

Literature Review on Use of Plastic Bottles for construction of Water Tank as a Sustainable Material

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ABSTRACT

Plastic bottles are becoming a growing segment of the municipal solid waste. While plastic bottles offer convenience, they also create unnecessary waste in landfills. As plastic bottles are non-biodegradable, they remain for ages in the environment. The waste Polyethylene Terephthalate (PET) bottles are considered as an urban junk with sustainability characteristic which can be used as a material instead of some conventional material such as brick in water tank construction.

The plastic bottles are filled with waste filler materials, and casting of block is done with the appropriate mortar mix. These blocks work as bricks and form a framework for walls of water tank in which plaster made of clay or a cement mixture fills the space between all bottles. This paper intends to investigate the application of plastic bottles as one of the urban wastage in water tank construction and that how it can lead to sustainable development. This paper also includes different factors such as cost, load capacity and reducing waste. Plastic bottle block may be more effective compared to some conventional building materials such as brick. We made efforts towards waste plastic bottle used as construction material. Considering some limitation in properties of plastic bottles, we tested bottle required properties, filler materials and made cost analysis between fly ash bottle block and conventional fly ash bricks.

Keywords– Plastic waste PET bottle, sustainable material, urban wastage, construction material, strength properties, innovative water tank construction.

I. INTRODUCTION

Plastics are produced from the oil that is considered as non-renewable resource. Because plastic has the insolubility property. Plastics are polymers, very long chain molecules linked together with chemical bond. About 500 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 plastics are very strong and durable. So use of plastic bottles as innovative materials for building can be a proper solution for replacement of conventional materials. The objective of this paper is to make it possible to use these plastic bottles in the buildings. It also intends to compare the characteristics of some construction materials such as brick, and concrete block. Disposal of non-bio-degradable substance has become an issue of major concern

now a days. Tremendous amount of plastic garbage has been created in the environment. Only one in six plastic bottles are properly recycled. Recycling of plastic bottles are very uneconomical, dirty and labor intensive. Recycling of plastic is associated with skin and respiratory problems, resulting from exposure to and inhalation of toxic fumes during the process. The biggest problem with plastic recycling is that it is difficult to automate the sorting of plastic waste, and so it is a labor intensive. A suitable approach for this situation is using some part of urban rubbish or waste as required materials for building construction. The paper intends to investigate the application of plastic bottles which is one of the unnecessary waste and how we can use in building construction and also that how it can lead to sustainable development. Many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas, where energy is often crucial in human development. With population growth in today's world, the need to the building has increased and to respond to this demand, the countries tend to use the industrial building materials and decline the use of indigenous and traditional materials. These factors in spite of increasing the energy consumption in the industry section; they can also raise the cost of homes and are considered as the barrier for users to obtain the basic needs of the life. So the best solution is reusing for which no additional energy is required and does not contribute to pollution. Indeed, when we reuse junk, we are helping to save the obtained energy which would otherwise be wasted. It is focused on not only the financial aspect but also the environmental aspect. Plastic bottles make up approximately 11% of the content landfills, causing serious environmental consequences.

II. LITERATURE SURVEY

a) Aditya Singh Rawat¹, R. Kansal, PET Bottles as Sustainable Building Material: A Step Towards Green Building Construction, Journal of Civil Engineering and Environmental Technology Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 1, Number 6; August, 2014 pp. 1-3.

This paper proposes the use of waste plastic PET bottles as construction entity to standardized bricks. As plastics are non-biodegradable its disposal has always been a problem. Waste plastic bottles are major cause of solid waste disposal. Polyethylene terephthalate is commonly used for carbonated beverage and water bottles. This is an environmental issue as waste plastic bottles are difficult to biodegrade and involves processes either to recycle or reuse. Today the construction industry is in need of finding cost effective materials for increasing the strength of structures. This project deals with the possibility of using waste PET bottles as a partial replacement. It can be concluded that benefit of the use of PET bottles include both improved ductility in comparison with raw blocks and inhibition of crack propagation after its initial formation. The solution offered in the paper is one of the answers to long standing menace of waste disposal.

b) Jayaprakash M C¹, Deeksha I M² and Soumya M R, PET Bottles for Eco-friendly Building in Sustainable Development, International Journal of Current Trends in Engineering & Research (IJCTER) e-ISSN 2455-1392 Volume 2 Issue 5, May 2016 pp. 318 – 326.

This paper proposes the use of waste plastic PET (Poly-ethylene Terephthalate) bottles as constructions entity to standardized bricks. As plastics are non-biodegradable its disposal as always been a problem. This is an environmental issue as waste plastic bottles are difficult to biodegrade and involves processes either to recycle

or reuse. Green building is one that may represent a regenerative process where there is actually an improvement and restoration of the site and its surrounding environment. The ideal “green” project preserves and restores habitat that is vital for sustaining life and becomes a net producer and exporter of resources, materials, energy and water rather than being a net consumer. Green building is the practice of constructing or modifying structures to be environmentally responsible, sustainable and resource-efficient throughout their life cycle. Thus, to envisaged the sustainable development and energy consumption in the construction of green building for quality living concept to fulfill the paradigm of the development of country. The present work may give the same sort of solution in the construction of buildings by using waste plastic PET bottles which are dumped on the open land. It may solve the reuse of the waste plastic PET bottles as a benefit to minimize the solid waste in the form of environment friendly green building concept for living as a cost effective material.

c) Mardiha Mokhtar¹, Suhaila Sahat¹, Baizura Hamid¹, Masiri Kaamin¹, M. Jahaya Kesot¹, Law Chia Wen¹, LooYong Xin¹, Ng Pei Ling¹, Vivian SimJia Lei APPLICATION OF PLASTIC BOTTLE AS A WALL STRUCTURE FOR GREEN HOUSE ARPN Journal of Engineering and Applied Sciences, 2006-2015.

Wall structure plays important roles in supporting the superstructures, separates spaces in buildings into sections and delineates a space in open air. Most of the construction of house in Malaysia use bricks and mortar which consists of cement, aggregates and water as the materials to build the structure of wall. However, materials such as cement and bricks manufacturing process will contribute to a high emission of carbon dioxide (CO₂) which may lead to global warming. Therefore, objective of this paper is to find an alternative solution to reduce this hazardous environmental problem. The alternative way that can solve the problem is by replacing the use of bricks in building construction by plastic bottles filled with sand as we called it plastic bottle green house. Reuse of these non-biodegradable plastic bottles not only can solve the environmental problem, but it can also reduce the pollution. The main concern of this project is the strength of bottle bricks. Therefore, there were two types of experiments were used to evaluate the properties of bricks and plastic bottle filled with sand which are compression test and temperature test in indoor and outdoor of wall structure. The compression test is prepared for 1.5L bottle brick, 250ml bottle brick and common clay brick. As a results, the strength of 1.5L and 250ml bottle bricks is 3 and 4 times respectively stronger compare to common clay brick. The comparison of indoor and outdoor wall temperature, air humidity and wind velocity between the plastic bottle green house and normal brick house has indicate that plastic bottle has recorded highest reading for outdoor wall temperature with 36°C and lowest reading on outdoor humidity and outdoor wind velocity with 78% and 0.8 m/s respectively. From these result it can be concluded that plastic bottle greenhouse have a potential as a wall construction material and further study on its other properties such as its lifespan and ratio between water, cement and sand usage as a mortar should be carried out.

d) Z Muyen, TN Barna, MN Hoque, Strength properties of plastic bottle bricks and their suitability as construction materials in Bangladesh, ISSN: 1017 – 8139.

With global solid waste generation rates rising faster than ever, urban development specialists warn that the growth will peak this century and will not start to decline without transformational changes in how we use and

reuse materials. The World Banks urban development specialists Daniel Hoornweg and PerinazBhada-Tata had placed the global Municipal Solid Waste (MSW) generation levels at approximately 1.3 billion tonnes per year in a 2012 report. They warned that the levels would increase to approximately 2.2 billion tonnes per year by 2025. This report also estimated the per capita global solid-waste generation rate would rise from more than 3.5 million tonnes per day in 2010 to more than 6 million tonnes per day in 2025. The „bottle brick“ is one such invention. Waste Polyethylene Terephthalate (PET) bottles packed with other dry solid wastes or sand and earth has been successfully used in a number of countries around the world. This study looked into the strength properties of waste PET bottles filled with fine sand. Five different sizes (250, 500, 1250, 1500 and 2000ml) of waste PET bottle bricks were tested for compressive strength and the largest bricks gave a compressive strength of 17.44 MPa.

III. CONCLUSION

From the above literature review we came to know that use of innovative materials with sustainable application such as plastic bottles can have considerable benefits including finding the best optimization in energy consumption of the region, reducing environmental degradation.

Plastic bottles can cause the green construction by saving energy and also, recycling of the materials, minimizing the emission of CO₂ etc.

The study also suggests that waste materials which are fine in size, if handled in controlled condition will provide sustainable development. Walls constructed using plastic bottle blocks have been less costly as compared to the regular bricks and also they provide greater strength than bricks.

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