**Homework 5**
**Perspectives on the evolution of structures**
**(Analysis 3 and Mastan modeling)**

You may work in groups of up to 3 but you must each make an individual design and submission.

Use mastan2, downloadable from www.mastan2.com for this homework

You have been set the design problem of spanning a 40 foot wide gap with a bridge made of steel. You are asked to consider the deflection and forces (scientific), amount of material used (social, as a stand-in for cost), and aesthetic effect (symbolic) of the bridge.

Some constraints and assumptions are made:

- All members have cross sectional area A = 3 $in^2$, moment of inertia $I_{yy}$ = 1 $in^4$, and elastic modulus E = 30000 ksi.
- A two dimensional design is sufficient.
- The bridge should be modeled and analyzed as a 2D frame, even if it looks like a truss.
- The bridge must support a total load of 30 kips between the supports.
- The supports may be pin-roller or pin-pin.
- The bridge must have a horizontal deck member.
- Use units of kips for force and inches for length.

To complete the assignment, follow these steps:

1) **Download the file hw5bridges.mat from the course website. This file contains three example bridge designs that solve the problem posed above.**
2) Open this file in mastan2.
   a) Run the analysis by choosing analysis>1st order elastic>planar frame (x-y)>apply
   b) Note and record the support conditions of each bridge.
   c) Record maximum tensile and compressive axial force and bending moment in each of the bridges.
   d) Record the maximum nodal displacement in each of the bridges.
   e) Determine the weight of the bridges by subtracting 30 kips, the total applied live load, from the sum of the y-direction reactions. This will give the weight of the bridge in kips since the density of steel has been provided to mastan2. Record these weights.
   f) Use the results of 2)b-e) to compare and contrast the three bridge forms given in the file.
3) Design and model a fourth bridge solving the same design problem. Exercise your creativity!
   a) Your design should connect nodes at (x = 0, y = 0) and (x = 480, y = 0) by a series of elements and may use either pin-roller or pin-pin supports
   b) Apply the live load by evenly distributing the 30 kip live load among all nodes along the horizontal deck of your design.

c) Section and material properties are already defined, so you simply need to attach them to elements you create.
d) Make a hand drawn schematic sketch of your design.

After you have designed your bridge, built the mastan2 model, and run the analysis, answer the following questions to complete Problem 2.

a) Report the maximum tensile and compressive axial force and bending moment.
b) Report the maximum nodal displacement
c) Determine the weight of your design
d) Compare the performance of your bridge (maximum tensile and compressive force, maximum bending moment, maximum nodal displacement, weight) to that of the example bridges.
e) Describe how you weighted social, scientific, and symbolic criteria in making your design.
f) Make a drawing, by hand, of what a real world bridge based on your two dimensional design would look like. Note that this should differ from the design of part 2d) in that 2d) asks for a schematic, engineering-style drawing, and this question asks for a more artistic/architectural rendering.

Video/youtube tutorials are available to help you complete the assignment. You are strongly encourage to watch these and make use of them

1) http://www.youtube.com/watch?v=d4veh0JRouU&feature=plcp
2) http://www.youtube.com/watch?v=TLS7WnaI9bs&feature=plcp
3) http://www.youtube.com/watch?v=fuSOBW5D-PM&feature=plcp