FINITE ELEMENT ANALYSIS OF RAPID FOOTING FOR INDUSTRIALISED BUILDING SYSTEM

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Specially dedicated to my beloved family

Thank you for all loves, cares and supports.

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ABSTRACT

The design and innovation of Industrialized Building System (IBS) requires lighter, stronger, better shape, and versatility. Therefore IBS has a common definition and perspective that coordinated in precision to form a structure. This paper presents finite element analysis on two different shape of rapid footing in order to obtain it potential to be immersed using forced vibration. The shapes are different in terms of the bearing area that in contact between footing and the soil surface. Test were conducted on granular soils of elastic modulus of 0.0174 N/mm^{2}and structures are vibrated vertically. The result obtained from the laboratory test on sand is compared with the result from finite element analysis for comparison. The vertical settlement of the footing of model 1 from laboratory test is 2 mm while from analysis is 3.40 mm. The vertical settlement of the footing of model 2 from laboratory test is 7mm while from analysis is at 7.02 mm. Results showed that the footing with confinement wall experienced higher settlement than the footing without wall due to its small contact area.

ABSTRAK

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Pada masa kini, reka bentuk dan inovasi Sistem Bangunan Perindustrian (IBS) kini menghasilkan komponen pembinaan yang lebih ringan , lebih kuat, lebih baik dari segi bentuk dan serba boleh. Oleh itu IBS mempunyai definisi biasa dan perspektif yang diselaraskan untuk membentuk struktur. Kajian ini memperkenalkan Analisis Unsur Terhingga keatas dua bentuk yang berbeza bentuk untuk mendapatkan potensi penurunan di bawah beban getaran. Bentuk adalah berbeza dari luas kawasan di atas permukaan tanah. Ujian dijalankan ke atas tanah pasir modulus elastik 0.0174 N/mm^2 dan struktur yang digetarkan menegak. Keputusan yang diperolehi daripada ujian makmal ke atas pasir dibandingkan dengan keputusan dari analisis untuk perbandingan. Keputusan menunjukkan bahawa asa dengan dinding mengalami penurunan lebih tinggi daripada asas yang tanpa dinding. Penurunan menegak asas model 1 daripada ujian makmal adalah 2 mm manakala dari analisis adalah 3.40 mm. Penyelesaian menegak kedudukan model 2 daripada ujian makmal adalah 7mm manakala dari analisis adalah di 7.02 mm.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

Industrialised Building System (IBS) is a construction method where all or part of the components of the structure is prefabricated in the factory and assemble on site construction. IBS enables quality improvement beside reduction of labour intensity. IBS can be different things to different industry players. However, there are several definition from different resources that reflected the concept of IBS which widely accepted by the construction industry. IBS is best defined according to CIDB Malaysia (2001) as a construction technique in which component are manufactured in a controlled environment, transported, positioned and assembled into a structure with minimal additional site works.

The first precast panelised wood house was shipped from England in 1624 to provide temporary housing for fishing fleet. From then on many precast systems were introduced; with some success and failures.The Industrialised Building System was introduced Malaysia in 1964 when the government launched two pilot housing project constructed using IBS. It was Tuanku Abdul Rahman Flats in Kuala Lumpur and Riffle Range Road Flats in Penang. Since then, numerous projects in Malaysia have utilises IBS especially when the construction require to built up quickly and with high accuracy and quality.

Definitions of industrialised building system has also been given by Esa and Nuruddin (1998) in which IBS is a continuum beginning from utilising craftmen for every aspect of construction to a system that use manufacturing production in order to minimise resource wastage and enhance value for end users. According to Badir-

Razali (1998), all building systems can be classified into four types of building system.

The implementation of IBS in Malaysia however was considered slow and not effective compared to developed countries such as United States, Europe and Japan. Although the government have introduced multiple initiatives of the use of IBS together with studies and solutions were introduced to increase the awareness of the usage of IBS in Malaysia. Besides that it is also to improve the implementation of IBS in terms of construction policy and guidelines to implement the usa of IBS in the local construction industry.

1.1 Problem Statement

The traditional system cannot fulfill the housing demand without forfeiture of quality of the structures due to a disability of this conventional technique, IBS is an ideal conceptualization and a unique way of simplifying construction works. However, the study of the IBS footing are close to none due to unseen variability of soil to support the structure. Faster and quick developed construction need to be developed so that the structure and components can be easily fabricated, transported and erected on site. This study is focused on the total settlement of the footings when forced vibration load is applied vertically to them. The development of small-scale tests in this thesis is for the proof of concept of the development of a rapid IBS footing system.

1.2 Objectives

The objectives of the study are:

1. To analyze two models of rapid footing of IBS system with and without confinement walls.
2. To determine the ability of immersion of the footing into soil under vertical forced dynamic loads using Autodesk Simulation Multiphysic.
3. To compare the results of laboratory test and finite element analysis for the assessment of the real footing sizes.

1.3 Scope of Study

The study is focusing on the finite element analysis of two model of IBS footing. Model 1 is without the confinement wall and model 2 with the confinement wall of 40 mm thick around the footing. Vibration load as in on-site testing are applied vertically and the total settlement are compared with the on-site settlement measurement. Analysis of Autodesk Simulation Multiphysic is used to simulate for the similarity between the models infinite element and laboratory experiment .

1.4 Significance of Study

From the background of study of IBS, it is obviously that IBS is a better and more efficient system among all the methods in term of constructibility. In the future, IBS will become the priority of choice of the clients due to many advantages on environment and economy. Therefore, it is important to improve the productivity and quality of IBS. Hence, this research is supporting the initiative of new design of footing for Industrialize Building System.

1.5 Expected Finding

The expected findings generated from the study are a lean mix design that designt to define strength and rheology of concrete for of component manufacturing.

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