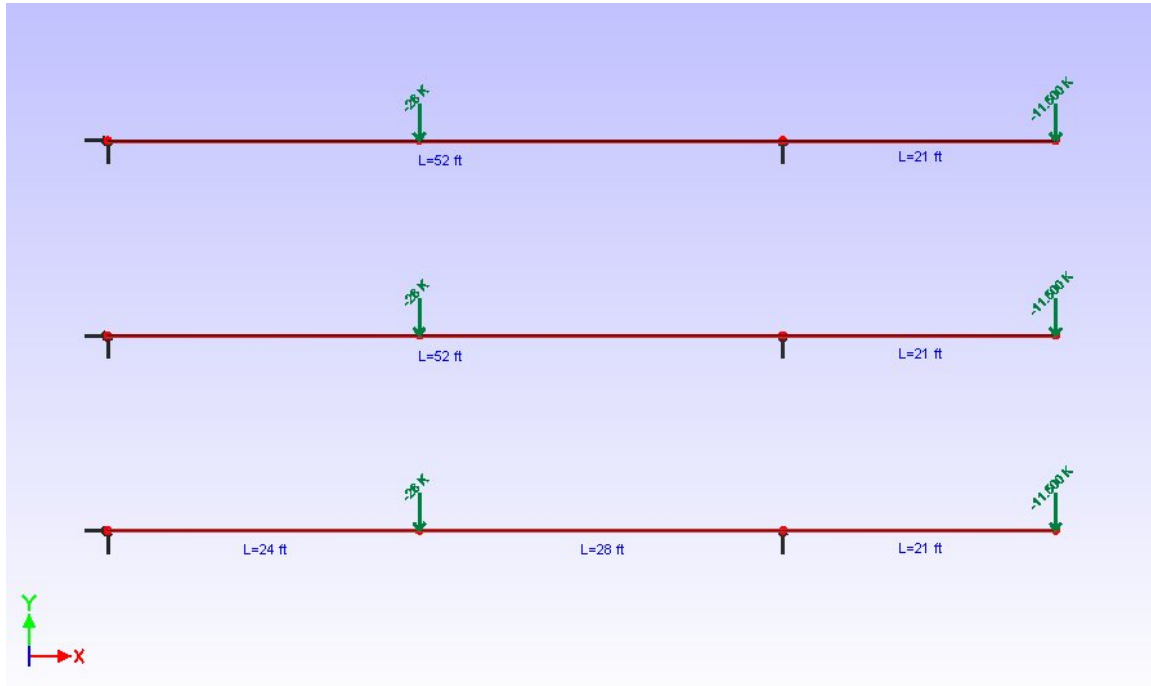


AISC Unbraced Lengths

Project Description:

This example project will use the beam models shown below to display how subtle modeling changes can affect design results and especially unbraced lengths and C_b values in Steel Beam Design group. We will investigate two different situations. In the first situation, we will assume the members are only braced at points of support. In the second situation, we will assume the members are braced at support locations and at points of load application.



Building the Model

Use the figure above as a guideline to create the three separate beam models. The members are all W12x87 A992 grade 50 steel wide flanges. Note that the bottom model consists of three separate members. The second model consists of two members, one loaded with a concentrated load at 24 ft. The third model consists of a combined member and a normal member.

Note that the loads should be applied in one service case and that the self-weight doesn't need to be included. To have a single service case be used by the design software, create a factored load combination having only the single service case with a factor of one.

If you need help creating the model or applying the loads, please consult the VisualAnalysis User's Guide (**Help | Contents**).

Creating Design Groups

Switch to a design view. For this tutorial we will not use the automatic design groups created by the software so first **select** all the beams and choose **Design | Remove Member(s) from Group**.

Bottom Beams:

Select the three bottom beams and choose **Design | Create Design Group**. Name the group "Bottom Beams". **Choose** Steel as the design type. **Choose** Next to move on to the next dialog and Finish to create the design group.

Middle Beams:

Select the two middle beams and choose **Design | Create Design Group**. Name the group "Middle Beams". **Choose** Steel as the design type. **Choose** Next to move on to the next dialog and Finish to create the design group.

Top Beams:

Select the two top beams and choose **Design | Create Design Group**. Name the group "Top Beams". **Choose** Steel as the design type. **Choose** Next to move on to the next dialog and Finish to create the design group.

Design Group Parameters

The design parameters are controlled completely through the Modify tab of the Project Manager.

Since the purpose of this example is to display how modeling changes can affect design parameters such as unbraced lengths and C_b values we will focus on the Bracing Parameters. Leave the General, Size Constraint, Beam Deflection, Column Deflection, Column, Design As, and Overrides parameters unchanged.

Bracing:

Situation 1 – Members braced at nodal support locations only.

For this situation, the first spans unbraced length should be set to 52 ft. The proper C_b value should be 1.67. If we leave all three design group's bracing parameters untouched, analyze the structure, and take a look at the resulting unity values we will notice that the unity values for the middle and top beam are the same. These unity values are correct as well. If you **double-click** on one of these members to create a design report, you will notice that an unbraced length of 52 ft is listed and a C_b value of 1.67 was used. If you **double-click** on one of the members that make up the first span of the bottom members, you will notice that the unbraced length is shorter than 52 ft (namely 24 or 28 ft) and the C_b value is incorrect. This is because of the way the design software works. It treats each individual member as a separate span. If you wanted to get the proper unity value, you would have to pick Length from the Top Bracing and Bottom Bracing drop down box (must specify for both top and bottom because both positive and negative moments are present), and specify a length of 52 ft. You would also have to override the C_b value entering a value of 1.67 (which would have to be calculated automatically). This would fix the unity value for the two members in the first span but it would also mess up the unity value for the cantilever member.

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The question might arise, why would you ever need to split the members? Wouldn't you just always go with the middle model? The answer is no. What if you had another member framing in at the 24ft location. You would need to have the node at the 24 ft location.

Conclusion:

If you can get away with using one "normal" member do it. If you need a node in the middle, make the member combined.

Situation 2 – Members braced at nodal supports and at loading points.

For this situation, focusing our attention on the first span, the unbraced length of the first beam should be 24ft with a C_b value of 1.67. The unbraced length of the second beam should be 28ft with a C_b value of 2.30. If you leave all of the design groups unbraced in all directions, analyze the model, and take a look at the design reports, you will note that the bottom model is set up correctly. In order to get the middle and top models to match the bottom model, you would have to specify a bracing fraction of 0.462 (24/52) to get the middle and top models to match the bottom model. Note that when you specify bracing as a fraction like this, the bracing is applied to all of the members in the group. The cantilever unity value may be reduced if you don't split it into its own group because of the shorter unbraced length.

Conclusion:

In this case it's probably easier to use the bottom model. You can get to the right result using a combined member or single member as well if you set up the design groups right and utilize the bracing parameters correctly.

Conclusion

The design process is not always as simple as just drawing in a series of beam elements and creating a design group. A little bit of thought and an understanding of how the software treats member elements could prevent erroneous design results.