## Roof Insulation

### Description

Set the R-Value of roof insulation to a specified value. Higher R-Values provide better insulation, lowering heat loss and heat gain through the roof.

### Modeler Description

Set the R-Value (ft^2\*h\*R/Btu) of the insulation material layer in all roofs in the model to a specified value. Find constructions used for roofs, make copies of these and assign them to the appropriate construction sets or surfaces. Identify which layer of the construction is the insulation layer. This could be a Material, No Mass Material, or Air Gap Material. If the Insulation layer is “Material” the thickness will be changed to attain the desired R-Value. If the insulation layer is “No Mass Material” or “Air Gap Material” the Thermal Resistance will be directly entered. If the construction doesn't appear to have an insulation layer, it will not be altered. Surfaces with "Adiabatic" boundary conditions are not specifically assumed to be interior or exterior. As a result constructions used on "Adiabatic" surfaces will not be altered. Constructions used on attic floors will not be altered.

### Use Case Types

New, Retrofit, Calibration

### Arguments

“R-Value (ft^2\*h\*R/Btu)” default(30.0)

### Initial Condition

This building had $NUM\_ROOF\_CONS$ type of roof construction; $ROOF\_CON1$ (R-$Roof\_con\_1\_R-val$), [repeat for all constructions; round R-Value to 1 decimal].

### Final Condition

The existing insulation for all roof constructions was modified to be $new\_ins\_R\_val$. This was applied to $SQFT$ of roof. After the change, the building had $num\_roof\_cons$ roof constructions; $ROOF\_CON1$ (R-$Roof\_con\_1\_R-val$), [repeat for all constructions; round R-Value to 1 decimal].

### Not Applicable

This model has no roofs. DefaultConstructionSets may have been altered, but since there are no roof surfaces this won’t impact the simulation.

### Info

### Warning

Requested insulation R-Value greater than 60 ft^2\*h\*R/Btu.

Requested insulation R-Value less than 1 ft^2\*h\*R/Btu.

Construction ’#{construction}’ does not appear to have an insulation later and will not be altered.

### Error

0 < R-Value < 500 ft^2\*h\*R/Btu

### Code Outline

* Loop through all DefaultConstructionSets
* Skip sets that are not used anywhere in the model
* Look for sets with a construction assigned for exterior roofs
* If found clone the construction and assign the clone to the construction set in place of the original construction.
* Send min and max R-Value for starting construction to initial condition.
* Append name of cloned construction with “\_alt\_roof\_Insulation”
* Add Construction to array named “used\_on\_roof” if it hasn’t already been added
  + I don’t’ want any constructions showing more than once.
* Loop through exterior roofs looking for any hard assigned constructions.
* If found clone the construction and assign the clone to the surface in place of the original construction.
* Send min and max R-Value for starting construction to initial condition.
* Append name of cloned construction with “\_alt\_roof\_Insulation”
* Add to “used\_on\_roof” if not already in it.
* Loop through “used\_on\_roof” array.
* Infer what layer is insulation using the following logic.
  + Find Material with highest R-Value
    - For No Mass and Air Gap there is a field for this.
    - For Material will need to look at thickness to calculate R-value
  + If highest R-value material has too low of a value then issue warning and don't alter this construction.
* Clone material and assign clone to construction.
* Append name of material with R-Value from argument
* Modify insulation layer R-value
  + If Material is No Mass or Air Gap then can directly edit the Thermal Resistance Field.
  + If Material is Material then alter thickness to attain proper R-Value.