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Finite Element Stress Analysis of Pin Joints for Isotropic and Composite Plate Materials

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ABSTRACT

Pin joints are used in most of the assembly process. Many types of loads acts on the pin joints in its working. Due to holes cut in the plate, stress concentration plays wide role in the joint strength and life. Due to the advances in the composite materials which are made of different manufacturing process, stress analysis is required to analyze the stress behavior at the joint.

The experiment is carried out for elastic pin and rigid pin conditions. The results shows higher contact pressure and Vonmises stress developed with rigid pin condition. In isotropic conditions, the maximum contact pressure is taking place at the top and bottom central regions due to loss of width of the plate due to axial loading. But the maximum contact pressure position is changing to the right in case of pin loading.

Keywords—Pin joints, elastic pin, rigid pin, etc.

I. INTRODUCTION

Pin joints are used in assembling the machine parts. This type of arrangement comes under temporary joints and easy to join the parts. Number of pins are used in the process. The drawback of these assembled components are raise of stress values to stress concentration effects. In general washers are used to remove the effect of stress concentration by increasing the area of contact. Various methods are available to calculate the stress concentration effects on the pin joints.

If the contact area of the component is widened, the problems of fatigue is less. If the widening is limited, there is very possibility of the problem with the assembled components. The calculation of the contact pressure is also difficult with these problems, as the contact region is highly nonlinear and keeps changing.

Many software's like Ansys, Abacus, FEM are used for analyzing the problems.

II. METHODOLOGY

- Analysing the problem for plate loading with elastic pin
- Analysing the problem for plate loading with rigid pin conditions
- Analysing the problem with composite pin with elastic pin conditions
- Calculating the problem with composite pin with rigid pin conditions

A. *GEOMETRY OF THE PROBLEM*

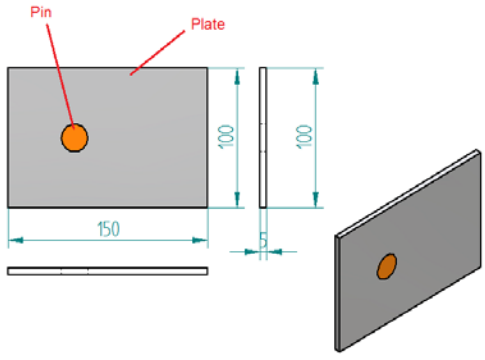

Fig1: Geometry of the problem.

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B. MESH PLOT

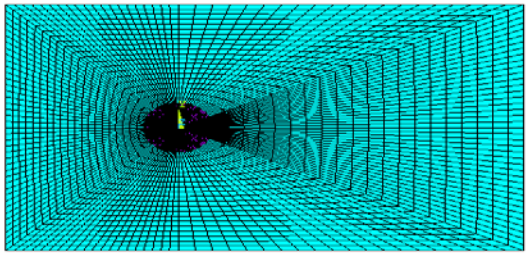

Fig.2: Generated mesh of the problem

III. LITERATURE SURVEY

Ronald Krueger et al.,[1] developed a 3D shell modeling technique was developed for which a local solid FEM is used only in the immediate vicinity. The goal was to combine the accuracy of the full 3D solution with the computational efficiency of a shell FEM. Multipoint constraints provided a kinematically compatible interface between the local 3D model and the global structural model which has been meshed with shell finite elements.

D.M. Kim et al.,[2] has discussed about composite and delamination due to shear stress on mode II edge conditions. Various analysis has been conducted to conclude possible methodology to avoid interlaminar normal stress which are the main source for delamination in the joints.

Dr. H.V. Lakshiminarayana et al.,[3] conducted various numerical techniques to find the crash worthiness of composites. Its absorption rate, release of energy and stress behavior along with critical region identifications has been done.

IV. RESULTS AND DISCUSSION

Results

1. Plate Loading System With Elastic Pin

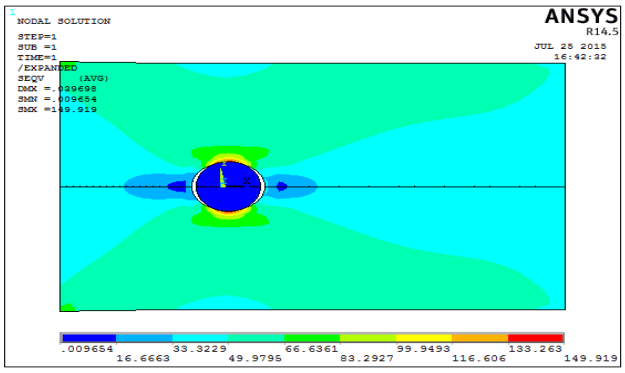

Fig3:Vonmises stress graph.

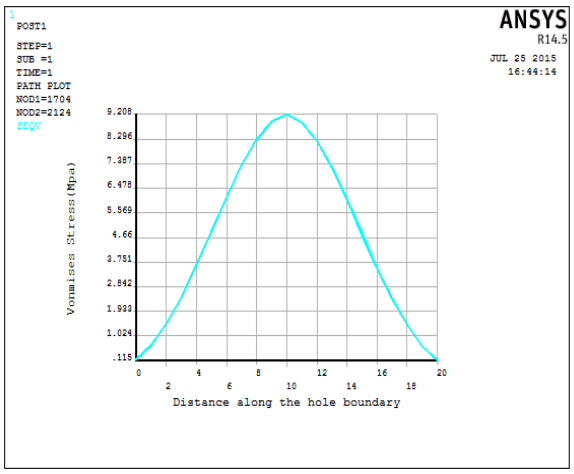

Fig4: Contact pressure variation.

2. Plate Loading System With Rigid Pin

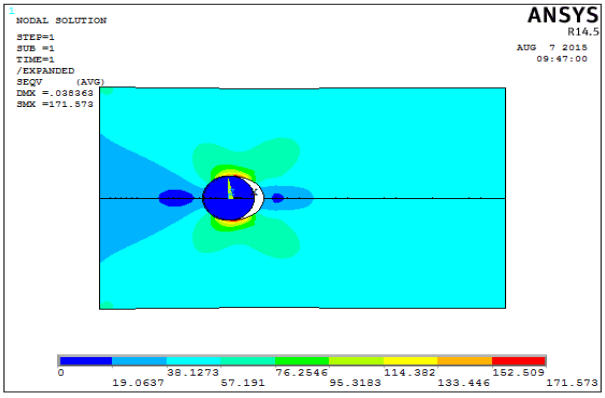

Fig.5: Vonmises Stress development.

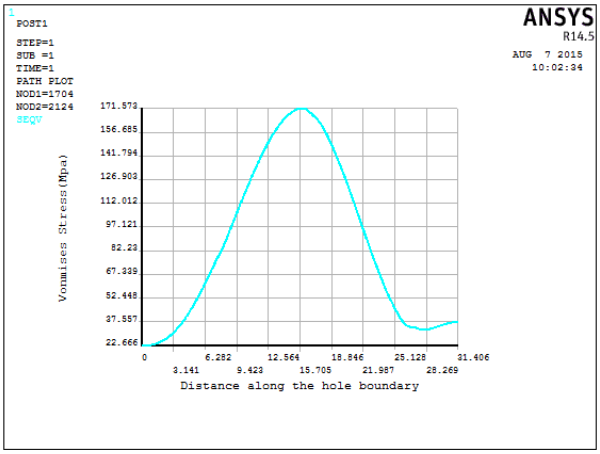

Fig6: Contact Pressure graph.

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3. Pin Loading System With Elastic Pin

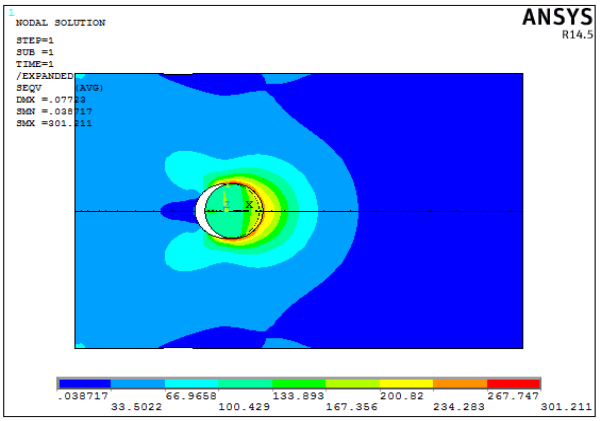

Fig7: Vonmises stress plot.

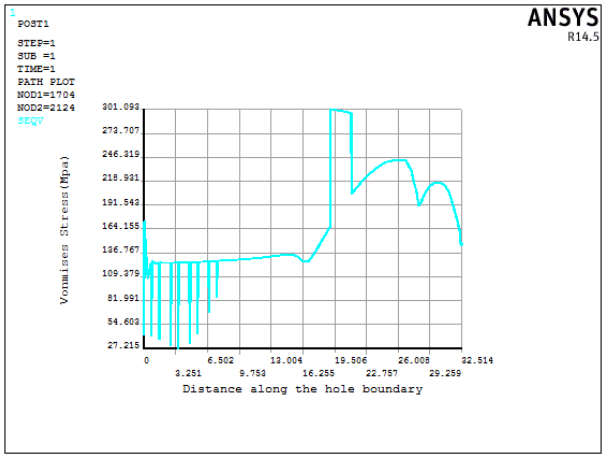

Fig8: Contact Pressure distribution graph.

4. Pin Loading System With Rigid Pin

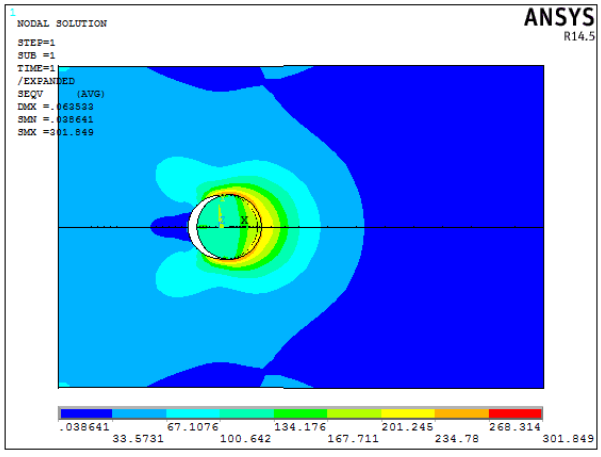

Fig9: Vonmises stress distribution

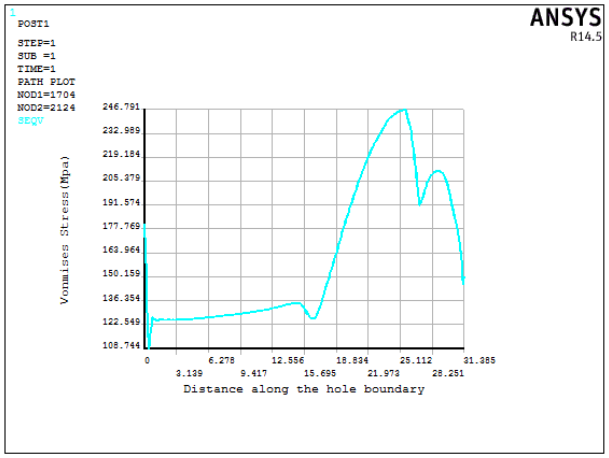

Fig10: Vonmises Stress graph.

5: Composite Plate:

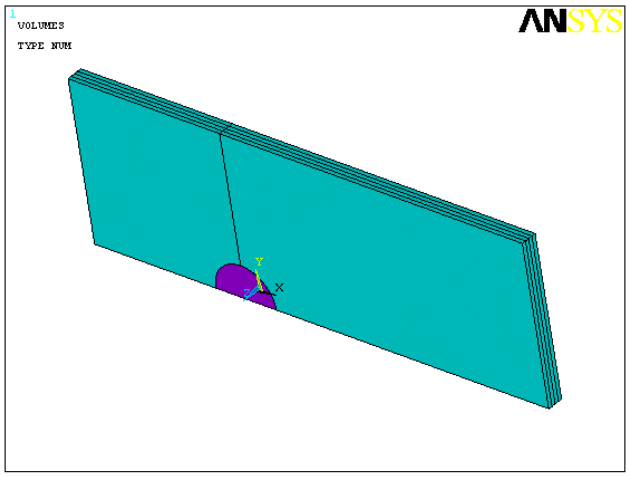

Fig11: Diagram of composite plate

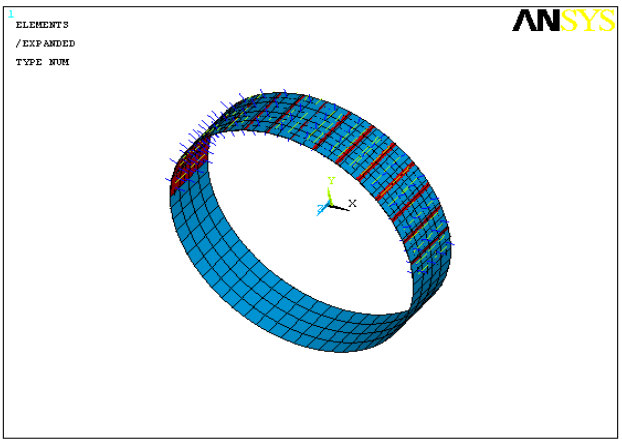

Fig12: Contact Pair creation.

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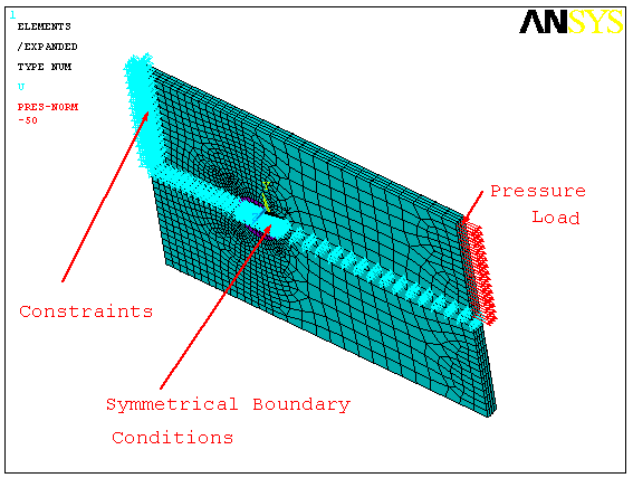

Fig13: Boundary Conditions.

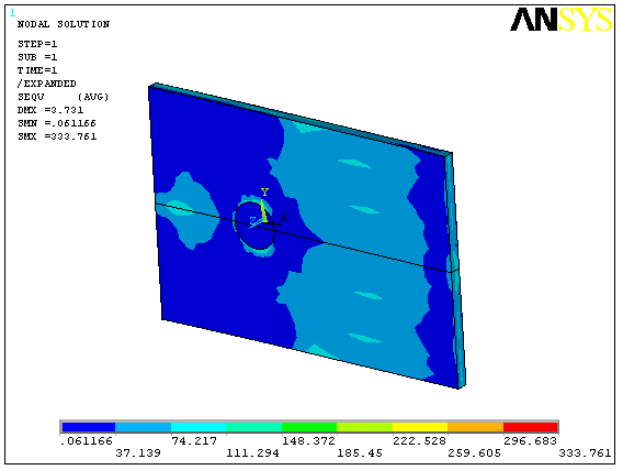

Fig14: Vonmises Stress diagram.

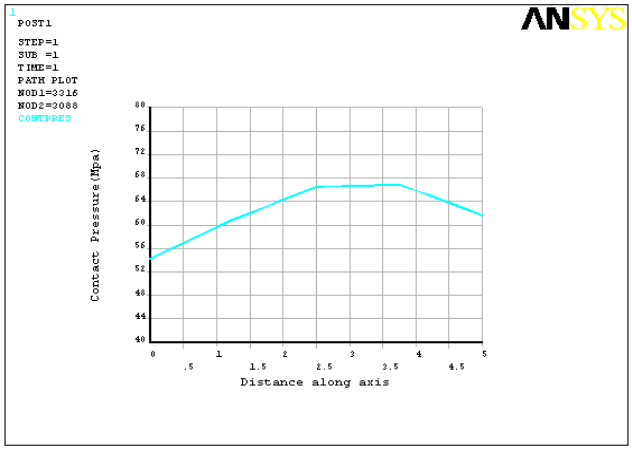

Fig15: Contact Pressure variation graph.

Discussion

Table 1: Plate Loading Results

Plate Loading	Deformation	Vonmises Stress	Contact Pr
Plate and Elastic Pin	0.03mm	149.9Mpa	14.49Mpa
Plate with rigid Pin	0.038mm	171.5Mpa	40.3Mpa

Table2: Pin Loading Results

Pin Loading	Deformation (mm)	Vonmises Stress	Contact Pr
Plate with Elastic Pin	0.077mm	301Mpa	290.28Mpa
Plate with rigid Pin	0.063mm	301.85Mpa	279.5Mpa

V. CONCLUSION

Experiment has been carried out to find the effect of contact pressure and stress distribution due to many types of loading system through pin and plate assemblies. The analysis results shows elastic plate and pin arrangements has lesser stress and contact pressures compared to the rigid pin arrangement for the plate loading. The results shows almost 3 times higher contact pressure development with rigid pin. But the pin loading arrangements shows little change of stress and contact pressure with either elastic or rigid condition of the pin.

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