INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 7, Issue 5 - V7I5-1313)
Available online at: https://www.ijariit.com

Structural Analysis of Angle Plate in ANSYS

Sitesh Anand
siteshanand1993@gmail.com
National Institute of Technical Teachers' Training and Research, Kolkata, West Bengal

ABSTRACT

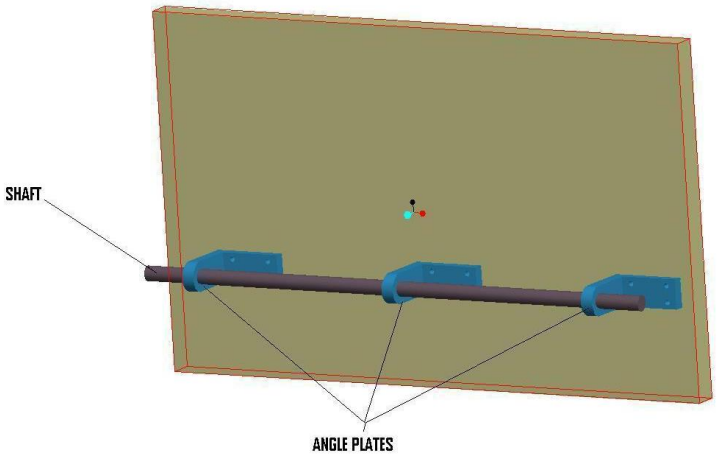
Angle plates are used for supporting long shafts in order to reduce the bending stresses produced in the shafts due to its own weight. Structural analysis of Angle plate by FEA software ANSYS is presented in this report. Loads on the angle plate are due to the weight of the portion of the shaft. The maximum stresses are observed at the bolt holes and the bend. Free end have the maximum deformation because it is free to move. The maximum stress is below the yield strength and so the design is in the safe region. Dynamic loading should be avoided by keeping the shaft balanced.

Keywords— *Angle Plate, Shaft, Bolt, Stress, Deformation*

1. INTRODUCTION

For power transmission along long distances shafts are used. Bending stresses are produced in the shafts due to its own weight. Angle plates are used as intermediate support for long shafts in order to reduce the bending stresses. This greatly increases the life of the shaft. A schematic diagram of an assembly of shaft and angle plates is shown in FIG. 1.

Few questions arises that weather the angle plate will support the shaft without failure or not, what are the stresses produced and how these are distributed throughout the angle plate and which are the critical regions where the maximum stresses act. To answer these questions we performed finite element analysis of the angle plate by ANSYS. Stresses and deformations are plotted throughout the angle plate. Regions where maximum stress and deformation occurs are highlighted.



Structural analysis of angle plate

The analysis procedure is described step by step as done in the ANSYS. Following are the major steps.

3D modelling of the angle plate

The 3D model is directly generated in the ANSYS. In the FIG. 2, a 3D model is shown. The four holes of diameter 50.8 mm each in the lower portion of angle plate are used for bolts for mounting of the angle plate. The upper portion hole of diameter 125 mm holds the shaft.

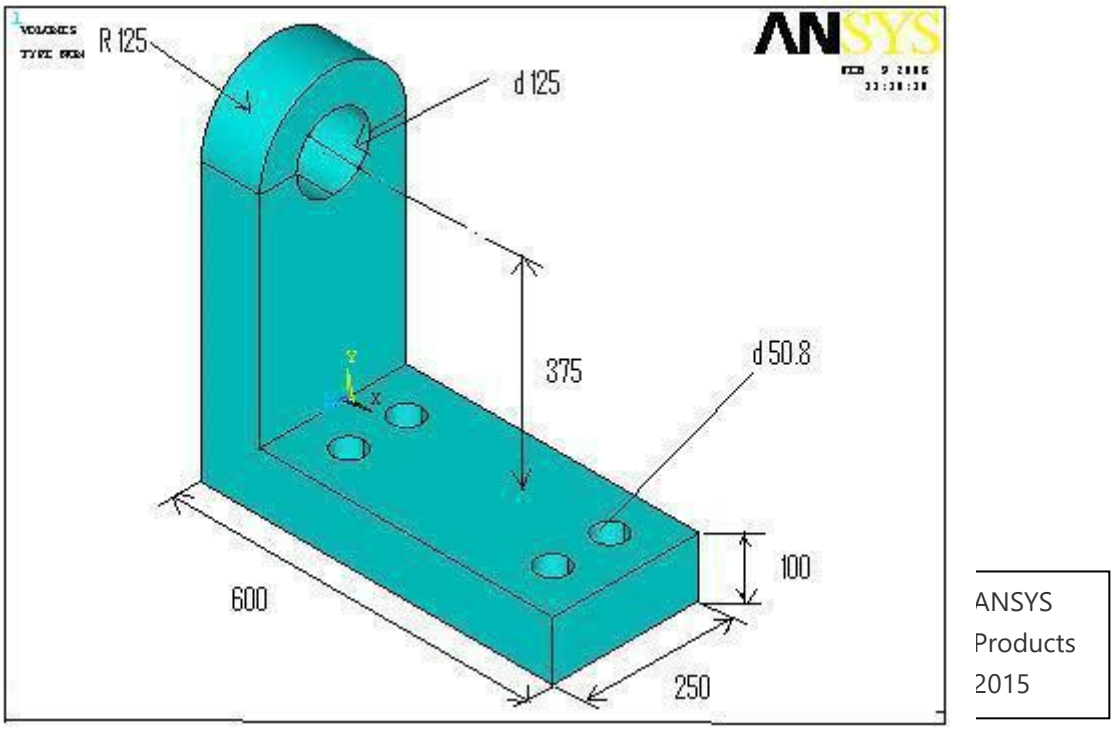


FIG. 2: A 3D Model of the angle plate (all dimensions are in mm)

2. MATERIAL

The angle plate is made of AISI 1018 steel. The mechanical properties of this type of material are given in table below.

Tensile strength (Mpa)	Yield strength (Mpa)	Young Modulus (Gpa)	Poison's ratio	Elongation (%)	Density (Kg/m^3)
400	220	200	0.27	25	7827

2.1 Meshing

After the geometry has been generated, the 3D model is then meshed by using ELEMENT 45. As there are five holes in the angle plate. We have used fine mesh option to enhance accuracy of the results. In FIG.3 the meshed model is shown.

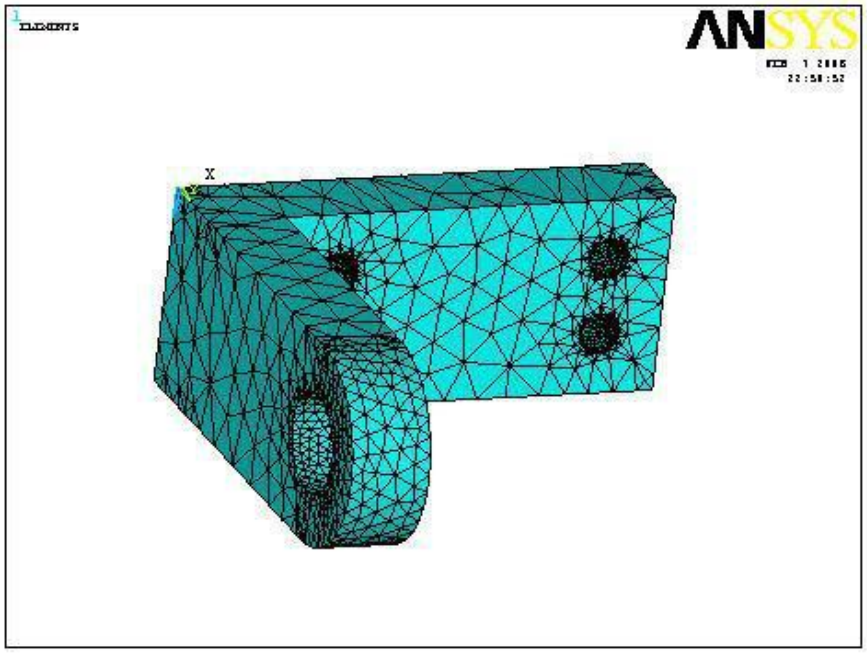


FIG. 3: Meshed model of the angle plate

2.2 Loads and constrains

After meshing, loads and constrains are applied. The angle plate is fixed at the four bolt holes. A static load whose components are 1000 N along Y-axis direction and 500 N along the Z-axis direction is applied as shown in FIG. 4.As the shaft rotates at high speed so the weight of the shaft does not act downward directly but makes certain angle with vertical as shown.

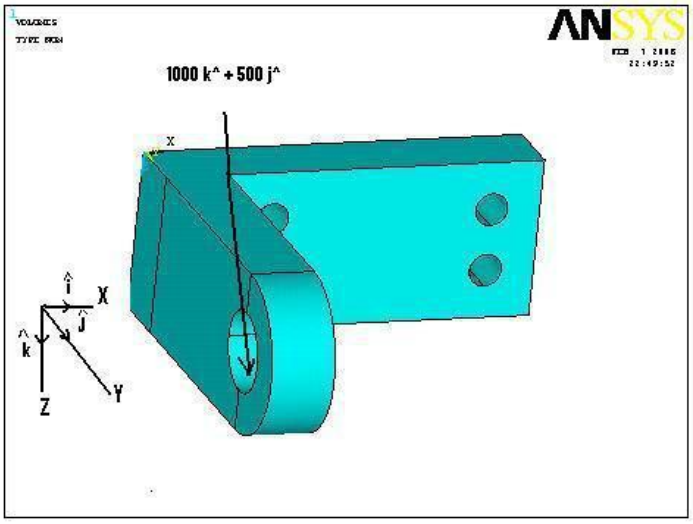


FIG 4: Load applied on the angle plate

3. RESULTS

The distribution of stress through the angle plate is shown in FIG. 5 and fIG. 6. In fig 5 distribution of stress through elements is shown and in fig 6 the stress distribution through nodes is shown. The maximum stress occurs at the upper left side bolt hole as shown by red color. The magnitude of the maximum stress is 24.3 Mpa. There are two major reasons for the maximum stress to occur at this hole; first it comes first to resist the downward motion of plate due to weight of the shaft, secondly due to stress concentration factor at the hole and closeness to bend. The yield strength of the material is 220 Mpa, far greater from the maximum stress, so the angle plate is safe up to this magnitude of loading. But as the shaft rotates and if there were some unbalance in the shaft then cyclic loading will be acting on the angle plate, which will greatly reduce the strength of the material.

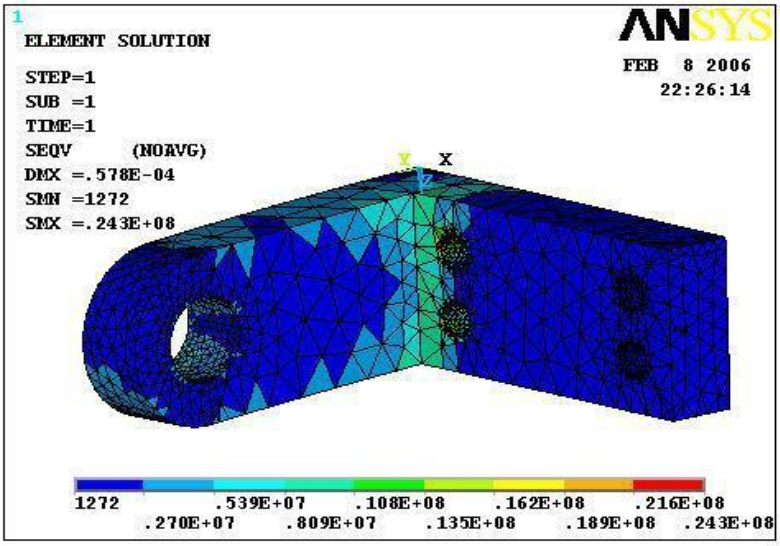


FIG. 5: Distribution of stress through Elements of the angle plate

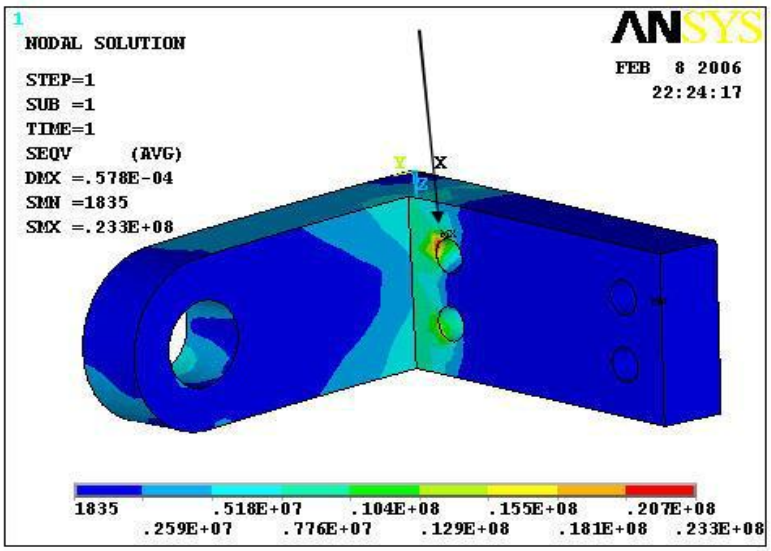


FIG. 6: Distribution of stress through Nodes of the angle plate

The maximum deformation is observed at the free end of the upper portion of angle plate a shown in FIG. 7. The magnitude of maximum deformation is .0578 mm.

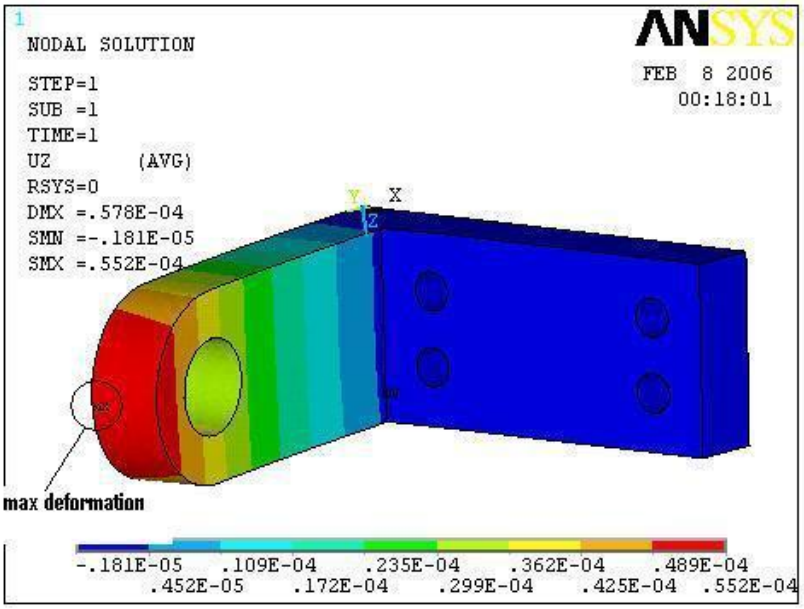


FIG. 7: Distribution of deformation through Nodes of the angle plate

4. CONCLUSION

For static loading due to the weight of the shaft portion, the angle plate will be safe. But for dynamic loading the case may not be same. In order to keep the angle plate safe from failure we have to keep the shaft balanced so that no dynamic forces will produce due to vibration of the shaft. For dynamic forces/fatigue loading the yield strength is considered to become half . The failure of the angle plate will occur by tearing of the upper left bolt hole. The surface of the bolt holes must be polished so that crack sizes at the surface become smaller and offer maximum resistance to tearing.

REFERENCES

1.Joseph Edward shigley “Mechanical Engineering design” fifth edition
2.http://web.mit.edu/kjb/www/Books/FEP_2nd_Edition_6th_Printing.pdf

