Perspectives
hw6 – analysis 3

Learning how to model structures and beginning to understand and interpret results

You may work in groups of up to 3 (and turn in only one assignment)

Use www.mastan2.com for this homework (tutorials exist online as well!)

Make a model of a building or a bridge and interpret the results

- Make the model 2D
- include at least 5 members, more is great, but don't try to make too realistic of a model just yet.
- You must use the same units for the whole model (so if you are going to use mm for the cross-section you cannot use m for the length, or ft for the length and cm for the member cross-section… very important!)
- For a member of width = b and height = h…. A=bh, $I=(1/12)bh^3$,
- E_{steel}=30,000,000 pounds/in^2=200,000N/mm^2,
  $E_{concrete}=(1/7)E_{Steel}$, $E_{Aluminum}=(1/3)E_{Steel}$
- See page 2 of this assignment for more hints

1. Provide a sketch of your model (provide a picture too if it is a real structure!) and indicate dimensions of the structure and dimensions of the cross-section members (i.e., A, I, E) on the sketch.

2. Provide a picture of your MASTAN model

3. Estimate weight and apply gravity load to your model
a. What are the displacements at key points, do they seem realistic, provide a pic
b. Provide a diagram of the axial forces in your structure
c Are the axial forces consistent with your intuition about the load path?
d Provide a diagram of the bending moments in your structure
e What do the locations of high bending moment indicate?

4. Estimate a lateral load (wind) and apply to your model
Answer the same questions (a)-(e) as above

Write this all up and hand it in.

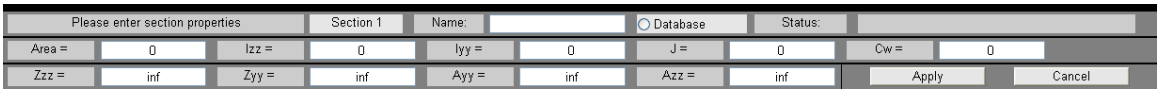
Note, you will want to do an analysis like this, plus more, for your final projects.

A note on units

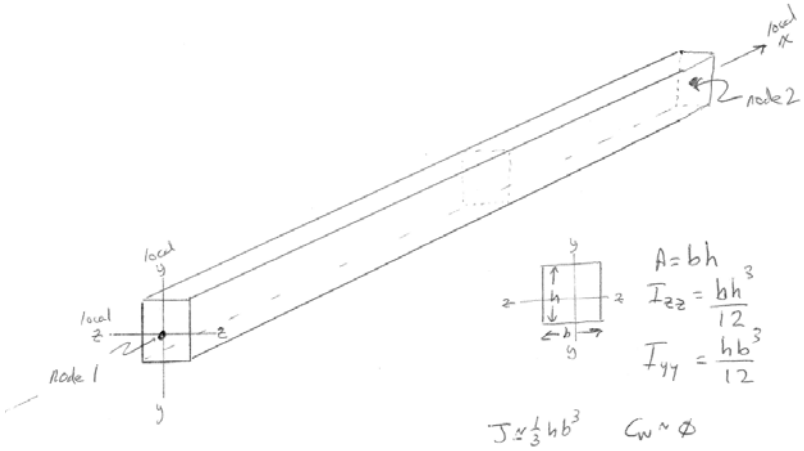
You need to use consistent units for length and force throughout your modeling. So, if you want to see displacement in millimeters, and forces in Newtons, then you use millimeters for all the dimensioning in your model and Newtons for all applied loads. (For better or worse in civil engineering in the U.S. imperial units are still typically used, with inches for length and kilo-pounds=1000 pounds also called a kip for force).

Properties of cross-sections

MASTAN asks you to tell it a lot about a member so that it may calculate the member's contribution to the structure accurately. Specifically, for each member type you must tell MASTAN:



For a member you define the two nodes that connect the member together. So, you define node 1 and node 2, for example (as shown below). Now your member which connects node 1 and node 2 has a certain size , here is how you define it:

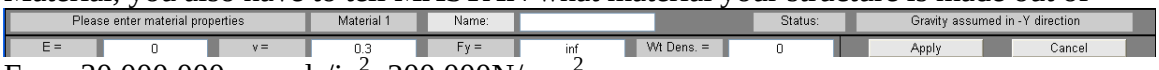


where A is the cross-sectional area, I is the second moment of area about the local zz and local yy axis, J is the St. Venant Torsion Constant, and Cw is the warping constant – do not worry about the other constants (they are for including the possibility of yielding of your member).

You may find more on these A, I, and J constants on the web, for example
A: http://en.wikipedia.org/wiki/Area#Areas_of_2-dimensional_figures
I: http://en.wikipedia.org/wiki/Second_moment_of_area
J: http://en.wikipedia.org/wiki/Torsion_constant

Material

Material, you also have to tell MASTAN what material your structure is made out of



E_{steel}=30,000,000 pounds/in^2=200,000N/mm^2,
$E_{concrete}=(1/7)E_{Steel}$, $E_{Aluminum}=(1/3)E_{Steel}$, $E_{wood}=(1/100)E_{Steel}$
For sure you can find more about these quantities on the web too.