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Reuse of Construction Industry Waste in Concrete

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A B S T R A C T

The construction and demolition waste are the waste mainly generated from the two activities i.e. from the construction activity and demolition activity. The waste which is produced during construction activities are called as construction waste and the waste produced during demolition activities are called demolition waste. The demolition waste is generated from the demolition of old structures like buildings, bridges, malls and roads. Construction industry in India generates about 20-32 million of waste annually. So, this C and D waste should be managed properly. Most of the construction and demolition waste in India is getting disposed into landfills. This may lead to the contamination of soil and water, also have negative effect on wildlife. Objective of this study is to replace coarse aggregate with demolition concrete waste. By taking the sample test in the Kolhapur region, the recycling of aggregate is done and which can be used for pavement design and other construction purposes. The rules and regulation regarding to land filling disposal are not implemented properly so this paper is expected to reduce the landfill disposal of the construction and demolition waste and to achieve the aim of reuse and recycle of that construction and demolition waste

Keywords: ***Compressive strength, Tensile strength, Flexural strength***.

I. Introduction

The need to manage construction and demolition waste (CDW) has led to environmentally-friendly actions that promote their use and recycling of this type of waste and other forms of waste valorization. The main priority is to foment sustainable construction work, which has the advantage of avoiding the deposit of large quantities of construction waste at landfills and greatly reducing the use of borrow material in construction projects. In this sense, the reuse of CDW materials significantly lessens the impact of construction work on the surrounding environment. It is generally agreed that construction and demolition waste (CDW) management practices should be guided by the "3R"–reduce, reuse and recycle – principle. Considering that CDW has leads to considerable environmental burdens and threats, reasonable treatment of the CDW is urgently needed. The positive contribution of recycling CDW is distinct when it is compared with traditional treatment methods, By Comparing three different scenarios (recycling, incineration and land filling) and found that in terms of global warming potential, the most environmentally friendly way of treating CDW is recycling, followed by incineration and the last is land filling. The construction and demolition waste are the waste mainly generated from the two activities i.e. from the construction activity and demolition activity. The waste which is produced during construction activities are called as construction waste and the waste produced during demolition activities are called as demolition waste. The Demolition waste is generated from the demolition of old structures like buildings, bridges, malls and roads. The construction and demolition waste is the waste mainly generated from the two activities i.e. from the construction activity and demolition activity. The waste which is produced during construction activities are called as construction waste and the waste produced during demolition activities are called as demolition waste. The Demolition waste is generated from the demolition of old structures like buildings, bridges, malls and roads

II. Methodology

Standard Consistency of Cement:

Cement paste of standard consistency is basically the cement paste of suitable percentage of water by weight that produce a consistency which permits a plunger of 10mm diameter to penetrate up to a depth of 5mm- 7mm above the bottom of vicat mould. It is necessary to determine that quantity of water to be mixed to prepare a cement paste of standard consistency for performing the test for setting time, soundness, compressive strength etc.

Trial No.	Weight of Cement (g)	Weight of Water (g)	% of weight Water	Penetration (mm)
1.	300	75	25%	33
2.	300	81	27%	17
3.	300	84	28%	15
4.	300	91.5	30.5%	6

Hence, the standard consistency of cement sample is to be 30.5%.

Sieve Analysis of Fine Aggregate:

IS Sieve size	Weight Retaining	Cumulative Weight	% cumulative weight
4.75 mm	8.4	8.4	0.28
2.36 mm	832.4	840.8	28.02
1.18 mm	985.7	1826.5	60.88
600 microns	275.7	2101.8	70.06
300 microns	270.1	2371.9	79.06
150 microns	280.0	2651.9	88.39
0.75 micron	215.6	2867.5	95.58
Pan	130.4	2997.9	99.93
			= 522.2

Fineness modulus of Crushed Sand = 5.22

Hence, this fine aggregate belongs to Zone III

NATURAL AGGREGATE

Natural aggregate consists of manufactured crushed stone and sand created by crushing bedrock, or naturally occurring unconsolidated sand and gravel. It is a major component of asphalt and concrete and is required in streets, highways, railroads, bridges, buildings, sidewalks, sewers, power plants, and dams—just about every part of the built environment. Natural aggregate is vital to the construction industry. Although natural aggregate is a high volume/low value commodity that is abundant, new sources are becoming increasingly difficult to find and develop because of rigid industry specifications, political considerations, development and transportation costs, and environmental concerns. There are two primary sources of natural aggregate: i) exposed or near-surface bedrock that can be crushed, and ii) deposits of sand and gravel. Remote sensing and airborne geophysics detect surface and near-surface phenomena, and may be useful for detecting and mapping potential aggregate sources; however, before a methodology for applying these techniques can be developed, it is necessary to understand the type, distribution, physical properties, and characteristics of natural aggregate deposits.

AGGREGATE REPLACEMENT

Disposal of wastes such as tire rubber, jarosite and sandstones have become a major environmental issue in all parts of the world especially in India. Every year millions of tires are discarded representing a serious threat to ecology. It was estimated that almost 1000 million tires end their service life every year and out of that, more than 50 % are discarded to landfills or garbage without any treatment. By the year 2030, there would be 5000 million tires to be discarded on a regular basis.

On the other hand, agro-wastes, to industrial by-products, alternative materials for fine aggregate in concrete can be of a wide variety.

Various types of aggregate replacements are: -

- Fibrous Concrete or Papercrete an Eco-friendly Alternative of Aggregate in Concrete
- Wastes of Plastic as Substitute of Aggregates in Concrete
- Glass Crete or Post-Consumer Glass the Sustainable Alternative of Aggregate in Concrete
- Expanded Polystyrene Concrete: Lightweight Alternative aggregate for Concrete
- Crushed Rubber as Aggregates in Concrete

III. RESULTS AND DISCUSSION

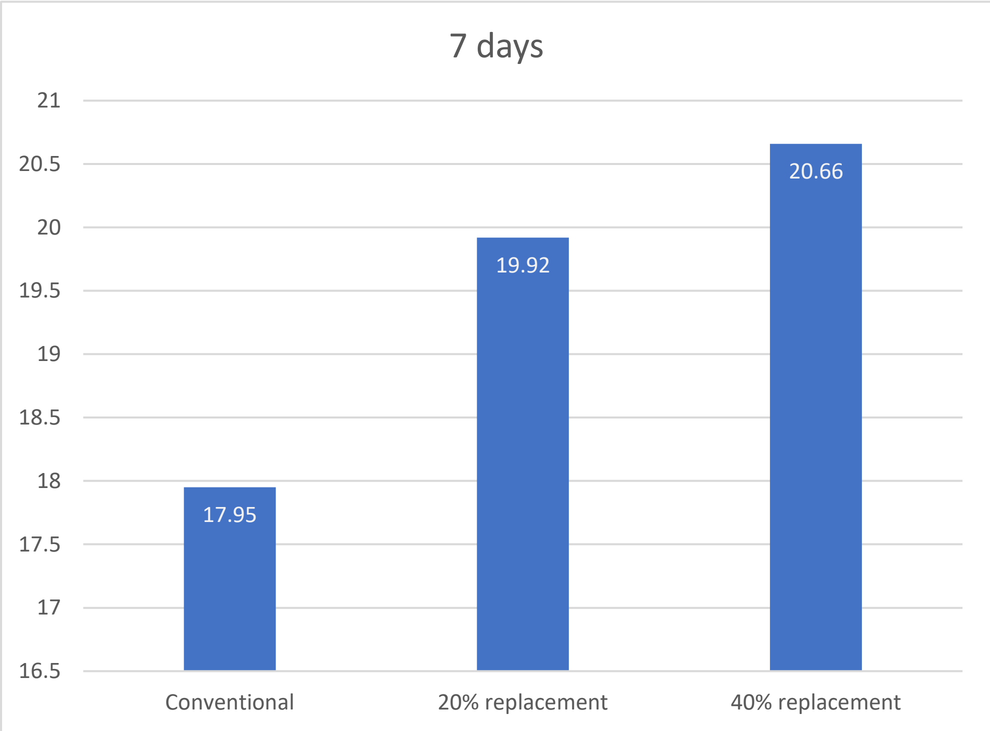
Compressive strength for cube

Compressive strength of concrete design mix was checked by casting and testing of cubes (size 150mm x 150mm x 150mm) after curing period of 7 days, and 28 days.

7 days compressive strength for cube

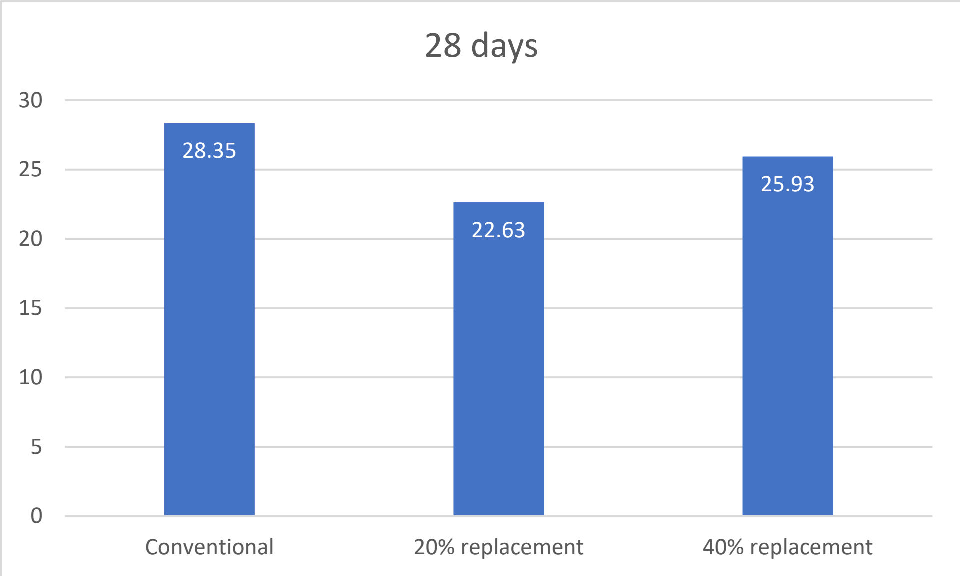
Cube	Length mm	Breadth Mm	Area of cube in mm^2	Load in KN	Compressive strength in N/mm^2	Average Compressive strength in N/mm^2
Conventional						
1	150.00	150.00	22500.00	360	16.000	17.957
2	151.00	150.00	22650.00	455	20.081	
3	150.00	148.00	22200.00	395	17.790	

20% Replacement						
1	149.75	150.75	22574.81	465	20.593	19.928
2	151.90	149.75	22747.02	440	19.340	
3	149.00	151.40	22558.60	448	19.850	
40% Replacement						
1	150.40	150.00	22560.00	510	22.601	20.662
2	148.60	151.00	22438.60	440	19.601	
3	151.60	148.40	22497.44	445	19.783	



28 days compressive strength for cube

Cube	Length mm	Breadth Mm	Area of cube in mm^2	Load in KN	Compressive strength in N/mm^2	Average Compressive strength in N/mm^2
Conventional						
1	152.55	151.15	23057.93	650	28.181	28.353
2	150.00	149.50	22425.00	635	28.310	
3	151.00	149.50	22574.50	645	28.570	
20% Replacement						
1	151.60	150.48	22812.76	430	18.840	22.634
2	150.68	148.80	22421.18	590	26.313	
3	151.00	148.40	22408.40	510	22.751	
40% Replacement						
1	147.40	151.50	22331.10	590	26.420	25.935
2	151.40	151.70	22967.38	590	25.680	
3	148.70	150.40	22364.48	575	25.710	

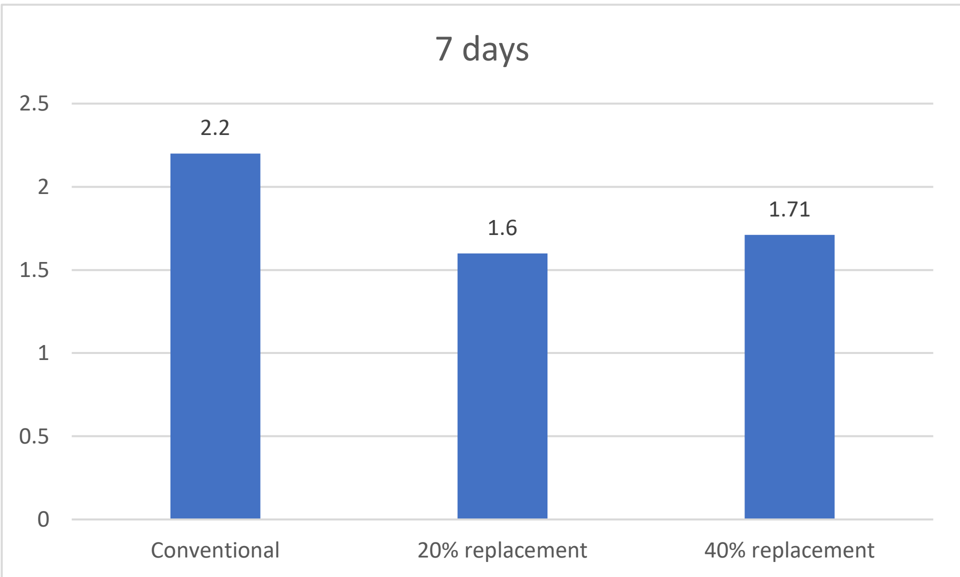


Split Tensile Strength For Cylinder

Tensile strength of the concrete design mix was checked by casting and testing of 100mm diameter and 20mm depth size cylinders after the curing period of 7 days and 28 days.

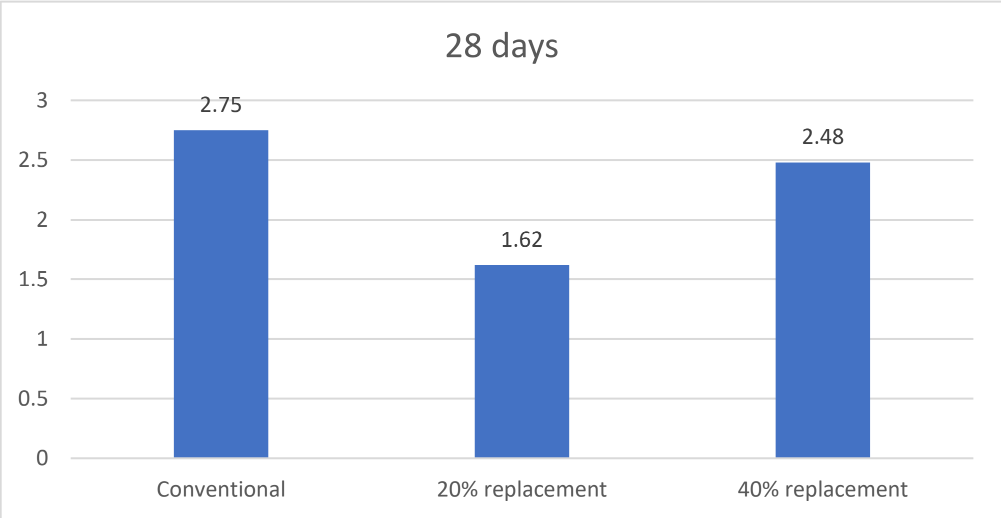
6.1.2.1 Days Split Tensile Strength For Cylinder

Cylinder	Diameter(D) in mm	Length (L) in mm	Load (P) in KN	fa=2P/IILD in N/mm^2	Average Tensile Strength in N/mm^2
Conventional					
1	100.00	199.00	75	2.401	2.2
2	100.00	202.00	65	2.040	
3	100.00	200.00	68	2.160	
20% Replacement					
1	100.00	200.00	50	1.592	1.6
2	100.00	200.00	54	1.711	
3	100.00	200.00	48	1.520	
40% Replacement					
1	100.00	200.00	40	1.270	1.71
2	100.00	200.00	64	2.030	
3	100.00	200.00	58	1.840	



28 Days Split Tensile Strength For Cylinder

Cylinder	Diameter(D) in mm	Length (L) in mm	Load (P) in KN	fa=2P/IILD in N/mm^2	Average Tensile Strength in N/mm^2
Conventional					
1	100.00	200.00	100	3.181	2.75
2	100.00	200.00	50	1.590	
3	100.00	200.00	110	3.500	
20% Replacement					
1	100.00	200.00	50	1.590	1.62
2	100.00	200.00	45	1.430	
3	100.00	200.00	58	1.840	
40% Replacement					
1	100.00	200.00	85	2.700	2.48
2	100.00	200.00	80	2.540	
3	100.00	200.00	70	2.221	

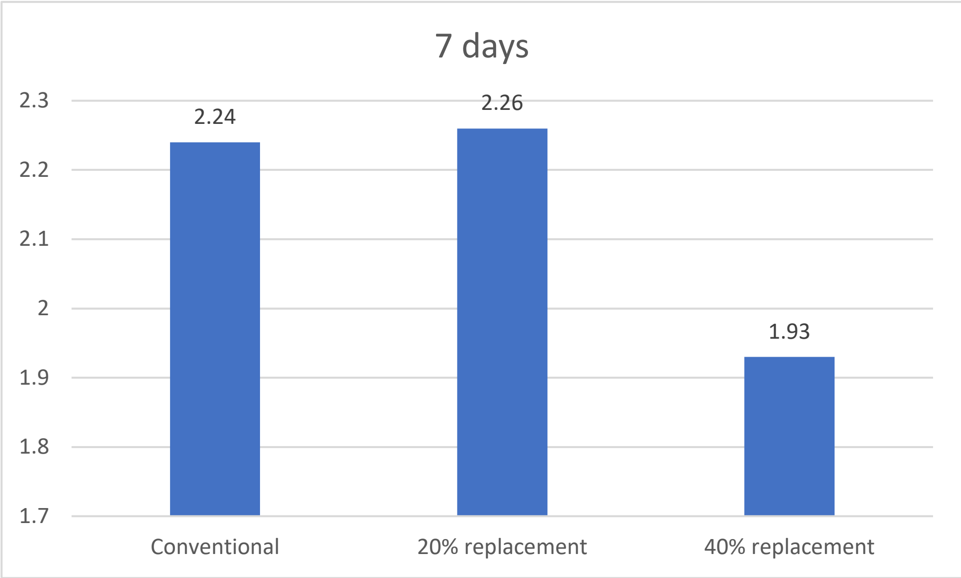


Flexural strength for beam

Flexural strength of the concrete design mix was checked by casting and testing of beams (size 500mm x 100mm x 100mm) after curing period of 7 days and 28 days.

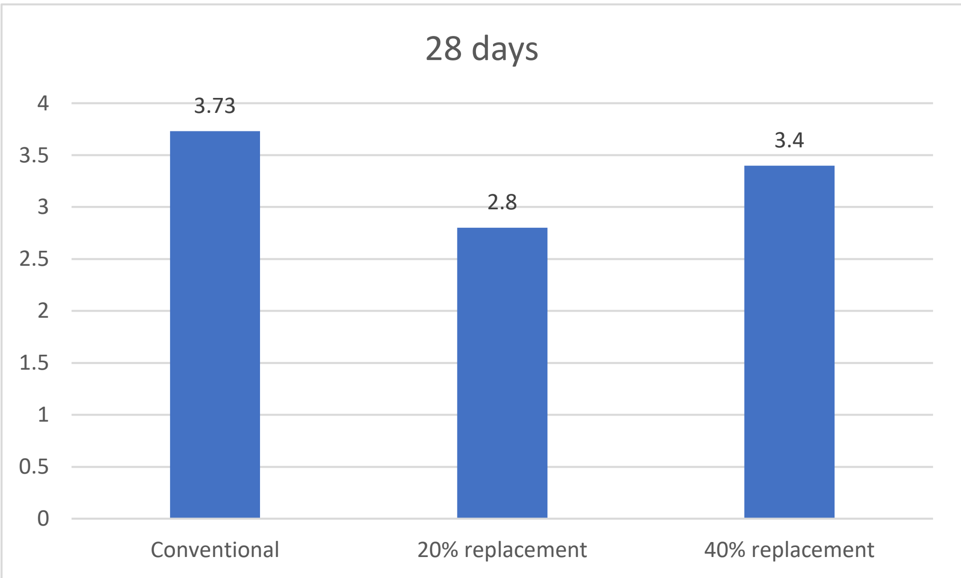
7 Days flexural strength for beam

Beam	Breadth (b) in mm	Depth (d) in mm	Shorter Distance (a) in mm	Length (supported) (L) in mm	Load (P) in KN	f_{ab}=PL/bd^2 in N/mm^2	f_{ab} in N/mm^2	Avg. fab in N/mm^2
Conventional								
1	100.00	100.00	152.00	400.00	6	2.400	2.120	2.24
2	100.00	100.00	195.00	400.00	5.5	2.200	2.200	
3	100.00	100.00	163.00	400.00	6	2.400	2.400	
20% Replacement								
1	100.00	100.00	177.00	400.00	6	2.400	2.400	2.26
2	100.00	100.00	188.00	400.00	5.5	2.200	2.200	
3	100.00	100.00	180.00	400.00	5.5	2.200	2.200	
40% Replacement								
1	100.00	100.00	190.00	400.00	5	2.000	2.000	1.93
2	100.00	100.00	177.00	400.00	5	2.000	2.000	
3	100.00	100.00	182.00	400.00	4.5	1.800	1.800	



28 Days flexural strength for beam

Beam	Breadth (b) in mm	Depth (d) in mm	Shorter Distance (a) in mm	Length (supported) (L) in mm	Load (P) in KN	fab=PL/bd^2 in N/mm2	fab in N/mm2	Avg. fab in N/mm2
Conventional								
1	100.00	100.00	135.00	400.00	9.5	3.800	3.800	3.73
2	100.00	100.00	195.00	400.00	9.5	3.800	3.800	
3	100.00	100.00	171.00	400.00	9	3.600	3.600	
20% Replacement								
1	100.00	100.00	174.00	400.00	5.5	2.200	2.200	2.8
2	100.00	100.00	155.00	400.00	9.5	3.800	3.800	
3	100.00	100.00	148.00	400.00	6	2.400	2.400	
40% Replacement								
1	100.00	100.00	144.00	400.00	8.5	3.400	3.400	3.4
2	100.00	100.00	148.00	400.00	9	3.600	3.600	
3	100.00	100.00	157.00	400.00	8	3.200	3.200	



4. Observation

a) It was observed that the WMC is lacking in providing the proper environment to the people of some areas especially the people of Hingoli Naka, Sawangi, Lakhada, Jamrun etc; because of lack of sweepers.

b) There are very minimum efforts taken by the corporation and the people living there for the cleanliness of environment.

c) At some places it was observed that the people were responsible for the spreading of waste as the use of bins was just for portrayal.

d) There is no coordination between the corporators and the government officials.

e) As all the old landfills are fully occupied the new unconditional landfills are generated which are near the houses of the people which create a risk to life for the people residing in that vicinity.

f) As the government is taking major steps for the waste management there are some positive changes which are acceptable; like people are getting aware about the waste segregation and they are already doing it and contributing in the initiative.

5. Conclusion

1. After testing all the samples (conventional as well as 20% and 40% replacement), rate of reduction in strength is less with 40% replacement of demolition waste aggregate.
2. The cost of M20 grade concrete with demolition waste aggregate (i.e. 40% replacement) is around 2.63% less than the Conventional concrete.
3. The percentage economy is increased with the increase in the grade of concrete but at the same point there is reduction in the percentage increase in the compressive strength, flexural strength and split tensile strength.
4. Though the strength of concrete replaced with demolition waste aggregate is less than conventional concrete, it can be used in RCC for small construction work.
5. Considering all above points, it is interesting to say that optimum utilization of Demolition waste aggregate in concrete is 40% as a partial replacement of Coarse aggregate by demolition waste aggregate

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