The University of Sydney

School of Civil Engineering

CIVL2201 Structural Mechanics

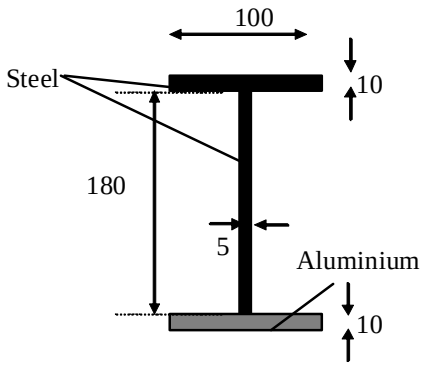
Assignment 2 – Bending and The World Trade Center

This assignment is to be submitted by 2 pm Thursday 21 May 2009. Submissions should be made directly to your tutor. Please submit stapled sheets only (no manilla folders or slip in sheet protectors etc).

This assignment is worth 5 % of the total mark.

Please attach the "Assignment Cover Sheet", available from the Structural Mechanics website, as the first page of the submission.

1) A company has manufactured a new type of doubly symmetric composite I section from steel and aluminium plates, the cross-section of which is shown. It can be assumed that $E_{aluminium}$ = 70000 MPa and E_{steel} = 200000 MPa, and that both materials exhibit linear elastic behaviour.
   a) Consider a cross-section of the beam which is subjected to a positive bending moment of 50 kNm about its horizontal centroidal axis.
      i. Determine the curvature
      ii. Draw the strain distribution across the section (values required).
      iii. Draw the stress distribution across the section (values required).



All dimensions are in mm

2) A pole is made from 2 rigidly connected circular hollow sections each 3 m in length. The pole is loaded by two twisting moments, 40 kNm and 20 kNm (in the same direction) at heights of 3 m and 6 m respectively (measured from the base). Each section of the pole has an outer diameter of 300 mm, but the material varies. The bottom half is made from steel (G_{steel} = 80000 MPa) with thickness 4 mm, and the top half is made from aluminium ($G_{aluminium}$ = 40000 MPa) with an unknown thickness. The pole is rigidly connected to a support at the base, and free at the top.

(a) Draw the FBD & twisting moment diagram.

(b) Determine the thickness of the aluminium portion in order to ensure that the maximum shear stress in the aluminium is one half of the maximum shear stress in the steel. What is the maximum shear stress in both the steel and aluminium?

(c) Draw a diagram that shows the rotation with respect to the fixed base at any height.

(d) Would the total twist rotation at the top relative to the fixed base increase or decrease if the materials were swapped (steel in the top half, aluminium in the bottom)? Briefly explain your answer.

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3) Read all of Chapter 2 of the ASCE / FEMA *World Trade Center Building Performance Study* which is on the internet at http://www.civil.usyd.edu.au/courses/civl2201/. Based on your student number, choose a portion of the allocated section of the report and in approximately 100 – 200 words plus a diagram explain what you have learned from reading this particular section. Directly quoting from the report would not be deemed suitable. (Students are not expected to summarise the entire allocated section in 100 words, just a small portion of their choice). Also if students want to summarise another different part of the report (but not any of those listed below) in 100 – 200 words, that is acceptable.

Second last number of student number: 9: External columns (pp 2.2 – 2.4)
Second last number of student number: 8: Composite floor/deck (pp 2.3 – 2.5)
Second last number of student number: 7: Outrigger truss (pp 2.5 – 2.10)
Second last number of student number: 6: Basement/foundations (pp 2.10 – 2.11)
Second last number of student number: 5: Passive fire systems (p 2.12)
Second last number of student number: 4: Fire suppression systems (pp 2.12 – 2.13)
Second last number of student number: 3: WTC 1 – Impact damage (pp 2.15 – 2.21)
Second last number of student number: 2: WTC 1 – Fire development (pp 2.21 – 2.23)
Second last number of student number: 1: WTC 1 – Structural response to fire (pp 2.24 – 2.26)
Second last number of student number: 0: WTC 1 - Collapse (pp 2.27)

Did you remember the correct units?

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