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Evaluating Stress Concentration Factor For A Finite Plate With Various Discontinuities Under Different Loading Conditions: A Critical Review

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Abstract

Perforated plates, including different shaped cutouts, are crucial parts of structures in mechanical, civil, and aerospace engineering. The total strength of the plate is decreased by the stress concentrations (SC) caused by these cutouts. The shape, size, orientation, boundary conditions, bluntness, kind of load, loading angle, and other features of the cutout all affect the distribution and severity of these stress concentrations, also known as stress concentration factors (SCF), or SCF. When building plates with discontinuities for a variety of industrial applications, it is essential to comprehend the impact of the type of load. This is especially true as structural components need to be more intricately designed to satisfy a wide range of engineering criteria. This article offers a thorough analysis of the impacts of various load types taken into account in previous research.

Through the synthesis of these results, this review seeks researchers to identify existing contributions in the field and to define future research directions.

Keywords:- Bidirectional, Discontinuity, Finite plate, Stress concentration, Stress concentration factor, Unidirectional.

1. Introduction

Plates with varying polygonal cutouts are frequently utilized in offshore, mechanical, aeronautical, civil, and mining engineering structures. Different polygonal-shaped cutouts are required in structural components and to either lighten the structure or provide access to other areas as pointed out by Kumar M. M. et. al (2013). When a polygonal shaped cutout is present in a plate, referred as discontinuity and affects how stress is distributed throughout the plate under different loading conditions. The SCF, which is the ratio of the highest stress to the nominal stress, can be used to evaluate the effects of SC mentioned by Kadam M. et al. (2014)".

Makwana A. B. et al. (2014) studied that the cutouts in the plate with polygonal shapes serve as weak spots and stress risers for the machine or structure. As a result, different polygonal cutouts result in distinct SC effects, which have an immediate effect on the structure's longevity. Therefore, it is crucial to comprehend how the presence of polygonal cutouts in a plate affects both SC and load bearing capability while building structures. For various industrial applications, the SCF assists in determining the optimal hole or cutout that best suits the structural part without compromising its strength under known loading conditions.

Many investigators have conducted studies on the assessment of SCF and stress distribution for finite plates (Ashokan K. 2009), (Woo Jinho, 2011), (Kawadkar D. B. et al., 2012), (Kumar M. M. et. al, 2013), (Kalita K., 2014), (Kadam M., 2014), (Watsar S. D, 2015) and infinite plates (Sharma D. S., 2011), (Sharma D. S., 2012), (Makwana A. B. et al., 2014) under various loading scenarios and methodologies.

The application of different loads and their effects on the SCF and stress distribution around the plate's discontinuities are reviewed in this paper.

The following are the objectives of the present study:

To determine the present status of research on the assessment of stress distribution and SCF under various loading situations that have been taken into consideration by different researchers.

To investigate how various loads placed on a plate affect the SCF.

To assess the contribution of each type of load that

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researchers have taken into consideration within the parameters of the literatures cited in this study.

A REVIEW ON APPLIED LOAD CONSIDERATION:

Different cutout shapes in a perforated plate under tensile loading have been examined, and the SCF for various bluntness and cutout shape orientations in the perforated plate have been discovered by Woo Jinho (2011). A laminated composite plate was used for the investigation; it is infinite in nature and was subjected to both uniaxial and biaxial loading by (Sharma D. S., 2011), and (Sharma D. S., 2012). Various cuttings in the finite plate loaded in a single direction were examined by Kawadkar D. B. et al. (2012).

Kadam M. et al. (2014) investigated the two cases related to SCF determination for a plate having centrally positioned cutout. In the first case, one end of the plate was fixed while the other was subjected to a tensile tension. In the second case, a tensile load was applied to both sides of the plate using compressive, uniaxial, and biaxial tensile loading conditions.

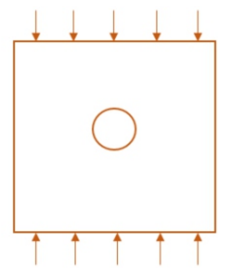
In their study, Makwana A. B. et al. (2014) examined the impact of SC surrounding a circular cutout in a composite infinite plate that was subjected to arbitrary UDL, unidirectional, and bidirectional loading. In order to maintain a consistent cross-sectional area, Kadam M. (2015) studied the effects of various loading conditions on the SCF of a plate with a centrally positioned circular aperture. Eight distinct scenarios, four occurrences of unidirectional and bidirectional tensile and compressive loading each, were analyzed in the study.

Under the assumptions of a plane stress state and uniaxial loading, the study examined the distribution of stress around standard cutouts in finite metallic plates (Jafari M., 2016). Ozkan M. T. et al. (2016) looked at the SCF in a plate with a circular cutout under axial tension loads.

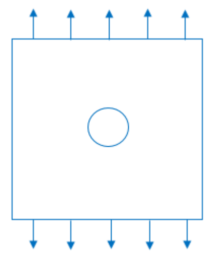
In accordance with the literature review cited within the parameters of this work, Figure 1 depicts a finite plate with discontinuity (such as a circular cutout) under various loads.

Dongarwar P.D. et al. (2016) investigated the reduction of SC with elliptical and circular stress raisers for plates with different kinds of cutouts under tensile loading. Sayyad S. M. et al. (2017) experimented with uniaxial tensile loading on a rectangular plate with square and triangle cutouts, and they found that the stress distributions and SCF in the perforated plates were affected. SC under unidirectional tensile load in a homogenous plate with a triangle cutout coated in a functionally graded layer was analyzed by Yang Q. et al. (2017). A square-shaped perforated steel plate (45C8) with various cutout forms was examined by Sahu R. (2017) for the SCF while taking bi-axial loading into account.

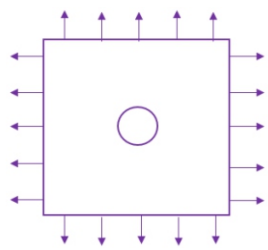
Fesharaki J. J. et al. (2017) investigated on SCF in a plate of Functionally Graded Material (FGM) with central cutouts (elliptical and circular) under tension force reveals that variations in the cutout's shape and the plate's material properties have an impact on the SCF surrounding the cutout in the plate. Roy A. et al. (2017) examined the effects of several heat treatment techniques on the SCF in a plate with a circular cutout under a continuous, unidirectional tensile stress.



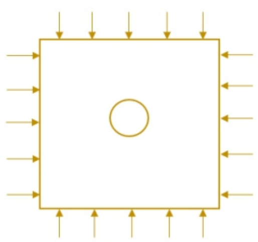
(a) Plate with central hole under uniaxial compression load



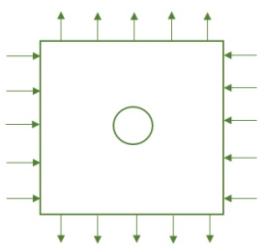
(b) Plate with central hole under uniaxial tension load



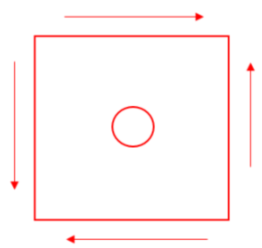
(c) Plate with central hole under biaxial tension load



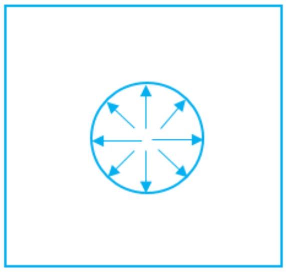
(d) Plate with central hole under biaxial compression load



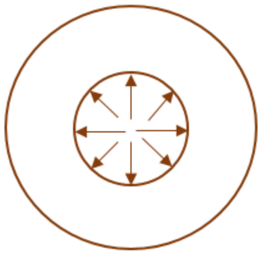
(e) Plate with central hole under uniaxial compression load along x axis and tension load along y axis



(f) Plate with central hole under shear load



(g) Plate with central hole under UDL/UPL



(h) Ring under UPL

Figure 1. A finite plate with discontinuity under different loading conditions

In order to determine the SCF for different notch diameter/width ratios, a series of tensile tests were conducted on E-glass laminated plates with square and circular cutouts (Khechai A. et al., 2018). Chawla K. et al. (2018) carried out a comprehensive analysis to ascertain the influence of different parameters on the stress and strain concentration factors (SCF and SNCF) in a composite plate with a cutout under uniaxial tension. In isotropic and laminated composite plates with circular and elliptical cuts that were subjected to uniaxial tensile stress, Khechai A. et al. (2018) assessed the SC. Bakhshi N. et al. (2019) evaluated plates that were subjected to biaxial loading conditions and looked at how plate length affected the distribution of stress around the cutout.

Table 1. Consideration of applied load.

Ref.	Authors	Kind of applied Load	Work Objective/s
[1]	Ashokan K. et al.	Radial load	To identify stress separation.
[2]	Woo Jinho et al.	Uniaxial tensile load	To identify the effect of cutout orientation on SC.
[3]	Sharma D. S.	Uniaxial and biaxial tension at infinite distance	Finding SC around cutouts in laminated composite infinite plate.
[4]	Sharma D. S.	Uniaxial, biaxial and shear	Study the effect of the cutout geometry and loading pattern on the SCF.
[5]	Kawadkar D.B. et al.	Uniaxial	Evaluation of SC in plate having different cutouts.
[6]	Kumar M. M. et al.	Uniaxial tensile force	Evaluation of SCF for Plate with different cutouts and bluntness.
[7]	Kalita K. et al.	A uniformly distributed load is applied as transverse load	SC mitigation in clamped steel plates and evaluation of percent reduction in Von Mises stress.
[8]	Kadam M. et al.	Uniaxial load	Effect of geometry of opening on the SCF for a Plate.
[9]	Watsar S. D. et al.	Uniaxial load	To evaluate stress distribution and SCF of finite plate with special shaped cut out.
[10]	Makwana A. B. et al.	Uniaxial, biaxial and uniform pressure loading	Stress investigation of FGM composite infinite plate with central cutout.
[11]	Kadam M. et al.	Uniaxial and biaxial load	Stress investigation of FGM composite infinite plate with central cutout.
[12]	Jafari M. et al.	Uniaxial load	Evaluation of SC in finite metal plates with regular cutouts.
[13]	Waldman W. et al.	Uniaxial and biaxial tensile loading	Shape optimization of cutouts in loaded Plates by minimization of multiple stress peaks in SC.
[14]	Ozkan m. T. et al.	Uniaxial loading	Determination of SCF for a central cutout within a plate of rectangular shape under tensile loading using different methods.
[15]	Dongarwar P. D. et al.	Uniaxial loading	Identify the SC effect of stress raiser (Cutouts) present in a plate with elliptical cutout under unidirectional tensile loading.
[16]	Sayyad S. M. et al.	Uniaxial loading	Exploration of the SC and SCF in metal rectangular plates with different cutouts and bluntness.

Ref.	Authors	Kind of applied Load	Work Objective/s
[17]	Yang Q. Q. et al.	Uniaxial and biaxial tension load	Analysis of SC in a homogeneous plate with an arbitrary shape cutout coated by a FG layer.
[18]	Sahu R.	Biaxial load	Identify the effect of SC on several shaped cutout with same cross section area (Calculation of nominal stress).
[19]	Fesharaki J. J. et al.	Uniaxial load	Evaluation of SCF in a FGM plate around a cutout.
[20]	Roy A. et al.	Uniaxial tensile force	To study the effect of cutouts with circular shape of dissimilar diameters in a rectangular plate subjected to uniform loading on SCF.
[21]	Khechaia A. et al.	Uniaxial tensile force	Identify the reduction in strength and stress investigation of composite plates with circular, square and rectangular cuts using DIC.
[22]	Chawla K. et al.	Uniaxial tension load	Evaluation of stress and SNCF in composites of orthotropic with cutout under unidirectional tension.
[23]	Khechai A. et al.	Uniaxial tension load	Evaluation of SC in isotropic and laminated plates with inclined elliptical cutouts using Numerical analysis.
[24]	Guan Y. et al.	Anti-plane shear	Evaluation of SC for arbitrarily shaped cutout with a functionally graded layer under in a homogenous plate under anti-plane shear.
[25]	Bakhshi N. et al.	Uniaxial and biaxial loading	Assessment of effect of length on the SCF of a POCP under in-plane loading.
[26]	Devaraj E. et al.	Static load (Uniaxial load)	To perform numerical and analytical analysis of SCF for a rectangular plate with discontinuities under static loading.
[27]	Liu K. et al.	Unidirectional stress and pure shear force	To identify the stress circulation around waist cutout on a plate based on MF.
[28]	Mahadik S. C.	Uniaxial load	To investigate SC in metal plates with bluntness and distinct shaped cutouts.
[29]	Patel P. et al.	Uniaxial tension and compression	To evaluate SCF for a plate with dissimilar position of the cutout.
[30]	Safaei B. et al.	Uniaxial tension load	To perform analysis for SC at the edge of cutout in plates by varying different cutout sizes.
[31]	Patel R. H. et al.	Uniaxial compression load	To analyze SCF in finite plate with diverse polygonal cutouts.
[32]	Mohsin I. et al.	Review Paper: Axial Load, In-Plane Bending (IPB), Out-of-Plane Bending (OPB), Combined Loads	The paper aimed to consolidate existing research on composite reinforcement of circular hollow section (CHS) joints to enhance their fatigue life. Specifically, it focused on understanding the role of stress concentration factors (SCFs) in composite-reinforced joints, identifying gaps in current knowledge, and proposing directions for future research.
[33]	Adnan R. et al.	Axial compression loading	To perform the multi-objective optimization of SCF for fatigue design of internal ring-reinforced KT-joints under brace axial compression loading
[34]	Shubhrata N. et al.	Review Paper: Uni-axial, Bi-axial, UDL, pure shear, bending moment, twisting moment	To carry out a critical review on stress concentration and its mitigation techniques in flat plate with singularities.
[34]	Yan D. et al.	Axial tension load, in-plane bending load	To investigate the stress concentration factors (SCFs) of SHS-CFSHS X-joints through experimental tests and finite element analysis (FEA) with the hot spot stress method serving as the analytical approach.

The effect of SC under unidirectional tension loading applied to a rectangular plate with various diameter cutout combinations has been examined by Devaraj E. et al. (2019). The stress distribution for normal cutout forms, such square, triangle, and circular, and in particular for the waist cutout on the infinite plate under unidirectional and bilateral loading circumstances, may be found analytically according to the methods developed by Liu K. et al. (2019).

In a study by Mahadik S. C. et al. (2020), the impact of unidirectional tension loading on the distribution and concentration factor of stress was assessed for a square plate with square, triangular, and elliptical cuts. Under axial tension and compression loading, Patel P. et al. (2021) assessed the SCF for a plate with a variable cutout position.

Using the Finite Element Method (FEM) methodology, Safaei B. et al. (2022) performed an analysis for SC at the cutout edge in plates under tensile loading by altering the cutout sizes. The SCF in a finite plate under unidirectional compression with different polygonal discontinuities was investigated by Patel R. H. et al. (2023) using FEM.

RESULTS AND DISCUSSION:

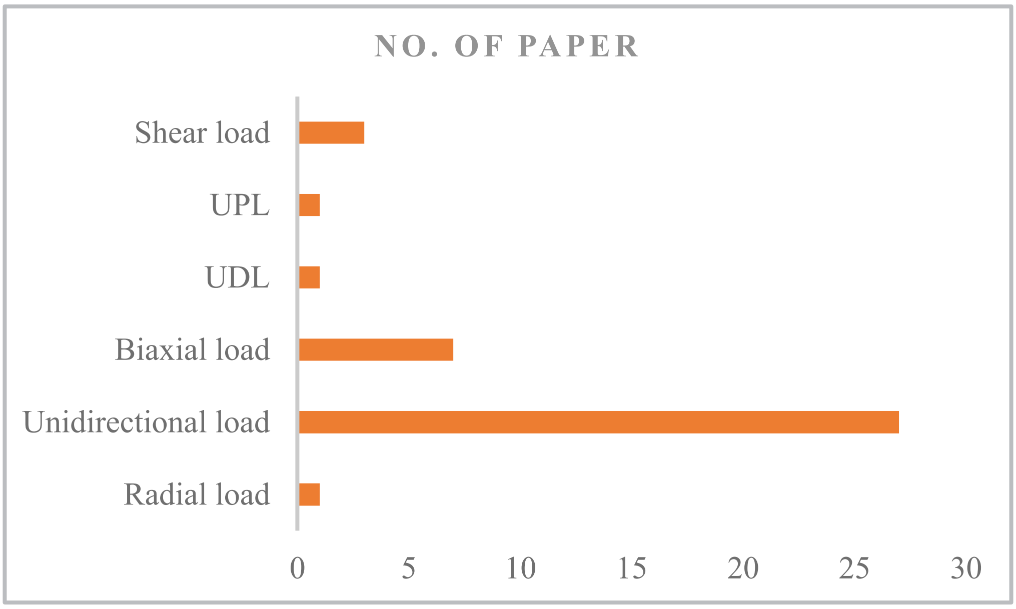


Figure 2. Number of papers considered various applied load

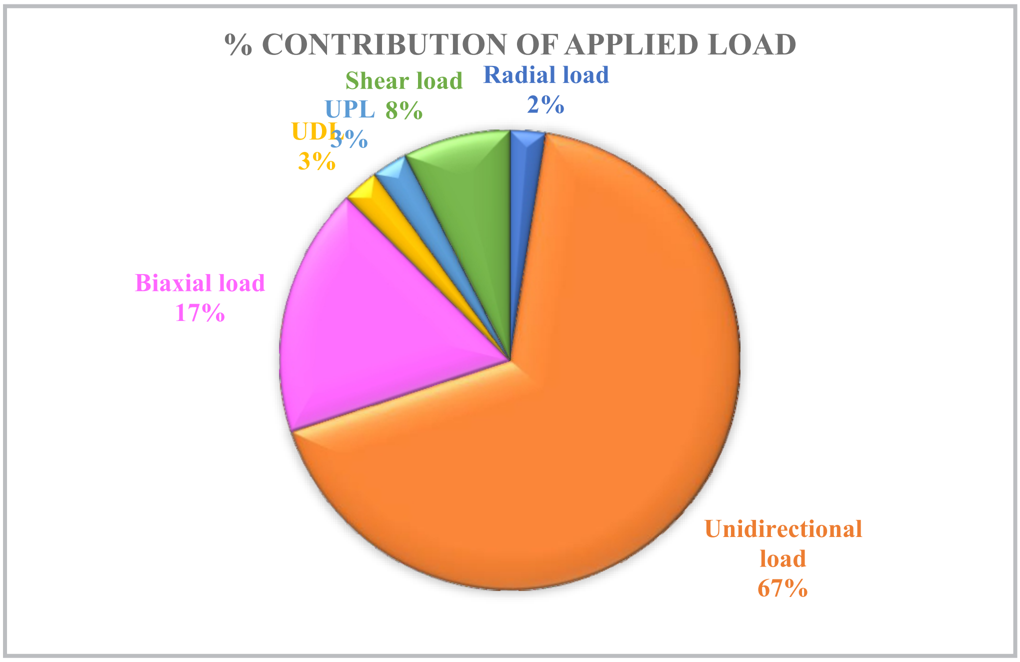


Figure 3. % Contribution of applied load within scope of reviewed research papers

The researchers have taken into account various types of loads in their study, as indicated by Figure 1, based on the problem that they have identified. One may think of the plate as infinite or finite in the problem statement.

The number of research papers taken into consideration in relation to the deliberate applied load is shown in Figure 2. The percentage contribution of applied load taken into account for the research article under consideration in this publication is displayed in Figure 3.

Additionally, it is projected that 67% of the attention will go toward unidirectional loads, 17% toward biaxial loads, 8% toward shear loads, 3% toward each of uniformly distributed load (UDL) and uniform pressure load (UPL), and 2% toward radial loads.

UDL and UPL are typically regarded as comparable. According to the literature review, the bulk of the work has taken into account the following: UDL (Kalita K., 2014), UPL (Makwana A. B. et al., 2014), shear loading (Sharma D. S., 2012), (Guan Y., 2018) (Liu K., 2019), uniaxial loading (tensile/compressive) (Kumar M. M. et. al, 2013), (Kadam M., 2014), (Makwana A. B. et al., 2014), (Kadam M. et al., 2015), (Jafari M., 2016), (Ozkan M. T., 2016), (Dongarwar P. D., 2016), (Sayyad S. M., 2017), (Yang Q. et al., 2017), (Fesharaki J. J. et al., 2017), (Roy A. et al., 2017), (Khechai A. et al., 2018), (Chawla K., 2018), (Khechai A. et al., 2018), (Devaraj E., 2019), (Liu K., 2019), (Mahadik S. C., 2020), (Patel P. et al., 2021), (Safaei B. et al., 2022), (Patel R. H., 2023), (Adnan R. et al. 2024), (Yan D. et al. 2024), biaxial loading (tensile/compressive) (Kadam M., 2014), (Makwana A. B. et al., 2014), (Kadam M. et al., 2015), (Sahu R., 2017), (Bakhshi N., 2019), (Liu K., 2019).

Additionally, it is discovered that SCF and stress distribution determined by researchers for different shaped cutouts within the finite and infinite plates under various loading conditions with the consideration of different parameters affecting on SCF.

CONCLUSIONS:

The following conclusions drawn based on the study conducted:

The study shows that the majorly of work carried out using the uniaxial or unidirectional tensile/compressive loading to evaluate the SC and SCF. In the context of the cited literature review in the current study, contribution percentage is roughly 67% for uniaxial loading and 17% for biaxial loading. This indicates that radial loading, UDL, UPL, and shear loading can all be taken into account in research projects as long as their respective contributions are less than 10%."

The consideration of load is depending on the kind of practical application and problem formulation to be considered for study (i.e. radial load, three-point load, unidirectional tensile/compressive load, biaxial tensile/compressive or combination of both, UDL, shear load etc.).

Variation in applied load does not affect the SCF. As per the definition of SCF it is the ratio of maximum and nominal stress. The maximum and nominal stress both are proportional to the applied load and therefore the variation in applied load will not effect on the SCF.

There is a scope to consider the combination of tensile and compressive load to evaluate the SCF as very limited cases reported the same within the scope of literature review referred. Also there is a scope to implement non-uniform tensile/compression load in uni-axial and bi-axial direction for a plate having different discontinuities to evaluate the SCF. Also one can consider the non-uniform cutouts for SCF study.

REFERENCES:

- Ashokan K., and K. Ramesh, 2009. An adaptive scanning scheme for effective cutout field stress separation in digital photoelasticity. Optics & Laser Technology, Elsevier, 41, pp. 25– 31.
- Woo Jinho and Won-Bae Na, 2011. Effect of cutout orientation on stress concentration of perforated plates with various cutouts and bluntness. International Journal of Ocean System Engineering, 1(2) pp. 95-101.
- DOI 10.5574/IJOSE.2011.1.2.095
- Sharma D. S., 2011. Stress Concentration Around Circular/Elliptical/Triangular Cutouts in Infinite Composite Plate. Proceedings of the World Congress on Engineering 2011, London, U.K. 3, ISBN: 978-988-19251-5-2.
- Sharma D. S., 2012. Stress distribution around polygonal cutouts. International Journal of Mechanical Sciences, Elsevier, 65, pp. 115–124.
- Kawadkar D. B. et al., 2012. Evaluation of stress concentration in plate with cutout and its experimental verification. International Journal of Engineering Research and Applications, 2 (5), pp.566-571.
- Kumar M. M. et. al, 2013. Study on the effect of stress concentration on cutout orientation of plates with various cutouts and bluntness. International Journal of Modern Engineering Research, 3 (3), pp. 1295-1303.
- Kalita K., 2014. Stress concentration mitigation in clamped steel plate. International Journal of Scientific World, 2 (1), pp. 21-26.
- DOI: 10.14419/ijsw.v2i1.2366.
- Kadam M., and Kulkarni V., 2014. Effect of Geometry of Opening on the Stress Concentration Factor for a Plate. International Conference on Design,

Manufacturing and Mechatronics, Pune, Maharashtra, India.

- https://www.researchgate.net/publication/319261149_Effect_of_Geometry_of_Opening_on_the_Stress_Concentration_Factor_for_a_Plate
- Watsar S. D., and Bharule A., 2015. Stress analysis of finite plate with special shaped cutout. International Journal of Scientific Engineering and Research, 3(4), pp. 145-150.
- Makwana A. B. et al., 2014. Stress analysis of functionally graded material plate with cutout. International Journal of Advanced Mechanical Engineering, 4(5), pp. 495-500.
- http://www.ripublication.com
- Kadam M. et al., 2015. Effect of loading conditions on the stress concentration factor for a plate. IOSR Journal of Mechanical and Civil Engineering, pp. 55-65.
- www.iosrjournals.org
- Jafari M., and Ardalani E., 2016. Stress concentration in finite metallic plates with regular cutouts. International Journal of Mechanical Sciences, Elsevier, 106(2016), pp. 220–230.
- http://dx.doi.org/10.1016/j.ijmecsci.2015.12.022
- Waldman W. and Heller M., 2015. Shape Optimization of Cutouts in Loaded Plates by Minimization of Multiple Stress Peaks. Ph. D. Thesis, Aerospace Division, Department of Defense, Defense Science and Technology Organization, Australian government, Published by Aerospace Division DSTO Defense Science and Technology Organization 506 Lorimer Street Fisherman’s Bend, Victoria 3207, Australia.
- Ozkan M. T. and Toktas I., 2016. Determination of the stress concentration factor (Kt) in a rectangular plate with a cutout under tensile stress using different methods. Fracture Mechanics and Modeling, 58(10), pp. 839-847. DOI 10.3139/120.110933
- Dongarwar P. D., and Khamankar S. D., 2026. The stress concentration effect of stress raiser presents in a tensioned plate with elliptical cutout by FEM and photo elasticity. International Research Journal of Engineering and Technology, 3(9), pp. 752-756.
- https://www.irjet.net/archives/V3/i9/IRJET-V3I9135.pdf
- Sayyad S. M., and Jagdish S. S., 2017. Exploration of the stress concentration in metallic plates with extraordinary cutout and bluntness. International Journal of Advanced Technology in Engineering and Science, 5(5), pp. 398-407.
- http://ijates.com/images/short_pdf/1494860836_C878ijates.pdf
- Yang Q. et al., 2017. Stress concentration analysis of an arbitrary shape cutout coated by a functionally graded layer. Symposium on Piezoelectricity, Acoustic Waves, and Device Applications, Chengdu, Sichuan, China, IEEE Xplore, pp. 293-297. DOI: 10.1109/SPAWDA.2017.8340343
- https://ieeexplore.ieee.org/document/8340343?denied=
- Sahu R., 2017. “Effect of stress concentration on various shaped cutout Having similar cross section area. International Journal of Advanced Research in Science and Engineering, 6(2), pp. 386-393.
- http://www.ijarse.com/images/fullpdf/1504680353_CIET_045.pdf
- Fesharaki J. J. et al., 2017. Stress concentration factor in a functionally graded material plate around a cutout”, Journal of Modern Processes in Manufacturing and Production, 6(1), pp. 69-81.
- https://journals.iau.ir/article_593974_8f9a1 119c22cb11df41803f3203f3062.pdf
- Roy A. et al., 2017. To study the effect of stress concentration factor on mild steel due to heat treatment. International Journal of Trend in Scientific Research and Development, 1(6), pp. 257-261.
- https://doi.org/10.31142/ijtsrd2506
- Khechai A. et al., 2018. Strength degradation and stress analysis of composite plates with circular, square and rectangular notches using digital image correlation. Composite Structures, Elsevier, 185, pp. 699-715.
- https://doi.org/10.1016/j.compstruct.2017.11.060
- https://www.sciencedirect.com/science/article/abs/pii/S0263822317321165
- Chawla K. and Ray-Chaudhuri S., 2018. Stress and strain concentration factors in orthotropic composites with cutout under uniaxial tension. Curved and Layer Structure. pp. 213–231.
- https://doi.org/10.1515/cls-2018-0016
- https://www.degruyter.com/document/doi/10.1515/cls-2018-0016/html?lang=en
- Khechai A. et al., 2018. Numerical analysis of stress concentration in isotropic and laminated plates with inclined elliptical cutouts. Journal of The Institution of Engineers (India): Series C, Springer. 100, pp. 511–522.
- https://doi.org/10.1007/s40032-018-0448-4
- https://link.springer.com/article/10.1007/s40032-018-0448-4
- Guan Y. and Li Y., 2018. Stress concentration and optimized analysis of an arbitrarily shaped cutout with

a graded layer under anti-plane shear. Applied Sciences, 8, 2619, pp. 1-13.

- doi:10.3390/app8122619
- Bakhshi N. and Taheri-Behrooz F., 2019. Length effect on the stress concentration factor of a perforated orthotropic composite plate under in-plane loading. Composite Materials and Engineering, 1(1), pp. 71-90.
- DOI: https://doi.org/10.12989/cme.2019.1.1.071
- http://www.techno-press.org/fulltext/j_cme/cme1_1/cme0101005.pdf
- Devaraj E., and Siyal P. S., 2019. Numerical and analytical analysis of SCF for a rectangular plate with discontinuities cutouts for static loading. International Journal of Scientific Research in Multidisciplinary Studies, 5(12), pp. 6-11.
- https://www.isroset.org/pdf_paper_view.php?paper_id=1646&2-IJSRMS-02851.pdf
- Liu K. and Wang Z., 2019. Stress distribution around waist cutout on finite plate based on mapping function. AIP Advances, 9, 075120, pp. 075120 - 075132.
- https://doi.org/10.1063/1.5106419
- Mahadik S. C. and Bhosle S. M., 2020. Investigation of the stress concentration in metallic plates with special shaped cutout and bluntness. International Journal of Mechanical and Production Engineering Research and Development, 10(3), pp. 13477-13488.
- http://www.tjprc.org/publishpapers/2-67-1600255915-IJMPERDJUN20201284.pdf
- Patel P. et al. 2021. Evaluation of stress concentration factor for a plate with different position of the cutout. International Journal of Creative Research Thoughts. 9(4), pp. 4042-4047.
- https://ijcrt.org/papers/IJCRT2104493.pdf
- Safaei B. et al., 2022. Analysis of stress concentration at the edge of cutout in plates with different widths by using FEM. IOP Conf. Series: Materials Science and Engineering, Civil Engineering Conference (CEC 2022), 1252 (2022) 012067.
- Doi: 10.1088/1757-899X/1252/1/012067
- Patel R. H. and Patel B. P. 2023. Analyzing stress concentration factor in finite plate with different polygonal discontinuities under uniaxial compression using FEM. Jurnal Kejuruteraan. 35(5), pp. 1033-1043.
- https://doi.org/10.17576/jkukm-2023-35(5)-05
- Mohsin I. et al. 2024. A systematic review of stress concentration factors (SCFs) in composite reinforced circular hollow section (CHS) joints. Composites Part C: Open Access, ELSEVIER, 15 (2024) 100515
- https://doi.org/10.1016/j.jcomc.2024.100515
- Adnan R. et al. 2024. Multi-Objective Optimization of Stress Concentration Factors for Fatigue Design of Internal Ring-Reinforced KT-Joints Undergoing Brace Axial Compression. Civil Engineering Journal. 10(06), pp. 1742-1764.
- http://dx.doi.org/10.28991/CEJ-2024-010-06-03
- Shubhrata N. et al. 2012. Stress Concentration and its Mitigation Techniques in Flat Plate with Singularities—A Critical Review. Engineering Journal, 16(1), pp. 1-16.
- DOI:10.4186/ej.2012.16.1.1
- Yan D. et al. 2024. Experimental and numerical investigations on stress concentration factors of concrete filled steel tube X-joints. Scientific Reports, 14:11415. https://doi.org/10.1038/s41598-024-62312-8.

