MET-2200: STRENGTH OF MATERIALS

Cuyahoga Community College

Viewing: MET-2200 : Strength of Materials

Board of Trustees:

January 2023

Academic Term:

Fall 2023

Subject Code

MET - Mech Eng/Manuf Ind Eng Tech

Course Number:

2200

Title:

Strength of Materials

Catalog Description:

Study of stress, strain and deformation of mechanical bodies due to static tensile, compressive, torsional, bending and combined loading. Deflection of beams and columns, design of beam for strength and structural connections.

Credit Hour(s):

3

Lecture Hour(s):

2

Lab Hour(s):

2

Other Hour(s):

0

Requisites

Prerequisite and Corequisite

MET-1601 Technical Statics.

Outcomes

Course Outcome(s):

Determine the effects of forces on objects made from real materials.

Essential Learning Outcome Mapping:

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Determine internal reactions in objects-axial forces, shear forces, and bending moments caused by external loads.
2. Compute the normal and shear stresses developed by these internal reactions.

Course Outcome(s):

Assess the deformation of materials due to axial stress and correlate this deformation to material properties.

Essential Learning Outcome Mapping:

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Describe a typical tension test and explain the resulting stress-strain curve.
2. Identify where modifications are required to account for fatigue effects and stress concentrations.

Course Outcome(s):

Determine stresses and deformation in objects that are loaded with torsional loads.

Objective(s):

1. Define the material property known as modulus of rigidity.
2. Compute the shearing stresses and deformations in solid and hollow circular shafts that carry torsional loads.

Course Outcome(s):

Calculate shear forces and bending moments in beams.

Objective(s):

1. Construct shear and moment diagrams.
2. Determine magnitude and locations for maximum values of internal force and moment existing in a beam.

Course Outcome(s):

Evaluate the nature of stresses in beams and design wood and steel beams.

Objective(s):

1. Design wood and steel beams by selecting appropriate members to carry certain loads without exceeding the allowable stresses.
2. Analyze tabulated values to analyze the forces carried by a typical residence, and specify appropriate dimensions and placement of various structural elements.
3. Analyze existing wood and steel beams to determine maximum values of bending stress and horizontal shearing stress caused by external loads.

Course Outcome(s):

Apply superposition techniques to compute deflections for beams.

Objective(s):

1. Identify methods of superposition.
2. Calculate Maximum Moment, Maximum Defections, and Slope at End for concentrated load at the free end of cantilever beam.
3. Calculate Maximum Moment, Maximum Defections, and Slope at End for concentrated load at any point on the span of cantilever beam.
4. Calculate Maximum Moment, Maximum Defections, and Slope at End for uniformly distributed load over the entire length of cantilever beam.
5. Calculate Maximum Moment, Maximum Defections, and Slope at End for triangular load, full at the fixed end and zero at the free end, of cantilever beam.
6. Calculate Maximum Moment, Maximum Defections, and Slope at End for moment load at the free end of cantilever beam.
7. Calculate Maximum Moment, Maximum Defections, and Slope at End for concentrated load at the mid-span of simple beam.
8. Calculate Maximum Moment, Maximum Defections, and Slope at End for uniformly distributed load over the entire span of simple beam.

Course Outcome(s):

Determine combined stresses.

Objective(s):

1. Group stresses by type, separating the stresses into bending and axial versus shear and torsional stresses.
2. Combine like types of stresses in an appropriate manner.
3. Combine different types of stresses, using appropriate combined stress theories.
4. Gain further understanding into how these combined stresses should be compared to the stress allowable for the materials being used in the design.

Course Outcome(s):

Analyze and design columns for structures and machine components.

Essential Learning Outcome Mapping:

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Calculate using the Euler column formula to analyze and design columns.
2. Apply empirical column formulas to design columns.

Methods of Evaluation:

a. Tests
b. Homework assignments
c. Evaluation of laboratory reports
d. Final examination

Course Content Outline:

a. Internal reactions: stress for axial loads
    i. Stress in an axially loaded member.
    ii. Average shear stress.
    iii. Bearing stress
    iv. Allowable stress, factor of safety.
b. Strain for axial loads: Hooke's law
    i. Axial strain.
    ii. The tension test and stress – strain diagram.
    iii. Axially loaded members.
    iv. Poisson's ratio.
    v. Thermal stresses.
c. Shear stresses and strains
    i. Hooke's law for shear.
    ii. Deformations and stress in a circular shaft.
    iii. Torsion test.
    iv. Power transmission
d. Shear forces and bending moments in beams
    i. Types of beams
    ii. Beam reactions
    iii. Shear force and bending moment diagrams
e. Bending and shear stresses in beams
    i. Distribution of bending stress.
    ii. Bending stress formula: flexure formula
    iii. Design of beams for strength.
    iv. Residential design using tabulated values.
f. Deflection of beams due to bending
g. Combined stresses
h. Columns
    i. Euler column formula.
    ii. Empirical column formulas for column design.

Resources

Morrow, H.W. and Robert Kokernak. *Statics and Strength of Materials.* 7th Ed. Upper Saddle River, NJ., 2010.

Onouye, Barry. *Statics and Strength of Materials:Foundations for Structural Design.* Upper Saddle River, NJ., 2005.

Hibbeler, Russell. *Mechanics of Materials*. 11th. Ed. Upper Saddle River, NJ., 2022.

Limbrunner, George F. *Applied Statics and Strenth of Materials.* 6th ed. 2015.

Elsevier, B. V. "Materials Today" Monthly. 2007-11-01 00:00:00.0.

Elsevier, B. V. "Materials Design" Monthly. 2007-11-01 00:00:00.0.

Resources Other

a. Materials Today. https://www.materialstoday.com/ Elsevier. 2018.
b. Korsunsky, Alexander, ed. Materials and Design. https://www.journals.elsevier.com/materials-and-design/ Elsevier. 2018.
c. Handouts, laboratory assignments.
d. Scientific calculator.

Instructional Services

OAN Number:
Transfer Assurance Guide OET008

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