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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)
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