www.ijiarec.com

ISSN:2348-2079

Volume-8 Issue-2

International Journal of Intellectual Advancements and Research in Engineering Computations

Experimental study on mechanical behaviour of concrete with partial replacement of coarse aggregate by demolished concrete waste

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ABSTRACT

Large quantities of construction and demolition wastes are continuing being generated which are just being dumped in the landfills. This requires large areas of land which is becoming difficult to find. The best solution would be to recycle and reuse the demolished waste which would not only help in predicting the environment but also help in dealing with construction wastes. That about the project reuse waste crushed concrete maters (WCC) from the lath wastage of crushed concrete replacing from coarse aggregate 20%, 40%, 60%, and 80%. The analysis of demolished crushed concrete aggregate (DCCA) concrete in regular mould cast is to be ready in (7, 14, and 28) days and its mechanical property such as compressive strength, split tensile strength was conducted. The test result show the maximum replacement of DCCA is 60% will give maximum strength to the concrete. The replacing of coarse aggregate uses of waste mater and required strength attain in the conventional M_{25} grade concrete.

INTRODUCTION

Since urban area is rising in excess of a moment in time, the stipulate used for innovative buildings and communications has stridently risen. With the vertical augment during the new-fangled structure the insist of usual aggregate have as well risen. The usage of natural aggregate is getting more and more intense with the advanced development in the infrastructure. In order to reduce the usage of natural aggregate, recycled aggregate can be used as replacement materials. Many old buildings and structures have overcome their age and limit of use. Structures not the portion the vents inside their scenario [1-5].

New construction for better economic growth and job opportunities, creation of building waste resulting from natural as well as man-made disasters. Demolished concrete fritter away obtain following the destruction of the arrangement is a life from correctly process previous to the coarse aggregate of it be able to exist used in concrete production. Consequently, these process coarse aggregates utilize in the concrete in cast-off aggregate and concrete.

The discarding of building waste in 5000 tons per day in overall analysis in India and South Asia. According to Hindu also 23.75 million ton wastes. In generated yearly inside in India in 2007. It grave harm to contaminate surroundings, huge and too inhabit an outsized quality of space. Inside concrete engineering at in attendance internationally consume 8 to 12 billion tons of innate aggregate annually. Owing to incessant employ of expected sources similar to stone and sand is an additional main problem to alter climatic state and humiliating the Earth and to meet by means of insist in the future. Through the use again of demolished concrete waste in the appearance of cast-off aggregate concrete is viewable because an effort in the direction preserving the natural resource and protect the environment and not wastefully equilibrium [6-10].

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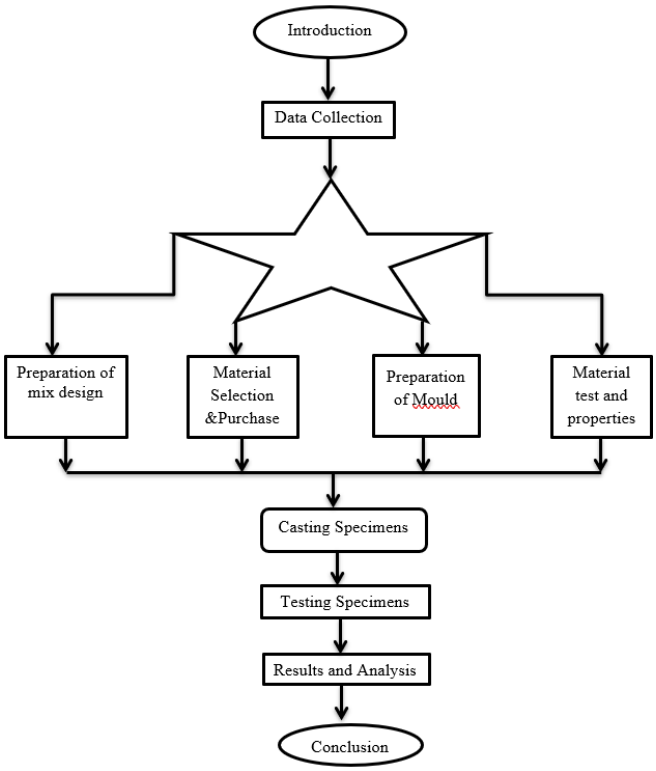
METHODOLOGY



EXPERIMENTAL INVESTIGATION

General

IS: 10262 (2009) is strictly followed in concrete mix. To avoid the balling effect cement content in the mix design was taken as 380 kg/m^3. For this project cube of 150 mm size & cylinder of 150×300 mm size which were casted by replacement of coarse aggregate by demolished concrete aggregate. In this project we have taken the demolished aggregate 20, 40%, 60%, 80% by weight of the conventional coarse aggregate then further tests conducted such as compression strength, split tensile strength for 7, 14, 28 days.

TESTING

Compressive strength test

Procedure

- Remove the specimen from water after specified curing time and wipe out excess water from the surface.
- Take the dimension of the specimen to the nearest 0.2m.
- Clean the bearing surface of the testing machine.
- Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
- Align the specimen centrally on the base plate of the machine.
- Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
- Apply the load gradually without shock and continuously at the rate of 140 kg/cm^2/minute till the specimen fails.
- Record the maximum load and note any usual features in the type of failure.

Formula

- Compression strength = load / area
- Area = L × B.

Table 1: Compressive strength of M_{25} for nominal mix

Compressive Strength(N/mm^2)	Sample 1	Sample 2	Sample 3	Average
M-25 (7d)	18	18.5	17.9	18.1
M-25 (14d)	22.5	20.5	24.5	22.5
M-25 (28d)	24.7	26.5	25.9	25.8

Table 2: Compressive strength of M_{25} for 20% replacement of coarse aggregate by demolished aggregates

Compressive Strength(N/mm^2)	Sample 1	Sample 2	Sample 3	Average
M-25 (7d)	18.2	18.9	18.4	18.6
M-25 (14d)	28.2	28.0	28.4	28.2
M-25 (28d)	34.2	30.1	33.2	34.3

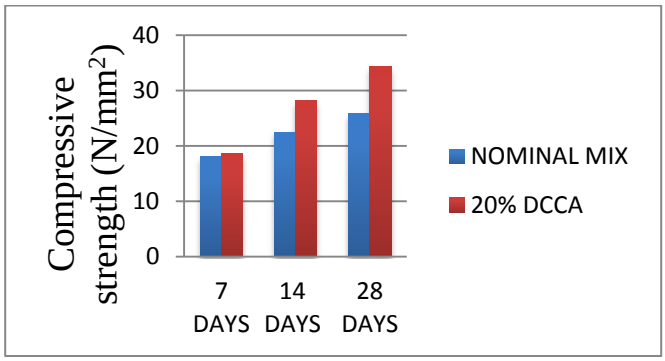


Figure1: 20% DCCA Compressive strength

Table 3: Compressive strength of M_{25} for 40% replacement of coarse aggregate by demolished aggregates

Compressive Strength(N/mm^2)	Sample 1	Sample 2	Sample3	Average
M-25 (7d)	18.4	18.6	18.6	19.2
M-25 (14d)	24.7	23.3	25.1	24.2
M-25 (28d)	34.6	35.6	35.2	35.3

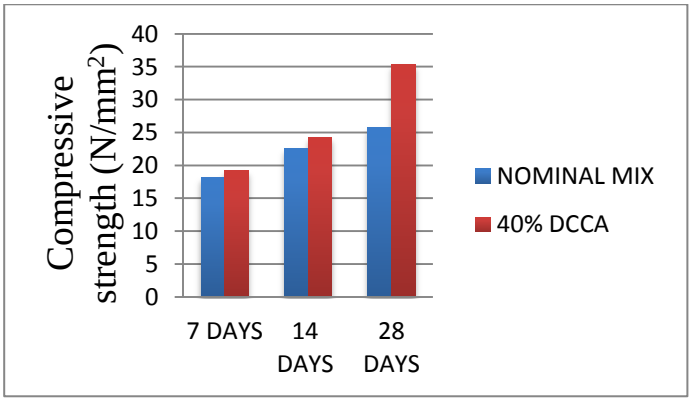


Figure 2: 40% DCCA Compressive strength

Table 4: Compressive strength of M_{25} for 60% replacement of coarse aggregate by demolished aggregates

Compressive Strength(N/mm^2)	Sample 1	Sample2	Sample 3	Average
M-25 (7d)	19.7	20.8	21.6	20.8
M-25 (14d)	29.6	28.9	28.7	29.2
M-25 (28d)	38.4	37.4	38.9	38.7

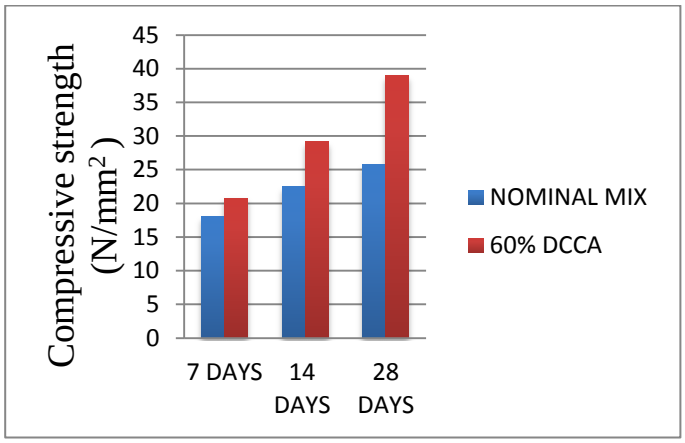


Figure 3: 60% DCCA Compressive strength

Table 5: Compressive strength of M_{25} for 80% replacement of coarse aggregate by demolished aggregates

Compressive Strength(N/mm^2)	Sample1	Sample 2	Sample 3	Average
M-25 (7d)	15.6	14.9	15.3	15.2
M-25 (14d)	29.7	28.1	27.9	28.7
M-25 (28d)	32.8	31.6	32.9	32.1

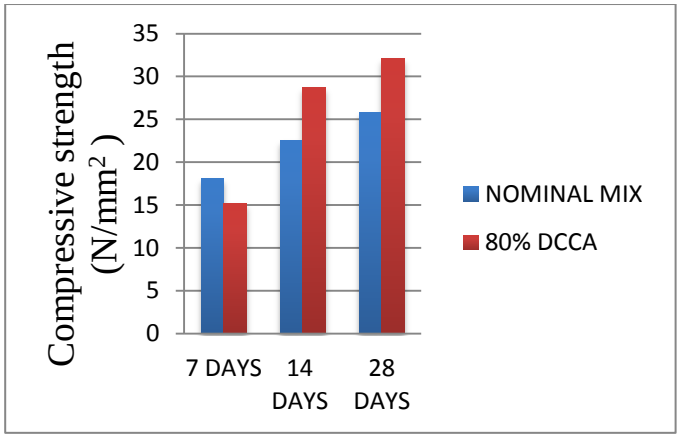


Figure 4: 80% DCCA Compressive strength

Comparison of compressive strength of DCCA or various percentage of demolished concrete aggregate

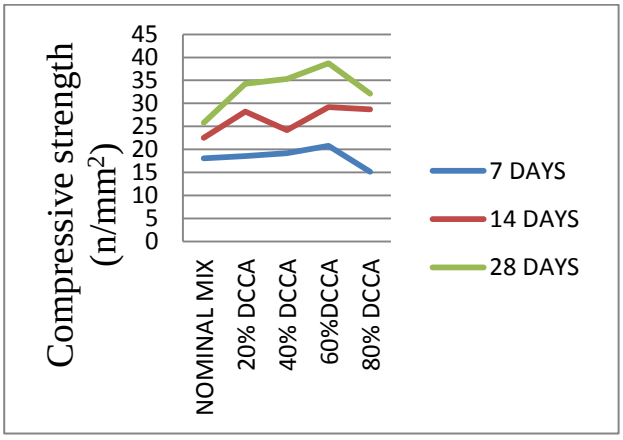


Figure 5: Compressive strength of different percentage of DCCA

SPLIT TENSILE STRENGTH TEST

Procedure

- Take the wet specimen from water after specified days of curing.
- Wipe out water from the surface of specimen.
- Draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place.
- Note the weight and dimension of the specimen.
- Set the compression testing machine for the required range.
- Keep are plywood strip on the lower plate and place the specimen.
- Align the specimen so that the lines marked on the ends are vertical and centered over the bottom plate.
- Place the other plywood strip above the specimen.
- Bring down the upper plate to touch the plywood strip.
- Apply the load continuously without shock at a rate of approximately 14 – 21 kg/cm^2/minute. Note down the breaking load.

Formula

- Split tensile strength = load / area
- Area = $\pi \times D \times L$.

Table 6: Split tensile strength of M_{25} for nominal mix

Split Tensile Strength(N/mm^2)	Sample 1	Sample2	Sample 3	Average
M-25 (7d)	2.4	2.6	2.3	2.4
M-25 (14d)	2.8	2.6	2.8	2.7
M-25 (28d)	3.6	3.3	3.7	3.5

Table 7: Split tensile strength of M_{25} for 20% replacement of coarse aggregate by demolished aggregates

Split Tensile Strength(N/mm^2)	Sample 1	Sample 2	Sample 3	Average
M-25 (7d)	1.20	1.19	1.23	1.20
M-25 (14d)	1.57	1.59	1.67	1.6
M-25 (28d)	2.1	2.3	2.5	2.2

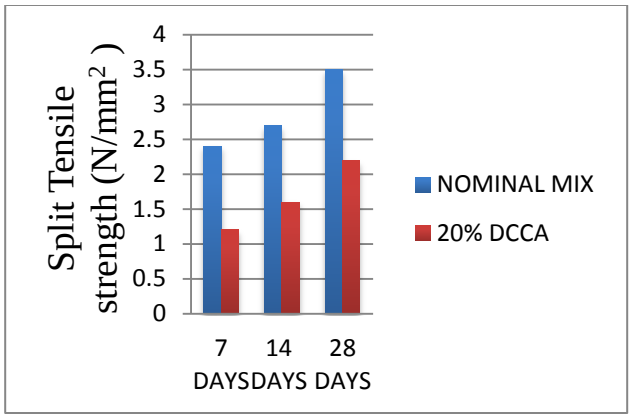


Figure 6: 20% DCCA split tensile strength

Table 8: Split tensile strength of M_{25} for 40% replacement of coarse aggregate by demolished aggregates

Split Tensile Strength(N/mm^2)	Sample 1	Sample 2	Sample 3	Average
M-25 (7d)	2.16	2.14	2.15	2.14
M-25 (14d)	2.48	2.39	2.41	2.42
M-25 (28d)	2.60	2.57	2.54	2.59

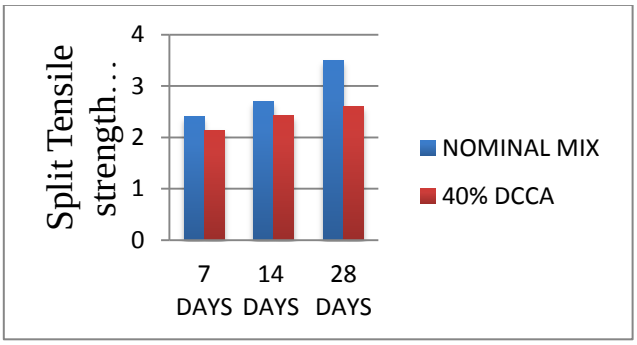


Figure 7: 40% DCCA split tensile strength

Table 9: Split tensile strength of M_{25} for 60% replacement of coarse aggregate by demolished aggregates

Split Tensile Strength(N/mm^2)	Sample1	Sample2	Sample3	Average
M-25 (7d)	3.19	3.20	3.21	3.15
M-25 (14d)	3.25	3.23	3.27	3.62
M-25 (28d)	4.2	3.9	4.2	4.10

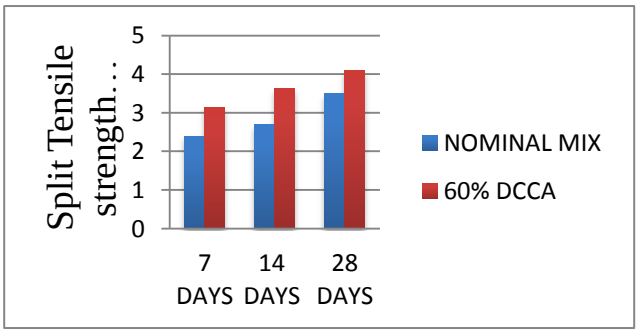


Figure 8: 60% DCCA split tensile strength

Table 10: Split tensile strength of M_{25} for 80% replacement of coarse aggregate by demolished aggregates

Split Tensile Strength(N/mm^2)	Sample1	Sample2	Sample3	Average
M-25 (7d)	3.2	3.0	3.1	3.1
M-25 (14d)	3.59	3.47	3.61	3.5
M-25 (28d)	4.0	3.9	4.2	4.0

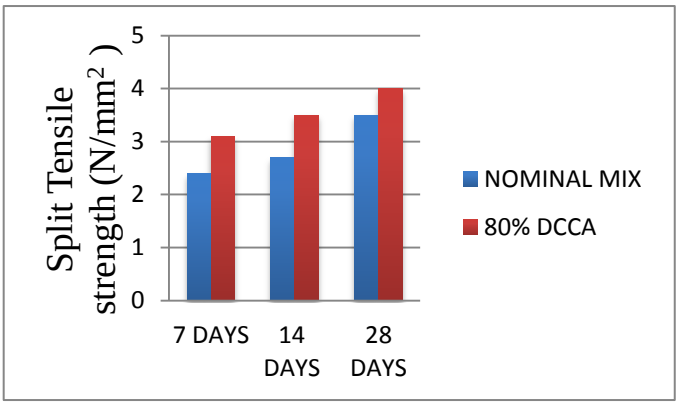


Figure 9: 80% DCCA split tensile strength

Comparison of split tensile strength of DCCA for various percentage of demolished concrete aggregate

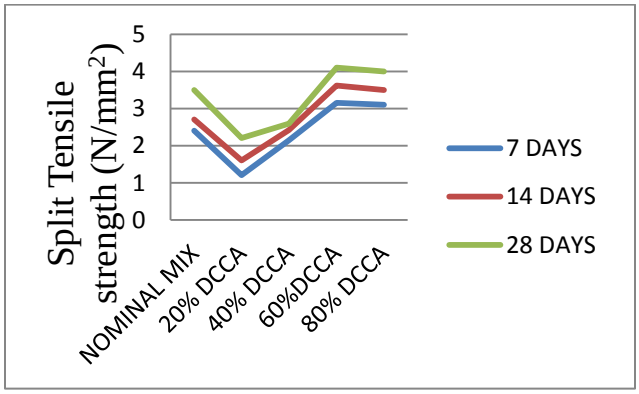


Figure 10: Split tensile strength of different percentage of DCCA

RESULT AND DISCUSSION

Compressive strength is the maximum compressive stress that, under a gradually applied load, a certain solid material can carry on without fracture. Compressive strength of 7, 14 and 28 days of the DCCA shown in the tables (5.2, 5.3, 5.4, & 5.5) for 20%, 40%, 60%, 80% replacement of coarse aggregate by demolished coarse aggregate for M25 mix. Three specimens for each proportion were cast and tested for comparative study. For 60% replacement of coarse aggregate the 28 days compressive strength is 38.7% of the compressive strength of conventional concrete. The split tensile strength is the maximum strength that, under a gradually applied load, a certain solid material can carry on without fracture. Tensile strength of 7, 14 and 28 days of the DCCA shown in the tables (5.7, 5.8, 5.9, & 5.10) for 20%, 40%, 60%, 80% replacement of coarse aggregate by demolished coarse aggregate for M25 mix. Three specimens for each proportion were cast and tested for comparative study. For 60% replacement of coarse aggregate the 28 days tensile strength is

4.10% of the tensile strength of conventional concrete.

CONCLUSION

The following conclusions are drawn from the experimental study.

- Demolished aggregate concrete may be an alternative to the conventional concrete.
- Demolished aggregate concrete can be partially replaced therefore we can get the result as better while comparative with full replacement.
- Test conducted on demolished aggregates concrete and results compared with natural coarse aggregate are satisfactory as per IS2386.
- Up to 60% of coarse aggregate replaced by demolished waste gave the better strength of plain concrete cubes and strength retention is in the range of 86-94% as compared to conventional concrete.
- Hence the use of DCCA as 100% of NCA in concrete can be seen as a positive steps towards sustainable development in concrete production
- Hence using DAC which help increase the recycling process and also it is one of the best method to avoid wastage from demolished construction sites.
- Finally conclude the compressive strength & split tensile strength was high when containing concrete waste 40% in concrete compared with conventional concrete.

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