MAIN:  
clc;clear;close all;

laminate = [140e9,10e9,7e9,0.3,0.0002,0,0,0,0,0,0;...

140e9,10e9,7e9,0.3,0.0002,45,0,0,0,0,0;...

140e9,10e9,7e9,0.3,0.0002,-45,0,0,0,0,0;...

140e9,10e9,7e9,0.3,0.0002,-45,0,0,0,0,0;...

140e9,10e9,7e9,0.3,0.0002,45,0,0,0,0,0;...

140e9,10e9,7e9,0.3,0.0002,0,0,0,0,0,0];

[Ex,Ey,Efx,Efy,Gxy,vxy,vyx]=laminateEngineeringConstants(laminate);

fprintf('Ex = %g, Ey = %g, Efx = %g\n',Ex,Ey,Efx)

laminate = [140e9,10e9,7e9,0.3,0.0002,30,1448e6,1172e6,48.3e6,248e6,62.1e6];

Nx=275000;

Ny=0;

Nxy=0;

Mx=0;

My=0;

Mxy=0;

[FSstress]=maximumStressTheory(laminate,Nx,Ny,Nxy,Mx,My,Mxy);

[FSstrain]=maximumStrainTheory(laminate,Nx,Ny,Nxy,Mx,My,Mxy);

[FStsai]=tsaiHillFailure(laminate,Nx,Ny,Nxy,Mx,My,Mxy);

Problem 1:

Ex = 6.29859e+10, Ey = 2.76784e+10, Efx = 1.05523e+11

function [Ex,Ey,Efx,Efy,Gxy,vxy,vyx]=laminateEngineeringConstants(laminate)

[~,~,~,~,thicknesses,~] = laminateReader(laminate);

t=sum(thicknesses);

ABDmatrixINV = laminateStiffnessMatrixINV(laminate);

Ex=1/(t\*ABDmatrixINV(1,1));

Ey=1/(t\*ABDmatrixINV(2,2));

Efx=12/(t^3\*ABDmatrixINV(4,4));

Efy=12/(t^3\*ABDmatrixINV(5,5));

Gxy=1/(t\*ABDmatrixINV(3,3));

vxy=-ABDmatrixINV(1,2)/ABDmatrixINV(1,1);

vyx=-ABDmatrixINV(1,2)/ABDmatrixINV(2,2);

end

Problem 2:

FSstress = 0.1043

FSstrain = 0.1043

FStsai = 0.1554

function [FS]=maximumStressTheory(laminate,Nx,Ny,Nxy,Mx,My,Mxy)

[~,~,~,~,~,~,longStrengthTen,longStrengthCom,tranStrengthTen,tranStrengthCom,strengthLT] = laminateReader(laminate);

[~,~,~,sigma1,sigma2,tau12,~,~,~,~,~,~]=forces2StressStrainLaminateNoPlot(laminate,Nx,Ny,Nxy,Mx,My,Mxy);

FS=zeros(length(longStrengthTen),1);

for i=2:2:length(sigma1)

if sigma1(i)>0

F1=longStrengthTen(i/2)/sigma1(i);

else

F1=-longStrengthCom(i/2)/sigma1(i);

end

if sigma2>0

F2=tranStrengthTen(i/2)/sigma2(i);

else

F2=-tranStrengthCom(i/2)/sigma2(i);

end

F3=strengthLT(i/2)/abs(tau12(i));

FS(i/2)=min([F1,F2,F3]);

end

end

function [FS]=maximumStrainTheory(laminate,Nx,Ny,Nxy,Mx,My,Mxy)

[E1s,E2s,~,v12s,~,~,longStrengthTen,longStrengthCom,tranStrengthTen,tranStrengthCom,strengthLT] = laminateReader(laminate);

[~,~,~,sigma1,sigma2,tau12,~,~,~,~,~,~]=forces2StressStrainLaminateNoPlot(laminate,Nx,Ny,Nxy,Mx,My,Mxy);

FS=zeros(length(longStrengthTen),1);

for i=2:2:length(sigma1)

if sigma1(i)>0

F1=longStrengthTen(i/2)/(sigma1(i)-v12s(i/2)\*sigma2(i));

else

F1=-longStrengthCom(i/2)/(sigma1(i)-v12s(i/2)\*sigma2(i));

end

v21=(v12s(i/2)/E1s(i/2))\*E2s(i/2);

if sigma2>0

F2=tranStrengthTen(i/2)/(sigma2(i)-v21\*sigma1(i));

else

F2=-tranStrengthCom(i/2)/(sigma2(i)-v21\*sigma1(i));

end

F3=strengthLT(i/2)/abs(tau12(i));

FS(i/2)=min([F1,F2,F3]);

end

end

function [FS]=tsaiHillFailure(laminate,Nx,Ny,Nxy,Mx,My,Mxy)

[~,~,~,~,~,~,longStrengthTen,longStrengthCom,tranStrengthTen,tranStrengthCom,strengthLT] = laminateReader(laminate);

[~,~,~,sigma1,sigma2,tau12,~,~,~,~,~,~]=forces2StressStrainLaminateNoPlot(laminate,Nx,Ny,Nxy,Mx,My,Mxy);

FS=zeros(length(longStrengthTen),1);

for i=2:2:length(sigma1)

if sigma1(i)>0

longStrength=longStrengthTen(i/2);

else

longStrength=longStrengthCom(i/2);

end

if sigma2>0

transStrength=tranStrengthTen(i/2);

else

transStrength=tranStrengthCom(i/2);

end

A=(sigma1(i)/longStrength)^2+(sigma2(i)/transStrength)^2-((sigma1(i)\*sigma2(i))/(longStrength)^2)+(tau12(i)/strengthLT);

FS(i/2)=1/sqrt(A);

end

end