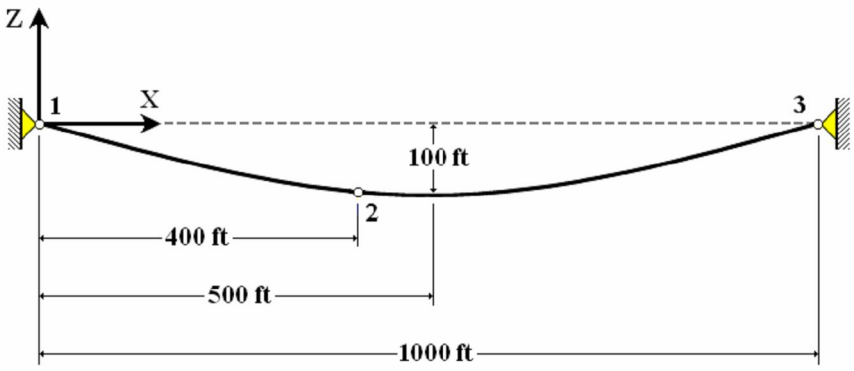
Cable-2

Title

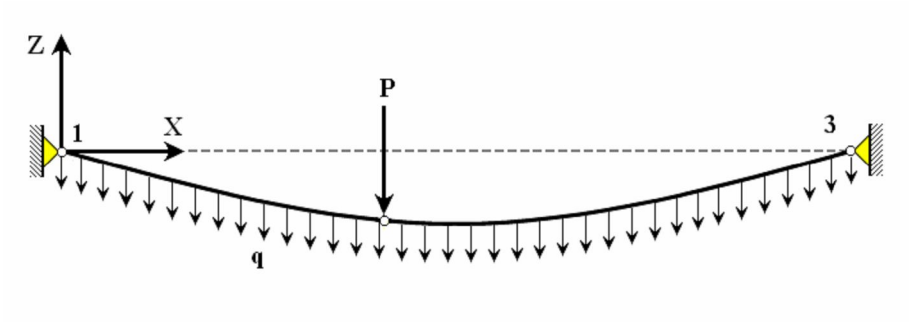
Large displacement anlaysis of a cable subjected to a uniform and concentrated vertical loads

Description

A suspended cable is subjected to a vertically uniform load (self-weight of the cable) and a concentrated load. The finite element model was created using two, 2-node cable elements, one for cable segment 1-2 and the other for the cable segment 2-3. Perform cable element analysis to determine the large displacement at node 2 and compare the obtained results with the target solution.
In the model, node 2 is set at an arbitrary Z-coordinate. The self weight is applied first and the self-deformed cable shape is determined at the equilibrium as a result of the analysis. Next the 8 kips vertical load is applied to node 2 at the equilibrium configuration.



Structural geometry and boundary conditions



Loading conditions

Model

Analysis Type

Cable element analysis

Unit System

ft, kips

Dimension

Unstrained length of cable segment 1-2 412.8837 ft
Unstrained length of cable segment 2-3 613.0422 ft

Element

Cable element

Material

Modulus of elasticity E = 19,000 kips/in^2
Weight density w = 0.0003098 kips/in^2

Section Property

Pipe: Outer diamenter 2.4 in , Thickness 0.24 in

Boundary Condition

Both ends pinned

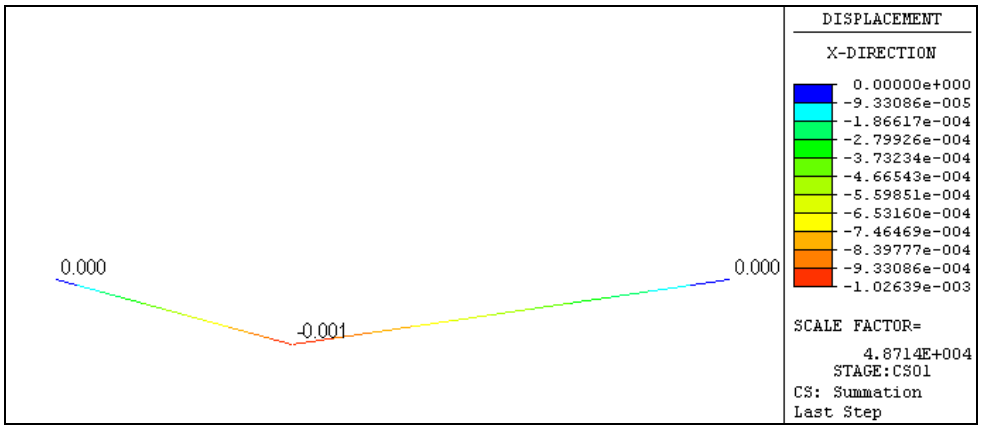
Loads

Self weight 0.00316 kips/ft

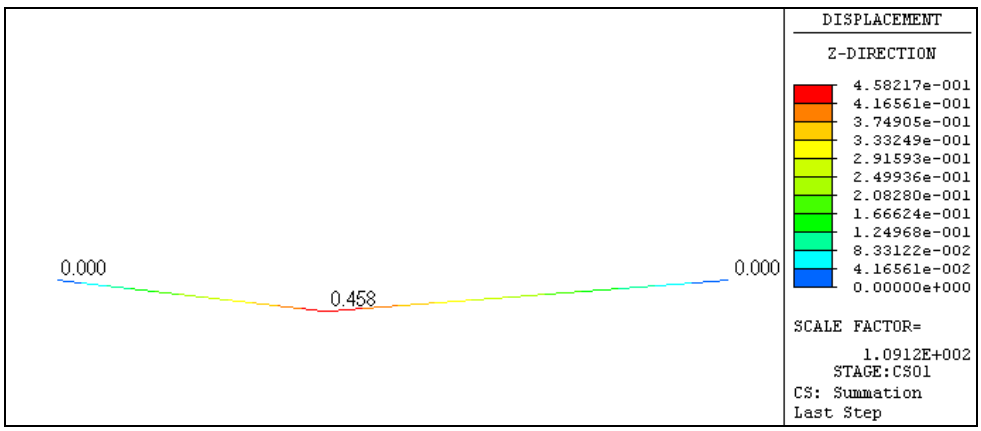
Results

Cable Analysis Results: Nodal displacement under self weight

X-Direction

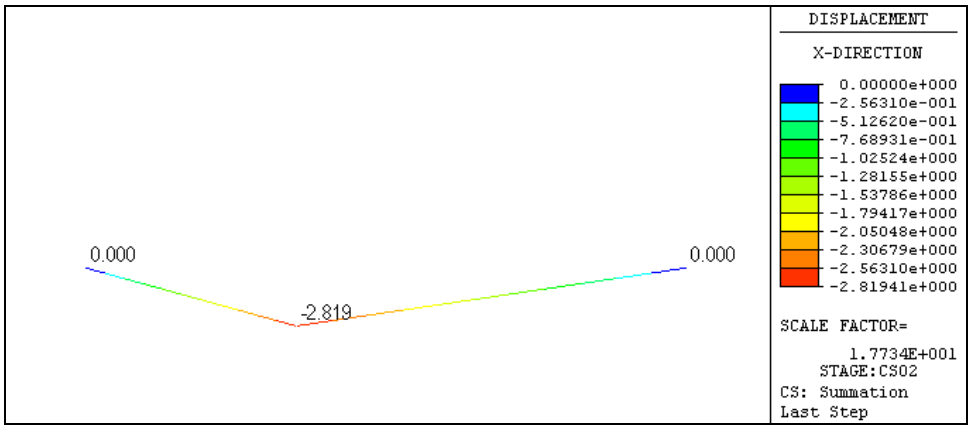


Z-Direction

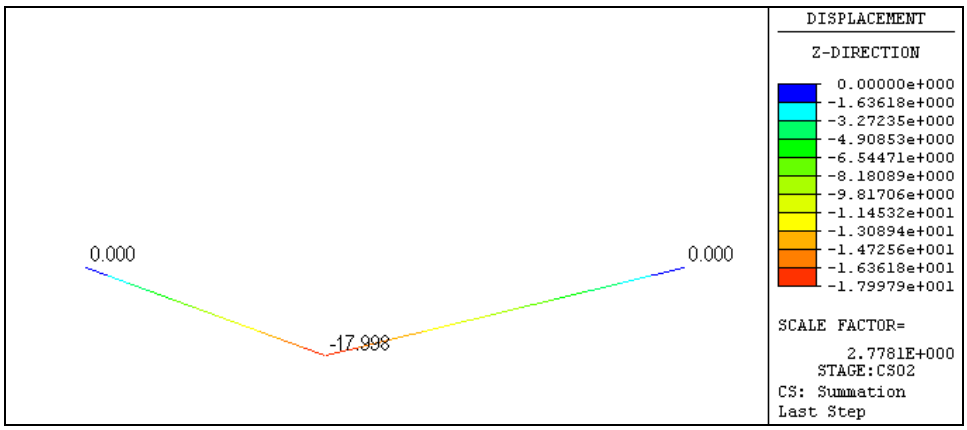


Cable Analysis Results: Nodal displacement under self weight and nodal load

X-Direction



Z-Direction



Comparison of Results

The displacement response was computed with a convergence tolerance of 0.001. The loading step (with the stiffness matrix re-calculated after every iteration) was used to reach the convergence. The nonlinear displacement response of node 2 is illustrated in the table below and compared with the target solution reported by Jayaraman and Knudson [1] and Tibert [2]. The predicted response is in excellent agreement with target solution.

Unit: ft

Direction	MIDAS	Target	Ratio MIDAS/Target
X-Direction	-2.818 (=-2.819-(-0.001))	-2.819	1.00
Z-Direction	-18.456 (=-17.998-0.458)	-18.457	1.00

Reference

1. Jayaraman, H.B., and Knudson, W.C. (1981). ¡A curved element for the analysis of cable structures.¡ Computers & Structures, Vol. 14, No. 3/4, 325?333.
2. Tibert, G. (1999). ¡Numerical Analyses of Cable Roof Structures,¡ Licentiate Thesis, Dept. of Structural Engineering, Royal Institute of Technology, Stockholm, Sweden.