6.5 Building Envelope Data

6.5.1 Materials

Energy simulation programs commonly define construction assemblies by listing a sequence of materials that make up that construction assembly. Appendix D has a list of standard materials that may be referenced by construction assemblies. Additional materials not listed in Appendix D may be defined as described below. Alternate methods may be used to define construction assemblies such as specifying the U-factor and optionally, a metric describing thermal mass such as *heat capacity* (HC). These alternate methods may not require identification of materials. When a material is defined, all of the properties listed below must be defined. Some materials listed in Appendix D are non-homogeneous, for instance, framing members with insulation in the cavity.

Material Name	
Applicability	When construction assemblies reference materials that are not standard
Definition	The name of a construction material used in the exterior envelope of the building
Units	Text, unique
Input Restrictions	Material name is a required input for materials not available from the standard list. The user may not modify entries for predefined materials.
Baseline Rules	Not applicable
Density	
Applicability	All non-standard materials
Definition	The density (or mass per unit of volume) of the construction material as documented in an ASHRAE handbook, a comparably reliable reference, or manufacturers' literature.
Units	Numeric input: lb/ft3
Input Restrictions	Density is a required input when non-standard materials are specified.
Baseline Rules	Not applicable
Specific Heat	
Applicability	All non-standard materials
Definition	The specific heat capacity of a material is numerically equal to the quantity of heat that must be supplied to a unit mass of the material to increase its temperature by 1 degree F.
Units	Btu/lb•°F
Input Restrictions	Specific heat is a required input when non-standard materials are specified. The specific heat capacity of the construction material as documented in an ASHRAE handbook, a comparably reliable reference, or manufacturers' literature.
Baseline Rules	Not applicable
Thermal Conductivity	
Applicability	All non-standard materials
Definition	The thermal conductivity of a material of unit thickness is numerically equal to the quantity of heat that will flow through a unit area of the material when the temperature difference through the material is 1 degree F.
Units	Btu/h•ft•°F
Input Restrictions	Thermal conductivity is a required input for non-standard materials.
Baseline Rules	Not applicable
Thickness	
Applicability	All non-standard materials
Definition	The thickness of a material
Units	ft or in. (cm)
Input Restrictions	Thickness is a required input for non-standard materials. The user shall document the data source for thermal conductivity used for additional materials under the *material name* descriptor.
Baseline Rules	Not applicable

6.5.2 Construction Assemblies

Assembly Name	
Applicability	All projects

Definition	The name of a construction assembly that describes a roof, wall, or floor assembly. The name generally needs to be unique so it can be referenced precisely by surfaces.
Units	Text, unique
Input Restrictions	Construction name is a required input.
Baseline Rules	Not applicable
Specification Method	
Applicability	All projects
Definition	The method of describing a construction assembly. The more simple method is to describe the U-factor of the construction assembly which can account for thermal bridging and other factors. However with this method, the time delay of heat transfer through the construction assembly is not accounted for. Generally, with the U-factor method, heat transfer is assumed to occur instantly. The more complex method is to describe the construction assembly as a series of layers, each layer representing a material. With this method, heat transfer is delayed in accord with the thermal mass and other properties of the assembly.
Units	List: choices are U-factor or Layers
Input Restrictions	The layers method shall be used for all constructions except for metal building or similar constructions with negligible thermal mass.
Baseline Rules	For each construction, the proposed design specification method shall be used.
U-factor	
Applicability	All construction assemblies that are specified by a U-factor
Definition	The steady state rate of heat transfer through a construction assembly
Units	Btu/h-ft²-°F
Input Restrictions	U-factors should be consistent with values in Appendix A of ASHRAE Standard 90.1-2007.
Baseline Rules	Not applicable
Layers	
Applicability	All construction assemblies that use the layers method of specification
Definition	A structured list of pairs of material names that describe a construction assembly, beginning with exterior finish and progressing through to the interior finish. Material names must be from the standard list (Appendix E) or defined (see above).
Units	Data structure: construction assembly
Input Restrictions	The user is required to describe all layers in the actual roof assembly and the proposed design will be modeled as input by the user.
Baseline Rules	See building descriptors for roofs, walls, and floors.
U-factor Derating Factor	
Applicability	All construction assemblies that use the layers method of specification
Definition	A derating factor to account for thermal bridges and other non-homogeneous construction features. The factor is a multiplier on the U-factor such that a value greater than one increases heat losses and gains. The layers method assumes that all layers are completely homogeneous and that there are no thermal bridges or other features that would increase heat gain or loss.
Units	Unitless
Input Restrictions	Default is 1.2 (120%). Minimum value is 1.0 and maximum value is 3.0.
Baseline Rules	The baseline building shall use a derating factor of 1.0, e.g. no derating.

6.5.3 Roofs

Roof Name	
Applicability	All roof surfaces
Definition	A unique name or code that identifies the roof and ties it to the construction documents submitted for energy code review. It is not mandatory to name roofs.
Units	Text, unique
Input Restrictions	None
Baseline Rules	None
Roof Type	
Applicability	All roof surfaces
Definition	One of three classifications of roofs defined in the baseline standard. These classifications are defined in ASHRAE Standard 90.1-2001 and ASHRAE Standard 90.1-2007 along with the associated User's Manuals. The prescriptive U-factor requirements for roofs depend on the type. For green building ratings and tax credits, it is not necessary to specify this information, as the PRM fixes the type for the baseline building to “insulation entirely above the deck.” This descriptor can be derived from other building descriptors and it may not be necessary for the software user to specify it directly.
Units	List: attic and other roofs; metal building roofs; and roofs with insulation entirely above deck.
Input Restrictions	This input is optional for the purposes covered by this manual.
Baseline Rules	All roofs in the baseline building are modeled as “insulation entirely above deck.”

Roof Geometry

Applicability	All roofs, required input
Definition	Roof geometry defines the position, orientation, azimuth, tilt, and dimensions of the roof surface. The details of how the coordinate system is implemented may vary between software programs. The data structure for surfaces is described in the reference section of this chapter.
Units	Data structure: surface
Input Restrictions	There are no restrictions other than that the surfaces defined must agree with the building being modeled, as represented on the construction drawings or as-built drawings.
Baseline Rules	Roof geometry will be identical in the proposed and baseline building designs.

Roof Construction

Applicability	All roofs, required input
Definition	A reference to a construction assembly for the proposed design. See the building descriptors above for construction assemblies.
Units	Dimensionless reference
Input Restrictions	All roof surfaces must reference a construction assembly.
Baseline Rules	Roofs in the baseline building are of the type “insulation entirely above deck.” The insulation requirement is determined by climate zone and is given in Table 6.5.3-1 [1]. The baseline building roof construction shall be modeled as layers as defined in Table 6.5.3-2 [2]. These tables reflect a construction that is available in the standard list of constructions.

Table 6.5.3-1: *"Baseline Building R-value and U-factor Criteria for Roofs"*

Applicable Standard	Space Category	Climate Zone	Standard Design	
			Minimum Insulation	Maximum Assembly
90.1 – 2001	Nonresidential	1-7	R-15 c.i.	U-0.063
		8	R-20 c.i.	U-0.048
	Residential	1,2,3,4,5,6,7	R-15 c.i.	U-0.063
		8	R-20 c.i.	U-0.048
	Semi-Heated	1	NR	U-1.282
		2,3,4	R-3.8 c.i.	U-0.218
		5,6,7	R-5.0 c.i.	U-0.173
		8	R-10.0 c.i.	U-0.093
90.1 – 2007 and 90.1 – 2010	Nonresidential	1	R-15 c.i.	U-0.063
		2-8	R-20 c.i.	U-0.048
	Residential	1-8	R-20 c.i.	U-0.048
	Semi-Heated	1, 2	R-3.8 c.i.	U-0.218
		3, 4	R-5.0 c.i.	U-0.173
		5	R-7.6 c.i	U-0.119
		6,7	R-10.0 c.i.	U-0.093
		8	R-15.0 c.i.	U-0.063

Table 6.5.3-2: *"Baseline Building Roof Construction Assemblies"*

Construction	Layer	Thickness (inch)	Conductivity (Btu/h ft F)	Density (lb/ft²)	Specific Heat (Btu/lb F)	R-value (ft²·°F·h/Btu)	U-factor (Btu/h-ft²-F)
Roof R-20 c.i.	Exterior air film					0.17	
	Roofing membrane					0.00	
	R-20 continuous insulation	4.8	0.02	1.8	0.29	20.00	
	Steel deck	0.06	26	480	0.10	0.00	
	Interior air film					0.61	
	Total for assembly					20.78	0.048
Roof R-15 c.i.	Exterior air film					0.17	
	Roofing membrane					0.00	
	R-15 continuous insulation	3.6	0.02	1.8	0.29	15.00	
	Steel deck	0.06	26	480	0.10	0.00	
	Interior air film					0.61	
	Total for assembly					15.78	0.063
Roof R-10 c.i.	Exterior air film					0.17	
	Roofing membrane					0.00	
	R-10 continuous insulation	2.4	0.02	1.8	0.29	10.00	

	[illegible]						
	Steel deck	0.06	26	480	0.10	0.00	
	Interior air film					0.61	
	Total for assembly					10.78	0.093
Roof R-7.6 c.i.	Exterior air film					0.17	
	Roofing membrane					0.00	
	R-7.6 continuous insulation	1.8	0.02	1.8	0.29	7.6	
	Steel deck	0.06	26	480	0.10	0.00	
	Interior air film					0.61	
	Total for assembly					8.38	0.119
Roof R-5 c.i.	Exterior air film					0.17	
	Roofing membrane					0.00	
	R-5 continuous insulation	1.2	0.02	1.8	0.29	5.00	
	Steel deck	0.06	26	480	0.10	0.00	
	Interior air film					0.61	
	Total for assembly					5.78	0.173
Roof R-3.8 c.i.	Exterior air film					0.17	
	Roofing membrane					0.00	
	R-3.8 continuous insulation	0.9	0.02	1.8	0.29	3.80	
	Steel deck	0.06	26	480	0.10	0.00	
	Interior air film					0.61	
	Total for assembly					4.58	0.218
NR.	Exterior air film					0.17	
	Roofing membrane					0.00	
	Steel deck	0.06	26	480	0.10	0.00	
	Interior air film					0.61	
	Total for assembly					5.78	1.282

Exterior Roof Surface Properties

Applicability	All roofs
Definition	The exterior roof surface properties descriptor defines the characteristics of exterior surfaces. Exterior surface properties include emissivity, reflectivity and roughness. The first two govern radiation exchange from the surface, while the latter governs the magnitude of the exterior air film resistance.
Units	Data structure: exterior surface properties
Input Restrictions	The default value is a reflectance of 0.30 and an emittance of 0.75. The default value may be overridden when roof materials are used that have been tested by the Cool Roof Rating Council (CRRC) and are called for in the construction documents. In cases where the default value is overridden, the user is required to submit documentation identifying the test procedure that was used to establish the non-default values.
Baseline Rules	The default values (see Input Restrictions above) shall be used for roofs for the baseline building.

6.5.4 Exterior Walls

Wall Name

Applicability	All walls, optional input
Definition	A unique name or code that relates the exterior wall to the design documents. This is an optional input since there are other acceptable ways to key surfaces to the construction documents.
Units	Text, unique
Input Restrictions	None
Baseline Rules	None

Wall Type

Applicability	All wall surfaces, optional
Definition	One of four categories of above-grade wall assemblies used to determine minimum insulation requirements for walls. The four wall type categories are as follows: a) mass walls, b) metal building walls, c) metal framing walls, and d) wood framing and other walls. These wall types are defined in the baseline standards and the associated User's Manuals. The prescriptive criteria of the baseline standards depend on the wall type, but for green building ratings and tax deduction calculations, the PRM specifies that all baseline walls shall be “metal framed” so the input is not used for the purposes of this manual.
Units	List: mass walls, metal building walls, metal framing walls, and wood framing and other walls
Input Restrictions	This input is optional for the purposes covered by this manual. This input can often be derived from other inputs and may not need to be explicitly specified.
Baseline Rules	[illegible]

Baseline Rules	All walls in the baseline building are modeled as "metal framed."

Wall Geometry

Applicability	All walls, required input
Definition	Wall geometry defines the position, orientation, azimuth, and tilt of the wall surface. The details of how the coordinate system is implemented may vary between simulation engines. The data structure for surfaces is described in the reference section of this chapter.
Units	Data structure: surface
Input Restrictions	There are no restrictions other than that the surfaces defined must agree with the building being modeled, as represented on the construction drawings or as-built drawings.
Baseline Rules	Wall geometry in the baseline building is identical to the proposed design.

Wall Construction

Applicability	All walls, required input
Definition	A reference to a construction assembly for the proposed design. See the building descriptors above for construction assemblies.
Units	Dimensionless reference
Input Restrictions	All wall surfaces must reference a construction assembly that meets the mandatory requirements of the appropriate baseline standard.
Baseline Rules	Walls in the baseline building are all of the type "metal framed". The insulation requirement is determined by the baseline standard and climate zone and is given in Table 6.5.4-1 [3]. The baseline building construction shall be modeled as layers as defined in Table 6.5.4-2 [4].

Table 6.5.4-1: *"Baseline Building R-value and U-factor Criteria for Walls"*

Applicable Standard	Space Category	Climate Zone	Standard Design	
			Minimum Insulation	Maximum Assembly
90.1 - 2001	Nonresidential	1-4	R-13	U-0.124
		5,6	R-13 + R-3.8 c.i.	U-0.084
		7,8	R-13 + R-7.5 c.i.	U-0.064
	Residential	1,2	R-13	U-0.124
		3	R-13 + R-3.8 c.i.	U-0.084
		4- 7	R-13 + R-7.5 c.i.	U-0.064
		8	R-13 + 10.0 c.i.	U-0.055
	Semi-Heated	1- 3	NR	U-0.352
		4 - 8	R-13	U-0.124
90.1 - 2007	Nonresidential	1,2	R-13	U-0.124
		3	R-13 + R-3.8 c.i.	U-0.084
		4-8	R-13 + R-7.5 c.i.	U-0.064
	Residential	1	R-13	U-0.124
		2-6	R-13 + R-7.5 c.i.	U-0.064
		7	R-13 +15.6 c.i.	U-0.042
		8	R-13 + R-18.8 c.i.	U-0.037
	Semi-Heated	1	NR	U-0.352
		2-7	R-13	U-0.124
		8	R-13 + R-3.8 c.i.	U-0.084

Table 6.5.4-2: *"Baseline Building Wall Construction Assemblies"*

Construction	Layer	Thickness (inch)	Conductivity (Btu/h ft F)	Density (lb/ft²)	Specific Heat (Btu/lb F)	R-value (ft²·°F·h/ Btu)	U-factor (Btu/ ft²·°F·h)
Wall R-13 + R-18.8	Air film					0.17	
	Stucco	0.400	0.4167	116	0.2	0.08	
	R-18.8 continuous insulation	1.800	0.0200	1.8	0.29	18.8	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	R-13 insulation/steel framing					6.00	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	Interior air film					0.68	
	Total for assembly					26.85	0.037
Wall R-13 + R-15.6	Air film					0.17	

15.6	Stucco	0.400	0.4167	116	0.2	0.08	
	R-15.6 continuous insulation	1.800	0.0200	1.8	0.29	15.6	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	R-13 insulation/steel framing					6.00	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	Interior air film					0.68	
	Total for assembly					23.65	0.042
Wall R-13 + R-10.0	Air film					0.17	
	Stucco	0.400	0.4167	116	0.2	0.08	
	R-10.0continuous insulation	1.800	0.0200	1.8	0.29	10.0	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	R-13 insulation/steel framing					6.00	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	Interior air film					0.68	
	Total for assembly					18.05	.055
Wall R-13 + R-7.5	Air film					0.17	
	Stucco	0.400	0.4167	116	0.2	0.08	
	R-7.5 continuous insulation	1.800	0.0200	1.8	0.29	7.50	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	R-13 insulation/steel framing					6.00	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	Interior air film					0.68	
	Total for assembly					15.55	0.64
Wall R-13 + R-3.8	Air film					0.17	
	Stucco	0.400	0.4167	116	0.2	0.08	
	R-3.8 continuous insulation	0.912	0.0200	1.8	0.29	3.80	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	R-13 insulation/steel framing					6.00	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	Interior air film					0.68	
	Total for assembly					11.85	0.84
Wall R-13	Air film					0.17	
	Stucco	0.400	0.4167	116	0.2	0.08	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	R-13 insulation/steel framing					6.00	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	Interior air film					0.68	
	Total for assembly					199.95	0.124
Wall R-13	Air film					0.17	
	Stucco	0.400	0.4167	116	0.2	0.08	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	Cavity/steel framing					0.79	
	Gypsum board	0.625	0.0930	50	0.2	0.56	
	Interior air film					0.68	
	Total for assembly					2.84	3.52

Exterior Wall Surface Properties

Applicability All walls

Definition

The exterior wall surface properties descriptor describes the characteristics of exterior wall surfaces. Exterior surface properties may include emissivity, reflectivity and roughness. The first two govern radiation exchange from the surface, while the latter governs the magnitude of the exterior air film resistance.

The descriptor is a critical default structure input, applicable to all models. Critical defaults require documentation to change. Data structures are outlined in the reference data structures section of this chapter.

Units Data structure: exterior surface properties

Input Restrictions The default value for emittance is 0.90. The default value for reflectance is 0.30. There is no default for roughness. The

	default values may be overridden only in cases when the lower reflectance can be documented by manufacturers' literature or tests.
Baseline Rules	The baseline building shall use default values for emittance and reflectance. The roughness of the baseline building walls shall be identical to the proposed design.

6.5.5 Exterior Floors

Floor Name	
Applicability	All floor surfaces
Definition	A unique name or code that relates the exposed floor to the design documents. Exposed floors include floors exposed to the outdoors and floors over unconditioned spaces, but do not include slab-on-grade floors, below grade floors, or interior floors.
Units	Text, unique
Input Restrictions	None
Baseline Rules	None
Floor Type	
Applicability	All exterior floor surfaces, optional
Definition	One of three categories of exposed floor assemblies used to determine minimum prescriptive insulation requirements. The three floor type categories are: a) mass floor, b) steel joist floor, and c) wood and other floors. Definitions of these three exterior floor types are contained in Section 3.2, *Definitions*, of the baseline standard and associated User's Manuals. This building descriptor is not used for the purposes of this manual, since the type for the baseline building is fixed at "steel joist". This building descriptor can often be derived from other information in the model and may not be required as an explicit input.
Units	List: mass floor, metal joist floor, and wood and other floors
Input Restrictions	This building descriptor input is optional for the purposes of this manual.
Baseline Rules	The baseline building floors shall be of type "steel joist."
Floor Geometry	
Applicability	All exterior floors, required input
Definition	Floor geometry defines the position, orientation, azimuth, and tilt of the floor surface. The details of how the coordinate system is implemented may vary between software programs. The data structure for surfaces is described in the reference section of this chapter.
Units	Data structure: surface
Input Restrictions	There are no restrictions other than that the surfaces defined must agree with the building being modeled, as represented on the construction documents or as-built drawings.
Baseline Rules	Baseline building floor geometry is identical to the proposed design.
Floor Construction	
Applicability	All floors, required input
Definition	A reference to a construction assembly for the proposed design
Units	Dimensionless reference
Input Restrictions	All floor surfaces must reference a construction assembly that meets the mandatory measures of the baseline standards.
Baseline Rules	Exterior floors in the baseline building are of type "steel joist." The insulation requirements depend on the baseline standard and the climate zone and are given in Table 6.5.5-1 [5]. The baseline building constructions shall be modeled as layers, which are defined in Table 6.5.5-2 [6].

Table 6.5.5-1: *"Baseline Building R-value and U-factor Criteria for Exposed Floors"*

Applicable Standard	Space Category	Climate Zone	Standard Design	
			Minimum Insulation	Maximum Assembly
90.1 - 2001	Nonresidential	1	NR	U-0.350
		2-5	R-19	U-0.052
		6-8	R-30	U-0.038
	Residential	1	NR	U-0.350
		2, 3	R-19	U-0.052
		4- 7	R-30	U-0.038
		8	R-38	U-0.032
	Semi-Heated	1, 2	NR	U-0.350
		3- 6	R-13	U-0.069
		7, 8	R-19	U-0.052
90.1 - 2007	Nonresidential	1	NR	U-0.350
		2,3	R-19	U-0.052

	4-7	R-30	U-0.038
	8	R-38	U-0.032
Residential	1	NR	U-0.350
	2,3	R-19	U-0.052
	4,5	R-30	U-0.038
	6-8	R-38	U-0.032
Semi-Heated	1	NR	U-0.350
	2-4	R-13	U-0.069
	5-8	R-19	U-0.052

Table 6.5.5-2: *"Baseline Building Exposed Floor Construction Assemblies"*

Construction	Layer	Thickness (inch)	Conductivity (Btu/h ft F)	Density (lb/ft²)	Specific Heat (Btu/lb F)	R-value (ft²·°F·h/Btu)	U-factor (Btu/ft²·°F·h)
Floor R-38	Interior air film (flow down)	-	-	-	-	0.92	-
	carpet and pad	-	-	-	-	1.23	-
	4" concrete	4	1.3333	140	0.2	0.25	-
	R-38 insulation between joists	-	-	-	-	28	-
	metal deck	0.06	26	480	0.1	0.00	-
	Semi-exterior air film	-	-	-	-	0.46	-
	Total for assembly					30.86	0.032
Floor R-30	Interior air film (flow down)	-	-	-	-	0.92	-
	carpet and pad	-	-	-	-	1.23	-
	4" concrete	4	1.3333	140	0.2	0.25	-
	R-30 insulation between joists	-	-	-	-	23.5	-
	metal deck	0.06	26	480	0.1	0.00	-
	Semi-exterior air film	-	-	-	-	0.46	-
	Total for assembly					26.36	0.038
Floor R-19	Interior air film (flow down)	-	-	-	-	0.92	-
	carpet and pad	-	-	-	-	1.23	-
	4" concrete	4	1.3333	140	0.2	0.25	-
	R-19 insulation between joists	-	-	-	-	16.37	-
	metal deck	0.06	26	480	0.1	0.00	-
	Semi-exterior air film	-	-	-	-	0.46	-
	Total for assembly					19.23	0.052
Floor R-13	Interior air film (flow down)	-	-	-	-	0.92	-
	carpet and pad	-	-	-	-	1.23	-
	4" concrete	4	1.3333	140	0.2	0.25	-
	R-13 insulation between joists	-	-	-	-	11.63	-
	metal deck	0.06	26	480	0.1	0.00	-
	Semi-exterior air film	-	-	-	-	0.46	-
	Total for assembly					14.49	0.069
Floor -no insulation	Interior air film (flow down)	-	-	-	-	0.92	-
	Carpet and pad	-	-	-	-	1.23	-
	4" concrete	4	1.3333	140	0.2	0.25	-
	Metal deck	0.06	26	480	0.1	0.00	-
	Semi-exterior air film	-	-	-	-	0.46	-
	Total for assembly					2.86	0.350

6.5.6 Doors

Door Name	
Applicability	All doors, optional input
Definition	A unique name or code that relates the door to the design documents submitted. Doors that are more than 50% glass are treated as windows and must be entered by the user using the windows building descriptors.
Units	Text, unique

Units	Text, unique
Input Restrictions	None
Baseline Rules	None

Door Type

Applicability	All doors, required input
Definition	The baseline standards classify doors as either: swinging or non-swinging. Non-swinging are generally roll-up doors. The prescriptive U-factor requirements depend on the door type so this input affects the baseline building criteria. The door types are described in greater detail in the baseline standards and the associated User's Manuals. This building descriptor may be derived from other building descriptors, in which case a specific input is not necessary.
Units	List: swinging or non-swinging
Input Restrictions	The door type shall be consistent with the type of door represented on the construction documents or as-built drawings.
Baseline Rules	The baseline building door type shall be the same as the proposed design.

Door Geometry

Applicability	All doors
Definition	Door geometry defines the position and dimensions of the door surface relative to its parent wall surface. The azimuth and tilt (if any) of the door is inherited from the parent surface. The position of the door within the parent surface is specified through X,Y coordinates. The size is specified as a height and width (all doors are generally assumed to be rectangular in shape). The details of how the geometry of doors is specified may vary for each energy simulation program.
Units	Data structure: opening
Input Restrictions	No restrictions, other than that the inputs shall agree with the construction documents or as-built drawings.
Baseline Rules	Door geometry in the baseline building is identical to the proposed design.

Door U-factor

Applicability	All doors
Definition	The thermal transmittance of the door, including the frame.
Units	Btu/h•ft•°F
Input Restrictions	Door U-factors shall be taken from the default values in Appendix A of ASHRAE Standard 90.1-2001 or ASHRAE Standard 90.1-2007, or shall be obtained from NFRC test procedures.
Baseline Rules	The door U-factor in the baseline building depends on the baseline standard, the climate zone and the type of door (swinging or non-swinging). Use values from Table 6.5.6-1 [7].

Table 6.5.6-1: *"Baseline Building U-factor Criteria for Doors"*

Applicable Standard	Swinging or Non-swinging	Climate Zone	Space Category		
			Nonresidential	Residential	Semi-Heated
ASHRAE Standard 90.1 - 2001	Swinging	1- 5	0.700	0.700	0.700
		6, 7	0.700	0.500	0.700
		8	0.500	0.500	0.700
	Non-swinging	1, 2	1.450	1.450	1.450
		3- 5	1.450	0.500	1.450
		6- 8	0.500	0.500	1.450
ASHRAE Standard 90.1 - 2007	Swinging	1- 4	0.700	0.700	0.700
		5, 6	0.700	0.500	0.700
		7, 8	0.500	0.500	0.700
	Non-swinging	1	1.450	1.450	1.450
		2, 3	1.450	0.500	1.450
		4	1.500	0.500	1.450
		5- 7	0.500	0.500	1.450

6.5.7 Fenestration

Note that fenestration includes windows, doors that have more than 50% glazed area, and skylights. A skylight is fenestration that has a tilt of less than 60° from horizontal.

Fenestration Name

Applicability	All fenestration, optional input
Definition	A unique name or code that relates the fenestration to the design documents and a parent surface.
Units	Text, unique
Input Restrictions	No restrictions
Baseline Rules	Not applicable

Fenestration Type (Vertical Fenestration)

Applicability	All vertical fenestration
Definition	This is a classification of vertical fenestration that determines the thermal performance and solar performance requirement for vertical fenestration.
Units	List (ASHRAE Standard 90.1-2007): Nonmetal framing (all); metal framing (curtainwall/storefront); metal framing (entrance door); or metal framing (all other) List (ASHRAE Standard 90.1-2001): Fixed or Operable
Input Restrictions	No restrictions, other than that the vertical fenestration type must agree with the type specified on the construction documents or the as-built drawings.
Baseline Rules	Same as the proposed design

Fenestration Type (Skylights)

Applicability	All skylights
Definition	This is a classification of skylights that determines the thermal performance and solar performance requirement for vertical fenestration.
Units	List: Glass skylight with curb; plastic skylight with curb; or skylights with no curb
Input Restrictions	No restrictions, other than the skylight types specified must agree with the construction documents or the as-built drawings.
Baseline Rules	Same as the proposed design

Fenestration Geometry

Applicability	All fenestration
Definition	Fenestration geometry defines the position and dimensions of the fenestration surface within its parent surface and the identification of the parent surface. The orientation and tilt is inherited from the parent surface. The details of how the coordinate system is implemented may vary between rating software programs.
Units	Data structure: opening
Input Restrictions	There are no restrictions, other than a match with the construction drawings or as-built drawings. Specification of the fenestration position within its parent surface is required for the following conditions: 1) exterior shading is modeled from buildings, vegetation, other objects; or 2) if daylighting is modeled within the adjacent space.
Baseline Rules	The geometry of the fenestration shall be identical to the proposed design with the following exceptions: • If the gross area of all windows in the building exceeds 40% of the gross above-grade exterior wall area in the building, the dimensions of each window in the baseline building shall be reduced in size such that the window area in the baseline building is equal to 40% of the above-grade exterior wall area. • If the gross area of skylights in the building exceeds 5% of the gross roof area, the dimensions of each skylight shall be reduced in size such that the skylight area in the proposed design is equal to 5% of the gross roof area.

Fenestration Construction

Applicability	All fenestration
Definition	A collection of values that together describe the performance of a fenestration system. The values that are used to specify the criteria are U-factor, SHGC and VT . Data may be specified in other ways, however, as long as the data are supported by appropriate tests.
Units	Data structure: fenestration construction
Input Restrictions	Performance information for fenestration shall be developed from NFRC test procedures or shall be taken from the default values in Appendix A of the baseline standard. Values entered shall be consistent with the specifications and the construction documents.
Baseline Rules	The requirements for vertical fenestration U factor, Solar Heat Gain Coefficient, and Visible light transmission by climate zone and framing type are found in Table 6.5.7-1 [8] and for skylight inputs in Table 6.5.7-2 [9]. In cases where there is no requirement (NR) for SHGC or VT, the baseline building shall be equal to the proposed design.

Table 6.5.7-1: *"Baseline Building Criteria for Vertical Glazing for 90.1 2001"*

Building type	Climate Zone	Window to Wall Ratio	Standard Design					
			Assembly U-factor		Assembly SHGC		Assembly VT	
			Fixed	Operable	All	North	All	North
Nonresidential	1	0-30.0%	1.22	1.27	0.25	0.61	0.25	0.61
		30.1-40.0%	1.22	1.27	0.25	0.44	0.25	0.44
	2	0-40.0%	1.22	1.27	0.25	0.61	0.25	0.61
	3(A,B)	0-10.0%	0.57	0.67	0.39	0.49	0.39	0.49
		10.1-20.0%	0.57	0.67	0.25	0.49	0.25	0.49
		20.1-40.0%	0.57	0.67	0.25	0.39	0.25	0.39
	3(C)	0-10.0%	1.22	1.27	0.61	0.82	0.61	0.82
		10.1-40.0%	1.22	1.27	0.39	0.61	0.39	0.61

	4	0-40.0%	0.57	0.67	0.39	0.49	0.50	0.62
	5	0-10.0%	0.57	0.67	0.49	0.49	0.62	0.62
		10.1-40.0%	0.57	0.67	0.39	0.49	0.50	0.62
	6	0-10.0%	0.57	0.67	0.49	0.49	0.62	0.62
		10.1-40.0%	0.57	0.67	0.39	0.49	0.50	0.62
	7	0-40.0%	0.57	0.67	0.49	0.64	0.49	0.64
	8	0-40.0%	0.46	0.47	NR	NR	NR	NR
Residential	1	0-30.0%	1.22	1.27	0.25	0.61	0.25	0.61
		30.1-40.0%	1.22	1.27	0.25	0.44	0.25	0.44
	2	0-10.0%	1.22	1.27	0.39	0.61	0.39	0.61
		10.1-40.0%	1.22	1.27	0.25	0.61	0.25	0.61
	3(A,B)	0-10.0%	0.57	0.67	0.39	0.49	0.39	0.49
		10.1-20.0%	0.57	0.67	0.25	0.49	0.25	0.49
		20.1-40.0%	0.57	0.67	0.25	0.39	0.25	0.39
	3(C)	0-10.0%	1.22	1.27	0.61	0.82	0.61	0.82
		10.1-20.0%	1.22	1.27	0.61	0.61	0.61	0.61
		20.1-30.0%	1.22	1.27	0.39	0.61	0.39	0.61
		30.1-40.0%	1.22	1.27	0.34	0.61	0.34	0.61
	4	0-40.0%	0.57	0.67	0.39	0.49	0.50	0.62
	5	0-10.0%	0.57	0.67	0.49	0.49	0.62	0.62
		10.1-40.0%	0.57	0.67	0.39	0.39	0.50	0.50
	6	0-10.0%	0.57	0.67	0.49	0.64	0.62	0.81
		10.1-40.0%	0.57	0.67	0.39	0.49	0.50	0.62
	7	0-40.0%	0.57	0.67	0.49	0.64	0.62	0.81
	8	0-40.0%	0.46	0.47	NR	NR	NR	NR
Semiheated	1-8	0-40.0%	1.22	1.27	NR	NR	NR	NR

Table 6.5.7-2: *"Baseline Building Criteria for Vertical Glazing for 90.1 2007 and 90.1-2010"*

Building type	Fenestration Type	Climate Zone	Standard Design		
			U-factor	SHGC	VT
Nonresidential	Non-Metal Framing	1	1.20	0.25	0.32
		2	0.75	0.25	0.32
		3	0.65	0.25	0.32
		4	0.40	0.40	0.51
		5,6	0.35	0.40	0.51
		7,8	0.35	0.45	0.57
	Metal Framing Curtainwall/ Storefront	1	1.20	0.25	0.32
		2	0.70	0.25	0.32
		3	0.60	0.25	0.32
		4	0.50	0.40	0.51
		5,6	0.45	0.40	0.51
		7,8	0.40	0.45	0.57
	Metal Framing Entrance Door	1	1.20	0.25	0.32
		2	1.10	0.25	0.32
		3	0.90	0.25	0.32
		4	0.85	0.40	0.51
		5,6	0.80	0.40	0.51
		7,8	0.80	0.45	0.57
Nonresidential (Continued)	Metal Framing All Other	1	1.20	0.25	0.32
		2	0.75	0.25	0.32
		3	0.65	0.25	0.32
		4	0.55	0.40	0.51
		5,6	0.55	0.40	0.51
		7,8	0.45	0.45	0.57

Residential	Non-Metal Framing	1	1.20	0.25	0.32
		2	0.75	0.25	0.32
		3	0.65	0.25	0.32
		4	0.40	0.40	0.51
		5,6	0.35	0.40	0.51
		7,8	0.35	NR	NR
	Metal Framing Curtainwall/ Storefront	1	1.20	0.25	0.32
		2	0.70	0.25	0.32
		3	0.60	0.25	0.32
		4	0.50	0.40	0.51
		5,6	0.45	0.40	0.51
		7,8	0.40	NR	NR
	Metal Framing Entrance Door	1	1.20	0.25	0.32
		2	1.10	0.25	0.32
		3	0.90	0.25	0.32
		4	0.85	0.40	0.51
		5,6	0.80	0.40	0.51
		7,8	0.80	NR	NR
	Metal Framing All Other	1	1.20	0.25	0.32
		2	0.75	0.25	0.32
		3	0.65	0.25	0.32
		4	0.55	0.40	0.51
		5,6	0.55	0.40	0.51
		7,8	0.45	NR	NR
Residential	Non-Metal Framing	1- 5	1.20	NR	NR
		6- 8	0.65	NR	NR
	Metal Framing Curtainwall/ Storefront	1- 5	1.20	NR	NR
		6- 8	0.60	NR	NR
	Metal Framing Entrance Door	1- 5	1.20	NR	NR
		6- 8	0.90	NR	NR
Residential (Continued)	Metal Framing All Other	1- 5	1.20	NR	NR
		6- 8	0.65	NR	NR

Table 6.5.7-3: *"Baseline Building Criteria for Skylights"*

Proposed Design	Applicable Standard	Climate Zone	% of Roof	Standard Design		
				U-factor	SHGC	VT
Glass Skylight with Curb	90.1 – 2001 & 90.1 - 2007	1,2	0-2.0%	1.98	0.36	0.46
			2.1-5.0%	1.98	0.19	0.24
		3 (A,B) - (all climate zone 3 for 2007)	0-2.0%	1.17	0.39	0.50
			2.1-5.0%	1.17	0.19	0.24
		3 (C) (2001 only)	0-2.0%	1.98	0.61	0.77
			2.1-5.0%	1.98	0.39	0.50
		4,5	0-2.0%	1.17	0.49	0.62
			2.1-5.0%	1.17	0.39	0.50
		6	0-5.0%	1.17	0.49	0.62
		7	0-2.0%	1.17	0.68	0.68
			2.1-5.0%	1.17	0.64	0.64
		8	0-2.0%	0.98	0.55	0.63
Plastic Skylight with Curb	90.1 - 2001 & 90.1 - 2007	1	0-2.0%	1.90	0.34	0.41
			2.1-5.0%	1.90	0.27	0.32
		2	0-2.0%	1.90	0.39	0.47
			2.1-5.0%	1.90	0.34	0.41
		3,4	0-2.0%	1.30	0.65	0.78
			2.1-5.0%	1.30	0.34	0.41

		5	0-2.0%	1.10	0.77	0.92
			2.1-5.0%	1.10	0.62	0.74
		6	0-2.0%	0.87	0.71	0.85
			2.1-5.0%	0.87	0.58	0.70
		7	0-2.0%	0.87	0.77	0.92
			2.1-5.0%	0.87	0.71	0.85
		8	0-2.0%	0.61	0.59	0.64
Skylight without Curb	90.1 – 2001 & 90.1 – 2007	1,2	0-2.0%	1.36	0.36	0.46
			2.1-5.0%	1.36	0.19	0.24
		3 (A,B) - (all climate zone 3 for 2007)	0-2.0%	0.69	0.39	0.50
			2.1-5.0%	0.69	0.19	0.24
		3 (C) (2001 only)	0-2.0%	1.36	0.61	0.77
			2.1-5.0%	1.36	0.39	0.50
		4,5	0-2.0%	0.69	0.49	0.62
			2.1-5.0%	0.69	0.39	0.50
		6	0-5.0%	0.69	0.49	0.62
		7	0-2.0%	0.69	0.68	0.68
			2.1-5.0%	0.69	0.64	0.64
		8	0-5.0%	0.58	0.55	0.63

External Shading Devices

Applicability	All fenestration
Definition	Devices or building features, such as overhangs, fins, shading screens, and setbacks of windows from the exterior face of the wall, that are documented on the construction documents and shade the glazing. Objects that shade the building but that are not part of the building and parts of the building that cause the building to shade itself are also modeled, but are not a part of this building descriptor. See *Shading of the Building Site*.
Units	Data structure: opening shade
Input Restrictions	No restrictions other than that the inputs must match the construction documents
Baseline Rules	The baseline building is modeled without external shading devices.

Internal Shading Devices

Applicability	All fenestration
Definition	Curtains, blinds, louvers, or other devices that are applied on the room side of the glazing material. Glazing systems that use blinds between the glazing layers are also considered internal shading devices. Glass coatings or components or treatments of the glazing materials are addressed through the Fenestration Construction building descriptor.
Units	Data structure
Input Restrictions	Internal shading shall not be modeled in the proposed design, unless it is automatically controlled, based on input from an astronomical timeclock, an exterior pyronometer, or other sensors. The control algorithm shall be documented on the construction documents. Interior shades without automatic controls shall not be modeled.
Baseline Rules	The baseline building shall be modeled without interior shades.

6.5.8 Below Grade Walls

Below Grade Wall Name

Applicability	All projects, optional input
Definition	A unique name that keys the below grade wall to the construction documents
Units	Text, unique
Input Restrictions	None
Baseline Rules	Not applicable

Below Grade Wall Geometry

Applicability	All projects
Definition	A geometric construct that describes the dimensions and placement of walls located below grade. Below grade walls have soil or crushed rock on one side and interior space on the other side. Some simulation models take the depth below grade into account when estimating heat transfer, so the geometry may include height and width.
Units	Data structure: below grade wall geometry
Input Restrictions	There are no restrictions other than that the inputs shall be in agreement with the construction documents.
Baseline Rules	The geometry of below grade walls in the baseline building is identical to the below grade walls in the proposed design.

Below Grade Wall Construction

Applicability	All projects, required input

Definition	A description of the manner in which a below grade wall is constructed or a representation of the thermal performance of the below grade wall that can be used by the energy simulation software to estimate heat transfer. The construction can be described as a C-factor which is similar to a U-factor, except that the outside air film is excluded or the construction can be represented as a series of layers, like exterior constructions.
Units	Data structure: construction assembly
Input Restrictions	No restrictions other than that the inputs shall be in agreement with the construction documents.
Baseline Rules	See Table 6.5.8-1 [10] and Table 6.5.8-2 [11].

Table 6.5.8-1: *"Baseline Building C-factor Criteria for Below-Grade Walls"*

Applicable Standard	Space Category	Climate Zone	Standard Design	
			Minimum Insulation	C-Factor
90.1 - 2001	Nonresidential	1- 6	NR	1.140
		7, 8	R-7.5 c.i.	0.119
	Residential	1-5	NR	1.140
		6- 8	R-7.5 c.i.	0.119
	Semi-Heated	1-8	NR	1.140
90.1 - 2007	Nonresidential	1- 4	NR	1.140
		5678	R-7.5 c.i.	0.119
	Residential	1-3	NR	1.140
		456	R-7.5 c.i.	0.119
		7	R-10 c.i.	0.092
		8	R-12.5 c.i.	0.075
	Semi-Heated	1- 8	NR	1.140

Table 6.5.8-2: *"Baseline Building Below-Grade Wall Construction Assemblies"*

Construction	Layer	Thickness (inch)	Conductivity (Btu/h ft F)	Density (lb/ft²)	Specific Heat (Btu/lb F)	R-value (ft²·°F·h/Btu)	C-factor (Btu/ft²·°F·h)
NR	115 lb/ft3 CMU, solid grout	8	0.45	115	0.20	0.87	1.140
R-7.5 c.i.	115 lb/ft3 CMU, solid grout	8	0.45	115	0.20	0.87	
	R-10 continuous insulation	1.8	0.02	1.8	0.29	7.50	
	Total assembly					8.37	0.119
R-10 c.i.	115 lb/ft3 CMU, solid grout	8	0.45	115	0.20	0.87	
	R-10 continuous insulation	2.4	0.02	1.8	0.29	10.00	
	Total assembly					10.87	0.092
R-12.5 c.i.	115 lb/ft3 CMU, solid grout	8	0.45	115	0.20	0.87	
	R-10 continuous insulation	3.0	0.02	1.8	0.29	12.50	
	Total assembly					13.37	0.075

6.5.9 Slab Floors in Contact with Ground

These building descriptors apply to slab-on-grade floors that are in direct contact with the ground.

Slab Floor Name

Applicability	All slab floors, optional
Definition	A unique name or code that relates the exposed floor to the construction documents.
Units	Text, unique
Input Restrictions	None
Baseline Rules	Not applicable

Slab Floor Type

Applicability	All slab floors, required
Definition	One of two classes for floors in contact with ground. The classes are: 1) heated slab-on-grade floors and 2) unheated slab-on-grade floors. Heated slab-on-grade floors include all floors that are heated directly in order to provide heating to the space. Unheated slab-on-grade floors are all other floors in contact with ground. See the baseline standards and the associated User's Manuals for additional definition.
Units	List: heated or unheated
Input Restrictions	None
Baseline Rules	Unheated

Slab Floor Construct

Slab Floor Geometry

Applicability All slab floors, required

Definition A geometric construct representing a slab floor in contact with the earth. The geometric representation can vary depending on how the energy simulation software models slabs-on-grade. Some models require that only the perimeter of the slab be entered. Other models divide the slab into a perimeter band within 2 ft of the edge and the interior portion or core area, such that the perimeter area and the core area sum to the total area of the slab.

Units Data structure: as appropriate for the simulation tool

Input Restrictions No restrictions

Baseline Rules Same as baseline building

Slab Floor Construction

Applicability All slab floors, required input

Definition

A description of how the slab is insulated (or not). How the construction is described will depend on the energy simulation model. Simple models may include just an F-factor, representing an instantaneous heat loss/gain to outside air. The F-factor could be related to the configuration of insulation in the proposed design. Other slab loss models may require that the surface area of the slab floor be divided between the perimeter and the interior. The insulation conditions then define heat transfer between both outside air and ground temperature.

The insulation condition for slabs includes the R-value of the insulation and the distance it extends into the earth at the slab edge and how far it extends underneath the slab.

Units Data structure: depends on the model that is used

Input Restrictions If the perimeter method is used to model the slab, F-factors shall be taken from Appendix A of ASHRAE Standard 90.1-2001 or ASHRAE Standard 90.1-2007. For all methods, inputs shall be consistent with the construction documents.

Baseline Rules Slab loss shall be modeled in the same manner in the baseline building as in the proposed design, e.g. if the perimeter method is used for the proposed design, the same method shall be used for the baseline building.
The configuration of insulation and the F-factors for the baseline building are shown in Table 6.5.9-1 [12]. If the perimeter method is not used, then the F-factors from the table shall be used in the baseline building. If an alternative modeling method is used, then inputs to the method for the baseline building shall be consistent with the insulation configuration described in Table 6.5.9-1 [12].

Table 6.5.9-1: *"Baseline Building F-factor Criteria for Slab-on-Grade Floors"*

Applicable Standard	Condition	Space Category	Climate Zone	Baseline Building	
				Insulation Configuration	F-Factor
90.1 – 2001	Unheated	Nonresidential	1-7	NR	0.730
			8	R-10 for 24 in. vertical	0.540
		Residential	1-6	NR	0.730
			7	R-10 for 24 in. vertical	0.540
			8	R-15 for 24 in. vertical	0.520
		Semi-Heated	1- 8	NR	0.730
	Heated	Nonresidential	1- 4	R-7.5 for 12 in. vertical	1.020
			5- 7	R-10 for 36 in. vertical	0.840
			8	R-10 for 48 in. vertical	0.780
		Residential	1- 3	R-7.5 for 12 in. vertical	1.020
			4, 5	R-10 for 36 in. vertical	0.840
			6- 8	R-10 for 48 in. vertical	0.780
		Semi-Heated	1- 7	R-7.5 for 12 in. vertical	1.020
			8	R-7.5 for 24 in. vertical	.0950
90.1 – 2007	Unheated	Nonresidential	1-5	NR	0.730
			6	R-10 for 24 in. vertical	0.540
			7,8	R-15 for 24 in. vertical	0.520
		Residential	1- 3	NR	0.730
			4, 5	R-10 for 24 in. vertical	0.540
			6, 7	R-15 for 24 in. vertical	0.520
			8	R-20 for 24 in. vertical	0.510
		Semi-Heated	1- 8	NR	0.730
	Heated	Nonresidential	1, 2	R-7.5 for 12 in. vertical	1.020
			3	R-10 for 24 in. vertical	0.900
			4- 6	R-15 for 24 in. vertical	0.860
			7	R-20 for 24 in. vertical	0.843

	8	R-20 for 48 in. vertical	0.688
Residential	1, 2	R-7.5 for 12 in. vertical	1.020
	3	R-10 for 24 in. vertical	0.900
	4, 5	R-15 for 24 in. vertical	0.860
	6- 8	R-20 for 48 in. vertical	0.688
Semi-Heated	1- 6	R-7.5 for 12 in. vertical	1.020
	7, 8	R-10 for 24 in. vertical	0.900

6.5.10 Heat Transfer between Thermal Blocks

Partition Name	
Applicability	All partitions, optional
Definition	A unique name or code that relates the partition to the construction documents.
Units	Text, unique
Input Restrictions	The text should provide a key to the construction documents.
Baseline Rules	Not applicable
Partition Geometry	
Applicability	All partitions
Definition	A geometric construct that defines the position and size of partitions that separate one thermal block from another. The construct shall identify the thermal blocks on each side of the partition. Since solar gains are not generally significant for interior partitions, the geometry of partitions is sometimes specified as just an area along with identification of the thermal blocks on each side.
Units	Data structure: surface with additional information identifying the two thermal blocks that the partition separates.
Input Restrictions	No restrictions other than agreement with the construction documents
Baseline Rules	The geometry of partitions in the baseline building shall be identical to the proposed design.
Partition Construction	
Applicability	All partitions
Definition	A description of the construction assembly for the partition
Units	Data structure: construction assembly
Input Restrictions	No restrictions other than the need for agreement with the construction documents
Baseline Rules	Partitions in the baseline building shall be steel framed walls with 5/8 in. gypsum board on each side.

Source URL: http://www.comnet.org/mgp/content/65-building-envelope-data

Links:
[1] http://www.comnet.org/mgp/content/653-roofs#baseline-building-r-value-and-u-factor-criteria-for-roofs
[2] http://www.comnet.org/mgp/content/653-roofs#baseline-building -roof-construction-assemblies
[3] http://www.comnet.org/mgp/content/exterior-walls#baseline-building-r-value-and-u-factor-criteria-for-walls
[4] http://www.comnet.org/mgp/content/exterior-walls#baseline-building-wall-construction-assemblies
[5] http://www.comnet.org/mgp/content/exterior-floors#baseline-building-r-value-and-u-factor-criteria-for-exposed-floors
[6] http://www.comnet.org/mgp/content/exterior-floors#baseline-building-exposed-floor-construction-assemblies
[7] http://www.comnet.org/mgp/content/doors#baseline-building-u-factor-criteria-for-doors
[8] http://www.comnet.org/mgp/content/fenestration#baseline-building-criteria-for-vertical-glazing-for-90.1-2001
[9] http://www.comnet.org/mgp/content/fenestration#baseline-building-criteria-for-skylights
[10] http://www.comnet.org/mgp/content/below-grade-walls#baseline-building-c-factor-criteria-for-below-grade-walls
[11] http://www.comnet.org/mgp/content/below-grade-walls#baseline-building-below-grade-wall-construction-assemblies
[12] http://www.comnet.org/mgp/content/slab-floors-contact-ground#baseline-building-f-factor-criteria-for-slab-on-grade-floors