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ESTIMATION OF POLAR MOMENT OF INERTIA OF L AND T SHAPE BEAMS USING MATLAB

Krishna Verma
B.Tech (Automobile) Student, School of Engineering & Technology ,S harda University, Greater Noida.

Abstract: *Abstract:-Through this paper an idea is generated for the estimation of polar moment of Inertia .The relation of polar moment of inertia with the twisting of material and its role in reducing the twisting effect is elaborated. In this section finding the polar moment of inertia of rectangular lamina in the shape of L and T is to be analyzed by the coding in the MATLAB software.*

Keywords:Moment of inertia, Polar moment, Matlab.

INTRODUCTION:

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The first moment of a force about any point is defined as the product of the force and the perpendicular distance between them. If the distance again multiplied by the first moment of inertia then it would be called as second moment of force. But instead of force if area is to be considered then it would be called as second moment of area, or if mass is considered then it would be called as second moment of mass. It is also termed as moment of inertia (second moment of area).Polar moment of inertia is the beam's (circular) ability to resist twist. It is actually the sum of moment of inertia about xx axis (Ixx) and about yy axis (Iyy). If Ipp is considered to be the polar moment of inertia then,

Ipp= Ixx + Iyy (mm^4)

BENEFITS OF FINDING POLAR MOMENT OF INERTIA:

As suppose circular beam goes under the process of twisting then we can make the beam to be less twistable by increasing its polar moment of inertia. Polar moment of inertia is inversely proportional to the twisting. Greater the polar moment of inertia of the beam lesser it would perform twisting. So this is great advantage of finding the polar moment of inertia to resist the twisting of the material.

FINDING THE MOMENT OF INERTIA

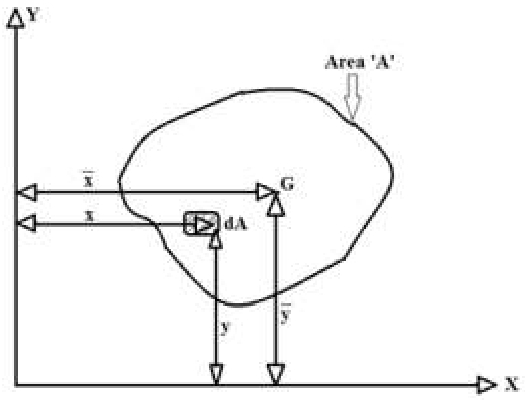


Fig: Moment of inertia (second moment of area)

Let a plane area 'A ' then moment of inertia of A is the second moment of small areas 'dA' comprising the area A about any axis X or Y in the plane of area A

Moment of inertia about xx =Ixx
Moment of inertia about yy =Iyy
Polar moment of inertia = Ipp
Now,
First moment of area dA about YY = dA × x
Second moment of area dA about YY = dA × x × x = dA × x^2

Therefore, $I_{yy} = \sum dAx^2 = ? \int dAx^2$

$I_{xx} = \sum dAy^2 = ? \int dAy^2$

$I_{pp} = I_{xx} + I_{yy}$

For rectangle, Ixx = bd?/ 12,

Iyy = db?/ 12

For triangle, Ixx= bh?/ 36

For circle, Ixx =Iyy = (∏r^4)/4

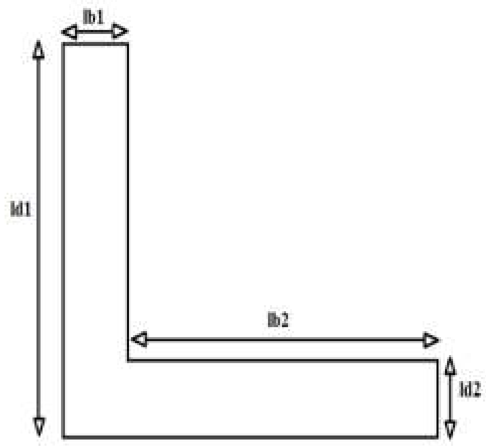
For semicircle, $I_{xx}= 0.11r^4$, $I_{yy}= (\Pi r^4)/8$

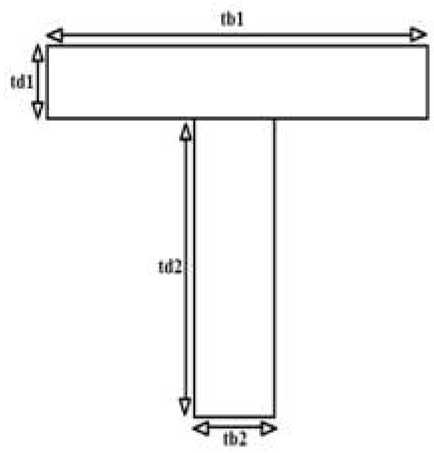
For quarter circle, $I_{xx}=I_{yy} = 0.055r^4$

For Ellipse, $I_{xx} = \Pi ab?/4$,

$I_{yy} = \Pi ba?/4$

ASSUMPTIONS MADE FOR L AND T SHAPE SECTIONS:





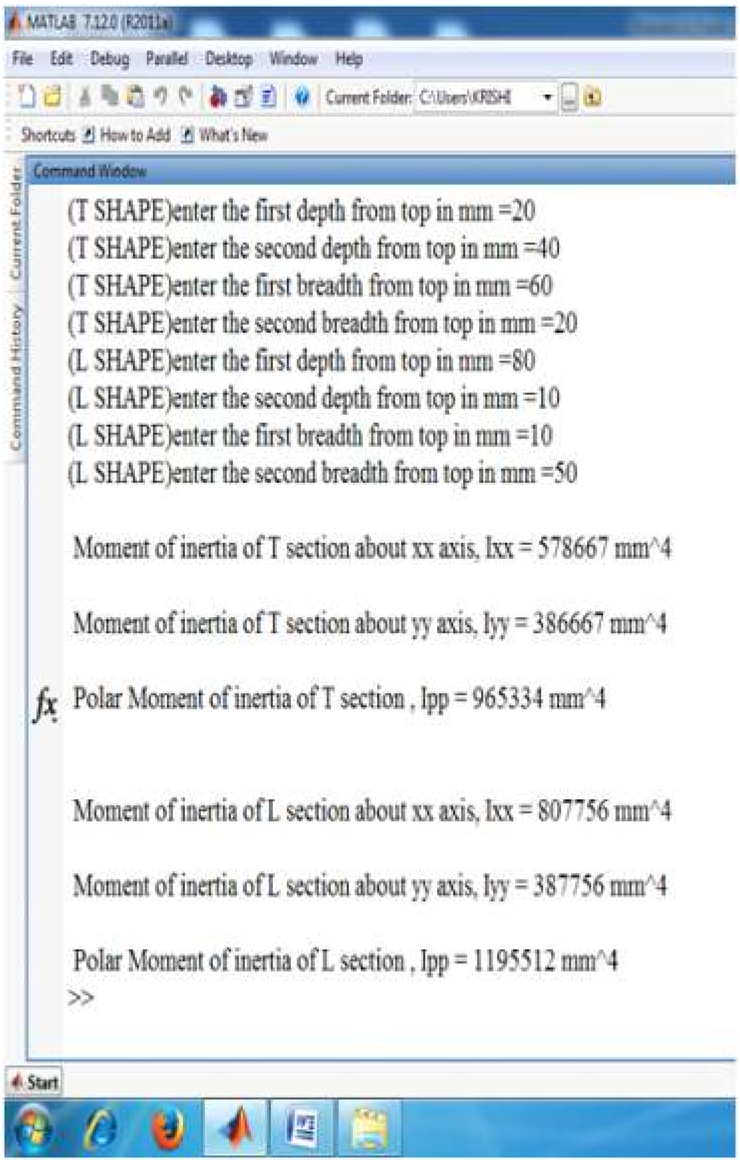
(T SHAPE) enter the first depth from top in mm =td1
(T SHAPE) enter the second depth from top in mm =td2
(T SHAPE) enter the first breadth from top in mm =tb1
(T SHAPE) enter the second breadth from top in mm =tb2
(L SHAPE) enter the first depth from top in mm =ld1
(L SHAPE) enter the second depth from top in mm =ld2
(L SHAPE) enter the first breadth from top in mm =lb1
(L SHAPE) enter the second breadth from top in mm =lb2

Program of Matlab

```
% For T shape section
td1=input('(T SHAPE)enter the first depth from top in mm =');
td2=input('(T SHAPE)enter the second depth from top in mm =');
tb1=input('(T SHAPE)enter the first breadth from top in mm =');
tb2=input('(T SHAPE)enter the second breadth from top in mm =');
ta1=td1*tb1;
ta2=td2*tb2;
ty1=(td1/2)+td2;
ty2=(td2/2);
tay=(ta1*ty1)+(ta2*ty2);
ybar=tay/(ta1+ta2);
h1=ty1-ybar;
h2=ty2-ybar;
tixx=(((tb1*td1^3)/12)+ta1*h1^2)+(((tb2*td2^3)/12)+ta2*h2^2);
tiyy=round((td1*tb1^3)/12)+((td2*tb2^3)/12);
tipp=round(tixx)+round(tiyy);

% For L shape section
ld1=input('(L SHAPE)enter the first depth from top in mm =');
ld2=input('(L SHAPE)enter the second depth from top in mm =');
lb1=input('(L SHAPE)enter the first breadth from top in mm =');
lb2=input('(L SHAPE)enter the second breadth from top in mm =');
la1=ld1*lb1;
la2=ld2*lb2;
lx1=lb1/2;
lx2=(lb2/2)+lb1;
ly2=(ld2/2);
ly1=(ld1/2);
lax=(la1*lx1)+(la2*lx2);
lay=(la1*ly1)+(la2*ly2);
lxbar=lax/(la1+la2);
lybar=lay/(la1+la2);
lh1x=ly1-lybar;
lh2x=ly2-lybar;
lh1y=lx1-lxbar;
lh2y=lx2-lxbar;
lixx=(((lb1*ld1^3)/12)+lb1*ld1*lh1x^2)+(((lb2*ld2^3)/12)+lb2*ld2*lh2x^2);
liyy=(((ld1*lb1^3)/12)+ld1*lb1*lh1y^2)+(((ld2*lb2^3)/12)+ld2*lb2*lh2y^2);
lipp=round(lixx)+round(liyy);
fprintf('\n Moment of inertia of T section about xx axis, Ixx = %d mm^4 \n',round(tixx));
fprintf('\n Moment of inertia of T section about yy axis, Iyy = %d mm^4 \n',round(tiyy));
fprintf('\n Polar Moment of inertia of T section , Ipp = %d mm^4 \n',round(tipp));
fprintf('\n')
fprintf('\n Moment of inertia of L section about xx axis, Ixx = %d mm^4 \n',round(lixx));
fprintf('\n Moment of inertia of L section about yy axis, Iyy = %d mm^4 \n',round(liyy));
fprintf('\n Polar Moment of inertia of L section , Ipp = %d mm^4 \n',round(lipp));
```

RESULT OF MATLAB PROGRAM IN THE COMMAND WINDOW



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Krishna Verma
B.Tech (Automobile) Student, School of Engineering & Technology ,Sharda University, Greater Noida.