NEW TECHNOLOGIES IN ROAD CONSTRUCTION

PROJECT REPORT

Submitted in partial fulfilment of the requirement for the award of the degree

of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision

of

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by

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to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY,

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HIMACHAL PRADESH, INDIA

May, 2025

DECLARATION

I hereby declare that work presented in this report entitled "**New Technologies In Road Construction**" in partial fulfilment of the requirement for the requirements for the award of degree in bachelor of Technology in the Department of Civil Engineering from **Jaypee University of Information Technology Waknaghat** is original record of my own work carried out under the supervision of **Dr. Tanmay Gupta**. This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.

Signature of Student

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Date: 13/05/2025

CERTIFICATE

This is to ensure that the work which is being introduced in the venture report named "**New Technologies In Road Construction**" in fractional satisfaction of the necessities for the honour of the level of Bachelor of Technology in Civil Engineering submitted to the Department of Civil Engineering, **Jaypee University of Information Technology, Waknaghat** is a true record of work completed by **Nishant Beniwal (211601)** under the management of **Dr. Tanmay Gupta** Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

Date: 13/05/2025

Signature of Supervisor	Signature of HOD
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Nishant Beniwal

211601

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ABSTRACT

Under PMGSY-III, states are required to use green and new technologies for at least 15% of their annual road construction projects. The main purpose of this rule is to encourage the building of roads that are not only cost-effective and quick to construct but also environmentally friendly. Traditional road construction methods depend heavily on natural resources like aggregates and hot mix asphalt, which require a lot of energy and cause significant pollution. In contrast, new approaches use recycled materials, such as waste plastic and cell filled concrete, to reduce environmental impact.

Some of the main green technologies being used include mixing shredded waste plastic into concrete, which helps recycle plastic and can improve the strength and durability of the roads. Cell filled concrete involves filling plastic cells with concrete to create strong and long-lasting road surfaces, especially suitable for rural areas. Other techniques, like cold mix technology, use bitumen at normal temperatures, saving energy compared to traditional hot mix methods. Cement and lime stabilization use local soils mixed with cement or lime to strengthen the road base, and full depth reclamation recycles old road materials for new construction.

These green technologies offer several benefits. They reduce pollution, conserve natural resources, and help manage waste by recycling materials like plastic. They can also lower construction costs and speed up the building process. So far, over 1,11,000 kilometers of roads have been built using these methods under PMGSY, showing significant progress.

Research has shown that adding the right amount of shredded waste plastic, such as LDPE, to concrete can improve its mechanical properties without weakening the structure. Plastic Cell Filled Concrete Block Pavement (PCCBP) has also performed well in real-life road tests and can be used to repair damaged roads. These methods not only improve road quality but also provide a practical way to recycle plastic waste.

In summary, using waste plastic and cell filled concrete in road construction under PMGSY-III is an effective and sustainable solution. These technologies help build strong, durable roads while reducing environmental pollution and making use of waste materials, supporting the goal of greener and more sustainable rural roads in India.

Keywords: *Plastic Waste, Aggregates, PMGSY, plastic waste, concrete, waste recycling, mechanical performance, PCCBP, LDPE*

CHAPTER–1

INTRODUCTION

1.1 GENERAL

India has the second-largest road network in the world, with more than 6.3 million kilometers of roads as of December 2022. In Himachal Pradesh alone, there are 19 National Highways covering 1,208 kilometers, 19 State Highways stretching 1,625 kilometers, and 45 Major District Roads totaling about 1,753 kilometers. As traffic has grown over the past twenty years, there is a greater need for roads that are stronger and last longer. To meet this challenge, new materials and methods are being tried, including the use of waste plastic in road construction.

Plastic waste is a major environmental issue because it does not break down easily and makes up about 5% of all municipal solid waste. By adding waste plastic to road materials, we can help solve both the problem of plastic pollution and the need for better roads. Research shows that mixing waste plastic with concrete or bitumen can make roads stronger, more durable, and better at resisting water damage. When plastic is added to hot aggregates, it coats them and improves the overall quality of the road mix. This process also reduces the amount of bitumen needed by up to 10%, which saves money and is better for the environment.

Plastic roads are especially useful in India, where weather conditions can be harsh, with high temperatures and heavy rain. These roads are more resistant to potholes and last longer. In studies, adding 5% to 15% waste plastic by weight of sand in the cement-treated base layer led to noticeable improvements in road strength and stability. This shows that using waste plastic in road construction is a practical and eco-friendly way to build better roads while also managing plastic waste more effectively.

1.2 Conventional Road Construction

Conventional road construction typically involves several key steps, using traditional materials and methods. The process can be broken down as follows (as shown in Figure 1):

1. Planning and Design

Planning: A detailed land survey is conducted to map out the route of the road, considering topography, soil conditions, and environmental impact.

Designing: Engineers design the road layout, including the width, alignment, thickness of layers, and drainage system.

2. Clearing and Excavation

Clearing: Vegetation, debris, and existing structures are cleared from the path where the road will be constructed.

Excavation: The ground is excavated to the required depth, depending on the design and soil conditions. Weak soils are removed or stabilised.

3. Subgrade Preparation

Compaction: The natural soil is compacted to create a stable base. If the soil is unsuitable (e.g., too soft or wet), stabilisation techniques or imported materials like gravel may be used.

Drainage Installation: Proper drainage is critical, so culverts, ditches, and stormwater systems are installed to manage water runoff and prevent erosion.

4. Base Layer Construction

Sub-base Layer: A sub-base of gravel or crushed stone is laid on top of the compacted soil to provide additional support and drainage. It is compacted to provide a firm foundation for the next layers.

Base Layer: A stronger layer of aggregate or crushed rock is applied, often stabilised with cement or bitumen to increase strength.

5. Pavement Construction

Binder Course: A layer of bitumen or asphalt is applied, sometimes mixed with aggregate. This layer binds the base to the surface layer.

Surface Layer: The top layer is usually asphalt (bituminous concrete) or concrete. For asphalt roads, a hot mix of asphalt and aggregate is spread, compacted, and smoothed. For concrete roads, a mix of cement, sand, and aggregates is poured and levelled.

6. Finishing and Marking

    a. Curing (for Concrete): If concrete is used, it needs to be cured over time to reach its full strength.

b. Road Marking: Once the road surface is ready, lane markings, road signs, and other safety features (like reflectors) are added.

Final Inspection: After construction, the road is inspected for quality and adherence to safety standards before opening for public use.

Maintenance

a. Regular maintenance is required to keep the road in good condition. This includes patching potholes, resurfacing worn sections, and maintaining drainage systems.

Materials Used

b. Asphalt/Bitumen: The most commonly used material for the surface layer of flexible pavements.
c. Concrete: Used in rigid pavements; offers durability but higher initial costs.
d. Aggregate: Crushed stone or gravel is used in the base and sub-base layers.

This conventional method, while effective, is increasingly being challenged by sustainable alternatives like using recycled materials (e.g., waste plastic) and adopting eco-friendly techniques.

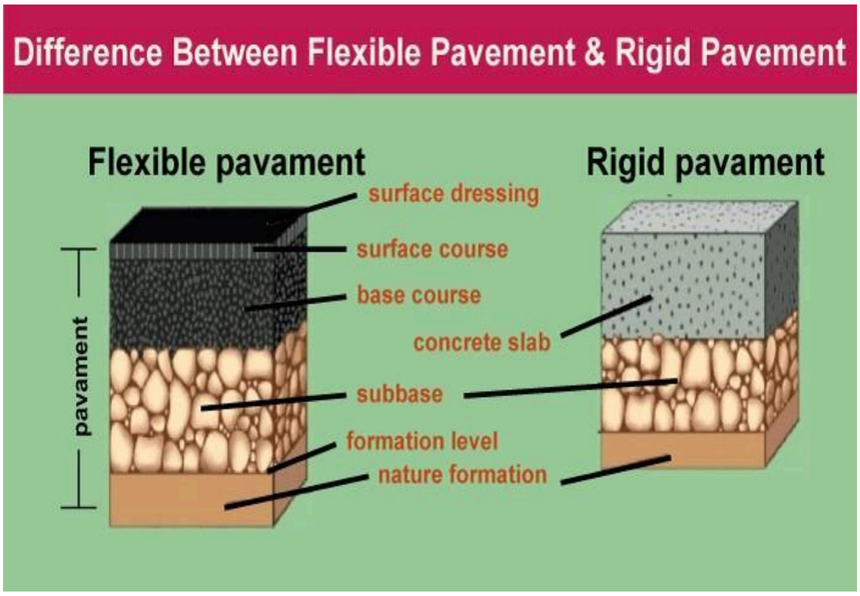


Figure 1.1 Flexible & Rigid Pavement

1.3 New Technologies in Road Construction

India’s vast and growing road network is traditionally built using flexible and rigid pavement technologies, governed by Indian Roads Congress (IRC) specifications. Conventional construction methods, while well-understood and widely adopted, heavily depend on high-quality natural materials, contributing to resource depletion and environmental degradation. In response, the country has shifted focus towards sustainable and cost-effective alternatives. Green technologies—such as plastic-modified bitumen, cold mix asphalt, cell-filled concrete, and stabilization with cement or lime—are being actively promoted under national programs like the Pradhan Mantri Gram Sadak Yojana (PMGSY). As of March 2022, over 69,000 Km of roads have been constructed using such innovative approaches, with a mandate under PMGSY-III for at least 15% of annual proposals to utilize new and green technologies (as shown in Figure 1.2).

This study examines the incorporation of waste plastic into CTB, with plastic content ranging from 5% to 15% by weight of sand. Laboratory evaluations based on mechanical properties criteria reveal that plastic-modified mixes offer enhanced strength, durability, and water resistance while reducing fine aggregate usage by up to 10%.

The findings highlight the dual benefit of sustainable waste management and improved road performance, positioning plastic roads as a viable solution for India's challenging climate and infrastructural demands.

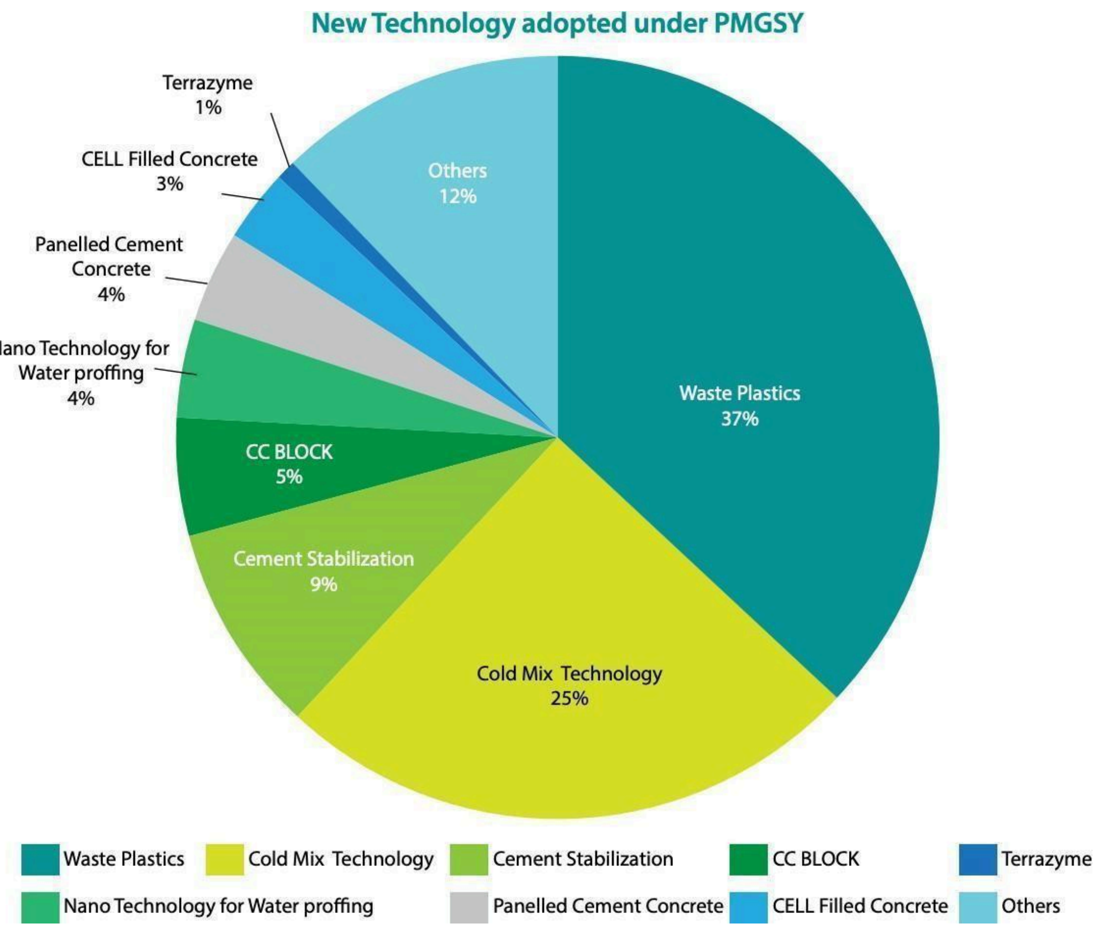


Figure 1.2 New Technologies in Road Construction (From PMGSY Report)

There are many new technologies used in the road Construction for the Sustainability. Such Technologies are Use of waste plastic, Cold mix Technology, Cement Stabilisation, CC Block, Nano Technology for Water Proofing, Panelled Cement Concrete, Cell Filled Concrete, Terrazyme.

1.3.1 Full-depth reclamation

Full-depth reclamation (FDR) is a method used to repair damaged asphalt roads by recycling the old road materials right at the site. In this process, a special machine breaks up the existing worn-out asphalt layer along with part of the layers underneath, such as water-bound macadam (WBM), wet mix macadam (WMM), and granular sub-base (GSB). The broken-up material is then mixed together with a stabilizer, which could be Portland cement, bitumen emulsion, foamed asphalt, or other chemical stabilizers. This mixture creates a new, stronger base layer for the road (as shown in Figure 1.3).

Once everything is blended, the new base is shaped and compacted to prepare it for a fresh top layer. FDR is a cost-effective and eco-friendly technique because it reuses the old road materials, reducing the need for new resources and cutting down on waste. It also saves time since there is no need to transport old materials away or bring in large amounts of new material. This method is especially useful for roads that have a lot of cracks, potholes, or other damage, and it helps extend the life and strength of the repaired road (as shown in Figure 1.4).

Some of the advantages of Full Depth Reclamation are as under:

- Most pavement distress can be treated satisfactorily.
- Cost effectiveness z Early opening to traffic (Within 7-8 hours) of compaction.
- Eliminates material disposal problem.
- Results in conservation of natural resources.
- Minimal air quality problem.
- Reduce carbon footprint.

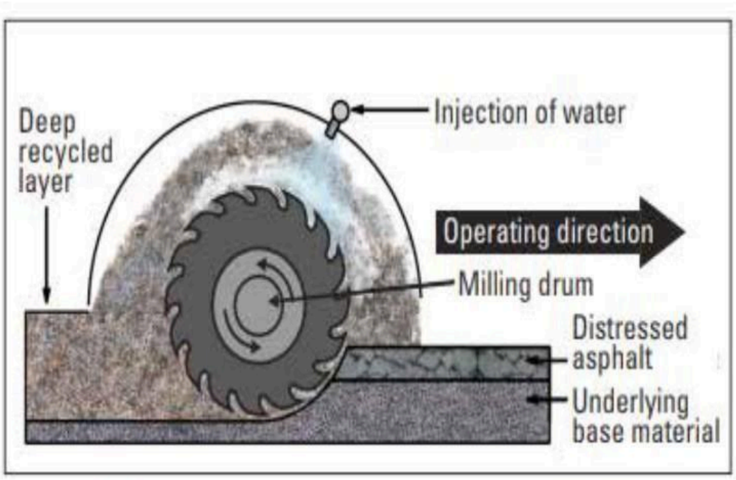


Figure 1.3 Cutting of Road for FDR

Figure 1.4 Laying of New Layer

1.3.2 Waste Plastic

In road construction, waste plastic is first shredded and then used to coat hot stones or aggregates. These coated aggregates are mixed with hot bitumen to make the final road material. This technique, as suggested by the Indian Roads Congress (IRC: SP:98-2013), has many benefits. Roads built with waste plastic are stronger and last longer, with better resistance to water, which helps prevent potholes and water damage. The plastic helps the materials stick together better, allowing the road to handle heavier traffic. Using plastic also reduces the amount of bitumen needed, making the process more economical (as shown in Figure 1.5).

This method also fills the small gaps in the stones, reducing problems like rutting and surface wear. As a result, these roads need very little maintenance, and their overall life is much longer than regular roads. Only certain types of plastics are used to make sure no harmful gases are released during construction. This process is simple, environmentally friendly, and does not require special equipment, making it easy to use in many places. By 2023, India had built almost 25,900 kilometers of roads using waste plastic, showing that this is a successful and sustainable way to improve road quality while managing plastic waste.

Madhya Pradesh has completed 8783.74 km which is the highest among all the States and UTs followed by Rajasthan and Chhattisgarh with the length 4646.29 km and 3090.67 km respectively completed using Waste Plastic.

Figure 1.5 Uses of Waste Plastic in Road Construction

1.3.3 Cold Mix

Cold Mix technology is a way of building and repairing roads using bitumen without needing to heat it. This method follows the guidelines set by the Indian Roads Congress (IRC: SP:100-2014) and helps save fuel and protect the environment because there is no heating involved. As a result, the construction process becomes much faster, which is especially helpful in areas where rain or bad weather often causes delays(as shown in Figure 1.6).

One of the main benefits of Cold Mix technology is that roads can be built two to three times faster than with traditional hot mix methods, and there is no need to buy new equipment or train workers differently. It is also a green technology, as it does not pollute the air and is very energy efficient. Roads made with Cold Mix are strong and last a long time because the mix has properties that prevent the surface from breaking apart. Construction can take place in almost any weather, including during the rainy season or in cold winters, as long as the ground is dry(as shown in Figure 1.7).

Another advantage is that local or semi-skilled workers can easily carry out the work, and since there is no use of hot materials, the risk of accidents is greatly reduced. Overall, Cold Mix technology is a simple, safe, and eco-friendly way to improve road connectivity, especially in places where traditional road building faces challenges.

Till 2023 under 16987.84 km of road length has been constructed using Cold Mix all over the country, Odisha has completed 3933.20 km which is the highest among all the States and UT followed by Uttarakhand and Assam with the length 1839.94 km and 1762.54 km respectively completed using Cold Mix Technology.

Figure 1.6 Laying of Cold Mix

Figure 1.7 Laying of Cold Mix

1.3.4 Cement Stabilisation

Building the base or sub-base of a road using cement and local soil or gravel is called Cement Treated Base (CTB) or Cement Treated Sub-Base (CTSB). In this method, the available soil or granular material is mixed well with cement and water, then compacted to form a solid and strong layer under the road. The cement helps to bind the soil particles together, which increases the strength and durability of the road foundation(as shown in Figure 1.8).

This technique has several benefits. Since it uses materials found nearby, it reduces the need for transporting materials over long distances, which saves on fuel and lowers construction costs. The machinery needed is also less compared to traditional methods. Roads built with CTB or CTSB are stronger and last longer, so they need less maintenance, which further reduces costs over the life of the road. The cement-stabilized layer also protects the road from water damage and erosion, helping to prevent common issues like cracks and potholes.

Overall, using cement to stabilize the base or sub-base is a cost-effective and reliable way to build roads, especially in areas where good quality materials are not easily available. This method is recommended by the Indian Roads Congress (IRC: SP:89-2010) and is suitable for both busy highways and rural roads(as shown in Figure 1.9).

Till 2023 under 5887.09 km of road length has been constructed using Cement Stabilisation all over the country, Jharkhand has completed 2959.39 km which is the highest among all the States and UT followed by Odisha and Telangana with the length 1404.45 km and 459.86 km respectively completed using Cement Stabilisation Technology.

Figure 1.8 Cement Stabilisation

Figure 1.9 Cement Stabilizing

1.3.5 Cell Filled Concrete

Cell-filled concrete pavement is a new road construction method developed by IIT Kharagpur to solve problems like heavy vehicle loads, poor drainage, and waterlogging. In this system, a layer of plastic cells made from recycled plastic is placed over the compacted ground or base layer. These cells are then filled with concrete or stones, creating a strong and stable road surface(as shown in Figure 1.10).

This technology has several benefits. It helps use recycled plastic, which is good for the environment. Unlike regular concrete roads, cell-filled concrete roads do not need expansion or contraction joints, so maintenance is easier and cheaper. The amount of stone and aggregate used is almost half of what is needed for normal concrete roads, making it more resource-efficient. If a small section of the road gets damaged, it can be fixed easily by replacing just the affected blocks, which saves time and money(as shown in Figure 1.11).

Cell-filled concrete pavement is also more affordable to build compared to traditional concrete roads and is very durable, needing little maintenance over time. By 2023, about 2,218 kilometers of roads in India had been built using this method. Assam has built the most, with nearly 566 kilometers, followed by Bihar and Rajasthan. Overall, cell-filled concrete pavement offers a cost-effective, eco-friendly, and long-lasting solution for building roads, especially in areas with heavy traffic and drainage problems.

Figure 1.10 Size of Plastic Cube

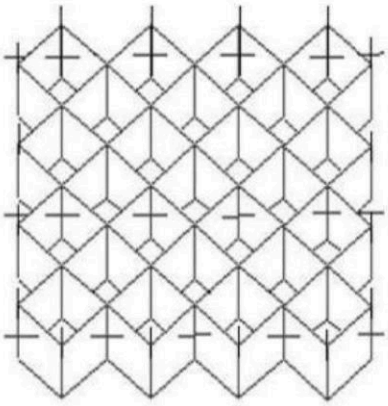
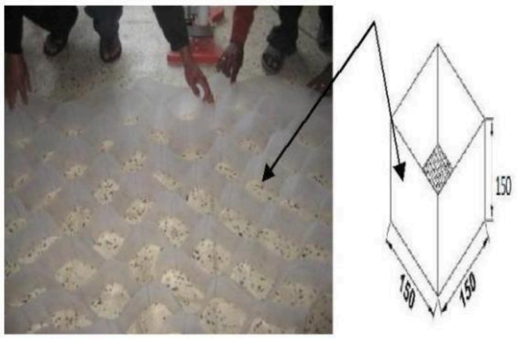
 

Figure 1.11 Cell Filled Concrete

1.4 Report Organisation

Chapter 1: The introduction part discusses various new technologies used in the rigid pavement as well as flexible pavement.

Chapter 2: Discusses various research paper studies related to our investigation. it is focussing on reviewing other related studies.

Chapter 3: Provide a description about various materials and methods used to complete this report. This includes basic tests on aggregate and samples involved.

Chapter 4. Result of Shredded Waste Plastic and PCCBP for M25

Chapter 5. Conclusion and Scope for Future

CHAPTER 2
LITERATURE REVIEW

2.1 GENERAL

Concrete, being the most widely used construction material, offers an opportunity for sustainable innovation. Integrating waste plastic into concrete not only provides a means of recycling and reusing non-biodegradable waste but also explores the potential for improved mechanical and durability characteristics. By partially substituting conventional materials such as fine or coarse aggregates and sometimes cement, this approach aligns with the global agenda for waste reduction and resource conservation.

This literature review aims to explore the feasibility, challenges, and benefits of using waste plastic in concrete. It examines the types of waste plastic used, methods of processing and incorporation, and the effects on concrete's fresh and hardened properties.

2.2 LITERATURE REVIEW:

Gonzalo-Orden, H., Linares-Unamunzaga, A., Pérez-Acebo, H. and Díaz-Minguela, J., 2019 [1]

Maintaining and repairing roads is important for meeting today's goals for sustainable development. One method that supports sustainability is full-depth reclamation, where old pavement is reused and mixed with cement to create a strong base. This process not only helps the environment by recycling materials but also offers technical and financial advantages. In Spain, these recycled pavements mixed with cement are called soil-cement or cement-bound granular material, even though there are no specific tests to measure how they behave. However, this naming isn't completely accurate because some leftover bitumen in the recycled pavement can make the material less stiff. This study aimed to find out how flexural strength (FS) relates to other key pavement properties, such as long-term unconfined compressive strength (UCS) and indirect tensile strength (ITS), and to compare these relationships with those found in traditional soil-cement and cement-bound materials. The results showed that lower strength values do not always mean worse performance, and recycled pavements with cement do not behave exactly the same as traditional materials.

Rajput, P.S. and Yadav, R.K., 2016 [2]

Burning waste plastics, especially plastic bags, causes environmental pollution and is a growing problem. However, using waste plastic in road construction can help solve this issue. When waste plastic is cleaned and shredded into small pieces, it can be mixed with hot stone aggregates during the road-building process. The plastic melts and coats the stones, and then hot bitumen is added to create the final mix. This study looked at adding different amounts of shredded plastic-6%, 8%, 10%, 12%, and 14% by the weight of bitumen-to semi-dense bituminous concrete. The results showed that the road mix was strongest when 12% plastic was used. Other important qualities of the road mix also improved with the addition of plastic. This method not only helps manage plastic waste but also makes the road material stronger and more durable

Jain, S. and Singh, B., 2021 [3]

Global warming is a serious problem, and the construction industry, including road building, adds to it by releasing greenhouse gases. To help reduce this impact, the highway industry is trying new, more sustainable methods. One such method is cold mix asphalt (CMA) technology. Unlike traditional hot mix asphalt, CMA does not need to heat the materials because it uses special liquid binders that work at room temperature. This makes the process more eco-friendly and saves energy and money. CMA is easy to use and can be applied in different weather conditions. However, it is not as strong or durable as hot mix asphalt, so it is mostly used for roads with less traffic or for temporary repairs. Even though researchers are working to make CMA stronger, it is still not widely used for busy roads. Overall, CMA is a good step towards greener road construction, but more improvements are needed for it to replace traditional methods in all situations.

Shooshpasha, I. and Shirvani, R.A., 2015 [4]

Adding cement to sandy soil can make it stronger and more stable. In this study, different amounts of lime Portland cement-2.5%, 5%, and 7.5% of the soil's dry weight-were mixed into the soil. The samples were shaped and compacted with the right amount of water, then left to cure for 7, 14, and 28 days. After curing, the samples were tested to see how much force they could handle and how they broke apart. The results showed that the soil became much stronger and less likely to move or shift when cement was added. However, the soil also became more brittle, meaning it would break more suddenly under pressure. Overall, using cement as a stabilizer improved the strength and firmness of sandy soil, but made it less flexible.

As fine aggregate replacement:

Albano et al. (2005) [6] investigated the characteristics of concrete that had 5% and 10% of natural sand by weight substituted for waste plastic (crumb plastic measuring 0.29 mm and 0.59 mm). Plastic scraps, both raw and processed, were utilised. Enhancing the interfacial bond between the concrete and the plastic was the goal of the treatment using a sodium hydroxide solution and a saline coupling agent. It was established that the properties of concrete in the fresh state and throughout the duration of curing have been changed due to the addition of crumb plastic. lowered ultrasonic pulse velocity, strength, tensile strength, and particle size density. Concrete's mechanical properties did not significantly improve after being treated with saline and sodium hydroxide.

Issa et al., (2013) [7] examined the chloride ion penetration resistance of mortars which adapted by means of the waste plastic. Plastic particles were used to 23 to replace natural sand by weight, from 0% to 15% in multiples of 2.5%. Water Absorption by way of immersion of plastic concrete gave better effects when compared to the normal mix. Comparable findings had been attained through. (Benazzouk et al., (2007) The inclusion of plastic particles to concrete increased resistance to the penetration of chloride ions. When 15% of the plastic particles were substituted, the penetration of chloride ions decreased. Chloride penetration was 14.2% lower at 5% replacement than in the control mix and 35.9% lower at 15% replacement. The combination with 12.5% plastic waste emulsion produced the greatest results. When compared to regular mix concrete, the combination showed improved mechanical qualities and a 55.9% decrease in chloride ion penetration.

Tayfun et al., (2010) examined the mechanical properties and drying shrinkage of self-consolidating mortars included with plastic particles of length 1 to 4 mm. Sand was in part replaced by plastic particles from 0% to 50% in multiples of 10%. Workability and unit weight of the concrete is lowered through the use of discarded plastic particles. Drying shrinkage values were decreased by plastic concrete with water cement ratios of 0.4, 0.43, and 0.47. Plastic concrete's flexural strength decreased by 33% to 52% and its compressive strength decreased by 46% to 52%. Up to 29% of plastic was used in lower water cement ratios to prevent cracks from forming during bending.

Mehmet et al. (2011) [8] investigated the water absorption and chloride ion permeability of self-compacting plastic concrete with a water cement ratio of 0.35 and crumb plastic substituted for 0%, 5%, 15%, and 20% with natural sand. Fly ash was used to replace cement from 20% to 60%. The increase in plastic content was observed to increase the amount of chloride ion penetration (28 days of curing), and after 90 days of curing, the fly ash helped to refine the pore shape and the chloride penetration significantly decreased.

Mustafa et al.,(2013) examined the properties of hollow concrete blocks that had crumb plastic added as a partial replacement for fine aggregates at 0%, 24%, 10%, 25%, and 50%. They discovered that the lack of cement-plastic particle bonds resulted in a decrease in compressive and tensile strength, and that, in comparison to normal concrete hollow block samples, load-bearing hollow blocks could be made with a maximum of 6.2% crumb plastic and non-load-bearing loads could be made with a maximum of 39.7% crumb plastic substitute.

2.3 Waste Plastic and PCCBP Reviews:

2.3.1 Review of previous work carried out in Various Countries

Researchers have studied how well Precast Concrete Cell-filled Block Pavement (PCCBP) works for roads. They tested different slab thicknesses and used rubber mats to see if these pavements could be placed directly on compacted soil. Thicker slabs and stiffer mats made the pavement stronger and better at spreading the weight from vehicles. Field tests showed that even thin slabs, like 50 mm, could be used for roads with light traffic, while thicker slabs, such as 150 mm, were strong enough for heavy vehicles. The pavement was built by placing plastic cells on the road base, filling them with stones, and then pouring mortar in between. Some tests used different materials for the base, like granite or sand, and found that the pavement lasted well, even after several years and heavy use. In India, researchers found that mixing cement, sand, and stones before putting them in the cells made stronger blocks with fewer gaps than pouring mortar afterward. Thicker blocks also had better strength and interlocking ability. Economic studies showed that PCCBP is often cheaper than traditional flexible or block pavements. Other tests used different base layers, like moorum or laterite, and found that these pavements were strong enough for low-traffic roads and showed little damage even after thousands of truckloads. Using recycled plastic for the cell walls and trying different concrete mixes also worked well, especially in areas where good materials are hard to find. In addition, some studies looked at replacing river sand with stone dust in concrete. They found that while stone dust made the concrete less workable, it actually made it stronger and better at resisting cracks. Overall, PCCBP is a strong, cost-effective, and durable option for building roads, especially in places with limited resources, and using alternatives like stone dust can help save money and materials.

2.4 Summary of Literature Review

A study of the literature shows that there have been few investigations on PCCBP, the use of stone dust in place of sand in concrete, and PCCBP distress studies. With the exception of a few trials carried out in India to gain further insight, no researchers globally have used PCCBP, which is most common in South Africa. An outline of past studies that are pertinent to the current effort is provided below:

1. Advantages: Using discarded plastic in concrete assists to waste reduction and alleviates environmental pollution. It offers a substitute for conventional disposal techniques that harm the environment, such landfilling or incineration.

2. Material Properties: Studies show that incorporating waste plastic as a partial replacement for fine aggregates or as a modifier can influence concrete's properties. These include:

a. Mechanical Properties: Compressive and tensile strengths often decrease due to weaker bonding between plastic and cement, but adjustments in mix design and treatments (e.g., chemical treatment of plastic) can mitigate this issue.
b. Durability: Improved resistance to chloride ion penetration and better thermal and acoustic properties have been observed in some studies, making the material suitable for specific applications.
c. Workability and Shrinkage: Plastic reduces the unit weight and workability of concrete but also helps reduce drying shrinkage and cracking under certain conditions.

3. Uses in Construction:

a. Road Pavements: Bituminous mixtures and pavements filled with plastic cells have effectively incorporated waste plastic, increasing road life and durability while lowering maintenance expenses.

b. Concrete Blocks: These hollow blocks with plastic additives demonstrated better insulating qualities but decreased strength, which made them suitable for non-load-bearingapplications.

c. Sustainability Initiatives: The integration of waste plastic accords with global efforts to minimise greenhouse gas emissions and promote eco-friendly construction techniques.

4. Difficulties and Restrictions:

a. Decreased mechanical qualities and bonding strength continue to be major difficulties.

b. To enable broad adoption, standardised testing procedures and design specifications are required for plastic-modified concrete.

c. Long-term performance and durability require additional inquiry.

PCCB works well on roads with less traffic. In comparison to traditional flexible and stiff pavement structures, PCCBP has a lower life cycle cost. The pavement's ability to spread load is improved when concrete blocks interlock. The road could be opened to regular traffic in less than a day because to the concrete's 15 MPa compressive strength.

There is very little data on how the blocks' elastic modulus varies with block thickness. According to limited testing, PCCBP may be applied as an overlay to concrete pavements. The results of replacing natural sand in concrete with waste stone dust were mixed, meaning that the compressive strength may or may not rise in comparison to regular concrete that solely contains natural sand. There are currently no established criteria for assessing the pavement condition index for the various kinds of distresses that PCCBP may encounter

2.5 Need of Study:

1. Waste Management and Environmental Protection

Reducing landfill pressure: Using plastic in road construction reduces the amount of plastic waste sent to landfills, which are rapidly filling up, leading to long-term sustainability benefits. • Carbon Footprint: Traditional road construction materials like bitumen are derived from fossil fuels, contributing to greenhouse gas emissions. Reusing plastic waste helps lower the carbon footprint of road projects.

• Plastic Pollution: Plastic waste, especially single-use plastics, has become a major

2. Improved Road Durability and Performance

• Increased Strength: Studies have indicated that roads constructed from plastic trash may be more resilient to deterioration. Better binding qualities of plastic-modified bitumen increase the road's resistance to heavy traffic loads.

• Water Resistance: Plastic repels water because it is hydrophobic. Potholes and cracks brought on by moisture seepage are less likely to occur on roads that employ plastic.

• Temperature Resistance: Plastic-infused roads are better suited for areas with intense heat since they can tolerate greater temperatures and resist softening.

3. Cost-Effectiveness

• Reduced building Costs: By reducing the quantity of pricey bitumen needed for road building, the addition of plastic to bitumen may result in reduced overall costs.

• Longer Lifespan: Plastic-made roads often require less regular maintenance and last longer. This means reduced repair costs and less inconveniences for road users.

• Resource Conservation: By using plastic trash as building material, less traditional materials are used, helping to protect natural resources like aggregates and bitumen.

4. Sustainable Development and Circular Economy

• Circular Economy Model: By turning garbage into a useful resource, using plastic waste into road construction promotes the ideas of a circular economy. It reduces the requirement for virgin materials and prolongs the lifecycle of plastic by closing the material use loop.

• Supporting Government Initiatives: The use of environmentally friendly and sustainable materials in infrastructure is being encouraged by numerous governments worldwide. Policies centred on recycling, trash reduction, and sustainable urban development are in line with the study of plastic garbage highways.

5. Innovation in Road Construction Technology

• New Construction Methods: The usage of plastic trash gives chances to reinvent existing road construction methods, spurring research and development of new technologies.

• Customisable Properties: Roads can be made to fit various situations (such as high traffic or extremely high or low temperatures) by varying the kind and quantity of plastic used to satisfy particular engineering specifications.

6 Economic and Social Advantages

• Job Creation: Especially in places with high trash levels, gathering, classifying, and processing plastic waste for road building can lead to the creation of jobs.
This supports environmental sustainability and boosts local economies.

• Public knowledge: These initiatives promote more responsible plastic use and increase public knowledge of recycling by showcasing the useful and advantageous applications of plastic trash.

7 International Use and Case Studies

• Proven Success: It has been demonstrated that using plastic trash for road construction is doable on a big scale by nations including the UK, the Netherlands, and India. These case studies promote additional study and adoption while providing insightful information.

◦ Scalable Solutions: Plastic trash roads provide a way to manage plastic garbage while enhancing infrastructure, making them a viable option for both industrialised and developing countries.

• Conformity to Sustainability Objectives: The use of plastic trash in road construction is in line with a number of the Sustainable Development Goals (SDGs) of the UN, including:

• SDG 9 (Industry, Innovation, and Infrastructure): Encourages innovation and sustainable industrialisation.

• Sustainable Cities and Communities (SDG 11): Promotes sustainable urbanisation and lessens the negative effects of cities on the environment. SDG 12 (Responsible Consumption and Production) promotes recycling and reuse as ways to cut down on waste production.

2.6 Research Gap

The majority of research assessed the qualities of concrete utilising waste plastic for HDPE and how they affect the strength of the concrete, according to the literature study that was done. There is currently minimal research on the usage of plastic cell-filled concrete and concrete made from waste plastic for LDPE.

2.7 Objectives of the Work

Objective 1: Explore the incorporation of waste plastic as a partial replacement in Cement Treated Base (CTB) material, assessing its impact on strength and durability through controlled lab experiments.

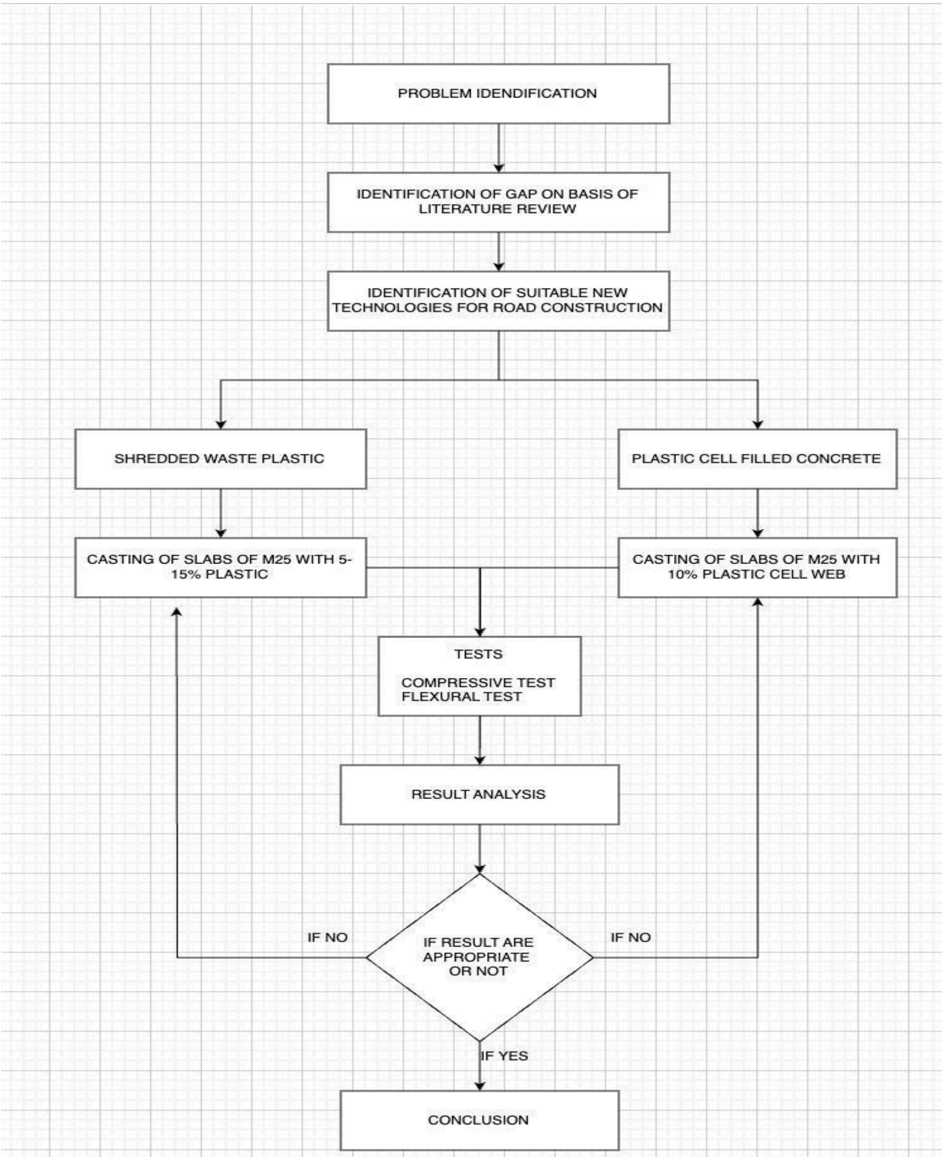
Objective 2: Design and test prototype methods for integrating waste plastic into plastic cell-filled concrete, aiming for enhanced strength and sustainability, feasible for laboratory-scale casting and testing.

CHAPTER 3

METHODOLOGY

3.1 GENERAL

The flow diagram shows the process of using LDPE plastic waste in concrete. It starts by identifying the main problem and reviewing previous research to find what is missing. Then, suitable LDPE plastic waste is selected, and a concrete mix design is prepared. After that, experiments are carried out, including tests on cement (such as consistency and fineness), aggregates (like abrasion and crushing), and concrete (including compression and tensile tests). The results from these tests are analyzed, and finally, it is checked whether the results are suitable or not for the intended purpose.



3.2 Material Utilised:

The various materials required for this study are listed in the table below.

S No.	Materials
1	cement
2	Coarse aggregate
3	Fine aggregate
4	Waste plastic

Table3. 1 Material Required

3.3 Material Properties

3.3.1 Cement

The project uses Pozzolana Portland Cement (PPC), which is based on fly ash. Fly ash and volcanic ash are examples of pozzolanic materials that are added to Ordinary Portland Cement (OPC) at a ratio of 15% to 35% to create PPC, a form of Portland cement.

Properties	Values
Bulk density	1400 Kg/m^3
soundness	2.5mm
fineness	330m^2
Final setting time	500 min
Specific gravity	3.12

Table3. 2 Properties of Cement

3.3.2 Aggregates

Coarse aggregate refers to materials like crushed stone that are too large to pass through a 4.75 mm sieve. The size of coarse aggregate used depends on the construction needs, and for making samples in this project, stones of 20 mm size were chosen. Additionally, pieces of plastic waste that were bigger than 12.5 mm were used as a substitute for some of the coarse aggregate. Fine aggregate, which is sand, was collected locally and followed the Indian Standard IS: 383-2016. The sand was sieved to remove any particles larger than 4.75 mm. Tests were done to check its density, water absorption, and how fine it was. The sand belonged to grading zone II, had a specific gravity of 2.83, a bulk specific gravity of 2.7, a fineness modulus of 2.61, and absorbed about 1% water.

3.3.3 Waste Plastic

Waste plastic refers to discarded or used plastic materials that are no longer useful in their original form and are often considered non-biodegradable waste. It is a significant environmental concern due to its long decomposition time and the challenges associated with its disposal. Waste plastic is commonly generated from various sources, including packaging, bottles, bags, electronics, and industrial processes(as shown in Figure 3.1).

Figure3. 1 Plastic cell cube & Shredded Plastic

3.4 Comparison between Shredded Waste Plastic and Cell Filled Concrete Technique:-

Table3. 3 SHREDDED WASTE PLASTIC V/S PLASTIC CELL FILLED CONCRETE

SHREDDED WASTE PLASTIC	**PLASTIC CELL FILLED CONCRETE**
Used light LDPE plastic	Used light LDPE plastic
Size- 3-4 mm	Web structure of (40*40*10) cm
Aggregate size 10 mm Cement PPC	Aggregate size 10 mm Cement PPC
Made Cubes and slabs	Made slabs
Tests 1. Compressive test 2. Flexural test	Tests 1. Compressive test 2. Flexural test
Shredded plastic was added in layers in concrete mix of M25	Small cubes of plastic (10*10*10) cm each were made and inserted in concrete mix of M25
Cured for 90 days at 23^0C	Cured for 28 days at 31^0C

For making M25 concrete in a small mixer, first measure all the materials (cement, sand, coarse aggregates, water, and any additives) according to the required mix ratio. This is called batching. Next, add the dry materials-cement, sand, and aggregates-into the mixer and mix them well for about 1-2 minutes. After that, slowly add the measured water and continue mixing for another 2-3 minutes until the mixture looks uniform and consistent. Once the concrete is well mixed, it is ready to use for casting(as shown in Figure 3.2-3.6).

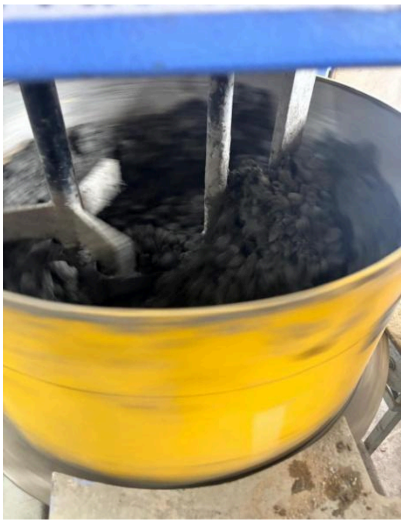


Figure 3.2 Concrete Mix M25

Figuren 3.3 Plastic Cell Web (40x40x10) cm


Figure3. 4 Plastic Cell Filled Concrete & Shredded waste Plastic Concrete slab


Figure3. 5 Slab of PCCBP (40x40x10) cm & Shredded waste Plastic Concrete slab

Figure3. 6 PCCBP Slab

3.5 Different Types of Tests

3.5.1 Normal Consistency Test on Cement

IS 4031(4)-1988 is used to perform the typical consistency test. Vicat's equipment and consistency plunger are used in the test. The test is carried out to establish the amount of water required to make a standard-consistency cement paste that is simple to use, put, and carry(as shown in Figure 3.7).

Figure3. 7 Vicat’s Apparatus.

3.5.2 Soundness of Cement

The exam is in accordance with IS 4031-3(1988). Cement's soundness is impacted by the additional lime (CaO) it contains. Slaked lime, which takes up more space than the original free calcium oxide, is created when this excess lime gradually hydrates. The constancy of volume change during the setting and hardening stages is a measure of cement's soundness(as shown in Figure 3.8).

The following formula determines how much water needs to be added:

$$(0.78 \times P \times Weight\ of\ cement)/100$$

Figure3. 8 Le-Chatelier’s Setup.

3.5.3 Fineness of the Cement

Cement fineness refers to the size of the cement particles and the experiment is performed based on IS: 4031-Part1-1996). The percent weight retained on a 90 micron IS sieve over the total weight of the sample is used to determine cement fineness. Cement fineness is determined in one of two ways: sieving or measuring the specific surface by air permeability. (Weight of residue shouldn’t be more than 10% of initial weight)(as shown in Figure 3.9).

Figure3. 9 Sieve Analysis (90μ).

3.5.4 Specific gravity (IS.4031 (11)-1988)

The weight of concrete proportions and the choice of concrete mix are significantly influenced by the specific gravity of cement, which is defined as the mass of a substance divided by the mass of a reference substance(as shown in Figure 3.10).

Figure3. 10 Le-Chatelier's Test

3.5.5 Aggregate Impact Test

The term "aggregate impact value" describes a material's ability to tolerate a shock load or quick impact. The ability of aggregate to withstand failure due to impact loads is another way to define its impact value. The aggregate's toughness—that is, its ability to withstand impact—is ascertained using the aggregate impact value test. It is recommended that the aggregates used to wear the course have an impact value of no more than 30%(as shown in Figure 3.11(a)&(b)).

Table3. 4 : Aggregate Impact Value Range (IS: 2386 (Part IV) -1963

Classification	**Aggregate Impact Value**
exceptionally Strong	<20%
strong	10 – 20%
satisfactory for road surfacing	20-30%
weak for road surfacing	>35%

Figure3. 11(a) Sieve Analysis of Plastic Waste **(b)** Impact Test for Plastic Waste

3.5.6 The Los Angeles Abrasion Test

One popular aggregate relative quality metric is the Los Angeles (L.A.) abrasion test. The abrasion and impact degradation of conventional aggregate grading are tested using a rotating steel drum loaded with steel balls for abrasion(as shown in Figure 3.12).

Table3. 5 : Los Angeles Abrasion Value (IS. 2386(4) 1963)

Sl. No.	Type of Pavement	Max. permissible abrasion value in %
1	water bound macadam sub base course	60
2	WBM base course with bituminous surfacing	50
3	bituminous bound macadam	50
4	WBM surfacing course	40

Figure3. 12 Los Angeles Abrasion Test

3.5.7 Compressive Strength (IS.4031 (6)-1988)

Under a progressively applied force, compressive strength is the greatest compressive stress that a solid material can sustain without cracking. Some materials deform permanently, while others shatter when they reach their compressive strength limit. When designing structures, compressive strength is a significant consideration. Concrete compressive strength is the most common performance measurement used by engineers when designing buildings and other structures(as shown in Figure 3.13(a)&(b)).

Figure3. 13 (a) Compressive Strength Casting (Cube-15cm*15cm*15cm)**(b)** Compressive testing using UTM

3.5.8 Flexural Strength (IS: 516 1959)

Flexural Strength is one of the measures of the tensile strength of concrete. It measures the tensile strength of unreinforced concrete beams and slabs to resist failure in bending. The test was done using a rectangular beam of 50cm*10cm*10cm dimensions(as shown in Figure 3.14).

Figure3. 14 Flexural Strength Testing using third point loading

3.6 Tests of Cement

3.6.1 Normal Consistency of Cement

According to IS 4031(Part 4) the cement consistency test was conducted.

The consistency of cement is used to determine the amount of water that should be added to cement to obtain a normal or natural consistency starting as a percentage of cement weight.

The table below presents the outcomes of the normal consistency test.

Table3. 6 Consistency test

S No	Cements weight	%of water to be added to the sample (ml)	Water weight to be added to the sample (ml)	Penetration Value
1	300	32	96	35
2	300	30	90	30
3	300	29	86	30

Normal Consistency of cement came out to be 32%.

3.6.2 Fineness Test:

The cement fitness test was carried out in compliance with IS 4031 (Part 1). The cement sample was filtered using a standard IS sieve. The proportion of cement retained on the sieve was calculated using the weight of cement particles larger than 90 microns.

The table below displays the fineness test results:

Table3. 7 Fineness Test

S. No	**Weight of cement sample in g (W_1)**	**Weight of cement retained on 90 um sieve in g (W_2)**	**Cement Fineness (W_2/W_1) * 100**
1	100	8.8	8.8%
2	100	6.7	6.7%
3	100	7.42	7.42%

Fineness value of cement = 7.64%

3.6.3 Specific gravity test:

The specific gravity test of cement was carried out in accordance with IS 4031 (Part 1). The weight of a specific gravity bottle (W_1) is used to calculate the specific gravity of a cement sample. Next, add cement paste to half of the bottle and note the weight (W_2). Avoiding air bubbles, fill the remaining bottle with kerosene, weigh it (W_3), and then clean and dry the bottle. Refill using a stopper and kerosene weight (W_4) Remove the kerosene, weigh it using a stopper (W_4), then fill it with water and weigh it again (W_5).

Table3. 8 Specific Gravity Test

Description of items	Result
Bottles' empty weight (W_1)	125.3
Bottle's weight + Cement (W_2)	189.8
Bottle's weight + Cement + Kerosene(W_3)	396.1
Bottle's weight + Kerosene(W_4)	347.7
Bottle's weight + Full Water (W_5)	64.5

Formula: $(W_2\text{-}W_1)$* specific gravity of kerosene / $[(W_4\text{-}W_1) - (W_3\text{-}W_1)]$
Specific gravity of cement = 3.12

3.7 Tests on Aggregates

3.7.1 Test for Abrasion

The Los Angeles abrasion test is used to quantify aggregate toughness and abrasion resistance, including crushing, degradation, and disintegration. An internal shelf in the drum raises and lowers the charge and sample with each revolution, producing impact pressures. The machine reaches the proper rpm, removes the contents, and computes the percentage loss.

Table3. 9 Abrasion Value of Coarse aggregate

Aggregate weight in g(W_1)	Aggregate's weight retain on 1.70mm sieve in g(W_2)	Abrasion Value
5000	2900	42

Abrasion Value = 42%.

3.7.2 Impact test

The effects test for coarse aggregate was conducted using the methodology outlined in IS 2386. The purpose of this test is to assess aggregate toughness. Many materials deteriorate quickly when they come into contact with defects, cracks, or notches.

Table3. 10 Impact Value of Aggregate

Cylinder weight with aggregates W_2(g)	**Aggregate's weight after passing through a 2.36 mm sieve W_1(g)**
400	62.5

Impact test value = $(W_1/W_2) * 100 = 15.6\%$

3.7.3 Crushing Test

Crushing test was done according to the IS 2386 to determine their crushing test value. It is conducted to assess the compressive strength and durability of aggregates used in construction materials. It helps determine the ability of aggregates to resist crushing under applied pressure, which is essential for ensuring the strength and longevity of structures like roads, pavements, and concrete foundations. In this test, a sample of aggregates is placed in a cylindrical mold, and a progressively increasing load is applied using a compression testing machine until the sample breaks. The **Aggregate Crushing Value (ACV)** is calculated by comparing the weight of the crushed material to the total weight of the sample, expressed as a percentage. A lower crushing value indicates stronger aggregates that can withstand higher loads without disintegration.

Table3. 11 Aggregate Crushing Value of Aggregates

Cylinder weight with aggregates W_1(g)	**Aggregate's weight passing through a 2.36mm sieve(g)**	**Aggregate crushing value (%) = $(W_1/W_2)*100$**
2376	550	20.1

Aggregate crushing value = 20.1%

Table3. 12 Particle size distribution of stone dust

Sieve size (mm)	**Percentage passing by weight (%)**	**Specified limit (passing %) for Zone II**
10	100	100
4.75	98.4	90-100
2.36	91.5	75-100
1.18	70.3	55-90
0.6	52.3	35-59
0.3	35.7	8-30
0.15	21.4	0-10

M25 Concrete Mix Design as per IS 10262:

1. Stipulations for Proportioning

- Grade: M25
- Cement: PPC grade (IS 12269)
- Maximum aggregate size: 20 mm
- Minimum cement content: 310 kg/m³
- Maximum water-cement ratio: 0.5
- Workability: 50–75 mm slump
- Exposure: Normal/Moderate
- Degree of supervision: Good

2. Material Properties (Example Values)

- Specific gravity of cement: 3.12
- Specific gravity of 20 mm aggregate: 2.88
- Specific gravity of 10 mm aggregate: 2.88
- Specific gravity of fine aggregate: 2.65
- Water: 1.00

3. Target Mean Strength

- Target mean strength (1.65 × S):
  25+1.65×4=31.625+1.65×4=31.6 MPa

4. Selection of Water-Cement Ratio

- Adopted W/C ratio: 0.43–0.45

5. Selection of Water Content

- For 20 mm aggregate, water content ≈ 186 kg/m³

6. Calculation of Cement Content

- Cement content = Water content / W/C ratio
  For example, 152 / 0.5 ≈ 304 kg/m³

7. Proportion of Aggregates

- Volume of coarse aggregate per unit volume (for 20 mm, Zone II sand, W/C 0.5): 0.63
- Volume of fine aggregate: 1 – 0.63 = 0.375

8. Mix Calculations (per 16000 cm³ of Concrete Slab (40*40*10))

- Volume of concrete = 16000 cm³
- Volume of cement = (mass of cement) / (specific gravity × 1000)
- Volume of water = (mass of water) / (specific gravity × 1000)
- Volume of admixture = (mass of admixture) / (specific gravity × 1000)
- Volume of all aggregates = 1 – (sum of above volumes)
- Mass of coarse aggregate = volume × proportion × specific gravity × 1000
- Mass of fine aggregate = volume × proportion × specific gravity × 1000

Material	Quantity(per 16000 cm^3)
Cement	9.86 Kg
Water	4.5 L
Fine Aggregate	9.86 Kg
Coarse Aggregate	19.72 Kg

CHAPTER 4

RESULT ANALYSIS

4.1 GENERAL

In this project, two concrete slabs were prepared using M25 grade concrete. The first slab was made by mixing shredded plastic waste into the concrete, while the second slab was made using PCCBP. Both slabs were cast in similar conditions and allowed to cure properly.

After curing, two important tests were performed on both slabs: the compressive strength test and the flexural strength test.

4.2 TESTS ON CONCRETE

4.2.1 Compressive Strength for Unmodified Cement

The compressive strength of the PPC cement was cast for 7, 14, and 28 days of curing(as shown in Figure 4.1).

As per the IS: 1489 guidelines.

Table4. 1 Compressive Strength of Cement - as per IS: 1489

Age in days	Portland Pozzolana Cement (N/mm^2)	Sample 1 (N/mm^2)	Sample 2 (N/mm^2)	Sample 3 (N/mm^2)	Average (N/mm^2)
7	19.6-21.6	18.4	17.2	19.6	18.4
14	25.5-32.4	26.5	24.4	25.3	25.4
28	36.3-47.1	39.8	39	37.6	38.8

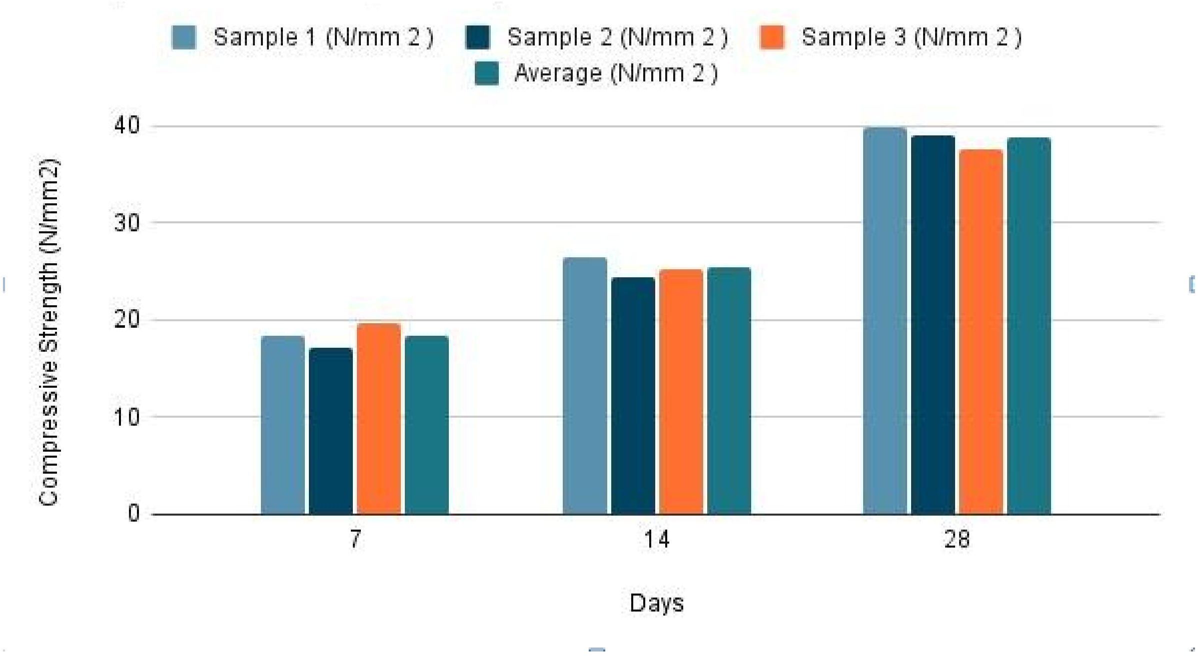


Figure 4.1 Graph of Compressive Strength of Cement

4.2.2 Flexural Strength for Unmodified Cement

The flexural strength test for the PPC cement was cast for 7, 14, and 28 days of curing(as shown in Figure 4.2,4.3).

As per the IS: 1489 guidelines.

Table4. 2 Flexural Strength of Cement

Age in days	**Sample 1 (N/mm^2)**	**Sample 2 (N/mm^2)**	**Sample 3 (N/mm^2)**	**Average (N/mm^2)**
7	1.7	1.9	1.6	1.73
14	2.4	2	2.3	2.23
28	3.2	3.1	2.9	3.07

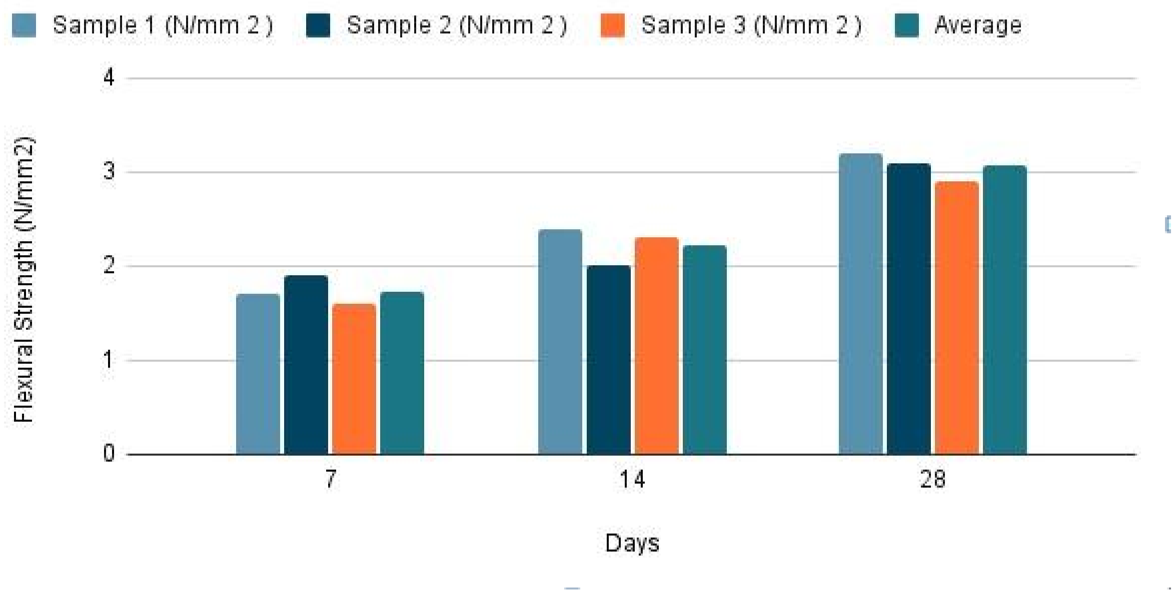


Figure4. 2 Graph of Flexural Strength

4.3 Compressive strength of Shredded Waste Plastic specimens of M25

Table4. 3 : Compressive strength of shredded waste plastic

Days	**Percentage of Plastic-5%**	**Percentage of Plastic-7.5%**	**Percentage of Plastic-10%**	**Percentage of Plastic-12.5%**	**Percentage of Plastic-15%**
7	23.5	22	18.5	18.5	16
28	30.7	29.3	24	21.3	18.3
90	33.1	31.1	26.2	24.9	20.4

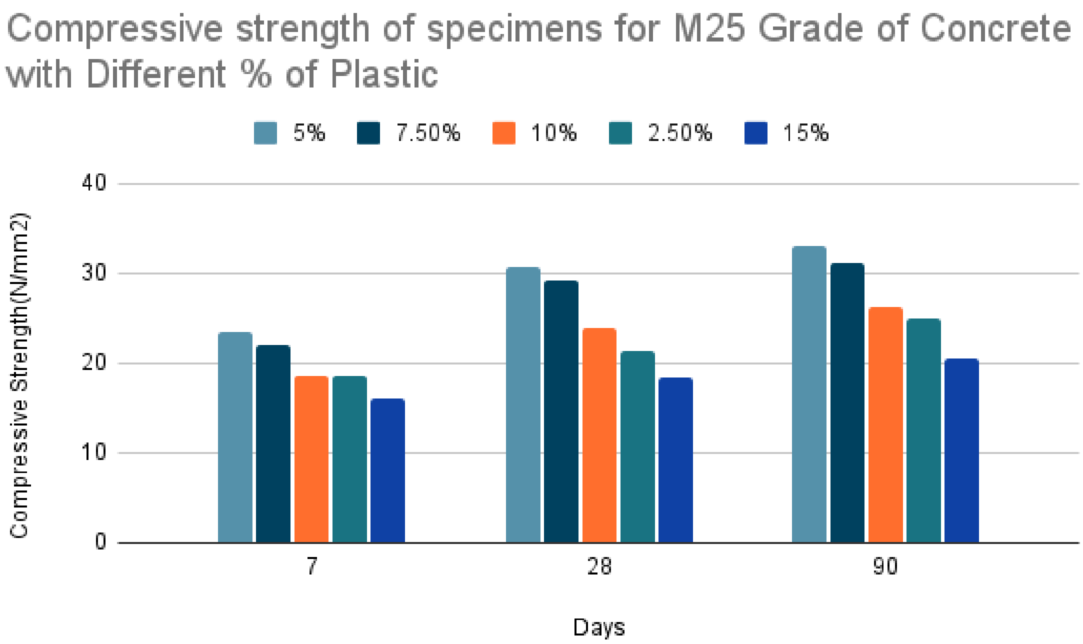


Figure4. 3 Graph of Compressive Strength of shredded plastic

4.4Flexural strength of Shredded Waste Plastic specimens of M25

Table4. 4 Flexural strength of shredded waste plastic

Days	Percentage of Plastic-5%	Percentage of Plastic-7.5%	Percentage of Plastic-10%	Percentage of Plastic-12.5%	Percentage of Plastic-15%
7	3.1	3.1	2.9	2.8	2.8
28	4.5	4.3	4.1	4.1	3.9
90	4.7	4.6	4.2	4.2	4

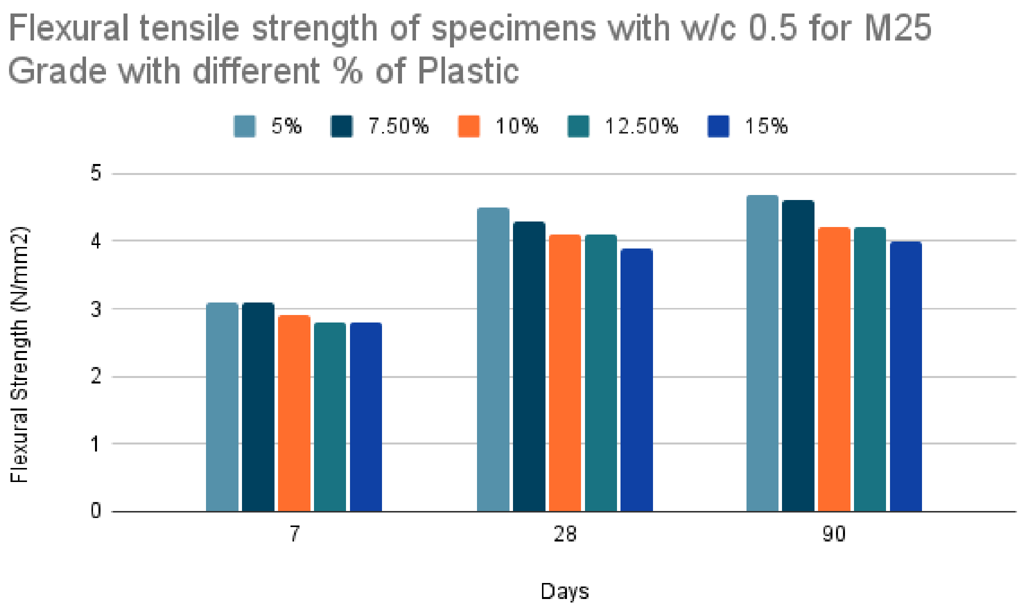


Figure4. 4 Graph of Compressive Strength of shredded plastic

4.5 28 Days Compressive and Flexural Strength of PCCBP for M25

The average compressive strength and flexural strength of PCCBP slab and beam for 28 days is (as shown in Figure 4.5-4.6)

Table4. 5 Laboratory and Theoretical Compressive Strength Comparison of 7 Days

Days	**Compressive Strength Of PCCBP With 10% Plastic N/mm^2**	**Flexural Strength Of PCCBP With 10% Plastic N/mm^2**
7	21.5	3.24
14	29.5	4.35
28	34.56	5.3

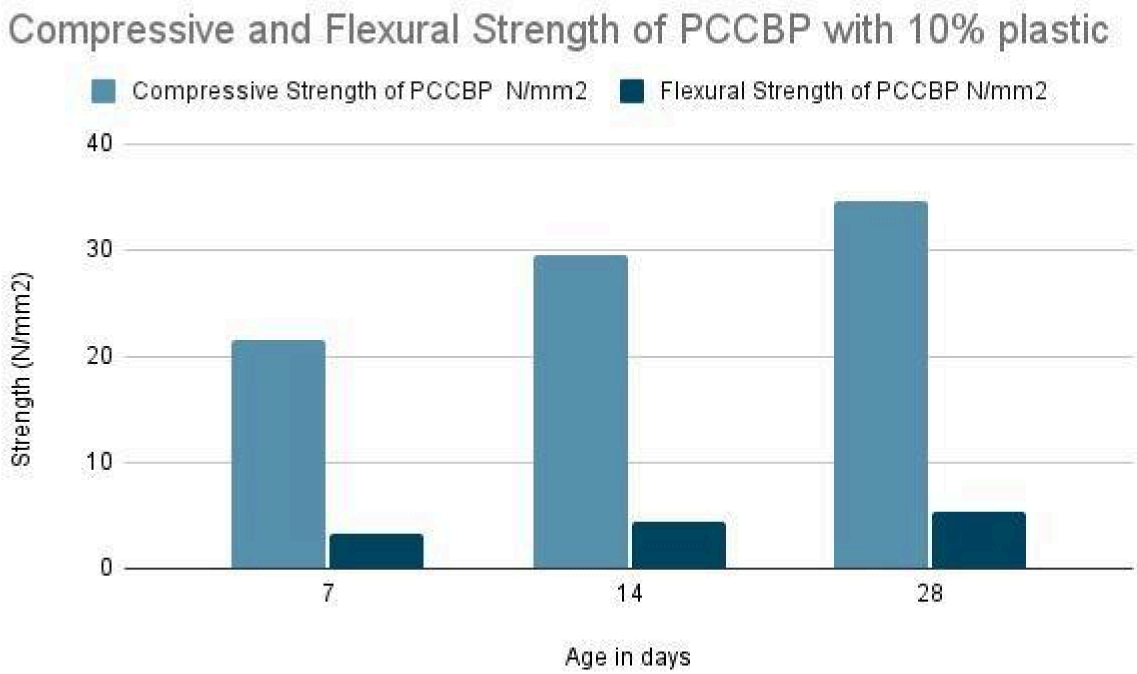


Figure 4.5 Graph of Compressive Strength 7 Days vs. % Replacement for PCCBP

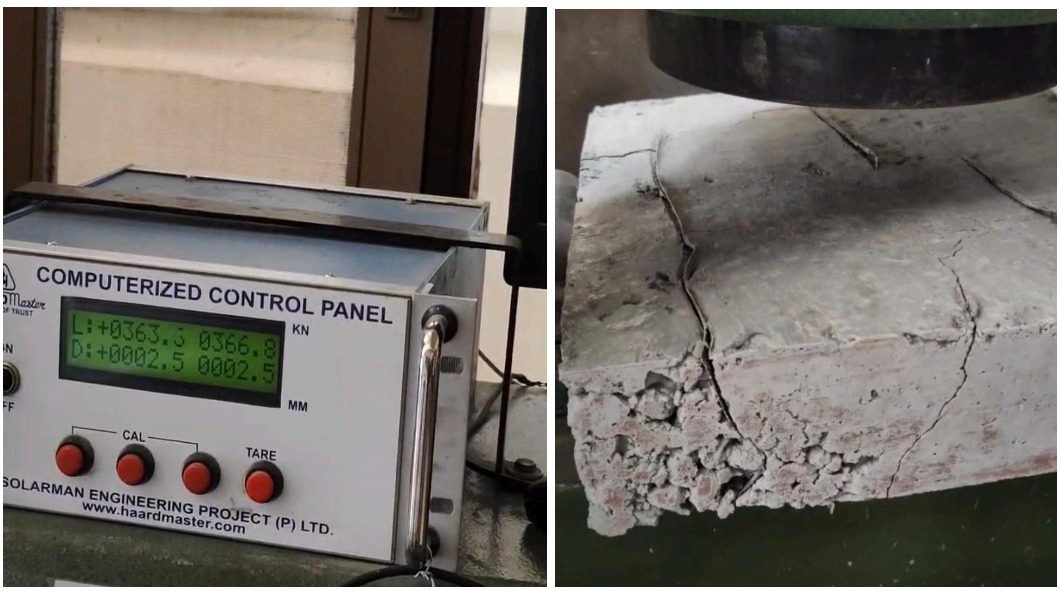


Figure 4.6 Testing of PCCBP Slab

CHAPTER 5

CONCLUSION

This experimental study focused on utilizing waste plastics as a partial replacement for fine aggregates in cement concrete. The investigation involved casting three series of concrete mixes. In the first series, M25 grade concrete was prepared with a water-cement ratio of 0.50, where Low-Density Polyethylene (LDPE) was used to replace fine aggregates in varying proportions ranging from 5% to 15.

These tests were aimed at assessing the mechanical and durability characteristics of concrete modified with waste plastic aggregates.

This thesis concludes that the PCCBP method offers better performance compared to the Shredded Waste Plastic technique.

PCCBP

In this experimental work I focused on utilizing waste plastics cells as a partial replacement for fine aggregates in cement concrete. The investigation involved casting three Slabs of (40*40*10) cm. In the first sample, M25 grade concrete was prepared with a water-cement ratio of 0.50, where Low-Density Polyethylene (LDPE) was used in web shape containing small cubes of (10*10*10) cm which replaces fine aggregates from 10%.

The incorporation of shredded waste plastic into cell-filled concrete presents a promising solution for addressing both environmental concerns and infrastructure demands. Through this study, it has been demonstrated that waste plastic can be effectively utilized as a partial replacement for conventional materials in concrete without significantly compromising structural integrity. The cell-filled concrete system, when combined with shredded plastic, enhances load distribution, reduces settlement, and offers improved durability in comparison to traditional sub-base materials.

This innovative approach not only contributes to sustainable construction by reducing plastic pollution and conserving natural resources but also offers economic benefits through the reduction in material costs. The experimental results support the feasibility of using shredded plastic as a reinforcing element in cell-filled concrete, particularly in applications such as pavements, low-traffic roads, and temporary structures.

Future research and large-scale field trials are encouraged to further validate the long-term performance, optimize mix proportions, and assess the behaviour under different environmental conditions. Overall, this project underscores the potential of transforming plastic waste into a valuable resource in the civil engineering domain.

Table5. 1 Difference between PCCBP and Shredded Plastic Techniques Based on Results

PLASTIC CELL FILLED CONCRETE	SHREDDED WASTE PLASTIC
Provide more compressive and flexural strength	Provide less compressive and flexural strength
Proper utilisation of waste plastic	Waste plastic is mixed in concrete as a component
If one cell block fails it can Replaced instead of whole pavement	If waste material get damaged whole pavement get damaged

Suggestion for future work

Concrete incorporating waste plastic fibers can be further evaluated for its strength and durability characteristics. Initial experiments were conducted using Ordinary Portland Cement (OPC) as the binder; however, future studies may explore the use of Portland Pozzolana Cement (PPC) as an alternative binder to assess its performance. Additionally, the carbon black powder derived from the pyrolysis of waste plastic presents potential for use either as a filler or as a partial replacement for cement in concrete mixtures.

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