EXPERIMENTAL STUDY ON FLEXURAL BEHAVIOUR OF STEEL BEAM AT DIVERSE LOADING

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Abstract - *Steel is one of the most sustainable construction materials. Its strength and durability coupled with its ability to be recycled again and again without ever losing quality make it truely compactable with long term sustainable development. Steel construction is placed in top list because it safeguards the building against damage in case of climatic effects like earthquakes and cyclones. In steel structures, channel sections are widely used because it has more shear capacity.*

The flexural behaviour of channel section ISMC75 at different loading conditions is studied in this experiment. The specimen was tested under in a loading frame by applying loads at one third points for its pure flexural behaviour. From the experiment it was found that, the load carrying capacity of the channel section when applying load on flange portion is 47% higher than the load applied on web portion.

Key Words: Steel construction, Channel section, Shear capacity, Two point Loading, Flexural behaviour.

1.INTRODUCTION

Structural steel is a solid material used for steel construction, which is fashioned with a specific shape following certain standards of chemical composition and strength. They can also be defined as hot rolled produces, with a cross section of different forms like angles, channels, beams and joints. There has been an increasing demand for structural steel for construction purposes in the United States and India. The structural steel all over the world predominates the construction development. This material has been comprehensively used in various constructions all over the world because of its various specific features that are very much preferably suited for construction.

Structural steel is long-lasting and also has unique physical property, ductility, because of which it is able to take up large deformations beyond the elastic limit without fracture. It can be well molded to give the preferred shape to give an ultimate appearance to the structure that has been constructed .Several types of structural steel sections are used in construction like beam, channel, angles and flats. When the beam is adequately supported against lateral buckling, the beam failure occurs due to the yielding of the material at the point of minimum moment.

A significant variation between steel and concrete constructions is that the designer has more control over the shape of reinforced concrete elements. For building a steel structure normally to use standard rolled sections. The main advantages of steel structures are their smaller weight to strength ratio, speed of erection, dismantling and its scrap value.

The steel beam is thus capable of reaching its plastic moment capacity under applied load. In this paper reports only the flexural behavior of steel channel section with load at web and flange portion. The purpose of this investigation was to study the flexural behavior of section with load at web portion in comparison with load at flange portion.

1.1 Steel Channel section

Steel channel sections are used preferably as supports and controller barriers. These are roll-formed products. The main metal used for making channels is steel along with aluminum. J, Hat, U and C sections are the certain variants that are available in the channels category. A major optional of the channel is the mild steel channel. Such channels are commonly used in heavy industries. They are commonly used in the heavy machinery industry and automotive industry too.

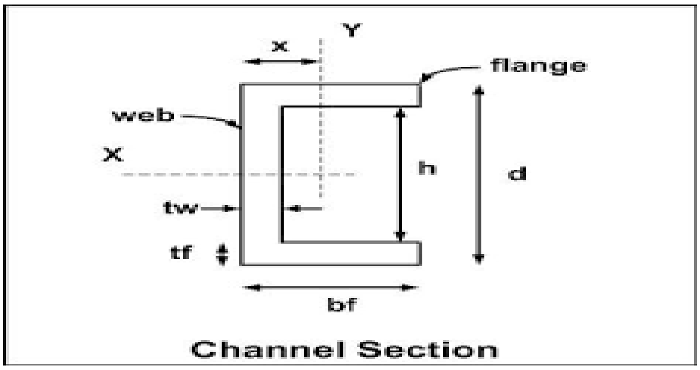

Fig- 1 Steel Channel Section

1.2 Applications of steel channel sections

Steel channels are subjected to an extensive range of uses. The application fields are:

- Construction
- Appliances
- Transportation
- Used in making Signposts
- Used in wood flooring for athletic purposes

2. EXPERIMENTAL PROGRAM

2.1 Properties of Channel section

ISMC 75 Steel channel section is used in this study. The cross section of section is shown in figure 2. As per IS800-2007, the properties of section are given table 1

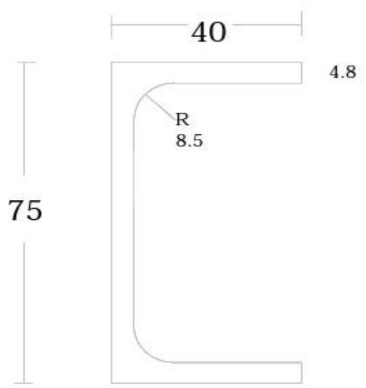

Fig -2: Channel Section ISMC 75

Table -1: The Properties Of Channel Section ISMC 75

Designation	ISMC 75
Weight per Meter(kg/m)	6.8
Sectional Area(cm^2)	8.67
Depth of Section,D (mm)	75
Width Of Flange,b_f(mm)	40
Thickness of Flange,t_f(mm)	7.3
Thickness of Web,t_w(mm)	4.4
Radii of Gyration,r_z(cm)	2.96
Radii of Gyration,r_y(cm)	1.21
Section Modulus,z_{ez}(cm^3)	20.8
Plastic modulus,z_{pz}(cm^3)	24.17
Shape Factor,Z_{pz}/Z_{ez}	1.1710

2.2 Test Setup and Procedure

The following test procedure used to found the load carrying capacity of steel channel section at web and flange portion.The given steel beam is measured and center of the span is marked. The steel beam is placed in the flexure test setup. The electrical strain gauges is fixed in the required place at the beam. Three numbers of LVDT is placed at the center of the bottom beam. The load cell is placed at the top of the steel beam. The load cell, strain gauge, LVDT is connected to the user data logger. The initial readings of the strain gauges are noted. The load is applied at the center of the top of the beam. The load is increased at an interval of 0.25 tones. The strain gauge readings were read from the user data logger. The data is collected from the computer at the specified interval of time.

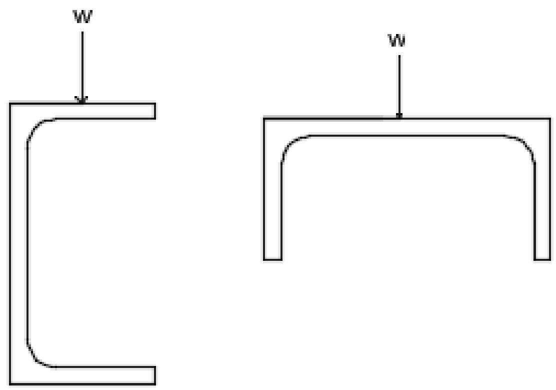

Fig -3: Load at web and flange portions

Fig -4: Digital Data logger

Fig -5: Testing of channel section

3. RESULTS AND DISCUSSIONS

3.1 Load at web portion

Table-2: Load and deflection at web portion

S.No	Load(kN)	Deflection (mm)
01	0.3	0.4
02	0.9	1.3
03	1.6	2.2
04	3.1	4.5
05	4.8	6.2
06	5.2	6.7
07	5.5	7.1
08	6.7	8.5
09	6.8	8.8
10	7	9.2
11	7.1	9.7
12	7.3	10.2
13	7.5	10.6
14	7.6	11.1
15	8.1	13.2
16	8.3	13.8
17	8.4	14.1
18	8.4	14.3
19	8.5	14.9
20	9.2	16.5
21	9.1	18.7
22	9.1	19.2
23	9.3	19.8
24	9.2	20.3
25	9.3	20.7
26	9.4	21.2
27	9.5	21.6
28	9.6	22.0
29	9.6	22.5
30	9.6	22.9
31	9.6	23.9
32	10	24.0
33	9.8	25.9
34	9.9	26.4
35	9.2	29.0
36	9.2	34.4
37	10	35.0
38	10.2	38.5
39	9.8	39.2
40	10	37.8
41	10.1	38.5
42	10.1	39.2
43	10.2	40.9

3.2 Load at flange portion

Table-3: Load and deflection at flange portion

S.No	Load(kN)	Deflection (mm)
01	2.7	0.3
02	3.8	0.7
03	4.7	1.1
04	5.8	1.5
05	6.6	1.8
06	7.8	2.2
07	8.1	2.5
08	9.1	3.0
09	10.1	3.5
10	11.0	3.9
11	12.1	4.2
12	13.2	4.6
13	14.0	5.1
14	15.1	5.4
15	16.0	5.8
16	16.7	6.1
17	17.4	6.5
18	18.3	6.7
19	18.8	7.1
20	19.0	7.4
21	20.3	7.8
22	21.0	8.1
23	21.2	8.4
24	21.8	9.0
25	23.0	9.3
26	23.5	10
27	23.0	10.4
28	23.1	11.1
29	23.0	11.4
30	23.2	11.8
31	23.4	12.2
32	23.5	12.6
33	23.7	13.1
34	23.8	13.5
35	23.5	13.8
36	28.9	14.1
37	24.0	15.0
38	24.2	15.4
39	24.5	15.8
40	24.9	16.3
41	25.3	16.8
42	25.8	17.0
43	25.2	17.2

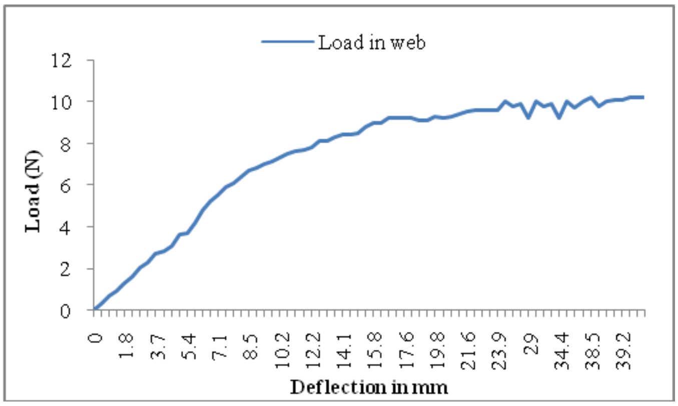

Chart -1: Behavior Of Steel Beam With Load At Web Portion

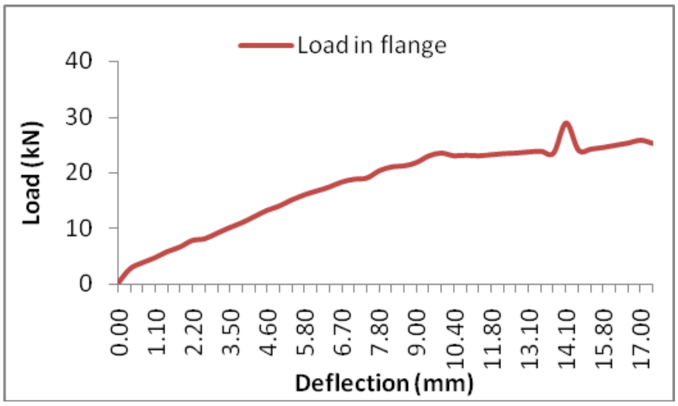

Chart -2: Behavior Of Steel Beam With Load At Flange Portion

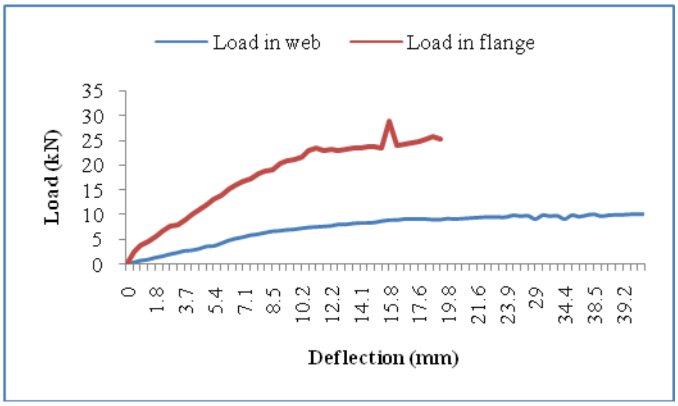

Chart -3: Comparison Of Behavior Of Steel Beam With Load At Web And Flange Portion

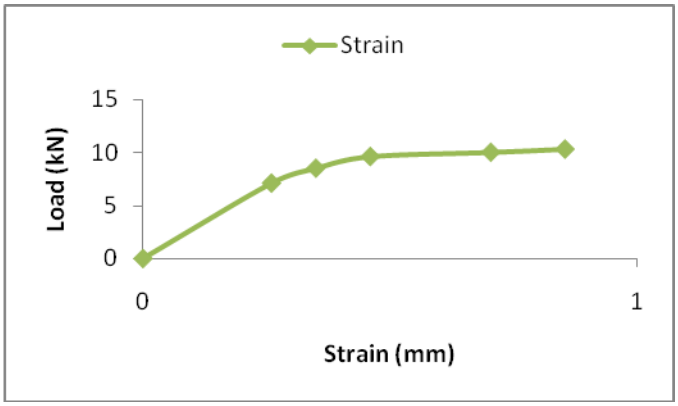

Chart -4: Load-Strain Behavior of the Beam

The load carrying capacity of the channel section when applying load on flange portion is 47% higher than the load applied on web portion.

3. CONCLUSIONS

The flexural behavior of channel section ISMC75 at different loading conditions is studied in this experiment. The specimen was tested under in a loading frame by applying loads at one third points for its pure flexural behavior.

From the experiment it was found that, the load carrying capacity of the channel section when applying load on flange portion is 47% higher than the load applied on web portion.

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