A PROJECT REPORT

ON

"EXPEREMENTAL STUDY ON PRECASTE COMPOUND WALL MANUFACTURED FROM PLASTIC WASTE"

SUBMITTED TO

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE

BACHELOR OF TECHNOLOGY
IN
CIVIL ENGINEERING
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VALLUR, PRAKASAM (Dt).

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CERTIFICATE

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Place:

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DECLARATION

We hereby declare that the work is being presented in this dissertation entitled **"Experimental Study on Precast Compound Walls Manufactured From Plastic Waste"** is submitted towards the partial fulfillment of requirements for the award of the degree of Bachelor of Technology in Civil Engineering work carried out under the supervision of **Mr. P. RAVI KUMAR,M.Tech** PACE Institute of Technology and Sciences. The results embodied in this dissertation report have not been submitted by me for the award of any other degree. Furthermore, the technical details furnished in various chapters of this report are purely relevant to the above project and there is no deviation from the theoretical point of view for design, development and implementation.

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ABSTRACT

The aim of this project is to replace cement with plastic waste in compound wall and to reduce the cost of compound wall when compared to that of convention concrete compound wall. At present nearly 56 lakhs tones of plastic waste is produced in India per year. The degradation rate of plastic waste is also a very slow process. Hence the project is helpful in reducing plastic waste in a useful way. In this project we have used plastic waste in different proportions with quarry dust, coarse aggregate and ceramic waste. The plastic compound wall were prepared and tested and the results were discussed Plastic waste used in this work was brought from the surrounding areas. Currently about 56 lakh tones of plastic waste dumped in India in a year. The dumped waste pollutes the surrounding environment. As the result it affects both human beings and animals in direct and indirect ways. Hence it is necessary to dispose the plastic waste properly as per the regulations provided by our government. The replacement of plastic waste for cement provides potential environmental as well as economic benefits. With the view to investigate the behaviour of quarry rock dust, recycled plastic, production ofplastic compound wall from the solid waste a critical review of literature was taken up from the observations of test results, PET can be reused with 50% of fine aggregate 50% coarse aggregate in Plastic precast compound wall. The physical and mechanical properties of materials used in Plastic precast compound wall were investigated. For thetest 3 cubes cube were cast for measuring Compressive strength. The recycled plastic and aggregate are used in various proportions mix designs and check there stability.

Keywords: *compressive strength, plastic waste, PET, recycled plastic*

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CHAPTER- 1
INTRODUCTION

1.1 OVER VIEW OF THE PROJECT

Plastic is a very common material that is now widely used by everybody in the world. Plastic plays a predominant role in reusable in this era, as it is compact and light in weight. Common plastic items that are used are covers, bottles, and food packages. The great problem with plastic is its decomposition. Plastic is made of polymer chemicals and they are non-biodegradable. This means that plastic will not decompose when it is placed in earth. Though plastic is very useful material that is flexible, robust and rigid they become waste after their use and they pollute the air and land. Recycling is processing use waste materials into new products to prevent waste of potentially useful materials. The increase in the popularity of using eco- friendly, low cost and lightweight construction materials inbuilding industry has brought about the need to investigate how this can be achieved by benefiting to the environment as well as maintaining the material requirements and their standards. From the advantages of plastic recycling procedure is used. For the production of plastic bricks is an optimal method for controlling the problem by decomposition of plastic waste and also it costs economical for the production of building materials. In this study, plastic waste from factories will be used to incorporate with cement and sand to produce sand bricks. The bricks will then be tested to study the compressive strength, efflorescence and water absorption. In the recent past research, the replacement and addition have been done with the direct inclusion of polyethylene, polyethylene terephthalate (PET) bottles in shredded form, chemically treated polyethylene- fibre, PET in small particles form by replacing natural coarse aggregate. Most of replacements have been done by volume calculation, and showed the decreased in compressive strength as the increased plastic waste. In this study, recycled plastic waste have been introduced in the form of crushed. The replacement of plastic waste material has been done by weight. Paver block paving is versatile, aesthetically attractive, functional, and cost effective and requires little or no maintenance if correctly manufactured and laid. Most concrete block paving constructed in India also has performed satisfactorily but two main areas of concern are occasional failure due to excessive surface wear, and variability in the strength of block. Natural resources are depleting worldwide at the same time the generated wastes from the industry and residential area are increasing substantially. The sustainable development for construction involves the use of Non-conventional and innovative materials, and recycling of waste materials in order to compensate the lack of natural resources and to find alternative ways conserving the environment. Plastic waste used in this work was brought from the surrounding areas. Currently about 56 lakh tonnes of plastic waste dumped in India in a year. The dumped waste pollutes the surrounding environment. As the result it affects both human beings and animals in direct and indirect ways. Hence it necessary to dispose the plastic waste properly as per the regulations provided by our government. The replacement of plastic waste for cement provides potential environmental as well as economic benefits.With the view to investigate the behaviour of quarry rock dust, recycled plastic, production of plastic paver block from the solid waste a critical review of literature was taken up. An attempt was made by Nivetha C et.al[1] to reuse the solid waste quarry dust fly-ash and PET with an aim not to lose the strength far from original Paver blocks. From the observations of test results, PET can be reused with 50% of quarry dust and 25 % of fly-ash in Plastic Paver block. The physical and mechanical properties of materials used in Plastic Paver block were investigated. For the test 6 cubes cube were cast for measuring Compressive strength. Satish Parihar et.al[2] used recycled plastic aggregate in various proportions in concrete mix and check there stability. Amount of waste plastic being accumulated in 21st centuries has created big challenges for their disposal, thus obliging the authorities to invest in felicitating the use of waste plastic coarse aggregate in a concrete is fundamental to the booming construction industry. Three replacement levels of 10 %, 20%, 30 by weight of aggregates were used for the preparation of the concrete. Poonam Sharma[3] et. al. discussed about cement concrete paver blocks for rural roads. Presently, different types of waste materials and industrial byproducts such as recycled concrete aggregate, glass, ceramic, fly ash, slag, etc., are being used with and without natural aggregates and ordinary Portland Cement (OPC), not only in traditional construction but also in digital construction like 3D printing. It has been shown that the properties of these materials are suitable to produce new concrete up to a certain limit. Therefore, numerous studies have been conducted to find the optimum content of these materials in concrete, which does not negatively influence the engineering properties of concrete. Waste materials such as plastics and glass, which present possible environmental hazards and are often landfilled, are often used in concrete for different applications. Globally, the use of plastics had seen an astronomical increase since 1920, when it was first developed for industrial use. The many advantages of plastics have caused the increase in its production by plastic industries. Compared to other materials such as glass and metal, plastics have lower cost, a higher strength-to-weight ratio, are more durable (resistant to deterioration), easy to work and shape, and have a low density. Some staggering statistics have shown that in 2013, 299 million tons of plastic were produced globally, exceeding the estimated consumption for 2015 by about 2 million tons. However, waste plastics are generally a threat to the global environment. While the production of plastics in its varied forms cannot be halted, recycling may be a solution to the threat waste plastics pose to the environment.Again, the recycling of all sorts of waste materials is sustainable and conserves natural resources. Millions of tons of plastic waste are generated all around the world, and they frequently find their way into rivers, coast, beaches, and the land. Only about 25% of plastic waste is recycled around the world. Recovery and recycling of plastics remain insufficient, and millions of tons end up in landfills and oceans every year. This percentage of recycled plastic can be increased by transforming waste plastic into products Sustainability 2018, 10, x FOR PEER REVIEW 2 of 26 plastics in its varied forms cannot be halted, recycling may be a solution to the threat waste plastics pose to the environment. Recycling of various types of organic and inorganic waste such as construction, electronics, and agricultural waste, among others, has drawn much attention due to the increasing cost of dumping the waste and decreasing space in landfills. Again, the recycling of all sorts of waste materials is sustainable and conserves natural resources. Millions of tons of plastic waste are generated all around the world, and they frequently find their way into rivers, coast, beaches, and the land. Only about 25% of plastic waste is recycled around the world. Recovery and recycling of plastics remain insufficient, and millions of tons end up in landfills and oceans every year. This percentage of recycled plastic can be increased by transforming waste plastic into products suitable for housing and construction. Figure 1 illustrates the cumulative amount of plastic waste generation and disposal from 1950 up to 2015 and the projected amount by 2050. Up to 2015, only about 16% of the waste generated was recycled. It is projected that by 2050, up to 33% of the waste generated will be recycled. Even if this projection comes true, the amount of unrecycled waste will still leave much to be desired.

Figure: 1.1 Non biodegradable plastic

1.1.1 PRESENT SCENARIO OF WASTE GENERATION IN INDIA

Growth of population has increased our urbanization as a result rising standard of living due to technological innovations have contributed to an increase both in the quantity and variety of solid wastes generated by industrial, agricultural activities, mining and domestic. Globally the estimated quantity of wastes generation was 12 billion tones in the year2002 of which 11 billion tones were industrial wastes and 1.6 billion tones were municipal solid wastes (MSW). About 19 billion tons of solid wastes are expected to be generated annually by the year 2020.Annually, Asia alone generates 4.4billion tons of solid wastes and MS comprise 795 million tons of which about 48 (6%) MT are generated in India. MSW generation in India, is expected to reach 300 Million tones and land requirement for disposal of this waste would be 169.6 km2 as against which only 20.2 km2 were occupied in 1997 for management of 48 Million tones. As it is studied that apart from municipal wastes, the organic wastes from agricultural sources alone contribute more than 350million tons per year. However, it is reported that about 600 million tons of wastes have been generated in India from agricultural sources alone. The Quantity of wastes generated from agricultural sources are sugarcane baggage, paddy and wheat straw and husk, wastes of vegetables, food products, tea, oil production, wooden mill waste, coconut husk, jute fibre, groundnut shell, cotton stalk etc. In the industrial sector inorganic solid waste could are coal combustion residues, bauxite red mud, tailings from aluminium, iron, copper and zinc primary extraction processes. Generation of all these inorganic industrial wastes in India is estimated to be 290 million Tons per annum. In India,4.5 million tons of hazardous wastes are being generated annually during different industrial process like electro plating, various metal extraction processes, galvanizing, refinery, petrochemical industries, pharmaceutical and pesticide industries. In most cases, waste plastics have been used in concrete either as fine or coarse aggregate. Although utilization of this type of waste in concrete is beneficial from an environmental point of view, its engineering (e.g., mechanical and thermal) properties are essentially different from natural aggregates (Table 1). It is also worth noting that the properties of recycled waste plastic concrete depend on the pre-treatment given to the waste plastic. The bond strength of plastic aggregates and the cement paste could be significantly influenced by the treatment.

1.1.2 ECO PRECAST WALLS:

An **Eco Pavement blocks** is a plastic bottle packed with used plastic to a set density. They serve as reusable building blocks. Eco bricks can be used to produce various items, including furniture, garden walls and other structures. Eco bricks are produced primarily as a means of managing consumed plastic by sequestering it and containing it safely, by terminally reducing the net surface area of the packed plastic to effectively secure the plastic from degrading into toxins and microplastics. Eco bricking is a both an individual and collaborative endeavour. The Eco bricking movement promotes the personal Eco bricking process as a means to raise awareness of the consequences of consumption and the dangers of plastic. It also promotes the collaborative process as a means to encourage communities to take collective responsibility for their used plastic and to use it to produce a useful product. To enable the production of Eco bricks at minimal environmental cost, the Global Eco brick Alliance promotes low-technology methods that do not require capital, fuel, electricity, or specialized equipment. Typically, producers use a wood or bamboo stick to manually pack plastic into the plastic bottle. Any size of transparent polyethylene terephthalate (PET) plastic bottle can be used to make an Eco bricks. The bottle and the packed plastic are clean and dry to prevent the growth of bacteria. Plastic is cut or ripped into small pieces then packed little by little, alternating between adding

the plastic and compacting it, layer by layer. The bottle is rotated with each press to ensure the plastic is evenly compacted throughout the bottle. This helps prevent voids and that the packing reaches the requisite solidity needed for a building block applications. Completed Eco bricks are packed solid enough that they can bear the weight of a person without deforming—a density range between 0.33g/ml and 0.7g/ml. Maximizing density minimizes the flammability of the Eco brick while increasing its durability and re-usability. Utilization of recycled waste plastics in concrete as a partial aggregate replacement has a clear effect on the properties of the material. Therefore, if this material is to be used in concrete in large quantities, it is important to know the relationship between the addition of recycled waste plastics and the engineering properties. This review provides a basis for understanding this relationship. A thorough search of peer-reviewed literature was undertaken to find studies in which recycled plastic has been used for the production of concrete. Major search engines (ScienceDirect, Google Scholar) were used. The focus was on recent literature, i.e., published after 2010, relevant to current developments in the field. Articles from reputable journalsdealing with building materials on the one hand and sustainable development and recycling on the other hand were extracted. Note that the number of citations of individual articles was not used as a selection criterion; instead, articles were selected based on their relevance to (parts of) this review. After collecting the relevant articles, we then categorized into those dealing with fresh, mechanical, and durability properties of concrete. Thereafter, each property was reviewed from the different publications, and a position statement was arrived at by these authors. Where differences or similarities exist, these were discussed extensively. The purpose of the paper is to present clearly, from experimental results, the performance of concrete containing recycled waste plastic regarding the fresh, mechanical, and durability properties. Therefore, this paper can be used as a valuable source of data for researchers for their future studies since it critically summarizes the recent findings on the use of waste plastics in concrete

1.1.3 HISTORY

Eco bricking plastic waste into bottles is a method for dealing with waste that has popped up organically around the world. Various simultaneous pioneers have helped shape the global around movement and refine the technology. Susana Heisse an environmental activist around Lake Atitlan in Guatemala in 2004. Alvaro Molina began on the island of Ometepe in 2003. The technique builds upon the bottle building techniques developed by German architect Andreas Froese (using sand filled Polyethylene terephthalate (PET) bottles) in South America in 2000.In 2010, in the Northern Philippines, Russell Maier and Irene Baking developed a curriculum guide of simplified and recommended practices to help local schools integrate Eco bricks into their curriculum. Applying the ancestral ecological principles of the Igorot’s for building rice terraces, they integrated Cradle-to cradle principles into Eco bricks methodology: ensuring that Eco bricks can reused at the end of the construction they are used in. Through the Department of Education, the guide was distributed to 1700 schools in 2014.

The open source development of Eco brick best practices and innovations that emerged from the Filipino movement became the genesis for the Global Eco brick Alliance as founded by Russell Maier, Joseph Stodge and Candice Mostert. The Global Eco brick Alliance continues to develop and maintain the conceptual and technological infrastructure of the global Eco brick movement as an Earth Enterprise.

Movements in South Africa began in 2012, when Joseph Stodge brought the concept to Grey ton, throwing an annual Trash to Treasure festival at the local dumpsite with South African, Candice Mostert, who started local school projects under Grey ton transition town building with the bricks made by the community. The movement has since grown in South Africa, with organizations like Waste-ED, founded by Candice Mostert, who works both in Zambia and Cape Towns surrounds to educate people about plastic and its value, and the architect Ian Demises as the Eco brick Exchange. Concrete is the most widely used man made construction material in the world and its second only to water as the most utilized substance in the planet. Seeking aggregates for concrete and to dispose of the plastic waste is the present concern. Today sustainability has got top priority in construction industry. In the present study the recycled plastics were used to prepare the coarse aggregates thereby providing a sustainable option to deal with the plastic waste. There are many recycling plants across the world, but as plastics are recycled they lose their strength with the number of recycling. So these plastics will end up as earth fill. In this circumstance instead of recycling it repeatedly, if it is utilized to prepare aggregates for concrete, it will be a boon to the construction industry. Most of the failures in concrete structures occur due to the failure of concrete by crushing of aggregates.

Plastic Coarse Aggregates which have low crushing values will not be crushed as easily as the stone aggregates. These aggregates are also lighter in weight compared to stone aggregates. Since a complete substitution for Normal Coarse Aggregate is not found feasible, a partial substitution with various percentage of Plastic Coarse Aggregate is done. Volumetric substitution was employed in this investigation. Hence in the present study, it is aimed at concrete mix with partial replacement of coarse aggregate by LDPE granules (0%, 10%, 20%, and 30%).This mix in the form of cubes and cylinders were subjected to compression and split tension to ascertain the behaviour and strength parameter.

1.1.4 20TH CENTURY PLASTIC DEVELOPMENT

Petroleum-derived energy has enabled the growth of the global economy over the last hundred years. The widespread adoption of fossil fuels has enabled transportation and material technologies to develop. However, in the refinement of crude oil, 4-13% cannot be processed into high value, high energy fuels. This by-product is useful as a feedstock for the ultra-cheap production of plastic polymers. Since 1950 an estimated 8,300 million metric tons (Mt) of virgin plastics have been produced worldwide; 9% of which had been recycled, 12% were incinerated and 79% have accumulated in landfills or the natural environment. Plastic associates products based have been considered as the world most consumer packaging solution. However, substantial quantities of plastic consumption have led to exponential increase of plastic derived waste. Recycling of plastic waste as valued added product such as concrete appears as one of promising solution for alternative use of plastic waste. This paper summarized recent progress on the development of concrete mixture which incorporates plastic wastes as partial aggregate replacement during concrete manufacturing. A collection of data from previous studies that have been researched which employed plastic waste in concrete mixtures were evaluated and conclusions are drawn based on the laboratory results of all the mentioned research papers studied Plastics have become an essential part of our modern lifestyle, and the global plastic production has increased immensely during the past 50 years. This has contributed greatly to the production of plastic-related waste. Reuse of waste and recycled plastic materials in concrete mix as an environmental friendly construction material has drawn attention of researchers in recent times, and a large number of studies reporting the behavior of concrete containing waste and recycled plastic materials have been published. This paper summarizes the current published literature until 2015, discussing the material properties and recycling methods of plastic and the influence of plastic materials on the properties of concrete. To provide a comprehensive review, a total of 84 studies were considered, and they were classified into sub categories based on whether they dealt with concrete containing plastic aggregates or plastic fibers. Furthermore, the morphology of concrete containing plastic materials is described in this paper to explain the influence of plastic aggregates and plastic fibers on the properties of concrete. The properties of concretes containing virgin plastic materials were also reviewed to establish their similarities and differences with concrete containing recycled plastics

1.1.5 PETROLEUM PROJECTIONS

According to the American Chemistry Council, since 2010 $186bn dollars is being invested in 318 new projects to fuel a 40% increase in plastic production over the nextdecade.] If current production and waste management trends continue, roughly 12,000 Mt of plastic waste will be in landfills or in the natural environment by 2050.[9] In addition, by2030, COemissions from the production, processing and disposal of plastic could reach 1.34 gigatons per year—equivalent to the emissions released by more than 295 new 500-megawatt coal-fired power plants.

1.1.6 PLASTIC POLLUTION AND CONTAMINATION

A tremendous amount of plastic waste litters our planet every year, and its cost is huge. According to the United Nations Environment Programme (UNEP) 2014 Yearbook, plastic contamination threatens marine life, tourism, fisheries and businesses and the overall natural capital cost for plastic waste is $75 billion each year. Increasing scientific documentation is demonstrating many dangers arising from plastic degradation. When plastic enters the biosphere it releases toxins, fragments into microplastics and emits greenhouse gases that interfere with ecological cycles.When plastic is burned or incinerated, toxic gases like dioxins, furans, and polychlorinated biphenyls are released into the atmosphere. Photo-oxidative degradation caused by exposure toultravoilet (UV) radiation and physical abrasion fragments plastic debris into smaller and smaller particles, known as microplastics.The degradation process corresponds directly to the amount of surface area of the plastic that is exposed as well as the length of time of exposure to UV rays. The majority of non-recyclable single use plastics are sheets and films with large surface areas and are highly susceptible to photodegrading. The photo degradation process also emits greenhouse gases, methane and ethylene.

Microplastics can have possible direct Eco toxicological impacts, accumulate in food chains and cause economic damage because of food safety concerns. Burned and incinerated plastics have been shown to release dioxins and other chemicals that are harmful to human health.

1.1.7 RURAL COMMUNITY IMPACT

In countries and communities without access to industrial recycling or incineration, plastic has accumulated in streets, ditches, and beaches. Without large scale options for managing plastic households and communities have been powerless to manage their own plastic, other than dangers and intoxicating low-temperature incineration, water, and land loose dumping.

1.1.8 FAILURE OF INDUSTRIAL RECYCLING

Between, 1950 and 2017 an estimated 8,300 million metric tons (Mt) of virgin plastics have been produced worldwide; only 9% were recycled, the rest have been dumped or burned.As of the early 2000s most industrial recycling was occurring in China where the majority of G7 countries were exporting their waste plastic.The processing of this plastic, in particular the dumping and incineration of unrecyclable, caused significant pollution in China.As of January 1, 2018, China banned plastic imports in its National Sword program. Since then, globally, more plastics are now ending up in landfills, incinerators, or likely littering the environment as rising costs to haul away recyclable materials increasingly render the practice unprofitable. The displaced plastic exports from Europe and America has been largely diverted to Indonesia, Turkey, India, Malaysia, and Vietnam] where lacking environmental regulations have resulted in wholesale air, water and earth pollution around processing plants.Critics observe that industrial recycling relies on the energy intensive export of plastic to other locations, that industrial recycling isn't a circular (processes turn a high grade plastic into a lower, less-recyclable form), and that recycling enables the unquestioned continuation of plastic consumption

1.1.9 ECO BUIDING APPLICATIONS

Eco bricks can be connected using tire bands, silicone, cob, and cement to build furniture, gardens, structures and more. Eco bricks are being used in different ways around the world. Ideally, Eco brick constructions use cradle to cradle design methods of combining the bottles—ensuring that the Eco bricks can be extricated without compromise to the bottle at the end of the construction's life span.It is useful to differentiate between short-term Eco brick and long term Eco brick applications

1.1.10 SHORT-TERM APPLICATIONS

Eco bricks can be combined together using tire bands or inner-tube-bands as short-term, non-permanent attachment methods to create applications that last months to several years. As short-term applications are not usually covered, such constructions are typically for indoor use, in order to prevent UV photodegrading of the bottles. Short-term applications range from:

- **Eco brick Milstein Modules:** Hexagon and triangle modules that are used for sitting, but can be combined together to form one or two level horizontal surfaces. Applicationsinclude tables, beds, stages, etc
- **Eco brick Dieleman Modules:** A geometric configuration of 16 Eco bricks that enables a stackable LEGO module. These modules can be stacked horizontally and vertically indefinitely. Applications include indoor playgrounds, temporary stalls, sheds, and circular structure
- **Eco brick Open Spaces:** A combination of hundreds of Milstein and Dieleman legomodules that enable the creation of interactive social spaces.

1.1.11 LONG-TERM APPLICATIONS

Eco bricks can be used with Earth building techniques to create structures that can last years or decades (it is not uncommon for traditional earth constructions to last centuries).In this way, earth mixes are used in between horizontally laid Eco bricks as mortar. Eco bricks can also used vertically and with traditional construction techniques in the Pura Vida Atlas style of building. Both methods are careful to avoid the complete covering of Eco bricks with cement which upon the end of the construction results in the destruction of Eco bricks upon extrication Examples of long-term Eco brick applications include:

- **Raised gardens:** Eco bricks are laid horizontal and completely covered
- **Raised benches:** Two or three levels of horizontally laid Eco bricks to make seats and benches
- **Food Forest Play Parks:** A combination of raised beds and benches to make a public green space, ideally filled with edible plants.
- **Walls:** Eco bricks can be laid horizontal with earth mortar to build vertical walls. The walls can between standing posts and beams or as a circular standing structure.

Alternatively, the pura vida method, uses chicken wire between posts to make walls from enclosed vertically standing Eco bricks.

1.2 OBJECTIVE

- The main objective of this review is to determine the suitability of waste voltaic bottles and polyethylene bags in the development of plastic precast compound wall for construction.

- To reduce the plastic waste.
- To use plastic waste material in construction methodology.
- To reduce the environmental and ecological challenge associated with plastic.
- To find alternatives of basic materials which are used in construction of plastic precast compound wall.
- To compare the compressive strength of Recycled Plastics used as Coarse Aggregate for Constructional Concrete with the Conventional concrete.
- To know its applications in construction industry.
- To reduce the pressure on naturally available materials by replacing it with recycled plastic aggregate
- Compare the physical characteristics of natural aggregate with Plastic recycled aggregate.
- To study the behavior of fresh and hardened concrete reinforced with plastic waste coarse aggregate.
- To study it's behaviour in construction of pavements and roads.
- To produce lightweight polymer concrete for multi-purpose use.

1.3 SCOPE OF PROJECT WORK

According to our research the major source of pollution in India is waste plastic. Growth of population, increasing urbanization, rising standards of living due to technological innovations have contributed to an increase both in the quantity and variety of solid wastes generated by industrial, mining, domestic and agricultural activities. Globally The estimated quantity of wastes generation was 56 million tones in the year. To find the possibilities of reducing the amount of waste plastic as it will create an eco-friendly environment as well as it used in construction of plastic precast compound wall.

1.4 PROBLEM STATEMENT

Solid waste management is the most pressing environmental challenge faced by urban and rural areas of India. India, with population exceeding 134 crores, is one of the largest producers of solid waste. There is rapid growth in the population and the increase in population comes with increase in waste generation. India generates around 62 million tons of solid waste annually, out of which only 20-30% is collected. The waste are disposed in open spaces, road sides and within residential buildings. Sorting plastic waste and using it in construction will reduce waste accumulation to a great extent. There are construction stages that does not require normal concrete or heavy load and alternatively lightweight can be used on the building or structure. The contineous rise in solid plastics waste and cost of building materials over the years in India and the world at large, forced researchers to look for ways of addressing the problem. Plastics waste which is one of the non-bio-gradable materials as stated earlier causes a lot of environmental pollution, and there is the need to find solution to such menace.

It was reported that recycling of waste materials can be economical and as a consequence reduces pollution and contamination. The problem with cement concrete are in terms of low tensile strength, permeability to liquids, corrosion of reinforcement, prone to biological or chemical attack, poor freeze/thaw resistances. Research and Development has a new dimension in the use of affordable local building materials in addressing the concrete drawbacks, such as the use of waste plastics and other admixtures forimproving the performance of concretes. Research has been carried out in advanced countries, on the use of waste plastic materials in concrete, but only few were reported in India. The study also evaluates differences in compressive strength and density based on variable addition of granulated waste plastic in the cement based composite respectively.

CHAPTER 2
LITERATURE REVIEW

Youcef Ghernouti et al. 1 The study present the partial replacement of fine aggregate in concrete by using plastic fine aggregate obtained from the crushing of waste plastic bags. Plastic bags waste was heated followed by cooling of liquid waste which was then cooled and crushed to obtained plastic sand having finesse modulus of 4.7. Fine aggregate in the mix proportion of concrete was replaced with plastic bag waste sand at 10%, 20%, 30% and 40% whereas other concrete materials remain same for all four mixes. In fresh properties of concrete it was observed from the results of slump test that with increase of waste content workability of 3 PK Mehta "Concrete Microstructure, properties and Materials" third edition, chapter1.

Raghatate Atul M.2 The paper is based on experimental results of concrete sample casted with use of plastic bags pieces to study the compressive and split tensile strength. He used concrete mix by using Ordinary Portland Cement, Natural River sand as fine aggregate and crushed granite stones as coarse aggregate, portable water free from impurities and containing varying percentage of waste plastic bags (0%, 0.2%, 0.4%, 0.6% 0.8% and 1.0%). Compressive strength of concrete specimen is affected by the addition of plastic bags and with increasing percentage of plastic bag pieces compressive strength goes on decreasing (20% decrease in compressive strength with 1% of addition of plastic bag pieces). On other hand increase in tensile strength of concrete was observed by adding up to 0.8% of plastic bag pieces in the concrete mix afterward it start decreasing when adding more than 0.8% of plastic bags pieces. He concluded that utility of plastic bags pieces can be used for possible increase in split tensile strength. This is just a basic study on use of plastic bags in concrete. More emphasis was required by varying the shape and sizes of plastic bags to be use in concrete mixes.

Praveen Mathew et al. [2013]3 They have investigated the suitability of recycled plastic as partial replacement to coarse aggregate in concrete mix to study effect on compressive strength, modulus of elasticity, split tensile strength and flexural strength properties of concrete. Coarse aggregate from plastic was obtained by heating the plastic pieces at required temperature and crushed to required size of aggregate after cooling. Their experimental results shown that plastic aggregate have low crushing (2.0 as compare to 28 for Natural aggregate), low specific gravity(0.9 as compare to 2.74 for Natural aggregate), and density value(0.81 as compare to

3.14 for Natural aggregate), as compare to Natural coarse aggregate. Their test results were based on 20% substitution of natural coarse aggregate with plastic aggregate. Increase in workability was reported when slump test for sample was carried out. Volumetric substitution of natural aggregate with plastic aggregate was selected best in comparison with grade substitution. At 400 centigrade temperature Plastic coarse aggregate shown considerable decrease in strength as compare to normal concrete. An increase of 28% was observed in compressive strength but decrease in split tensile strength and modulus of elasticity was observed. They recommended that with use of suitable admixture @0.4% by weight of cement will improve the bonding between matrix and plastic aggregate; however they demand more research to address the tensile behavior of concrete prepared with 20% plastic aggregate.

R L Ramesh et al. 4 They have used waste plastic of low density poly ethylene as replacement to coarse aggregate to determine its viable application in construction industry and to study the behavior of fresh and harden concrete properties. Different concrete mix were prepared with varying proportions (0%, 20%, 30% & 40%) of recycle plastic aggregate obtained by heat treatment of plastic waste (160-200 centigrade) in plastic granular recycling machine. A concrete mix design with 1: 1.5: 3 proportions was used having 0.5 water/cement ratio having varying proportion of plastic aggregate as replacement of crushed stone. Proper mixing was ensured and homogeneous mixture was prepared. A clear reduction in compressive strength was reported with increase in percentage of replacing plastic aggregate with crushed aggregate at 7, 14 and 28 days of casted cubes (80% strength achieved by replacing waste plastic up to 30%). The research highlights the potential application of plastic aggregate in light weight aggregate. Their research was narrowed down to compressive strength of concrete with no emphasis given to flexural properties of concrete. They suggest future research scope on plastic aggregate with regard to its split tensile strength to ascertain its tensile behavior and its durability aspects for beams and columns.

Zainab Z. Ismail et al. [2007]5 they have conducted comprehensive study based on large number of experiments and tests in order to determine the feasibility of reusing plastic sand as partial replacement of fine aggregate in concrete. They conducted tests on concrete samples for dry/fresh density, slump, compressive and flexural strength and finally toughness indices on room temperature They have collected waste plastic from plastic manufacture plant consist of 80% polyethylene and 20% polystyrene which was crushed (varying length of 0.15-12mm and width of 0.15-4mm). Concrete mix were produce with ordinary Portland cement, fine aggregate (natural sand of 4.74mm maximum size), coarse aggregate (max size below 20mm) and addition of 10%, 15% and 20% of plastic waste as sand replacement. Their test results indicate sharp decrease in slump with increasing the percentage of plastic, this decrease was attributed to the presence of angular and non uniform plastic particles. In spite of low slump however, the mixture was observed with good workability and declared suitable for application. Their tests also revealed the decrease in fresh and dry density with increasing the plastic waste ratio; however increase was reported in dry density with time at all curing ages. Decrease in compressive and flexural strength was observed by increasing the waste plastic ratio which can be related to decrease in adhesive strength between plastic waste particles with cement. However, load-deflection curve of concrete containing plastic waste showed the arrest of propagation of micro cracks which shows its application in places where high toughness is required. The study has shown good workability in spite of low slump but w/c content kept constant in all samples. They should have reduced the water content in order to improve the strength when workability was not an issue.

P. Suganthy et al.[2013]6 This study investigate the application of pulverized fine crushed plastic (produce from melting and crushing of high density polyethylene) as replacement of fine aggregate in concrete with varying known percentages. Their main focus was on optimum replacement of natural sand by pulverized plastic sand. Five concrete mixes were produced from specified concrete materials having replacement of fine aggregate (sand) by 0, 25, 50, 75 and 100% respectively to study the test graph results of various concrete properties. The results showed increase in water/cement ratio with increase replacement of sand with plastic particles to achieve desired 90mm concrete slump. They have also observed from the results that gradual decrease in strength of concrete specimen for plastic replacement up to 25% but afterward the decrease in strength israpid which shows suitable replacement up to 25% of sand with plastic pulverized sand. They have also concluded after testing of specimen (having different proportion of plastic replacement) for Ultimate and yield strength that both strength decreases with increase replacement of sand with pulverized plastic particles. Their study lacks detailed testing of properties of concrete because only compressive strength and w/c ratio tests will not be sufficient to study the matrix as a whole to be suitable for construction. No efforts were made to explore the use of admixtures in controlling of compressive strength reduction in a mix containing pulverized plastics.

Khilesh Sarwe.[2014]7 This study presents the results of addition of waste plastics along with steel fibres with an objective to seek maximum use of waste plastic in concrete. Two different categories of mix were casted in cubes (150mm x 150mm x 150mm), one with varying percentages of plastic wastes (0.2%, 0.4%, 0.6%, 0.8% and 1% weight of cement) and another mix of plastics waste/steel fibers (0.2/0.1, 0.4/0.2, 0.6/0.3, 0.8/0.4 and 1/0.5 % by weight of cement) to study the compressive strength at 7 and 28 days strength. The combine mix of plastic waste and steel fibers has shown more strength as compare to concrete mix prep only with plastic waste. He has reached to conclusion that a plastic waste of 0.6% weight of cement when used with steel fiber of 0.3 % (weight of cement) has shown the maximum compressive strength. This study has really focused on addressing the issue of reduced compressive strength

with addition of plastic waste. Steel fibers when used along with plastic wastes will affect all the properties of concrete but the researcher only focused on compressive strength property which is insufficient to give clear picture of concrete behavior.

A Bhogayata et al. [2012]8 they have studied the environment friendly disposal of shredded plastic bags in concrete mix to be use in construction industry which have dire need for alternative material to be use in lieu of conventional materials. Different test results were analyzed after testing on 48 x concrete cubes(150mm x 150mm x150mm) prepared from varying percentage of polyethylene fibers (0.3, 0.6, and 0.9 to 1.2% of volume of concrete) with conventional concrete material to prepare mixes. Two type of plastic bag fibers were used, one cut manually (60mm x 3mm) and another shredded into a very fine random palettes. Cubes were tested for 7&28 days compressive strength and compaction. They concluded that good workability was shown by the mix added with shredded fibers due to its uniform and higher aspect ratio evenly sprayed in the mix. Addition of plastics up to 0.6% is considered suitable after which reduction in compressive strength and compaction is seen affected. They observed that strength loss was less in concrete having shredded fibers of plastic as compare to hand cut macro fibers. Their research focus was only on comparative study of compressive strength but no work was carries out on other concrete properties like tensile strength, modulus of elasticity and density of concrete.

M. Elzafraney et al. [2005]9 this study has incorporated use of recycled plastic aggregate in concrete material for a building to work out its performance with regards to thermal attributes and efficient energy performance in comparison with normal aggregate concrete. The plastic content concrete was prepared from refined high recycled plastics to meet various requirement of building construction like strength, workability and finish ability etc. Both buildings were subject to long and short term monitoring in order to determine their energy efficiencies and level of comfort. It was observed that recycled plastic concrete building having good insulation used 8% less energy in comparison of normal concrete; however saving in energy was more profound in cold climate in building with lower insulation. They recommended that efficiency of energy can further be increase if recycle plastic of high thermal capacity is used. They have suggested the use of recycle plastic aggregate concrete being economical and light weights are having high resistance to heat. The author should also incorporate the comparison of both buildings with regards to durability and strength.

Pramod S. Patil.et al. [2007]10 This study presents the use of plastic recycled aggregate as replacement of coarse aggregate for production of concrete. They used forty eight specimen and six beams/cylinders casted from variable plastic percentages (0, 10, 20, 30, 40 and 50%) used as replacement of coarse aggregate in concrete mixes. They have conducted various tests and observed decrease in density of concrete with increase percentage of replacement of aggregate with recycle plastic concrete. They also reported decrease in compressive strength for 7 and 28 days with increase in percentage of replacement of coarse aggregate with recycle plastic aggregate. They have recommended feasibility of replacing 20 % will satisfy the permissible limits of strength. Again these researchers limited their research to only compressive strength property and no work was carried out to study the other important properties of concrete. Their research also lacks use of various admixtures in concrete to cater for the loss in strength.

A. Kamaruddin et al.(2000) : "Potential use of Plastic Waste as Construction Materials: Recent Progress and Future Prospect" Plastic associates products based have been considered as the world most consumer packaging solution. However, substantial quantities of plastic consumption have led to exponential increase of plastic derived waste. Recycling of plastic waste as valued added product such as concrete appears as one of promising solution for alternative use of plastic waste. This paper summarized recent progress on the development of concrete mixture which incorporates plastic wastes as partial aggregate replacement during concrete manufacturing. A collection of data from previous studies that have been researched which employed plastic waste in concrete mixtures were evaluated and conclusions are drawn based on the laboratory results of all the mentioned research papers studied.

K.S.Rebeiz andA.P.Craft(2000): "Plasticwastemanagementin construction: technological and institutionalissues" The main objective of a solid waste management system is to effectively safeguard the public health, safety, and welfare. The various options involved in a waste management process are landfilling, incineration, and recycling wastes into useful products. Plastics recycling, in particular, would not be successful unless the proper infrastructure to collect the waste is being set, the technology to economically reprocess the waste into new products is available, and the establishment of markets for the cost-effective use of recycled products are developed. The development of new construction materials using recycled plastics is important to both the construction and the plastics recycling industries. Extensive research investigated the use of resins based on recycled poly (ethylene terephthalate) (PET) plastic waste for the production of a high performance composite material, namely polyester concrete (PC). Resins using recycled PET offer the possibility of a lower source cost of materials for forming good quality PC. PC products also allow the long-term disposal of PET waste, an important advantage in recycling applications. 16 |P a g e Evaluation of use of Plastic Waste in Construction.

OriyomiM.Okeyinka etal.(2001): "AReviewonRecycledUseofSolid Wastes in Building Materials" Large quantities of solid wastes being generated worldwide from sources such as household, domestic, industrial, commercial and construction demolition activities, leads to environmental concerns. Utilization of these wastes in making building construction materials can reduce the magnitude of the associated problems. When these waste products are used in place of other conventional materials, natural resources and energy are preserved and expensive and/or potentially harmful waste disposal is avoided. Recycling which is regarded as the third most preferred waste disposal option, with its numerous environmental benefits, stand as a viable option to offset the environmental impact associated with the construction industry.This paper reviews the results of laboratory tests and important research findings, and the potential of using these wastes in building construction materials with focus on sustainable development. Research gaps, which includes; the need to develop standard mix design for solid waste based building materials; the need to develop energy efficient method of processing solid waste use in concrete; the need to study the actual behavior or performance of such building materials in practical application and the limited real life application of such building materials have also been identified. A research is being proposed to develop an environmentally friendly, lightweight building block from recycled waste paper, without the use of cement, and with properties suitable for use as walling unit. This proposed research intends to incorporate, laboratory experimentation and modeling to address the identified research gaps.

Ahmed Trimbakwala (2003): "PlasticRoads UseofWaste Plastic inRoad Construction" India has a road network of over 5,472,144 kilo-metres (3,400,233 mi) as on 31 March 2015, the second largest road network in the world. The plastic wastes can be used in road construction and the field tests withstood the stress and proved that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems. Plastic use in road construction is not new. It is already in use as PVC or HDPE pipe mat crossings built by cabling together PVC (polyvinyl chloride) or HDPE (high-density poly-ethylene) pipes to form plastic mats. Waste plastic is ground and made into powder; 3 to 4 % plastic is mixed with the bitumen. The durability of the roads laid out with shredded plastic waste is much more compared with roads with asphalt with the ordinary mix. The use of the innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment and also creating a source of income. 17 |P a g e Evaluation of use of Plastic Waste inConstruction

Azmat Shaikh, Nabeel Khan, Faisal Shah, Devendra Shukla, Gaurav Kale (2003): "Use of Plastic Waste in Road Construction" Plastic waste is one such resource, a major component of solid waste which is abundantly available and disposed of without proper treatment. There has been an exponential growth in municipal plastic waste disposal especially in urban areas which deteriorates the beauty of the landscape. Plastic was found to be an effective binder for bitumen mixes used in flexible pavements. This efficient method helps the pavements to resist higher temperature by minimizing the formation of cracks and reducing rainwater infiltration which otherwise leads to the development of potholes. These pavements have shown improved crushing and abrasion values and reduced water seepage.Plastic roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes. Bituminous Concrete (BC) is a composite material mostly used in construction projects like road surfacing, airports, parking lots etc. It consists of asphalt or bitumen (used as a binder) and mineral aggregate which is mixed together & laid down in layers then compacted. Now a day, the steady increment in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature put us in a demanding situation to think of some alternatives for the improvisation of the pavement characteristics and quality by applying some necessary modifications which shall satisfy both the strength as well as economic aspects. Also considering the environmental approach, due to excessive use of polythenes in the day to day business, the pollution to the environment is enormous. Since the polythenes are not biodegradable, the need of the current hour is to use the waste polyethene in some beneficial purposes.

Mohammed Jalaluddin (2003): "Use of Plastic Waste in Civil Constructions and Innovative Decorative Material (Eco- Friendly)" The project elucidates about the use of plastic in civil construction. The components used include everything from plastic screws and hangers to bigger plastic parts that are used in decoration, electric wiring, flooring, wall covering and waterproofing. Plastic use in road construction that have shown same hope in terms of using plastic waste in road construction. i.e. plastic roads. Plastic roads mainly use plastic carry bags, disposable cups and PET bottles that are collected from garbage dumps as important ingredients of the construction materials. By using plastic waste as modifier, we can reduce the quantity of cement and sand by their weight, hence decreasing the overall cost of construction. At 5% optimum modifier content, strength of modified concrete we found to see the times greater than the plain cement concrete. Using plastic poisons our food chain under the plastic affects human health. By the disposable plastics is the main source of plastic. For these plastic pollution is not only the ocean also in desert. Plastic will increase the melting point of the bitumen. Rain water will not seep through because of the plastic in the tar. So, this technology will result in lesser road repairs. 18 |P a g e Evaluation of use of Plastic Waste inConstruction

Mojtaba et al. (2006) : "Using plastic instead of bricks in Buildings" Concluded that reusing the plastic bottles as the building materials can have substantial effects on saving the building embodied energy by using them instead of bricks in walls and reducing the CO2 emission in manufacturing the cement by reducing the percentage of cement used. It is counted as one of the foundation's green project and has caught the attention of the architecture and construction industry. Generally the bottle houses are bioclimatic in design, which means that when it is cold outside is warm inside and when it is warm it is cold inside. Constructing a house by plastic bottles used for the walls, joist ceiling and concrete column offers us 45% diminution in the final cost. Separation of various components of cost shows that the use of local manpower in making bottle panels can lead to cost reduction up to 75% compared to building the walls using the brick and concrete block.

Shilpi et al. (2006) : "Plastic PET bottles use in bottle brick technique" Concluded that by utilizing PET bottles in construction recycled materials, thermal comfort can be achieved in very low cost housing, benefit in residents for those who cannot afford to buy and operate heating and cooling systems. Plastic is non biodegradable, toxic, highly resistant to heat and electricity (best insulator) and not recyclable in true sense, plastic PET bottles use in bottle brick technique. This gives relief for the poor people of India to provide cheap and best houses for living .

Puttaraj et al. (2006) : "Use of waste plastic in plastic-soil brick" This research paper examined that efficient usage of waste plastic in plastic-soil bricks has resulted in effective usage of plastic waste and thereby can solve the problem of safe disposal of plastics, also avoids its widespread littering and the utilization of quarry waste has reduced to some extent the problem of its disposal. Plastics are produced from the oil that is considered as non-renewable resource. Because plastic has the insolubility about 300 years in the nature, it is considered as a sustainable waste and environmental pollutant. So reusing or recycling of it can be effectual in mitigation of environmental impacts relating to it. It has been proven that the use of plastic bottles as innovative materials for building can be a proper solution for replacement of conventional materials .

Pratima et al. (2008): “Solution to plastic pollution problems in landfills” Plastic bottles wall have been less costly as compare to bricks and also they provide greater strength than bricks. The PET bottles that are not recycled end up in landfills or as litter, and they take approximately 1000 years to biodegrade. This has resulted in plastic pollution problems in landfills, water ways and on the roadside, and this problem continues to grow along with the plastic bottle industry.

CHAPTER- 3

MATERIALS AND METHODOLOGY

3.1 Plastic:

3.1.1 Introduction and Properties :

Plastic is a material consisting of any of a wide range of synthetic or semi-synthetic organics that are malleable and can be moulded into solid objects of diverse shapes. Plastics are typically organic polymers of high molecular mass, but they often contain other substances. They are usually synthetic, most commonly derived from petrochemicals, but many are partially natural. Plasticity is the general property of all materials that are able to irreversibly deform without breaking, but this occurs to such a degree with this class of mouldable polymers that their name is an emphasis on this ability. Due to their relatively low cost, ease of manufacture, versatility, and imperviousness to water, plastics are used in an enormous and expanding range of products, from paper clips to spaceships. They have already displaced many traditional materials, such as wood, stone, horn and bone, leather, paper, metal, glass, and ceramic, in most of their former uses. In developed countries, about a third of plastic is used in packaging and another third in buildings such as piping used in plumbing or vinyl siding. Other uses include automobiles (up to 20% plastic), furniture, and toys. In the developing world, the ratios may be different - for example, reportedly 42% of India's consumption is used in packaging. Plastics have many uses in the medical field as well, to include polymer implants, however the field of plastic surgery is not named for use of plastic material, but rather the more generic meaning of the word plasticity in regards to the reshaping of flesh.

Figure 3.1.1 : plastic waste

3.1.2 Categories of Plastic:

- Polyester (PES) – Fibres, textiles.
- Polyethylene terephthalate (PET) – Carbonated drinks bottles, peanut butter jars,plastic film, microwavable packaging.
- Polyethylene (PE) – Wide range of inexpensive uses including supermarket bags,plastic bottles.
- High-density polyethylene (HDPE) – Detergent bottles, milk jugs, and moulded plastic cases.
- Polyvinyl chloride (PVC) – Plumbing pipes and guttering, shower curtains, window frames, flooring.
- Polyvinylidene chloride (PVDC) (Saran) – Food packaging.
- Low-density polyethylene (LDPE) – Outdoor furniture, siding, floor tiles, shower curtains, clamshell packaging.
- Polypropylene (PP) – Bottle caps, drinking straws, yogurt containers, appliances, car fenders (bumpers), plastic pressure pipe systems.
- Polystyrene (PS) – Packaging foam/"peanuts", food containers, plastic tableware, disposable cups, plates, cutlery, CD and cassette boxes.

- High impact polystyrene (HIPS) -: Refrigerator liners, food packaging, and vending cups. Polyamides (PA) (Nylons) – Fibres, toothbrush bristles, tubing, fishing line,
- low strength machine parts: under-the-hood car engine parts or gun frames. Acrylonitrile butadiene styrene (ABS) – Electronic equipment cases (e.g., computer monitors, printers, keyboards), drainage pipe
- Polyethylene/Acrylonitrile Butadiene Styrene (PE/ABS) – A slippery blend of PE and ABS used in low-duty dry bearings.
- Polycarbonate (PC) – Compact discs, eyeglasses, riot shields, security windows,traffic lights, lenses.
- Polycarbonate/Acrylonitrile Butadiene Styrene (PC/ABS) – A blend of PC and ABSthat creates a stronger plastic.Used in car interior and exterior parts, and mobile phone bodies.
- Polyurethanes (PU) – Cushioning foams, thermal insulation foams, surface coatings, printing rollers (Currently 6th or 7th most commonly used plastic material, forinstance the most commonly used plastic in cars).

3.1.3 Health hazard:

Pure plastics have low toxicity due to their insolubility in water and because they are biochemically inert, due to a large molecular weight. Plastic products contain a variety of additives, some of which can be toxic. For example, plasticizers like adipates and phthalates are often added to brittle plastics like polyvinyl chloride to make them pliable enough for use in food packaging, toys, and many other items. Traces of these compounds can leach out of the product. Owing to concerns over the effects of such leachates, the European Union has restricted the use of DEHP (di-2-ethylhexyl phthalate) and other phthalates in some applications, and the United States has limited the use of DEHP, DPB, BBP, DINP, DIDP, and DnOP in children's toys and child care articles with the Consumer Product Safety Improvement Act. Some compounds leaching from polystyrene food containers have been proposed to interfere with hormone functions and are suspected human carcinogens. Other chemicals of potential concern include alkylphenols.

Whereas the finished plastic may be non-toxic, the monomers used in the manufacture ofthe parent polymers may be toxic. In some cases, small amounts of those chemicals canremain trapped in the product unless suitable processing is employed. For example, theWorld Health Organization's International Agency for Research on Cancer (IARC) has recognized vinylchloride, the precursor to PVC, as a human carcinogen. Some polymers may also decompose into the monomers or other toxic substances when heated. In 2011, it was reported that "almost all plastic products" sampled released chemicals with estrogenic activity, although the researchers identified plastics which did not leach chemicals with estrogenic activity.

Most plastics are durable and degrade very slowly; the very chemical bonds that make them so durable tend to make them resistant to most natural processes of degradation. However, microbial species and communities capable of degrading plastics are discovered from time to time, and some show promise as being useful for bio remediating certain classes of plastic waste. Since the 1950s, one billion tons of plastic have been discarded and some of that material might persist for centuries or much longer, as is demonstrated by the persistence of natural materials such as amber.

Serious environmental threats from plastic have been suggested in the light of the increasing presence of micro plastics in the marine food chain along with many highly toxic chemical pollutants that accumulate in plastics. They also accumulate in larger fragmented pieces of plastic called nurdles. In the 1960s the latter were observed in the guts of sea birds and since then have been found in increasing concentration. In 2009, it was estimated that 10% of modern waste was plastics, although estimates vary according to region. Meanwhile, 50-80% of debris in marine areas is plastic. Before the ban on the use of CFCs in extrusion of polystyrene (and in general use, except in life-critical fire suppression systems; see Montreal Protocol), the production of polystyrene contributed to the depletion of the ozone layer, but current extrusion processes use non-CFCs.

3.1.4 Climate change:

The effect of plastics on global warming is mixed. Plastics are generally made from petroleum. If the plastic is incinerated, it increases carbon emissions; if it is placed in a landfill, it becomes a carbon sink although biodegradable plastics have caused methane emissions. Due to the lightness of plastic versus glass or metal, plastic may reduce energy consumption. For example, packaging beverages in PET plastic rather than glass or metal is estimated to save 52% in transportation energy.

3.1.5 Recycling :

Thermoplastics can be re-melted and reused, and thermoset plastics can be ground up and used as filler, although the purity of the material tends to degrade with each reuse cycle. There are methods by which plastics can be broken back down to a feedstock state. The greatest challenge to the recycling of plastics is the difficulty of automating the sorting of plastic wastes, making it labour-intensive. Typically, workers sort the plastic by looking at the resin identification code, although common containers like soda bottles can be sorted from memory. Typically, the caps for PETE bottles are made from a different kind of plastic which is not recyclable, which presents additional problems to the automated sorting process. Other recyclable materials such as metals are easier to process mechanically. However, new processes of mechanical sorting are being developed to increase capacity and efficiency of plastic recycling. While containers are usually made from a single type and colour of plastic, making them relatively easy to be sorted, a consumer product like a cellular phone may have many small parts consisting of over a dozen different types and colours of plastics. In such cases, the resources it would take to separate the plastics far exceed their value and the item is discarded. However, developments are taking place in the field of active disassembly, which may result in more consumer product components being re-used or recycled. Recycling certain types of plastics can be unprofitable, as well. For example, polystyrene is rarely recycled because it is usually not cost effective. These unrecycled wastes are typically disposed of in landfills, incinerated or used to produce electricity at waste-to energy plants.

3.2 Aggregates: Fine Aggregates:

3.2.1 Introduction Fine aggregate :

(Sand) is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e. a soil containing more than 85% sand-sized particles (by mass). The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO2), usually in the form of quartz. The second most common type of sand is calcium carbonate, for example aragonite, which has mostly been created, over the past half billion years, by various forms of life, like coral and shellfish. It is, for example, the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean .

Figure 3.2.1: Fine Aggregate

3.2..2 Composition:

In terms of particle size as used by geologists, sand particles range in diameter from 0.0625 mm (or 1»16 mm) to 2 mm. An individual particle in this range size is termed a sand grain. Sand grains are between gravel (with particles ranging from 2 mm up to 64 mm) and silt (particles smaller than 0.0625 mm down to 0.004 mm). The size specification between sand and gravel has remained constant for more than a century, but particle diameters as small as 0.02 mm were considered sand under the Albert Atterberg standard in use during the early 20th century. A 1953 engineering standard published by the American Association of State Highway and Transportation Officials set the minimum sand size at 0.074 mm. A 1938 specification of the United States Department of Agriculture was 0.05 mm. Sand feels gritty when rubbed between the fingers (silt, by comparison, feels like flour).

ISO 14688 grades sands as fine, medium and coarse with ranges 0.063 mm to 0.2 mm to 0.63 mm to 2.0 mm. In the United States, sand is commonly divided into five sub-categories based on size: very fine sand (1»16 – 1»8 mm diameter), fine sand (1»8 mm – 1»4 mm), medium sand

(1»4 mm – 1»2 mm), coarse sand (1»2 mm – 1 mm), and very coarse sand (1 mm – 2 mm). These sizes are based on the Krumbein phi scale, where size in Φ = -log2D; D being the particle size in mm. On this scale, for sand the value of Φ varies from −1 to +4, with the divisions between subcategories at whole numbers. The most common constituent of sand, in inland continental settings and non-tropical coastal settings, is silica (silicon dioxide, or SiO2), usually in the form of quartz, which, because of its chemical inertness and considerable hardness, is the most common mineral resistant to weathering. The composition of mineral sand is highly variable, depending on the local rock sources and conditions. The bright white sands found in tropical and subtropical coastal settings are eroded limestone and may contain coral and shell fragments in addition to other organic or organically derived fragmental material, suggesting sand formation depends on living organisms, too. The gypsum sand dunes of the White Sands National Monument in New Mexico are famous for their bright, white colour. Arkose is a sand or sandstone with considerable feldspar content, derived from weathering and erosion of a (usually nearby) granitic rock outcrop. Some sands contain magnetite, chlorite, glauconite or gypsum. Sands rich in magnetite are dark to black in colour, as are sands derived from volcanic basalts and obsidian. Chlorite-glauconite bearing sands are typically green in colour, as are sands derived from basaltic (lava) with a high olivine content. Many sands, especially those found extensively in Southern Europe, have iron impurities within the quartz crystals of the sand, giving a deep yellow colour. Sand deposits in some areas contain garnets and other resistant minerals, including some small gemstones.

3.2..3 Study :

The study of individual grains can reveal much historical information as to the origin and kind of transport of the grain. Quartz sand that is recently weathered from granite or gneiss quartz crystals will be angular. It is called Grus in geology or sharp sand in the building trade where it is preferred for concrete, and in gardening where it is used as a soil amendment to loosen clay soils. Sand that is transported long distances by water or wind will be rounded, with characteristic abrasion patterns on the grain surface. Desert sand is typically rounded.

3.2.4 Uses Agriculture:

- Sandy soils are ideal for crops such as watermelons, peaches and peanuts, and their excellent drainage characteristics make them suitable for intensive dairy farming.
- Aquaria: Sand makes a low cost aquarium base material which some believe is better than gravel for home use. It is also a necessity for saltwater reef tanks, which emulate environments composed largely of aragonite sand broken down from coral and shellfish.

- Artificial reefs: Geotextile bagged sand can serve as the foundation for new reefs.
- Artificial islands in the Persian Gulf for instance.
- Beach nourishment: Governments move sand to beaches where tides, storms or deliberate changes to the shoreline erode the original sand.
- Brick: Manufacturing plants add sand to a mixture of clay and other materials for manufacturing bricks.
- Cob: Coarse sand makes up as much as 75% of cob.
- Mortar: Sand is mixed with masonry cement or Portland cement and lime to be used in masonry construction.
- Concrete: Sand is often a principal component of this critical construction material.
- Hydraulic Fracturing: A drilling technique for natural gas, which uses rounded silica sand as a "proppant", a material to hold open cracks that are caused by the hydraulic fracturing process.
- Glass: Sand is the principal component in common glass. Landscaping: Sand makes small hills and slopes (for example, in golf courses).
- Paint: Mixing sand with paint produces a textured finish for walls and ceilings or nonslip floor surfaces.
- Railroads: Engine drivers and rail transit operators use sand to improve the traction of wheels on the rails.
- Recreation. Playing with sand is a favourite beach time activity. One of the most beloved uses of sand is to make sometimes intricate, sometimes simple structures known as sand castles. Such structures are well known for their impermanence. Sand is also used in children's play.
- Special play areas enclosing a significant area of sand, known as sandboxes, are common on many public playgrounds, and even at some single family homes
- Roads: Sand improves traction (and thus traffic safety) in icy or snowy conditions. Sand animation: Performance artists draw images in sand. Makers of animated films use the same term to describe their use of sand on frontlit or backlit glass.
- Sand casting: Casters moisten or oil molding sand, also known as foundry sand and then shape it into moulds into which they pour molten material. This type of sand must be able to withstand high temperatures and pressure, allow gases to escape, have a uniform, small grain size and be non-reactive with metals.
- Sand castles: Shaping sand into castles or other miniature buildings is a popular beach activity.

- Sandbags: These protect against floods and gunfire. The inexpensive bags are easy to transport when empty, and unskilled volunteers can quickly fill them with local sand in emergencies.

3.3 Aggregates: Coarse Aggregates:

3.3.1 Introduction:

Construction aggregate (coarse aggregate), or simply “aggregate”, is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined materials in the world. Aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material. Due to the relatively high hydraulic conductivity value as compared to most soils, aggregates are widely used in drainage applications such as foundation and French drains, septic drain fields, retaining wall drains, and road side edge drains.

Aggregates are also used as base material under foundations, roads, and railroads. In other words, aggregates are used as a stable foundation or road/rail base with predictable, uniform properties (e.g. to help prevent differential settling under the road or building), or as a lowcost extender that binds with more expensive cement or asphalt to form concrete. Preferred bituminous aggregate sizes for road construction are given in EN 13043 as d/D (where the range shows the smallest and largest square mesh grating that the particles can pass). The same classification sizing is used for larger armour stone sizes in EN 13383, EN 12620 for concrete aggregate, EN 13242 for base layers of road construction and EN 13450 for railway ballast.

The American Society for Testing and Materials publishes an exhaustive listing of specifications including ASTM D 692 and ASTM D 1073 for various construction aggregate products, which,by their individual design, are suitable for specific construction purposes. These products include specific types of coarse and fine aggregate designed for such uses as additives to asphalt and concrete mixes, as well as other construction uses. State transportation departments further refine aggregate material specifications in order to tailor aggregate use to the needs and available supply in their particular locations. Sources for these basic materials can be grouped into three main areas: Mining of mineral aggregate deposits, including sand, gravel, and stone; use of waste slag from the manufacture of iron and steel; and recycling of concrete, which is itself chiefly manufactured from mineral aggregates. In addition, there are some (minor) materials that are used as specialty lightweight aggregates: clay, pumice, perlite, and vermiculite.

Figure 3.3.1: Coarse Aggregate

3.3.2 History:

People have used sand and stone for foundations for thousands of years. Significant refinement of the production and use of aggregate occurred during the Roman Empire, which used aggregate to build its vast network of roads and aqueducts. The invention of concrete, which was essential to architecture utilizing arches, created an immediate, permanent demand for construction aggregates.

3.3.3 Modern production:

The advent of modern blasting methods enabled the development of quarries, which are now used throughout the world, wherever competent bedrock deposits of aggregate quality exist. In many places, good limestone, granite, marble or other quality stone bedrock deposits do not exist. In these areas, natural sand and gravel are mined for use as aggregate. Where neither stone, nor sand and gravel, are available, construction demand is usually satisfied by shipping in aggregate by rail, barge or truck. Additionally, demand for aggregates can be partially satisfied through the use of slag and recycled concrete. However, the available tonnages and lesser quality of these materials prevent them from being a viable replacement for mined aggregates on a large scale. Large stone quarry and sand and gravel operations exist near virtually all population centers. These are capital intensive operations, utilizing large earth-moving equipment, belt conveyors, and machines specifically designed for crushing and separating various sizes of aggregate, to create distinct product stockpiles.

3.3.4 Recycled materials for aggregates:

The largest-volume of recycled material used as construction aggregate is blast furnace and steel furnace slag. Blast furnace slag is either air-cooled (slow cooling in the open) or granulated (formed by quenching molten slag in water to form sand-sized glass-like particles). If the granulated blast furnace slag accesses free lime during hydration, it develops strong hydraulic cementitious properties and can partly substitute for Portland cement in concrete. Steel furnace slag is also air-cooled. In 2006, according to the USGS, air-cooled blast furnace slag sold or used in the U.S. was 4.3 million tonnes valued at $49 million, granulated blast furnace slag sold or used in the U.S. was 3.2.2 million tonnes valued at $318 million, and steel furnace slag sold or used in the U.S. was 4.4.7 million tonnes valued at $40 million. Air-cooled blast furnace slag sales in 2006 were for use in road bases and surfaces (41%), asphaltic concrete (13%), readymixed concrete (16%), and the balance for other uses. Granulated blast furnace slag sales in 2006 were for use in cementitious materials (94%), and the balance for other uses. Steel furnace slag sales in 2006 were for use in road bases and surfaces (51%), asphaltic concrete (12%), for fill (18%), and the balance for other uses.

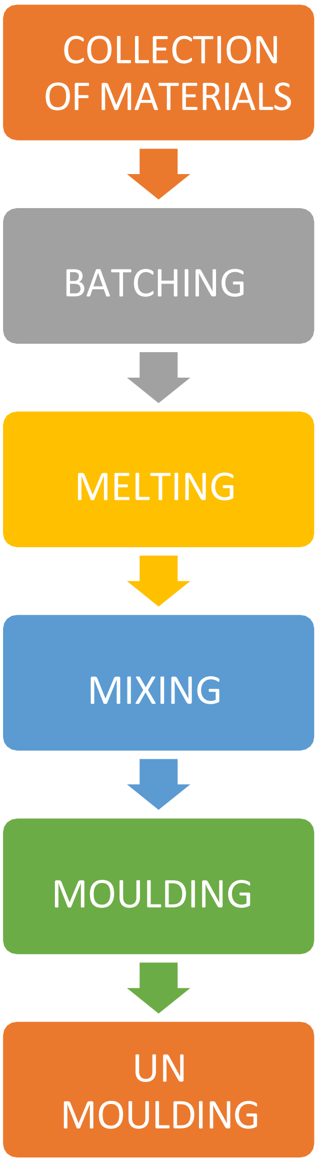
Glass aggregate, a mix of colours crushed to a small size, is substituted for many construction and utility projects in place of pea gravel or crushed rock, often saving municipalities like the City of Tumwater, Washington Public Works, thousands of dollars (depending on the size of the project). Glass aggregate is not sharp to handle. In many cases, the state Department of Transportation has specifications for use, size and percentage of quantity for use. Common applications are as pipe bedding—placed around sewer, storm water or drinking water pipes to transfer weight from the surface and protect the pipe. Another common use would be as fill to bring the level of a concrete floor even with a foundation. Use of glass aggregate helps close the loop in glass recycling in many places where glass cannot be smelted into new glass. Aggregates themselves can be recycled as aggregates. Unlike deposits of sand and gravel or stone suitable for crushing into aggregate, which can be anywhere and may require overburden removal and/or blasting, “deposits” of recyclable aggregate tend to be concentrated near urban areas, and production from them cannot be raised or lowered to meet demand for aggregates.

Supply of recycled aggregate depends on physical decay of structures and their demolition. The recycling plant can be fixed or mobile; the smaller capacity mobile plant works best for asphalt-aggregate recycling. The material being recycled is usually highly variable in quality and properties. Many aggregate products of various types are often recycled for other industrial purposes. In Bay City, Michigan, for example, a recycle program exists for contractors and their own unused products. These piles are composed of unused mixed concrete, block, brick, gravel, pea stone, and other used materials. Composed of several alternating piles that grow to hundreds of feet in height and diameter. These piles are then crushed to provide gravel for roads and driveways, among other purposes. This program has huge economic and environmental benefits to the local and surrounding area. Contractors save on disposal costs and less aggregate is buried or piled and abandoned. According to the USGS in 2006, 2.9 million tonnes of Portland cement concrete (including aggregate) worth $21.9 million was recycled, and 1.6 million tonnes of asphalt concrete (including aggregate) worth $11.8 million was recycled, both by crushed stone operations. Much more of both materials are recycled by construction and demolition firms not in the USGS survey. For sand and gravel, the USGS survey for 2006 showed that 3.2.7 million tonnes of cement concrete valued at $32.0 million was recycled, and 3.4.17 million tonnes of asphalt concrete valued at $43.3.1 million was recycled.

Again, more of both materials are recycled by construction and demolition firms not in this USGS survey. The Construction Materials Recycling Association indicates that there are 325 million tonnes of recoverable construction and demolition materials produced annually. Many geosynthetic aggregates are also made from recycled materials. Being polymer based, recyclable plastics can be reused in the production of these new age of aggregates.

Steps involved in making of plastic precast comound wall

- Collection of Materials.
- Batching.
- Melting.
- Mixing.
- Moulding
- Unmoulding.



Flowchart of plastic precast compound wall manufacturing process

MIX DESIGN

GRADE	MIX RATIO
M1	1:1:2
M2	1:1.5:2
M3	1:2:3
M4	1:1.5:3

Table 1: Various Mix Ratios Considered

- **COLLECTION OF PLASTIC MATERIALS**

The plastic material should be collected from the factories waste and hospital waste and industries waste and also food packages and plastic bottles this will come under the LDPE plastic type.

- **BATCHING OF PLASTIC**

Measurement of materials for making brick is called batching. After collection of materials we separate the types of plastic and remove any other waste presented in the collected material and check that any water content in in sample collected ten proceed for burning.

- **MELTING OF WASTE PLASTIC**

After completion batching the plastic waste were taken for burning in which the plastic bags are drop one by one into the container and allowed to melt. These would be done in closed vessel because to prevent the toxic gases released into atmosphere. These will be at the temperature of 90-110 degrees centigrade.

- **MIXING OF WASTE PLASTIC WITH SAND**

Mixing of materials is essential for the production of uniform and strength for wall. The mixing has to be ensure that the mass becomes homogeneous, uniform in colour and consistency.

Generally, there are two types of mixing, Hand mixing and mechanical mixing. In this project, we adopted hand mixing. until the entire plastic content required for making plastic wall of one mix proportion is added into it. then these plastic liquids thoroughly mixed by using trowel before it hardens. The mixture has very short setting bags are turned to molten state; the river sand is added to it. The sand added is mixed time. Hence mixing process should not consume more time.

- **MOULDING**

After completion of proper mixing we place mix into required mould. In these projects we use the plastic precast compound wall sizes (250X30X5cm). after 2 hours remove from the mould and then done for use.

- **UNMOULDING**

After completion of moulding, we have to wait for 15 min for the settling and cooling of the plastic precast compound wall. Now we can remove from the mould.

CHAPTER 4

RESULTS AND DISCUSSION

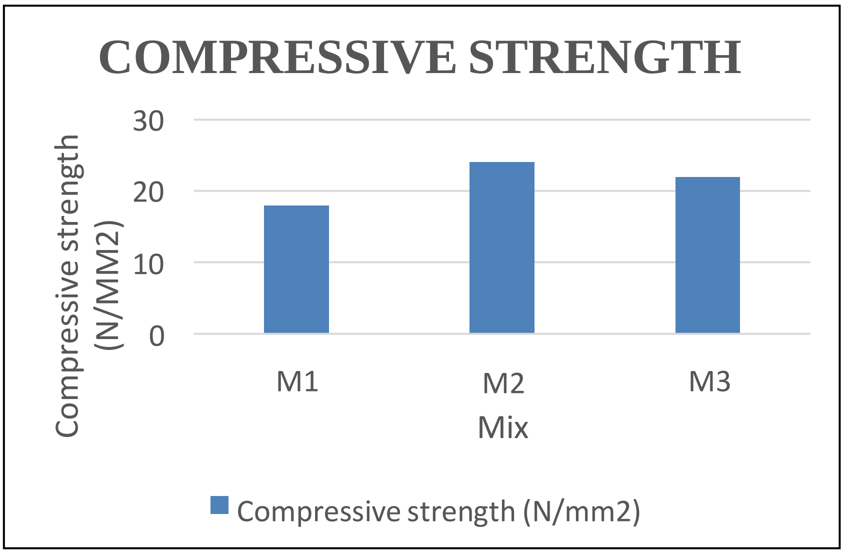
COMPRESSIVE STRENGTH

The tests on Compressive strength of the specimen brick shall be calculated for 5 different ratio specimens using the formula as follows,

Compressive strength = load/area

MIX DESIGNATION	PLASTIC FINE AND COARSE AGGREGATE RATIO	COMPRESSIVE STRENGTH(N/MM^2)
M1	1:1:2	18 N/MM^2
M2	1:1.5:2	24 N/MM^2
M3	1:2:3	22 N/MM^2

Table II. COMPRESSIVE STRENGTH



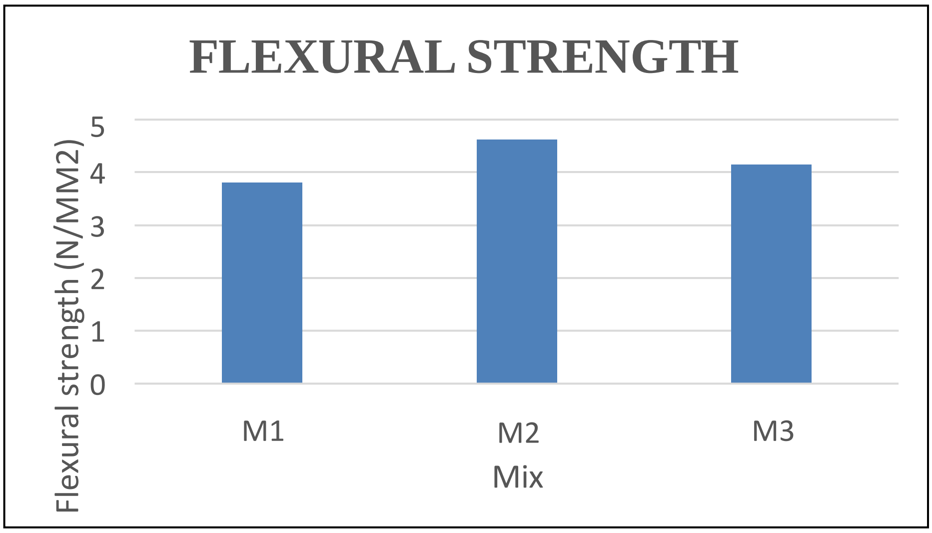
GRAPH OF COMPRESSIVE STRENGTH

FLEXURE TEST

Flexure test is more affordable than a tensile test and test results are slightly different. The material is laid horizontally over two points of contact (lower support span) and then a force is applies to the top of the material through either one or two points of contact (upper loading span) until the sample fails.

Mix Design	Plastic Fine & Course Aggregate Ratio	Flexure Strength (N/mm^2)
M1	1:1:2	3.8 N/mm^2
M2	1:1.5:2	4.62 N/mm^2
M3	1:2:3	4.24 N/mm^2

TABLE III: FLEXURE TEST



GRAPH OF FLEXURE TEST

OVEN TEST RESULT

SPECIMEN	TEMPERATURE IN (ºC)°	REMARK
M1	50	No change
	100	No change
	170	Melts
M2	50	No change
	100	No change
	170	Melts
M3	50	No change
	100	No change
	170	Melts

Table IV. OVEN TEST RESULT

SOUNDNESS TEST

This sound is carried any of the two bricks. If the two bricks are not broken after striking with each other and a clear ringing sound is produced, then it means that the bricks are sufficiently sound.

COST ANALYSIS:

Cost analysis of plastic precast compound wall for 1:1:2 ratio for 250x30x5cms mould

Required plastic 12 kg = Rs.120/-
Required sand 12 kg = Rs.24/-
Required coarse aggregate 24 kg = Rs.24/-
Steel required 3 kg (Fe500) = Rs.120/-

288/-
Weight of wall slide = 12 kg+12 kg+24 kg+3 kg = 51 kg
Mould size = (250x30x5) cm
= 2.5x0.3x0.05
Volume = 0.0375 m^3

Density of precast compound wall = 51/0.0375 = 1360 kg/m^3

CHAPTER -5

CONCLUSIONS & ENHANCEMENT

5.1 CONCLUSION

The experimental results have shown the use of waste plastic material in making concrete/mortar can provide an alternative solution to minimize the environmental impact due to unscientific disposal of waste plastic.

The following conclusions were drawn:

- Waste plastic, which is available everywhere, may be put to an effective use in precast compound walls.
- Plastic precast compound walls can help reduce the environmental pollution, thereby makingthe environment clean and healthy.
- Plastic precast compound walls reduce the usage of cement in making of pavement blocks.
- Plastic precast compound walls give an alternative option of pavement to the customers onaffordable rates.
- Water absorption of plastic pavement blocks is zero percent.
- Compressive strength of Plastic precast compound walls is 24N/mm^2 at the compressive load of 96KN.
- Flexure strength of Plastic precast compound walls is 4.62N/mm^2.

a) A variety of plastic waste has been used in many ways in Plastic precast compound walls. The compressive strength of the Plastic precast compound walls produced comply the standard outlined, which is more than the acceptable range outlined.

b) A suitable proportion between plastic waste and other materials used need to be optimized to meet the standard outlined for manufacturing of Plastic precast compound walls. Further research and development is needed to improve the quality and durability of Plastic precast compound walls.

We conclude that the Plastic precast compound walls are useful for the construction industry when we compare with normal precast compound walls.

- The waste plastic used for experiments is of LDPE (Low Density Poly Ethylene), 5- 7mm size and specific gravity of waste plastic is found to be 0.92.
- The mechanical properties of the test concrete did not display any notable differences depending on the color of the plastic waste.

- This research also has potential application for the production of lightweight concrete, for minimizing the amount of polymer wastes in landfills, and the creation of decorative, attractive landscaping products.

Advantages and Disadvantages :

Advantages:

- A better workability is achieved for plastic reinforced concrete in comparison to the conventional one.
- Considerable reduction in the weight results in the formation of light weight concrete. Behaviour of concrete by partial replacement of coarse aggregate with recycled plastic granules Dept. of Civil Engineering, TOCE, BANGALORE .
- Recycled plastic in the construction purpose can set a benchmark by utilizing the non-biodegradable waste and eventually minimizing the environmental pollution.

Disadvantages:

- Strength achieved for the plastic replaced concrete is slightly less than the conventional concrete but can be improved by the use of admixtures.
- Cost of plastic is high in the place where we need to buy from the dealers and hence the cost of construction also increases.
- There is no proper bonding of plastic materials in the matrix unless admixtures are Used.
- Plastics may be degraded under the action of direct sunlight which reducestheir mechanical strength.
- Many plastics are flammable unless treated. High embodied energy content.

5.2 FUTURE ENHANCEMENT

- The present research can be extended to The test can be carried out for different grades of concrete.
- The use of admixtures in the test can be performed to get improved strength.
- Experimental study has to be conducted for other varieties of plastics like HDPE, PP, PET etc.
- The durability of such a concrete has to be tested for beams and columns with varying proportions of waste plastic at different ages.

- The use of waste plastics in concrete is relatively a new development in the world of concrete technology and lot of research must go in before this material is actively used in concrete construction.
- The use of plastics in concrete lowered the strength of resultant concrete, therefore, the research must be oriented towards ternary systems that helps in overcoming this drawback of use of plastics in concrete.
- Estimation of the types, quantity and useful components present in the waste plastic materials in the city and surrounding areas.
- Methodology for collection and sorting out the useful components of the plastic waste.
- Carrying out further laboratory investigations, construction of some test tracks and field studies on the performance of concrete using the modified concrete.
- Working out relative economics of using the modified concrete mixes in road construction works, considering the improved performance and increased service lifeof the pavement.
- Preparation of specifications and standards for the construction industry.
- The studies can be further extended by addition of admixtures to make the concrete not to alter its strength considerably even with the addition of more percentage of plasticwaste.
- Durability studies can be conducted so as to study its properties in the long run. Tensile strength can be studied where concrete needs more tensile capacity.

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Journal

- To be communicated

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