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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023**

COURSE NAME : AIRCRAFT STRUCTURE
COURSE CODE : BDX 30303
PROGRAMME CODE : BDX
EXAMINATION DATE : FEBRUARY 2023
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER **FOUR QUESTIONS ONLY**.
2. THIS FINAL EXAMINATION IS
CONDUCTED VIA **CLOSED BOOK**.
3. STUDENTS ARE **PROHIBITED** TO
CONSULT THEIR OWN MATERIAL OR
ANY EXTERNAL RESOURCES
DURING THE EXAMINATION
CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **FIVE (5) PAGES**

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- Q1** (a) Explain three criteria of symmetrical bending of the beams. Sketch two cross-section of symmetrical beams. (5 marks)
- (b) A fuselage stringer of Airbus A320 having the cross-section shown in **Figure Q1(b)** is subjected to a bending moment of -1500 Nm in a vertical plane. Calculate the coordinate of centroid (\bar{x} , \bar{y}) and maximum direct stress due to bending stating the point at which it acts. (15 marks)
- Q2** (a) State three assumptions made in thin wall sections approximation. Provide the sketch for actual thin wall and approximate representation of the section. (5 marks)
- (b) A wing stringer of Boeing 777 can be modelled as thin-walled beam with the approximate cross-section as shown in **Figure Q2(b)**. The beam is subjected to a bending moment M_x in the plane of the web 23. Prove that the I_{xx} , I_{yy} and I_{xy} of the cross-section are $(10h^3t)/3$, $(5h^3t)/12$ and $(-3h^3t)/4$, respectively. Analyze the beam to determine the direct stress at each point in the beam cross-section. (15 marks)
- Q3** (a) Describe about divergence phenomenon. Explain how it could occur. (5 marks)
- (b) The fuselage of a light passenger-carrying aircraft has the circular cross-section shown in **Figure Q3(b)**. The cross-sectional area of each stringer is 100 mm^2 and the vertical distances given in the figure are to the mid-line of the section wall at the corresponding stringer position. If the fuselage is subjected to a bending moment of 200 kNm applied in the horizontal plane of symmetry, calculate the direct stress distribution. (15 marks)
- Q4** (a) Describe the flutter and buffeting phenomena. (5 marks)
- (b) **Figure Q4(b)** shows a wing spar of Diamond DA62 aircraft. The web of the beam has a thickness of 2 mm and is fully effective in resisting direct stress. The beam tapers symmetrically about its horizontal centroidal axis and the cross-sectional area of each flange is 400 mm^2 . Determine the shear flow distribution in the web of the tapered beam at a section A-A. Sketch the shear flow distribution obtained. (15 marks)

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- Q5** (a) Explain about static dan dynamic aeroelasticity. Give 2 phenomena occur for each type of aeroelasticity. (5 marks)
- (b) The fuselage in **Q3(b)** is subjected to a vertical shear load of 100 kN applied at a distance of 150 mm from the vertical axis of symmetry. As the shear center coincides with the center of symmetry, the loading system could be replaced as shown in **Figure Q5(b)**. From the shear load analysis, q_{b32} , q_{b43} and q_{b54} were obtained as 30.3 N/mm, 53.5 N/mm and 66.0 N/mm, respectively. By using the q_b values given, calculate the distribution of shear flow in the section. (15 marks)

– END OF QUESTIONS –

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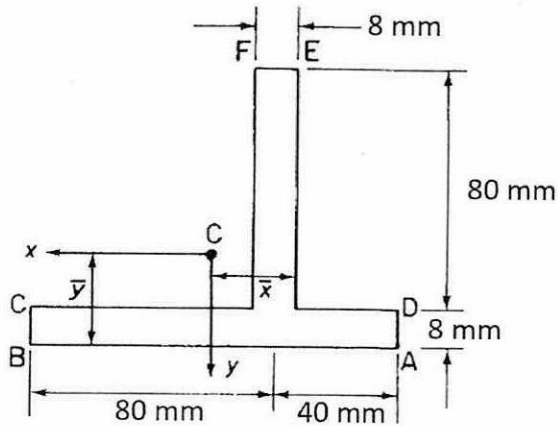


Figure Q1(b)

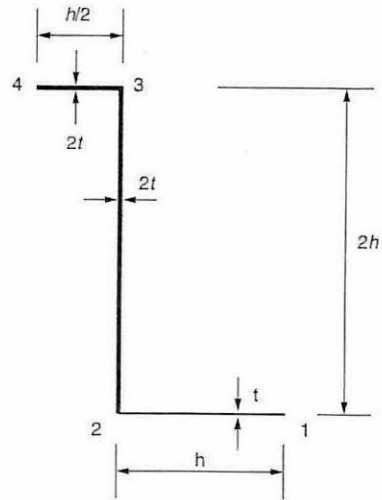


Figure Q2(b)

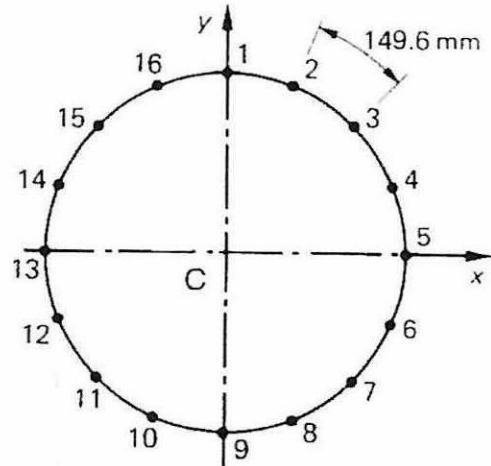
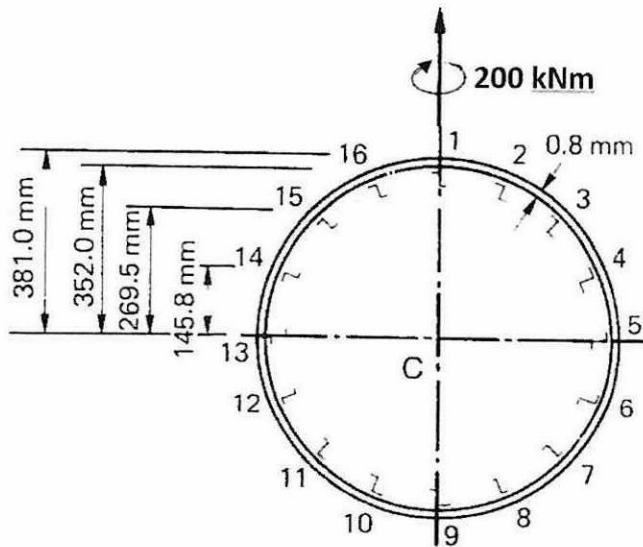


Figure Q3(b)

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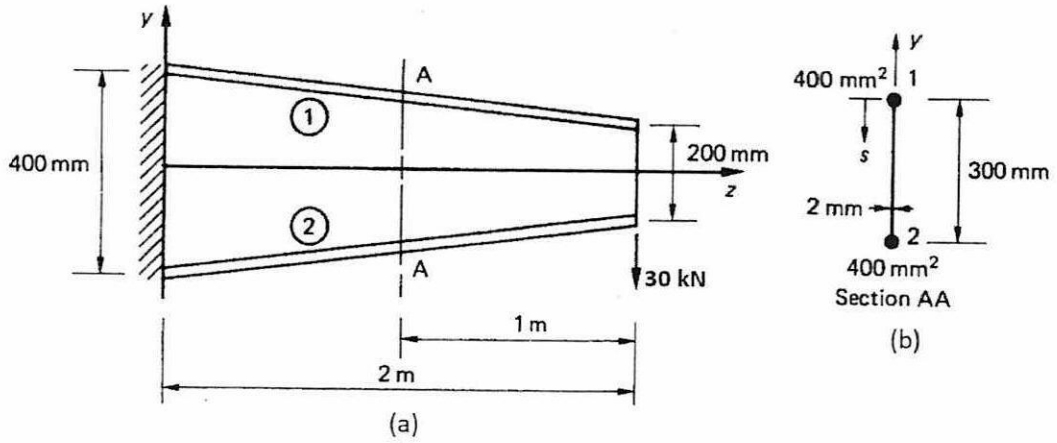


Figure Q4(b)

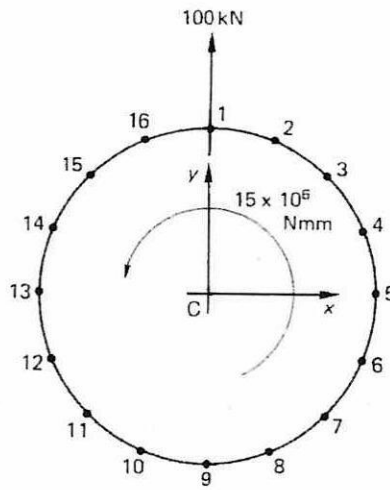


Figure Q5(b)

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