AE238 Quiz 01 Soham Phanse 19D170030

Q1. $U = (x^3 - 3y + z)\,i + (-2x + y^2)\,j + (2x^4 - 1.5z + yx)\,k$

for strain components we know, if $U = (u, v, w)$

$$\epsilon_{xx} = \frac{\partial u_x}{\partial x} = 3x^2 \Big|_{-1,1,-1} = \boxed{-3.}$$

$$\epsilon_{yy} = \frac{\partial v}{\partial y} = 2y \Big|_{-1,1,-1} = \boxed{2}$$

$$\epsilon_{zz} = \frac{\partial w}{\partial z} = x^4 - 1.5 \Big|_{-1,1,-1} = \boxed{-0.5}$$

$$\epsilon_{xy} = \cancel{\tfrac{1}{2}}\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right) = \cancel{\tfrac{1}{2}}\left(-3 + (-2)\right)_{-1,1,-1} = \cancel{-\tfrac{5}{2}}\ \boxed{-2}$$

$$\epsilon_{yz} = \frac{\partial w}{\partial y} + \frac{\partial v}{\partial z} = (x - x) = \boxed{0.}$$

$$\epsilon_{zx} = \frac{\partial u}{\partial z} + \frac{\partial w}{\partial x} = 1 + 4zx^3 + y \Big|_{-1,1,-1} = 1 + 4(-1)(-1)^3 + 1$$

$$= 1 + 4 + 1 = \boxed{6}$$

Q3. we have $\sigma_{xx} = 2x^3y^2$ $\sigma_{yy} = xy^4$

$\tau_{xy} = -2x^2y^3$.

We know that equilibrium conditions are (in 2D)

$$\frac{\partial \sigma_{xx}}{\partial x} + \frac{\partial \sigma_{xy}}{\partial y} + F_1 = 0 \,; \quad \frac{\partial \sigma_{yx}}{\partial x} + \frac{\partial \sigma_{yy}}{\partial y} + f_2 = 0$$

As we don't have any body forces, we get

1. $$\frac{\partial}{\partial x}(2x^3y^2) + \frac{\partial}{\partial y}(-2x^2y^3) = 6x^2y^2 + (-6x^2y^2) = 0$$

2. $$\frac{\partial}{\partial x}(-2x^2y^3) + \frac{\partial}{\partial y}(xy^4) = -4xy^3 + (4xy^3) = 0$$

we can see that the stresses satisfy the equilibrium conditions.

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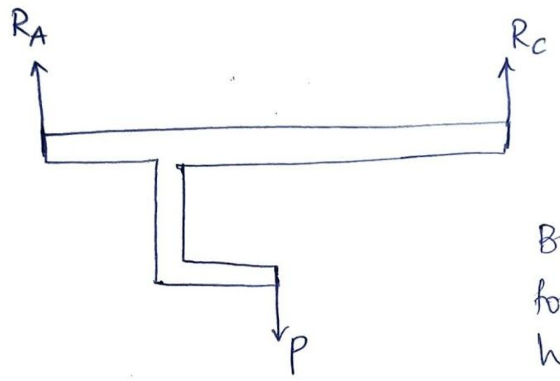
Q4.

Sign conven

$+ \circlearrowright \circlearrowleft$

Moments.



By normal force balance we have.

$R_A + R_C = P$

Now for rotational stability of the beam, taking moment about point A we get,

$(R_A \times 0) + (P \times \frac{L}{2}) + (R_C \times L) = 0 \Rightarrow \frac{PL}{2} = -R_C L$

$\Rightarrow \boxed{R_C = -\frac{P}{2}}$

Similarly taking. moments about C,

$(R_A \times L) + (R_C \times 0) + (P \times \frac{L}{2}) = 0 \Rightarrow R_A = \frac{P}{2}$

Hence we have both. $\boxed{R_A = R_C = \frac{P}{2}}$