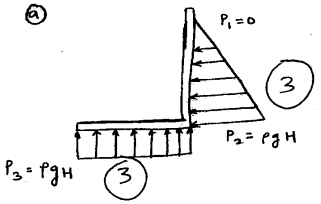
T1AM 202 Prelim 2. Grading Scheme.

(16) P.1) (by Tian Tang)

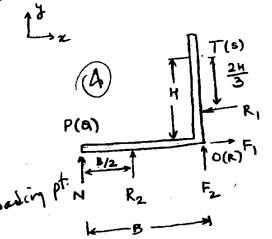
(a)



If no distrib (-1)
If shape OK, but mag wrong (-1)

(b)

(16)



each error at loading pt. (-1)

$R_1 = \bar{P}_{OTSR} \cdot A_{OTSR}$

$= \frac{0 + \rho g H}{2} \cdot HW$

$\boxed{R_1 = \frac{1}{2} \rho g H^2 W}$ (1) -① ←

$R_2 = \bar{P}_{OPQR} \cdot A_{OPQR}$

$R_2 = \rho g H (W B)$

$\Rightarrow \boxed{R_2 = \rho g H W B}$ (1) -② ←

(13) (c) use FBD above

$\Sigma M_{/OR} = 0 \Rightarrow R_1 \cdot \frac{H}{3} - R_2 \frac{B}{2} - N \cdot B = 0$ — ③ (3~4 equiv eqn)

sub. ① and ② into ③ $\Rightarrow N = \frac{\rho g H W}{6B} (H^2 - 3B^2)$ -④

* Note that N is total force of the line load along QP so the line load along QP will be

$\bar{N} = \frac{N}{W} \Rightarrow \boxed{\bar{N} = \frac{\rho g H}{6B} (H^2 - 3B^2)}$ — ⑤ ←

-2 algebra or numerical errors

(-1)

$\Sigma F_x = 0 \Rightarrow F_1 - R_1 = 0 \Rightarrow \boxed{F_1 = \frac{1}{2} \rho g H^2 W}$ — ⑥

$\Sigma F_y = 0 \Rightarrow N + R_2 + F_2 = 0 \Rightarrow F_2 = -(N + R_2)$

$\boxed{F_2 = -\frac{\rho g H W}{6B} (H^2 + 3B^2)}$ -⑦

(2)

* Note that there are two hinges O and R and forces F_1 & F_2 are sum of the forces at O and R and because of symmetry forces at O & R will be half of F_1 and F_2.

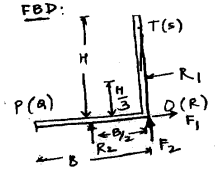
$\boxed{F_{Rx} = F_{Ox} = \frac{F_1}{2} = \frac{1}{4} \rho g H^2 W}$ -⑧ ←

$\boxed{F_{Ry} = F_{Oy} = \frac{F_2}{2} = -\frac{\rho g H W}{12B} (H^2 + 3B^2)}$ -⑨ ←

(d) when the gate is just pushed open, the normal force along QP is equals to zero.

(8)

FBD:



$\Sigma M_{/OR} = 0$

$\Rightarrow R_1 \cdot \frac{H}{3} - R_2 \cdot \frac{B}{2} = 0$ -⑩

sub ① & ② into ⑩

$\frac{1}{2} \rho g H^2 W \cdot \frac{H}{3} = \rho g H W B \frac{B}{2}$

$\Rightarrow \boxed{H = \sqrt{3}\, B}$ -⑪ ←

Concept of $\bar{N} = 0$ (6)

Algebra (2)

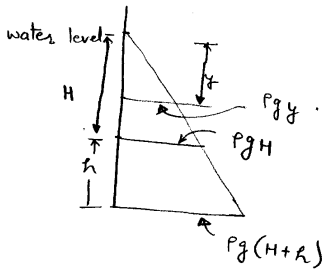
Prelim 2. Q. 1 Comments (by: Pankaj)

1a)

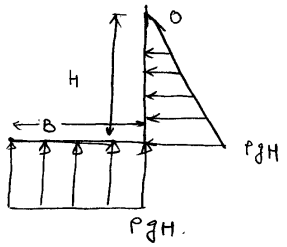
assumption - i) weight of gate = 0
ii) atmospheric pressure = 0

pressure in static water is same in all the directions at any point and force due to pressure is perpendicular to the surface under consideration.

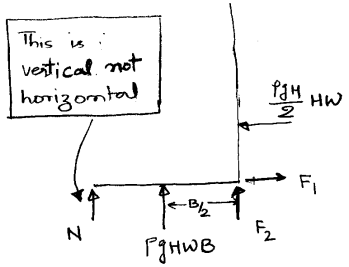
Variation of pressure with depth



so the so the pressure on the gate



Pressure Distribution



FBD

Note: 1. some of you tried to use Buoyancy force surprisingly you would get correct force distribution on the bottom. by

Area of bottom face = WB.

B = weight of water displaced = ρgV

= ρg HWB (↑)

pressure distibution of bottom face (uniform)

$$= \frac{\rho g H W B}{W B} = \rho g H.$$

but you need to realize that the horizontal force on the gate due to water pressure is not zero (which is not the case with submerge objects because they have water all around them) but in this case there is no water on left side of gate to compensate the pressure force on right side of the gate.

1c) There are two hinges at O and R so forces will be devided between them equally

1d) when gate just opens the force on lip PQ will be zero because there wont be any contact.

Grading Comeents:

(PC1) - Algebra mistake

(PC2) - mistake carried over

(PC3) - when gate opens $f_{ap} = 0$

(PC4) - forces at each hinge will be half of total forces.

TAM 202

Grading scheme & comments for Problem 2, Prelim 2

2 a) i) Force on Washer L, $F_L = 3000$ KN.
ii) Force in upper rod, $F_U = 6000$ KN.
iii) Force on washer at R, $F_R = 6000$ KN.

Comments: Full marks if all three parts correct & FBD drawn for (i), (ii) & (iii). (-2) for each part incorrect. If forces found incorrectly and incorrect values used in (2b), (2c) & (2d), no points taken off.

2 b) Tension stress in the upper rod

$$\sigma = \frac{F_U}{A} = \frac{6000\ KN}{2000\ mm^2} = 3\ GPa.$$

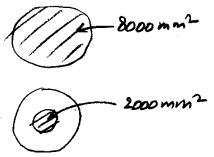
Note: $2000\ mm^2 = 2000 * 10^{-6}\ m^2$
$1\ mm^2 = 10^{-6}\ m^2$.

Comments: Full marks if Area taken correctly (Area of the rod). No Marks taken off if force F_U wrong from Part (2 a) i). Most of the students got this right. (-2) for wrong area of cross section. (-1) for wrong unit conversions (for eg. $2000\ mm^2 = 2000 * 10^{-4}\ m^2$ or $2000\ mm^2 = 2000 * 10^{-9}\ m^2$ etc.)

2 c) Avg. bearing stress between washer & the box beam (at R)

$$\sigma_b = \frac{F_R}{A_b}$$

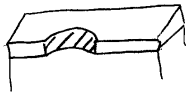
A_b = bearing area
$= (8000 - 2000)\ mm^2$
$= 6000\ mm^2$



$$\sigma_b = \frac{6000\ KN}{6000\ mm^2} = 1\ GPa.$$

Comments: Full marks only when Area taken correctly. No marks taken off if Force F_R wrong from Part (2a). (-2) for wrong Area of cross section. Some of you got confused between 'Bearing stress' & 'shearing stresses'. 'Bearing stresses' act-normal to the contact Area. An Extra (-1.5) points if 'shear stresses' calculated instead of normal (bearing stresses).

2 d) $\tau = \frac{F_S}{A_S}$



$F_S = 6000\ KN$.
A_S = Area in shear $= (300 * 15)\ mm^2$
$= 4500\ mm^2 = c.t$

Comments: Full marks if Area calculated correctly. (-2) for wrong area. (-1.5) if shear stresses are confused with bearing stresses. No marks taken off for wrong value of force from 2a).

2 e) i) $F_{U1} = 6000$ KN.] [2 points for each part.]
ii) $F_S = 8000$ KN.]

Comments: (-2) for every parts that is wrong which means (0/4) if both parts are wrong.

2(f) The load carried by washer at R (built design a) is twice as much as by S (the intended design)

Comments: Whoever got 2(d)(ii) & 2a(iii) right got this perfectly correct. However, some of you who got all the values consistently half also got this part correct. Full points if the student realizes that load at R in design a) is twice the load in the intended design.

TAM 202 – Prelim 2, Problem 3 Comments by Vijay Muralidharan.

Grading Scheme:

a) $\boxed{\delta_b = \delta_s + 0.01 \text{ in}}$ → (5 points)
Saying that the brass deflects "0.01" more.
Most students have written the compatibility equation as
$\delta_b = \delta_s$

b) Equilibrium : $\boxed{T_b = -T_s}$ → (3 points)

c) $\boxed{\text{Expressions for } \delta_s \text{ \& } \delta_b}$ → (15 points)
Deflections → Made of that due to temp. change & Axial Loads.
Most students have not considered the axial loads at all!!

d) Final Answers, Numerical simplifications, etc. → (5 points.)

Part b

Students who have mentioned Poisson's ratio → 2 points.
Right answer with the correct reason → 6 points
2 Bonus points if reasoning is good!!

(P3A) → Means Axial Loads have not been considered.
I have used this symbol for some of the papers I graded initially.