Effect of Mesh Size on Finite Element Analysis of Beam

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Abstract

In Finite Element analysis the size of mesh is critical. The size of the mesh is closely related to the accuracy and number of mesh required for the meshing of the element. This paper presents the effect of the mesh size on the accuracy of the result. On the basis of the results obtained guidelines for choosing the appropriate mesh size in finite element analysis has been provided. The static analysis has been performed to know the effect of mesh size and number of mesh using creo 2.0 software. Model under study is cantilever carrying uniformly distributed load made of Fe30 material.

Keywords: *Finite element analysis, Mesh size, Static analysis.*

I. INTRODUCTION

In Finite Element Analysis the accuracy of the result obtained is determined by size of the mesh. According to the theory of Finite Element Analysis, finite modal with small element size yields high accuracy as compared to the modal with large element size. Also, if the size of the element is large then complexity of the modal increases, it is only used where high accuracy is required [1]. Objective of this paper is to choose the optimum size of the mesh to obtain accurate result. The objective of this paper is to present the effect of size of mesh on stress and deflection of the modal. In order to achieve this goal, in present study series of static analysis is performed on cantilever beam with uniformly distributed load throughout the span to reveal the effect of size of element on the result.

II. LITERATURE SURVEY

Number of investigations has been done to show the effect of mesh size on the accuracy of the results obtained using finite element analysis. Weibing Liu, Mamtimin Geni and Lie Yu has obtained different results by changing the element size and type. It was observed that calculation accuracy of modal analysis is higher with tetrahedral element and modal analysis accuracy can be increase with increasing the number of nodes.[2] Victor Debnath and BikramjitDebnath has obtained more accuracy in there result by increasing the number of nodes in there analysis.[3]Yucheng Liu presented a study on finding the effects of finite element size on the accuracy of numerical analysis result, based on which brief guideline on choosing best element size in finite element modeling are provided.[4].Mohammed Waseem H.S and Kiran Kumar N has worked on delamination of cantilever beam using ansys software.[5]. The present study analysis on cantilever beam is doneusingcreo 2.0 software to predict the change in results with change in mesh size.

III. PROBLEM STATEMENT

Modal under study is cantilever beam of the dimensions as shown in table I, of Fe30 material.

Table I : Dimensions Of Cantilever Beam

Length of beam	100mm
Width of beam	10mm
Height of beam	10mm

Amount of load and type of constraint acting on the modal are the actual load acting on the structure. Load of 500N is acting on the beam as uniformly distributed load throughout its length and one end of the beam is given fixed constraint as shown in Fig.1.

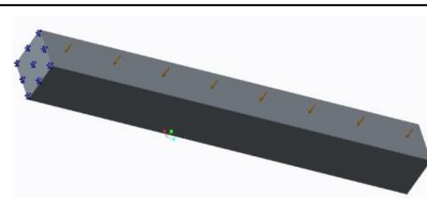

Fig. 1. Cantilever Beam with Load and Constraint

IV. STATIC ANALYSIS

A series of FE modal are generated for the beam with mesh size from 2mm to 6mm with tetra mesh using automatic mesh technique.Fig.2.shows the beam with mesh size of2mm.Fig.3.showsthe beam with mesh size of 3mm.Fig.4.shows the beam with mesh size of 4mm. Fig.5.shows the beam with mesh size of 5mm. Fig.6.shows the beam of mesh size 6mm.

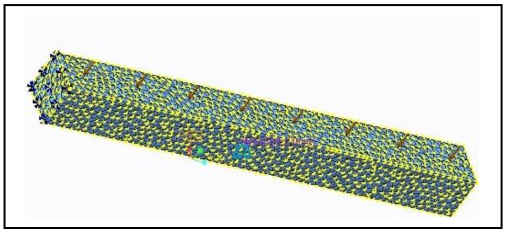

Fig.2. Beam with Mesh size 2mm

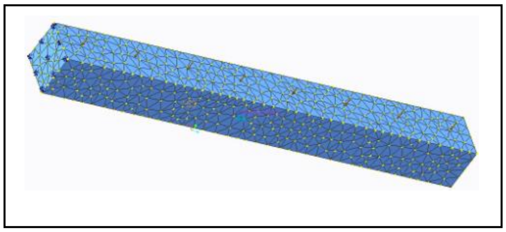

Fig.3. Beam with Mesh size 3mm

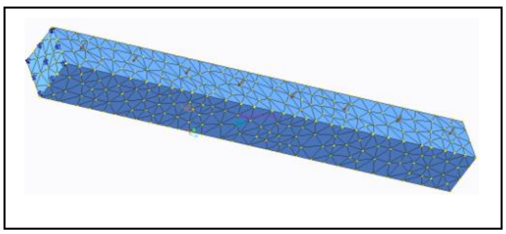

Fig.4. Beam with Mesh size 4mm

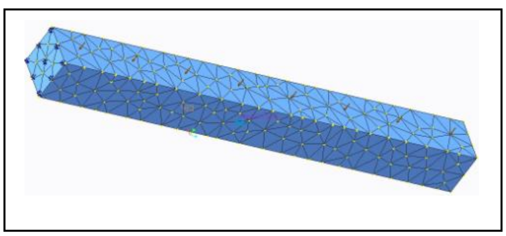

Fig. 5. Beam with Mesh size 5mm

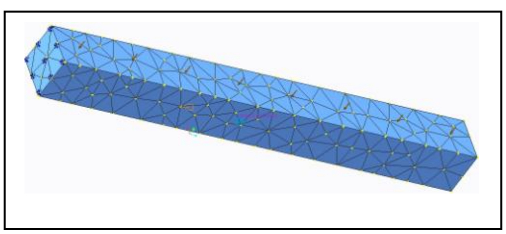

Fig. 6. Beam with Mesh size 6mm

V. RESULTS

Vonmises and displacement for each modal is calculated for different mesh size as shown in Fig. 8-13.

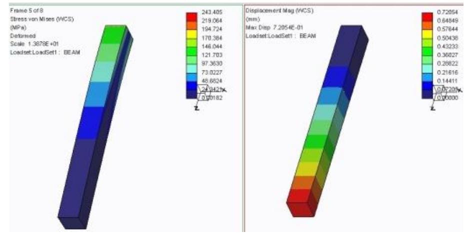

Fig.7.Vonmises Stress and Displacement for Mesh Size 2mm.

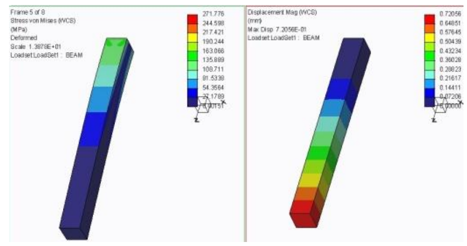

Fig.8.Vonmises and Displacement for Mesh Size 3mm

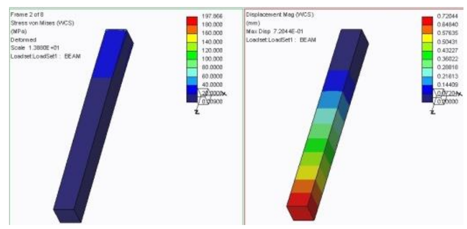

Fig.9.Vonmises And Displacement for Mesh Size 4mm

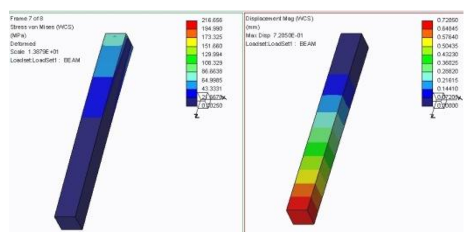

Fig. 10.Vonmises and Displacement for Mesh Size 5mm

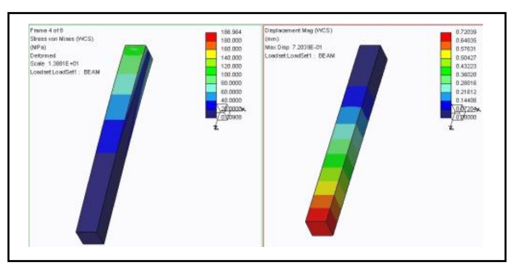

Fig. 11.Vonmises Stress and Displacement For Mesh Size 6mm

VI. COMPARISON OF THE RESULT

In table II and table III static analysis is presented and percentage of error is calculated for each Vonmises stress and displacement for each element size.

Table II: Vonmises Stress Results And Vonmises Error Percentage

Element Size	Vonmises Stress (MPa)	Error Percentage
2 mm	271.776	0
3 mm	243.405	12.6
4 mm	216.656	20.8
5 mm	197.866	27.2
6 mm	186.964	31.2

Table III : Deflection And Deflection Error Percentage

Element Size	Deflection (mm)	Error Percentage
2 mm	0.72056	0
3 mm	0.72054	0.00277
4 mm	0.72050	0.00836
5 mm	0.72044	0.01665
6 mm	0.72039	0.02359

VII.CONCLUSION

On the basis of table II and table III following conclusions are made:

1. Percentage of error is by far less for deflection as compared to vonmises stress. According to Finite Element Analysis theory, stresses are not predicted as accurately as displacement.

2. Large variation in vonmises stress is due stress concentration at edges of beam.

3. As it is observed by changing the mesh size, vonmises stress and displacement of the cantilever beam decreases.

4. The result obtained in present study is similar to that obtained by other authors in their study.

REFERENCE

[1] ShashikantT.More,Dr. R.S.Bindu, "Effect Of Mesh Size On Finite Element Analysis Of Plate Structure,IJESIT,vol.4,May 2015.

[2] Weibing Liu, MamtiminGeni, and Lie Yu, "Effect of Mesh Size of Finite Element Analysis in Model Analysis Periodic Symmetric Struts Support,Key Engineering Materials" Vol.462-463,2011,pp 1008-1012.

[3] Victor Debnath,BikramjitDebnath "Deflection And Stress Analysis Of Beam On Different Elements Using Ansys APDL",IJMET,vol.5,june 2011,pp 70-79.

[4] Yucheng Liu, Choose the Best Element Size to Yield Accurate FEA Results While Reduce FE Models'sComplixity, British Journal of Engineering and Technology, Vols. 1 No. 7, 2013, pp 13-28.

[5] Mohammed Waseem H.S and Kiran Kumar N. "Finite Element Modelling For Delamination Analysis Of Double Cantilever Beam Specimen",SSRG-IJME,vol.1,September 2