ARCH 567: Advanced Architectural Structures, Winter 2012
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Improving the integration of sustainable strategies in schematic design.

Developing a multi-faceted tool to improve thermal resistance in architectural enclosure systems

This study seeks to develop a tool that can be quickly and easily used by schematic designers to set a thermal resistance target for the complete enclosure system and receive options in a variety of variables to achieve that goal.

1. Please ENTER Pricing for insulation Material		
Type	Cost / SF / IN	R-Value
Vacuum Insulated Panel	$5.00	30
Expanded Poly (EPS)	$0.35	7
Extruded Poly (XPS)	$0.70	4
Spray Foam	$1.05	7
Mineral Wool	$0.45	4

*The figures given are exclusive of installation and support structure costs

2. Please ENTER WWR for Opaque Wall		
	Opaque Wall	Window
Window to Wall Ratio	60.00%	40.00%

3. Please ENTER Target Wall Enclosure R-Value	
Target R-Value for Enclosure System	20

4. Your Thermal Bridge Adjusted R-Value is:	
Adjusted R-Value	20.83

5. Least expensive insulation by R-Value of window selection.			
	Cost / SF ($)	Type	Thickness Required (IN)
R-1 Window	$ 0.00	n/a	n/a
R-2 Window	$ 0.00	n/a	n/a
R-3 Window	$ 0.00	n/a	n/a
R-4 Window	$ 0.00	n/a	n/a
R-5 Window	$ 2.86	EPS	8.17
R-6 Window	$ 1.66	EPS	4.73
R-7 Window	$ 1.27	EPS	3.64
R-8 Window	$ 1.09	EPS	3.10

① Use standard forumla to find adjusted R-value of the WWR. The U-Value is the reciprocal of the R-Value of a material or building assembly. As the R-Value describes the thermal resistance of a material or assembly, the U-Value describes the thermal conductivities of a material or assembly.

② Modify formula: find the adjusted R-Value for a wall assembly using one of the three CSS (Cascadia Clip).

③ Modify formula: convert all U-values to R-values and rearrange the formula to solve for the adjusted R-Value of the comprehensive wall assembly after thermal bridging.

④ Modify formula: find the $R_{ADJUSTED}$ for each WWR, and R_{WINDOW} values R-1—R-8.

① $U_{TOTAL\ WALL} = (\%_{OPAQUE\ AREA} \cdot U_{OPAQUE\ WALL}) + (\%_{GLAZE\ AREA} \cdot U_{GLAZE})$

② $U_{TOTAL\ WALL} = (\%_{OPAQUE\ AREA} \cdot U_{OPAQUE\ WALL}) + (\%_{FIBERGLASS\ AREA} \cdot U_{FIBERGLASS}) + (\%_{STEEL\ BOLT} \cdot U_{STEEL})$

③ $R_{ADJUSTED} = \%_{OPAQUE\ AREA} / ((1 / R_{TARGET}) - ((\%_{FIBERGLASS} / R_{FIBERGLASS}) + (\%_{STEEL} / R_{STEEL})))$

④ $R_{ADJUSTED} = \%_{OPAQUE\ AREA} / ((1 / R_{OPAQUE(ADJUSTED\ FOR\ TB)}) - ((\%_{WINDOW} / R_{WINDOW}))$

WINDOW-TO-WALL RATIO	WWR
R-VALUE OF THE WINDOW	R_{WINDOW}
R-VALUE OF THE ENCLOSURE	R_{TARGET}
CLADDING SUPPORT SYSTEM	CSS
COST	$
INSULATION TYPE	VIP, XPS, EPS, SF, MP

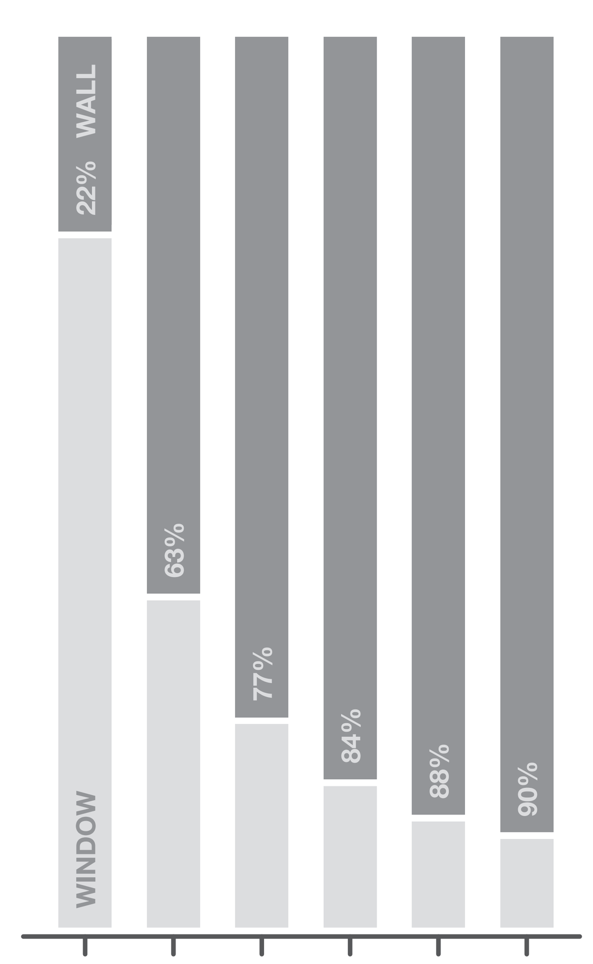


Chart 1 — Maximum window-to-wall ratios per target R-value.

Assumed parameters:
Window R-value of 4
Cascadia Clip Cladding Support System

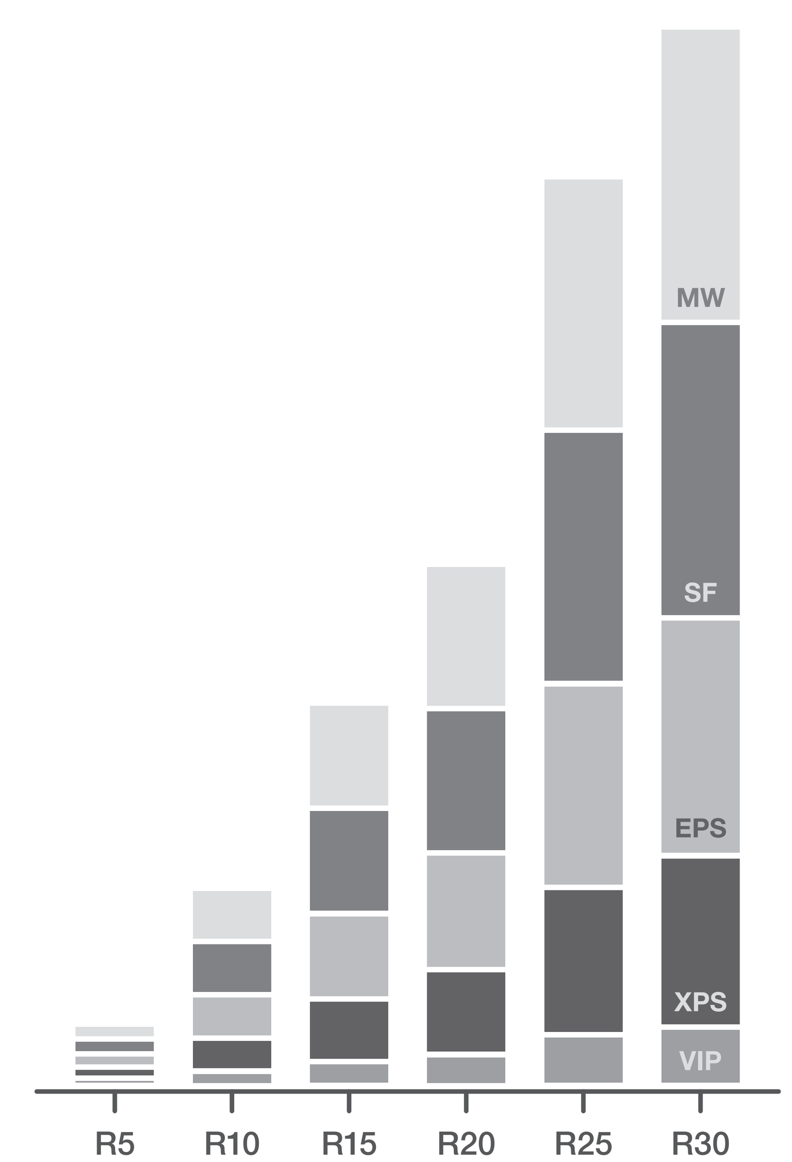
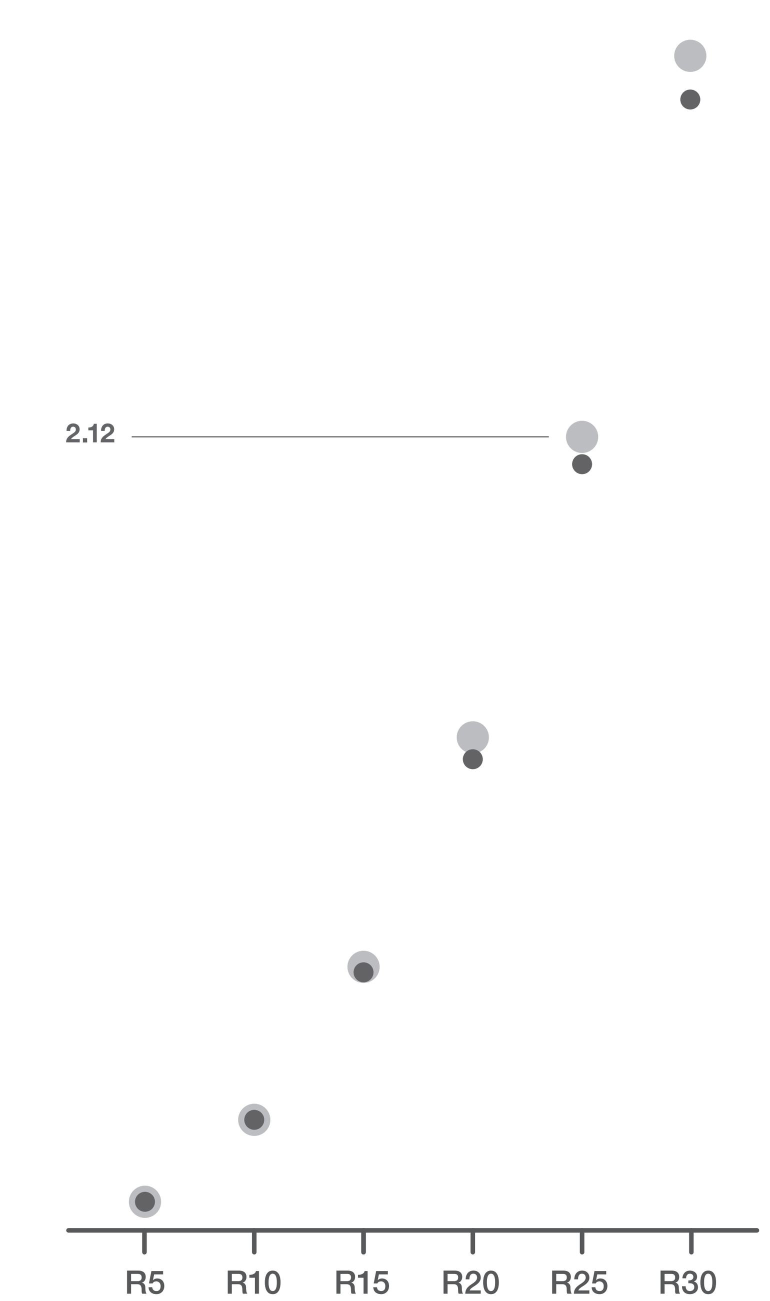


Chart 2 — Insulation type thickness per target R-value.

Assumed parameters:
60 wall ratio / 40% WWR
Window R-value of 4
Cascadia Clip Cladding Support System



FIBERGLASS CLIP
CASCADIA CLIP
METAL CLIP

Chart 3 — Change in actual required R-value per cladding support clip type.

Assumed parameters:
60 wall ratio / 40% WWR