

**UNIVERSITI TEKNOLOGI MARA**

**PERFORMANCE OF STEEL FIBRE AND WIRE  
MESH IN WALL PANEL SUBJECTED TO AXIAL  
LOAD**

**NURHARNIZA ABDUL RAHMAN**

Thesis submitted in fulfillment of the requirements for the degree of  
**Master of Science Civil Engineering (Structural)**

**Faculty of Civil Engineering**

**MAY 2008**

## Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of University Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree to be subjected to the disciplinary rules and regulations of University Teknologi MARA.

Name of Candidate    NURHARNIZA ABDUL RAHMAN  
Candidate's ID No.    2006666073  
Programme            MASTER OF SCIENCE CIVIL ENGINEERING  
                              (STRUCTURAL)  
Faculty                CIVIL ENGINEERING  
Thesis Title            STRESS ANALYSIS OF STEEL FIBRE REINFORCED  
                              CONCRETE WALL PANEL

Signature of Candidate   
Date                    23 OCTOBER 2007

## ABSTRACT

Exploration and development of new and high performance construction materials, such as fibre reinforced concrete has offered many advantages and gained confidence amongst builders in Malaysia. Towards greater development of IBS components, utilisation of steel fibre in concrete mix to replace reinforcing bars improved significantly. Investigations showed the mix provides durable and strong concrete especially when subjected to flexural influences. Most design codes have not stipulated thorough regulations on steel fibre concrete structural elements. It is thus necessary to understand the effect of material contents on the mechanical strength properties of this steel fibre concrete. In this study steel fibre is applied into wall panel (**SteFib WP**) aiming at better understanding about the mix subjected to compressive axial load. **SteFib WP** was prepared using Grade 40 normal OPC concrete with water cement ratio of 0.354, dosage of 5 kg (0.4%) steel fibre of 1200 MPa strength, measuring 75x1000x1500 mm (thickness:length:height). The aspect ratio ( $h/l$ ) and slenderness ratio ( $h/t$ ) of the wall panel are 1.5 and 20 respectively. The wall panel was subjected to compressive axial load with pinned-fixed end conditions and both ends pinned until failure. **SteFib WP** samples failed in buckling. The addition of steel fibres increased the flexural and ultimate capacity of the plain concrete wall panel. The improvement includes fracture toughness, helps to stop micro cracks forming macro-cracks, improves concrete ductility and its energy absorption capacity, as well as enhances overall durability. Fibre concrete mix is practical and economically attractive as it can be mixed, placed, and compacted using normal techniques. Since CIDB is committed in IBS construction, **SteFib WP** contributes to the development as an IBS component. **SteFib WP** has better carrying capacity and advantages in terms of crack control than reinforced concrete wall panel.

## TABLE OF CONTENT

<b>Declaration</b>	<b>i</b>
<b>Acknowledgement</b>	<b>ii</b>
<b>Table of Contents</b>	<b>iii</b>
<b>List of Figures</b>	<b>vi</b>
<b>List of Tables</b>	<b>ix</b>
<b>List of Appendices</b>	<b>x</b>
<b>List of Symbols</b>	<b>xi</b>
<b>Abstract</b>	<b>xii</b>

<b>TITLE</b>	<b>PAGE</b>
--------------	-------------

### **CHAPTER 1 INTRODUCTION**

<b>1.1 Introduction</b>	<b>1</b>
<b>1.2 Statement of Problem</b>	<b>4</b>
<b>1.3 Objectives of The Study</b>	<b>4</b>
<b>1.4 Scope of The Study</b>	<b>5</b>
<b>1.5 Conclusion</b>	<b>5</b>

### **CHAPTER 2 LITERATURE REVIEW**

<b>2.1 Introduction</b>	<b>6</b>
<b>2.2 Masonry Wall Panel</b>	<b>6</b>
<b>2.3 Composite Masonry Wall</b>	<b>8</b>
<b>2.4 Masonry Walls With Reinforced Composites</b>	<b>9</b>
<b>2.5 Surface-reinforced Masonry Walls</b>	<b>12</b>
<b>2.6 Glass Fibre Reinforced Gypsum Wall Panels</b>	<b>14</b>
<b>2.7 Wire Fabric Reinforced Concrete Wall Panel</b>	<b>19</b>
<b>2.8 Materials</b>	<b>23</b>

2.8.1	<i>Concrete</i>	23
2.8.2	<i>Steel Fibre</i>	23
2.9	<b>Behavior of Steel Fibre</b>	24
2.10	<b>Types of Steel Fibre</b>	25
2.11	<b>Mechanical Properties of Steel Fibre</b>	28
2.11.1	<i>Poisson's Ratio</i>	28
2.12	<b>Method to Choose Required Steel Fibre</b>	29
2.13	<b>Mixing Designs and Procedure</b>	30
2.14	<b>Theoretical analysis</b>	31
2.14.1	<i>American Concrete Institute (ACI 318)</i>	31
2.14.2	<i>Standard Australia (AS3600)</i>	31
2.14.3	<i>British Standard (BS 8110: Part 1)</i>	32
2.14.4	<i>Euler buckling load</i>	35

### **CHAPTER 3      METHODOLOGY**

3.1	<b>Introduction</b>	37
3.2	<b>Wall Panel Concrete Work</b>	38
3.2.1	<i>Steel Fibre</i>	38
3.2.2	<i>Concrete Mix Design</i>	39
3.2.3	<i>Batching</i>	40
3.2.4	<i>Mixing</i>	41
3.3	<b>Experimental</b>	46
3.3.1	<i>Cube Test</i>	46
3.3.2	<i>Experimental Set-up</i>	47

### **CHAPTER 4      RESULTS AND DISCUSSION**

4.1	<b>Introduction</b>	52
4.2	<b>Concrete Work</b>	52
4.2.1	<i>Cube Test</i>	53
4.2.2	<i>Slump Test</i>	55