BEHAVIOUR OF H -SECTIONS WITH SLENDER FLANGE BUILT UP SECTION IN PRE ENGINEERING BUILDING

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Abstract - *This paper presents analytical study on the local buckling of slender flange. The classification of section plays an important role in design of Pre engineering building (PEB). Sections are classified on the basis of the slenderness ratio. Classification of steel section varies in accordance with code. A model is prepared in ANSYS by subjecting H-section beam under uniform loading with varying width to thickness ratios which are close to the limit value of current standard of IS 800:2007. Generally, a slender section is not used in steel structures as it cannot attain its full load carrying capacity. The aim of this paper is to determine the limit at which load slender flange buckles locally, and to compare provisions of slenderness ratio in AISC and IS 800:2007.*

Key Words: Local buckling, Plate buckling, Slender flange, ANSYS, Different codes.

1. INTRODUCTION

Members of steel live in different forms of structures and bridges. To build an effective, productive, secure system, understanding the actions of these participants under different loads is essential. Many methods were used to study steel members behaviour. The attributes of the member shall be based on the geometry of the member. The Member can also behave like a beam as the depth of built-up sections is small. If the depth of the member is large, it can be like a truss. Experimental work was commonly used to analyze the behavior of individual loaded members. [1][2][7] [8.]

Yet in recent years, thanks to advanced expertise and capability of computer software and hardware, the use of finite element analyzes has expanded. The recommended approach for addressing complicated problems has now been established. Computer software is used much quicker and highly economical for designing these leaders. Better and more effective research can be made to comprehend entirely the actions and commitment of steel members to an entire system using FEM products. Throughout the present research, attempts were made to model the integrated steel beams using the framework of finite elements. [1][4][7][8].

This research analyzes the flange beam and compared the slenderness ratio of the beam from IS 800-2007and AISC.

1.1 What is local buckling?

Local buckling of the compression flange (FLB) occurs when the width/thickness ratio of the plate elements is high. The general concept was discussed in some detail in the notes on plate buckling. The fourth limit state for beams is Flange Local Buckling, or FLB for short. It is exactly the same as Web Local Buckling, except the width-thickness ratio is in terms of the flange and not the web. This type of buckling occurs when the width-thickness ratio is not large enough to withstand the moment on the beam. The way to prevent this type of buckling is to limit the with-thickness ratio. The limits can be computed for flange local buckling. The width-thickness ratio is compared to λpλ p and λrλ r. Then the maximum moment can be calculated.

Equations to determine FLB

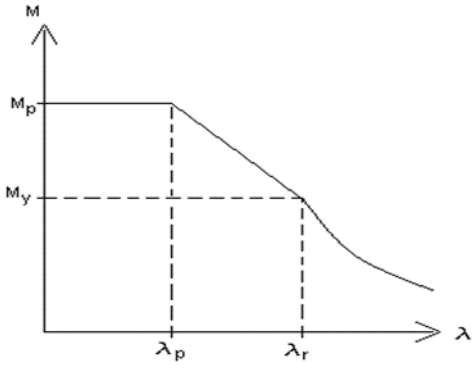

Fig: 1: The graph illustrates the options for FLB

When,

bt<λpb t λ p

there is no FLB and the cross section is compact because,

Mn=MpM n M p

Mp=FyZ≤1.5MyM p F y Z 1.5 M y

from the yielding state.

When,

$\lambda p<bt<\lambda r\lambda$ p b t λ r

the graph is linear, and therefore a linear interpolation between MpM p and MyM y is used for the maximum moment.

And finally, when

$bt>\lambda rb$ t λ r

the graph is non-linear, the flange is non-slender, and there is an equation to find the maximum moment. [1][6][5][10].

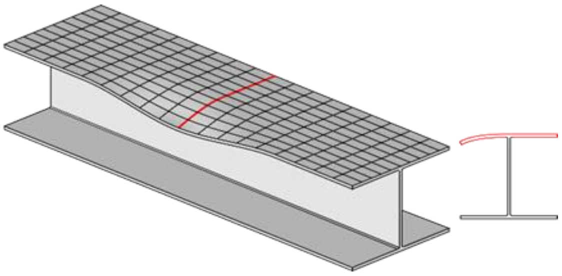

Fig 2. Flange buckle

1.2. ANSYS

It is a general purpose software, used to simulate interactions of all disciplines of physics, structural, vibration, fluid dynamics, heat transfer and electromagnetic for engineers. Ansys publishes engineering analysis software across a range of disciplines as follows Finite element analysis structural analysis computational fluid dynamics Heat transfer explicit dynamic analysis.

1.3. Finite element analysis (FEA)

It is the modelling of products and systems in a virtual environment, for the purpose of finding and solving potential (or existing) structural or performance issues. FEA is the practical application of the finite element method (FEM), which is used by engineers and scientist to mathematically model and numerically solve very complex structural and fluid.

2. Design of Section

2. I –Section

I beam have a spread of necessary uses within the steel housing industry. They're typically used as essential support trusses, or the most frameworks, in buildings. Steel I beams guarantee a structure's integrity with relentless strength and support. The large power of I beams reduces the necessity to incorporate varied support structures, saving time and cash, in addition as creating the structure additional stable. The flexibility and liableness of I beams create them a desired resource to each builder. I beam square measure the selection form for steel builds owing to their high practicality. The form of I beams makes them wonderful for one-way bending parallel to the online. The horizontal flanges resist the bending movement, whereas the online resists the shear stress. They'll take varied styles of hundreds and shear stresses while not buckling. They're additionally price effective, since the "I" form is associate degree economic style that doesn't use excess steel. With a large style of I beam varieties, there's a form and weight for just about any demand. The versatile practicality of the I beam is what offers it the alternate name universal beam, or UB. [1][7][3].

3. Methodology

By Making model in Ansy's and checking for the local buckling in the flange of H section. According to India code 800:2007 width to thickness ratio [w/t] is 23.33. According to Is code ratio, b/t ratio should be kept below this, so that the flange should not fail. The slenderness ratio of the India standards [23.33] and American standards [30] is compared. Various loading is applied in the form of uniform distributed load.

3.1 Procedure of Ansy's Modelling:

- A model of length 7.5m was prepared. Material and physical properties are mentioned in table 1 ,2,3,4 and table 5.
- The beam is simply supported at the edges so that one edge can freely move along the z-axis.
- In static structure, we have edited property of material like young modulus, yield strength, Poisson ratio.
- Young's modulus is taken as 210Pa.
- Yield strength is taken as 345GPa
- Poisson ratio is taken as 0.31.
- Slenderness ratio is taken to be 155/6=25.833.
- To understand the in-depth behavior of flange, the model has finely meshed.
- For trail purpose flange width of 150-210mm is taken so that slenderness ratio (b/tf) is close to the limiting value.
- In order to observe the behavior of flange, the web is fixed from both edges.

- The pressure of 1 Mpa is uniformly applied on the span.
- The fig shows the various graphs so that the slenderness ratio vs buckling vs total deformation vs directional deformation.

4. Results

4.1 ANSYS results

The results obtained from ANSYS are shown in table 1,2,3,4 and table 5.

Table no. 1 below shows difference in results obtained through ANSYS and variation in buckling load in Slenderness ratio.

Table :1 Variation in Buckling Load in Slenderness Ratio

Slenderness Ratio (b/t_f)	Buckling Load (KN)
25	333.787
25.83	344.169
26.67	362.28
27.5	374.962
28.34	390.749
29.16	411.06
30	426.168
30.83	438.006
31.66	454.119
32.5	469.462
33.34	486.825
34.16	506.944
35	523.687

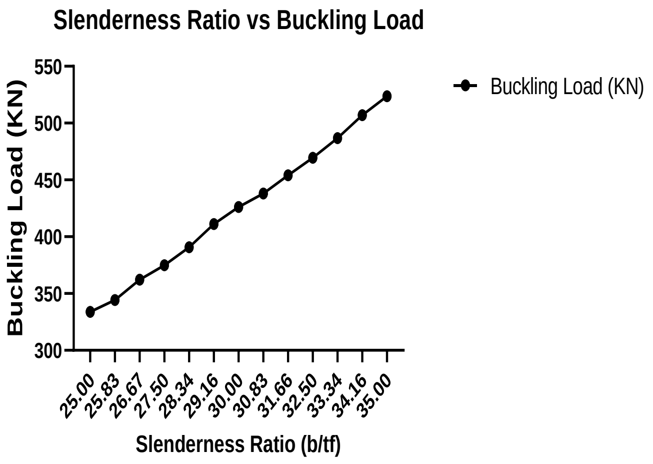

Fig :3 Slenderness Ratio in Buckling Load

Table no. 2 below shows difference in results obtained through ANSYS and variation in buckling load in total deformation.

Table 2: Variation of Buckling load in Total Deformation

Buckling Load (KN)	Total deformation (mm)
333.787	28.344
344.169	66.395
362.28	69.191
374.962	56.557
390.749	52.447
411.06	48.761
426.168	45.511
438.006	42.566
454.119	39.911
469.462	37.502
486.825	35.354
506.944	33.369
523.687	31.574

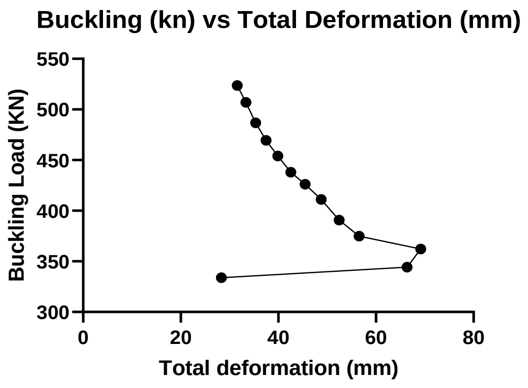

Fig :4 Buckling Vs Total Deformation

Table no. 3 below shows difference in results obtained through ANSYS and variation in buckling load in directional deformation in 'x' direction.

Table:3 Variation in Buckling Load Vs Directional Deformation in 'x' Direction

Buckling Load (KN)	Directional deformation in x-direction (mm) min	Directional deformation in x-direction (mm) max
333.787	0.175	1
344.169	0.156	1
362.28	0.1477	1
374.962	0.1385	1
390.749	0.1206	1

411.06	0.11683	1
426.168	0.09539	1
438.006	0.0953	1
454.119	0.090467	1
469.462	0.082574	1
486.825	0.079393	1
506.944	0.075304	1
523.687	0.072889	1

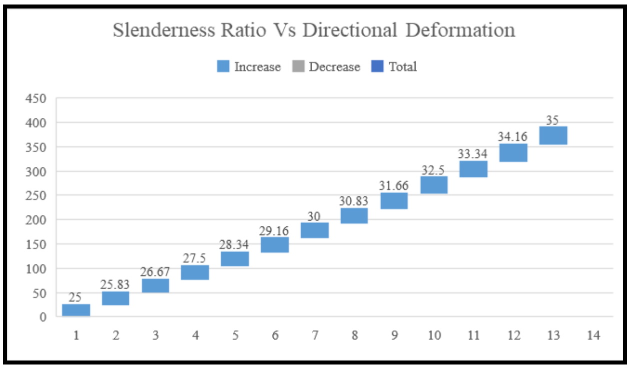

Fig :5 Variation in Buckling Load Vs Directional Deformation in 'x' Direction

Table no. 5 below shows difference in results obtained through ANSYS and variation in buckling load in total deformation and directional deformation.

Table 4. Variation in Buckling load in Total Deformation and directional deformation

Slenderness Ratio (b/t_f)	Total deformation (mm)	Directional deformation in x-direction (mm) min	Directional deformation in x-direction (mm) max
25	28.344	0.175	1
25.83	66.395	0.156	1
26.67	69.191	0.1477	1
27.5	56.557	0.1385	1
28.34	52.447	0.1206	1
29.16	48.761	0.11683	1
30	45.511	0.09539	1
30.83	42.566	0.0953	1
31.66	39.911	0.090467	1
32.5	37.502	0.082574	1
33.34	35.354	0.079393	1
34.16	33.369	0.075304	1
35	31.574	0.072889	1

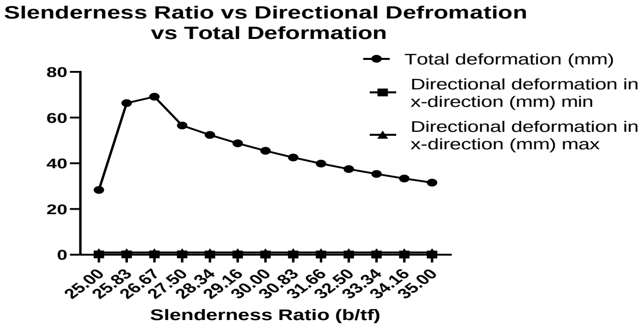

Fig 6: Slenderness Ratio Vs Directional Deformation

5. CONCLUSIONS

This analytical study is an attempt to understand the behavior of slender flange. From the results, it can be concluded that,

- With the increase in slenderness ratio (width/thickness), more load is required to cause buckling this is because direct compression is not possible in the flange shown in table 1 and fig 3.

- With the increase in slenderness ratio, total deformation decreases as shown in fig 4.

- With the increase in slenderness ratio, it can be seen from the above fig .5 directional deformation in x-direction decreases.

- AISC gives more economical structure compared to IS 800:2007 as it allows slenderness ratio for flange i.e. b/tf to extend up to 28 before the introduction of stiffeners. Else local buckling can be prevented by increasing thickness of flange.

6. REFERENCES

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