



12 Pages

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.**

1	Student Number	150600
2	Title of Examination Paper	CAE + Stress Analysis
3	Module Code	M5002064
4	Date and Time of Examination	09/05/19
5	Examination Venue	1Q 310
6	Seat Number	49
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	10
2	20
3	9
Total	39

(Gweler yr ochr arall am y fersiwn Cymraeg)

657



1). Force due to pressure = Area of material it acts
 $p \cdot d \cdot L = \sigma_H \cdot L \cdot t \cdot 2$
 $\sigma_H = \frac{p \cdot d \cdot L}{2Lt} = \frac{pd}{2t}$

$$\sigma_H = \frac{pd}{2t}$$

b) $\sigma_{H \max} = 200 \text{ MPa}$ Fuselage = 3.5 m d
 $t = 0.5 \times 10^{-3} \text{ m}$ $P = \rho gh$

determine $h_{\max}$ to nearest 500 ft.

i) $P = \frac{\sigma_H \cdot 2t}{d} = \frac{(200 \times 10^6)(2)(0.5 \times 10^{-3})}{3.5} = 57.143 \text{ kPa (A)}$

Assuming $\rho = 1$ $g = 9.81$

~~max altitude = 15,000 ft~~ $h = \text{height}$.

~~iii)~~ $P = \frac{\sigma_H \cdot 4t}{d} = \frac{(200 \times 10^6)(4)(0.5 \times 10^{-3})}{3.5}$

$h = \frac{P}{\rho g} = 114.286 \text{ kPa}$

$h = \frac{114.286 \times 10^3}{(9.81)(1)} = 11.649 \text{ m} = 4000 \text{ ft.}$

ii) $h = \frac{75.3 \times 10^3}{(9.81)(1)} = 7.676 \text{ m} = 2500 \text{ ft}$

c) ~~Pressurizing the cabin reduces higher than the atmospheric pressure results in lower stresses on the plane structure allowing for higher altitudes to be reached.~~

pressurizing the cabin to a similar P as atmospheric reduces stress on the structure

shown by $\sigma_H = \frac{Pd}{2t}$ $P = \text{pressure difference.}$

AND?

d) Force due to p on $\frac{1}{2}$ sphere = Material Resisting

$$\frac{P \cdot \pi d^3}{4} = \sigma_H \cdot \pi \cdot t \cdot d$$

$$\text{Stress} = \frac{F}{A}$$

$$A = \text{circumference} \times t$$

$$\therefore \sigma_H = \frac{P \pi d^3}{4 t d \pi} = \frac{P d}{4 t}$$

e) Spherical tanks are able to cope with higher stresses than cylindrical tanks, so due to σ_H sphere = $\frac{1}{2}$ σ_H cylinder. But although, cylindrical tanks are cheaper to produce ~~and~~ making them the primary ~~for~~ choice for containment where possible.

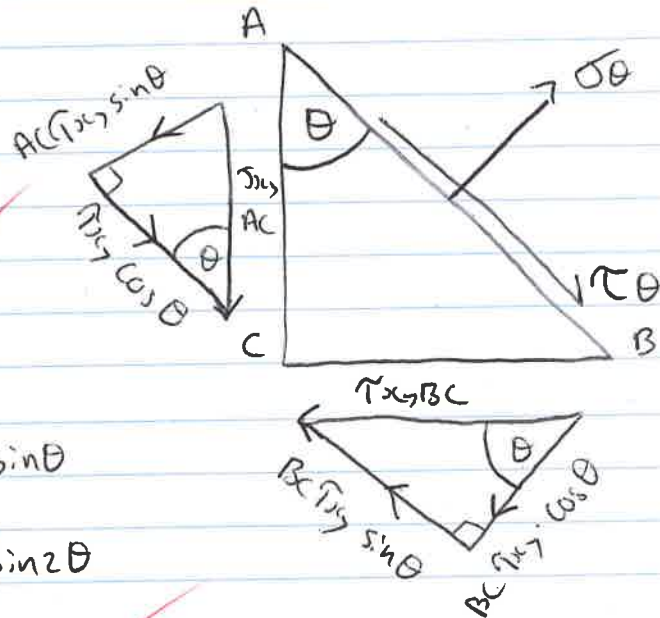
2. Principle stress = Maximum and minimum value of stress that an element experiences. Magnitude only.

Principle plane = The plane on which the Max or Min stresses act in 0

(3)

i) Normal Stress

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



$$\begin{aligned} \sigma_{\theta} &= \sin \theta \tau_{xy} \cos \theta + \cos \theta \tau_{xy} \sin \theta \\ &= \tau_{xy} \frac{1}{2} \sin 2\theta + \tau_{xy} \frac{1}{2} \sin 2\theta \end{aligned}$$

$$\therefore \sigma_{\theta} = \tau_{xy} \cdot \sin 2\theta$$

(5)

ii) Shear stress

$$\begin{aligned} \tau_{\theta AB} + \tau_{xy} \cos \theta AC &= BC \tau_{xy} \sin \theta \\ \tau_{\theta} + \tau_{xy} \cos^2 \theta &= \tau_{xy} \sin^2 \theta \\ \tau_{\theta} + \tau_{xy} \frac{1}{2} (1 + \cos 2\theta) &= \tau_{xy} \cdot \frac{1}{2} (1 - \cos 2\theta) \end{aligned}$$

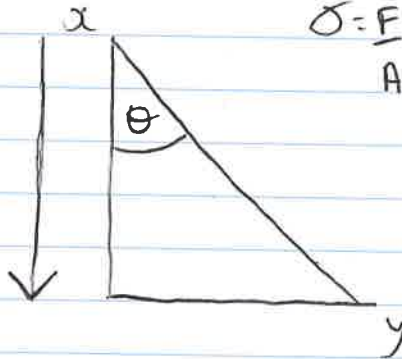
$$\tau_{\theta} + \frac{1}{2} \tau_{xy} + \frac{1}{2} \tau_{xy} \cos 2\theta = \frac{1}{2} \tau_{xy} - \frac{1}{2} \tau_{xy} \cos 2\theta$$

$$\tau_{\theta} = \frac{1}{2} \tau_{xy} - \frac{1}{2} \tau_{xy} \cos 2\theta - \frac{1}{2} \tau_{xy} - \frac{1}{2} \tau_{xy} \cos 2\theta$$

$$\begin{aligned} \tau_{\theta} &= -\frac{1}{2} \tau_{xy} \cos 2\theta - \frac{1}{2} \tau_{xy} \cos 2\theta \\ &= -\tau_{xy} \cdot \cos 2\theta. \end{aligned}$$

(5)

c) Area = $800 \times 10^{-6} \text{ m}^2$ tensile force = $45 \times 10^3 \text{ N}$
 $\theta = 20^\circ$



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

$$\sigma_x = \frac{45 \times 10^3 \text{ N}}{800 \times 10^{-6}} = 56.25 \text{ MN m}^{-2}$$

Normal Stress

Shear Stress

$$\sigma_\theta = (0.5)(56.25 \times 10^6) + (0.5)(56.25 \times 10^6) \cos(40)$$

$$\tau_\theta = (0.5)(56.25 \times 10^6) (\sin(40))$$

$$\tau_\theta = 18.078 \text{ MN m}^{-2}$$

$$\sigma_\theta = 49.67 \text{ MN m}^{-2}$$

(7)

3. A Design problem is more subjective to ~~part~~ geometry where as analysis problem is whether the part can do its job or not.

(2)

b) Design considered iterative because many designs can all have the same functionality but different geometry. Analysis problem is sequential because there are set requirements for a product to meet.

(3)

c) Identifying the problem.

- is the problem real, are assumptions correct
- does it meet customer satisfaction

Research problem

- has another solution been found

Generate Ideas

- Brainstorm on possible solutions
- use diagrams to illustrate information
- gather a team of people from various disciplines to maximise creativity

Analyse + select solution

Functional analysis, Mechanical analysis
Safety requirements

implement solution and improve

- Create prototype for testing under real conditions
- Complete legislative documents
- Obtain protection for your design.

(3)

Question No.

Examiner

Arholwr yn unig

ty Cwestiwn

Question No.

Examiner C

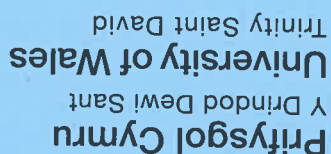
Question No.

Examiner

Arholwr yn unig

ty Cwestiwn





12 Tüdalen

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plynwch et a'i sello i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgriften ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgrifft annarllennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgriennwch eich atebion mewn inc.

- b. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw ffras nodiadau yn y llyfr atebion a thynnu llinell drwyddlynt.

- b. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwylwlr/gwylwyr.

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

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Archoliad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

[illegible]

(See the other side for English version)

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF: