```
clear all
clc
figure
%Young's moduli ratio 2H RS and 2H SR composites%%%%%
subplot(1,2,1);
n=5; %number of platelets in each period in stairwise staggered
 composite
pr=0.5; %volume fraction of regular staggered composite (2HRS)
ps=0.5; %volume fraction of Stairwise staggered composite
gbe=1./1000; % Ratio of shear modulus of matrix to Young's modulus of
 platelet, Gm/Ep
z=0.5; %overlap ratio in regular staggered composite
rr=0:5:450; %Aspect ratio of platelet in 2HRS composite
for rs=[10,20,40,80,160,320,450] %Aspect ratio of platelet in
 stairwise staggered
%composite, at the first level of
%hierarchy
as=(ps.*rs.*rs.*gbe)./(3*(1-ps)); %alpha_s
A=(((n.*((3*n)-4))./(3*((n-1).^2)))+(((n.*n)./(3*(n-1).*as))));
ars=(pr.*rr.*rr.*gbe.*A)./(ps.*(1-pr).*3);%alpha_RS
Erat=(A.*((4./3)+((1./((3*z.*(1-z).*ars)))))).^-1; %E_RS/E_p phi_R
 phi_S
plot (rr,Erat,'linewidth', 1.5);
hold on;
end
xlabel ('\rho_{RS}', 'fontsize', 18,'fontweight','bold')
ylabel ('E_{RS}/Ep \phi_R \phi_S', 'fontsize', 18,'fontweight','bold')
legend ('\rho_S = 10', '\rho_S = 20', '\rho_S = 40', '\rho_S =
 80','\rho_S = 160','\rho_S =320','\rho_S =450')
pbaspect([5 4 1])
set(gca,'fontsize',16)
xlim([0 450])
set(gcf,'color','w')
subplot(1,2,2);
rs=0:5:450;%Aspect ratio of platelet in 2HSR composite
for rr=[10,20,40,80,160,320,450]%Aspect ratio of platelet in regular
 staggered
%composite, at the first level of
%hierarchy
ar=(pr.*rr.*rr.*gbe)./(3*(1-pr)); %alpha_R
A=((4./3)+((1./((3*z.*(1-z).*ar)))));
asr=(ps.*rs.*rs.*gbe*A)./(pr.*(1-ps).*3); %alpha_RS
Erat=(A.*(((n.*((3*n)-4))./(3*((n-1).^2)))+(((n.*n)./
(3*(n-1).*asr))))).^-1;%E_SR/E_p phi_R
plot (rs,Erat,'linewidth', 1.5);
hold on;
end
xlabel ('\rho_{SR}', 'fontsize', 18,'fontweight','bold')
ylabel ('E_{SR}/Ep \phi_R \phi_S', 'fontsize', 18,'fontweight','bold')
legend ('\rho_R = 10', '\rho_R = 20', '\rho_R = 40', '\rho_R =
 80','\rho_R = 160','\rho_R =320','\rho_R =450')
set(gca,'fontsize',16)
```

```
pbaspect([5 4 1])
xlim([0 450])
%%%%%%%%%Strength ratio 2H RS and 2H SR Composites %%%%%%%%
%for all values of n (4 CASES)
%rho=aspect ratio;
figure
subplot(1,2,1);
sigtotau=10; %sigma^p_crit/tau^m_crit
rscrit=(n-1)*sigtotau;%critical aspect ratio in first level of
 hierarchy
for rs=5:5:100
% CASE 1 and 2
if rs<=rscrit
rrcrit=(ps*rs)./n; %critical aspect ratio in second level of hierarchy
else
rrcrit=(ps*sigtotau*(n-1))./n;
end
rr=0:1:120;
y=zeros(size(rr));
for i=1:numel(rr)
%case 1 n 2
if rr(i)<=rrcrit
y(i) = rr(i)./(2*ps*sigtotau);
%case 3
elseif rr(i)>rrcrit && rs<=rscrit
y(i)=(rs)./(2*n*sigtotau);
%case 4
else
y(i)=(n-1)./(2*n);
end
end
plot (rr,y,'linewidth',1.5)
hold on;
end
xlim([0,120])
ylim([0,0.42])
set(gca,'fontsize',16)
xlabel ('\rho_R_S','fontweight','bold', 'fontsize', 18)
ylabel ('\sigma^R^S_{critical}/ \phi_R \phi_S
 \sigma^P_{critical}','fontweight','bold', 'fontsize',18)
legend({'\rho_S = 5', '\rho_S = 10', '\rho_S = 15', '\rho_S =
 20','\rho_S = 25','\rho_S = 30','\rho_S=35','\rho_S=40'})
pbaspect([5 4 1])
subplot(1,2,2);
rrcrit=sigtotau; %critical aspect ratio in first level of hierarchy
for rr=5:5:40
% CASE 1 and 2
if rr<=rrcrit
rscrit=(n-1)*pr*rr*0.5; %critical aspect ratio in first level of
 hierarchy
else
rscrit=(n-1)*pr*sigtotau*0.5;
end
rs=0:1:120;
```

```
y=zeros(size(rs));
for i=1:numel(rs)
%case 1 n 2
if rs(i)<=rscrit
y(i) = rs(i)./(pr*n*sigtotau);
%case 3
elseif rs(i)>rscrit && rr<=rrcrit
y(i)=(rr.*(n-1))./(2*n*sigtotau);
%case 4
else y(i)=(n-1)./(2*n);
end
end
plot (rs,y,'linewidth',1.5)
hold on;
end
xlim([0,120])
ylim([0,0.42])
set(gcf,'color','w')
%title ('\sigma^S^R_{critical}/ \phi_R \sigma^P_{critical} for
 Stairwise Staggered platelets set(gca,'fontsize',16)
xlabel ('\rho_S_R','fontweight','bold', 'fontsize', 18)
ylabel ('\sigma^S^R_{critical}/ \phi_R \phi_S
 \sigma^P_{critical}','fontweight','bold', 'fontsize',18)
legend({'\rho_R = 5', '\rho_R= 10', '\rho_R = 15', '\rho_R =
 20','\rho_R = 25','\rho_R = 30','\rho_S=35','\rho_S=40'})
pbaspect([5 4 1])
figure
%%%%%%%%%Strain ratio 2H RS and 2H SR Composites%%%%%%%%%%%%%
%for all values of n (4 CASES)
subplot(1,2,1);
rscrit=(n-1)*sigtotau;
for rs=5:10:45
rr=0:1:120;
y=zeros(size(rr));
Ers=zeros(size(rr));
ar=zeros(size(rr));
% CASE 1 and 2
if rs<=rscrit
rrcrit=(ps*rs)./n;
else
rrcrit=(ps*sigtotau*(n-1))./n;
end
for i=1:numel(rr)
ar(i)=(pr.*rr(i).*rr(i).*gbe)./(3*(1-pr));
as=(ps.*rs.*rs.*gbe)./(1-ps)*3;
Ers(i)=(((4/3)+(3*z.*ar(i).*(1-z)).^-1).^-1)*((n.*(3*n-4)/
(3*((n-1).^2)))+(n.*n./(3*as.*(n-1)))).^-1;
%case 1 n 2
if rr(i)<=rrcrit
y(i) = rr(i)./(2*ps*sigtotau*Ers(i));
%case 3
elseif rr(i)>rrcrit && rs<=rscrit
y(i)=(rs)./(2*n*sigtotau*Ers(i));
%case 4
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else
y(i)=(n-1)./(2*n*Ers(i));
end
end
plot (rr,y,'linewidth',1.5)
hold on;
end
xlim([0,120])
ylim([0,140])
set(gca,'fontsize',16)
xlabel ('\rho_R_S','fontweight','bold', 'fontsize', 18)
ylabel ('\epsilon^R^S_{critical}/ \epsilon^P_{critical}\phi_R
 \phi_S','fontweight','bold','fontsize',18)
legend({'\rho_S = 5', '\rho_S = 15', '\rho_S = 25', '\rho_S =
 35','\rho_S = 45'})
pbaspect([5 4 1])
subplot(1,2,2);
rrcrit=sigtotau;
for rr=5:10:45
rs=0:1:120;
y=zeros(size(rs));
Esr=zeros(size(rs));
asr=zeros(size(rs));
ar=(pr.*rr.*rr.*gbe)./(3*(1-pr));
A=((4./3)+((1./((3*z.*(1-z).*ar)))));
% CASE 1 and 2
if rr<=rrcrit
rscrit=(n-1)*pr*rr*0.5;
else
rscrit=(n-1)*pr*sigtotau*0.5;
end
for i=1:numel(rs)
asr(i)=(ps.*rs(i).*rs(i).*gbe*A)./(pr.*(1-ps).*3);
Esr(i)=(A.*(((n.*((3*n)-4))./(3*((n-1).^2)))+(((n.*n)./
(3*(n-1).*asr(i)))))).^-1;
%case 1 n 2
if rs(i)<=rscrit
y(i) = rs(i)./(pr*n*sigtotau*Esr(i));
%case 3
elseif rs(i)>rscrit && rr<=rrcrit
y(i)=(rr.*(n-1))./(2*n*sigtotau*Esr(i));
%case 4
else
y(i)=(n-1)./(2*n*Esr(i));
end
end
plot (rs,y,'linewidth',1.5)
hold on;
end
xlim([0,120])
ylim([0,140])
set(gca,'fontsize',16)
xlabel ('\rho_S_R','fontweight','bold', 'fontsize', 18)
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ylabel ('\epsilon^S^R_{critical}/ \epsilon^P_{critical}\phi_R \phi_S
 ','fontweight','bold','fontsize', 18)
legend({'\rho_R = 5', '\rho_R= 15', '\rho_R = 25', '\rho_R =
 35','\rho_R = 45'})
pbaspect([5 4 1])
set(gcf,'color','w')
figure
%%%%%%%%%Toughness ratio 2H RS and 2H SR composites%%%%%%%%%%
%rho=aspect ratio;
subplot(1,2,1);
rscrit=(n-1)*sigtotau;
for rs=5:10:45
rr=0:1:120;
y=zeros(size(rr));
Ers=zeros(size(rr));
ar=zeros(size(rr));
% CASE 1 and 2
if rs<=rscrit
rrcrit=(ps*rs)./n;
else
rrcrit=(ps*sigtotau*(n-1))./n;
end
for i=1:numel(rr)
ar(i)=(pr.*rr(i).*rr(i).*gbe)./(3*(1-pr));
as=(ps.*rs.*rs.*gbe)./(1-ps)*3;
Ers(i)=(((4/3)+(3*z.*ar(i).*(1-z)).^-1).^-1)*((n.*(3*n-4)/
(3*((n-1).^2)))+(n.*n./(3*as.*(n-1)))).^-1;
%case 1 n 2
if rr(i)<=rrcrit
y(i) = rr(i)*rr(i)./(2*2*ps*ps*sigtotau*sigtotau*Ers(i));
%case 3
elseif rr(i)>rrcrit && rs<=rscrit
y(i)=(rs*rs)./(2*2*n*n*sigtotau*sigtotau*Ers(i));
%case 4
else
y(i)=((n-1).^2)/(2*2*n*n*Ers(i));
end
end
plot (rr,y,'linewidth',1.5)
hold on;
end
xlim([0,35])
ylim([0,45])
set(gca,'fontsize',16)
xlabel ('\rho_R_S','fontweight','bold', 'fontsize', 18)
ylabel ('w^R^S_{critical}/ w^P_{critical}\phi_R
 \phi_S','fontweight','bold', 'fontsize', 18)
legend({'\rho_S = 5', '\rho_S = 15', '\rho_S = 25', '\rho_S =
 35','\rho_S = 45'})
pbaspect([5 4 1])
subplot(1,2,2);
rrcrit=sigtotau;
for rr=5:10:45
rs=0:1:120;
```

```
y=zeros(size(rs));
Esr=zeros(size(rs));
asr=zeros(size(rs));
ar=(pr.*rr.*rr.*gbe)./(3*(1-pr));
A=((4./3)+((1./((3*z.*(1-z).*ar)))));
% CASE 1 and 2
if rr<=rrcrit
rscrit=(n-1)*pr*rr*0.5;
else
rscrit=(n-1)*pr*sigtotau*0.5;
end
for i=1:numel(rs)
asr(i)=(ps.*rs(i).*rs(i).*gbe*A)./(pr.*(1-ps).*3);
Esr(i)=(A.*(((n.*((3*n)-4))./(3*((n-1).^2)))+(((n.*n)./
(3*(n-1).*asr(i))))))).^-1;
%case 1 n 2
if rs(i)<=rscrit
y(i) = rs(i).*rs(i)./(pr*pr*n*n*sigtotau*sigtotau*Esr(i));
%case 3
elseif rs(i)>rscrit && rr<=rrcrit
y(i)=(rr.*rr.*((n-1).^2))./(2*2*n*n*sigtotau*sigtotau*Esr(i));
%case 4
else y(i)=((n-1).^2)./(2*2*n*n*Esr(i));
end
end
plot (rs,y,'linewidth',1.5)
hold on;
end
xlim([0,35])
ylim([0,20])
set(gca,'fontsize',16)
xlabel ('\rho_S_R','fontweight','bold', 'fontsize', 18)
ylabel ('w^S^R_{critical}/ w^P_{critical}\phi_R \phi_S
 ','fontweight','bold', 'fontsize', 18)
legend('\rho_R = 5', '\rho_R= 15', '\rho_R = 25', '\rho_R =
 35','\rho_R = 45')
pbaspect([5 4 1])
set(gcf,'color','w')
```