

**APPLICATION OF PLASTIC BOTTLE WASTE ON LIGHTWEIGHT  
COMPOSITE STRUCTURE MATERIALS**

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## DECLARATION

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Special for  
my wonderful family.

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## ABSTRACT

This report presents the work on plastic bottle as an alternative material in construction as lightweight composite structure material. The alternative construction such as in wall partition, fence, pavement and pedestrian pathway. The conventional concrete or the common concrete are well known to be high in weight, low resistant to humidity and corrosion and higher heat conductivity. A study in this project was conducted to determine if Polyethylene Terephthalate (PET) is suitable to resolve this problems as an aggregate in lightweight concrete. Physical and mechanical properties of the lightweight PET aggregate concrete with various composition has been determined by analysis based on result obtained from relevant tests. The tests were based on regulation of American Society for Testing and Materials (ASTM) which is the test of the PET aggregate can be accepted if density below than  $1800\text{kg/m}^3$ . The Polyethylene Terephthalate (PET) nowadays, based on the recently studies, have been accepted as a successful building materials. Even though it offers less compression strength and flexibility compared to the basic concrete, PET offers high ductility. The finding revealed that PET can be adopted as it can reduces the uses of sand used in concrete and it also proved to be more economical. Plastic bottle or Polyethylene Terephthalate or PET or PETE or Polyester is knowingly as non-biodegradable and very toxic.

## ABSTRAK

Laporan ini menunjukkan satu alternatif yang mana menjadikan botol plastik sebagai salah satu bahan dalam struktur bahan komposit yang ringan. Alternatif ini boleh digunakan sebagai bahan gantian tembok, pagar dan jalan bagi penjalan kaki. Konkrit asal lebih dikenali dengan nilai berat yang agak tinggi, rendah daya halangan kepada lembapan dan hakisan serta juga tinggi tahap darjah kepanasan yang mampu ditanggung. Kajian ini dilakukan untuk membuktikan bahawa adakah sisa botol plastik atau Polyethylene Terephthalate atau PET atau PETE atau Polyester sesuai untuk masalah bahan gantian dalam struktur komposit ringan. Beberapa ujian telah dilakukan untuk menentukan bacaan fizikal dan mekanikal bagi komposit ringan. Ujian tersebut adalah berdasarkan American Society for Testing and Materials (ASTM) jika ketumpatan adalah berada di bawah paras  $1800\text{kg/m}^3$  untuk dilabel sebagai komposit ringan. Kebelakangan ini, Polyethylene Terephthalate (PET) telah diterima sebagai salah satu bahan dalam industri pembinaan merujuk kepada kajian-kajian yang telah dijalankan sebelum ini. Jika dibandingkan dengan kekuatan mampatan dan fleksibiliti adalah kurang sedikit berbanding dengan bahan asas pembinaan, namun, PET membuatkan komposit itu tinggi nilai kemulurannya. Kajian telah membuktikan, PET boleh mengurangkan penggunaan pasir dan juga lebih ekonomik. Botol plastik PET juga sukar dilupus dan sangat bertoksik.

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**LIST OF SYMBOLS**

$\rho$	=	density, kg/m <sup>3</sup>
$m$	=	mass, kg
$v$	=	volume, m <sup>3</sup>
$r$	=	radius, mm
$d$	=	Diameter of Specimen, <i>mm</i>
$\pi$	=	Pi
$h$	=	height, mm
$kN$	=	kilo Newton
$MPa$	=	Mega Pascal

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## CHAPTER 1

### INTRODUCTION

#### 1.1 BACKGROUND

Lightweight materials are importance for many countries for lots of reasons. Many research proves that, lightweight is a cross cutting for crucial performance such as energy, transportation and generals products. Lightweight material generally can be divided into a few groups, which are:

- Metal
- Composites
- Polymers

In this project, the objective is more to discuss about the plastic bottle on lightweight composite structure materials. This creates the potential for additional capabilities or resources to be added to a platform and the benefits for construction industry and economic.

Concretes were used since ancient Romans, to prove, Egyptians also used to build the one of the Seven Wonders, pyramid. To conclude, concrete is the basic unit of building. As time flees, many building are built for high population demanding.

Since thousands of years ago, the environment has become a part of our lives. However, when the discoveries of science and technology get more attentions and become our lifestyles, environment is omitted. Pollutions nowadays not become our priority to protect.

## **1.2 PROBLEM STATEMENT**

There are tons of plastics that ended up as wastes. For example is the plastic bottle. Plastic bottle waste nowadays is considered to be a major problem. This is an environmental issue as its takes thousand years to bio-degrade, involves processes either to recycle or to reuse and if incinerated, they will produce toxic fumes. This will affect human health beside increase the world temperature. Hence, this project studies the proper way to reuse the plastic bottle waste.

## **1.3 OBJECTIVE**

The main objective in this project:

- a. To perform a study in concrete for manufacturing process by using Polyethylene Terephthalate (PET), plastic bottle as an aggregate.
- b. To determine the physical and mechanical properties of the lightweight concrete using plastic bottles waste.

## 1.4 SCOPE OF PROJECT

The scope of this project is concerned on the material used as alternative aggregate in lightweight concrete along with the classification of that as follows:

- Materials being used in the composition of lightweight concrete in this project is Polyethylene Terephthalate (PET), sand, cement, additive (fly ash) and water.
- The microstructure on the lightweight concrete structure.
- Analyse the mechanical properties of the lightweight concrete with different composition for compression strength and tensile strength.
- Analyse the physical properties of the lightweight concrete along with density and water absorption percentage.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

This project presents the work on plastic bottles as an alternative construction material. According to Ramadevi and Manju (2012), plastic bottle waste or Polyethylene Terephthalate or PET or PETE or Polyester is known as non-biodegradable. This is one of the factors of environmental pollution. Today, the construction industry is in need of finding cost effective materials for increasing the strength of concrete and structures. This project deals with the possibility of using the plastics bottles wastes as the partially in concrete.

## 2.2 CONCRETE

Concrete can be described as a universal material. Peter (2010) finds concrete has been and continue to be a great for all types of constructions throughout the world and has been described as the most important construction material. Concrete is a mixture of cement, sand (aggregates) and water. Cement is an essential components because when it is hydrated or no more water excess, its binds the aggregates together to form the hard, strong and useful. Sometimes, fly ash (Figure 2.1) is added as an additive. The type of sand usually used for construction is the river sand. To make a strong concrete, the ratio of the materials should be correct.

The strength, toughness and other characteristics of the concrete is depending on the mixing composition, the method used and other control processes. However, for country like Malaysia, India, Indonesia and others, the normal strength of concrete is very much different from the west. This is because of the temperature and air humidity.



Figure 2.1: Fly ash.



Figure 2.2: River sand.

From Figure 2.2, river sand is used in this project as aggregates. Aggregates are inert granular materials such as sand, gravel or crushed stone that, along with water and cement, are essential ingredient in concrete. There are two types of aggregates, fine and coarse. Aggregates strongly influence concrete's properties as stated in Cement Concrete Basic. Figure 2.3 shows the water used.



Figure 2.3: Water.

Wang, et al. (2000) stated that it is most frequently used in construction material; however, it has low tensile strength, low ductility, and low energy absorption. An intrinsic cause of the poor tensile behaviour of concrete is its low toughness and the presence of defects. Therefore improving concrete toughness and reducing the size