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Experimental Investigation on Concrete Made Use of Demolished Brick Waste as a Fine Aggregate & Demolished Concrete Waste as a Coarse

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ABSTRACT: Concrete is the material which is being used in infrastructure development throughout the world. Fine aggregate is a prime material used for preparation of mortar and concrete and which plays a major role in mix design. A large amount of concrete structures are demolished in India and other countries. But only small quantities of demolished waste are reused. This will have serious problems creating environmental pollution and also requires large amount of space for dumping the waste. Hence, our project aims at reuse of demolished concrete and brick waste. In our research work, we have collected the demolition waste from our college work site our college building was demolished for the purpose of renovation. Construction of any concrete structures requires huge amount of natural fine aggregate & coarse aggregate. So by using the demolition waste, we can reduce the cost of purchasing natural fine aggregate & coarse aggregate.. Our project deals with replacing of fine aggregate by brick waste in various proportions of 0%, 20%, 40%, 60%, 80% and 100%. Replacing of coarse aggregate by concrete waste in various proportions of 100%, 80%, 60%, 40%, 20% and 0%. Cubes and cylinder were casted for different mix proportions and kept curing for 3, 14 and 28 days. After the curing the cubes and cylinder were tested to find the compressive strength and split tensile strength of concrete. The results were discussed and conclusions were made accordingly, test results found that 20%-40% replacement of brickbats and 40%-60% replacement of demolished waste achieved better Strength.

KEYWORDS: Brick bats waste as fine aggregate, Compressive Strength Test, Demolition waste as coarse aggregate, Split Tensile Strength Test.

I. INTRODUCTION

One of the major problem being faced by cities and towns relates to the management of Contraction demolish Waste. Waste quantities are increasing and municipal authorities are not able to upgrade or scale up the facilities required for



proper management of such wastes. Cities and towns, in future, will not get wastelands for the further dumping of wastes. Infact, there will be a need to go for total recycling and reuse of waste and aim for ZeroWastefor land filling. For the cubes, the replacement of coarse aggregate up to 30% by demolished waste gives strength closer to the strength of plain concrete cubes and strength retention was recorded in the range of 86.84 - 94.74% for the recycled concrete mix [2]. The maximum compression strength and split tensile strength is obtained when 30% of ceramic tile aggregate was replaced with coarse aggregate [7]. Test results showed that up to 30% coarse RCA had no effect on the ceiling strength

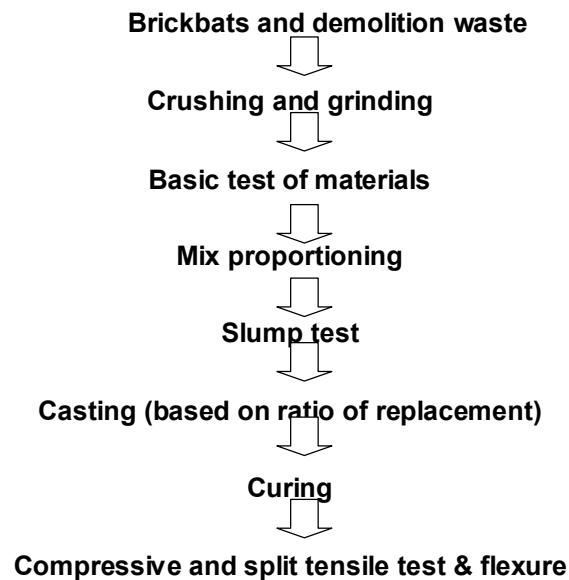
II. RELATED WORK

Examined different properties in reused concrete and brick masonry waste materials and suggests suitable recommendations for further enhancing life of structures, thereby resulting in sufficient economy to the cost of buildings.

Gowri Shankar M in this paper City Waste Management is maintained by clearing the C & D Waste from stockyards by the "Replacement of Fine Aggregate and Coarse Aggregate". The Optimum Mix is V4 (20% of RFA and 30% of RCA) with Maximum Compressive Strength of 40.21N/mm² with 2.59% of Water. **AbsorptionIbtisam Kamal**. The work could be drawn from the results of the current study demonstrated that incorporation of demolition concrete aggregate as coarse aggregate in concrete is quite feasible, it resulted in reduction of density and water absorption and enhancing compressive strength of concrete at certain level of demolition aggregate. **AlessandraMobili**. Bricks and Concrete Wastes as Coarse and Fine Aggregates in Sustainable Mortars Results show that it is feasible to replace a natural calcareous aggregate entirely by recycled aggregates coming from waste bricks and waste concrete in order to contribute in decreasing the depletion of natural quarry and the disposal of waste materials. **Alessandra mobili, chiara criosue** .16th September 2018 Brick and concrete wastes as coarse and fine aggregates in sustainable mortars. **American Journal of engineering research Jafar Bolouri Bazaz(2010)**. Experimental investigation on Partial replacement of fine aggregate with brickbats. Replacement of fine aggregate as crushed brick bats, the strength is less compared to conventional concrete , **American Journal of engineering research Mohammad Abdur Rashid(2010)** Experimentation investigation on partial replacement of coarse aggregate by demolition waste. Replacement of only coarse aggregate by demolition waste, compressive strength was less upto 50% replacement .**American Journal of engineering research Tiara dharshith(2014)**, 2014 Experimentation investigation on partial replacement of fine aggregate by brick bats and glass powder. Replacement of only fine aggregate by brickbats and glass powder, compressive strength was optimum at 15%, 20%, 30% and less at 10% ,**American Journal of engineering research Keerthinarayn and shrinivasan(2010)** ,Experimental investigation on Partial replacement of fine and coarse aggregate with brickbats and demolition waste. Replacement of fine and coarse aggregate as crushed brick bats and demolition waste, the strength is achieved at 30% replacement of both materials by comparing with other proportion of various proportions. **Shiva Kumar M N, Nithin K S, B M Gangadharappa** ,6th June 2014Use of building demolished waste as coarse aggregates in porous concrete.EXPERIMENTALINVESTIGATION ON NO FINEPOROUS CONCRETE USING BRICKBATS AND COARSE AGGREGATEOF BUILDING DEMOLITION WASTE 2019-20 School of civil engineering Page 3 ,**M usha rani, J Martina Jenifer** ,8th FEB 2016.An experimental study on portial replacement of sand with crushed brick in concrete ,**Rekha kasi** ,22nd September 2016. Usage of recycled brick as coarse aggregates in concrete.

III. METHODOLOGY

To obtain the above objectives for the study, the following methodology is adopted:



IV. EXPERIMENTAL RESULTS

Table 1: replacement percentage

Mix	Fine Aggregate		Coarse Aggregate	
	Brick Bats	M-sand	Demolished Concrete	Natural Coarse Aggregate
C.C	0%	100%	0%	100%
MIX 1	100%	0%	0%	100%
MIX 2	80%	20%	20%	80%
MIX 3	60%	40%	40%	60%
MIX 4	40%	60%	60%	40%
MIX 5	20%	80%	80%	20%
MIX 6	0%	100%	100%	0%

➤ Materials:
The materials which are used in this research are :

- Cement
- Fine Aggregate

- Natural Fine Aggregate (NFA)
- Recycled Fine Aggregate (RFA)
- Coarse Aggregate
- Natural Coarse Aggregate (NCA)
- Recycled Coarse Aggregate (RCA)

➤ Processing Of Materials

In first explained the processing of materials, which converts the construction and demolition waste into the replicable form of fine and coarse aggregates.

➤ Testing of Materials

Materials are tested for its Specific gravity, Water Absorption and Impact value.

Table 2: Laboratory Test Results

Aggregate Type Value	Specific Gravity	Water Absorption	Impact	Consistency	Initial setting time	Final setting time
Cement	3.13	-		30%	85 mins	5 hrs 30 mins
NFA	2.5	1.00%	-	-	-	-
B.B	1.82	1.27%	-	-	-	-
NCA	2.16	1.07%	29.4 %	-	-	-
D.W	1.90	1.50%	32.4 %	-	-	-

○ Recycled Fine Aggregate

The fine aggregate is obtained by processing of Demolition waste material, that is, brick bats



Before Processing



After Processing

Fig1. Fine Aggregate Materials

○ Recycled Coarse Aggregate

The Coarse aggregate is obtained by processing of Demolition waste material, that is, from concrete



Before Processing



After Processing

Fig2. Course Aggregate Materials

➤ Mix Design

By analyzing various mix proportions, following Mix design is obtained to work for concrete casting.

Grade designation	=M35
Maximum nominal size of aggregate	=20mm
Minimum cement content (53 grade)	=438kg/m ³
Chemical add mixture	=none
Water cement ratio	=0.45
Fine aggregate	=759kg
Coarse aggregate	=788kg
Water content	=198kg/m ³
Mix ratio	=1:1.7:1.8

1. TESTING & RESULTS

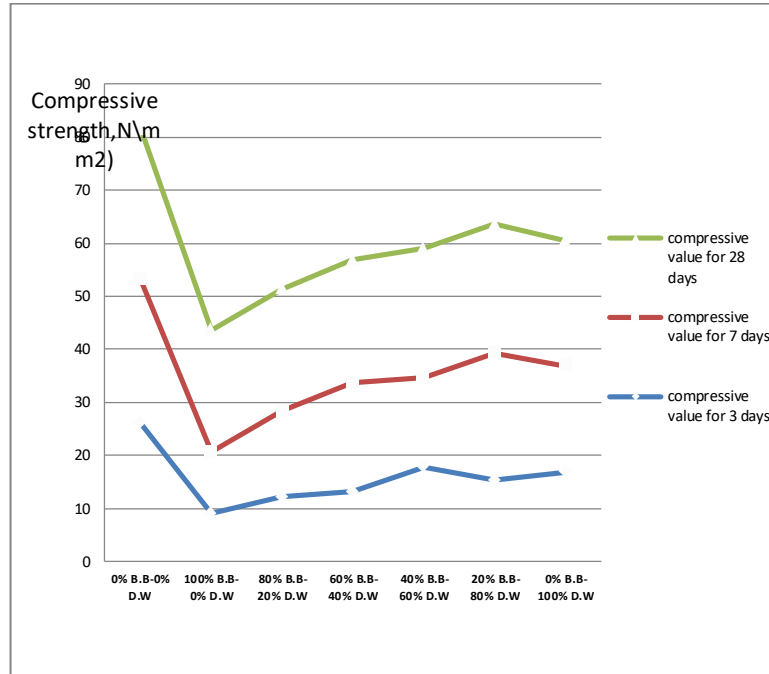
• Compressive Strength

Compressive Strength of the cubes were tested by using CTM (Compressive Testing Machine) in which compressive load is applied on the specimen till the specimen fails in compression that load at which the specimen fails is termed as compressive strength. For this study cube of 150 mm nominal concrete cubes were casted.

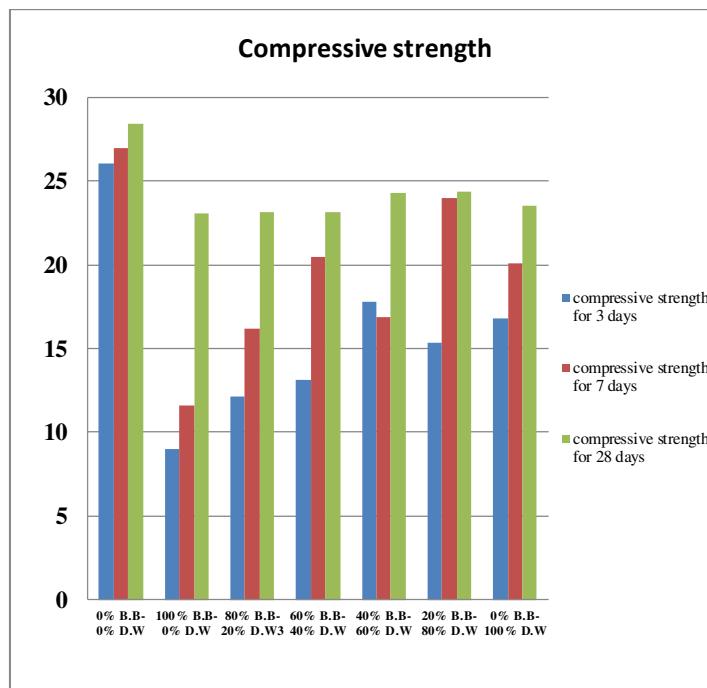
In this study we have taken 7 different mix proportions and casted the concrete cubes of 10 samples in each mix proportions then the compressive strength for 3, 7, 28 days strength was obtained. There are 9 samples in each mix and the compressive strength is the average of the 3 samples of 3, 7, 28 days

Table 3 : Compression Strength values (N/mm²)

SL NO	% replacement of F.A and C.A With B.B and D.W	Water cement ratio	Slump value (mm)	3 days	7 days	28 days
1.	Conventional concrete 0% B.B-0% D.W	0.45	93	26.07	26.96	28.4
2.	100% B.B-0% D.W	0.45	93	9.03	11.62	23.05
3.	80% B.B-20% D.W	0.45	93	12.1	16.2	23.13
4.	60% B.B-40% D.W	0.45	93	13.1	20.5	23.15
5.	40% B.B-60% D.W	0.45	93	17.7	16.88	24.30
6.	20% B.B-80% D.W	0.45	93	15.3	23.95	24.35
7.	0% B.B-100% D.W	0.45	93	16.82	20.1	23.5



Graph 1: compressive strength for 3,7 and 28 days



Bar graph 1: compressive strength for 3,7 and 28 days

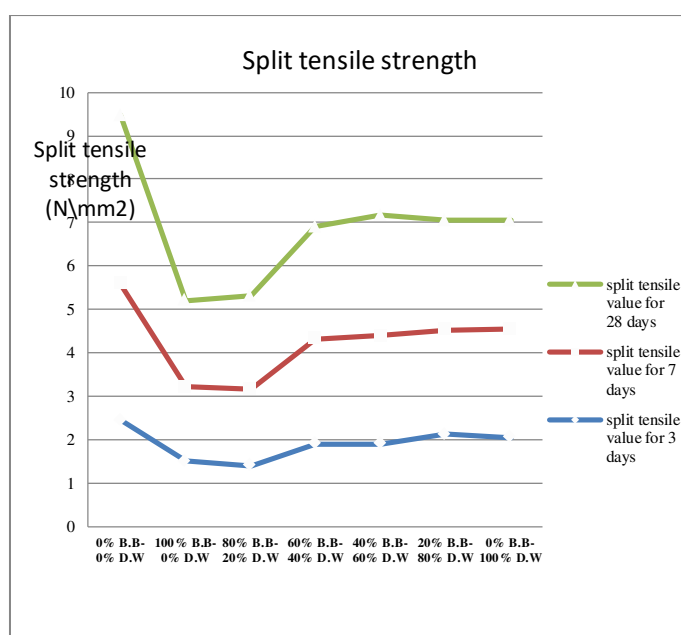
- ❖ Compressive strength increased for 20%-40% of brick bats & 60%-80% of demolished waste.
- Split tensile Strength

Split tensile Strength of the cylinders were tested by using CTM (Compressive Testing Machine) in which load is applied on the specimen till the specimen fails in tension that load at which the specimen fails is termed as split tensile strength. For this study cylinder of 150 mm dia and 300mm height nominal concrete cylinders were casted.

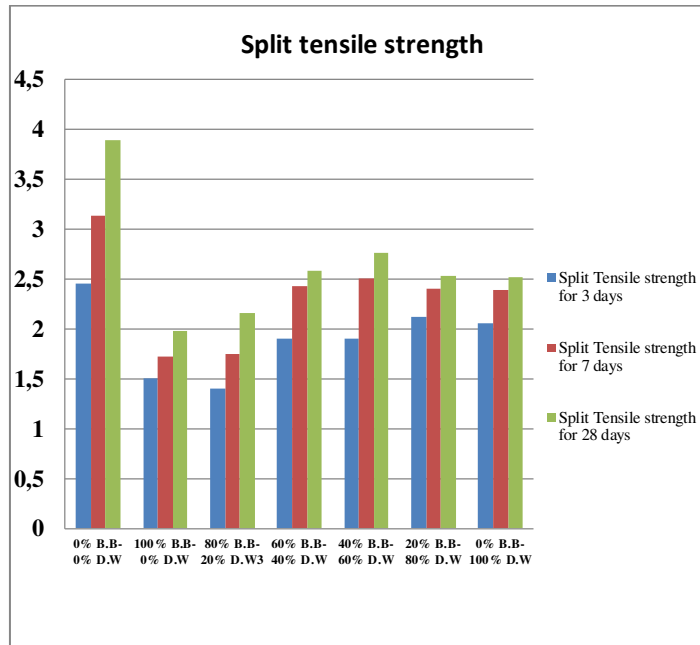
In this study we have taken 7 different mix proportions and casted the concrete cylinder of 10 samples in each mix proportions then the split tensile strength for 3, 7, 28 days strength was obtained. There are 9 samples in each mix and the split tensile strength is the average of the 3 samples of 3, 7, 28 days.

Table 4: Split tensile Strength values (N/mm^2)

S L N O	% replacement of F.A and C.A With B.B and D.W	Water cement ratio	Slump value (mm)	3 days	7 days	28 days
1.	Conventional concrete 0% B.B-0% D.W	0.45	93	2.45	3.13	3.89
2.	100% B.B-0% D.W	0.45	93	1.5	1.72	1.98
3.	80% B.B-20% D.W	0.45	93	1.4	1.75	2.16
4.	60% B.B-40% D.W	0.45	93	1.9	2.42	2.58
5.	40% B.B-60% D.W	0.45	93	1.90	2.50	2.76
6.	20% B.B-80% D.W	0.45	93	2.12	2.40	2.53
7.	0% B.B-100% D.W	0.45	93	2.05	2.38	2.51



Graph 2: Split tensile strength for 3, 7 and 28 days



Bar graph 2: Split tensile strength for 3, 7 and 28 days

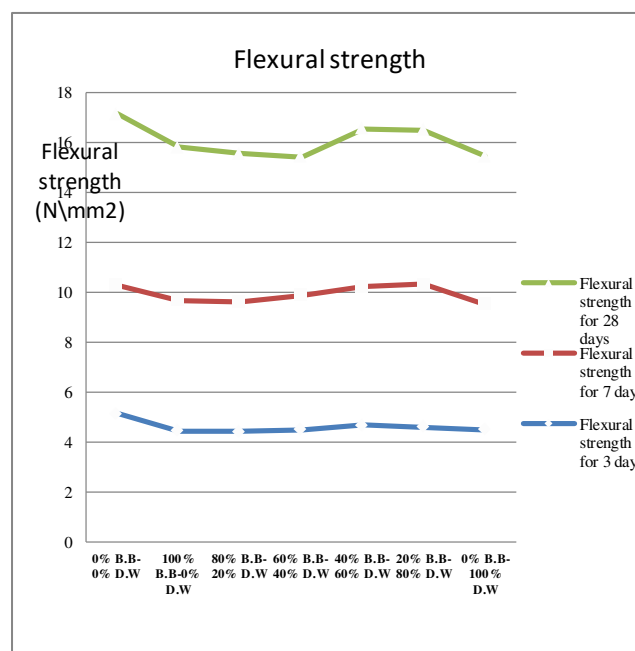
- ❖ Split tensile strength increased for 20%-40% of brick bats & 60%-80% of demolished waste.
- **Flexural Strength**

Flexural Strength of the cubes were tested by using UTM (universal testing machine) in which load is applied on the specimen till the specimen fails in that load at which the specimen fails is termed as compressive Flexural strength. For this study beams of 500 mm length 100mm width and 100mm depth nominal concrete beams were casted.

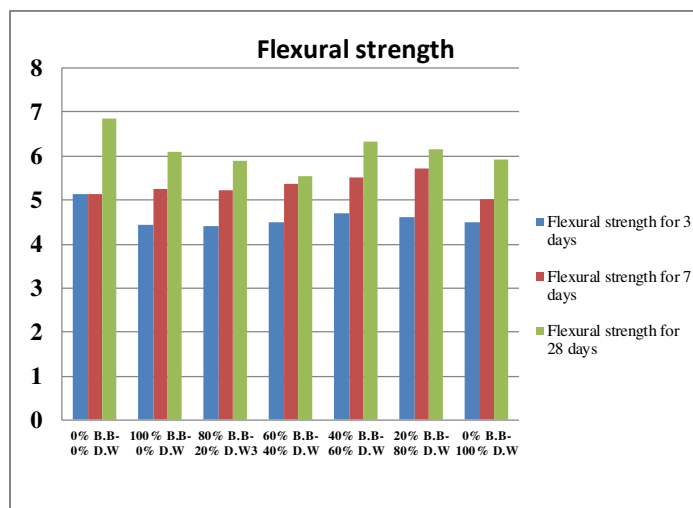
In this study we have taken 7 different mix proportions and casted the concrete beams of 10 samples in each mix proportions then the flexural strength for 3, 7, 28 days strength was obtained. There are 9 samples in each mix and the flexural strength is the average of the 3 samples of 3, 7, 28 days

Table 5: Flexural Strength values (N/mm²)

SL NO	% replacement of F.A and C.A With B.B and D.W	Water cement ratio	Slump value (mm)	3 days	7 days	28 days
1.	Conventional concrete 0% B.B- 0% D.W	0.45	93	5.14	5.14	6.84
2.	100% B.B- 0% D.W	0.45	93	4.44	5.24	6.11
3.	80% B.B- 20% D.W	0.45	93	4.42	5.21	5.9
4.	60% B.B- 40% D.W	0.45	93	4.50	5.37	5.54
5.	40% B.B- 60% D.W	0.45	93	4.69	5.52	6.33
6.	20% B.B- 80% D.W	0.45	93	4.61	5.71	6.16
7.	0% B.B- 100% D.W	0.45	93	4.5	5.01	5.93



Graph 3: Flexural strength for 3, 7 and 28 days



Bar graph 3: Flexural strength for 3, 7 and 28 days

- ❖ Flexural strength increased for 20% of brick bats & 80% of demolished west

Permeability of concrete

The ability to measure concrete durability accurately is difficult. As water is a common mechanism for transporting aggressive elements into concrete, the thought has been that the measurement of Water Permeability of Concrete would reflect the durability of the concrete. This is true to a certain degree, but caution must be taken to ensure that the test is used in its correct capacity, Procedure Preparation of Test Specimen

- Pressure Head
- Sealing of Test Specimen
- Testing the Seal.
- Assembling the Apparatus
- Running the Test

Calculation

$$K = Q / (A * T * H / L)$$

Table 5 : Permeability of concrete

Replacement	5min	10min	15min	30min	1hr	2hr
Conventional Concrete	0.24	0.49	0.68	0.98	0.99	1.48
100%B.B 0% D.C	0.24	0.51	0.52	1.24	2.12	2.63
80%B.B 20%D.C	0.49	0.53	0.95	1.49	2.19	3.29
60%B.B 40%D.C	0.25	0.70	1.11	1.68	2.71	4.01
40%B.B 60%D.C	0.25	0.72	1.22	1.61	2.62	3.98
20%B.B 80%D.C	0.51	0.51	0.98	1.39	2.09	3.18
0%B.B 100%D.C	0.24	0.51	0.52	0.94	2.12	2.43

Replacement	3hr	4hr	5hr	6hr	24h	48hr
Conventional Concrete	1.63	1.84	2.01	2.45	2.49	2.52
100%B.B 0% D.C	3.21	3.45	4.29	4.97	10.89	11.01
80%B.B 20%D.C	3.97	4.26	4.75	5.24	9.22	9.31
60%B.B 40%D.C	4.73	5.03	5.26	5.51	7.21	7.68
40%B.B 60%D.C	4.56	4.95	5.11	5.32	7.15	7.57
20%B.B 80%D.C	3.70	4.15	4.51	5.03	9.04	9.16
0%B.B 100%D.C	3.01	3.35	4.19	4.50	9.79	10.05

V. CONCLUSION

- An Experimental investigation conducted on various proportions of mixes replacing fine aggregate as brickbats and coarse aggregate as demolition waste. This mixes are compared with compressive and split tensile strength of conventional M35 Concrete.
- The main aim is to study the influence of partial and complete replacement of fine and coarse aggregates with brick bats and demolition waste and trying to find percentage of material replaced in concrete that enhance the strength of concrete.
- From the above graph and flow chart study we can conclude that compressive strength is increased for 20%-40% with replacement of brick bats and 60%-80% with replacement of demolition waste. By comparing with conventional concrete these two percentages of replacement gives good strength compared to other replacement.
- From the above graph and flow chart study we can conclude that flexure is increased for 40% with replacement of brick bats and 60% with replacement of demolition waste. By comparing with conventional concrete this percentages of replacement gives good strength compared to other replacement.
- The permeability of concrete is the ability of concrete to resist the water flow 40% with replacement of brick bats and 60% with replacement of demolition waste. By comparing with conventional concrete this percentages of replacement gives good strength compared to other replacement.
- As concrete is the dominant construction material its demand will keep increasing till its alternative comes up. The property of Demolition waste and brick bats depends on the source of its raw material and so selection of a good quality of material is very important for obtaining good quality of concrete.
- Demolition wastes possess comparatively lower bulk density crushing and impact values and higher water absorption as compared to natural aggregate. Brick bats possess more water absorption compared to natural fine aggregate.
- Utilization of Demolition waste concrete as a base material for roadways can reduce the pollution involved in transporting the material.



➤ Cost of casting concrete with replacement of brick bats and demolition waste when compared to Plain Concrete is very low and the properties tested are approx equal to PCC.

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