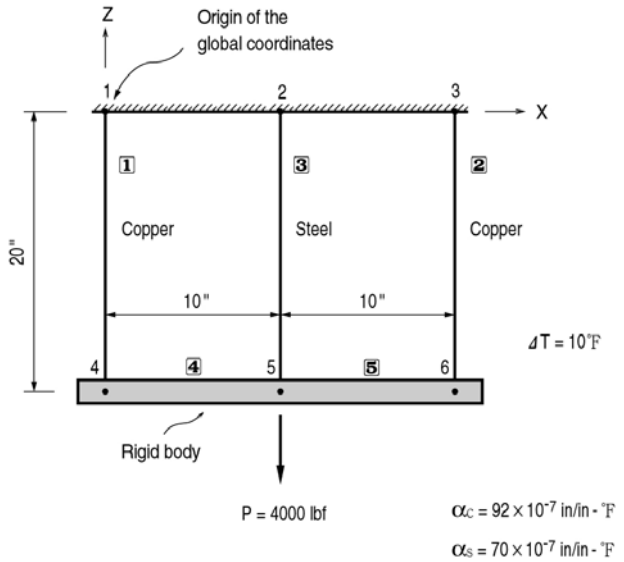
TS-1

Title

Analysis of a structure due to temperature change

Description

Examine the resultant stresses of a structure comprised of steel and copper members. The structure is subjected to a concentrated load and a uniform temperature change over the entire structure.



Structural geometry and analysis model

MODEL

Analysis Type

2-D thermal stress analysis

Unit System

in, lbf

Dimension

Length of hanger = 20.0 in Space = 10.0 in

Element

Truss element (Vertical member) and beam element (Rigid body)

Material

Steel	Modulus of elasticity	$E_s = 30 \times 10^6$ psi
	Coefficient of thermal expansion	$\alpha_s = 70 \times 10^{-7}$ in/in $\cdot$ °F
Copper	Modulus of elasticity	$E_c = 16 \times 10^6$ psi
	Coefficient of thermal expansion	$\alpha_c = 92 \times 10^{-7}$ in/in $\cdot$ °F
Rigid beams	Modulus of elasticity	$E_B = 1.0 \times 10^{15}$ psi

Sectional Property

Truss (Vertical)	Area	A	= 0.1 in^2
Beam (Rigid body)	Moment of inertia	Iyy	= 1.0 in^4

Boundary Condition

Nodes 1 ~ 3 ; Constrain Dx and Dz. (Hinge supports)

Analysis Case

A concentrated load, 4000 lbf is applied to the node 5 in the –Z direction.

Temperature change over the entire structure

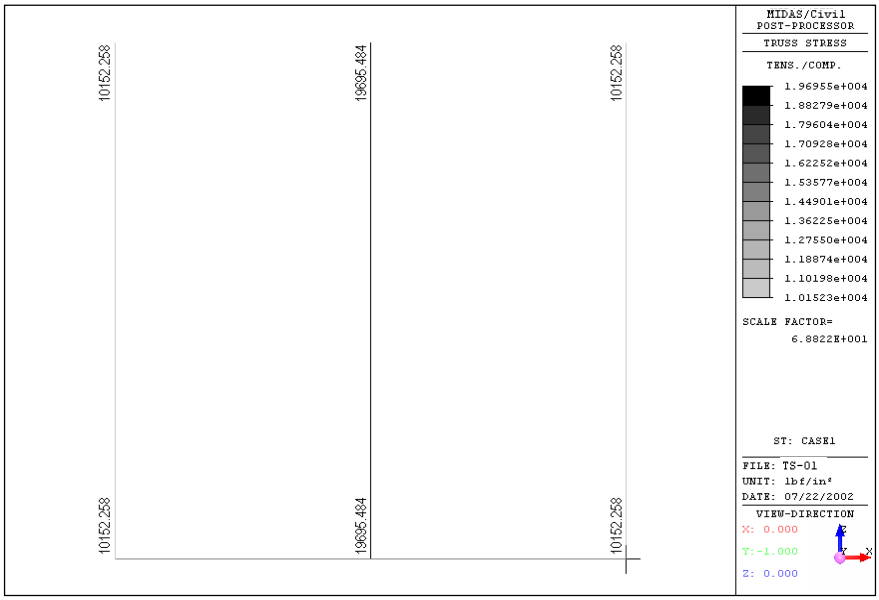
Initial temperature = 15 °F

Final temperature = 25 °F

Results

Stresses

	Elem	Load	Stress-I (lbf/in²)	Stress-J (lbf/in²)
▶	1	CASE1	10152.258	10152.258
	2	CASE1	10152.258	10152.258
	3	CASE1	19695.484	19695.484



Stress of the structure

Comparison of Results

Unit : psi

Stress	Ref.1	MIDAS/Civil
Steel (σ_s)	19695	19695
Copper(σ_c)	10152	10152

Reference

Timoshenko, S.,. "*Strength of Materials, Part 1. Elementary Theory and Problems*", 3rd Edition , D,Van Nostrand Co., Inc., New York, 1955, p. 30, Problem 9.