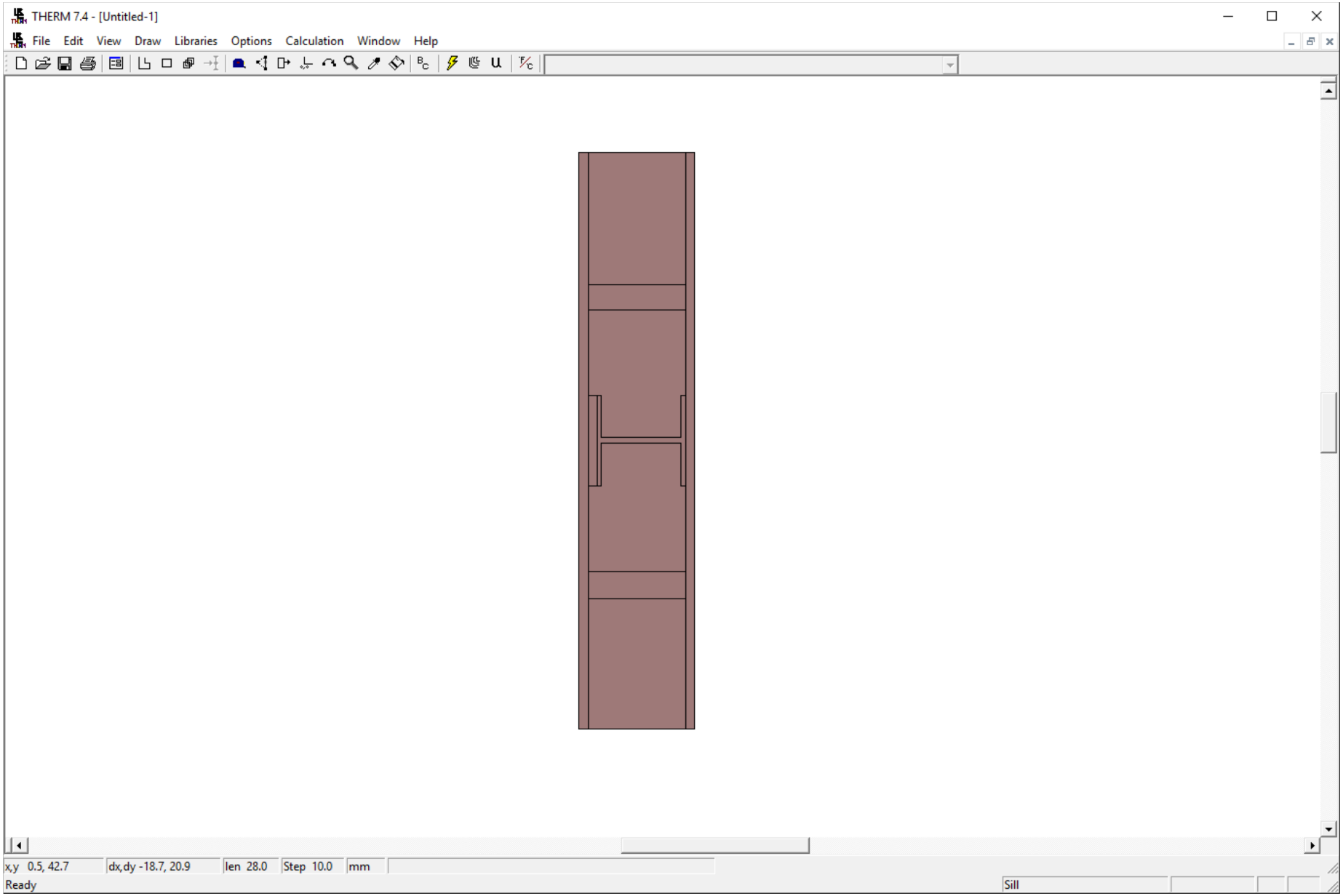
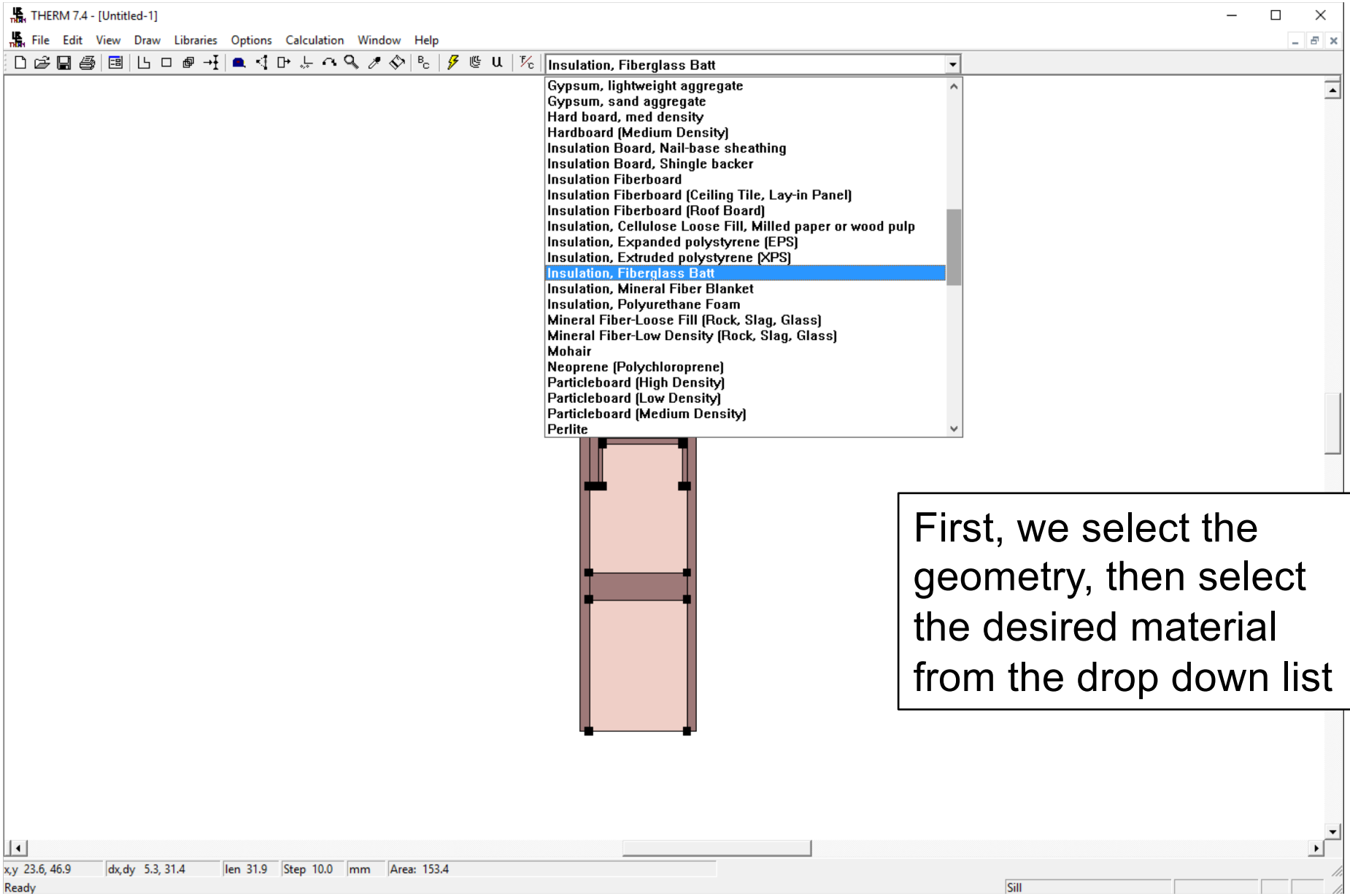
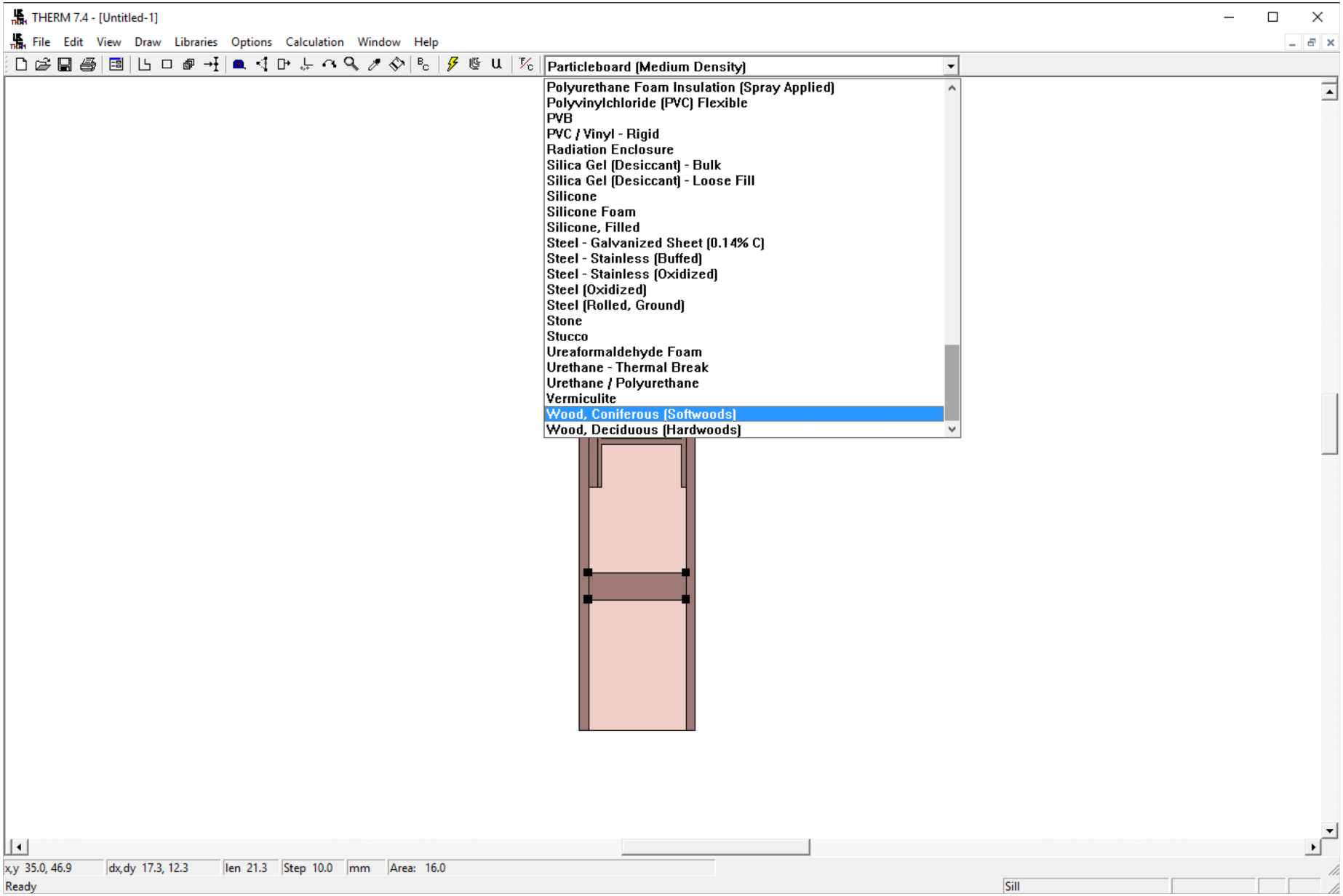
Assign Material Properties

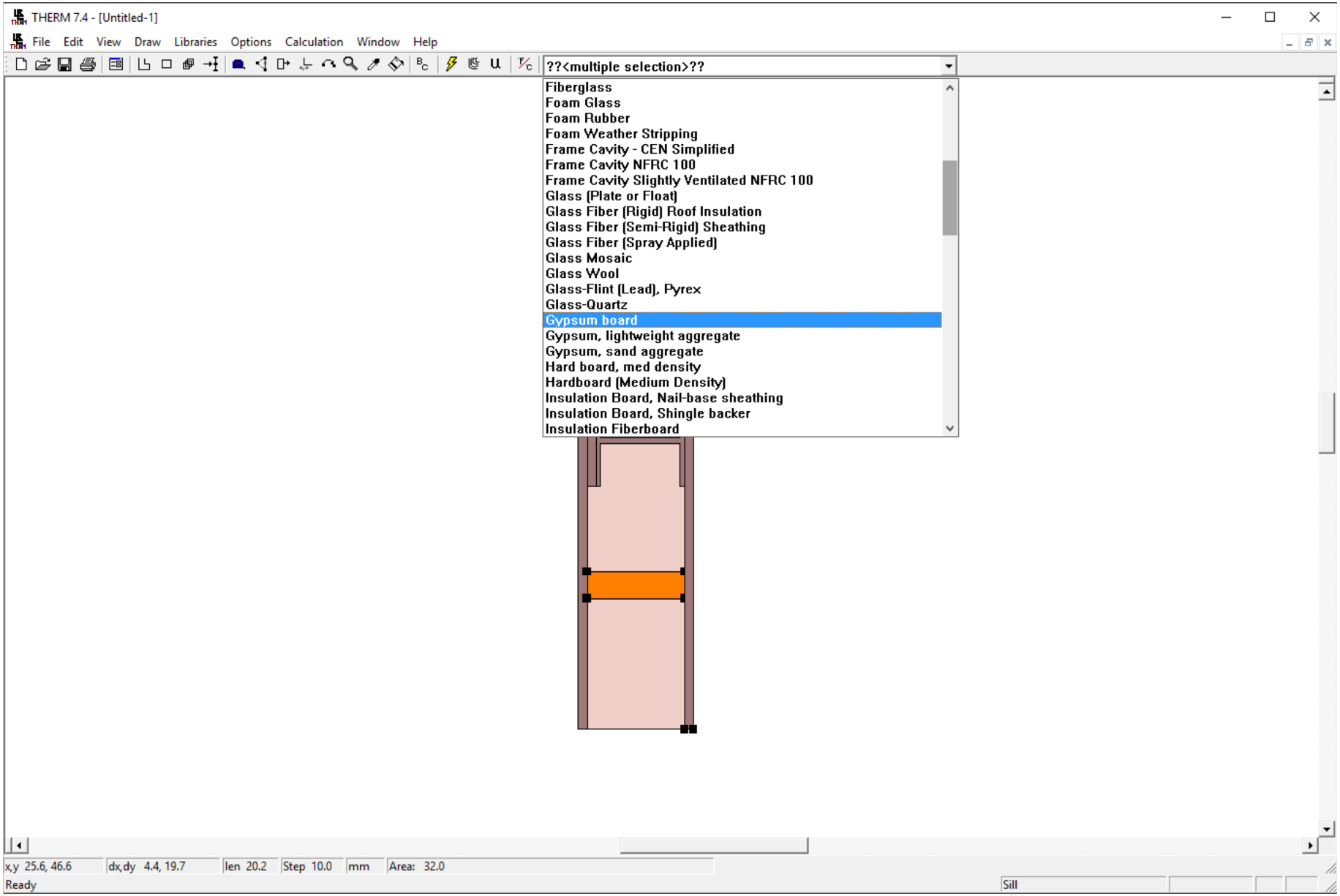
.../Share/THM files/01 Beginner/Therm Example_2_Materials.THM

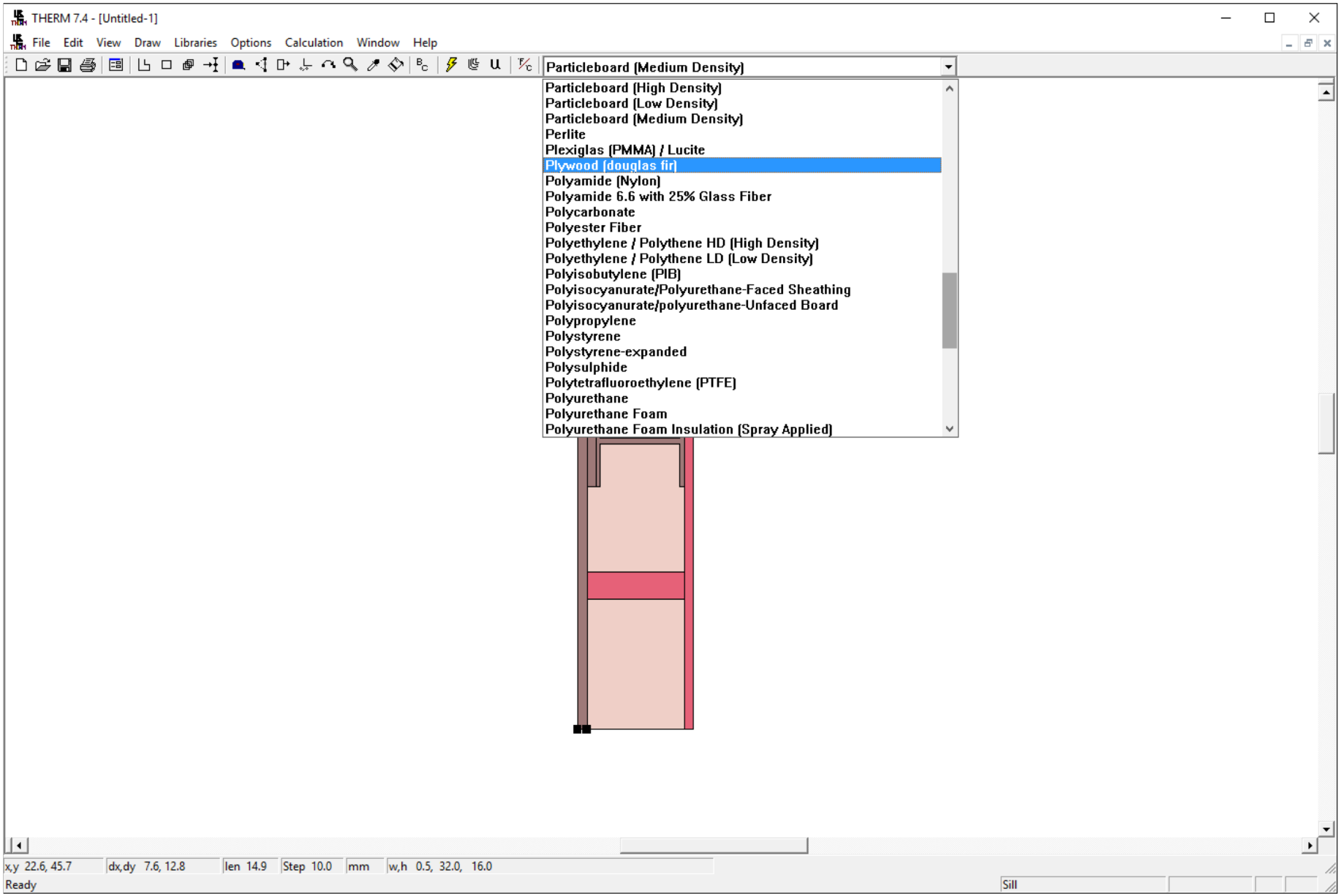

THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
x,y 0.5, 42.7
dx,dy -18.7, 20.9
len 28.0
Step 10.0
mm
Ready
Sill

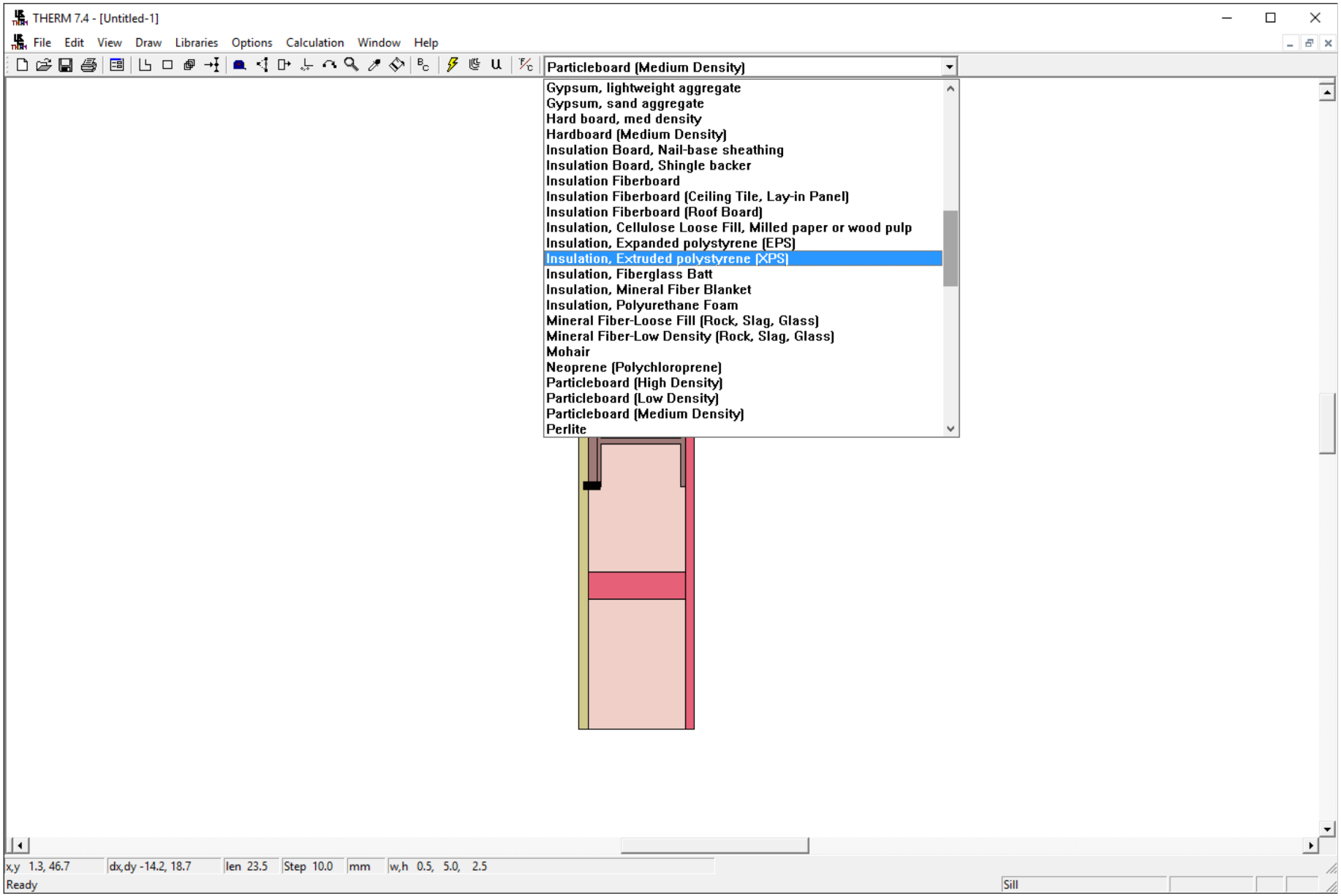


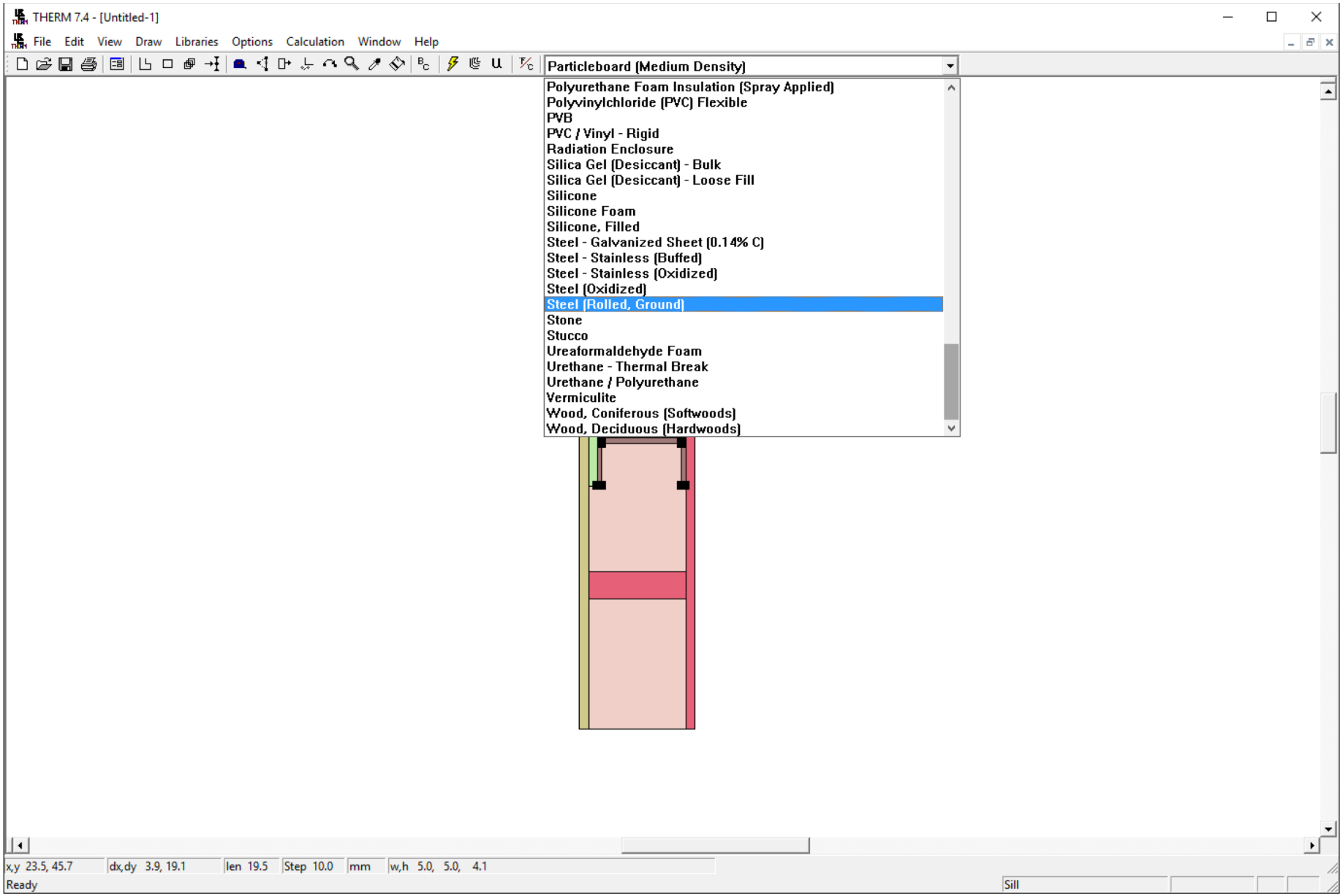
First, we select the geometry, then select the desired material from the drop down list


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Particleboard (Medium Density)
Polyurethane Foam Insulation (Spray Applied)
Polyvinylchloride (PVC) Flexible
PVB
PVC / Vinyl - Rigid
Radiation Enclosure
Silica Gel (Desiccant) - Bulk
Silica Gel (Desiccant) - Loose Fill
Silicone
Silicone Foam
Silicone, Filled
Steel - Galvanized Sheet (0.14% C)
Steel - Stainless (Buffed)
Steel - Stainless (Oxidized)
Steel (Oxidized)
Steel (Rolled, Ground)
Stone
Stucco
Ureaformaldehyde Foam
Urethane - Thermal Break
Urethane / Polyurethane
Vermiculite
Wood, Coniferous (Softwoods)
Wood, Deciduous (Hardwoods)
x,y 35.0, 46.9
dx,dy 17.3, 12.3
len 21.3
Step 10.0
mm
Area: 16.0
Ready
Sill


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
??<multiple selection>??
Fiberglass
Foam Glass
Foam Rubber
Foam Weather Stripping
Frame Cavity - CEN Simplified
Frame Cavity NFRC 100
Frame Cavity Slightly Ventilated NFRC 100
Glass (Plate or Float)
Glass Fiber (Rigid) Roof Insulation
Glass Fiber (Semi-Rigid) Sheathing
Glass Fiber (Spray Applied)
Glass Mosaic
Glass Wool
Glass-Flint (Lead), Pyrex
Glass-Quartz
Gypsum board
Gypsum, lightweight aggregate
Gypsum, sand aggregate
Hard board, med density
Hardboard (Medium Density)
Insulation Board, Nail-base sheathing
Insulation Board, Shingle backer
Insulation Fiberboard
x,y 25.6, 46.6
dx,dy 4.4, 19.7
len 20.2
Step 10.0
mm
Area: 32.0
Ready
Sill


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Particleboard (Medium Density)
Particleboard (High Density)
Particleboard (Low Density)
Particleboard (Medium Density)
Perlite
Plexiglas (PMMA) / Lucite
Plywood (douglas fir)
Polyamide (Nylon)
Polyamide 6.6 with 25% Glass Fiber
Polycarbonate
Polyester Fiber
Polyethylene / Polythene HD (High Density)
Polyethylene / Polythene LD (Low Density)
Polyisobutylene (PIB)
Polyisocyanurate/Polyurethane-Faced Sheathing
Polyisocyanurate/polyurethane-Unfaced Board
Polypropylene
Polystyrene
Polystyrene-expanded
Polysulphide
Polytetrafluoroethylene (PTFE)
Polyurethane
Polyurethane Foam
Polyurethane Foam Insulation (Spray Applied)
x,y 22.6, 45.7
dx,dy 7.6, 12.8
len 14.9
Step 10.0
mm
w,h 0.5, 32.0, 16.0
Ready
Sill


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Particleboard (Medium Density)
Gypsum, lightweight aggregate
Gypsum, sand aggregate
Hard board, med density
Hardboard (Medium Density)
Insulation Board, Nail-base sheathing
Insulation Board, Shingle backer
Insulation Fiberboard
Insulation Fiberboard (Ceiling Tile, Lay-in Panel)
Insulation Fiberboard (Roof Board)
Insulation, Cellulose Loose Fill, Milled paper or wood pulp
Insulation, Expanded polystyrene (EPS)
Insulation, Extruded polystyrene (XPS)
Insulation, Fiberglass Batt
Insulation, Mineral Fiber Blanket
Insulation, Polyurethane Foam
Mineral Fiber-Loose Fill (Rock, Slag, Glass)
Mineral Fiber-Low Density (Rock, Slag, Glass)
Mohair
Neoprene (Polychloroprene)
Particleboard (High Density)
Particleboard (Low Density)
Particleboard (Medium Density)
Perlite
x,y 1.3, 46.7
dx,dy -14.2, 18.7
len 23.5
Step 10.0
mm
w,h 0.5, 5.0, 2.5
Ready
Sill

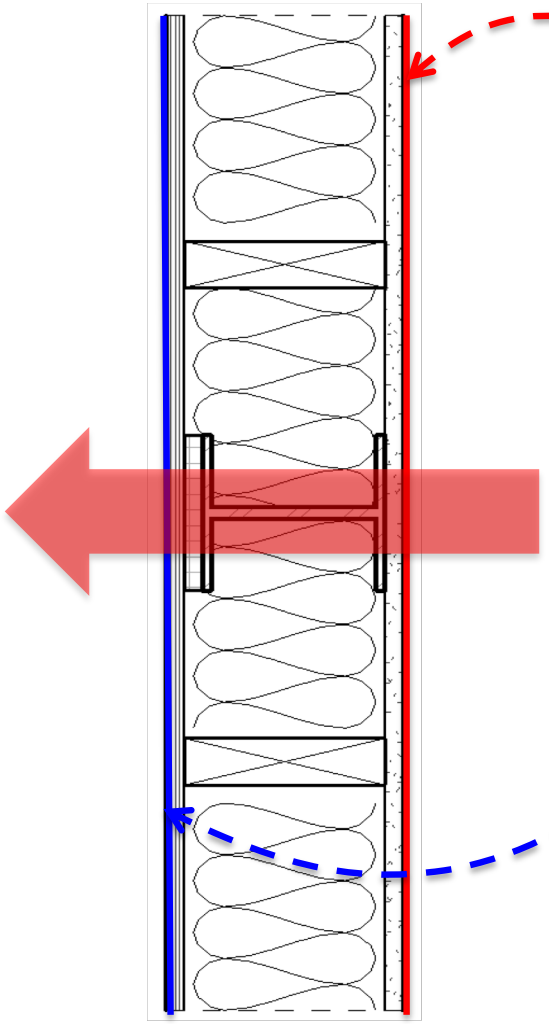

THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Particleboard (Medium Density)
Polyurethane Foam Insulation (Spray Applied)
Polyvinylchloride (PVC) Flexible
PVB
PVC / Vinyl - Rigid
Radiation Enclosure
Silica Gel (Desiccant) - Bulk
Silica Gel (Desiccant) - Loose Fill
Silicone
Silicone Foam
Silicone, Filled
Steel - Galvanized Sheet (0.14% C)
Steel - Stainless (Buffed)
Steel - Stainless (Oxidized)
Steel (Oxidized)
Steel (Rolled, Ground)
Stone
Stucco
Ureaformaldehyde Foam
Urethane - Thermal Break
Urethane / Polyurethane
Vermiculite
Wood, Coniferous (Softwoods)
Wood, Deciduous (Hardwoods)
x,y 23.5, 45.7
dx,dy 3.9, 19.1
len 19.5
Step 10.0
mm
w,h 5.0, 5.0, 4.1
Ready
Sill

Assigning ‘Boundary Conditions’

…/Share/THM files/01 Beginner/Therm Example_3_BC.THM

BC + U-Factor ‘TAGS’

THERM needs us to specify the **surface temperature**, as well as **surface film-coefficient** information. We’ll also specify some custom **U-Factor Tags** which will allow us to measure the amount of heat flow later on.

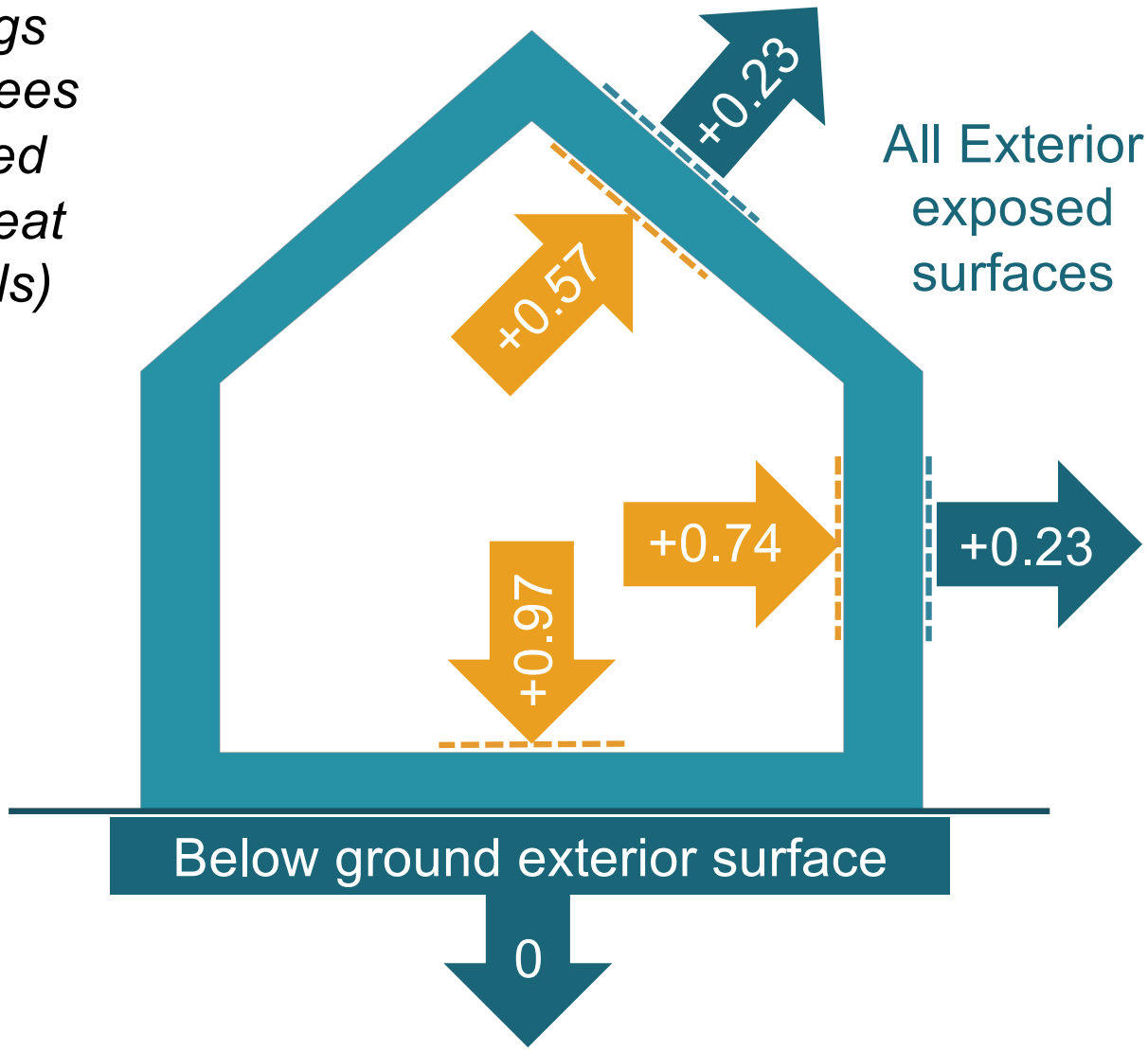


We’ll specify this edge as the interior ‘gate’ and set it as a U-Factor tag of ‘Inside’

We’ll specify this edge as the exterior ‘gate’ and set it as a U-Factor tag of ‘Outside’

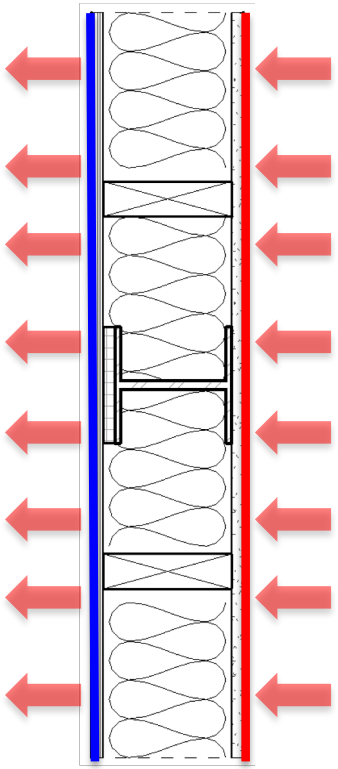
Surface Film Resistances

**Note: Ceilings over 60 degrees are considered 'horizontal' heat flow (like walls)*

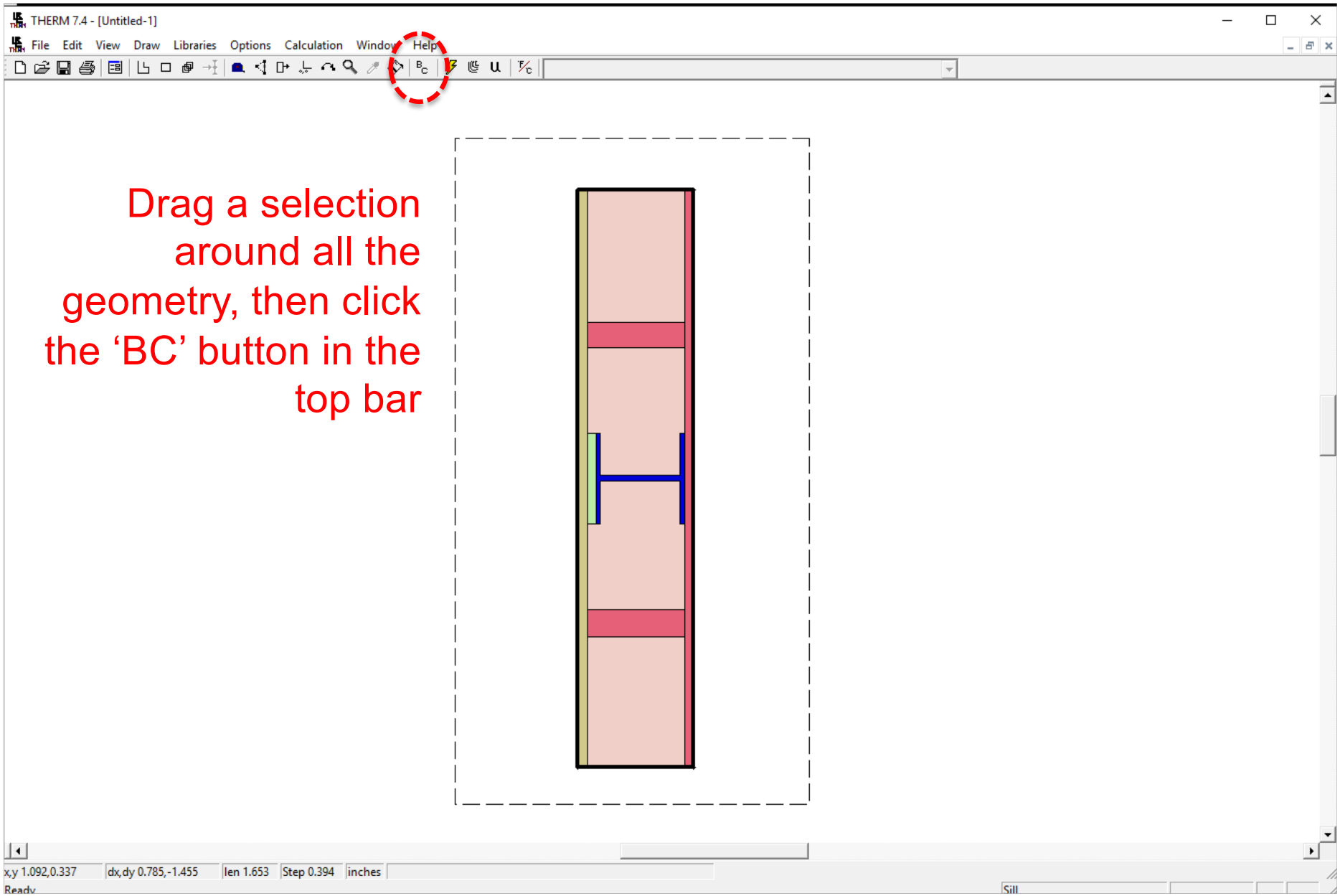


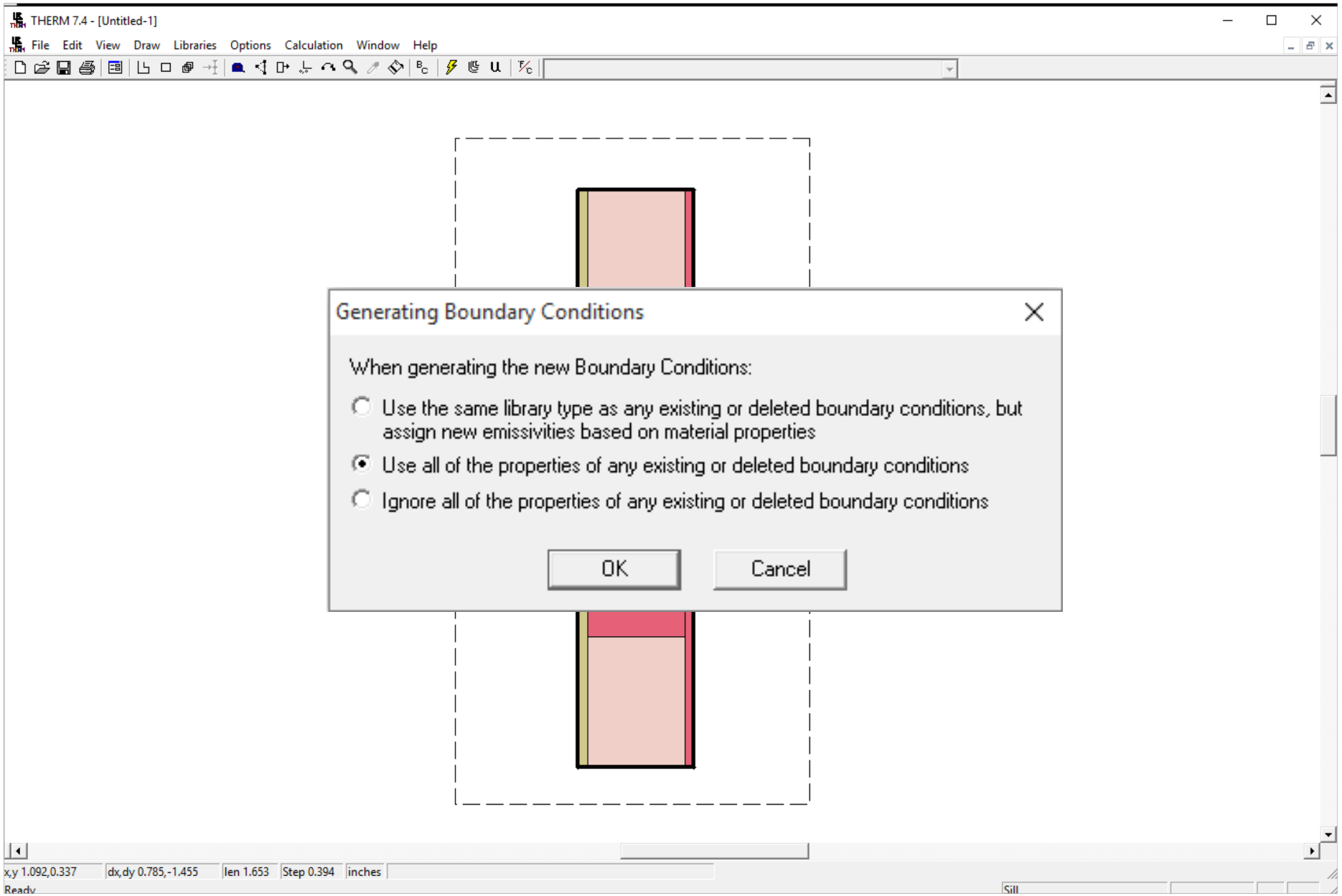
Boundary Conditions

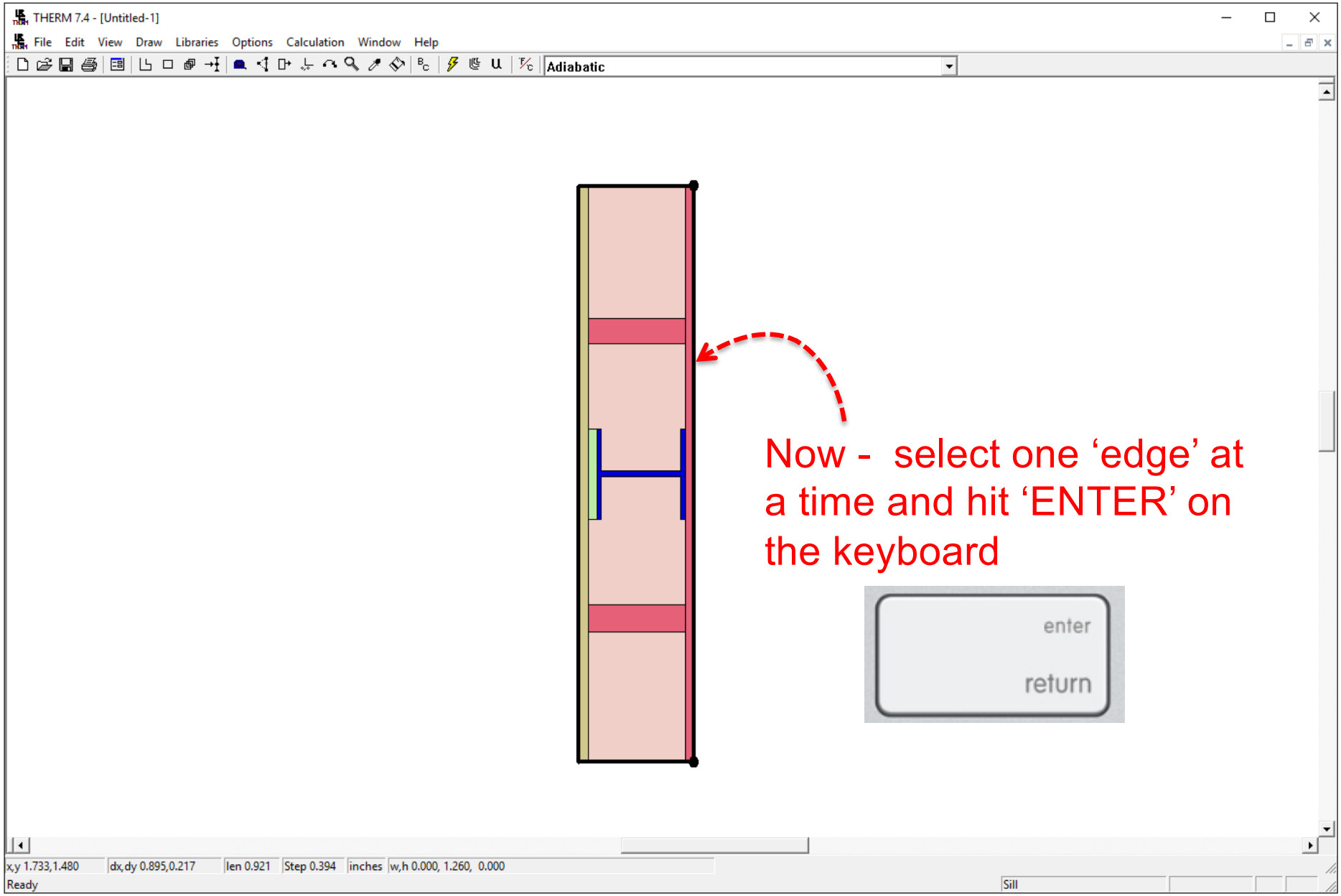
Horizontal Heat Flow (Ext)
T = 28°
R_{SI} = 0.23 hr·ft²·F/Btu

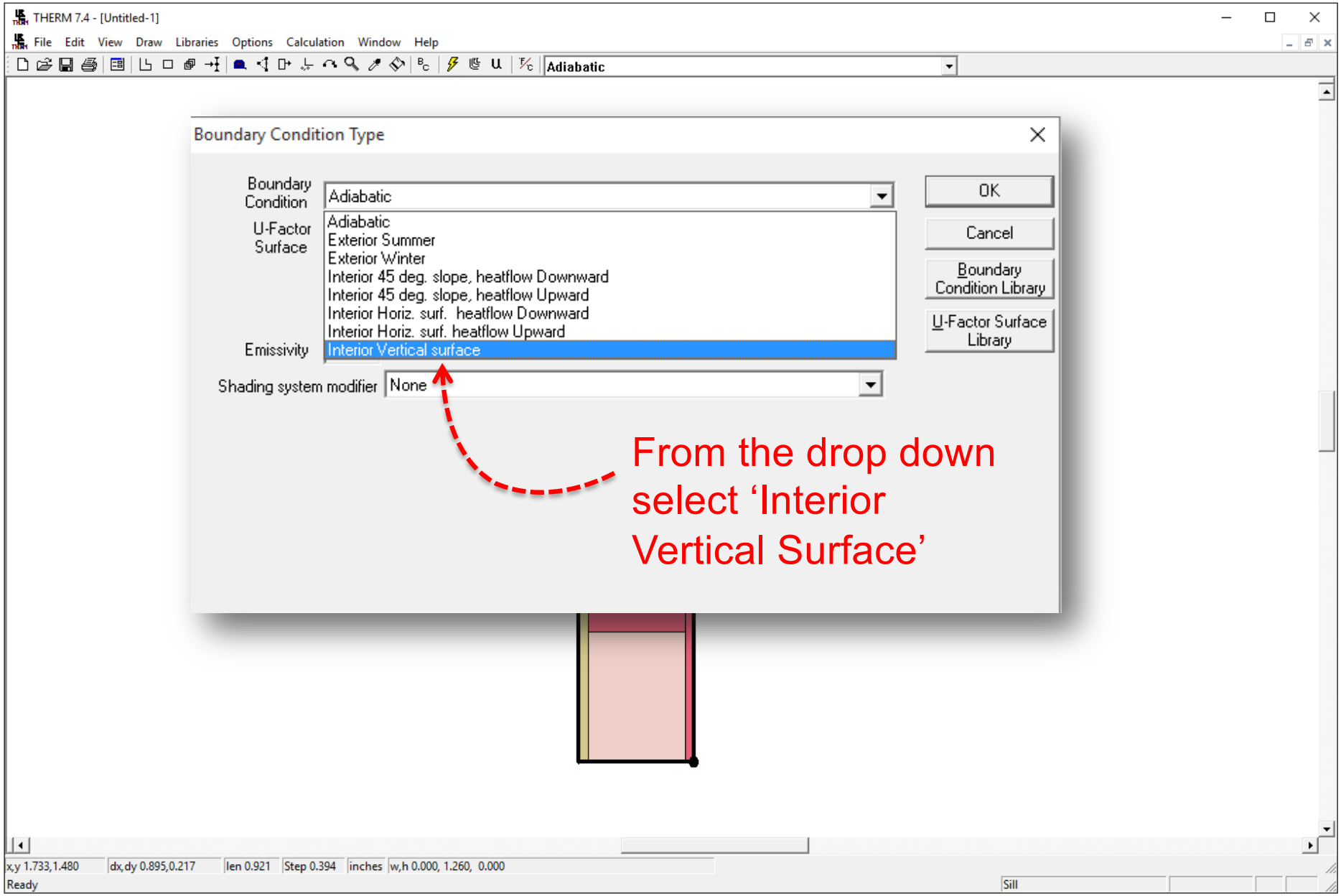


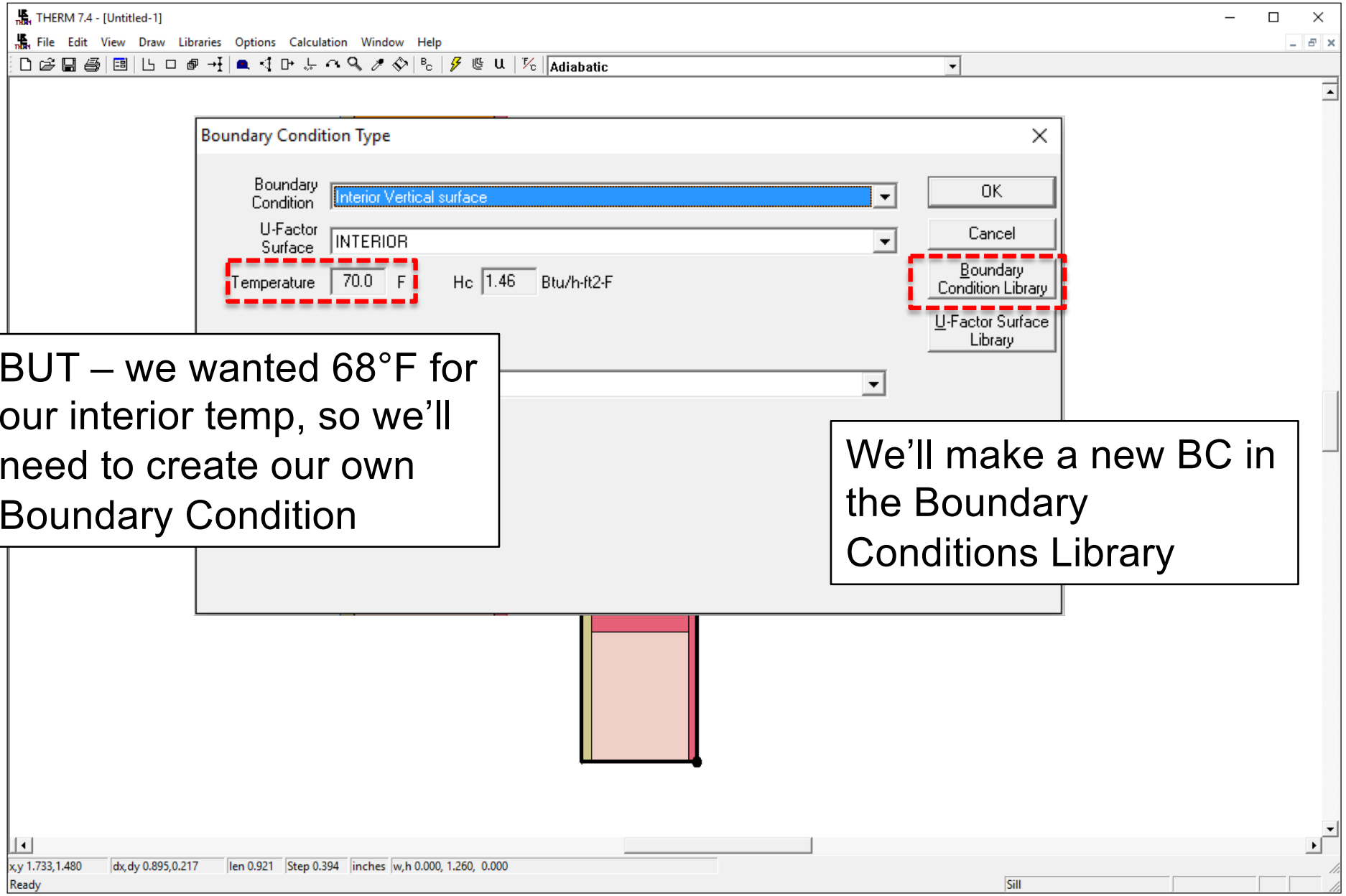
Horizontal Heat Flow (Int)
T = 68°
R_{SI} = 0.74 hr·ft²·F/Btu


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Drag a selection around all the geometry, then click the ‘BC’ button in the top bar
x,y 1.092,0.337
dx,dy 0.785,-1.455
len 1.653
Step 0.394
inches
Ready
Sill


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Generating Boundary Conditions
When generating the new Boundary Conditions:
Use the same library type as any existing or deleted boundary conditions, but assign new emissivities based on material properties
Use all of the properties of any existing or deleted boundary conditions
Ignore all of the properties of any existing or deleted boundary conditions
OK
Cancel
x,y 1.092,0.337
dx,dy 0.785,-1.455
len 1.653
Step 0.394
inches
Ready
Sill

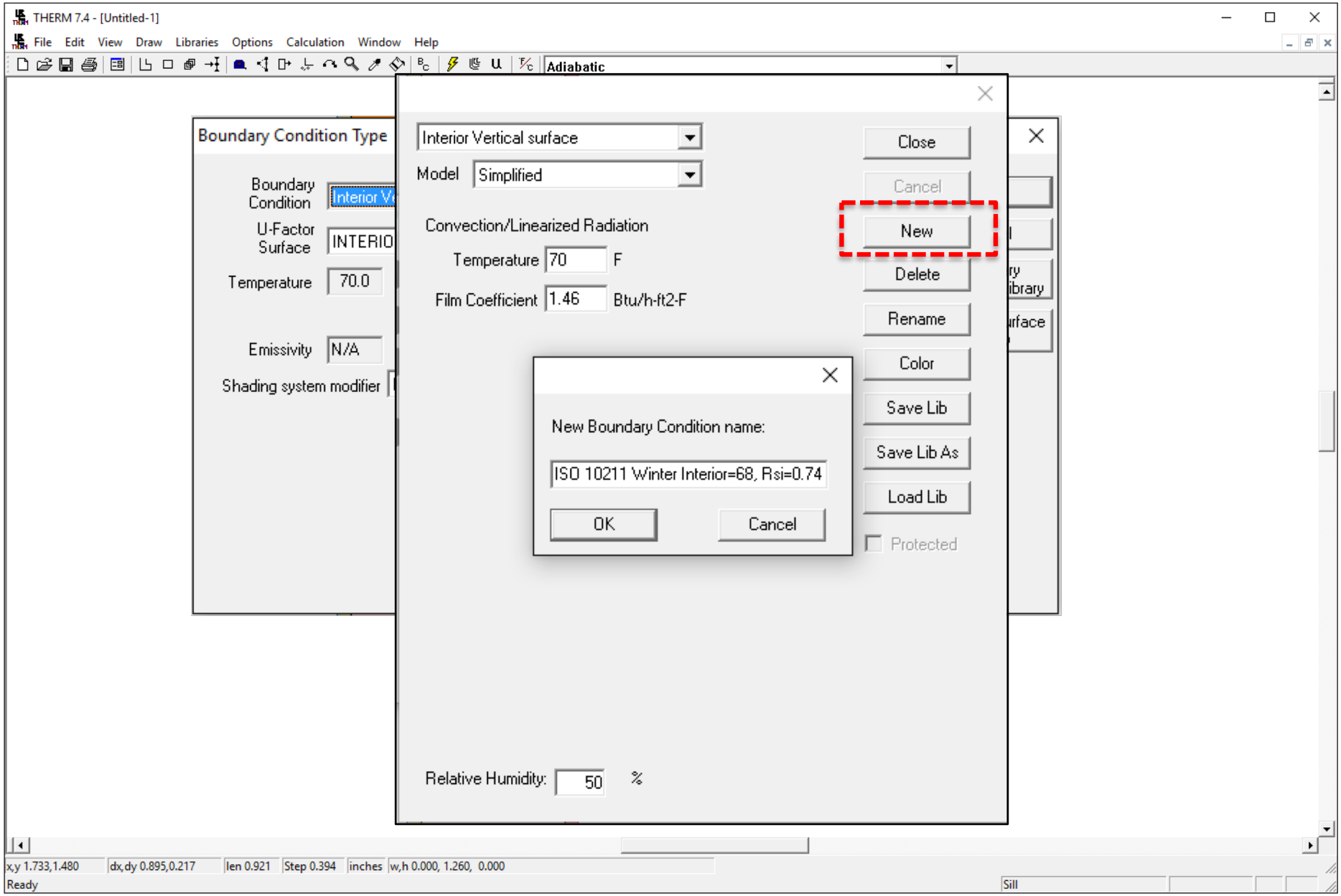

THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Adiabatic
Now - select one 'edge' at a time and hit 'ENTER' on the keyboard
enter
return
x,y 1.733,1.480
dx,dy 0.895,0.217
len 0.921
Step 0.394
inches
w,h 0.000, 1.260, 0.000
Ready
Sill


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Adiabatic
Boundary Condition Type
Boundary Condition
Adiabatic
U-Factor Surface
Adiabatic
Exterior Summer
Exterior Winter
Interior 45 deg. slope, heatflow Downward
Interior 45 deg. slope, heatflow Upward
Interior Horiz. surf. heatflow Downward
Interior Horiz. surf. heatflow Upward
Emissivity
Interior Vertical surface
Shading system modifier
None
OK
Cancel
Boundary Condition Library
U-Factor Surface Library
From the drop down select 'Interior Vertical Surface'
x,y 1.733,1.480
dx,dy 0.895,0.217
len 0.921
Step 0.394
inches
w,h 0.000, 1.260, 0.000
Ready
Sill



BUT – we wanted 68°F for our interior temp, so we'll need to create our own Boundary Condition

We'll make a new BC in the Boundary Conditions Library



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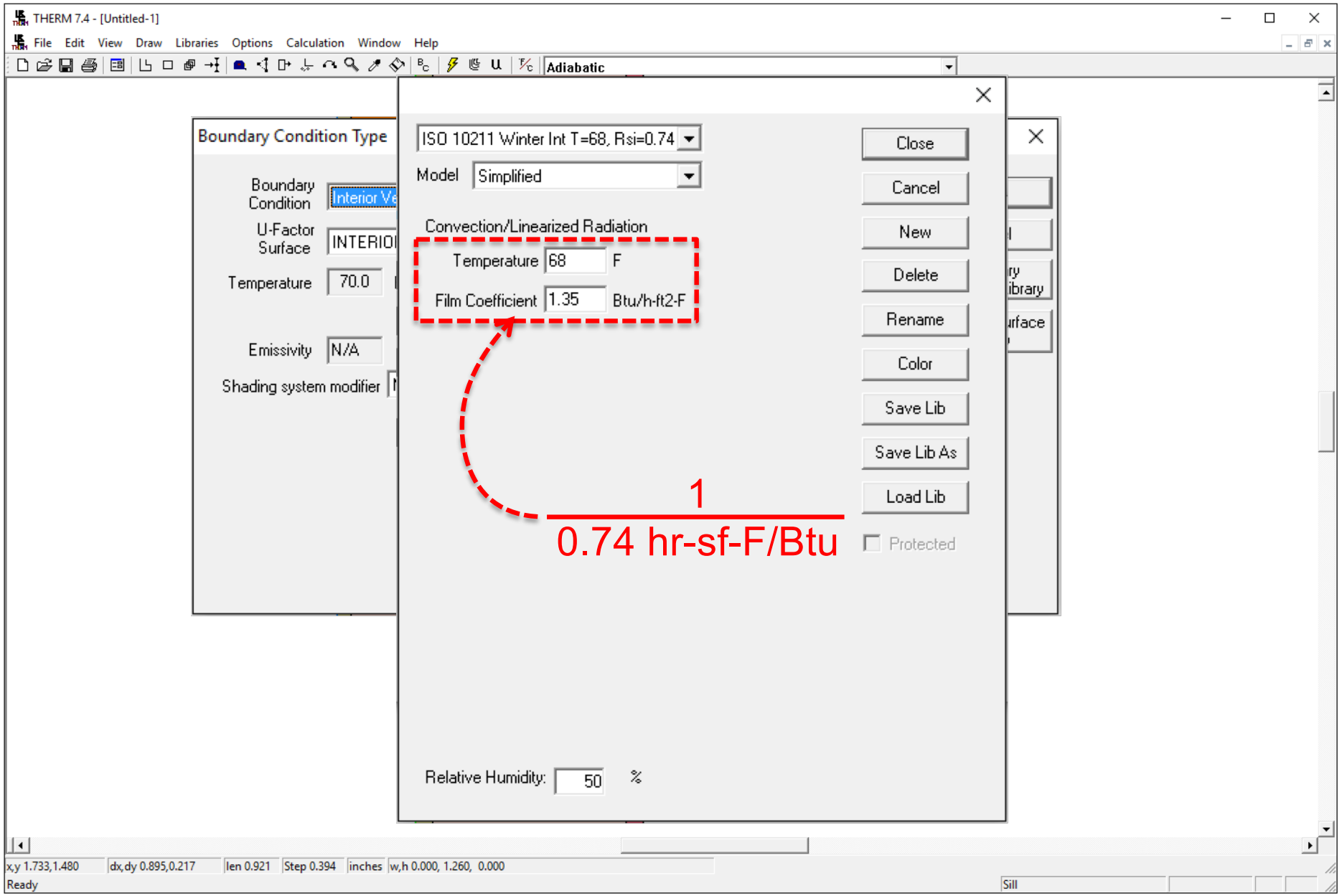
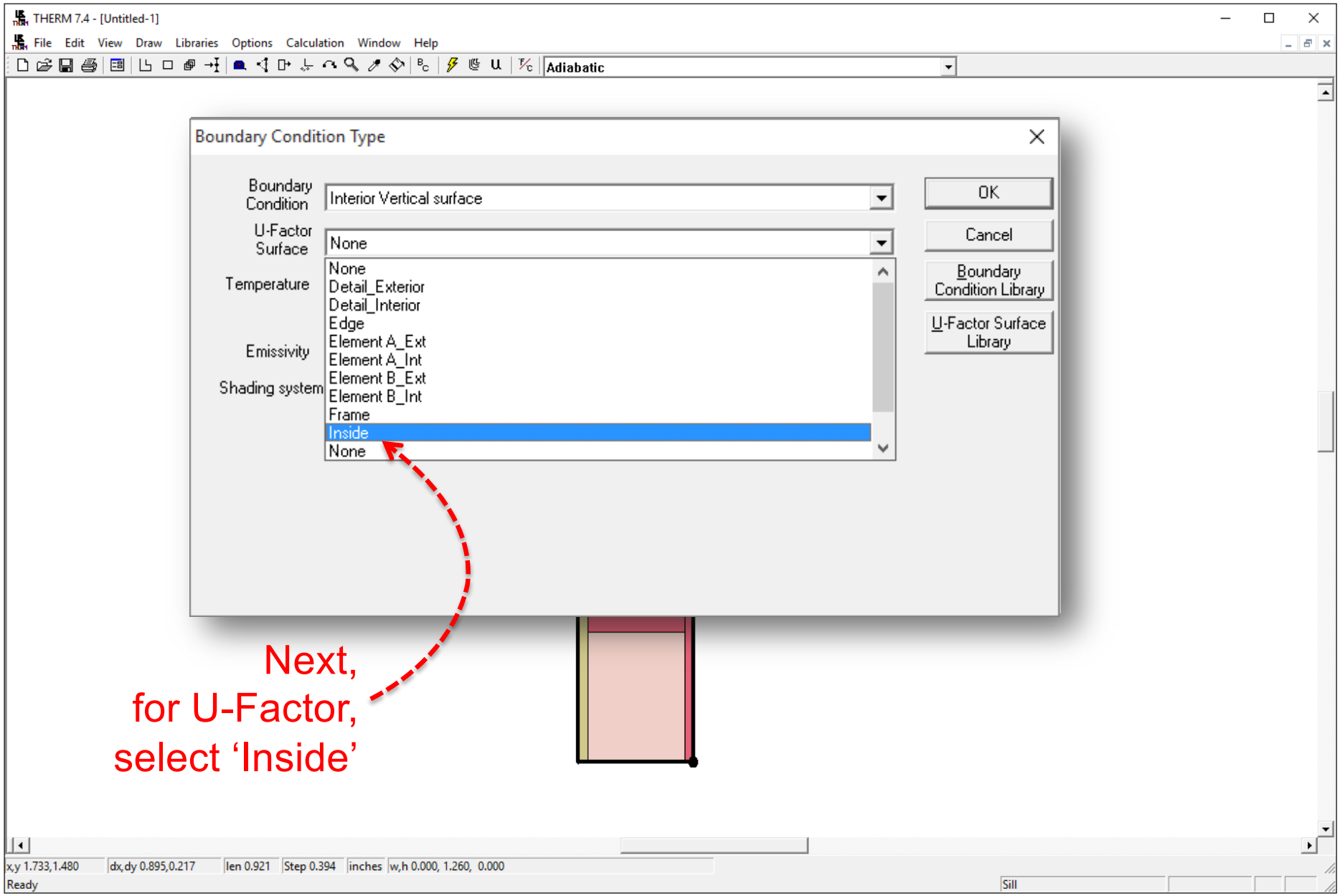
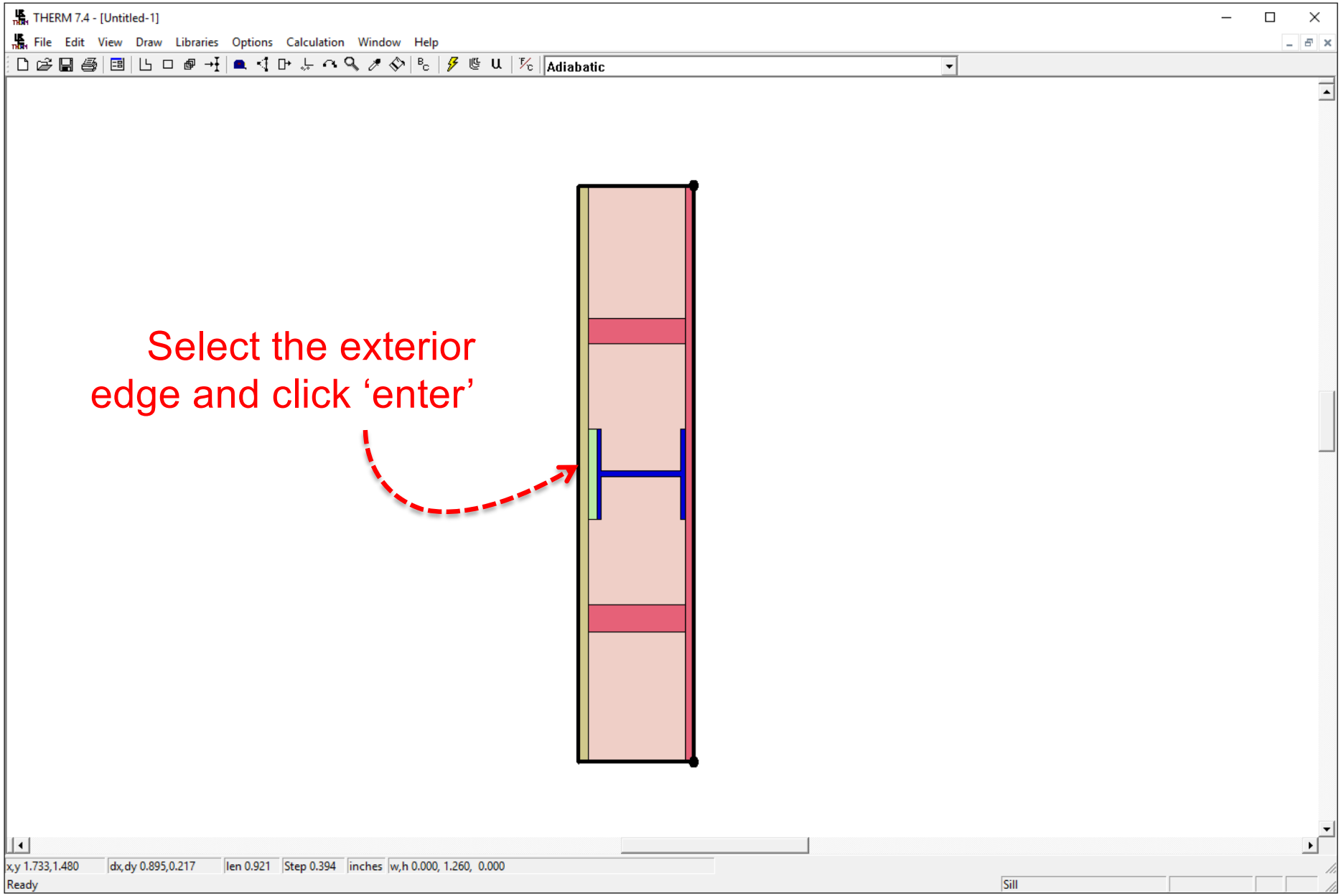

THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Adiabatic
Boundary Condition Type
Boundary Condition
Interior Ve
U-Factor Surface
INTERIOI
Temperature
70.0
Emissivity
N/A
Shading system modifier
ISO 10211 Winter Int T=68, Rsi=0.74
Model
Simplified
Convection/Linearized Radiation
Temperature 68 F
Film Coefficient 1.35 Btu/h-ft2-F
Close
Cancel
New
Delete
Rename
Color
Save Lib
Save Lib As
Load Lib
Protected
1
0.74 hr-sf-F/Btu
Relative Humidity: 50 %
x,y 1.733,1.480
dx,dy 0.895,0.217
len 0.921
Step 0.394
inches
w,h 0.000, 1.260, 0.000
Ready
Sill


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Adiabatic
Boundary Condition Type
Boundary Condition
Interior Vertical surface
U-Factor Surface
None
Temperature
Emissivity
Shading system
None
Detail_Exterior
Detail_Interior
Edge
Element A_Ext
Element A_Int
Element B_Ext
Element B_Int
Frame
Inside
None
OK
Cancel
Boundary Condition Library
U-Factor Surface Library
Next,
for U-Factor,
select 'Inside'
x,y 1.733,1.480
dx,dy 0.895,0.217
len 0.921
Step 0.394
inches
w,h 0.000, 1.260, 0.000
Ready
Sill


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Adiabatic
Select the exterior edge and click ‘enter’
x,y 1.733,1.480
dx,dy 0.895,0.217
len 0.921
Step 0.394
inches
w,h 0.000, 1.260, 0.000
Ready
Sill

Exterior Boundary Temp?

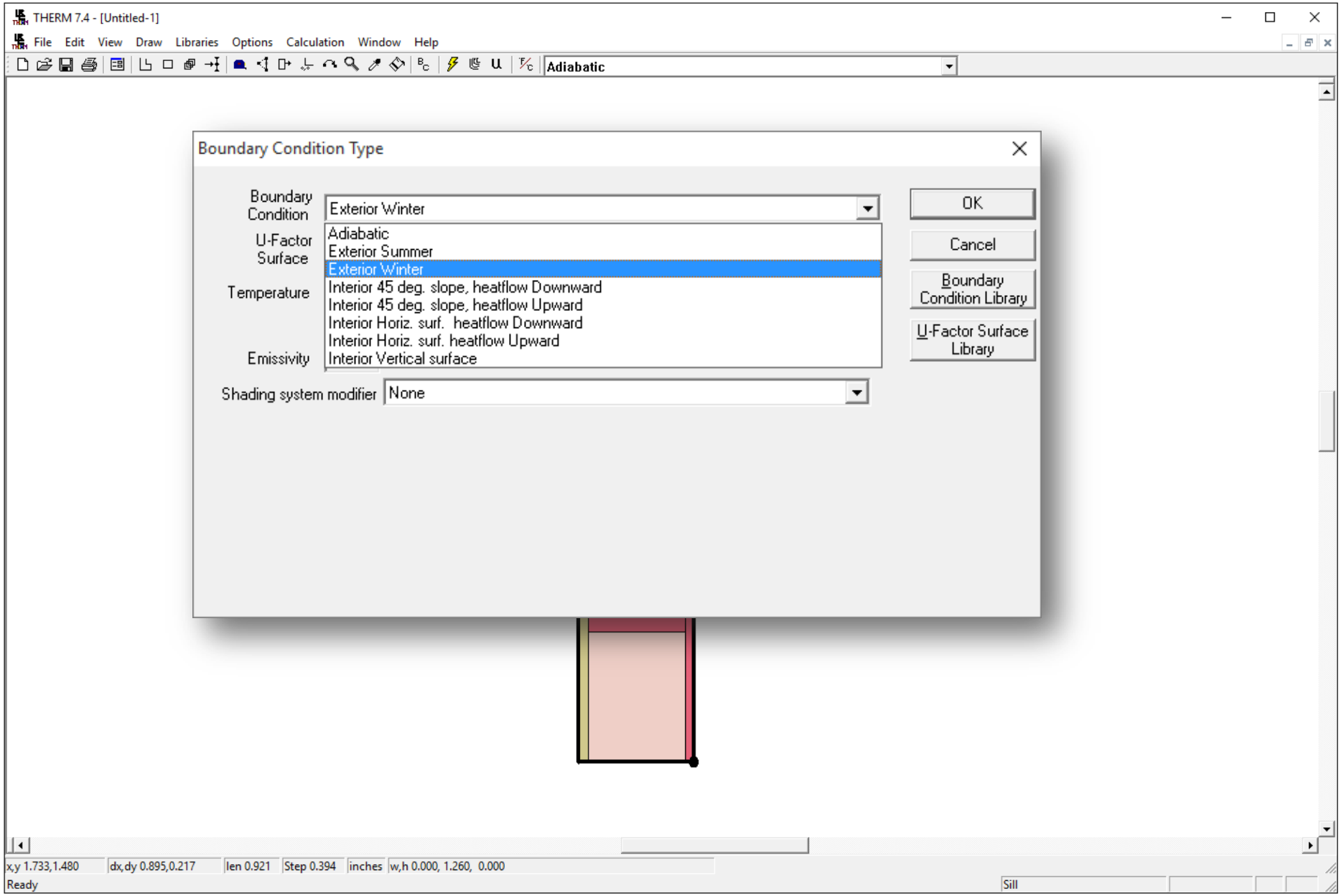
- ISO 10211 gives no useful guidance
- PHI says to use 20°C int. and -10°C ext.
- If using the model to evaluate RH or condensation risk, follow ISO 13788:

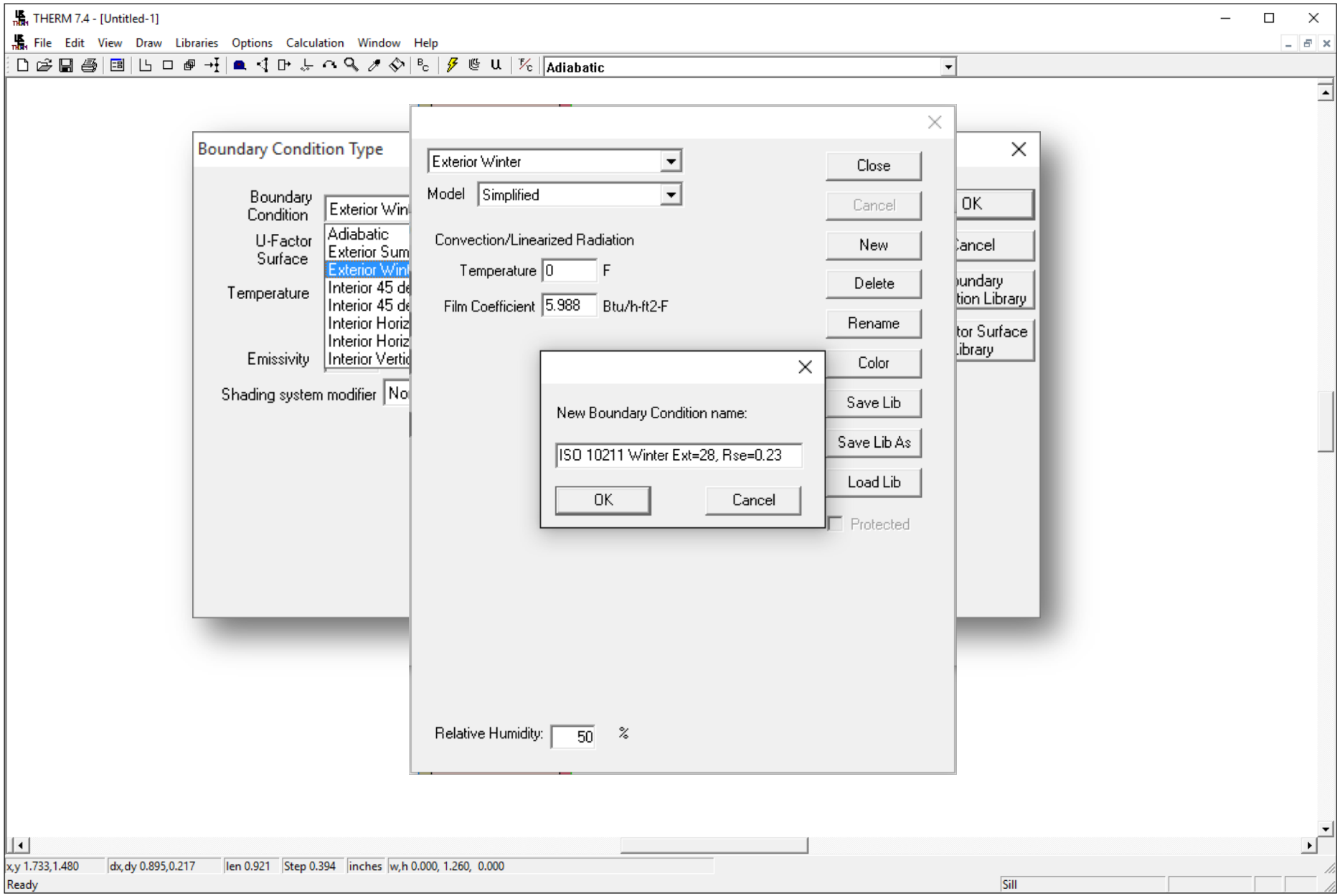
4.2 External boundary conditions

4.2.1 Location

Unless otherwise specified, the external conditions used shall be representative of the location of the building, taking account of altitude where appropriate.

NOTE Unless other information is available (for example in national standards), it can be assumed that temperature falls by 1 K for every 200 m increase in altitude.


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Adiabatic
Boundary Condition Type
Boundary Condition
Exterior Winter
U-Factor Surface
Temperature
Emissivity
Adiabatic
Exterior Summer
Exterior Winter
Interior 45 deg. slope, heatflow Downward
Interior 45 deg. slope, heatflow Upward
Interior Horiz. surf. heatflow Downward
Interior Horiz. surf. heatflow Upward
Interior Vertical surface
Shading system modifier
None
OK
Cancel
Boundary Condition Library
U-Factor Surface Library
x,y 1.733,1.480
dx,dy 0.895,0.217
len 0.921
Step 0.394
inches
w,h 0.000, 1.260, 0.000
Ready
Sill



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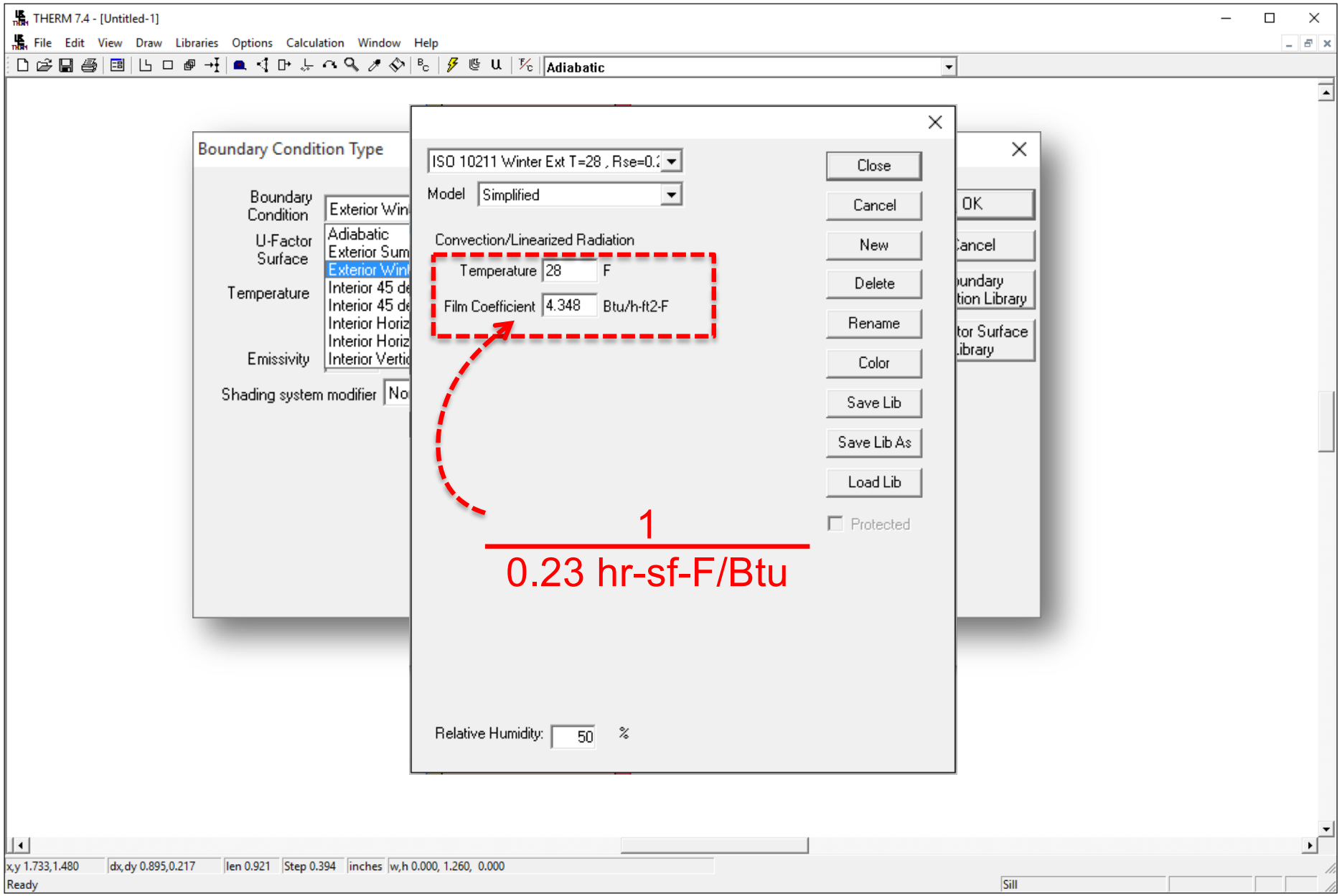

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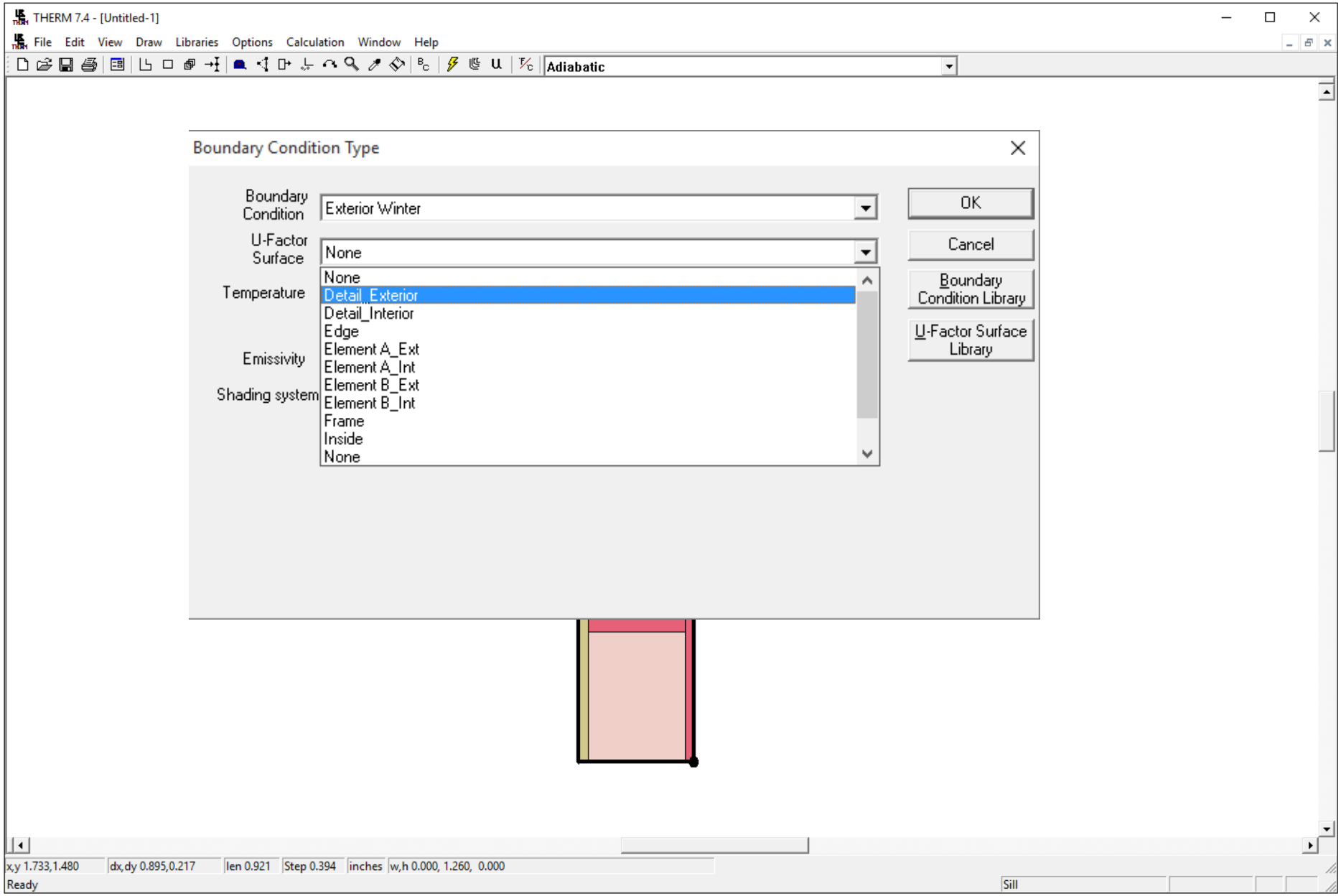
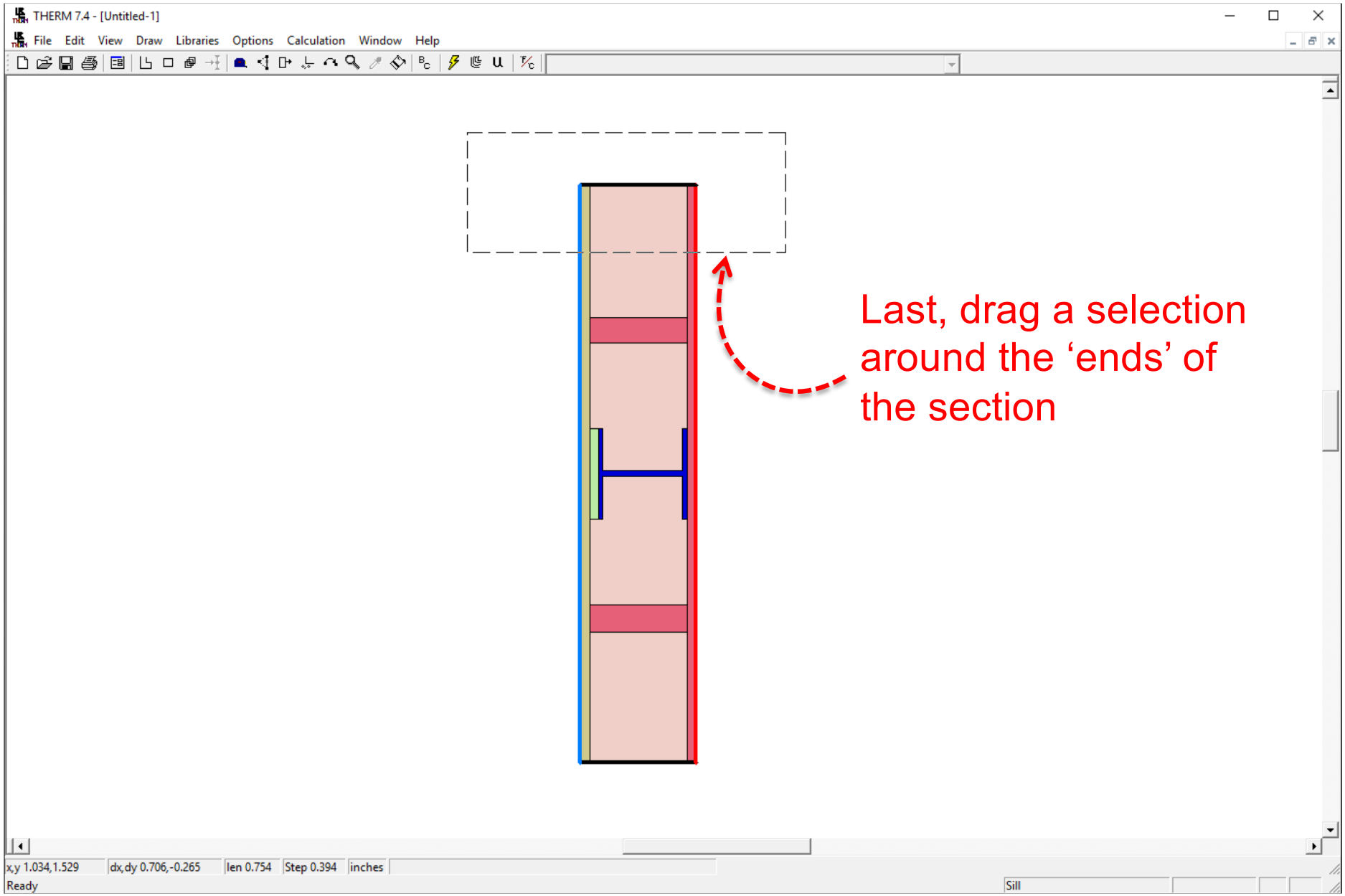
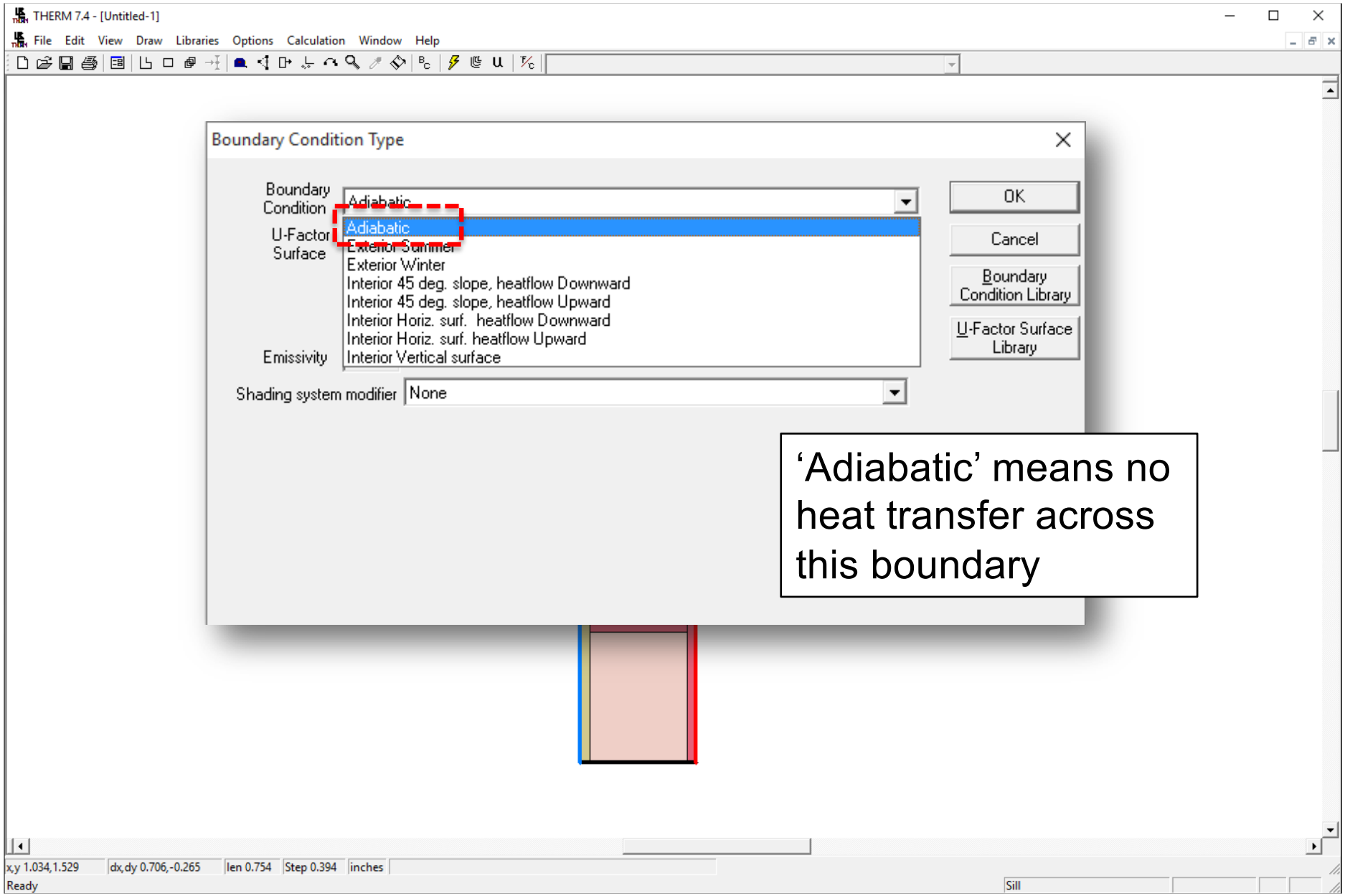
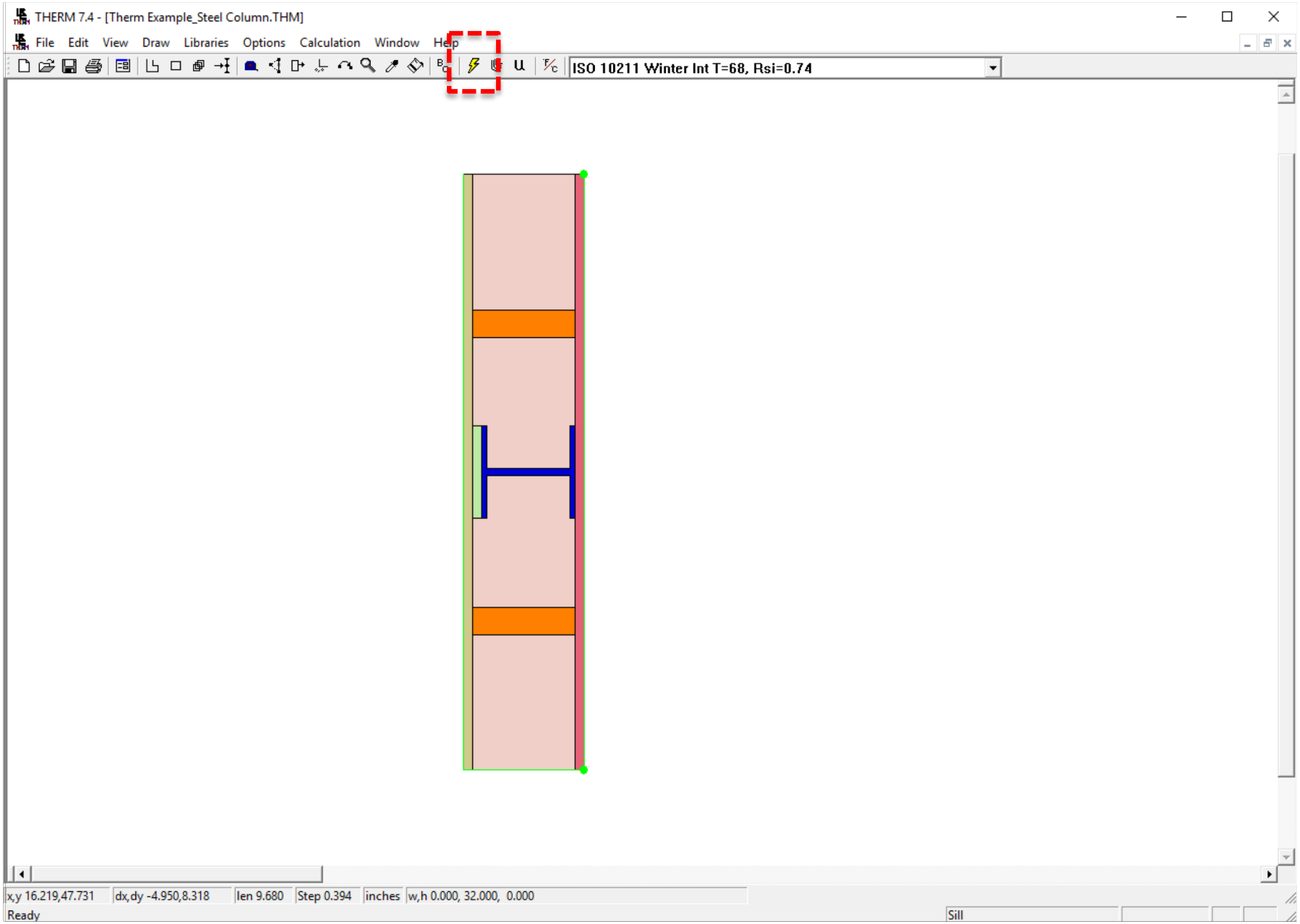
bldgtyp

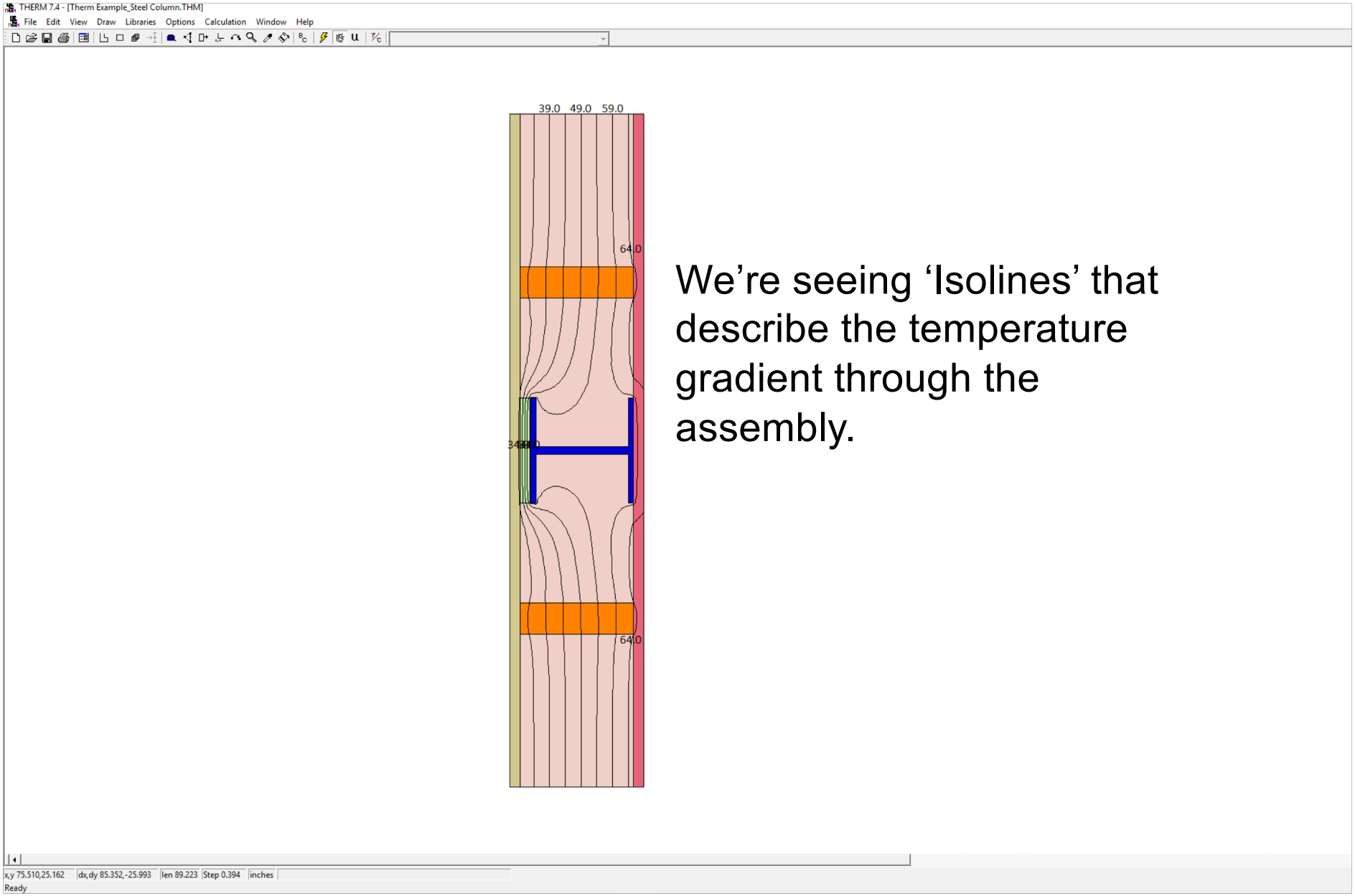

THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Adiabatic
Boundary Condition Type
Boundary Condition
Exterior Winter
U-Factor Surface
None
Temperature
Emissivity
Shading system
None
Detail_Exterior
Detail_Interior
Edge
Element A_Ext
Element A_Int
Element B_Ext
Element B_Int
Frame
Inside
None
OK
Cancel
Boundary Condition Library
U-Factor Surface Library
x,y 1.733,1.480
dx,dy 0.895,0.217
len 0.921
Step 0.394
inches
w,h 0.000, 1.260, 0.000
Ready
Sill


THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Last, drag a selection around the ‘ends’ of the section
x,y 1.034,1.529
dx,dy 0.706,-0.265
len 0.754
Step 0.394
inches
Ready
Sill

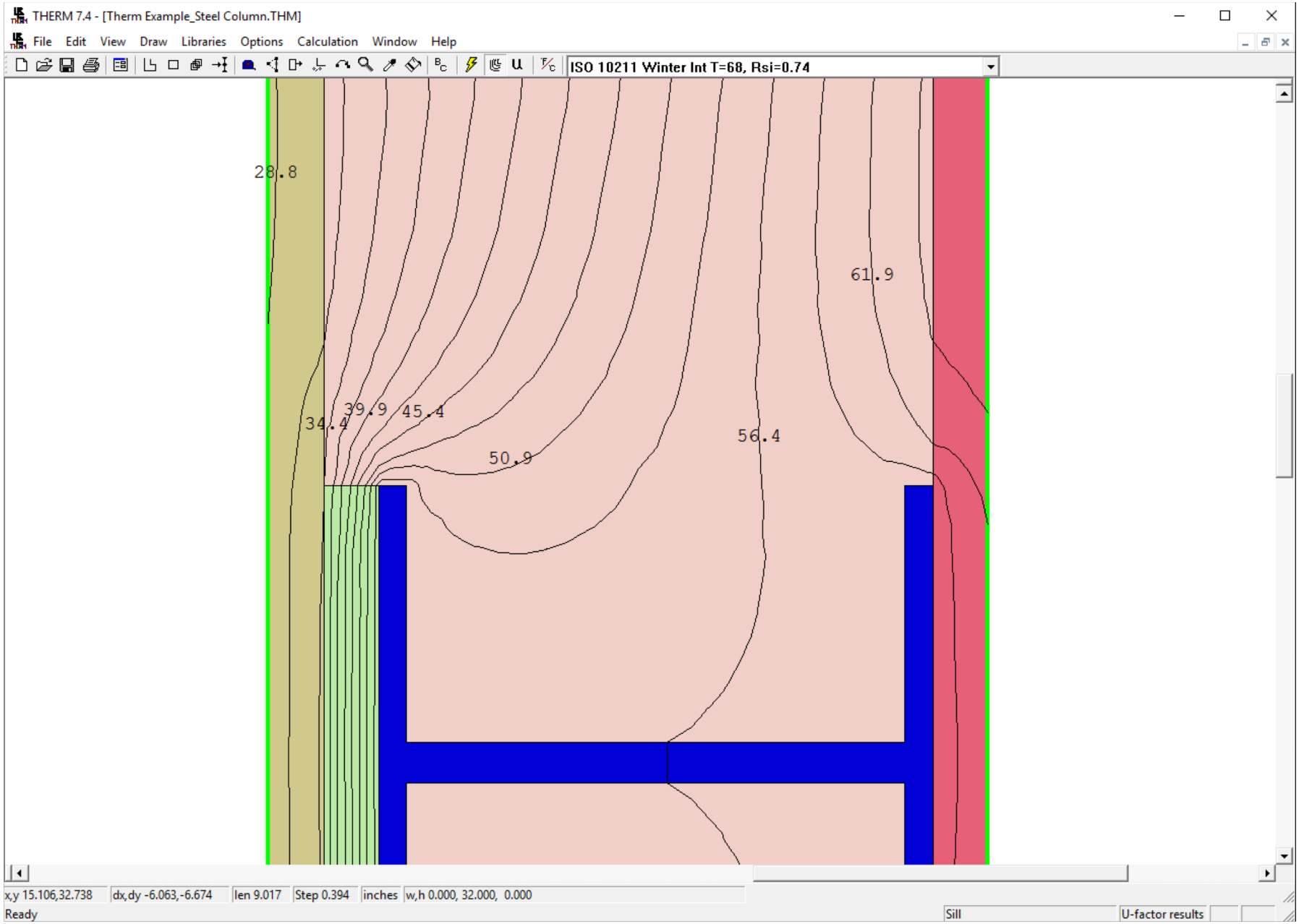

THERM 7.4 - [Untitled-1]
File Edit View Draw Libraries Options Calculation Window Help
Boundary Condition Type
Boundary Condition
Adiabatic
U-Factor Surface
Emissivity
Adiabatic
Exterior Summer
Exterior Winter
Interior 45 deg. slope, heatflow Downward
Interior 45 deg. slope, heatflow Upward
Interior Horiz. surf. heatflow Downward
Interior Horiz. surf. heatflow Upward
Interior Vertical surface
Shading system modifier
None
OK
Cancel
Boundary Condition Library
U-Factor Surface Library
'Adiabatic' means no heat transfer across this boundary
x,y 1.034,1.529
dx,dy 0.706,-0.265
len 0.754
Step 0.394
inches
Ready
Sill

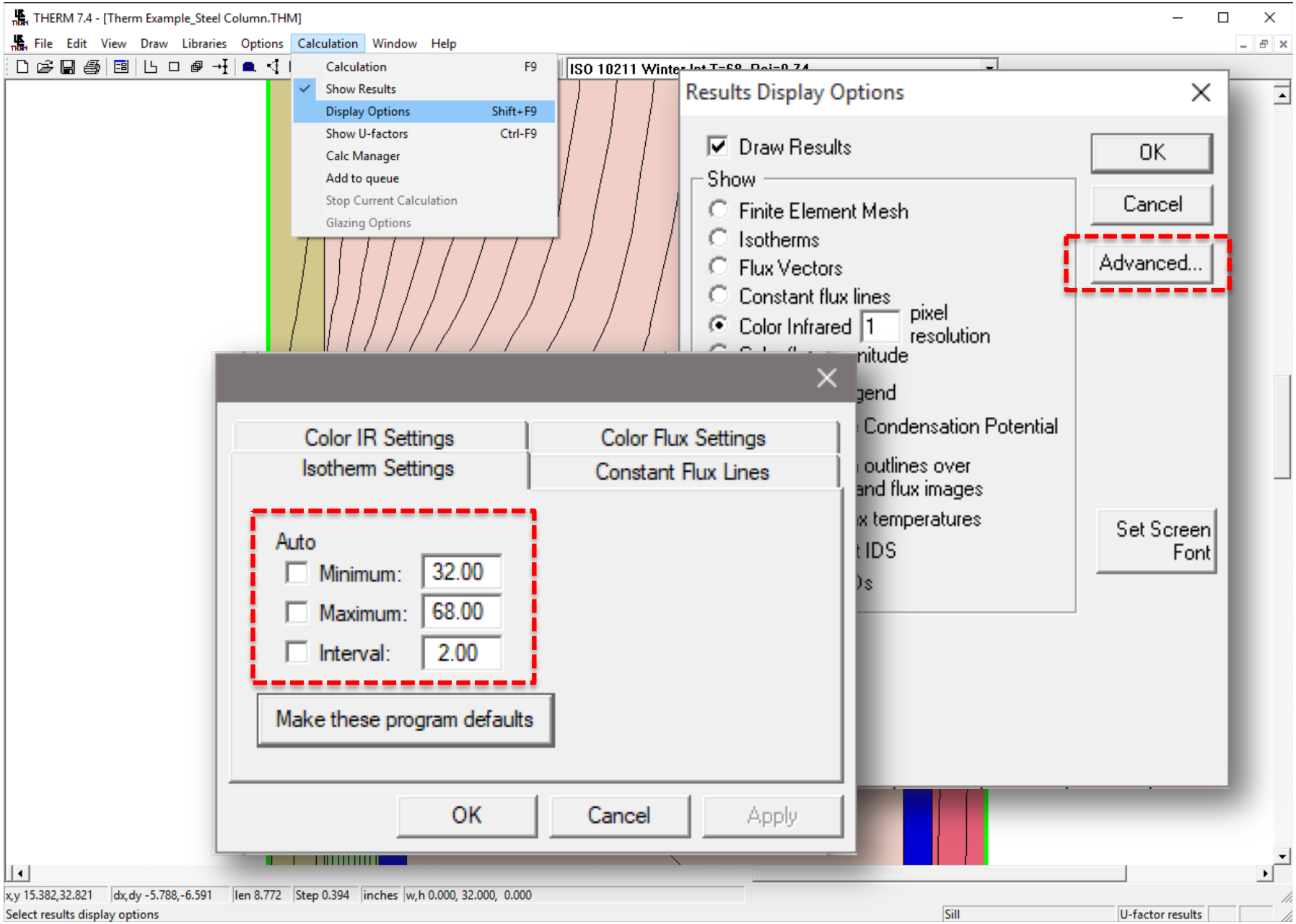
Running the Simulation


THERM 7.4 - [Therm Example_Steel Column.THM]
File Edit View Draw Libraries Options Calculation Window Help
ISO 10211 Winter Int T=68, Rsi=0.74
x,y 16.219,47.731
dx,dy -4.950,8.318
len 9.680
Step 0.394
inches
w,h 0.000, 32.000, 0.000
Ready
Sill



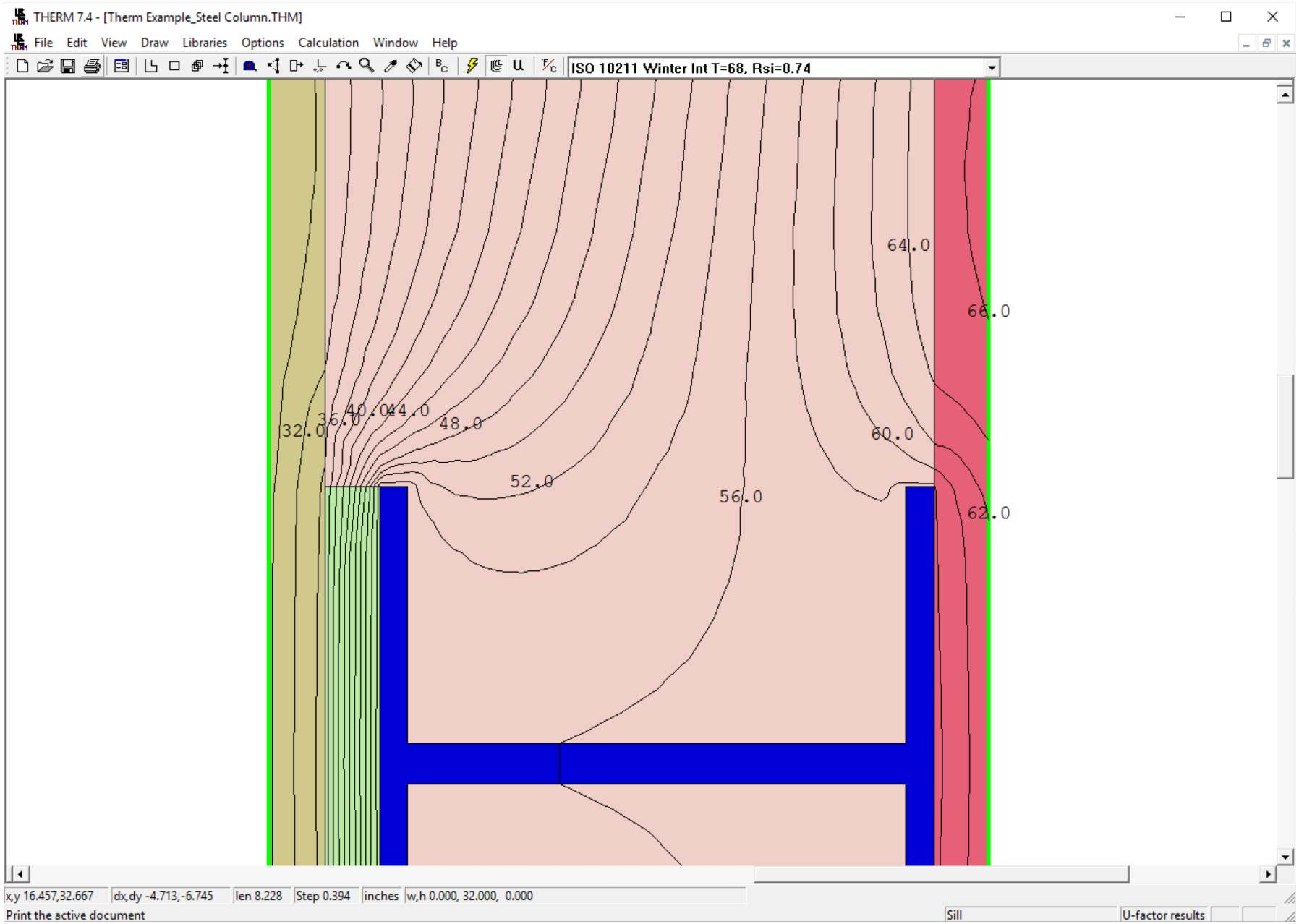
We're seeing 'Isolines' that describe the temperature gradient through the assembly.

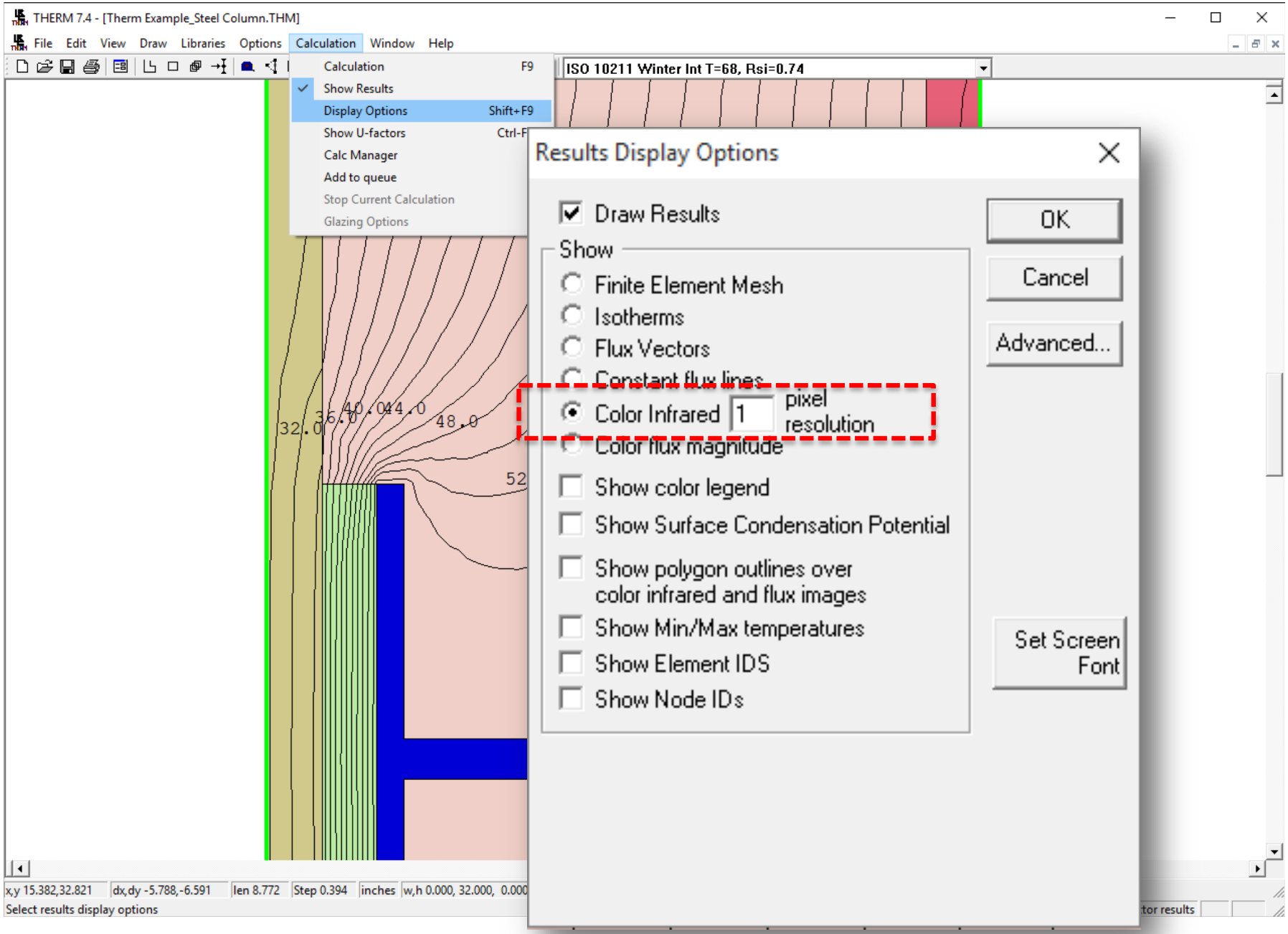

THERM 7.4 - [Therm Example_Steel Column.THM]
File Edit View Draw Libraries Options Calculation Window Help
ISO 10211 Winter Int T=68, Rsi=0.74
28.8
34.4
39.9
45.4
50.9
56.4
61.9
x,y 15.106,32.738
dx,dy -6.063,-6.674
len 9.017
Step 0.394
inches
w,h 0.000, 32.000, 0.000
Ready
Sill
U-factor results



AIA New York CENTER FOR ARCHITECTURE

bldgtyp


THERM 7.4 - [Therm Example_Steel Column.THM]
File Edit View Draw Libraries Options Calculation Window Help
ISO 10211 Winter Int T=68, Rsi=0.74
64.0
66.0
32.0
36.0
40.0
44.0
48.0
52.0
56.0
60.0
62.0
x,y 16.457,32.667
dx,dy -4.713,-6.745
len 8.228
Step 0.394
inches
w,h 0.000, 32.000, 0.000
Print the active document
Sill
U-factor results



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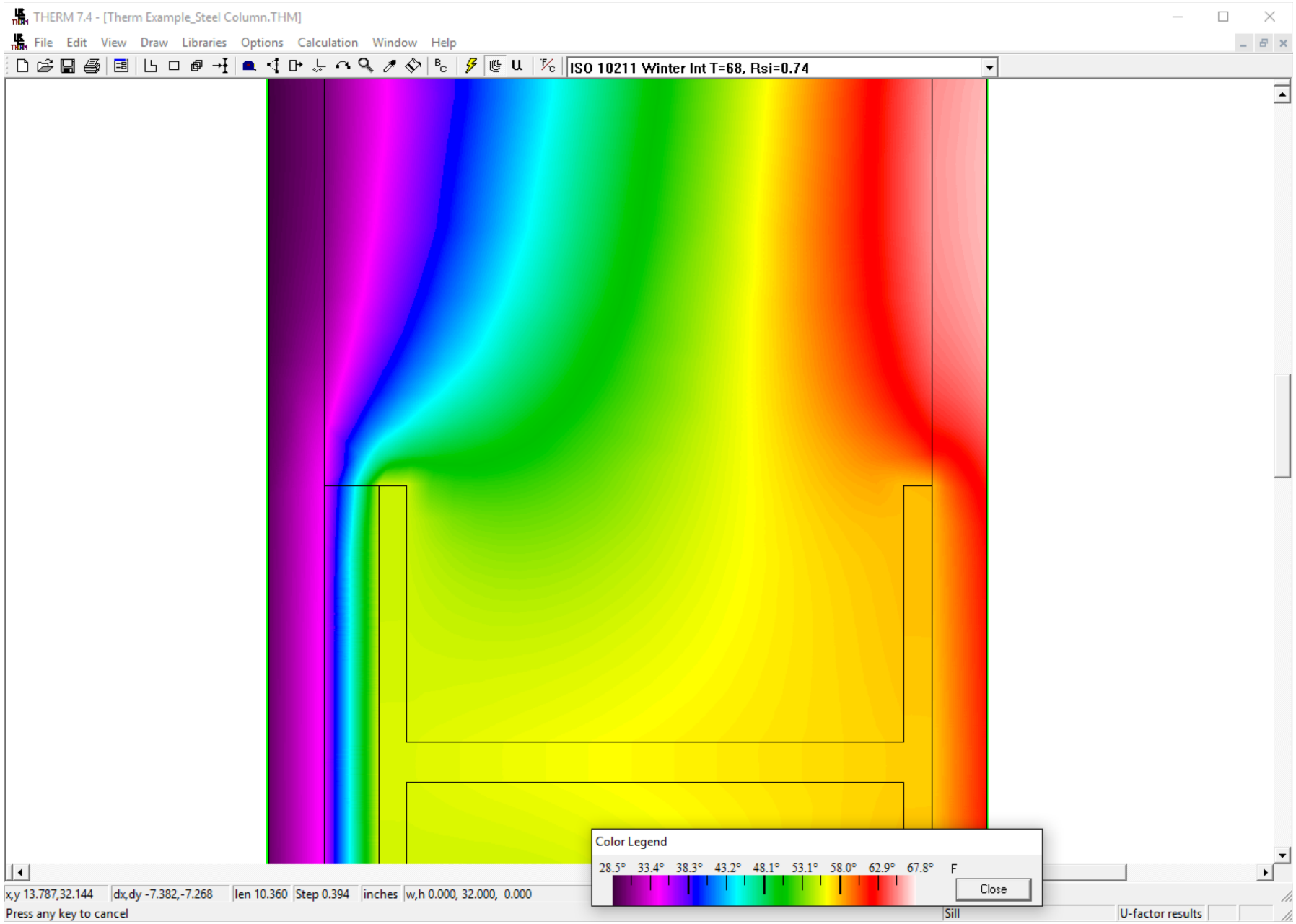
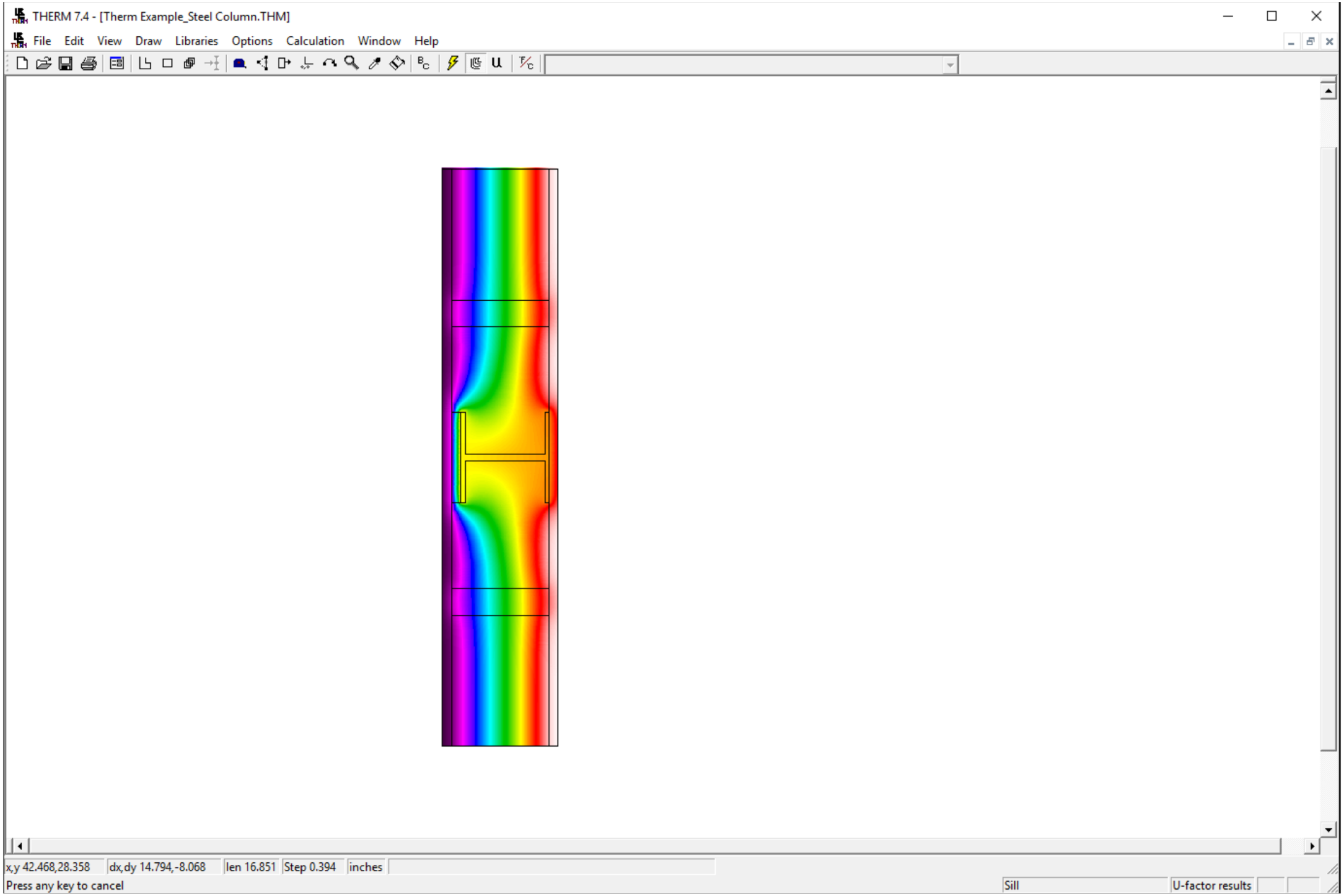
bldgtyp


THERM 7.4 - [Therm Example_Steel Column.THM]
File Edit View Draw Libraries Options Calculation Window Help
ISO 10211 Winter Int T=68, Rsi=0.74
Color Legend
28.5° 33.4° 38.3° 43.2° 48.1° 53.1° 58.0° 62.9° 67.8° F
Close
x,y 13.787,32.144
dx,dy -7.382,-7.268
len 10.360
Step 0.394
inches
w,h 0.000, 32.000, 0.000
Press any key to cancel
Sill
U-factor results


THERM 7.4 - [Therm Example_Steel Column.THM]
File Edit View Draw Libraries Options Calculation Window Help
x,y 42.468,28.358
dx,dy 14.794,-8.068
len 16.851
Step 0.394
inches
Press any key to cancel
Sill
U-factor results