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The effective width of cold-formed C-section by IS:801 and comparing it with AISI:2007

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ABSTRACT

Buildings built with cold formed sections as primary members (frames) and secondary members (purlins) offers viable alternative solutions for wide range applications of social sectors like housing, education etc. Design of cold formed sections has obvious complexity in view of buckling of sections and stress in the compression element, especially in flexure. In this study, using IS: 801 equations, effective section properties of C section are calculated for a wide range of configurations with different b/t ratios for flange subjected to maximum allowable stress. The study also includes simple design tools and few standard colds formed sections having a similar configuration but for thickness to be used for residential or community shelters for different wind zones. A resource is made to compare the results with similar studies using AISI code.

Keywords**—** *Cold formed section, Primary members, Buckling of section, B/T ratio, IS: 801, AISI*

1. INTRODUCTION

Cold form sections as primary members (frames) and secondary members (purlins) offer a wider range of applications in varying sectors like education, health, housing etc. CFS section has large flat width to thickness ratio and leading to buckling of element still CFS have following inherent characteristics,

- Flexibility in designs.
- Easy and fast manufacturing and erection.
- Ease in transportation and handling.
- Low maintenance.
- Easy future expansion.

Methods of forming of cold formed sections are:

- Cold rolled forming operation.
- Press break operation.

In this study, usual stiffened CFS C-section with lips has been focused. Works on flexural strength performance and buckling mode prediction of cold-formed steel has been done and conclude that “web stiffeners to the C-section do not improve the bending capacity significantly, it just helps to reduced local buckling”.

2. DESIGN METHODOLOGY

2.1 Assumptions

The whole study has been concentrated on following assumptions,

- C-section with lips is considered for analysis.
- The section is predominantly in flexure.
- Only compression flange shall undergo buckling.
- Though compression flange undergoes buckling, the shift in neutral axis towards tension flange is negligible.

2.2 Shifting of the neutral axis

In the case of flexure member only top flange buckle and area concentration shifts toward bottom tension fibre and neutral axis shift downward with a small amount of eccentricity (Δ) as shown in the following figure:

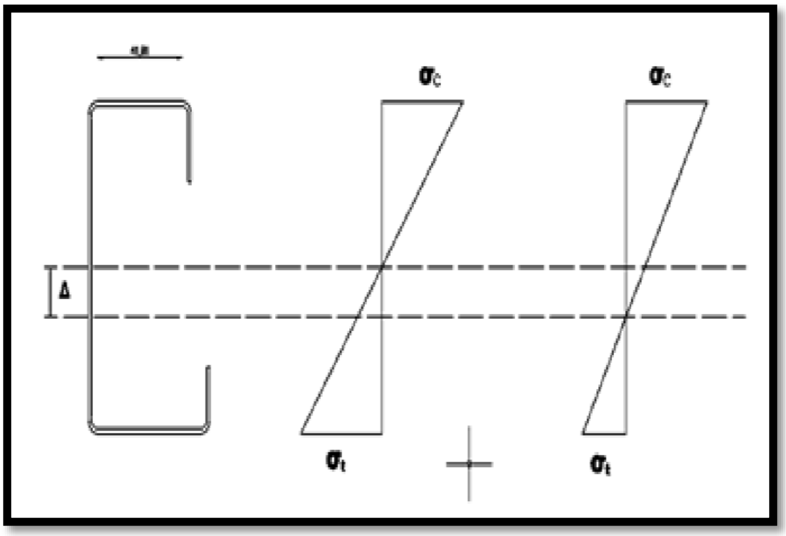

Fig. 1: Sifting of the neutral axis

2.3 Designing of 'C' section by IS: 801 and performing calculations manually.

- Depth of section (D) = 200mm
- Width of section (B) = 60mm
- Thickness of section (t) = 1.5mm
- Lip size = 20mm
- Outer Radius of curved portion in section (r_o) = 4.5mm
- Inner Radius of curved portion in section (r_i)= 3mm

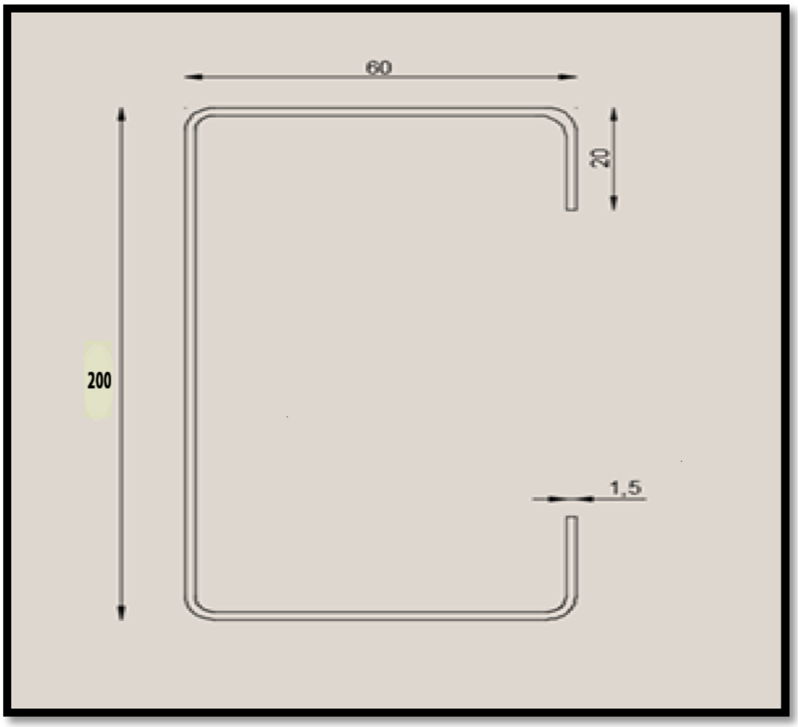

Fig. 2: C- section dimensions

3. CALCULATIONS

3.1 Simple calculations

Calculation for Flat Width of section (W):

$W=B-2(r_i+t)$

W= 60 -2 (3+1.5)

W = 51mm

The ratio of Flat Width to Thickness (W/t):
W/t = 51/1.5
W/t = 34mm

3.2 According to IS: 801 – 1975
Clause 5.2.1.2 (For load determination)

- Flanges are fully effective (b= w) up to...

$$\left(\frac{w}{t}\right)_{lim} = 1435/\sqrt{f}$$
$$\left(\frac{w}{t}\right)_{lim} = 1435/3384.45$$
$$\left(\frac{w}{t}\right)_{lim} = 24.67mm$$

Here, we get (W/t) > $(W/t)_{lim}$

- For Flanges With (W/t) larger than $(W/t)_{lim}$

$$\frac{b}{t} = \frac{2120}{\sqrt{f}}\left(1 - \frac{465}{(W/t) \times \sqrt{f}}\right)$$

$$\frac{b}{1.5} = \frac{2120}{\sqrt{3384.45}}\left(1 - \frac{465}{34 \times \sqrt{3384.45}}\right)$$

b=41.81mm

- Therefore the width lost in local buckling (b')[Curtailment]

b' = W – b
b' = 51 – 41.81
b' = 9.2mm

4. DATA CONSIDERED FOR ANALYSIS

Sections considered for calculation of gross and effective sectional properties as,

				Acording to IS:801-1975	According to AISI:2007
b(mm)	t(mm)	w(mm)	b/t	be/b	be/b
60	1.5	51	40	0.83	0.947
65	1.5	56	43.33333	0.796667	0.903667
70	1.5	61	46.66667	0.763333	0.860333
75	1.5	66	50	0.73	0.817
80	1.5	71	53.33333	0.696667	0.773667
85	1.5	76	56.66667	0.663333	0.730333
90	1.5	81	60	0.63	0.687

Fig. 3: Data analysis

5. GRAPHICAL REPRESENTATION

Graphical representation of width to thickness ratio changes with respect to dimensions. The ratio of effective width to the initial width ration is given by:

5.1 According to IS: 801-1975

$$\frac{b_e}{b} = \frac{2120}{\sqrt{f}}\left[1 - \frac{465}{\left(\frac{w}{t}\right) \times 58.176}\right] \times t$$

5.2 According to AISI: 2007

The ratio of effective width to the initial width ration is given by:-

$$\frac{b_e}{b} = -0.013 \times \frac{b}{t} + 1.467$$

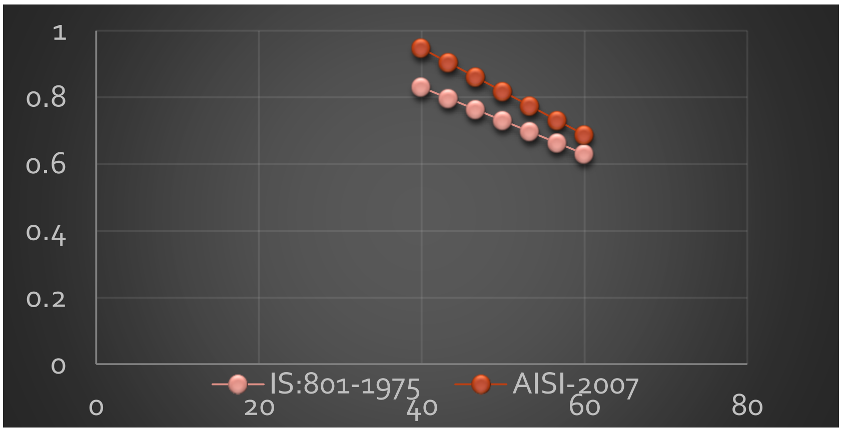

Fig. 4: Graph comparison of the ratio of initial width to the effective width

6. CONCLUSION

When the thickness is constant and width varies according to conditions.

- By IS: 801: 72.84 %
- By AISI: 81.67%
- Percentage difference: 8.96%

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