Overall Heat Transfer Coefficient Determination

A test was conducted to determine the U value for fire. This test was necessary due to the lack of information characterizing the heat transfer behavior of a fire. The test was based on the amount of energy transferred through a known and perfectly insulated distance in a rod of known material. For this test a rectangular piece of 1018 steel was used and the temperature difference over a 2 inch nearly perfectly insulated section was taken to determine energy flux. This allowed for a quantification of the energy transferred to the rod with the equations below. The method of calculations was similar to that used for the sizing of the beam, with the difference coming from rearranging the formula to solve for h.

$$q = \frac{-k(T_B - T_H)A}{\Delta x}$$

Conductive heat equations used for perfectly insulated rod section

$$q = Mtanh(mL_c)$$

Adiabatic tip condition used for fin calculation

$$m = \sqrt{UPkA_c} * \theta_b$$

Equation where U was made a variable and solved for

Rod Length (m):	0.132
Rod CSA (m^2):	0.0006048
1018 CRS (W/mK):	51.9
Length between TC (m):	0.0508
Resistance of TC section (C/W):	1.6183952
Length of Rod between walls(m):	0.0254
T Fire (Deg C):	750
Rod Thickness (m):	0.01905
Rod Width (m):	0.03175
Perimeter (m):	0.1016
Lc (m)	0.141525

Delta T (Deg K)	Location of Charcoal	Hot TC (Deg C)	Cold TC (Deg C)	Q (W)	Approx. Tbase (Deg C)	U (W/m^2K)
97.00	close to bottom of stove	358.00	261.00	59.94	406.50	16.2
120.00	at rod	380.00	260.00	74.15	440.00	24.8
141.00	one inch above rod	431.00	290.00	87.12	501.50	44.2