CHAPTER 1

INTRODUCTION

1.1 General

Concrete is one of the most widely used construction material, it is usually associated with Portland cement as the main component for making concrete. Ordinary Portland cement (OPC) is conventionally used as the primary binder to produce concrete.Production of Portland cement is currently exceeding 2.6 billion tons per year worldwide andgrowing at 5 percent annually. The environmental issues associated with the production of Ordinary Portland cement are well known. Portland cement production is a major contributor to carbon-di- oxide (CO_2) emissions as an estimated five to eight percent of all human-generated atmospheric CO_2 worldwide comes from the concrete industry. The global warming is caused by the emission of greenhouse gases, such as CO_2, to the atmosphere by human activities. Among the greenhouse gases,CO_2 contributes about 65% of global warming. The amount of the carbon dioxide released duringthe manufacture of Ordinary Portland cement due to the calcinations of limestone and combustion offossil fuel is approximately in the order of one tonne for every tonne of Ordinary Portland cement produced [1&2].

Although the use of Portland cement is still unavoidable until the foreseeable future, many effortsare being made in order to reduce the use of Portland cement in concrete. These efforts include the utilization of supplementary cementing materials such as fly ash, silica fume, granulated blastfurnace slag, rice-husk ash and metakaolin, and finding alternative binders to Portland cement.

On the other hand, a huge volume of fly ash is generated around the world, most of the fly ash is not effectively used, and a large part of it is disposed in landfills which affects aquifers and surface bodies of fresh water. In this respect, the geo-polymer technology proposed by Davidov its shows considerable promise for application in concrete industry as an alternative binder to the Portland cement. In terms of reducing the global warming, the geo-polymer technology could reducethe CO_2 emission to the atmosphere caused by cement industries by about 80%. Corrosion ofreinforcement has been established as the predominant factor causing wide spread premature deterioration of concrete construction worldwide, especially of the structures located in the coastal marine environment. The most important causes of corrosion initiation of reinforcing steel are the ingress of chloride ions and carbon dioxide to the steel surface. After initiation of the corrosion process, the corrosion products (iron oxides and hydroxides) are usually deposited in the restricted space in the concrete around the steel. Their formation within this restricted space sets up expansive stresses, which crack and spall the concrete cover. This in turn results in progressive deterioration of the concrete.

When corrosion of the reinforcement in concrete structures had been realized to be a serious problem world-wide in the year1960 and 1970 and the amount of damages still increased considerably in the year1980, extensive research programs had been initiated to understand the mechanisms of reinforcement corrosion and to become able to assess, repair and maintain those structures appropriately. Reinforced concrete probes with cable connections to each rebar have beenproduced extensively to study the potentials, polarization behaviour, macro cell effects and the influences of the concrete mix as well as the environmental conditions like temperature, humidity, chloride content, etc.

Quality control, maintenance and planning for the restoration of these structures need non-destructive inspections and monitoring techniques that detect the corrosion at an early stage. Corrosion loss consumes considerable portion of the budget of the country by way of either restoration measures or reconstruction. There have been a large number of investigations on the problems of deterioration of concrete and the consequent corrosion of steel in concrete. Properly monitoring the structures for corrosion performance and taking suitable measures at the appropriate time could affect enormous saving. Moreover, the repair operation themselves are quite complex andrequire special treatments of the cracked zone, and in most instances the life expectancy of the repairis limited. Accordingly, corrosion monitoring can give more complete information of changing condition of a structure in time Corrosion of the reinforcement is a common form of degradation of reinforced concrete structures. As a matter of fact the chemical attack varies the mechanical properties of both the steel rebars and concrete, and the bond characteristics. The problem of the durability of the reinforced concrete structure is arisen, dramatically, in the last decades. The analysis of the actual damages in Reinforced Concrete constructions has shown that one of the most dangerous degradation phenomena is connected to the corrosion of the rebars.

The problem of electronic waste (e-waste) poses a significant threat to the environment and human health globally. The toxic emissions from e-waste, including acids, hazardous compounds, heavy metals, and carcinogenic chemicals, contaminate soil and air, directly and indirectly harming ecosystems. With the rapid growth in technology and the increased use of electronic and electrical equipment (EEE), e-waste has become a substantial portion of the solid waste stream. However, there are limited recycling solutions available, leading to a need for better disposal methods .About 80% to 85% of various electronic items, wastes are decomposed in landfills which might include or discharge lethal gases into air, may have an effect on human beings and environment. For solving and minimizing the discarding of huge quantity E-waste substance, recycle of E-waste materials in concrete production is well thought-out as the mainly possible purpose. It helps to eliminate the concrete materials deficiency issues that are currently going on in construction industry and it also helps to develop the strength of concrete mix and decrease the rate of concrete.

The amount of e-waste requiring environmentally friendly disposal is steadily increasing. E-waste consists mainly of metals (over 60%), plastics (around 30%), and hazardous pollutants (about 2.70%)

1.2 PLASTIC PAVER BRICKS IN INDIA

A large number of plastic wastes have been collected from several places such as tourist and public places etc., High density polyethylene e-waste are collected, cleaned, and used as a replacement for cement in the manufacturing of Paver Blocks. E-waste is available in large quantity and hence the cost factor comes down. when we having waste plastic then we can use as reuse, recycle and reduce. Be mindful of what you do, pay attention to the items you buy, and always check yourself to see if you need it or if it comes in a package with less waste. The global market for waste plastic in manufacturing of brick is experiencing substantial growth, and is expected to continue to grow rapidly in the next few years. Plastic is one of the most widely used materials for applications like packaging and manufacturing of various products.

According to UNEP, the total E-wastegenerated globally is around 300 million which accounts for 18% of the total waste generateannually. The recycle and reuse of plastic is very complicated process attributed to the variety of E-waste and its different compositions thus, only 9% of all the plastic waste ever produced has been recycled, 12% has been incinerated, while the rest 79% has accumulated in various landfillsand natural water bodies refer figure 1.1. Bricks are an essential construction material used extensively for the purpose of construction of partition walls, structural walls, boundary walls and is also used in road construction. Global research over the last few years have proved that waste plastic can be effectively used in the manufacturing of bricks, which is a key driver in the growth of market for waste plastic in manufacturing of bricks throughout the forecast period

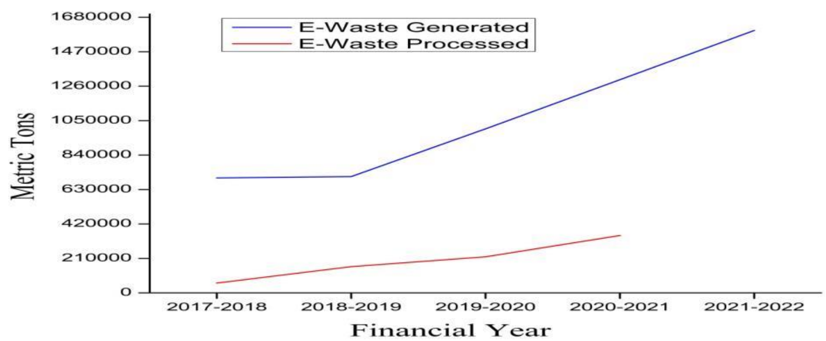

Figure 1.1 Graph of E Waste Generated Financial Year

1.3 WHY INTERLOCKING CONCRETE BLOCKS MADE USING E-WASTE AND INDUSTRIAL WASTE:

Bricks are usually manufactured of clay or cement, both are exhaustible natural resources, and the irrational use of cement and clay increase carbon emission. Plastic being a non-decomposablematerial is either incinerated or dumped in landfills, which results in air and soil pollution. Hence,the use of plastic waste in the form of powder or flakes can significantly reduce the quantity of soil and cement required for the manufacturing of bricks as well as reduce the quantity of plastic waste. Use of plastic also reduces cost of bricks which ensure substantial increase in utilizing waste plastic in manufacturing of bricks. It can be concluded that e-waste modified concrete provide a glimmer of hope for the safe and sound disposal of increasing quantity of e-waste. However, more comprehensive experimental studies are required to explore full potential of e-waste aggregates as natural coarse aggregates replacement for the large-scale production of concrete. Refer figure 1.2

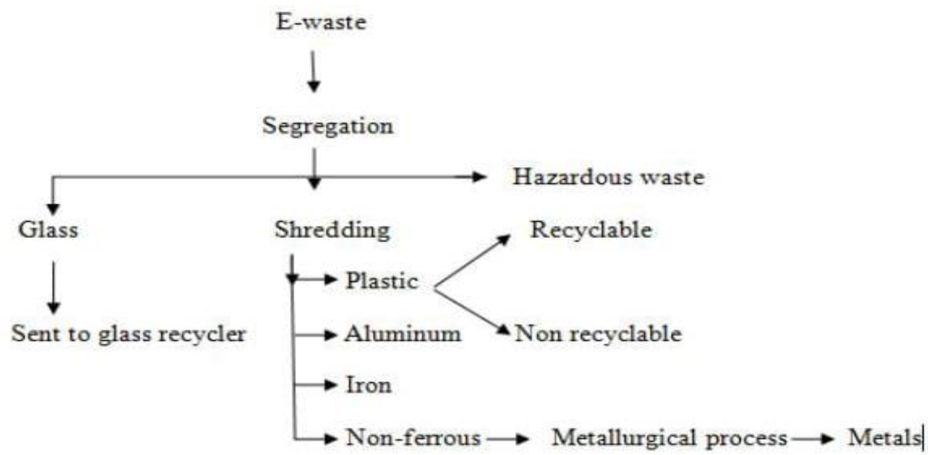

Figure 1.2 Flow Chart of Classification of E Waste

1.4 FUTURE WORK

Plastic waste paver bricks give us hope and a way to work on innovative things related to the plastic and to try to invent some new civil engineering materials which shows some remarkable response in future industry and changes the thoughts of the researchers, users and industries. Such as, in goingfor

- E-waste tracks for running and jogging in place of concrete or stone tracks.
- Research on Composition of plastic with ggbs, construction debris, fly ash etc.

1.5 TYPE OF BRICK MOULD SHAPE

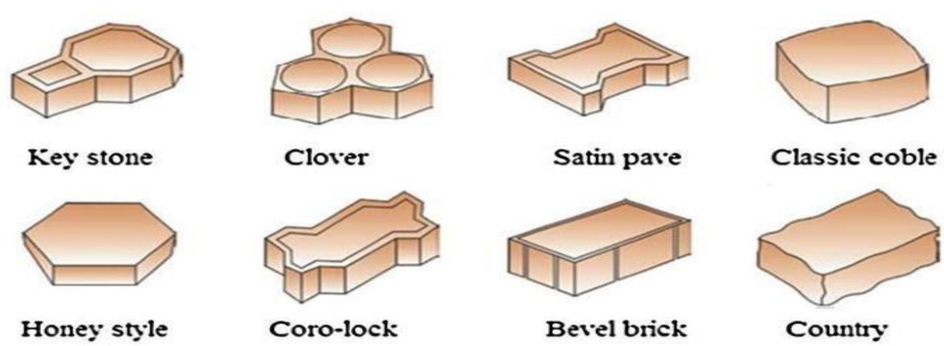

Figure 1.3 Types of Mould Shapes

1.7 OBJECTIVES

- Reduce the accumulation of electronic waste and transform it into useful raw material using simple, low-cost, and environmentally friendly technology.
- Idea focuses on partially replacing coarse aggregate in concrete with electronic waste ranging from 10% to 30%.Additionally, Industrial Waste such as fly ash and slag are added as a partial replacement for cement in each 20 percentage and the mechanical properties of these mixes is evaluated in an experimental study.
- The objective of E-Plastic Waste usage is for the reduction of issues about the landfill, pollution caused by incineration, and also to regulate the depletion of natural resources.

1.8 SCOPE

- Optimum proportions of E- waste as a constituent of construction materials are required
- Explore E-waste materials that can be used as filler and their effect on properties of masonry bricks
- Cost–benefit analysis for the commercial production of such construction material.

1.9 ARTIFICIAL AGGREGATE PROPERTIES, APPLICATION AND PARAMETER

However, for any manufactured aggregate or artificial aggregate, the key physical properties are bulk density, specific gravity, unit weight, porosity, and water absorption. Artificial aggregates (AAs) are man-made construction material, and the properties greatly depend on its manufacturing process (e.g. granulation and hardening) and the raw materials (usually different source of wastes) used .The aggregate has been an important material in various industries as it can be used in may apply depending on their properties. The by-product such as fly ash been mostly researched to be use for structural concrete. The artificial lightweight aggregate as well can be grouped as a granular thermal insulation product as it has good thermal insulation .The aggregate strength is usually not a factor except in lightweight and high strength concrete. However, aggregate characteristics other than strength, such as the size, shape, surface texture, grading and mineralogy are known to affect concrete strength in varying degrees. Although the water / cementious material ratio is an important factor affecting the strength of concrete, the aggregate properties cannot be ignored. The aggregate strength is usually not a factor except in lightweight and high strength concrete. However, aggregate characteristics other than strength, such as the size, shape, surface texture, grading and mineralogy are known to affect concrete strength in varying degrees.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

Literature review describes about the previous journal papers and research papers who did some research and project related to waste materials produced for blocks.

2.2 LITERATURE REVIEW

Ikechukwu and Naghizadeh et.al. : Said that 20%, 30%, and 40% of PET plastic waste with the addition of foundry sand. It is observed that compressive strength increases with an increase in plastic content by up to 30%, and further addition of plastic reduces the strength. The reference value is taken as 13.41 MPa for compressive strength, 2.8 MPa for tensile strength, 10% for waterabsorption, and 1,894 kg/m^3 for density. It is found that the plastic content brick shows greater compressive strength, least water absorption, high tensile strength, and least density in comparison tothe reference brick.

Intan and Santosa et.al: Said that the introduced 9 : 1, 8 : 2, 7 : 3, 6 : 4, and 5 : 5 ratios of PET or LDPEplastic waste by adding building material waste into it. It is observed that compressive strength increases up to the 6 : 4 ratio with an increase in plastic content; more addition reduces the strength suddenly for PET waste. PET shows greater compressive strength and density but less water absorption and porosity compared to LDPE plastic brick for the same content of the plastic sample.

Khan et.al.: Said that the design of green buildings should thus begin with the selection and use of eco- friendly Introduced 5% and 10% of PET plastic waste by adding cement and silica fumes into it. The reference value is taken as 30.17 MPa on the 1st day, 40.06 MPa on the 7th day, and 56.83 MPa on the 28th day for compressive strength and 7.08 MPa on the 28th day for tensile strength. It is observed that the plastic content brick shows the least compressive and flexural strength compared to the reference brick. It might seem that density, compressive strength, and water absorption increase with time in comparison to past values

Bhogayata and Arora et.al. : Said that the introduced 0.5%, 1.0%, 1.5%, and 2.0% metalized plastic waste. It is observed that compressive strength decreases with an increase in plastic content while a decrement in density is recorded. Tensile strength was observed to increase up to 1%, and after that, a decrement was seen for both flexural and splitting tensile strength. The reference value is taken as 41 MPa for compressive strength; 3.55 MPa and 3.10 MPa for flexural tensile strength and splitting tensile strength, respectively; and 2,460 kg/m^3 for density. It is observed that the plastic content brick shows less compressive strength, greater tensile strength, and less density com- pared to the reference brick.

Awoyera et.al : Said that the introduced 1.5% and 2.5% of PET plastic waste with the addition ofceramics, cement, waste tiles, sand, and granite. The pattern of split tensile strength was observed toincrease with content. The reference value is 21.7 MPa for compressive strength, 2.70 MPa for splittensile strength on the 28^{th} day, and 8.1% for water absorption on the 14^{th} day of observation. It isobserved that the plastic content brick shows greater compressive strength, greater tensile strength atcertain plastic content, and greater water absorption rate compared to the reference brick

Velmurugan et.al.: Said that the introduced 20%, 25%, and 30% of polyethylene plastic waste with the addition of M-sand, river sand, and fly ash. It is observed that compressive strength increased with an increase in plastic content, while an increment in hardness was also recorded. It can be observed that plastic with fly ash content impacts greater strength and hardness. The reference value is taken as 17-28 MPa for the compressive strength. The plastic content samples have strength in the reference list.

Vanitha et.al (2015) made a study using recycled plastics to partially substitute coarse aggregate in M20 concrete. Aggregates were substituted in different percentages and tests such as tensile strength and compressive strength tests were conducted to study the performance of the blocks. The results show that the compressive strength of M 20 concrete with waste plastics for paver blocks is within the acceptable level and can be used for road construction.

Shyam Prakash Koganti et.al (2017) have used several industrial waste products, including quarry dust, glass powder, ceramic dust, and coal dust, are used as a partial replacement for fine aggregate. After replacing it with waste materials, strength standards were assessed. It says that quarry dust could be replaced up to 20%, and the observed strength variation is not particularly noticeable.

Balasubramanian et.al (2020) have done tests in this study to compare the compressive strength of a typical block to the results of completely replacing fine aggregate with demolition trash. Concrete paver blocks with the M40 mix design were used in the test. Results show that the concrete paver blocks compressive strength has decreased slightly compared to the conventional concrete mix. Therefore, low load-bearing pavements can employ the concrete blocks created from demolition trash. The study has suggested using such paver blocks for low volume traffic roads.

Jeevan Ghuge et.al (2019) considered the utilisation of plastic waste in manufacturing of paver blocks . In this paper the use of plastic as a binder is studied. For the study 3 cubes of 0.00205m3 were casted, concrete blocks were casted each with plastic as a binder and without using water. In this process plastic collected from different sources burnt in a close chamber and melt it to the liquid state. And then that liquid plastic added into other ingredients for making plastic paver block. After sufficient curing of both ordinary and plastic concrete block it has to be checked under compression testing machine (CTM) to know its compressive strength under gradually applied compressive force on the specimen. After placing the paver block on the platform and applied the load on a smooth surface steadily and uniformly at the rate of 35N/sq.mm/minute till the block failed. The test results describe that average compressive strength of ordinary concrete paver block on its complete curing of 28th day is 19.54 N/mm2 where in case of plastic paver block it is 16.05N/mm2. From the obtained results it is clear that plastic paver block has almost equal strength as that of ordinary one. It can be concluded that plastic paver block can be used in the park, footpath and yards of the residential as well as commercial building because the compressive strength is sufficient for the smooth utility of user.

Jerome Song Yeo et.al (2021) have used various types of waste materials in making the paver blocks. Some of such waste materials were soda-lime glass, recycled concrete wastes, marble waste, crumb rubber wastes, etc. The study investigated the impact of waste materials on the mechanical properties of paving blocks. The study has shown that soda-lime glass, recycled aggregates, marble wastes, and crumb rubber wastes could be mixed at appropriate proportions to make high-performance paver blocks.

Akshay Kumar Bacha et.al(2016)A Replacement for Conventional Building Materials by EPS-Wire Mesh Panel . In this study attempt is made to understand the strength behaviour of the EPS wire mesh panel with normal conventional concrete by varying the thickness of plaster, and is examined under compression loading. Since the number of joints in an EPS Panel when used for wall construction will be less hence the strength of wall marginally increases. The EPS panel of size 1mx1m was used for testing Compressive strength of 2.26 N/mm2 and 2.64 N/mm2 were obtained for 25mm and 35mm plaster thickness. Since the number of vertical and horizontal joints can be minimized marginally by using the EPS panel in wall construction hence the strength is improved. As compared to the weight of conventionally built wall, EPS panel wall reduces the weight so in construction of multi story buildings EPS panels can be considered as the best suitable replacement for conventional methods of wall construction. EPS panels are most suitable for thermal insulated wall due to the presence of polystyrene in the panel.

Suchithra et.al (2022) It has been investigated whether building and demolition trash, as well as recycled plastic waste, may be used to make paver blocks. They suggested that C&D waste be mixed with melted polyethylene terephthalate wastes. The study was done to find the durability, water absorption, compressive strength, and flexural strength of the blocks and have seen acceptable results for their use

Yazi Meng et.al (2018) highlight the typical qualities of concrete blocks made using waste materials. The study shows that the fire resistance properties of the blocks were improved by using recycled crumb rubber, plastic wastes, and crushed bricks. Moreover, the proportion of waste materials used in concrete blocks can be increased significantly to substitute the natural aggregate to meet the specifications for concrete blocks.

Mahaveer Prasad et.al (2018) studied Use of plastic waste in concrete mix . The concrete mix was design to study the effect of replacement of sand by fine plastic waste material. The polyethylene wastes are cutted into small pieces and grinded into fine grains. Portland cement mixed with fine plastic wastes material and water using different percentages of wastes as 0%, 5%, 10%, 13% were made. The best compressive strength for product was found in the mixture has 5%, 10%, and 13% polyethylene. The yield points for them are 970, 797, and 874 N, for immerged 7 days, respectively, and 1520 for mixed of 5% and 1296 N 10% after immerged 28 days. The stress-strain behavior is plastic behavior which has several stages of deformation It works as semi crystalline polymer, flexible concrete and not brittle as Sand-Portland cement concrete. Therefore, their stress – strain diagram exhibited both elastic and plastic deformation before fracture. Moreover, the products with 5% to 13% waste plastic material have good workability to make holes without any problem. However, when the percentage of waste decrease or increase, the workability will be weak and power was generated during the cutting operation.

Mr. Nitin D Arsod, V Kannao et.al (2019) studied a paper on experimental investigation on concrete paver block and plastic paver block . The research work is determination of the effect of use PVC plastic waste powder as replacement of cement in percentage 0, 10, 20, and 30. Cube specimens of 36 numbers were cast cured and tested cube for 7, 14, and 28 days compression strength. PVC was powdered to fine powder and mixed along with sand and cement uniformly. Then 10mm coarse aggregate is mixed along with this As PVC plastic is mixed, it requires more water. The finishing, shape, interlocking and appearance of the paver block are good. From our experimental study, we concluded that 10% replacement of cement with PVC plastic is applicable. Skilled labour not required for installation paver block.

Eshmaiel et.al(2014) have looked into ways to lessen the amount of cement in paving blocks using waste and by-product materials such as ground granulated blast-furnace slag (GGBS), plasterboard gypsum (PG), and cement bypass dust (BPD) etc. Different mixtures' binary and ternary blend combinations are taken into consideration. A cementitious mix containing GGBS, BPD, and plasterboard gypsum up to5% by weight can replace portland cement without having a significant impact on the strength or durability of the blocks, according to tests on the tensile strength, skid/slip, and freeze/thaw resistance of paving blocks. Selected mixtures' results from XRD and XRF tests have been presented and analyzed. When compared to the percentage of cement used in factories, the cement content of concrete blocks made with GGBS, and BPD can be reduced by up to 30%

Sojobi et.al (2016) evaluated the performance of eco-friendly lightweight interlocking concrete paving units incorporating sawdust wastes and laterite. The study demonstrated the feasibility of using organic waste materials in the production of interlocking concrete blocks, thereby reducing the environmental impact of construction activities. However, the research did not specifically address the incorporation of e-waste and industrial waste in the concrete blocks.

Olofinnade et.al (2021) discussed solid waste management in developing countries and the reusing of steel slag aggregate in eco-friendly interlocking concrete paving blocks production. Although the research addressed the utilization of waste materials in concrete production, it did not specifically mention the integration of e-waste and industrial waste in the manufacturing process.

Llanes et.al (2021) investigated the use of construction and demolition waste as recycled aggregate for environmentally friendly concrete paving. The findings highlighted the potential of utilizing recycled materials in concrete production to reduce environmental impact. However, the study did not delve into the incorporation of e-waste and industrial waste in the concrete blocks.

Salla et.al (2021) conducted an experimental study on various industrial wastes in concrete for sustainable construction. The findings emphasized the importance of utilizing industrial waste in concrete production to achieve sustainability goals. However, the study did not specifically investigate the incorporation of e-waste in the manufacturing process of interlocking concrete blocks.

2.3 SUMMARY OF THE LITERATURE

- Result of various investigation shows that significant improvement on setting time and compressive strength can be obtained by adding GGBS aggregate in the mixes
- E-waste or Electronic waste poses a significant threat to the environment and human health globally .The toxic emission from including acids hazardous compounds heavy metals and carcinogenic ,chemicals ,contaminate soil and air directly and indirectly harming ecosystems .For solving and minimizing the discarding of huge quantity E-waste substance, recycle of E-waste materials in concrete production.
- The main objective of using e waste and industrial waste is waste management as e-waste counts as a major space filling material in landfills for the above literature .It found that the compressive strengh tends to decreases with the increases in percentage of addition of E-waste .However, adding an optimum amount can give compressive strength almost same as the conventional paver bricks .That is an optimum amount of 30% gives

acceptable compressive strength value .It can also be found that e-waste gives good thermal insulation and properties to a conventional paver bricks.

Growing amounts of E-waste in our ecosystem can be strategically tackled by its recycling/reuse in an effective and beneficial manner. This review gave a focused summary of the research work being carried out to exploit E-waste as a constituent of construction material. It is a meticulous study of utilization of waste plastic in construction bricks, blocks, tiles and concrete for road construction.

CHAPTER 3

METHODOLOGY AND EXPERIMENDATION

3.1 GENERAL

The physical and chemical properties of materials, methodology and mixture proportions of concreteto be used in this work are discussed in this chapter.

3.2 PROPERTIES OF RAW MATERIALS

In manufacturing process, several raw waste materials are used as follows.

1. E-Waste
2. Fly Ash
3. GGBS
4. Plasticizer
5. Water

3.2.1 E-WASTE:

Electronic waste is also represented because the discarded electronic equipments like mobile phones, computers, social unit appliances that fail or aren't any fitter for its originally meant use. Everyday advancements in technology have resulted in fast growing surplus of electronic waste around the globe Table 3.1 shows the physical property of E-waste and refer figure 3.1.

Table 3.1 E-Waste

S.No	Property	Value
1	Density at 20^0 C	1.41 kg/m^3
2	Elastic Modulus	2.8- 3 GPa
3	Tensile Strength	55 – 75 MPa
4	Elongation at break (%)	50 – 150 %
5	Thermal conductivity	0.5– 0.24 W m-1K-1

Figure 3.1 E-Waste

3.2.2 FLY ASH :

Fly ash is extracted from pulverized or crushed coal by suitable process such as by cyclone separation or electrostatic precipitation. Fly ash collected at later stages of electrostatic precipitator is finer than the fly ash collected at initial stages of electrostatic precipitator. The figure of fly ash is given figure 3.2 The physical properties of fly ash is given in Table 3.2

Table 3.2 physical properties of fly ash

S.No	Physical Property	Value
1	Specific gravity	2.02
2	Physical Form	Powder Form
3	Silicon dioxide (SiO_2)	54.93%
4	Aluminum oxide (Al_2O_3)	23.50%
5	Ferric oxide (Fe_2O_3)	4.56%
6	calcium oxide (CaO)	3.85%

Figure 3.2 Fly ash

3.2.3 GGBS(Ground Granulated Blast Furnace Slag):

Ground granulated blast furnace slag (GGBS) is obtained byquenching molten iron slag from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. The specific gravity of GGBS is found to be 3.1. The chemical composition of GGBS is given in Table 3.3

Table 3.3 physical properties of GGBS

Sl.no	Physical property	Value
1	Specific Gravity	2.98
2	Bulk Density	1454.5kg/m
3	Ph	10.03
4	Fineness	2.33%

Figure 3.3 Ground Granulated Blast Furnaces Slag

SUPER PLASTICIZERS:

Super plasticizers are also known as high range water reducers. Conplast SP430 which is based on sulphonated napthalene Polymers is supplied as a brown liquid and it is instantly dispersible in water. Conplast SP430 has been specially formulated to give high water reduction upto 25% without loss in workability or to produce high quality concrete of reduced permeability. The quantity of super plasticizer added in concrete is 3% by weight of cementitious materials.

WATER:

Water that is clean and free from injurious amounts of oils, acids, alkalis, salt, sugar, organic materials or other substances that may be deleterious to concrete is used. Extra water is added to improve the workability and the amount of water added is 10% by weight of binder materials (fly ash and GGBS)

3.3 METHODOLOGY

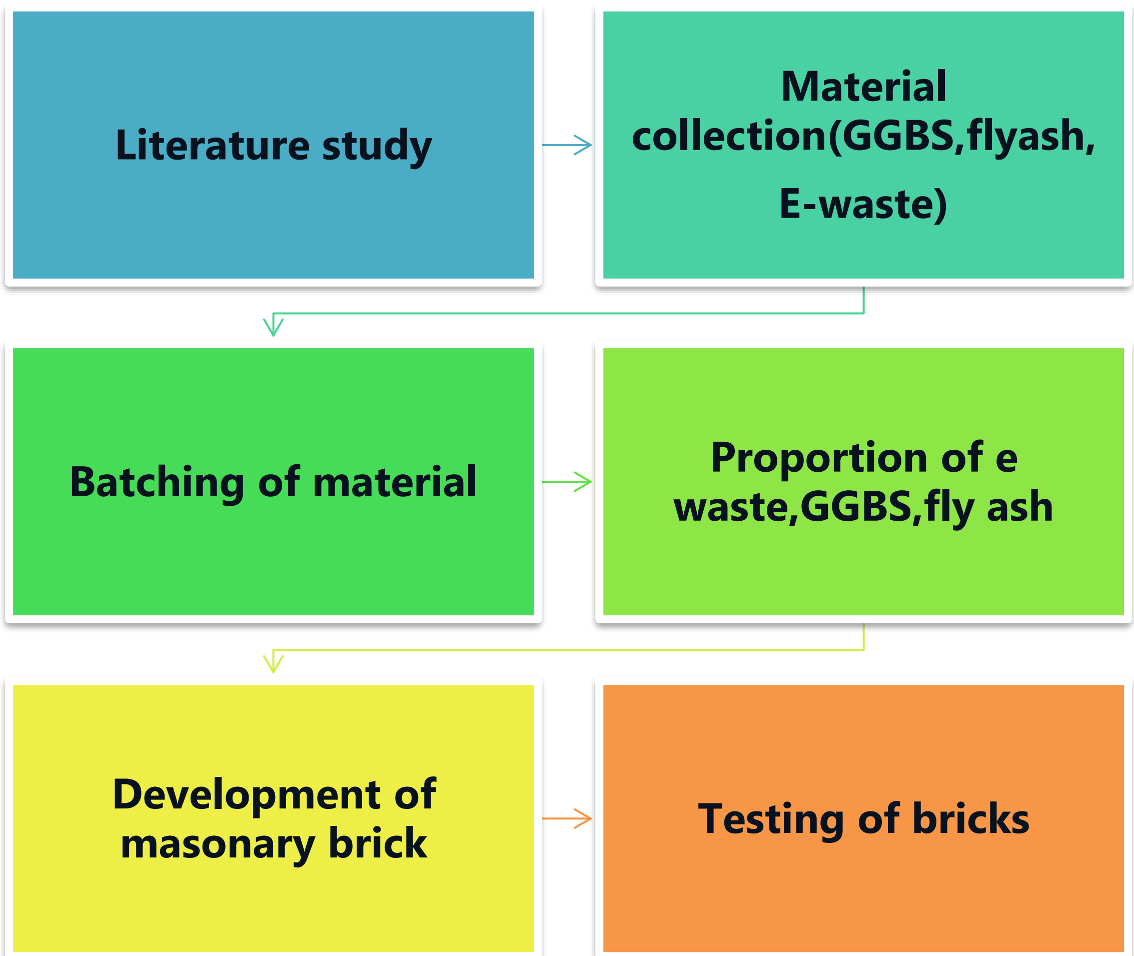

Figure 3.4 Methodology

3.3.1 Optimization of Binder material and utilization of E-wastes as filler material for the waste plastic brick

The mix designs for WPB bricks samples used in this investigation vary in percentages by dry mass of the filler materials (E-waste, fly ash). Various mixes of percentages in an increment of 10%, 20% & 30%. During this experimental program, E-Plastic Waste cast alongside the opposite basic materials during a mixed proportion of M25 grade (1:1:2) and tested as per the Indian standards for precast concrete blocks for paving. These test results are then compared with the results of conventional paver blocks.

The mix was then cast into bricks mould of 220 mm length x100 mm depth x70mm height that had been coated with a silicone-based release spray to eliminate any form of adherent to walls of the mould . The samples were compressed with compression stress equivalent to 5 MPa from a pressure jack to reduce randomly distributed void within the bricks matrix before cooling in room temperature of 24^0C.The computed results were compared with the results of conventional paver blocks and it had been found the planning paver block was on par to the traditional paver block for the specified tests conducted consistent with IS15658:2006.

Optimization of mixing ratio of E-waste and mixtures of industrial waste materials like ggbs, shredded plastic and concrete debris for the fabrication of paver brick. (By this stage, the first objective of the research proposal will be achieved. Refer figure 3.4.

3.4 STEPS INVOLVED IN MANUFACTURING PROCESS

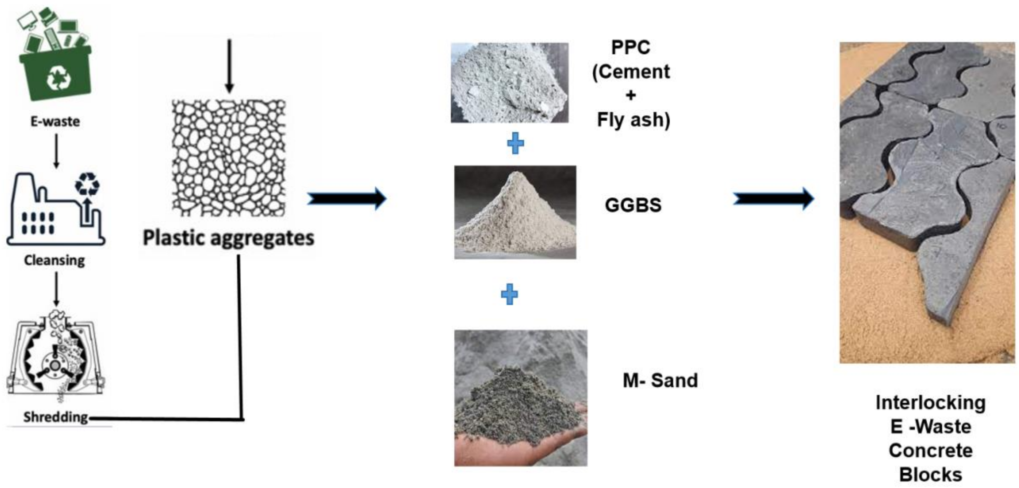

Figure 3.5 Steps Involved In Manufacturing Process.

1. **Collection of Material**

   E-waste can be collected from the E-waste plant for example demolition of computer ,tv ,mouse ,keyboard etc .GGBS can be purchased from the local supplier.For the consumption of the fly ash we are using ppc cement(Portland pozzolana cement) ,which will be blended with fly ash

2. **Batching of material**

   Measurement of material is called Batching. After collection of plastic waste check that there should notbe present water content in the plastic waste if presented, then dried

3. **Mixing**

   The material used taken as per mix design provided by measuring the weight and then it is mixed along with the water and plasticizer with the purposed amount

4. **Moulding**

   Apply the oil on the inner surface of mould, so that bricks can be removed easily. If oil is not applied,after solidification of brick will not come out easily. So proper oiling is needed before filling the mixture in the mould. Prepared mixture is filled into the wooden mould and tamping is done by rod to achieve proper compaction and the wooden mould is filled properly. And block can be removed from the mould after 24 hours.

COLLECTION OF E-WASTE

BATCHING OF MATERIAL

MIXING

MOULDING

3.5 Processing

Most common method in which glass waste powder is used in various products is with cement to make bricks and other related products. But, such products exhibit high efflorescence leading to inferior quality. This is occurs due to presence of water and hydration process. In our proposed product, it is combined together eliminated the use of water and cement. use E-waste as filler material in addition of GGBS and fly ash acts as binding material. enhances the mechanical properties of the final product.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 General

In this chapter, the experimental results obtained are discussed and presented in the form of tables and graphs. The test results of flexural behavior of corrosion induced RCC beams and GPA concrete beamsare discussed in detail.

4.2 INVESTIGATION OF PROPERTIES OF PLASTIC PAVER BRICKS USING VARIOUS TESTS

4.2.1 Compressive Strength Test (IS 3495-1992 Part 1):

In this study, the impact of compressive strength on newly developed WPB has been tested by applying compressive force in the range 14 N/mm^2. After the molding process, the well- defined shape brick has been kept in compression testing machine and then the compressiveforce has been applied slowly on the brick surface till the sample get brittle. From the analysis, the compressive strength of the brick has been evaluated by using the given belowequation. Kindly refer Figure 4.1 and 4.2 . illustrate the comprehensive test of 5%, conventional paver bricks and table 4.1 the result and values are provided in table 4.
Compressive Strength of Bricks = Maximum Load at Failure (N)/ Area of bed face (mm^2)

Figure 4.1 Compressive strength of 10%and 20%

Figure 4.2 Failure of plastic paver bricks during compression test

Table4.1 Results of compression strength test

S/No	Properties	10% Plastic	20% Plastic	30% Plastics	No Plastic
1	Area	0.0028	0.0028	0.0028	0.0028
2	Peak Load	975	935 kN	910 kN	950 kN
3	Results	34.82	33.39	32.50	33.92

- **CALCULATION**

10% brick peak load : 975kN Area: 0.028m^2

Compressive strength of 10% brick : $\frac{975 * 1000}{28000}$

: 34.82 N/mm^2

20% brick peak load : 935kN Area : 0.028m^2

Compressive strength of 20% brick : $\frac{935 * 1000}{28000}$

: 33.392 N/mm^2

30% brick peak load : 910kN Area : 0.028m^2

Compressive strength of 30% brick : $\frac{910*1000}{28000}$

: 32.5 N/mm^2

No plastic brick peak load :950KN Area : $0.028m^2$

Compressive strength of no plastic brick : $\frac{950*1000}{28000}$

: $33.95\ N/mm^2$

Note: Minimum average compressive strength of brick shall not be less than 7.5 N/mm^2 when tested as per IS-3495 (Part1):1992. The compressive strength of any individual brickshall not be falling below the minimum average compressive strength by more than 20%.

4.2.2 Water absorption test (IS:3495 Part-2):

In this work, to conduct water absorptiontest ofthe waste plastic bricks first weighted in dry condition and they are immersed in water for 24 hours. After that they are taken out from water and they are wipe out with cloth. Then the difference between the dry and wet bricks percentage are calculated. Kindly refer figure 5.3 and table 4.2 for the result and images of the water absorption test

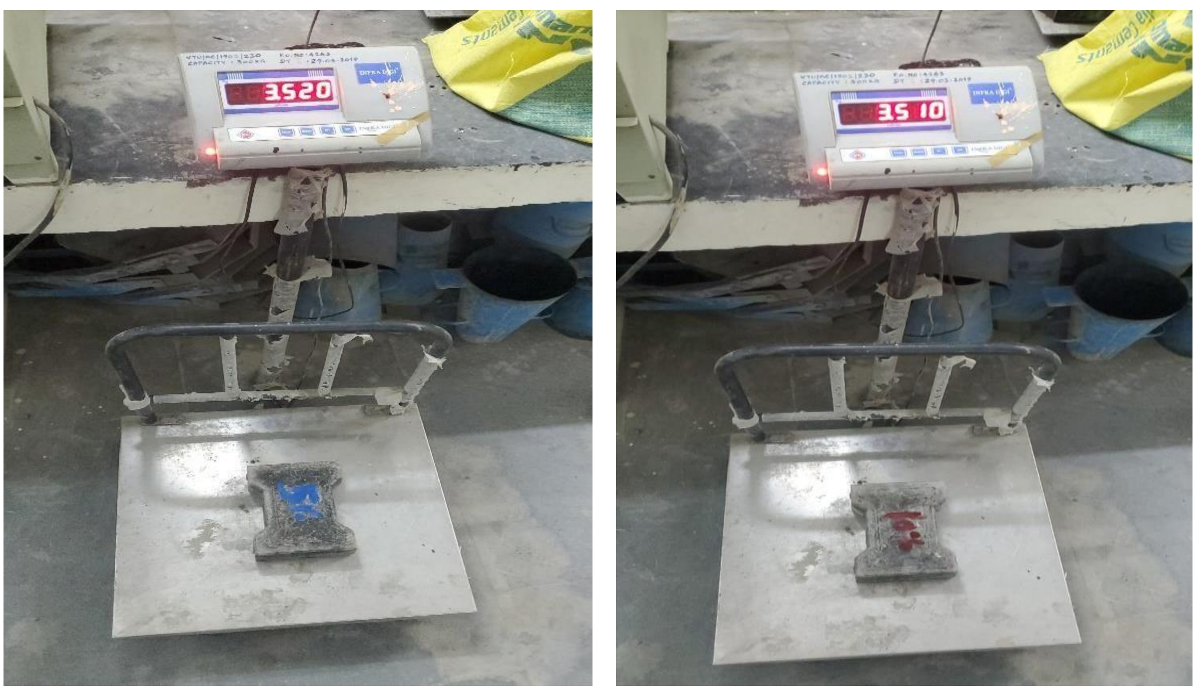

Figure4.3 Weight before water absorption of both 10% and 30% paver block

Figure 4.4 Weight of 20%and 30% paver block after water absorption

Table 4.2 Result of water absorption test

S/No	**Bricks**	**W2**	**W1**	**Water Absortion**
1	10%	3585	3485	2.789
2	20%	3600	3520	2.222
3	30%	3590	3510	2.228
4	0%	3770	3720	2

CALCULATION:

Water absorption of paver blocks : $\dfrac{(W2-W1)*100}{W2}$

10% : $\dfrac{(3585 - 3485)*100}{3585}$

: 2.789

20% : (3600 - 3520)*100

3600

: 2.222

30% : $\frac{(3590 - 3510)*100}{3590}$

: 2.228

0% : $\frac{(3770 - 3720)*100}{3770}$

: 2

Note: The bricks when tested in accordance with the procedure laid down in IS: 3495 (Part-2):1976 afterimmersion in cold water for 24 hours, shall have water absorption not more than 20%.

4.2.3 Efflorescence test (IS:3495 Part-3):

The presence of alkalis in bricks is harmful and theyform a grey or white layer on brick surface by absorbing moisture. To find out the presence of alkalis in bricks this test is performed. In this test a brick is immersed in fresh water for24 hours and then it's taken out from water and allowed to dry in shade. Kindly refer Table for the result of the efflorescence test

Table4.3 Result of efflorescence test

S.No	Test Conducted	10% Pet waste	20% Pet waste	30% Pet waste	Tested as per Standard	Limits as per code (First Class)
1	Efflorescence Test	sight	Slight (<10%)	Slight (<10%)	IS 3495 (Part 3):1992	Slight

4.2.4 Fire resistance test (ASTM E119):

The Plastic is highly susceptible to fire but in case of Plastic waste bricks, the presence of filler material imparts insulation. To find out no change in the structural properties of block of bricks up to 180°C to check visible cracks are seen and to find deterioration with increase in temperature. Kindly refer Table 4.4 for the result of the fire resistance test

Table 4.4 Result for fire resistance test

S.No	Test Conducted	10% pet waste	20 % petwaste	30% pet waste	Tested as per Standard	Limitsas percode (First Class)
1	Fire ResistanceTest	One Hour	One Hour	One Hour	ASTM E119	OneHour

4.2.5 Density test (IS: 2185 (Part 1): 2005):

The density of blocks is determined as the ratio between the weight of the specimen after drying at 105 degrees Celcius and the volumeof the specimen . Kindly refer Table 4.5 and figure 4.5 for the result and images of the density test

Table 4.5 Result of density test

S.No	Test Conducted	VOLUME	MASS	Tested asper Standard	DENSITY
1	10% pet waste	$5.6*10^{-3}$	3.55	IS: 2185	648 kg/m^3
2	20% pet waste	$5.6*10^{-3}$	3.52	IS: 2185	645kg/m^3

3	30 % pet waste	$5.6*10^{-3}$	3.51	IS: 2185	643kg/m^3
	Conventional Specimen	$5.6*10^{-3}$	3.77	IS: 2185	691kg/m^3

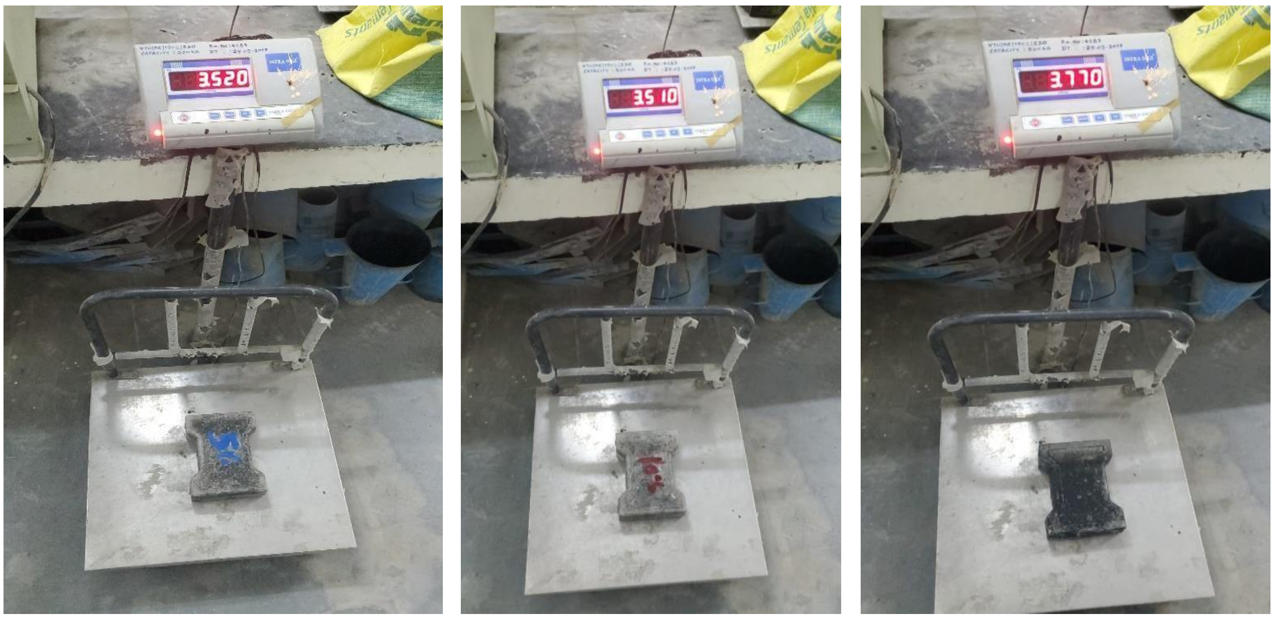

Figure 4.5 Oven dry of 10%,30% and conventional brick paver bricks

CALCULATION:

Density of 10% Brick = 3.55/0.028*0.195

= 645kg/M^3

Density of 20% Brick = 3.51/0.028*0.195

= 643kg/M^3

Density of 30% Brick = 3.77/0.028*0.195

= 691kg/M^3

To examine the mechanical properties of bricks such as compressive strength, impact strength, water absorption, efflorescence, density, hardness, and fire resistance made of plastics and industrial waste materials.

CHAPTER 5

CONCLUSION

An experimental study has been done on concrete using electronic waste as coarse aggregate and also with fly ash & GGBS as replacement of cement and following points is observed from the present study.

- Workability of the concrete increases when percentage of the electronic waste increases
- When fly ash & GGBS content added to electronic waste concrete, it has been observed that workability increased. Workability of fly ash & GGBS with electronic waste concrete is even more than conventional and electronic waste concrete.
- Compressive strength of electronic waste concrete decreases with increase in the percentage of e-waste.
- It has been observed that when we replace cement by fly ash & GGBS in concrete along with electronic waste as a coarse aggregate compressive strength increases.
- Cement replacement of 30% by GGBS &40% of flyash along with electronic waste gives best result.
- Current study concluded that Electronic waste can replace coarse aggregate upto 20% or 30%.
- Current study also concluded that electronic waste can replace coarse aggregate upto 30% in concrete when 30% GGBS & 40% of fly ash is replaced by cement.

Although plastic bricks are to disposition of plastic throughout the nature which helps to avoid the junking of plastic in landfills is diminished which emerges to be economical. Plastic is an unsustainable material and have non-biodegradable property which badly makes toxic effect around the globe. But plastic being a versa- tile material have different property (durable, strong, easily moulded) which can use as a green material and also the best solution for reducing environmental pollution. These bricks can be fitting to those countries which face difficulties on disposing the plastics. Although plastics have drawback of causing pollution but also have numerous advantages; give better insulation, low porosity, cheap & easily available. Therefore, low-cost bricks as used in construction material helps the environment as best way for disposal the plastic is to reuse/recycle it andland. Plastic bricks are superior inall ways with comparison with local sand bricks as they as more economical, higher compressive strength, low water absorption and light weighted plastic paver bricks.

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