OUT OF PLANE BEHAVIOUR OF PROFILED STEEL SHEET DRY BOARD (PSSDB) SQUARE PANEL

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Especially to my beloved parent, Mr Lawrence Anak Juwum and Mrs Miderdine Anak Lamit, to my beloved sibling,Priscilla, Prissy Talesy and Petty Talesy

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ABSTRACT

Profiled steel sheet dry board as a floor slab and it is a new innovation of composite slab structure in construction industry. It is consists of profiled steel sheet, dry board and screw as a connector. This study is to investigate the behavior of profiled steel sheet dry board (PSSDB) square panel. Plywood was chosen as dry board, SDP – 51 chosen as profiled steel sheet and self-drilling and self-tapping screw is used for connector. The component material was selected from the local market. This study consists of two part of analysis which is the theoretical analysis study for deflection of PSSDB and the experimental study for deflection of PSSDB at center point load mid span. Vibration test is also conducted in experimental study to investigate the damping effect of PSSDB. In theoretical analysis study, slip and strain at everywhere of connection between plywood and steel sheet is zero and assumed the plane section remains plane. This situation is knows as full interaction. The transformed section method was used to analyses PSSDB since it created from different material as raw material. The result of analysis pointed out that the deflection of PSSDB is increase when the load pointed on the PSSDB was increased. From experiment study, the first deflection was 1.86 mm at 1.55 kN. The maximum deflection was 47.83 mm at 21.7 kN. It was found that, damping ratio for the flooring system is 0.00045. A natural frequency, f_n was 86 Hz and damped frequency was 85.9 Hz. The specimen stiffness was 26.78x 10^6 N/m. The value of critical damping coefficient and actual damping coefficient was respectively 99110.56 Ns/m and 44.60 Ns/m.

ABSTARK

Papan kering plat keluli berprofil sebagai kepingan lantai merupakan inovasi baru struktur kepingan komposit dalam industri pembinaan. Ia terdiri daripada plat keluli berprofil, papan kering dan skru sebagai penyambung. Kajian ini bertuluan untuk mengkaji cirri-ciri jalur jalur kayu segi empat papan kering plat keluli berprofil (PSSDB). Kepingan papan lapis digunakan sebagai papan kering, plat keluli berprofil mengunakan SDP-51 dan skru benam dan tebuk sendiri digunakan sebagai penyambung. Bahan komponen dipilih dari pasaran tempatan. Kajian ini terdiri daripada dua bahagian analisis iaitu kajian analisis teori terhadap kekuatan lentur PSSDB dan kajian secara eksperiman kekuatan lentur PSSDB pada beban runcing di tengah-tengah rentangan. Kajian getaran juga dijalankan dalam kajian eksperiman untuk mankaji kesan getaran terhadap PSSDB. Dalam kajian analisis teori, gelinciran dan regangan pada setiap sambungan diantara kepingan papan lapis dan plat kekuli berprofil adalah diabaikan dan permukaan dianggap kekel rata. Keadaaan ini dikenali sebagai tindak balas penuh. Kajian ini dibuat mengunakan teknik penukaran keratan untuk menanalisis PSSDB yang mengunakan bahan yang berbeza sebagai bahan asas. Keputusan dari analisis menunjukkan lenturan PSSDB meningkat apabila beben yang dikenakan pada PSSDB meningkat. Daripada eksperimen yang dijalankan, lenturan pertama adalah 1.86 mm pada 1.55 kN. Lenturan maksimum adalah 47.83 mm pada 21.7 kN. Didapati juga, ‘damping ratio’ bagi system lantai ini adalah 0.00045. Nilai bagi ‘ Natural frequency’ adalah 86 Hz dan ‘damped frequency’ adalah 85.9 Hz. Nilai kekakuan bagi specimen adalah 26.78×10^6 N/m. Nilai bagi pekali ‘ crital damping’ dan ‘ actual damping’ adalah masing-masing 99110.56 Ns/m dan 44.60 Ns/m.

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PSSDB	Profiled Steel Sheet Dry Board
P_U	Ultimate Load
A_S	Cross Section Area Of PSS
m	Ratio Eb / Es
Eb	Elastic Buckling Load
Es	Modulus Of Elastic of PSS
k’	0.14 For Partial Interaction
k	Reduction Factor
σ_y	Yield Stress Of PSS
Pcr	Euler Bulking Load
Π	Phi
E_S	Modulus Of Elastic Of PSS
I_C	Moment Of Inertia Of Composite Section
K	1.5 For Wall One End Fixed And The Other End Partially Restrained In Direction
H	Height Of Wall

P	Maximum Withdrawal Load In Pounds (Ib)
G	Specific Gravity Of Wood
D	Shank Diameter Of Screw In Inch (in)
L	Length Of Penetration Of Threaded Part Of Screw
E	Modulus Of Elasticity
P’	Force
L	Length Of Sample
’	Displacement
B	Width Of Sample
H	Thickness Of Sample
M	Gradient
D	Shank Diameter Of Screw
Q	Concentrated Load
K	Slip Modulus
V	Slip Between Two Adjacent Parts
EI	Stiffness Of The System

f	Frequency
W	Mechanical Resonance Frequency
g	Gravity Constants
r	Natural Frequency
Hz	Hertz
Ap	Cross Section
δ	Deflection
dB	Decibel
Δ	Differential
C	Actual Damping Coefficient
Cc	Critical Damping Coefficient
SDP	Steelon Deck Plate
PC	Personal Computer
∑	Total
BTM	Base Metal Thickness

CHAPTER 1

INTRODUCTION

1.1 General

Construction method play important role in construction project. In Malaysia, construction industry is based on the conventional method which is the traditional method of construction. This method consists of reinforce concrete, timber building construction, masonry construction and precast concrete. This method takes time to carry out, need more workers and it will produce wastage at the construction site. That is some of the disadvantage of using conventional method and it look not too efficient.

In the last few decades, many researches have been done to overcome existing problem and were found new method for construction called Industrial Building System (IBS). Through this system, all the component of building such as concrete floor slab, concrete column and concrete beam was casted or constructed in factory. Beside that, composite structure also initiated for one of structure component which consist of combination of steel sheet, dry board and also concrete. One of the examples of composite structure initiated was Profiled Steel Sheet dry Board (PSSDB). This composite structure was improved to increases the potential of PSSDB in construction industry through research and study.

This research presents the Out of plane behavior of Profiled Steel Sheet dry Board (PSSDB) square panel. The study has been carrying out to investigate the structure performance of flooring system square panel.

1.2 Overview

Dry board consists of plywood and chipboard. Plywood made by slicing wood into thin layer and gluing three or more layer of wood slice together to form sheet. Chipboard manufactured by gluing wood particle such as saw mill, saw dust and wood chip under heat and pressure condition. To increase strength and stiffness of profiled steel sheet in floor system, Profiled Steel Sheet Dry Board (PSSDB) has been initiated. The idea was initiated by Wright and Evans (1987) in United Kingdom.

PSSDB is created from profiled steel sheet connected with dry board. The connection is made by self- drilling and self tapping screw between steel sheet and plywood. The main function of steel sheet is to increase strength of dry board in square panel. It is also perform as a joist for small size of building flooring system.

1.3 Problem statement

Dry board such as plywood usually used in flooring system for small building. The strength and stiffness properties of normal plywood still not adequate carry heavy load in flooring system. In this study, profiled steel sheet dry board (PSSDB) will be introduced to improve the performance of plywood as a material for flooring system. A steel sheet is put together at the bottom of plywood sheet and connected using self drilling and tapping screw. This composite structure is known as profiled steel sheet dry board. Steel sheet is probable can used to increase strength and stiffness of plywood in flooring system.

1.4 Aim and objective

The aims of this study are to investigate the shear connection performance using push-out test and evaluate the properties of dry board.

The objectives of this study are:

i. To determine load carrying capacity and deflection behavior of PSSDB panel.
ii. To investigate the properties of locally available component material of PSSDB panel.
iii. To investigate the potential of PSSDB panel toward vibration affect.

1.5 Scope of study

The study consists of two parts which is to predict the deflection of PSSDB panel using theoretical analysis study and carry out experimental study to find out the maximum deflection of PSSDB panel. This study will be carry out in laboratory by using push out test to investigate the performance of PSSDB sample. In addition, vibration test for the PSSDB panel also have been carry out.

1.5.1 Theoretical Analysis Study

Theoretical analysis study is to predict the deflection of PSSDB panel. PSSDB is one of the composite structures and method used to analysis the composite structure is differ from the structure made by only one material because consists of several material. Detail explanation of analysis will be discussed at Chapter 4 of this study.

1.5.2 Experimental Study

i. Two samples 1500 mm x 1000 mm will be prepared for test.
ii. Samples will be set as simple supported with two support reaction.
iii. For the first sample, point load will be applied at the center of the sample to find out the maximum deflection at the center of the sample.