

CE 203 STRUCTURAL MECHANICS I (Section 3)

Second Semester 1429 / 2008 (072)

H.W. # 7

Due on Sunday 7-4-1429 / 13-4-2008 (any time)

Deadline for submission: **Monday 8-4-1429 / 14-4-2008 (before you sit in class)**

- 1) A torque T is applied to a 4-m long shaft which has the cross-section shown in Fig. P1. If the allowable shear stress is 50 MPa, and if the angle of twist is limited to 0.003 rad, **determine the maximum torque T** that can safely be applied. $G = 40$ GPa. [Sec. 5.7] (20 pts.)
- 2) A shaft of I cross-section is subjected to a torque T as shown in Fig. P2. **Calculate the maximum torque T** that can be applied if (i) the yield shear stress is 200 MPa and the factor of safety is 2 and (ii) the allowable relative angle of twist of the two ends of the shaft is not to exceed 6 degrees over its 2-m length. $G = 28$ GPa. [Handout] (20 pts.)
- 3) The cross section of a torsional member can be one of the shapes shown in Fig. P3. The length, the applied torque, and the material are the same regardless of the section chosen. (Note that the **material** areas of the sections are all the same).
 - a) **Order the sections in terms of their efficiency in shear**, from best to worst. Prove your order!
 - b) **Order the sections in terms of their efficiency in rotation** (angle of twist), from best to worst. Show why they are in this order!
 - c) What **conclusions/recommendations** can you make?

Note: Solve section 2 by two different theories (?) and compare.

[All sections covered in chapter 5 in the textbook + Handouts] (60 pts.)

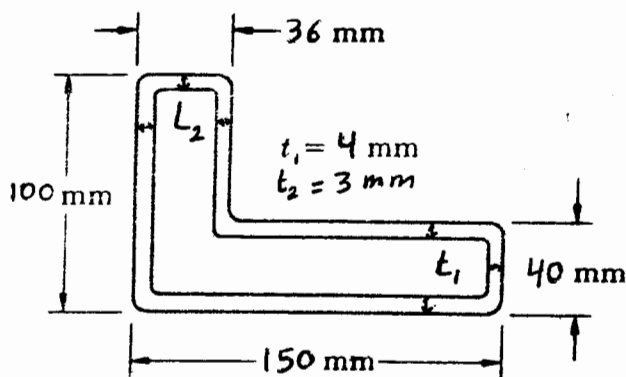


Fig P1

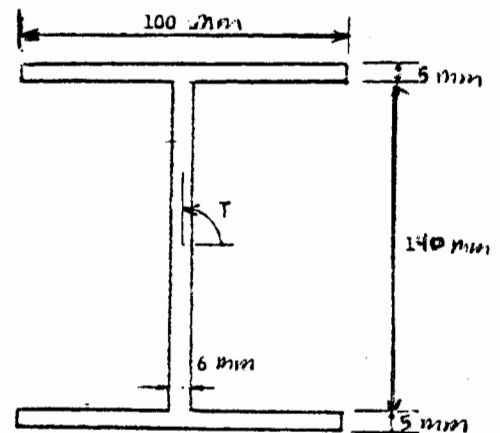
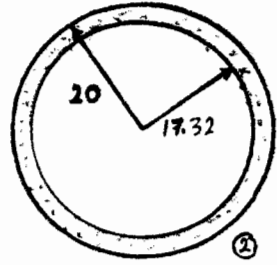


Fig P2

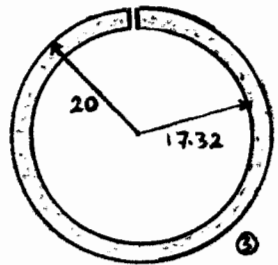
All dimensions are in the same length units.



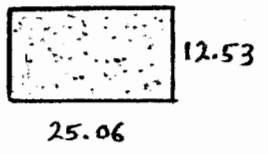
①



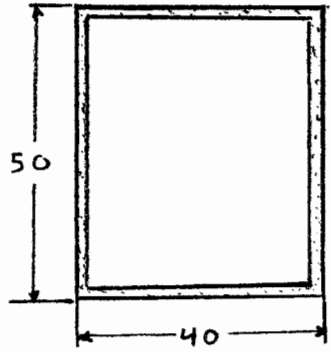
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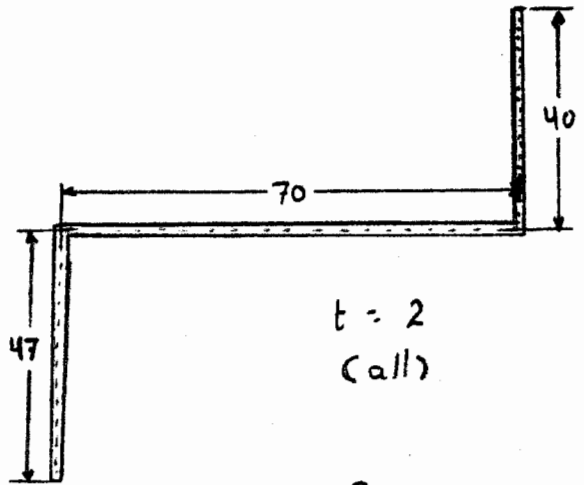


④



⑤

$t = 1.82$
(all)



$t = 2$
(all)

⑥

Fig. P3

Do your work yourself!! Remember that the homework carries 20% of the course grade; in addition, *solving it is the best way to understand the subject.* Of course, you can seek my help anytime in the homework as well as in anything else.

As an engineer, review the guidelines for submitting homework assignments given to you in class **BEFORE** you start solving and writing the homework. **FOLLOW ALL THESE GUIDELINES.** Cheating, copying, etc. is!!!!