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Composite :- $[0/60/0/30]$

$$E_1 = 131 \text{ GPa}$$

$$E_2 = 9.8 \text{ GPa}$$

$$G_{12} = 5.8 \text{ GPa}$$

$$v_{12} = 0.22$$

$$t = 0.125 \text{ mm}$$

$$\sigma_L^+ = 850 \text{ MPa}$$

$$\sigma_L^- = -700 \text{ MPa}$$

$$\sigma_T^+ = 60 \text{ MPa}$$

$$\sigma_T^- = -160 \text{ MPa}$$

$$\tau_{LT} = 75 \text{ MPa}$$

$$N_x, N_y, N_{xy} = 10, 3, 0 \text{ KN/m}$$

$$M_x, M_y, M_{xy} = 15, 0, 0 \text{ N}$$

→ 1) Calculation of $E_x, E_y, G_{xy}, \nu_x, \nu_y, \nu_{xy}$ using the force vector provided

2) Using E matrix to calculate the stresses

3) Final testing criterion

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%% Background Information
t = 0.125;
theta = [0 60 0 30]; % In Degrees
theta = theta.*(pi/180); % Conversion to Radians - I my system Default is radians

E1 = 131;
E2 = 9.8;
G12 = 5.8;
nu_12 = 0.22;

sl_up = 850;
sl_down = 700;
st_up = 40;
st_down = 160;
tau = 75;

S = [1/E1 -nu_12/E1 0; -nu_12/E1 1/E2 0; 0 0 1/G12];

Q_local = S^-1;

T = @(x) [(cos(x))^2 (sin(x))^2 2*cos(x)*sin(x); (sin(x))^2 (cos(x))^2 -
2*cos(x)*sin(x); -cos(x)*sin(x) cos(x)*sin(x) (cos(x))^2 - (sin(x))^2];

%% 1.) Calculating ABD Matrix
A = zeros(3);
B = zeros(3);
D = zeros(3);

for k = 1:4
    z_k = (3-k)*0.125;
    z_k1 = z_k - 0.125;
    Q_global = ((inv(T(theta(k))))*(Q_local)*(inv(transpose(T(theta(k))))));
    A = A + 0.125*Q_global;
    B = B + (0.125*(z_k + z_k1))*Q_global;
    D = D + (0.125*(z_k^2 + z_k1^2 + z_k*z_k1))*Q_global;
end

abd = [A B; B D];

fm = [10;3;0;15;0;0];
e_mat = abd\fm;

%% 2.) Using epsilon matrix for calculations of Stresses

epsilon = e_mat(1:3) + (10^-3*1.5*t)*e_mat(4:6); % z = 1.5 - Mid of the 30 deg
Plane from the center layer of composite
qbar = ((inv(T(theta(4))))*(Q_local)*(inv(transpose(T(theta(4))))));
sigma_global = qbar*epsilon;

F11 = abs(1/(sl_up*sl_down));
F22 = abs(1/(st_down*st_up));
F66 = abs(1/(tau^2));
F1 = (1/sl_up - abs(1/sl_down));
F2 = (1/st_up - abs(1/st_down));
F12 = 0.5*sqrt(F11*F22);

sigma = T(theta(4))*sigma_global

tsai_wu = F11*sigma(1)^2 + F22*sigma(2)^2 + F66*sigma(3)^2 + F1*sigma(1) +

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$$F2*\sigma(2) + 2*F12*\sigma(1)*\sigma(2)$$

$$\begin{array}{lcl} \sigma_{11} = 71.0834 \in (-700, 850) \\ \sigma_{22} = \cancel{4.2942} 4.2942 \in (-160, 40) \\ \tau_{12} = -6.3180 ; |\tau_{12}| < 75 \end{array} \left. \vphantom{\begin{array}{l} \sigma_{11} \\ \sigma_{22} \\ \tau_{12} \end{array}} \right\} \begin{array}{l} \text{No failure} \\ \text{Acc. to} \\ \text{Max. Stress} \\ \text{Criterion} \end{array}$$

$$\text{Tsay-Wu} \rightarrow 0.0806 < 1$$

\rightarrow No failure acc. to
Tsay-Wu Criterion.