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Comparative analysis of Rectangular Plate by Finite element method and Finite Difference Method

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***Abstract:** Plates are commonly used to support lateral or vertical loads. Before the design of such a plate, analysis is performed to check the stability of plate for the proposed load. There are several methods for this analysis. In this research, a comparative analysis of rectangular plate is done between Finite Element Method (FEM) and Finite Difference Method (FDM). The plate is considered to be subjected to an arbitrary transverse uniformly distributed loading and is considered to be clamped at the two opposite edges and free at the other two edges. The Finite Element Method (FEM) is a numerical technique for finding approximate solutions to boundary value problems for partial differential equations. It is also referred to as finite element analysis (FEA). FEM subdivides a large problem into smaller, simpler, parts, called finite elements. The work covers the determination of displacement components at different points of the plate and checking the result by software (STAAD.Pro) analysis. The ordinary Finite Difference Method (FDM) is used to solve the governing differential equation of the plate deflection. The proposed methods can be easily programmed to readily apply on a plate problem. Keywords: Arbitrary, FEM, FDM, boundary.*

I. INTRODUCTION

Recent construction practices are demanding more advance analysis methods to analyze various distinct structural elements. The study is done by analyzing plate element with different mesh-strip interval size using finite element method and finite difference method for clamped boundary condition.

Finite element method is a popular computer aided numerical method based on the discretisation of the domain, structure or continuum into number of elements and obtaining the solution. Values inside finite elements can be recovered using nodal values. In this paper, the behaviour of plate subjected to different loading condition with various boundary conditions is studied. The finite difference method has emerged as a powerful tool of structural analysis. The method is economical and competitive with the well known Finite Element Method.

It is an approximate method and basic approximation involves replacement of continuous domain by a pattern of discrete points within the domain. In mathematical approach the continuous formulation is reduced to discrete formulation by simply replacing derivatives with infinite difference approximation.

In short differential equation is converted into difference equation. Thus the idea behind this method is to replace the governing differential equation and the equations defining boundary conditions by corresponding finite difference quantities as some selected points.

II. LITERATURE DETAILS

In the study determined design and analysis of Rectangular plate for stress relief. The sudden change in stress flow lines increases the stress to a significant level. With the gradual change in gradient of flow lines stress relief can be observed. The rise in the stress concentration factor reaches to its maximum value 3 at the periphery of central circular hole. The maximum SCF value can be reduced either by material removal at the vicinity or by shape optimization or by strengthening the hole by inclusion of additional stronger material. Material removal by inclusion of auxiliary holes will be beneficial if the distance between the holes and its diameter is optimum.

The material removal method will be more feasible in infinite plates due to the availability of sufficient space around the central circular hole. Modal analysis of orthotropic thin rectangular plate to determine its natural frequencies and mode shapes by using analytical method based on Rayleigh-Ritz energy approach. In case of rectangular structures, rectangular patch gives the maximum reduction level in frequency compared with square and circular patches.

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III. METHODOLOGY

Proposed research work is carried out in following manner.

There are three phases as shown below.
This report includes Phase-1, Phase-2 and Phase-3.

A. Phase 1
1) Basic study of structure & methods of analysis
2) Detail study of Finite Element Method
3) Detail Study of Finite Difference Method

B. Phase 2
1) Verification Problem
2) FEM-- Computational analysis for below cases using STAAD Pro.
3) Mesh density
a) 4x4
b) 8x8
c) 16x16

C. Phase 3
1) To solve above cases with change in width size using Finite Difference method
2) Observations
3) Comparison
4) Conclusion
5) Future scope

IV. CONCLUSION

From the results obtained for considered plate element using Finite Element Method and Finite Difference Method, it can be concluded that With change in mesh density, the displacement results obtained for various cases solved that is for 4 x 4, 8 x 8 & 16 x 16 size, the values changes making displacement profile curve smooth and sharp. Similarly, when the cases are considered for Finite Difference method with change in mesh size, it can be seen that the values of displacement changes to some extent making the displacement profile sharp.

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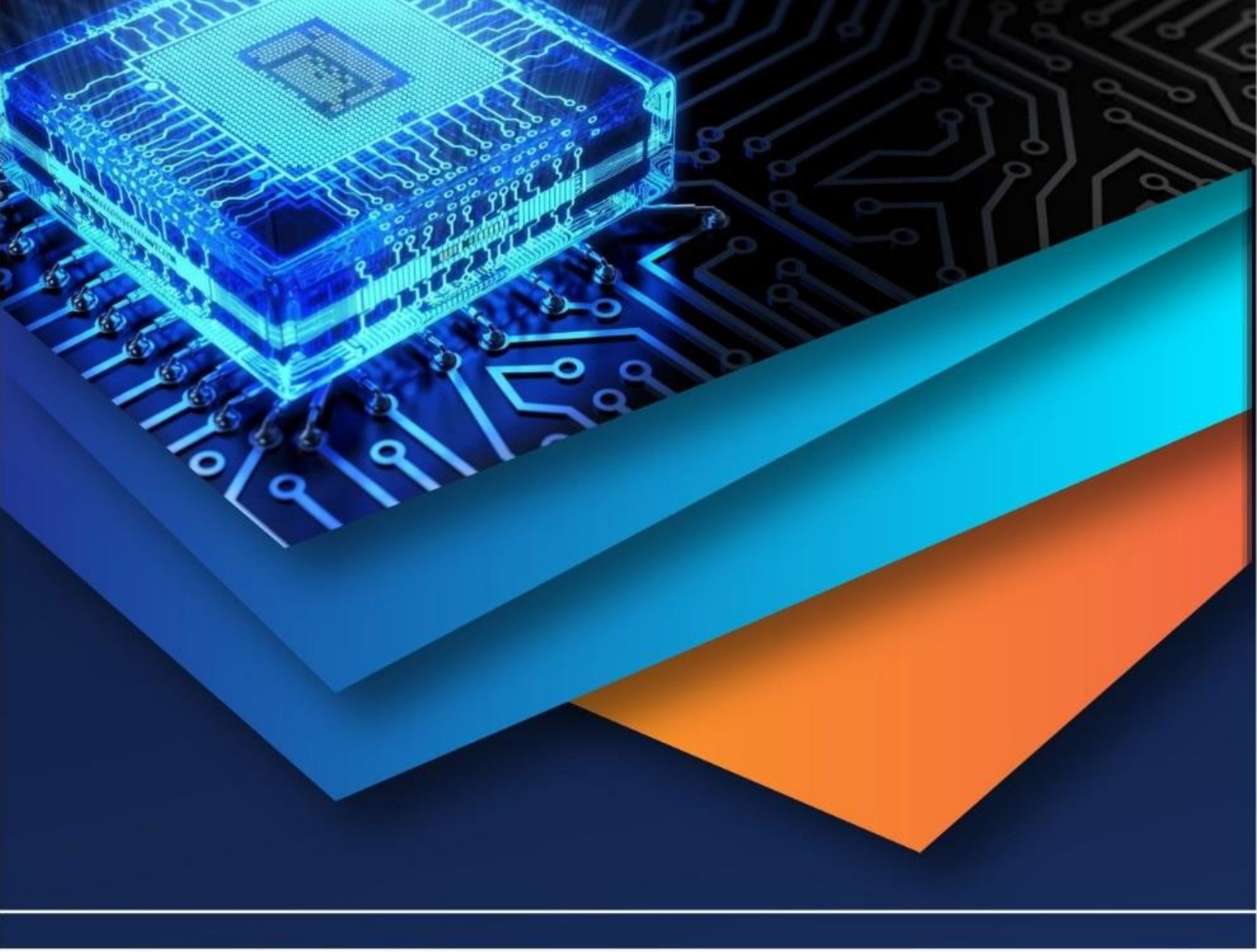

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