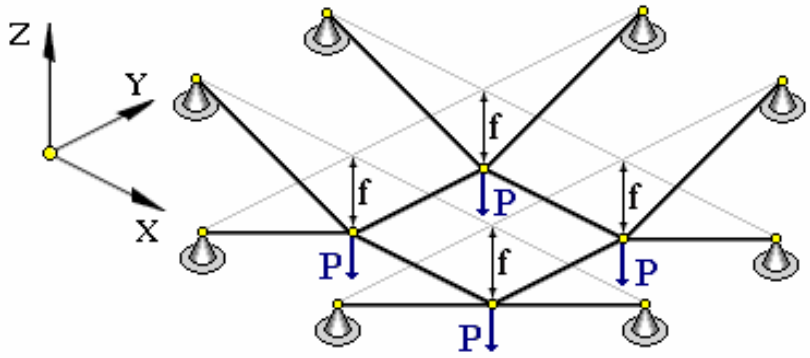
# Cable-3

## Title

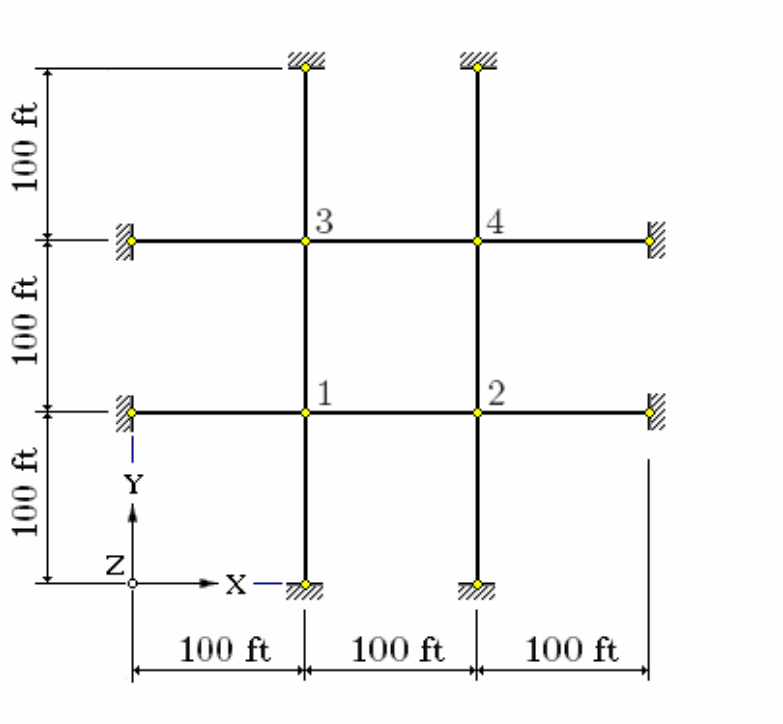
Prestressed cable net under self weight and vertically concentrated loads

## Description

A pre-stressed cable net is subjected to a small uniform self-weight, vertically concentrated loads applied at each cable intersection point, and pre-stressing forces in both horizontal and inclined members. The finite element model was created using twelve, 2-node cable elements, one for each of the eight inclined members and one for each of the four horizontal members. Perform cable element analysis to determine the displacements at the cable intersection points.




*Structural geometry and boundary conditions*




*Finite element model in XY-plane view*

# 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 |
| Sag in initial configuration | f = 30 ft |

***Element***

Cable element

***Material***

| | |
|---|---|
| Modulus of elasticity | E = 12,000 kips/in$^2$ |
| Weight density | w = 3.671e-5 kips/in$^2$ |

***Section Property***

Pipe: Outer diameter 4.0 in , Thickness 0.24 in

***Boundary Condition***

All supports are pinned.

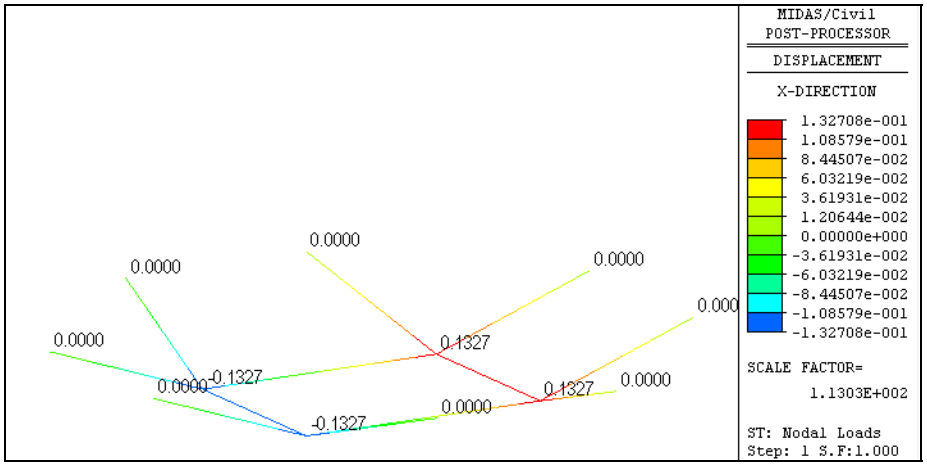
***Loads***

| | |
|---|---|
| Self weight | 0.0001 kips/ft |
| Vertical loads | 8 kips |
| Prestressing force in horizontal members | 5.459 kips |
| Prestressing force in inclined members | 5.325 kips |

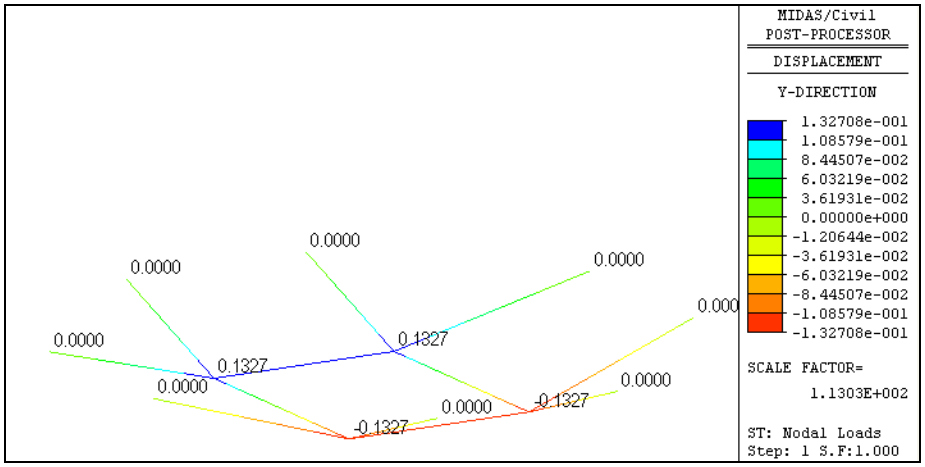
# Results

***Cable Analysis Results: Displacements of cable intersection points***

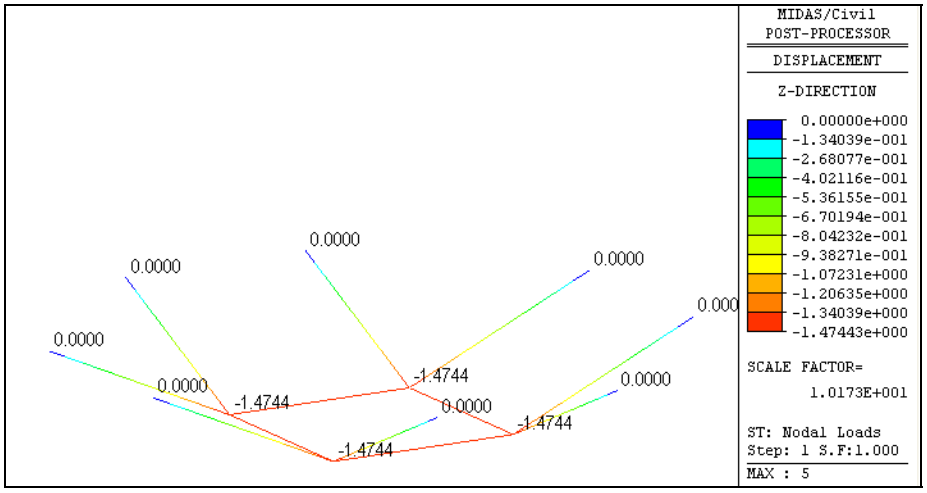
X-Direction




Y-Direction



Z-Direction


MIDAS/Civil
POST-PROCESSOR
DISPLACEMENT
Z-DIRECTION
0.00000e+000
-1.34039e-001
-2.68077e-001
-4.02116e-001
-5.36155e-001
-6.70194e-001
-8.04232e-001
-9.38271e-001
-1.07231e+000
-1.20635e+000
-1.34039e+000
-1.47443e+000
SCALE FACTOR=
1.0173E+001
ST: Nodal Loads
Step: 1 S.F:1.000
MAX : 5
0.0000
0.0000
0.0000
0.0000
0.000
0.0000
0.0000
-1.4744
-1.4744
0.0000
0.0000
-1.4744
-1.4744

## Comparison of Results

The displacement response was computed with a convergence tolerance of 0.001. In order to reach the convergence, the loading step (with the stiffness matrix re-calculated after every iteration) was used. The nonlinear displacement response of cable intersection points are illustrated in the table below and compared with the target solution reported by Jayaraman and Knudson [1] and Tibert [2].

Unit: ft

| Direction | MIDAS | Target | Ratio MIDAS/Target |
|---|---|---|---|
| X-Direction | -0.1327 | -0.1328 | 1.00 |
| Y-Direction | -0.1327 | -0.1328 | 1.00 |
| Z-Direction | -1.4744 | -1.4765 | 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.