PLASTIC INTEGRATED INTERLOCKING BRICKS

Project Report

Submitted by

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in partial fulfillment of the requirements
for the award of the degree of

Bachelor of Technology
in
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Rajagiri School of Engineering & Technology
Kochi, Kerala, India

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Bonafide certificate

This is to certify that the project report entitled **Plastic Integrated Interlocking Bricks** submitted by **Tom J Palamattam (RET15ME124)**, **Nitin James (RET15ME096)**, **Vipin Prabhakran (RET15ME127)** and **T J Kuriakose (RET15ME117)** in partial fulfillment of the requirements for the award of degree of **Bachelor of Technology** in **Mechanical Engineering** is a bonafide record of the work carried out under our guidance and supervision at Rajagiri School of Engineering & Technology, Kochi, Kerala, India.

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Rajagiri School of Engineering & Technology
Department of Mechanical Engineering

Institute Vision

To evolve into a premier technological and research institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

Institute Mission

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

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To evolve into a centre of excellence by imparting professional education in mechanical engineering with a unique academic and research ambience that fosters innovation, creativity and excellence.

Department Mission

- To have state-of-the-art infrastructure facilities.
- To have highly qualified and experienced faculty from academics, research organizations and industry.
- To develop students as socially committed professionals with sound engineering knowledge, creative minds, leadership qualities and practical skills.

Program Educational Objectives (PEOs)

- PEO 1: Demonstrated the ability to analyze, formulate and solve/design engineering/real life problems based on his/her solid foundation in mathematics, science and engineering.
- PEO 2: Showcased the ability to apply their knowledge and skills for a successful career in diverse domains viz., industry/technical, research and higher education/academia with creativity, commitment and social consciousness.
- PEO 3: Exhibited professionalism, ethical attitude, communication skill, team work, multidisciplinary approach, professional development through continued education and an ability to relate engineering issues to broader social context.

Program Outcomes (POs)

Engineering Graduates will be able to:

- PO 1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO 2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO 3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- PO 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and nee for sustainable development.
- PO 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO 9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO 10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO 11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
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- PSO 1:Apply their knowledge in the domain of engineering mechanics, thermal and fluid sciences to solve engineering problems utilizing advanced technology.
- PSO 2: Successfully apply the principles of design, analysis and implementation of mechanical systems/processes which have been learned as a part of the curriculum.
- PSO 3: Develop and implement new ideas on product design and development with the help of modern CAD/CAM tools, while ensuring best manufacturing practices.

Acknowledgment

This project report has been possible only due to support and help from various people. This report would not be complete unless their contributions are acknowledged.

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Above all, we thank God Almighty for giving me strength, courage and blessings to complete this work.

Abstract

Plastics are materials consisting of a wide range of synthetic or semi-synthetic organic compounds that are malleable and so can be moulded into solid objects. We are incorporating these plastic wastes for making interlocking bricks. First we found out the exact proportion of different components of a conventional interlocking brick. And then we made a conventional interlock to keep it as a reference brick. We found out different properties of this interlocking brick to compare the same properties with plastic integrated interlocking bricks which in different ratio of mixtures. After comparing the properties, we choose the best one among them.

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Chapter 1

Introduction

Plastics are synthetic materials that are produced from a wide range of organic polymers. Use of plastic is increasing by 10 percent year by year in our country. Kerala produces 480 tonnes of plastic waste per day. About 6000 tonne of plastic waste was accumulated in Kochi during flood. Plastic needs more than 100 years to decompose. Therefore we are making use of this waste plastic to manufacture of interlocking bricks. Interlocking bricks are bricks which can lock itself with other bricks they are mainly made up of cement and clay. But we use this plastic waste for manufacturing. Most commonly found plastic wastes are PET and HDPE which reduces cost and weight of interlocking bricks. It also improves its thermal, alkali resistance, elastic modulus and its compressive strength. Thus we can reduce overall plastic pollution in the city.

Chapter 2

Literature Survey

- The paper "Use of recycled aggregates in molded concrete bricks and blocks(2002)", proposed the idea about producing concrete bricks and paving blocks using recycled aggregates obtained from construction and demolition waste. In this paper we discuss the effect of flyash in concrete and how much it affects the copressive strength and also other properties. It was found that addition of flyash about 25-50 % had little effect on compressive strength whereas the cost savings where huge. Also it was found that the transverse strength actually increased with the addition of flyash.

- The paper "Pyrolysis of municipal plastic wastes for recovery of gasoline-range hydrocarbons (2004)", proposed the idea about non-catalytic pyrolysis of plastic waste materials to gasoline range hydrocarbons. The yield of gaseous products increase with increasing pyrolysis temperature. The yields of liquid products inrease with increasing pyrolysis temperature up to 675K and then slightly decrease from 675K to 850K. Individual yield of each gas product with increasing pyrolysis temperature is irregular.

- The code " IS 15658 (2006): Precast concrete blocks for paving" This standard specifies constituent materials, products requirements and test methods for solid, unreinforced pre-cast cement concrete paver blocks and complimentary products used for light, medium, heavy and very heavy traffic paving applications and other applications.

- The paper "Reuse of thermosetting plastic waste for lightweight concrete(2008)", proposed a technique for producing concrete bricks and paving blocks using recycled aggregates and grounded thermosetting plastic. Thermosetting plastics cannot be recycled because of strong linkage between between the molecules and cannot be melted. This paper suggested that thermosetting plastics can be grounded and can be mixed with cement with the help of aluminium powder.

- The code "Concrete Mix Proprtioning Guidelines(2009) (IS10262)" gave us the guidelines for concrete mix design proposition . This standard provides the guidelines for proportioning concrete mixes as per the requirements using the concrete making materials including other supplementary materials identified for this purpose, The proportioning is carried out to achieve specified characteristics at specified age , workability of concrete and durability requirements.

- The paper "Development of sustainable geopolymer mortar using industrial waste materials(2016)" identifies the most suitable or ideal pozzolan in the development of geopolymer concrete, to compare the compressive strengths of different mix proportions N-sand, M-sand and quarry dust and also to investigate the compressive strength of geopolymer mortar using locally available waste materials such as FA, POFA, BFS as binders.

- The paper "Effect of aggregate properties on the mechanical and absorption characteristics of geopolymer mortar(2017)" mainly deals with various properties when different aggregates mainly natural sand ,crushed lime stone and combined sand mixed with fly ash based geopolymer mortar. After the diffrent Testing procedures we found out that Combined sand- crushed limestone shows less water absorption and water sorptivity than other aggregates due to finer particles lead to a reduction in the spaces between particles and the pores due to the finer texture of crushed limestone. It also increases the compressive strength of the bricks. So here in this project we make use of this crushed limestone to increase the above mentioned properties of interlocking bricks.

- The paper "Recycling woven plastic sack waste and PET bottle waste as fiber in recycled aggregate concrete(2018)", proposed a potential engineering of Recycled PET Bottles Waste (RPET) and Recycled Woven Plastic Sack Waste (RWS) fiber reinforced Recycled Aggregate Concrete (RAC). This paper discussed how plastic wastes can be used as fibers in recycled concrete. This paper also discussed the potential of silica fumes in concerte as it is found to increase the compressive strength in concrete. We also discuss how plastic fibers can improve post cracking behaviour.

- The paper "The heating of polymer composites by electromagnetic induction", proposes the idea of utilising induction heating technology for heating plastics without causing much pollution by adding different conducting heating promoters along with the plastics with the required proportion. Different promoters are added and tested with the plastics with different proportion, the results obtained was then compared and analyzed.

2.1 Motivation

The primary aim is to reduce plastic pollution. Interlocking bricks have poor compressive strength compared to plastic interlocking bricks. Water absorption rate is still high on plastic bricks. We use plastic as an aggregate to improve compressibility and splitting tensile strength of the brick. We can use crushed limestone to reduce water absorption in bricks.

2.2 Objectives

- To reduce plastic pollution.
- To manufacture plasttic integrated interlocking bricks with different proportions.
- To compare the different properties of interlocking bricks.
- To reduce weight and cost without compromising its compressive strength.
- To improve its thermal and alkali resistance.
- To improve elastic modulus of brick.

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2.3 Methodology

We collected thermoplastics(PET and HDPE) and are washed thoroughly. Plastics are shredded using a shredding machine. Diffrent tests were conducted to find out mix proprtion and a conventional interlocking brick was made using this mix proprtion. This was taken as a reference. Now plastic is used to replace coarse aggregate by weight bt 5% 10% etc. see fig 2.1

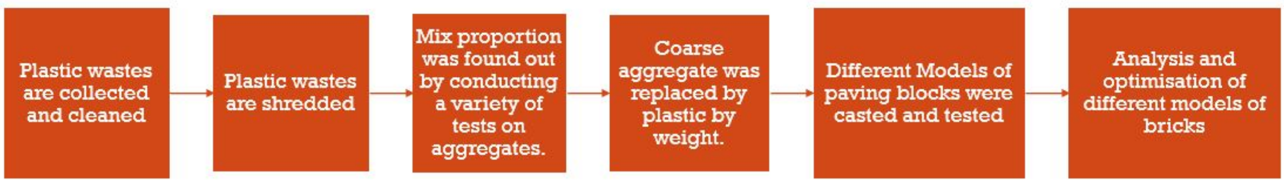

Figure 2.1: Methodology

Chapter 3

Plastic Integrated Brick

3.1 Mould Designing

We designed an I shaped mould of volume and also made 3 identitical moulds. These moulds were made of mild steel. These were cut, milled and grinded into required sizes and shape then they were joined together by welding. see fig 3.1.

Figure 3.1: Moulds

3.2 Properties of Materials

3.2.1 Cement

1. Specific gravity test for cement: Specific gravity is the ratio of the density of a substance to the density of a reference substance at a fixed temperature. Here we find the value of specific gravity of cement using Le Chatelier Flask. fig 3.2. Here we take OPC grade 53 cement as its suitable for interlocking tiles. Thus, the specific gravity of cement is found out to be 3.928.

Figure 3.2: Le Chatelier Flask

3.2.2 M-Sand

1. Test for specific gravity of m-sand: The specific gravity of fine aggregate is determined with the help of an instrument called pycnometer fig 3.3. and is found out to be 2.173.

2. Determination of sieve zones: 1 kg of the sample is weighed and sieved as given in table 3.1 From this data it is inferred that m-sand is of zone 2.

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3. Determination of moisture content: Moisture content of m-sand is measured by percentage difference in weights of given sample of m-sand and 24-hour oven-dried sample of same initial weight.The moisture content of m-sand is found to be 1.67%. oven fig 3.4

Figure 3.3: Pycnometer

Table 3.1: Sieve Zones

Sieve sizes (mm)	Weight retained (kg)
4.75	0.001
2.36	0.123
1.18	0.258
0.600	0.215
0.300	0.239
0.150	0.130
Pan	0.026

3.2.3 Metal Chips

1. Test for specific gravity of metal chips: The mass of a coarse aggregate sample is determined in normal, oven-dry and submerged states. These values are then used to calculate specific gravity and is found as 2.71.

2. Determination of moisture content: Moisture content of metal chips is measured by percentage difference in weights of given sample and 24-hour oven-dried sample of same initial weight. The moisture content of coarse aggregate is found to be 0.35%.

Figure 3.4: Oven

3.3 Mix design for conventional interlocking brick

Based on above data, mix design is tabulated according to IS-10262. For 1m3 of volume, mix proportion is given on Table 3.2

Calculations:

- Grade designation=M40
- Type of cement=OPC 53.
- Max. nominal size of aggregate=20mm.
- Min. cement content=400kg/m3.
- Max water-cement Ratio=0.40.
- Workability=0 slump.
- Exposure condition=severe.
- Type of aggregate=Angular.
- Max cement content=450kg/m3.

- Specific gravity of Cement= 3.298.
- Specific gravity of coarse aggregate=2.71.
- Specific gravity of fine aggregate=2.173.
- Water absorption of caorse aggregate=0.35%.
- Water absorption of Fine aggregate=0.1.67%.
- Sieve analysis Fine aggregate=zone 2.

1.Target Mean Compressive Strength:

$$= f_{ck} + 1.6\sigma = 40 + 1.65 * 5 = 48.25MPa$$

$$where\ f_{ck} = characteristic\ compressive\ strength$$

$$\sigma = standard\ deviation = 5.$$

2. Selection of water-cement Ratio:

$$Assume\ water - cement\ ratio = 0.4$$

3. Calculation of cement content:

$$Minimum\ cement\ content = 400kg/m^3$$

$$Maximum\ cement\ content = 450kg/m^3$$

$$Assume\ cement\ content = 400kg/m^3$$

4. Calculation of water:

$$water\ content = 400 * 0.4 = 160kg$$

5. As per cl no 3.5.1

$$V = [W + \frac{C}{S_C} + \frac{1}{P} * \frac{F_a}{S_{fa}}] * 1000$$

$$V = [W + \frac{C}{S_C} + \frac{1}{1-P} * \frac{C_a}{S_{ca}}] * 1000$$

$$where\ V = volume$$

$$S_{fa},\ S_{Ca}\ and\ S_c = specific\ gravity\ of\ fine\ aggregate,\ coarse\ aggregate\ and\ cement.$$

Table 3.2: Mix design

components	**Weight(kg)**
Cement	400
Water	160
Fine aggregate	554
Coarse aggregate	481

$$F_a \; and \; C_a \; are \; weights \; of \; coarse \; and \; fine \; aggregates \; in \; mix \; proportion.$$

$$C = Minimum \; cement \; content.$$

$$W = [Weight \; of \; water \; in \; 1 \; m^3] = 160Kg.$$

$$For \; 20mm \; maximum \; size, \; entrapped \; air = 2\%.$$

$$P = Fine \; aggregate \; by \; percentage \; volume \; of \; Total \; aggregate = 0.365$$

$$For \; Coarse \; aggregate \; (P) = 0.635.$$

$$v = 1 - 0.02 = 0.98m^3$$

6. Calculation for fine aggregate:

$$0.98 = [160 + \frac{400}{3.298} + \frac{1}{0.365} * \frac{F_a}{2.173}] * 1000$$

$$F_a = 554kg$$

7. Calculation for coarse aggregate:

$$0.98 = [160 + \frac{400}{3.298} + \frac{1}{0.635} * \frac{C_a}{2.71}] * 1000$$

$$Ca = 1202Kg.$$

$$Considering \; 20mm : 10mm = 0.6 : 0.4.$$

$$For \; 20mm \; size \; coarse \; aggregate = 721Kg.$$

$$For \; 10mm \; size \; coarse \; aggregate = 481Kg.$$

3.4 Making plastic integrated interlocking bricks

We decided to incorporate plastic waste to interlocking brick. We replaced course aggregate with HDPE in pellete form with 5%,10%,15% plastic by weight. Now we compare different properties of plastic integrated interlocking bricks with reference brick(concrete interlock). Samples required for compression, water absorption, abrasion and splitting tensile stress(fig 3.5) were made. Sample of an plastic interlocking brick is shown in fig 3.6 interlocking properties of interlocks are demonstrated in fig 3.7 and fig 3.8.

Figure 3.5: Specimen for testing splitting tensile strength

Figure 3.6: Plastic integrated interlocking brick

Figure 3.7: Interlocking property of plastic integrated bricks

Figure 3.8: Interlocking property of plastic integrated bricks

Chapter 4

Results and Discussion

All the specimens are water cured for 7-day and 28-day before conducting these tests.

4.1 Compression Test

We conducted the compression test on compression testing machine for conventional interlocking bricks as well as 5%, 10%, 15% and 20% plastic integrated interlocking bricks. Following is the data for 7 day and 28 day water cured tests for interlocking bricks.

Test procedure: The specimen is placed in between the plates of the compression testing machine(fig 4.2) (CTM). Load is applied till a crack is formed in the specimen and this value is noted. The compression load data is given in table 4.1 for 7-day cured specimens and in table 4.2 for 28-day cured specimen . It is observed that compression load increases with plastic content. A graph has been plotted on this data (fig 4.1). From the graph it is inferred that 10% plastic is the optimum value as it gives maximum compressive load.

Table 4.1: Compression load data (7-day)

Plastic(%)	**Compression Load (MPa)**		
	Test 1	**Test 2**	**Average**
0	**4.55**	**4.65**	**4.6**
5	**6.21**	**5.91**	**6.06**
10	**6.42**	**7.08**	**6.725**
15	**2.420**	**3.24**	**2.840**

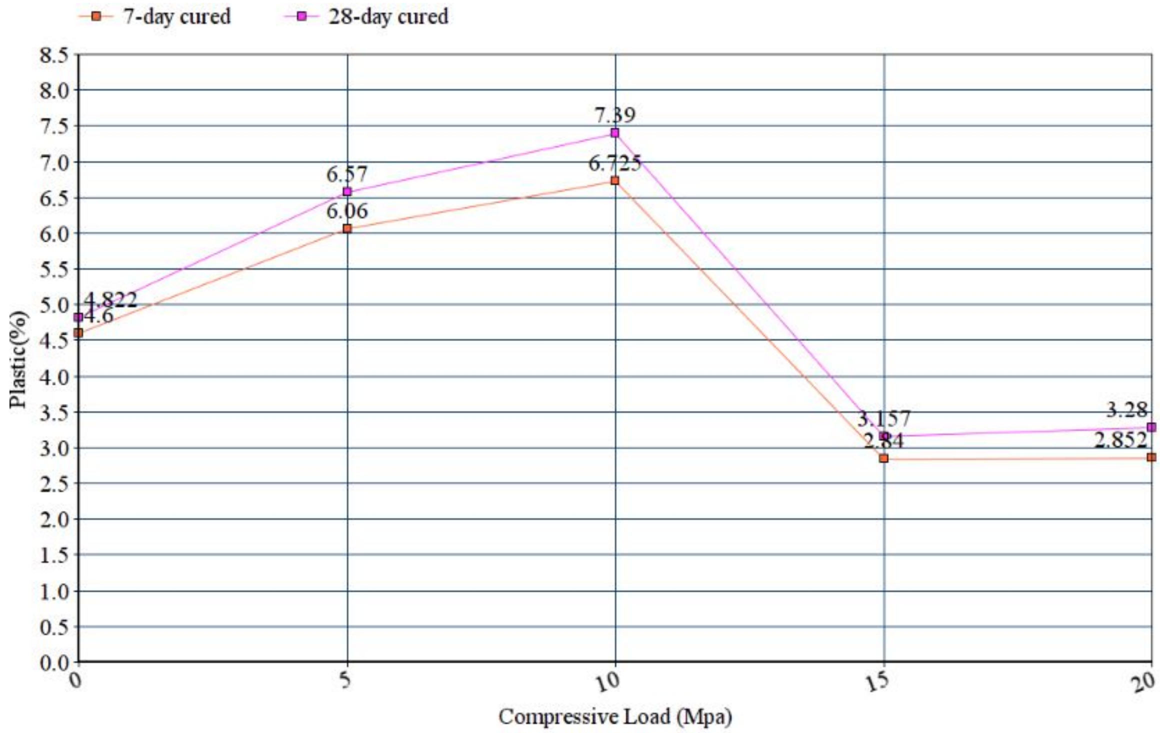

Figure 4.1: Compression test

Table 4.2: Compression load data (28-day)

Plastic(%)	Compression Load (MPa)		
	Test 1	**Test 2**	**Average**
0	5.32	4.324	4.822
5	6.920	6.22	6.57
10	7.84	6.94	7.39
15	2.98	3.37	3.175
20	3.14	3.42	3.28

4.2 Water Absorbtion test

The dry weight of the specimen is noted then test specimen shall be completely immersed in water (fig(4.3)) at room temperature for 1 day. The specimen then shall be removed from the water and allowed to drain for 1 min. Visible water on the specimens shall be removed with a damp cloth. The specimen shall be immediately weighed and is noted. Now the percentage variation in weights before and after immersion is taken as water absorption rate and is given in table 4.3 and the graph is plotted in fig 4.4. From this data it is inferred that 10% plastic is the optimum value as it gives not too high or not too low water absorption rate.

Figure 4.2: CTM

Figure 4.3: Water Absorption

4.3 Abrasion Test

Abrasion resistance is an important factor for an interlocking tile. It is the measure of wear for the interlocking brick. Abrasion should be low for an ideal interlocking brick.

Test procedure: Square-shaped specimens(fig 4.5) measuring 7cm*7cm shall be cut from the interlocking tile. The contact face and the opposite face of the specimen shall be parallel and flat.The grinding disc shall be run at a speed of 30 rpm. The disc shall be stopped after one cycle of 112 revolutions.The specimen shall be turned 90° in the

Table 4.3: Water Absorption Data

Plastic(%)	**Water absorption(%)**
0	2.2
5	1.5
10	1.3
15	1.022

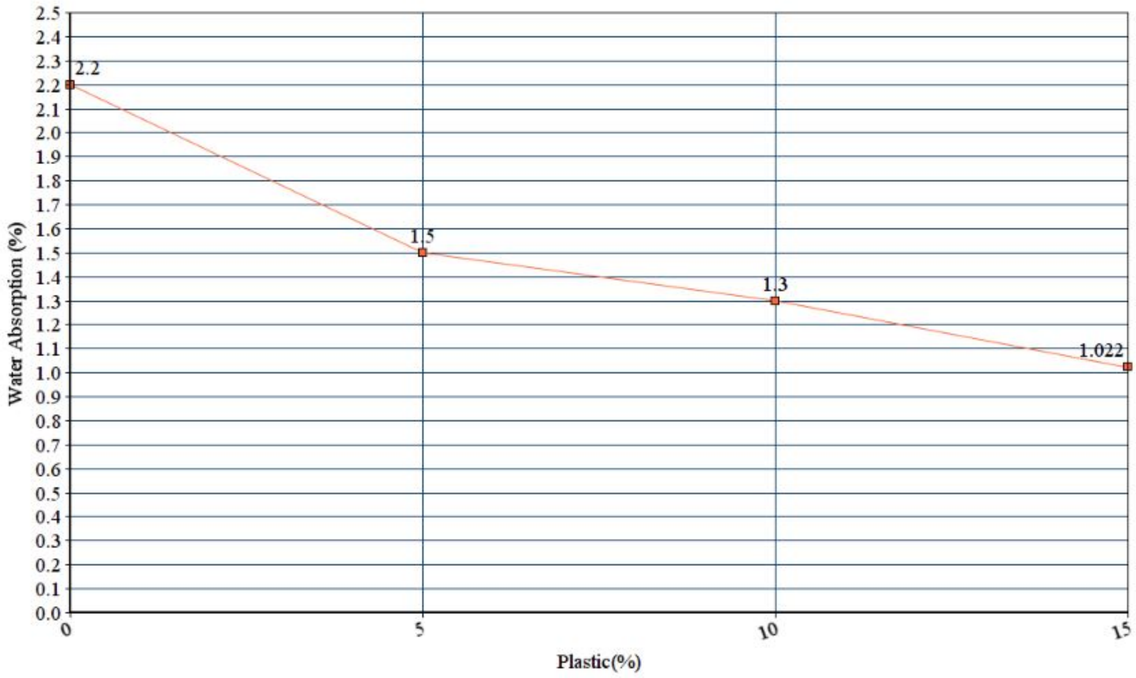

Figure 4.4: Water Absorption Test

clockwise direction and 20 g of abrasive powder shall be evenly strewn on the testing track before starting the next cycle. Their weights and thickness are noted before and after abrasion and is given in table 4.4 for 7 day cured specimen and in table 4.5 for 28 day cured specimen. This data is plotted in graph 4.6. From the data it is inferred that 10% plastic is the optimum value as it gives maximum abrasion resistance.

Table 4.4: Abrasion Test Data(7-day)

Plastic(%)	**Loss in weight after abrasion (%)**	**Reduction in thickness (In mm)**
0	0.9	2
5	0.76	1
10	0.58	1
15	0.59	1
20	0.638	1

4.4 Splitting Tensile Strength

Tensile strength is one of the most important and basic property of interlocking bricks. Splitting Tensile test is a method of determining the tensile strength of concrete using a cylinder which splits across the vertical diameter.

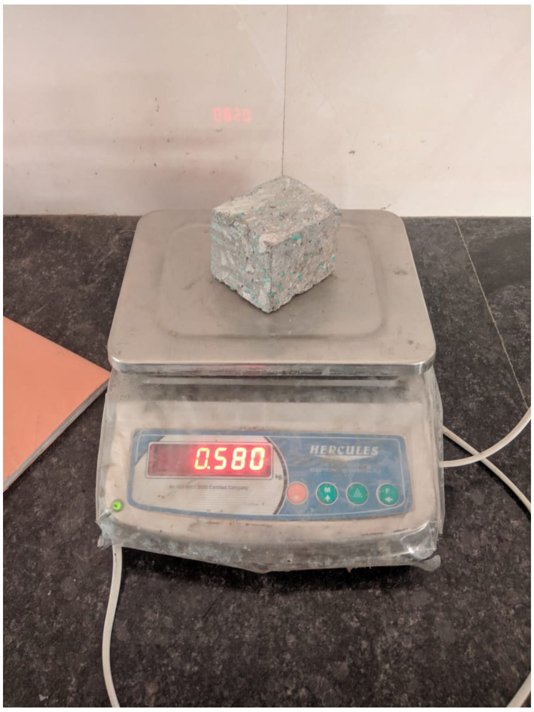

Figure 4.5: Square Specimen

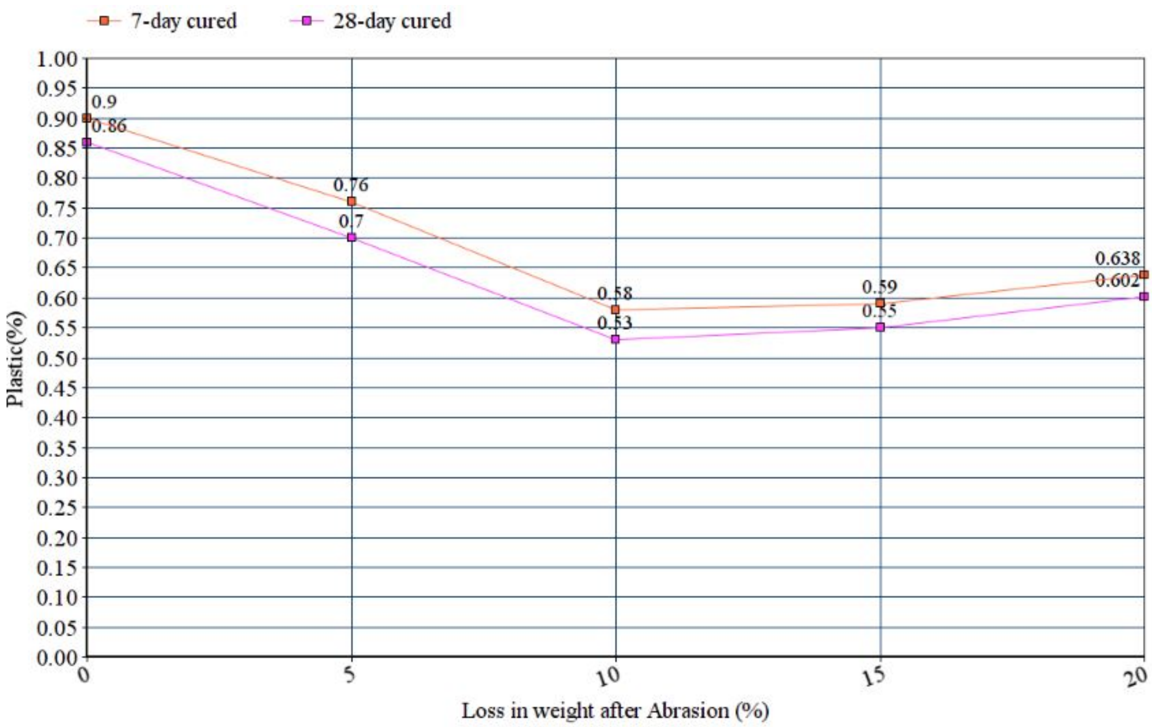

Figure 4.6: Abrasion Test

Test procedure: Cylindrical Specimens of diameter and length of 150mm and 300 mm are used. The specimen is placed between two bearing strips. Load is applied on

Table 4.5: Abrasion Test data(28-day)

Plastic(%)	**Loss in weight after abrasion(%)**	**Reduction in thickness(mm)**
0	0.86	2
5	0.71	1
10	0.53	1
15	0.55	1
20	0.602	1

a CTM machine(fig4.8). until a crack is generated in the specimen. These loads were notted down in table 4.6 for 7 day cured specimen and in table 4.7 for 28 day cured specimen and are plotted on graph 4.7. from the data it is inferred that 10% plastic is the optimum value as it gives maximum tensile load.

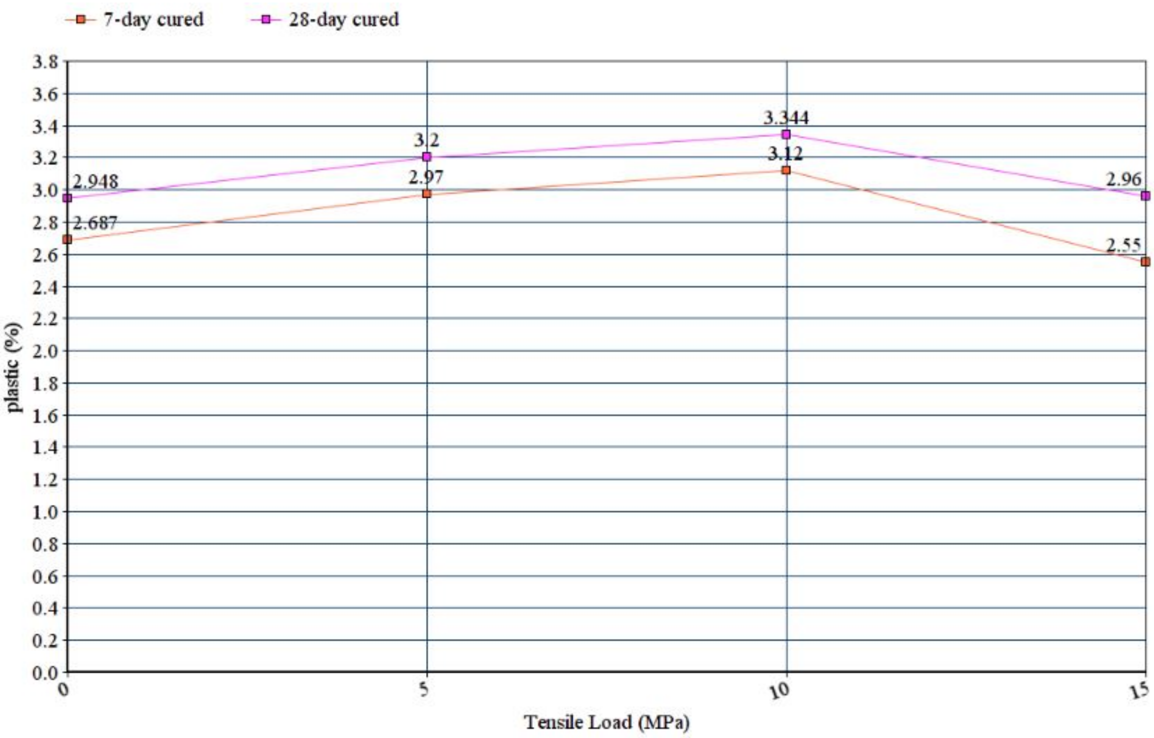

Figure 4.7: Splitting Tensile Test

Figure 4.8: Splitting Tensile Test

Table 4.6: Splitting Tensile Test(7-day)

Plastic(%)	**Tensile Load (MPa)**		
	Test 1	**Test 2**	**Average**
0	**2.220**	**3.154**	**2.687**
5	**2.5**	**3.44**	**2.970**
10	**3.22**	**3.01**	**3.120**
15	**3.39**	**2.55**	**2.970**

Table 4.7: Splitting Tensile Test(28-day)

Plastic(%)	**Tensile Load (MPa)**		
	Test 1	**Test 2**	**Average**
0	3.114	2.782	2.948
5	3.42	2.98	3.2
10	3.76	3.12	3.344
15	3.28	2.64	2.960

4.5 Optimisation of Plastic Content

From these tests we were able to conclude the optimum plastic concentration as 10%. see graph 4.9 and 4.10 . A comparison between our 10% plastic incoprated brick and conventional interlock is given on table 4.8 (7 day Tests) and 4.9 (28 day Tests).

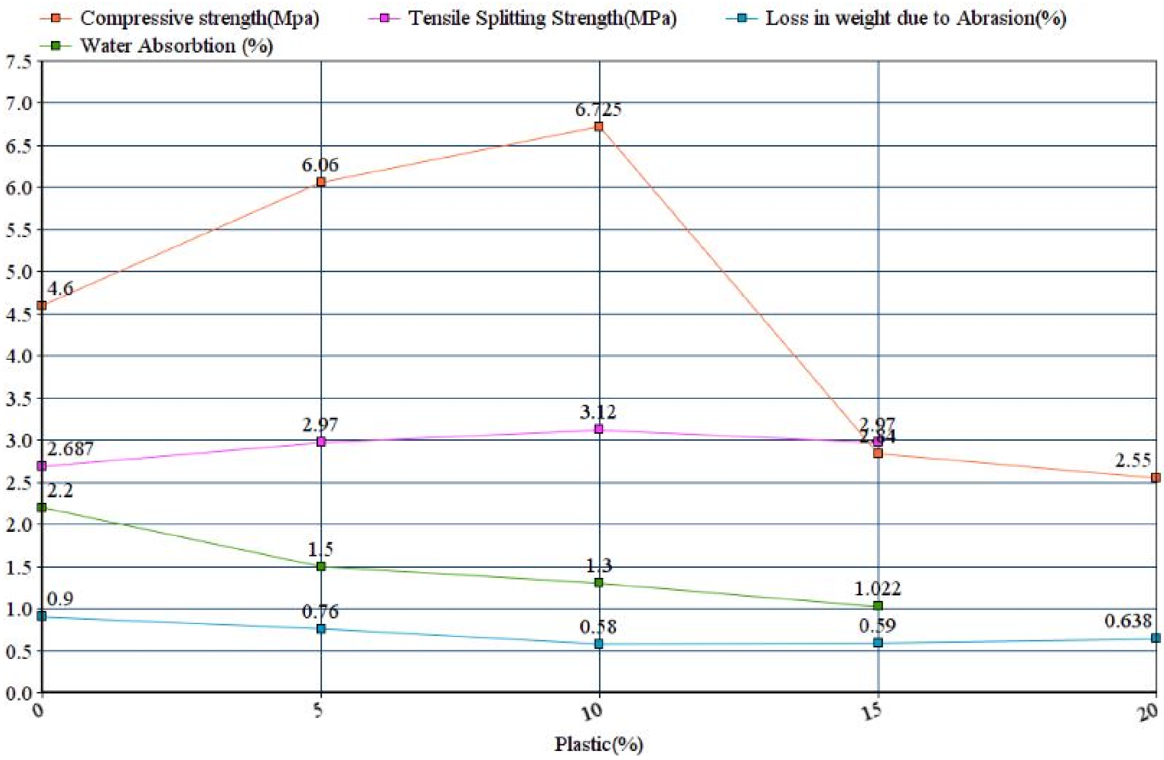

Figure 4.9: Test Results-7 day

Table 4.8: Comparison between 10% plastic incoprated interlocking brick and conventional interlock(7-day)

Tests	**Conventional Interlock**	**10% plastic Interlock**
Compression Load(MPa)	4.6	6.725
Tensile Load(MPa)	2.687	3.120
Water Absorption(%)	2.2	1.3
Loss In Weight afterAbrasion (%)	0.9	0.58

Table 4.9: Comparison between 10% plastic incoprated interlocking brick and conventional interlock(28-day)

Tests	**Conventional Interlock**	**10% plastic Interlock**
Compression Load(MPa)	4.822	7.34
Tensile Load(MPa)	2.948	3.344
Water Absorption(%)	7.39	1.3
Loss In Weight after Abrasion (%)	0.86	0.53

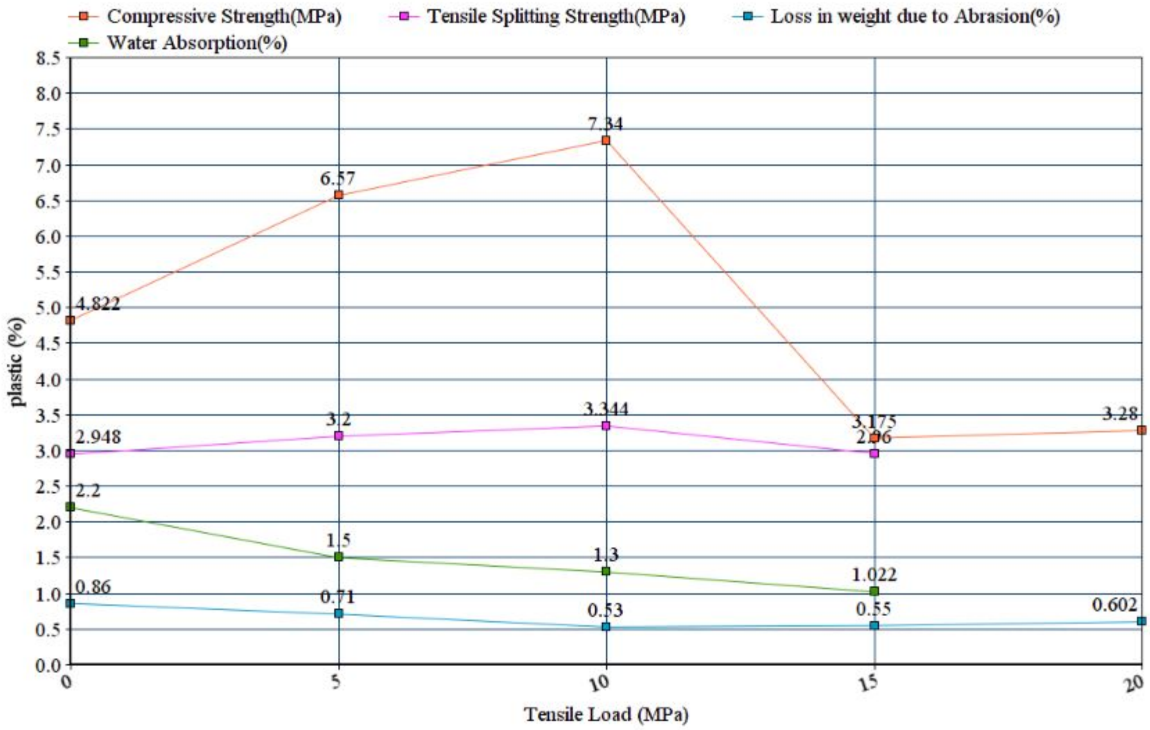

Figure 4.10: Test Results-28 day

Chapter 5

Conclusion and Scope of the work

From the literature survey we found about how plastic and recycled concrete can be used in construction engineering. We made 3 moulds in phase 1 and also bought aggregates and other addiives required for this project. in phase 2 we found out the mix proportion by conducting several tests. With this, we made conventional interlocking brick and also made plastic integrated interlocking bricks by replacing coarse aggregate with HDPE plastic. We conducted compression, abrasion and water absorption tests on these specimens. we found out the optimum plastic concentration as 10%.

Future Scope:

- Plastic integrated interlocking bricks do not compromise the properties of a conventional interlocking brick. so they can be manufactured in masses.
- Here we use HDPE as a replacement for coarse aggregate. in future we can use fine powder of HDPE to replace fine aggregate.
- Plastic can be also used in molten form and mixed with concrete.
- Additives like Aluminium powder, Silica fume etc can be used to improve the properties of concete.
- Plastic integrated interlocking bricks can be recycled to extract the plastic as well as other aggregates to be used again.

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Proposed work plan

Year	2018	2018	2018	2019	2019	2019	2019
Month	July-Aug	Aug-Sep	Sep-Oct	Nov-Dec	Jan-Feb	Mar-Apr	Apr-May
Literature Survey	★	★	★	★	★	★	★
Design and Analysis				★			
Selection of Raw materials					★		
Manufacturing of Bricks					★	★	
Testing & Comparison						★	★

Project Outcomes

On completion of this project, I have gained traits and attributes in the practical field of engineering that can enhance my growth as a Mechanical Engineer.

1. Ability to collect information about producing plastic interlocking bricks using recycled materials and plastic.
2. To design mould shredding machine for developing plastic interlocking brick sample.
3. To modify conventional brick with plastic and suitable aggregates, thus we are able to incorporate sustainable engineering into our project.
4. To analyse and test properties using ANSYS.
5. To associate knowledge collected from literatures to design and develop plastic interlocking bricks.
6. To estimate the cost of different components required for project.

Mapping Project Outcomes (PROs)to Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

PROs	POs	PSOs	PEOs
PRO.1	PO1, PO2	-	-
PRO.2	PO3, PO4, PO5, PO7, PO9, PO11	PSO2	-
PRO.3	PO3, PO4, PO7, PO11	-	PEO1
PRO.4	PO5	PSO2, PSO3	-
PRO.5	PO6, PO7, PO9	-	PEO2
PRO.6	PO2, PO11	-	-

Justification

PRO1:

- PO1 : We gained knowledge about making plastic interlocking bricks by literature survey.
- PO2 : We were able to identify possible addictives to improve the properties of interlocking bricks.

PRO2:

- PO3 : Plastic interlocking bricks can solve plastic disposal problems, therefore contributing to environmental health.
- PO4 : We analysed the data and found out the appropriate concentration of aggregates for interlocking bricks.
- PO5 : We use modern IT tools to model the shredding machine.
- PO7 : Plastic interlocking bricks can contribute to sustainable engineering as it make use of plastic waste.
- PO9 : We decided to work together with another group for making shredding machine.
- PO11 : We estimated the cost of shreadding machine.
- PSO2 : We use our knowledge based on modeling softwares to design shreading machine.

PRO3:

- PO3 : We are testing different aggregates so that we can meet the requirements of a normal interlocking bricks.Also plastic interlocks can help in reducing plastic waste accumulation.
- PO4 : We use experiments and analysis to find suitable aggreagates and its concentration for making interlocking bricks.
- PO11 : We calculated the cost of diffrent aggreagates inorder to make interlocking bricks.
- PEO1 : Plastic waste accumulation is a major problem we face on a day to day basis, thus we are using our knowlede based on our literature review to solve this problem.

PRO4:

- PO5 : We use modern tools to analyse interlocking bricks.
- PSO2 : We apply principles of design and analysis on analysis software which we learned in our curriculum.

- PSO3 : We use analysis software for design of interlocking bricks.

PRO5:

- PO6 : Plastic interlocking bricks solves one of the biggest problems faced by the modern society.
- PO7 : Plastic interlocking bricks are sustainable and environmental friendly.
- PEO2 : Plastic interlocking bricks makes use of our knowledge based on literature surveys.

PRO6:

- PO2 : Based on knowledge from literature review. We formulated diffrent aggreagates which can be used for making plastic interlocking bricks to estimate the total cost.
- PO11 : We use the above data to optimize and estimate the cost of components.