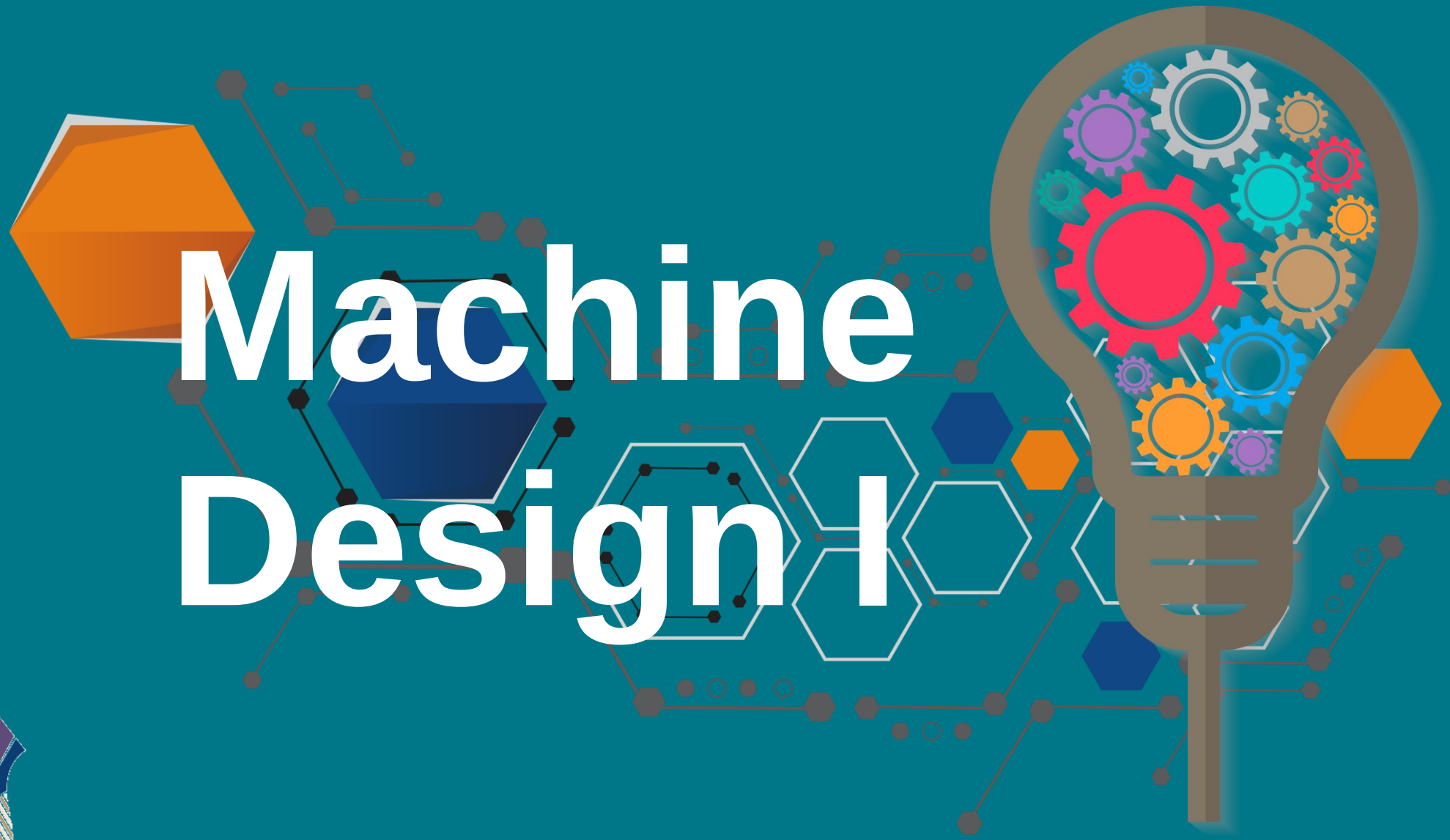

Machine Design I

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INTRODUCTION

- What is Design?
- What is Machine Design?
- What is Mechanical Design?

What is Design?

Design is the process of creating a plan, concept, or drawing for the construction or manufacture of an object, system, or structure.

Design involves the application of engineering and artistic principles to solve problems, meet needs, and achieve specific goals.

It is a highly creative process that involves a deep understanding of the properties of materials, the laws of physics, and the principles of aesthetics.

What is Mechanical Design?

Mechanical design is a specialized area of design that focuses on the development of mechanical systems and components.

It involves the creation of detailed drawings, models, or prototypes of mechanical parts, machines, or systems that meet specific functional requirements. Mechanical design can be used in a wide range of applications, including manufacturing, transportation, robotics, aerospace, and many others.

What is Machine Design

Machine design is a subset of mechanical design that specifically deals with the design of machines.

It involves the creation of detailed drawings and models of machines, including their components, systems, and sub-systems, that meet specific performance requirements.

Machine design is a complex and interdisciplinary field that involves a deep understanding of engineering principles, materials science, and manufacturing processes.

What is Machine Design

It is essential for the development of safe, reliable, and efficient machines, such as engines, pumps, turbines, and many others.

Overall, design, mechanical design, and machine design are critical concepts in engineering and play a vital role in the development of new products, systems, and structures that meet the needs of society.

By applying creativity, technical knowledge, and scientific principles to the design process, engineers can create safe, reliable, and effective solutions to complex problems.

what is the concept of safety from a Mechanical Engineering point of view?

SAFETY

In mechanical engineering, safety is a critical concept that is essential for ensuring that mechanical systems and products are designed, operated, and maintained in a way that minimizes the risk of harm or injury to people and the environment.

Safety

- From a mechanical engineering point of view, safety involves a number of considerations, including the design, materials, manufacturing, operation, maintenance, and disposal of mechanical systems and products.

- Engineers must consider potential hazards and risks associated with their designs, and work to minimize these risks through appropriate design choices, such as selecting appropriate materials, dimensions, and manufacturing processes.

Safety

Safety also involves a consideration of the performance requirements and environmental conditions that a mechanical system or product will be exposed to and ensuring that the system or product is designed to operate safely and effectively under these conditions.

This includes testing and validation of the system or product to ensure that it meets relevant safety standards and regulations.

In addition, safety requires proper maintenance, inspection, and repair of mechanical systems and products throughout their lifecycle to ensure that they continue to function safely and effectively over time.

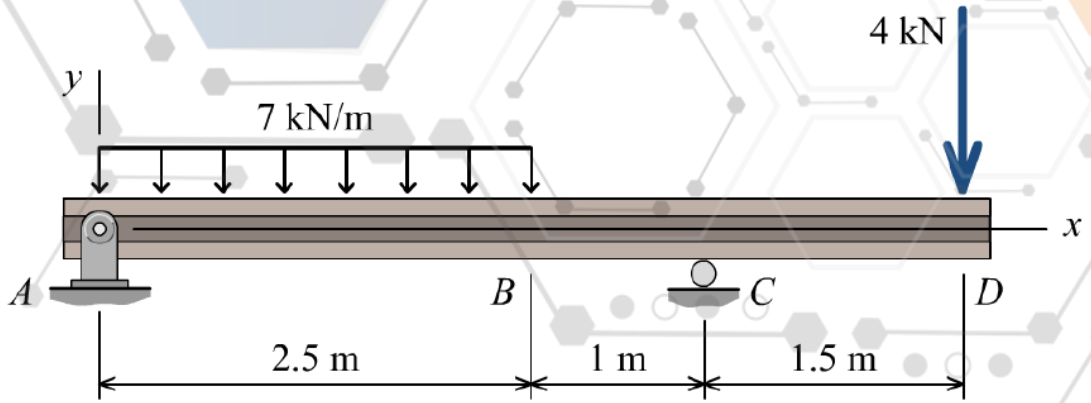
Safety

- This includes identifying and addressing potential wear and tear, corrosion, or damage that could compromise the safety of the system or product.
- Overall, safety is a critical concept in mechanical engineering that underpins the development of safe and reliable mechanical systems and products.
- By incorporating safety considerations into the design, manufacturing, operation, and maintenance of mechanical systems and products, engineers can help to minimize the risk of harm or injury and ensure the well-being of people and the environment.

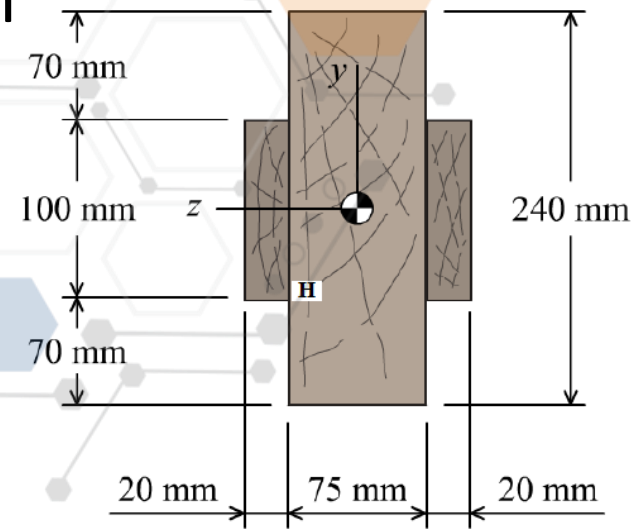
The Design Process

A wood beam supports the loads shown. Determine:

a. the magnitude and location of the maximum shear force
b. the magnitude of the maximum negative (CCW) bending moment
c. the maximum transverse shear stress in the beam
d. the maximum tension bending stress in the beam



Simply supported timber beam

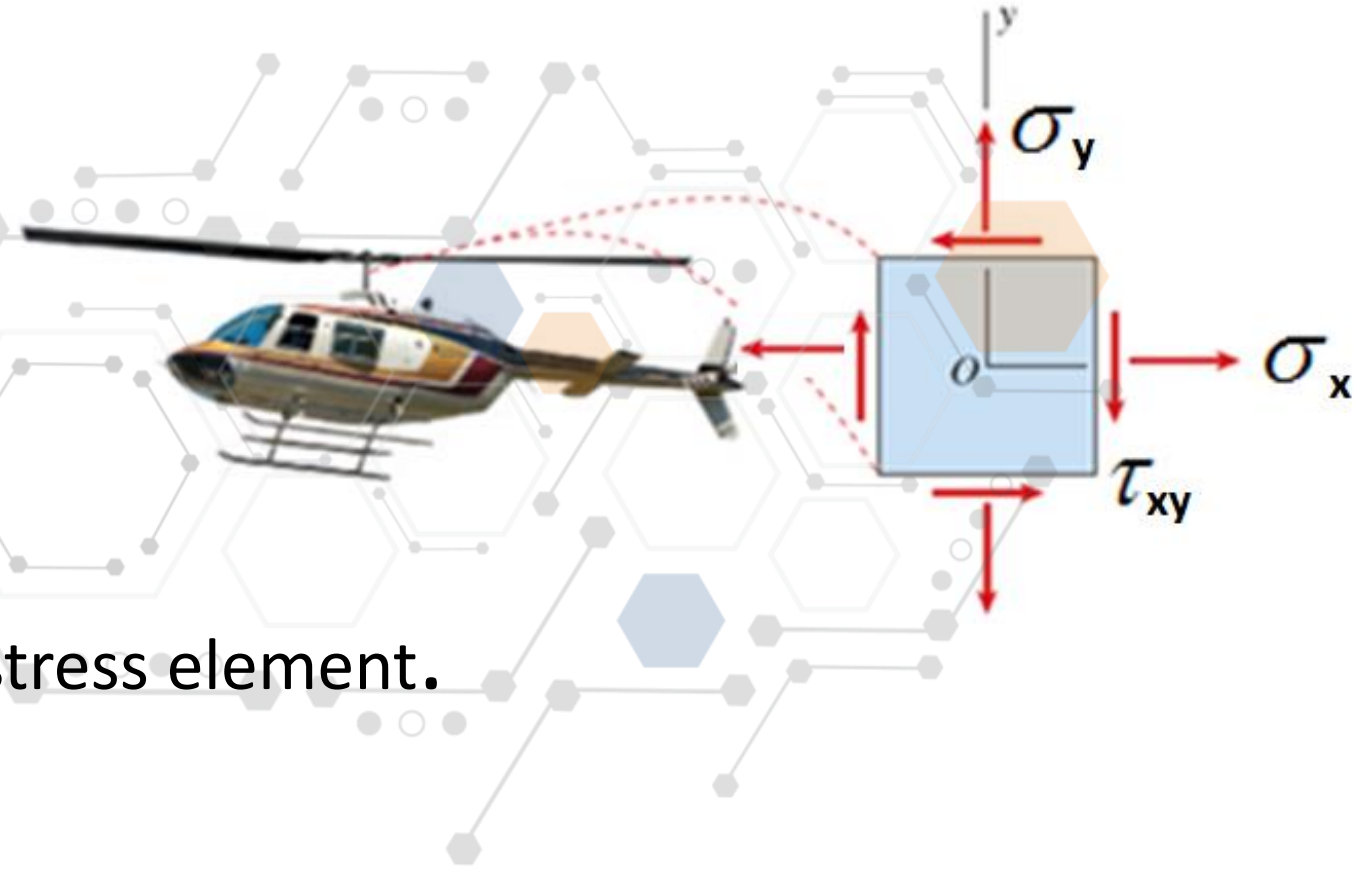


Cross-sectional dimensions

The Design Process

The stresses on the rotor shaft of a helicopter are given as:

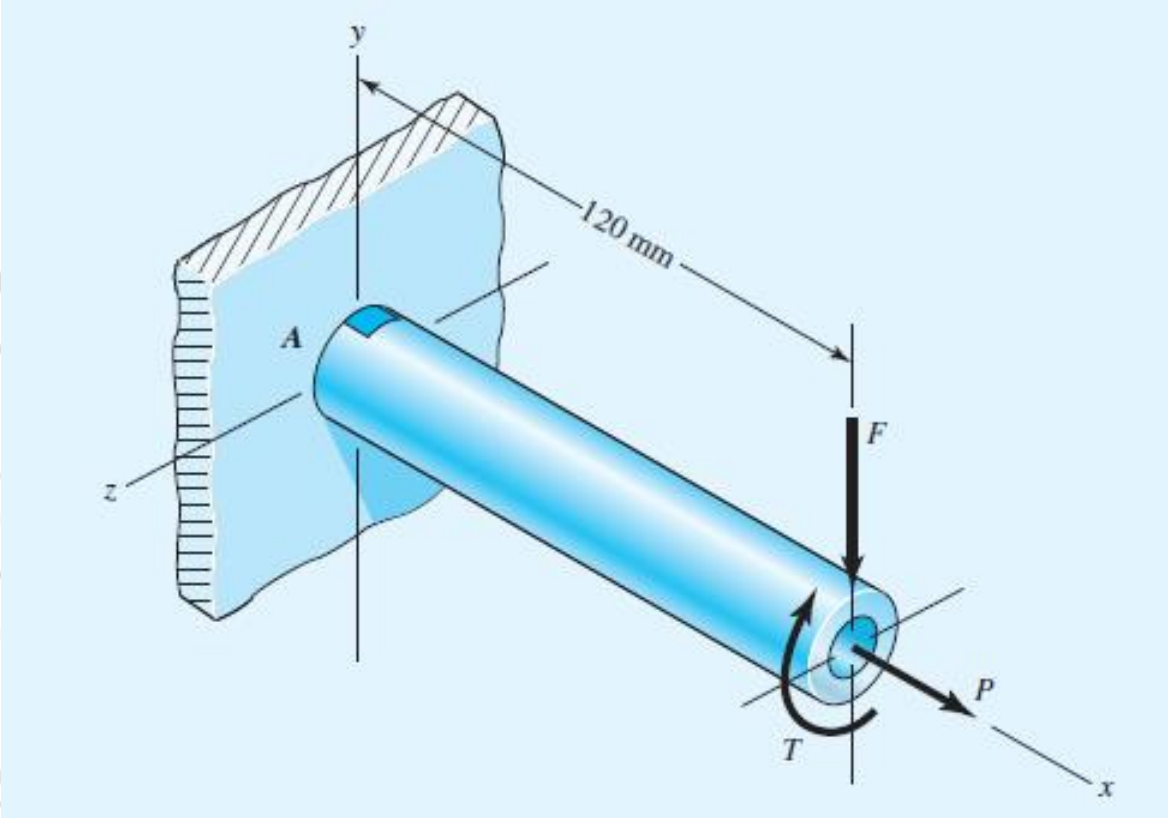
$$\sigma_x = 160\,\text{MPa}$$
$$\sigma_y = 40\,\text{MPa}$$
$$\tau_{xy} = -80\ \text{MPa}.$$



Draw Mohr's circle for the given stress element.

The Design Process

The cantilevered hollow beam shown is to be made of 2014 aluminum alloy treated to obtain a specified minimum yield strength of **276 MPa**. The cross section of the tube is 42 mm and the wall thickness is 5 mm. The bending load is F **= 1.75 kN**, the axial tension is P**= 9.0 kN**, and the torsion is T **= 72 N.m**. What is the factor of safety for this cantilever?



The Design Process

A vertical pipe column with an outside diameter of 325 mm and a wall thickness of 10 mm supports the loads shown. Determine the magnitudes of the principal stresses at point K.