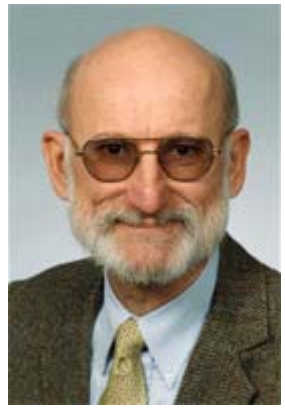
Engineering Science and Mechanics Department



Standards in *Mechanics of Materials with Design*

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Design in Mechanics Series

- 2nd Year: *Mechanics of Materials with Design*
- 3rd Year: *Computer Methods in Design*
  - numerical methods; Interpolation, Splines and drawing curves; Computer graphics; Solid modeling; and Simulation
- 4th Year: *Advanced Mechanics of Materials with Design*
- We include Design without adding credits

Mechanics of Materials…w/ Design

- *Mechanics* (or Strength) *of Materials* is a 2nd year engineering course in engineering
  - Traditionally taught as an analysis course
    - Students learn fundamentals of stress and deformation in axial, bending and rotational loading of structural elements
- We integrate design process and a project over a 10-week period

How do we do it?

- Streamline the syllabus
  - Teach six hours of design process and fundamental topics
  - Schedule them just in time to support the design project and sprinkle “design exercises” throughout the course

- Supplement the textbook with a “design website” http://www.esm.psu.edu/courses/emch13d/design/default.htm

Design Website

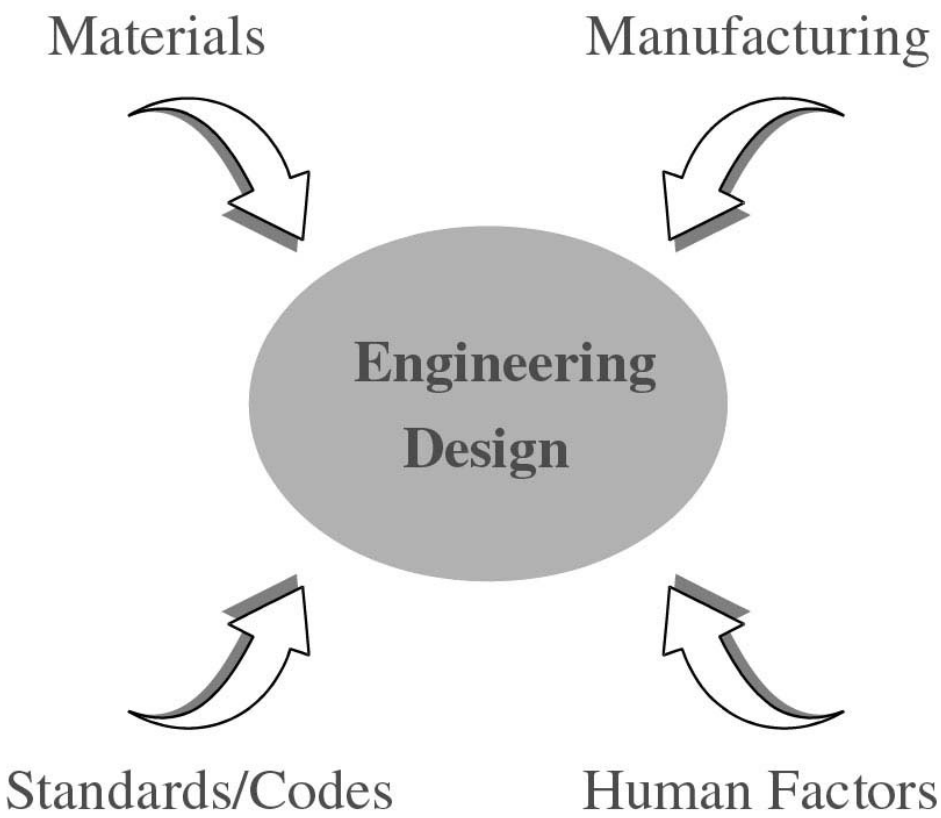
Infrastructure necessary to learn design

- Design theory, e.g., $A = P_{max}/\sigma_{yield}/FS$
- Design technologies
- Report specifics (How-to and forms)
- Guidance: Samples of work and projects

DESIGN DATA IS ABSOLUTELY NECESSARY TO DO ENGINEERING DESIGN

RELIABLE DATA AVOIDS UNNECESSARY AND INCORRECT USE OF ASSUMPTIONS

Our Use of Standards



Design Data

- Materials
  - Metals, plastics, fabrics and ropes, woods, and fasteners and chains
- Manufacturing
  - Overview of many manufacturing methods
- Standards and codes
  - for specifications, testing, and performance
- Human Factors
  - Links to anthropometric data

Standards: What we cover

- The public system → ISO → ANSI → Standards writing organizations
- The concept of consensus
- Standards vs. Codes
- Searching for standards
  - Examples:
    http://www.StandardsMall.org
    NSSN: A National Resource for Global Standards

    http://www.dtic.mil/dtic/prodsrvc/stinet.html
    Penn State Libraries

Using Standards: Handcart

- Design of a Handcart (Dolly)
  - STINET → Find a Document →

    DoD Index of Specs & Standards →

    Search for "dolly" ➲

    MIL-T-19147D: *Trucks, Dolly, Rectangular, with Four Swivel Casters*

- Not exactly our design, but a similar product, so it provides design insight

Handcart continued

- Find specification for aluminum tubing
  - Penn State Library → Hook, Carla. (1996) *Index and Directory of Industry Standards* ➲
  - ASTM B483-95: *Standard Specification for Aluminum and Aluminum Alloy Drawn Tubes for General Purpose Applications* ➲

ASTM Standard (continued)

- Looking for 42 ksi, we find that we can use tubing made of alloy 6061 that ranges in wall thickness from .025 inches to .5 inches, so
  - Design analysis ➲

    required wall thickness BUT what do we specify?
  - Search of vendors' products ➲

    nominal size tubing available to meet specifications

Using Standards: Fasteners

- NSSN → Search for Standards
- ^ hex nut ^ All Words ^ All Developers ➲ 37 documents, SAE, etc., but NOT ASME
  so Repeat Search…
- ^ American National Standard for Square and Hex Bolts and Screw - Inch Series ➲
- “The query is too complex or invalid syntax has been used”

Fasteners (continued)

- ^ Hex Bolts and Screw Inch Series ^ All Words ^ All Developers ➲
- **No documents were found**.
- ^ Hex Bolts Inch Series ^ All Words ^ All Developers > Start Search ➲
- **ANSI/ASME B18.2.1-1996:** *Square and Hex Bolts and Screws (Inch Series)*
  - **GREAT!! SUCCESS at last!**

Fasteners (continued)

- A student designer said, “It contains a table which gives dimensions and nominal sizes of Hex Bolts where we find that .35 inches is not a nominal size for bolts. Hence we choose to use bolts that are 3/8 of an inch in size because this is the closest nominal size that is larger than the minimum diameter we calculated.”

Conclusion: Students learn…

- about standards and codes
  - how to find them
  - how to use them
- but learning to do design while learning theory is not for struggling students, though most of them like it!