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EFFECT OF SHAPE AND SIZE IN FEM ANALYSIS FOR PLATE ELEMENT

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Abstract: It is important to make structure safe and secure for inhabitants till its useful life. Being part of construction designing it becomes utmost important to design structure safe and stable. The core of it is in perfect analysis of structure. Out of various such analysis of structure one such is Finite Element Method. In finite element models, element size is a critical issue which closely relates to the accuracy of the finite element models while directly determines their complexity level. Thus, a primary problem in creating finite element model is to choose appropriate element size which can yield correct simulation results while reduce the model's complexity as much as possible. This paper presents a systematic study on finding the effects of finite element size on the accuracy of numerical analysis results ,based on which brief guidelines of choosing the best element size in finite element modeling are provided. Static, modal, and impact analysis are involved in this study to discuss the effects of element size in numerical analysis.

Keywords: Element size, mesh density

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INTRODUCTION

In finite element method of analysis (FEM), the accuracy of the FEM results and requested computing time are determined by the finite element size (mesh density). According to FEM theory, the FE models with fine mesh (small element size) yield to highly accurate results but may take longer computing time. On the contrary, those FE models with coarse mesh (large element size) may lead to less accurate results but do save more computing time. Also, small element size will increase the FE model's complexity which is only used when high accuracy is required. Large element size, however, will reduce the FE model's size and is extensively used in simplified models in order for providing a quick and rough estimation of designs. Due to its importance, in generating FE models, the foremost problem is to choose appropriate elements size so that the created models will yield accurate FEM of analysis.

Literature Review-:

Padmakar Raut(1) This study compares the performance of linear and quadratic tetrahedral elements and hexahedral elements in various structural problems. The problems selected demonstrate The advantages and disadvantages are shown using tetrahedral and hexahedral elements. Some recommendations and general rules are given for finite element users in choosing the element shape similarly , Yaning Li and Tomasz Wierzbicki(2)It is found that the stress and strain fields have high gradients in the localization zone and the continuing application of the classical stress-strain relation in the localization zone is the cause for mesh size effects in Finite Element (FE) simulations. An equivalent element model is developed to calibrate the non-local stress-strain re lation for different mesh sizes. An example of how the mesh size effects can be reduced by using the mesh-size-dependent non-local stress-strain is shown.

Michael Lee(3) This paper attempts to provide a viable method to establish the correlation between the deflection and stress results of a shaped (distorted) plate analyzed as a thin shell when compared to the original (flat) thin plate analytical solution. This paper analyzes an elastic loading of plates with different shapes which are obtained from the loading of the previous (plate) iteration with less deflection. Shasshikant T. More, Prof. S. Bindu (4) Different components and structures having different nature of in nature, hence designs need to be verified by finite element analysis to cross-check strength. Presently static analysis is performed with design codes and standard. This paper intends to optimize design of bogie structure subjected to multi-axial loading, by performing fatigue analysis. Ansys is used to perform finite element analysis. Similalry, Jinho Woo & Won-Bae Na (5) The main objective of this paper is for stress analysis of finite plate with special shaped cut out for stress distribution and Stress Concentration Factor (SCF). An Experimental investigation is taken to study the stress analysis of plate with special shaped cut out. The results based on Experimental analysis are compared with result obtained using finite element analysis (FEA). M. Brocca and Z.P. Bazant, **(6)** The paper presents a finite-element study of the size effect of compressive failure of geometrically similar concrete columns of different sizes. The test columns considered hereare reduced-scale specimens made with micro-concrete of maximum aggregate size 3.35 mm and are loaded eccentrically. The analysis employs the microplane model for concrete. It is based on the crack-band concept and is shown to capture with good approximation the size effect observed experimentally.

Detailed Study-

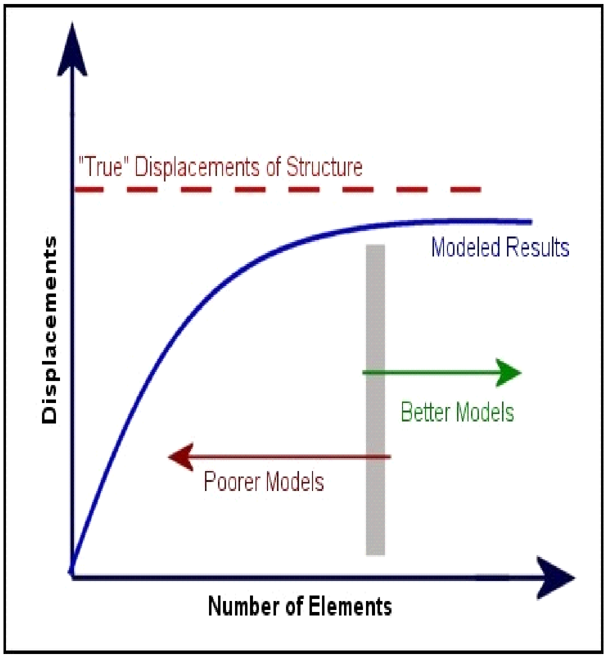
Classification of Structure:-Skeletal structures or discrete element;- skeletal structures are those which are formed by joining discrete structural elements at their ends forming joints. Each member may be straight or curved & it's sectional dimensions. Continuum structure;- These structures include structures formed frame surface elements like flats, slabs, carved shell element & solids. Such structures do not have distinct joints.

Conditions of Structural analysis:- Both for skeletal structure & continuum structure & for method of analysis the solution must satisfy following three conditions:- **1.**Equilibrium of forces. **2** Compatibility of displacements. **3.** Force displacement relation as specified by elastic properties.

Types of Finite Element- Though there are different types of elements with various shapes, elements in FEA are generally grouped into one 1D element, 2D elements, and 3D elements. They are recognized based on their shapes. For example, elements can take on the form of a straight line or curve, triangle or quadrilateral, tetrahedral and many more. The simplest element is a line made of two nodes. All line elements, whether straight or curved, are called 1D element . Examples of 1D element are truss element and beam element. 2D elements are surface elements with triangle or quadrilateral as their basic shapes 13,. Examples of 2D elements are 3-node triangular element and 6-node triangular element. These surface elements can have either regular or irregular shapes shown in Fig -1. 2D elements are plane elements. They are often used to solve 2D elasticity problems. 3D elements are usually used to mesh volumes. They are derived from 2D elements and are used when the volume of the structure cannot be neglected. Generally 3D elements have quadrilateral or hexagonal shape. Examples of 3D solid elements are 4-node tetrahedral element, 10-node tetrahedral element, 8-node isoparametric element, etc.

Methods of Analysis. 1. Classical Method. **2** Numerical Method.

OPTIMISING PLATE ELEMENTS:- The following picture shows what happens as "refine" the model by using smaller elements. The goal is to get into the "flat area" for the model.



LOAD VECTOR:-

Plates may be loaded with a perpendicular pressure or a thermal change. Pressures and thermal gradient load were cause bending in the plate, and are only for 3D models and the plane grid.

PRESSURE LOADS-

Plate pressure loads act only in the local z-axis, or perpendicular to the plate. these loads may be uniform, linear or warped

MESH LINEAR-

By applying a linear load to an entire mesh of plates, where the load is defined based on global positions and the directions and the individual pressure on each element are calculated automatically.

THERMAL LOADS-

Plate elements may also resist thermal loads. Currently both a temperature change load and a temperature gradient load may be applied. The temperature change load acts uniformly through the thickness in all directions.

CONCLUSION:

Out of various literatures reviewed and study done related to methods of analysis static and dynamic methods, it is clear that for mega or big structures computational analysis becomes unavoidable. Since, the method of conversion from infinite to finite structures is part of finite element method, the knowledge of FEM is important as well as the results of analysis seems to be satisfactory as compared to classical methods. However, the convergence depends upon the selection of size and shape of mesh elements. Further study will be focused on convergence criteria in finite element method and result outputs will be projected as per analysis results for comparision.

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