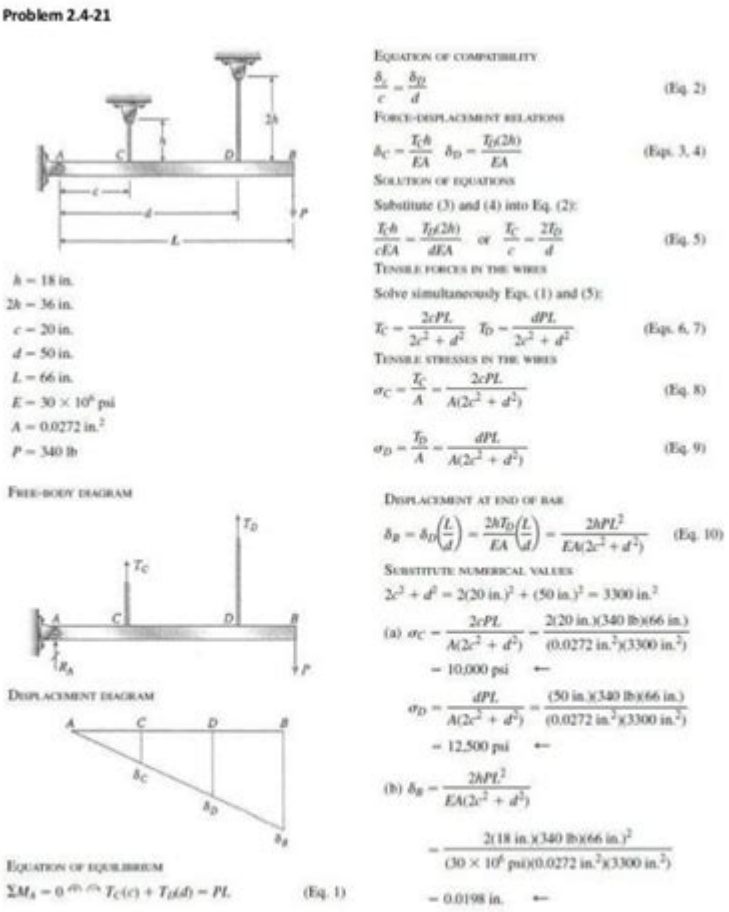
Mechanics Of Materials 9th Edition Solutions



Problem 2.4-21

$h = 18$ in.
$2h = 36$ in.
$c = 20$ in.
$d = 50$ in.
$L = 66$ in.
$E = 30 \times 10^6$ psi
$A = 0.0272$ in.^{2}
$P = 340$ lb

FREE-BODY DIAGRAM

DISPLACEMENT DIAGRAM

EQUATION OF EQUILIBRIUM

$$\Sigma M_A = 0 \quad T_C(c) + T_D(d) = PL \qquad \text{(Eq. 1)}$$

EQUATION OF COMPATIBILITY

$$\frac{\delta_C}{c} = \frac{\delta_D}{d} \qquad \text{(Eq. 2)}$$

FORCE-DISPLACEMENT RELATIONS

$$\delta_C = \frac{T_C h}{EA} \quad \delta_D = \frac{T_D(2h)}{EA} \qquad \text{(Eqs. 3, 4)}$$

SOLUTION OF EQUATIONS

Substitute (3) and (4) into Eq. (2):

$$\frac{T_C h}{cEA} = \frac{T_D(2h)}{dEA} \quad \text{or} \quad \frac{T_C}{c} = \frac{2T_D}{d} \qquad \text{(Eq. 5)}$$

TENSILE FORCES IN THE WIRES

Solve simultaneously Eqs. (1) and (5):

$$T_C = \frac{2cPL}{2c^2 + d^2} \quad T_D = \frac{dPL}{2c^2 + d^2} \qquad \text{(Eqs. 6, 7)}$$

TENSILE STRESSES IN THE WIRES

$$\sigma_C = \frac{T_C}{A} = \frac{2cPL}{A(2c^2 + d^2)} \qquad \text{(Eq. 8)}$$

$$\sigma_D = \frac{T_D}{A} = \frac{dPL}{A(2c^2 + d^2)} \qquad \text{(Eq. 9)}$$

DISPLACEMENT AT END OF BAR

$$\delta_B = \delta_D\left(\frac{L}{d}\right) = \frac{2hT_D}{EA}\left(\frac{L}{d}\right) = \frac{2hPL^2}{EA(2c^2 + d^2)} \qquad \text{(Eq. 10)}$$

SUBSTITUTE NUMERICAL VALUES

$$2c^2 + d^2 = 2(20 \text{ in.})^2 + (50 \text{ in.})^2 = 3300 \text{ in.}^2$$

(a) $$\sigma_C = \frac{2cPL}{A(2c^2 + d^2)} = \frac{2(20 \text{ in.})(340 \text{ lb})(66 \text{ in.})}{(0.0272 \text{ in.}^2)(3300 \text{ in.}^2)}$$

$$= 10{,}000 \text{ psi} \quad \leftarrow$$

$$\sigma_D = \frac{dPL}{A(2c^2 + d^2)} = \frac{(50 \text{ in.})(340 \text{ lb})(66 \text{ in.})}{(0.0272 \text{ in.}^2)(3300 \text{ in.}^2)}$$

$$= 12{,}500 \text{ psi} \quad \leftarrow$$

(b) $$\delta_B = \frac{2hPL^2}{EA(2c^2 + d^2)}$$

$$= \frac{2(18 \text{ in.})(340 \text{ lb})(66 \text{ in.})^2}{(30 \times 10^6 \text{ psi})(0.0272 \text{ in.}^2)(3300 \text{ in.}^2)}$$

$$= 0.0198 \text{ in.} \quad \leftarrow$$

Mechanics of Materials 9th Edition Solutions is a crucial resource for students and professionals studying engineering mechanics. This textbook, authored by Ferdinand P. Beer, E. Russell Johnston Jr., and John T. DeWolf, provides comprehensive coverage of the principles of mechanics of materials, essential for understanding the behavior of solid materials under various types of loading. The 9th edition has been updated to include new examples, enhanced illustrations, and improved problem sets, making it an invaluable guide for anyone involved in the field of civil and mechanical engineering.

Overview of Mechanics of Materials

Mechanics of materials, often referred to as strength of materials, deals with the behavior of solid objects subject to stresses and strains. It examines how materials deform under

various forces and how they can be used safely within structural applications. Understanding these principles is vital for engineers who design and analyze structures, machinery, and various components.

Key Concepts

1. Stress and Strain: The fundamental concepts of mechanics of materials are stress (force per unit area) and strain (deformation per unit length). They are critical for understanding how materials respond to external forces.
2. Material Properties: Different materials have distinct properties, such as elasticity, plasticity, and toughness, which affect their performance under load.
3. Loading Conditions: Materials can be subjected to various loading conditions, including tension, compression, torsion, and bending. Each type of load results in different stress and strain distributions within the material.
4. Failure Theories: Engineers must understand the conditions under which materials fail. Various theories, such as the maximum stress theory and the maximum strain theory, help predict failure points.

Features of the 9th Edition

The 9th edition of Mechanics of Materials includes several enhancements that improve its educational value:

- Updated Examples: The textbook features new, real-world examples that apply mechanics of materials concepts to practical engineering problems.
- Enhanced Illustrations: The illustrations in this edition have been improved for clarity, aiding in the understanding of complex concepts.
- Problem Sets: Each chapter includes a variety of problems, ranging from straightforward calculations to complex design scenarios, encouraging critical thinking and application of theories.
- Online Resources: The edition is accompanied by online resources, including interactive simulations and additional problem-solving tools, allowing for a more engaging learning experience.

Solution Manual Overview

The solutions manual for Mechanics of Materials 9th Edition is an essential companion for students. It provides step-by-step solutions to the problems presented in the textbook, helping students to understand the problem-solving process and check their work.

Benefits of Using the Solutions Manual

1. Clarifies Concepts: By reviewing detailed solutions, students can gain a clearer

understanding of the mechanics of materials concepts.
2. Enhances Problem-Solving Skills: Working through the solutions encourages students to develop their problem-solving skills, which are essential for engineering practice.
3. Prepares for Exams: The solutions manual serves as an effective study aid, allowing students to practice and prepare for exams with confidence.
4. Self-Assessment: Students can use the solutions to self-assess their understanding of the course material, identifying areas where they may need further study or support.

Common Topics Covered in Solutions

The solutions manual typically covers a range of topics, including but not limited to:

- Axial Load: Solutions involving axial loading of members and the resulting stresses and strains.
- Torsion: Analysis of circular shafts under torsional loads, including shear stress distributions.
- Bending: Solutions related to bending of beams, including shear and moment diagrams.
- Combined Loading: Problems involving multiple types of loading and how they interact.
- Column Buckling: Analysis of stability and buckling of columns under axial loads.
- Stress Transformation: Techniques for transforming stresses to different orientations, including Mohr's circle.

How to Use the Solutions Manual Effectively

To maximize the benefit from the solutions manual, students should consider the following strategies:

1. Attempt Problems First: Before consulting the solutions manual, students should attempt to solve problems on their own to develop their skills.
2. Review Step-by-Step: When using the solutions manual, review each step carefully to understand the reasoning and calculations involved.
3. Work in Groups: Collaborative study can enhance understanding. Discussing problems with peers can provide new insights and reinforce learning.
4. Seek Help When Needed: If certain concepts remain unclear, students should seek assistance from instructors or tutors to clarify any misunderstandings.

Conclusion

The Mechanics of Materials 9th Edition Solutions manual is an indispensable resource for students and professionals in the engineering field. By providing detailed solutions and explanations to complex problems, it enhances the learning experience and helps to solidify the foundational concepts of mechanics of materials. As students engage with the material, they not only gain knowledge but also develop critical thinking and problem-solving skills essential for their future careers in engineering. Whether used for individual

study, group work, or exam preparation, the solutions manual serves as a key tool in mastering the principles of mechanics of materials.

Frequently Asked Questions

What are the key features of the 'Mechanics of Materials 9th Edition' solutions?

The 'Mechanics of Materials 9th Edition' solutions include comprehensive step-by-step explanations, detailed diagrams, and numerous example problems that illustrate the principles of mechanics in various applications.

Where can I find the solutions for 'Mechanics of Materials 9th Edition'?

Solutions for 'Mechanics of Materials 9th Edition' can be found in official solution manuals, educational websites, and tutoring platforms that specialize in engineering courses.

Are there any online resources for studying the 'Mechanics of Materials 9th Edition' solutions?

Yes, several online platforms such as Chegg, Course Hero, and various university websites offer access to solutions and study guides for 'Mechanics of Materials 9th Edition'.

How does the 9th edition differ from previous editions in terms of solutions?

The 9th edition typically includes updated problems, more real-world applications, and enhanced illustrations, making the solutions more relevant and easier to understand compared to previous editions.

Can the solutions for 'Mechanics of Materials 9th Edition' help with exam preparation?

Yes, the solutions provide valuable insights into problem-solving techniques, which can enhance understanding and retention of material, making them useful for exam preparation.

Is there a difference in the approach to problem-solving in the 9th edition solutions?

The 9th edition emphasizes a more conceptual understanding of mechanics, integrating modern engineering practices and analytical techniques which may differ from earlier editions.

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