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FEM for Stress Reduction by Optimal Auxiliary Holes in a Loaded Plate with Elliptical Hole

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Abstract : Steel is widely used in machine parts, structural equipment and many other applications. In many steel structural elements, holes of different shapes and orientations are made with a view to satisfy the design requirements. The presence of holes in steel elements creates stress concentration, which eventually reduce the mechanical strength of the structure. Therefore, it is of great importance to investigate the state of stress around the holes for the safety and properties design of such elements. By literature survey, it is known that till date, there is no analytical solution to reduce the stress concentration by providing auxiliary holes at a definite location and radii in a steel plate. The numerical method can be used to determine the optimum location and radii of auxiliary holes. In the present work plate with an elliptical hole, for a steel material subjected to uniaxial load is analyzed and the effect of stress concentration is graphically represented .The introduction of auxiliary holes at a optimum location and radii with its effect on stress concentration is also represented graphically. The finite element analysis package ANSYS 11.0 is used to analyse the steel plate. The analysis is carried out using a plane 42 element. Further the ANSYS optimization model is used to determine the location and radii for optimum values of auxiliary hole to reduce stress concentration. All the results for different diameter to plate width ratio are presented graphically. The results of this study are in the form of the graphs for determining the locations and diameter of optimal auxiliary holes. The graph of stress concentration v/s central hole diameter to plate width ratio. The Finite Elements results of the study indicates that the stress concentration effect of central elliptical hole in an uniaxial loaded plate can be reduced by introducing auxiliary holes on either side of the central circular hole.

Keywords : finite element method, optimization, stress concentration factor, auxiliary holes
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