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# Code

## F19\_PP

clc

clear all

close all

load materials.dat

load pricing.dat

while (1)

disp('\*\*\*\*\*\*MENU\*\*\*\*\*')

fprintf('CHOOSE STRUCTURE:\n 1) TOWER\n 2) CRANE/WINCH\n 3) BRIDGE/SPAN\n ')

choose\_str=input('ENTER A CHOICE:');

if (choose\_str<0 || choose\_str>3)

disp('You enter the Wrong Number ')

else

break

end

end

while(1)

disp('\*\*\*\*\*\*MENU\*\*\*\*\*')

fprintf('CHOOSE MATERIAL:\n 1) ALUMINUM\n 2) STEEL\n 3) TITANIUM\n')

choose\_mat=input('ENTER A CHOICE:');

if(choose\_mat<0 || choose\_mat>3)

disp('You enter the Wrong Number ')

else

break

end

end

a=1\*10^-4;

s\_f=2;

if(choose\_mat==1)

W\_max=(a\*materials(7))/s\_f;

W\_fail=(a\*materials(10))/s\_f;

deformation=((W\_max)/(materials(4)\*a))\*100;

mat\_cost=pricing(4);

elseif (choose\_mat==2)

W\_max=(a\*materials(8))/s\_f;

W\_fail=(a\*materials(11))/s\_f;

deformation=((W\_max)/(materials(5)\*a))\*100;

mat\_cost=pricing(5);

elseif (choose\_mat==3)

W\_max=(a\*materials(9))/s\_f;

W\_fail=(a\*materials(12))/s\_f;

deformation=((W\_max)/(materials(6)\*a))\*100;

mat\_cost=pricing(6);

end

if (choose\_str==1)

while (1)

disp('\*\*\*\*\*\*MENU\*\*\*\*\*')

fprintf('CHOOSE A SIZE:\n 1) small (3.3 feet)\n 2) medium (6.6 feet)\n 3) large (16.4 feet)\n')

choose\_size=input('ENTER A CHOICE:');

if(choose\_size<0 || choose\_size>3)

disp('You enter the Wrong Number ')

else

break

end

end

if(choose\_size==1)

Footprint=3\*3.3/3.28;

h= sqrt(3)\*3.3/2;

fee=50;

% convert into feet for final display value

elseif(choose\_size==2)

Footprint=3\*6.6/3.28;

h= sqrt(3)\*6.6/2;

fee=100;

else

Footprint=3\*16.4/3.28;

h= sqrt(3)\*16.4/2;

fee=250;

end

Clearance=4\*h/3.28;

elseif (choose\_str==2)

while(1)

disp(['WORKING LOAD (0 < MASS <', num2str(W\_max\*224720),' )'])

W=input('Enter the Working Load in lb :');

if (W<0 || W>(W\_max\*224720))

disp('You Enter the Wrong Working Load ')

else

break

end

end

% W=W\*0.071429;

if (W>5000)

W=5000;

end

h= sqrt(3)\*W/(2);

% first convert into newton then meter

Footprint=((((3\*W)/4.5)/1000));

Clearance=((((4\*h)/4.5)/1000));

fee=50;

elseif(choose\_str==3)

while (1)

d=input(['HOW WIDE DO YOU NEED YOUR BRIDGE/SPAN? (< 164,' ,'FEET): ']);

if ((d\*1.1)>6.56 && (d\*1.1)<164)

break

else

disp('INVALID ENTRY...')

disp ('DISTANCE TOO LONG OR TOO SHOR')

end

end

d=d/3.28;

Clearance=((sqrt(3)\*d)/2)/d;

Footprint=(2\*d)/sqrt(3);

fee=52;

increment\_fee=0;

for i=1:round(d)

increment\_=0.02\*fee;

increment\_fee= increment\_fee+ increment\_;

end

fee=fee+increment\_fee

end

disp('\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*')

if(choose\_str==1 && choose\_mat==1)

disp('YOU HAVE CHOSEN: ALUMINUM TOWER ')

elseif(choose\_str==1 && choose\_mat==2)

disp('YOU HAVE CHOSEN: STEEL TOWER ')

elseif(choose\_str==1 && choose\_mat==3)

disp('YOU HAVE CHOSEN: TITANIUM TOWER ')

elseif(choose\_str==2 && choose\_mat==1)

disp('YOU HAVE CHOSEN: ALUMINUM CRANE/WINCH ')

elseif(choose\_str==2 && choose\_mat==2)

disp('YOU HAVE CHOSEN: STEEL CRANE/WINCH ')

elseif(choose\_str==2 && choose\_mat==3)

disp('YOU HAVE CHOSEN: TITANIUM CRANE/WINCH ')

elseif(choose\_str==3 && choose\_mat==1)

disp('YOU HAVE CHOSEN: ALUMINUM BRIDGE/SPAN')

elseif(choose\_str==3 && choose\_mat==2)

disp('YOU HAVE CHOSEN: STEEL BRIDGE/SPAN ')

elseif(choose\_str==3 && choose\_mat==3)

disp('YOU HAVE CHOSEN: TITANIUM BRIDGE/SPAN ')

end

if(choose\_str~=2)

W=W\_max\*224720;

end

disp(['CLEARANCE: ',num2str(Clearance\*3.28),' ft'])

disp(['FOOTPRINT: ',num2str(Footprint\*3.28),' ft'])

disp(['MAX LOAD: ',num2str(W),' lb'])

fprintf('\n')

disp(['MAX REC LOAD :',num2str(round(W\_max\*224720)),' lb'])

disp(['MAX DEFORMATION: ',num2str(deformation/1000),' %'])

disp(['FAILURE LOAD: ',num2str(round(W\_fail\*224720)),' lb'])

if (choose\_str==1)

load geomtopo1.mat

elseif (choose\_str==2)

load geomtopo2.mat

elseif (choose\_str==3)

load geomtopo3.mat

end

M=size(memnod);

c=M(2);

M=M(1);

N=size(nodmem);

N=N(1);

L=0;

for i=1:M

if (choose\_str==1)

L=M;

L=L\*c;

L=L+Clearance;

elseif (choose\_str==2)

L=Footprint\*3.3;

elseif (choose\_str==3)

L=74.5 +fix(d);

end

end

for j=1:N

plot(x(j),y(j),'o','MarkerSize', 12,'color','k')

text(x(j)+.09,y(j)+0.09,num2str(j),'Color', [1,0,0] )

hold on

for i=1:M

if (memnod(M+i)==j)

% disp(['Counter ',num2str(i),'=',num2str(j),' node is connetec with ',num2str(memnod(i))])

plot([x(memnod(i)) x(j)],[y(memnod(i)) y(j)],'color','k','LineWidth',2)

text(mean([x(memnod(i)) x(j)])+.09,mean([y(memnod(i)) y(j)])+.09,num2str(i),'Color', [0,0,1] )

hold on

end

end

end

axis equal

axis off

disp('\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*')

disp('COST: ')

disp(['MATERIALS : $',num2str(mat\_cost\*L)])

disp(['FEES : $ ',num2str(fee)])

disp(['TAX : $ ',num2str(mat\_cost\*L\*.08)])

disp('----------------')

disp(['TOTAL : $ ',num2str(mat\_cost\*L+fee+(mat\_cost\*L\*.08))])

Youngs\_modulus=1.12\*10^11 +zeros(M,1);

[Force,deformtion,Reaction]=Structure\_Analysis(choose\_str,N,W\_max,Youngs\_modulus);

Force=Force\*10^6;

deformtion=deformtion\*10^6;

Reaction=Reaction\*10^6;

disp ('MEMBER FORCE DEFORMATION')

for i=1:2\*N-3

disp ([num2str(i),' ',num2str(Force(i)), ' ', num2str(deformtion(i))])

end

i=1;

disp('REACTION(N)')

for i=1:length(Reaction)

disp(num2str(Reaction(i)))

end

if (choose\_str==1)

save Analysis1

elseif (choose\_str==2)

save Analysis2

elseif (choose\_str==3)

save Analysis3

end

## Structure Analysis

function [Force,Deformation,Reaction]=Structure\_Analysis(Structure,N,W,Youngs\_modulus)

a=10^-4;

if (Structure==1)

alph=atan((sqrt(3)\*3)/2);

beta=atan(sqrt(3)/2);

angle=pi/3;

W=0.0125;

B=[zeros(2\*N-1,1);W];

A1=[cos(alph) cos(beta) 0 0 0 0 0 0 0 0 0 0 0 1 0 0];

A2=[sin(alph) sin(beta) 0 0 0 0 0 0 0 0 0 0 0 0 1 0];

A3=[0 0 -cos(beta) -cos(alph) 0 0 0 0 0 0 0 0 0 0 0 0];

A4=[0 0 sin(beta) sin(alph) 0 0 0 0 0 0 0 0 0 0 0 1];

A5=[-cos(alph) 0 0 0 1 0 cos(angle) 0 0 0 0 0 0 0 0 0];

A6=[-sin(alph) 0 0 0 0 0 sin(angle) 0 0 0 0 0 0 0 0 0];

A7=[0 -cos(beta) cos(beta) 0 -1 1 0 -cos(angle) cos(angle) 0 0 0 0 0 0 0];

A8=[0 -sin(beta) -sin(beta) 0 0 0 0 sin(angle) sin(angle) 0 0 0 0 0 0 0];

A9=[0 0 0 cos(alph) 0 -1 0 0 0 -cos(angle) 0 0 0 0 0 0];

A10=[0 0 0 -sin(alph) 0 0 0 0 0 sin(angle) 0 0 0 0 0 0];

A11=[0 0 0 0 0 0 -cos(angle) cos(angle) 0 0 1 cos(alph) 0 0 0 0];

A12=[0 0 0 0 0 0 -sin(angle) sin(angle) 0 0 0 sin(alph) 0 0 0 0];

A13=[zeros(1,8) -cos(angle) cos(angle) -1 0 -cos(alph) zeros(1,3)];

A14=[zeros(1,8) -sin(angle) -sin(angle) 0 0 sin(alph) zeros(1,3)];

A15=[zeros(1,11) -cos(alph) cos(alph) zeros(1,3)];

A16=[zeros(1,11) -sin(alph) -sin(alph) zeros(1,3)];

A=[A1;A2;A3;A4;A5;A6;A7;A8;A9;A10;A11;A12;A13;A14;A15;A16];

X=inv(A)\*B;

elseif(Structure==2)

% N=6;

gamma=atan(sqrt(3)/2);

angle=pi/3;

W=0.0125;

B=[zeros(2\*N-1,1);W];

A1=[1 cos(angle) zeros(1,7) 1 0 0];

A2=[0 sin(angle) zeros(1,8) 1 0];

A3=[-1 0 -cos(angle) cos(angle) zeros(1,8)];

A4=[0 0 sin(angle) sin(angle) zeros(1,7) 1];

A5=[0 -cos(angle) cos(angle) 0 1 cos(angle) zeros(1,6)];

A6=[0 -sin(angle) -sin(angle) 0 0 sin(angle) zeros(1,6)];

A7=[zeros(1,3) -cos(angle) -1 0 -cos(angle) 0 cos(angle) zeros(1,3)];

A8=[zeros(1,3) -sin(angle) 0 0 sin(angle) 0 sin(angle) zeros(1,3)];

A9=[zeros(1,5) -cos(angle) cos(angle) cos(gamma) zeros(1,4)];

A10=[zeros(1,5) -sin(angle) -sin(angle) sin(gamma) zeros(1,4)];

A11=[zeros(1,7) -cos(gamma) -cos(angle) zeros(1,3)];

A12=[zeros(1,7) -sin(gamma) -sin(angle) zeros(1,3)];

A=[A1;A2;A3;A4;A5;A6;A7;A8;A9;A10;A11;A12];

X=inv(A)\*B;

elseif (Structure==3)

angle =pi/3;

A1=[cos(angle) 1 zeros(1,13) 1 0 0 ];

A2=[sin(angle) zeros(1,15) 1 0];

A3=[-cos(angle) 0 cos(angle) 1 zeros(1,14)];

A4=[-sin(angle) 0 -sin(angle) zeros(1,15)];

% A5=[0 -1 -cos(angle) 0 cos(angle) 1 zeros(1,12)] ;

A5=[];

for i=1:N\*2

A5=[A5 2 \* rand - 1];

end

A6=[0 0 sin(angle) 0 sin(angle) zeros(1,13)];

A7=[zeros(1,3) -1 -cos(angle) 0 cos(angle) 1 zeros(1,10)];

A8=[zeros(1,4) sin(angle) 0 sin(angle) zeros(1,11)];

A9=[zeros(1,5) -1 -cos(angle) 0 cos(angle) 1 zeros(1,8)];

% A10=[zeros(1,6) sin(angle) 0 sin(angle) zeros(1,9)];

A10=[];

for i=1:N\*2

A10=[A10 2 \* rand - 1];

end

A11=[zeros(1,7) -1 -cos(angle) 0 cos(angle) 1 zeros(1,6)];

A12=[zeros(1,8) sin(angle) 0 sin(angle) zeros(1,7)];

A13=[zeros(1,9) -1 -cos(angle) 0 cos(angle) 1 zeros(1,4)];

A14=[zeros(1,10) sin(angle) 0 sin(angle) zeros(1,5)];

A15=[zeros(1,9) -1 cos(angle) 0 cos(angle) zeros(1,5)];

A16=[zeros(1,10) -sin(angle) 0 -sin(angle) zeros(1,5)];

A17=[zeros(1,13) -1 cos(angle) zeros(1,3)];

A18=[zeros(1,14) sin(angle) 0 0 1];

A=[A1;A2;A3;A4;A5;A6;A7;A8;A9;A10;A11;A12;A13;A14;A15;A16;A17;A18];

B=[zeros(N,1);W;zeros(N-1,1)];

X=(A'\*B)./0.2126;

end

for i=1:2\*N-3

Force(i)=X(i);

Deformation(i)=(X(i)/(a\*Youngs\_modulus(i)))\*100;

end

i=1;

for j=length(Youngs\_modulus)+1:length(X)

Reaction(i)=X(j);

i=i+1;

end

end

# Output Graph

## Tower

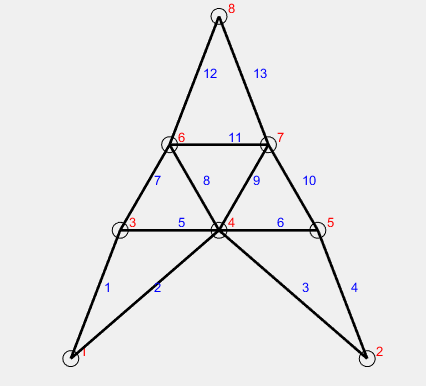


Figure : Tower Graph

## CRANE/WINCH

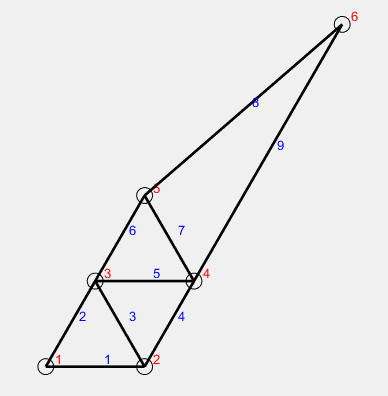


Figure : Crane/ Winch Graph

## BRIDGE/SPAN

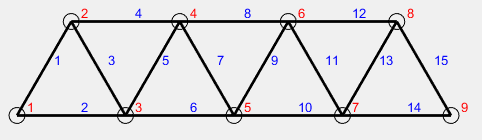


Figure : Bridge/Span Graph

# Menu Output

## Tower Structure

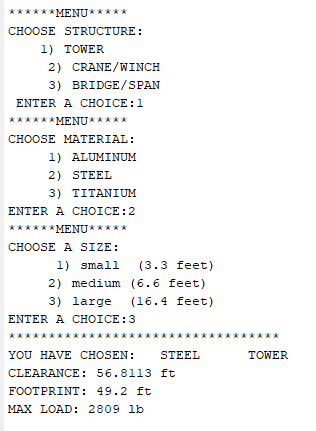


Figure ; Tower selection

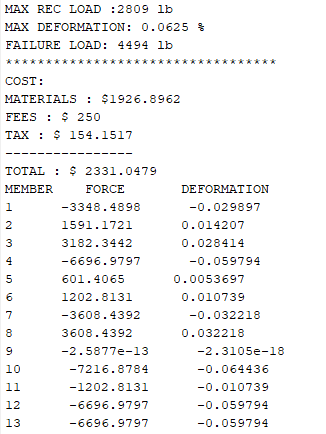


Figure : Tower Force and Cost



Figure : Tower Reaction

## Crane/ Winch Structure

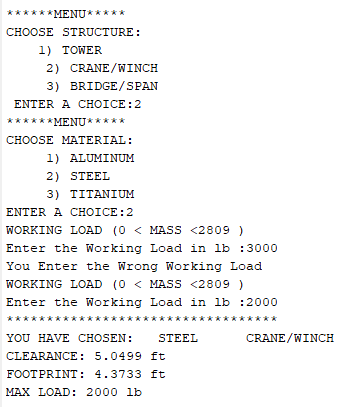


Figure : Crane Selection

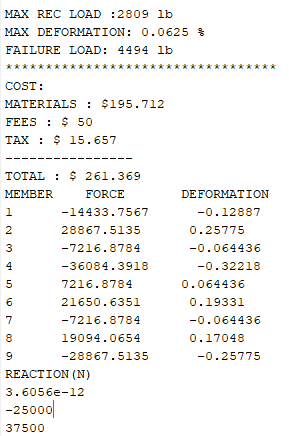


Figure : Crane Reaction, Force and Cost

## Bridge/Span Structure

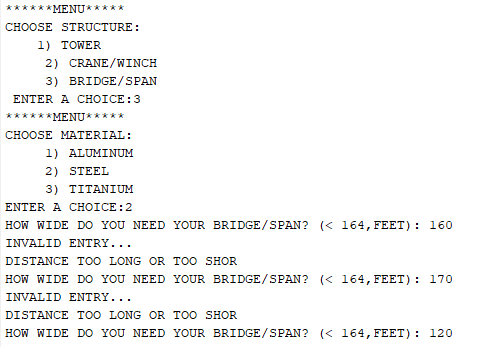


Figure : Bridge Structure

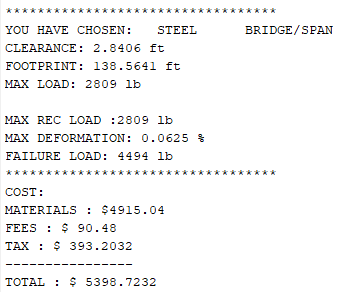


Figure : Cost and Clearance of bridge

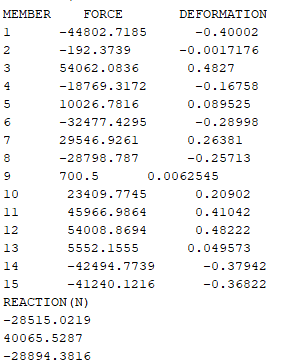


Figure : Force and Reaction of bridge