

## **BAB V**

### **KESIMPULAN DAN SARAN**

#### **5.1. Kesimpulan**

Setelah program diagram interaksi dua sumbu dibuat dan hasil hitungan program dari data kolom kemudian diperiksa secara manual, maka dapat ditarik kesimpulan sebagai berikut :

1. Program penggambaran diagram interaksi kolom menggunakan dua sumbu yang telah dibuat memberikan waktu penyelesaian yang lebih singkat dan lebih detail dibandingkan dengan penggambaran yang dilakukan secara manual.
2. Perbedaan antara hitungan dari analisis kekuatan penampang kolom dua sumbu, baik yang dilakukan secara manual maupun dengan program dalam tabel perbedaan tidak lebih dari 0,1 %. Perbedaan ini mungkin disebabkan oleh adanya pembulatan dalam hitungan, sehingga dapat dikatakan bahwa program komputer yang dibuat cukup teliti.

#### **5.2. Saran**

Saran yang dapat diberikan oleh penulis adalah :

1. Hitungan untuk analisis kekuatan penampang kolom perlu dikembangkan apabila dikehendaki adanya pengaruh kelangsingan kolom.
2. Program diagram interaksi kolom dua sumbu dapat lebih dikembangkan dalam segi tampilan resolusi maupun interval nilai  $c$  dengan menggunakan bahasa program yang berorientasi objek (*Object Oriented Programming*), dikarenakan adanya keterbatasan kemampuan bahasa Pascal.

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*Lampiran 1. Listing Program*

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{$N+}
USES dos,crt,graph;

TYPE data=record
  h,b,ds,fc,fy,D,h1,b1,E,nh,nb,ntul:longint;
  ey,Rhotul,Atot,jrkh,jrkb,beta:single;
  MnmakY,MnmakX,PnmakY,PnmakX,Pomak,Pomin,Pnmak,Pkhusus:single;
  Pny,Pnx,Mny,Mnx:array [1..3000] of single;
  Mnyvalue,Mnxvalue,Pnvaluepos:array [1..4] of single;
  Pnvalueneg:array [1..2] of single;
  kmakX,kmakY,ksbX,ksbY:integer;
  nama:string[8];
end;

VAR menu:array [12..15] of string[20];
    i,j,k,gd,gm,kodeerror,sorot,hasil:integer;
    tombol:char;
    datakol:file of data;
    namafile:string[12];
    tampang:data;
    sukses:boolean;
    jrktepib,jrktepib,Pored,Pnred:single;

PROCEDURE bukafile(namafile:string);
begin
  assign(datakol,namafile);
  rewrite(datakol);
end;

PROCEDURE panggil(namafile:string;var tampang:data;var sukses:boolean);
begin
  {$I-}
  assign(datakol,namafile);
  reset(datakol);
  {$I+}
  if (IOresult<>0) or (namafile='')then begin
    sukses:=false;
  end
  else begin
    read(datakol,tampang);
    sukses:=true;
  end;
end;

PROCEDURE modegrafik;
begin
  clrscr;
  gd:=detect;
  Initgraph(gd,gm,'');
  kodeerror:=graphresult;
  if kodeerror<>grOk then begin
    writeln('Error grafik:',graphErrorMsg(KodeError)); readln;
    Halt(1);
  end;
end;

PROCEDURE kontrol(var tampang:data);
begin
  with tampang do begin

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h1:=h-2*ds-d; jrkh:=h1/(nh-1);
b1:=b-2*ds-d; jrkb:=b1/(nb-1);
ey:=fy/E;
ntul:=2*(nh+(nb-2)); Atot:=0.25*Pi*D*D*ntul;
RhoTul:=Atot*100/(b*h);
Pnmak:=0.8*(0.85*fc*(b*h-Atot)+fy*Atot)/1000;
Pkhusus:=(0.1*fc*b*h)/1000;
end;
end;

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FUNCTION nilbeta(fc :longint):single;
var beta:single;
begin
with tampang do begin
if fc<=30 then beta:=0.85;
if fc>30 then beta:=0.85-0.008*(fc-30);
if beta<0.65 then beta:=0.65;
nilbeta:=beta;
end;
end;

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PROCEDURE diagramx(var tampang:data);
var di,es,fs,As,T,M,ax,cx,Ccx,Ttx,Mtx: single;
begin
with tampang do begin
k:=0; kmakX:=0; MnmakX:=0; PnmakX:=0; ksbX:=0;
repeat
k:=k+1; Ttx:=0; Mtx:=0;
cx:=(h/2000)*k;
ax:=nilbeta(fc)*cx;
Ccx:=0.85*fc*b*ax;
for i:=1 to nh do begin
di:=ds+0.5*D+jrkh*(i-1);
es:=(0.003*(cx-di))/cx;
fs:=Abs(es)*E;
if (es>=ey) or (es<=-ey) then begin
fs:=fy;
end;
As:=nb*0.25*Pi*D*D;
if (i>1) and (i<nh) then begin
As:=2*0.25*Pi*D*D;
end;
T:=As*fs;
if es<0 then begin
T:=As*fs*-1;
end;
M:=T*(0.5*h-di);
Ttx:=Ttx+T;
Mtx:=Mtx+M;
end;
Pnx[k].:=(Ccx+Ttx)/1000;
Mnx[k].:=(Ccx*((h-ax)/2)+Mtx)/1000000;
if PnmakX<Pnx[k] then PnmakX:=Pnx[k];
if MnmakX<Mnx[k] then MnmakX:=Mnx[k];
if kmakX<k then kmakX:=k;
if Pnx[k]<=0 then ksbX:=k;
if Mnx[k]<=0 then break;
until Mnx[k]<=0;
for i:=1 to 4 do begin
Mnxvalue[i].:=(MnmakX/4)*i;
end;
for i:=1 to 2 do begin
Pnvalueneg[i].:=(Pnx[1]/2)*i;
end;
end;

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for i:=1 to 4 do begin
  Pnvaluepos[i]:=(PnmakX/4)*i;
end;
end;
end;
PROCEDURE diagramy(var tampang:data);
var di,es,fs,As,T,M,ay,cy,Ccy,Tty,Mty: single;
begin
with tampang do begin
  k:=0; kmakY:=0; MnmakY:=0; PnmakY:=0; ksbY:=0;
  repeat
    k:=k+1; Tty:=0; Mty:=0;
    cy:=(b/2000)*k;
    ay:=nilbeta(fc)*cy;
    Ccy:=0.85*fc*h*ay;
    for i:=1 to nb do begin
      di:=ds+0.5*D+jrkb*(i-1);
      es:=(0.003*(cy-di))/cy;
      fs:=Abs(es)*E;
      if (es>=ey) or (es<=-ey) then begin
        fs:=fy;
      end;
      As:=nh*0.25*Pi*D*D;
      if (i>1) and (i<nb) then begin
        As:=2*0.25*Pi*D*D;
      end;
      T:=As*fs;
      if es<0 then begin
        T:=As*fs*-1;
      end;
      M:=T*(0.5*b-di);
      Tty:=Tty+T;
      Mty:=Mty+M;
    end;
    Pny[k]:=(Ccy+Tty)/1000;
    Mny[k]:=(Ccy*((b-ay)/2)+Mty)/1000000;
    if PnmakY<Pny[k] then PnmakY:=Pny[k];
    if MnmakY<Mny[k] then MnmakY:=Mny[k];
    if kmakY<k then kmakY:=k;
    if Pny[k]<=0 then ksbY:=k;
    if Mny[k]<=0 then break;
  until Mny[k]<=0;
  for i:=1 to 4 do begin
    Mnyvalue[i]:=(MnmakY/4)*i;
  end;
end;
end;
end;
PROCEDURE kontrolP(var tampang:data);
begin
with tampang do begin
  Pomak:=PnmakX;
  if PnmakY>PnmakX then begin
    Pomak:=PnmakY;
  end;
  Pomin:=Pnx[1];
  if Pny[1]>=Pnx[1] then begin
    Pomin:=Pny[1];
  end;
end;
end;
end;

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PROCEDURE bingkai2;
begin
end;
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PROCEDURE simpan(var namafile:string; var tampang:data);
begin
with tampang do begin
nama:=namafile;
hasil:=pos('.', namafile);
namafile := namafile + '.SON';
end;
end;
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PROCEDURE listing(var namafile:string; var tampang:data; var sukses:boolean);
var DirInfo:SearchRec;
kolom:byte;
begin
repeat
clrscr;
writeln('Daftar File : ');
FindFirst('.*.SON', Archive, DirInfo);
kolom:=0;
while DosError=0 do begin {no error}
kolom:=kolom + 1;
if kolom>5 then begin
kolom:=1; writeln;
end;
write(DirInfo.Name:12, ' ');
FindNext(DirInfo);
end;
writeln;writeln;
write('Masukkan nama file : ');readln(namafile);
simpan(namafile,tampang);
if hasil<>0 then begin
write('Nama file tidak perlu ekstensi !');
readkey;
end;
panggil(namafile,tampang,sukses);
until sukses=true;
end;
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PROCEDURE inputan(namafile:string; var tampang:data);
begin
with tampang do begin
repeat
gotoxy(15,7);write(' ');
gotoxy(15,7);write('Nama file data (Mak 8 karakter) = '); readln(namafile);
for i := 1 to Length(namafile) do begin
namafile[i] := UpCase(namafile[i]);
end;
simpan(namafile,tampang);
if hasil<>0 then begin
gotoxy(15,8);write('Nama file tidak perlu ekstensi !');
end;
until (hasil=0) and (nama<> '');
gotoxy(15,8);write(' ');
gotoxy(15,8);write('Tinggi penampang kolom h(mm) = ');readln(h);
repeat
gotoxy(15,9);write(' ');
gotoxy(15,9);write('Lebar penampang kolom b(mm) <=h = ');readln(b);
until b<=h;
gotoxy(15,10);write('Tegangan tekan beton f'c(MPa) = ');readln(fc);
gotoxy(15,11);write('Tebal selimut beton ds(mm) = ');readln(ds);
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repeat
gotoxy(15,12);write(' ');
gotoxy(15,12);write('Mutu baja tulangan fy(MPa) <=400 = ');readln(fy);
until fy<=400;
gotoxy(15,13);write('Modulus elastisitas baja Es(MPa) = ');readln(E);
gotoxy(15,14);write('Diameter tulangan D(mm) = ');readln(d);
gotoxy(15,15);write('Faktor reduksi kekuatan  $\phi$  = ');readln(red);
gotoxy(15,16);write('Jumlah tulangan searah h = ');readln(nh);
gotoxy(15,17); write('Jumlah tulangan searah b = ');readln(nb);
kontrol(tampang); diagramy(tampang); diagramx(tampang); kontrolP(tampang);
end;
bukafile(namafile);
write(datakol,tampang);
close(datakol);
end;

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PROCEDURE edit(namafile:string;var tampang:data;var sukses:boolean);
var pil,pil2,pil3:char;
begin
with tampang do begin
listing(namafile,tampang,sukses);
clrscr;
bingkai2;
gotoxy(16,4 );writeln(' FILE : ',nama);
gotoxy(16,5 );writeln(' 0.Tinggi penampang kolom h(mm) = ',h);
gotoxy(16,6 );writeln(' 1.Lebar penampang kolom b(mm) = ',b);
gotoxy(16,7 );writeln(' 2.Tegangan tekan beton f'c(MPa) = ',fc);
gotoxy(16,8 );writeln(' 3.Tebal selimut beton ds(mm) = ',ds);
gotoxy(16,9 );writeln(' 4.Mutu baja tulangan fy(MPa) = ',fy);
gotoxy(16,10);writeln(' 5.Modulus elastisitas baja Es(MPa) = ',E);
gotoxy(16,11);writeln(' 6.Diameter tulangan D(mm) = ',D);
gotoxy(16,12);writeln(' 7.Faktor reduksi kekuatan  $\phi$  = ',red);
gotoxy(16,13);writeln(' 8.Jumlah tulangan searah h = ',nh);
gotoxy(16,14);writeln(' 9.Jumlah tulangan searah b = ',nb);
repeat
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Pilih data yang akan diedit [Esc utk batal] : '); pil:=readkey;
if pil='0' then begin
repeat
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Masukkan nilai h(mm) baru = ');readln(h);
if h<b then begin
gotoxy(15,17);write('hkolom < bkolom masukkan lagi');
end;
until (h>=b);
gotoxy(15,17);write(' ');
end
else if pil='1' then begin
repeat
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Masukkan nilai b(mm) baru = ');readln(b);
if b>h then begin
gotoxy(15,17);write('bkolom > hkolom masukkan lagi');
end;
until (b<=h);
gotoxy(15,17);write(' ');
end
else if pil='2' then begin
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Masukkan nilai fc(MPa) baru = ');readln(fc);
end
else if pil='3' then begin
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Masukkan nilai ds(mm) baru = ');readln(ds);

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end
else if pil='4' then begin
repeat
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Masukkan nilai fy(MPa) baru = ');readln(fy);
until fy<=400;
end
else if pil='5' then begin
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Masukkan nilai E(MPa) baru = ');readln(E);
end
else if pil='6' then begin
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Masukkan nilai D(mm) baru = ');readln(D);
end
else if pil='7' then begin
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Masukkan nilai  $\phi$  baru = ');readln(D);
end
else if pil='8' then begin
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Jumlah tulangan searah h = ');readln(nh);
end
else if pil='9' then begin
gotoxy(15,16);write(' ');
gotoxy(15,16);write('Jumlah tulangan searah b = ');readln(nb);
end
else if pil=#27 then begin
bukafile(namafile);
write(datakol,tampang);
close(datakol);
end
else begin
gotoxy(15,16);write(' ');
gotoxy(15,16);writeln('Pilihan tidak ada');
end;
kontrol(tampang); diagramy(tampang); diagramx(tampang); kontrolP(tampang);
gotoxy(15,18); write('Data perlu diedit lagi?(Y/T) : ');readln(pil2);
pil2:=upcase(pil2);gotoxy(15,18);write(' ');
until pil2='T';
gotoxy(15,18); write('Data disimpan dengan nama baru?(Y/T) : ');readln(pil3);
pil3:=upcase(pil3);
if pil3='Y' then begin
repeat
gotoxy(15,19);write(' ');
gotoxy(15,19);write('Masukkan nama file yang baru : '); readln(namafile);
for i := 1 to Length(namafile) do begin
namafile[i] := UpCase(namafile[i]);
end;
simpan(namafile,tampang);
if hasil<>0 then begin
gotoxy(15,20);write('Nama file tidak perlu ekstensi !');
end;
until (hasil=0) and (nama<>'');
bukafile(namafile);
write(datakol,tampang);
close(datakol);
end
else begin
bukafile(namafile);
write(datakol,tampang);
close(datakol);
end;
end;
end;

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PROCEDURE outtampang(var tampang:data);
const bttat=60;bttbw=180;
var hsk,bsk,skx,sky:single;
    hstring,bstring:string[5];
begin
with tampang do begin
hsk:=120; bsk:=0.5*(b/h)*hsk;
sky:=hsk/h; skx:=2*bsk/b;

{*gambar sumbu*}
setcolor(9);setlinestyle(0,0,1);
line(545,120,545,50);
line(545,120,555+round(bsk),120);
setttextstyle(smallfont,1,4);
outtextxy(539,45,'>');
setttextstyle(smallfont,0,4);
outtextxy(555+round(bsk),114,'>');
setcolor(15);
outtextxy(552+round(bsk),121,'x');
outtextxy(534,45,'y');

{*gambar tampang*}
setcolor(15);setlinestyle(0,0,1);
rectangle(545-round(bsk),bttat,545+round(bsk),bttbw);
setcolor(3);
for i:=1 to nh do begin
circle(545-round(bsk)+round((ds+0.5*D)*sky),bttat+
round((ds+0.5*D+(i-1)*jrkh)*sky),round(D*(skx+sky)*0.125));
circle(545-round(bsk)+round((b1+(ds+0.5*D))*sky),bttat+
round((ds+0.5*D+(i-1)*jrkh)*skx),round(D*(skx+sky)*0.125));
end;
for i:=2 to (nb-1) do begin
circle(545-round(bsk)+round((ds+0.5*D+(i-1)*jrkb)*skx),bttat+
round((ds+0.5*D)*skx),round(D*(skx+sky)*0.125));
circle(545-round(bsk)+round((ds+0.5*D+(i-1)*jrkb)*skx),bttat+
round((h1+(ds+0.5*D))*skx),round(D*(skx+sky)*0.125));
end;
setcolor(15);
line(564+round(bsk),bttat,564+round(bsk),bttbw);
line(562+round(bsk),bttat,566+round(bsk),bttat);
line(562+round(bsk),bttbw,566+round(bsk),bttbw);
line(545-round(bsk),41,545+round(bsk),41);
line(545-round(bsk),39,545+round(bsk),43);
line(545+round(bsk),39,545+round(bsk),43);
str(h,hstring);
setttextstyle(smallFont,1,4);
outtextxy(567+round(bsk),bttat+round(0.42*h*sky),hstring);
str(b,bstring);
setttextstyle(smallFont,0,4);
outtextxy(535,27,bstring);
end;
end;

PROCEDURE Outdiagram(namafile:string;var tampang:data;var sukses:boolean);
const baat=45;babw=445;baki=50;baka=470;batg=260;
var sbx,skaplotP,skaplotM,skamny,skamnx,skapnNeg,skapnPos:single;
    PoredY,MoredY,PoredX,MoredX,Pnmak,Pumak:single;
    Pyplot,Myplot,Pxplot,Mxplot,Pyred,Myred,Pxred,Mxred,kbr,y:integer;
    Mnstr,Mnxstr,Pnstrpos:array [1..4] of string[7];
    Pnstmeg:array [1..2] of string[7];
    tinggi:byte;
    fcstr,dsstr,fystr,Estr,Rhostr,tstr,Dstr,bstr,eyst,nmstr:string[16];
    Pmakstr,Pminstr,MmakYstr,MmakXstr,Pnmakstr,Pumakstr:string[19];

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    judulstr,awalstr,keduastr,totalstr:string[60];
begin
with tampang do begin
listing(namafile,tampang,sukses);
{*skala*}
skaplotP:=(babw-baat)/(Pomak-Pnx[1]);
sbx:=babw-(Abs(Pnx[1])*skaplotP);
skaplotM:=(baka-(baki+0.5*(baka-baki)))/MnmakX;
skaMnx:=(baka-(baki+0.5*(baka-baki)))/4;
skaMny:=(MnmakY/MnmakX)*SkaMnx;
if MnmakY>MnmakX then begin
    skaplotM:=(baka-(baki+0.5*(baka-baki)))/MnmakY;
    skaMny:=(baka-(baki+0.5*(baka-baki)))/4;
    skaMnx:=(MnmakX/MnmakY)*SkaMny;
end;
skaPnNeg:=(babw-sbx)/2;
skaPnPos:=(sbx-baat)/4;

{*keadaan reduksi*}
for k:=1 to kmakX do begin
    PoredX:=Pnx[k];
    MoredX:=Mnx[k];
    if PoredX>=Pnmak then break;
end;
for k:=1 to kmakY do begin
    PoredY:=Pny[k];
    MoredY:=Mny[k];
    if PoredY>=Pnmak then break;
end;
Pumak:=red*Pnmak;

modegrafik;
{*judul*}
outtextxy(85,1,'DIAGRAM INTERAKSI KOLOM UNIAKSIAL DUA SUMBU');
outtextxy(95,12,'BERDASARKAN SK SNI T-15-1991-03 VERSI 1.0');
{*batas kotak diagram}
rectangle(baki-10,baat-20,baka+10,babw+20);

{*mengatur sb y atau Pn*}
settextstyle(smallfont,1,4);
line(batg,baat-20,batg,babw+20);
outtextxy(batg-6,24,'>');
outtextxy(batg-6,457,'<');

{*mengatur sb x atau Mny dan Mnx*}
settextstyle(smallfont,0,4);
line(baki-10,round(sbx),baka+10,round(sbx));
outtextxy(baki-9,round(sbx)-6,'<');
outtextxy(baka+6,round(sbx)-6,'>');
outtextxy(baki-6,round(sbx)+3,'My');
outtextxy(baka-5,round(sbx)+3,'Mx');
outtextxy(batg-10,26,'P');
outtextxy(batg-10,453,'P');

{*mengatur tampilan value*}
setcolor(15);
for i:=1 to 3 do begin
    str(round(Mnxvalue[i]),Mnxstr[i]);
    outtextxy(240+round(skaMnx*i+(i*2)),470,Mnxstr[i]);
    line(batg+round(skaMnx*i),465,batg+round(skaMnx*i),469);
end;
str(round(Mnxvalue[4]),Mnxstr[4]);
outtextxy(240+round(skaMnx*4+(4*2)),470,Mnxstr[4]);
line(batg+round(skaMnx*4)+2,465,batg+round(skaMnx*4)+2,469);

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for i:=1 to 3 do begin
  str(round(Mnyvalue[i]),Mnystr[i]);
  outtextxy(265-round(skaMny*i+(i*5)),470,Mnystr[i]);
  line(batg-round(skaMny*i),465,batg-round(skaMny*i),469);
end;
str(round(Mnyvalue[4]),Mnystr[4]);
outtextxy(265-round(skaMny*4+(4*5)),470,Mnystr[4]);
line(batg-round(skaMny*4)-2,465,batg-round(skaMny*4)-2,469);
for i:=1 to 2 do begin
  str(round(Pnvalueneg[i]),Pnstrneg[i]);
  outtextxy(0,round((sbx+skaPnNeg*i)-5),Pnstrneg[i]);
  line(baki-10,round(sbx+skaPnNeg*i),baki-15,round(sbx+skaPnNeg*i));
end;
for i:=1 to 4 do begin
  str(round(Pnvaluepos[i]),Pnstrpos[i]);
  outtextxy(0,round((sbx-skaPnPos*i)-5),Pnstrpos[i]);
  line(baki-10,round(sbx-skaPnPos*i),baki-15,round(sbx-skaPnPos*i));
end;
outtextxy(15,round(sbx-5),'0.0');
line(baki,round(sbx),baki-15,round(sbx));

{*plot titik-titik sumbu X*}
moveto(batg,babw);
for k:=1 to ksbX do begin
  setcolor(3);setlinestyle(3,0,1);
  Pxplot:=babw-round(Abs(Abs(Pnx[k])-Abs(Pnx[1]))*skaplotP);
  Mxplot:=batg+round(Mnx[k]*skaplotM);
  k:=k+40;
  lineto(Mxplot,Pxplot);
  if k>=ksbX then begin
    lineto(batg-round(Mnx[ksbX]*skaplotM),round(sbx));break;
  end;
end;
moveto(batg,round(sbx+red*(babw-sbx)));
for k:=1 to ksbX do begin
  setcolor(5);
  Pxplot:=babw-round(Abs(Abs(Pnx[k])-Abs(Pnx[1]))*skaplotP);
  Pxred:=round(sbx+red*(Pxplot-sbx));
  Mxplot:=batg+round(Mnx[k]*skaplotM);
  Mxred:=batg+round(0.8*Mnx[k]*skaplotM);
  k:=k+40;
  lineto(Mxred,Pxred);
  if k>=ksbX then begin
    lineto(batg+round(0.8*Mnx[ksbX]*skaplotM),round(sbx));break;
  end;
end;

for k:=ksbX to kmakX do begin
  setcolor(3);setlinestyle(0,0,1);
  Pxplot:=babw-round((Pnx[k]-Pnx[1])*skaplotP);
  Pxred:=round(sbx-red*(sbx-Pxplot));
  Mxplot:=batg+round(Mnx[k]*skaplotM);
  Mxred:=batg+round(red*Mnx[k]*skaplotM);
  if red*Pnx[k]<=Pkhusus then begin
    Mxred:=batg+round((0.8-((0.8-red)*red*Pnx[k]/Pkhusus))*Mnx[k]*skaplotM);
  end;
  Putpixel(Mxplot,Pxplot,3);
  Putpixel(Mxred,Pxred,5);
  if Pnx[k]>=Pnmak then break;
end;
Putpixel(batg,baat,3);
moveto(batg+round(MoredX*skaplotM),round(sbx-Pnmak*skaplotP));
for k:=ksbX to kmakX do begin
  setcolor(3);setlinestyle(3,0,1);

```

```

    if Pny[k]>=Pnmak then break;
end;
Putpixel(batg,baat,3);
moveto(batg-round(MoredY*skaplotM),round(sbx-Pnmak*skaplotP));
for k:=ksbY to kmakY do begin
    setcolor(3);setlinestyle(3,0,1);
    Pyplot:=babw-round((Pny[k]-Pny[1])*skaplotP);
    Myplot:=batg-round(Mny[k]*skaplotM);
    if Pny[k]>Pnmak then begin
        k:=k+100;
        lineto(Myplot,Pyplot);
        if k>kmakY then begin
            lineto(batg,baat);break;
        end;
    end;
end;
Putpixel(batg,round(sbx-red*(sbx-baat)),5);
moveto(batg-round(red*MoredY*skaplotM),round(sbx-Pumak*skaplotP));
for k:=ksbY to kmakY do begin
    setcolor(5);setlinestyle(3,0,1);
    Pyplot:=babw-round((Pny[k]-Pny[1])*skaplotP);
    Pyred:=round(sbx-red*(sbx-Pyplot));
    Myplot:=batg-round(Mny[k]*skaplotM);
    Myred:=batg-round(red*Mny[k]*skaplotM);
    if Pny[k]>Pnmak then begin
        k:=k+50;
        lineto(Myred,Pyred);
        if k>=kmakY then begin
            lineto(batg,round(sbx-red*(sbx-baat)));break;
        end;
    end;
end;

{*plot keadaan reduksi*}
setcolor(3); setlinestyle(0,0,1);
str(round(Pnmak),Pnmakstr);
outtextxy(0,round(sbx-(Pnmak*skaplotP))-5,Pnmakstr);
line(batg,round(sbx-Pnmak*skaplotP),batg-round(MoredY*skaplotM),
    round(sbx-Pnmak*skaplotP));
line(batg,round(sbx-Pnmak*skaplotP),batg+round(MoredX*skaplotM),
    round(sbx-Pnmak*skaplotP));
line(baki-10,round(sbx-Pnmak*skaplotP),baki-15,
    round(sbx-Pnmak*skaplotP));
setcolor(5);
line(batg,round(sbx-Pumak*skaplotP),batg-round(red*MoredY*skaplotM),
    round(sbx-Pumak*skaplotP));
line(batg,round(sbx-Pumak*skaplotP),batg+round(red*MoredX*skaplotM),
    round(sbx-Pumak*skaplotP));

{*grid*}
setcolor(7);setwritemode(0);setlinestyle(1,0,1);
for i:=1 to 3 do begin
    line(batg+round(skaMnx*i),baat-20,batg+round(skaMnx*i),babw+20);
    line(batg-round(skaMny*i),baat-20,batg-round(skaMny*i),babw+20);
    line(baki-10,round(sbx-skaPnPos*i),baka+10,round(sbx-skaPnpos*i));
end;
line(batg+round(skaMnx*4)+2,baat-20,batg+round(skaMnx*4)+2,babw+20);
line(batg-round(skaMny*4)-2,baat-20,batg-round(skaMny*4)-2,babw+20);
line(baki-10,round(sbx-skaPnPos*4),baka+10,round(sbx-skaPnpos*4));

```

```

for i:=1 to 2 do begin
  line(baki-10,round(sbx+skaPnNeg*i),baka+10,round(sbx+skaPnNeg*i));
end;

{*tampil data*}
setcolor(3);setlinestyle(0,0,1);
line(500,195,550,195);
setcolor(5);
line(500,215,550,215);
setcolor(15);
outtextxy(560,189,'Mn-Pn');
outtextxy(560,208,'Mu-Pu');
rectangle(485,230,630,465);
line(485,252,630,252);
line(485,254,630,254);
line(485,354,630,354);
settextstyle(defaultfont,0,1);
tinggi:=textheight('jK');
y:=238;
nmstr:='FILE : '+nama;
outtextxy(500,y,nmstr);
settextstyle(smallfont,0,4);
y:=240+tinggi+10;
str(fc,fcstr);
fcstr:=' '+fcstr+' MPa';
outtextxy(500,y,'Ÿc'); outtextxy(520,y,fcstr);
y:=y+tinggi+5;
str(beta:0:3,bstr);
bstr:=' '+bstr;
outtextxy(500,y,'á'); outtextxy(520,y,bstr);
y:=y+tinggi+5;
str(ds,dsstr);
dsstr:=' '+dsstr+' mm';
outtextxy(500,y,'ds'); outtextxy(520,y,dsstr);
y:=y+tinggi+5;
str(fy,fystr);
fystr:=' '+fystr+' MPa';
outtextxy(500,y,'Ÿy'); outtextxy(520,y,fystr);
y:=y+tinggi+5;
str(E,Estr);
Estr:=' '+Estr+' MPa';
outtextxy(500,y,'Es'); outtextxy(520,y,Estr);
y:=y+tinggi+5;
str(RhoTul:0:2,Rhostr);
Rhostr:=' '+Rhostr+' %';
outtextxy(500,y,'á'); outtextxy(520,y,Rhostr);
y:=y+tinggi+5;
str(D,Dstr);
str(ntul,tstr);
if fy>=320 then begin
  tstr:=' '+tstr+' D'+Dstr;
end
else begin
  tstr:=' '+tstr+' P'+Dstr;
end;
outtextxy(500,y,'tul'); outtextxy(520,y,tstr);
y:=y+tinggi+15;
str(round(Pomak),Pmakstr);
Pmakstr:=' '+Pmakstr;
outtextxy(500,y,'Pomak'); outtextxy(595,y,'KN'); outtextxy(535,y,Pmakstr);
y:=y+tinggi+5;
str(round(Pomin),Pminstr);
Pminstr:=' '+Pminstr;
outtextxy(500,y,'Pomin'); outtextxy(595,y,'KN'); outtextxy(535,y,Pminstr);

```

```

y:=y+tinggi+5;
str(round(Pnmak),Pnmakstr);
Pnmakstr:=' '+Pnmakstr;
outtextxy(500,y,'Pnmak'); outtextxy(595,y,'KN'); outtextxy(535,y,Pnmakstr);
y:=y+tinggi+5;
str(round(Pumak),Pumakstr);
Pumakstr:=' '+Pumakstr;
outtextxy(500,y,'Pumak'); outtextxy(595,y,'KN'); outtextxy(535,y,Pumakstr);
y:=y+tinggi+5;
str(round(MnmakX),MmakXstr);
MmakXstr:=' '+MmakXstr;
outtextxy(500,y,'MnmakX'); outtextxy(595,y,'KNm'); outtextxy(535,y,MmakXstr);
y:=y+tinggi+5;
str(round(MnmakY),MmakYstr);
MmakYstr:=' '+MmakYstr;
outtextxy(500,y,'MnmakY'); outtextxy(595,y,'KNm'); outtextxy(535,y,MmakYstr);
line(485,440,630,440);
line(485,442,630,442);
settextstyle(defaultfont,0,1);
awalstr:=chr(83)+chr(111)+chr(110)+chr(110)+chr(121)+' ';
keduastr:=awalstr+chr(73)+chr(46)+chr(65)+chr(46)+' ';
totalstr:=keduastr+chr(40)+chr(50)+chr(48)+chr(48)+chr(48)+chr(41);
outtextxy(490,450,totalstr);
outtampang(tampang);
readkey;
closegraph;
end;
end;

```

PROCEDURE bingkai;

```

begin
end;

```

BEGIN

```

textcolor(7); textbackground(0);
clrscr;
menu[12] :='1.Input Data  ';
menu[13] :='2.Edit Data  ';
menu[14] :='3.Output Diagram ';
menu[15] :='4.Exit      ';
bingkai;
repeat
for i:=12 to 15 do begin
gotoxy(35,i);writeln(menu[i]);
end;
textcolor(15); textbackground(7);
gotoxy(35,12);write(menu[12]);
sorot:=12;
repeat
tombol := readkey;
if tombol = #0 then begin
tombol:=readkey;
if tombol = 'H' then begin
textcolor(7); textbackground(1);
gotoxy(35,sorot);write(menu[sorot]);
dec(sorot);
if sorot<12 then
sorot:=15;
textcolor(15); textbackground(7);
gotoxy(35,sorot);write(menu[sorot]);
end
else if tombol = 'P' then begin
textcolor(7); textbackground(1);
gotoxy(35,sorot);write(menu[sorot]);

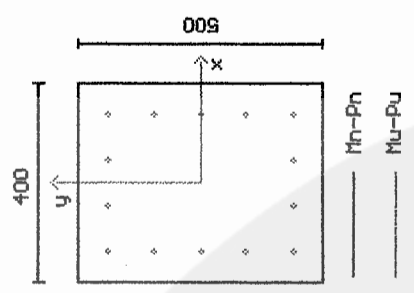
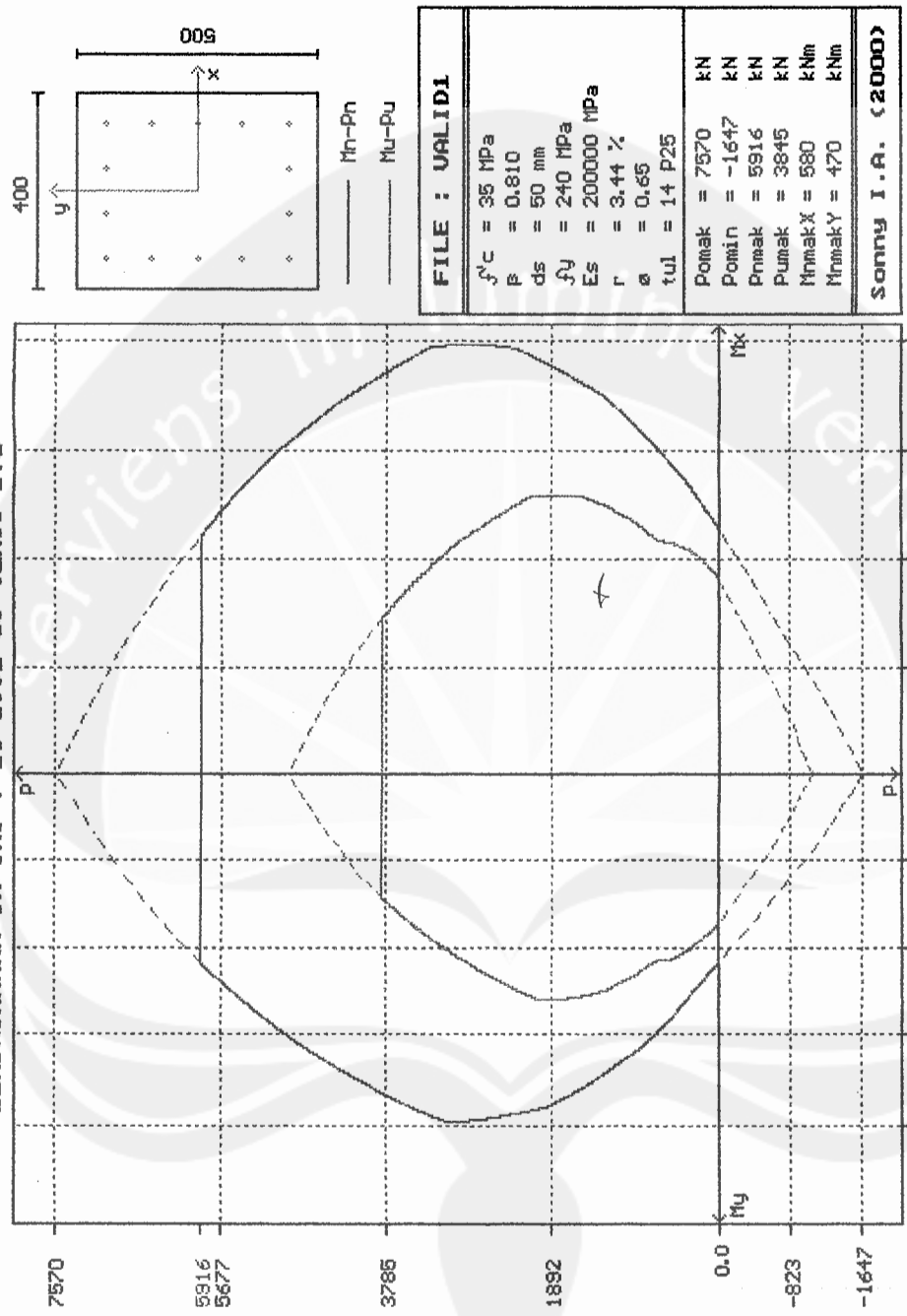
```

```
inc(sorot);
if sorot>15 then
  sorot:=12;
  textcolor(15); textbackground(7);
  gotoxy(35,sorot);write(menu[sorot]);
end;
end;
until tombol=#13;
  textcolor(7); textbackground(0);
  clrscr;

if sorot=12 then begin
  inputan(namafile,tampang);
  clrscr;
  bingkai;
end;
if sorot=13 then begin
  edit(namafile,tampang,sukses);
  clrscr;
  bingkai;
end;
if sorot=14 then begin
  outdiagram(namafile,tampang,sukses);
  clrscr;
  bingkai;
end;
if sorot=15 then begin
  exit;
end;
until sorot=15;
END.
```



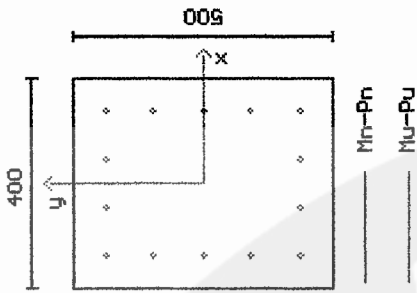
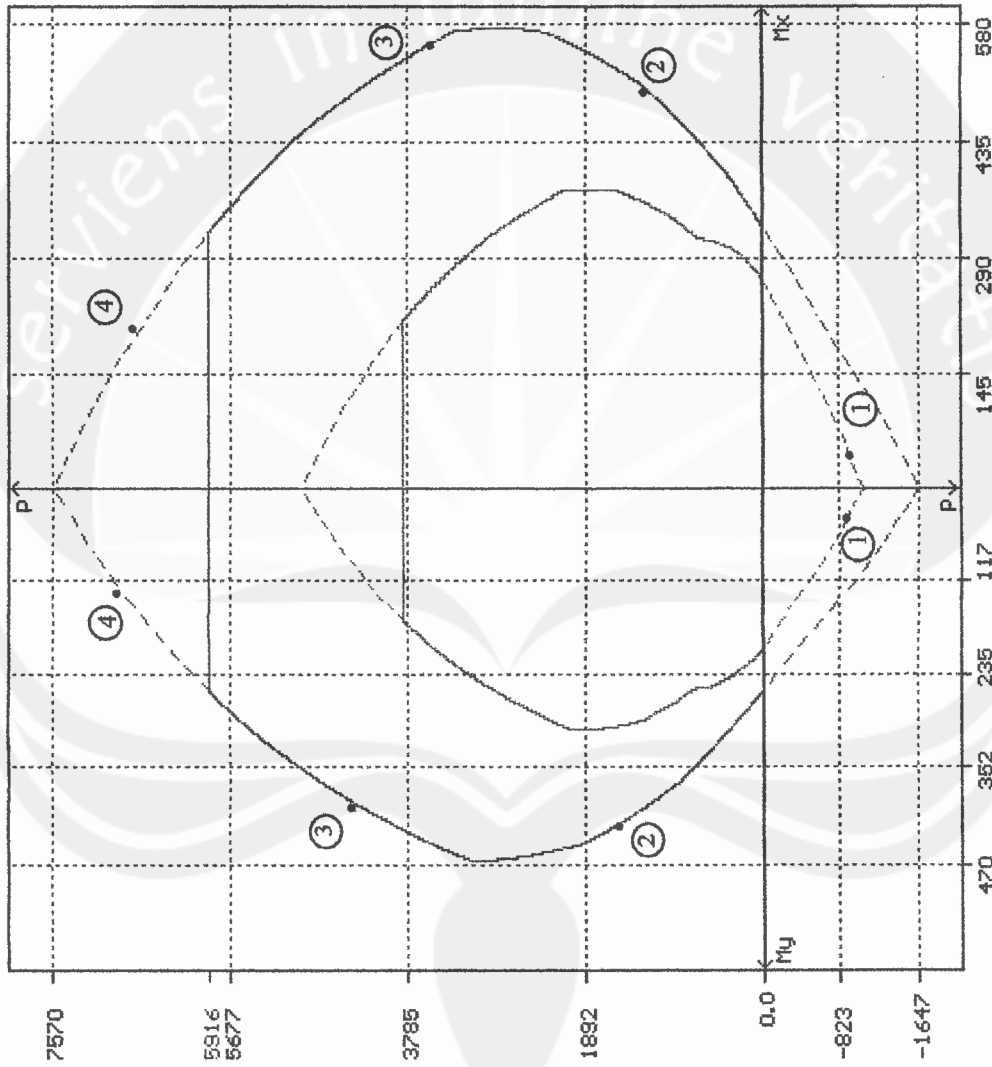
DIAGRAM INTERAKSI KOLOM SEGI EMPAT UNIAKSIAL DUA SUMBU  
BERDASARKAN SK SNI T-15-1991-03 VERSI 1.0



Lampiran 2. Contoh Hasil Program



DIAGRAM INTERAKSI KOLOM SEGI EMPAT UNIAKSIAL DUA SUMBU  
BERDASARKAN SK SNI T-15-1991-03 VERSI 1.0



<b>FILE : VALID1</b>	
$f'_c = 35$ MPa	Pomak = 7570 kN
$\rho = 0.810$	Pomin = -1647 kN
$d_s = 50$ mm	Pmaks = 5916 kN
$f_y = 240$ MPa	Pumak = 3845 kN
$E_s = 200000$ MPa	MmaksX = 580 kNm
$r = 3.44$ %	MmaksY = 470 kNm
$\phi = 0.65$	
$t_{ul} = 14$ P25	
<b>SONNY I. A. (2000)</b>	

Lampiran 3. Plot Hasil Hitungan Manual