OVERALL ENVELOPE TDV ENERGY APPROACH

Project Name:	Date:	Climate Zone:

WINDOW RATIO CALCULATION §143(b)

A. TOTAL LINEAR DISPLAY PERIMETER		FT × 6 FT =	ft^2	DISPLAY AREA
B. TOTAL GROSS EXTERIOR WALL AREA		ft^2 × 0.40 =	ft^2	40% of GROSS EXTERIOR WALL AREA
C. ENTER LARGER OF (A or B)			ft^2	MAXIMUM STANDARD AREA
D. ENTER PROPOSED WINDOW AREA			ft^2	PROPOSED AREA

If the Proposed Window Area is greater than the Maximum Standard Area, then go to Window Adjustment step below.

E. WINDOW WALL RATIO = (Row D) Divided by (Row B) = _____ Must meet RSHG in Table 143-A, 143-B, or 143-C

WEST WINDOW RATIO CALCULATION

F. WEST LINEAR DISPLAY PERIMETER		FT × 6 FT =	ft^2	WEST DISPLAY AREA
G. WEST EXTERIOR WALL AREA		ft^2 × 0.40 =	ft^2	40% of WEST EXTERIOR WALL AREA
H. ENTER LARGER OF (F or G)			ft^2	MAXIMUM STANDARD WEST AREA
I. ENTER PROPOSED WEST WINDOW AREA			ft^2	PROPOSED WEST WINDOW AREA

If the Proposed West Window Area is greater than the Maximum Standard West Area, then Go to Window Adjustment step below.

J. WINDOW WALL RATIO = (Row I) Divided by (Row G) = _____ Must meet RSHG in Table 143-A, 143-B, or 143-C

Combined Area for North, East and South Walls

K. N/E/S DISPLAY PERIMETER (A Minus F)		FT × 6 FT =	ft^2	N/E/S of WEST EXTERIOR WALL AREA
L. N/E/S EXTERIOR WALL AREA (B Minus G)		ft^2 × 0.40 =	ft^2	40% N/E/S AREA
M. ENTER LARGER OF K or L			ft^2	MAXIMUMN STANDARD N/E/S/ AREA
N. PROPOSED N/E/S/ WINDOW AREA (D Minus I)			ft^2	PROPOSED N/E/S/ AREA

Window Adjustment

O. IF D>C and/or if I>H, Proceed to the calculation Step 1 for all walls or Step 2 for West wall. If not, go to the Skylight Area Test on ENV-3C Page 6, **CALCULATE ADJUSTED AREAS.**

1. IF D>C: Use the calculated Window Adjustment Factor (WAF) for all walls.

MAX. STANDARD AREA (from C)		PROPOSED WINDOW AREA (from D)		WINDOW ADJUSTMENT FACTOR
	÷		=	

2. IF I>H: Calculate one Window Adjustment Factor (WAF) for the West wall.

MAX. STANDARD WEST AREA (from H)		PROPOSED WEST AREA (from I)		WEST WINDOW ADJUSTMENT FACTOR
	÷		=	

MAX. STANDARD AREA (from C)		PROPOSED AREA (from D)		WEST WINDOW ADJUSTMENT FACTOR
	÷		=	

Project Name:	Date:	Climate Zone:

SKYLIGHT RATIO CALCULATION §143(b)

	ACTUAL GROSS ROOF AREA		MAXIMUM ALLOWED STANDARD SKYLIGHT AREA	
A IF Atrium/Skylight Height is ≤ 55 ft; **or**		ft2 × 0.05 =	ft^2	
B. IF Atrium/Skylight Height is > 55 ft		ft^2 × 0.10 =	ft^2	
C. Proposed Skylight Area		ft^2		
D. Skylight Ratio = Proposed Skylight Area (Row C) Divided by Actual Gross Roof Area =			%	SRR_{Prop}
E. Maximum Allowed Skylight Roof Ratio = Maximum Allowed Standard Skylight Area (Row A or B) Divided by Total Gross Exterior Roof Area =			%	SRR_{STD}

IF THE PROPOSED SKYLIGHT AREA IS GREATER THAN THE STANDARD SKYLIGHT AREA PROCEED TO THE NEXT CALCULATION FOR THE SKYLIGHT AREA ADJUSTMENT. IF NOT GO TO PAGE 3 OF 6.

SKYLIGHT AREA ADJUSTMENT

IF F>D, Proceed To Calculation Step 1

Step 1. Calculated the Skylight Adjustment Factor (SAF).

STANDARD SKYLIGHT AREA		PROPOSED SKYLIGHT AREA (IF E = 0 ENTER 1)		SKYLIGHT ADJUSTMENT FACTOR (SAF)
	÷		=	

CARRY THE WINDOW ADJUSTMENT FACTOR (SAF) TO PAGE 6 OF 6 TO CALCULATE THE ADJUSTED AREA

OVERALL ENVELOPE TDV ENERGY APPROACH

Project Name:	Date:	Climate Zone:

TDV for the Standard Design Building, See Reference Nonresidential Appendix NA5.2

Occupancy Type and Coefficients Tables ☐ Nonresidential, See Table NA5-3 ☐ 24-Hour Use, See Table NA5-4 ☐ Retail, See Table NA5-5

A	B	C	D	E	F	G	H	I	J	K	L	M
						Criteria			Coefficients for[9]			
									U-factor	SHGC	VT	
Assembly Type[1]	Orientation	Number Of Like Assembly Type[4]	Roofs or Floor Mass Type[5]	Exterior Surface Area	Fenetration Type	U-factor[6]	SHGC[7]	VT[8]	$Cs_{u,i}$	$Cs_{s,i}$	$Cs_{t,i}$	Standard TDV Energy[10]
											Sum of Total Standard Design	

1. *Indicate type of assembly for the Envelope* (e.g. Wall, Floor, Roof, Window, Skylight & Door). One assembly type for each row.
2. *Enter the area of each different assembly.*
3. *Enter the type of fenestration; M=Manufactured, SB=Site-built, SK= Skylight and F=Fabricated.*
4. *Grouping of like assemblies in the same orientation is allowed. Iindicate the number in column E.*
5. *Enter Roofs, Floors, Walls,and for Mass Walls the catergories are light mass(HC<7), medium mass (7<=HC,15), and heavy mass (HC>=15).*
6. *Standard Design U-factor are from Table 143-A, B or C.*
7. *Standard Design SHGC are from Table 143-A, B or C. Enter "0" if not applicable for each skylight. Note: Not all vertical windows have an overhang then assume SHGC as value entered.*
8. *To calculate the fenestration standard design VT in Column I. Multiply Column H by 1.2.*
9. *Coefficients for; U-factor (**$Cs_{u,i}$**), SHGC (**$Cs_{s,i}$**), and VT(**$Cs_{t,I}$**, can be found in Table NA5.2, through Table NA5.5 of the Reference Nonresidential Appendices NA5. The Coefficient for SHGC and VT are only enter for the **fenestration products**. Enter "0" when not applicable.*
10. *Calculate the TDV Standard Design for for each Envelope Assembly Type: TDV_{Std} = Column C x [Column E x ((U-factor$_{Si}$ x C_{Sui}) + (SHGC$_{Si}$ x C_{Ssi}) + (VT$_{Si}$ x C_{Sti}))] for each Assembly Type. See Nonresidential Manual Examples in Section 3.7.1 for details.*

OVERALL ENVELOPE TDV ENERGY APPROACH

Project Name:	Date:	Climate Zone:

TDV for the Proposed Design Building, See Reference Nonresidential Apendix NA5.3

Occupancy Type and Coefficients Tables ☐ Nonresidential, See Table NA5-3 ☐ 24-Hour Use, See Table NA5-4 ☐ Retail, See Table NA5-5

A	B	C	D	E	F	G	H	I	J	K	L	M	N
					Criteria			Coefficients for					Proposed TDV Energy[11]
								U- factor[8]	SHGC[8]	VT[8]	Cool Roof [9]	Overhang[10]	
Assembly Type[1]	Orientation[2]	Number Of Like Assembly Type[2A]	Total Exterior Surface Area[3]	Fenestration Type[4]	U-factor [5]	SHGC[6]	VT[7]	$C_{su,i}$	$C_{Ss,i}$	$C_{t,i}$	M_{CR}	M_{OH}	
											Total Proposed Design[12]		
												Proposed ≤ Standard	

1. *Indicate type of assembly for the Envelope (e.g. Wall, Floor, Roof, Window, Skylight & Door). One assembly type for each row.*
2. *Indicate the orientation for walls, doors & windows. 2A. Note: Grouping of like assemblies in the same orientation is allowed. Enter the number in column C.*
3. *Indicate the Exterior Surface Area of the Assembly for that one assembly or if like assemblies then the total surface area of all assemblies in the same orientation.*
4. *Enter the type of fenestration; M=Manufactured, SB=Site-built, SK= Skylight and F=Fabricated.*
5. *Proposed Design U-factor are from Table 143-A, B or C for the appropriate assembly type.*
6. *Proposed Design SHGC are from Table 143-A, B or C. Enter "0" if not applicable. Note: Not all vertical windows have an overhang then assume SHGC as value entered.*
7. *To calculate the fenestration proposed design VT in Column H. Multiply Column G by 1.2.*
8. *Coefficients for; U-factor ($Cs_{u,i}$), SHGC ($Cs_{s,i}$), and VT($Cs_{t,I}$, can be found in Table NA5.2, through Table NA5.5 of the Reference Nonresidential Appendices NA5. The Coefficient for SHGC and VT are only entered for the* ***fenestration products****. Enter "0" when not applicable.*
9. *Calculate the Cool Roof, M_{CR}, first by using the next page (Page 5 of 6). Enter the value in the Proposed Column L.*
10. *Calculate the Overhang M_{OH} on the next page (Page 5 of 6). Enter the value in the Proposed Column M.*
11. *The Proposed TDV energy use for all assemblies other than roofs must be equal to or less than Standard TDV in Page 3 of 6. Therfore; TDV_P = Column D x [(U factor x CSu) + (CRui x URi x MCRi) + (SHGCP x CSsi x MOH) + (VTP x CSt)] Enter the calculated value in Column N.*
12. *Sum up all the Proposed TDV Energy in Column N and enter value in the cell. Similarly enter the sum of all Standard TDV Energy and compare. Proposed must be ≤ to the Standard.*

OVERALL ENVELOPE TDV ENERGY APPROACH (Page 5 of 6) ENV-3C

Cool Roof Multiplier (M_{CR})

PROJECT NAME	DATE

Occupancy Type and Coefficients Tables	☐ Nonresidential, See Table NA5-3	☐ 24-Hour Use, See Table NA5-4	☐ Retail, See Table NA5-5	Climate Zone:

Coefficients of						Calculation	
A	B	C	D	E	F	G	
Reflectance	Emittance	Proposed Aged Solar Reflectance	Standard Aged Solar Reflectance[1]	Proposed Thermal Emittance	Standard Thermal Emittance	Cool Roof Multiplier[2]	
C_{Ref}	C_{Emit}	$\rho_{aged\ prop}$	$\rho_{aged\ std}$	ε_{prop}	ε_{std}	$M_{CR,I}$	
							Enter multiplier in Page 4 of 6 Column L.

Excerpt from Table NA5-2. Where: Standard design values for Solar Reflectance and Thermal Emittance.	Standard Aged Solar Reflectance (Column D)	Standard Thermal Emittance (Column F)
Low-Rise, Low-Sloped, CZ2 through CZ15	0.55	0.75
Low-Rise, Low-Sloped, CZ1 and CZ16	0.10	0.75
High-Rise, Low-Sloped, CZ10 through CZ15	0.55	0.75
High-Rise, Low-Sloped, CZ1-9 and CZ16	0.10	0.75
Steep-Sloped, CZ2 through CZ15	0.25	0.75
Steep-Sloped, all other	0.10	0.75

1. *Proposed Aged Design Solar Reflectance;* $\rho_{aged\ prop} = (0.7\ x\ \rho_{init\ prop}) + 0.06$, Where ($\rho_{init\ prop}$) *reflectance value is found in the CRRC Directory. Enter results of the Cool Roof Multiplier equation in footnote 2.*

2. *Cool Roof Multiplier* $M_{cR,I} = 1 + C_{Ref}\ x\ (\rho_{aged\ prop} - \rho_{aged\ std}) + C_{Emit}\ x\ (\varepsilon_{prop} - \varepsilon_{std})$ **or** 1+ Col A *x* (Col C - Col D) + Col B *x* (Col E – Col F)

Overhang Multiplier (M_{OH})

Occupancy Type and Coefficients Tables	☐ Nonresidential, See Table NA5-3	☐ 24-Hour Use, See Table NA5-4	☐ Retail, See Table NA5-5	Climate Zone:

	Coefficients of		Fenestration Overhang			Calculation	
A	B	C	D	E	F	G	
Overhang Orientation	1st Projection Factor[1]	2nd Projection Factor[1]	Horizontal Projection (ft^2)	Vertical Distance (ft^2)	Projection Factor[2]	Overhang Multiplier[3]	
	a_i	b_i	H	V	PF	$M_{OH,I}$	
							Enter multiplier in Page 4 of 6 Column M.

1. Where: a_i *and* b_i *are the coefficients for the overhang projection factor (see tables) and is climate zone dependent.*

2. PF= H/V *(Horizontal (H) projection of the overhang from the surface of the window in feet, but no greater than V and the Vertical (V) distance from the window sill to the bottom of the overhang, in feet.) Enter results in Column F.*

3. $M_{OH,I} = 1 + (a_i\ x\ PF_i) + b_i\ x\ PF_i^2$. *Enter results in Column G.*

OVERALL ENVELOPE TDV ENERGY APPROACH (Page 6 of 6) ENV-3C

PROJECT NAME	DATE

WINDOW AREA ADJUSTMENT CALCULATIONS

A		B	C	D	E	F	G
					WINDOW ADJUSTMENT	ADJUSTED WINDOW	ADJUSTED WALL
WALL NAME (e.g. Wall-1, Wall-2)	ORIENTATION N E S W	GROSS AREA	DOOR AREA	WINDOW AREA	FACTOR (From Page 1of 6)	AREA (D×E)	AREA B-(F+C)
	☐ ☐ ☐ ☐						
	☐ ☐ ☐ ☐						
	☐ ☐ ☐ ☐						
	☐ ☐ ☐ ☐						
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TOTALS:							

SKYLIGHT AREA ADJUSTMENT CALCULATIONS

A	B	C	D	E	F
ROOF NAME (e.g. Roof-1, Roof-2)	GROSS AREA	SKYLIGHT AREA	SKYLIGHT ADJUSTMENT FACTOR (From Page 2 of 6)	ADJUSTED SKYLIGHT AREA (C×D)	ADJUSTED ROOF AREA (B - E)
TOTALS:					