Exam Date & Time: 19-Jun-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

DEPARTMENT OF AERONAUTICAL AND AUTOMOBILE ENGINEERING
MAKE UP EXAMINATION

ADVANCED AIRCRAFT STRUCTURES [AAE 2225]

Marks: 50 **Duration: 180 mins.**

Advance Aircraft Structures

Answer all the questions. Section Duration: 180 mins

Answer all Questions

1) Discuss the primary functions of following wing components: spars, stringers, and ribs with neat sketches. (2)

2) Discuss the transparent plastic and reinforced plastic materials used in the aircraft construction? (4)

3) Evaluate the internal forces in the members AB, AC, BC, BD, and CD of the truss structure shown in figure 1. (4)

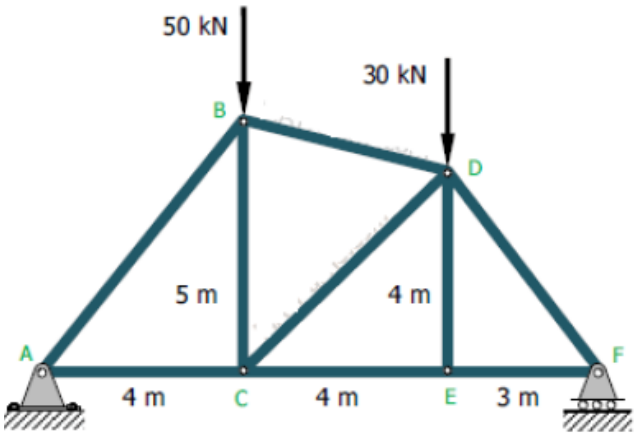


Figure: 1

4) Differentiate between Warren type and Pratt type of fuselage construction. List their advantages and disadvantages. (2)

5) An airplane has just touched down in landing as shown in figure 2. and braking force of 35000 lb on the rear wheels is being applied to bring the airplane to rest. The landing horizontal velocity is 85 MPH (125 ft/sec). Neglecting air forces on the airplane and assuming the propeller forces are zero, what are the ground reactions R_1 and R_2. Evaluate the landing run distance with the constant braking force? (4)

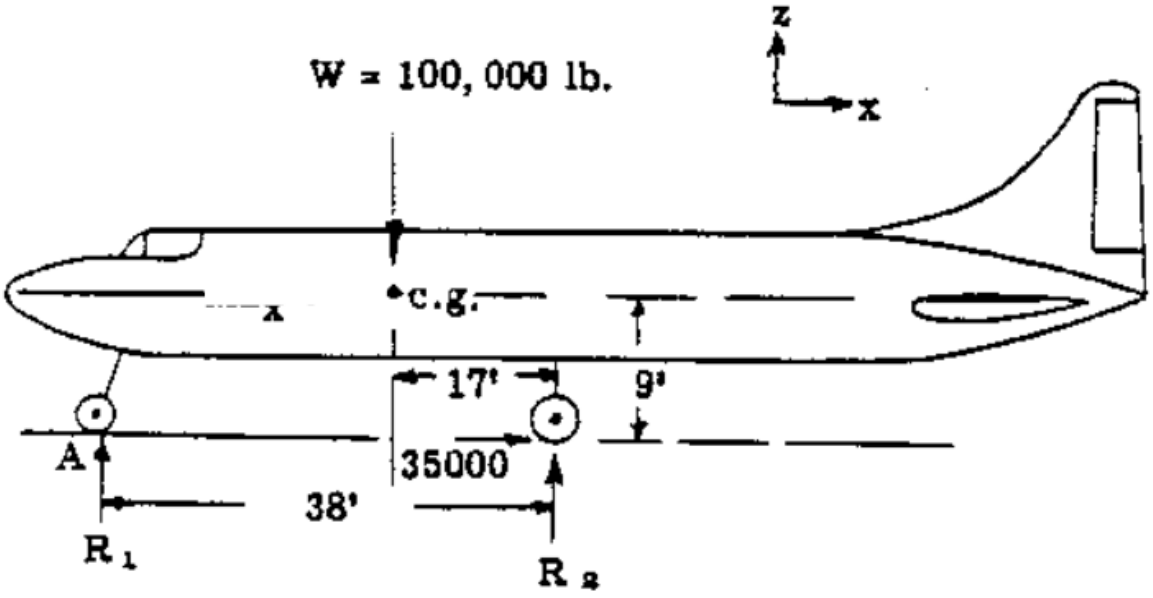
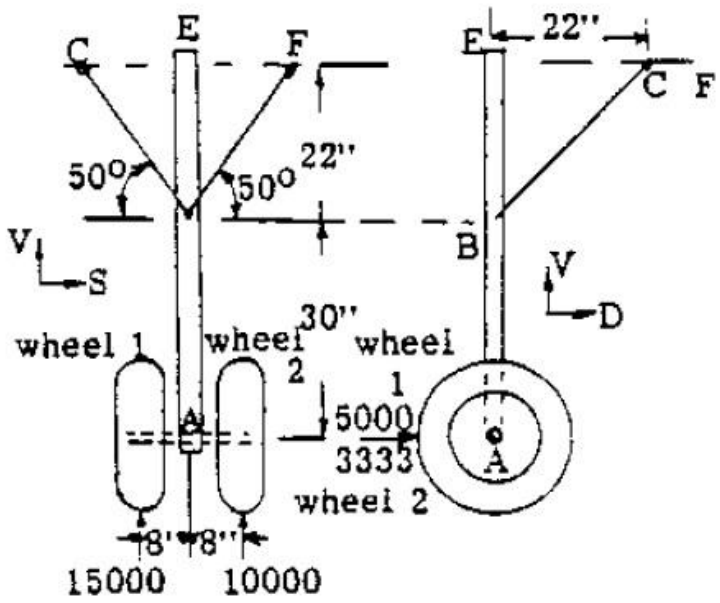


Figure: 2

6) A thin-walled circular section beam has a diameter of 200mm and is 2 m long; it is firmly restrained against rotation at each end. A concentrated torque of 30 kNm is applied to the beam at its mid-span point. If the maximum shear stress in the beam is limited to 200N/mm^2 and the maximum angle of twist to 2°, Determine the minimum thickness of the beam walls. Take G=25000N/mm^2. (4)

7) What is the definition of a beam-column, and where are instances of beam-columns typically observed within aircraft structures? (2)

8) The landing gear as illustrated in Figure 3 is representative of a main landing gear. The brace members BC, BF and BE are two force members. Draw the space force diagram.



(4)

Figure: 3

9) For the above example Q8 (Figure 3), Determine the reaction forces at points C, E and F assuming no side forces. (4)

10) Explain why determining shear centre is important in structural analysis. (2)

11) Elaborate the various steps involved in finding the shear flow and shear centre of a closed section. (4)

12) Figure 4 shows the section of an angle purlin. A bending moment of 3000Nm is applied to the purlin in a plane at an angle of 30° to the vertical y axis. If the sense of the bending moment is such that its components M_x and M_y both produce tension in the positive xy quadrant, estimate the maximum direct stress in the purlin stating clearly the point at which it acts. (4)

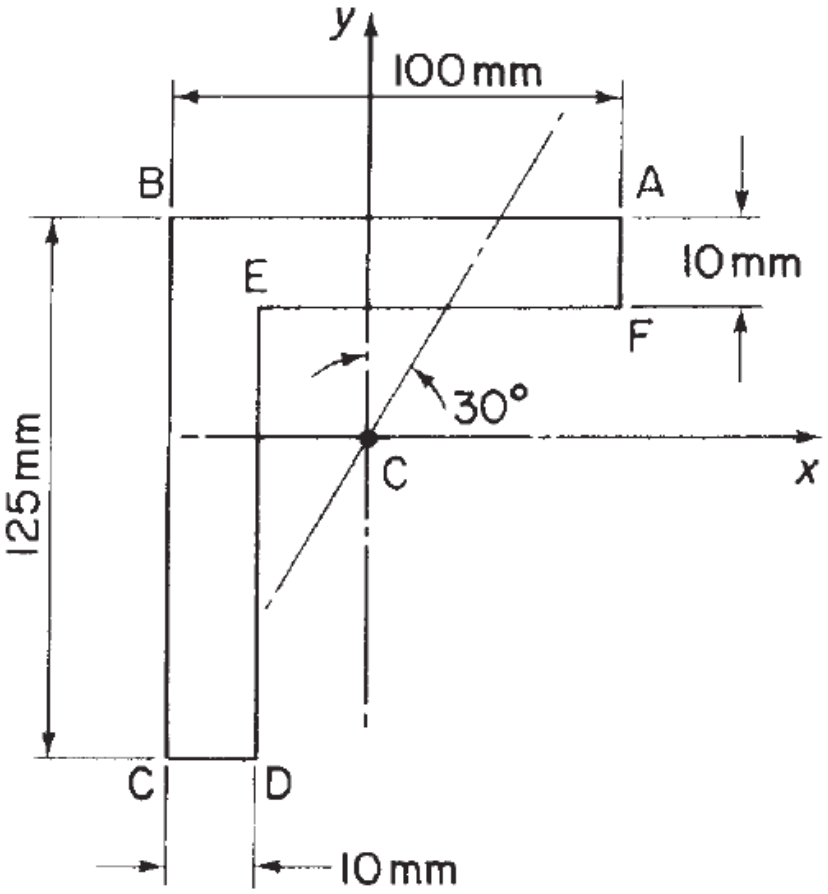


Figure: 4

13) Briefly explain how structural idealisation simplifies complex systems for analysis. (2)

14) Idealize the box section shown in figure 5 into an arrangement of direct stress carrying booms positioned at the four corners and panels which are assumed to carry only shear stresses. Hence determine the distance of the shear centre from the left-hand web. (4)

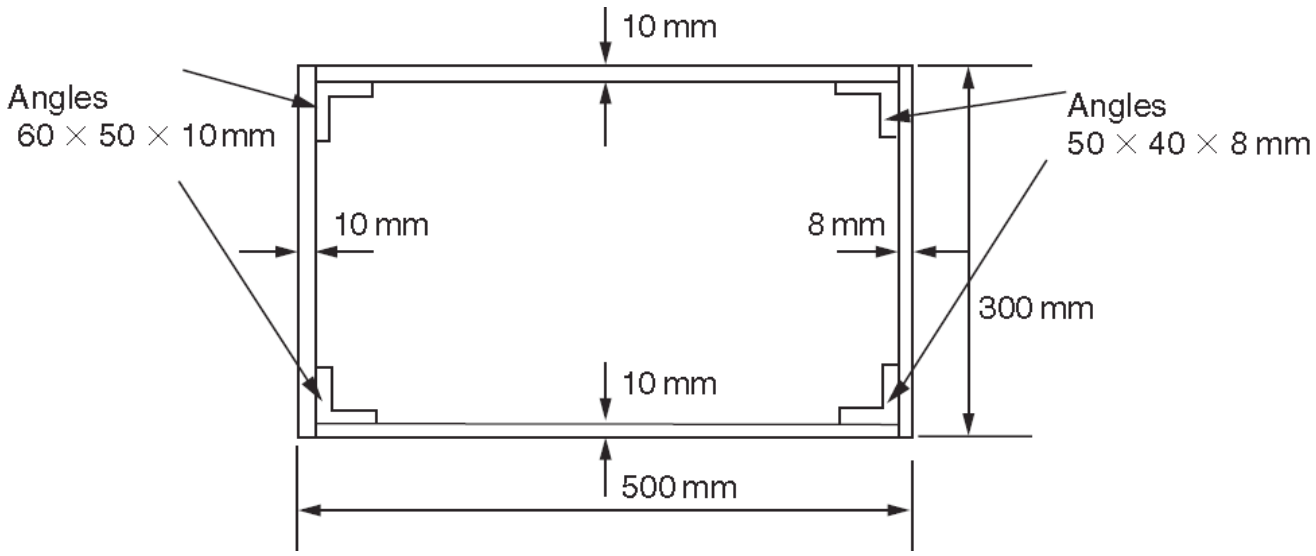


Figure: 5

15) Figure 6 shows the cross-section of a single cell, thin-walled beam with a horizontal axis of symmetry. The direct stresses are carried by the booms B_1 to B_4, while the walls are effective only in carrying shear stresses. Assuming that the basic theory of bending is applicable, Determine the shear flow around the section. The shear modulus G is the same for all walls. Cell area=135000mm^2. Boom areas: B_1 =B_4 =450mm^2, B_2 =B_3 =550mm^2. (4)

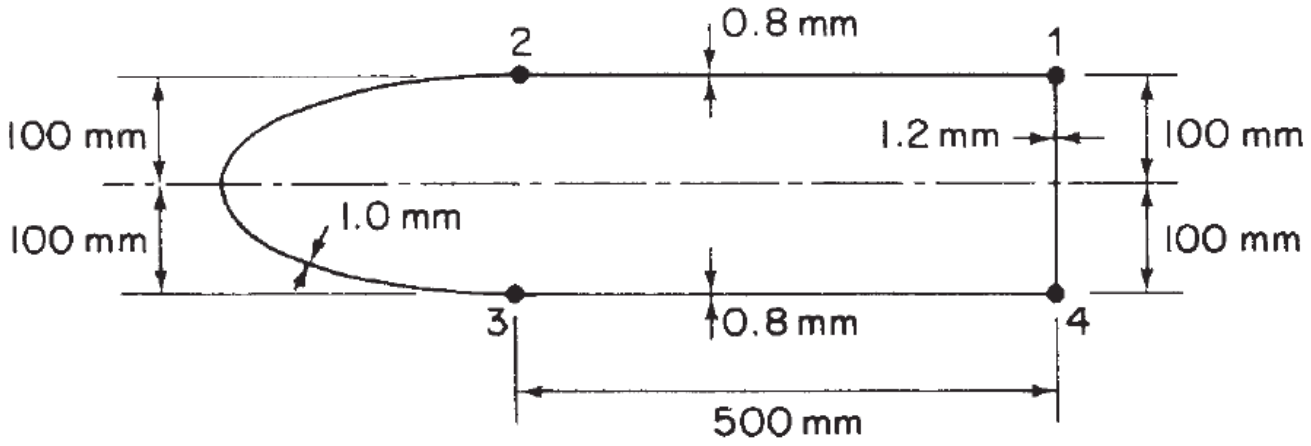


Figure: 6

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