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Experimental Investigation of Modified Concrete Using Demolished Aggregate and Rubber Crumbs

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ABSTRACT

The concrete material has to be demolished during ongoing or old construction. The concrete waste obtained from these processes is called "Demolished Concrete". The environmental protection and for promotion of the principles of sustainable development has led to recycled aggregate. Demolished sites and restoration schemes are sources of large amounts of solid waste, which today is being used as landfill. The reusing and recycling the demolished concrete a better economy can be achieved without an effecting of environment.

In the past studies as per literature study most of the researches done only strength parameters of concrete with the help of different percentages of demolished aggregates. In this present study in addition of strength characteristics durability is also done.

The preservation of natural resources and the environment is important to modern development. Recycled aggregates are made from material recovered during demolition activities, which are then crushed, screened, and washed to get the desired grading. Concrete is made from recycled coarse aggregates derived from crushed concrete. With the rapid expansion of car production for the next generation, there is a possibility of an increase in crumb rubber. Crumb rubber can be disposed of in landfills and burned, both of which are damaging to the environment. The goal of this study is to find out how recycled materials can be used in concrete. This initiative's major purpose is to use crumb rubber as a fine aggregate and demolished structural waste as a coarse aggregate. This study will make use of concrete grade M30. Specimens such as cubes, cylinders, and prisms will be developed in the future, and each specimen will be cast in a distinct mix proportion. Mechanical properties tests are performed after 28 days taken from the curing chamber.

Keywords : Demolished Concrete waste, Crumb rubber, Coarse aggregate, fine aggregate, landfills, Mechanical properties.

I. INTRODUCTION

Over the years there has been a change in the use of building materials. Cheap and locally available materials such as moulded earth bricks, stones, thatch, timber, steel, aluminium, plastics and fibers of various types and forms have replaced the traditional and costly materials. However, all these materials have been developed to meet specific requirements of climate, availability of skilled labour and specific raw materials to affect the desired economy.

Although construction and demolition waste materials are often grouped together under the generic term "C&D waste", the materials generated from these activities can be quite different. One reason for this is that construction activities make use of currently available manufacturing processes and materials while demolition activities often remove older structures. Older buildings can contain materials no longer used in the construction industry today, resulting in a different waste stream. An example of this is asbestos, which was a common insulation material forty years ago, but is now regarded as hazardous waste. Differences between construction and demolition waste are also due to the nature of each process. Demolition procedures typically remove the whole structure, resulting in 20-30 times more waste material than construction activities. Materials such as metal, which is rarely wasted during the construction process, can form a significant percentage of total demolition waste when a building is torn down.

Due to the increase in the economic growth after development and redevelopment projects in the country and subsequent increase in the urbanization in the cities has made the construction sector to increase drastically, but also environmental impacts from construction and demolition (C & D) waste are increasingly becoming a major issue in urban solid waste management. Environmental issues such as increase in the flood levels due to the illegal dumping of construction and demolition waste into the rivers, resource depletion, shortage of landfill and illegal dumping on hill slopes are evident in the metro cities.

For the purpose of management of C&D Wastes in India, Construction and demolition waste has been defined as 'waste which arises from construction, renovation and demolition activities. Also included within the definition are surplus and damaged products and materials arising in the course of construction work or used temporarily during the course of on-site activities. The various streams of wastes to be considered will include;

- ✓ Excavated materials
- ✓ Concrete
- ✓ Tiles, brick, ceramics, asphalt concrete
- ✓ Plaster
- ✓ Glass
- ✓ Metal and steel
- ✓ Plastics
- ✓ Wood, asphalt, and
- ✓ Concrete rubbles, etc

The primary method adopted in waste handling is carried through by interviewing professionals like project managers, architects, civil engineers, contractors and government officials like city engineers, solid waste management officials.

Secondary information is gathered by compiled data from secondary source like various research papers, various international journals, various international reports on construction and demolition waste management. And also, proceedings of waste management organizations and also some reports of surveys did by various agencies and institution. Some information is collected thorough waste management

and national authorities' websites in construction waste and demolition management.

II. Literature Review

OSAMA YOUSSF JULIE E. MILLS etc(2022)

In this research, a wide range of experimental investigations were carried out, with the aim of moving crumb rubber concrete (CRC) from the lab to the slab for the residential construction sector. Two 4 × 9 m large-scale reinforced concrete residential footings were constructed. One was cast with CRC and the other with a standard residential mix of conventional concrete (CC), both with nominal 20 MPa strength. In addition, two reinforced ground slabs with different dimensions were constructed out of CRC and CC mixes, with nominal 32 MPa strength. All mixes were provided by a commercial ready-mix company and the construction was undertaken by an experienced footing contractor. A large range of factors have been investigated and compared.

The 7-day/28-day strength ratio decreased by 13% and 2% for 20 MPa and 32 MPa mixes, respectively when the rubber presented. The compressive strength of all CC and CRC mixes displayed some variations with time (18 month), and CRC did not show any tendency to reduce with time. No adverse effect of using rubber in concrete in developing the carbon dioxide penetration into the concrete cover was observed and rubber could possibly reduce the CO2 attack.

Sabir khan (2019)

The objective of the study was to investigate experimentally the property and strength of Crumb rubber concrete rubberised concrete with the following test compressive strength, split tensile strength. Test conducted on hard hardened concrete Crumb. In present work weight batching hand mixing is used to study cube compression test and split tensile strength on cylinder on clean and crumb rubber concrete (rubberised concrete) were carried on number of samples and these tests results are compared with conventional concrete of M 25 grade. the result stated that the addition of Crump Rubber to concrete decreases the compressive strength from 26.6 7N/mm2 to 22 .62 N/mm2 Which means decrease of compressive strength of concrete marginally. The split tensile strength decreases about 43 percentage when 15 percentage crump rubber is replaced.

III. Objectives of the Research

The specific objectives of the present investigation are listed below.

- ✓ To study the utilization of demolished construction waste and crumb rubber as a replacement of natural aggregate in M30 grade of concrete.
- ✓ To study the mechanical and physical properties of demolished and construction waste aggregate by conducting experimental work.
- ✓ The present study aims to reuse the recycle waste with a view to contributing to the sustainable development of activities in the construction sector.

Rubber Crumbs

Crumb rubber means a small piece or the powdered form of tire used in vehicles that are being made after removing thin steel wire from the tire. Crumb rubber is one of the materials used in concrete. Fine aggregate is partially replaced with crumb rubber in various percentages. The fine modulus of the CR is 2.18 and the specific gravity is 1.15.

IV. EXPERIMENTAL INVESTIGATION AND PROCEDURE

Slump Test

Concrete consistency is assessed using the slump test, which may be performed in a lab or on-site. The

results of a slump test reveal if concrete in various batches is uniform. Concrete slumps' shapes provide details about the material's quality and use. It is also possible to evaluate the characteristics of concrete with relation to its propensity to separate by giving it a few tamping or blows by tapping a rod on the base plate. Because the equipment is inexpensive and the process is straightforward, this test has been in use since 1922. The Slump cone's design demonstrates how easily concrete can be worked. British Standard: Indian standard for slump cone testing is IS 1199-1959.

Table 1 Slump Cone test of concrete

Workability for M30 concrete without 5% red mud

Initial time in min.	Collapse in mm.
After 30 min.	190 mm
After 60 min.	170 mm
After 90 min.	155 mm
After 120 min.	140 mm

Compressive Strength

The capacity to support loads on the surface of a material or structure without breaking or deforming is known as compressive strength. An object's size will decrease when it is compressed, but it will extend when it is under tension. Compressive strength of concrete is evaluated in accordance with (IS:516-1959).

Compressive Strength = Load / Cross-sectional Area.

Apparatus for Compressive Strength Test

Fig 1 Apparatus for Compressive Strength Test

V. RESULTS AND DISCUSSION

Table 5.1 Compressive strength of concrete in kN/mm²

Compressive Strength N/mm²

Sample	7 Days	28 Days
Sample 0	24.67	38.14
Sample 1	23.14	36.61
Sample 2	21.57	35.46
Sample 3	20.13	34.78
Sample 4	18.37	31.25
Sample 5	19.24	32.68
Sample 6	20.88	33.54
Sample 7	18.43	31.87
Sample 8	16.24	38.14
Sample 9	18.72	31.04

Sample 10	19.27	31.93
Sample 11	18.28	29.75
Sample 12	14.81	27.69
Sample 13	15.23	28.14
Sample 14	16.09	28.87
Sample 15	15.39	27.94

Inference- The result expresses the Compressive strength of the specimen. The strength

decrease with an increase of DCW contents without any addition of CR. After adding 10% of

CR and various percentages of DCW. Comparatively sample 6 gives optimum value then next addition of 20% of CR and various percentage of DCW. mix 10 gives a higher value in that range, finally 30% of CR and various percentages of DCW.Sample 14 attains more strength in that range of proportion. Tests and analysis give a clear view, that is optimum values are obtained in 20% of DWC and 10%, 20%, and 30% of CR.

Split Tensile Strength N/mm^2

Sample	7 Days	28 Days
Sample 0	2.63	3.74
Sample 1	2.48	3.58
Sample 2	2.36	3.57
Sample 3	2.17	3.28
Sample 4	2.19	3.36
Sample 5	2.24	3.43
Sample 6	2.36	3.41
Sample 7	2.09	3.28
Sample 8	1.94	2.98
Sample 9	2.07	3.32
Sample 10	2.14	3.41
Sample 11	2.09	3.33
Sample 12	1.76	2.72
Sample 13	1.84	2.83
Sample 14	2.02	3.16
Sample 15	1.91	2.93

Table 4. Flexural Strength Test N/mm^2

Flexural Strength N/mm^2

Sample	7 Days	28 Days
Sample 0	2.41	3.71
Sample 2	2.38	3.51
Sample 6	2.31	3.42
Sample 10	2.19	3.34
Sample 14	2.05	3.21

VI. CONCLUSION

Based on the experimental tests and analysis, the following conclusion of this study was compressive strength and split tensile strength of all mixes except conventional were consecutively lower than the mean target strength due to the addition or

replacement. The strength of the specimens falls particularly due to the addition of crumb rubber compared to demolished concrete waste. The optimum mix ratio of the replacement was constant of 20% Crumb rubber and 10%, 20%, and 30% demolished concrete waste giving decreasing strength. The flexural strength was analyzed in conventional and optimum mix demonstrating the reduction of strength because of excess crumb rubber in the specimen. The density of the specimen decreases with an increase in the rubber quantity, which made the lightweight concrete. The Crumb Rubber was used in a relatively low percentage in concrete but it considerably reduces the crumb rubber contained in the environment because the specific surface area is larger compared to the density.

Water absorption increases gradually with an increase in the crumb rubber content due to porosity and weak bonding action. Overall, this study explains this technology is more convenient in the use of non-load-bearing structures, concrete pavements, breast walls, and parapet walls.

When replacement of RA is increased in concrete mixes, the slump of concrete mixes is decreased. It was expected because recycled aggregate is high in water absorption.
The sample 10 and above exceeded the mark of 10 mm so failed in the soundness test in the experimental analysis.

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