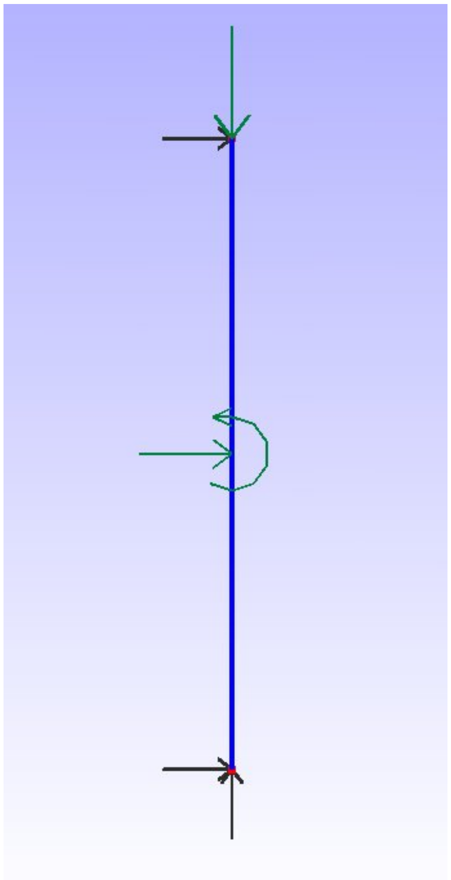
AISC LRFD Column Design

Project Description:

This example project will use the column shown below to illustrate the process of designing a steel column according to AISC LRFD provisions using VisualDesign.



Modeling and Loading

The column is 16 feet long. It is pinned at its base and fixed in the x-direction at its top. Use a W 12X35 shape for the preliminary size. Select ASTM A992 Grade 50 Steel for the material.

Note that the loads are applied as one service case. We will assume that the loads were factored in advance. For the purposes of this example, don't include the self-weight. At the top of the column a 120 kip axial load is applied. At mid-height, a 20 kip axial load, 5 kip horizontal load, and 20 kip-ft moment are applied to the member.

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

Design Group Parameters

Move into Design View and select the column. The design parameters are controlled completely through the Modify tab of the Project Manager.

General:

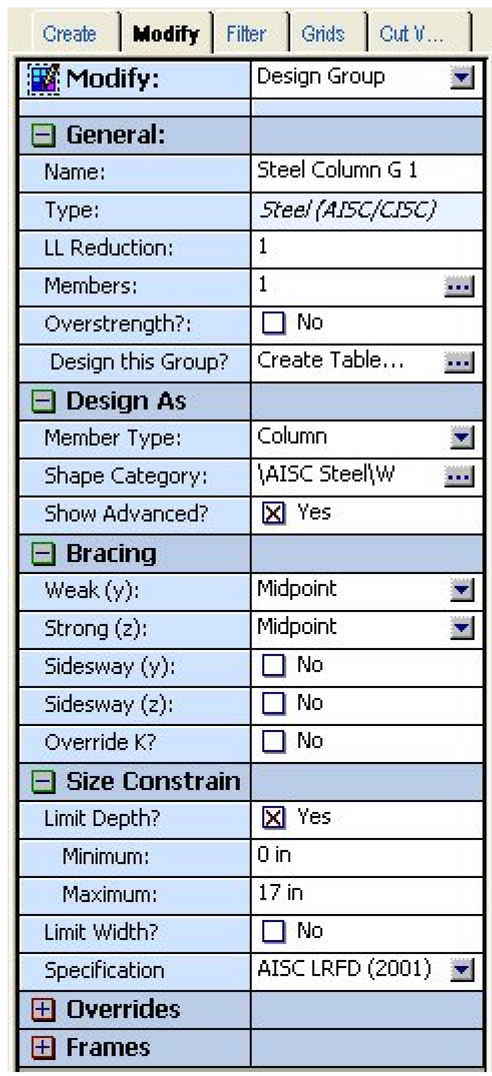
The first set of parameters in the Modify tab is the General group. Leave these parameters unchanged for this tutorial.

Design As

Under the Member Type ***select*** Column and turn on the "Show Advanced?" option box. Pick AISC LRFD for the Specification.

Bracing:

Assume that the column is braced at the end and midpoint in both the strong and weak directions. Also located under the bracing parameters are inputs for the overall frames in which the column or group of columns in the design group belong to. Even though the model is only two dimensional, the frame parameters are set up for three dimensions. They are intentionally set up this way so that weak axis buckling is not forgotten. If you are only interested in checking buckling about one axis the software can be "tricked" as will be discussed below.



We will assume the frame is braced in both the z and y directions. The z direction refers to a frame that lies in a plane created by the member's local x-axis and its local z-axis. The y direction refers to a plane created by the member's local x-axis and its local y-axis.

K Factors:

The ky value refers to the effective length factor for buckling in a plane created by the member's local x-axis and local z-axis. In other words, it is the effective length factor for buckling in which the member kicks out in its local z-direction. The ky value is used to calculate the slenderness ratio ky*ly/ry.

The kz value refers to the effective length factor for buckling in a plane created by the member's local x-axis and local y-axis. In other words, it is the effective length factor for buckling in which the member kicks out in its local y-direction. The kz value is used to calculate the slenderness ratio kz*lz/rz.

The default setting for the k factors is to let the design software calculate them automatically according to Chapter C of the AISC LRFD – Third Edition. This procedure utilizes the relative rigidity of members framing into a joint and the nodal support conditions to calculate the effective length factors. In this example we have removed the member from the frame it belonged to. This means the effective length factors probably will not be calculated properly using the automatic option. With this in mind, we will need to override the k factors. Check the Override kz and

Override ky options. Edit boxes appear allowing you to specify k factors. Enter 1.0 for the ky value. Enter 1.0 for the kz value as well. If you wanted to ensure that buckling about one axis or the other didn't control, you could specify a low k factor here for the axis you didn't want to control.

Size Constraints:

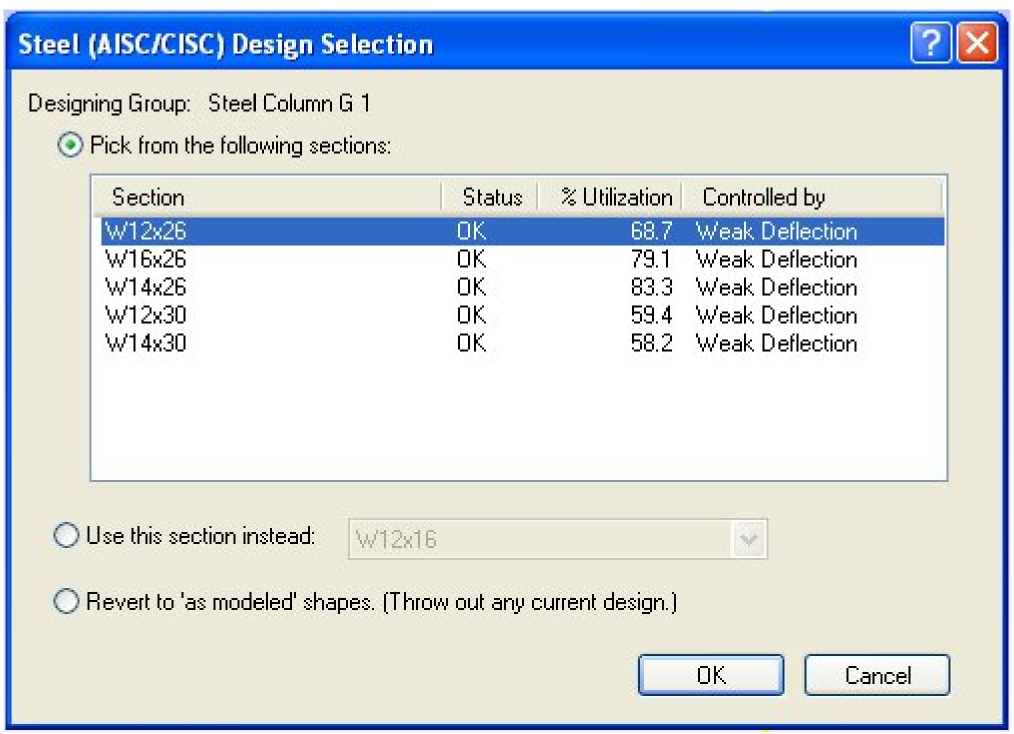
The next set of parameters is the Size Constraints group. Assume for this example that for architectural reasons, the member's depth must be under 17 in. ***Click*** on the Limit Depth check box to expand the maximum depth parameters and enter 17in for the maximum. Setting these size constraints let's the software know that you only want it to check members in the Design As Shape Category with depths in this range. This can speed up the design process considerably by reducing the total number of shapes to check during the design process.

Overrides:

Leave the Overrides unchanged.

Designing the Member

After analyzing, change to the design view and take a look at the member. If the member is inadequate it will be shown in Red. Select the member, ***right-click***, and choose Design Selected Group. You are presented with a number of sections that are adequate based on the design parameters you set up. Select a size and choose ok. If you look at the design view now, the member should change color and a new unity value should be reported. Notice that the unity value has a ~ in front of it, indicating that it is a preliminary unity value, based on the analysis with the original member in place. To get an updated unity value, the design changes must be synchronized.



Synchronizing Design Changes

Select **Analyze | Synchronize Design Changes** to accomplish this. You will be prompted to re-analyze, select "Yes", and when it finishes re-analyzing go back to a Design View and review the unity check. It should no longer have the ~ in front of it, indicating that is a final unity value.

If the unity value is greater than one the member has failed and you need to reiterate the design process. The closer the unity value is to one the more efficient, but less conservative the design.