LAMPIRAN 1

PROGRAM PERHITUNGAN SIMPANGAN TERHADAP TEGANGAN

```
function  [u]=displacement(V)
% Parameter Geometri
%=============
L1=255;
L2=235;
Lf=50;
Lc=210-Lf;
Lg=2;
tsi=2;
ta=2;
tn=0.6;
L3=Lf+Lc;
% Material Properties
%=============
E=169e9;
v=0.22;
K=2.9e-6;
kp=41e-6;
kv=0.026e-6;
kn=2.25e-6;
rho=23;
den=2.33e-6;    % rho = massa jenis polysilicon (ug/um3)
dens=den*4;     % dens = rho x luas (2 x 2 um)
%=============
% Tambahan
wh=2;
wc=10;
%V=5;
zeta=-5.4354e-4;
Ts=303;
t=tsi;
%=============
S=tsi*(2*ta/tsi+1)/wh+1;
Rt=ta/kv+tn/kn;
%=============
V1=V*(L1+Lg)/(L1+L2+Lg);
V2=V*L2/(L1+L2+Lg);
%=============
B1=V1^2/(L1^2*rho*kp);
B2=V2^2/(L2^2*rho*kp);
A1=(S/(kp*Rt*t)+B1*zeta)^.5;
A2=(S/(kp*Rt*t)+B2*zeta)^.5;
%=============
z11=exp(A1*(L1+Lg));
z12=exp(-A1*(L1+Lg));
z21=exp(A2*L2);
z22=exp(-A2*L2);
Rcold=pi/(2*wh*log(wh/wc));
A = [1 1 0 0 0;...
    0 0 1 1 0;...
    z11 z12 0 0 -1;...
    0 0 z21 z22 -1;...
    A1*z11 -A1*z12 A2*z21 -A2*z22 -Rcold];
```

```
%=============
b1=-B1/A1^2;
b2=-B2/A2^2;
B = [b1; b2; -Ts+b1; -Ts+b2; -Ts*Rcold];
%=============
C=A\B;
%======================
% ANALISIS MEKANIK
%======================
% Delta
dL1=K*(B1*L1/A1^2+C(1)*exp(A1*L1)/A1-C(1)/A1-C(2)*exp(-
A1*L1)/A1+C(2)/A1);
dL2=K*(B2*L2/A2^2+C(3)*exp(A2*L2)/A2-C(3)/A2-C(4)*exp(-
A2*L2)/A2+C(4)/A2);
dLg=K*(B1*Lg/A1^2+(C(1)*exp(A1*L1)/A1-C(2)*exp(-
A1*L1)/A1)*(exp(A1*Lg)-1));
% Momen Inersia
Ih=1/3*dens*L1^3;   % L?
Ic=1/3*dens*Lc^3;
If=1/3*dens*Lf^3;
% Koefisien Fleksibilitas
f(1,1)=1/(E*Ih)*(L2^3/3+L2^2*Lg+L1^3/3+L2^2*L1-L1^2*L2);
f(2,1)=-1/(2*E*Ih)*(2*L1*L2*Lg+L2*Lg^2-L1^2*Lg);
f(3,1)=-1/(2*E*Ih)*(L1*L2+L2*Lg+L2^2-L1^2);
f(4,1)=1/(2*E*Ih)*(2*L1^3-L1^2*L2+2*L2*Lg*L3+2*L2*L1*L3-L1^2*L3);
f(5,1)=1/(2*E*Ih)*(2*L1^2*Lg-4*L1*L2*Lg-3*Lg^2*L2);
f(6,1)=-1/(2*E*Ih)*(2*L1*L2+2*L2*Lg-L1^2);
f(1,2)=f(2,1);
f(2,2)=1/(3*E*Ih)*(3*L1*Lg^2+Lg^3);
f(3,2)=1/(2*E*Ih)*(2*L1*Lg+Lg^2);
f(4,2)=1/(2*E*Ih)*(2*L3*L1*Lg-Lg^2*L2-L1^2*Lg);
f(5,2)=1/(E*Ih)*(2*L1*Lg^2);
f(6,2)=1/(2*E*Ih)*(2*L1*Lg+Lg^2);
f(1,3)=f(3,1);f(2,3)=f(3,2);
f(3,3)=1/(E*Ih)*(L1+L2+Lg);
f(4,3)=1/(2*E*Ih)*(L1^2-L1*L3-L3*Lg);
f(5,3)=1/(2*E*Ih)*(3*Lg^2+4*L1*Lg);
f(6,3)=1/(E*Ih)*(L1+Lg);
f(1,4)=f(4,1);f(2,4)=f(4,2);f(3,4)=f(4,3);
f(4,4)=Lf^3/(3*E*If)+Lc*(L3+Lf)*(2*Lc^3+6*Lc*Lf*L3)/(2*E*Ic*(3*Lc^2+6
*Lc*Lf))...
    +1/(3*E*Ih)*(6*L3^2*Lg+L1^3+3*L1*L3^2-3*L3*L1^2);
f(5,4)=-1/(E*Ih)*(2*L1*Lg*L3+2*Lg^2*L3-L1^2*Lg);
f(6,4)=-Lf^2/(2*E*If)-Lc*(L3+Lf)/(2*E*Ic)-1/(2*E*Ih)*(4*L3*Lg-
L1^2+2*L1*L3);
f(1,5)=f(5,1);f(2,5)=f(5,2);f(3,5)=f(5,3);f(4,5)=f(5,4);
f(5,5)=1/(E*Ih)*(4*Lg^2*L1)+8*Lg^3/(3*E*Ih);
f(6,5)=1/(E*Ih)*(2*Lg*L1+2*Lg^2);
f(1,6)=f(6,1);f(2,6)=f(6,2);f(3,6)=f(6,3);f(4,6)=f(6,4);f(5,6)=f(6,5)
;
f(6,6)=1/(E*Ih)*(L1+2*Lg)+Lf/(E*If)+Lc/(E*Ic);
% Komponen Hasil
Y= [dLg;(dL1-dL2);0;dLg;dL1;0];
% Cari Nilai Xi
X=f\Y;
% Displacement
Ma=X(1)+X(4);
Mb=X(1)*(L2-L1)-X(2)*Lg-X(3)+X(4)*(L3-L1)-2*X(5)*Lg-X(6);
u=1/(E*Ih)*(-Ma*L1^3/3+(L1*Ma-Mb)*L1^2/2+L1^2*Mb);
u=abs(u);
```

LAMPIRAN 2

PROGRAM PERHITUNGAN DISTRIBUSI TEMPERATUR PADA MASING-MASING LENGAN PANAS

```
%function 2arms()
% Parameter Geometri
%=============
L1=255;
L2=235;
Lc=160;
Lf=50;
Lg=2;
tsi=2;
ta=2;
tn=0.6;

% Material Properties
%=============
E=169e9;
v=0.22;
K=2.9e-6;
kp=41e-6;
kv=0.026e-6;
kn=2.25e-6;
rho=23;
%=============
% Tambahan
wh=2;
wc=10;
V=1;
zeta=-5.4354e-4;
Ts=303;
t=tsi;
%=============
S=tsi*(2*ta/tsi+1)/wh+1;
Rt=ta/kv+tn/kn;
%=============
V1=V*(L1+Lg)/(L1+L2+Lg);
V2=V*L2/(L1+L2+Lg);
%=============
B1=V1^2/(L1^2*rho*kp);
B2=V2^2/(L2^2*rho*kp);
A1=(S/(kp*Rt*t)+B1*zeta)^.5;
A2=(S/(kp*Rt*t)+B2*zeta)^.5;
%=============
z11=exp(A1*(L1+Lg));
z12=exp(-A1*(L1+Lg));
z21=exp(A2*L2);
z22=exp(-A2*L2);
Rcold=pi/(2*wh*log(wh/wc));
A = [1 1 0 0 0;...
    0 0 1 1 0;...
    z11 z12 0 0 -1;...
    0 0 z21 z22 -1;...
    A1*z11 -A1*z12 A2*z21 -A2*z22 -Rcold];
%=============
b1=-B1/A1^2;
b2=-B2/A2^2;
```

```
B = [b1; b2; -Ts+b1; -Ts+b2; -Ts*Rcold];
%=============
C=A\B;
%=============
% Solusi
%=============
x1=0:2:L1;
x2=L2+Lg:-2:0;
T1=Ts-b1+C(1)*exp(A1*x1)+C(2)*exp(-A1*x1);
T2=Ts-b2+C(3)*exp(A2*x2)+C(4)*exp(-A2*x2);
x=0:2:L1+L2+Lg;
T= [T1 T2];
% Grafik
%subplot(2,2,1);
plot(x1,T1);grid on;
xlabel('Posisi Lengan (um)');
ylabel('Temperatur(K)');
title('Distribusi Temperatur terhadap Posisi Lengan');
%subplot(2,2,2);
figure;plot(x2,T2);grid on;
xlabel('Posisi Lengan (um)');
ylabel('Temperatur(K)');
title('Distribusi Temperatur terhadap Posisi Lengan');
%subplot(2,2,3:4);
figure;plot(x,T);grid on;
xlabel('Posisi Lengan (um)');
ylabel('Temperatur(K)');
title('Distribusi Temperatur terhadap Posisi Lengan');
```