Engineering Institute of Technology.

Master of Engineering (Mechanical)

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***Abstract*-This study analyzes the plate's structural performance with the help of Ansys Workbench, where the plate is cut in three designs such as round cut, square cut, and box cut. As per the basis of this research analytical performance, it is found that the output of this study indicates the effect of various cut shapes on the plate's design integrity. The output highlights the displacement level, and equivalency stress also highlights the mesh operation result based on the plate surface cut. The findings of this study indicate the effectiveness of Ansys Workbench by performing plate and bar models and provide some important information for finding proper designs based on their structure.**

Keywords- Plate models, displacement, structural behavior, Ansys Workbench, and equivalent stress.

I. INTRODUCTION

The purpose of this study is to evaluate the effective performance of the Ansys workbench by identifying round shape cut, box-cut, and square-cut problems. As per the basis of "XYZ Inc. " the analyzed output has come out from the selected plate model. It has been found that plates have been used for buildings houses and also used in various construction purposes in general, mostly used in the part of walls. The design structure analysis of this study component such as plate helps for unique product development. The plate which is built by the material provides significant pressure on the top edge which is 7 □ 107□/□2, and provides a scenario required at the time of the investigation. This study analysis finds equivalent stress as well as displacements for three cuts of the plate based on their design integrity and optimization. Simulation of this research performs the complete analysis based on analytical as well as numerical processes. This plate analysis of performed with a laminate material which is one of the problems for this study as it is more complex than the beam.

Aim

This study aims to analyze the design output of a plate model and Bar model using ANSYS Workbench by evaluating the stress as well as displacements for three cuts of the plate in various conditions.

Objective

- To affect material behavior using Ansys Workbench by setting appropriate properties and geometry.
- To analyze structural integrity by analyzing stress distribution and deformation operations under specified loading conditions for plate models.
- To compare outcomes from different cut-out shapes to identify optimal design configurations for the various performances.

II. METHODOLOGY

A. Part Modellings

This research performs *primary analysis* where it uses a plate and cutting the plate into three parts such as round shape cut, box cut, and square cut. The simulation of this plate cut performs some operations, such as finding their displacement, applied pressure, as well as equivalent stress [1]. The quantitative analysis has been selected for this research where for each cut the length, height, and width value is fixed.

B. Motion Analysis

Motion model analysis for plates helps to measure the respective motions based on the structure of the cut. The motion of each plate has been determined by the measurement of the distances based on the specific points. This helps them to determine the presence of the active movement of the plates. This analysis helps to measure the plate motion on the basis of its three cuts [2]. Motion analysis is used to understand plate model behavior as well as help to estimate their performance stability.

III. RESULT AND DISCUSSION

Q1:

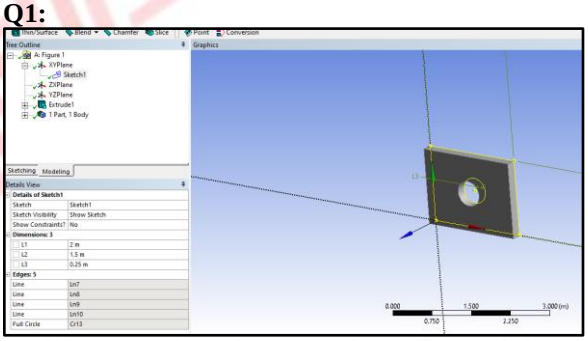

Fig 1. Round shape cut in the plate

The graphical form of a round-shaped cut plate has been illustrated by the above figure. The length of this plate is 2□, □□□□*h*□ is 1.5□ □□□ □*h*□□□□□□□ is 0.2m, and in this plate, L3 indicates the round cut area. Extrude1 operation has been performed in this section to make it solid, and the research takes 5 edges to create a round cut in the plate.

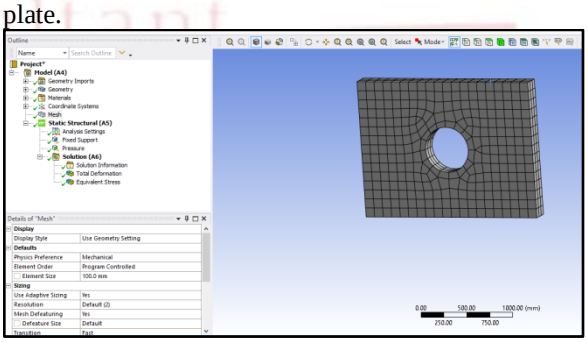

Fig 2. Mesh operation

The above figure shows the mesh operation done in the plate by using ANSYS software. Mesh operation takes adaptive sizing and fixed resolution as the

default where the element size is 100.0 mm and the Round shape cut plate takes the A4 model to perform the mesh operation.

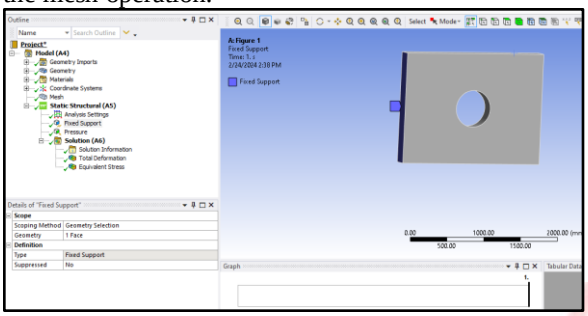

Fig 3. Fixed support

The fixed support structure of the round-shaped plate has been illustrated in the above figure. This round shape cut plate takes 1s to build fixed support and in this plate, the blue color indicates the fixed support area.

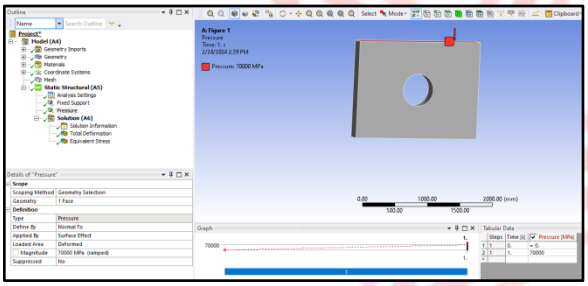

Fig 4. Pressure applied

Applied pressure in the round shape cut plate has been described in the above figure. The plate shows the value 70000 MPa as an applied pressure in the round shape plate which has been indicated by the red color.

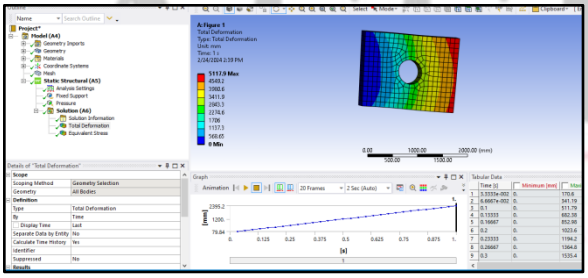

Fig 5. Total displacement

The above figure represents the total displacement of the circle-cut plate, which has been indicated by different colors. The red color shows the maximum displacement which value is 5117.9, and the blue color indicates the minimum displacement area. The graph of this plot is also shown in this figure where the blue line represents the average range [4].

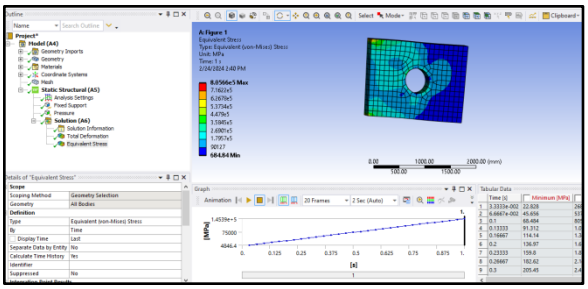

Fig 6. Equivalent stress

The above figure represents the equivalent stress generated in the round shape cut plate. The blue color of this place indicates the minimum equivalent stress which ranges from 684.84 and the red section value is 8.0566e5 where the stress is maximum. The type of this plate stress is “equivalent (Von-Mises) stress” and the unit of the stress is indicated by MPa in seconds [3].

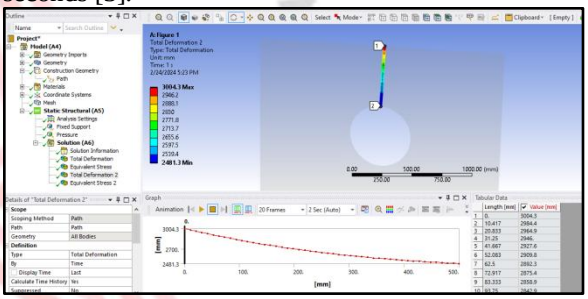

Fig 7. Displacement operation in cut-out shapes

The circle-cut plate shows the load path of their cut-out shape based on the displacement operation. The cutout shape shows the maximum load value which is 3004.3 mm, and the minimum load value which is 2481.3 mm, where the graph shows that in the beginning, the load is high.

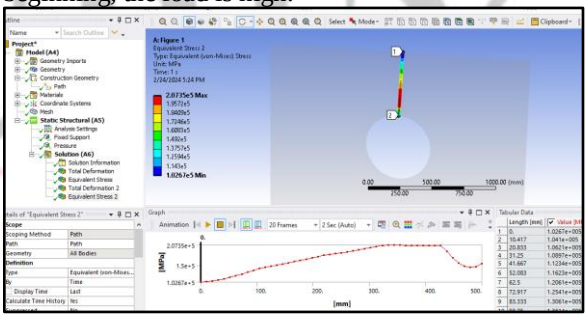

Fig 8. Equivalent stress operation in cut-out shapes

The equivalent stress operation on the round-shaped cut plate shows a load path in their cut-out shapes. The maximum value of the load path is 2.0735e5 MPa, and the minimum value of this load path is 1.0267e5 MPa.

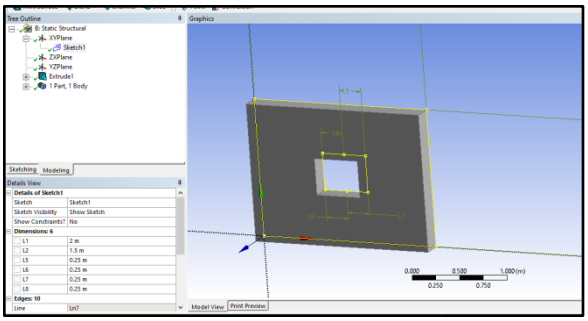

Fig 9.Box shape cut in plate

Box shape cut in this study plate has been shown by the above figure which has been done by using ANSYS software. The dimensions of this plate are indicated by the number of L, such as the L1 value is 2m, the L2 value is 1.5m, L5 value is 0.25m which is the same for L6, L7, and L8.

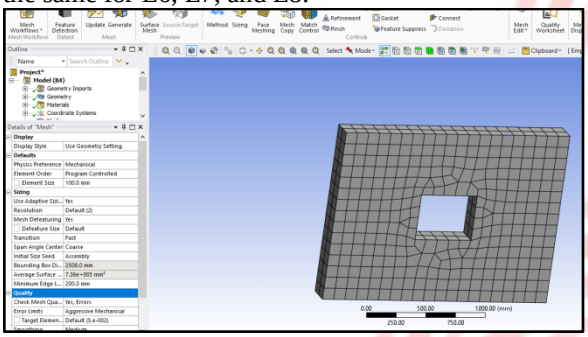

Fig 10. Mesh operation

Mesh operation for the box cut plate has been represented by the above image where it provides some significant value. The element size of this plate is displayed in the range of 100.0mm, and the box is displayed in the range of 2508.0mm where the average surface value is 7.36e+005mm2.

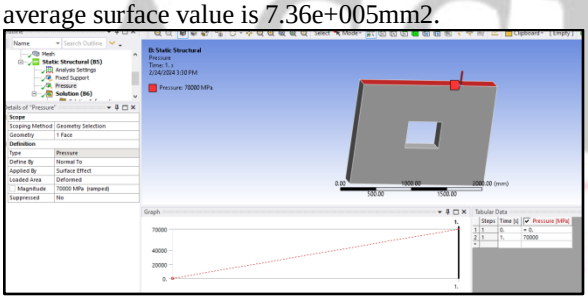

Fig 11. Pressure applied

The above figure represents the area and the range of applied pressure in the box cut plate. It takes 1s to do this where the magnitude range is 70000 MPa which is also known as pressure indicated by red color in the plate.

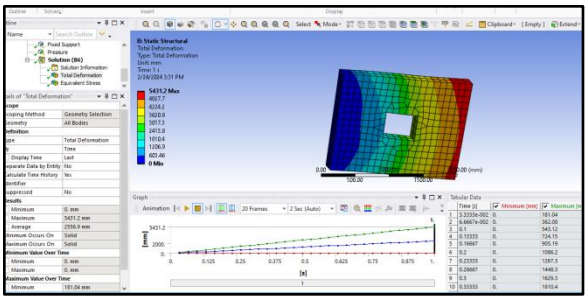

Fig 12. Total displacement

Total displacement of the box cut plate has been illustrated in the above figure. The red section of the plate shows the maximum displacement range which is 5431.2mm and it is minimum in the blue section area as 0, as well as the average value of the displacement is 2556.9 mm. A graph which presented in the figure shows three lines where the red color represents the minimum value, the blue color represents the average value, and the green color represents the maximum value [5].

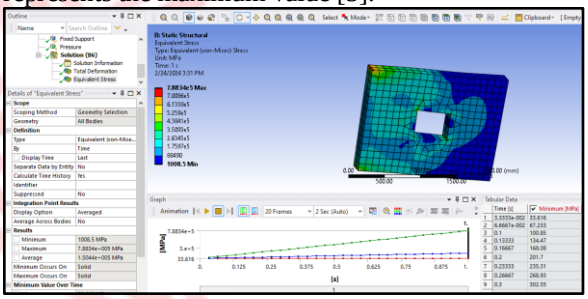

Fig 13. Equivalent stress

The equivalent stress of the box cut plate described in the above image, where the minimum output is 1008.5 MPa, the average output is 1.5044e+005 MPa and the maximum output is 7.8834e+005 MPa.

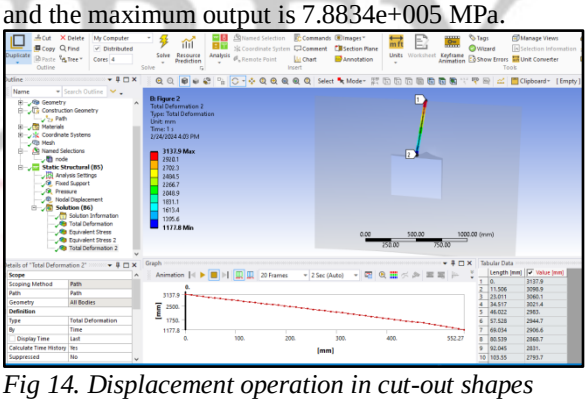

Fig 14. Displacement operation in cut-out shapes

The load path for displacement operation in the cut-out shapes is shown in the above image, and this image shows the maximum value as 3137.9mm and the minimum value as 1177.8mm.

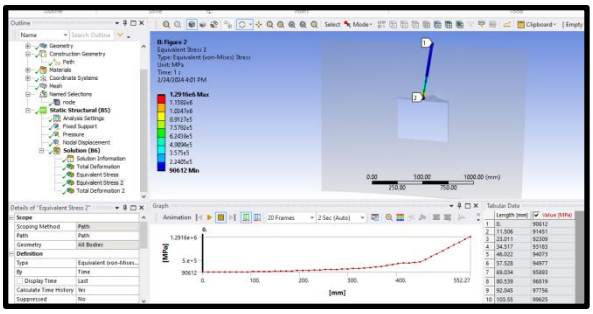

Fig 15. Equivalent stress operation in cut-out shapes

Equivalent stress operation based on the cut-out shape of the box cut plate helps to find the load path. The graphical representation of the load path is indicated by a red line which indicates the volume of the load.

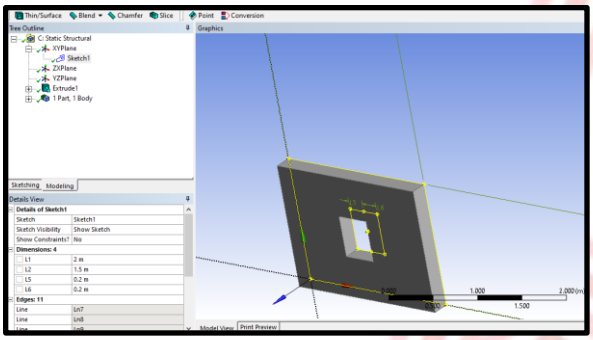

Fig 16. Square shape plate

The structure of the square shape plate is represented by the above figure, where the dimensions of the plate indicate the length as L1 with a value is 2□, height as L2 with a value is 1.5□ □□□ thickness as L5, and L6 with a value is 0.2m.

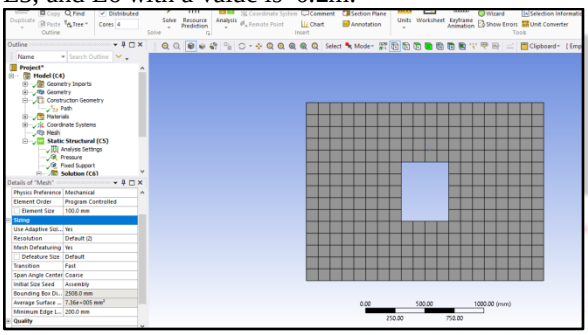

Fig 17. Mesh operation

The above figure represents the mesh operation that is done in the square cut plate and also indicates some values. Model C4 performs this operation where the bounding box dimension value is 2508.0 mm, the average surface value is 7.36e+005mm2 and the minimum age length is 200.0 mm.

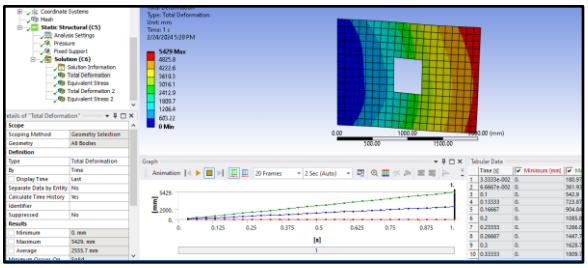

Fig 18. Total displacement

Total displacement of the square cut plate has been described in the above image. In this plate, the red color indicates the maximum displacement as a value of 5429 mm and the blue color indicates the minimum displacement as a value of 0, and it also shows the average value which range is 2555.7 mm.

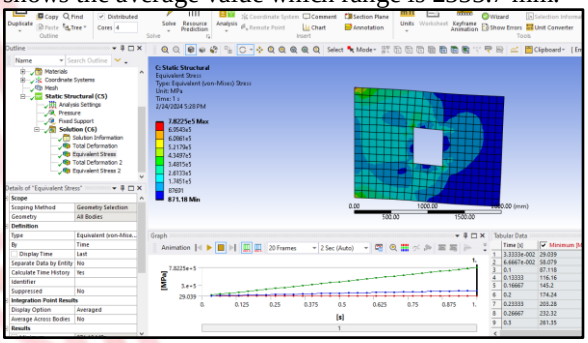

Fig 19. Equivalent stress

The equivalent stress of a square cut plate shows the maximum stress value as 7.8225e5 MPa and the minimum stress value as 871.18 MPa.

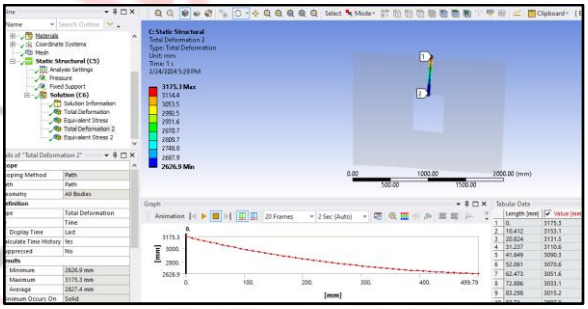

Fig 20. Displacement operation in cut-out shapes

Based on, the cut-out shape of a square cut plate, the above figure shows a load path, where the maximum value is 3175.3 mm, and the average value is 2827.4 mm as well as the minimum value is 2626.9 mm.

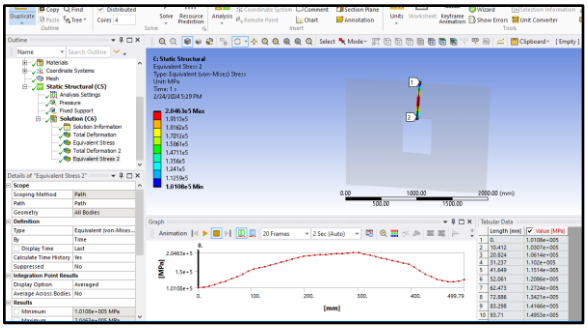

Fig 21. Equivalent stress operation in cut-out shapes

The load path of a square cut plate for equivalent stress operation has been explained by the above graph, where the load has been increased based on stress increment.

Displacement Comparison

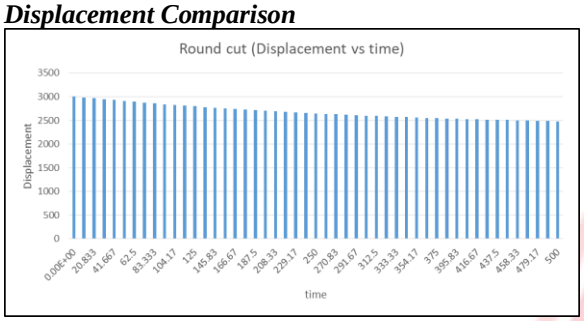

Fig 22. Round cut model

Comparison between displacement and time for round cut plate has been explained in the plot. The X-axis of this plot represents the time, and Y-axis represents the displacement. As per the basis of this plot, when the time is 0 the displacement is maximum in the range 3000mm, and it decreases when the time is increased [6].

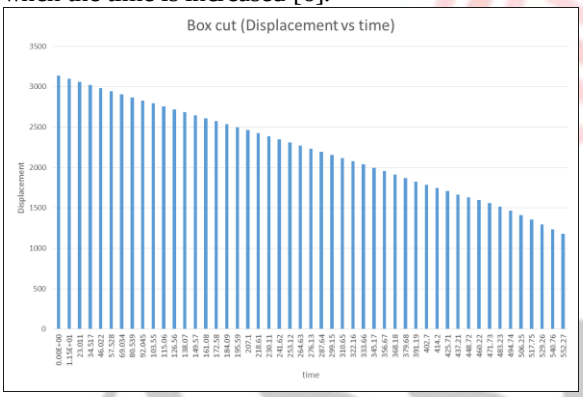

Fig 23. Box cut model

The above plot shows the comparison between the displacement and time in the case of a box cut plate. The displacement is maximum in the range of around 3000mm when the time is 0 and the displacement is reduced based on the increment of each time.

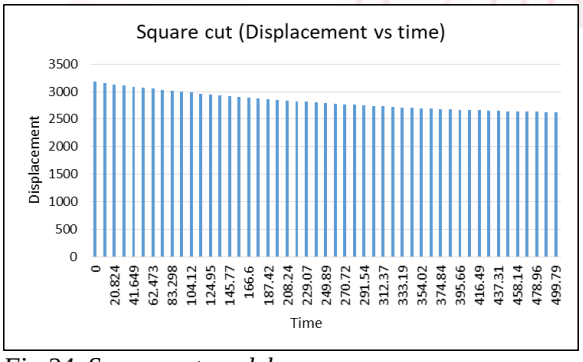

Fig 24. Square cut model

The comparison of the square cut plate's displacement as well as time has been described in the above plot. The plot of this comparison shows the maximum range of the displacement which is around 3200 mm.

Equivalent stress Comparison

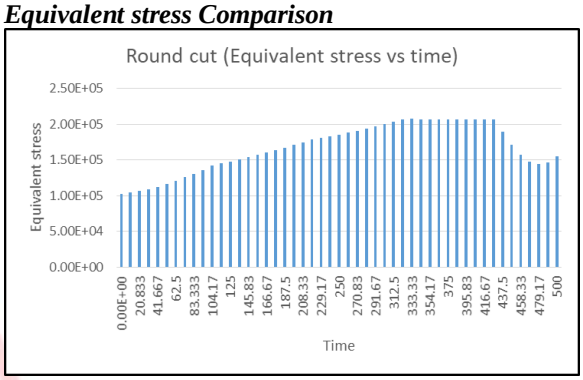

Fig 25. Round cut model

The equivalent stress comparison of equivalent stress and time for the round cut plate has been explained by the plot. It shows that the equivalent stress is minimum as the range 1.00E+05 when the time is 0, and maximum such as 2.00E+05 when the time is 395.83.

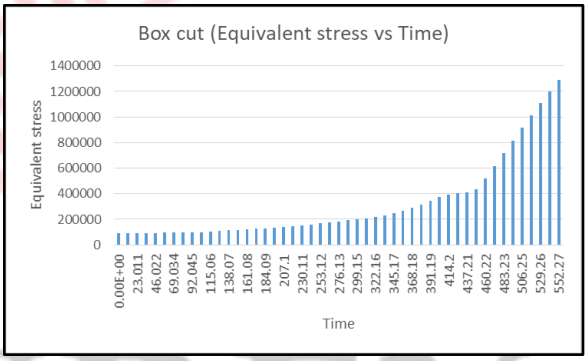

Fig 26. Box cut model

The stress comparison between equivalent stress and time for box cut plate has been indicated in the above plot. The plot shows, that when the time is 0, the equivalent stress is also 0, and when the time is 552.27 the equivalent stress is 1300000.

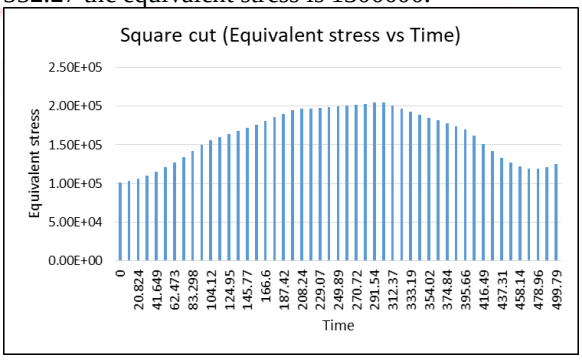

Fig 27. Square cut model

The plot indicates the comparison between equivalent stress as well as time for the square cut plate. It explains that in the middle of the time equivalent stress is maximum.

Q2:

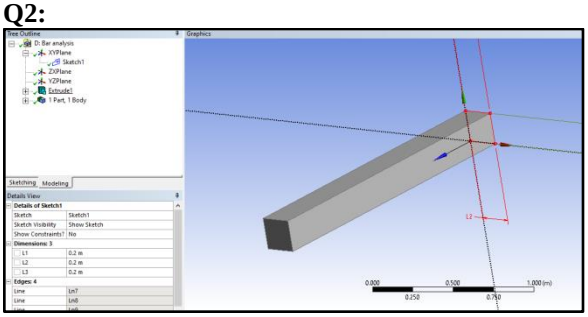

Fig 28. Bar model

The above figure shows the bar with specific dimensions such as a length is 2m indicated by L1, L2, and L3, and with module elasticity in the range of 200 GP. Extrude 1 operation has been done to build this bar model, which specifies some values.

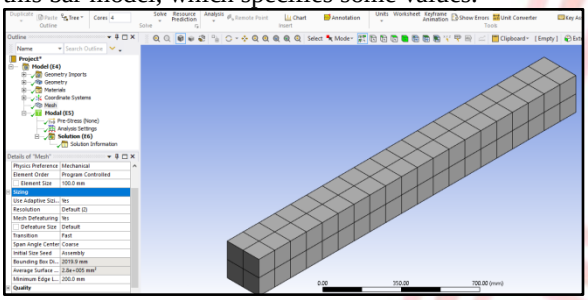

Fig 29. Mesh operation

Mesh operation of the bar model has been explained in the above figure, where the element size is 100.0 mm. The performance of the resolution takes as default for this mesh operation, and this operation finds the value of the bounding box is 2019.9 mm.

Q3:

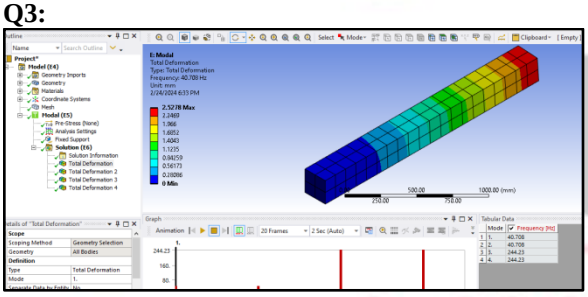

Fig 30. First frequency

Based on the bar model the first natural frequency has been represented by the above image. This image shows some frequency values, where the maximum frequency value is 2.5278 mm which is indicated by red color and the minimum value is 0 indicated by blue color.

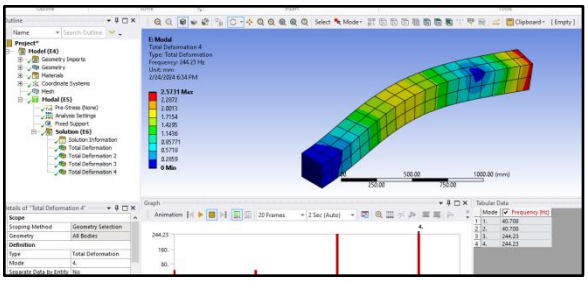

Fig 31. Second frequency

The above image explains the second frequency based on the finite element method for the bar. The deformation value for this case is 4, and it indicates that in the red section, the frequency is maximum in a range of 2.5731 mm.

IV. CONCLUSION

The performance of Ansys Workbench software for analysis of the plate by its three cuts provides some important understanding based on their structural behavior. As per the basis of its analysis method, this research finds the displacement, and stress distribution for each cut of the plate such as box cut, round cut, and square cut. The simulation of this research gives a proper understanding of the output of the plate when it runs in different conditions of loading. Round-cut plate performance displays various types of displacement values and stress levels all around its surface area. On the other side, the box cut plate also shows different displacements based on its area structure of stress distribution. The square cut plate shows a similar displacement idea and gets the value based on the structure of its surface and shows the stress distribution level. The motion analysis of this study highlights the motion of the plate based on its structure to find its complete behavior. It comparison plot which done in this study for each cut shows the relation or difference between time and displacement in various conditions. So, based on this study can say that this research shows the significance of Ansys Workbench for analyzing the plate in different cuts. The output of this study provides some important information about its structural design to find its structural integrity.

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