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REUSE OF DEMOLITION AND CONSTRUCTION WASTE FOR THE MANUFACTURING OF PAVER BLOCKS

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Abstract

With the rising demand for developed areas and the paucity of land, redevelopment projects are becoming more common. The treatment of “construction and demolition (C&D)” waste in India is a matter of concern in the construction industry. C&D garbage accounts for around a third of all municipal solid trash generated in India. Construction, real estate, and the destruction of unlawful structures, among other things, are major sources of trash generation. The importance of C&D waste management in India is highlighted by this. Reuse, recycling, and demolition are used in building and waste management in countries such as the United Kingdom, the United States, France, Denmark, Germany, as well as Japan. 70 percent of the construction sector is unaware of recycling procedures, according to a research commissioned by the “Technology Information, Forecasting, and Assessment Council (TIFAC)”.

Keywords: Construction, demolition, concrete, waste management, municipal solid waste..

1. INTRODUCTION

Landfills that take C&D garbage are limited in size. Most of them have already closed or are about to shut down. Nowadays, the majority of C&D waste produced in Connecticut is dumped of in out-of-state landfills, with just around 7% reported as recycled. These data solely reflect waste that travels via Connecticut's permitted solid waste operations and is reported to the “Department of Environmental

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Protection (DEEP)". The reported recycled rate of 7 percent includes most clean fill created as well as recovered and recycled, scrap metal recycled from construction projects, materials immediately transferred from a work site to an out-of-state recycling end market, as well as commodities consumed once more on site.

1.1. Disposal of Construction and Demolition Waste

The generation of waste on a building site is often impossible to avoid. In fact, in 2016, 61 percent of waste produced in the UK would be from the construction, destruction, and excavation industries.

On the other hand, proper management is important for every company if it produces waste. And it should be also observed that the company is following the waste management hierarchy or not, as this hierarchy helps in reduction, reuse and recycling of waste before its disposal. For UK, it is essential for reduction in environmental impacts.

Disposing the C&D wastes is a concern for environment since basically it is great source for wastage and pollution. It is better to recycle the C&D wastes.

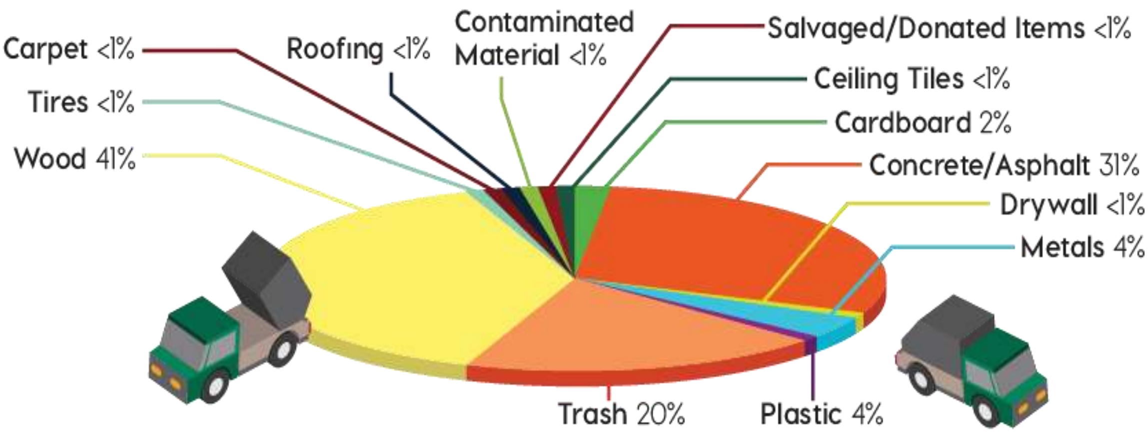

Figure 1: Disposal of waste

1.2. Paver Block

Concrete paver blocks were introduced in the Netherlands in the 1950s as an alternative to paver bricks. Blocks have gone from non-interlocking to partially interlocking to fully interlocking to various interlocking forms in the previous 50 years.. A thin, compressed bedding material is placed over small element, solid unreinforced precast concrete paver blocks that is erected on an appropriately shaped foundation coarse within an interlocking concrete block pavement. Some of the advantages of concrete paving blocks are: versatility, attractiveness, functional as well as cost effective. These blocks require little or no maintenance at all if correctly manufactured and placed. In India, for construction field

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"Interlocking concrete paving block technology" has been introduced. In construction this technology is used in parking areas and footpaths.

Figure 2: Different designs of paver blocks

1.3. Benefits of Using C&D Wastes for Making Paver Blocks

The main benefits of using C&D waste for manufacturing paver blocks are:

- To reduce the cost
- To avoid the purchase of new materials
- To avoid going to dumpsite
- To reduce waste going to landfill

Many economic and environmental advantages may be gained by recycling and reusing building materials. Builders and constructors may save money if the materials can be reused. Disposal costs are less expensive than recycling costs. Many environmental advantages may be gained by reducing the amount of garbage that is sent to landfills.

2. LITERATURE REVIEW

(Kedar et al., 2020) Every year, approximately tones of plastic waste are generated in India. Plastic garbage also takes a long time to degrade. The goal of this study is to employ plastic waste in conjunction with fine aggregates to minimise the cost of paver blocks as compared to traditional concrete blocks, as well as to provide better interlocking than other paver blocks. Hence this work is helpful in reducing plastic waste which leads to protect environment from pollution. We used plastic waste in different proportion with the HDPE granules, coarse aggregates, cement, water and fine aggregates. The paver blocks were prepared and tested with reference of IS code. Result of this work indicate that prepared paver block can be used for area varying from non-traffic to light traffic road.

(Maheswari et al., 2020) Due to vast population increase, the use of plastic are in day by day is more. Several researches worked on carrying waste plastic application in construction industry. Every year, roughly lakhs of tonnes of trash plastic are produced in India. The goal of this research is to substitute

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cement in paver blocks with waste plastic, lowering the cost of paver blocks in comparison to traditional concrete paver blocks. In this project, researchers mixed waste plastic with sand in various amounts. The paver bocks were made and tested, and the findings were thoroughly reviewed.

(Pabon et al., 2020) Recycled materials are increasingly being used in the construction of new buildings all around the globe. Recycled plastic pavers were compared to hydraulic concrete pavers in terms of economic and financial resilience and effectiveness while adhering to current rules. The study's technical and economic findings were both good.

(Kumar et al., 2020) It is imperative to develop a substitute for NA since natural aggregates are in short supply. Natural coarse aggregates of 10mm have been replaced by coarse recycled concrete aggregates produced from construction and demolition wastes in the production of I-shaped recycled paver blocks. The RPBs were tested for visual inspection, dimension tolerance, strength attributes, water absorption, and impact testing.. CRCA may be substituted for up to 60% of natural aggregates in PBs, and lab-made RPBs beat factory-made RPBs in terms of their performance.

(Sudha et al., 2020) Reduction in the price of paver blocks is the main objective of this study for which cement is also replaced with the ceramic waste after comparing with the conventional concrete paver block. Nowadays, the use of ceramic is increasing in construction works in the form of sanitary fittings, electrical insulations and in the form of tiles. But there are some limitations such as large quantity of ceramic waste material is converted into wastage during the time of transportation, manufacturing and fixation due to its brittle nature. Ordinary Portland cement is used in the present study which is replaced by crushed ceramic tiles. With conventional blocks, the ceramic blocks were compared, casted and tested by analyzing their compressive and flexural strength via experimental investigations. Hardness properties of paver block were investigated through the tests. This experiment demonstrates that waste from the tile industry can be used in paver blocks as a partial replacement for cement.

(Thorat et al., 2019) study regard the properties of the paver block which is manufactured using waste plastic and crushed sand. Waste plastic used to replace cement in the production of pavement block. conventional M20 grade concrete paver block and paver block made of waste plastic and crushed sand of proportion waste plastic to crushed sand: 100:00, 90:10, 80:20,70:30 and 60:40 and tested for weight, water absorption, rebound hammer and compressive strength test. Paver block of proportion 100% plastic and 0% sand gives maximum compressive strength of 23 N/mm2 which is more than conventional M20 grade concrete paver block.

(Nadu & Waste, 2019) From various researches, it was observed that there is a considerable imbalance between the accessibility of building material as well as their demand. However, demolition waste is present in huge amount and also plastic waste is increasing which is affecting the environment. Instead of utilising cement, an attempt was made in this effort to manufacture paver blocks utilising discarded low density polyethylene bags as well as waste material. For sustainability, the obtained plastic paver bocks are used which possess thermal as well as sound insulation properties so that pollution can be controlled. This method is considered to be the best one for avoiding the accumulation of plastic wastes as well as demolition waste in society. Such plastic wastes are naturally available in the environment in surplus quantity so that the cost factor can be reduced.

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(Pattnaik et al., 2018) For several years, the problems related with construction sites are known. It is important for the construction industries to support the economic development as well as population growth of the world. In footpaths, gardens and parking areas, interlocking concrete paving bocks are the ideal material used for better look and finish. Hot bituminous mix is used for the conventional construction of pavement as cement concrete technology is not a desirable method. There is a demand of alternating construction techniques due to rising costs of construction materials. For the enhancement in usage of concrete paving blocks, it is important to understand the products manufactured with local materials and indigenously produced mineral admixtures. By using fly ash, aggregates, waste glass powder, concrete paving blocks can be produced in the present study. For variable mix proportions, cement is substituted with fly ash & waste glass powder. According to the findings, fly ash and waste glass powder can be utilised as a cement substitute because their strength is not affected.

(Velumani & Senthilkumar, 2018) In order for industrial wastes to be reused, waste management has a substantial impact. Paper industry wastewater treatment generates sludge. Sludge is formed when hypo sludge and textile effluent treatment plants are combined. It's also difficult to get rid of the muck. There is a need for an environmentally friendly method of producing paver bricks. There are several uses for paver bricks, including pedestrian walkways and municipal roadways. Textile effluent treatment plant sludge and hypo sludge were used to make paver blocks in a first-of-its-kind experiment in this research. Polypropylene fibre and silica fume have been explored in paver blocks.

(Priya & Janani, 2018) Waste materials are a major environmental problem, which is harm to the environment. It is important to reuse the waste materials coming out from construction site. Wastes are like masonry, blocks, tiles, etc. are more. In order to avoid that, the wastes can be crushed and added additional raw materials and it can be converted to paver block (interlocking stones) and can be used in same construction site itself. After recycling, wastes are reused in the construction for making paver blocks. In this paper, a detailed study has been done that paver blocks can be made from construction wastes, and comparison has been done by its quality.

3. METHODOLOGY

The materials and methods which were used in the present study are presented in this chapter for answering the required research questions with the objective of understanding the extent to which the recycling of C&D waste can give their contribution in the manufacturing of paver blocks as these blocks are used in various applications. The following chapter provides a detail study about the materials and methodology used in this research.

The experimental work consists of –

1. Individual material properties
2. Making of a composite material
3. Properties of newly formed composite
    a) Tensile Test

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b) Compressive Strength
c) Water absorption Test
d) Breaking load and Flexural test

4. RESULTS AND DISCUSSION

4.1. Results for Compressive strength

Compressive strength, or compression strength, is the ability of any material or the structure of a material to endure stresses such that its size may be decreased. This is employed to counteract tensile strength, which resists elongating stresses. While tensile strength resists tension, compressive strength opposes being squeezed together.

Table 1: Compressive Strength of Paver Block (N/mm^2) AT 7, 14 & 28 DAYS

Days	Compressive Strength (N/mm^2)
7 DAYS	28.56
14 DAYS	30.21
28 DAYS	32.79

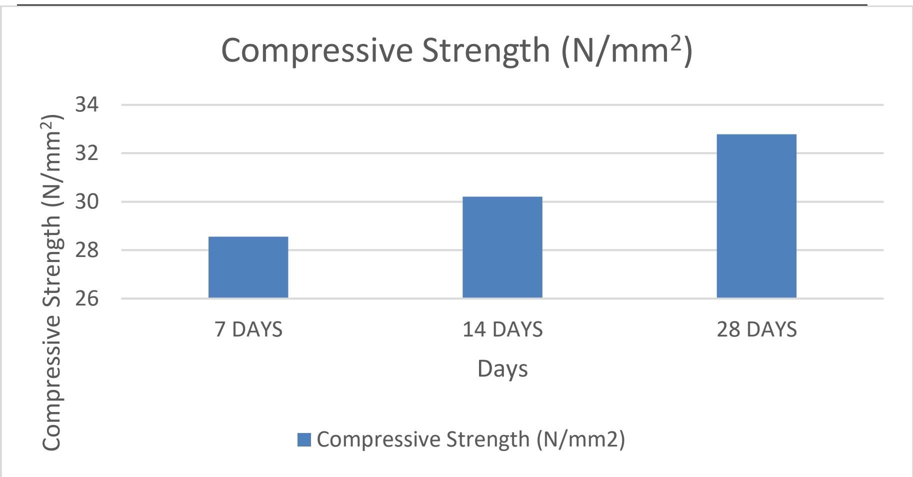

Figure 3: Compressive strength test result graph

The "compressive strength of the paver block" at 7 days was recorded as 28.56 m/mm^2 which increased to 30.21 m/mm^2 and at the final stage i.e. on 28th day, the "compressive strength of the paver block" was 32.79 m/mm^2 which was highest.

4.2. Results for Water Absorption

For determining the amount of water absorbed in particular conditions, water absorption methodology is used. Water absorption is affected by various factors such as: category of plastic, types of additives used, temperature as well as length of the exposure. The light is shed by the data on the performance of material under water or humid environment.

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The typical interlocking paving stone does not show permeability, meaning it will not drain water. Flexibility is the benefit of Regular pavers, but not permeability.

Table 2: Water absorption test results

S. No.	Mix Design of Paver Blocks	Water Absorption (%)
1	Trial 1	1.178
2	Trial 2	1.104
3	Trial 3	1.082
4	Trial 4	1.156
5	Trial 5	1.212

A comparison graph between different values of 5 different trials is shown in figure below.

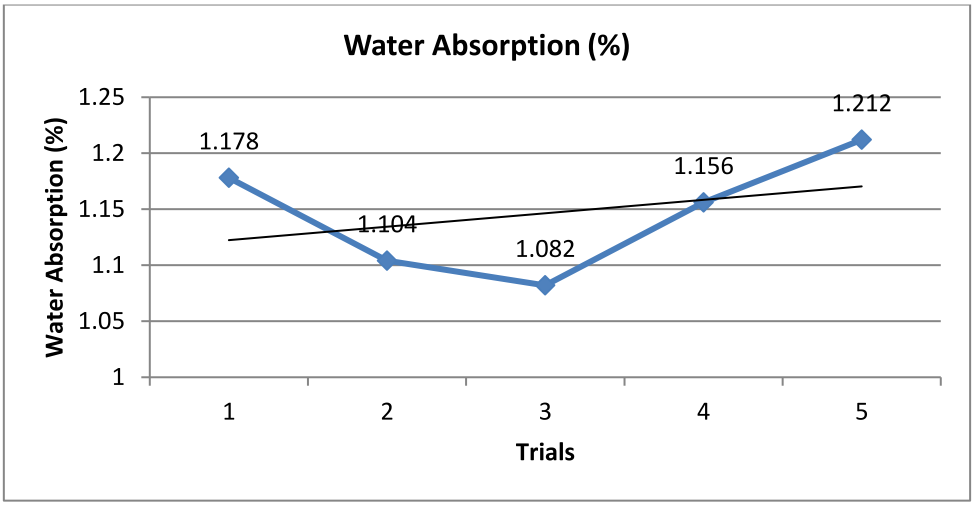

Figure 4: Comparison of Water Absorption values from test.

4.3. Results for tensile splitting strength

For concretes, tensile strength is considered as pone of the most basic and important properties. The designing of concrete structural elements requires knowledge. Pre-stresses concrete structures also need its value. For determining the flexural strength, recourse is also important. Additionally, computation of direct tensile as well as splitting of tensile strength is significant for recourse.

Table 3: Tensile Strength of Paver Block (N/mm2) AT 7, 14 & 28 DAYS

Days	Tensile Strength (N/mm^2)
7 DAYS	1.5
14 DAYS	1.9
28 DAYS	2.21

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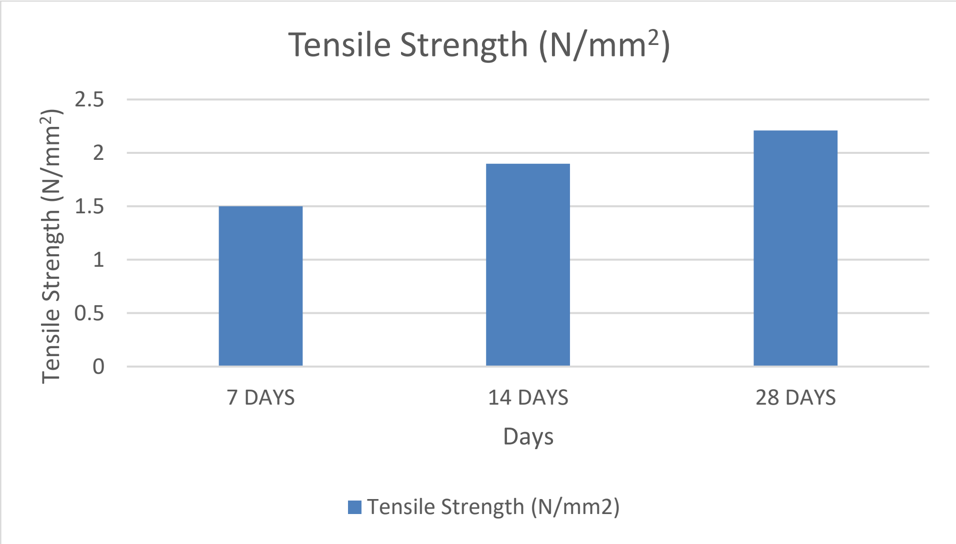

Figure5: Tensile strength test result graph

For tensile splitting test, the tensile strength of paver blocks gives maximum value of strength is 2.12Mpa on the 28th day. However, it was 1.5 MPa on the 7th day and 1.9 MPa on the 14th day.

4.4. Breaking Load and Flexural Strength

As a result, the study's main goal was to see if there were any other test methods that may potentially replace field-cast beam specimens while evaluating the same or similar strength qualities as the flexure test. Because of the inherent issues connected with casting and handling the very large beam specimens required by the test protocol, concrete flexural strength is difficult to evaluate reliably in the field.

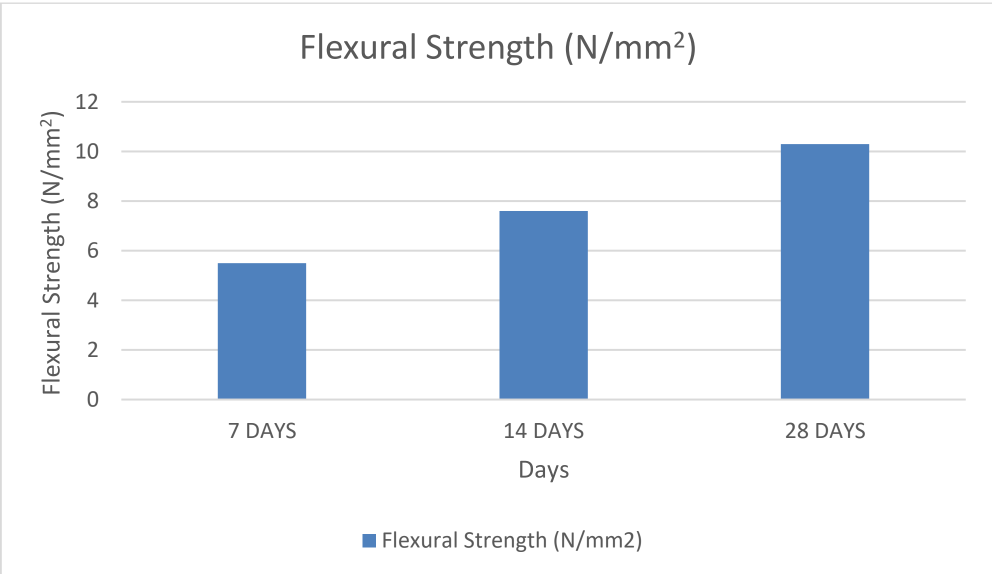

Figure 6: Flexural strength test result graph

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Table 5: Flexural Strength of Paver Block (N/mm2) AT 7, 14 & 28 DAYS

Days	**Flexural Strength (N/mm^2)**
7 DAYS	5.5
14 DAYS	7.6
28 DAYS	10.3

5. CONCLUSION

Despite the existence of a legislative framework, there's been little implementation in the sector of C & D waste management in urban India. All stakeholders have a key role to play in this context for sustainable development, as mentioned in the investigation. On the basis of current construction practices, future challenges are massive with the excessive demand for infrastructure and residential, as well as the resulting growth in the construction industry. For framing and envelop, high rise buildings and in-situ construction are coming up which will be further reconstructed after 40 50 years. There is a big challenge in managing C&D waste, on the basis of situation of scale of these projects and materials in future.

Additionally, manufacturing of concrete paver blocks is cost effective. Through this methodology, the demolition waste is utilized and limits the improper disposal of C&D wastes. This method is more sustainable.

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