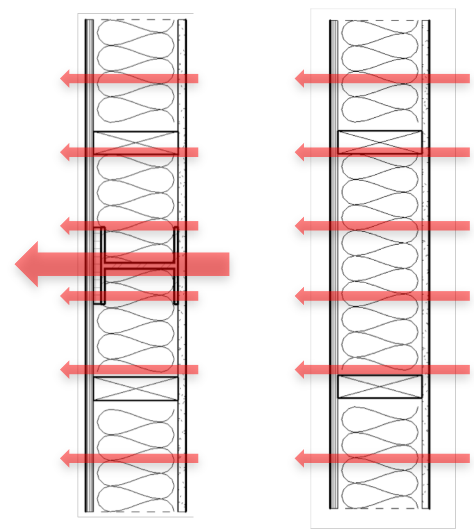
Calculating PSI Values (Ψ)

Calculating PSI Values (Ψ)

Total losses from 'typical' assembly

$$\text{Psi Value } (\Psi) = \frac{\text{Losses}_{2D} - \text{Losses}_{1D}}{\Delta T}$$

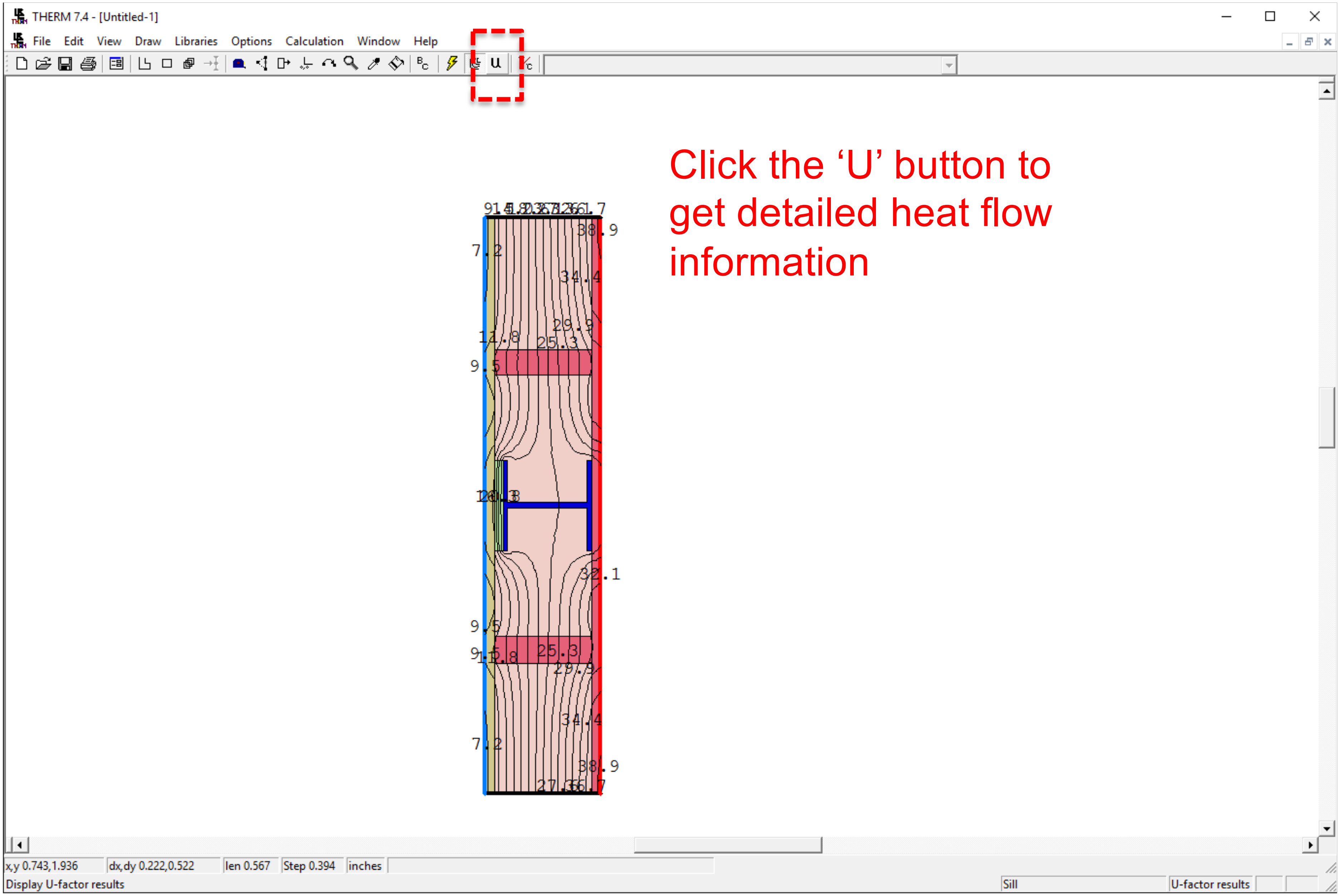
Total losses from 'actual' assembly

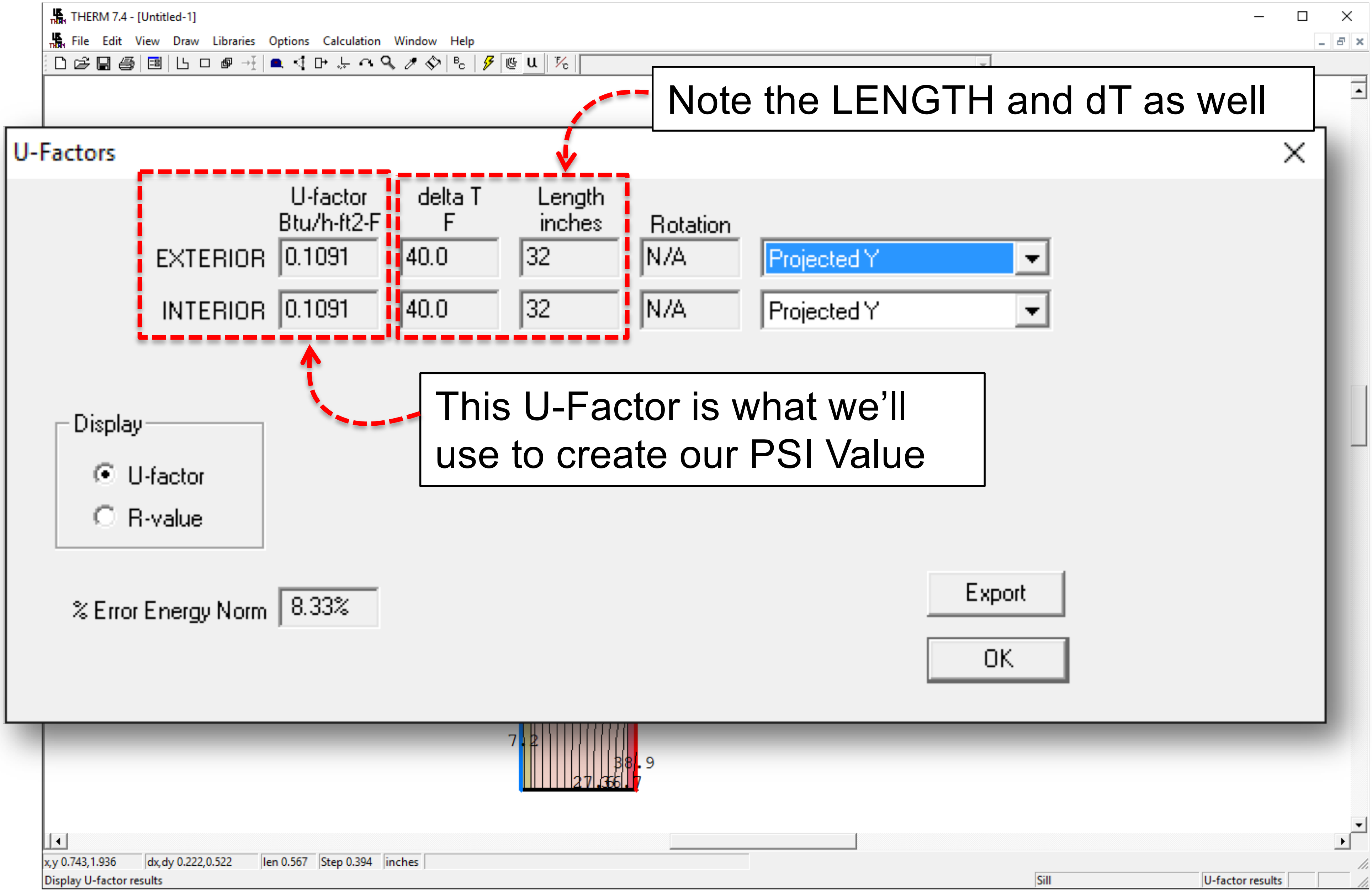


$$\text{Losses}_{2D} = \text{U-factor}_{2D} \times \text{Length}_{2D} \times \Delta T$$

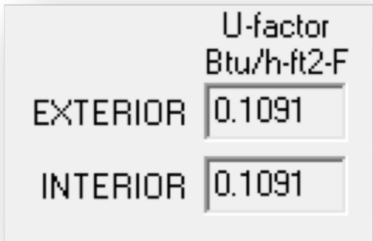
$$\text{Losses}_{1D} = \text{U-factor}_{1D} \times \text{Length}_{1D} \times \Delta T$$

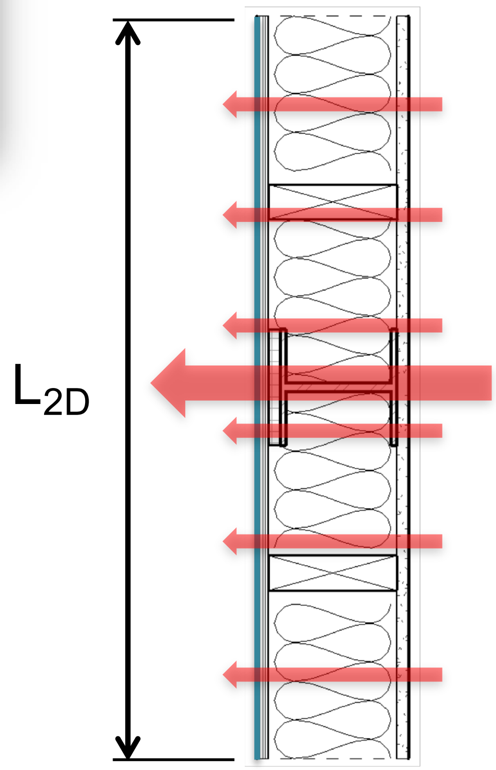
Click the ‘U’ button to get detailed heat flow information




THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Note the LENGTH and dT as well
U-Factors
U-factor Btu/h-ft2-F
delta T F
Length inches
Rotation
EXTERIOR 0.1091 40.0 32 N/A Projected Y
INTERIOR 0.1091 40.0 32 N/A Projected Y
This U-Factor is what we'll use to create our PSI Value
Display
U-factor
R-value
% Error Energy Norm 8.33%
Export
OK
x,y 0.743,1.936
dx,dy 0.222,0.522
len 0.567
Step 0.394
inches
Display U-factor results
Sill
U-factor results

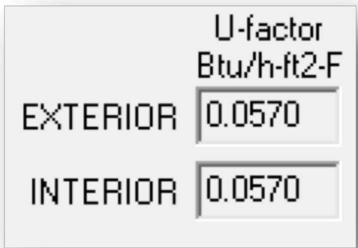
Calculate Losses$_{2D}$

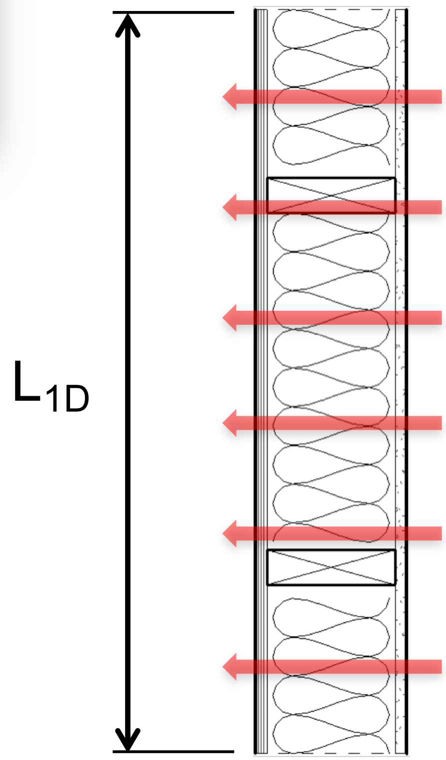




THERM's U-Factor takes into account all the particulars of the actual detail and combines it into one value which represents heat flow over the entire area

Calculate Losses$_{1D}$





We also need to model the typical ‘clear field’ assembly without the disrupting element in a separate THERM file to calculate its U-Factor.

Calculating Psi (Ψ)

$$\Psi = (Losses_{2D} - Losses_{1D}) \div \Delta T$$

$$Losses_{2D} = U\text{-}factor_{2D} \times L_{2D} \times \Delta T$$

$$Losses_{1D} = U\text{-}factor_{1D} \times L_{1D} \times \Delta T$$

INPUTS		
$U\text{-}factor_{2D}$ (Actual)	=	0.1091 Btu/hr-ft^2-F
$U\text{-}factor_{1D}$ (Typical)	=	0.0570 Btu/hr-ft^2-F
L_{2D}	=	2.66’ (32”)
L_{1D}	=	2.66’ (32”)
ΔT	=	40°F

$Losses_{2D}$ = Total losses from ‘actual’ assembly
$Losses_{1D}$ = Total losses from ‘typical’ assembly

Calculating Psi (Ψ)

$Losses_{2D}$	**$Losses_{1D}$**
$U\text{-factor}_{2D} \times L_{2D} \times \Delta T$	$U\text{-factor}_{1D} \times L_{1D} \times \Delta T$
0.1091 × 2.66’ × 40°F	0.0570 × 2.66’ × 40°F
= 11.64 BTU/hr·ft	**= 6.06 BTU/hr·ft**

$$\Psi = (Losses_{2D} - Losses_{1D}) \div \Delta T$$

$$\Psi = (\ 11.64\ \text{Btu/hr·ft} - 6.06\ \text{Btu/hr·ft}\ ) \div 40°\text{F}$$

$$\Psi = 0.139\ \text{BTU/hr·ft·°F}$$

Calculating Losses via Linear Thermal Bridges

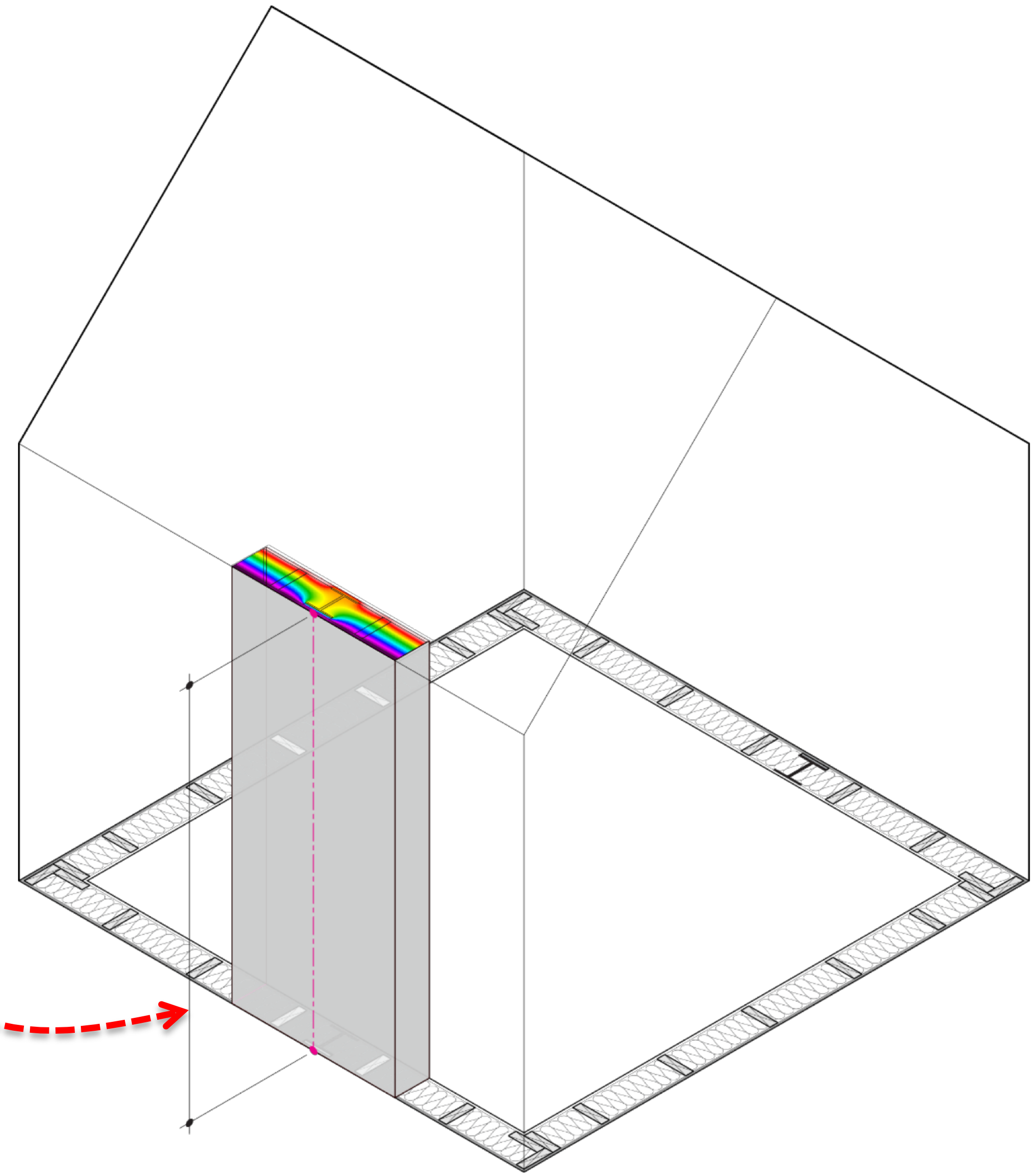
$$Q_{T\text{-}tb} = L \times \Psi \times f_t \times G_t$$

$$\text{kBtu/yr} = \text{ft} \times \frac{\text{Btu}}{(\text{hr} - \text{ft-}^\circ\text{F})} \times \text{unitless} \times \frac{(\text{k}^\circ\text{F-hr})}{\text{yr}}$$

(Transmission Losses) $Q_{T\text{-}tb}$ = Length of the Thermal Bridge (ft)
×
PSI-Value (Btu/hr-ft-˚F)
×
Temp. Correction Factor (if needed)
×
Yearly Heating Degree Hours (k˚F-hr/yr)
=kBtu/yr

Thermal Bridge Length?

The length of the thermal bridge is needed in order to calculate the actual yearly heat loss



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Calculating Losses via Linear Thermal Bridges

$$Q_{T\text{-}tb} = L \times \Psi \times f_t \times G_t$$

EXAMPLE:

NYC, G_t = 117 kFh/yr

Ψ = 0.139 BTU/hr-ft-F

Length = 2 columns @ 10' long each

$Q_{T\text{-}tb}$ = (2 × 10') × 0.139 Btu/hr-ft-F × 1.0 × 117 kFh/yr

$Q_{T\text{-}tb}$ = 20 ft × 0.139 Btu/hr-ft-F × 1.0 × 117 kFh/yr

$Q_{T\text{-}tb}$ = 325.26 kBtu/yr

We have to ADD an additional 325 kBtu/yr of losses to our energy model due to the steel columns

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