

Department of Civil Engineering
NED University of Engineering & Technology

CE-5002 Thesis

Research Proposal

**Use of Plastic Waste Bricks in Construction Industry Multi-
Perspective Feasibility Assessment**

MEM (Construction Management)

Student: FAKHRU DIN (CE-031/2021-22)

Supervisor: Dr. RANA RABNAWAZ AHMED
Assistant Professor
Department of Civil Engineering
NED University of Engineering & Technology

Co-Supervisor: Dr. SYED SALMAN MOBEEN
Assistant Professor
Department of Civil Engineering
NED University of Engineering & Technology

Supervisors Signature:

TABLE OF CONTENTS

	Page No.
1. Introduction.....	3
2. Literature Review	3
3. Research Significance.....	4
4. Objectives... ..	4
5. Scope.....	4
6. Methodology.....	5
7. Thesis Schedule	6
8. References.....	6

1. Introduction

Urbanization and advancement in the lifestyles of human are major contributors to the high volume of wastes generated and disposed of annually. There are human activities, in product manufacturing and post utilization that generate wastes. Yet, these wastes are mostly managed by disposal into landfills. However, high costs associated with landfilling, coupled with its ineffectiveness in some less developed regions, and land-space consumption are the major constraints to the management of these wastes. The volume of solid wastes generated increases annually, whereas only a limited amount is recycled and landfilled, and a large proportion of wastes are deposited directly or indirectly to the environment.

One of the solid wastes generated in large quantities and being of a high threat to the sustainability of our planet is plastic waste. Because of vast usage of Plastic, such as in automotive, manufacturing, packaging, and healthcare, about 300 million metric tons of plastic wastes have been estimated to be generated annually comprises various categories such as polyvinyl chloride (PVC-U), polystyrene or Styrofoam (PS), polypropylene (PP), high-density polyethylene (HDPE) empirical formula, polyethylene terephthalate (PETE), and others. A report by the Environmental Protection Agency has shown that out of such massive quantity of plastic wastes generated annually, only 7% is recycled, about 8% incinerated and the remaining are landfilled. Besides the negative impact on both marine and terrestrial environment, it plays a vital role in global warming due the emission of greenhouse gases (GHG) throughout its life.

According to the latest joint report by Accelerator Lab Pakistan (ACC Lab) with United Nations Development Programme (UNDP), Pakistan wasted more than 3.3 million tons plastic annually which is highest %age of mismanagement of plastic waste in South Asia.

According to Rajarapu Bhushaiah *et al.*, (2019) abundant availability of waste plastic everywhere, may be put to an effective use like brick. Ultimately it can help to reduce the environmental pollution, thereby making the environment clean and healthy. Hopefully Plastic waste bricks would provide an alternative option of bricks to the customers on affordable rates.

The chemical industry contributes to around 15% to the global anthropogenic GHG (Green House Gas) emissions. The universal collective application of plastic GHG world life-cycle emissions in 2015 was 1.7 Gt (Gigatonne) of CO₂ -equivalent (CO₂e), increasing to a composite annual growth rate of 8.4% by 2050. T O Ogundairo *et al.*, (March 2021)

Now a day rapid industrial and population growth has resulted in various types of waste such as plastic. According to Central Pollution Control Board (CPCB), total plastic waste which is collected and recycled in India is estimated to be 9205 tons per day (approx. 60% of total plastic waste) and 6137 tons (40%) remain uncollected and littered. Rishabh Kumar *et al.*, (2021).

In order to find an effective alternative to manage these wastes and improve the sustainability of our environment, this study, therefore, mainly focuses on the feasibility assessment of plastic waste brick (PWB) from multiple perspectives. These includes but not limited to environmental, social, economical, technical aspects, etc...

2. Literature Review

According to Rochman, Browne, in the year 2012 alone, it was estimated that about 280 million tonnes of plastic has been produced worldwide. From that amount, about 130 million tonnes of the plastics were landfilled or recycled. Of the remaining 150 million tonnes, plastic will find their place in daily lives of human being.

Moreover, plastic brick has been used in existing “Rohingya refugee camp” and newly proposed displacement camp in the coast island “Bhasan Char” as construction material to build new shelters, can be sustainable use and plastic waste management in the country. Also this was a feasible solution against shelter issues of the people of Rohingya. The vulnerability due to heavy monsoon rain, wind, cyclones, and the gaps and lack in funding to build new rigid and safe shelters can be effectively mitigated by using this low cost, environment-friendly plastic brick as building block in refugee camp.

Globally the estimated quantity of wastes generation was 12 billion tones in the year 2002 of which 11 billion tones were industrial wastes and 1.6 billion tones were municipal solid wastes (Bhushaiah et al., 2019). About 19 billion tons of solid wastes are expected to be generated annually by the year 2020. Annually, Asia alone generates 4.4 billion tons of solid wastes and MSW 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.

According to Prathik Kulkarni *et al.*, (2022) India produces about a 3.5 million tons of waste plastic every year which has almost doubled in the last five years. The production of waste plastic adversely affects our ecosystem and even it is linked with air pollution. Due to this high rate of production, it was brought to investigate and scrutinize the feasibility of using waste plastic as an alternative for manufacturing the brick. As they will be benefiting the environment as well as maintaining the requirements of materials and their standards.

The collected waste in Pakistan is mostly thrown in open dumping grounds without any segregation, pre-treatment or environmental protection measures. Ultimately the current rate of urbanization and population growth rate are significantly contributed in the production of plastic waste that can easily be available and accessible for the use as a construction material in many parts of the country

By utilizing this waste as an alternate replacement, it could be inferred that these materials could be preserved inside concrete structures for ages. Although no studies have yet to forecast the service life of concrete structures containing plastic waste materials, the use of plastic waste in concrete can contribute meaningfully toward a more sustainable and holistic construction industry. It is evident, that there is a clear gap to assess the technical, economic and environmental feasibility of plastic waste brick (PWB) in real time construction applications.

According to estimates from 2021, Asia has the highest production rates, accounting for 49% of the world’s total output, with China being the top worldwide producer by 32%, followed by Europe and North America, with 15% and 19% whereas the remaining countries are followed with less significance in terms of plastic consumption. Aditya Singh *et al.*, (May 2023).

3. Research Significance

As an alternative to traditional bricks, this study suggests to use a certain percentage of plastic waste as to provide the best use of plastic waste as an aggregate in the construction of green productive plastic brick.

High costs associated with landfilling, coupled with its ineffectiveness in some less developed regions, and land-space consumption are the major constraints to the management of these wastes. Utilization of plastic waste as a construction material in the industry provides positive impacts to the industry, society, economy and environment.

4. Objectives

The aim of this study is to assess the Feasibility from Multi-Perspective for using Plastic Waste Bricks in Construction Industry.

Following are the objectives of this research:

- To investigate the possibility of using plastic waste bricks in construction sector.
- To build a small scale structure made up of plastic waste bricks.
- To assess the feasibility from multiple perspectives.

5. Scope

This study is limited to small scale structure building and testing only. This assessment provides a detail feasibility analysis of plastic waste brick.

6. Methodology

Following figure provides methodology for the study.

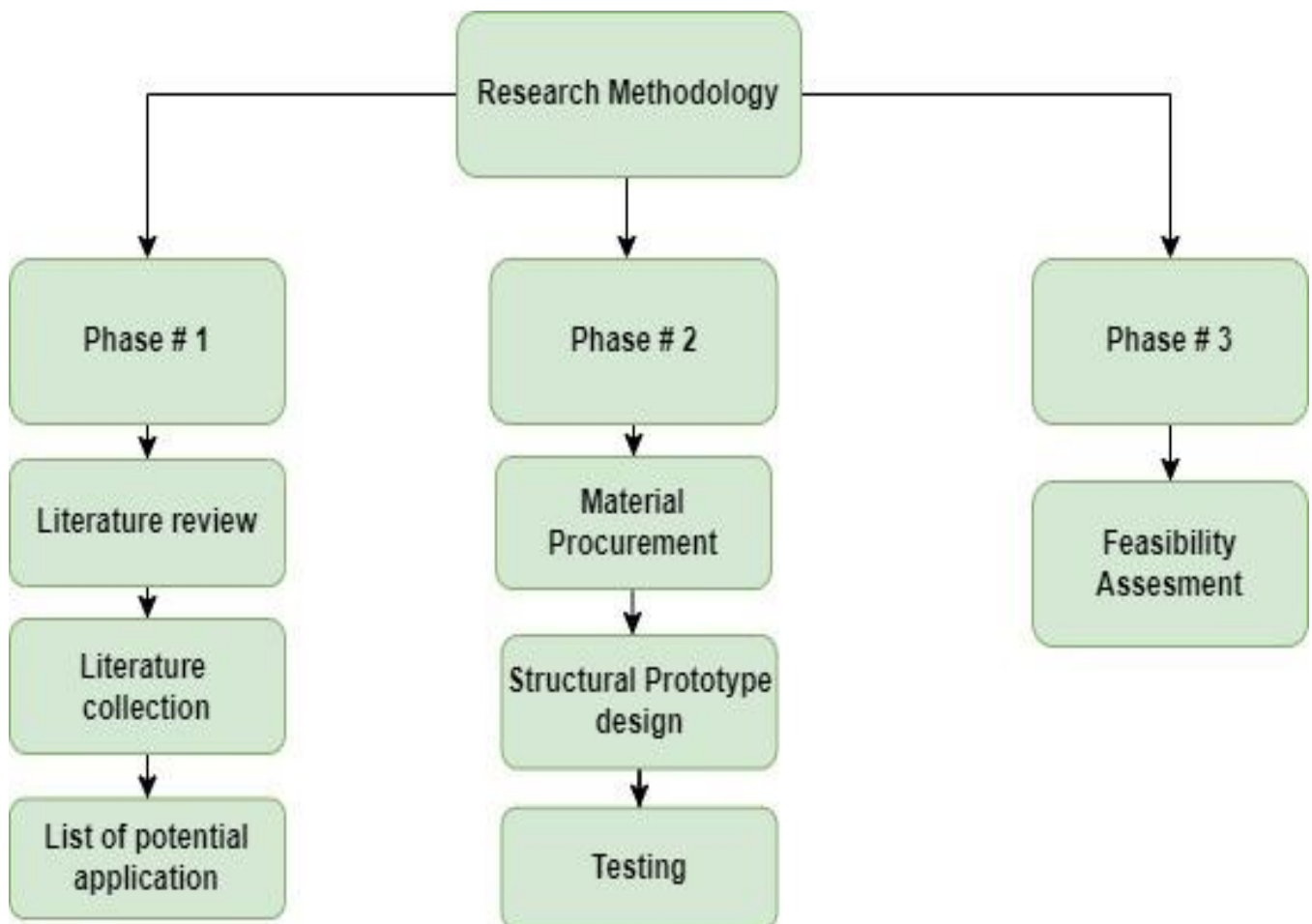


Figure 1: Methodology

Phase#1:

An analysis and investigation would be carried out by studying relevant studies as to make comparison and find the optimal feasible region while using plastic waste brick in construction industry. In this section various research papers and articles to be study to find and extract the relevant data that support this approach.

Phase#2:

This would be the execution phase of small structure which comprise the following sub sections;

a) Procurement

In this phase procurement and Assembling of materials, apparatuses etc would be carried out. This phase would provide key support to building/execution phase after the assembling the required material and techniques for design/execution.

b) Execution

After developing of plastic waste brick (PWB), small scale structure would be executing by using plastic waste brick (PWB) as a building block. In this phase various activities shall be carried out such as;

- Batching
- Mixing
- Moulding
- Curing
- etc

c) Testing

Multiple laboratory tests have to be carried out. i.e; Water Absorption, Flexural strength, Compressive strength test.

Phase#3:

This will cover the feasibility assessment in multiple perspective (i.e. Technical, Economical, social, Environmental etc). However, based on scope limitations, its definition will be establish latter on.

7. Thesis Schedule

Activity	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Literature Review												
Problem identification and Thesis proposal												
Literature collection												
Data Analysis												
Laboratory experimentation												
Report Development												
Thesis write-up												
Defense												

References

- Evode, *et al.*, (2021). Plastic waste and its management strategies for environmental sustainability. *Case Studies in Chemical and Environmental Engineering*, 4, 100142.
- Haque, M. S. (2019). Sustainable use of plastic brick from waste PET plastic bottle as building block in Rohingya refugee camp: a review. *Environmental Science and Pollution Research*, 26(36), 36163-36183.
- Lamba, P *et al.*, (2022). Recycling/reuse of plastic waste as construction material for sustainable development: a review. *Environmental Science and Pollution Research*, 29(57), 86156-86179.
- Zulkernain, *et al.*, (2021). Utilisation of plastic waste as aggregate in construction materials: A review. *Construction and Building Materials*, 296, 123669.
- Rishabh Kumar, *et al.*, (2021). A review on utilization of plastic waste materials in bricks manufacturing process. *Materials Today: Proceedings*, 46, 6775-6780.
- Bhushaiah *et al.*, (2019). Study of plastic bricks Made from waste Plastic. *Int. Res. J. Eng. Technol*, 6(6).
- Newaj, *et al.*, (2014). Utilization of waste plastic to save the environment. In *International conference on mechanical, industrial and energy engineering, KUET, Khulna, Bangladesh* (pp. 1-4).
- Bhatia *et al.*, (2019). Paver blocks made of Recycled plastic-bonded sand. *Journal of Environmental Engineering and its Scope*, 2(1, 2, 3).
- T O Ogundairo *et al.*, (2021, March). A review on plastic waste as sustainable resource in civil engineering applications. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1036, No. 1, p. 012019). IOP Publishing.
- Wendimu, *et al.*, (2021). Suitability and utilization study on waste plastic brick as alternative construction material. *J. Civ. Constr. Environ. Eng*, 6, 9-12.
- Kulkarni, P *et al.*, (2022). Recycling of waste HDPE and PP plastic in preparation of plastic brick and its mechanical properties. *Cleaner Materials*, 100113.
- Aditya Singh *et al.*, (May 2023). "Utilization of Plastic Waste for Developing Composite Bricks and Enhancing Mechanical Properties: A Review on Challenges and Opportunities", *Advances in Polymer Technology*, vol. 2023, Article ID 6867755, 24 pages, 2023.

I appreciate all the provided comments. The attached revised proposal addresses all the comments to ensure the quality of submitted proposal as advised. The comment-wise responses are mentioned in the following table.

S.No	Comments	Responses
1.	Supervisor's name on proposal was incorrect.	Names are now corrected and checked for proper prefixes.
2.	Citation shall be provided in introduction section.	As advised, following more citations were added, such as Rajarapu Bhushaiah et al., (2019); Rishabh et al., (2021); T O Ogundairo <i>et al.</i> , (2021, March);
3.	Literature review is incomplete and only single citation is provided. Needs revision.	As addressed in 2 nd comment few citations were already added in introduction Section. Furthermore, to strengthen the literature review, three number of citations were added in this section as well, that is Rajarapu Bhushaiah et al., (2019); Prathik Kulkarni et al., (2022); Aditya Singh <i>et al.</i> , (May 2023).
4.	Multi-perspective needs to be define.	Typically, multi-perspective may include perspectives like Economical, Technical, Legal, environmental etc. However based on scope limitations, its definition will be establish latter on.
5.	Methodology has not been defined. Methodology steps should have been explained in sub section.	Now a clear description of methodology diagram is provided in section # 06.
6.	Only four papers have been cited.	This comment is already address in step#2 and 3. Now the total citations are 12.