VM92

Insulated Wall Temperature

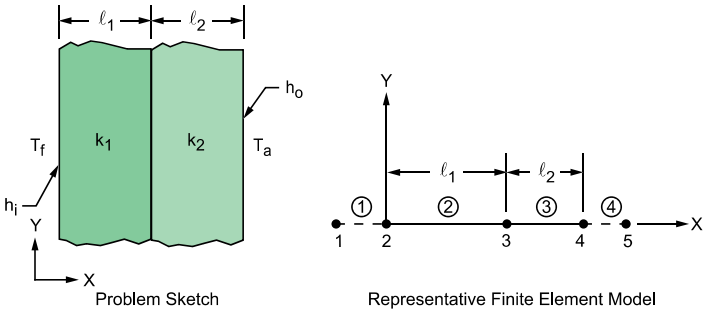
Overview

Reference:	F. Kreith, *Principles of Heat Transfer*, 2nd Printing, International Textbook Co., Scranton, PA, 1959, pg. 32, ex. 2-5.
Analysis Type(s):	Thermal Analysis (**ANTYPE** = 0)
Element Type(s):	Convection Link Elements (LINK34) 3-D Conduction Bar Elements (LINK33)
Input Listing:	vm92.dat

Test Case

A furnace wall consists of two layers, firebrick and insulating brick. The temperature inside the furnace is T_f and the inner surface convection coefficient is h_i. The ambient temperature is T_a and the outer surface convection coefficient is h_o. Neglect the thermal resistance of the mortar joints and determine the rate of heat loss through the wall q, the inner surface temperature T_i, and the outer surface temperature T_o.

Figure 92.1: Insulated Wall Temperature Problem Sketch



Material Properties	Geometric Properties	Loading
k_1 = 0.8 Btu/hr-ft-°F k_2 = 0.1 Btu/hr-ft-°F h_i = 12 Btu/hr-ft^2-°F h_o = 2 Btu/hr-ft^2-°F	I_1 = 9 in = 0.75 ft I_2 = 5 in = 5/12 ft	T_f = 3000°F T_a = 80°F

Analysis Assumptions and Modeling Notes

A 1 ft^2 area is used for the convection and conduction elements. Nodes 1 and 5 are given arbitrary locations. Feet units are input as (inches/12) for convenience. POST1 is used to extract results from the solution phase.

Results Comparison

	Target[*1*]	Mechanical APDL	Ratio
q, Btu/hr	513.	513.	1.001
T_i , °F	2957.	2957.	1.000
T_o , °F	336.	337.	1.002

1. Rounded-off values (normalized)