



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

Complete, fold and seal
(see note 2 below)

SURNAME:

Ahmed

FORENAME(S):

Uzayr

1	Student Number	P148023
2	Title of Examination Paper	CAE + Stress analysis
3	Module Code	M3X02064
4	Date and Time of Examination	12pm 09/08/19 I2-310
5	Examination Venue	I2-310
6	Seat Number	6033
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	17
2	17
3	11
Total	45



(1) a) Prove $\sigma_H = \frac{PD}{2t}$

$\therefore \text{Internal Force} = \text{Pressure} \times \text{Projected Area}$
 $= P \times DL$

$\therefore \text{Resistant Force} = 2\sigma_H \times tL$

$\therefore \text{Internal} = \text{Resistant} \rightarrow \therefore PDL = 2\sigma_H tL$

$\therefore \sigma_H = \frac{PDL}{2tL} = \frac{PD}{2t}$

b) $\sigma_H \text{ MAX} = 200 \times 10^6 \text{ Pa}$, $\phi = 3.5 \text{ m}$, $t = 0.5 \times 10^{-3} \text{ m}$

(i) $\therefore \sigma_H = \frac{PL}{2t}$

$\therefore P_{\text{int}} = \frac{\sigma_H 2t}{D} = \frac{200 \times 10^6 \times 2 (0.5 \times 10^{-3})}{3.5} = 57142857.14 \text{ Pa}$
 $= 57.1 \text{ KPa}$

Pressure at sea level from table 1 = 101 KPa

$\therefore 101 \text{ KPa} - 57.1 \text{ KPa} = 43.9 \text{ KPa}$

$\therefore \text{From table max altitude with } P = 43.9 \text{ KPa} = 20,000 \text{ ft}$

(ii) Pressure at 8000 ft = 75.3 KPa

$\therefore 75.3 \text{ KPa} - 57.1 \text{ KPa} = 18.2 \text{ KPa}$

$\therefore \text{From table max altitude with } P = 18.2 \text{ KPa} = 40,000 \text{ ft}$

c) Allow plane to fly higher where air is less dense, leading to more efficient flight

(1) 2) Prove $\sigma_H = \frac{P_d}{4t}$

$$\text{Internal force} = \frac{P \times \pi D^2}{4}$$

$$\text{Resistant force} = \cancel{2\sigma_H \pi D t} \quad 2\sigma_H 4\sigma_H \pi D t$$

$$\text{Internal} = \text{Resistant} \therefore \frac{P \pi D^2}{4} = 2\sigma_H \pi D t$$

$$\therefore \sigma_H = \frac{P \pi D^2}{4 \pi D t} =$$

$$\frac{P D}{4 t}$$

$$\text{Internal force} = P D \pi$$

$$\text{Resistant force} = 4\sigma_H \pi D t$$

$$\text{Internal} = \text{Resistant} \therefore P D \pi = 4\sigma_H \pi D t$$

$$\therefore \sigma_H = \frac{P}{4t}$$

$$\text{Internal force due to pressure} = P \times D \pi$$

$$\text{Resistant force} = \cancel{4\sigma_H \pi D t} \quad 4\sigma_H \pi D t$$

$$\text{Internal} = \text{Resistant} \therefore P D \pi = 4\sigma_H \pi D t$$

$$\therefore \sigma_H = \frac{P D \pi}{4 \pi D t} =$$

$$\frac{P}{4t}$$

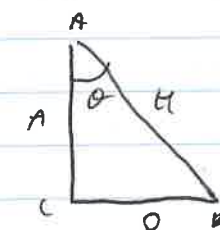
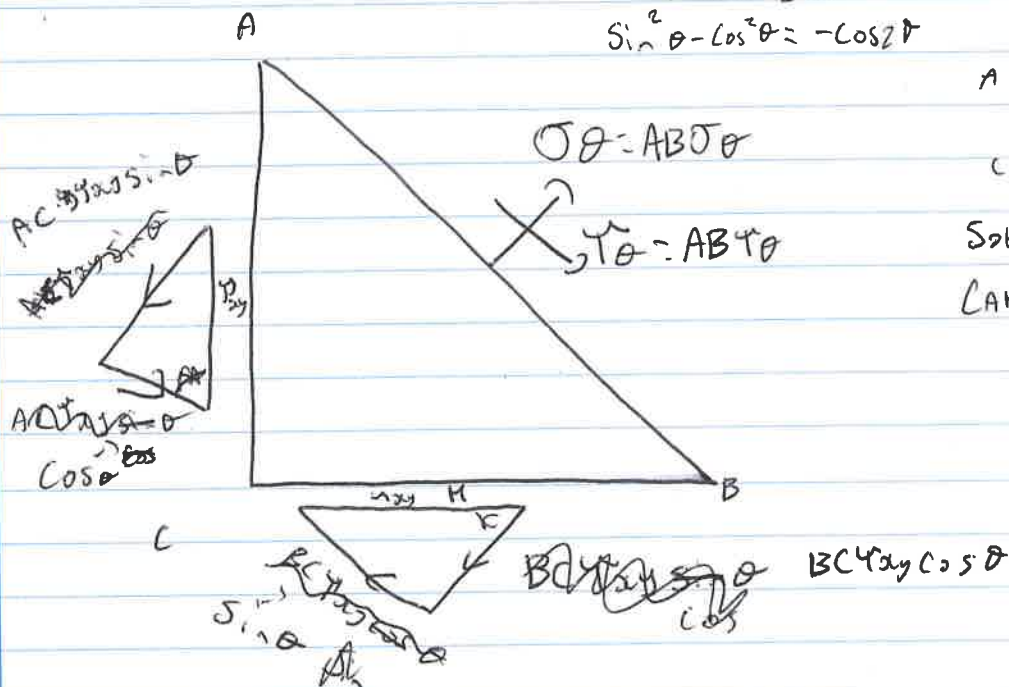
(4)

- (2) a) Principle stress is the min/max value of stress on a plane for an element. Principle plane is the angle at which these min/max values occur.

b) (i) Shear stress only, Prove $\sigma_\theta = \tau_{xy} \sin 2\theta$

$$\sin \theta \cos \theta = \frac{1}{2} \sin 2\theta$$

$$\sin^2 \theta - \cos^2 \theta = -\cos 2\theta$$



$$\sin \theta = \frac{BC}{AB}$$

$$\cos \theta = \frac{AC}{AB}$$

Normal $\rightarrow$ $\tau = \tau$

~~$$\sigma_\theta = \frac{AC}{AB} \tau_{xy} \sin \theta + \frac{BC}{AB} \tau_{xy} \cos \theta$$~~

~~$$\sigma_\theta = \frac{AC}{AB} \tau_{xy} \cos \theta + \frac{BC}{AB} \tau_{xy} \sin \theta$$~~

~~$$\sigma_\theta =$$~~

$$\therefore \sigma_\theta = \frac{AC}{AB} \tau_{xy} \sin \theta + \frac{BC}{AB} \tau_{xy} \cos \theta$$

$$\sigma_\theta = \tau_{xy} \sin \theta \cos \theta + \tau_{xy} \sin \theta \cos \theta$$

$$\sigma_\theta = \tau_{xy} \frac{1}{2} \sin 2\theta + \tau_{xy} \frac{1}{2} \sin 2\theta$$

$$(2) \sigma_{\theta} = \frac{1}{2} T_{xy} \sin 2\theta + \frac{1}{2} T_{xy} \sin 2\theta$$

$$= T_{xy} \sin 2\theta$$

$$(ii) \downarrow = \uparrow$$

$$AB T_{\theta} + AC T_{xy} \cos \theta = BC T_{xy} \sin \theta$$

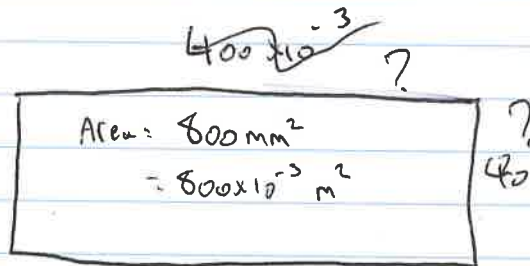
$$\therefore T_{\theta} = \frac{BC}{AB} T_{xy} \sin \theta - \frac{AC}{AB} T_{xy} \cos \theta$$

$$\therefore T_{\theta} = T_{xy} \sin^2 \theta - T_{xy} \cos^2 \theta$$

$$\therefore T_{\theta} = -T_{xy} \cos 2\theta$$

(C) C.S.A = 800 mm^2 , tensile force = $45 \times 10^3 \text{ N}$ at each end, find Normal + Shearing Stress at 20° to loading

$$\sigma = \frac{F}{A}$$



tensile force

$$\theta = 20^\circ$$

$$2\theta = 40^\circ$$

$$\sigma_x =$$

$$\sigma_y =$$

$$\sigma_{\theta} = \frac{1}{2} (\sigma_x + \sigma_y) + \frac{1}{2} (\sigma_x - \sigma_y) \cos 2\theta$$

$$\sigma_{\theta} = \frac{1}{2} \left(\sigma = \frac{F}{A} = \frac{45 \times 10^3 \text{ N}}{800 \times 10^{-3} \text{ m}^2} = 56250 \text{ N m}^{-2} \right)$$

$$= 56.25 \text{ KN m}^{-2}$$

$$\sigma_{\theta} = \frac{1}{2} (56.25 + 56.25) + \frac{1}{2} (56.25 - 56.25) \cos 2\theta$$

= force on each end, so plane doesn't matter

$$\sigma_{\theta} = \frac{1}{2} (56.25 + 56.25) + \frac{1}{2} (\sigma_x - \sigma_y) \cos 2\theta$$

(2) (1) $\sigma_{\theta} = \frac{1}{2} (86.25 + 86.25) + \frac{1}{2} (86.25 - 86.25) \cos(2 \times 20)$

$$\sigma_{\theta} = \frac{1}{2} (112.5) + \frac{1}{2} (0) \cos 40$$

$$\sigma_{\theta} = \frac{1}{2} (112.5) + 0$$

$$\sigma_{\theta} = 56.25 \text{ KNm}^{-2} = \text{Normal Stress}$$

$$\tau_{\theta} = \frac{1}{2} (86.25 - 86.25) \sin 40$$

$$= \frac{1}{2} (0) \sin 40$$

(=0) $\rightarrow$ No Shear Stress

X (4)

③ (a) Design Problem can have many different equally viable ~~design~~ solutions whereas an analysis problem only has 1 correct solution.

/ (3)

(b) Design Problem is iterative because, even if your product/solution meets design criteria objectives, there is potential for improvements in several areas. Analysis problems are sequential, you analyse data, manipulate differential equations, one after the other till you reach the end point/solution.

/ (5)

(c) British Standard made from 2004, focuses more on ergonomics but doesn't state when in the design process this should occur.

(3)

French - 2004 1984, focuses more on safety + regulations.

Question No.

Examiner O

Question No.

Examiner's On

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Arholwr yn unig

Question No.

Examiner O

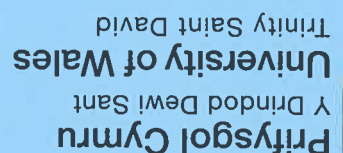
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12 Tudalen

8. Rhaid dychwelyd pob llyfr. Ni chanafeir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

[illegible]