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DESIGN AND ANALYSIS OF CANTILEVER BEAM

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ABSTRACT

A long, thin cantilever beam with a uniform rectangular cross-section and homogenous, isotropic linear elastic material characteristics is the object of this investigation into deflection and stress distribution. Cantilever beam deflection is fundamentally a three-dimensional issue. There is a compression in the opposite direction to every elastic stretch in the same direction.Stress, strain, and deformation may be found via the use of static and modal analysis in this project. throughout the design phase of a structural or machine component's vibration properties, including its inherent frequencies and mode shapes. As a result, it has emerged as a go-to method for explaining and controlling a wide variety of vibration phenomena seen in the real world.Using the same I, C, and T cross-sectional beams, we examined the stress and natural frequency for various materials in this study. We use ANSYS for both the design and analysis of the cantilever beam. The natural frequency, mode forms, and deflection of a cantilever beam made of various sections and materials may be obtained by vibrating the beam, which is fixed at one end.

Key words: Finite element analysis, cantilever beam,static and model analysis.

1INTRODUCTION

A cantilever is a structural member—beam, plate, etc.—that is supported at one end solely by another, often a vertical one. Alternatively, cantilevers may be built using slabs or trusses. The moment and shear stresses act upon the cantilever as it transfers the structural load to the support.Unlike a simply supported beam in a post and lintel system or a building supported at both ends with loads applied between the supports, cantilever architecture allows overhanging structures to be built without external bracing.Use CasesThe skyscrapers, bridges, and buildingsCantilever bridges and balconies (sometimes called corbels) are two of the most common examples of cantilevers used in building. It is common practice to construct cantilevers in pairs for use in cantilever bridges; each pair supports a single end of the center section. Cantilever truss bridges are exemplified by the Forth Bridge in Scotland. An example of a cantilever in a structure with a more conventional wood frame is the jetty. or forebay. In the southern United States a historic barn type is the cantilever barn of log construction.Temporary cantilevers are often used in construction. The partially constructed structure creates a cantilever, but the completed structure does not act asa cantilever. This is very helpful when temporarysupports, or falsework, cannot be used to support the structure while it is being built (e.g., over a busy roadway or river, or in a deep valley).

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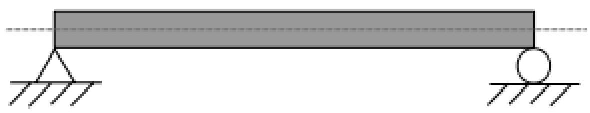
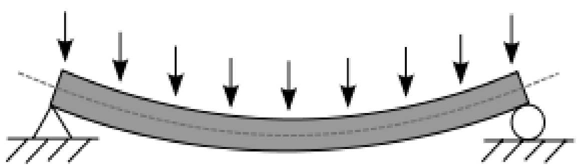
So some truss arch bridges (see Navajo Bridge) are built from each side as cantilevers until the spans reach each other and are then jacked apart to stress them in compression before final joining. Nearly all cable- stayed bridges are built using cantilevers as this is one of their chief advantages. Many box girder bridges are built segmentally, or in short pieces. This type of construction lends itself well to balanced cantilever construction where the bridge is built in both directions from a single support. Does not require a support on the opposite side (probably the main reason you would ever have a cantilever





beam).Creates a negative bending moment, which can help to counteract a positive bending moment created elsewhere. This is particular helpful in cantileverswith a backspan where a uniform load on the backspan creates positive bending, but a uniform loadon the cantilever creates negative bending.

Disadvantages

- Large deflections
- Generally results in larger moments
- You either need to have a fixed support, or have a backspan and check for uplift of the far support.

LITERATURE REVIEW

MODELLING, SIMULATION AND ANALYSIS OF CANTILEVER BEAM OF DIFFERENT MATERIAL BY FINITE ELEMENT METHOD, ANSYS

The dynamic analysis of a beam with multiple degree of freedom (MDOF) are studied in this paper. Due to the destructive effects of vibration inmachines and structures due to resonance. In multiple degree of freedom system, there are n natural frequencies and the concept of resonance iscomplicated by the effect of mode shapes. In the present work cantilever beam of different materialsand dimensions is considered for the dynamic analysis of free vibration at no load condition as well as comparison between materials. The modelling, simulation and analysis of cantilever beam is done by using ANSYS and theoretically by finite element method (FEM) for the evaluation of natural frequency and mode shape.

3. PROBLEM DESCRIPTION:

The objective of this project is to make a 3D modelof the cantilever beam and study the static and model behavior of the cantilever beam by performing the finite element analysis. 3D modeling software (PRO- Engineer) was used for designing and analysis

A statically determinate beam, bending (sagging) under a uniformly distributed load

ADVANTAGES AND DISADVANTAGES

Advantages

software (ANSYS) was used for static and modal analysis.

The methodology followed in the project is asfollows:

- Create a 3D model of the cantilever beam assembly using parametric software pro- engineer.
- Convert the surface model into Para solid file and import the model into ANSYS todo analysis.
- Perform static analysis on the cantileverbeam.
- Perform model analysis on the existing model of the cantilever

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beam.

4. INTRODUCTION TO CAD/CAE:

Computer-aided design (**CAD**), also known as **computer-aided design and drafting** (**CADD**), isthe use of computer technology for the process of design and design-documentation.

4.1. INTRODUCTION TO CATIA

CATIA (an acronym of computer-aided three- dimensional interactive application) is a multi- platform software suite for computer-aided design (CAD), computer-aided manufacturing (CAM), computer-aided engineering (CAE), PLM and 3D,developed by the French company Dassault Systems.

CATIA started as an in-house development in 1977 by French aircraft manufacturer AVIONS MARCEL DASSAULT, at that time customer of the CADAM software to develop Dassault's Mirage fighter jet. It was later adopted by the aerospace, automotive, shipbuilding, and other industries.

Initially named CATI (conception assistée tridimensionnelle interactive – French for interactive aided three-dimensional design), it was renamed CATIA in 1981 when Dassault created a subsidiary to develop and sell the software and signed a non- exclusive distribution agreement with IBM.

4.2. INTRODUCTION TO FINITE ELEMENT METHOD:

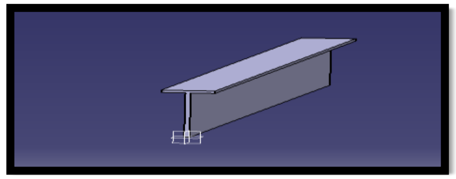
Finite Element Method (FEM) is also called as Finite Element Analysis (FEA). Finite Element Method is abasic analysis technique for resolving and substituting complicated problems by simpler ones, obtaining approximate solutions Finite element method being a flexible tool is used in various industries to solve several practical engineeringproblems. In finite element method it is feasible to generate the relative results.

5. RESULTS AND DISCUSSIONS:

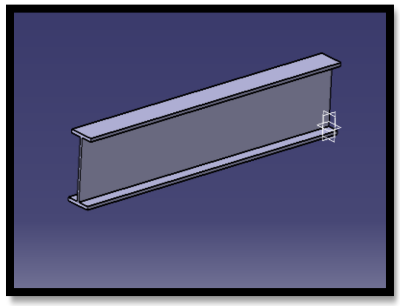
5.1. Models of cantilever beam using pro-e wildfire 5.0: The cantilever beam is modeled using the given specifications and design formula from databook. The cantilever beam outer casing body profile is sketched in sketcher and then it is extruded using extrude option.

Cantilever beam 3D

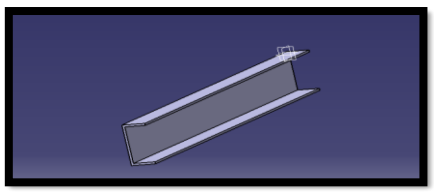
modelI-Section

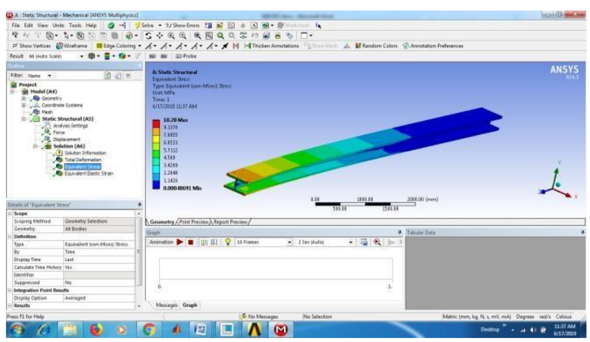


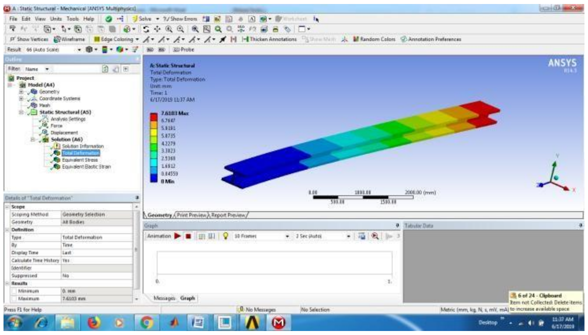
C-Section



T-Section

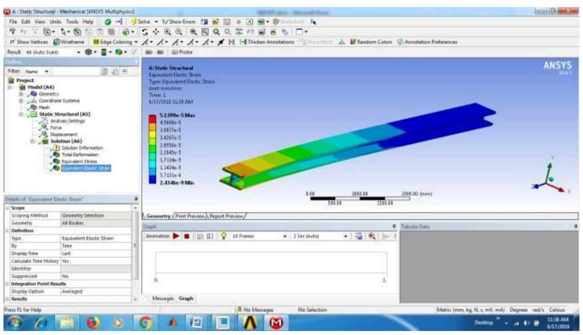






According to the above contour plot, the maximum stress is at the fixed the fixed end because we are applying the loads at the free end.

STRAIN



According to the above contour plot, the maximumstrain occurs at the fixed end of the beam i

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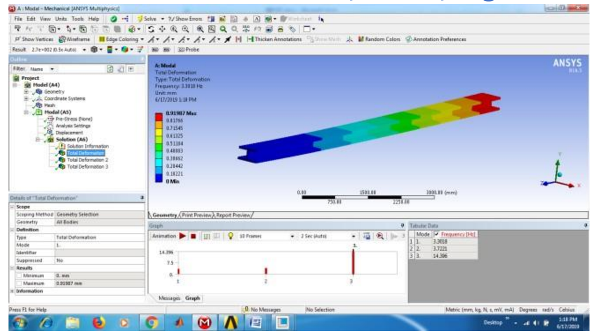
5.3 MODAL ANALYSIS OFCANTILEVERBEAM

Material-Steel

Total Deformation-1



Total deformation-2STRUCTURAL ANALYSIS OF CANTILEVER BEAM

MATERIAL-Steel

Deformation

According to the above contour plot, the deformation is maximum at the free end of the beam and the deformation is minimum at the fixed end. At thiscondition the maximum deformation of the beam is

STRESS

7. CONCLUSION

Using the same I, C, and T cross-sectional beams, we examined the stress and natural frequency for various materials in this study. We use ANSYS for both the design and analysis of the cantilever beam. The natural frequency, mode forms, and deflection with various sections and materials are obtained by vibrating the cantilever beam, which is fixed at one end.Static study shows that when using cast iron as the material for the I-section cantilever beam, deformation and stress values are lower than when using steel or stainless steel. Modal analysis shows that I-section cantilever beams have lower deformation and frequency values than T-section ones.Therefore, it is clear that cast iron is the superior material for the cantilever beam in this type I-section diagram.

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