

PAVER BLOCK USING PLASTIC WASTE

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in
Civil Engineering
By

NAVEEN KUMAR V (Register No: 39200025)

SARAVANABALAN M (Register No: 39200037)



**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

APRIL 2023



SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with "A" grade by NAAC
Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119
www.sathyabama.ac.in

DEPARTMENT OF CIVIL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **NAVEEN KUMAR V (Reg No. 39200025)** and **SARAVANABALAN M (Reg No. 39200037)** who carried out the project entitled **"PAVER BLOCK USING PLASTIC WASTE"** under our supervision from SEPTEMBER 2022 TO APRIL 2023.

Internal Guide

Dr. R . NIRMALA (M.E. ,Ph.D.)

Head of the Department

Submitted for Viva voce Examination held on 19.04.2023

Internal Examiner

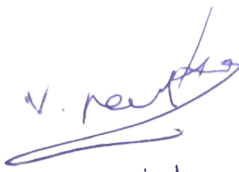
External Examiner

DECLARATION

We **NAVEEN KUMAR V (Reg. No. 39200025)** and **SARAVANABALAN M (Reg. No. 39200037)** hereby declare that the Project Report entitled “**PAVER BLOCK USING PLASTIC WASTE**” done by us under the guidance of **Dr. R. NIRMALA** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering.

DATE: 13.04.2023

PLACE: Chennai

1. 
2. 

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr. Devyani Gangopadhyay, B.Arch., M.T.P., Ph.D.**, Dean, School of Building and Environment and **Dr. S. Packialakshmi, M.E., Ph.D.**, and **Dr. R. Padmapriya, M.E., Ph.D.**, Head of the Department, Dept. of Civil Engineering for providing us necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep sense of gratitude to our Project Guide for **Dr. R. NIRMALA** valuable guidance, suggestions and constant encouragement paved way for the successful completion of our project work. As well as we would like to thanks our Non-teaching staff member **Mr. KARTHIKEYAN B.E.**, for his guidance to finish all the experiments which have been involved in this research.

We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Civil Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

Delrin is known for its exceptional toughness, stiffness, and resistance to moisture, chemicals, and abrasion. It is used in a variety of applications, including automotive parts, electrical components, consumer goods, and industrial machinery. Delrin is also popular in the field of precision engineering due to its low coefficient of friction and excellent dimensional stability.

This study aims to investigate the feasibility of using Delrin plastic waste as a partial replacement of M sand in paver block manufacturing. The physical and mechanical properties of the paver blocks were evaluated, including compressive strength, water absorption, density, and durability. The results showed that the use of Delrin plastic waste as a partial replacement for M sand had a positive impact on the properties of the paver blocks. The compressive strength increased with an increase in the percentage of Delrin plastic waste used, while water absorption decreased. The study concludes that the use of Delrin plastic waste as a partial replacement for M sand in paver block manufacturing is feasible and has the potential to reduce environmental pollution while producing durable and high-quality paver blocks.

The project involves the preparation of Delrin waste through a series of mechanical and chemical processes, followed by mixing with other raw materials to form a composite material for paver block production. The composite material is then molded into paver blocks using a hydraulic press and cured under controlled conditions.

The resulting paver blocks are tested for compressive strength, water absorption, and abrasion resistance to evaluate their performance characteristics. The project concludes to demonstrate that paver blocks made using Delrin waste have similar or better properties than conventional paver blocks while offering an environmentally sustainable alternative.

TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE NO
	ABSTRACT	V
	LIST OF FIGURES	Ix
	LIST OF TABLES	Xi
1	INTRODUCTION	1
	1.1 GENERAL	1
	1.2 HARMFUL EFFECTS OF PLASTIC	1
	1.3 DEFINITION OF PLASTIC	2
	1.4 NEED FOR RECYCLING PLASTIC	2
	1.5 RECYCLING OF PLASTIC	3
	1.6 PROCESS OF RECYCLING OF PLASTIC	3
	1.7 EXPLANATION OF RECYCLING OF PLASTIC	3
	1.8 OBJECTIVE	4
	1.9 SCOPE OF THE PROJECT	4
	1.10 AIM	4
2	LITERATURE SURVEY	5
	2.1GENERAL	5
	2.2 REVIEW OF THE LITERATURES	5

3	METHOD OF INVESTIGATION	
	3.1 PROPERTIES OF CEMENT	14
	3.2 PROPERTIES OF FINE AGGREGATE	15
	3.3 PROPERTIES OF COARSE AGGREGATE	16
	3.4 PROPERTIES OF DELRIN PLASTIC	17
	3.5 PROPERTIES OF WATER	18
	3.6 COMPRESSION TEST	23
	3.7 WATER ABSORPTION TEST	24
4	RESULTS AND DISCUSSION	26
	4.1 WATER ABSORPTION TEST	26
	4.2 COMPRESSIVE STRENGTH TEST	28
5	SUMMARY AND CONCLUSION	33
	5.1 SUMMARY	33
	5.2 CONCLUSION	33
	REFERENCES	35

LIST OF TABLES

TABLE NO	TITLE	PAGE NO
3.1	MIX % OF M SAND AND DELRIN PLASTIC	17
3. 2	MIX PROPORTION	20
4.1	WATER ABSORPTION TEST RESULT	27
4.2	COMPRESSIVE STRENGTH TEST	29

LIST OF FIGURES

FIGURE NO	TITLE	PAGE NO
2.1	METHODOLOGY OF THE PROJECT	4
3.1	DELRIN PLASTIC	17
3.2	MIXING OF PLASTIC	21
3.3	CASTING	21
3.4	VIBRATING (TAMPING)	21
3.5	DEMOULDING I SHAPED PAVER BLOCKS	22
3.6	CURING OF I SHAPED PAVER BLOCKS	22
3.7	COMPRESSION TEST ON 20%	23
3.8	COMPRESSION TEST ON 10%	23
3.9	COMPRESSION TEST ON 30%	24
3.10	COMPRESSION TEST ON 0%	24
3.11	WATER ABSORPTION TEST (BAR CHART)	27
4.1	WATER ABSORPTION TEST (LINE GRAPH)	28
4.2	COMPRESSIVE STRENGTH (LINE GRAPH)	30
4.3	COMPRESSIVE STRENGTH TESTING	30
4.4	WEIGHT OF PAVER BLOCK	31
4.5	BREAKING LOAD IN (KN)	31

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Plastic is a material that we use constantly and for a wide range of things. The effects of plastic pollution are severe, though. According to estimates, billions of tonnes of plastic make their way into the waters of the world, damaging marine life and having an impact on human health. The worldwide economy, notably the fishing and aquaculture sectors, is significantly impacted by plastic pollution as well.

Two of the most widely used plastics, polyethylene and polypropylene, also make up a significant amount of plastic garbage. Waste composition varies across nations and is influenced by elements like socioeconomic traits, waste management initiatives, and consumption habits. Yet, plastic garbage generation is widespread throughout all nations.

1.2 HARMFUL EFFECTS OF PLASTIC

An important source of waste delrin plastic is utilized as a binding medium in the manufacture of paver blocks, a substantial contributor to the building industry. However, the use of plastic waste has detrimental effects on the environment, leading to the investigation of substitute binding materials. The replacement of various percentages of delrin plastic waste with m sand for the creation of I-shaped paver blocks is the subject of this report.

This study's goals are to investigate the viability of employing m-sand as a replacement for Delrin plastic waste and to evaluate any potential effects on the production of I-shaped paver blocks' quality, cost, and environmental sustainability. We will specifically look into replacing 10%, 20%, and 30% of delrin plastic waste with m sand and contrast the outcomes to paver blocks made entirely from delrin plastic waste.

In addition to comparing the cost-effectiveness of each method, this paper will analyse the physical, mechanical, and environmental characteristics of paver blocks made with various percentages of m sand replacement. We expect that this investigation will be helpful in revealing the potential of m sand as a substitute for

delrin plastic waste in the manufacture of I-shaped paver blocks and in the advancement of more environmentally friendly building techniques.

1.3 DEFINITION OF PLASTIC

Polyethylene, PVC, nylon, and polycarbonate are just a few examples of the diverse organic polymers used to create plastic, which is a synthetic or semi-synthetic substance. These materials are distinguished by their exceptional durability and resilience to wear, moisture, and chemicals, as well as their capacity to be moulded and shaped under heat and pressure.

Plastics can be produced in many different shapes, such as films, sheets, rods, tubes, and fibers, and they can be treated using a number of different methods, including injection molding, extrusion, and blow moulding. They can be found in a variety of products, from consumer items and packaging to automotive and aerospace parts.

The adaptability and flexibility of plastic, which can be tailored to fulfil a range of requirements, is one of its main benefits. Plastic is not biodegradable and can take hundreds of years to decompose in the environment, hence it is also well known for its negative effects on the ecosystem. As a result, initiatives are being made to create more environmentally friendly alternatives to conventional plastic materials.

1.4 NEED FOR RECYCLING PLASTIC

Environmental Impact: Plastic trash poses a serious threat to the environment, especially when it contaminates natural ecosystems like oceans and waterways or fills landfills. Recycling plastic lessens the production of garbage, conserves resources, and lessens the environmental effects of plastic waste. Recycling plastic helps to conserve natural resources including energy, water, and raw materials. We can lessen the demand for virgin plastic production, which uses a lot of energy and resources, by recycling plastic.

Economic Benefits: Recycling plastic can create jobs and economic opportunities, particularly in the recycling industry. By establishing a more circular economy, we can create a more sustainable and resilient economy that benefits both people and the planet.

Economic Gains: Recycling plastic can generate employment and business prospects, especially for the recycling sector. We can build a more resilient and sustainable economy that benefits both people and the environment by implementing a more circular economy.

Climate Change: Since recycling plastic uses less energy than producing virgin plastic, it can help reduce greenhouse gas emissions. We can lower our carbon footprint and lessen the effects of climate change by lowering our reliance on the creation of virgin plastic.

1.5 RECYCLING OF PLASTIC

Building a sustainable future requires recycling plastic. When plastic garbage enters landfills or other natural ecosystems like oceans and waterways, it poses a serious threat to the environment. Recycling plastic can lessen waste production and lessen the risk of environmental pollution. Additionally, it protects resources including raw materials, water, and energy. We can lessen the demand for virgin plastic production, which uses a lot of energy and resources, by recycling plastic. Additionally, recycling plastic can boost the economy and lead to the creation of jobs, particularly in the recycling sector. We can build a more resilient and sustainable economy that benefits both people and the environment by implementing a more circular economy. Overall, recycling plastic is crucial to building a future that is robust and sustainable. We can create a more circular economy that benefits both people and the environment by reducing plastic waste and saving resources.

1.6 PROCESS OF RECYCLING OF PLASTIC

Collection of waste materials

Sorting of materials

Cleaning of materials

Shredding or crushing of materials

Manufacturing of new products

1.7 EXPLANATION OF RECYCLING PLASTIC

Collection of waste materials: The first step in the recycling process is the collection of waste materials from households, businesses, and public places.

Sorting of materials: Once collected, the waste materials are sorted into different categories based on their type (e.g. plastic, paper, glass, metal, etc.) using manual or automated methods.

Cleaning of materials: After sorting, the materials are cleaned to remove any contaminants such as dirt, oil, or food residue that may be present.

Shredding or crushing of materials: The cleaned materials are then shredded or crushed into small pieces to make them easier to handle and transport.

End: The final step is the use of these new products by consumers, completing the recycling loop.

1.8 OBJECTIVE

- To determine the property of waste plastic (Delrin plastic) in the development of paver blocks.
- To evaluate water absorption test of ordinary concrete paver blocks and plastic paver blocks.
- To evaluate compressive strength of ordinary concrete paver blocks and plastic paver blocks.

1.9 SCOPE OF THE PROJECT

The project's scope may also involve determining potential difficulties and dangers, as well as assessing the environmental effects of employing leftover delrin plastic in paver blocks. The initiative can also entail working with regional government bodies and waste management organizations to promote recycling of delrin plastic trash and lessen its environmental impact.

1.10 AIM

The aim of the study was described below,

The goal of a project for paver blocks made of Delrin plastic waste is to turn waste plastic into a practical building material while lowering its environmental impact. In order to ensure that the strength and durability of the finished paver blocks exceed industry standards, the project intends to create a method for transforming

waste Delrin plastic into a form that can be used in paver blocks. As part of the project, a marketing strategy will be created to encourage the use of Delrin plastic waste paver blocks in construction projects and assess the environmental impact of the manufacturing process. In the end, the project hopes to promote eco-friendly methods of recycling plastic garbage and lessen the amount of plastic waste dumped in landfills.

Durability: Plastic paver blocks are strong and durable, able to withstand heavy traffic loads and harsh weather conditions.

Eco-friendliness: They are made from recycled plastic, which reduces the amount of plastic waste in landfills and the environment.

Low maintenance: Plastic paver blocks require minimal maintenance, with no need for sealing or chemical treatments.

Easy to install: They are easy to install, saving time and labor costs.

Versatile: They can be used in a variety of applications, such as for driveways, walkways, and patios.

Cost-effective: Plastic paver blocks are often cheaper than traditional paving materials.

Safe: They provide good traction and are slip-resistant, making them a safe option for outdoor surfaces.

CHAPTER 2

LITERATURE SURVEY

2.1 GENERAL

The research project presented in this report has been drawn from various international journals and serves as a reference for the analysis of the underlying concepts.

2.2 REVIEW OF THE LITERATURES

Jeevan Ghuge et al. (2019) conducted a study to examine the usage of plastic waste as a binder in paver block production. In order to create plastic paver blocks, the method entailed melting the plastic that was gathered from various sources in a small chamber and combining it with other materials. After adequate curing, a compression testing machine was used to gauge the compressive strength of both regular and plastic paver blocks. According to the findings, the average compressive strength of the plastic paver block was 16.05 N/mm², which was nearly on par with the strength of a regular concrete paver block (19.54 N/mm²). Therefore, it can be inferred that plastic paver blocks can be utilised in parks, walkways, and yards of residential and commercial structures because their compressive strength is adequate for a smooth user experience.

Prasad and Jayswal (2017) To cast on a small mold, the waste polyethylene was divided into small pieces and ground into fine grains before being combined with Portland cement and water in various waste material percentages (0%, 5%, 10%, and 13%). containing yield points of 970, 797, and 874 N after immersion for seven days, respectively, and 1520 N for the mixture of 5% and 1296 N for the mixture of 10% after immersion for twenty-eight days, the results demonstrated that the mixtures containing 5%, 10%, and 13% polyethylene had the best compressive strength .In contrast to the brittle Sand-Portland cement concrete, the stress-strain behaviour demonstrated plastic behaviour with multiple phases of deformation, making it semi-crystalline and flexible. Before fracture, both elastic and plastic deformation could be seen in the stress-strain diagram. The goods with 5% to 13% waste plastic material likewise showed good workability to make holes without any

issues, but when the proportion of waste material declined or rose, the workability weakened and generated power during cutting operations.

Subramani (2015) looked into substituting plastic waste for coarse particles in structural concrete. The discarded plastic was processed by melting it at a particular temperature to achieve the required brittleness, then extruding and cooling it to create rocks that were around 100 mm in size. The concrete compositions utilised these crushed plastic boulders, which had an aggregate size requirement of 20 mm or less. The study comprised substituting 5%, 10%, and 15% of the standard coarse particles with plastic aggregates to examine the effect of employing plastic aggregates on the qualities of concrete. In order to evaluate how internal curing affected different concrete qualities, the researchers also ran a thorough experimental programme.

Shanmugavalli and Gowtham (2017) explored the potential of using plastic waste, fly ash, and quarry dust to produce paver blocks with a lower cost than traditional concrete paver blocks. The goal of the project was to replace cement with plastic waste and investigate the feasibility of using the resulting mixture to create functional paver blocks. To achieve this, plastic waste was heated in a metal bucket at a temperature above 150°C until it melted, and then quarry dust, coarse aggregate, ceramic waste, and other materials were added in the appropriate proportions and mixed thoroughly. Three different mixtures were cast into paver blocks, and tests were conducted to assess compression and moisture content. The resulting paver blocks made with plastic waste, quarry dust, coarse aggregate, and ceramic waste showed better results than traditional concrete paver blocks, and they exhibited good heat resistance. Although their compressive strength was lower than that of concrete paver blocks, they could be used in pedestrian paths, gardens, cycle ways, and other non-traffic and light-traffic roads. The use of plastic waste in paver blocks could help reduce the cost of producing these blocks while also promoting sustainability by reusing plastic waste.

Vieira (2016) used an entirely random experimental design with mixture and process variables to optimise the design mix for creating pre-cast concrete blocks. The subject of the investigation was polymerized concrete, which was made of mixed compounds of cement and water. The researchers analysed each potential model using ANOVA to evaluate all alternative models in order to find the best design mix. The linear-linear model was chosen because it did not demonstrate lack

of fit and was able to predict how the process variables would respond to a change in the variable mixture condition levels. The polymerized concrete was created under the best possible experimental conditions utilising 4.8 mm polystyrene beads, 5.0% polystyrene as an aggregate replacement, 18.3% cement, 73.4% aggregate, and 8.3% water. Due to this circumstance, polymerized concrete blocks have compressive strengths more than 15 Mpa, making them appropriate for paving. The researchers were successful in their objectives, and the material they acquired might be utilised to build walls or as paving blocks. Despite the lack of surface treatment or additive addition in the investigation, the polymerized concrete's strength remained over 15 MPa for 28 days.

Agyemana et al. (2019) looked at the viability of employing recycled plastic waste as a binding substance for paving stones. In order to create concrete paving blocks that would serve as the control group, the researchers mixed cement, quarry dust, and sand in a 1:1:2 ratio by weight or volume. The control group was subjected to tests for compressive strength and water absorption. They also made composite paving blocks with low plastic content (LP) in a 1:1:2 mix ratio and high plastic content (HP) in a 1:0.5:1 mix ratio by weight or volume, and tested them for compressive strength at 7, 14, and 21 days after curing with water sprinkling. According to the findings, the HP and LP paving blocks had compressive strengths of 8.53 N/mm² (with water absorption of 0.5%) and 7.31 N/mm² (with water absorption of 2.7%), respectively, after 21 days of curing. These were more than the figure of 6.07 N/mm² (with a water absorption of 4.9%) for the control group. Due to their low water absorption property and relatively low compressive strengths compared to global specifications of 5-25% and low-density to moderate concrete strength of 0.69-17.24 N/mm², respectively, the authors suggested using paving blocks made from recycled plastic waste in non-traffic areas such as walkways, footpaths, pedestrian plazas, landscapes, monument premises, and waterlogged areas.

Arsod et al. (2019) The effect of replacing cement with PVC plastic waste powder in percentages of 0, 10, 20, and 30 was investigated in the 2019 paper on experimental inquiry on concrete paver block and plastic paver block. The cube specimens underwent casting, curing, and compression strength testing after 7, 14, and 28 days. After the PVC waste had been ground into a powder and combined

with cement and sand, 10 mm of coarse aggregate was added. After mixing with water, the paver block was completed with good shape, interlocking, and beauty. The study discovered that installing paver blocks did not require professional labour and that a replacement of 10% cement with PVC plastic was suitable.

John Babafemi et al. (2018) The performance of recycled plastic in concrete was reviewed by the authors, who concentrated on how it affected the concrete's mechanical, fresh, and durability properties when employed as fine and coarse particles or fiber. Due to increased air content and a lack of bonding between plastic and natural aggregates, the study discovered that plastic aggregates' non-reactive behaviour can lower concrete's performance in both mechanical and durability tests. However, the performance of plastic in concrete can be greatly enhanced by the use of surface treatments such as chemical solutions like sodium hypochlorite and sodium hydroxide. This is due to crystals that are created by the chemical treatment on the plastic's surface, which dissolve in the water used in the concrete mix and disintegrate in the highly alkaline environment of the cement, producing oxygen. Recycling plastic waste for use in civil engineering projects like paving and infrastructure can be a more environmentally friendly option than dumping it in landfills. Concrete bricks, blocks, façade components, nonstructural concrete panels, and temporary shelters can all be made using plastic aggregates. Additionally, plastic fibres can be incorporated into concrete to prevent fractures, shrinkage, and creep, which could reduce the need for natural aggregates and minimise the price of concrete.

Mandlik et al. (2013) The study's goal was to develop a mix design for light-weight EPS concrete that would have a density under 1800 kg/m^3 and appropriate compressive strength for usage in building. The research discovered that using chemically coated crushed polystyrene granules in place of some of the coarse aggregate in normal weight concrete mixtures led to the creation of lightweight structural concrete with unit weights ranging from 1200 to 2000 kg/m^3 . The study looked into and reported on the engineering characteristics of the polystyrene aggregate concrete, including its compressive strength, elastic modulus, drying shrinkage, and creep. The study also showed that the size of the EPS particles affected the compressive strength of the concrete, with smaller beads performing better. It was discovered that EPS was less expensive than regular concrete, and

that adding more EPS beads to the concrete mix decreased its compressive and tensile strength. But all of the EPS concrete that lacked a specific bonding agent demonstrated good workability and was simple to compact and polish.

Pradhan and Maharjan (2016) to create a lightweight concrete brick and determine how much it would cost to use it in Nepal's earthquake-affected regions. EPS beads, cement, sand, coarse aggregate, and a variety of aggregate-to-EPS ratios (0%, 10%, 20%, 30%, and 100%) were used to create the lightweight bricks. The study discovered that hand mixing and hand compaction can result in good finishing, and that the cost of EPS concrete bricks is largely determined by the quantity of cement used. When compared to traditional bricks, the study further demonstrated that it is feasible to create these lightweight bricks at a fair cost.

Mohd Sari (2018) to assess the mechanical properties of cement brick that use them as partial substitutes for sand and ordinary Portland cement. (OPC). The purpose of the study is to ascertain the bricks' density, compressive strength, and water absorption characteristics. While POFA replacement varies from 5% to 25%, EPS replacement dosages are 20%, 30%, 40%, and 50%. According to the findings, bricks that replace 30%, 40%, and 50% of the EPS have densities that are less than 1680 kg/m^3 , which is regarded as lightweight. After 56 days of curing, the brick with 25% POFA replacement had a density of 1629 kg/m^3 , whereas the brick with 50% EPS replacement had the lowest density at 1328 kg/m^3 . These bricks' capacities to absorb water range from 7.20% to 18.19%. The lowest water absorption was seen in the brick with 0% POFA and 50% EPS replacement, whereas the highest absorption was seen in the brick with 25% POFA and 0% EPS replacement. In summary, the research finds that using EPS and POFA as partial substitutes for sand and OPC, respectively, can lead to the creation of cement bricks that are lightweight and environmentally benign. By adjusting the EPS and POFA dosages, it is possible to optimise the mechanical properties of the bricks.

Leo (2016), "EPS Geofoam Behaviour as Flexible Pavement Subgrade Material." Through a series of tests in a dummy pavement testing facility, the behaviour of expanded polystyrene (EPS) geofoam utilised as subgrade and fill material underneath flexible pavement was examined. Pavement test sections with a wearing course, a gravel base layer, and a sand subbase were put up

experimentally and placed on EPS blocks inside a test tank. A loaded wheel was used to mimic traffic loading on the test pavement while it was moving around an oval-shaped test track. The experiment looked at how the performance of the EPS geofoam was affected by repetitive traffic loading.

Cajun (2015) The lightweight mortar employed in this study has effective mechanical characteristics that make it a good material for masonry in buildings. Without using pozzolans, additives, or additional aggregates, this mortar's ingredients are recycled EPS as an aggregate and commercial Portland cement as a binder. The failure routes of these bricks follow the interfaces of the polystyrene aggregate particles and cut through the cement paste and aggregate particles themselves, in contrast to concrete with coarse aggregate.

Bhuinyan and Dahatonde (2016) could be used as a filler material for pavement design. Incorporating EPS geofoam, according to the authors, can greatly lessen small settlements and lead to decreased maintenance costs. An elastoplastic substance called EPS geofoam hardens but relaxes in stiffness as confining pressure rises. It is a common material for pavement construction because it is 100 times lighter than dirt and costs less than soil. It is a widely acknowledged solution in the building industry all over the world because of its lightweight nature and higher performance when compared to conventional soil or subgrade materials.

Aman Mulla and Amol Shelake's (2015) work investigates the use of expanded polystyrene (EPS) beads as a partial replacement for coarse aggregate. Three mix proportions of spherical EPS beads with diameters ranging from 1.18 to 2.36 mm were used, and workability, compression, split tensile strength, and density tests were all carried out on the EPS beads concrete mix proportions. The findings indicated that while the compressive strength of the EPS beads concrete mix is lower than that of traditional concrete, it nevertheless offers reasonable workability. The designed mix proportions, according to the authors, are however suitable for usage in cladding panels and tilt-up panels.

Thomas Tamut was to look at how concrete's compressive and tensile strengths would change if expanded polystyrene (EPS) beads were used as a partial replacement for coarse aggregates. In the study, these characteristics of concrete with EPS beads were contrasted with those of unmodified concrete devoid of EPS. The findings demonstrated that the compressive strength declined with increasing EPS content, with 30% EPS resulting in a 45% reduction at 28 days compared to the no-EPS scenario. Similar to that, tensile strength dropped as EPS content rose. However, the workability of all EPS-concrete mixtures was good and got better as the EPS proportion rose.

Esan et al. (2017) These tiles preserve the underlayers while simultaneously providing the building envelope with thermal insulation, lowering energy use and harm to the environment. According to European standards for environmental evaluation of buildings, the research uses a "cradle to gate" method to evaluate the environmental performance of thermal insulation tiles for different life-cycle stages and environmental categories.

Shrinath Hogade (2016) carried out a study in to evaluate the strength behaviour of EPS wire mesh panels to conventional concrete. According to the study, employing EPS panels to build walls decreases the need for joints, which somewhat boosts wall strength. When tested with EPS panels measuring 1 m x 1 m, compressive strength figures of 2.26 N/mm² and 2.64 N/mm² for plaster thicknesses of 25 mm and 35 mm, respectively, were obtained. Additionally, EPS panels are a great alternative to traditional ways for multi-story structure construction because they greatly reduce the weight of the wall when compared to those methods. Additionally, because of the polystyrene in the panel, EPS panels are appropriate for thermally insulated walls. Overall, the research indicates that EPS panels are an effective substitute for traditional building materials in the construction of walls because they provide greater strength, lighter weight, and better thermal insulation.

Subramanian and Sudhakar (2019) Numerous research projects have recently focused on the utilization of plastic waste in the production of paver blocks. The use of plastic waste in the production of paver blocks was found to raise the strength of the block, improve its durability, and decrease its water absorption. The

researchers also discovered that adding plastic debris to paver blocks increased the stones' flexural strength.

Ali et al. (2018) looked at the mechanical characteristics of paver blocks. Researchers discovered that recovered plastic trash paver blocks had comparable compressive strength to those constructed of more traditional materials. However, compared to standard paver blocks, the paver blocks constructed from recycled plastic waste had higher tensile and flexural strengths.

Okafor et al. (2017) examined the creation of paver blocks using recycled plastic and quarry dust. The researchers discovered that the compressive strength of the paver blocks was greatly improved by the inclusion of recycled plastic and quarry dust. Additionally, they noted that the usage of recycled plastic in paver blocks decreased the negative effects of plastic waste on the environment by offering an environmentally beneficial alternative. In conclusion, it has been discovered that using plastic waste in the production of paver blocks enhances their strength, durability, and water absorption. Additionally, it has been discovered that adding plastic trash increases the flexural, tensile, and compressive strength of paver blocks. Additionally, the use of recycled plastic in the production of paver blocks can lessen the negative environmental effects of plastic waste and offer a sustainable option for the building sector.

METHODOLOGY

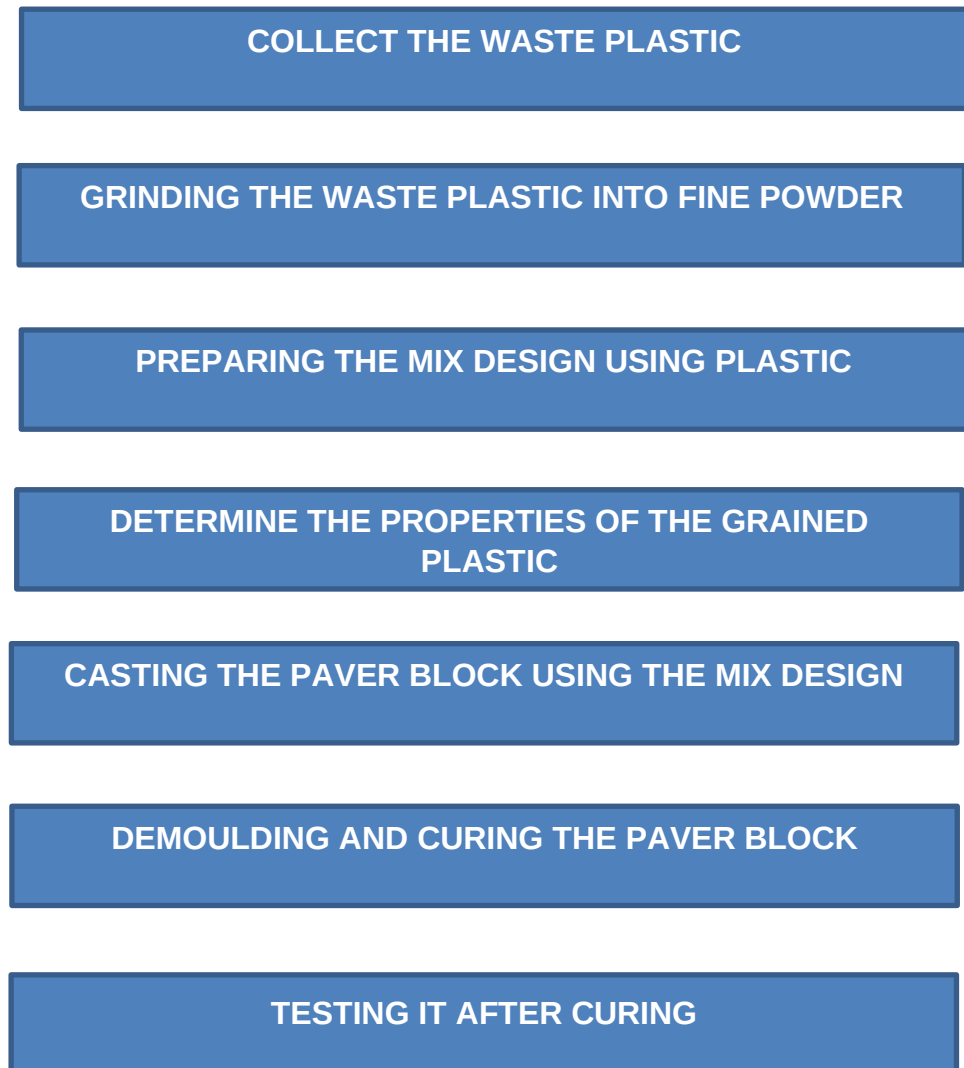


FIG.2.1 METHODOLOGY OF THE PROJECT

CHAPTER 3

METHOD OF INVESTIGATION

3.1 PROPERTIES OF CEMENT

A type of cement that is frequently utilised in the building sector is OPC 53 Grade cement. After 28 days of curing, this cement has a high compressive strength of 53 MPa, making it appropriate for use in high-rise constructions, bridges, and other structures requiring great strength. OPC 53 Grade cement is also simple to work with and gives ample time for concrete to be laid and finished thanks to its modest initial setting time of 30 to 60 minutes and final setting time of 270 minutes. Because of the higher fineness of this cement compared to OPC cements of lesser grades, the cement paste is easier to work with and the concrete's strength is increased. In order to maintain the longevity of the concrete construction, OPC 53 Grade cement has exceptional durability features that make it resistant to extreme climatic conditions like freeze-thaw cycles, chemical assault, and abrasion. Additionally, it has a lower shrinkage rate, which is crucial for the durability of the concrete structure, and a higher heat of hydration, which is important in large concrete constructions like dams and bridges. OPC 53 Grade cement offers exceptional qualities all around that make it perfect for use in a variety of construction applications.

$$\begin{aligned} & \text{M25} \\ \text{Cement} &= 350 \text{ kg/m}^3 \\ \text{BLOCK SIZE} &= 0.00264 \\ &= 350 \times 0.00264 \\ &= 0.924 \text{ kg} \\ \text{For 24 blocks} & \\ &= 0.924 \times 24 \\ &= 22.176 \text{ kg} \\ \text{20\% waste in work} & \\ &= 22.176 + 20\% \text{ (for work waste)} \\ &= 22.176 + 4.435 \\ &= 26.611 \end{aligned}$$

3.2 PROPERTIES OF FINE AGGREGATE

Concrete, cement, and other building materials must all contain fine aggregate, such as M Sand. Rocks, quarry stones, or bigger aggregates are crushed into sand-sized particles to create M Sand. M Sand is the perfect material for use in construction thanks to a variety of characteristics.

The fineness modulus, a gauge of the sand's particle size distribution, is one of the crucial characteristics of M Sand. M Sand is within the approved range for fine aggregates used in concrete production with a fineness modulus of 2.3-3.1. Due to this quality, M Sand works well as a substitute for natural sand in concrete.

M Sand is cubical in shape and has a smooth texture, which makes the concrete mix easier to work with. Natural sand's angular and rough texture can make the mixture challenging to work with, but M Sand's smooth texture makes it easier to produce a consistent, homogenous concrete mix.

Additionally, the particle sizes in M Sand are equally dispersed within a certain range, which is referred to as having a well-graded particle size distribution.

The low moisture content of M Sand, which makes it simple to deal with and prevents lumps from forming in the concrete mix, is another significant characteristic of the material. M Sand does not readily absorb water since it has a poor absorption rate. This characteristic makes sure that the strength and durability of the concrete are not jeopardized while also assisting in maintaining the water-cement ratio in the concrete mix.

Last but not least, M Sand contains little silt and clay, two contaminants that can compromise the strength and longevity of concrete. This characteristic makes M Sand an appropriate substitute for natural sand in the manufacturing of concrete.

$$\text{Fine aggregate required} = 775 \text{ kg/m}^3$$

$$\text{Block size} = 0.00264 \text{ m}^3$$

$$\text{F.A required for 1 paver block} = 775 \times 0.00264 = 2.046$$

3.3 PROPERTIES OF COARSE AGGREGATE

For the creation of premium paver blocks, coarse aggregate, specifically 12.5mm coarse aggregate, is also a crucial component. For outdoor surfaces like roads, walks, and patios, paver blocks are a popular option, and to ensure their longevity and function, the coarse aggregate needs to have certain characteristics.

Strength is a crucial quality of coarse aggregate for paver bricks. Heavy loads and continuous foot traffic must be withheld by the aggregate without breaking or wearing it down. For paver blocks, 12.5mm coarse aggregate works best since it gives the blocks a solid foundation and allows for enough drainage.

The shape of the coarse aggregate used to make paver bricks is also crucial. To make sure that the blocks interlock tightly and stay in place, the aggregate should be angular in shape rather than rounded or smooth.

The 12.5mm coarse aggregate used to make paver blocks should be strong and shaped, as well as having a range of particle sizes that promote effective compaction and drainage. Additionally, the aggregate must be devoid of any impurities that can compromise the longevity or functionality of the paver blocks, such as dust, clay, or organic compounds.

Quantity of coarse aggregate = 1127

Block size = 0.00264 m³

= 1127 x 0.00264

= 2.975 kg

For 24 blocks

= 2.975 x 24

= 71.4 kg

3.4 PROPERTIES OF DELRIN PLASTIC

Thermoplastic Delrin is a substance renowned for its high strength, stiffness, and resistance to wear and impact. It is the trademark name for a specific kind of polymer made from formaldehyde called an acetal homopolymer.

Delrin is suitable for a variety of applications because to a number of special qualities. It is perfect for use in bearings and other moving parts because, for instance, it has a low coefficient of friction. Additionally, it is impervious to chemicals and moisture, making it appropriate for usage in severe conditions.

Delrin may be moulded into intricate shapes and is simple to process. It is frequently employed in the production of electrical parts, automotive components, bearings, and gears. Drum sticks and guitar picks are only a couple of the musical instruments that are made with it.

Delrin has the benefit of being a lightweight material that can sustain significant stress and strain without breaking. It can tolerate repeated use without failing because it is also fatigue resistant.

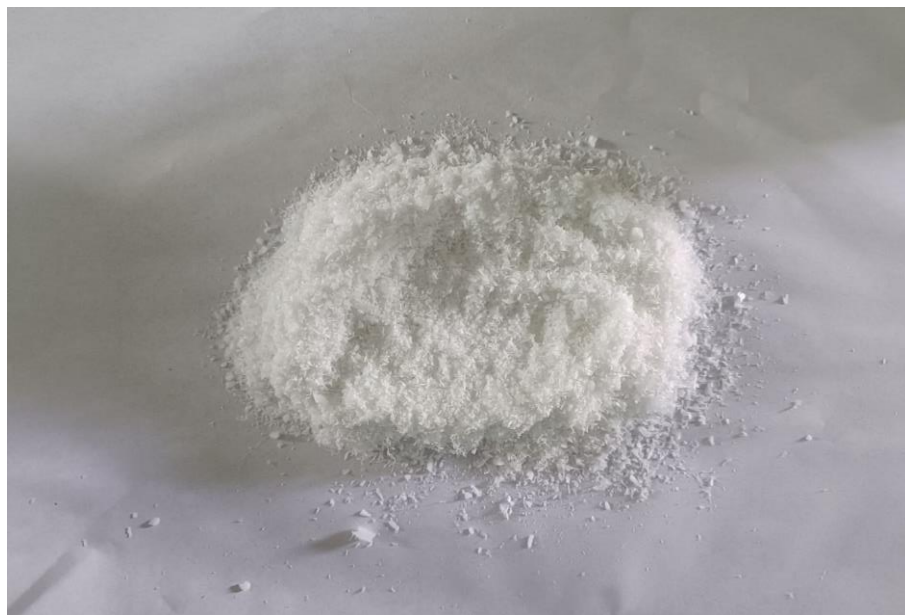


FIG. 3.1 DELRIN PLASTIC

The fig. 3.1 Represents the grained Delrin plastic. It is the type of thermoplastic polymer known for its high strength, stiffness, durability. It is a brand name for a type of acetal plastic, also known as polyoxymethylene (POM).

TABLE 3.1 MIX PERCENTAGE OF M SAND AND DELRIN PLASTIC

MIX	M-SAND	DELRIN PLASTIC
M 0	100%	0%
M 1	90%	10%
M 2	80%	20%
M 3	70%	30%

3.5 PROPERTIES OF WATER

Water is a transparent, flavorless, and odorless liquid that is necessary for the mixing and laying out of paver stones. In the case of paver blocks, water is often utilised as a mixing agent to give the dry components—such as sand and cement—that are used to make the paver base a paste-like consistency.

Water activates the cement in the dry components, helps to bind them together, and creates a solid foundation for the paver blocks when it is introduced to the mixture. As too much water might weaken the base and cause the pavers to shift or become uneven over time, it is crucial to use the proper amount of water in the mixture.

Water is necessary for mixing and installing paver blocks, as well as maintaining the paver blocks' long-term stability and durability. In order to avoid

water pooling or accumulating around the pavers, which can eventually cause erosion and damage, proper drainage and watering are essential.

Quantity of water	= 157.6 kg/m ³
Block size	= 0.00264 m ³
	= 157.6 x 0.00264
	= 0.416 kg
24 blocks	= 0.416 x 24
	= 9.984 kg
20% ' , extra	= 9.984 + 20%
	= 9.984 + 1.996
	= 11.98 kg or 11.98 L

TABLE 3.2 MIX PROPORTION

MIX NO.	M 0	M 1	M 2	M 3
WATER CONTENT	2.99 l	2.99 l	2.99 l	2.99 l
CEMENT	6.653 kg	6.653 kg	6.653 kg	6.653 kg
FINE AGGREGATE	2.046 kg	1.841 kg	1.64 kg	1.432 kg
COARSE AGGREGATE	2.975 kg	2.975 kg	2.975 kg	2.975 kg
PLASTIC GRAINTED	-	1.23 kg	2.455 kg	3.682 kg

**FIG.3.2 MIXING OF PLASTIC**

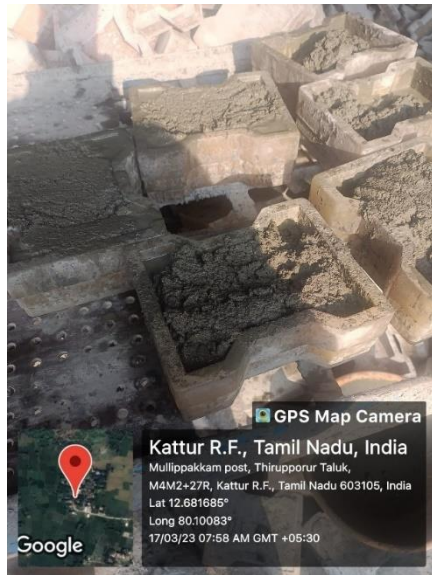


FIG.3.3 CASTING



FIG.3.4 VIBRATING (TAMPING)



FIG. 3.5 DEMOULDED I SHAPED PAVER BLOCKS



FIG. 3.6 CURING OF I SHAPED PAVER BLOCKS

The fig. 3. 2, 3.3, 3. 4, 3. 5, 3.6 represents the making of mortar and casting it in the I-shaped paver block mould and later letting it set in the mould for one full night, after which the paver block is demolded and curing it well for 14 days respectively.

3.6 COMPRESION TEST

Finding the force necessary to crush an I-shaped paver block under a compressive load is the goal of a compression test. Typically, the test is carried out in a lab setting with specialized tools.

A typical paver block sample is sandwiched between two compression plates to conduct the compression test. The sample is subjected to an ever-increasing force from the top plate until it fails, at which point the block is crushed. The compressive strength of the paver block is defined as the maximum load that the block can support before failing.

The type of material used, the block's dimensions, and the manufacturing method are only a few of the variables that affect an I-shaped paver block's compressive strength. Usually, the compressive strength is expressed in megapascals (MPa) or pounds per square inch (psi).

The paver blocks' quality and compliance with the standards needed for usage in building projects can be evaluated using the results of a compression test.



FIG.3.7 COMPRESSION TEST ON 0%



FIG.3.8 COMPRESSION TEST ON 10%



FIG.3.9 COMPRESSION TEST ON 20%



FIG. 3.10 COMPRESSION TEST ON 30%

The fig. 3.7, 3.8, 3.9, 3.10 represents the compressive strength and breaking load of the paver block in kN at 0%, 10%, 20% and 30% paver blocks.

3.7 WATER ABSORPTION TEST

A common method for determining how much water a paver block can absorb is to do a water absorption test on an I-shaped paver block. This test is crucial because it helps evaluate how long the paver block will last and how resistant it is to weathering and other environmental variables.

According to the Indian Standard (IS) rule, the paver block's water absorption should not be greater than 6%. The paver block is not of good quality and might not be appropriate for use in outdoor applications if the water absorption is greater than 6%.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 WATER ABSORPTION TEST

A dry paver brick is submerged in water for the duration of the test, which is typically 24 hours. After being taken out of the water, the paver brick is dried off on the surface. After that, while the block is still wet, it is weighed, and the weight is noted.

By calculating the difference between the weight of the wet block and the weight of the dry block prior to immersion, the amount of water absorbed by the paver block can be determined. The proportion of water absorbed by the paver block is calculated by multiplying this figure by the weight of the dry block prior to immersion and dividing the result by 100.

The water absorption test aids in evaluating the paver block's quality. The block may not be appropriate for use in outdoor applications since it may not endure weathering and other environmental variables if there is a significant proportion of water absorption, which shows that the block is porous. A paver block that absorbs little water, on the other hand, is of good quality and can tolerate exposure to moisture and water.

Overall, the water absorption test is a crucial procedure that aids in evaluating the paver blocks' quality and suitability for use in outdoor applications.

TABLE – 4.1 WATER ABSORPTION TEST RESULT

SI. NO	SAMPLE ID*	WEIGHT OF THE BLOCK BEFORE CURING (KG)	WEIGHT OF THE BLOCK AFTER CURING (KG)	WEIGHT OF WATER ABSORBED (KG)	PERSENTAGE OF WATER ABSORPTION (%)
1.	0%	5.705	5.915	0.210	3.68
2.	10%	4.920	4.975	0.055	1.12
3.	20%	4.955	5.070	0.115	2.32
4.	30%	4.710	4.865	0.155	3.29

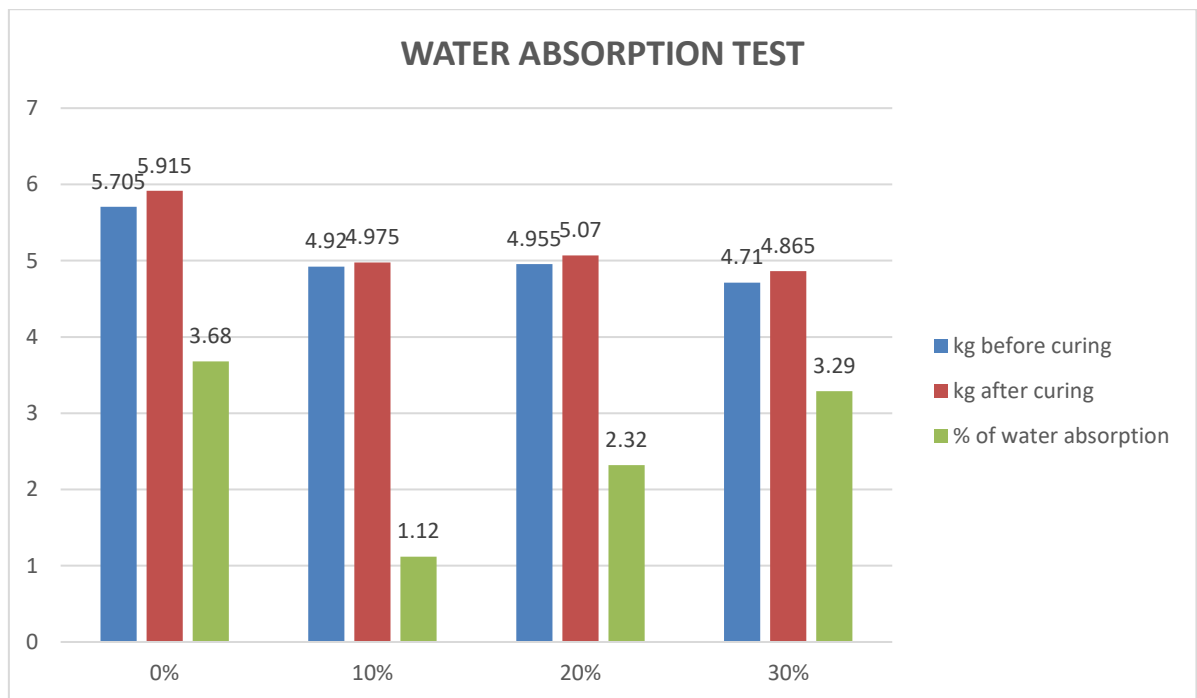


FIG. 4.1 GRAPH OF WATER ABSORPTION TEST

4.2 COMPRESSIVE STRENGTH

A test to evaluate if paver blocks can resist a compressive load without failing is known as the compressive strength test. The test is typically conducted on a minimum of three randomly chosen paver blocks from a lot or batch, and the strength of the lot is typically represented by the average value of the compressive strength.

The paver block is subjected to a compressive load during the test until it fails or cracks. A compression testing device, which can measure the load and the deformation of the paver block, is used to apply the load.

The paver block is put on the compression testing machine's base with its surface flat and horizontal to conduct the test. The paver block is supported by a compression pad on top, and a constant load is applied to it until it breaks. The load is imparted to the paver block until it cracks or achieves its maximum load-bearing capacity.

By dividing the greatest load applied during the test by the paver block's cross-sectional area, the compressive strength of the paver block is determined. The outcome is given in N/mm² or MPa.

As it serves to verify that the paver blocks can survive the pressures and loads, they will face in their intended application, such as pedestrian walkways, driveways, or parking lots, the compressive strength test is a crucial quality control step in the paver block production process. In the long term, a paver block with a higher compressive strength will be more cost-effective because it will be more durable and last longer.

TABLE 4.2 COMPRESSIVE STRENGTH TEST

SI.NO	WEIGHT (KG)	SAMPLE ID*	BREAKING LOAD (kN)	AREA (mm ²)	COMPRESSION STRENGTH(N/mm ²)	CORRECTED COMPRESSIVE STRENGTH (N/mm ²)
1	5.765	0%	1172	29518.62	39.70	46.85
2	4.895	10%	1128	29518.62	38.21	45.09
3	5.070	20%	695	29518.62	23.54	27.78
4	4.850	30%	579	29518.62	19.61	23.14

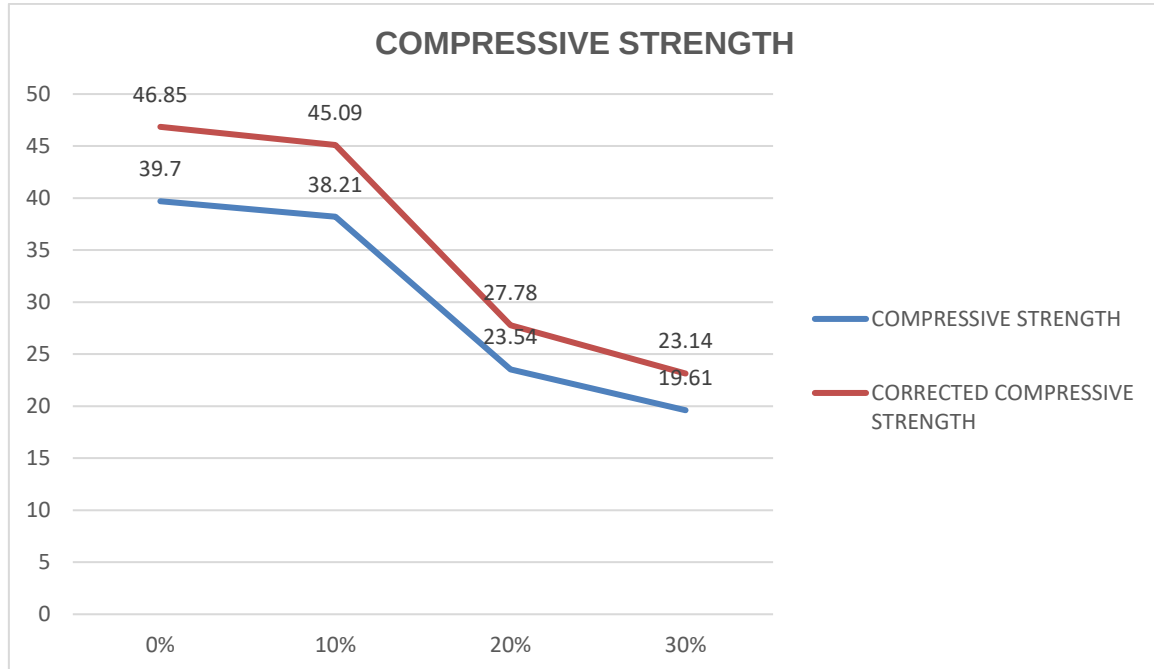


FIG. 4.3 COMPRESSIVE STRENGTH

The fig. 4.3 represents Compressive strength of paver block's breaking load is decreasing at 30% (plastic used paver block) when compared to normal 0% paver block.

Compressive strength of paver block's breaking load is passing the test at 10% (plastic used paver block).

Though the Compressive strength of paver block's breaking load is not completely passing the test at 20% (plastic used paver block), it is still eligible to be used at pedestrian pavements.

Corrected compressive strength is also same as the initial compressive strength.

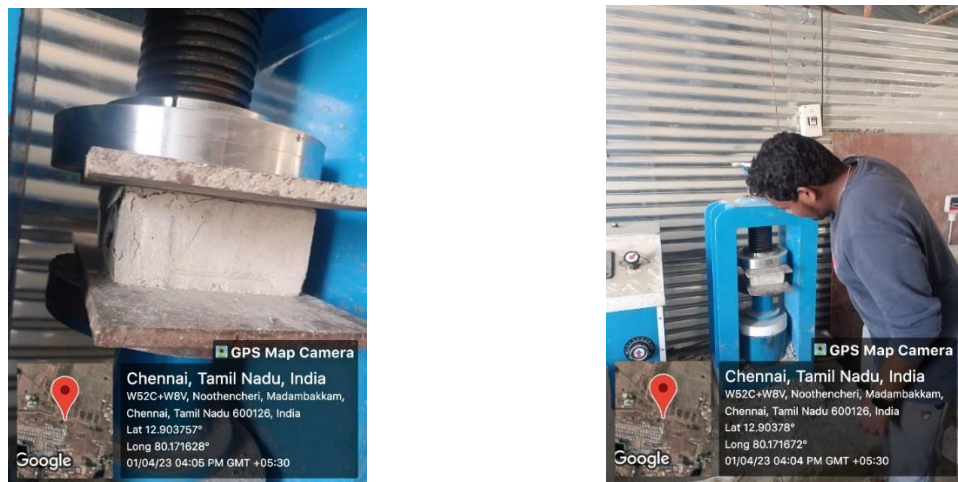


FIG.4.4 COMPRESSIVE STRENGTH TESTING

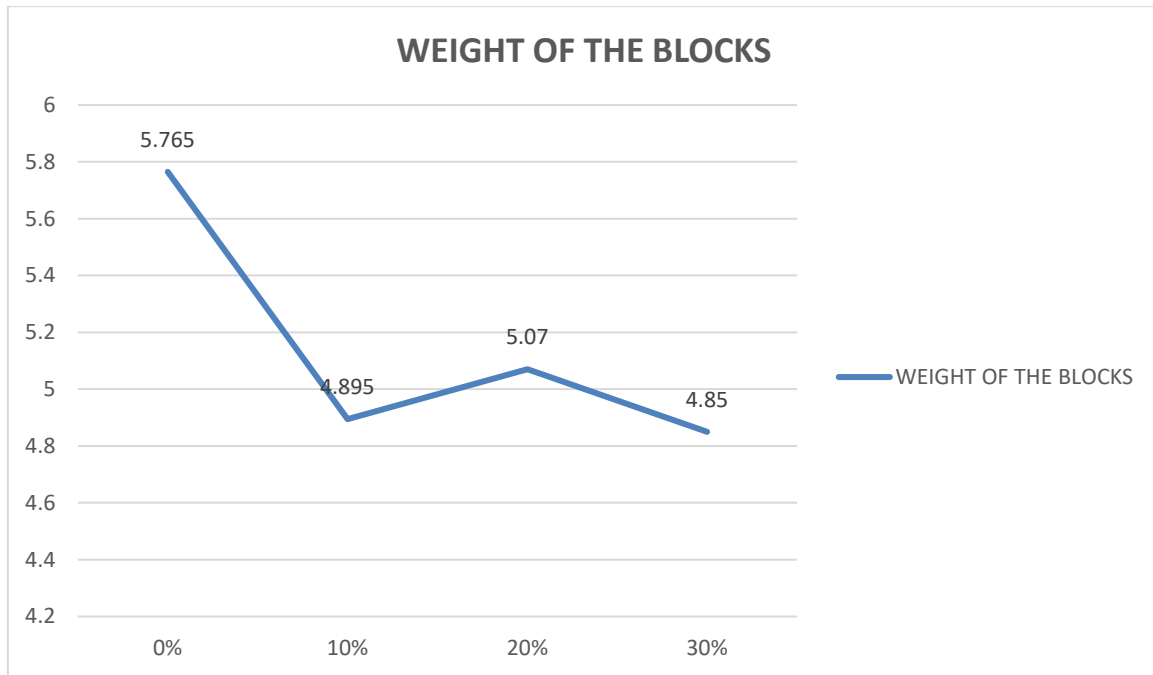


FIG. 4.5 WEIGHT OF PAVER BLOCKS

The fig. 4.5 represents weight of the paver blocks manufactured with plastic wastes are decreasing considerably when compared to normal 0% paver blocks. This acts as an additional market value to the new product.

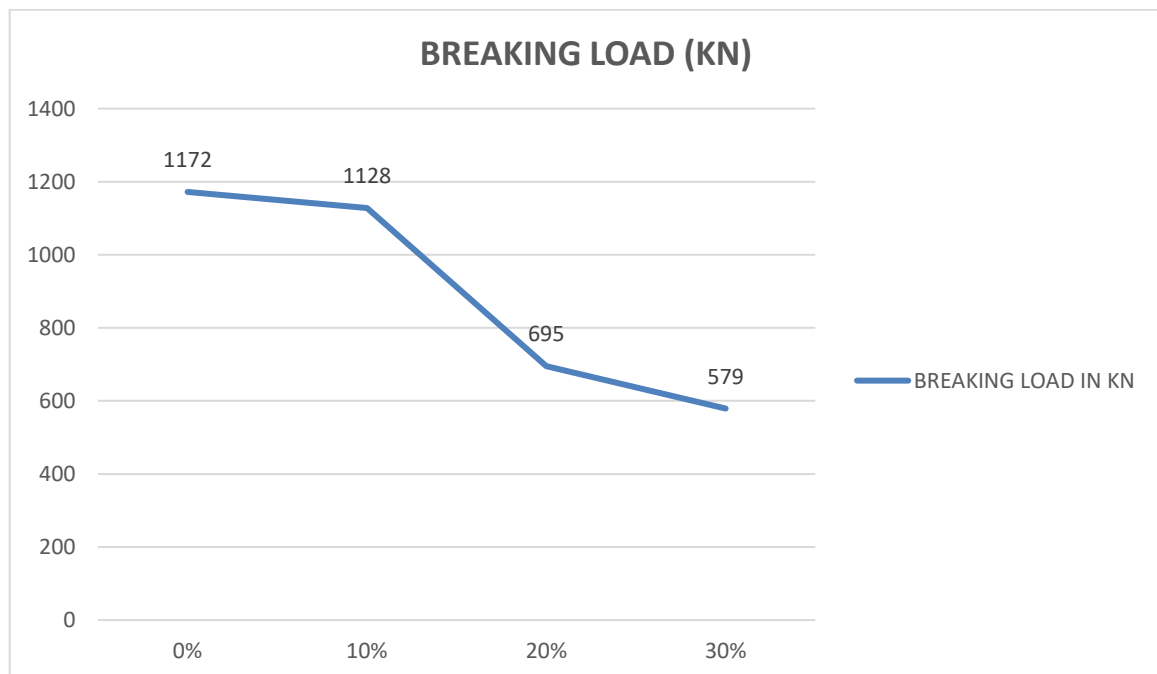


FIG. 4.6 BREAKING LOAD IN (KN)

The breaking load of the manufactured paver blocks with plastic waste at 20% and 30% are decreasing which is a major disadvantage of the new product. (fig. 4.6 represents).

Due to its environmental friendliness and potential to lessen the quantity of plastic waste dumped in landfills, paver blocks produced from recycled plastic have grown in popularity. To utilised them in building, these paver bricks must have the necessary strength and durability, though.

For paver blocks constructed from plastic waste, the compressive strength test is a crucial evaluation. The test aids in identifying the highest weight that the paver block can support before failing. To make sure that the paver block can sustain the desired loads and last for a long time, it is essential to make sure that its compressive strength satisfies the necessary specifications.

According to research, leftover plastic can be used to create paver blocks with good compressive strength and little water absorption. In fact, plastic trash can make paver blocks stronger and more durable. The performance of the paver block can be impacted by the production method and the quality of the plastic waste used. Because of this, it's essential to make sure the plastic waste used to make paver blocks is of high quality and that the manufacturing process is carried out properly.

In conclusion, using plastic trash to create paver blocks can be a sustainable and green choice. But it is vital to make sure they adhere to the specifications for compressive strength and water absorption. The tests can offer useful details regarding the paver blocks' performance and build quality, ensuring that they are appropriate for the purpose for which they are intended.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1 SUMMARY

Tests for compressive strength and water absorption are both necessary for assessing the caliber and robustness of paver blocks.

A paver block's maximum load before failing or breaking is ascertained using the compressive strength test. This test aids in determining the paver block's strength and durability, which are essential for its use in high-traffic areas including driveways, parking lots, and pathways. The paver block's top surface is loaded during the test until it breaks. The block's compressive strength is then determined using the maximum load it can support.

The water absorption test, on the other hand, quantifies the volume of water that a paver block can hold. This test aids in determining the block's ability to withstand water penetration, which is essential for determining how long it will last and how resistant it will be to damage from freeze-thaw cycles. The test is soaking the paver block in water for a certain amount of time, followed by measurements of the block's weight before and after the test. According to the weight differential, it is possible to calculate how much water the block has absorbed.

These two tests are crucial because they reveal essential details on the caliber and toughness of paver blocks. They aid in making sure the blocks are acceptable for their intended purpose and meet the necessary criteria. Therefore, it is advised to carry out both tests to assess the overall effectiveness and caliber of paver blocks.

5.2 CONCLUSION

- Utilising scrap plastic in the manufacture of paver blocks is a useful approach to dispose of plastic trash.
- When compared to concrete paver block, the price of paver blocks is lower.
- In comparison to that concrete paver block, the weight of the plastic paver is lower.
- Weight of plastic added blocks are decreased it is advantage for the loading and transporting the paver block.
- This product acts as an eco-friendly approach as we are trying to use recycled plastic in the making process. The selected plastic cannot be used in any alternative products on a larger scale.
- This product can be used in adaptive redesigning of existing damaged pathways and parking spaces.
- It is a sustainable design approach. These paver blocks are designed considering the growing environmental needs.
- These comparatively lightweighted paver blocks are also budget friendly.

Here are some key points to include in the conclusion for paver block for Delrin plastic:

- Delrin plastic is a durable and lightweight material that offers several advantages over traditional materials for paver block production.
- Delrin plastic is resistant to weathering and wear, making it suitable for use in outdoor applications such as paver blocks.
- The low coefficient of friction of Delrin plastic reduces the likelihood of skidding and slipping, making it a safer option for high-traffic areas.
- The use of Delrin plastic in paver blocks offers environmental benefits, as it is a recyclable material that reduces the need for virgin plastic production.
- Delrin plastic paver blocks offer a promising solution for creating sustainable and long-lasting outdoor surfaces that can withstand heavy use and extreme weather conditions.

REFERENCES

1. B Shanmugavalli, "the reuse of plastic waste along with fly ash and quarry dust in paver blocks". International Journal of Engineering Research & Technology , 2017.
2. Jeevan Ghuge, "The utilization of plastic waste in manufacturing of paver blocks". International Research Journal of Engineering and Technology , 2019 .
3. Kashiyani B. K., "Innovative Addition of Polypropylene Fiber in Interlocking Paver Block to Improve Compressive Strength" , 2010.
4. Ling Tung-Chai, "The Effect of Cement and Water Cement Ratio on Concrete Paving Block", Regional Postgraduate Conference on Engineering and Science , 2014 .
5. Mahaveer Prasad, "Use of plastic waste in concrete mix". International Research Journal of Engineering and Technology ,2017.
6. Muraleedharan.T "Past and Present Efforts for Popularisation of Interlocking Concrete Block Pavement Technology in India" ,2016 .
7. Martinec P., "Concrete Interlocking Paving Blocks Compression Strength Determination Using Non-Destructive Methods" , 2013.
8. M. Ravikumar "Experimental Studies on Iron-Ore Tailing based Interlocking Paver", International Journal of Earth Sciences and Engineering 2011.
9. N.A. Kamarulzaman, that was published in December 2018 in the Journal of Science and Technology 2011.
10. Shrama S "Studies of the Properties of Paver Block using Fly Ash", International Journal for Scientific Research & Development , 2012.
11. T Subramani, "The experimental study on plastic as a coarse aggregate for structural concrete". International Journal of Application or Innovation in Engineering & Management , 2015.