

INVESTIGATION OF BRICK USING CLAY  
AND FLY ASH

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B. ENG(HONS.) CIVIL ENGINEERING

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### **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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## ABSTRAK

Pelupusan bahan sisa industri ke tapak pelupusan telah menjadi isu alam sekitar yang serius. Sebaliknya, pengambilan sumber semula jadi disebabkan pembuatan bata konvensional dianggap bahaya untuk ekosistem kita. Untuk mengatasi masalah ini, banyak kajian telah dijalankan untuk mengguna semula bahan buangan yang menggabungkan sumber semula jadi sebagai bahan binaan ke dalam pelbagai field seperti kejuruteraan awam. Tujuan kajian ini adalah untuk mengkaji kemungkinan menggunakan tanah liat tanah yang menggabungkan abu terbang (oleh produk sisa batubara) untuk menghasilkan batu bata yang mampan, dan juga kajian yang bertujuan untuk menentukan sifat-sifat kejuruteraan bata tanah liat yang menggabungkan abu terbang seperti mampatan dan ujian kekuatan lenturan dan ujian penyerapan air. Pemboleh ubah utama kajian ini ialah abu terbang dan nisbah pengantiannya yang berbeza adalah (0%, 20%, 30%, 40%, 50%, 60%). Abu-abu terbang yang menggunakan kajian ini diperolehi dari Loji Kuasa Port Dickson, Negeri Sembilan. Walau bagaimanapun, hasil daripada makmal menunjukkan bahawa bata tanah liat yang menggabungkan sehingga 20% abu terbang pada pengawetan umur 28 hari menunjukkan kekuatan mampatan tertinggi, iaitu 20.3MPa berbanding semua campuran lain. Sementara itu, ujian penyerapan air menunjukkan bahawa kandungan lembapan bata tanah liat menggabungkan kenaikan abu terbang dengan peningkatan peratusan abu terbang. Oleh itu, penemuan kajian ini menunjukkan bahawa bata tanah liat yang menggabungkan sehingga 20% dari fly-ash boleh dianggap sebagai kandungan fly ash yang optimum untuk menghasilkan batu bata yang lebih mampan yang membawa kepada penyelesaian ekonomi.

## ABSTRACT

Disposal of industrial waste material in to landfill has become serious an environmental issue. On other hand, consumption of natural resources due to manufacturing of conventional brick is considered hazard for our ecosystem. In order to overcome this issue, many studies have been conducted to reuse waste materials incorporating with natural resources as construction material into various filed such as civil engineering. The purpose of this study is to investigate possibility of using earthen material clay incorporating with fly-ash (by waste product of coal) for producing sustainable brick, and also the study aimed to determine engineering properties of clay bricks incorporating with fly-ash such as compressive and flexural strength test and water absorption test. The main variable of the study is fly-ash and its different replacing ratio are (0%, 20%, 30%, 40%, 50%. 60%). The fly-ash that used this study was obtain from Port Dickson Power Plant, Negeri Sembilan. However, results from laboratory showed that clay bricks incorporating up to 20% of fly-ash at 28 days of age curing present the highest compressive strength, which is 20.3MPa compared to all other mixes. Meanwhile, water absorption test presented that moisture content of clay bricks incorporating with fly-ash increase with increased of fly-ash percentages. Therefore, the findings of this study suggests that clay bricks incorporating up to 20% of fly-ash can be considerable as the optimum fly-ash content for producing more sustainable bricks which is leading to economical solution.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

Consuming natural virgin resources and disposal of industry waste materials in the landfill have generally been considered a local environmental issues, and it is becoming a force of global importance, considering the importance of environment conservation, there are numerous studies that have been conducted in nowadays, and conclusion of these studies are minimization, prevention and correction of these environmental issues. However, Issues need to be solved in effective ways immediately and create better structure for the present and future generations.

Bricks are inevitable in the construction of buildings, and it is the most basic building material for the construction. In last decades conventional method of bricks were mainly produced from virgin materials such as clay and shale. Manufacturing of bricks need extraction of clay and remove topsoil, therefore Consuming high amount of clay as continuously for brick production can cause problem to the environment (Naganathan et al, 2015).

On the other hand, due to industrialization, the generation of industry waste disposal has keep increasing in each year, one of these waste disposal is coal fly-ash, which is fine waste material of power generation plant. It is obtained during coal combustion process and considered a major environmental hazard (Abbas et al, 2017).

Hence to save environmental, the conventional method of Brick production causes substantial depletion of virgin resources, by avoiding that issue we can produce Bricks in sustainable way, which is minimizing the amount of clay to be used in brick

production and partial with fly-ash residue instead of dumping waste into landfill. However, it's found that clay bricks incorporating with fly-ash are feasible eco-friendly compared with convention method of bricks (Kanchidurai et al, 2018).

## **1.2 Problem Statement**

Nowadays, the environmental consideration is factor of any design to ensure that the availability of earth natural resources and the sustainability of method for construction. This study utilizes many advantages which enable using industrial waste materials such as fly ash in the design of construction's material and less usage of virgin resources such as clay to save environmental. Million tons of ash from industrial waste products have been generated and estimated around 600 million tons annually, with fly ash only is about 500 million tonnes at from 75% up to 80% of the total ash produced. That means fly ash has been increasing in high amount throughout the world, and most of that amounts dumped in to the landfills. In addition, dumping this residue into the landfills causes serious problems which are pollution hazards due to the substantial ash content in the earth, such as wind and water erosion, furthermore, in terms of wind erosion fly ash Particles when release into the air can cause irritation and inflammation to eyes, skin and Throat and upper respiratory tract of Humans. in terms of water erosion, it is leaching substance of (e.g. salts heavy metals) into ground water and causes ground water contamination (Haynes, 2009). On the other hand, due to manufacturing of bricks, the first country that produced largest amount of bricks in world wild is China, while India and Canada is the second and third countries. In Canada produced 700 million tons of bricks while India produced 180 billion tons of bricks and consumed around 300 million tons of fertile soil per day for brick production (Abbas et al., 2017). however, this pattern of material demand can't be fully met as time increases because the material are virgin resources and non-renewable. By using this material as clay incorporating with fly-ash for brick production, the usage of clay will be decreased while waste can be managing to good use instead of dump in the landfill.

### **1.3 Objectives**

The main objectives of this research was to explore the effect of bricks using clay and fly ash. Towards achieving above mentioned aim, the related objectives were I identified as follows:

1. To study suitable mix design of brick using clay and fly-ash
2. To investigate the mechanical behaviour of brick using clay and fly-ash.
3. To determine the water absorption of brick using clay and fly-ash.

### **1.4 Scope of Work**

This paper aimed to investigate the compressive strength and flexural strength of brick using clay and fly-ash. the selected materials for this experiment are fly-ash, clay and water.

### **1.5 Significance of Study**

One of the major environmental problems in the world is disposal of waste materials, and dumping industrial waste material into landfill not only polluting environmental but also considered burdening on the earth. Therefore, dumping landfill sites are restricted in many parts of the world, because in the world, some countries waste materials from industries discharged into rivers and causes serious diseases. there was study utilized that waste discharge into river and causes serious diseases such as alzheimer and mental that retardation (Abbas et al, 2017),(Hegazy et al, 2012). Moreover, natural resources of the clay are under depletion due to the continuous extraction in everyday, therefore in this study was used to investigate the alternative uses of waste as new method to improve the environmental issues in construction materials. The method that the study investigated is consuming limited amount of clay

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