DESIGN OF COMPRESSION MEMBER USING VARIOUS INDIAN STANDARD SECTION BASED ON IS 800:2007

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ABSTRACT:
Since the beginning the steel structures have been the architectural expression of vision and monetary affluence. The Compression member are structural elements that are pushed together or carry a load, more technically they are subjected only to axial compressive forces. Analysis and design of axially compressed steel section presented in this paper was conducted through analytical study, design based on IS code. The selection of section for compression member is depending on the required area of the member which is directly influenced to design compressive strength of the compression member. This paper focuses entirely to the efficient use of Indian standard section in design of compression members. A typical design of compression member is taken for the investigation and various Indian standard sections have been taken based on the required area for the result on the efficient and economical Indian standard sections.

Keywords: monetary, compressive force, compression member, section, efficient

I. INTRODUCTION
Steel structures are those structures which are made of steel components connected with each other to share and transfer the applied loads with adequate safety and serviceability. The strength of steel structure is much higher as comparison to that of concrete and timber structure. There are various types of steel structure like truss, tower, bridge, stair case etc. The products of structural steel are available in various shapes and sizes so that the structural engineer could select the suitable sections to according to the requirement of the design.

There are various products that are made by using the various process are plates, strips, shapes and sections (angles, tees, beams, channels), flats and bars. They are classified according to the Bureau of Indian standards as follows:
(I) Beams (ISJB, ISLB, ISMB, ISWB)
(II) Columns/ Heavy -weight Beams (ISSC, ISHB)
(III) Parallel Flange Beam and Column Sections (ISNPB, ISWPB)
(IV) Channels (ISJC, ISLC, ISMC, ISMCP)
(V) Angles (ISA) etc.

II. PROBLEM STATEMENT
Generally compression member are those member on which load is transferred though their axis. For the analysis of those components various Indian standard sections has been considered from steel table and IS CODE 800-2007. Basically the criteria’s for selecting the sections is depending on the required area of the member.

Following is the design problem-
Design a stanchion 3.5m long, in a building, subjected to a factored load of 550kN. Both the ends of the stanchion are effectively restrained in a direction and position. Use the steel of grade Fe410. (Source: S.K. DUGGAL “DESIGN OF STEEL STRUCTURE”)

III. OBJECTIVES
Following are the objectives of the above mentioned problem-
- To identify the effective Indian Standard section based on design compressive strength.
- To recognize the cost effective section.
- Comparison of slenderness ration of different Indian Standard section
- To evaluate the design compressive stress of various IS Sections
- Determination of the efficient IS sections based on design conditions.
IV. METHODOLOGY

For the investigation of the problem various IS section has been used based on the required area of the member. Following IS section has been considered-

<table>
<thead>
<tr>
<th>S.No.</th>
<th>INDIAN STANDARD SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ISHB 150 @ 339.1 N/m</td>
</tr>
<tr>
<td>2</td>
<td>ISHB 150 @ 265.9 N/m</td>
</tr>
<tr>
<td>3</td>
<td>ISLB 250 @ 273.6 N/m</td>
</tr>
<tr>
<td>4</td>
<td>ISLB 275 @ 323.7 N/m</td>
</tr>
<tr>
<td>5</td>
<td>ISWB 200 @ 282.5 N/m</td>
</tr>
<tr>
<td>6</td>
<td>ISWB 225 @ 332.5 N/m</td>
</tr>
</tbody>
</table>

Following materials used for the design-
- IS CODE 800-2007
- Steel Table

(I) Given Data:
- Length = 3.5m
- Factored load = 550 KN.
- Fe-410 grade Steel

(II) Calculation of Required Area and Selection of IS section
A= \(550 \times 10^2/134 = 4104 \text{ mm}^2\)
Based on the above required area ISHB 150 @ 339.1N/m section has been selected from the IS Code.
Following are the properties of the section-
- Area of the section A = 4408 mm\(^2\)
- Thickness of the flange \(t_f = 9 \text{ mm}\)
- Width of flange \(b_f = 150 \text{ mm}\)
- Unit Weight = 339.1 N/m

(III) Calculation of Effective slenderness ratio
Effective slenderness ratio = \(\frac{kl}{r} = 67.91 < 180 \text{ mm}\)

(IV) Buckling Class
Based on the Effective slenderness ratio from IS code the buckling class B is taken on Y axis.

(V) Calculation of Design compressive stress
Design compressive stress is based on the Buckling class and Yield stress of steel.
Hence \(F_{cd} = 169.135 \text{ N/mm}^2\).

(VI) Calculation of design compressive strength
\(P_d = A_c \times f_{cd}\)
\(= 4408 \times 169.135 \approx 745.54 \text{ kN} > 500 \text{ kN}\)
Hence the design compressive strength is more than the required compressive strength.
Similarly various IS sections have been considered for the calculation of the design compressive strength which is as follows:
Table-2 Design compressive strength of Indian Standard section

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Section</th>
<th>Unit weight N/m</th>
<th>Area a mm²</th>
<th>Thickness of Flange</th>
<th>Width of flange</th>
<th>Buckling class</th>
<th>Axis</th>
<th>Effective Slenderness Ratio</th>
<th>Design Compressive Ratio</th>
<th>Required compressive strength</th>
<th>Design Compressive Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ISHB 150</td>
<td>339.1</td>
<td>440 8</td>
<td>9</td>
<td>150</td>
<td>B</td>
<td>yy</td>
<td>67.91</td>
<td>169.135</td>
<td>550</td>
<td>745.54</td>
</tr>
<tr>
<td>2</td>
<td>ISHB 150</td>
<td>265.9</td>
<td>344 8</td>
<td>9</td>
<td>150</td>
<td>B</td>
<td>yy</td>
<td>64.265</td>
<td>174.6</td>
<td>550</td>
<td>602</td>
</tr>
<tr>
<td>3</td>
<td>ISLB 250</td>
<td>273.6</td>
<td>359 3</td>
<td>8.2</td>
<td>125</td>
<td>B</td>
<td>yy</td>
<td>97.63</td>
<td>199.05</td>
<td>550</td>
<td>423.01</td>
</tr>
<tr>
<td>4</td>
<td>ISLB 275</td>
<td>323.7</td>
<td>420 2</td>
<td>8.8</td>
<td>140</td>
<td>B</td>
<td>yy</td>
<td>87.16</td>
<td>138</td>
<td>550</td>
<td>582.2</td>
</tr>
<tr>
<td>5</td>
<td>ISWB 200</td>
<td>282.5</td>
<td>397 1</td>
<td>9</td>
<td>140</td>
<td>B</td>
<td>yy</td>
<td>76.08</td>
<td>156.06</td>
<td>550</td>
<td>620.4</td>
</tr>
<tr>
<td>6</td>
<td>ISWB 225</td>
<td>332.5</td>
<td>432 4</td>
<td>9.9</td>
<td>150</td>
<td>B</td>
<td>yy</td>
<td>70.62</td>
<td>165</td>
<td>550</td>
<td>713.49</td>
</tr>
</tbody>
</table>

V. RESULT ANALYSIS

Based on the above analysis various comparative results have been investigated which are presented as in a graphical manner:

(i) Comparison on compressive strength of different IS section

![Figure 1- Compressive strength of different IS section](image)

In above graph the strength of ISHB 150@339.1 N/m is more as compare to other IS sections because the radius of gyration is least in this section.

(ii) Unit weight comparison

![Figure 2- Unit weight comparison graph](image)
Comparison of Slenderness ratio of different IS section

![Slenderness ratio comparison](image)

**Figure-3 Slenderness ratio comparison**

Comparison of design compressive stress of various IS section

![Graph for the comparison of Required and Desired Compressive Strength](image)

**Figure-4 Graph for the comparison of Required and Desired Compressive Strength**

VI. ACKNOWLEDGEMENT
We are graceful and would like to express our sincere gratitude to all the researchers who carried their work in this field. I would also like to thank to entire members of IJIERE for providing me the best platform for successful completion of work and presenting the research work

VII. CONCLUSION
(i) The maximum compressive strength is obtained for the Section ISHB 150@ 339.1N/m because of the less slenderness ratio. (Refer fig 1)
(ii) The most efficient sections is ISHB 150@ 265.9N/m and ISWB 200@ 282.5N/m as compare to other sections because these sections are highly efficient in terms of strength and have low cost. (Refer Fig 1 & Fig 2)
(iii) The design compressive strength DEPENDS on the effective slenderness ratio, as the effective slenderness ration increased design compressive strength decreased.
VIII. REFERENCES


[3] RANGACHAR NARAYANAN, V.KALAYANARAN, ETAL “TEACHING RESOURCE ON STRUCTURAL STEEL” DESIGN VOLUME 1 OF 3, INSTITUTE FOR STEEL DEVELOPMENT & GROWTH.

