

# Troubleshooting REScheck and COMcheck Projects

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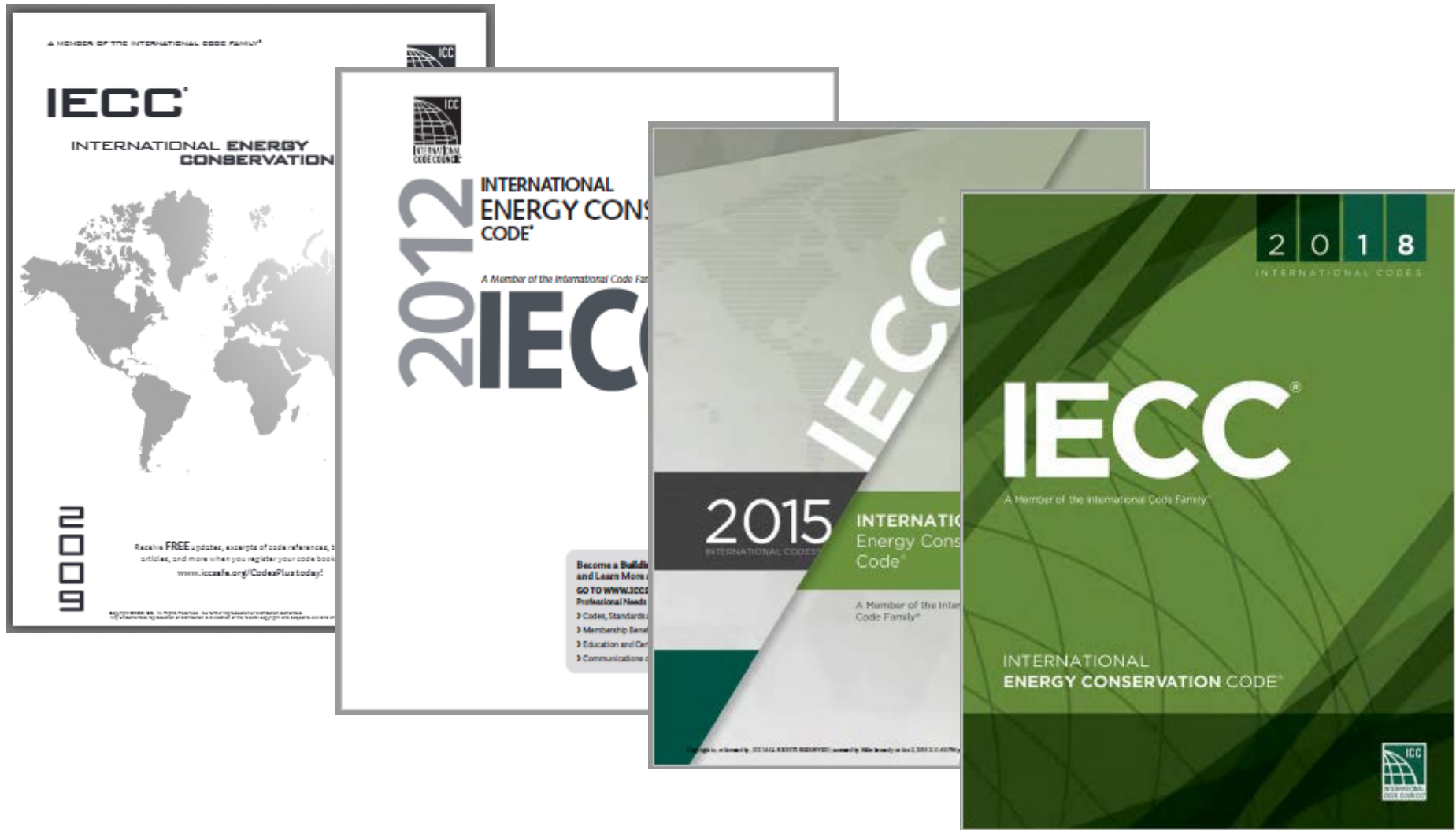
# Course Description and Learning Objectives

This webinar, which is part of DOE's Building Energy Codes Program *Energy Codes Commentator* webinar-based training series, will present case studies reviewing challenges that can be addressed via REScheck and COMcheck software, the popular compliance software tool supported by the U.S. Department of Energy. Case studies will focus on common challenges which can result in non-compliance, and what design changes and user inputs can be implemented as a remedy. Both residential and commercial projects will be covered, as will distinctions between various energy editions of model codes. Valuable troubleshooting techniques will also be presented using samples based on real-world projects.

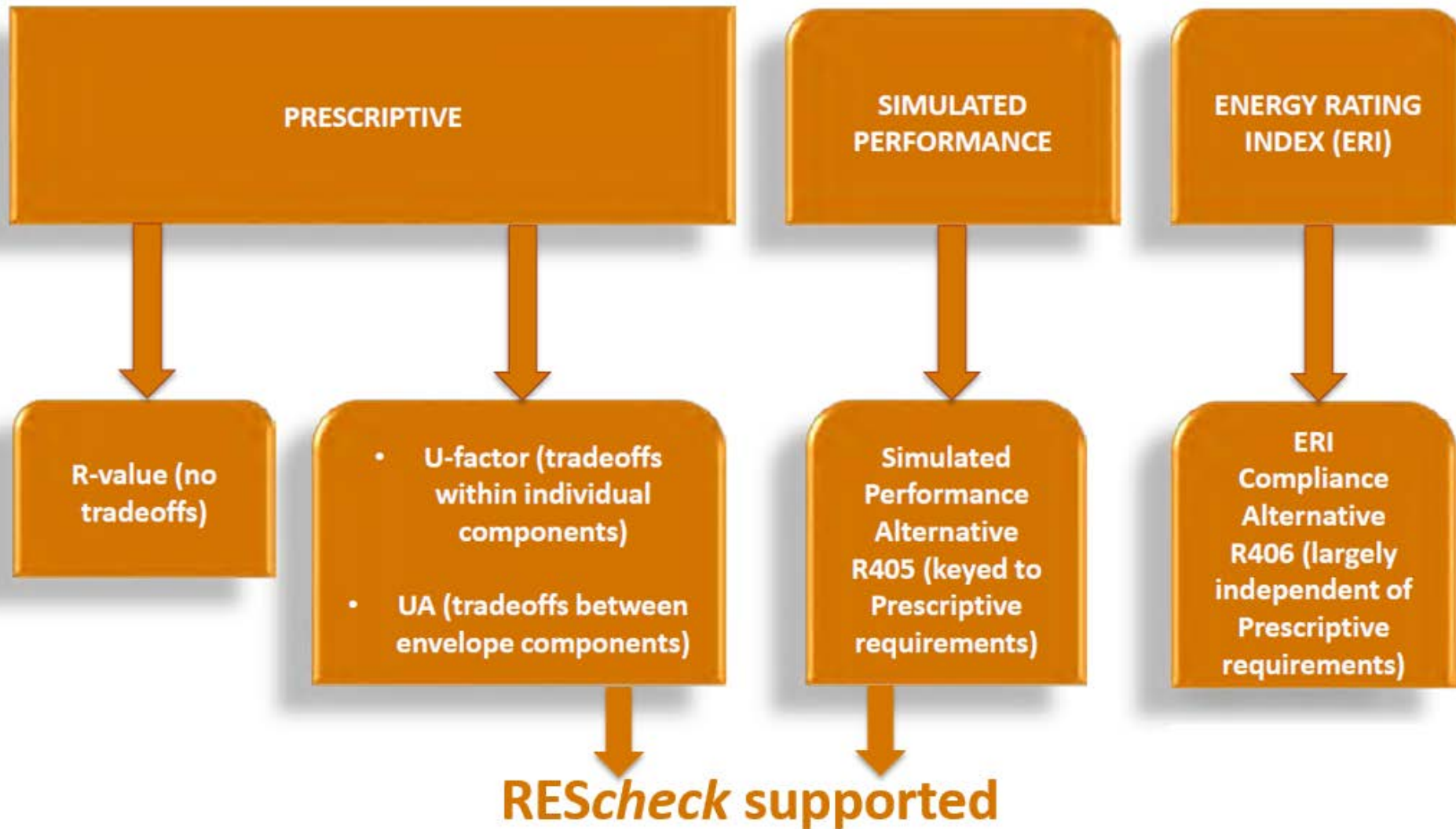
## Learning Objectives:

1. Attendees will learn what and how building envelope assemblies are calculated and the compliance path from code is used to calculate a compliance result using REScheck.
2. Attendees will learn what and how building envelope assemblies and lighting fixtures/wattages are calculated and compliance paths from IECC and ASHRAE 90.1 used to calculate compliance results using COMcheck.
3. Attendees will learn what design changes have the biggest impact and how to change a building project that is failing to incompliance.
4. Attendees will be able to apply troubleshooting techniques.

# REScheck Supported Energy Codes



# Residential Energy Code Compliance Methods



## ► Total UA

- Considers thermal conductance of envelope assemblies
- “Trades-off” UA from above-code assemblies to below-code assemblies
- $UA = U\text{-factor} \times \text{Area}$  for each building assembly
- Sum UA for Proposed Building compared to SUM UA for Code (Budget) Building

## ► Performance alternative

- Considers the whole building energy performance
- Based on simulated performance of your building compared to an equivalent code building
- Requires additional inputs (over UA approach): building orientation, minimum of four walls having unique orientations, and a minimum of one roof and floor
- Envelope trade-off only, no mechanical equipment trade-off



# Energy Code Envelope Assembly Requirements

**TABLE R402.1.2**  
**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b, e</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>f</sup>	FLOOR R-VALUE	BASEMENT <sup>c</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>c</sup> WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 <sup>h</sup>	8/13	19	5/13 <sup>f</sup>	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 <sup>h</sup>	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 <sup>h</sup>	13/17	30 <sup>g</sup>	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 <sup>h</sup>	15/20	30 <sup>g</sup>	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 <sup>h</sup>	19/21	38 <sup>g</sup>	15/19	10, 4 ft	15/19

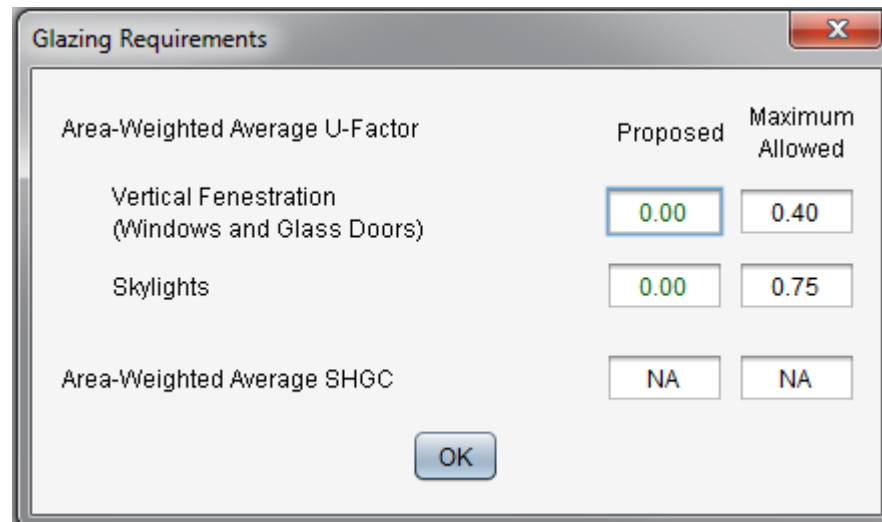
**TABLE R402.1.4**  
**EQUIVALENT U-FACTORS<sup>a</sup>**

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR <sup>b</sup>	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

# Envelope Mandatory Requirements

**R402.5 Maximum fenestration *U*-factor and SHGC (Mandatory).** The area-weighted average maximum fenestration *U*-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.48 in *Climate Zones* 4 and 5 and 0.40 in *Climate Zones* 6 through 8 for vertical fenestration, and 0.75 in *Climate Zones* 4 through 8 for *skylights*. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in *Climate Zones* 1 through 3 shall be 0.50.

(Source: 2018 IECC)



The dialog box titled "Glazing Requirements" contains a table with the following data:

Area-Weighted Average U-Factor	Proposed	Maximum Allowed
Vertical Fenestration (Windows and Glass Doors)	0.00	0.40
Skylights	0.00	0.75
Area-Weighted Average SHGC	NA	NA

An "OK" button is located at the bottom center of the dialog box.

# Diagnostic Data: Energy Code, Climate Zone, Project Type, Compliance Method

Untitled.rck - REScheck 4.6.5      Code: 2015 IECC

File Edit View Options Code Tools Help

Project Envelope Mechanical Requirements

**Location**

State: Montana  
City: Bozeman  
Climate zone: 6b

**Project Type**

☒ New Construction ☐ Addition ☐ Alteration

**Building Characteristics**

☒ 1- and 2-Family, Detached ☐ Multifamily  
Conditioned Floor Area: 0 ft<sup>2</sup>  
☐ All ducts and air handlers located within conditioned spaces  
[Explanation of duct testing requirements...](#)  
☐ Project includes a thermally isolated sunroom  
☐ Project includes a pool or inground permanent spa  
☐ Project includes an interior wood-burning fireplace

**Project Details (optional)**


This information will appear on the compliance certificate. [Edit Project Details...](#)

Title/Site/Permit

Owner/Agent

Designer/Contractor

Notes

 No envelope assemblies specified TBD %

Compliance Method: UA Trade-Off      Max. UA: 0      Your UA: 0

If you can't find the building's city, choose a nearby city that has similar weather conditions.



# Diagnostic Data on Compliance Certificate



REScheck Software Version 4.6.5

## Compliance Certificate

Project North Meadows Development

Energy Code:	<b>2018 IECC</b>	←
Location:	<b>Absarokee, Montana</b>	
Construction Type:	<b>Single-family</b>	
Project Type:	<b>New Construction</b>	←
Conditioned Floor Area:	<b>3,000 ft<sup>2</sup></b>	
Climate Zone:	<b>6 (7385 HDD)</b>	←
Permit Date:	<b>3/17/00</b>	
Permit Number:		

# Evaluate Assembly Performance

TABLE R402.1.4  
EQUIVALENT U-FACTORS<sup>a</sup>

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR <sup>b</sup>	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

	Component	Assembly	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA
	▼ Building							
1	Wall 1	Wood Frame, 16" o.c. ▼	1000	ft <sup>2</sup>	19.0	5.0	0.045	45
2	Wall 1 copy 1	Wood Frame, 24" o.c. ▼	1000	ft <sup>2</sup>	19.0	5.0	0.044	44
3	Wall 1 copy 2	Steel Frame, 16" o.c. ▼	1000	ft <sup>2</sup>	19.0	5.0	0.071	71
4	Wall 1 copy 3	Steel Frame, 24" o.c. ▼	1000	ft <sup>2</sup>	19.0	5.0	0.064	64

# Evaluate Assembly Performance (cont)

Zone 6 Example Failing.rck - REScheck 4.6.5 Code: 2018 IECC

File Edit View Options Code Tools Help

Project Envelope Mechanical Requirements

Ceiling Skylight Wall Window Door Basement Floor Crawl Wall

	Component	Assembly	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA
	▼ Building							
1	Ceiling 1	Flat Ceiling or Scissor Truss	3000	ft2	25.0	0.0	0.04	120
2	▼ Wall 1	Wood Frame, 16" o.c.	1647	ft2	20.0	6.0	0.042	57
3	Door 1	Glass	84	ft2			0.31	26
4	Window 1	Vinyl Frame, Double Pane with Low-E	204	ft2			0.32	65
5	▼ Wall 2	Wood Frame, 16" o.c.	276	ft2	13.0	0.0	0.082	21
6	Door 3	Solid	18	ft2			0.3	5
7	Floor 1	All-Wood Joist/Truss, Over Unconditioned ...	3000	ft2	15.0	0.0	0.057	171

❌ Fails 36.4 % Worse Than Code


Compliance Method: UA Trade-Off Max. UA 341 Your UA 465

TABLE R402.1.4  
EQUIVALENT U-FACTORS\*

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR*	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055


# Evaluate Assembly Performance (cont)

	Component	Assembly	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA
	▼ Building							
1	Wall 1	Wood Frame, 24" o.c.	1000	ft2	20.0	5.0	0.043	43
2	Wall 1 copy 1	Wood Frame, 24" o.c.	1000	ft2	20.0	0.0	0.057	57

 
11.1 % Worse Than Code

Compliance Method: UA Trade-Off    Max. UA     Your UA

	Component	Assembly	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA
	▼ Building							
1	Wall 1	Wood Frame, 24" o.c.	1800	ft2	20.0	5.0	0.043	77
2	Wall 1 copy 1	Wood Frame, 24" o.c.	200	ft2	20.0	0.0	0.057	11

 
2.2 % Better Than Code

Compliance Method: UA Trade-Off    Max. UA     Your UA

# Mandatory Requirement Fails Example


Zone 6 Example Failing.rck - REScheck 4.6.5 Code: 2018 IECC

File Edit View Options Code Tools Help

Project Envelope Mechanical Requirements

Ceiling Skylight Wall Window Door Basement Floor Crawl Wall

	Component	Assembly	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA
▼	Building							
1	Ceiling 1	Flat Ceiling or Scissor Truss	3000	ft2	25.0	0.0	0.04	120
2	▼ Wall 1	Wood Frame, 16" o.c.	1647	ft2	20.0	6.0	0.042	57
3	Door 1	Glass	84	ft2			0.31	26
4	Window 1	Vinyl Frame, Double Pane with Low-E	204	ft2			0.5	102
5	▼ Wall 2	Wood Frame, 16" o.c.	276	ft2	13.0	0.0	0.082	21
6	Door 3	Solid	18	ft2			0.3	5
7	Floor 1	All-Wood Joist/Truss, Over Unconditioned ...	3000	ft2	15.0	0.0	0.057	171

 Average fenestration U-factor exceeds maximum (for details select View menu or Help)

Compliance Method: UA Trade-Off Max. UA 341 Your UA 502

Enter the U-factor of the glazing component.

Glazing Requirements

	Proposed	Maximum Allowed
Area-Weighted Average U-Factor		
Vertical Fenestration (Windows and Glass Doors)	0.44	0.40
Skylights	0.00	0.75
Area-Weighted Average SHGC	NA	NA

OK

TBD %

# COMcheck and Commercial Code Compliance

## Building System

## Compliance Options

Envelope

HVAC

SWH

Power

Lighting

Other

**Mandatory Provisions**  
(required for most compliance options)

**Prescriptive Option**

**Trade Off Option** 

**Energy Cost Budget:  
Performance Simulation**

**Energy Code Compliance**



# COMcheck Commercial Energy Codes



- ▶ ASHRAE 90.1 (Pre-2013) Normative Appendix C Methodology for Building Envelope Trade-Off Option
  - 90.1-2007/2010
  - 2009/2012 IECC
- ▶ ASHRAE 90.1-2013/2016 Appendix C has limited performance method (EnergyPlus)
- ▶ 2015/2018 IECC Component Performance Alternative (hybrid Total UA method)

# Envelope Trade-Off Methods (cont.)

## 90.1-2007/2010 and 2009/2012 IECC : Normative Appendix C Methodology for Building Envelope Trade-Off Option

- Building energy cost factor computed using regression equations
- 90.1-2007/2010: Window/wall and skylight/roof ratio limitations **enforced but tradable**
- 2009/2012 IECC: Window/wall and skylight/roof ratio limitations **enforced as hard limit**

## 90.1-2013/2016 Appendix C Envelope Trade-Off Methodology

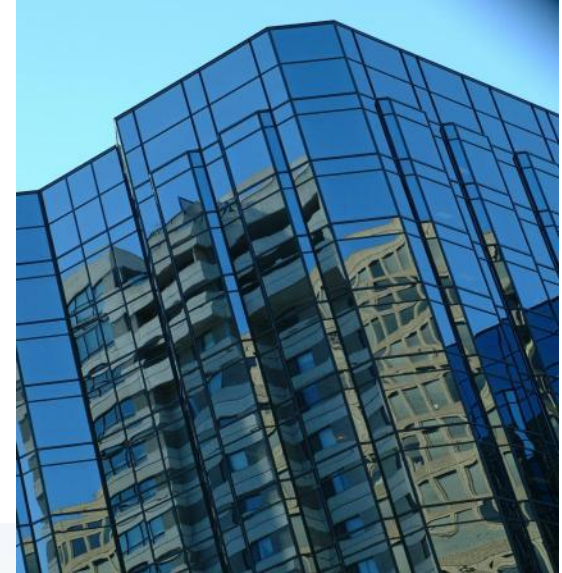
- Envelope components are assigned to isolated thermal zones based on
  - Building Envelope Area types (BEAT) play influential role
  - Space conditioning categories (SCC)
  - Window/wall and skylight/roof ratio limitations **enforced but tradable**

## 2015/2018 Component Performance Method Criteria

- Envelope assemblies must pass on 'hybrid' Total UA based criteria
- Window/wall and skylight/roof ratio limitations **enforced but tradable**
- SHGC prescriptive requirement enforced

# Project Types and Compliance Methods

- ▶ New Construction:
  - Trade-off compliance method
  - Prescriptive – Oregon only
- ▶ Addition
  - Trade-off compliance method
  - Prescriptive – Oregon only
- ▶ Alteration
  - Prescriptive compliance



# IECC Envelope Opaque Assembly Requirements

TABLE C402.1.4  
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, U-FACTOR METHOD<sup>a, b</sup>

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade																
Mass <sup>e</sup>	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	U-0.061	U-0.061
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052	U-0.064	U-0.045
Wood framed and other <sup>c</sup>	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.036	U-0.036
Walls, below grade																
Below-grade wall <sup>c</sup>	C-1.140°	C-1.140°	C-1.140°	C-1.140°	C-1.140°	C-1.140°	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092	C-0.092	C-0.092
Floors																
Mass <sup>d</sup>	U-0.322°	U-0.322°	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051	U-0.055	U-0.051
Joist/framing	U-0.066°	U-0.066°	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors																
Unheated slabs	F-0.73°	F-0.73°	F-0.73°	F-0.73°	F-0.73°	F-0.73°	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40	F-0.40	F-0.40
Heated slabs <sup>f</sup>	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55
Opaque doors																
Swinging door	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

(Source: 2018 IECC)

# IECC Envelope Fenestration Requirements

**TABLE C402.4**  
**BUILDING ENVELOPE FENESTRATION MAXIMUM *U*-FACTOR AND SHGC REQUIREMENTS**

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Vertical fenestration																
U-factor																
Fixed fenestration	0.50		0.50		0.46		0.38		0.38		0.36		0.29		0.29	
Operable fenestration	0.65		0.65		0.60		0.45		0.45		0.43		0.37		0.37	
Entrance doors	1.10		0.83		0.77		0.77		0.77		0.77		0.77		0.77	
SHGC																
Orientation <sup>a</sup>	SEW	N	SEW	N	SEW	N	SEW	N	SEW	N	SEW	N	SEW	N	SEW	N
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.36	0.48	0.38	0.51	0.40	0.53	0.45	NR	0.45	N
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.43	0.53	0.46	0.56	0.48	0.58	NR	NR	NR	NR
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.58	0.58	0.61	0.61	0.64	0.64	NR	NR	NR	NR
Skylights																
U-factor	0.75		0.65		0.55		0.50		0.50		0.50		0.50		0.50	
SHGC	0.35		0.35		0.35		0.40		0.40		0.40		NR		NR	



# 90.1 Envelope Requirements

TABLE 5.5-6 Building Envelope Requirements for Climate Zone 6 (A, B)\*

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
<i>Roofs</i>						
Insulation Entirely above Deck	U-0.048	R-20.0 c.i.	U-0.048	R-20.0 c.i.	U-0.093	R-10.0 c.i.
Metal Building <sup>a</sup>	U-0.049	R-13.0 + R-19.0	U-0.049	R-13.0 + R-19.0	U-0.072	R-16.0
Attic and Other	U-0.027	R-38.0	U-0.027	R-38.0	U-0.034	R-30.0
<i>Walls, Above-Grade</i>						
Mass	U-0.080	R-13.3 c.i.	U-0.071	R-15.2 c.i.	U-0.151 <sup>b</sup>	R-5.7 c.i. <sup>b</sup>
Metal Building	U-0.069	R-13.0 + R-5.6 c.i.	U-0.069	R-13.0 + R-5.6 c.i.	U-0.113	R-13.0
Steel-Framed	U-0.064	R-13.0 + R-7.5 c.i.	U-0.064	R-13.0 + R-7.5 c.i.	U-0.124	R-13.0
Wood-Framed and Other	U-0.051	R-13.0 + R-7.5 c.i.	U-0.051	R-13.0 + R-7.5 c.i.	U-0.089	R-13.0
<i>Walls, Below-Grade</i>						
Below-Grade Wall	C-0.119	R-7.5 c.i.	C-0.119	R-7.5 c.i.	C-1.140	NR
<i>Floors</i>						
Mass	U-0.064	R-12.5 c.i.	U-0.057	R-14.6 c.i.	U-0.137	R-4.2 c.i.
Steel-Joist	U-0.038	R-30.0	U-0.032	R-38.0	U-0.052	R-19.0
Wood-Framed and Other	U-0.033	R-30.0	U-0.033	R-30.0	U-0.051	R-19.0
<i>Slab-On-Grade Floors</i>						
Unheated	F-0.540	R-10 for 24 in.	F-0.520	R-15 for 24 in.	F-0.730	NR
Heated	F-0.860	R-15 for 24 in.	F-0.688	R-20 for 48 in.	F-1.020	R-7.5 for 12 in.
<i>Opaque Doors</i>						
Swinging	U-0.700		U-0.500		U-0.700	
Nonswinging	U-0.500		U-0.500		U-1.450	
Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
<i>Vertical Glazing, 0%–40% of Wall</i>						
Nonmetal framing (all) <sup>c</sup>	U-0.35		U-0.35		U-0.65	
Metal framing (curtainwall/storefront) <sup>d</sup>	U-0.45	SHGC-0.40 all	U-0.45	SHGC-0.40 all	U-0.60	SHGC-NR all
Metal framing (entrance door) <sup>d</sup>	U-0.80		U-0.80		U-0.90	
Metal framing (all other) <sup>d</sup>	U-0.55		U-0.55		U-0.65	
<i>Skylight with Curb, Glass, % of Roof</i>						
0%–2.0%	U <sub>all</sub> -1.17	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -0.98	SHGC <sub>all</sub> -0.46	U <sub>all</sub> -1.98	SHGC <sub>all</sub> -NR
2.1%–5.0%	U <sub>all</sub> -1.17	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -0.98	SHGC <sub>all</sub> -0.36	U <sub>all</sub> -1.98	SHGC <sub>all</sub> -NR
<i>Skylight with Curb, Plastic, % of Roof</i>						
0%–2.0%	U <sub>all</sub> -0.87	SHGC <sub>all</sub> -0.71	U <sub>all</sub> -0.74	SHGC <sub>all</sub> -0.65	U <sub>all</sub> -1.90	SHGC <sub>all</sub> -NR
2.1%–5.0%	U <sub>all</sub> -0.87	SHGC <sub>all</sub> -0.58	U <sub>all</sub> -0.74	SHGC <sub>all</sub> -0.55	U <sub>all</sub> -1.90	SHGC <sub>all</sub> -NR
<i>Skylight without Curb, All, % of Roof</i>						
0%–2.0%	U <sub>all</sub> -0.69	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -0.58	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -1.36	SHGC <sub>all</sub> -NR
2.1%–5.0%	U <sub>all</sub> -0.69	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -0.58	SHGC <sub>all</sub> -0.39	U <sub>all</sub> -1.36	SHGC <sub>all</sub> -NR



# 90.1 Envelope Opaque Assembly Requirements

**TABLE 5.5-6 Building Envelope Requirements for Climate Zone 6 (A, B)\***

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
<i>Roofs</i>						
Insulation Entirely above Deck	U-0.048	R-20.0 c.i.	U-0.048	R-20.0 c.i.	U-0.093	R-10.0 c.i.
Metal Building <sup>a</sup>	U-0.049	R-13.0 + R-19.0	U-0.049	R-13.0 + R-19.0	U-0.072	R-16.0
Attic and Other	U-0.027	R-38.0	U-0.027	R-38.0	U-0.034	R-30.0
<i>Walls, Above-Grade</i>						
Mass	U-0.080	R-13.3 c.i.	U-0.071	R-15.2 c.i.	U-0.151 <sup>b</sup>	R-5.7 c.i. <sup>b</sup>
Metal Building	U-0.069	R-13.0 + R-5.6 c.i.	U-0.069	R-13.0 + R-5.6 c.i.	U-0.113	R-13.0
Steel-Framed	U-0.064	R-13.0 + R-7.5 c.i.	U-0.064	R-13.0 + R-7.5 c.i.	U-0.124	R-13.0
Wood-Framed and Other	U-0.051	R-13.0 + R-7.5 c.i.	U-0.051	R-13.0 + R-7.5 c.i.	U-0.089	R-13.0
<i>Walls, Below-Grade</i>						
Below-Grade Wall	C-0.119	R-7.5 c.i.	C-0.119	R-7.5 c.i.	C-1.140	NR
<i>Floors</i>						
Mass	U-0.064	R-12.5 c.i.	U-0.057	R-14.6 c.i.	U-0.137	R-4.2 c.i.
Steel-Joist	U-0.038	R-30.0	U-0.032	R-38.0	U-0.052	R-19.0
Wood-Framed and Other	U-0.033	R-30.0	U-0.033	R-30.0	U-0.051	R-19.0
<i>Slab-On-Grade Floors</i>						
Unheated	F-0.540	R-10 for 24 in.	F-0.520	R-15 for 24 in.	F-0.730	NR
Heated	F-0.860	R-15 for 24 in.	F-0.688	R-20 for 48 in.	F-1.020	R-7.5 for 12 in.
<i>Opaque Doors</i>						
Swinging	U-0.700		U-0.500		U-0.700	
Nonswinging	U-0.500		U-0.500		U-1.450	

# 90.1 Envelope Fenestration Requirements

Source: 90.1-2010

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, 0%–40% of Wall						
Nonmetal framing (all) <sup>c</sup>	U-0.35		U-0.35		U-0.65	
Metal framing (curtainwall/storefront) <sup>d</sup>	U-0.45	SHGC-0.40 all	U-0.45	SHGC-0.40 all	U-0.60	SHGC-NR all
Metal framing (entrance door) <sup>d</sup>	U-0.80		U-0.80		U-0.90	
Metal framing (all other) <sup>d</sup>	U-0.55		U-0.55		U-0.65	
Skylight with Curb, Glass, % of Roof						
0%–2.0%	U <sub>all</sub> -1.17	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -0.98	SHGC <sub>all</sub> -0.46	U <sub>all</sub> -1.98	SHGC <sub>all</sub> -NR
2.1%–5.0%	U <sub>all</sub> -1.17	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -0.98	SHGC <sub>all</sub> -0.36	U <sub>all</sub> -1.98	SHGC <sub>all</sub> -NR
Skylight with Curb, Plastic, % of Roof						
0%–2.0%	U <sub>all</sub> -0.87	SHGC <sub>all</sub> -0.71	U <sub>all</sub> -0.74	SHGC <sub>all</sub> -0.65	U <sub>all</sub> -1.90	SHGC <sub>all</sub> -NR
2.1%–5.0%	U <sub>all</sub> -0.87	SHGC <sub>all</sub> -0.58	U <sub>all</sub> -0.74	SHGC <sub>all</sub> -0.55	U <sub>all</sub> -1.90	SHGC <sub>all</sub> -NR
Skylight without Curb, All, % of Roof						
0%–2.0%	U <sub>all</sub> -0.69	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -0.58	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -1.36	SHGC <sub>all</sub> -NR
2.1%–5.0%	U <sub>all</sub> -0.69	SHGC <sub>all</sub> -0.49	U <sub>all</sub> -0.58	SHGC <sub>all</sub> -0.39	U <sub>all</sub> -1.36	SHGC <sub>all</sub> -NR

Source: 90.1-2013

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0%–40% of Wall</i>		(for all frame types)		(for all frame types)		(for all frame types)			
Nonmetal framing, all	U-0.32			U-0.32			U-0.45		
Metal framing, fixed	U-0.42			U-0.42			U-0.51		
Metal framing, operable	U-0.50	SHGC-0.40	1.10	U-0.50	SHGC-0.40	1.10	U-0.59	NR	NR
Metal framing, entrance door	U-0.77			U-0.68			U-0.77		
<i>Skylight, 0%–3% of Roof</i>									
All types	U-0.50	SHGC-0.40	NR	U-0.50	SHGC-0.40	NR	U-0.85	NR	NR

# Project: Critical Diagnostic Data

example2015IECC.cck - COMcheck 4.1.1.0 Code: 2015 IECC

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Location

State Montana City Absarokee  
Climate zone: 6b

Project Type

☒ New Construction ☐ Addition ☐ Alterations

Compliance Options

Efficiency Option Reduced Lighting Power [Help...](#)  
Air Barrier Option Air leakage test [Help...](#)

Project Details (optional)

[Edit Project Details...](#) This information will appear on the compliance certificate.

Building Envelope Area Types Interior Lighting Method and Areas Exterior Lighting Areas

[Add](#) [Delete](#) [Duplicate](#)

	Building Type	Area Description	Area	W/ft2	Space Conditioning
1	Library	Law library	10000	1.07	Nonresidential
2	Office	Paralegal office	1000	0.74	Nonresidential

Envelope +5.2% [CPA: -78] Interior Lighting +29% Exterior Lighting +19%

# Project: Building Envelope Area Types

- ▶ Primarily impacts envelope compliance
- ▶ Whole building types that describe the envelope (separating conditioned and unconditioned spaces)
- ▶ Space conditioning type
  - Nonresidential
  - Residential
  - Semiheated (no mechanical cooling) – 90.1 only

Building Envelope Area Types

Interior Lighting Method and Areas

Exterior Lighting Areas

Add

Delete

Duplicate

	Building Type	Area Description	Area	W/ft2	Space Conditioning
1	Office	Main law office	10000	0.82	Nonresidential
2	Library	Law library	5000	1.19	Nonresidential
3	Parking Garage	Garage	2000	0.21	Semiheated

# Diagnostic Data on Envelope Report



COMcheck Software Version 4.1.1.0

## Envelope Compliance Certificate

### Project Information

Energy Code:	2015 IECC
Project Title:	Project Demo
Location:	Bozeman, Montana
Climate Zone:	6b
Project Type:	New Construction
Vertical Glazing / Wall Area:	40%
Permit Date:	998877
Permit No.	XYZ

Construction Site:  
123 Main St.  
Mainville, MT 59515

Owner/Agent:  
John Doe  
Acme Real Estate Agency  
321 Example Ave.  
Example, MT 99522  
444-333-2222  
example@example.com

Designer/Contractor:  
Jane Contractor  
Excel Contractors, Inc.  
444 Contractor Ave.  
Contractorville, MT 99999  
999-999-9999  
email@email.com

### Additional Efficiency Package(s)

On-site Renewable Energy

### Building Area

### Floor Area

1-Law library (Court House) : Nonresidential	10000
--	-------

### Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U- Factor <sup>(a)</sup>
Roof: Insulation Entirely Above Deck, [Bldg. Use 1 - Law library]	10000	---	30.0	0.032	0.032
Slab floor: Slab-On-Grade:Unheated, Vertical 2 ft., [Bldg. Use 1 - Law library] (c)	400	---	10.0	0.540	0.540
<b>NORTH</b>					
Exterior Wall 1: Wood-Framed, 24" o.c., [Bldg. Use 1 - Law library]	1000	13.0	7.5	0.050	0.051
Window 1: Metal Frame:Fixed, Perf. Specs.: Product ID AX321, SHGC 0.40, VT 0.44, [Bldg. Use 1 - Law library] (b)	400	---	---	0.360	0.360
<b>EAST</b>					
Exterior Wall 2: Wood-Framed, 24" o.c., [Bldg. Use 1 - Law library]	1000	13.0	7.5	0.050	0.051
Window 2 in Wall2: Metal Frame:Fixed, Perf. Specs.: Product ID AX321, SHGC 0.40, VT 0.44, [Bldg. Use 1 - Law library] (b)	400	---	---	0.360	0.360

# Example: TBD due to incomplete specification

Comcheck Feed Store case study.cck - COMcheck 4.0.6.1 Code: 90.1 (2010) Standard

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Semi-Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor
▼ Building													
1	Roof 1	Metal Building, Standin...	1 - Feed store ...			Double In...	5000	ft2	30.0	0.0	0.051		
2	West Exterior	Steel-Framed, 16" o.c.	1 - Feed store ...	West			500	ft2	15.0	15.0	0.043		
3	West Exterior	Metal Building Wall	1 - Feed store ...	West		Single La...	175	ft2	15.0	0.0	0.100		
4	East Exterior	Steel-Framed, 16" o.c.	1 - Feed store ...	East			500	ft2	15.0	15.0	0.043		
5	Vehicle bay	Other Door				Non-Swin...	100	ft2			0.000		
6	Man-door	Insulated Metal				Swinging	21	ft2			0.520		
7	East Exterior	Metal Building Wall	1 - Feed store ...	East		Single La...	175	ft2	15.0	0.0	0.100		
8	South exterior	Steel-Framed, 16" o.c.	1 - Feed store ...	South			1000	ft2	15.0	15.0	0.043		
9	South wall	Metal Frame, Double P...			Product ID: Pella ...		108	ft2			0.320	0.40	1.20
10	Main entry	Glass			Product ID: Door ...		42	ft2			0.450	0.40	0.89
11	South exterior	Metal Building Wall	1 - Feed store ...	South		Single La...	500	ft2	15.0	0.0	0.100		
12	North exterior	Steel-Framed, 16" o.c.	1 - Feed store ...	North			1000	ft2	15.0	15.0	0.043		
13	Man-door	Insulated Metal				Swinging	21	ft2			0.520		
14	North Exterior	Metal Building Wall	1 - Feed store ...	North		Single La...	200	ft2	15.0	0.0	0.100		
15	Floor 1	Slab-On-Grade-Unhea...	1 - Feed store ...			Insulation...	300	ft		10.0			

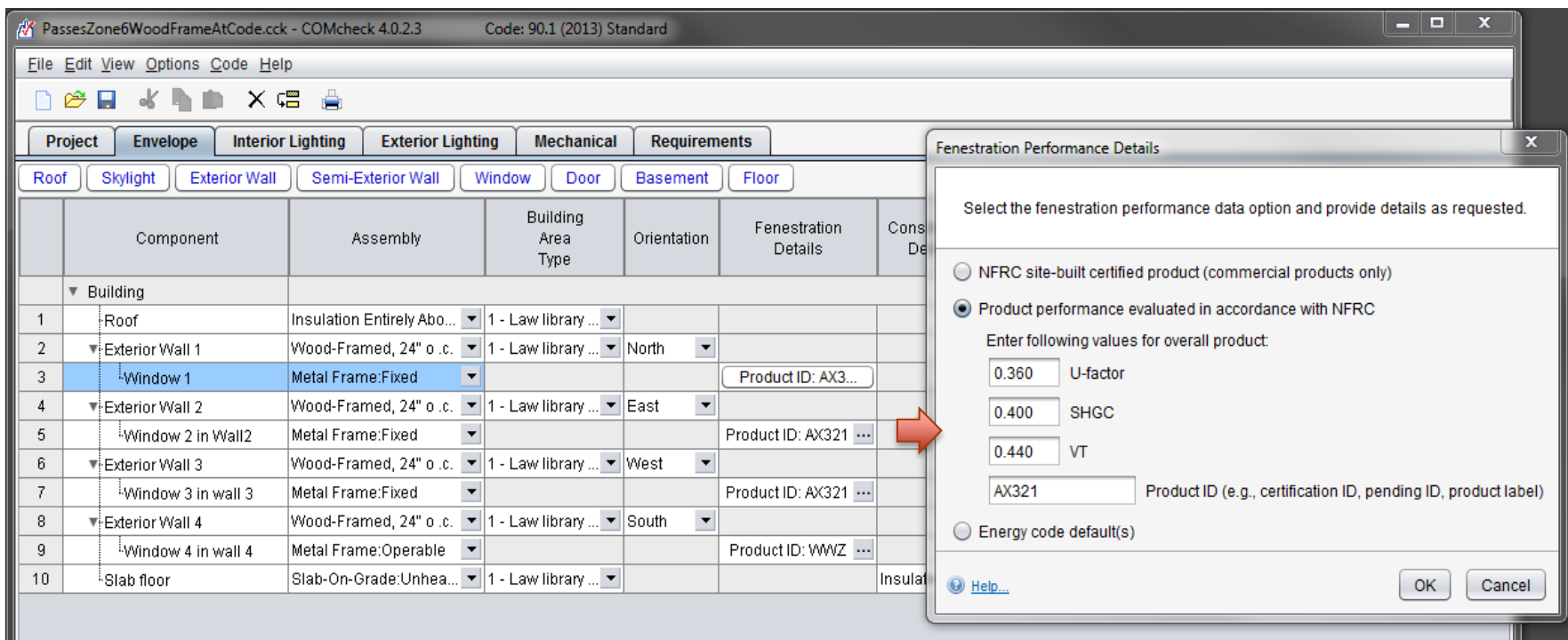
Envelope TBD Interior Lighting +44% Exterior Lighting +18%

- ▶ After you've entered building components, look at compliance result
  - Look for fields with red text
  - If TBD, look for missing data



# Fenestration Performance and Compliance

- ▶ NFRC site-built certified product
- ▶ Performance evaluated (per NFRC guidelines)
- ▶ Energy code defaults



The screenshot displays the COMcheck 4.0.2.3 software interface. The main window shows a table of building components with columns for Component, Assembly, Building Area Type, Orientation, Fenestration Details, and Cons. De. The 'Window 1' component is selected, and a 'Fenestration Performance Details' dialog box is open. The dialog box prompts the user to select a fenestration performance data option and provide details as requested. The 'Product performance evaluated in accordance with NFRC' option is selected. The user has entered the following values for overall product: U-factor (0.360), SHGC (0.400), and VT (0.440). The Product ID is entered as AX321. The 'Energy code default(s)' option is also available. The 'OK' button is highlighted.

Component	Assembly	Building Area Type	Orientation	Fenestration Details	Cons. De.
1 - Roof	Insulation Entirely Abo...	1 - Law library ...			
2 - Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	North		
3 - Window 1	Metal Frame:Fixed			Product ID: AX3...	
4 - Exterior Wall 2	Wood-Framed, 24" o.c.	1 - Law library ...	East		
5 - Window 2 in Wall2	Metal Frame:Fixed			Product ID: AX321 ...	
6 - Exterior Wall 3	Wood-Framed, 24" o.c.	1 - Law library ...	West		
7 - Window 3 in wall 3	Metal Frame:Fixed			Product ID: AX321 ...	
8 - Exterior Wall 4	Wood-Framed, 24" o.c.	1 - Law library ...	South		
9 - Window 4 in wall 4	Metal Frame:Operable			Product ID: WWZ ...	
10 - Slab floor	Slab-On-Grade:Unhea...	1 - Law library ...			Insulat

Fenestration Performance Details

Select the fenestration performance data option and provide details as requested.

☐ NFRC site-built certified product (commercial products only)

☒ Product performance evaluated in accordance with NFRC

Enter following values for overall product:

0.360 U-factor

0.400 SHGC

0.440 VT

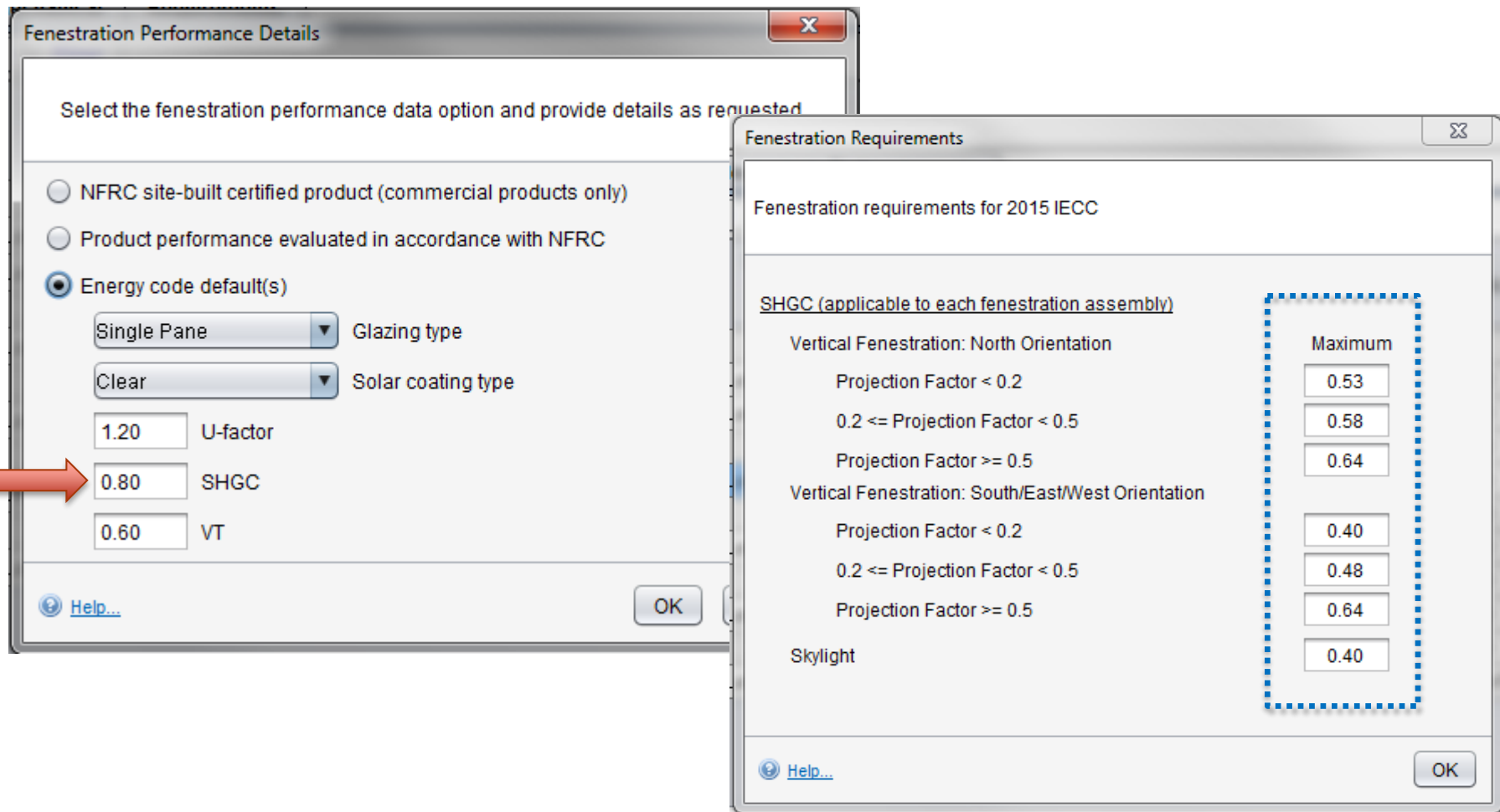
AX321 Product ID (e.g., certification ID, pending ID, product label)

☐ Energy code default(s)

[Help...](#) **OK** **Cancel**

# Example: 2015/2018 IECC Fenestration SHGC Noncompliance Using Energy Code Default Option

‘Energy code default(s)’ do not mean fenestration performance requirement will be applied



**Fenestration Performance Details**

Select the fenestration performance data option and provide details as requested

☐ NFRC site-built certified product (commercial products only)

☐ Product performance evaluated in accordance with NFRC

☒ Energy code default(s)

Single Pane Glazing type

Clear Solar coating type

1.20 U-factor

0.80 SHGC

0.60 VT

[Help...](#) **OK**

**Fenestration Requirements**

Fenestration requirements for 2015 IECC

SHGC (applicable to each fenestration assembly)

Vertical Fenestration: North Orientation

Projection Factor < 0.2 Maximum 0.53

0.2 <= Projection Factor < 0.5 0.58

Projection Factor >= 0.5 0.64

Vertical Fenestration: South/East/West Orientation

Projection Factor < 0.2 0.40

0.2 <= Projection Factor < 0.5 0.48

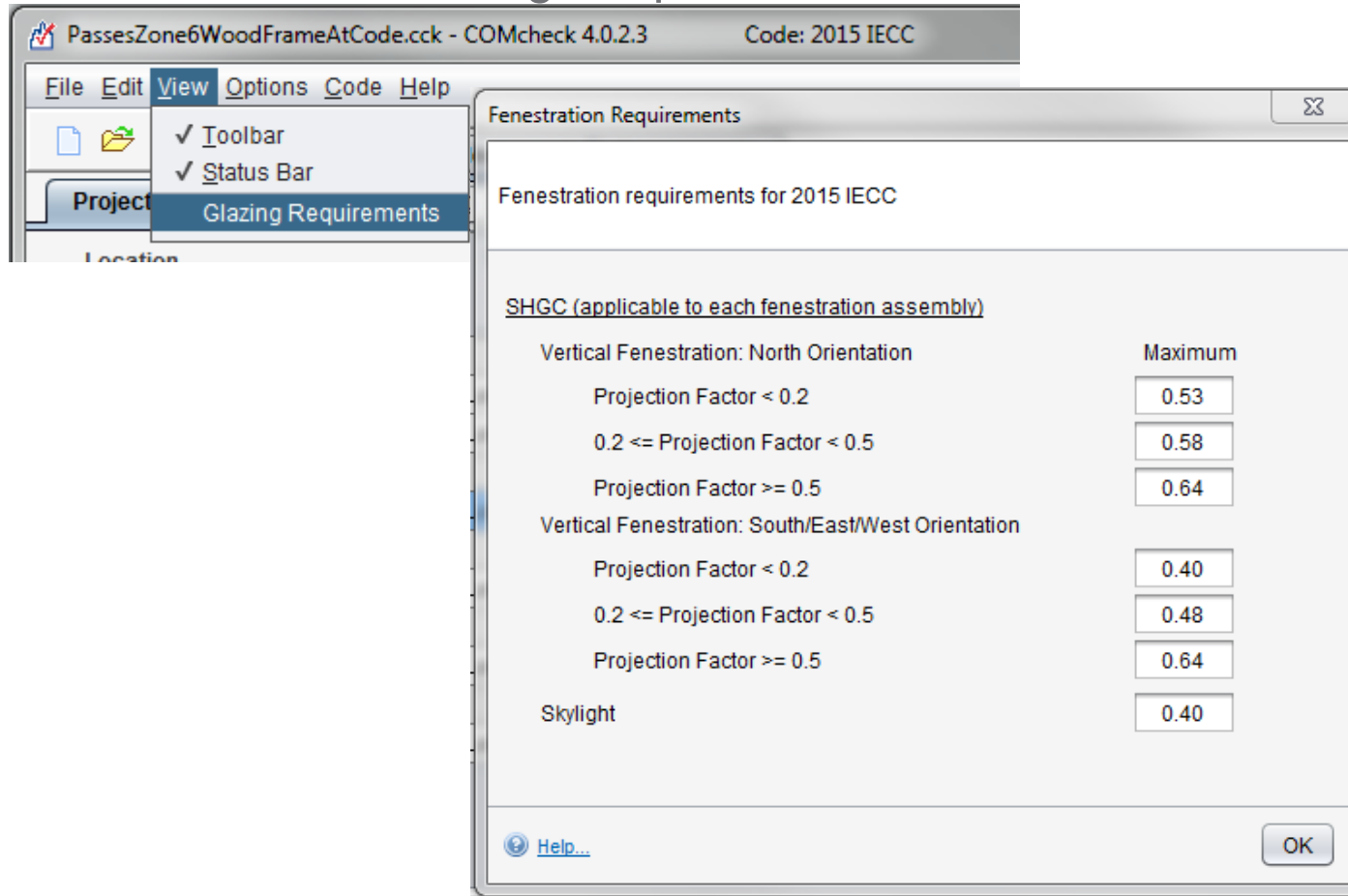
Projection Factor >= 0.5 0.64

Skylight 0.40

[Help...](#) **OK**

# Envelope: 2015/2018 IECC Fenestration Requirements

## ► Menu View->Glazing Requirements



# Example : 2015 IECC Project failing due to window/wall percentage enforcement

Zone6WoodFrameAtCode.cck - COMcheck 4.1.1.0 Code: 2015 IECC

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area or Slab Perimeter	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA	SHGC	Projection Factor	VT
▼ Building															
1	Roof	Insulation Entirely Above Deck	1 - Law library ...				10000	ft2		30.0	0.032	320			
2	▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	North			1000	ft2	13.0	7.5	0.050	30			
3	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	144	0.40	0.00	0.44
4	▼ Exterior Wall 2	Wood-Framed, 24" o.c.	1 - Law library ...	East			1000	ft2	13.0	7.5	0.050	30			
5	Window 2 in Wall2	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	144	0.40	0.00	0.44
6	▼ Exterior Wall 3	Wood-Framed, 24" o.c.	1 - Law library ...	West			1000	ft2	13.0	7.5	0.050	30			
7	Window 3 in wall 3	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	144	0.40	0.00	0.44
8	▼ Exterior Wall 4	Wood-Framed, 24" o.c.	1 - Law library ...	South			1000	ft2	13.0	7.5	0.050	30			
9	Window 4 in wall 4	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	144	0.40	0.00	0.44
10	Slab floor	Slab-On-Grade:Unheated	1 - Law library ...			Insulation...	400	linear ft.		10.0		216			

Envelope -9.7%
Interior Lighting +19%
Exterior Lighting +15%

# Example : 2015 IECC Project failing due to window/wall percentage enforcement (cont)



COMcheck Software Version 4.1.1.0

## Envelope Compliance Certificate

### Project Information

Energy Code: 2015 IECC  
Project Title: Project Demo  
Location: Bozeman, Montana  
Climate Zone: 6b  
Project Type: New Construction  
Vertical Glazing / Wall Area: 40%  
Permit Date: 998877  
Permit No. XYZ

**C402.4.1 Maximum area.** The vertical fenestration area (not including opaque doors and opaque spandrel panels) shall not be greater than 30 percent of the gross above-grade wall area. The skylight area shall not be greater than 3 percent of the gross roof area.

Construction Site:  
123 Main St.  
Mainville, MT 59515

Owner/Agent:  
John Doe  
Acme Real Estate Agency  
321 Example Ave.  
Example, MT 99522  
444-333-2222  
example@example.com

Designer/Contractor:  
Jane Contractor  
Excel Contractors, Inc.  
444 Contractor Ave.  
Contractorville, MT 99999  
999-999-9999  
email@email.com

### Additional Efficiency Package(s)

On-site Renewable Energy

### Building Area

### Floor Area

1-Law library (Court House) : Nonresidential

10000

### Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U- Factor <sup>(a)</sup>
Roof: Insulation Entirely Above Deck, [Bldg. Use 1 - Law library]	10000	---	30.0	0.032	0.032
Slab floor: Slab-On-Grade:Unheated, Vertical 2 ft., [Bldg. Use 1 - Law library] (c)	400	---	10.0	0.540	0.540
<b>NORTH</b>					
Exterior Wall 1: Wood-Framed, 24" o.c., [Bldg. Use 1 - Law library]	1000	13.0	7.5	0.050	0.051
Window 1: Metal Frame:Fixed, Perf. Specs.: Product ID AX321, SHGC 0.40, VT 0.44, [Bldg. Use 1 - Law library] (b)	400	---	---	0.360	0.360
<b>EAST</b>					
Exterior Wall 2: Wood-Framed, 24" o.c., [Bldg. Use 1 - Law library]	1000	13.0	7.5	0.050	0.051
Window 2 in Wall2: Metal Frame:Fixed, Perf. Specs.: Product ID AX321, SHGC 0.40, VT 0.44, [Bldg. Use 1 - Law library] (b)	400	---	---	0.360	0.360

# Example : 2012 IECC Project failing due to window/wall percentage enforcement (cont)

Zone6WoodFrame WWR eg fails.ckk - COMcheck 4.1.1.0 Code: 2012 IECC


File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
▼	Building													
1	Roof	Insulation En								30.0	0.032			
2	▼ Exterior Wall 1	Wood-Frame								7.5	0.050			
3	Window 1	Metal Frame:									0.360	0.40	0.00	0.44
4	▼ Exterior Wall 2	Wood-Frame								7.5	0.050			
5	Window 2 in Wall2	Metal Frame:									0.360	0.40	0.00	0.44
6	▼ Exterior Wall 3	Wood-Frame								7.5	0.050			
7	Window 3 in wall 3	Metal Frame:									0.360	0.40	0.00	0.44
8	▼ Exterior Wall 4	Wood-Framed, 24" o.c.	1 - Law library ...	South			1000	ft2	13.0	7.5	0.050			
9	Window 4 in wall 4	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	0.40	0.00	0.44
10	Slab floor	Slab-On-Grade:Unheated	1 - Law library ...			Insulation...	400	linear ft.		10.0				

**COMcheck**

 The window and glazed door area of your building exceeds 30% of the gross area of above-grade walls. This limit can be increased to 40% provided daylighting requirements are met. For requirement details visit the Options page in the help file. To apply this allowance, select Options->Daylighting Allowances->Vertical Fenestration Area.

Alternatively, the 2012 IECC allows you to demonstrate compliance using ASHRAE/IES Standard 90.1-2010, which does not impose this limitation. Select '90.1 (2010) Standard' from the Code menu to proceed with this alternative.

☐ Don't show again. OK

Envelope -1% Interior Lighting +45% Exterior Lighting +65%



# Example : 2015 IECC Project failing due to window/wall percentage enforcement (cont)

Zone6WoodFrame WWR eq fails.cck - COMcheck 4.1.1.0 Code: 2015 IECC

File Edit View Options Code Help

Project E Mechanical Requirements

Roof Styling

Comments/Description (Envelope)  
✓ Orientation (Envelope)  
✓ Visible Transmittance (Envelope)  
Daylighting Allowances (Envelope)  
Glazing Allowances (Envelope)  
✓ Interior Lighting Exemptions and Allowances  
Exterior Lighting Exemptions

Vertical Fenestration Area  
Skylight Area

Area Type Orientation

	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA	SHGC	Projection Factor	VT
▼ Building											
1 Roof	Insulation Entirely Above Deck	1 - Law library ...	10000	ft2		30.0	0.032	320			
2 ▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	1000	ft2	13.0	7.5	0.050	30			
3 Window 1	Metal Frame:Fixed		400	ft2			0.360	144	0.40	0.00	0.4
4 ▼ Exterior Wall 2	Wood-Framed, 24" o.c.	1 - Law library ...	1000	ft2	13.0	7.5	0.050	30			
5 Window 2 in Wall2	Metal Frame:Fixed		400	ft2			0.360	144	0.40	0.00	0.4
6 ▼ Exterior Wall 3	Wood-Framed, 24" o.c.	1 - Law library ...	1000	ft2	13.0	7.5	0.050	30			
7 Window 3 in wall 3	Metal Frame:Fixed		400	ft2			0.360	144	0.40	0.00	0.4
8 ▼ Exterior Wall 4	Wood-Framed, 24" o.c.	1 - Law library ...	1000	ft2	13.0	7.5	0.050	30			
9 Window 4 in wall 4	Metal Frame:Fixed		400	ft2			0.360	144	0.40	0.00	0.4
10 Slab floor	Slab-On-Grade:Unheated	1 - Law library ...	400	linear ft.		10.0		216			

Envelope -9.7% [CPA: 120] Interior Lighting +42% Exterior Lighting +65%

Passes when daylighting allowance is selected:

10	Slab floor	Slab-On-Grade:Unheated	1 - Law library ...	Insulation...	400	linear ft.	10.0	216			
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Envelope +0.3% [CPA: -4] Interior Lighting +42% Exterior Lighting +65%

# Example : 90.1-2013 project fails due to internal gains from solar heat

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
▼ Building														
1	Roof Entire Facility	Insulation Entirely Above Deck	1 - Guardh...				190	ft2		35.0	0.028			
2	Floor	Slab-On-Grade:Unheated	1 - Guardh...			Insulation: Horizontal ...	56	linear ft.		15.0				
3	North Wall	Steel-Framed, 16" o.c.	1 - Guardh...	North			92	ft2	19.0	11.0	0.050			
4	South Wall	Steel-Framed, 16" o.c.	1 - Guardh...	South			92	ft2	19.0	11.0	0.050			
5	Window 3	Metal Frame:Fixed			Product ID: NA ...		40	ft2			0.420	0.40	0.00	1.00
6	East Wall	Steel-Framed, 16" o.c.	1 - Guardh...	East			132	ft2	19.0	11.0	0.050			
7	Window 1	Metal Frame:Fixed			Product ID: NA ...		60	ft2			0.420	0.40	0.00	1.00
8	West Wal	Steel-Framed, 16" o.c.	1 - Guardh...	West			132	ft2	19.0	11.0	0.050			
9	Window 2	Metal Frame:Fixed			Product ID: NA ...		60	ft2			0.420	0.40	0.00	1.00

☒ Check Envelope Compliance
 [Help](#)
 Envelope **-5%**
 Interior Lighting **TBD**
 Exterior Lighting **TBD**

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
▼ Building														
1	Roof Entire Facility	Insulation Entirely Above Deck	1 - Guardh...				190	ft2		35.0	0.028			
2	Floor	Slab-On-Grade:Unheated	1 - Guardh...			Insulation: Horizontal ...	56	linear ft.		15.0				
3	North Wall	Steel-Framed, 16" o.c.	1 - Guardh...	North			92	ft2	19.0	11.0	0.050			
4	South Wall	Steel-Framed, 16" o.c.	1 - Guardh...	South			92	ft2	19.0	11.0	0.050			
5	Window 3	Metal Frame:Fixed			Product ID: NA ...		40	ft2			0.420	0.33	0.00	1.00
6	East Wall	Steel-Framed, 16" o.c.	1 - Guardh...	East			132	ft2	19.0	11.0	0.050			
7	Window 1	Metal Frame:Fixed			Product ID: NA ...		60	ft2			0.420	0.33	0.00	1.00
8	West Wal	Steel-Framed, 16" o.c.	1 - Guardh...	West			132	ft2	19.0	11.0	0.050			
9	Window 2	Metal Frame:Fixed			Product ID: NA ...		60	ft2			0.420	0.33	0.00	1.00

☒ Check Envelope Compliance
 [Help](#)
 Envelope **+0.1%**
 Interior Lighting **TBD**
 Exterior Lighting **TBD**

# Example : Metal Building Roof Liner specification

example2015IECC.cck - COMcheck 4.1.1.0      Code: 2015 IECC


File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area or Slab Perimeter	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA	SHGC	Projection Factor	VT
▼ Building															
1	Roof 1	Insulation Entirely Abo...	1 - Law library ...				10000	ft2	50.0		0.020	200			
2	Roof 2	Metal Building, Standin...	1 - Law library ...			Liner Syst...	0	ft2	0.0	0.0	0.280	0			
3	▼ Exterior Wall 1	Wood-Framed, ...									0.038	38			
4	Window 1	Metal Frame:Fix									0.420	210	0.40	0.00	0.44
5	▼ Exterior Wall 1	Wood-Framed, ...									0.038	38			
6	Window 1	Metal Frame:Fix									0.420	210	0.40	0.00	0.44
7	▼ Exterior Wall 1	Wood-Framed, ...									0.038	38			
8	Window 1	Metal Frame:Fix									0.420	210	0.40	0.00	0.44
9	▼ Exterior Wall 1	Wood-Framed, ...									0.038	38			
10	Window 1	Metal Frame:Fix									0.420	210	0.40	0.00	0.44
11	Exterior Wall 5	Wood-Framed, ...									0.038	19			
12	Exterior Wall 5 c	Wood-Framed, ...									0.038	19			
13	Floor 2	Slab-On-Grade										204			

**COMcheck**

 ASHRAE 90.1 (2013) Standard only provides two rated cavity insulation levels for the selected assembly: R-0 and R-30. Insulation levels and equivalent U-factors within this range are supported using linear interpolation. Note however that this method produces results that will be conservative relative to rated insulation levels. No additional credit will be provided for cavity insulation above R-30. As an alternative, consider specifying the assembly as an 'Other' assembly type.

Metal building roof insulation that is draped over and compressed when the metal roof panels are attached is to be considered cavity insulation. Continuous insulation is assumed to be uninterrupted by any framing or structural members and where no compression of the insulation occurs. Please verify that your entries are correct. Refer to the Help system for definitions of continuous and cavity insulation.

OK

# Example : Metal Building Roof Liner specification (cont)

MB Liner Insul Misspecification.ckk - COMcheck 4.1.1.0 Code: 2015 IECC

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA	SHGC	Projection Factor	VT
▼	Building														
1	Roof 2	Metal Building, Standin...	1 - Law library ...			Liner Syst...	1781	ft2	19.0	11.0	0.077	137			
2	▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	North			1500	ft2	19.0	0.0	0.065	65			
3	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		500	ft2			0.420	210	0.20	0.00	0.44
4	▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	East			1500	ft2	19.0	0.0	0.065	65			
5	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		500	ft2			0.420	210	0.20	0.00	0.44
6	▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	West			1500	ft2	19.0	0.0	0.065	65			
7	Window 1	Metal Frame:Fixed			Product ID: AX321 ...								0.20	0.00	0.44
8	▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	South									0.20	0.00	0.44
9	Window 1	Metal Frame:Fixed			Product ID: AX321 ...										
10	Exterior Wall 5	Wood-Framed, 24" o.c.	2 - Paralegal o...	North											
11	Exterior Wall 5	Wood-Framed, 24" o.c.	2 - Paralegal o...	East											
12	Floor 2	Slab-On-Grade:Unhea...	1 - Law library ...			Insula									

Envelope -0.1% [CPA: 1] Interior Lighting

**TABLE A2.3**

Insulation System	Rated R-Value of Insulation	Total Rated R-Value of Insulation	Overall U-Factor for Entire Base Roof Assembly
<b>Thru-Fastened without Thermal Spacer Blocks</b>			
None	0		U-1.280
R-10	10		U-0.153
R-11	11		U-0.139
R-13	13		U-0.130
R-16	16		U-0.106
R-19	19		U-0.098
Liner System	R-11+R-19	30	U-0.044

Climate zone 3 requires "R-19 + R-11 LS"  
(Liner System) or U-0.035

# Example : Metal Building Roof Liner specification (cont)

MB Liner Insul Misspecification.cck - COMcheck 4.1.1.0 Code: 2015 IECC

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA	SHGC	Projection Factor	VT
▼ Building															
1	Roof 2	Metal Building, Standin...	1 - Law library ...			Liner Syst...	1781	ft2	30.0	0.0	0.040	71			
2	Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	North			1500	ft2	19.0	10.0	0.038	38			
3	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		500	ft2			0.420	210	0.20	0.00	0.44
4	Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	East			1500	ft2	19.0	10.0	0.038	38			
5	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		500	ft2			0.420	210	0.20	0.00	0.44
6	Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	West			1500	ft2	19.0	10.0	0.038	38			
7	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		500	ft2			0.420	210	0.20	0.00	0.44
8	Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	South			1500	ft2	19.0	10.0	0.038	38			
9	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		500	ft2			0.420	210	0.20	0.00	0.44
10	Exterior Wall 5	Wood-Framed, 24" o.c.	2 - Paralegal o...	North			500	ft2	19.0	10.0	0.038	19			
11	Exterior Wall 5	Wood-Framed, 24" o.c.	2 - Paralegal o...	East			500	ft2	19.0	10.0	0.038	19			
12	Floor 2	Slab-On-Grade:Unhea...	1 - Law library ...			Insulation...	400	linear ft.		20.0		204			

Envelope +13.3% [CPA: -201] Interior Lighting +29% Exterior Lighting +19%

# Example: Slab-On-Grade misspecification

Slab problems.cck - COMcheck 4.1.1.0 Code: 90.1 (2013) Standard

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Semi-Exterior Wall Window Door Basement Floor

Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
▼ Building										
▼ Roof	Insulation Entirely Above Deck	1 - Warehouse (Warehouse Nonresidential 22864 sq....)				22864	ft2		30.0	0.0
Skylight	Metal Frame with Thermal Br...			Product ID: PrisM....		256	ft2			0.4
Roof	Insulation Entirely Above Deck	3 - Second Floor ( Office Nonresidential 1554 sq.ft. )				1554	ft2		30.0	0.0
▼ Ext. Wall	Other Metal Building Wall	1 - Warehouse (Warehouse Nonresidential 22864 sq....)	West			4496	ft2			0.0
Door	Insulated Metal				Swinging	42	ft2			0.3
▼ Ext. Wall	Other Metal Building Wall	1 - Warehouse (Warehouse Nonresidential 22864 sq....)	East			4496	ft2			0.0
Door	Insulated Metal				Swinging	21	ft2			0.3
Ext. Wall	Other Metal Building Wall	1 - Warehouse (Warehouse Nonresidential 22864 sq....)	North			5190	ft2			0.0
▼ Ext. Wall	Other Metal Building Wall	1 - Warehouse (Warehouse Nonresidential 22864 sq....)	South			4934	ft2			0.0
Door	Insulated Metal				Swinging	21	ft2			0.3
Door	Insulated Metal				Garage door < 14% glazing	384	ft2			0.0
▼ Ext. Wall	Other Metal Building Wall	2 - First Floor ( Office Nonresidential 1554 sq.ft. )	South			400	ft2			0.0
Door	Insulated Metal				Swinging	21	ft2			0.3
Ext. Wall	Other Metal Building Wall	3 - Second Floor ( Office Nonresidential 1554 sq.ft. )	South			400	ft2			0.0
Floor	Slab-On-Grade:Unheated	3 - Second Floor ( Office Nonresidential 1554 sq.ft. )			Insulation: Horizontal with Vertical , 2 ft	22864	linear ft.		0.0	

☒ Check Envelope Compliance
 [Help...](#)
Envelope **TBD**
Interior Lighting **TBD**
Exterior Lighting **TBD**



# Example: Slab-On-Grade Construction Details

Untitled.cck - COMcheck 4.1.1 Code: 2018 IECC

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area or Slab Perimeter	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA	SHGC	Projection Factor
	▼ Building													
1	Floor 1	Slab-On-Grade:Unhea...	1 - Court Hous...			Insulation: Horizontal , 2 ft	200	linear ft.		10.0		140		
2	Floor 1 copy 1	Slab-On-Grade:Unhea...	1 - Court Hous...			Insulation: Vertical , 2 ft	200	linear ft.		10.0		108		

# Example: 90.1-2013/2016 Glazing Orientation

Zone6WoodFrame 2013 fails E\_W rotation.cck - COMcheck 4.1.1.0 Code: 90.1 (2013) Standard

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Semi-Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
▼	Building													
1	Roof	Insulation Entirely Abo...	1 - Law library ...				10000	ft2		30.0	0.032			
2	▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	North			1000	ft2	13.0	7.5	0.050			
3	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		200	ft2			0.360	0.40	0.00	0.44
4	▼ Exterior Wall 2	Wood-Framed, 24" o.c.	1 - Law library ...	East			1000	ft2	13.0	7.5	0.050			
5	Window 2	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	0.40	0.00	0.44
6	▼ Exterior Wall 3	Wood-Framed, 24" o.c.	1 - Law library ...	West			1000	ft2	13.0	7.5	0.050			
7	Window 3	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	0.40	0.00	0.44
8	▼ Exterior Wall 4	Wood-Framed, 24" o.c.	1 - Law library ...	South			1000	ft2	13.0	7.5	0.050			
9	Window 4	Metal Frame:Fixed			Product ID: AX321 ...		200	ft2			0.360	0.40	0.00	0.44
10	Slab floor	Slab-On-Grade:Unhea...	1 - Law library ...			Insulation: ...	400	linear ft.		15.0				

☒ Check Envelope Compliance 
 [Help...](#) 
 Envelope **-0.4%** 
 Interior Lighting **+42%** 
 Exterior Lighting **+65%**

Envelope FAILS

**Modelling requirement:** If the majority of window area faces east and west, COMcheck must model and simulate the code (budget) building 4 times, with the front facing each of the 4 cardinal orientations in turn, then average the 4 energy performance results and compare that result to the proposed energy cost factor.

# Example: 90.1-2013/2016 Glazing Orientation (cont)

Zone6WoodFrame 2013 fails E\_W rotation.cck - COMcheck 4.1.1.0 Code: 90.1 (2013) Standard

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Semi-Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
▼	Building													
1	Roof	Insulation Entirely Abo...	1 - Law library ...				10000	ft2		30.0	0.032			
2	▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	East			1000	ft2	13.0	7.5	0.050			
3	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		200	ft2			0.360	0.40	0.00	0.44
4	▼ Exterior Wall 2	Wood-Framed, 24" o.c.	1 - Law library ...	South			1000	ft2	13.0	7.5	0.050			
5	Window 2	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	0.40	0.00	0.44
6	▼ Exterior Wall 3	Wood-Framed, 24" o.c.	1 - Law library ...	North			1000	ft2	13.0	7.5	0.050			
7	Window 3	Metal Frame:Fixed			Product ID: AX321 ...		400	ft2			0.360	0.40	0.00	0.44
8	▼ Exterior Wall 4	Wood-Framed, 24" o.c.	1 - Law library ...	West			1000	ft2	13.0	7.5	0.050			
9	Window 4	Metal Frame:Fixed			Product ID: AX321 ...		200	ft2			0.360	0.40	0.00	0.44
10	Slab floor	Slab-On-Grade:Unhea...	1 - Law library ...			Insulation: ...	400	linear ft.		15.0				

☒ Check Envelope Compliance
 [Help...](#)
 Envelope **+1%**
 Interior Lighting **+42%**
 Exterior Lighting **+65%**

Envelope PASSES

Rotate the orientations of each wall 90 degrees and the project passes.

# Example: 90.1-2013/2016 Glazing Orientation (cont)

Zone6WoodFrame 2013 fails E\_W rotation.cck - COMcheck 4.1.1.0      Code: 90.1 (2013) Standard

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Semi-Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
▼ Building														
1	Roof	Insulation Entirely Abo...	1 - Law library ...				10000	ft2		30.0	0.032			
2	▼ Exterior Wall 1	Wood-Framed, 24" o.c.	1 - Law library ...	North			1000	ft2	13.0	7.5	0.050			
3	Window 1	Metal Frame:Fixed			Product ID: AX321 ...		200	ft2			0.360	0.40	0.00	0.44
4	▼ Exterior Wall 2	Wood-Framed,									0.050			
5	Window 2	Metal Frame:Fi									0.360	0.40	0.00	0.44
6	▼ Exterior Wall 3	Wood-Framed,									0.050			
7	Window 3	Metal Frame:Fi									0.360	0.40	0.00	0.44
8	▼ Exterior Wall 4	Wood-Framed,									0.050			
9	Window 4	Metal Frame:Fi									0.360	0.40	0.00	0.44
10	Slab floor	Slab-On-Grade												

Envelope FAILS

Computer > OSDisk (C:) > Users > <user name> > AppData > Local > Temp > COMcheck > OpenStudio\_Runs >

Include in library Share with Burn New folder

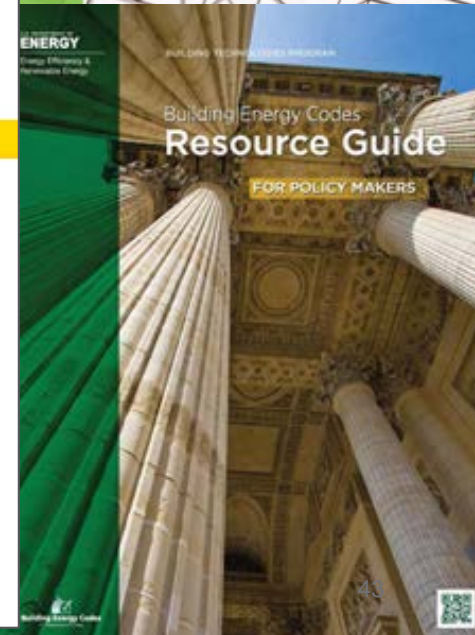
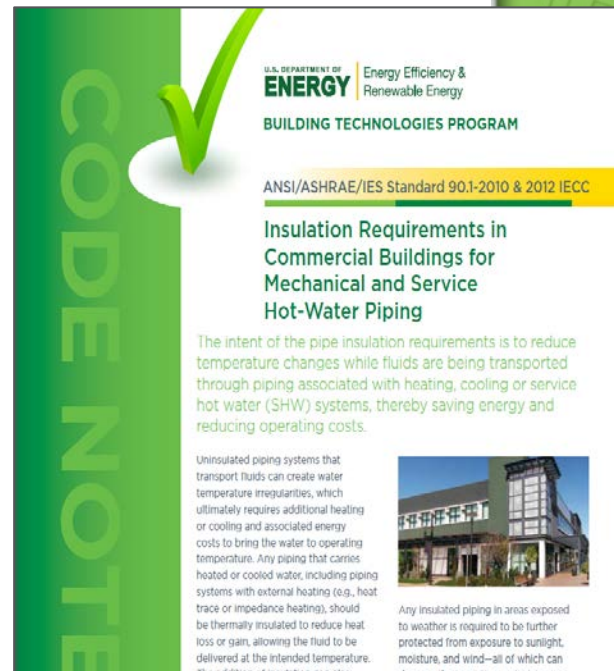
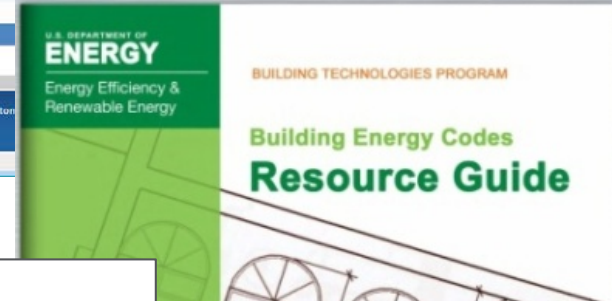
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code_bldg_job_dir_N270	5/8/2019 1:4
prop_bldg_job_dir	5/8/2019 1:4
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# U.S. DOE: Building Energy Codes Program Resources

- ▶ Compliance software
- ▶ Technical support
- ▶ Code notes
- ▶ Publications
- ▶ Resource guides
- ▶ Training materials

[www.energycodes.gov](http://www.energycodes.gov)

Row	Component	Assembly	Orientation	Building Area Type	Fenestration Details	Construction Details	Gross Area	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
1	Roof	Insulation Entirely Above Deck		1 - Retail (Nonresidential...)			10000 ft <sup>2</sup>		38	0.026
2	Ext. Wall	Wood-Framed, 24in. o.c.	North	1 - Retail (Nonresidential...)			2600 ft <sup>2</sup>	20	10	0.037
3	Window	Vinyl Frame: Fixed								
4	Door	Insulated Metal								



# THANK YOU!

Building Energy Codes Program

[www.energycodes.gov](http://www.energycodes.gov)

BECP help desk

<https://www.energycodes.gov/HelpDesk>

