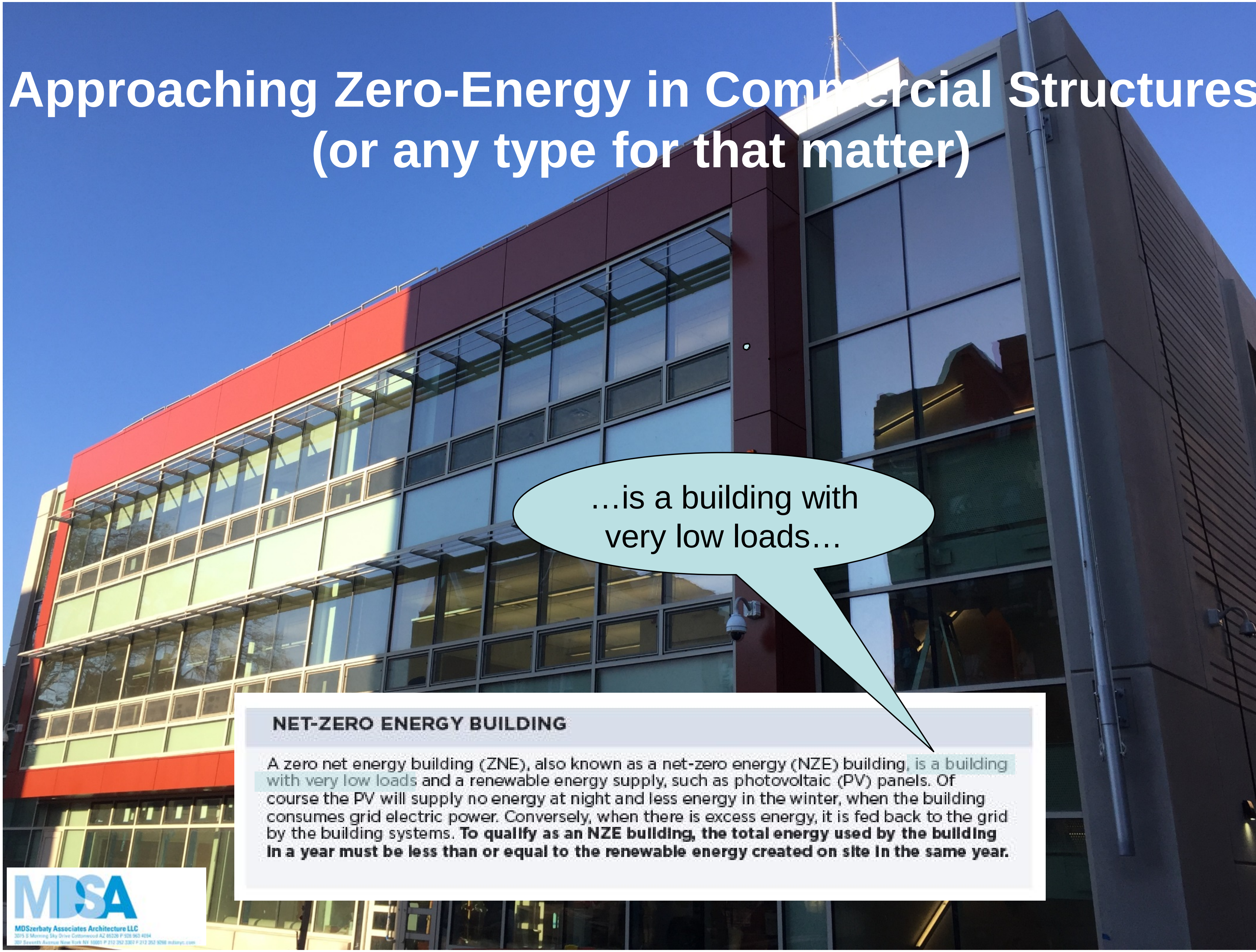
Approaching Zero-Energy in Commercial Structures (or any type for that matter)

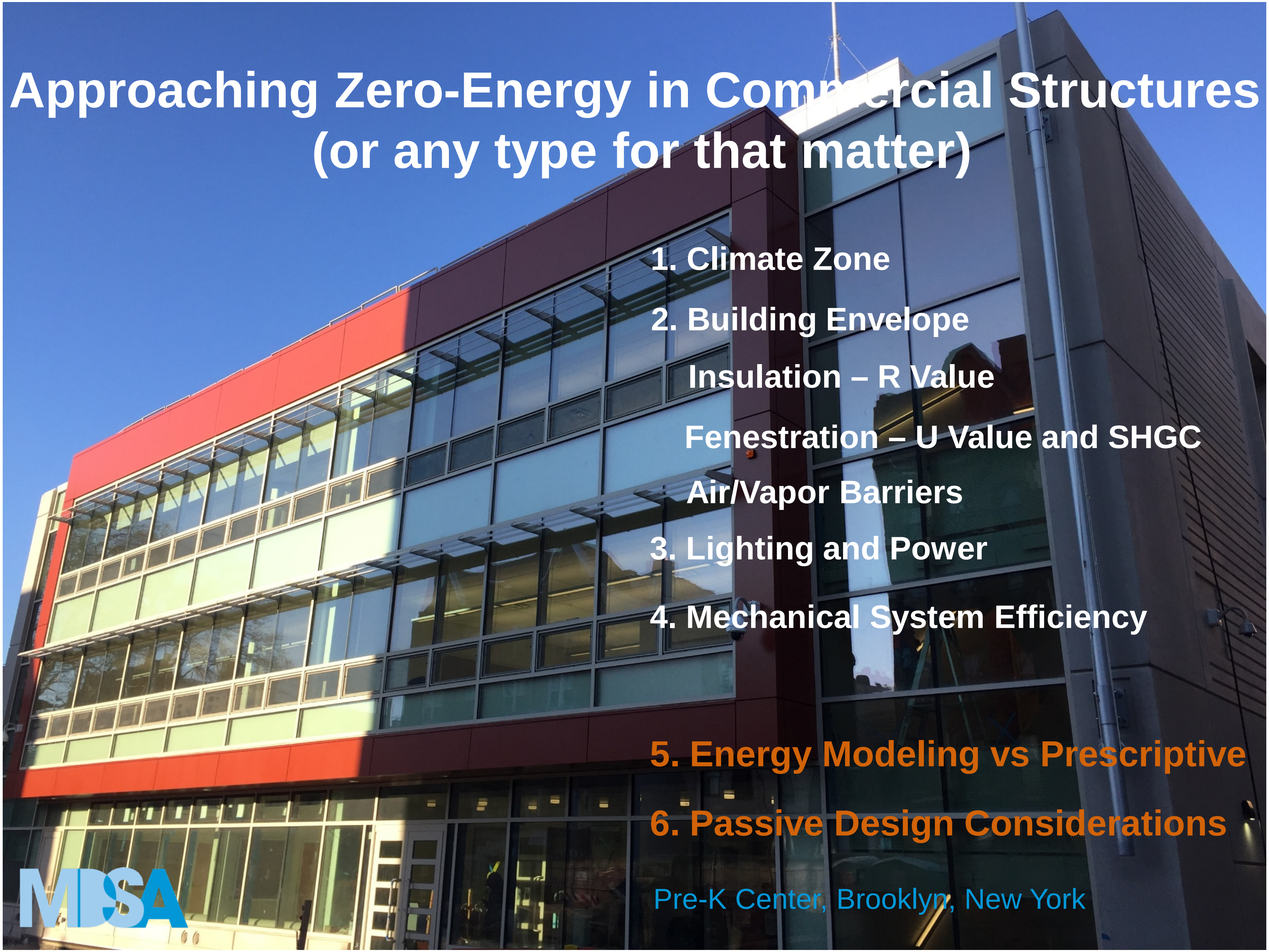


NET-ZERO ENERGY BUILDING

A zero net energy building (ZNE), also known as a net-zero energy (NZE) building, is a building with very low loads and a renewable energy supply, such as photovoltaic (PV) panels. Of course the PV will supply no energy at night and less energy in the winter, when the building consumes grid electric power. Conversely, when there is excess energy, it is fed back to the grid by the building systems. **To qualify as an NZE building, the total energy used by the building in a year must be less than or equal to the renewable energy created on site in the same year.**

MDSA
MDSzerbaty Associates Architecture LLC

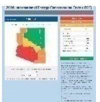
Approaching Zero-Energy in Commercial Structures (or any type for that matter)

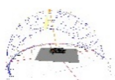


1. Climate Zone
2. Building Envelope
   - Insulation – R Value
   - Fenestration – U Value and SHGC
   - Air/Vapor Barriers
3. Lighting and Power
4. Mechanical System Efficiency
5. Energy Modeling vs Prescriptive
6. Passive Design Considerations

Pre-K Center, Brooklyn, New York

First, A Little History





Williamsburg Child Care Center, Brooklyn

This 19,200-square-foot public child care facility accommodates children of a variety of ages. The three-story Center is largely devoted to classroom but also includes administrative offices, facility support rooms, ground-level and rooftop play areas and a kitchen.

With children's well-being foremost, the design prioritizes a healthy indoor environment. Green materials were selected after a rigorous review of their potential to minimize the emission of toxins or volatile organic compounds. Natural light, introduced in several ways, conserves energy by reducing the use of electric lighting and enhances the quality of the learning environment. A glazed interior light well, toward the rear of the site, extends from the roof to the ground level. It introduced daylight to the inner core of the facility, which is walled-in at the rear and both sides by neighboring buildings constructed to the lot lines.

The compact shape, light shelves, and a light well allow the center to make the most of natural light and reduce energy consumption.

At the Williamsburg Child Care Center, recycled materials can be found in the carpet, rubber flooring, ceiling panels, concrete, steel, walls, bathroom tiles and partitions, and furniture.

The bamboo millwork and linoleum flooring in the center are made of materials that grow back quickly, reducing the use of non-renewing resources.
Indoor air quality is improved by the walk-off mats at the entrances, low-emitting materials and finishes and separate ventilation for services areas.

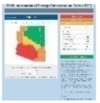
CLIAMATE CHANGES: from the light-colored, highly reflective roofing to the perimeter planting with its structural soil, the Williamsburg Child care center is designed to mitigate the Urban Heat Island effect by reducing atmospheric temperature.

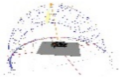
Insulation – Increased R-Value
Lighting – Occupancy Controls
Mechanical System Efficiency

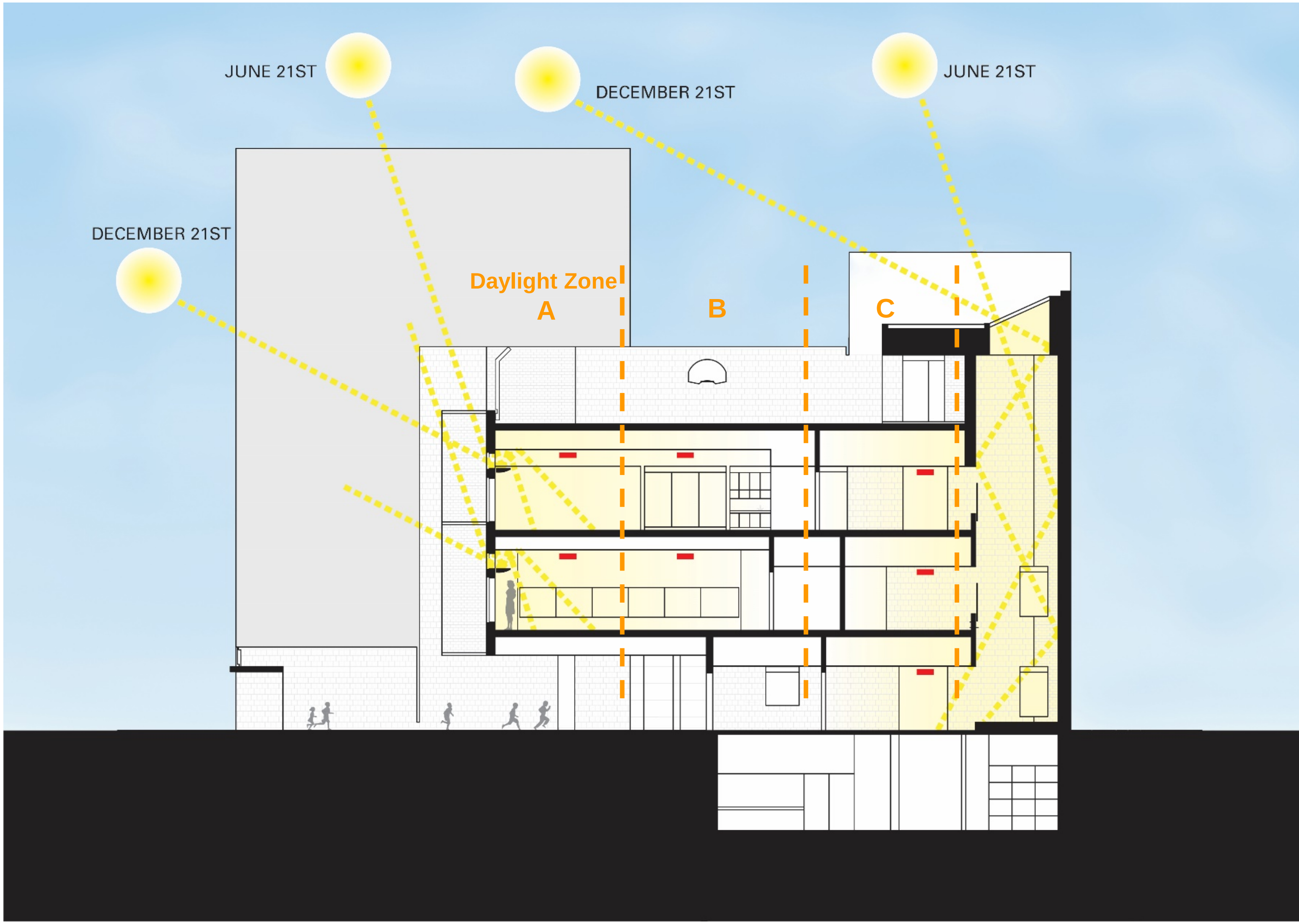
Fenestration – Daylight Transmittance
Lighting – Light Reduction Controls
System Commissioning

HIGH PERFORMANCE BUILDINGS 1999

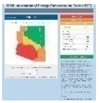
Winging it at the time







HIGH PERFORMANCE BUILDINGS 1999



Williamsburg Child Care Center, Brooklyn

This 19,200-square-foot public child care facility accommodates children of a variety of ages. The three-story Center is largely devoted to classroom but also includes administrative offices, facility support rooms, ground-level and rooftop play areas and a kitchen.

With children's well-being foremost, the design prioritizes a healthy indoor environment. Green materials were selected after a rigorous review of their potential to minimize the emission of toxins or volatile organic compounds. Natural light, introduced in several ways, conserves energy by reducing the use of electric lighting and enhances the quality of the learning environment. A glazed interior light well, toward the rear of the site, extends from the roof to the ground level. It introduced daylight to the inner core of the facility, which is walled-in at the rear and both sides by neighboring buildings constructed to the lot lines.

- The compact shape, light shelves, and a light well allow the center to make the most of natural light and reduce energy consumption.
- At the Williamsburg Child Care Center, recycled materials can be found in the carpet, rubber flooring, ceiling panels, concrete, steel, walls, bathroom tiles and partitions, and furniture.

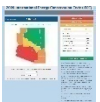
The bamboo millwork and linoleum flooring in the center are made of materials that grow back quickly, reducing the use of non-renewing resources.
Indoor air quality is improved by the walk-off mats at the entrances, low-emitting materials and finishes and separate ventilation for services areas.

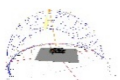
CLIAMATE CHANGES: from the light-colored, highly reflective roofing to the perimeter planting with its structural soil, the Williamsburg Child care center is designed to mitigate the Urban Heat Island effect by reducing atmospheric temperature.

Relationship to Existing Codes and Standards — ASHRAE 62-1989

Relationship to Green Building Rating Systems — USGBC LEED 2.0 2000 in development

HIGH PERFORMANCE BUILDINGS 1999



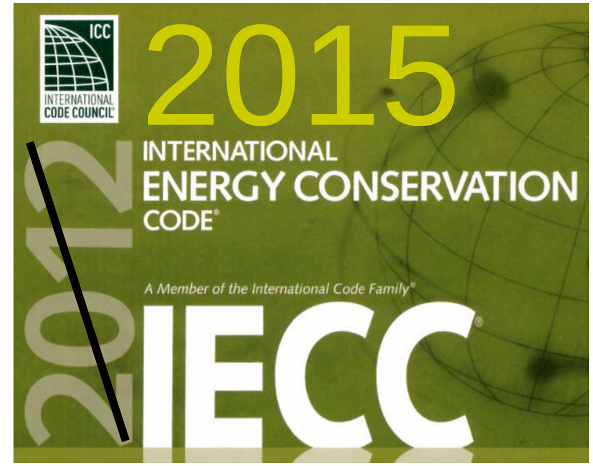


2018 - How Many Are There?!

ASHRAE®

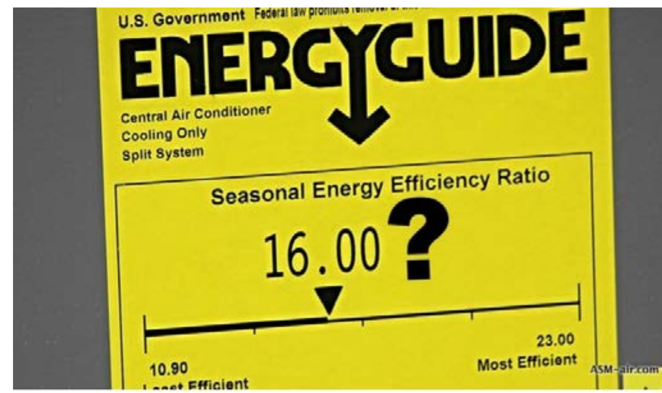
90.1-2007
90.1-2010
90.1-2013
90.1-2016

ZERO
ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY



RESNET
HERS®
INDEX

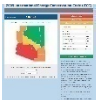
energy
ENERGY STAR

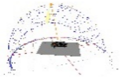


U.S. GREEN BUILDING COUNCIL
LEED CERTIFIED
USGBC®

2012 IECC Commercial Scope and Envelope Requirements
July 2011

CODES AND STANDARDS





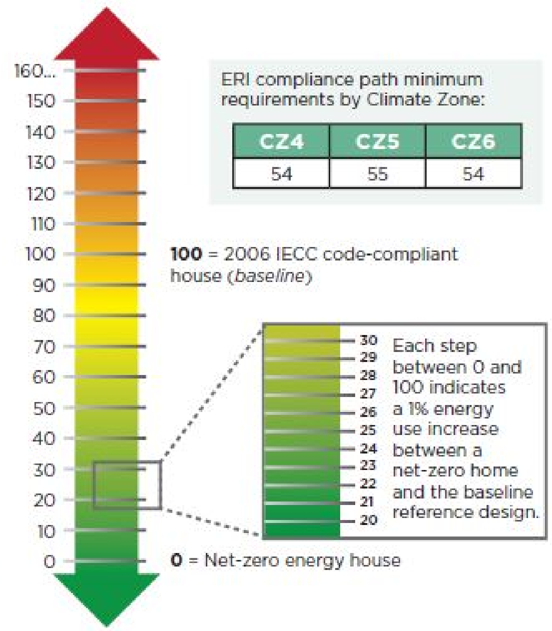
ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

The Energy Rating Index (ERI) is a new compliance path that provides designers with more flexibility than the prescriptive path. The ERI is similar to the RESNET HERS index:

- Each home is rated and given a score on the scale that coincides with its potential energy use.
- A score of 0 is the rough equivalent of a net-zero home, meaning that the home produces an equivalent amount of energy to the amount it uses.
- The *baseline ERI reference design* (score of 100) is a theoretical home that meets minimum 2006 IECC prescriptive requirements.
- Each incremental integer value equals 1% additional total energy use of the rated design, relative to the reference design.

ERI differs from the performance and prescriptive path in several ways. Firstly, ERI considers all of the energy used in the residence, not just the fuel used in heating, cooling and service hot water heating systems. It also takes into account major appliances and plug loads. ERI allows equipment and appliance efficiencies to be involved in tradeoffs.

ERI still requires that mandatory provisions of the code be met. However, for building thermal envelope efficiency and SHGC requirements, the ERI method references the 2009 IECC tables, which are more lenient.



ERI compliance path minimum requirements by Climate Zone:

CZ4	CZ5	CZ6
54	55	54

The ERI pathway is very similar to the HERS rating index, with 0 being a net-zero design and 100 being the standard reference design

DOCUMENTATION AND COMPLIANCE

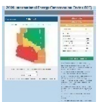
ERI ratings must be third party verified. Currently, projects that choose this pathway must employ a HERS rater to inspect the residence for proper insulation, provide the blower door test and provide the rating.

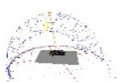
In Climate Zone 5, a rating of 55 or below meets compliance and in Climate Zones 4 and 6 a rating of 54 or below complies. Having a HERS Rater as part of the design team can be a great resource to help simplify the compliance process and deliver a higher-performing building.

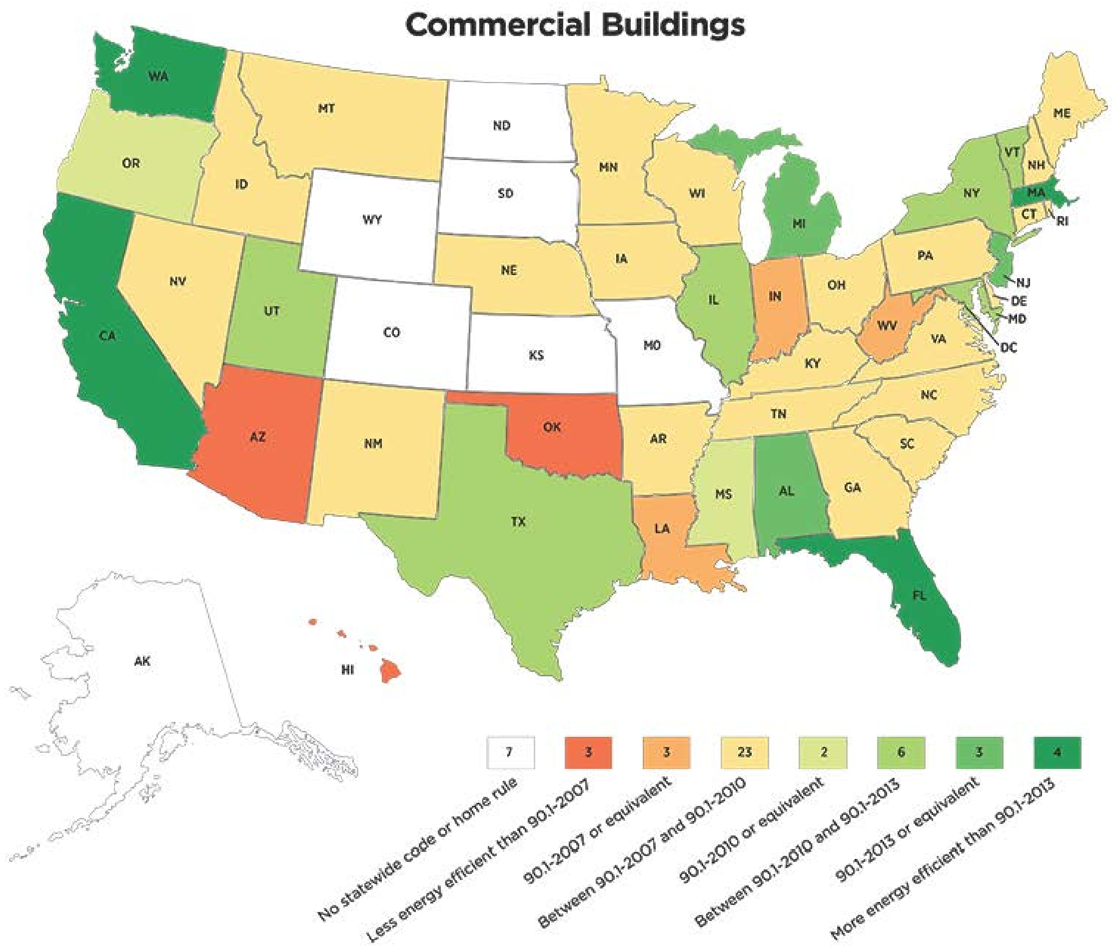
The code stipulates documentation, software, and compliance report requirements similar to those in the performance path, although this process is simplified by having a third-party rater involved. The applicant will still be required to file the results with the code official.

Where is Arizona?



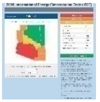


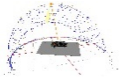




Updated as of December 15, 2017

ENERGY CODE ADOPTION BY STATE



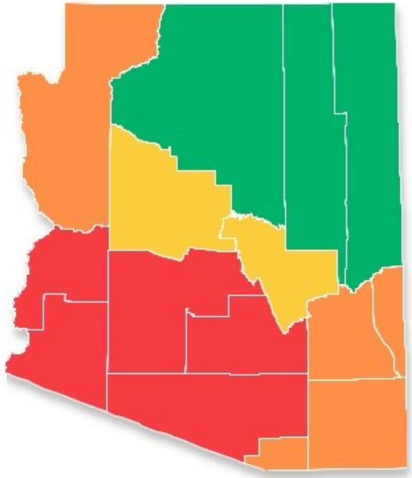


2009 International Energy Conservation Code (IECC)

« Back to U.S. map

ARIZONA

Click a county to see the requirements for its climate zone.



Select a state and county to view its minimum insulation requirements.

State: Arizona

County: Yavapai

Visit the Status of State Energy Codes website to see if Arizona has adopted the 2009 IECC.

- Climate Zone 2
- Climate Zone 3
- Climate Zone 4 (Except Marine)

Ceiling R-value	38
Wood Frame Wall R-value	13
Mass Wall R-value [i]	5/10
Floor R-value	19
Basement Wall R-value [c]	10/13
Slab R-value [d], Depth	10, 2 ft
Crawlspace Wall R-value [c]	10/13
Fenestration U-Factor [b]	0.35
Skylight U-Factor [b]	0.60
Glazed fenestration SHGC [b, e]	NR

- Climate Zone 5 & 4 Marine

a. R-values are minimums. U-factors and SHGC are maximums. R-19 batts compressed into a nominal 2x6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.

b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c. "15/19" means R-15 continuous insulated sheathing on he interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in zones 1 through 3 for heated slabs.

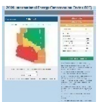
e. There are no SHGC requirements in the Marine zone.

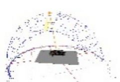
f. Basement Wall Insulation is not required in warm-humid locations.

g. Or insulation sufficient to fill the framing cavity. R-19 is

Arizona is a “Home-Rule” State

PRESCRIPTIVE REQUIREMENTS





Where is Yavapai County? 2006 IECC with Amendments

Climate Zone 2 — Below 3500

Climate Zone 3

Climate Zone 4 — Above 3500

	Climate Zone 4 (Above 3500)	Climate Zone 2 (Below 3500)
Ceiling R-value	38	**30**
Wood Frame Wall R-value	13	13
Mass Wall R-value [i]	5/10	4/6
Floor R-value	19	13
Basement Wall R-value [c]	10/13	0
Slab R-value [d], Depth	10, 2 ft	0
Crawlspace Wall R-value [c]	10/13	0
Fenestration U-Factor [b]	0.35	0.65
Skylight U-Factor [b]	0.60	0.75
Glazed fenestration SHGC [b, e]	NR	0.30

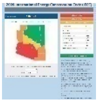
Climate Zone 5 & 4 Marine

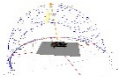
Later Code Adoptions IECC 2015

Commercial	**Residential**
R-38	R-38
R-13 + R-3.8 CI or R20	R-13 + R-3.8 CI or R20
R-9.5 CI	R-11.4 CI
R-30	R-30
R-7.5 CI	R-10 CI
R-19, 2 ft	R-15, 2 ft
R-7.5	R-10
0.35	0.35
0.50	0.50
0.40	0.40

Camp Verde 2012 IECC with Amendments
Clarkdale 2006 with Amendments
Prescott 2012 with Amendments
Sedona …

PRESCRIPTIVE REQUIREMENTS



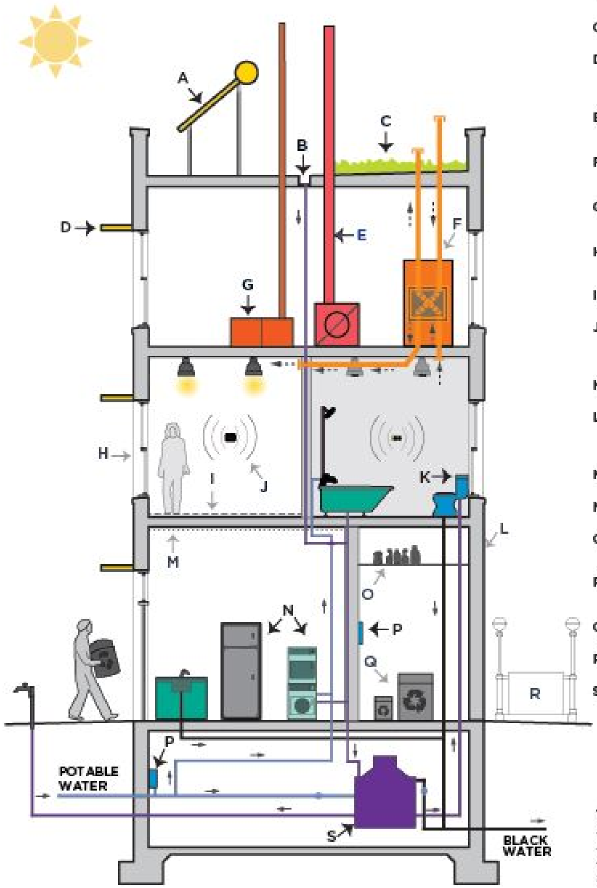


WHOLE BUILDING APPROACH

The "whole-building approach" is the idea that all systems such as lighting, HVAC, plumbing, and envelope are all interconnected and work together in an efficient building.

Changing one aspect of the building envelope may have unintended c nsequences elsewhere. For example, increasing the efficiency of the thermal envelope will lead to a lower de nd on the boiler, but if the boiler is already over-sized, it will short-cycle more and run less efficiently. Convers swapping out inefficient, heat-producing incandescent light bulbs with LEDs will lower the amount of heat i he building, and the boiler will have to work harder to compensate.

Consider all of a building's systems at once and be aware of how changes in one s m may affect other systems. The ultimate goal is *synergy* between systems, meaning that each system w in cooperation with the others, creating a result that is greater than the sum of its parts. For example, upgradi uilding's thermal envelope while simultaneously installing a smaller, more efficient boiler will have a positi ct on the building's performance that would not be possible separately.

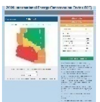


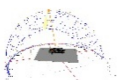
- **A Solar Thermal** Provide renewable so water heating
- **B Rain Water Harvest** Uses water for toilets + gard
- **C White Roof or Green Roof** Reduces urban heat island effect
- **D Sun Control Devices** Reduce solar heat gain in summer, direct daylight into room to lower lighting loads
- **E Condensing Boiler** Reduces energy use for heat + hot water supply
- **F Heat Recovery Ventilation or Controlled Exhaust Ventilation** Reduces energy use
- **G Cogeneration** Uses both heat + electric power from local generator
- **H High Performance Windows** Increase comfort + save energy
- **I FSC Wood Flooring** Supports sustainable forestry
- **J Occupancy + Daylighting Controlled Lighting** Reduces energy use, improves indoor environment
- **K Low Water/Dual-Flush Toilet** Reduces water use
- **L Continuous High R-value Insulation** Increases comfort + saves energy
- **M Recycled Ceiling Tiles** Reduce resource use
- **N ENERGY STAR Appliances** Reduce electrical + water use
- **O Low VOC Green Cleaning Products** Improve indoor air quality
- **P Meters + Submeters** Increase awareness of energy + water use
- **Q Recycling** Reduces resource use
- **R Access to Mass Transit** Reduces energy use
- **S Greywater System** Recycles water to toilets + garden

The whole building approach sees a building as an interconnected network of systems that all affect each other. Changes in any one system can impact how other, seemingly unrelated systems, function as well.

…is the idea that all systems are interconnected…

THE TOTAL PICTURE

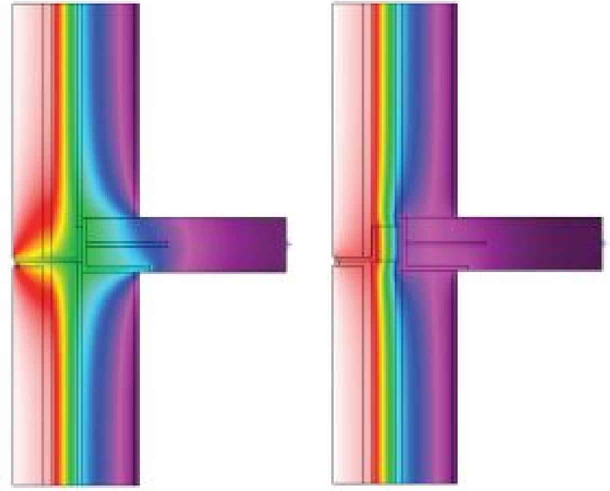




THERMAL BRIDGING

Thermal bridging occurs when a poorly insulating material allows heat flow across a thermal barrier. To prevent thermal bridging you must provide a thermal break, such as continuous insulation, seen in the illustration to the right

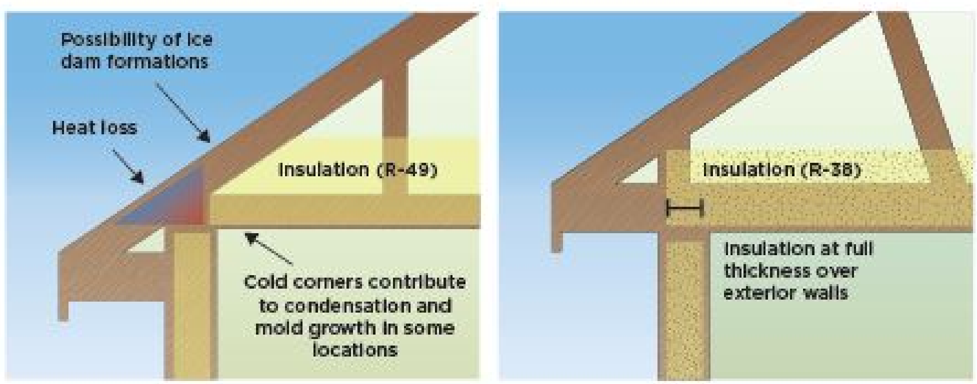
Thermal bridging at slab edge.



Thermal modeling demonstrates how heat transfers through a thermal bridge (left) and how effective construction mitigates heat loss.

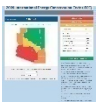
R402.2.1 CEILINGS WITH ATTIC SPACES

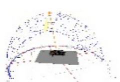
Ceilings with attic spaces can comply in two ways. The first is to follow the requirements in R402.1.2, which requires an R-Value of 49. Alternately, R-38 is permissable as long as it extends over the wall top plate at the eaves. Note that this reduction cannot be used if using the U-factor alternative or the total UA alternative.



An "energy truss" can prevent cold corners by allowing the ceiling insulation to overlap with the wall insulation

CURRENT ISSUES





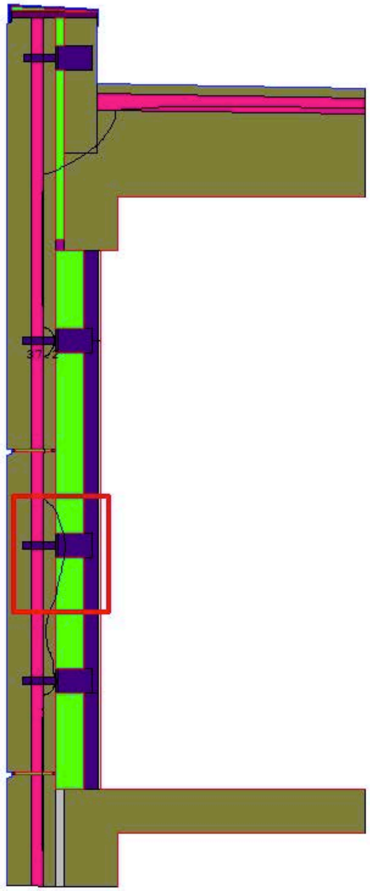
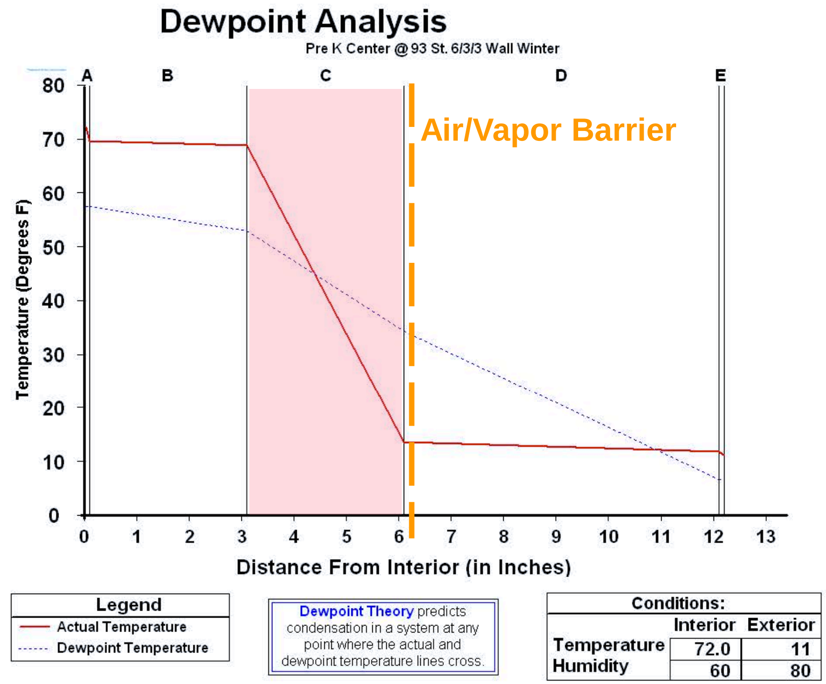


Figure 2: THERM results. Line of condensation at an interior surface shows where there is risk of condensation.



	Component Name	Thickness	R-Value	Rep
A	Interior Air Film	0.100	0.68	0.001
B	Concrete	3.000	0.24	0.930
C	FOAMULAR 250	3.000	15.00	2.700
D	Concrete	6.000	0.48	1.860
E	Out Air Film Winter	0.100	0.17	0.001
F				
G				
H				
I				
J				
K				
L				
	TOTAL	12.200	16.57	5.492

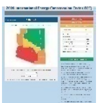
Interface	Temperature Actual	Temperature Dewpnt	Accum (oz/day-sqft)
-A	72.00	57.32	0.000
AB	69.50	57.31	0.000
BC	68.61	52.83	0.000
CD	13.39	34.18	* 0.005
DE	11.63	6.48	0.000
EF	11.00	6.45	0.000
FG			
GH			
HI			
IJ			
JK			
KL			
L-			

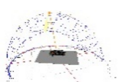
* - Indicates area of condensation potential.

NOTICE: This calculation is based on the theory of Water Vapor Migration presented in the ASHRAE 1993 Fundamentals Handbook. Actual performance may vary depending upon air infiltration. workmanship, and building materials.

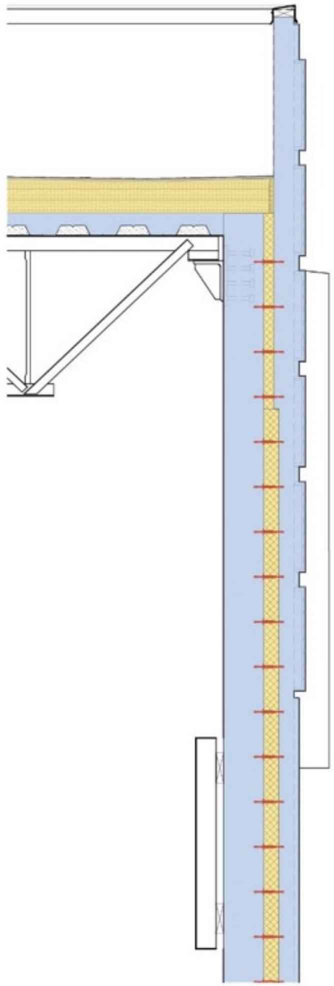
BUILDING ENVELOPE



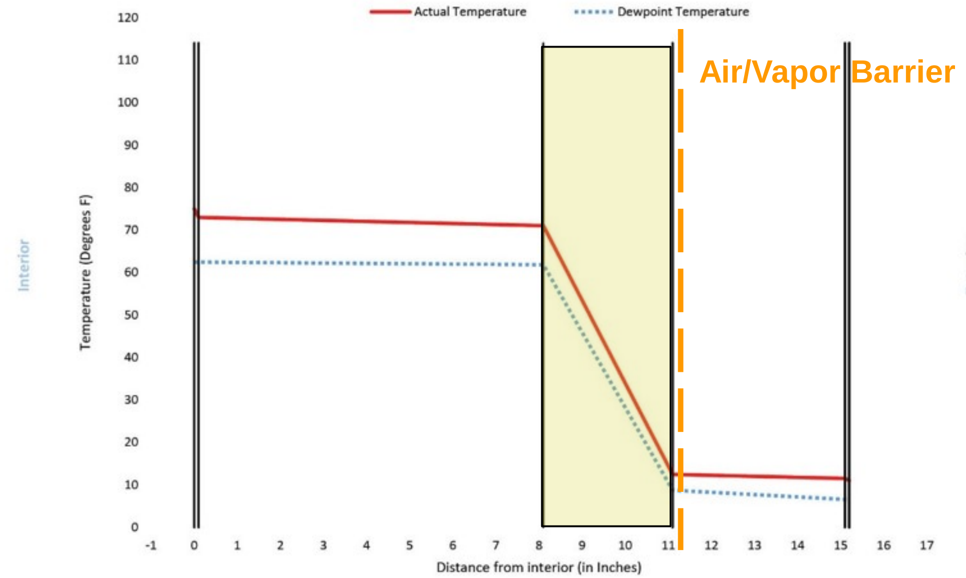




DEWPOINT ANALYSIS - WINTER
PS 81 GYM
QUEENS, NY



THERM results. Line of condensation at an interior surface shows where there is risk of condensation.

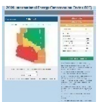


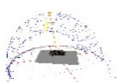
Conditions:	Interior	Exterior
Temperature	75	11
Humidity	65	80

	Component Name	Thickness	R-value	Rep
A	Interior Air Film	0.1	0.68	0.001
B	Interior Concrete	8	0.64	2.48
C	ISOMASS	3	19.5	100
D	Exterior Concrete	4	0.32	1.24
E	Exterior Air Film Winter	0.1	0.17	0.001
	TOTAL	15.2	21.31	103.7

Interface	Distance from interior	Temp Actual	Temp Dewpoint	Accum oz/day-sq.ft.
	0	75.00	62.44	
AB	0.1	72.96	62.44	0.000
BC	8.1	71.04	61.82	0.000
CD	11.1	12.47	8.75	0.000
DE	15.1	11.51	6.57	0.000
EF	15.2	11.00	6.57	0.000

BUILDING ENVELOPE





wrightsoft

Building Analysis
Upper Level
Oak Creek Heating and Cooling

Job:
Date: Aug 14, 2013
By: Todd Bean

PO Box 3604, Sedona, AZ 86340 Phone: (928) 204-1120 Fax: (928) 204-1095 Email: oakcreeksm@gmail.com Web: www.oakcreeksheetmetal.com

Project Information

For: Szerbaty Residence
Morning Sky Dr, Cottonwood, AZ 86326

Design Conditions

Location:
Cottonwood, AZ
Elevation: ***3500*** ft
Latitude: 35°N

Outdoor:	**Heating**	**Cooling**
Dry bulb (°F)	***20***	102
Daily range (°F)	-	29 (H)
Wet bulb (°F)	-	64
Wind speed (mph)	15.0	7.5

Indoor:	**Heating**	**Cooling**
Indoor temperature (°F)	70	75
Design TD (°F)	50	27
Relative humidity (%)	50	50
Moisture difference (gr/lb)	48.7	-34.5

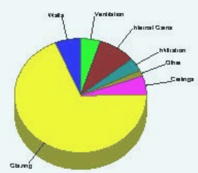
Infiltration:
Method: Simplified
Construction quality: Average
Fireplaces: 0

Heating

Component	Btuh/ft²	Btuh	% of load
Walls	3.6	3665	17.5
Glazing	14.5	8127	38.7
Doors	0	0	0
Ceilings	1.4	2393	11.4
Floors	1.4	812	3.9
Infiltration	2.3	3606	17.2
Ducts		0	0
Piping		0	0
Humidification		0	0
Ventilation		2390	11.4
Adjustments		0	
Total		**20994**	**100.0**

Cooling

Component	Btuh/ft²	Btuh	% of load
Walls	1.6	1638	6.4
Glazing	31.7	17743	68.8
Doors	0	0	0
Ceilings	0.8	1390	5.4
Floors	0.8	432	1.7
Infiltration	0.6	959	3.7
Ducts		0	0
Ventilation		1272	4.9
Internal gains		2360	9.1
Blower		0	0
Adjustments		0	
Total		**25794**	**100.0**



Latent Cooling Load = 0 Btuh
Overall U-value = 0.079 Btuh/ft²-°F

WARNING: window to floor area ratio = 34.0% - more than 25%.

Bold/italic values have been manually overridden

wrightsoft

AED Assessment
Upper Level
Oak Creek Heating and Cooling

Job:
Date: Aug 14, 2013
By: Todd Bean

PO Box 3604, Sedona, AZ 86340 Phone: (928) 204-1120 Fax: (928) 204-1095 Email: oakcreeksm@gmail.com Web: www.oakcreeksheetmetal.com

Project Information

For: Szerbaty Residence
Morning Sky Dr, Cottonwood, AZ 86326

Design Conditions

Location:
Cottonwood, AZ
Elevation: ***3500*** ft
Latitude: 35°N

Outdoor:	**Heating**	**Cooling**
Dry bulb (°F)	***20***	102
Daily range (°F)	-	29 (H)
Wet bulb (°F)	-	64
Wind speed (mph)	15.0	7.5

Indoor:	**Heating**	**Cooling**
Indoor temperature (°F)	70	75
Design TD (°F)	50	27
Relative humidity (%)	50	50
Moisture difference (gr/lb)	48.7	-34.5

Infiltration:

Test for Adequate Exposure Diversity

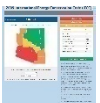
Maximum hourly glazing load exceeds average by 19.6%.

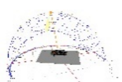
Zone has adequate exposure diversity (AED), based on AED limit of 30%.

AED excursion: 0 Btuh

Bold/italic values have been manually overridden

ENERGY ANALYSIS/MODELING





SOUTH ELEVATION	REFER TO A201
WALL TYPE	AREA
W1	432 FT²
W2	605 FT²
W3	296 FT²
UW (UNDERGROUND)	1380 FT²
FENESTRATION TYPE	AREA
F1	2556 FT²
F2	631 FT²
F3	N/A
F4	N/A
GROSS ENVELOPE AREA= 5900 FT²	

WEST ELEVATION	REFER TO A204
WALL TYPE	AREA
W1	2898 FT²
W2	75 FT²
W3	220 FT²
UW (UNDERGROUND)	916 FT²
FENESTRATION TYPE	AREA
F1	N/A
F2	N/A
F3	92 FT²
F4	100 FT²
GROSS ENVELOPE AREA= 4301 FT²	

NORTH ELEVATION	REFER TO A202
WALL TYPE	AREA
W1	1587 FT²
W2	449 FT²
W3	462 FT²
UW (UNDERGROUND)	889 FT²
FENESTRATION TYPE	AREA
F1	2546 FT²
F2	806 FT²
F3	154 FT²
F4	N/A
GROSS ENVELOPE AREA= 6803 FT²	

EAST ELEVATION	REFER TO A203
WALL TYPE	AREA
W1	2713 FT²
W2	75 FT²
W3	470 FT²
UW (UNDERGROUND)	875 FT²
FENESTRATION TYPE	AREA
F1	N/A
F2	N/A
F3	92 FT²
F4	100 FT²
GROSS ENVELOPE AREA= 4058 FT²	

FLOORS (MASS)	REFER TO A407
FLOOR TYPE	AREA
FM	263 FT²
GROSS FLOOR (MASS) AREA= 263 FT²	

ROOF	REFER TO A105, A208
ROOF TYPE	AREA
R1	6524 FT²
R2	303 FT²
GROSS ROOF AREA= 6827 FT²	

ENERGY ANALYSIS GENERAL NOTES

ALL CALCULATIONS AND VALUES PER ASHRAE 90.1-2010, CLIMATE ZONE 4A.

(5.4.3.1.1) AIR BARRIER CONSTRUCTION

1. THE CONTINUOUS AIR BARRIER SHALL EXTEND OVER ALL SURFACES OF THE BUILDING ENVELOPE (AT LOWEST FLOOR, EXTERIOR WALLS, AND ROOF).
2. THE CONTINUOUS AIR BARRIER SHALL BE DESIGNED TO RESIST POSITIVE AND NEGATIVE PRESSURES FROM WIND, STACK EFFECT, AND MECHANICAL VENTILATION.

(5.4.3.1.2) AIR BARRIER INSTALLATION / PENETRATIONS

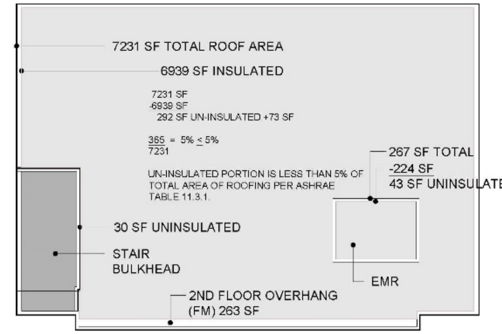
1. THE FOLLOWING AREAS OF CONTINUOUS AIR BARRIER IN THE BUILDING ENVELOPE SHALL BE WRAPPED, SEALED, CAULKED, GASKETED, OR TAPED IN AN APPROVED MANNER TO MINIMIZE AIR LEAKAGE:
   - 1.1. JOINTS AROUND FENESTRATION AND DOOR FRAMES (BOTH MANUFACTURED AND SITE BUILT)
   - 1.2. JUNCTIONS BETWEEN WALLS AND FLOOR, BETWEEN WALLS AT BUILDING CORNERS, BETWEEN WALLS AND ROOFS OR CEILINGS.
   - 1.3. PENETRATIONS THROUGH THE AIR BARRIER IN BUILDING ENVELOPE ROOFS, WALLS, AND FLOORS.
   - 1.4. BUILDING ASSEMBLIES USED AS DUCTS OR PLENUMS.
   - 1.5. JOINTS, SEAMS, CONNECTIONS BETWEEN PLANES, AND OTHER CHANGES IN AIR BARRIER MATERIALS.

DOORS AND ACCESS OPENINGS TO SHAFTS, CHUTES, STAIRWAYS, AND ELEVATOR LOBBIES

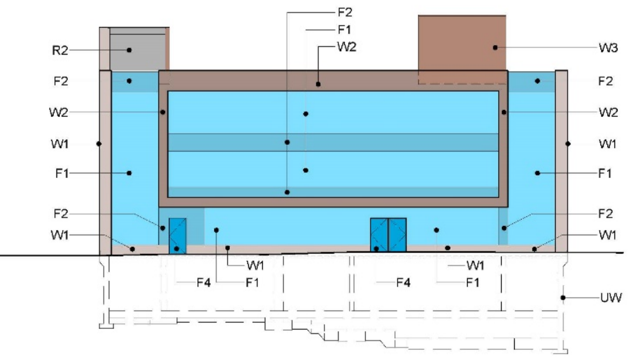
1. OPENINGS FOR EXTERIOR STAIR BULKHEADS, ELEVATOR DOORS, AND SMOKE HATCHES SHALL BE GASKETED, WEATHERSTRIPPED OR SEALED.

(6.4.3.4.2) SHUTOFF DAMPERS

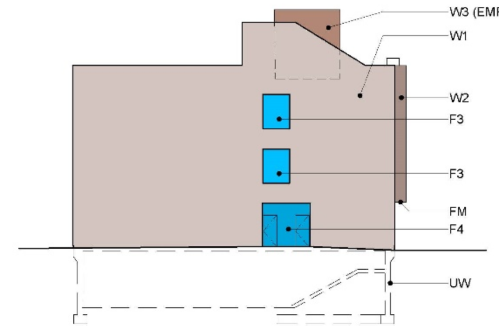
1. STAIR AND ELEVATOR SHAFT VENTS AND OTHER OUTDOOR AIR INTAKES AND EXHAUST OPENINGS INTEGRAL TO THE BUILDING ENVELOPE SHALL BE EQUIPPED WITH NOT LESS THAN A CLASS I MOTORIZED, LEAKAGE-RATED DAMPER WITH A MAX LEAKAGE RATE OF 4 CFM/SF AT 1.0 IN WG.



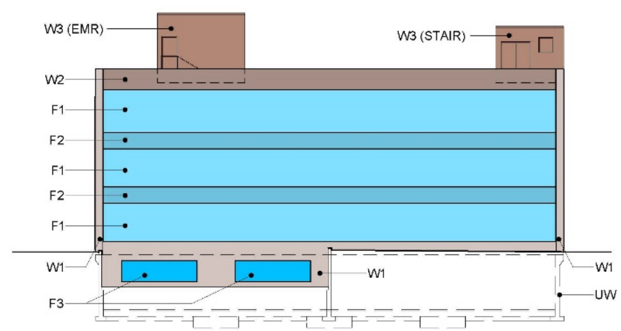
ROOF PLAN REFER TO A105



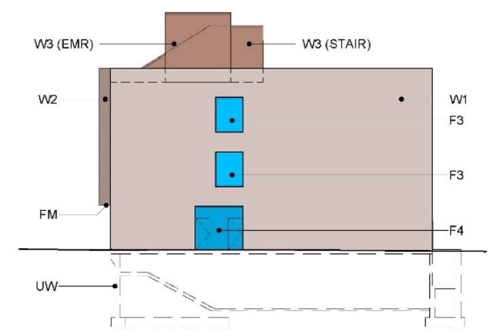
SOUTH ELEVATION REFER TO A201



WEST ELEVATION REFER TO A204

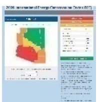


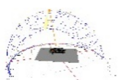
NORTH ELEVATION REFER TO A202

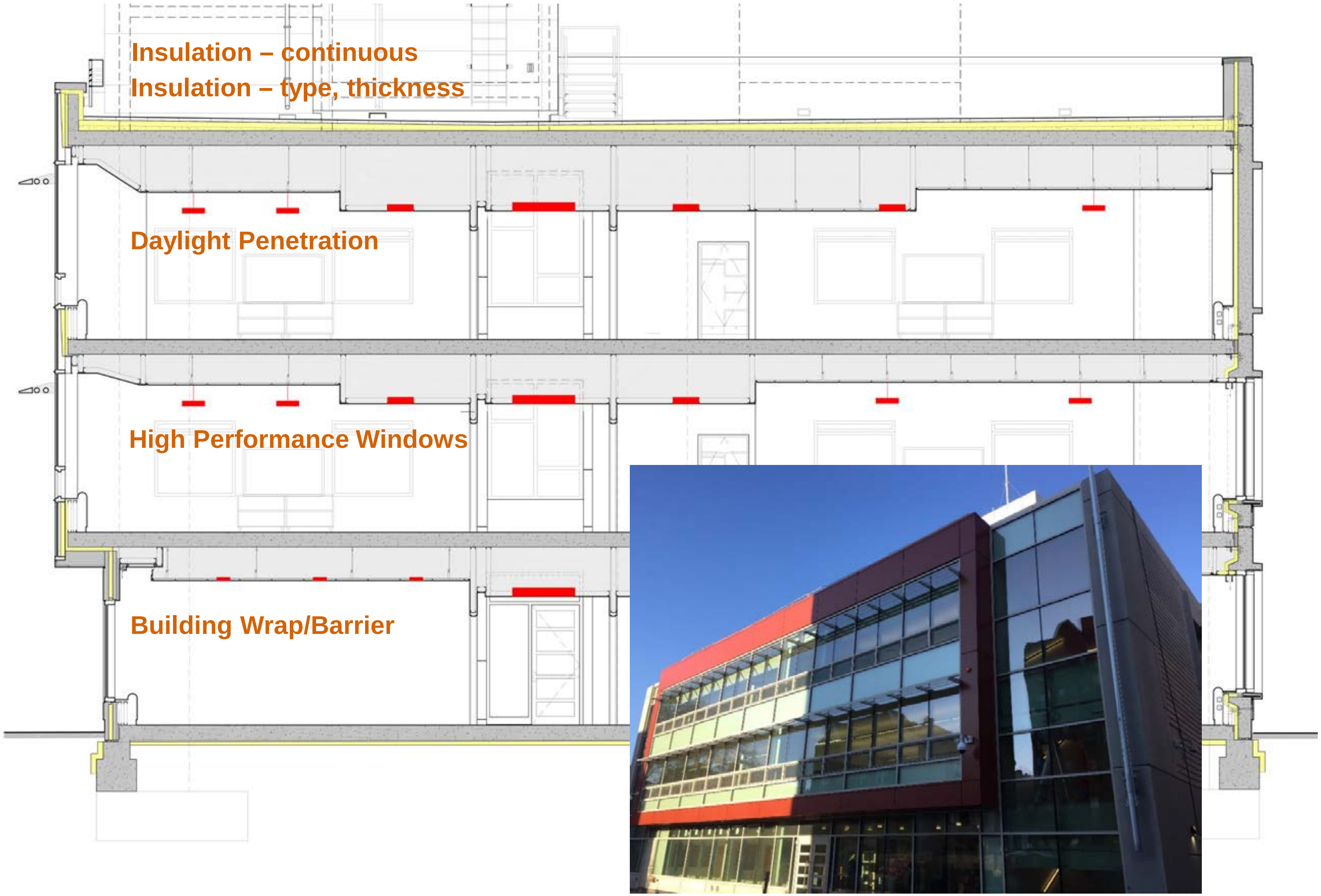


EAST ELEVATION REFER TO A203

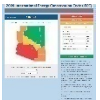
BUILDING ENVELOPE MODELING

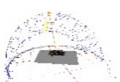


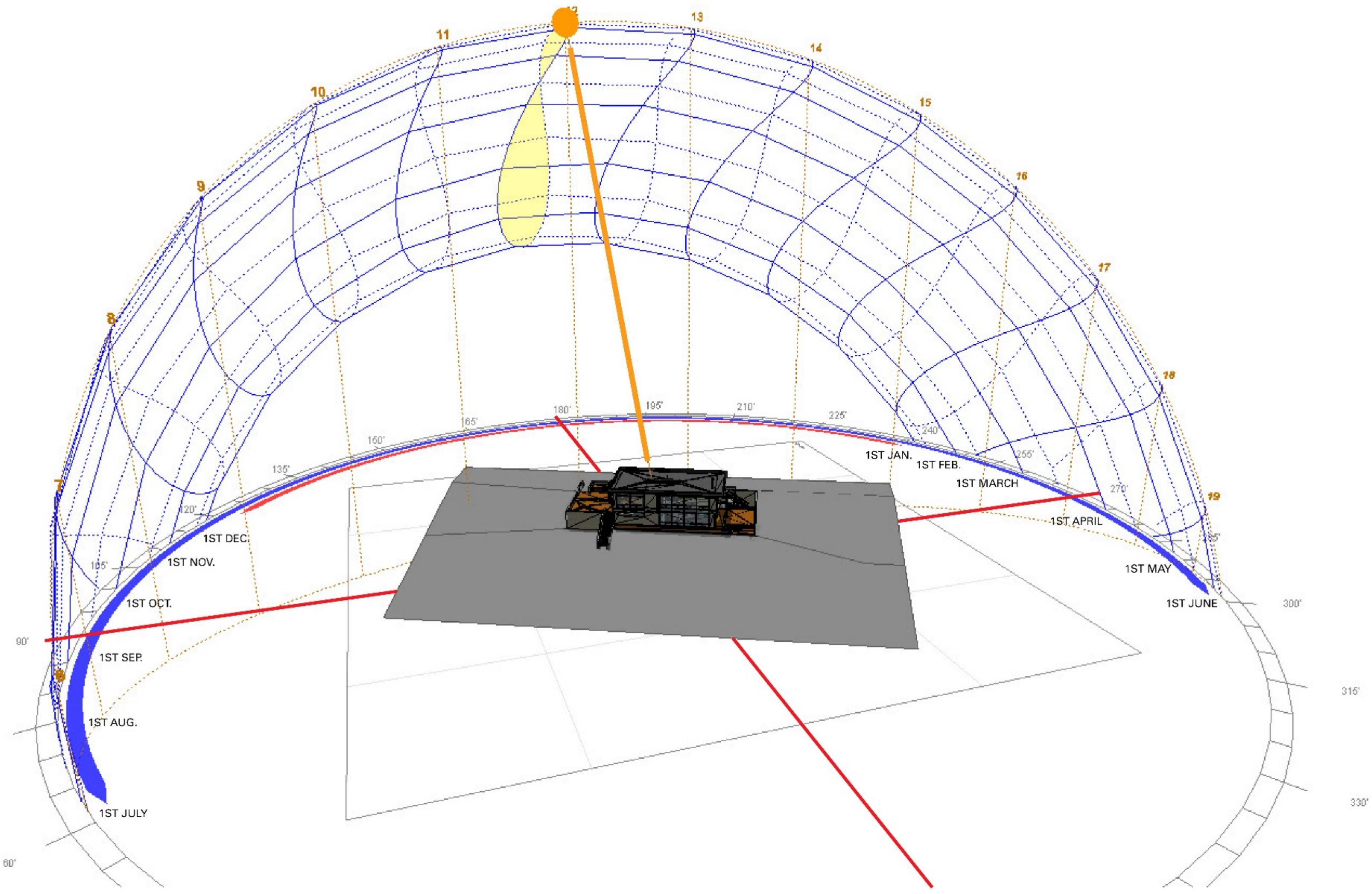




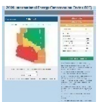
BUILDING ENVELOPE MODELING – INTERIOR AFFECTS

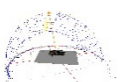


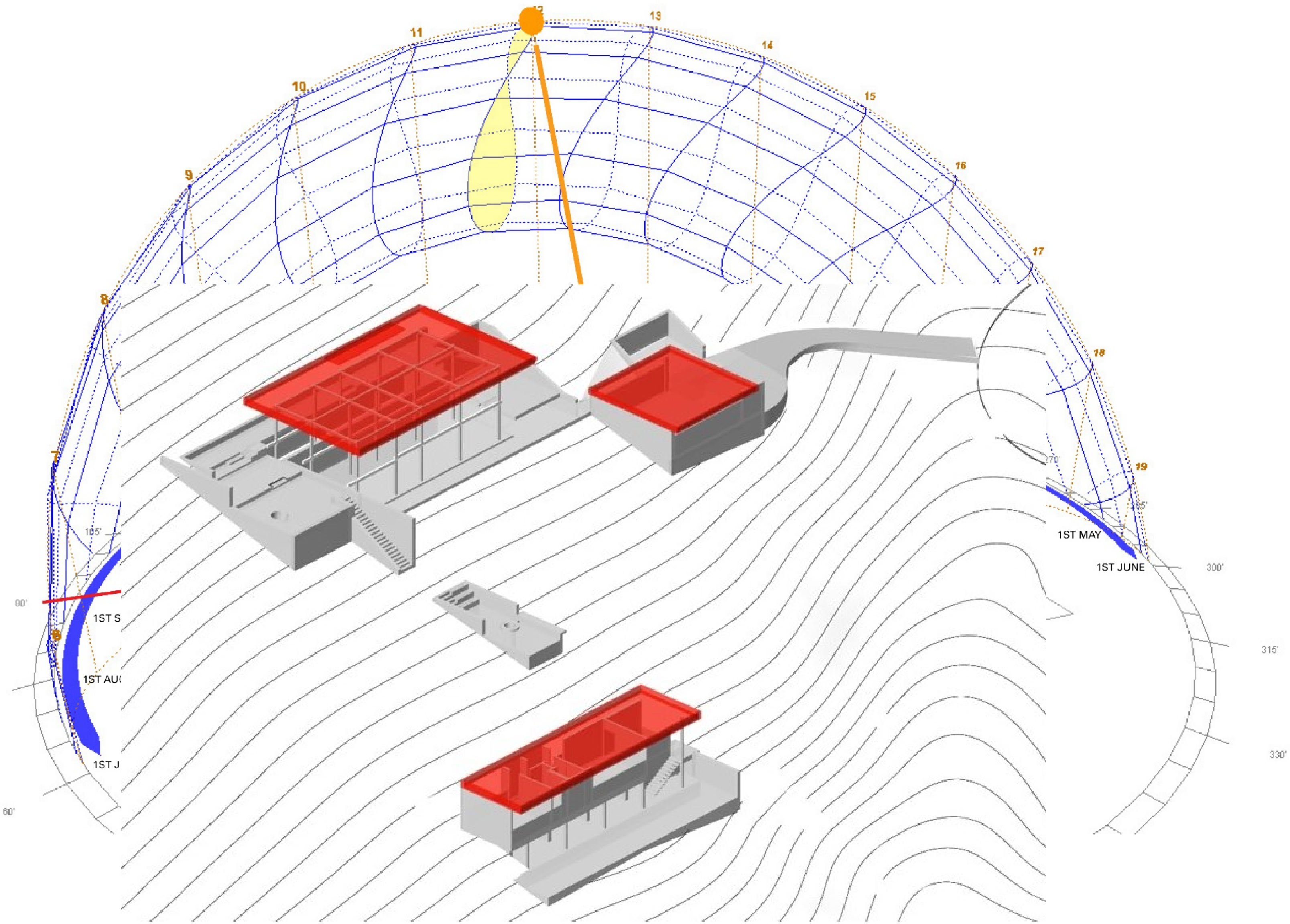




ELEMENTS OF PASSIVE DESIGN
Morning Sky Residence, Cottonwood, AZ

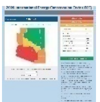


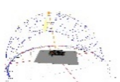


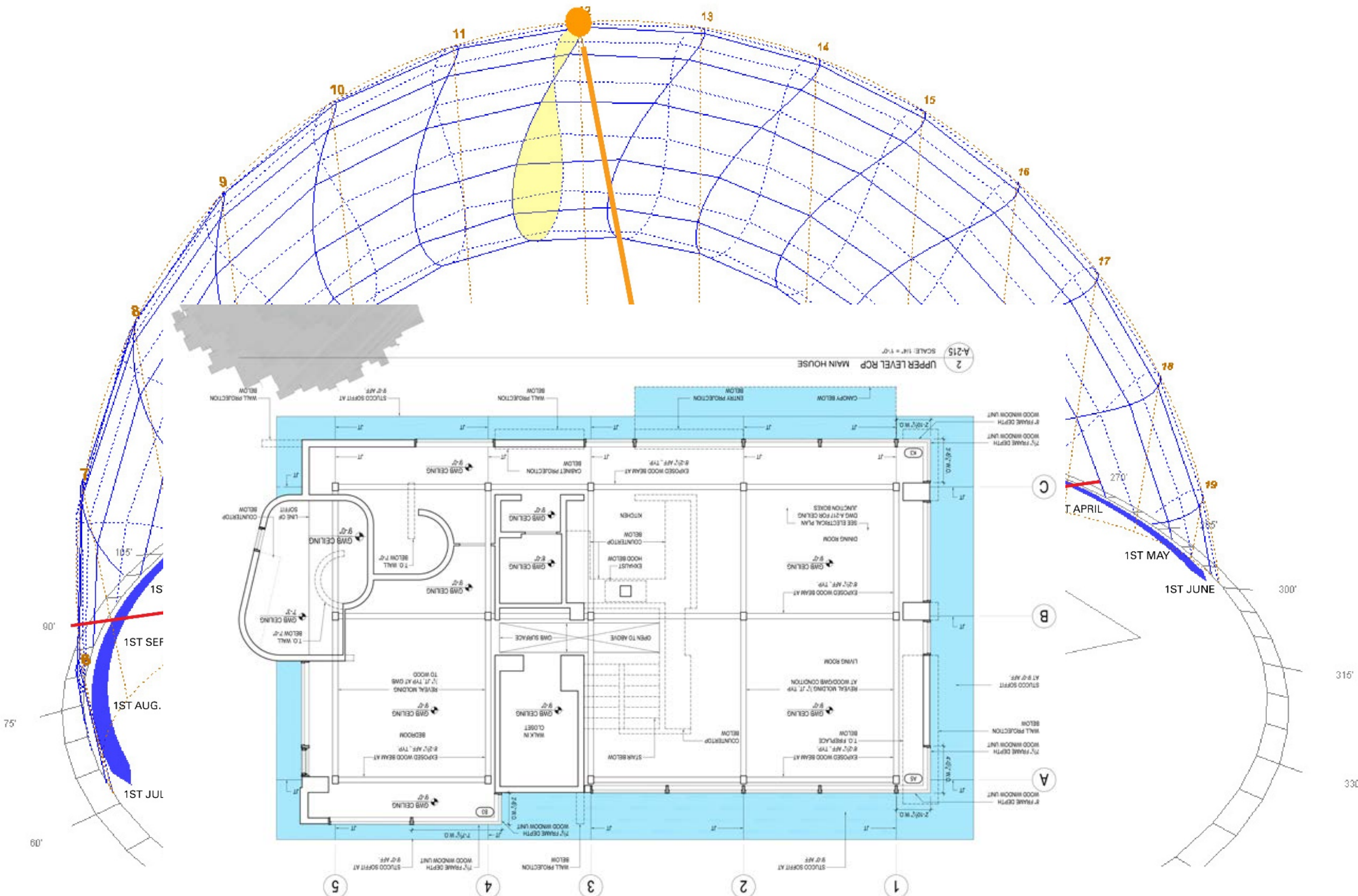


ELEMENTS OF PASSIVE DESIGN

Morning Sky Residence, Cottonwood, AZ

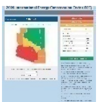


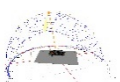


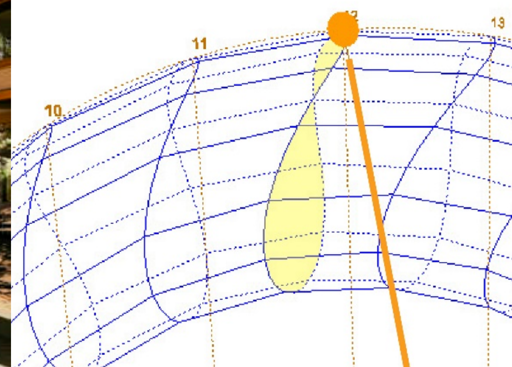


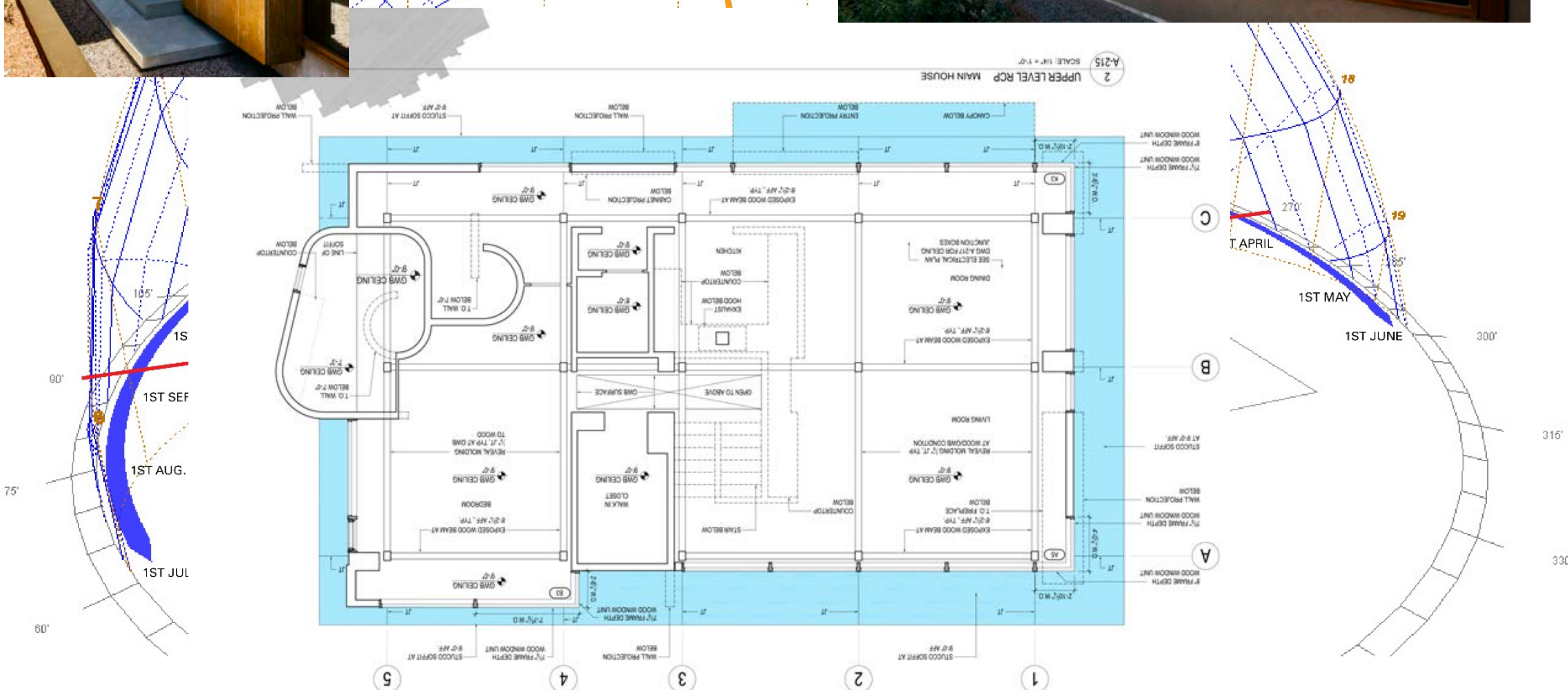
ELEMENTS OF PASSIVE DESIGN

Morning Sky Residence, Cottonwood, AZ





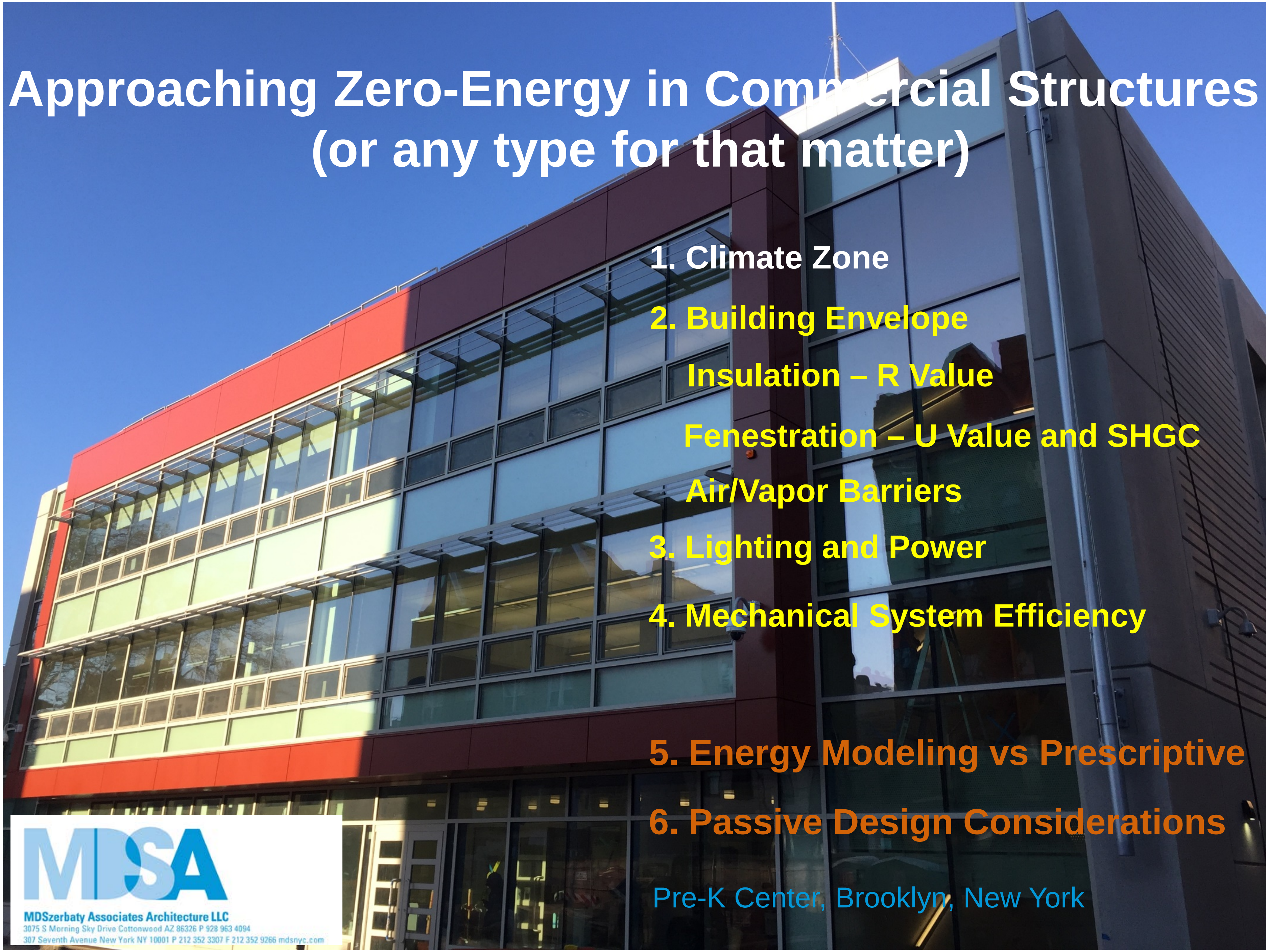




ELEMENTS OF PASSIVE DESIGN

Morning Sky Residence, Cottonwood, AZ

Approaching Zero-Energy in Commercial Structures (or any type for that matter)



1. Climate Zone
2. Building Envelope
   - Insulation – R Value
   - Fenestration – U Value and SHGC
   - Air/Vapor Barriers
3. Lighting and Power
4. Mechanical System Efficiency
5. Energy Modeling vs Prescriptive
6. Passive Design Considerations

Pre-K Center, Brooklyn, New York

MDSA
MDSzerbaty Associates Architecture LLC
3075 S Morning Sky Drive Cottonwood AZ 86326 P 928 963 4094
307 Seventh Avenue New York NY 10001 P 212 352 3307 F 212 352 9266 mdsnyc.com