

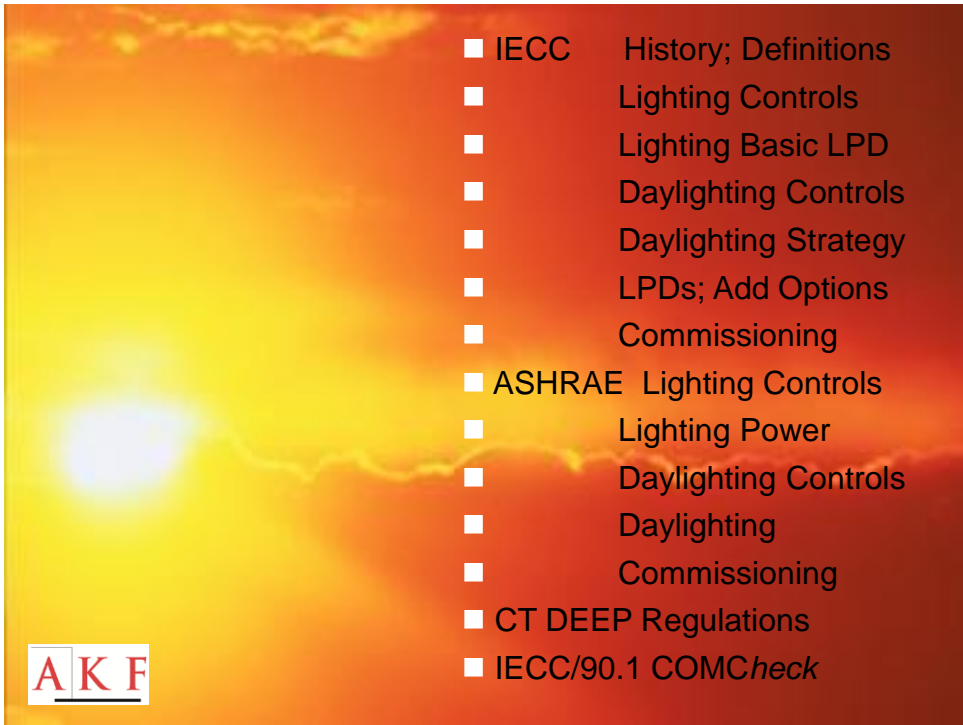


State of Connecticut
Department of Administrative Services
Division of Construction Services
Office of Education and Data Management


Daylighting Options and the 2012 IECC

*Presented by
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for the*

*Office of Education and Data Management
Spring 2016 Career Development Series*



- IECC History; Definitions
- Lighting Controls
- Lighting Basic LPD
- Daylighting Controls
- Daylighting Strategy
- LPDs; Add Options
- Commissioning
- ASHRAE Lighting Controls
- Lighting Power
- Daylighting Controls
- Daylighting
- Commissioning
- CT DEEP Regulations
- IECC/90.1 COMCheck



Lighting and Daylighting

Natural Light as a Historical Resource



- 40,000 years (or more)?
- Good example of how much we tend to forget or to ignore what we learned in history
- Solar is not 100% free, but maybe the least costly energy available

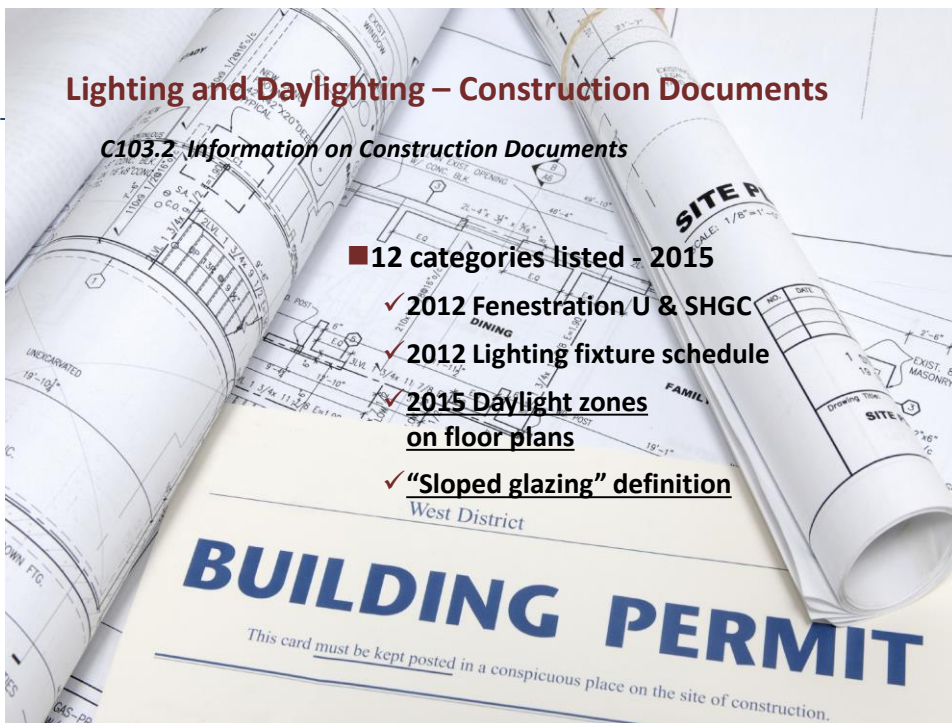


Daylighting - and Lighting

Daylighting History in IECC

IECC 2004-2009 Optional; Fenestration at 40% vertical, 3% skylighting

- **2000** Fenestration varies – 10-50%; 3% skylights; U-factors vary; no daylighting requirements
- **2004** No daylighting requirements
- **2006** No daylighting requirements
- **2009** No daylighting requirements; **505.2.2.3** requires ‘independent’ automatic lighting control if daylighting provided



Construction Documents

C103.2 Information on Documents (2 NEW in 2015)

2012 Details shall include, but not be limited to

- “insulation materials and their R-values; fenestration U-factors and SHGC’s; area-weighted U-factor and SHGC calculations; mechanical systems and equipment types, sizes and efficiencies; economizer description; systems and controls; duct sealing, duct and pipe insulation and location; lighting fixture schedule with wattage and control narrative; and air sealing details”

2015 Creates Details List

1. Insulation materials; R-values
2. Fenestration
3. Area-weighted U- and SHGC factors
4. Mechanical system design, control
5. Mechanical, SWH system/equipment types, sizes, efficiencies
6. Economizer descriptions
7. Equipment & system controls
8. **Fan motor HP, controls**
9. Duct sealing; duct & pipe insulation
10. Lighting fixture schedule; narrative
11. **Location of daylight zones on floor plans**
12. Air sealing details

Important Definition Changes



Section C202

- Above-Grade Wall – See C402.2.1- (15%)
- General Lighting
- Fenestration
 - ✓ *Vertical*
 - ✓ *Sloped*
 - ✓ *Dynamic glazing*
- *Skylight (15⁰->30⁰)*
- *Visible transmittance*

Applicable Definitions

C202; IBC 2404.2*



- Vertical Glazing
 - ✓ Changes to 90.1 definition
- Sloped Glazing *
 - ✓ IBC 2404.2 Safety Glazing
- Visible transmittance [VT]
 - ✓ drives SHGC
- Dynamic glazing
- Undefined:
 - ✓ Sidelighting
 - ✓ Toplighting

Managing Lighting

Through Design and Control – C405

- Basic Design Goal: Safely and effectively illuminate all general and specific use(s) in building spaces / areas
 - ✓ General lighting
 - ✓ Task lighting
 - ✓ M.O.E. illumination
- Exterior and interior



Lighting Controls - Basics

Basic Concepts: Lighting Controls

- Manual lighting controls
 - ✓ Light reduction
- Additional control
 - ✓ T.O.D. switch devices
 - ✓ Occupancy sensors
 - ✓ Override control
- Daylight zone control
 - ✓ Manual
 - ✓ Automatic
 - ✓ Multi-level
- Dedicated applications



Lighting – Manual Control (Mandatory)

C405.2.1.1 Interior Lighting Controls



- Manual control of separate spaces with status indication
- Exceptions:
 - ✓ Continuously lit security or emergency area
 - ✓ Stairways, corridors, M.O.E.

Managing Natural Light

Through Design and Control – C402.3

■ **Daylighting Scope:**

All illumination uses where lighting energy can be effectively and safely reduced with natural lighting sources and controls

- ✓ Using practical building design solutions,
- ✓ Adding daylight-responsive controls where achievable.



Glazing Strategies

Taming Natural Lighting – Intensity & Glare

- Coatings/films - SHGC
- Shading - PF
- Diffusion – Obscured
- *Redirection – Light shelf
- *Refraction films – (new)



Glazing Strategies

Taming Natural Lighting – Redistribution

- *Refraction films – (3M new product)



Lighting Controls



Lighting Reduction Controls (Mandatory)

C405.2.1.2

- Manual light reduction control by at least 50% in a reasonably uniform manner
 - ✓ All lamps or luminaires
 - ✓ Dual switching: alternate rows
 - ✓ Individual switching
- Exceptions:
 - ✓ One room, one luminaire
 - ✓ Occupancy sensor control
 - ✓ Spaces using < 0.6 w/sf
 - ✓ Spaces with daylight-responsive automatic controls
 - ✓ Eight specific use spaces



Lighting Controls (Mandatory)

C405.2.2 Additional Lighting Controls



- Automatic time switch control
- Occupancy sensors
- Daylight-responsive control
- Exceptions
 - ✓ Sleeping units
 - ✓ Patient care spaces
 - ✓ Safety & security spaces
 - ✓ Continuous utilized spaces

Additional Lighting Controls

C405.2.2.2 Occupancy Sensors

- Spaces \geq 300 sf
- Switch off after 30 minutes of non-occupancy



- Classrooms
- Meeting rooms
- Lunch/break rooms
- Private offices
- Restrooms
- Storage rooms
- Custodial closets

Additional Lighting Controls

C405.2.2.3 Daylight Zone Control

- Max. 2,500sf lighting zone
- Independent control; either manual or automatic
- Can be continuous dimming
- Can be multi-level stepped dimming controls
 - ✓ Where daylight exceeds general lighting, a power rating reduction to \leq 35% must be achieved





Mars Hill

Maine

Lighting Power - Basics

Basic Concepts: LPD by Type of Use



- Limits allowable power
- Basically $LPD \times A$
 - ✓ Of building
 - ✓ Of space
- Special Exceptions
 - ✓ Means of Egress
 - ✓ Safety/security
- Rules for how to calculate
- Exempt Lighting
 - ✓ 14 categories

Lighting Density

C405.5.1 Connected Lighting Power Assumptions

Tables C405.5.2 LPD Values

- Line voltage – lighting
 - ✓ E26/other screw base: max. W
 - ✓ Fixture rating, other luminaires
 - ✓
 - ✓ Low Voltage – transformer or system rating
- Exceptions for 14 lighting categories



Lighting Power Densities

C405.5 Indoor Lighting Power Allowances (ILPA)

LPD by Use and Occupancy

- 33 Building Area Types
- Unlisted – similar use

LPD Space by Space

- 93 Space Types
- 2 Atrium listings
- Unlisted – similar use

Building Area Type	33	LPD (w/SF)
Automotive facility		1.2
Convention center		1.2
Courthouse		1.2
Space by Space Type	93	LPD (w/SF)
Courthouse		
Courtroom		1.90
Confinement cells		1.10
Judge chambers		1.30

Lighting Power Density Calculations

C405.5.1 Connected Lighting Power

(1) Building Area Method

■ $LPD \times \sum \text{Actual Floor Area}$

■ Mixed uses - sum separately

■ There are 14 Exceptions

- ✓ Exception for Casino Gaming Areas cannot be found in either interior ILPA Table



Lighting Power Density Calculations

C405.5.1 Connected Lighting Power

(2) Space-by-Space Method

■ $LPD \times \text{Area of Space and}$

■ $\sum \text{Area } 1 \text{ LP, area } 2 \text{ LP, etc.};$
divide by total floor area



Lighting Power Density Changes

C405.5.2 Table C405.5.2

- Conforms with 90.1-2013 ILPD changes
- Two new Building Type Options:
 - ✓ 5 densities **INCREASED**
 - ✓ 26 densities **UNCHANGED**
 - ✓ 0 densities **DECREASED**
- Space-by Space densities also change
- Toplighting and Sidelighting
- Combines lighting; new Tables
- Adds occupancy sensor controls
 - ✓ Locker rooms, warehouse aisleways
 - ✓ Control 50% reductions



https://www.ashrae.org/standards/90_1_2010_2013Addenda.pdf

Lighting Notes

Table C405.5.2(2) Notes - Additional Lighting for Specific Areas

- Four Merchandise Uses
- Vehicles, sporting goods,
 - I. Products unlisted below
 - II. Vehicles, sporting goods, electronics
 - III. Artwork, furniture, clothing, cosmetics
 - IV. Jewelry, crystal, china
- Switched separately



Lighting Notes to Table C405.5.2(2)

C405.2.3 Specific Application Dedicated Controls

Dedicated and Master
Separate Lighting Control

- Display / Accent Lighting
- Case Lighting
- Hotel Sleeping Units
- Individual task lights
- Food warming
- Lighting education



DAYLIGHTING

Daylighting Definitions

C202

■ Adjacent to vertical fenestration

- ✓ 15 ft. primary daylight area width
- ✓ 2 ft. side coverage

■ Under skylights:

- ✓ ≥ 15 ft. + skylight width

■ Not mentioned

- ✓ Transom; clerestory
- ✓ Ends of partitions
- ✓ Aperture

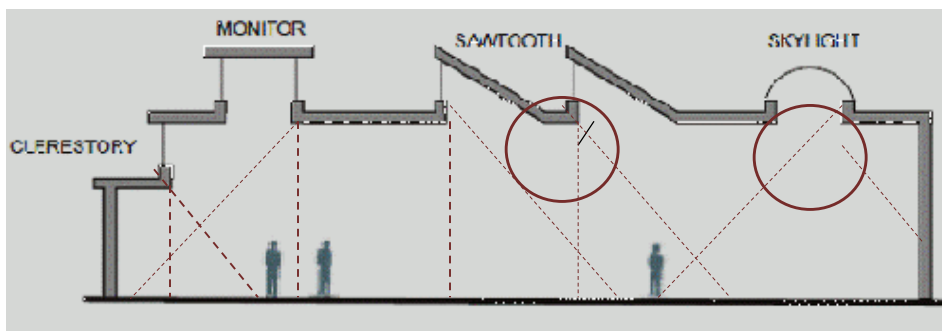


Glazing: What Counts? As What?

Basic Daylighting to Illuminate Interiors

Windows?

Skylights?



AKF

Daylighting Controls - Basics

Basic Concepts: Daylight-responsive control

- Natural light responsive
- Control lighting reductions
- May be multi-level or by individual fixture
- Immediate response to natural light changes with no delays
- Multiple orientations sensing



Measuring Daylight Opportunities / Problems

Solar Insolation "PATHFINDER" Tool

Sets for:

- Latitude
- Orientation

Determine:

- Bright sky
- Sun Angles
- Shading



Daylighting

C202; IBC 2404.2 Skylight and Sloped Glazing Definitions*



IECC Definitions: Daylighting

*C202; IBC 2404.2**

- Vertical Glazing [$\geq 60^\circ$ *]
 - ✓ Changes to 90.1 definition
- Skylight [$< 60^\circ$ *]
- *Sloped Glazing [$> 15^\circ$] per IBC 2404.2 Safety Glazing
- Undefined:
 - ✓ Light tubes
 - ✓ Deck prisms
 - ✓ Rooftop monitor*



Averaging Fenestration U- Factors

C402.3.4 Area-weighted U-factor

Separate area weighting:

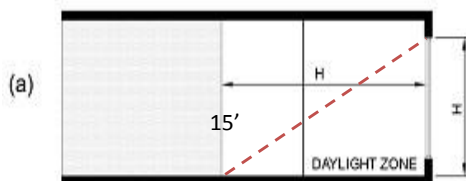
- Fixed fenestration
- Operable fenestration
- Entrance doors
- Skylights (all)



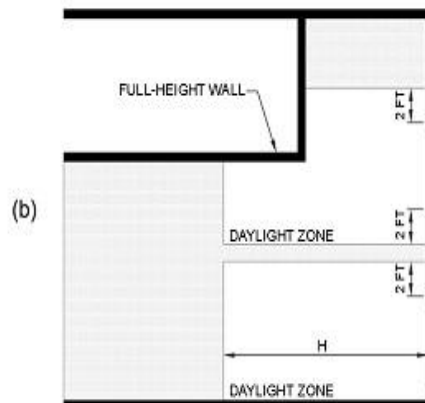
Sidelighting

C202 Daylight Zone Adjacent to Vertical Fenestration

- Daylight zone is 15 feet, regardless of window head
- Zone width/depth extends over partitions less than ceiling height



(a) Section view
(b) Plan view of daylight zone



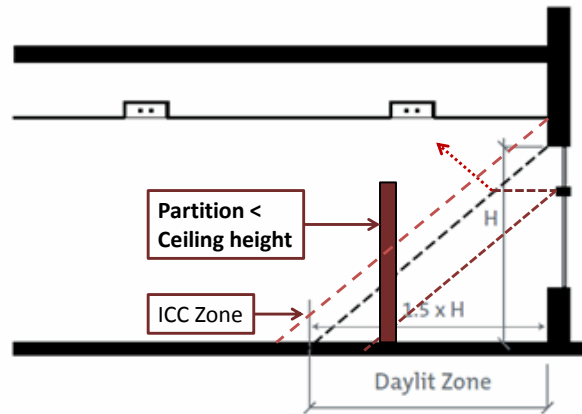
Sidelighting

C202 Prescriptive Definition

Daylight Zone =

- 15' – not head height
- Side margins of 2'
- Opaque wall cutoffs

- Light shelf does not change area measurement
- No allowances for technical strategies
- No penalties for non-uniformity of lighting



DAYLIT ZONE—SIDELIGHTING

Fenestration Limitations – (prescriptive option)

C402.3.1.2 Increased Skylight Area with Daylighting Controls



Vertical fenestration limits

- 30% without auto controls
- 40% with averaged F.A. \geq 50%
 - ✓ Limited to CZ 1-6
 - ✓ Applies to all stories
 - ✓ VT compliance (visible transmittance)
- VT \geq 1.1 x SHGC
 - ✓ NFRC 200

Sunlight Control in IECC

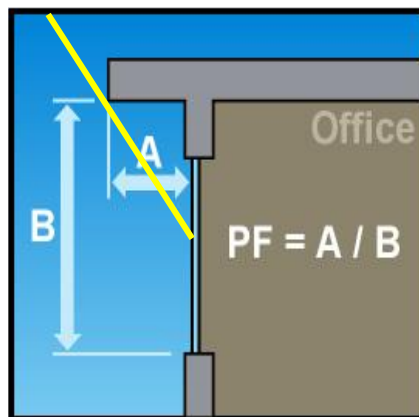
Daylighting Control: Projection Factor



Using Projection Factors

C402.3.3.1 SHGC Adjustment

- Fenestration U-factor constant; can be averaged
- SHGC factor modified by PF
- Modifications of SHGC are permitted by applying the percentages in Table C402.3.3.1



Daylighting

C402.3.2 Daylighting Required



- **Skylighting (Mandatory).**
15 areas with $\geq 50\%$ of floor area (FA) using **daylight-responsive** controls
 - ✓ Has $\geq 3\%$ min. skylight area to daylight zone with VT ≥ 0.40 ; or with $\geq 1\%$ effective aperture
 - ✓ Not required where lighting power densities are $< 0.5\text{W/s.f.}$
 - ✓ Not required in areas where daylight is obstructed

Daylighting

C402.3.2 Daylighting Prescriptive Requirement



Enclosed spaces $> 10,000$ s.f. directly under a roof with ceiling heights $\geq 15'$

Assembly Uses:

Gym; convention & transportation centers

Business & Mercantile Uses**

Offices; Retail stores; Automotive services

Associated spaces

Lobby; Atrium; Concourse; Corridor

Factory Uses:

Manufacturing**, Workshop;

Storage Uses:**

Warehouses (non-refrigerated);

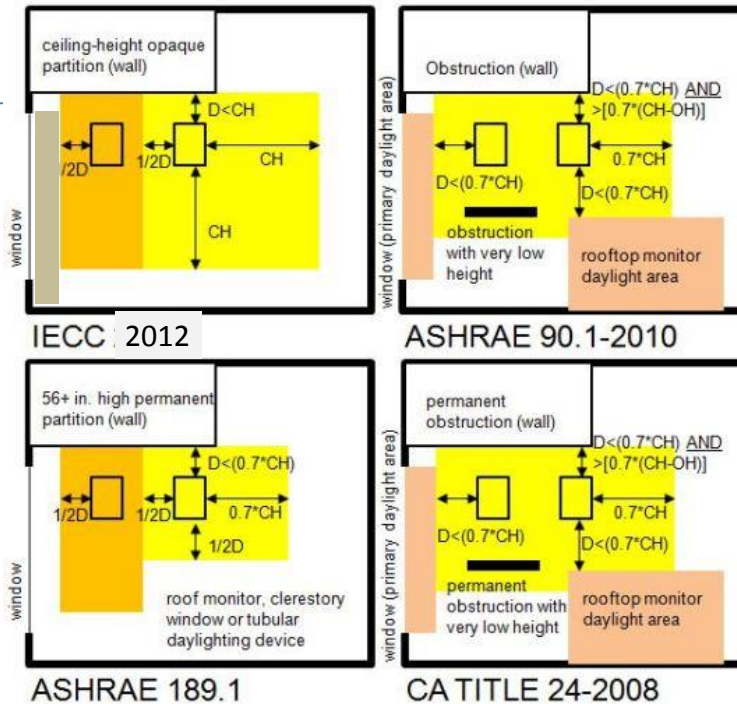
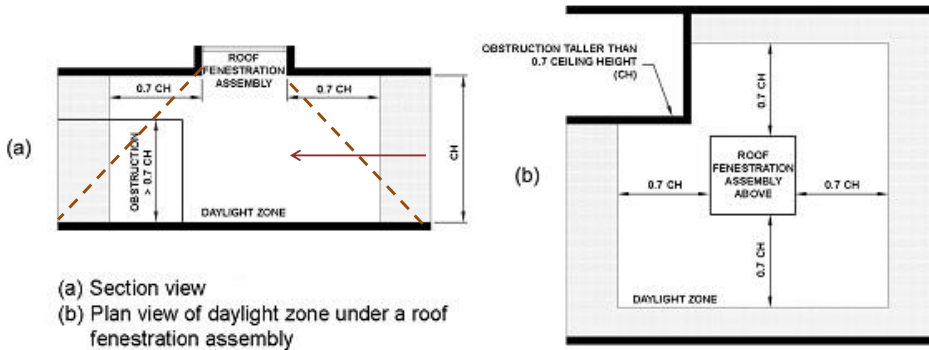
Distribution / Sorting, Storage

** **90% haze factor; these uses**

Skylights

C202 Daylight Zone Under Skylights

- Floor area dimension equals twice the height of the ceiling plus skylight width
- Only full-height partitions block the light to other portions of the illuminated area

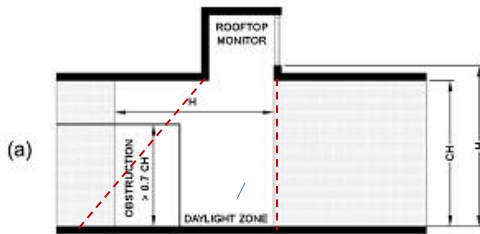


Toplighting

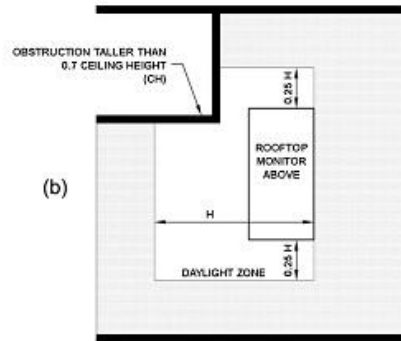
C402.3.2.1 Exception 4 (but does not define rooftop monitors)

■ Monitor Floor Area Allowance

■ Side illumination allowance



(a) Section view
(b) Plan view of daylight zone under a rooftop monitor



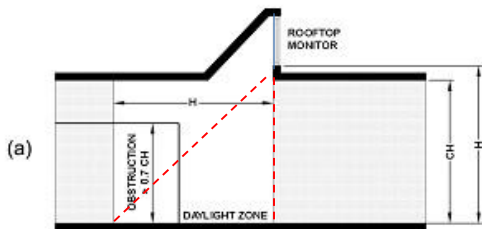
Toplighting - Alternative Monitor

C202 (lacks definition and description)

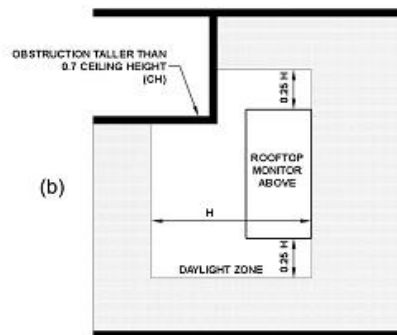
■ Treat like vertical fenestration

■ Sidelit area = 2 ft each side

■ Daylight zone = 15 ft from glass



(a) Section view
(b) Plan view of daylight zone under a rooftop monitor

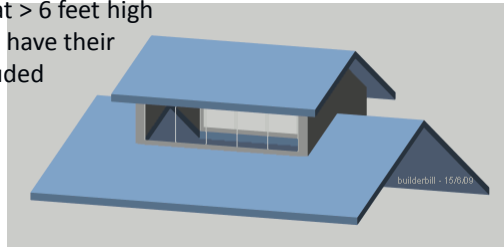


Daylight Responsive Controls

C402.3.2 / Fig. C405.2.3.2 (2015)

Rooftop Monitor Zones Change

- Zone: sill height of roof monitor fenestration, not 15'
 - ✓ Accounts for rooftop monitor glazing
 - ✓ Exception: where site shading occurs
- VT in existing buildings determines if a zone
- Figure C405.2.3.2. Partitions at > 6 feet high using roof monitor daylighting have their floor area below monitor included



Skylight Haze Factor

C402.3.2.2 Obscured Toplight Glazing

- Glazing material OR diffuser
 - ✓ > 90% obscuration
 - ✓ ASTM D 1003
- **Exception.** Achieve equivalent:
 - ✓ Geometry of skylight well
 - ✓ Fixed or automatic baffles



Obscured Toplighting

C402.3.2.2 90% Haze Factor



SHGC Daylight Control Exception

C402.3.3.3 Increased Skylight SHGC

- Daylight zones with automatic daylight-responsive lighting controls
- SHGC increases from 0.40 to ≤ 0.60
- Limited to CZ 1-6



Fenestration Maximum U-factors and SHGC

C402.5 Area-weighted U-factor and SHGC (Mandatory)



- Average maximum using tradeoffs for vertical glazing in CZ 4-5 is U-0.48
- Average maximum using tradeoffs for skylights in CZ 4-8 is U-0.75
- SHGC tradeoffs in CZ4-8 are not allowed

Additional Efficiency Options

C406.1 (2) Efficient Lighting System



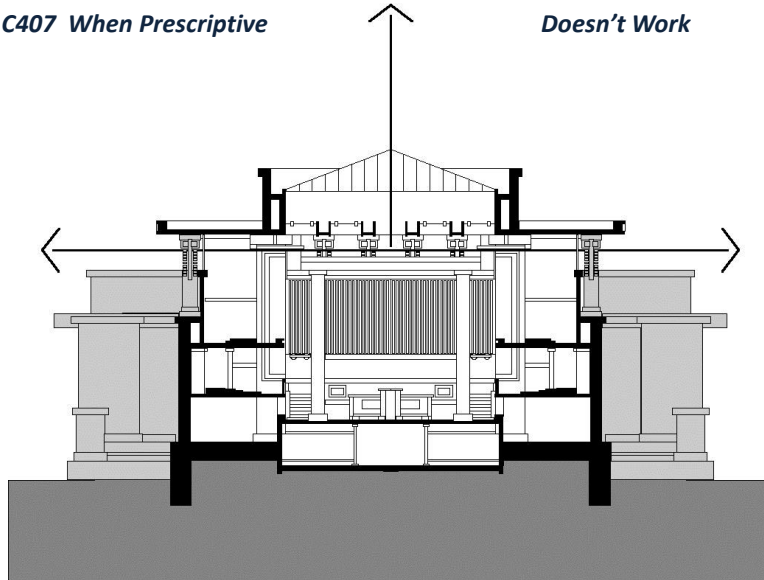
- Use of an additional option beyond a single category
- Contributes to 21% DEEP goal
- HVAC and renewable energy are the other options
- 2015 adds two further options to this path



Total Building Performance

C407 When Prescriptive

Doesn't Work



Total Building Performance

Table C407.5.1(1) Glazing Criteria

- Fenestration limit
 - ✓ Proposed value if < 40%
 - ✓ 40% if proposed is greater
- U-factor
 - ✓ 0.38 Fixed
 - ✓ 0.45 Operable
 - ✓ 0.77 Entry door
- SHGC 0.40
- No daylighting requirements



Total Building Performance

C407 Mandatory Compliance Inconsistencies

■ Fenestration at 40%

- ✓ Proposed value if $\leq 40\%$
- ✓ 40% if proposed is greater

■ U-factor	0.38 (all)
	0.45
	0.77
	0.40



■ Skylight limit of 3%

- ✓ Proposed value if $\leq 3\%$
- ✓ 3% if proposed is greater

■ U-factor	0.50 (all)
■ SHGC	0.40

Total Building Performance

Table C407.5.1(1) Glazing Criteria



■ Skylight limit of 3%

- ✓ Proposed value if $< 3\%$
- ✓ 3% if proposed is greater

■ U-factor	0.50 (all)
------------	------------

■ SHGC	0.40
--------	------

- ✓ Both from Table C402.3

■ No daylighting requirements

Total Building Performance

C407 Mandatory Compliance Inconsistencies

- Skylight limit of 3%
 - ✓ Proposed value if $\leq 3\%$
 - ✓ 3% if proposed is greater
- U-factor 0.50 (all)
- SHGC 0.40



Total Building Performance

C407 Mandatory Compliance Inconsistencies

- | | |
|-----------------------------|-----------------------------|
| ■ Fenestration at 40% | ■ Skylight limit of 3% |
| ✓ Proposed value if $< 3\%$ | ✓ Proposed value if $< 3\%$ |
| ✓ 3% if proposed is greater | ✓ 3% if proposed is greater |
| ■ U-factor 0.50 (all) | ■ U-factor 0.50 (all) |
| ■ SHGC 0.40 | ■ SHGC 0.40 |

Commissioning

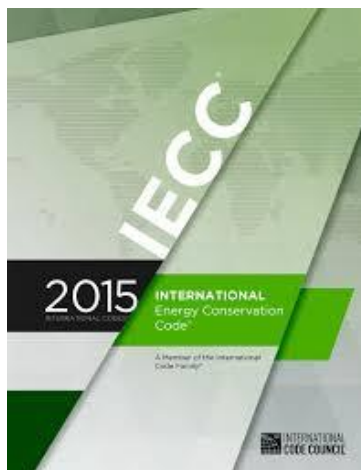
C408.3 Lighting System Functional Testing

- Installed lighting and power
- Luminaires; fixtures; systems
- Lighting controls
 - ✓ Time Switch controls
 - ✓ Automatic controls
 - ✓ Occupancy sensors
 - ✓ Daylight-responsive controls
- Override controls
- Safety; security;
- 24-hour operation



2015 International Energy Conservation Code

Previews of Coming Changes



- C402 Envelope
- C402 Daylighting
- C406 Lighting Power
- C406 Lighting Controls
- C407 Added Efficiency Options
- C408 Commissioning



Glazing: Orientation in 2015 (*prescriptive*)

Table C402.4: U-factor / SHGC Requirements by Orientation

Climate Zone	1		2		3		4 except Marine		5 and Marine		6		7	
Vertical Fenestration U-factors														
Fixed	0.50		0.50		0.46		0.38		0.38		0.36		0.29	
Operable	0.65		0.65		0.60		0.45		0.45		0.43		0.37	
Doors	1.10		0.83		0.77		0.77		0.77		0.77		0.77	
SHGC	ESW N		ESW N		ESW N		ESW N		ESW N		ESW N		ESW N	
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.40	0.53	0.40	0.53	0.40	0.53	0.45	N/R
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.48	0.58	0.48	0.58	0.48	0.58	N/R	N/R
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.64	0.64	0.64	0.64	0.64	0.64	N/R	N/R
Skylights														
U-factor	0.75		0.65		0.50		0.50		0.50		0.50		0.50	
SHGC	0.35		0.35		0.35		0.40		0.40		0.40		N/R	

Increased Skylighting in 2015

C402.3.2 Mandatory Skylighting

15 Types



≤ 50% floor area coverage from Skylight Fenestration ≤ 2 stories

≤ 25% floor area for > 2 stories

■ Spaces ≥ 5ksf (*2.5ksf 2013)

■ Ceiling > 15 ft. (* ≥ 75% 2013)

■ Aperture ≥ 1-3% (two options)

■ Exceptions: 8

Daylighting Refinements in 2015

C402.4.1 Modifies Fenestration; [also C405.2.3 (2&3) Controls]

Requirements undergoing refinement

- C402.4.1.1 Increased to 40% glazing if total floor area:
 - ✓ ≥ 25% in buildings > 2 stories
 - ✓ ≥ 50% in buildings < 2 stories
- **ADDS** Exception for perimeter zones < 2.5kSF with controls
- *Daylight responsive controls* now defined



Daylighting Refinements in 2015

C402.4.1 Modifies Fenestration; [also C405.2.3 (2&3) Controls]

Mandatory skylighting refined

- C402.4.1.2 where skylight area for specific uses (15 types); room area decreases to < 2.5 kSF
 - ✓ **ADDS Exception for perimeter zones < 2.5kSF with controls**



Alternative Prescriptive Compliance Packages in 2015

Table C406.3 ILPA / ELPA Reductions

- Reduced LPD Limits
 - ✓ Whole building LPD values must use Table C406.3, or prescriptive Table C405.4.2(2) for individual space values; reduced by 10%



Increased Skylighting in 2015

C402.3.2 Mandatory Skylighting



15 Types

Assembly Uses:

- Gym; convention and transportation centers

Business & Mercantile Uses:

- Offices**; Retail stores**
Automotive services**

Associated spaces

- Lobby; Atrium; Concourse; Corridor

Factory Uses:

- Manufacturing**; Workshop;

Storage Uses**:

- Warehouses (non-refrigerated);
Distribution / Sorting, Storage

** 90% haze factor; these uses

Added Efficiency Compliance Options in 2015

Table C406.3 ILPA / ELPA Reductions

■ Reduced LPD Limits

- ✓ Whole building LPD values must use Table C406.3, or prescriptive Table C405.4.2(2) for individual space values; reduced by 10%



Additional Efficiency Package Options in 2015

C406.3 / Table C406.3 Reduced LPD Values



■ Table C406.3 Notes

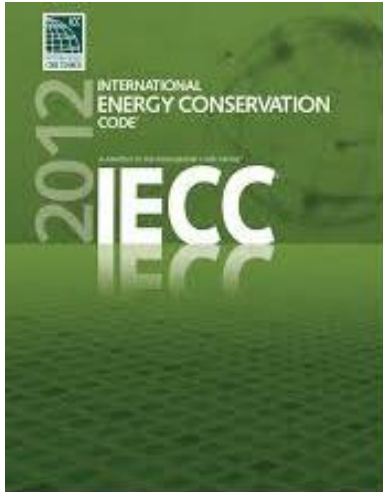
- ✓ Use specific LPD values, not general
- ✓ LPD values are 90% of TC405.5.2(1) where daylighting is $\geq 30\%$ of FA
- ✓ Use second LPD values when $< 30\%$
- ✓ Warehouses must achieve $\geq 70\%$ F/A
- ✓ Daylighting must use auto controls/



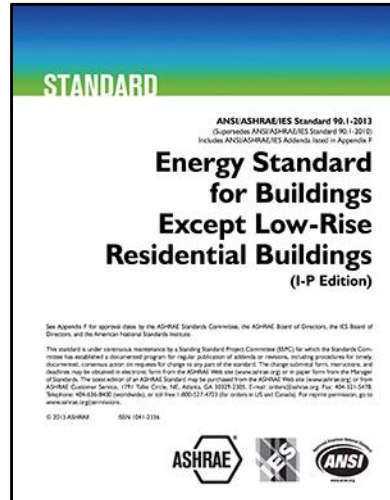
BREAK

The Commercial Option: ASHRAE 90.1

IECC C401.2.1 names 90.1 as option



Sections 5.5.4 & 9.4 elaborate



Lighting Control Outside the Envelope

9.4.1.3 Parking Garage Lighting Control

- Automatic lighting shutoff
- LPD reduction $\geq 30\%$ in lighting zones unoccupied for > 30 min.
 - ✓ Except where HID $< 150w$ used
- Daylight transition zone separately controlled using daylight sensors
- Daylight-responsive control of perimeter sidelighting areas
 - ✓ Except transition zones and ramps without parking



Construction Documents

4.2.2 Compliance Documentation 2010

Documentation shall show
...in detail:

- All pertinent data of the building equipment and systems...
- To determine compliance by the building official and...
- Indicate compliance with this standard.
- Supplemental data, such as:
 - ✓ Calculations,
 - ✓ Worksheets
 - ✓ Compliance forms

Inspections required
...before concealment:

- a. Wall insulation
- b. Roof/ceiling insulation
- c. Slab/foundation wall insulation
- d. Fenestration after all glazing placed
- e. Continuous air barrier
- f. Mechanical systems and equipment
- g. Electrical equipment and systems

Interior Lighting: Basic LPD Controls

9.4.1 Manual and Automatic Controls



- Allows manual ON control at 50% power for daylighting circuits,
- Automatic OFF controls required
- Stepped control required for general lighting
- Space control exceptions:
 - ✓ Lighting for MOE, restrooms, service and storage rooms
- Occupant sensors also required in eight space categories

Lighting Controls

9.4.1 Building Lighting

- **Startup: $\leq 50\%$ + step control**
 - ✓ All non-exempt spaces
 - ✓ Step control to 30-70%
 - ✓ Threshold 2500 sf max.
 - ✓ Four Exceptions
- **Occupancy sensors – 8 uses**
 - ✓ Exceptions:
 - ✓ Multi-scene control
 - ✓ Shops, laboratories
 - ✓ Safety/security
 - ✓ 24-hour operation



Managing Controls

Through Design and Control – 9.4.1.6

- **Basic Control Goal: Effectively control all illumination within spaces without intervention**
- **Additional control:**
 - ✓ **Task lighting**
 - ✓ **M.O.E. illumination**
- **Manual control is still optional where automatic control is not mandated**



Lighting Controls

9.4.1.2 Space-by-Space Control



- Same automatic startup to 50% power in all spaces w/o manual lighting control
- Exceptions:
 - ✓ Public corridors
 - ✓ MEP rooms
 - ✓ Public lobbies, entrances
 - ✓ Stairwells
 - ✓ Storage rooms

Lighting Controls

9.4.1.2 Space-by-Space Control



- Step reduction between 30-70%
- Occupant sensor shutoff at ≤ 30 minutes w/ 2 hr. override
- No automatic control for 24hr operation; patient care spaces; safety/security spaces & uses

Lighting Control In Both Codes

Sections ICC C405 and 90.1-9.4

IECC [CE]	Controls	ASHRAE 90.1
■ C405.2	■ Space Control -50% on	■ 9.4.1
■ C405.2.2	■ Auto shutoff	■ 9.4.1.1
■ C405.2.2.3	■ Primary Sidelighting	■ 9.4.1.4
■ C405.2.2.3.3	■ Secondary Sidelighting	■ N/R
■ C405.2.2.3	■ Toplighting	■ 9.4.1.5
■ C405.2.3	■ Additional controls	■ 9.4.1.6
■ C405.2.1.2	■ Lighting reduction controls in spaces that use < 6w/sf	■ 9.4.2.1a



Lighting Power Densities

Table 9.5.1 Interior Lighting Power – Building Area Method

- 90.1-2010 LPD changes
- For most building types, LPDs are reduced.
 - ✓ Partial Table shown
- Average LPDs:
 - ✓ • 90.1-2007..... 1.09
 - ✓ • 90.1-2010.....0.906
 - ✓ • Difference ... -16.9%

Building Area Type*	LPD	
	(W/R ²)	
Automotive facility	0.9	0.82
Convention center	1.2	1.08
Courthouse	1.2	1.05
Dining: bar lounge/leisure	1.3	0.99
Dining: cafeteria/fast food	1.4	0.90
Dining: family	1.6	0.89
Dormitory	1.0	0.61
Exercise center	1.0	0.88
Gymnasium	1.1	1.00
Health-care clinic	1.0	0.87
Hospital	1.2	1.21
Hotel	1.0	1.00
Library	1.3	1.18
Manufacturing facility	1.3	1.11
Motel	1.0	0.88
Motion picture theater	1.2	0.83
Multifamily	0.7	0.60
Museum	1.1	1.06
Office	1.0	0.90
Parking garage	0.3	0.25

Lighting Power Densities

Table 9.6.1 Space-by-Space Method

Common Space Types ^a	LPD, W/ft ²	RCR Threshold
Atrium		
First 40 ft in height	0.03 per ft (height)	NA
Height above 40 ft	0.02 per ft (height)	NA
Audience/Seating Area—Permanent		
For auditorium	0.79	6
For Performing Arts Theater	2.43	8
For Motion Picture Theater	1.14	4
Classroom/Lecture/Training	1.24	4
Conference/Meeting/Multipurpose	1.23	6
Corridor/Transition	0.66	Width < 8 ft
Dining Area		
For Bar Lounge/Leisure Dining	1.31	4
For Family Dining	0.89	4

- The Room Cavity Ratio allows LPD values to be increased based on the geometry of the space meeting thresholds
- Modifies settings in lighting power control
- Adds power for complex room shapes and heights
- Not in IECC

Lighting Power Density Changes

9.6.2 / Table 9.5.1 ASHRAE 90.1 Addendum 'by'

- Conforms with 90.1-2013 ILPD changes
- Building Type Option:
 - ✓ 5 densities **INCREASED**
 - ✓ 5 densities **UNCHANGED**
 - ✓ 21 densities **DECREASED**
- Space-by Space densities also change
- Toplighting and Sidelighting
- Combines lighting; new Tables
- Adds occupancy sensor controls
 - ✓ Locker rooms, warehouse aisleways
 - ✓ Control 50% reductions



https://www.ashrae.org/standards/90_1_2010_2013Addenda.pdf

LPD Room Geometry Adjustments

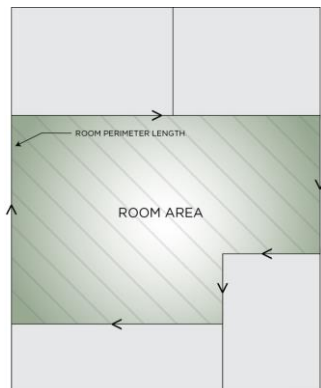
Table 9.6.1 Room Cavity Ratio [RCR] – Space Method Only

- Additional LPD for unusually shaped spaces
- RCR = $\frac{2.5 \times HC \times 2L \times 2W}{\text{Room Area}}$
- Min. threshold values – 4-10
- All Corridors < 8 ft wide
- Not applicable for:
 - ✓ Atriums
- Allows 120% LPD

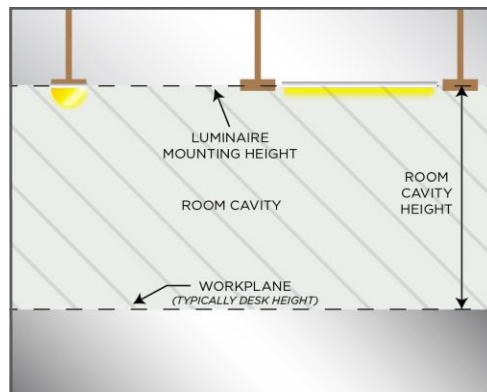
Room Cavity Ratio

9.6.3 Modifying LPD of Complex spaces

- Manual control



- Manual control



Lighting Power Density - Additions

Table 9.6.2 & 5.5.4.2.3 Credit for Additional Lighting Controls

- Control strategies beyond mandatory lighting control requirements (5.5.4.2.3) offer 12 different LPD adjustments
- Based on 5 space groups only
- Must meet all mandatory lighting control measures
- Notes describe operating features necessary to qualify

Additional Control Method (in Addition to Mandatory Requirements).	Space Type				
	Open Office	Private Office	Conference Room, Meeting Room, Classroom (Lecture/ Training)	Retail Sales Area	Lobby, Atrium, Dining Area, Corridors/ Stairways, Gym/ Pool, Mall Concourse, Parking Garage
Manual, continuous dimming control or Programmable multi-level dimming control	0.05	0.05	0.10 ¹	0.10	0
Programmable multi-level dimming control using programmable time scheduling	0.05	0.05	0.10 ¹	0.10	0.10
Multi-level occupancy sensors	0.05	0.05	0.05	0	0



Daylighting in 90.1

Daylighting History in the ASHRAE Codes

90.1-2004 to 2010



- **2004** No requirements; fenestration at $\leq 40\%$; skylights at 2% & $\leq 5\%$
- **2007** No daylighting required; **5.5.4.4.1** introduces PF factors modified by building orientation for vertical glazing; **lower U- and SHGC factors** for skylight areas $\leq 2.0\%$ of gross FA.

Daylighting in the ASHRAE Codes

90.1-2004 to 2010

- **2010** Fenestration still at $\leq 40\%$; skylights $\leq 5\%$; **5.5.4.2.3** now requires mandatory skylighting of 15 types; $\geq 5,000\text{sf}$ over at least 50% of the floor area (FA)



ASHRAE Definitions: Sidelighting

90.1 Section 3.2

- Primary sidelighted area
- Secondary sidelighted area
- Side extension [2']
- Head height
- Daylight area
- Clerestory, dormer



ASHRAE Definitions: Toplighting

3.2 Toplighting

- Skylight [$< 60^\circ$ horizontal]
- Daylight area
- Skylight well
- Skylight aperture
- Rooftop monitor



Combining Sloped Glazing, Skylights

5.5.4.2 Using Both Percentages to Best Effect



AKF

Fenestration Limitations

5.5.4.2.2 Vertical Fenestration Area – (prescriptive option)



Vertical fenestration limits

- 30% without auto controls
- 40% with averaged F.A. \geq 50%
 - ✓ Limited to CZ 1-6
 - ✓ < 3 stories \geq 50% (2015)
 - ✓ ≥ 3 stories \geq 25% (2015)

Visible transmittance [VT]

- $VT \geq 1.1 \times SHGC$

Fenestration Limitations

5.5.4.2.2 Maximum Skylight Fenestration Area – (prescriptive option)



Increased Fenestration Limit

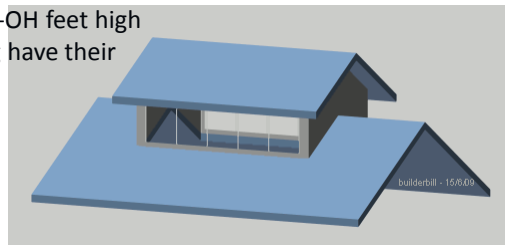
- Up to 75%
- Street façade only
- 20ft max. height
- Separate SHGC computation for SHGC and glazing – no average

Daylight Responsive Controls

5.5.4.2.3 Exception (d)

Rooftop Monitor Zones Change

- Zone: sill height of roof monitor fenestration, not 15'
 - ✓ Accounts for rooftop monitor glazing
 - ✓ Exception: where site shading occurs
- VT in existing buildings determines if a zone
- Figure 3.2 Partitions at < MSH-OH feet high using roof monitor daylighting have their floor area totally included



Direct Sunlight Control

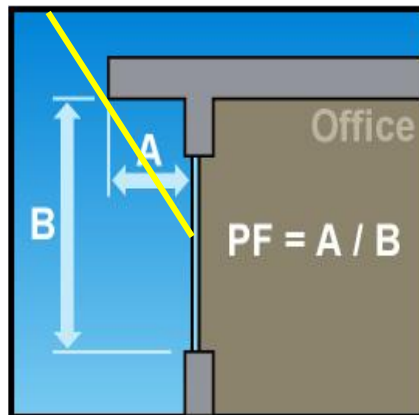
Table 5.5.4.4 Daylighting Control: Projection Factor



Projection Factor: Direct Sunlight Control

Table 5.5.4.4.1 Maximum U-factor and SHGC

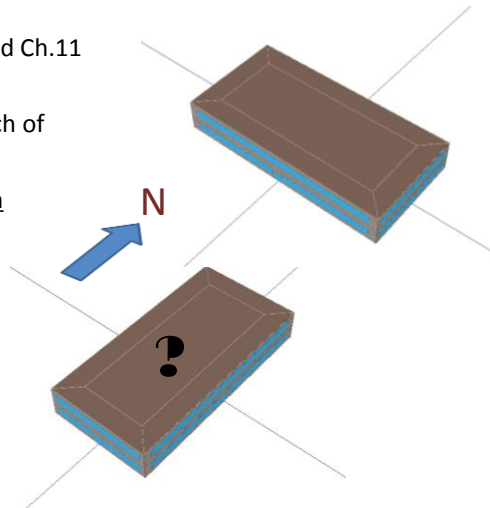
- Fenestration U-factor constant; can be averaged
- SHGC factor modified by PF – see Table 5.5.4.4.1
- Modifications of SHGC are permitted by applying the percentages



Fenestration Orientation - 2010

5.5.4.5 Fenestration – Addendum ‘bn’

- Changes to section 5.5.4.5 and Ch.11 for locations of fenestration
- E & W orientations < 25% each of total vertical fenestration
- Physical dimensions of design solution may be affected



Building Thermal Glazing Changes

5.5.4 Prescriptive Envelope Fenestration Option

- Fenestration remains capped at 40%; SHGC by VT/SHGC; dependent on percentages of glazing
 - ✓ Vertical glazing orientation limitations covered by Section 5.5.4.5
 - ✓ Dynamic glazing SHGC 5.5.4.4.2
 - ✓ 5.5.4.2.1 Exception: Street Storefront ($\leq 75\%$ - a definite bonus) **2. PF



Building Thermal Glazing Changes

5.5.4 Prescriptive Envelope Fenestration Option

■ 5.5.4.5 Fenestration Orientation

- ✓ Façade glazed areas 30° of true E/W
- ✓ Fenestration improvements may be “traded off” against other components of the building envelope only per 5.6.1



Building Thermal Glazing Changes

5.5.4 Skylight Area Limits

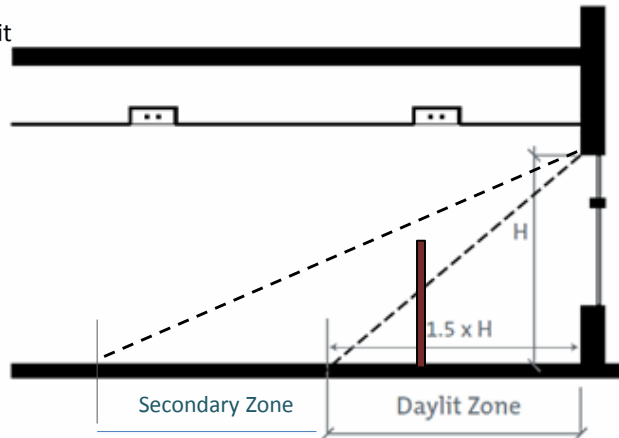
- Skylights remain at two niches:
0-2% and 2.1-5%
- Different U- and SHGC factors
- Table has 3 classes for skylight glazing materials, curb heights
 - ✓ Exception: Skylights outside of scope NFRC 200, VT determined by ASTM E972



Sidelighting

3.2 Prescriptive Figures: Daylight Zones

- Equals head height
- 2x for secondary limit
- Side margins of 2'
- Opaque wall cutoffs
- Obstruction < 5 ft
- No allowances yet - technical strategies



DAYLIT ZONE—SIDELIGHTING

Increased Skylighting – (prescriptive mandate)

5.5.4.2.3(a) Minimum Skylight Areas; 15 Types



Assembly Uses:

- Gym/exercise center; convention and transportation centers

Business & Mercantile Uses**:

- Offices**; Retail stores**
- Automotive services**

Associated spaces

- Atrium; Concourse; Corridor; Lobby

Factory Uses:

- Manufacturing**, Workshop;

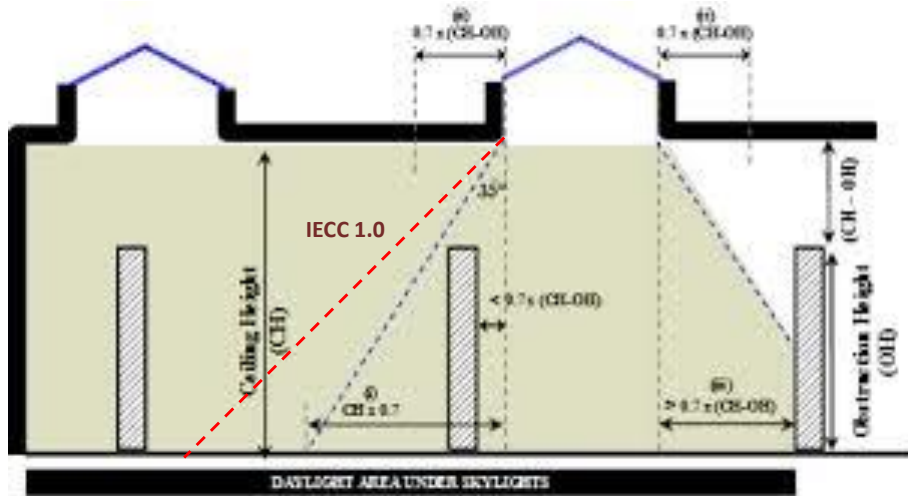
Storage Uses**:

- Warehouses (non-refrigerated); Distribution/Sorting, Storage

** 90% haze factor; these uses

Skylighting

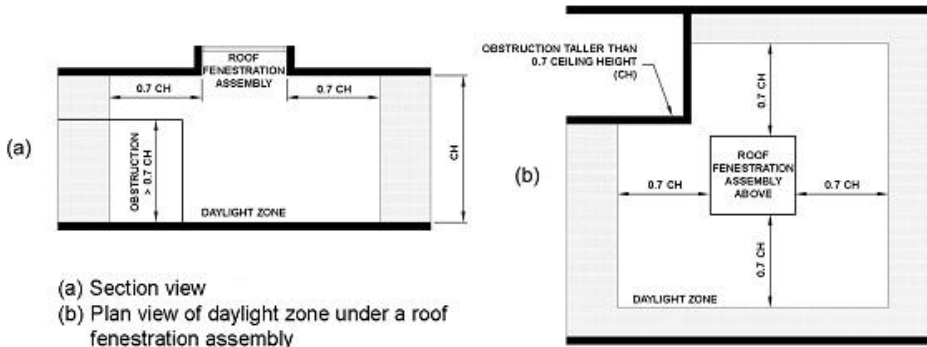
90.1 3.2 Illuminated Area more defined



Toplighting

5.5.4.2.2 Maximum Skylight Area

- 5% of gross roof area
- Maximum Floor Area calculated
- Building thermal envelope



(a) Section view
 (b) Plan view of daylight zone under a roof fenestration assembly

ASHRAE Definitions: Effective Aperture

90.1 Section 3.2

Skylight illumination depends on:

- Skylight AREA
- Skylight VT
- Skylight WELL



Understanding Effective Skylight Aperture

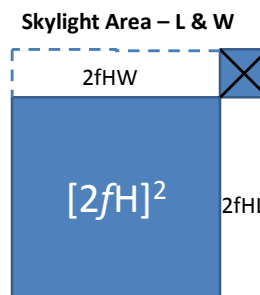
90.1 Section 5.5.4.2.3 Floor Area Ratio

Target: $\geq 50\%$ F.A.

■ Aperture $\geq 1\%$ F.A.

■ Aperture $\leq 10\%$

- ✓ H in the equation is the ceiling height distance - f is the fraction allowed by each code: 0.7, 0.9, 1.0

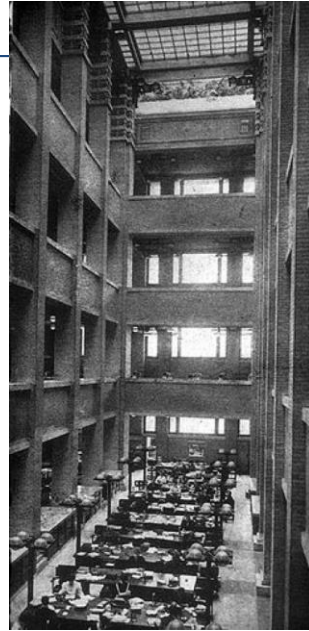


Total F.A. per skylight =
 $2fH^2 + WL + 2f(HL + HW)$

Skylight SHGC

5.5.4.4.2 Exemption from Tables 5.5.x SHGC

- Diffuses/obscures $\geq 90\%$ of light
- Has VT > 0.40
- General lighting in daylight zone below controlled with multilevel daylight-responsive controls
- Use of dynamic glazing



Skylight SHGC

5.5.4.5 Exemptions Through Orientation

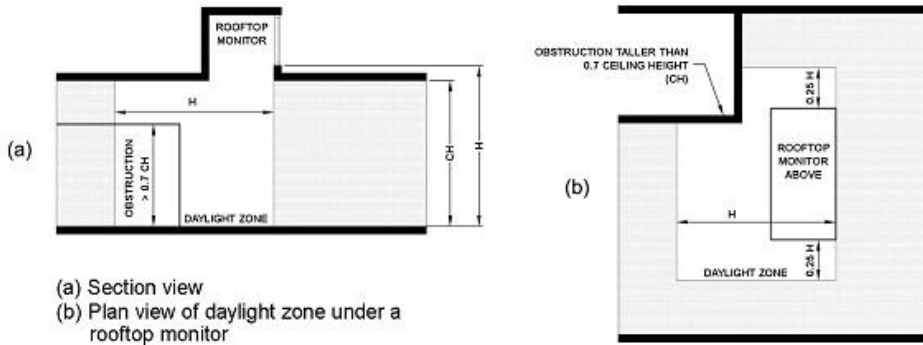
Any condition qualifies:

- Street-side façade per 5.5.4.4.1c
- Existing building within 20ft of south face \geq height of proposed
- Permanently shaded on 75% of East & West fenestration areas between 9 to 3 at June solstice
- Alterations/additions with no added vertical fenestration area



Rooftop Monitor In 90.1

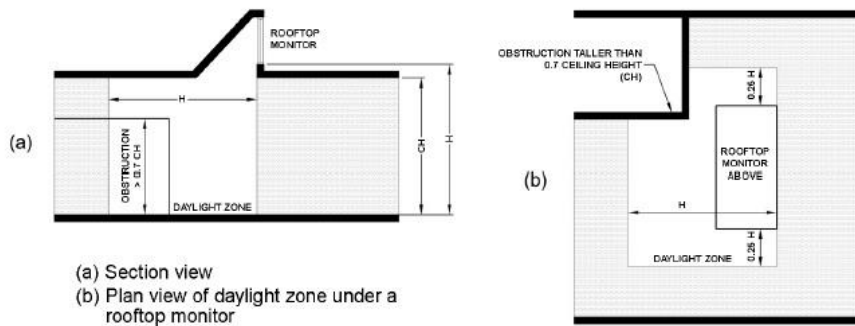
Basic Concepts: Luminaire Control



Rooftop Monitors

IBC Issues – IECC & 90.1

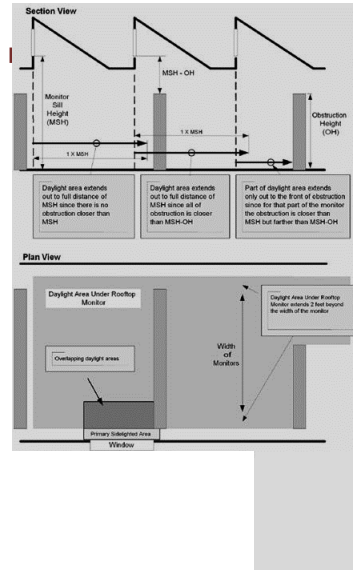
- Wind, snow loadings
- Flashings



Use of Rooftop Monitors

Table 9.5.1 Building Area Method

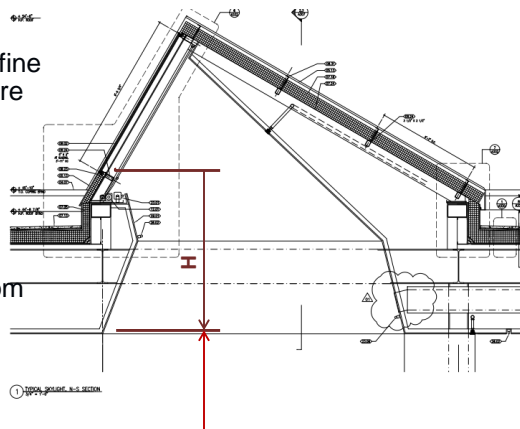
- Daylighting starts vertically to the floor under the monitor lip
- Extends to a depth equal to the height of the glazing sill
- Partitions block lighting only when length from the vertical leading edge is greater than the height of the obstruction
- Overlapping side or top-lighted areas are not counted twice



Twinking Distribution – Performance Options

Height of Skylight Well Considered

- Using light paths to define a better lighting aperture and reduce glare
- Sill height thru well measured to the floor defines the FA length; skylights measured from ceiling to floor



Commissioning

9.4.4 Functional Testing

Devices and Control Systems

- Occupant sensors performance
- Programmable/T.O.D. controls can turn lights off
- Photosensors will reduce lighting levels based on usable daylight
- Safety/security exceptions
- **4.2.4** Inspections. Electrical equipment and systems; after installation; before concealment



Future Lighting Definitions

3.2 Definitions

- Dynamic glazing properties
- Clerestory added to 'roof monitor



Future Daylighting Definitions 2015

3.2 Definitions

- Dynamic glazing properties
- Clerestory added to 'roof monitor'



Future Control Strategies 2015

Chapter 11 ('cf')

- Baseline Glazing Area ('cf')
- Changes based on Use Type



Targeting Daylighting - 2013

Integrating with General Lighting

90.1-2013, 9.4.1.3

- Revises skylight percentages
- Changes daylighting control by combining with general lighting where practical
- Adds more spaces to be top-lit
- Reduces E/W glazing allowed



Daylighting in future ASHRAE Codes

ASHRAE 90.1-2013

- **5.5.4.1** Vertical glazing and PF factors modified further through building orientation limits;
- **5.5.4.2.3** 6% skylight area allowed with all building and daylighting criteria met
- **5.5.4.5** Reduced glazing within 900 of true E/W ('bw')
- **9.6.2** Lighting and daylighting values/controls for more occupancy types
- Reduction in daylight-responsive control limits to 2.5k from 5.0k ('bv')
- Ch.11 Baseline glazing reductions based on use (cf')

DEEP Regulations 16a-38k

An OVERLAY - Not governed by the CT Codes Adoption

- Applies to State/State-funded construction
 - > \$5 million new
 - > \$2 million addition
- 21% less energy use
- Demonstrate whether building meets performance or tradeoff compliance
- If applicable, report is submitted with CDs.



AKF

COMCheck – Compliance Option

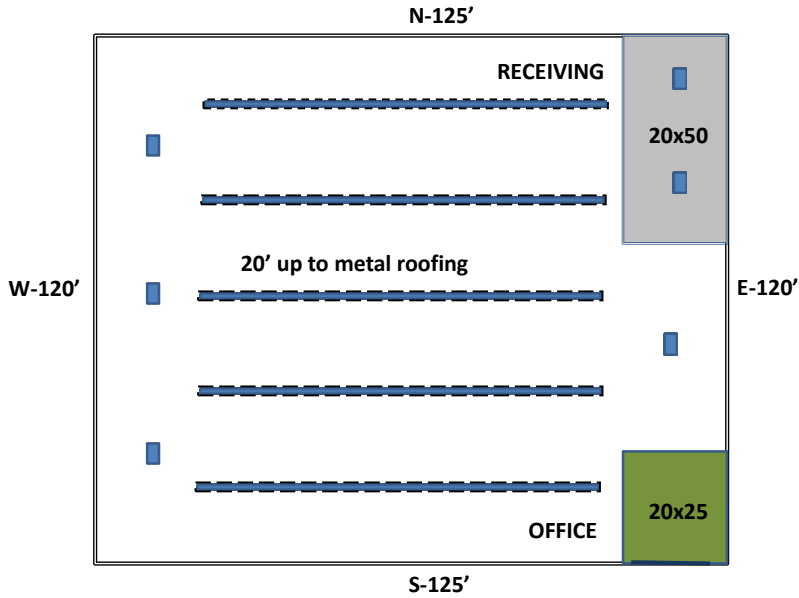
Version 4.0.2.8 UA Compliance Alternative

- Used to show compliance with either 2012 IECC or ASHRAE 90.1-2013
 - Now updated to ICC 2015
 - Not updated to 90.1-2016
- Completely electronic: user inputs all building data
- Will demonstrate whether building meets performance or tradeoff based compliance
- If used, report is submitted with construction documents.



www.energycodes.gov/comcheck

Case Study – 15ksf Warehouse



The Project Screen - Details

9. 1. GET THE CODE EDITION

2. Location
 State: Massachusetts
 City: Hyannis

3. Project Type
 New Construction Addition Alterations

4. Compliance Options
 Efficiency Options: High Performance HVAC
 Air Barrier Options: Air leakage test

5. Space Conditioning
 Select all that apply:
 Nonresidential Residential

6. Project Details (optional)
 Title/Site/Permit: _____

7. Building Use
 Building Area Method selected. Table below:

	Building Type	Area Description	Area	W/Rt2
1	Retail		10000	1.4

8. Exterior Lighting Areas
 Exterior Lighting Zone: Neighborhood business district

	Exterior Lighting Area	Area Description	Quantity	Units	W/Unit	Tradable
1	Entry canopy	Covered promen...	1200	Rt2	0.25	Yes
2	Other door (not main entry)	Rear exits	30	Rt of door ...	20	Yes
3	Parking area	Under building	62000	Rt2	0.06	Yes
4	Stairway		800	Rt2	1.0	Yes

10. Code: 2012 IECC

COMCheck

CODE: 2012 IECC

(IECC 2015 available)

■ **PROJECT SCREEN TAB** (on left)

- Location
- Project Type:
 - ✓ **NEW? ADDITION? RENOVATION?**
- Compliance Options
 - ✓ **Air barrier Options**
 - ✓ **Efficiency Options**
- Interior Lighting Method TAB
- Project Details
 - ✓ **(get the information)**

■ **PROJECT FOLDERS** (under on right)

- Building Envelope Area Type
 - ✓ **(dropdown for Categories)**
- HVAC Equipment
- Interior Lighting Method/Areas
 - ✓ **(dropdown for categories)**
- Exterior Lighting Areas
 - ✓ **(dropdown Zone categories)**
- Project Scoring (on bottom)



6. Get the Details

User to fill out:

- Project title
- Address
- Owner/Agent
- Designer
- Contractor (if known)
- General description...

Project Details (optional)

Title/Site/Permit | **Owner/Agent** | **Designer/Contractor**

Enter the project title, construction site, and permit information.
This information will appear on the compliance certificate.

Title:

Construction Site

Address 1:

Address 2:

City:

State: Massachusetts

Zip Code:

Permit

Permit #:

Permit Date:

Notes:

Help OK Cancel



Envelope Compilation – OOPS!

Untitled.ckk - COMcheck 3.9.3 Code: 2012 IECC

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Ext. Wall Window Door Basement Floor

Component	Assembly	Fenestration Details	Construction Details	Gross Area	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor
1 Building									
1 Roof 1	Attic Roof with Wood Joists			10000 Ft2	38.0	0.0	0.027		
2 Skylight 1	Wood Frame:Glass, No C...	Non-NFRC:NA		50 Ft2			0.550	0.40	
3 Exterior Wall 1	Wood-Frame, 16" o.c.			3000 Ft2	20.0	0.0	0.064		
4 Window 1	Metal Frame with Thermo...	Non-NFRC:NA		900 Ft2			0.380	0.40	0.00
5 Door 1	Glass (> 50% glazing):M...	Non-NFRC:NA		480 Ft2			0.770	0.40	0.00
6 Door 2	Insulated Metal		Swinging	210 Ft2			0.370		
7 Floor 1	Concrete Floor (over unc...			10000 Ft2		10.0	0.076		

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.

Envelope FAILS: Glazing area of building exceeds 30% of gross area of above-grade walls. Envelope -4% Interior Lighting +21% Exterior Lighting +24%

Use the 'Options' menu to add or remove orientation and daylighting control factor.



Tool Box: AREA CALC Take-Off

Component Tabs

Untitled - AreaCalc 2.3.2

File Edit Tools Help

Windows Skylights Doors Ceilings Walls Basements Floors Crawl Walls

Click a window name to add it to the window list on the right.

	Add to Library	Window Name	Assembly Type	Quantity	Width	Height	Unit Area	Total Area	U-Factor	SHGC	Comments/Description
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											

Gross Roof/Ceiling Area total [] Ft2 Window Area Total [0.00] Ft2

Enter a Window directly into the grid or click in the Library Name column to select a Window.



AREA CALC – CEILINGS & SKYLIGHTS

MBOIAtest - AreaCalc 2.3.2

File Edit Tools Help

Windows Skylights Doors Ceilings Walls Basements Floors Crawl Walls

Assembly Type	Width	Length	Gross Area	Comments/Description
1 Cathedral Ceiling (no attic)	9'-4"	34'-0"	317.33 ft2	Sloped ceilings in 2nd Floor bedrooms, bath & hall
2 Flat Ceiling or Scissor Truss	10'-10"	34'-0"	368.33 ft2	Flat ceiling portion, 2nd Floor
3 Steel Joist/Rafter, 24" o.c., 2x10	13'-0"	34'-0"	442.00 ft2	Ceiling of 1st Floor
4 Other	3'-4"	15'-0"	50.00 ft2	Insulate under stairs to 2nd floor
5				

Gross Ceiling Area Total 1177.66 ft2

Select the Assembly Type and enter its dimensions directly into the grid.

MBOIAtest - AreaCalc 2.3.2

File Edit Tools Help

Windows Skylights Doors Ceilings Walls Basements Floors Crawl Walls

Click a skylight name to add it to the skylight list on the right.

Add to Library	Skylight Name	Assembly Type	Quantity	Width	Height	Unit Area	Total Area	U-Factor	SHGC	Comments/Description
1	2 Bath	Wood Frame, Dou	1	1'-10"	3'-2"	5.81 ft2	5.81 ft2	0.350	0.470	
2										
3										
4										
5										

Gross Roof/Ceiling Area total [] ft2 Skylight Area Total 5.81 ft2

Enter a Skylight directly into the grid or click in the Library Name column to select a Skylight.



AREA CALC – WALLS AND FLOORS

MBOIAtest - AreaCalc 2.3.2

File Edit Tools Help

Windows Skylights Doors Ceilings Walls Basements Floors Crawl Walls

Assembly Type	Length	Height	Gross Area	Comments/Description
1 Wood Frame, 24" o.c.	34'-0"	10'-0"	340.00 ft2	North Wall 1st Floor - FRONT
2 Wood Frame, 24" o.c.	30'-0"	10'-0"	300.00 ft2	East Wall 1st Floor
3 Wood Frame, 24" o.c.	17'-0"	5'-0"	85.00 ft2	East Wall 2nd Floor - lower
4 Wood Frame, 24" o.c.	WB = 17'-0", WT = 10'-1"		41.75 ft2	East Wall 2nd Floor - upper
5 Wood Frame, 24" o.c.	34'-0"	10'-0"	340.00 ft2	South Wall 1st Floor - REAR
6 Wood Frame, 24" o.c.	30'-0"	10'-0"	300.00 ft2	West Wall 1st Floor - lower
7 Wood Frame, 24" o.c.	WB = 17'-0", WT = 10'-1"		41.75 ft2	West Wall 2nd Floor - upper
8 Wood Frame, 16" o.c.	12'-0"	6'-0"	96.00 ft2	1/2 x 2 stair walls to unconditioned basement
9 Wood Frame, 16" o.c.	34'-0"	4'-2"	141.67 ft2	Knee wall on 2nd floor at eaves
10 Wood Frame, 16" o.c.	31'-0"	4'-2"	129.17 ft2	Knee wall on 2nd floor at eaves
11				

Gross Wall Area Total 1815.34 ft2

Select the Assembly Type and enter its dimensions directly into the grid.

MBOIAtest - AreaCalc 2.3.2

File Edit Tools Help

Windows Skylights Doors Ceilings Walls Basements Floors Crawl Walls

Assembly Type	Width	Length	Gross Area	Comments/Description
1 All Wood Joist/Truss, Over Uncon	30'-0"	32'-6"	975.00 ft2	Basic, deletes stair well basement/1st floor/2nd floor
2				
3				
4				
5				

Floor Area Total 975.00 ft2

Select the Assembly Type and enter its dimensions directly into the grid.



AREA CALC – WALLS AND FLOORS

MBOIAtest - AreaCalc 2.3.2

File Edit Tools Help

Windows Skylights Doors Ceilings Walls Basements Floors Crawl Walls

	Assembly Type	Length	Height	Gross Area	Comments/Description
1	Wood Frame, 24" o.c.	34'-0"	10'-0"	340.00 R2	North Wall 1st Floor - FRONT
2	Wood Frame, 24" o.c.	30'-0"	10'-0"	300.00 R2	East Wall 1st Floor
3	Wood Frame, 24" o.c.	17'-0"	5'-0"	85.00 R2	East Wall 2nd Floor - lower
4	Wood Frame, 24" o.c.	WB = 17'-0", WT = 10'-1"		41.75 R2	East Wall 2nd Floor - upper
5	Wood Frame, 24" o.c.	34'-0"	10'-0"	340.00 R2	South Wall 1st Floor - REAR
6	Wood Frame, 24" o.c.	30'-0"	10'-0"	300.00 R2	West Wall 1st Floor - lower
7	Wood Frame, 24" o.c.	WB = 17'-0", WT = 10'-1"		41.75 R2	West Wall 2nd Floor - upper
8	Wood Frame, 16" o.c.	12'-0"	8'-0"	96.00 R2	1/2 x 2 stair walls to unconditioned basement
9	Wood Frame, 16" o.c.	34'-0"	4'-2"	141.67 R2	Knee wall on 2nd floor at eaves
10	Wood Frame, 16" o.c.	31'-0"	4'-2"	129.17 R2	Knee wall on 2nd floor at eaves
11					

Gross Wall Area Total 1815.34 R2

Select the Assembly Type and enter its dimensions directly into the grid.

MBOIAtest - AreaCalc 2.3.2

File Edit Tools Help

Windows Skylights Doors Ceilings Walls Basements Floors Crawl Walls

	Assembly Type	Width	Length	Gross Area	Comments/Description
1	All-Wood Joist/Truss, Over Uncon	30'-0"	32'-6"	975.00 R2	Basic, deletes stair well basement/1st floor/2nd floor
2					
3					
4					
5					

Floor Area Total 975.00 R2

Select the Assembly Type and enter its dimensions directly into the grid.



Requirements Reviews

Untitled.cck - COMcheck 3.9.3 Code: 2012 IECC

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Select the category of interest then select a requirement from the list to view and modify in the details section below.

Project Envelope Interior Lighting Exterior Lighting Mechanical All Mechanical Help...

Requirements

Requirements Specific To: HVAC System 1:

- [C403.2.8] HVAC piping insulation thickness. Where piping is installed in or under a slab, verification may need to
- [C403.2.7.1-3] Ductwork operating >3 in. water column requires air leakage testing.
- [C403.3.1, C403.3.1.1] Air economizers provided where required, meet the requirements for design capacity, control
- [C403.4.2] VAV fan motors >=7.5 hp to be driven by variable speed drive, have a vane-axial fan with variable pitch
- [C403.2.4.2] Heating and cooling to each zone is controlled by a thermostat control. Minimum one humidity control
- [C403.2.4.1.1] Heat pump controls prevent supplemental electric resistance heat from coming on when not needed.
- [6.4.1.4, 6.4.1.5] Equipment minimum efficiency: Heat Pump: 3.20 COP 12.00 EER (12.4 IEER)

HVAC:

- [C403.2.4.5] Freeze protection and snow/ice melting systems capable for future connection to controls.

Details

Mechanical: HVAC System 1

[C403.2.8] HVAC piping insulation thickness. Where piping is installed in or under a slab, verification may need to occur during Foundation Inspection.

Compliance Choices:

- Requirement will be met.
- Exceptions
- Piping within HVAC equipment.
- Factory-installed piping within room fan-coils and unit ventilators tested under AHRI 440
- Fluid temperatures between 60 and 105°F.
- Fluid not heated or cooled.
- Strainers and valves associated with 1 inch or smaller piping
- Underground piping with fluids no hotter than 60°F.

Envelope FAILS: Glazing area of building exceeds 30% of gross area of above-grade walls. Envelope -4% Interior Lighting +21% Exterior Lighting +24% Requirements

Use the 'Options' menu to add or remove orientation and daylighting control factor.



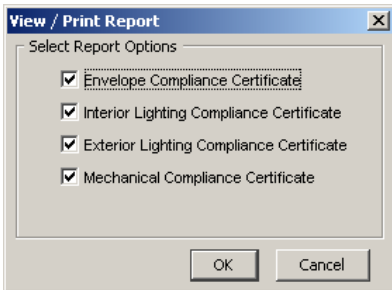
Final Report

Checklists:

- Envelope
- Interior Lighting
- Exterior Lighting
- HVAC / SWH
- Add Options

2012 IECC	Plan Review	Compliant	Comments/Assumptions
C102.2 (P1.7)	Plans and/or specifications provide all information with which compliance can be determined for the building envelope and document where exceptions to the standard are claimed.	<input type="checkbox"/> Complies <input checked="" type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C102.2 (P1.7)	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the mechanical systems and equipment and document where exceptions to the standard are claimed. Load calculations per applicable engineering standards and handbooks.	<input type="checkbox"/> Complies <input checked="" type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C102.2 (P1.4)	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the interior lighting and electrical systems and equipment and document where exceptions to the standard are claimed. Information provided shall include interior lighting power calculations, voltage of bulbs and ballasts, transformers and control devices.	<input type="checkbox"/> Complies <input checked="" type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C102.2 (P1.2)	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the exterior lighting and electrical systems and equipment and document where exceptions to the standard are claimed. Information provided shall include exterior lighting power calculations, voltage of bulbs and ballasts, transformers and control devices.	<input type="checkbox"/> Complies <input checked="" type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C406 (P1.7)	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the additional energy efficiency package options.	<input type="checkbox"/> Complies <input checked="" type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	Requirement will be met.
C402.3.1 (P1.17)	Vertical fenestration area <= 30 percent of the gross above-grade wall area.	<input type="checkbox"/> Complies <input checked="" type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C402.3.1 (P1.17)	Skylight area <= 3 percent of the gross roof area.	<input type="checkbox"/> Complies <input checked="" type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

(View) Certificates



COMcheck Software Version 3.9.3 Envelope Compliance Certificate

2012 IECC

Section 1: Project Information

Project Type: New Construction
 Project Title:
 Construction Title: Owner/Agent: Designer/Contractor:

Additional Efficiency Package: High Efficiency HVAC. If items that do not meet the performance requirements will be identified in the mechanical requirements sheet/contract.

Section 2: General Information

Building Location (for weather data): Atlantic, Massachusetts
 Climate Zone: 6a
 Building Space Conditioning Type(s): Non-residential
 Vertical Glazing (Wall Area Fc): 44%
 Skylight Glazing / Roof Area Fc: 1%

Building Type: Residential

Section 3: Envelope Assemblies

Climate Specific Requirements	Component Name/Description	Core Area or Perimeter	U-Factor	R-Value	U-Factor	U-Factor	Budget U-Factor
Roof 1: All-Ceiling Insulation		1000	0.0	0.02	0.02		
Skylight 1: Wood Frame Glass, No-Unit, Part Type 10 her		50	-	-	0.560	0.500	
Other Fenestration Product ID: WH, SHGC 0.410		3000	0.0	0.0	0.096	0.096	
Window 1: Metal Frame w/ Thermal Break Glass, Part Type: Other Fenestration Product ID: WH, SHGC 0.410		400	-	-	0.360	0.360	
Door 1: Glass or Glass-Insert Metal Frame, Entrance Door, Part Type 10 her Fenestration Product ID: WH, SHGC 0.410		900	-	-	0.770	0.770	
Door 2: Insulated Metal, Sliding		210	-	-	0.370	0.370	
Floor 1: Concrete Floor (over unconditioned space)		1000	-	0.0	0.076	0.076	

(a) Budget U-factors are used for software baseline calculations (R-Value), and are not code requirements.
 (b) Fenestration products require supporting documentation for proposed U-factors.
 (c) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.

COMCheck

CODE: 90.1-2010

(90.1-2013 available)

<ul style="list-style-type: none"> ■ PROJECT SCREEN TAB (on left) ■ Location ■ Project Type: <ul style="list-style-type: none"> ✓ NEW? ADDITION? RENOVATION? ■ Project Details <ul style="list-style-type: none"> ✓ (get the information) 	<ul style="list-style-type: none"> PROJECT FOLDERS (under on right) ■ Building Envelope Area Type <ul style="list-style-type: none"> ✓ (dropdown for Categories) ■ HVAC Equipment ■ Interior Lighting Method/Areas <ul style="list-style-type: none"> ✓ (dropdown for categories) ■ Exterior Lighting Areas <ul style="list-style-type: none"> ✓ (dropdown for Zone category) ■ Project Scoring: (on bottom)
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COMCheck Data Entry

Code – Both

(90.1-2013 / IECC 2015 available)

<ul style="list-style-type: none"> ■ REQUIREMENTS Project BUTTONS <ul style="list-style-type: none"> ✓ Project ✓ Envelope ✓ Interior Lighting ✓ Exterior Lighting ✓ Mechanical ■ Requirements List Checkoffs <ul style="list-style-type: none"> ✓ Code requirement ✓ Plan review requirement ■ Project Requirement Descriptions ■ Compliance Choices 	<ul style="list-style-type: none"> DETAILS ■ Compliance Choices ■ Exceptions (if any) ■ Plan Reference <ul style="list-style-type: none"> ✓ Page ✓ Section ✓ Table ✓ Figure
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Questions/Resources

Available Over Your Internet Connection

- <http://www.ct.gov/dcs/cwp/view.asp?a=4447&q=521446&dcsNav=|>
- www.iccsafe.org/erratacentral
- https://www.ashrae.org/standards/90_1_2010_2013Addenda.pdf
- <http://www.energycodes.gov/sites/default/files/documents/901-2013www.energycodes.gov/resources>
- www.bcap.org
- www.buildingscience.com
- www.akfgroup.com



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