



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.**

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FORENAME(S): HAB TOM

1	Student Number	1810854
2	Title of Examination Paper	CAE & STRESS ANALYSIS
3	Module Code	M5X02064
4	Date and Time of Examination	09/05/19
5	Examination Venue	I8
6	Seat Number	G044
7	Number of Answer Books handed in	3

List the numbers of the questions you have attempted	Office Use
1	10
2	18
3	$8\frac{1}{2}$
Total	$36\frac{1}{2}$

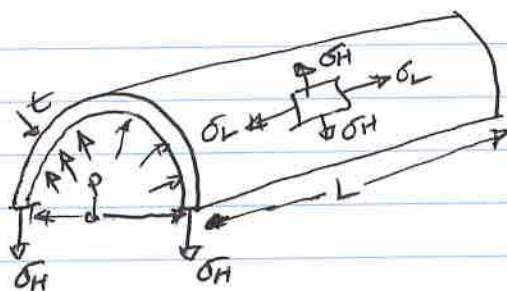
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60.8%



#1.

a.



Resolving the forces acting on the thin cylinder.
Upward Force = downward force.

Proj Pressure to the cylinder $\times$ Area of cylinder = Hoop stress $\times$ total Area of cyl.

$$P \cdot \pi d L = \sigma_H \times (2tL)$$

$$P \cdot d = 2\sigma_H t$$

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

where.

σ_H = Hoop stress

P = Pressure inside cylinder.

d = internal diameter of the cylinder.

t = thickness of cylinder.

Given.

b.

Material Al7075

$$\sigma_H = 200 \text{ MPa}$$

$$d = 3.5 \text{ m}$$

$$t = 0.5 \text{ mm} = 0.5 \times 10^{-3} \text{ m}$$

$$P = \rho g h$$

$$(i) 500 \text{ ft} = 99.5 \text{ kPa}$$

$$h = ?$$

Solution

$$\rho = 1700 \text{ kg/m}^3$$

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

$$P = \frac{\sigma_H 2t}{d}$$

$$P = \frac{200 \times 10^6 \text{ Pa} \times 2 \times 0.5 \times 10^{-3} \text{ m}}{3.5 \text{ m}}$$

$$P = 57.14285 \text{ kPa}$$

$$\text{Pressure} = \text{Pressure at sea level} + P =$$

$$P_{\text{pressure}} = 99.5 \text{ kPa} + 57.143 \text{ kPa} = 156.643 \text{ kPa}$$

$$P = \text{Pressure} = 101 \text{ kPa} + 57.14285 = 158.143 \text{ kPa}$$

$$\text{Pressure} = 0 + 57.14285 \text{ kPa}$$

$$P = 57.14285 \text{ kPa}$$

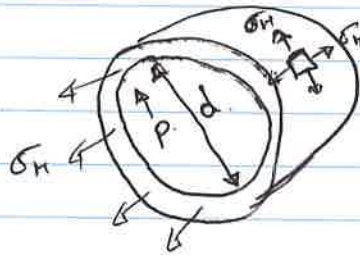
$$(ii) P = 57.14285 \text{ kPa}, P_{\text{at sea level}} = 101 \text{ kPa}$$

$$800 \text{ ft} = 75.3 \text{ kPa}$$

$$P = 57.143 \text{ kPa} + 75.3 \text{ kPa} = 132.443 \text{ kPa}$$

$$P = 57.14285 + 101 = 158.143 \text{ kPa}$$

d.



Resolving of the Forces = 0.

Forces by the pressure inside sphere = Forces in the circumference of sphere.

Pressure * Area inside sphere = Hoop stress * Circumference.

$$P * \frac{\pi d^2}{4} = \sigma_H * \pi d t$$

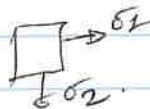
$$P * \frac{d^2}{4} = \sigma_H * d t$$

$$\boxed{\sigma_H = \frac{P d}{4 t}}$$

- e. Because the stress on the cylinder and sphere is different. In cylinder hoop stress and (pressure). Because the pressure exerted by with projected Area are different, the project Area in cylinder = $\pi d L$ but in sphere circumference $\left(\frac{\pi d^2}{4}\right)^{\frac{1}{2}}$

2.

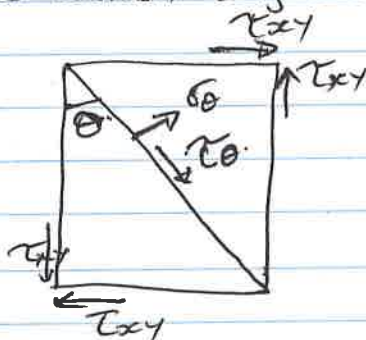
(a) Principal stresses: ~~are~~ the stresses ~~generated~~ ~~happened~~ to the principal plane. (σ_1, σ_2)



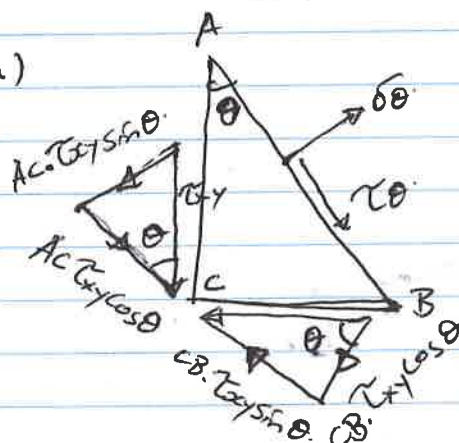
Principal plane: is the stress ~~are~~ is a plane which the stresses are acted on it (plane).

(2)

(b) Stress element subjected to shear stress, τ_{xy}



(i)



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

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

Resolve ~~perpendicular~~ force with plane AB.

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

$$\frac{AC}{AB} \cdot \tau_{xy} \sin \theta + \frac{CB}{AB} \tau_{xy} \cos \theta = \frac{\sigma_{\theta} \cdot AB}{AB}$$

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

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

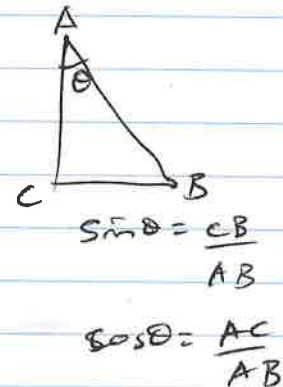
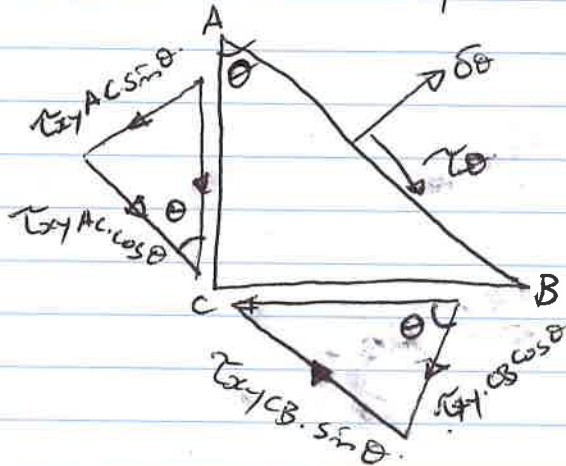
$$\tau_{xy} \left(\frac{1}{2} \sin 2\theta \right) + \tau_{xy} \left(\frac{1}{2} \sin 2\theta \right) = \sigma_{\theta}$$

$$\sin 2\theta \left(\frac{\tau_{xy}}{2} + \frac{\tau_{xy}}{2} \right) = \sigma_{\theta} \Rightarrow$$

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

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

(ii) Shear stress on the plane.



Resolving //el forces.

$$\tau_{xy} \cdot CB \cdot \sin \theta - \tau_{xy} AC \cdot \cos \theta = \tau_\theta \cdot AB$$

$$\frac{\tau_{xy} \cdot CB \cdot \sin \theta}{AB} - \frac{\tau_{xy} AC \cdot \cos \theta}{AB} = \tau_\theta \cdot \frac{AB}{AB}$$

$$\tau_{xy} \sin \theta \cdot \sin \theta - \tau_{xy} \cos \theta \cdot \cos \theta = \tau_\theta$$

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

$$\tau_{xy} (\sin^2 \theta - \cos^2 \theta) = \tau_\theta \quad \therefore$$

$$\text{but, } \sin^2 \theta - \cos^2 \theta = -\cos 2\theta$$

$$\tau_{xy} (-\cos 2\theta) = \tau_\theta$$

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

(C)

Give:

$$A = 800 \text{ mm}^2$$



$$\sigma_y = \frac{F}{A} = \frac{45 \times 10^3 \text{ N}}{800 \times 10^{-6} \text{ m}^2} = \frac{45 \times 10^9}{800} = \frac{45 \times 10^7}{8} \frac{\text{N}}{\text{m}^2}$$

$$\sigma_y = 56.25 \times 10^6 \text{ N/m}^2$$

$$\sigma_y = 56.25 \text{ MPa}$$

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

$$\sigma_x = 0, \tau_{xy} = 0$$

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

$$\sigma_{\theta} = \frac{1}{2}(56.25 \text{ MPa}) + \frac{1}{2}(-56.25 \text{ MPa}) \cos 40^\circ$$

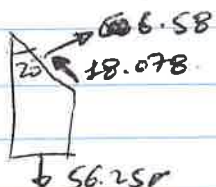
$$\sigma_{\theta} = 28.125 \text{ MPa} - 21.5449 \text{ MPa}$$

$$\sigma_{\theta} = \underline{\underline{6.58 \text{ MPa}}} \text{ (Tensile)}$$

$$\tau_{\theta} = \frac{1}{2}(\sigma_x - \sigma_y) \sin 2\theta, \sigma_x = 0$$

$$\tau_{\theta} = \frac{1}{2}(-\sigma_y) \sin 40^\circ = \frac{1}{2}(-56.25) \sin 40^\circ \text{ MPa}$$

$$\tau_{\theta} = \underline{\underline{-18.078 \text{ MPa}}} \text{ (compressive)}$$



! All stress in MPa

(6)

3.

(a) Design problem and an Analysis problem.

Design problem is vaguely or not understood

Design problem is the problem solution of a design which is to fulfill customer needs, but design problem's specifically meets the specification of the properties, determine the problem with a cyclic (iterative) method. It may be usage, unsolved or the design may not work.

Analysis problem is only one answer to any design, which gives the solution without flexibility, it is the primarily sequential.

3

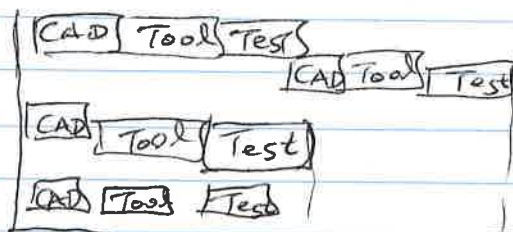
(b) Design problem is an iterative process (cyclic process) which means design problem has a degree of freedom to back for each process in order to get a ~~plus~~ close or good output for the product design. Iterative process is a process which gives an option to back for the steps in the process and assess each individual, so design problem assess each step & back if the result is not performed.

2 1/2

(c) Descriptive theories are carried out to design process to this level.

1/ French model 1. Historical of Design. (CAD →)

2.

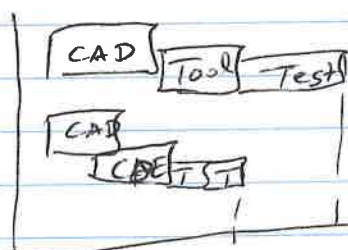


Historical of Design (CAD). (CAD led process).

The step start with CAD → Tool Basic Tools → Test Parts.
which is in iterative method.

And 2nd step

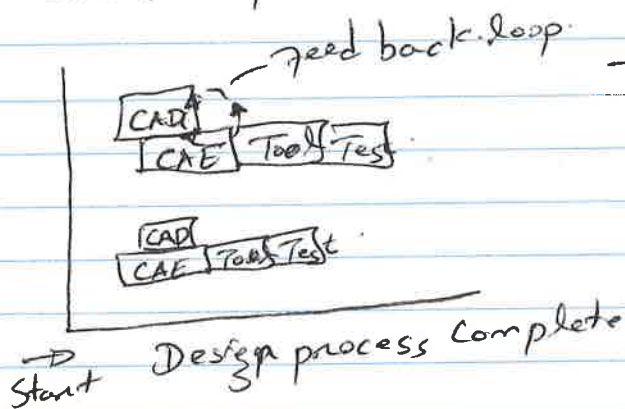
2. CAD with CAE. (The process led with CAD).



CAD Assessment CAD.

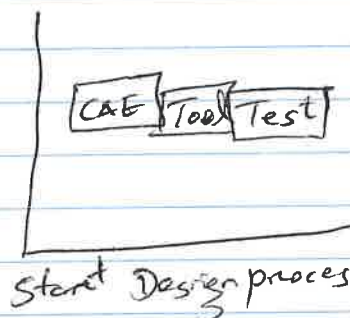
* CAD is complete the gear process and it takes time.

3. CAE led process.



The process

4. CAE led the design process.



CAE Assessment CAE.

completed.

* CAE is complete the process. It takes less time & cost.

Advantage.

- CAD

3

Question No.

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Question No.

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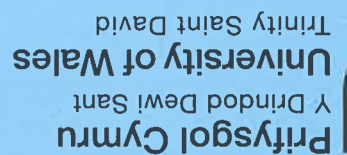
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Examiner Only

Question No.

Examiner Only





Cyfarwyddiadau i Ymgeiswyr

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

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

4. Ysgriftennwn eich atebion mewn inc.
5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
6. Ni ddylid rhwygo 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 gwylwllwr/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 amgylchiadau.

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

[illegible]

(See the other side for English version)

Llenwch, plynwch a seliwch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF: