Fall, 2022

ME 323 – Mechanics of Materials

Lecture 36 – Stress due to combined load

Reading assignment: Ch.14 lecturebook

PURDUE UNIVERSITY | Mechanical Engineering

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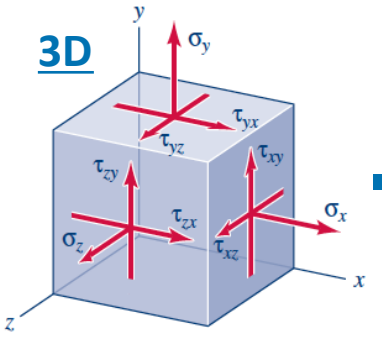
1936: The chairlift revolutionized the sport

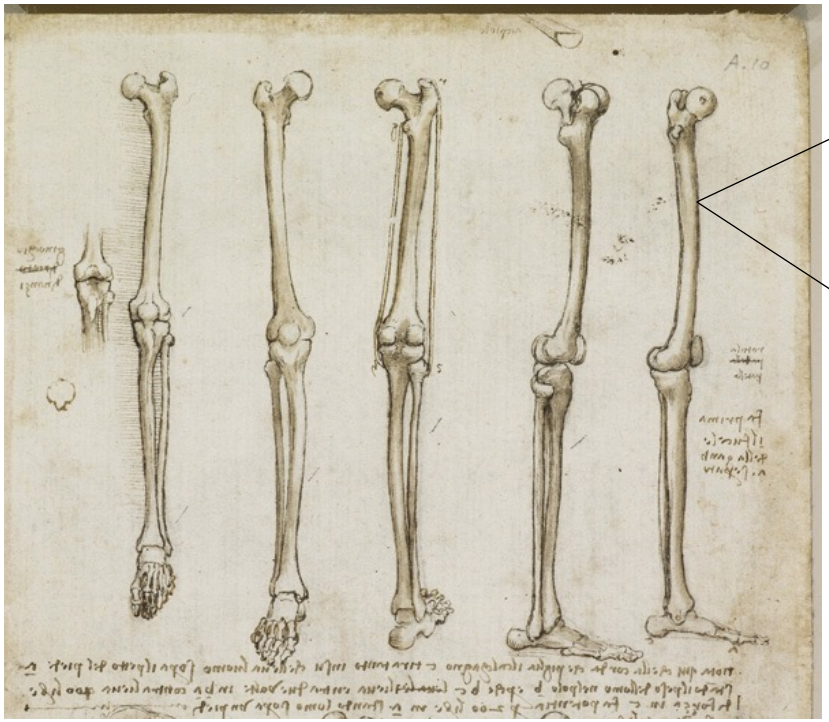
After a ski resort tragedy, engineers design a safer connector between the cable and chair on the lift: *"Linear static stress analyses were performed under two specific conditions: when the jaws were closed and attached to the cable, and when the jaws were open for transition to the loading track, where the force of the springs was the greatest. Built-in visualization tools in the finite element analysis (FEA) software were used to view the stress results with a von Mises display."* doi.org/10.1115/1.2000-FEB-7

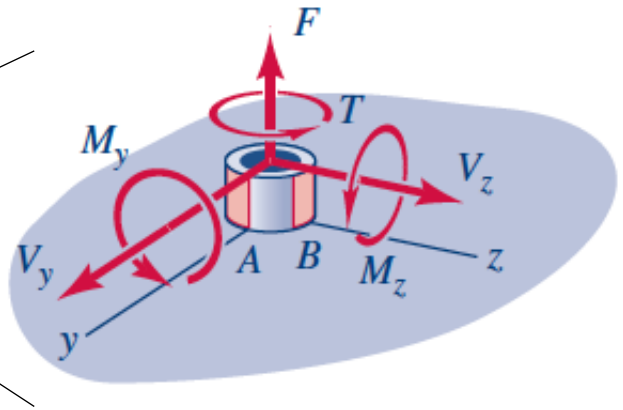
Video

Stress due to combined load



Combined axial and torsional loads, bending

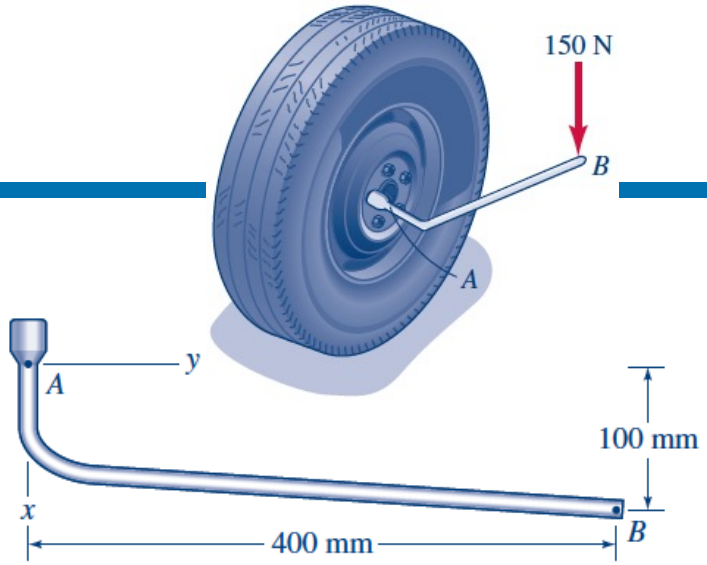




- Determine the internal resultants at a given point.
- Determine the centroid of the cross section (principal axes pass through the centroid).
- Calculate and combine individual stresses.
- Determine principal stresses and maximum shear stress.

Note: Easy, but you need to be very careful and systematic!

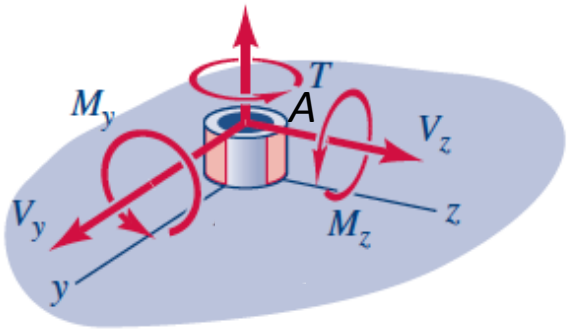
Stress due to combined load



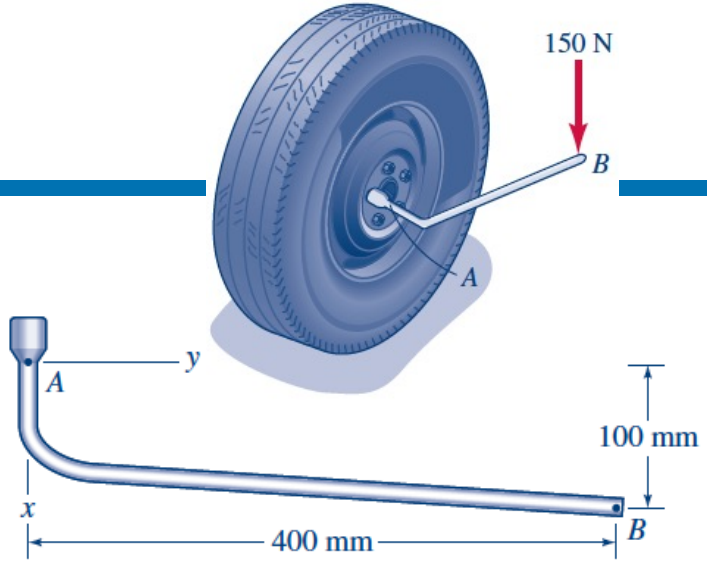
Problem 80 (cont.):

Determine the principal stresses and the maximum shear stress at point A (i.e., the point on top of the wrench handle). The diameter of the circular cross section is 12.5 mm.

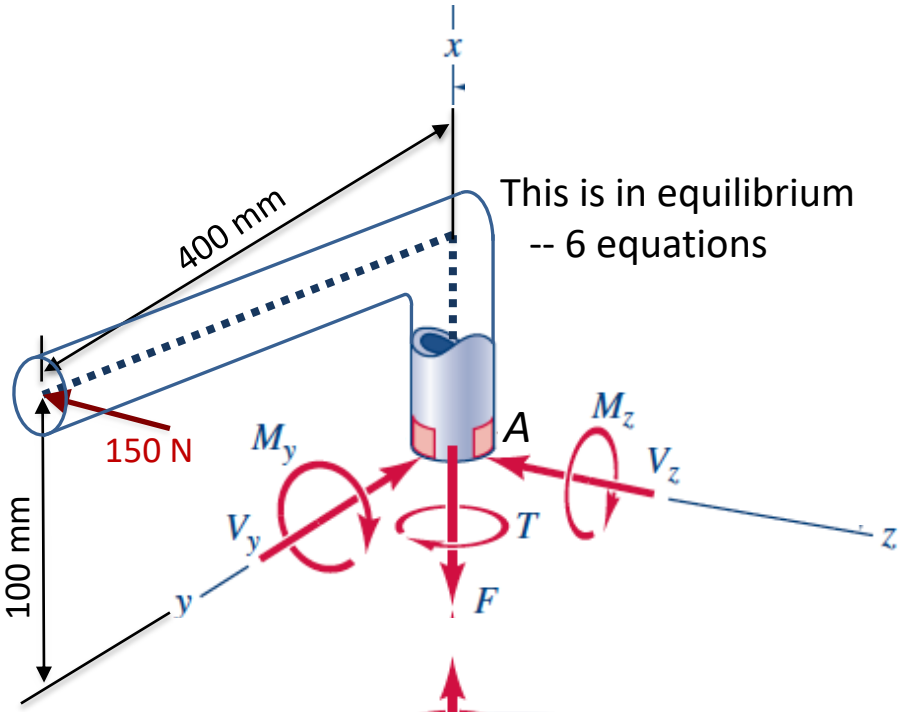
Internal resultants on a positive face!!



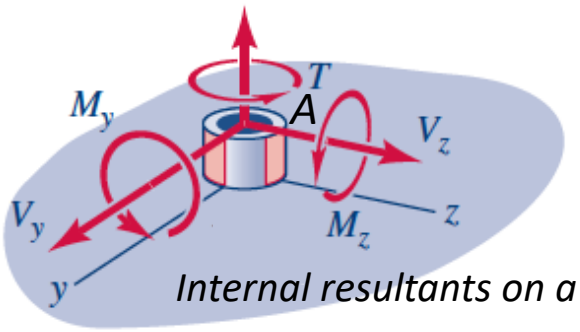
Stress due to combined load



Problem 80 (cont.):

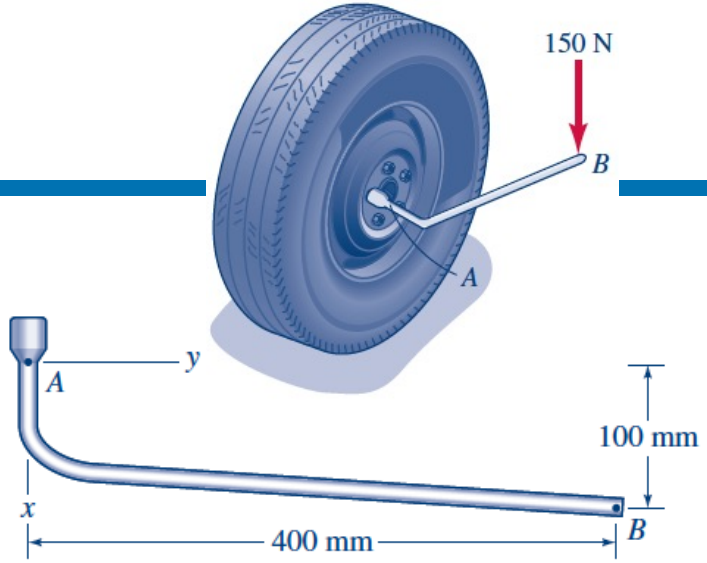


This is in equilibrium
-- 6 equations



Internal resultants on a positive face!!

Stress due to combined load



Problem 80b (Practice problem):

Determine the principal stresses and the maximum shear stress at point A (i.e., the point on top of the wrench handle). The diameter of the circular cross section is 12.5 mm.

What is the point at the circular cross section that fails first if load P increases from zero?
[You will be able to answer this questions after Lectures 37-38]

Stress due to combined load

Problem 81 (Practice problem):

A tubular shaft is subjected simultaneously to a specified torque T and to an axial load P. Using the Mohr's circle, determine the maximum axial load that can be applied without exceeding a given allowable tensile stress.

Stress due to combined load

Any questions?