Cold Formed Section -Effective Width Calculation Study of IS-801 ,IS811 And AISI-2007

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Abstract- *Buildings constructed the usage of bloodless-shaped sections as number one members (frames) and secondary members (purlins) gives a feasible opportunity answers for huge variety packages of social sectors like housing, training etc. Design of bloodless shaped sections has apparent complexity in view of buckling of sections vis-à-vis strain with inside the compression element, mainly in flexure. In this study, the usage of IS801 equations, powerful segment homes of C segment are calculated for huge variety of configurations with exceptional b/t ratios for flange subjected to most allowable strain. These segment homes are used to conform most beneficial body configurations for numerous wind zones of the country. Study additionally gives easy layout gear and few preferred bloodless shaped sections having comparable configuration however for thickness for use for residential or network shelters for exceptional wind zones. A recourse is made to examine the outcomes with comparable research the usage of AISI code.*

Keywords- b/t ratio, Cold-formed steel (CFS), effective width, flexural strength, slenderness limits.

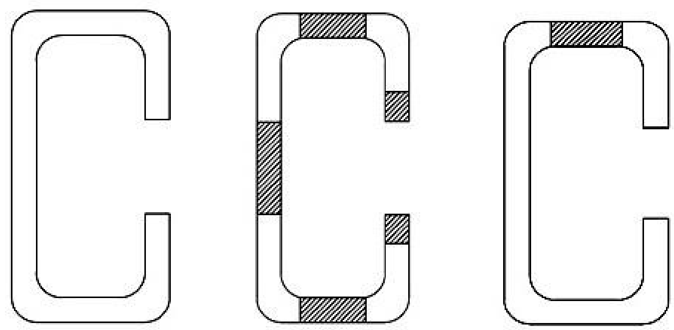
I. INTRODUCTION

i. Cold shape sections as number one members (frames) and secondary members (purlins) provide a much wider variety of packages in various sectors like education, health, housing etc. CFS phase has huge flat width to thickness ratio and main to buckling of detail nonetheless CFS have following inherent characteristics, Flexibility in designs.
ii. Easy and fast manufacturing and erection.
iii. Ease in transportation and handling.
iv. Economical and light in weight.
v. Low maintenance.
vi. Easy future expansion.

Methods of forming of cold formed sections are,

i. Cold rolled forming operation.
ii. Press break operation.

In this study, usual stiffened CFS C-section with lips has been focused. Buckling of C-section element under axial compression and flexure as,



(a) (b)

(a) compression (b) Flexure (c) Gross section Axial
Fig.1 - Buckling of C-section elements.

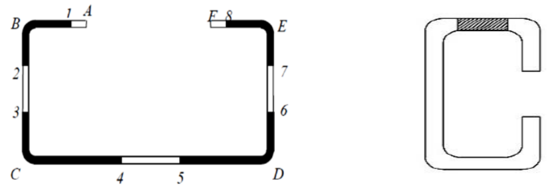
EFFECTIVE WIDTH CONCEPT

The idea of effective width can be used to assess the impacts of local buckling. Lightly stressed regions in the centre are neglected since they are ineffective at resisting applied loads. The regions closest to the supports are significantly more effective and are assumed to be fully functional.

EFFECTIVE SECTION PROPERTIES

The effective section attributes are determined by employing the effective widths of individual elements in the analysis of member behaviour. Consider the compression member ABCDEF shown in Fig.3.1 as an example. The member's functional parts have been darkened (i.e. 1-B, B-2, 3-C, C-4, 5-D, D-6, 7-E, and E-8). Compression resistance is deemed inefficient for sections A-1, 2-3, 4-5, 6-7, and 8-F. As a rule, the areas closest to the supporting edges are the most effective.

In the case of compression members, all elements are subject to reductions in width. Fig.(3.1a) In the case of flexural members, in most cases, only the compression elements are considered to have effective widths.



(a) (b)

FIG.3.1 : EFFECTIVE WIDTH OF COMPRESSION AND FLEXURE SECTION.

II. STUDY OF IS:801 (31ST JANUARY 1975)

Cold-formed steel structural members are made from flat steel that is not thicker than 125 mm and is cold-formed in rolls or a press brake. This standard was first issued in 1958, and it was based primarily on the 1956 edition of Specification for the Design of Cold Formed Metals.

American Iron and Steel Institute, New York, published steel structural members.

The Sectional Committee determined that when amending the Indian Standards, it should be brought in line with the AISI public union edition from 1966, as it has been the case in the past.

This is a well accepted approach in this country that is best suited to this type of construction.

Under one or more of the following conditions, this form of construction is acceptable and cost-effective.

the following circumstances:

a) Where the heavier, hot-rolled shapes are uneconomical due to moderate weights and spans for example, joists, purlins, girts, trusses, complete framing for one- and two-storey residential, commercial and industrial structures;
b) Where it is desired that load-carrying members also provide useful surfaces, for example, door panels and roof decks, mostly installed without any shoring and wall
panels.

 Effective sectional properties calculation, (Compression on stiffened element)

 For load calculation,
Flanges are fully effective (b = w) up to (w/t) lim =1435/√f
For flanges with (w/t) larger than (w/t) lim

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

Exception: Flanges of closed squares and rectangular tubes are fully effective (b=w)
up to (w/t)lim =
1540
√f
for flanges with w/t larger than (w/t)lim.

$$\frac{b}{t} = \frac{2120}{\sqrt{f}}\left[1 - \frac{420}{\left(\frac{w}{t}\right)\sqrt{f}}\right]$$

For deflection determination,
Flanges are fully effective (b = w) up to (w/t) lim =1850/√f
For flanges with (w/t) larger than (w/t) lim

$$\frac{b}{t} = \frac{2710}{\sqrt{f}}\left[1 - \frac{600}{\left(\frac{w}{t}\right)\sqrt{f}}\right]$$

Exception: Flanges of closed squares and rectangular tubes are fully effective (b=w)
up to (w/t)lim =
1990
√f
for flanges with w/t larger than (w/t)lim.

$$\frac{b}{t} = \frac{2710}{\sqrt{f}}\left[1 - \frac{545}{\left(\frac{w}{t}\right)\sqrt{f}}\right]$$

Where,
w/t = flat width ratio
b = effective design width in cm, and
f = actual stress in the compression element computed on the basis of the effective
design width in kgf/s
q.cm

III. STUDY OF IS:811 (22nd July 1987)

The Bureau of Indian Standards adopted this Indian Standard (Second Revision) on July 22, 1987. The Steel Economy Program is publishing a series of Indian Standards, including this one. The first edition of this book was published in 1961, and it was revised in 1965. The British Standards Institution's BS 2994-1976 'Specification for Cold Rolled

Steel Sections' was used to aid in the development of this standard.
In this revision, the following major modifications have been effected:

a) A series of zed sections with lips has been added.
b) Box sections and the strength properties of the various profiles have been deleted.
c) The sectional properties have been expressed to three significant figures.

-Steel strips or sheets no thicker than 10 mm are used to make cold formed light gauge steel sections. Cold-rolling is the most cost-effective method for large manufacturing, while press brakes are the most cost-effective method for smaller quantities of specific forms. analysis & design of cold-form section buildings for inaccessible terrains

IS-811 is a set of economic sections that must be chosen by a committee as part of the steel economy programme. (example: a steel table)

-Equal angle, unequal angle, channel without lip-square, rectangle, channel with lip-square, rectangle, hat section, lipped z-section, and so on are all covered by IS-811.
-The thickness of the section ranges are used by the Committee (1.25mm to 6mm). Practical designers, on the other hand, used to have section ranges from (0.8mm to 3mm). As a result, the IS-811's ready parts are insignificant.

IV. STUDY OF AISI (October 2007)

This specification covers the design of structural members made of carbon or low-alloy steel sheet, strip, plate, or bar with a thickness of less than 1 in. (25.4 mm).

Except as clearly specified differently, any compatible system of measurement units may be used throughout the standard. U.S. customary units (force in kilo pounds and length in inches), SI units (force in Newton and length in millimetres), and MKS units (force in kilogrammes and length in centimetres) are among the unit systems discussed in those Sections.

A structure must be constructed to execute its needed duties for the duration of its expected life. The serviceability limit states must be selected based on the structure's intended purpose and tested using realistic loads and load combinations.
A. Flange Flat-Width-to-Thickness Considerations

(a) **Maximum Flat-Width-to-Thickness Ratios**

Maximum allowable overall flat-width-to-thickness ratios, (w/t) dis regarding intermediate stiffeners and taking t as the actual thickness of the element, shall be determined in accordance with this section as follows:

(1) Stiffened compression element having one longitudinal edge connected to a webor flange element, the other stiffened by:
Simple lip, w/t <= 60
Any other kind of stiffener
i) when Is < Ia, w/t <= 60
ii) when Is >= Ia, w/t <= 90

where
Is = Actual moment of inertia of full stiffener about its own centroidal axis parallel to
element to be stiffened
Ia = Adequate moment of inertia of stiffener, so that each component element will
behave as a stiffened element

(2) Stiffened compression element with both longitudinal edges connected to other
stiffened elements, w/t <= 500

(3) Unstiffened compression element, w/t <=60

(b) **Maximum Web Depth-to-Thickness Ratios**
The ratio, h/t, of the webs of flexural members shall not exceed the following limits:

(a) For unreinforced webs: (h/t)max = 200
h = Depth of flat portion of web measured along plane of web
t = Web thickness. Where a web consists of two or more sheets, the h/t ratio iscomputed for the individual sheets.

Effective width of elements,
□ Strength Determination
b = w for $\lambda \leq 0.673$
b = ρw for $\lambda > 0.673$

Where,
b = effective design width of uniformly compressed element for strength determination
w = flat width of compression element
ρ = reduction factor determined from following equation,

$$\rho = \frac{1 - 0.22/\lambda}{\sqrt{\lambda}} \quad \lambda \leq 1$$

Where the plate slenderness factor λ is given as,

$$\lambda = \sqrt{\frac{f}{fcr}}$$

$$fcr = \frac{k\pi^2 E}{12\,(1-\mu^2)}\left(\frac{t}{w}\right)^2$$

The above equation for the plate slenderness factor can be simplified by using μ = 0.3:

$$\lambda = \frac{1.052}{\sqrt{k}}\left(\frac{w}{t}\right)\sqrt{\frac{fmax}{E}}$$

Where
k = plate buckling coefficient
= 4.0 for stiffened elements , 0.43 for unstiffened elements
w = width of stiffened compression element
t = thickness of compression element
E = modulus of elasticity
f = maximum compressive edge stress in element without considering safety factor

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