Fig. 1 Experimental Methodology

Material Used

The Ordinary Portland Cement of 43 grade OPC conforming to IS: 8112-1989 is used. The cement has uniform color i.e. grey with a light greenish shade and was free from any hard lump. The specific gravity of cement is 3.15. Normal consistency is 31% Initial and final setting time is 85 & 340 min respectively.

Fine Aggregate:

The sand used for the experimental program was locally procured and confirmed to grade zone II as per Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust. The specific gravity and water absorption are 2.7 and 0.99 and fineness modulus is 2.5.

Coarse aggregate:

The coarse aggregate with a maximum size 20mm having a specific gravity 2.65 and fineness modulus of 7.25 and water absorption of 0.6%.the aggregate crushing value is 17.29% and aggregate impact value 13.31%.

Demolished Brick and Marble aggregate:
Demolition wastes are obtained from a local building that has been demolished. The aggregates passing through IS sieve 20mm and retained on 12.5mm are taken. The specific gravity of brick and marble aggregates is 1.73 and 2.64 and water absorption of brick and marble aggregate is 14.5% and 0.55%.

Water:
Water used for mixing and curing shall be clean and free from injurious amounts of Oils, Acids, Alkalis, Salts, Sugar, Organic materials, Potable water is generally considered satisfactory for mixing concrete Mixing and Curing with sea water shall not be permitted. The PH value shall not be less than 6.

Mix Ratio:
The mix designed was prepared according to the IS-10262:2009 recommendation for concrete mix design. 1:1.7:2.46 mix proportioning ratio was determined for targeted strength of 38.25 MPa For all cases 0.45 water/cement (w/c) ratio was used. And got a quantity of material for this mix ratio:

Table 1. Quantity of material

	Cement	fine aggregate	coarse aggregate	water
quantity (kg/m^3)	425.73	727.16	1050.34	191.58
Ratio	1	1.70	2.46	0.45

Table 2 Mix Proportion

	Cement (kg/m^3)	Brick Ballast (Kg/m^3)	Marble Waste (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	water content (kg/m^3)
MIX I	425.73	0	0	727.16	1050.34	191.58
MIX II	425.73	52.51	52.51	727.16	945.30	191.58
MIX III	425.73	105.03	105.03	727.16	840.28	191.58
MIX IV	425.73	157.55	157.55	727.16	735.23	191.58

A careful procedure is adopted in the batching, mixing, and casting operations. The coarse aggregates and fine aggregates were weighted first with accuracy. The concrete mixture is prepared by mixing machine on a watertight platform. Six clean and oiled molds for each category were then placed on the vibrating table respectively and filled in three layers. The vibration was stopped as soon as the cement slurry appeared on the top surface of the mould. The specimens were allowed to remain in the steel mould for the first 24 hours at ambient condition. After that, these were remolded with care so that no edges were broken and placed in curing tank at ambient temperature for curing. The ambient temperature for curing was 20 ± 27C. The specimens were brought out from water approximately 24 hours before testing and kept at room temperature till testing.

3 RESULTS AND DISCUSSION

(a) Workability Test:

To find the workability of demolished brick and marble bat based concrete by the slump Test.

Table 1 Slump Result

Mix description	Percentage of brick & marble waste in %	Slump Value (mm)
Mix I	0	65
Mix II	10	57
Mix III	20	52
Mix IV	30	46

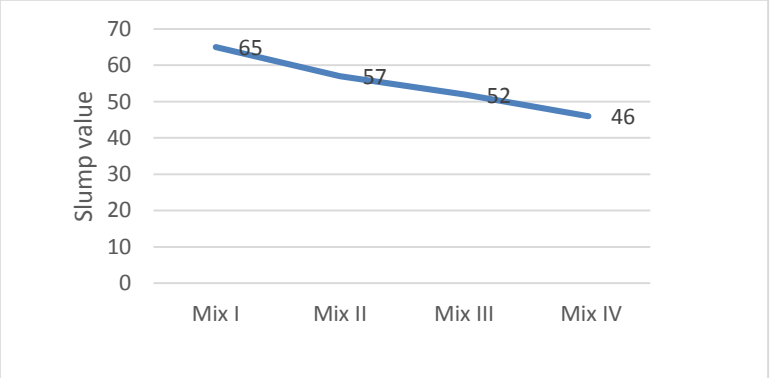

Fig. 2 slump value of various concrete mix

(b) Compressive Strength Test:

Compressive Strength Test Result Shown In Table Below

Table 2 Compressive Strength Result

Sr. No.	Replacement in %	Compressive strength in N/mm^2	
		7days	28days
Mix I	0	25.5	30.25
Mix II	10	17.33	22.06
Mix III	20	19.65	23.59
Mix IV	30	27.96	34.06

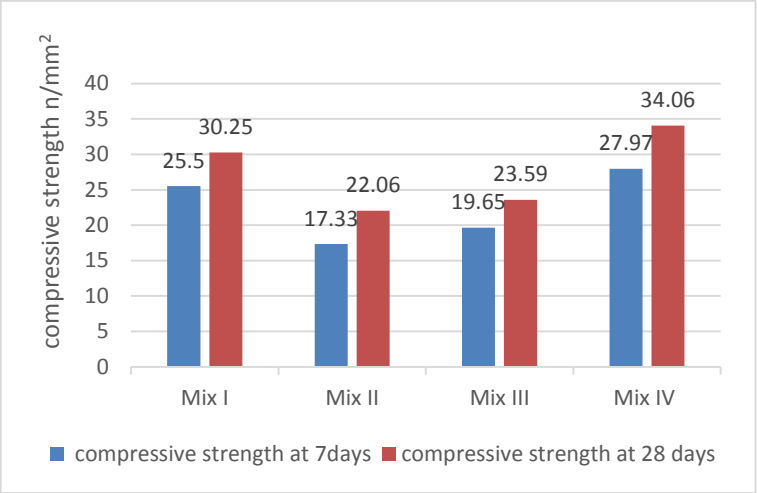

Fig. 2 Compressive strength of concrete with varying amount of demolished waste at 7 and 28days

(c) Split Tensile Strength

Split tensile Strength Test Result Shown in Table Below

Table 3 Split tensile Strength Result

Sr. No.	Replacement in %	Split tensile strength in N/mm^2
		28days
Mix I	0	2.43
Mix II	10	2.15
Mix III	20	2.31
Mix IV	30	2.3

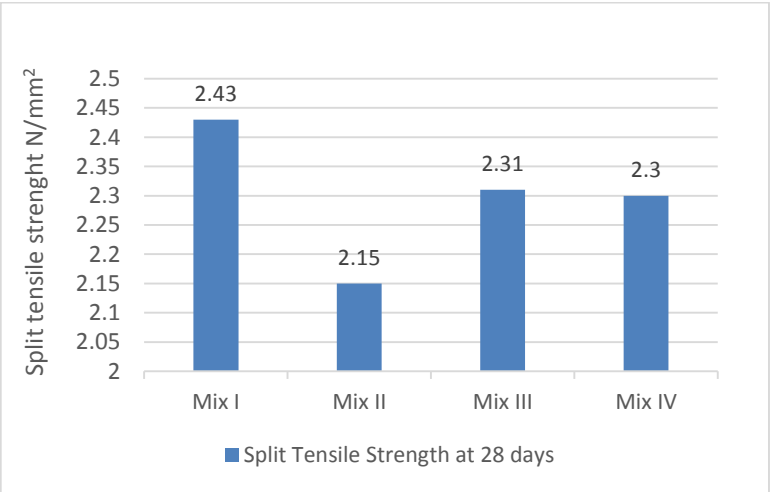

Fig. 3 Split tensile strength of concrete with varying amount of demolished waste at 28days

CONCLUSI0NS

- Use of such waste materials not only cuts down the cost of construction but also contributes in safe disposal of waste materials
- Concrete made by using demolished brick and marble as a coarse aggregate, initially it gives the low compressive strength 32.03% and 22.94 for the replacement 10% and 20% at the age of 7 days.

- The compressive strength was found 2.46% higher than that of conventional concrete when the coarse aggregate is replaced by 30% by demolished brick and marble aggregate at the age of concrete 7 days.

- The compressive strength was found 27.07%, 22.01 lower than that of conventional concrete when the coarse aggregate is replaced by 10% and 200% by demolishing brick and marble aggregate respectively at the age of 28 days.
- The compressive strength was found 12.59% higher than that of conventional concrete when the coarse aggregate is replaced by 30% by demolishing brick and marble aggregate at the age of concrete 28 days.
- Split Tensile strength of demolishing brick and marble based concrete was lower by 11.52%, 4.93%, and 34% than that of conventional concrete for the replacement of 10%, 20%, and 30%, at the age of concrete 28 days.

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