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Determination of Stress and Deflection of Simply Supported Beam for Various Cross-Sections

K. Varundeep, N. S. K.Teja, K.Vamsi Krishna, B. Akhil Babu, Avrk Teja, J. Sri Harsha
Department of Mechanical Engineering, K L University, Guntur, Andhra Pradesh, India

ABSTRACT

The simply supported beam is a rigid structural element which has pinned support at one end and roller support at the other, and depending on the load applied, it undergoes shearing and bending. Basically, there are different types of beams, like cantilever beam, simply supported beam and in that there will be different types of cross-sections, like rectangular, circular etc. In this present work we have taken a simply supported beam and three cross-sections are selected and analysis is done and the stress and deflection of all the three cross-sections were found and tabulated. For carrying out the analysis Ansys workbench software is chosen.

Keywords: Simply supported beam, Ansys, Stress, deflection, Rectangular, Circular, T cross section.

I. INTRODUCTION

First of all we should know what is a Beam? Beams are the bars which are subjected to perpendicular loads. In the concept of beams we come across the major classification of beams as statically determinate and statically indeterminate beams. If the equilibrium conditions are sufficient to compute the reactions then it is called as statically determinate beams. And if Deflections along with equilibrium conditions are sufficient to find reactions then it is called as statically indeterminate beams.

In the further classification there are different types of beams like simply supported beam, cantilever beam etc. Basically in general terms, a simply supported beam (SSB) is the simplest structural element, as the name suggests it is supported at both the ends, it can be either and pinned support on both the ends or pinned and roller supports one each ends. It will only undergo both bending and shearing. In the concept of beams there is another term used which is called as supports. These are identified by the resistance offered to forces. The different types of supports are: Roller supports, Pinned supports, fixed support.

II. METHODS AND MATERIAL

Modelling and Analysis

In this present work the modelling and analysis was carried out in Ansys software. By following certain set of steps a simply supported beam of rectangular cross section is drawn in Ansys as shown in fig.1.

Rectangular Cross-Section:

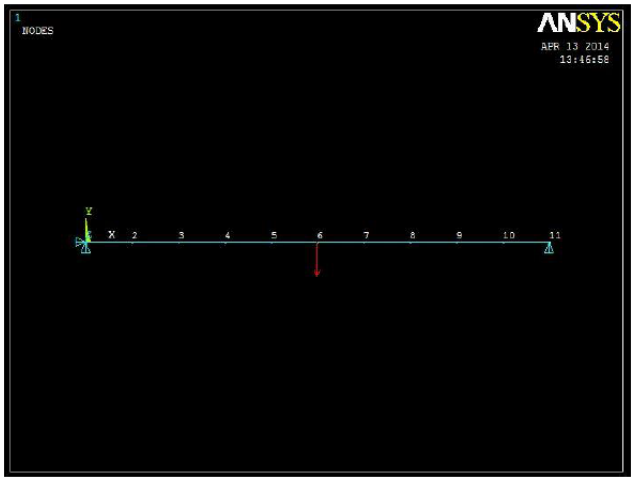

Figure1. Rectangular Cross-section of SSB

For finding out the deflection:

******POST1 NODAL DEGREE OF FREEDOM LISTING******

LOAD STEP= 1 SUBSTEP= 1

TIME= 1.0000 LOAD CASE= 0

The following degree of freedom results are in Global Coordinates:

Node	UY
1	0.0000
2	-231.25
3	-443.75
4	-618.75
5	-737.50
6	-781.25
7	-737.50
8	-618.75
9	-443.75
10	-231.25
11	0.0000

The maximum absolute value is at node 6 and is equal to -781.25, since we get the maximum deflection at the mid-span of the SSB.

Fig.2 shows the deflection of SSB for a rectangular cross-section.

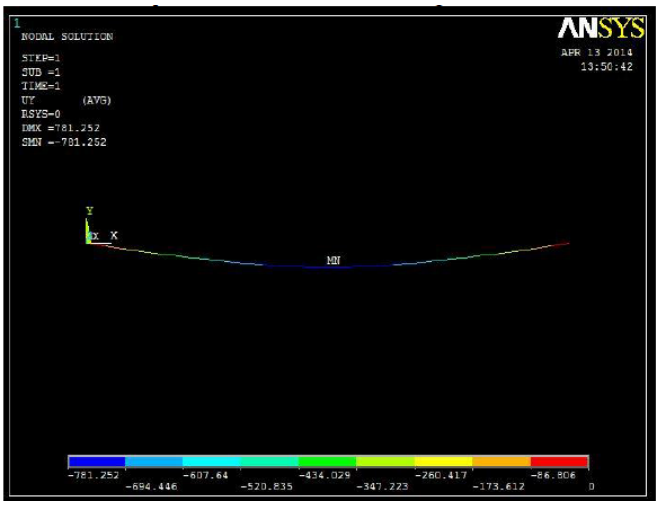

Figure 2. Deflection of SSB (Rectangular)

For finding out the stress:

****** POST1 ELEMENT TABLE LISTING ******

Element	Stress
2	0.34925E-11
3	750.00
4	1500.0
5	2250.0
6	3000.0
7	3750.0
8	3000.0
9	2250.0
10	1500.0
11	750.00

The minimum value of stress obtained is 0.34925E-11 and the maximum value is 3750 and is shown in fig.3

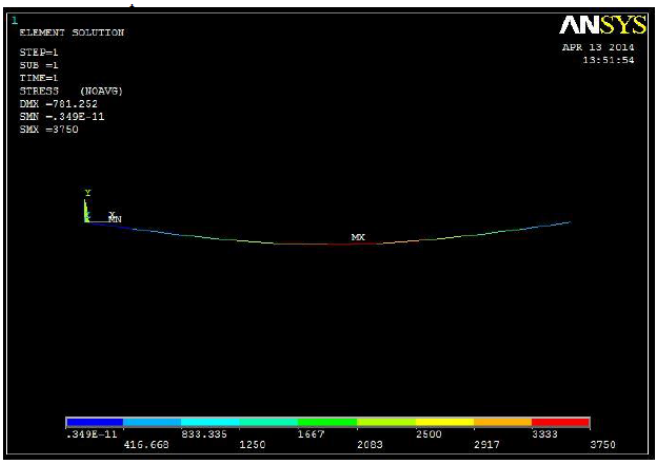

Figure 3. Stress plot of the beam (Rectangular)

Circular Cross-section:

Let us find the deflection of the beam for this type of cross section.

****** POST1 NODAL DEGREE OF FREEDOM LISTING ******

LOAD STEP= 1

SUBSTEP= 1

TIME= 1.0000

LOAD CASE= 0

The following degree of freedom results are in global coordinates:

Node	UY
1	0.0000
2	-38.769

3	-74.394
4	-103.73
5	-123.64
6	-130.98
7	-123.64
8	-103.73
9	-74.394
10	-38.769
11	0.0000

The maximum absolute value of deflection obtained is -130.98 at node-6, since we get the maximum deflection at the mid-span of the SSB shown in fig.4

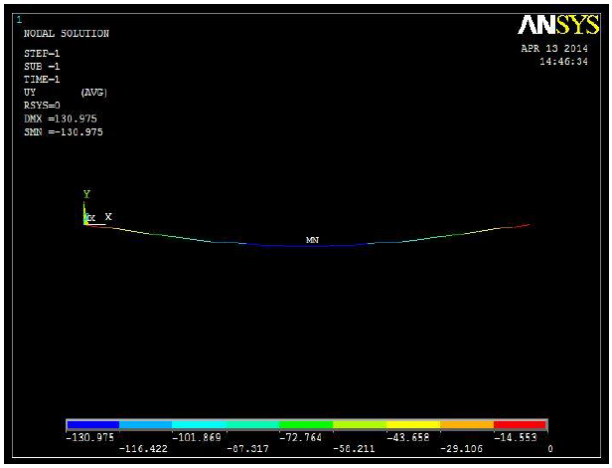

Figure 4. Deflection of SSB (Circular)

For finding out the stresses:

****** POST1 ELEMENT TABLE LISTING ******

Element	Stress
1	-0.16523E-11
2	354.83
3	709.65
4	1064.5
5	1419.3
6	1774.1
7	1419.3
8	1064.5
9	709.65
10	354.83

The minimum value of stress is -0.16523E-11 and the maximum value is 1774.1 as shown in the fig.5

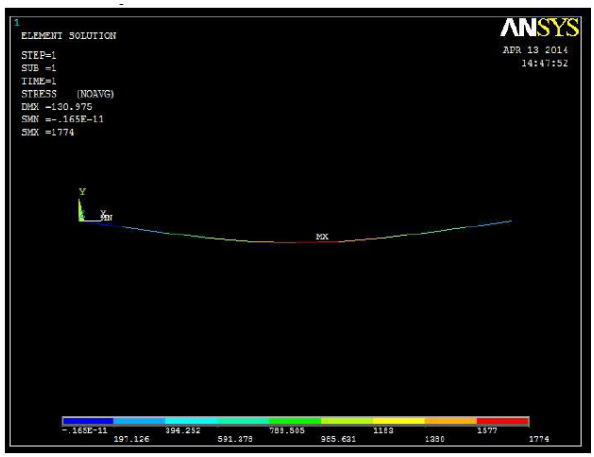

Figure 5. Stress plot of the beam (Circular)

T Cross-section:

****** POST1 NODAL DEGREE OF FREEDOM LISTING ******

LOAD STEP= 1
SUBSTEP= 1
TIME= 1.0000
LOAD CASE= 0

The following degree of freedom results are in global coordinates:

Node	UY
1	0.0000
2	-4.2961
3	-8.2439
4	-11.495
5	-13.701
6	-14.514
7	-13.701
8	-11.495
9	-8.2439
10	-4.2961
11	0.0000

The maximum absolute value of deflection obtained is -14.514, since we get the maximum deflection at the mid-span of the SSB as shown in the fig.6

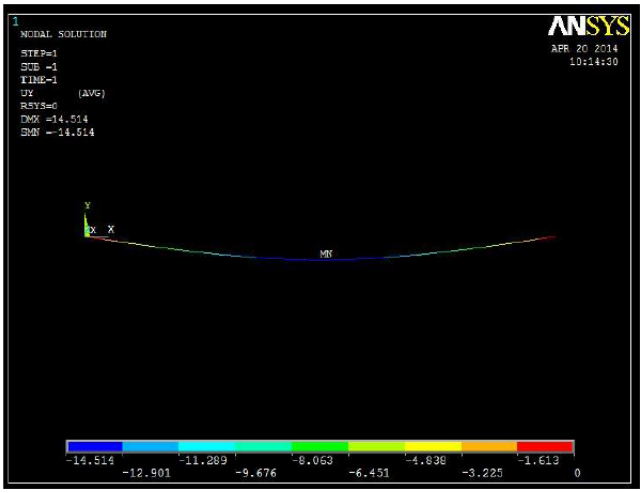

Figure 6. Deflection of SSB (T Cross-section)

For finding out the stresses:

****** POST1 ELEMENT TABLE LISTING ******

Element	Stress
1	0.0000
2	94.050
3	188.10
4	282.15
5	376.20
6	470.25
7	376.20
8	282.15
9	188.10
10	94.050

The minimum value of stress obtained is 0.0000 and maximum value of stress obtained is 470.25 as shown in fig.7

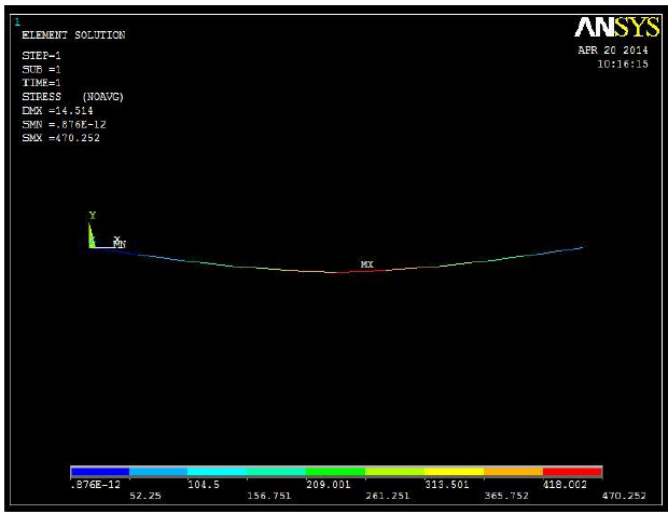

Figure 7. Stress plot of SSB (T Cross-section)

III. CONCLUSION

The deflection and stresses obtained for all the three cross-sections of simply supported beam are tabulated below.

Cross-Section	Deflection	Stress
Rectangular cross-section	781.252	3750
Circular cross-section	130.975	1774
T Cross-section	14.514	470.252

Since T-cross section has lesser stress it would be better to use that shape of cross-section for simply supported beam.

IV. REFERENCES

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