INDIAN INSTITUTE OF TECHNOLOGY

Date 23.4.2001 FN / ~~AN~~ Time : ~~2~~ / 3 Hrs. Full Marks 60 No. of Students 18

~~Autumn~~ / Spring Semester, 19 2001 Deptt. Aerospace Engineering Sub. No. 113004

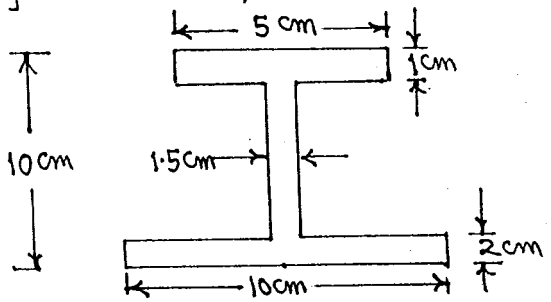
3rd Yr. B.Tech. (H) / ~~B.Arch. (H)~~ / ~~M.Sc.~~ Sub. Name Aerospace Structural Analysis

Instruction Answer all questions

Q.1(a) An aircraft structure is subjected to some general form of external loading. As structural analyst, you are required to design the wing box structure. With the help of a neat sketch of the box structure, explain how would you proceed for the design? (8)

(b) Explain CSRD assumptions and structural idealization. (4)

Q.2(a) A column has the cross-section as shown in the figure. Length = 1m, E = 70 GPa. Both the ends are fixed. Calculate the first and second critical buckling loads for the column.



Clearly sketch the buckling mode shapes. (8)

(b) Discuss the concept of effective length. Using this concept, write down the P_{cr} of a fixed-free column. Draw the first three buckling mode shapes. (4)

Q.3 Figure shows an unsymmetrical beam section composed of four stringers subjected to B.Ms as shown. $A_{stringer} = 65\ mm^2$. The material of the stringers are different as shown Determine the stress and total load on each stringer. Give equilibrium check.

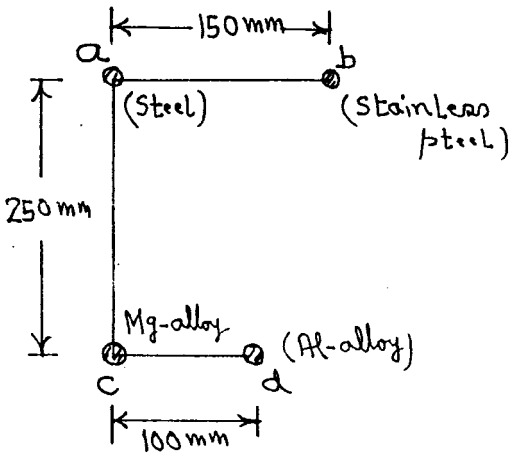
(Hint: Transform the section to an equiv. system with all stringers made of one alloy only, say Mg-alloy) (12)

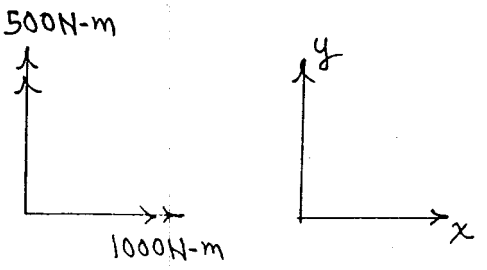
N.B. 1. Questions must not be written beyond the border lines. 2. Please use only BLACK INK

P. K. DATTA

Signature of the Donor - Setter

Name in Capital Letter



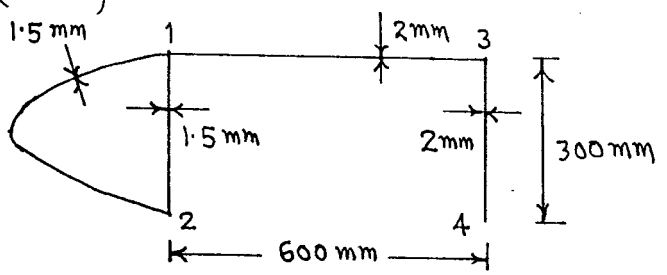


$t_{web} = 2$ mm

Material	Steel	Stainless Steel	Mg-alloy	Al-alloy
E (N/mm^2)	2.1×10^5	1.93×10^5	0.45×10^5	0.7×10^5

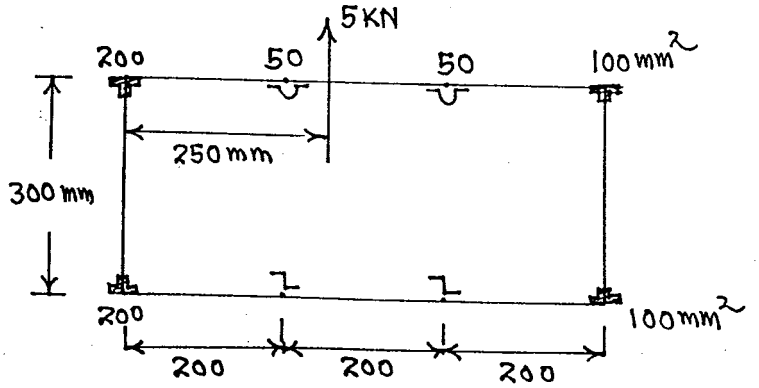
Q.4

Find the angle of twist per unit length in the wing whose c.s. is shown, when it is subjected to a torque of 10 KNm. Find also the maximum shear stress in the section. $G = 25000$ N/mm^2. Wall 12 (outer) = 900 mm. Nose cell area = 20000 mm^2.



(12)

Q.5 Figure below shows a single cell beam with 8 flange members, carrying a 5 KN shear load. Calculate shear flow distribution and locate the position of the shear centre.



Skin thickness = 2mm
(effective in shear)

(12)

DKDatta 16/4/01