ANALYSIS OF CANTILEVER STEEL BEAM

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I/We* hereby declare that I/We* have checked this thesis/project* and in my/our* opinion, this thesis/project* is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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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

The usage of steel beam has been run for a long time in a construction industry. The application of cantilever steel beam become popular choice of Industry, by extending the steelwork design into residential housing. The objectives of this project are to analyse the forces and stresses in a selective size steel cantilever beam and finding the maximum vertical force (Newton) for beam which is hot rolled shape IPE 120 and is made of Fe430 steel. The thesis presents the linear analysis of cantilever steel beam by using ANSYS 12.0. Finite Element Software was use to model the cantilever steel beam with I beam section IPE 120. ANSYS software is used to analyse linear static of the forces and stress for the elastic 2D cantilever steel beam. The model geometry is defined with elements and nodes. This thesis also shows the theoretical calculation of stress. The results from ANSYS software were compared with the theoretical calculation results. The finite element behaviour of cantilever steel beam was found to be slightly different with the theoretical calculation and behaviour.
TABLE OF CONTENT

CHAPTER TITLE PAGE

TITLE PAGES i
ACKNOWLEDGEMENT ii
ABSTRAK iii
ABSTRACT iv
TABLE OF CONTENTS v
LIST OF TABLES x
LIST OF FIGURES xi
LIST OF SYMBOLS xv
LIST OF ABBREVIATIONS xvi

1 INTRODUCTION

1.1 Introduction 1
1.2 Problem Statement 2
1.3 Objective of Study 2
1.4 Scope of Study 3
1.5 Significant of Study 3

2 LITERATURE REVIEW

2.1 Introduction 5
2.2 Steel Beam 5
2.2.1 Steel I Beam 7
2.2.2 Cantilever Beam - Single Load at the End 11
2.2.3 Cantilever Types
2.2.4 Advantages and Disadvantages of Using the Steel Beam
2.3 Hot Rolled Steel
   2.3.1 Benefits of hot rolled steel
2.4 Cold Formed Steel Structure
   2.4.1 Benefits of Cold-formed Steel Section

3 METHODOLOGY

3.1 Introduction
3.2 ANSYS Concepts
3.3 ANSYS Modeller
3.4 Approach and Assumption
3.5 Parameters of Cantilever Steel Beam
3.6 Stress Analysis Steps
   3.6.1 Preprocessing
   3.6.2 Solution
   3.6.3 Postprocessing
3.7 Interactive Step-by-Step Solution
   3.7.1 Preprocessing
   3.7.2 Solution
   3.7.3 Solve
   3.7.4 Post processing

4 RESULT AND ANALYSIS

4.1 Introduction
4.2 Boundary Condition
4.3 Forces and Moment
4.3.1 Graph Result of Force and Moment
4.3.1.1 Bending Moment for Initial Load (2500N)
4.3.1.2 Bending Moment for forces of 3000N
4.3.1.3 Bending Moment for forces of 3500N
4.3.1.4 Bending Moment for forces of 4000N
4.3.1.5 Bending Moment for forces of 4500N
4.3.1.6 Bending Moment for forces of 5000N
4.3.1.7 Bending Moment for forces of 5500N
4.3.1.8 Bending Moment for forces of 6000N
4.3.1.9 Bending Moment for forces of 6500N
4.3.1.10 Bending Moment for forces Of 7000N

4.4 Table of Stresses Result From Ansys
4.5 Value of Stress From Theoretical Calculation
4.5.1 Calculation of Stress
4.5.2 Theoretical Value of Stress

4.6 Graph Result of Stress and Strain
4.6.1 Graph Result of Stress and Strain
For 2500N of Load

4.6.2 Graph Result of Stress and Strain 61

For 3000N of Load

4.6.3 Graph Result of Stress and Strain 61

For 3500N of Load

4.6.4 Graph Result of Stress and Strain 62

For 4000N of Load

4.6.5 Graph Result of Stress and Strain 62

For 4500N of Load

4.6.6 Graph Result of Stress and Strain 63

For 5000N of Load

4.6.7 Graph Result of Stress and Strain 63

For 5500N of Load

4.6.8 Graph Result of Stress and Strain 64

For 6000N of Load

4.6.9 Graph Result of Stress and Strain 64

For 6500N of Load

4.6.10 Graph Result of Stress and Strain 65

For 7000N of Load

4.7 Graph Relationship of Load and

Maximum Stress

5 CONCLUSION AND RECOMMENDATIONS 67

5.1 Introduction 67

5.2 Conclusion 67

5.3 Recommendations 68

REFERENCES 70
<table>
<thead>
<tr>
<th>TABLE</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Load To Be Analyzed</td>
<td>45</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURES</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Steel I Beam</td>
<td>7</td>
</tr>
<tr>
<td>2.2</td>
<td>I Beam Section</td>
<td>9</td>
</tr>
<tr>
<td>2.3</td>
<td>Wide-flange I-beam</td>
<td>10</td>
</tr>
<tr>
<td>2.4</td>
<td>Force and Moment Diagram of Overhanging Cantilever Steel Beam</td>
<td>11</td>
</tr>
<tr>
<td>2.5</td>
<td>Schematic Image of Three Types of Cantilever</td>
<td>12</td>
</tr>
<tr>
<td>3.1</td>
<td>Project Flow Chart</td>
<td>20</td>
</tr>
<tr>
<td>3.2</td>
<td>A-A Section Cantilever Steel Beam</td>
<td>21</td>
</tr>
<tr>
<td>3.3</td>
<td>Change Title</td>
<td>23</td>
</tr>
<tr>
<td>3.4</td>
<td>Setting Civil Fem</td>
<td>24</td>
</tr>
<tr>
<td>3.5</td>
<td>Setting The Code</td>
<td>24</td>
</tr>
<tr>
<td>3.6</td>
<td>Setting The Unit</td>
<td>25</td>
</tr>
<tr>
<td>3.7</td>
<td>Define Materials</td>
<td>26</td>
</tr>
<tr>
<td>3.8</td>
<td>Select Steel Material</td>
<td>27</td>
</tr>
<tr>
<td>3.9</td>
<td>Confirm The Selected Material</td>
<td>27</td>
</tr>
<tr>
<td>3.10</td>
<td>Select Beam Element Types for Code Checking</td>
<td>28</td>
</tr>
<tr>
<td>3.11</td>
<td>Select Cross Section</td>
<td>29</td>
</tr>
<tr>
<td>3.12</td>
<td>Select Beam and Shell properties</td>
<td>29</td>
</tr>
<tr>
<td>3.13</td>
<td>Create Nodes In Actives Coordinate System</td>
<td>30</td>
</tr>
<tr>
<td>3.14</td>
<td>Create Nodes</td>
<td>30</td>
</tr>
<tr>
<td>3.15</td>
<td>Pick nodes</td>
<td>31</td>
</tr>
<tr>
<td>3.16</td>
<td>Create Nodes Between Two Nodes</td>
<td>31</td>
</tr>
</tbody>
</table>
3.17 Fill Between Node 32
3.18 Pick All Nodes 33
3.19 Copy Elements by Automatically Numbered 34
3.20 Copy Element 35
3.21 Select Element to Be Constrained 36
3.22 Numbered Line 36
3.23 Pick Node To Put Load 37
3.24 Select The Direction of Forces 37
3.25 Location of Load 38
3.26 Solve Current Load Step 38
3.27 Read Results by Load Step Number 39
3.28 Graph Force and Moment Results 40
3.29 Check Boundary View and View Point. 40
3.30 Cross Section Explorer 41
3.31 Graph Stress and Strain Results 41
3.32 List Stress and Strain Results 42
3.33 List Stress and Strain Results 43
3.34 Graph Sections Results 44
4.1 Boundary Condition For Cantilever Steel Beam 47
   Hot Rolled IPE 120
4.2 Bending Moment Z for Hot Rolled IPE 120 48
   (2500N)
4.3 Bending Moment Z for Hot Rolled IPE 120 49
   (3000N)
4.4 Bending Moment Z for Hot Rolled IPE 120 (3500N) 49
4.5 Bending Moment Z for Hot Rolled IPE 120 (4000N) 50
4.6 Bending Moment Z for Hot Rolled IPE 120 (4500N) 50
4.7 Bending Moment Z for Hot Rolled IPE 120 (5000N) 51
4.8 Bending Moment Z for Hot Rolled IPE 120 (5500N) 52
4.9 Bending Moment Z for Hot Rolled IPE 120 (6000N) 52
4.10 Bending Moment Z for Hot Rolled IPE 120 (6500N) 53
4.11 Bending Moment Z for Hot Rolled IPE 120 (7000N) 53
4.12(a) Table of Stress of Cantiliver Steel beam, Hot Rolled IPE 120 54
4.12(b) Table of Stress of Cantilever Steel beam, Hot Rolled IPE 120 55
4.13(a) Table of Stress of Cantilever Steel beam, Hot Rolled IPE 120 56
4.13(b) Table of Stress of Cantilever Steel beam, Hot Rolled IPE 120 57
4.14 Over hanging Cantilever Steel Beam 57
4.15 Value of Stress and Strain From Theoretical xiii 59
Calculation Hot Rolled IPE 120

4.16 Graph of Stress SX at Point 50 (2500N) 60
4.17 Graph of Stress SX at Point 50 (3000N) 61
4.18 Graph of Stress SX at Point 50 (3500N) 61
4.19 Graph of Stress SX at Point 50 (4000N) 62
4.20 Graph of Stress SX at Point 50 (4500N) 62
4.21 Graph of Stress SX at Point 50 (5000N) 63
4.22 Graph of Stress SX at Point 50 (5500N) 63
4.23 Graph of Stress SX at Point 50 (6000N) 64
4.24 Graph of Stress SX at Point 50 (6500N) 64
4.25 Graph of Stress SX at Point 50 (7000N) 65
4.26 Maximum Stress vs Load for Cantilever Steel I Beam IPE 120 65
LIST OF SYMBOL

\[ \delta = \text{Deflection} \]
## LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEM</td>
<td>Finite Element Method</td>
</tr>
<tr>
<td>AISC</td>
<td>America Institute of Steel Construction</td>
</tr>
<tr>
<td>AISI</td>
<td>America Iron and Steel Institute Specification</td>
</tr>
<tr>
<td>ASD</td>
<td>Australia Steel Structure Code</td>
</tr>
<tr>
<td>LRFD</td>
<td>Load and Resistance Factor Design</td>
</tr>
<tr>
<td>BS</td>
<td>British Standard</td>
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<tr>
<td>CAN/CSA</td>
<td>Canadian Standard</td>
</tr>
<tr>
<td>SABS</td>
<td>South Africa Standard</td>
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<tr>
<td>3D</td>
<td>Three-Dimensional</td>
</tr>
<tr>
<td>IWF</td>
<td>International Weightlifting Federation</td>
</tr>
<tr>
<td>1D</td>
<td>One-Dimensional</td>
</tr>
<tr>
<td>CAE</td>
<td>Computer Aided Engineering</td>
</tr>
<tr>
<td>FE</td>
<td>Finite Element</td>
</tr>
<tr>
<td>2D</td>
<td>Two-Dimensional</td>
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<tr>
<td>CAD</td>
<td>Computer Aid Design</td>
</tr>
<tr>
<td>UC</td>
<td>Universal Column</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
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<td>----------------------------------</td>
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<tr>
<td>UB</td>
<td>Universal Beam</td>
</tr>
<tr>
<td>RSJ</td>
<td>Rolled Steel Joist</td>
</tr>
<tr>
<td>DIN</td>
<td>Deutsches Institut fur Normung</td>
</tr>
<tr>
<td>IS</td>
<td>International Standard</td>
</tr>
<tr>
<td>FEA</td>
<td>Finite Element Analysis</td>
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<tr>
<td>CS</td>
<td>Coordinate System</td>
</tr>
<tr>
<td>LS</td>
<td>Load Step</td>
</tr>
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<td>UDL</td>
<td>Distribution Load</td>
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<td>AS/NZS</td>
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</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Introduction

Beams are one of structural element which hold bending load and shear loads. It more dominant that axial load. The supports of beam are also very diverse and one of it is cantilever beam. Cantilever beam is a beam that has fixed support at one end and free at the other end. Cantilever beam can be made from many of materials, one of which is steel section. Its light weight and have a large enough strength, and made by fabrication so it has an isotropic material making easier to be applied as a beam structure. But cantilevered structure that has bigger number of internal forces toward its fixed supports, causing usage of uniform steel section becomes less optimal. Therefore, it will be investigated stress and deformation I section steel beam with uniform cross-section with half IWF steel section with diagonal cut so it has non-prismatic section when used as a cantilever beam.

A new set of effective-length factors is presented for designing doubly symmetric I-shaped built-in cantilever beams against lateral-torsional buckling when subject to different loading and restraint conditions at the cantilever tip. This refined approach rectifies inherent problems of current solutions caused by overlooking the restraint conditions as well as the limitations that existed in their original derivation. Because of these problems, the effective-length factors currently available may result in either overly conservative or unconservative designs, depending on the type of problem involved. Also, an interaction buckling design model is suggested for overhanging beams, in which the load is applied only at the cantilever tip. This design model takes into account the ratio of the length of the cantilever span to that of the back span, a significant parameter that has not generally been considered. Finally, a design procedure is given for determining the elastic critical moments of crane-trolley beams.
These analyses are based on a finite-element model that will be performing in finite element software.

1.2 Problem Statement

Across every industry today, companies are facing tough challenges—such as increased product complexity, new materials and manufacturing processes—and new opportunities from the availability of sensor-based data. Engineering today's complex systems requires new approaches, combining 1D simulation, 3D CAE, test and analytics. There are many other systems can give output at short time. But most of the result will be never accurate at time. To get an accurate result of analysis, the geometry and loads of the cantilever beam also need to be accurate. To get an accurate result of stress analysis I need to perform 3 or more analysis with different mesh densities (h Refinements. If the difference between the last and the second last analysis is below 10% then you know you are close to the maximum stress.

Repeating the steps will theoretically increase the accuracy of the next iteration of results. This means that a simulation requires much more time to compute the results, but the result may change by an insignificant value. The results of a Stress Analysis may change and you want to understand the accuracy of your stress results. Part level FE analysis falls short of natural boundary conditions. Moreover, the stress levels are higher and distribution is significantly different in compare the repeating steps will help to get an accurate results.

1.3 Objectives of Study

The aims of this study are:

i. To analyse the forces and stresses in a selective size steel cantilever beam.

ii. To find the maximum vertical force (Newton) for beam which is hot rolled shape IPE 120 and is made of Fe430 steel.
1.4 Scope of Study

The scope of study for this project is to determine the maximum load that can be applied to selective cross section of cantilever steel beam. We will discretize the beam with elastic 2D beam elements. Model geometry is defined with elements and nodes. All models were modelled and analysed by using finite element analysis software ANSYS. In this study, several samples with same dimension but different loading apply to I section cantilever steel beam, so it had a comparable loading. Analysis is held by using finite element method in a computer program named ANSYS as calculation program. The result showed that different loading will give different result of analysis. The analysis will be repeated until it reach the limit of loading that selective cross section of cantilever steel beam can withstand.

1.5 Significant of Study

The reasons in conducting this topic are to identify the maximum loading that selective cross section of cantilever steel beam can withstand. This significantly reduced the number of trial calculations required after knowing the actual limit of loading for any cantilever steel beam work. Finding the maximum loading in several material is very important in Engineering Field because all calculation need to be very accurate and possible. Several complex cases showing the validity and efficiency of the algorithm.

This research will give benefit to architectural art and technology which are responsible for coming up with initial concepts and designs, architectural technologists are more concerned with the technical side of construction. They work closely with architects and other building professionals to resolve any potential design problems before construction starts. These modification will improve in selecting the best materials and processes for the project surveying sites and identifying location benefits carrying out feasibility studies and risk assessments, increase ability in analyses architectural plans and drawings, highlighting any possible risks or problems and making amendments using 2D applications (2D), increase ability in specifying the appropriate technology and tools to be used in the project and advising where this
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