"REVIEW & ANALYSIS OF CANTILEVER BEAM CRANE FOR WEIGHT REDUCTION BY USING TOPOGRAPHY METHOD"

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ABSTRACT

Abstract- Almost all industrial equipment falls in the category of heavy weight material of I beam section. Hence it is essential to study and reduce the weight and strength in various composite structures.In this thesis ,review& analysis of Vf, web type structure are investigated for cantilever condition of crane.Primary goal is to develop an equiavalent cross section of structutre material model,which is best a good substantial advantages can be obtained with regard to easy of modelling and model modification. The models of the I Section ,web, and Vf section are done in CATIA V5R20 and weight is analyzed.The structural analysis of Vf,web section is done using ANSYS work bench. Bending stress and deflection is compared with I beam section in analytically. The aim of the project is reduce the weight, deformation and increase the strength. Deformation compared the experimentally by using Universal Testing Machine with analytically as well as summarized the proposed technique for reduction in weight, which will help to investigate the various aspects of weight reduction and strength improvement of various section i.e. Web section, and Vf section.

Key Word: Universal Testing Machine.

I.INTRODUCTION

Material handling is a vital component of any manufacturing system and the material handling industry is consequently active, dynamic, and competitive. A crane is a mechanical hoisting contrivance equipped with a rope drum, wire rope and sheaves that are utilized both to hoist and lower materials and to move them horizontally. It utilizes simple machines to engender mechanical advantage which avails to move loads beyond the mundane capability of a human. Cranes are commonly utilized in the convey industry, in the construction industry and in the manufacturing industry. The overhead cranes handle and transfer heftily ponderous loads from one position to another. Electric overhead travelling cranes are widely utilized in many industries for hoisting the safe working load. The escalating price of structural material is an ecumenical quandary. Many minute scale industries purchase the subsisting electric overhead cranes from more astronomically immense industries and make the required modification to suit their requisite.

The general procedure for design of peregrinating crane girders is accomplished through the utilization of codes and standards. 3D-modeling of overhead crane I beam, Vf core Web core sandwich structure have done in Catia To find the displacements and stress values by analysis software ANSYS workbench 14.5.In additament to the obtained weight reduction, these solutions can often bring space savings, stress decreases, deformation withal decreases, stress decreases .

The objective of this project is to reduce the weight of a cantileverbeam crane by using ANSYS workbench.

To accomplish this, the following specific objectives are outlined:

1.Review the theory of different structure.
2.Numerically determine the bending stress and deflection for structures.
3.Generate models of structures (I, web, Vf core) by using CATIA.
4.Determine the stress and deflection of structures by using ANSYS.
5.Compare Analytical and Numerical result of stress and deflection of structures.
6.Determine the deflection of structures by using Universal Testing Machine.
7.Check the experimental and ANSYS result of deflection.
8.Compare the ANSYS result of structure.
9.Selections of structure low weight, small deformation of the Vf, Web core.

II.LITERATURE REVIEW

[1]Penttikujala,AlanKlanac(2005-05)steel sandwich panels that are welded by laser can preserve 30-50% weight compared to conventional steel structures ,panels of metallic face sheets and a pyramidal truss core subjected to panel bending and in plane compression testing to explore the effects of relative core density and process parameters.

[2]**PenttiKujala(2002)**Laser welding is used in preaparation of ofmetalic sandwich panels ,when analysis is done then found that it has excellent properties with weight optimization in more application.

[3]JeomKeePaika, Anil K. Thayamballi, Gyu Sung Kim (1999) In this stdy of strength properties of honeycomb sandwich panel which have Al as main material.

[4]KujalaPentti and KlanacAlan(2002) When laser welding is used in steel sandwich panel then weight is reduce upto the 30-50%campairing with the conventional steel structure.

[5]Devendra B. Sonawane(2015) Composite structure and steel structure models in CATIA are efficiently imported into ANSYS workbench and structural analysis is done and equipollent stress and total deformation is observed. In rectangular composite structure the equipollent stress as well as weight is additionally reduced compare to Rectangular steel structure. In rectangular composite structure equipollent stress decreases by around 10% and weight is decreases by around 20% as compare Rectangular steel structure.AndIn circular core composite structure equipollent stress decreases by around 62% and weight is decreases by around 30% as compare circular core steel structure.

III.METHODOLOGY

Design Procedure

1. Moment of Inertia

$I = \frac{bd^3}{12}$

2. Sectional modulus

$Z_{XX} = \frac{I_{XX}}{y_{max}}$

3. Bending stress

$6_b = \frac{M}{z}$

4. Maximum deflection

$Y = \frac{WL^3}{3EI}$

IV.PREPARING THE3-D MODEL

I section beam, Web core &Vf-core is modeled in CATIA. Then the geometry is saved in STP format and imported to ANSYS workbench. In ANSYS Workbench the STP format is imported and geometry will show three contact pairs. Materials properties are given to the geometry. Now mesh the geometry as optimum meshing size, convergence study optimum mesh size is selected and structural analysis is done by fixing the geometry at one end of the span of the beam and pressure is applied at top face of the plate. Now by solving the structure the deflection and von misses stress are noted of load 500N to 3000N.

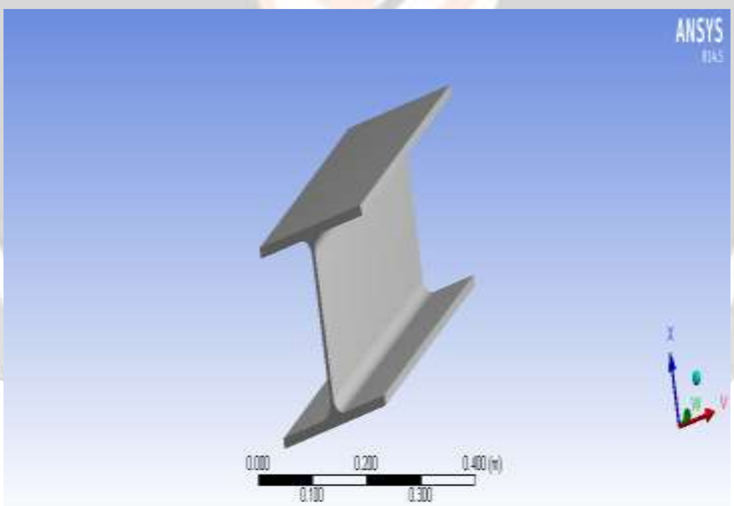


Fig.1.3-D Model of I section

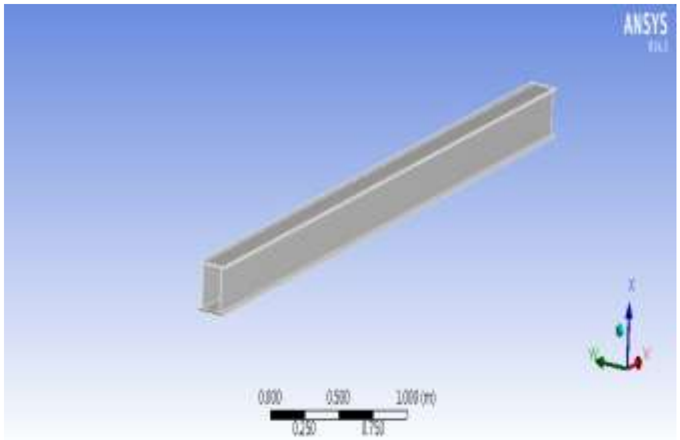


Fig.2.3-D Model of Web section

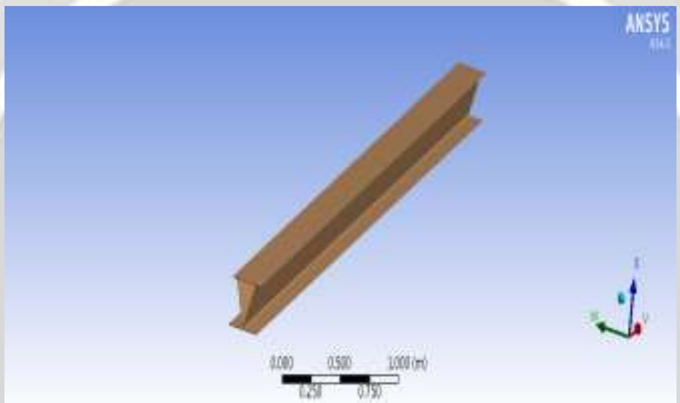


Fig.3.3-D Model of Vf section

V.MESHING

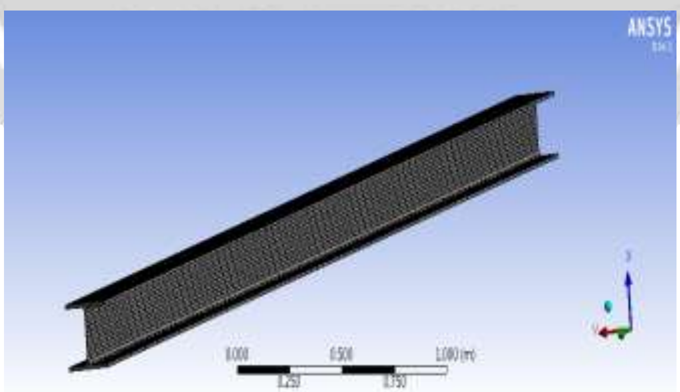


Fig.4.Meshing of I section

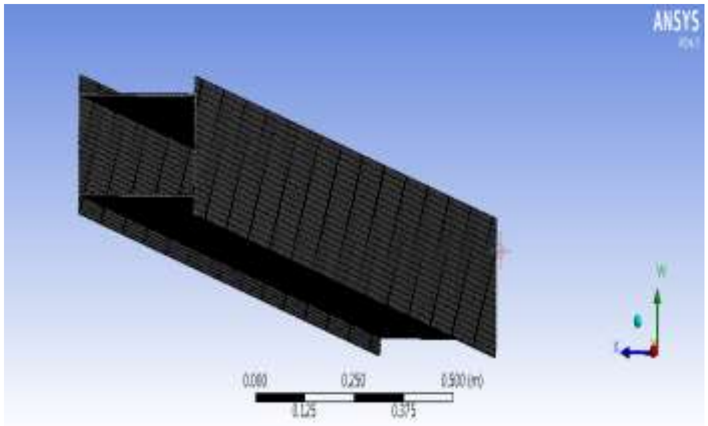


Fig.5.Meshing of Web section

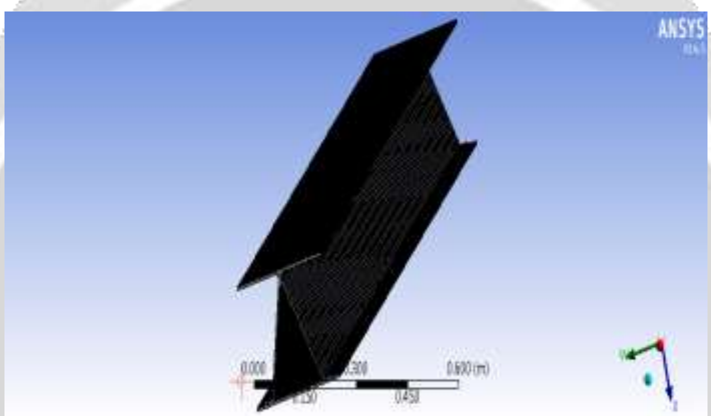


Fig.6.Meshing of Vf section

VI.RESULT ANALYSIS AND DISCUSSION

The main objective of this project is to compare the overall result of sandwich structure model of deformation, equivalent stress and self weight Overall numerical, analytical by using ANSYS, and experimental by using universal testing machine data are collected from a I section, Web core, and Vf section. Comparison between the numerical and analytical result of I section, Web , and Vf section of deformation and equivalent stress. Also comparison between the ANSYS result and experimental result of I section, Web core and Vf core section of deformation .The ANSYS and experimental results were performed 500 N and 3000 N load applied.

A)Theoretical ,ANSYS workbench & Experimental results of Stress

Model manufactured 400 mm long structure for the result of experimental as well as ANSYS. Compare the result of I, Web, and Vf section in experimental as well as ANSYS workbench result at 500N to 3000N load.

Table1:comparison of result at 500N

Type of section	Theoretical Result (N/mm^2)	Ansys Result (N/mm^2)	UTM Result (N/mm^2)
I-Section	10.295	11.41	11.5

Web-Section	12.64	15.818	16.0
Vf-Section	12.64	18.292	18.5

Table 2:comparison of result at 1000N

Type of section	**Theoretical Result** (N/mm^2)	**Ansys Result** (N/mm^2)	**UTM Result** (N/mm^2)
I-Section	20.59	22.82	23.1
Web-Section	25.54	31.636	31.8
Vf-Section	25.24	36.584	37.0

Table 3:comparison of result at 1500N

Type of section	**Theoretical Result** (N/mm^2)	**Ansys Result** (N/mm^2)	**UTM Result** (N/mm^2)
I-Section	50.559	34.21	34.5
Web-Section	37.86	47.454	47.6
Vf-Section	37.86	54.876	55

Table 4:comparisonof result at 2000N

Type of section	**Theoretical Result** (N/mm^2)	**Ansys Result** (N/mm^2)	**UTM Result** (N/mm^2)
I-Section	41.19	45.64	45.8
Web-Section	50.48	63.232	63.5
Vf-Section	50.48	73.168	73.5

Table 5:comparison of result at 2500N

Type of section	**Theoretical Result** (N/mm^2)	**Ansys Result** (N/mm^2)	**UTM Result** (N/mm^2)
I-Section	51.4199	57.65	58.0
Web-Section	63.175	79.09	79.5

Vf-Section	63.175	91.46	91.8

Table 6:comparison of result at 3000N

Type of section	Theoretical Result (N/mm^2)	Ansys Result (N/mm^2)	UTM Result (N/mm^2)
I-Section	61.7759	68.46	68.8
Web-Section	75.72	94.506	95.0
Vf-Section	75.7259	109.35	110.0

By comparing the weight percentage and increase in strength percentage and the decrease in deflection percentage the results gives that for 12.514 % decrease of weight gives 0.13% increase of strength and 52.30% decrease of deflection in web core sandwich structure comparing the I section beam.

B) Theoretical ,ANSYS workbench & Experimental results of deflection

Model manufactured 400 mm long structure for the result of experimental as well as ANSYS. Compare the result ofI , Web, and Vf section in experimental as well as ANSYS workbench result at 500N to 3000N load.

Table 7:comparison of result at 500N

Type of section	Theoretical Result(mm)	Ansys Result(mm)	UTM Result(mm)
I-Section	0.084	0.095986	0.0968
Vf -Section	0.0632	0.092454	0.0934
Web-Section	0.060	0.080336	0.0813

Table 8:comparison of result at 1000N

Type of section	Theoretical Result(mm)	Ansys Result(mm)	UTM Result(mm)
I-Section	0.168	0.1919	0.192
Vf -Section	0.1265	0.18681	0.0191
Web Section	0.1265	0.16067	0.170

Table 9:comparison of result at 1500N

Type of section	Theoretical Result(mm)	Ansys Result(mm)	UTM Result(mm)
I-Section	0.252	0.28796	0.288
Vf -Section	0.189	0.27736	0.280
Web Section	0.189	0.24101	00.245

Table 10:comparisonof result at 2000N

Type of section	Theoretical Result(mm)	Ansys Result(mm)	UTM Result(mm)
I-Section	0.3365	0.38394	0.385
Vf -Section	0.252	0.36982	0.375
Web Section	0.24	0.32134	0.327

Table 11:comparison of result at 2500N

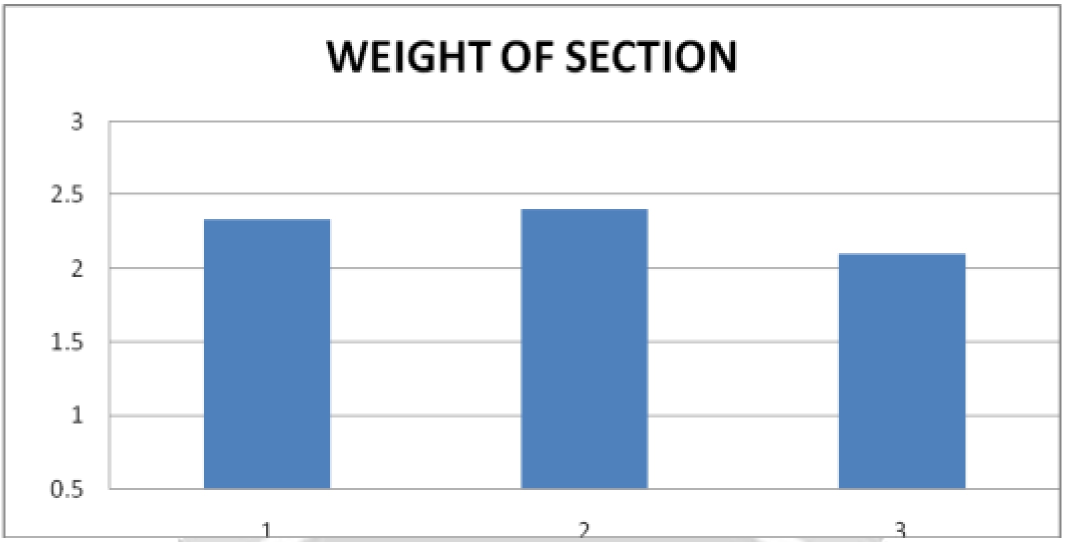
Type of section	Theoretical Result(mm)	Ansys Result(mm)	UTM Result(mm)
I-Secction	0.420	0.47993	0.4800
Vf -Section	0.315	0.46227	0.4750
Web Section	0.30	0.40568	0.4060

Table 12:comparison of result at 3000N

Type of section	Theoretical Result(mm)	Ansys Result(mm)	UTM Result(mm)
I-Section	0.504	0.57592	0.5760
Vf -Section	0.378	0.55472	0.5555
Web Section	0.36	0.48202	0.4920

C) Weight Reduction

The aim of this project is beam weight reduction by using different section.



Graph 1. Weight ofI,Vf,Web structures

In above fig shows that various structures weight, the weight of web core structure is low as compare to the other structure. There for the Web structure is optimize structure.

VIII.CONCLUSION

1.The deflection and self weight of Web structure is small as compare to the Vf core structure.

2.The deflection of web structure is 1.15% small as compare to I section & 4.51% as compair to Vf section.

3.The stress of web structure is 5.77 $(\boldsymbol{N/mm^2})$ small as compare to Vf section.

4.Then web core structure is optimum structure for weight reduction.

REFERENCES

[1] Penttikujala "Ultimate strength analysis of all steel sandwich panels"Rakenteiden Makaniikka,vol.31Nrot 1-2,1998

[2] PenttiKujala "Steel Sandwich Panels – From Basic Research to Practical Applications" 2Vol. 16/ISSN 0784-6010 2002

[3] JeomKeePaika, Anil K. Thayamballi, Gyu Sung Kim,
"The strength characteristics of aluminum honeycomb sandwich panels", Thin-Walled Structures 35 (1999) 205–231

[4]KujalaPentti and Klanac Alan, "Analytical And Numerical Analysis of Non – Symmetrical All Steel SandwichPanels Under Uniform Pressure Load", International Design Conference - Design 2002 Dubrovnik, May 14 - 17, 2002.

[5] Devendra B. Sonawane,"Composite Section Design For Minimum weight in structural Application "international journal of Science &Research(IJSR)Vol4,Issue 1,January2015.