INVESTIGATING THE STRENGTH OF POLYSTYRENE AS AGGREGATE REPLACEMENT TO PRODUCE LIGTHWEIGHT CONCRETE WALL PANEL

AZIEMAH BINTI HASHIM

B.ENG (HONS.) CIVIL ENGINEERING
UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

DECLARATION OF THESIS / UNDERGRADUATE PROJECT PAPER AND COPYRIGHT

Author's full name : **AZIEMAH BINTI HASHIM**

Date of birth : **24 FEBRUARY 1993**

Title : **INVESTIGATING THE STRENGTH OF POLYSTYRENE AS AGGREGATE REPLACEMENT TO PRODUCE LIGTHWEIGHT CONCRETE WALL PANEL**

Academic Session : **2015/2016**

I declare that this Final Year Project Report is classified as:

☐	**CONFIDENTIAL**	(Contains confidential information under the Official Secret Act 1972)*
☐	**RESTRICTED**	(Contains restricted information as specified by the organization where research was done)
☑	**OPEN ACCESS**	I agree that my thesis to be published as online open access (full text)

I acknowledged that Universiti Malaysia Pahang reserves the right as follows:

1. The Final Year Project Report is the property of Universiti Malaysia Pahang.
2. The Library of Universiti Malaysia Pahang has the right to make copies for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

Certified by

_____	_____
SIGNATURE	SIGNATURE OF SUPERVISOR
930224-10-6148	**SHARIZA BINTI MAT ARIS**
(NEW IC NO. / PASSPORT NO.)	NAME OF SUPERVISOR
Date: 30 JUNE 2016	Date: 30 JUNE 2016

NOTES * If the Final Year Project Report is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization with period and reasons for condentially or restriction

INVESTIGATING THE STRENGTH OF POLYSTYRENE AS AGGREGATE REPLACEMENT TO PRODUCE LIGTHWEIGHT CONCRETE WALL PANEL

AZIEMAH BINTI HASHIM

A thesis in fulfilment of the requirement for the award of the degree of Bachelor of Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JUNE 2016

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Civil Engineering and Earth Resources.

Signature : …….
Name of Supervisor : SHARIZA BINTI MAT ARIS
Date : 30 JUNE 2016

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature : ……

Name : AZIEMAH BINTI HASHIM

ID Number : AA12196

Date : 30 JUNE 2016

TABLE OF CONTENT

CHAPTER 2 LITERATURE REVIEW

LIST OF TABLE

LIST OF FIGURES

LIST OF SYMBOLS

MPa	-	Mega Pascal
kN	-	Kilo Newton
kN/ m^2	-	Kilo Newton per Metre Square
kg/m^3	-	Kilogram per Metre Cube
mm	-	Milimeter
m^3	-	Meter cube
s	-	second
kg	-	Kilogram
P	-	Load
%	-	Percent

LIST OF ABBREVIATIONS

ASTM	-	America Society for Testing and Materials
BS	-	British Standard
EPS	-	Expended Polystyrene
OPC	-	Ordinary Portland Cement
LVDT	-	Linear Variable Deformation Transformer

INVESTIGATING THE STRENGTH OF POLYSTYRENE AS AGGREGATE REPLACEMENT TO PRODUCE LIGTHWEIGHT CONCRETE WALL PANEL

AZIEMAH BINTI HASHIM

A thesis in fulfilment of the requirement for the award of the degree of Bachelor of Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JUNE 2016

ABSTRACT

This study was conducted to determine the compressive strength of lightweight concrete (LWC) containing expended polystyrene (EPS) or most known as polystyrene beads which is designated for load bearing wall application. In order to produce the LWC, EPS beads were chosen as lightweight aggregate because it gives advantages in term of their characteristic such as low density, high strength, good thermal and sound insulation. Besides that, it was also suitable for structure that would be exposed to impact like shear wall. In this study, twelve (12) unreinforced concrete wall panel with dimension 100 x 600 x 600 mm were produced. The size of polystyrene beads were 3.0 mm in diameter. There are four (4) concrete mix proportion that were used in this study which is (1:3:0), (1:2.5:0.5), (1:2:1) and (1:1.5:1.5). All sample were tested at Heavy Structure Laboratory, University Malaysia Pahang. The lightweight concrete wall panel were tested by using Magness Frame machine in order to get the ultimate axial and deflection parameter. The concrete wall panel were setup under pinned- fixed end condition. Then ultimate axial load of wall panel were determine by using British Standard (BS98110-97). Based on the test conducted, the compressive strength of lightweight concrete cube for RATIO 2 is the highest which is 20.645 N/mm^2 while the lowest is RATIO 3 with strength 16.545 N/mm^2.While for ultimate axial load, the maximum ultimate axial load at 28 days is RATIO 1 which is 194.79 kN and the lowest is RATIO 3 with 136.25 kN. Hence, when compare between RATIO 1 with the CONTROL, the difference of strength of wall panel did not give significant difference. There only small margin of differences of both specimen. Meanwhile, for deflection the data recorded by Linear Variable Differential Transformer (LVDT) are inconsistent. This is because the concrete wall panel were experience the compression and tension during the test conducted.

ABSTRAK

Kajian ini dijalankan untuk menentukan kekuatan mampatan konkrit ringan (LWC) yang mengandungi expended polystyrene (EPS) atau lebih dikenali sebagai manik-manik polistirena yang telah direka untuk penggunaan dinding galas beban. Bagi menghasilkan mampatan konkrit ringan , manik-manik polistirena telah dipilih sebagai batu baur ringan kerana ia memberi kelebihan dari segi ciri–cirinya seperti rendah ketumpatan, kekuatan tinggi, penebat haba dan bunyi yang baik. Selain itu, ia juga sesuai untuk struktur yang akan terdedah kepada kesan dinding ricih. Di dalam kajian ini, Dua belas (12) panel dinding konkrit tanpa tetulang dengan dimensi 100 x 600 x 600 mm akan dihasilkan. Saiz manik-manik polistirena adalah 3.0 mm diameter. Terdapat empat (4) jenis concrete campuran yang digunakan di dalam kajian ini iaitu (1:3:0), (1:2.5:0.5), (1:2:1) dan (1:1.5:1.5). Kesemua sampel telah diuji di Makmal Sruktur Berat, Universiti Malaysia Pahang. Panel dinding konkrik ringan telah diuji dengan menggunakan mesin Magness Frame untuk mendapatkan parameter beban paksi muktamad dan pesongan. Dinding panel konkrit telah disusun dengan keadaan pin-tetap. Kemudian, beban paksi muktamad dinding panel ditentu menggunakan standard British ((BS98110-97). Berdasarkan ujian yang dijalankan, kekuatan mampatan kiub konkrit ringan untuk RATIO 2 adalah yang paling tertinggi iaitu 20.645 N/mm^2, manakala yang terendah adalah RATIO 3 dengan kekuatan 16.545 N/mm^2. Manakala, bagi beban paksi muktmad, beban paksi muktamad maksimum pada hari yang kedua puluh lapan (28) adalah RATIO 1 iaitu 194.79 kN dan yang terendah adalah RATIO 3 dengan kekuatan 136.25 kN. Oleh itu, apabila dibandingkan antara RATIO 1 dengan CONTROL, perbezaan kekuatan dinding panel tidak memberikan perbezaan yang ketara. Terdapat hanya sedikit perbezaan bagi kedua-dua specimen. Sementara itu, bagi pesongan data yang direkodkan oleh Linear Variable Differential Transformer (LVDT) adalah tidak konsisten. Ini adalah kerana panel dinding konkrit mengalami mampatan dan tegangan ketika ujian dijalankan.

CHAPTER 1

INTRODUCTION

1.1 Background of Research

Styrofoam or most known as polystyrene was widely used as food packaging and to protect the product from damage during transport or storage, but nowadays it was use in innovative building material that lends to design and structural integrity of many building projects. Polystyrene or Expended Polystyrene (EPS) has powerful design element and ideal choice for green building design. For an example, the uses of lightweight concrete for wall panel in construction building have seem to give many advantages compare than conventional brickwork method in term of the minimizing labour and material cost. Therefore, to overcome this weakness, the lightweight concrete is chosen as an alternative solution.

In addition, with the existing this new technology it was able to speed up the construction progress which is the construction speed could be faster by using lightweight concrete in precast construction. Furthermore, it was lighter loads during construction, reduced self-weight in structures and increased thermal resistance and the most important advantages of using lightweight concrete is the possible decrease in construction

Lightweight concrete is generally accepted as concrete having a density around 1440 up to 1800kg/m^3 compare than the normal weight concrete with density around 2240 to 2400 kg/m^3.Therefore, many researches have been carried out new alternative in order to enhance the performance of lightweight concrete wall panel.

However, this research focuses on the design of a lightweight concrete wall panel to analyse the relationship between the loads applying with the deflection of the wall panel. Hence, twelve (12) samples of wall panel were prepared with the different ratio and percentages amount of polystyrene to investigate the behaviour of the polystyrene beads in the concrete mixture.

1.2 Problem Statement

Nowadays, lightweight concrete are used in various construction industry. This is because there are many beneficial use of a structural lightweight concrete such as reduce the weight of structure, which then allow the structural designer to come out with the innovative idea in construction field. As we know, wall panel is widely used in building construction such as partition and carrying load but in order to construct the wall, it was need a lot of time especially in multi-storied and high rise building. Therefore, the construction of the project became slower if use the conventional brickwork method due to require for constructing the partition work and to create many of internal unit. In addition, it was required a lot of manpower from the beginning of the project until the finishing work. Hence, it was seem like to have a better performance in construction industry to replace the conventional brickwork method. Moreover, by using lightweight concrete it was able to overcome this problem which is it can speed up the construction progress. The construction speed could be faster by using lightweight concrete in precast construction. So, this innovative idea was suggested which it will reduce the time of construction, manpower and minimize the uses of raw materials such as granite and gravel that was decreasing in day by day.

Furthermore, primary reason of using lightweight concrete for structural purposes is to reduce the self-weight of the concrete structures. Reducing the self-weight of the structures is vital for the structural safety. Besides the construction works become easier because the use of lightweight concrete in the field of precast concrete wall structures.

However, there was some problem in order to produce a good quality of lightweight concrete. This is because the mixture is very sensitive with water content and it was also difficult to place because of the porosity and angularity of the aggregate. In some mixes, it may separate the polystyrene and float toward surface if the excessive water ratio poured. Hence, the skill of mixing was required during handle this process. Besides, mixing time is longer than conventional concrete to ensure the lightweight concrete was proper mixing.

1.3 Objective of Study

i. To determine the compressive strength of the lightweight concrete to produce the wall panel.
ii. To determine the ultimate load that unreinforced wall can sustain when use the polystyrene as an aggregate replacement based on (BS 8110:97)
iii. To check the deflection on the wall panel.

1.4 Scope of Study

Basically, this research covered the construction of lightweight concrete wall panel for the housing building application. The main focus of this study is to design the lightweight concrete wall panel to determine the compressive strength to be used as wall panel. This study also to determine the ultimate load of unreinforced concrete wall can sustain when use the polystyrene as an aggregate replacement. In addition, this research was carried out in order to check the deflection of the wall panel. The deflection is very important indicator in order to determine the characteristic of the lightweight concrete mixing.