

---

# Stresses in Beams

## Mini Project 1

**ME321: Mechanics of Deformable Bodies**

---

---

# Objective

A point load or a distributed load is applied on a straight beam with arbitrary cross section. We aim to determine the stress distribution on a cross section at a user-specified location of the straight beam. Note that the bending can be symmetric as well as unsymmetric.

---

---

# Tasks

- To determine what inputs should be given to the program/code to carry out the aforementioned task.
  - To determine the type of loading scenario and cross section of the straight beam from the inputs.
  - To determine the bending moment diagram and shear force diagram for the given inputs.
  - To determine whether the bending in the beam is symmetric or unsymmetric.
  - To determine the stress distribution and deformations on the cross section at a particular location of the beam using the related relations derived in the lectures for Symmetric as well as Unsymmetric Bending.
-

---

# Roles

- **Coding:** Emphasis would be given in developing a back end program for implementing the aforementioned task. The task would be accomplished for point loads and distributed loads scenario with straight beams of common cross sections including both Symmetric as well as Unsymmetric Bending cases.
  - **Visualization:** Work primarily involves pre and post processing. Aim is to implement a user friendly interface to ensure reliability at key execution points. It includes identification of applicable cases into classes to smoothen user input method, displaying schematic for proper visualisation of a given problem statement/case and presenting gathered output through appropriate graphs.
  - **Validation:** The task would be to test the base code for various possible cases. It includes classification of cases in different class of problems according to type of loading or given boundary condition. For each case, we need to check which components of stresses are nonzero and validate its magnitude. In addition, we also need to validate the same for different geometries and materials.
  - **Documentation:** The aim is to create an in depth but easy to interpret documentation on stresses in beams. The documentation will include the theoretical propositions before moving on to the practical implementation of the problem. It would also comprise of a user's guide to the code thereby ensuring a holistic compilation of the subject.
-

# Timeline

---

- **Week 1 (14-21 October):**
    - To develop a code which would implement task for cross sections with common geometries in case of Symmetric Bending.
    - Identification of plausible cases followed by division into classes.
    - To learn and gain familiarity with key visualization tools such as MATLAB GUIDE
    - To finish documentation of basic theoretical knowledge of the topic.
  - **Week 2 (21- 28 October):**
    - To upgrade the code such that it can implement the aforementioned task for cross sections whose Second Moment of Inertias are a result of combination of Second Moment of Inertias of common cross sections in case of Symmetric Bending.
    - Perform test and validate outputs for different cases in above mentioned cross-sections.
    - To set up an interface for accepting raw user inputs along with a post-processing window for showing gathered output
    - To start work on creating a user manual for the code
  - **Week 3 (28 October- 4 November):**
    - To upgrade the code such that it can implement task for common and combination of cross sections in case of unsymmetric bending.
    - Perform test and validate outputs for different cases in above mentioned cross-sections.
    - To search for implementation errors in the visualization section and improve it accordingly.
    - To append the visualizations developed to the document
  - **Week 4 (4- 11 November):**
    - To upgrade the code such that it can implement task for arbitrary cross section in case of symmetric as well as unsymmetric bending.
    - Final debugging of visualization tab.
    - Appending the validations performed and finalizing the document
-

---

# Deliverables

At the end of this project we aim to achieve 2 major milestones

- To come up with a document which provides a comprehensive knowledge of the topic.
  - An intuitive software program that pictorially represents various loading scenarios and can be used to better understand the topic. It can also be used to verify the solutions to problems pertaining to stresses in beams.
-

---

# Clarifications

- Regarding arbitrary cross section of beam; initially we aim to get the validated results only for common cross sections. Thereafter we aim to get validated results for cross sections whose Area Moment of Inertia can be determined from the Area Moment of Inertias of common cross sections. Thereafter we aim to get validated results for an arbitrary cross section.
  - Depending on instructor's consent, we might not be able to implement the task for some of the above mentioned cross sections.
  - Coming to Visualization part, primary objective is to at least come up with a good input and post processing window. We do aim to prepare an interactive GUI having various options available to user for setting up his problem statement (type of loading, cross-section type , boundary conditions). In a limited time frame, we may be unable to implement the same.
-

---

# Thank You!

Team:

Meet Gandhi	15110049
Darshan Patel	15110083
Rajat Ranjan	15110098
Saksham Singal	15110112

