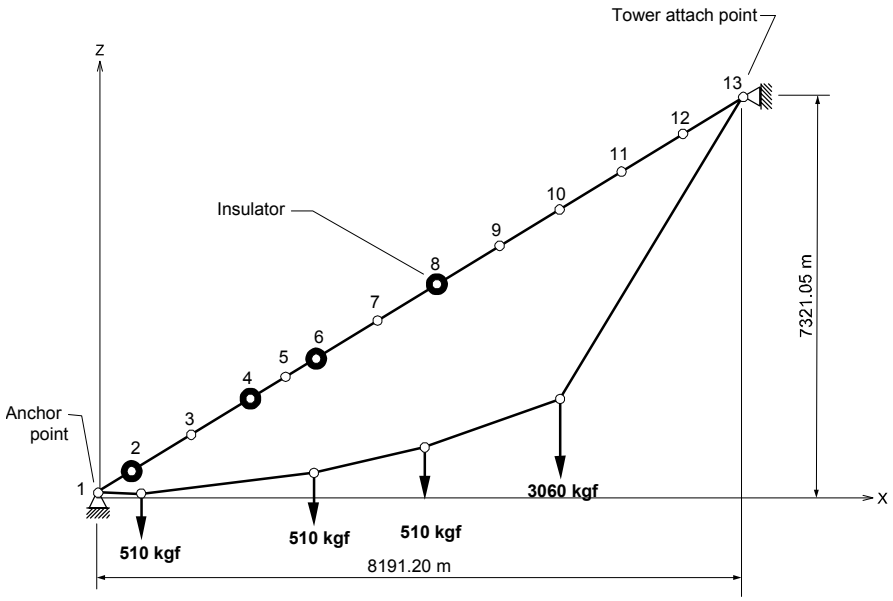
GNL-7

Title

Static large displacement analysis of a tower cable

Description

A cable stretched between a ground anchor point and tower attach point was analyzed for static displacements. The cable was modeled using 12 truss elements of linear elastic material.
The initial tension in the cable was 7520.0 kgf. Insulators each were located at nodes 2, 4 and 6, and a cluster of 6 insulators was located at node 8. Nodes 3, 5, 7 and 9 through 12 are intermediate nodes located along the cable without insulators.
The total vertical load acting on the cable nodes was 5761.2 kgf, which includes the insulator weights and cable self-weight w_0.
Define the nonlinear response for node 8.



Structural geometry and analysis model

MODEL

Analysis Type

2-D static large displacement analysis (X-Z plane)

Unit System

m, kgf

Dimension

Length 8191.20 m

Element

Cable element

Material

Modulus of elasticity $E = 1.9\times10^7$ kgf/m^2
Poisson's ratio $\nu = 0.2$
Cable self-weight $w_0 = 0.106667$ kgf/m

Sectional Property

Area = 0.361 m^2

Boundary Condition

Node 1: Constrain D_X and D_Z
Node 13: Constrain D_X and D_Z

Load Case

The initial tension in the cable is 7520.0 kgf
Insulators weighing 510 kgf each are located at nodes 2, 4 and 6.
A cluster of 6 insulators totaling 3060 kgf is located at node 8.

Results

	Node	Load	Step	DX (m)	DY (m)	DZ (m)	RX ([rad])	RY ([rad])	RZ ([rad])
▶	8	Load	nl_001	106,17	0,00	-118,30	0,00	0,00	0,00
	8	Load	nl_002	156,86	0,00	-174,30	0,00	0,00	0,00
	8	Load	nl_003	190,89	0,00	-211,80	0,00	0,00	0,00
	8	Load	nl_004	217,22	0,00	-240,76	0,00	0,00	0,00
	8	Load	nl_005	239,02	0,00	-264,72	0,00	0,00	0,00

the nonlinear response

Comparison of Results

Unit: m

Total load percentage	Theoretical		MIDAS/Civil	
	δ_X	δ_Z	δ_X	δ_Z
0.2	107.71	-121.59	106.17	-118.30
0.4	159.13	-180.28	156.86	-174.30
0.6	193.56	-219.87	190.89	-211.80
0.8	220.15	-250.61	217.22	-240.76
1.0	242.14	-276.16	239.02	-264.72

Reference

Bathe, K-J., Ozdemir, H., Wilson, E. L. (1974*)*. "*Static and Dynamic Geometric and Material Nonlinear Analysis*", UCSESM Report No. 74-4, University of California at Berkeley, Berkeley, Ca