Cantilever Beam - Numerical Results (OLD)

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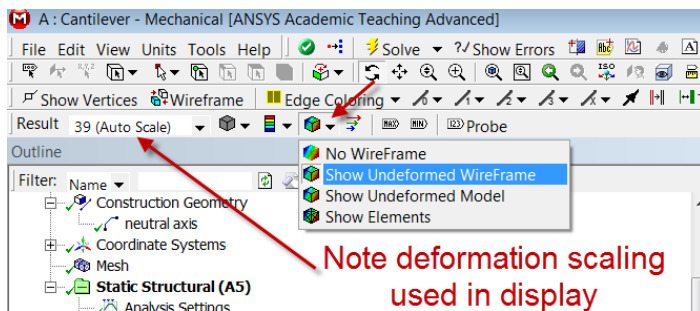
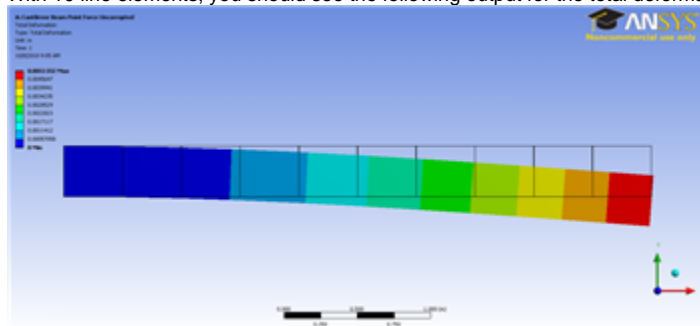## Step 6: Numerical Results

Total Deformation

First, examine the total deformation by clicking on the Total Deformation object in the tree. Turn on the *Undeformed Wireframe* as shown below.

With 10 line elements, you should see the following output for the total deformation.


Click Here for Higher Resolution

If you turn off *View > Thick Shells and Beams*, you will see the deformation of the line elements. The 3D beam view is constructed from this. The maximum deformation is 0.0051 m which matches the hand-calculation value from the Pre-Analysis.

When ANSYS displays the beam deformation, it just connects the displacements at nodes by straight lines. The display ignores the fact that we also have the slope at the nodes. So you'll see an unphysical-looking kinked line in the deformation display. This is a shortcoming of the *display*, not of the underlying beam element formulation. You'll see the displayed deformed shape getting smoother as you refine the mesh.

The beam deformation can be animated by clicking on the play button, , which is located underneath the beam deformation results. This will interpolate between the initial undeformed and final deformed configurations.

Maximum Bending Stress

In order to examine the maximum bending stress first expand the Beam Tool folder, ⊞ ⎯ 🗒 Beam Tool , which is located under "Solution(A6)". Next, click on the Maximum Bending Stress button, ✅🧊 Maximum Bending Stress .
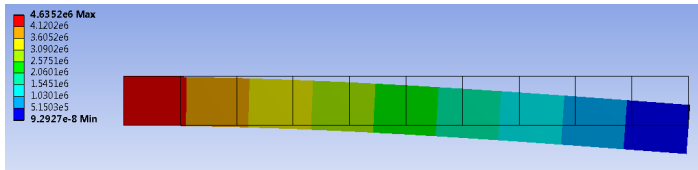

Note that in this display, ANSYS shows the same value across the cross-section. This visualization is misleading. The maximum bending stress occurs only at the top fiber. The value that ANSYS reports is 4.635 MPa which matches the value from the Pre-Analysis exactly.

Bending Moment

To view the bending moment along the beam, click *Total Bending Moment* in the *Outline* window. You should see the following in the graphics window.
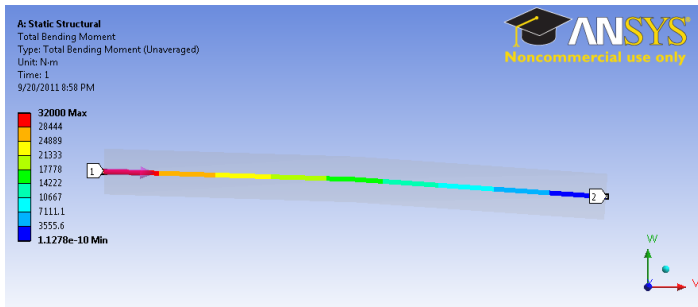
Click here to enlargeAlso notice that the values were plotted in a graph in the *Graph* window and also displayed in a table. The values can be exported into a Excel or text file by right-clicking on the table.
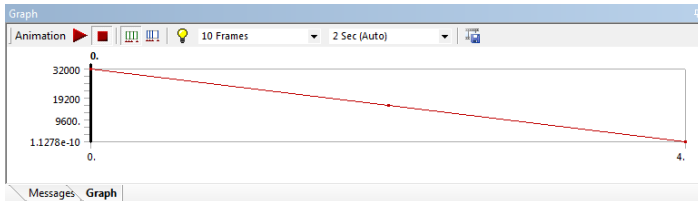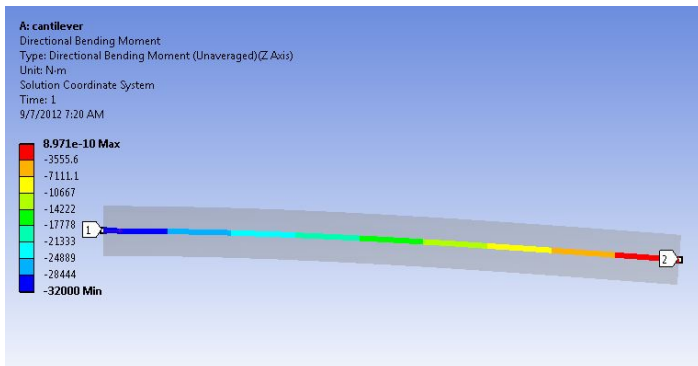

Click here to enlargeIn the above, pay close attention to maximum and minimum values of the bending moment. At the left end, the bending moment is 32000 Nm; the calculation for moment is

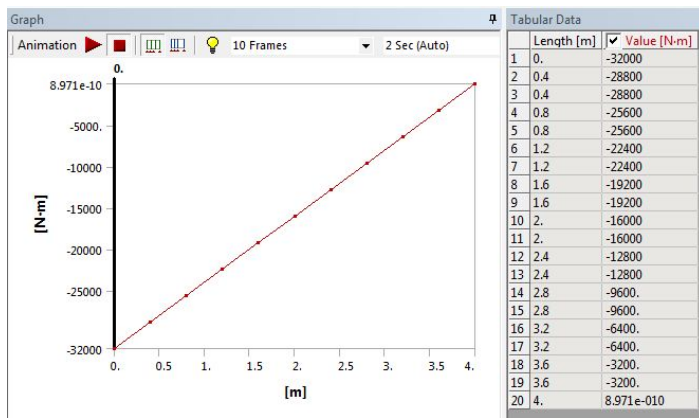$$M = F \times d = (8000 N) \times (4 m) = 32000 Nm$$

So this checks out. We also notice that the minimum moment 1.1278E-10 Nm. Because this value is over 1E-14 smaller that the largest value, it can be assumed to be zero to machine precision.

Directional Bending Moment

To view the directional bending moment along the beam, click *Directional Bending Moment* in the *Outline* window. You should see the following in the graphics window. The Directional Bending Moment gives us the sign along with the magnitude.

click here for full view

	Length [m]	Value [N·m]
1	0.	-32000
2	0.4	-28800
3	0.4	-28800
4	0.8	-25600
5	0.8	-25600
6	1.2	-22400
7	1.2	-22400
8	1.6	-19200
9	1.6	-19200
10	2.	-16000
11	2.	-16000
12	2.4	-12800
13	2.4	-12800
14	2.8	-9600.
15	2.8	-9600.
16	3.2	-6400.
17	3.2	-6400.
18	3.6	-3200.
19	3.6	-3200.
20	4.	8.971e-010

Go to Step 7: Verification & Validation