IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 21, Issue 3 Ser. 1 (May. – June. 2024), PP 51-55
www.iosrjournals.org

"The Study On Eco-Plastic Constructed Building And Its Sustainable Strategy With An Analysis By Comparing Conventional Construction."

G.V.S Supraja Rama Lakshmi[1], CH.Mounika[2]
[1]*Research Scholar Acharya Nagarjuna University College of Architecture and Planning, Guntur, India.*
[2]*Assistant Professor Architect JBR Architecture College, Hyderabad, India.*

Abstract
Plastic pollution is the most ignored problem which the world facing currently. So, In what ways can Architecture be a solution for plastic pollution? How and which plastic waste can be integrated into construction materials, And will they be sustainable for the life and Eco-system of the world? Plastic waste has been accumulating since the year of its invention. Besides its revolutionary properties plastic has ended as a single-use material.
As an architect, it is responsible to understand the global problems and creating habitats or spaces that are self-sustainable or helpful for the Eco-system. Architectural awareness about the Eco-plastic material should take place by encouraging and adopting Eco-plastic materials into the construction of buildings and public spaces. Apart from promoting the Eco-plastic material, The essential role of Architecture in the recycling of plastic waste and environment is also explained.
The incentive of this research is to specifically focus on the sustainable properties of Eco-plastic construction with the support of existing practically possible research. Case study of an existing Eco-plastic building and a conventional building are compared at different levels as environmental, Economical, Ecological, and social to describe the merits and demerits of Eco-plastic. An analysis is derived from the comparison of projects and concluded with further developments.
Key-Words: *Eco-plastic, Plastic pollution, Recyclable plastic, Plastic architecture, Eco-plastic materials, Sustainability.*

Date of Submission: 03-05-2024 Date of Acceptance: 13-05-2024

I. Synopsis

Introduction:

Plastics have become such an entrenched part of our lives, some of the early uses of plastic are dated as far back as 3,500 years ago as a natural occurring sap from gum trees. During the mid-19 and 20th centuries, synthetic plastics are made, but the development of its structure and principals are still happening. Because of plastic utility, its global production has developed about every decade. Sine 1950 the plastic production is measured as 9.2 billion tons which is equal to the weight of nearly 1,600 great pyramids of Giza. Although plastic had long ceased to be a revolutionary material instead it became trash due to single usage. It takes between 500 to 1,000 years to break down plastic. Scientists are discovering other solutions to recycle plastic and manufacturers using biodegradable plastics in their production.

Although recycling, burning taking place still 80% of plastic is still around, A lot ends up in the ocean about 8 million metric tons a year which are endangered to marine animals and hazardous to mankind. Under all the circumstances of plastic, it is responsible for an architect to know about the ecological and environmental issues in the present and future So that the architecture will somehow support the sustainability of the world. This research on the Eco-plastic construction with its sustainable strategies will help in the development of Eco-plastic buildings and spaces that are human habitats

Need For The Study:

a) To help architecturally in the recycle and reduction of plastic waste by constructing Eco-plastic human habitats.
b) This study supports the sustainability strategies of Eco-plastic construction.
c) To help architecturally in conserving natural resources by replacing regular construction materials to Eco-plastic materials.

d) This study will explain the manufacturing of Eco-plastics for construction by stating the benefits and uses both architecturally and environmentally

Aim:

I aim to study Eco-plastic construction which is sheltered for humans and also beneficent for Environment, Social, Economy, and Ecology.

Objectives:

a) To study on which plastic waste is suitable for construction and how different materials are manufactured using plastic waste.
b) Identifying parameters on the basics of where Eco-plastic materials can be used in the construction of architectural buildings.
c) explaining the sustainable strategies of using Eco-plastic in construction.
d) A broad comparison of a regular constructed building to Eco-plastic building.
e) Encourage future dwellings and spaces to adopt Eco-plastic materials in construction.

Scope:

The study will emphasize the need to adopt plastic waste in the construction of buildings. Using plastic pollution as an opportunity to prove its function and ability in architecture for the present and future. Through the production and material, usage can promote the mitigation of greenhouse gases, natural resources, and pollution. The study will also focus on the benefits of using Eco-plastic in connection to various sectors such as Environmental, Ecological, Economical, and Social. This dissertation looks into the sustainable properties of Eco-plastic which can be integrated into the construction of sustainable habitats. A comparison of regular constructed buildings and an Eco-plastic building is explained to create awareness about Eco-plastic materials in construction. This is done concerning to satisfy human comforts and construction of practically possible habitat. This dissertation will state the properties and durability of Eco-plastic under natural calamities and hazards. This paper will also attempt at discussing a few strategies to develop the existing use of Eco-plastic in architecture.

Limitation:

a) This study will be focused on existing research done on plastic waste and production into construction materials.
b) No new materials are made in a lab for this study.
c) The secondary and primary case studies are sourced from the internet.
d) The structural features and basic load calculations are taken from existing case studies.
e) The strategies for developing Eco-plastic buildings might not apply to all types of buildings.

Research Framework:

The research will be based on the following things.

a) To begin with, a study of existing global statistics on plastic pollution and hazardous situations.
b) Types and classification of plastic waste which is used as a construction material.
c) Gathering existing literature about material plastic.
d) Identification of architectural techniques to help the difficulty of plastic pollution.
e) Comparing the case studies that supporting the research to be addressed in the dissertation, books, internet, Existing projects, and architectural articles are to be studied and understood.
f) Identifying techniques and construction process using Eco-plastic materials.
g) Understanding the sustainable strategies of using Eco-plastic.
h) Elaborating the advantages of using Eco-plastic construction useful both architectural and other sectors.
i) Comparison of regular construction to Eco-plastic construction and its analysis.
j) Doing SWOT analysis about Eco-plastic architecturally according to research.
k) Analyzing the data from all the research.
l) Attempts to develop the use of Eco-plastic in further architectural construction purposes.

II. Literature Study

Plastics are introduced roughly 100 years ago, today almost everything we use is made up of plastic. It is made up of synthetic or semi-synthetic organic compounds which can be melted and molded into different shapes. Since synthetic polymers are so durable, plastic takes between 500 and 1000 years to break down but most of the plastics we use today are meant to be thrown away. According to the CPCB estimate on plastic generated in India in 2017-2018 is 66,787.85 tones, enough to fill 66,079 trucks and each truck with 10 tones. India consumes an estimated 16.5 million tones, about 1.6 truck full, of plastic annually as per June 2018 report.

The global statistics on plastic production is 8.3 billion metric tons in it, 6.3 billion metric ends up as plastic waste. That situation, there are warnings, by 2050, there will 12 billion metric tons of plastics in landfills. search states that 8 million metric tons of plastic waste end up in the ocean every year. Therefore, it is causing a hazard to many living organisms, humans, plants, and animals. Plastic pollution is creating greenhouse gas emissions that contribute to the imbalance of climate and warming of our world.

Apart from other recycling schemes done it is impossible to give up on common recycling methods. It is responsible that the humans and different sectors in manufacturing should integrate on recycling by improving recycling methods. Therefore, Architecture has its responsibility for recycling plastic waste since the buildings we design should survive on the planet rather than plastic.

III. Literature Review

General:

The purpose of this lesson is to study existing research on plastic recycling methods and construction benefits.

Potential use of Plastic Waste as Construction Materials: Recent Progress and Future Prospect:

The author studied and addressed the potential use of plastic in two ways, experimenting on plastic composition with concrete and using laboratory analysis of similar research papers. The author explains the importance of mixing concrete with plastic to replace aggregate during concrete manufacturing. In this study, the difference from other studies is explaining the properties of plastic waste and stating the types, forms of recyclable plastic waste available, and useful to mix with the concrete. The study is concluded with laboratory tests on the concrete mix from plastic waste and the further prospect is explained in minimal on environmental balance and recommended to be explored further.
(Citation: M A Kamaruddin et al (2017)).

Inference:

Therefore, this article connects to the present research in multiple ways, Knowing the importance of recycling plastic waste, Types of plastic wastes, and segregation according to the classifications of each plastic waste in factors like strength, structure, and properties. The article also stated the importance of integrating plastic waste into construction.

A Review on Recycled Use of Solid Wastes in Building Materials: .

The study addresses the various solid waste on landfill causing pollution and environmental damage. Describes the global statistics on pollution and solid waste and promotes reusable ideas in construction materials. This study focuses on encouraging safe and harmless waste disposal and recycle to create new materials in buildings to save natural resources. Factors such as sustainability, environmental friendly are discussed with a summary and the practical performance of recycling constructed buildings is also identified.
(Citation: Oriyomi M. Okeyinka, David A. Oloke, Jamal M. Khatib(2007)).

Inference:

Therefore, this study helps in the study of recycled use in building materials from different solid wastes. Also, this study concentrates less on plastic recycling and no laboratory experiments are conducted.

Reuse of Plastic Bottles as a Construction Material:

This study focuses on disposal and non-biodegradable plastic materials by explaining the present pollution of plastics. The author also presents the problems of the urban poverty line and urban rubbish by stating the recycling status. Therefore the author identifies the solutions by using plastic waste in constructing materials for buildings. The literature review is a collection of supporting studies. There are times the article shows the advantages and disadvantages of plastics and recycling. The construction process is described and the properties of plastics and other materials used explained.
(Citation: Atul Chaurasia, Mr.Sumit Gangwar et al (2019)).

Inference:

Therefore, the plastic bottle and other construction materials are calculated and presented in detail and concluded by stating the sustainable properties of the construction.

Use of plastic waste in civil constructions and innovative decorative: .

This study and research focus on different uses of plastic waste and recycling of the plastic waste in two ways, decorative, eco-friendly walls with vertical gardening, plastic bottle house. This article is written by identifying the existing practically constructed projects and supporting them with the construction process,

structural calculations, and benefits. A comparison of regular brick walls and plastic bottle wall (constructed using PET plastic bottles) is described. This article also includes multiple literature reviews that help in supporting promoting plastic constructions and recycling. Therefore, the overall view of the article describes plastics, types of recyclable plastics, the importance of recycling, Disadvantages of plastic bottles, and including examples of existing projects of vertical gardening and plastic house construction. In conclusion, the author describes the benefits of opting plastic wall construction in factors of cost, energy consumption, carbon emissions, and other sustainable strategies with numerical values.
(Citation: Mohammed Jalaluddin et al (2017)).

Inference:

This article is helpful in multiple ways about plastic and construction with calculations that support the research in further areas of descriptions.

Eco-Architecture: Pet Bottle Houses:

In this article, the author narrates the present global situation and elaborates on the importance of recycling plastic waste in the construction field. This article introduces the plastic bottle brick construction by practically constructing a small-scale project in real. Then the advantages of this construction are stated by the process and method of construction. This article is different from other studies due to its practical project and by stating the construction calculations. The article concludes by discussing the benefits of and sustainability of plastic bottle brick.
(Citation: Shilpi Saxena, Monika Singh et al (2013))

Inference:

Therefore, the article helps in calculations of plastics need and as an example of plastic base construction.

Utilization of waste plastic in the manufacturing of brick:

This study of plastics in manufacturing brick focuses on the replacement of regular mud bricks to improve durability, saving natural resources, recycling of plastic waste, and sustainability. This article explains the process and procedure of creating plastic bricks by using waste plastic bottles, sand, bitumen in different mixing proportions. In this thesis, the author attempts to study the properties of plastic manufactured bricks. Therefore, the plastic brick is tested for compressive strength, water absorption, and unit weight. The study is concluded by developing the strength of the brick block after taking the inferences of the compressive test and the successful performance of the brick block is stated.
(Citation: Jannatul MAOWA and Muhammad Harunur RASHID et al (2018)).+

Inference:

This study of manufacturing plastic brick block and research provides a successful plastic construction material. The strength calculation of the brick can be explained in the present research.

IV. Comparative Analysis

Comparison Of Housing Structures Made from Eco-Plastic and Conventional Construction:

Introduction:

This study shows the total plastic approach and the benefits of plastic recycling, time consumed in the process of recycling and labor. Also states the actual practical situation of using plastic constructions. This paper is different from other due to the analysis of plastic structures and material by using FEA software. The problems of fireproofing and base development were also studied and explained.

Materials Used:

Polyethylene Terephthalate (PET), Polypropylene (PP), Poly Vinyl Acetate (PVA), Poly Vinyl Chloride (PVC), Polystyrene (PS), Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), etc. all these comes in thermoplastic category which contribute to 80% of total plastic use. Whereas Bakelite, Epoxy, Melamine, Polyester, Polyurethane, Urea – Formaldehyde, etc. comes under thermoset plastics category which contributes 20% of our plastic use.

Recycling Process:

For recycling plastics into Recycled Plastic Lumbers (RPL), thermoplastics are used. To form these blocks, mixed thermoplastics are not sorted out by their chemical properties, they are only properly cleaned. After that, the mixed waste plastics are heated and compressed and then molded to quickly form a required

shape. The products made out of Recycled Plastic Lumbers (RPL) are very long lasting, even companies give 50 years warranty on any RPL product.

Plastic lumbers are 100% plastics. They are made up by mixing thermoplastics all together and melted at around 400 degree Celsius and then extruded or molded into desired shapes.

Design And Analysis Of House And Living Room:

To test whether the commingled plastic can sustain the loads mentioned according to IS-875 for residential buildings, some CAD models were made by considering the general public living area in India. Such housings structures were developed using two methods. One type is load bearing structure and other is framed structure. In load bearing structures the walls of the building are subjected to transfer the load to ground. In framed structures, loads are supported using the outer frame.

All these structures were designed only for residential dwelling houses. Load bearing capacity is designed according to that consideration of IS-875, various loads on the building were implemented for computer-based analysis.

V. Conclusion

Eco-plastic homes shall be very beneficial for limiting the plastic waste going up for landfilling and ocean dumping. It will also bring good prices for waste plastic collection which ultimately increases the waste plastic collection quantity. There is also a chance of an increase in employment, as new industry will form out of this.

Houses made up of Eco-plastic have other benefits like quick housing with very low cost. Anyone with needs of the quick and cheap house can afford this. Further design optimization can make it cheaper than ever before. The complete assembly of houses can be achieved in several days. Earthquake prone areas should have such type of houses on priority because the density of material is low, hence if collapsed it will not hit people deadly. Also, if broken they can be reassembled. This will save lives as well as money required for rebuilding.

The computer-based analysis has shown that maximum stresses came inside the structure as 2.32 MPa for load bearing structure and 6.32 MPa, 3.48 MPa, and 3.32 MPa for framed structure. Hence Recycled Plastic Lumber can sustain stresses induced due to compression (25.88 MPa) and tension (10.15 MPa) both. The houses were tested for imposed, wind, and snow loading. Total deformation of a slab of the first floor was around 7.5 cm for load-bearing structure and 5.5cm, 3.28cm, and 2.56cm for framed structures. This shows that the houses will be safe for a living but due to less elasticity modulus large deformations are coming. Hence it implies that these houses cannot be built above the ground floor ICSESD- 2017 Proceedings IRA-International Journal of Technology & Engineering 55without any further frame development or without using any other material for the slab.

However, products like a Thermo-polymerized rock (TPR) can be used for slab only to build further stories over the ground floor. TPR is a synthetic concrete manufactured from reclaimed minerals and hard recyclable plastics. It is 6 times as strong as equivalent (Gen 3) concrete and 30% lighter in weight. This will increase the cost but it will be beneficial for floor increment.

Bibliography

[1] Https://Insights.Globalspec.Com/Article/7419/10-Kinds-Of-Thermoplastics-And-What-You-Can-Do-With-Them
[2] Https://Waste4change.Com/7-Types-Plastic-Need-Know/
[3] Https://Www.Thebalancesmb.Com/An-Overview-Of-Plastic-Recycling-4018761
[4] Https://Www.Explainthatstuff.Com/Bioplastics.Html
[5] Https://Www.Youtube.Com/Watch?V=Jr7jyzf9tjk
[6] Https://Www.Youtube.Com/Watch?V=Ckwqr1jd158
[7] Https://Whittakerassociates.Com/Eco-Friendly-Plastics/
[8] Https://Publications.Waset.Org/10003128/A-Review-On-Recycled-Use-Of-Solid-Wastes-In-Building-Materials
[9] Https://Www.Archdaily.Com/869926/This-House-Was-Built-In-5-Days-Using-Recycled-Plastic-Bricks
[10] Https://Www.Intelligentliving.Co/Plastic-Houses-Resistant-Earthquakes/
[11] Https://Www.Drishtiias.Com/To-The-Points/Paper3/Plastic-Waste-1
[12] Https://Www.Statista.Com/Topics/5401/Global-Plastic-Waste/
[13] Https://En.Wikipedia.Org/Wiki/Plastic
[14] Https://Www.Nationalgeographic.Com/Environment/Habitats/Plastic-Pollution/
[15] Https://Ourworldindata.Org/Plastic-Pollution
[16] Https://Www.Weforum.Org/Agenda/2018/08/The-World-Of-Plastics-In-Numbers
[17] Https://Science.Howstuffworks.Com/Environmental/Green-Tech/Sustainable/Eco-Plastic.Htm
[18] Https://Ourworldindata.Org/Faq-On-Plastics
[19] Https://Www.Archdaily.Com/81714/Silver-Shack-Chae-Pereira-Architects
[20] Https://Themazatlanpost.Com/2019/07/04/Mexican-Engineer-Uses-Recycled-Plastic-To-Build-Earthquake-Resistant-Houses
[21] Https://Newatlas.Com/Eco-Shield-Plastic-Home-Resist-Earthquake-Haiti/17499/
[22] Https://Www.Weforum.Org/Agenda/2018/08/The-World-Of-Plastics-In-Numbers
[23] Https://Www.Statista.Com/Topics/5401/Global-Plastic-Waste/

[24] Https://Www.Drishtiias.Com/To-The-Points/Paper3/Plastic-Waste-1
[25] Https://Seedscientific.Com/Plastic-Waste-Statistics/
[26] Https://Www.Archdaily.Com/869926/This-House-Was-Built-In-5-Days-Using-Recycled-Plastic-Bricks
[27] Https://Www.Archdaily.Com/869926/This-House-Was-Built-In-5-Days-Using-Recycled-Plastic-Bricks?Ad_Medium=Gallery