IJSRD - International Journal for Scientific Research & Development| Vol. 1, Issue 9, 2013 | ISSN (online): 2321-0613

Stress Induced in Two Nodal Fixed System is Directly Proportional to Nodal Displacement only

Shukla Asitkumar N[1]
[1]PG Student
[1, 2, 3]Department of Mechanical & Automobile Engineering
[1]School of Engineering and Technology, Sharda University, Grater Noida - 201310, Uttar Pradesh (west), India

Abstract—In this research work we found that the stress concentration in rope ways or any two system having only two nodes and having load somewhere in between the nodes then the stress generated in the system is directly proportional to nodal displacement only. To have idea of such physical system we have considered practical example of rope ways in mind.

Key words: Stress Concentration in two nodal systems, Stress Proportional to nodal displacement, Finite element method in stress calculations, Stress in rope ways.

I. INTRODUCTION

In this research paper we have considered a rope way system, we have assumed that there is no sagging has been noticed, we have considered the system as sag free. And now onwards by some mathematical formulas we going to evaluate stress are being induced in the system. By using finite element approaches.

II. FEM IN RELEVANT FIELD

We've considered sag free rope as the two nodal systems and somewhere in between these two nodes load is being applied down wards. With some angle of inclination with the rope.

III. METHODOLOGY

As shown in fig. 1 P and Q are two final extreme destinations, the length of the rope connecting P and Q is 'l'.

So the vertical and horizontal distance between two extreme destinations is 'l sinθ' and 'l cosθ' respectively.

Suppose the load is R then according to the figure the horizontal distance from lower extreme point to the load is 'R tanθ' similarly respective inclined length is 'R secθ'

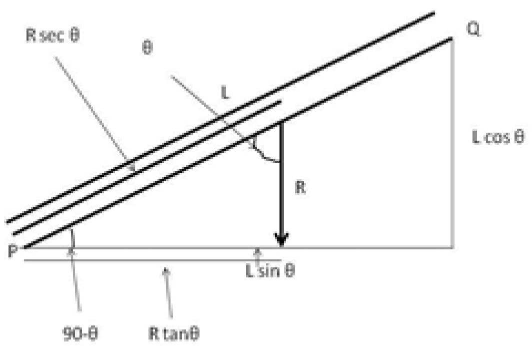

Fig. 1: Calculation triangle

Now to calculate stress being induced in the given case

The generalize eqn. For stress is given by

$$\sigma = E\,\varepsilon \; [2]$$

Where,

σ = Stress
ε = Strain
E = constant

Now,

$$\varepsilon = \frac{\partial u}{\partial x}$$

$$\Rightarrow \quad \varepsilon = \frac{\partial u}{\partial \xi}\frac{\partial \xi}{\partial x} \; [3]$$

But,

$$\xi = \frac{2(x-X1)}{(x2-x1)} - 1 \; [1]$$

$$\Rightarrow \quad \partial\xi/\partial x = 2/((x2-x1)) = \frac{2}{\iota}$$

Similarly

$$U = [N_1 \quad N_2] \cdot \begin{bmatrix} U_1 \\ U_2 \end{bmatrix} [4]$$

$$N1 = (1-\xi)/2[5]$$

$$N2 = (1+\xi)/2 \; [6]$$

$$\frac{\partial N_1}{\partial \xi} = -\frac{1}{2}$$

$$\frac{\partial N_2}{\partial \xi} = \frac{1}{2}$$

So,

$$\frac{\partial u}{\partial \xi} = \begin{bmatrix} \frac{\partial N_1}{\partial \xi} & \frac{\partial N_2}{\partial \xi} \end{bmatrix} \cdot \begin{bmatrix} U_1 \\ U_2 \end{bmatrix}$$

$$\frac{\partial u}{\partial \xi} = \begin{bmatrix} -\frac{1}{2} & \frac{1}{2} \end{bmatrix} \cdot \begin{bmatrix} U_1 \\ U_2 \end{bmatrix}$$

$$\frac{\partial u}{\partial \xi} = \frac{1}{2}[-1 \quad 1] \cdot \begin{bmatrix} U_1 \\ U_2 \end{bmatrix}$$

So the strain will be

$$\varepsilon = \frac{\partial u}{\partial \xi}\frac{\partial \xi}{\partial x}$$

$$= \frac{1}{2}[-1 \quad 1] \cdot \begin{bmatrix} U_1 \\ U_2 \end{bmatrix} \cdot \left(\frac{2}{i}\right)$$

$$= \frac{1}{i}[-1 \quad 1] \cdot \begin{bmatrix} U_1 \\ U_2 \end{bmatrix}$$

Now for stress calculation

Stress,

$$\sigma = E\,\varepsilon$$

$$= E \cdot \frac{1}{i}[-1 \quad 1] \cdot \begin{bmatrix} U_1 \\ U_2 \end{bmatrix}$$

So, it's very clear that stress depends upon the displacement (U1, U2) and the length over which it has been analyzed.

While if we talk about fixed system then length is prefixed so it will vary on nodal displacement.

IV. CONCLUSION

The stress in rope way is directly proportional to nodal displacement and inversely proportional to length. Hence once the length is determined then it will be proportional to nodal displacement only.

ACKNOLEDGEMENT

I thankfully acknowledge my FEM faculties at Sharda University Prof. Kaushalyendra Dubey Sir and Amit Swamy Sir. I am also thankful to encouraging faculties of Sharda University specially our HOD Prof. T. Sharma sir and Prof. G. P. Sinhasir. Not forgetting the root my B.E. faculties who implanted roots of FEM in my knowledge Prof. J. B. Valaki and Prof. D. J. Marsonia and I am also thankful to some extra ordinary and hardworking faculties of my graduating college GEC – Bhavnagar specially Prof. H. N. Jani sir, Prof. S. H. Zala sir, Prof. H. G. Vyas sir, Prof. K. S. Vaghoshi sir, Prof. J. H. Pandit sir and Prof. M. Lohiya sir.

REFERENCES

[1] Ch.3, One dimensional problem. Eqn 3.4, Pg 49, “Finite Elements in Engineering” PHI Publications by Chandrupatala, ISBN: 978-81-203-2106-9, New Jersey, U.S.A. 2002.
[2] Ch 6. Finite Element Analysis, Eqn 6.28, Pg 6-23 “Computer Aided Design” by Patil R.B. ISBN : 978-81-8492-637-8, Pune, Maharashtra India January 2011
[3] Ch.3, One dimensional problem. Eqn 3.10, Pg 51, “Finite Elements in Engineering” PHI Publications by Chandrupatala, ISBN: 978-81-203-2106-9, New Jersey, U.S.A. 2002.
[4] Ch 6. Finite Element Analysis, Eqn 6.66, Pg 6-41 “Computer Aided Design” by Patil R.B. ISBN : 978-81-8492-637-8, Pune, Maharashtra India January 2011
[5] Ch.3, One dimensional problem. Eqn 3.5, Pg 49, “Finite Elements in Engineering” PHI Publications by Chandrupatala, ISBN: 978-81-203-2106-9, New Jersey, U.S.A. 2002.
[6] Ch.3, One dimensional problem. Eqn 3.6, Pg 49, “Finite Elements in Engineering” PHI Publications by Chandrupatala, ISBN: 978-81-203-2106-9, New Jersey, U.S.A. 2002.
[7] Ch.3, One dimensional problem. Eqn 3.90, Pg 79, “Finite Elements in Engineering” PHI Publications by Chandrupatala, ISBN: 978-81-203-2106-9, New Jersey, U.S.A. 2002.

