COMPARATIVE ANALYSIS IN STEEL SECTION FOR DEFLECTION USING ANSYS

[1]S.DhivyaBharathi [2]M Praveena[2]S Pradeep[2]C R Rakesh raj

[1] Assistant Professor, Department of Civil Engineering,

Bannari Amman Institute of Technology, Sathyamangalam, Erode, Tamilnadu, India,

[2] Under Graduate students, Department of Civil Engineering,

Bannari Amman Institute of Technology, Sathyamangalam, Erode, Tamilnadu, India.

ABSTRACT- *The deformed shape and position of a member when subjected to a bending load is known as the deflection. In this paper, we compare the deflection of the steel beam section while acting loading conditions by using ANSYS and manual calculation. The steel beam section is considered as a linear section analyse is made two different sections by using ANSYS static structural model. The results discussed and analysing by manual and ANSYS results. The fixed beam with point load is taken for the exercise.*

Keywords: Deflection, steel beams, ANSYS, Fixed End Condition.

INTRODUCTION

The ANSYS worktable setting is an Associate in nursing intuitive up-front finite part analysis tool that's utilized in conjunction with CAD systems and/or Design Modeller. ANSYS workbench could be a computer code setting for playacting structural, thermal, and magnetic force analyses. The category focuses on pure mathematics creation and optimization, attaching existing pure mathematics, fitting the finite part model, solving, and reviewing results. The category can describe a way to use the code yet as basic finite part simulation ideas and results interpretation.

Beam might be characterized as a part whose length is substantial in correlation with its thickness and is loaded with transverse loads or couples that produce critical bowing impacts. Beams are by and large ordered by their geometry and way in which they are bolstered. Geometrical grouping incorporates such highlights as the state of cross-segment, regardless of whether the beam is straight or bent and whether the beam is decreased or has a consistent cross area. On the way in which they are upheld, the beams may promptly be named cantilevers, essentially bolstered, overhanging, persistent and fix-finished beam. Beams can be additionally arranged by the kind of load they are conveying, for instance, a cantilever beam conveying a consistently circulated load might be named a consistently loaded cantilever beam.

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.

HISTORY OF ANSYS

Inc. is an American Computer-aided engineering software developer headquartered south of Pittsburgh in Cecil Township, Pennsylvania, United States, and The Company was founded in 1970. By John A. Swanson as Swanson Analysis Systems, Inc (SASI) The Company grew by 10 percent to 20 percent each year, and in 1994 it was sold to TA Associates. The new owners took SASI's leading software, called ANSYS Stable release 17.0 (January 2016)

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.

Benefits of FEA

It can be used in new product design, or to refine an existing product, to ensure that the design will be able to perform to specifications prior to manufacturing with FEA you can: Predict and improve product performance and reliability Reduce physical prototyping and testing Evaluate different designs and materials Optimize designs and reduce material usage.

DEFLECTION

Assumes some particular shape which is called beam, it is assumed that shear strain do not deflection at any point along the beam span is deflection curve. The vertical distance between a developing the theory determining the deflection of a In deformed position; the axis of the beam point in neutral axis and corresponding a point in the significantly influence the deformation. The deflection curve is called deflection at that point. In the function of bending moments and property of the beam which was initially in a straight longitudinal line material and cross section.

STRUCTURAL STEEL

Structural steel has numerous applications over a wide scope of ventures to be specific, development, fabricating, transport, mining, shipbuilding, vitality, and bundling. It is the most favoured metal by draftsmen, architects, specialists, temporary workers, and fabricators. It is profoundly strong, erosion safe, pliable and moderate. Underneath recorded are a couple of basic steel applications in various modern divisions:

Construction

Basic steel has different applications in the development business. It is utilized in planning and building mechanical spaces. Basic steel has a high solidarity to weight proportion which makes it perfect to use in the development of substantial structures, for example, structures, stockrooms, spans, and manufacturing plants and so on. Bars, steel outlines, segments, bars, supports, plates and numerous others are made by basic steel fabricators which are utilized in the development business.

Transport

Auxiliary steel is utilized to make trucks, transmissions, prepares, rails and ships, grapple chains, air ship undercarriages, and stream motor segments. The majority of these vehicles contain a decent extent of basic steel. Specialists and architects pick basic steel on account of its flexibility, consumption obstruction, elasticity, pliability, flexibility, and moderateness.

Mining

The mining business has numerous utilizations of basic steel. The vast majority of the components in the mining foundation are manufactured utilizing basic steel. All workshops, workplaces, basic components of mines, for example, mining screens, fluidized bed boilers, structures are made utilizing basic steel. Basic steel is anything but difficult to clean in view of its smooth surface in this manner settling on it a perfect decision for the mining business.

Ship Building

Most marine vehicles are made utilizing basic steel. It is utilized to make super tankers, submarines, water crafts, stepping stools, steel ground surface and grinding, stairs and created areas of steel. Basic steel can withstand a great deal of outside weight, it doesn't rust and can be formed into any shape effectively; these characteristics makes auxiliary steel incredibly helpful in the shipbuilding business.

Vitality

There are numerous auxiliary steel applications in the vitality division. Vitality division includes wind control, atomic power, electric power and gaseous petrol. A great deal of the mechanical structures, for example, transmission towers, pipelines, wind turbines, electromagnets, transformer centres, oil and gas wells are made utilizing basic steel. Aside from this, there are numerous other auxiliary steel applications in the vitality segment.

Bundling

Steel is viewed as a decent component for bundling as it shields the items from water, air, light presentation, and contaminants. The steel utilized in bundling is normally tin covered to forestall consumption. Nourishment, drink holders, bottle tops and different terminations are made utilizing auxiliary steel. "Bundling steel is made of low carbon cold moved steel strip, and are surface wrapped up."

Design of Section

I Section

I beams 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 reliableness 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.

Channel Section

The structural channel isn't used the maximum amount in construction as symmetrical beams, partly as a result of its bending axis isn't targeted on the dimension of the flanges. If a load is applied equally across its prime, the beam can tend to twist far from the net. This could not be a liability or drawback for a selected style, however could be an issue to be thought-about.

Channels or C-beams are typically used wherever the flat, back facet of the net may be mounted to a different flat surface for optimum contact space. They're additionally typically welded along succeeding to create a non-standard I-beam.

DESIGN OF BEAM

LOADING ACTING ON BEAM

Due to the self-weight of the beam – 1 kN/m

Due to the 150mm thick slab = (1 x 3 x 0.15) x 25 = 11.25kN/m

Due to Floor Finishing @ 0.5 KN/m^2 = (1 x 3) x 0.5 = 1.5 kN/m

Live Load - @ 4 KN/m^2 = (1 x 3) x 4

=12kN/m

Total Load per meter run, w = (1 + 11.25 + 1.5) +12 = 25.75 kN/m

Total Load = 154.5kN

EFFECTIVE LENGTH

l = 6 + (0.25/2) + (0.25/2) = 6+0.125+0.125 = 6.25m

M = ($w.l^2/8$) = ((25.75 x 6.25^2)/8)

= 125.73 kN-m

= 125.73 x1000 x 1000 N-mm

= 125730000 N-mm

Maximum Permissible Stress = 0.66 X Yield Strength.

Fe250 the Yield Strength is 250 N/mm^2,

Hence

Maximum Permissible Stress, f = 0.66 x 250 = 165 N/mm^2.

$Z_{required}$ = (M/f) = (125730000/165) = 762000 mm^3 = 762 cm^3

I SECTION

ISMB 350 @52.4 kg/m having the following properties,

Sectional Area, a =66.71 cm2

Depth of Section, h = 350mm

Thickness of Web, t_w = 8.1mm

Moment of Inertia, I_{xx} = 13630.3cm^4

Section modulus, z_{xx} = 778.9 cm^3

SHEAR FORCE

Maximum Shear Force

V = (w l/2) = ((25.75 x 6.25)/2) =80.45 kN

Average Shear Stress in Beam

T_{va} = ($V/h.t_w$) = (80450/(350 x 8.1))

= 28.38 N/mm^2 < 100 N/mm^2

DEFLECTION

Actual Deflection = (5/384) x ($W.l^3/E.I$)

= 1.877 cm

Permissible Deflection = l/300

= 2.083 cm

CHANNEL SECTION

ISMB 400 @49.4 kg/m having the following properties,

Sectional Area, a =62.93 cm2

Depth of Section, h = 400mm

Thickness of Web, t_w = 8.6mm

Moment of Inertia, I_{xx} = 15082.8cm^4

Section Modulus, Z_{xx} = 754.1 cm^3

SHEAR FORCE

Maximum Shear Force

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

V = w ((L/2)-D)

=66.95 kN = 66950 N

Average Shear Stress in Beam

$T_{va} = (V/D.t_w) = (66950/ (400x 8.6))$

$= 19.46 \ N/mm^2 < 100 \ N/mm^2$

DEFLECTION

Actual Deflection

$= (5/384) \times (W.l^4/E.I) = 14.4$ cm

Permissible Deflection

= l/325= 19.23 cm

PROPERTIES OF STRUCTURAL STEEL

S NO	PROPERTY NAME	VALUE	UNIT
1	Density	7850	Kg/m^3
2	Young's modulus	2E+11	Pascal
3	Bulk modulus	1.66E+11	Pascal
4	Shear modulus	7.69E+11	Pascal
5	Tensile yield strength	2.5E+08	Pascal
6	Compressive yield strength	2.5E+08	Pascal
7	Tensile ultimate strength	4.6E+08	Pascal
8	Compressive ultimate strength	0	Pascal
9	Poisson's ratio	0.3	-

PREPROCESSING IN ANSYS

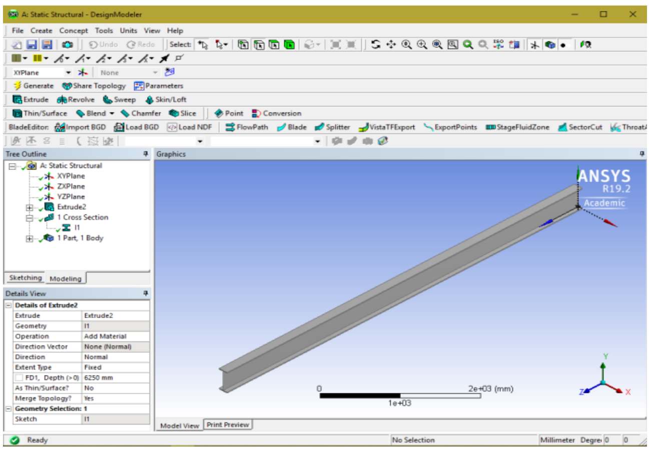
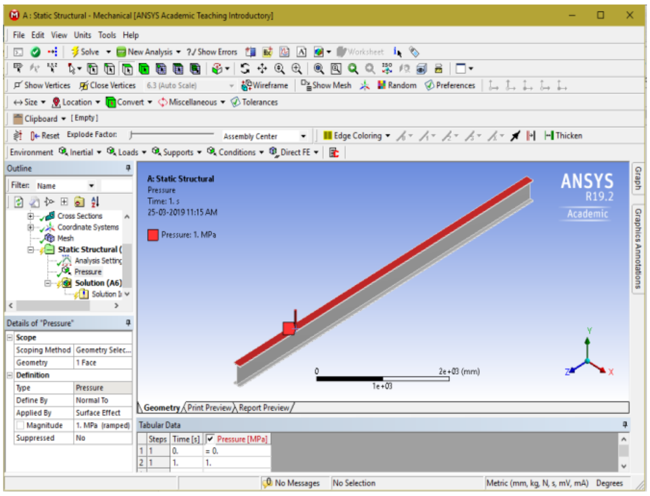


Fig 1-Model I section

Fig 2- Meshing of beam



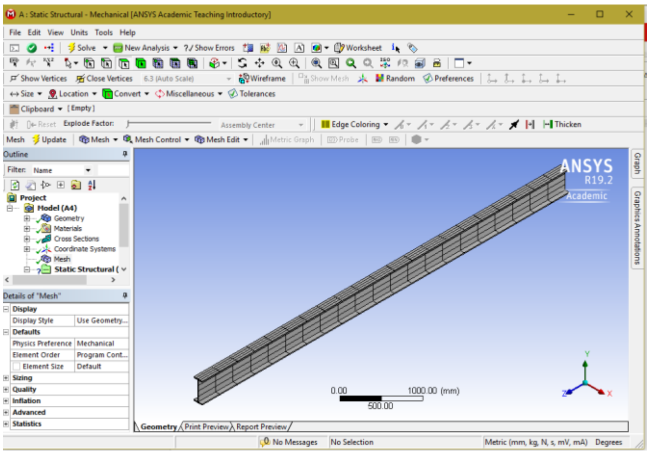


Fig 3- Loading of beam

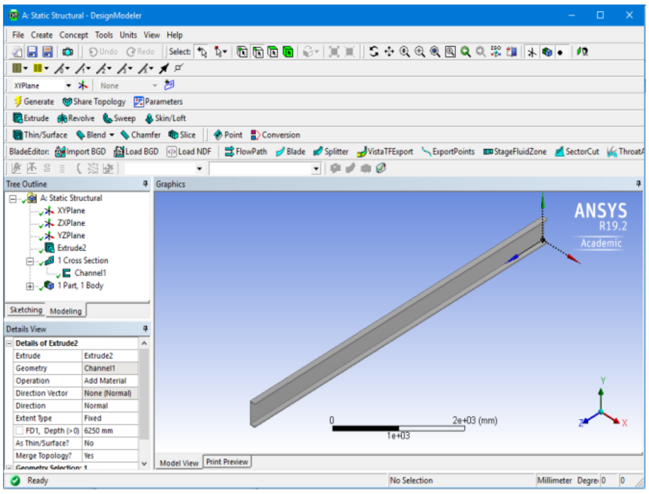


Fig 4- Model channel section

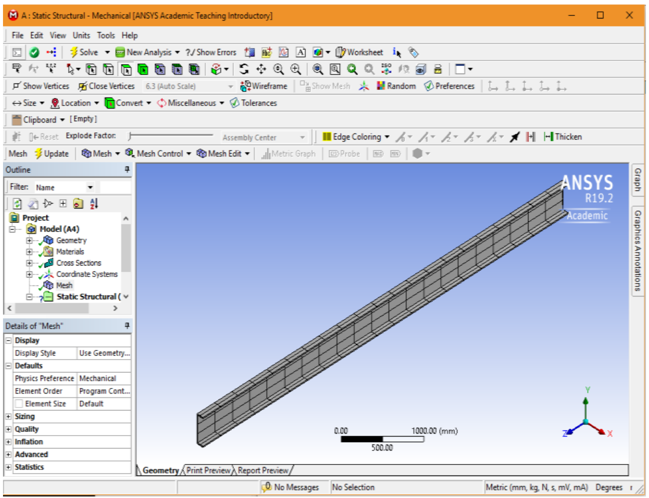


Fig 5- Meshing of section

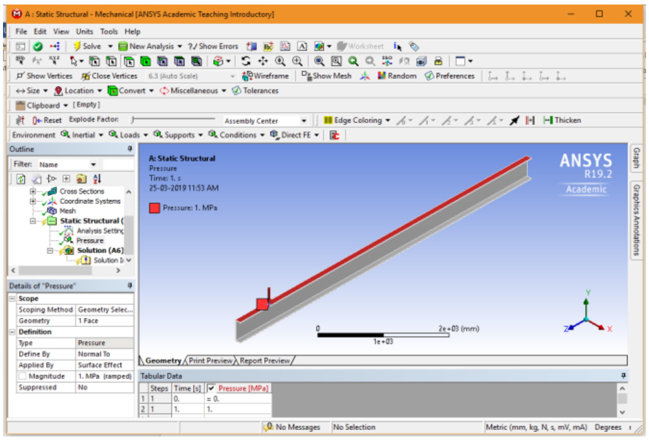


Fig 6-Loading of beam

RESULT

S NO	Beam section	Average Deflection	Permissible Deflection
1	I section	1.877 cm	2.083 cm
2	Channel section	14.4 cm	19.23 cm

ANSYS RESULT

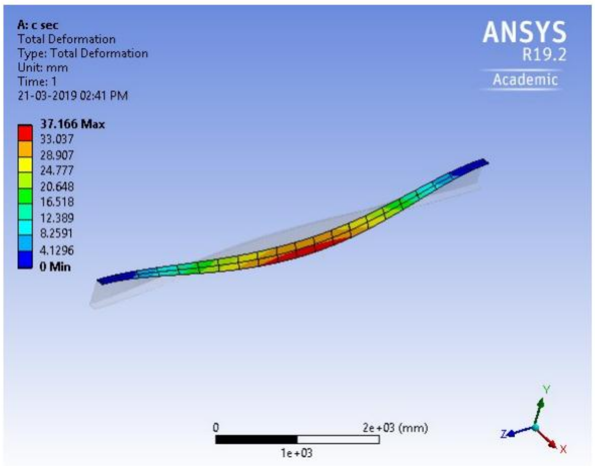


Fig 7-Deflection of I section

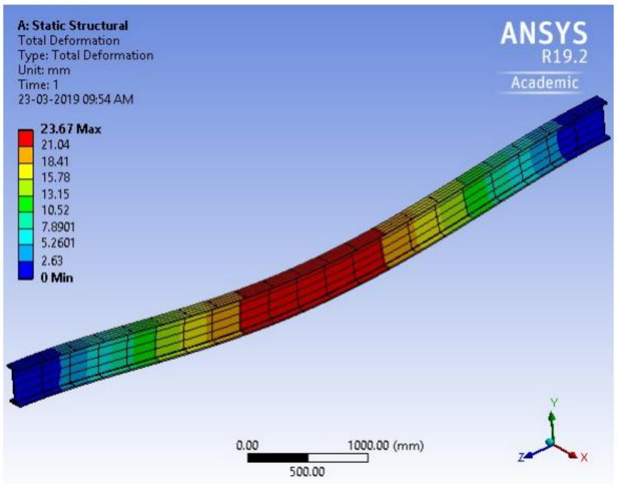


Fig 8- Deflection of Channel section

CONCLUSION

By comparing deflection results of theoretical analysis with ANSYS and the sample steel beam, with deflection, are acceptable as per the IS code. By this it can be justified that the approach adopted using ANSYS is quite perfect and the results are accurate in comparison with theoretical values. A steel I and C beam steel section is modelled and analysed. So to analyse different geometries of irregular shape, ANSYS can be adopted since other software's don't give us the liberty to do that. Further validation is possible experimentally and has better chances of giving the same result as that from ANSYS. The results are accurate since ANSYS module is based upon FEM.

REFERENCES

[1] Comparative Analysis of Deflection of Simply Supported Beam of Different Material Subjected to U.D.L using ANSYS - Dinesh Agarwal

[2] Comparative Analysis of Deflection of Simply Supported Beam of Different Material Subjected to U.D.L using ANSYS Dinesh Agarwal

[3] Analytical Modelling of Built-up Steel Beams Using ANSYS - N. Shanmugasundaram and Prince G. Arulraj

[4] "Investigation of Structural Analysis of Composite Beam Having I- Cross Section under Transverse Loading" - Ashish A. Desai ,Prof.Chhapkhane N.K.

[5]https://www.youtube.com/watch?v=mAZKGNcDDvs

[6] https://www.youtube.com/watch?v=CTi1ru-pfi0

[7]https://www.youtube.com/watch?v=XECmd-BPKa8