

A REVIEW OF STRESS ANALYSIS ON VARIOUS CUTOUTS ON PLATE

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ABSTRACT

In this paper, an attempt is made to review the literature on stress analysis of various-shaped cutouts in a plate which are used in various structural elements in aerospace, mechanical and civil engineering structures. Therefore, this study mainly focuses on stress concentration analysis of perforated steel plates with various cutouts like circular, triangular, rectangular, and square.

I. INTRODUCTION

In today's era, there is increasing use of plates and shells of various constructions as primary structural elements in aerospace, mechanical and civil engineering structures. In recent years, the increasing need for lightweight efficient structures has led the structural engineer to the field of structural shape optimization. Reduction in the weight of different shapes are widespread application in engineering, such as aerospace, marine, automobile & mechanical structure achieves primary weight-saving and if carried to sufficiently great lengths enables the designer to use smaller power plants, thus achieving substantial secondary improvements in stress concentration.

The presence of cut-out in plates is especially carried out for inserting bolts and nuts. In order to reduce the weight of the structural members, the dimple cut-outs play a crucial role. Therefore, this study mainly focuses on stress concentration analyses of mild steel plates according to dimple cut-out orientations like circular, triangular, rectangular, and square.

II. LITERATURE REVIEW

More research work has been done in the field of mechanical testing of stress concentration for engineering applications.

Achchhe Lal, B. M. Sutaria, Rahul Kumar [1] "Stress analysis of a composite plate with a cutout of various shapes" This paper presents that, in composite plate found innumerable applications in various compositions due to its properties. The geometry of the cutouts should be of different shapes and they can create equal stress in the plate. For the safety and equilibrium of the structure, it is necessary to analyze the stress concentration factor and axial deformation, and stress distribution. For mathematical modeling finite element-based plane

stress analysis is used. A program developed in MATLAB. The distribution of stress around the hole is also studied.

Madhusudan S. Tavade, Prof. R. S. Tajane [2] “Stress Concentration in Metallic Plates with Rectangular Cut-out” In this paper the researcher states that in structure thin panels and shells are used as the primary structural elements. Due to the increasing need for lightweight structure. It led's to structural shape optimization to reduce the weight of an element. Different cutouts are required. The elements are getting damaged during their service life.

S.B.Masuti, K. S. Mangrulkar [3] “Analysis of the stress concentration on cut-out orientation in plates” In this paper the researcher states that as per service requirement cutouts are made into a structure, resulting in loss of strength. There are Different shapes are used for different applications. The manhole of any pressure vessel is either circular or elliptical. These holes are worked as a stress increaser. Due to this, the machine can break down. That's why it is important to predict stress concentration for holes. Due to chemical spoiling, the irregularity in the hole shape may be caused.

Laxman Bharambe, Dr. S. I. Kolhe [4] “Stress Concentration of plate with rectangular cut-out” In this paper, the researcher states that circular, triangular, and square cutouts are widely used in structural members. This cutout creates a stress concentration in plates. To analyze the stress concentration ANSYS is used.

M. L. Pavan Kishore, A. Chandrashekhar, M. Avinash, Raunak Das [5] “Stress analysis of rectangular and square plates with various cut-outs” In this paper, the researcher states that during manufacturing, geometric irregularities in the structure result in improper stress distribution. Which affects the strength and vibration behavior when a component operated in a waver environment. For analysis of three different types of mild Steel and two different loading conditions are used with this conclusion we found where the maximum stress occurs. The methodology adopted is based on the numerical techniques of the finite element method. Which uses SOLID 185 In ANSYS 19.1 solver.S. Durgadevagi and N. A. Jabez [6] “A Comparative Analysis of Slab with Different Shape of Cutout for Various End Conditions Using ANSYS,” In this paper, the researcher states that, Cutouts gave to reduce self-weight, to provide benefits and aesthetics. When these patterns are loaded modifications in bending qualities of a piece also ultimate load ability of the pattern. Study on the difference of displacement, strain, and tensions. Steady support piece on all walls least deportation and longest tensions along ends of the piece. ANSYS software was used to analyze the reinforced cement slab criteria.

A. Khechaia, A. Tatib, B. Guerirac, A. Guettalaa, P. M. Mohited [7] “Strength degradation and stress analysis of composite plates with circular, square and rectangular notches using digital image correlation” In this paper, the researcher states that, Using the digital image correlation study on Strength degradation and stress analysis of composite plates with circular, square and rectangular notches. The design of the high-performance compound structures includes various shape and size discontinuities for various objectives. Under various working loading, the zones near these notches become critical areas.

Rohit Chowdhury, M. Saiteja Reddy, P. C. Jain and P. Bangaru Babu [8] “Stress Concentration Around Cut-Outs In Plates And Cylindrical Shells” In This Paper, the researcher states that Due to reinforcement produce an effect on stress concentration around the cutouts. Flat plate and cylindrical shell, subjected to compressive load, containing two identical cutouts along the length to determine the effect on stress concentration factor with variations of the distance between the cutouts. A parametric study is carried out to understand the variation of the stress concentration. This study assumes the use of homogenous, isotropic material. This research uses the FEA software package, ANSYS APDL mechanical. Mathematical, in none dimensional format diameter of cutouts to the distance between them at which they discontinue to affect one another.

Arjun Prasad, Govind Shaji, Gokul P. V. [9] “Numerical Analysis of Thin Plates using Finite Element Software” In this investigation, Plates are important structural members. Used in the field of structural engineering, ship technology, and aerospace engineering. Holes are provided in thin plates for aesthetics and

providing some services. Using finite element software ANSYS, calculate static of thin plates with holes. These holes generate stress concentration and re-distribution of stress around the hole it causing a decrease in strength. Due to the pitting corrosion holes are developed in the plates. Calculate the effect of shape, size of the orientation of holes, and also the influence of boundary conditions on thin plates. Vikash Singh Dhiraj, Nandit Jadvani and Kanak Kalita [10] "Stress and strain analysis of functionally graded plates with circular cutout" In this paper, the researcher states that Stress concentration is caused by the failure of structural parts under static load. stress and strain concentration factors in UDFGM plate with a central circular cutout are indicated by carrying out a limited element study on the ANSYS APDL platform. When designing a permeated UDFGM plate the material variation parameter is an important criterion. By establishing proper material variety parameters and the principle of material gradation, the stress and strain concentration can be decreased.

Lican Zhuang, Bixin Su, Minghao Lin, Yiyuan Liao, Yafang Peng, Yinglong Zhou, Dongmei Luo [11] "INFLUENCE OF THE PROPERTY OF HOLE ON STRESS CONCENTRATION FACTOR FOR ISOTROPIC PLATES" In this paper, the stress concentration factor (SCFs) is predicted by the ANSYS finite element models for the isometric plates with different holes. The influences of the geometric and equipment parameters of the hole on SCFs are discussed. The geometric shape of holes includes many shapes and combined-section. The change the property of a material. The hole with a smooth shape is reasonable to decrease the stress concentration factor. To improve the ability to resist stress concentration. It is significant to improve the mechanical properties. The present study may provide designers with effect.

Babulal K. S., I. Vimalkannan, A. Pradeep, P. Muthukumar [12] "Scf On Isotropic Rectangular Plate with Central Circular Hole Using Finite Element Analysis" In this paper, the researcher states that the present work is the study of an anisotropic rectangular plate with a centrally located circular hole under uniform tensile load. There are loaded plates with the presence. The stress concentration factor has been calculated by using both analytical and finite element methods. Solid works simulation is used for modeling.

Dheeraj Gunwant [13] "Stress Concentration Studies in Flat Plates with Rectangular Cut-Outs Using Finite Element Method" In this paper research states that stress concentration studies in flat plates with Rectangular Cut-Out Using Element Method" presence of cut-outs of different shapes are available. They're designed with lightweight components. However, the presence of such cut-outs includes highly. In recent years, FEM has evolved as a crucial tool for handling such problems. There are studying the effect of various geometric parameters. In this first step, the model has been subjected to uniaxial load. The value of SCF exhibited good agreement with analytical values. Dheeraj Gunwant, Rahul Kshetri, Kamal Singh Rawat [14] "Determination of Stress Concentration factor in Linearly Elastic Structures with Different Stress-Raisers Using FEM" In this paper, the researcher states that Stress concentration is the localization of stress around stress. Sudden changes in the geometry of the structure increase the stress values. These values are higher than values obtained by the basic equation of solid mechanics. Evaluating it requires techniques like the finite element method. The finite component method is used to solve engineering problems. Focus on the determination of stress razor linear elastic structures. The results in the FEM are compared with the result obtained by the analytical correlations given in the literature. Plane 82 is used for discretion.

Ezazahmed N. Shaikh, Khushbu C. Panchal, Dhaval B. Patel [15] "Stress Analysis of an Infinite Plate With Different Shaped Cutouts In Composite Plate" In this paper research states that, for reducing weight in the machine components, holes and openings are provided. Its discontinuities are reducing the agent for the structures. Under different loading conditions predict failure of components the stress field around the discontinuity must be understood. The composite laminate is an attempt to find a solution to determine the stress concentration around holes of different sizes. As a solution, the conclusions are obtained by coding in MATLAB 7.8 and this conclusion good matched with ANSYS 11.0 conclusion. Rameshwar Sahu [16] "Effect of Stress Concentration on Various Shaped Hole Having Similar Cross Section Area" In this paper research

states that in this point chosen a drilled Steel plate (45C8) and a square shape of dimensions 50×50mm and density is 10mm and disparate holes of shape. Then like rectangular, triangular, and circular. Then next I have locked one side model and apply tensile stress on the 22nd side. Then obtaining small stress and computed stress attention factors for any holes of the pattern. we have used CAD software. Then find out shape is good in outlook less robust with stress robust. This is applied shape for any petitions.

Satish D. Watsar, Ajay Bharule [17] “Stress Analysis of Thin Plate with Special Shaped Cutout: A Review” In this paper, the researcher states that, At this point check on stress calculation of thin plate with an outstanding shaped cutout. Plate with many shaped cutouts always utilized new and elegant aerospace, mechanical and civil engineering patterns. The awareness of the action of the cutout on a gear bearing ability and stress attention of such plate is designed on the system. A no. of logical experiment methods is ready for stress calculation around various species of the cutout for various situations in a plate made up of various elements in this plate. A try has been created in the current job to different methods formulated for stress calculation and stress concentration components.

S. B. Masuti, K. S. Mangrulakar [18] “Analysis and Validation of Stress Concentration On Cut Out Orientation Plates” In this paper, the researcher states that vacancies are made into a pattern to conform to some duty laws, resulting in this courageous degradation. In the method, various patterns of holes are used in various appeals. For instance, a manhole of any tension, the container is circular, or gate off an airplane is a rectangular gap having a chamfer of some radius at the nook. This gap job as a stress increase and various guides to loss of machine elements. It is a critical characteristic of stress analysis to indicate stress concentration of formal and informal holes. The informality in these holes’ pattern because of chemical demotion. Below is the impact of outside loading and chemical methods some different patterns may develop. Laxman Bharambe, Dr. S. I. Kolhe [19] “Stress Concentration of plate with rectangular cutout” In this paper researcher states that, the stress concentration of the plate with a rectangular cutout. Logical analysis exists stress analysis of a plate with various main cutouts. The awareness of the impacts of the cutout on the load path’s ability and stress attention of such plates is significant in the method of structure. Unique intensity is spotted on the horizontal infinite plates exposed to uniaxial friction weight. The outcomes founded on a logical outcome are related to stem utilizing finite components technique. This indicates precision and logical outcomes for stress calculation of plates with outstanding main cutout.

III. CONCLUSION

From the above literature review we observed that most of the researcher have taken input parameters for designing engineering structures with circular, rectangular, square and triangular shaped cut-outs, a dependable estimation of stress is important. The various shaped cut-outs featured in our study can be used for preliminary design of plates with dimple shaped cut-outs.

IV. FUTURE WORK

The researcher has taken parameters for designing of a low weight. They cut various shapes from the plate but it increases the stress concentration factor on plate. So, it will help to reduce the weight as well as stress concentration factor on the plate. It will be carried out by FEA and through experiments.

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