

An Experimental Investigation of Compressive Strength on Concrete by Using Waste Cardboard

DIKSHA ALONE¹, GANGOTRI MESHAM², PALLAVI EKARE³

^{1, 2, 3} Department of Civil Engineering, GHRAET, Nagpur

Abstract- Paper industries and Cardboard is growing with the everyday increase of their product's usage around the world. To deal with the demand of building material in construction field and to reuse the waste cardboard, innovative composite concrete mix is manufactured by replacing aggregate with the waste cardboard pulp.

Present study is depends on investigation of compressive strength of concrete by using partial replacement of waste cardboard material. To determine strength of concrete compressive testing machine is used. The main objective of this research is to investigate the best mix proportion of cardboard performing comparative analysis of three different mix proportions. From the result, it is found that by adding 25% of cardboard got efficient result.

Indexed Terms- waste cardboard, compressive strength

I. INTRODUCTION

Now a days the population is continuously increasing which increases the demand of structures. As the demand of construction material increases, proportionality the cost of material increases and the availability of material decreases. There are over 407 million metric ton of cardboard being manufactured according to 2017 survey. In the United State and Canada, there are approximately 1500 corrugated packing plant. The demand for using cardboard as package material has made it single largest waste product (by weight) in trash and it is estimated that over 24million tons of cardboard discarded each year into the landfill creating serious environmental problems. The industries are conscious about recycling the cardboard for environmental and economic reasons. Therefore special research has been carried out to utilize waste cardboard in construction material up to some proportion. Partial replacement of

aggregate by cardboard sludge to gain compressive strength of cubic specimen.



Fig. (1) Cardboard

The cardboard production is technological process and sufficient amount of cardboard is produced in industries. The cardboard is chemical composition of lignin (C31 H34 O11) n, which is obtained from trunks of trees and also obtained from recycled cardboard. It is chemical composition of glucan, lignin, xylan and crude proteins. The production of cardboard is carried out by pressing together most fibres, typically cellulose pulp derived from wood, rags or grasses and drying them into flexible sheets. Paperboard, sometimes known as cardboard, is generally thicker (usually 0.25 mm or 10 mm) than paper. Cardboard is available in different forms, commonly available products are single faced board, single wall board, rigid cardboard box and folded cartons etc. The pulp production of cardboard can be obtained in cheap and efficient way.

The cardboard is main ingredient for preparing boardcrete. It is an anisotropic material and the strength, quality of fibre is depend upon the type of wood from which it is prepared and amount of water in pulp. The main advantage of cardboard is its recyclable quality and this makes it environment friendly. It is light weight in nature and low cost material but The storage of cardboard is not helpful as its not best option for weather proofing like water and other types of liquid. Cardboard may get deformed

under extreme pressure hence it should be stored very carefully. The average rate of recycle of cardboard in 1993 was 55%. In 2011 that figure jumped to 91% due to mainstream adoption of recycling. In this infographic it is important to look at the impact of cardboard by simply recycling it.

II. BRIEF OF LITERATURE

YD Shermale, MB Varma et al, They studied, for minimizing the use of cement. which cause in depleting or make problems to environment, the alternative for this waste paper use as option used. Papercrete, new composite material for partial replacement with portland cement.

Mr. Yogesh D. Shermale, Dr. Mahaveer B. Varma et al, they determined the properties of papercrete concrete. The cubes are made of size 100*100*100mm with material sand, fly ash and glass fiber. The trial mixes are used for making cubes and the cubes remained as for 28 days for air curing. The main purpose of the investigation is to determine the compressive strength and density of papercrete of trial mixes.

Vachira Sangrutsamee, Panya srichandra et al, They studied, the aggregate is replaced by re-pulped waste paper and determined the physical, mechanical and thermal properties of paper composite. The existing masonry blocks compared with proposed blocks to check the environment conservation goals, to support energy saving and affordable insulating building material.

Mariyam Marie Delcasse*, Rahul V** et al They concluded that, the large amount of paper wasted everyday, to make one tonne of paper it takes fifteen trees, that means 720 million trees are used to make paper for year. In this paper, the conventional bricks compared with the papercrete bricks. For mix-proportioning no IS-Code is available so that the trial-error based mix-proportion is used. The 1:1.25:2 (cement,paper,sand) ratio used.

Aiyewalehinmi E.01, Adeoye T. E2 et al, They investigated that, the different water/cement ratio as 0.5, 0.55, 0.60 and 0.65 are taken and the compressive strength of proposed cube checked by comparing

with the virgin aggregate cubes. And found that at higher percentage of water/cement ratio gave the same compressive strength as virgin aggregate at 28 days.

Bhupesh Pandey et al, To reduce the emission of CO₂ and fulfill the demand of building material papercrete is used as a binding material as an alternative which is low-cost, lightweighted and ecofriendly.

Md. Safiuddin^{1*}, M. A. Salam² et al, For potential use of waste paper or solid waste this investigation and research is needed. The product of utilized waste should be low-cost, and ecofriendly and sustainable. Also the problem related to disposing and landfilling of solid waste and other may solve.

Ronaldo S. Gallardo, Mary Ann Q. Adajar et al, They studied that, the paper-sludge from paper mill used as partial replacement of fine aggregate in concrete mix. To obtain the workability and strength of concrete an ASTM Type D/G superplasticizer is used in concrete mix.

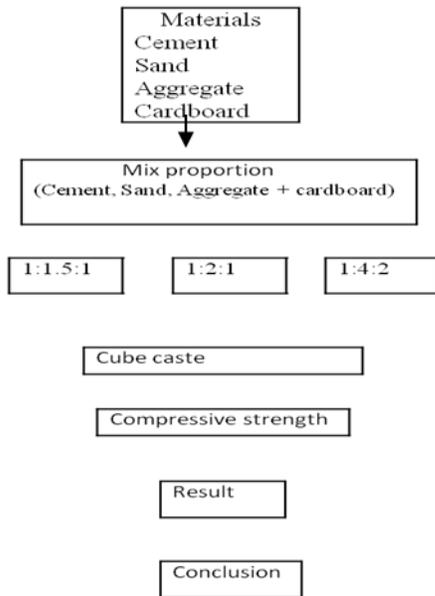
Afnan Ahmad, Mujeebur Rahman et al, In this paper, there is comparison between three ratios of cement, cardboard and sand (1:1:1.5, 1:1:2, 1:2:4). This trial investigation for reducing general concrete material and for environment sustainability. Here cardboard is partially replaced with aggregates.

III. RESEARCH PAPER OBJECTIVE

Potential use of waste cardboard in construction material. The aggregate get partially replaced with cardboard on trial and error basis.

To determine the compressive strength of different mix proportions of concrete.

IV. EXPERIMENTAL PROCEDURE



4.1 Raw material

Cardboard is actually nothing more than fibers and water. The fibers are found in wood. The different kinds of woods are used for making of cardboard. The study is based on the potential use of waste cardboard as a partial replacement of aggregate. Cardboard is generic term for heavy duty paper based product having greater thickness and superior durability or other specific mechanical attributes to paper, such as foldability, rigidity and impact resistance.

4.2 Preparation of pulp

The waste cardboard cannot be used directly, so that the cardboard get converted into its pulp form for this the small pieces of cardboard get cut and dipped into the water for two days .After days it get converted into its pulp form by soaking the water.



Fig. (2). Pulp preparation

4.3 Ratio used

The investigational study is based on trial and error method .The three different ratios are used to determine the compressive strength by replacing aggregate with cardboard pulp. The ratios are (1:2:1), (1:1.5:1) and (1:4:2), (cement, sand, cardboard).There is no specific IS CODE for the mix design.

Table No.1: Mix proportion

Mix Proportion (cement , sand , cardboard + aggregate)	Cardboard replacement in %
1:1.5:1	75% cardboard
1:2:1	50% cardboard
1:4:2	25% cardboard

4.4 Sample preparation

The cardboard pulp is firstly formed because cardboard is main ingredient of concrete mix. The 15cmX15cmX15cm mould is taken for casting the cubic specimen. According to mix ratio proportion the cement, sand, aggregate and cardboard pulp weighted .The 0.45w/c used for mix proportion based on trial and error. By proper tamping the mould get filled with concrete. The specimen get prepared for 7 days, 14 days and 28 days curing period. So total number of samples were prepared.



Fig. (3). Moulded cube

4.5 Testing sample

The compressive strength test was carried out on the specimen samples after 7, 14 and 28 days curing respectively. The compressive test is carried out to determine the behaviour of composite material by axial loading. The compressive strength testing machine is used.



Fig. (4). Compression test setup

The compressive strength of material is determined by the ability of the material to resist failure in the form cracks and fissure.

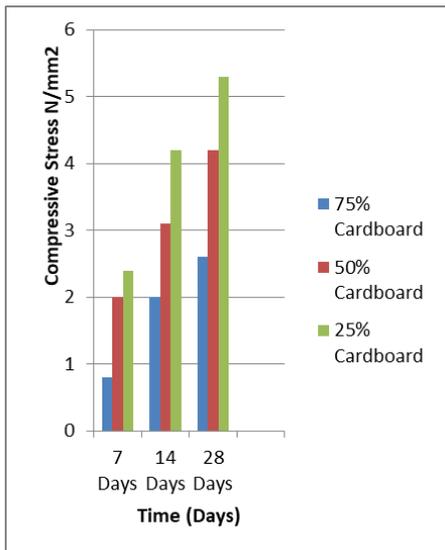
V. RESULT AND DISCUSSION

The result shows that the compressive strength is maximum in ratio (1:4:2). The minimum compressive strength is obtained in the ratio (1:1.5:1).

Hence the 25% replacement of cardboard pulp with aggregate in concrete mix gives the better strength for axial loading on the cubic specimen. It can be used for non-load bearing partition wall and structure.

Table No.2: Observation table

Mix Proportion	7Days (N/mm ²)	14 Days (N/mm ²)	28 Days (N/mm ²)
1:1.5:1	0.8	2	2.6
1:2:1	2	3.1	4.2
1:4:2	2.4	4.2	5.3



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