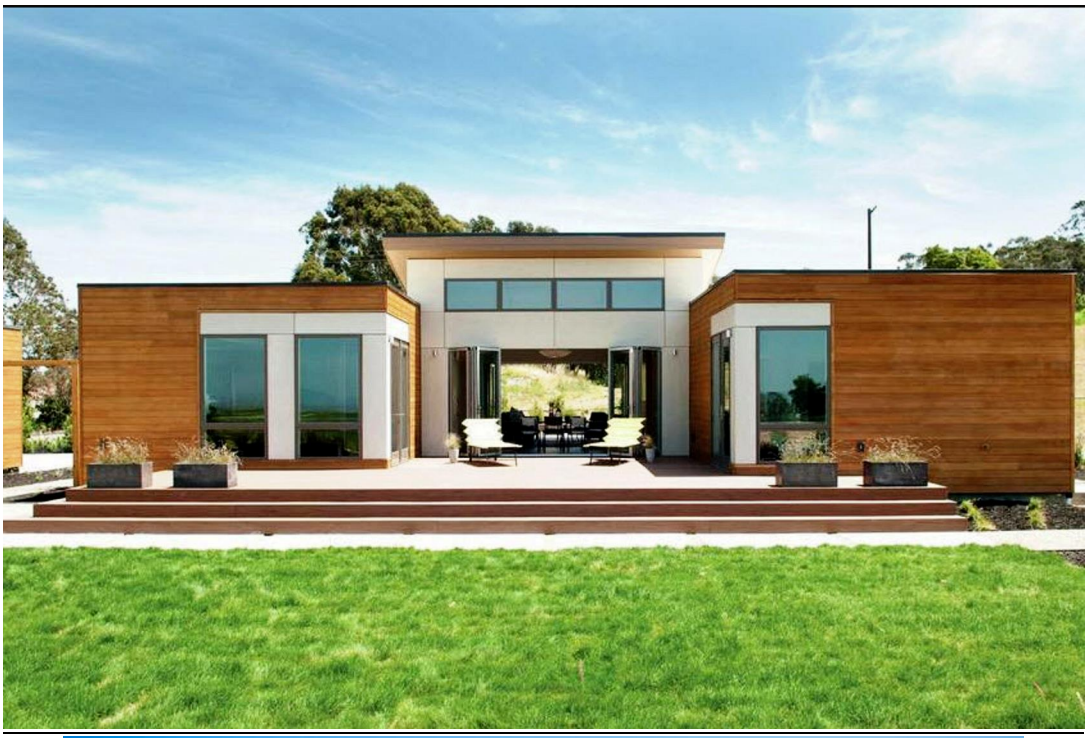
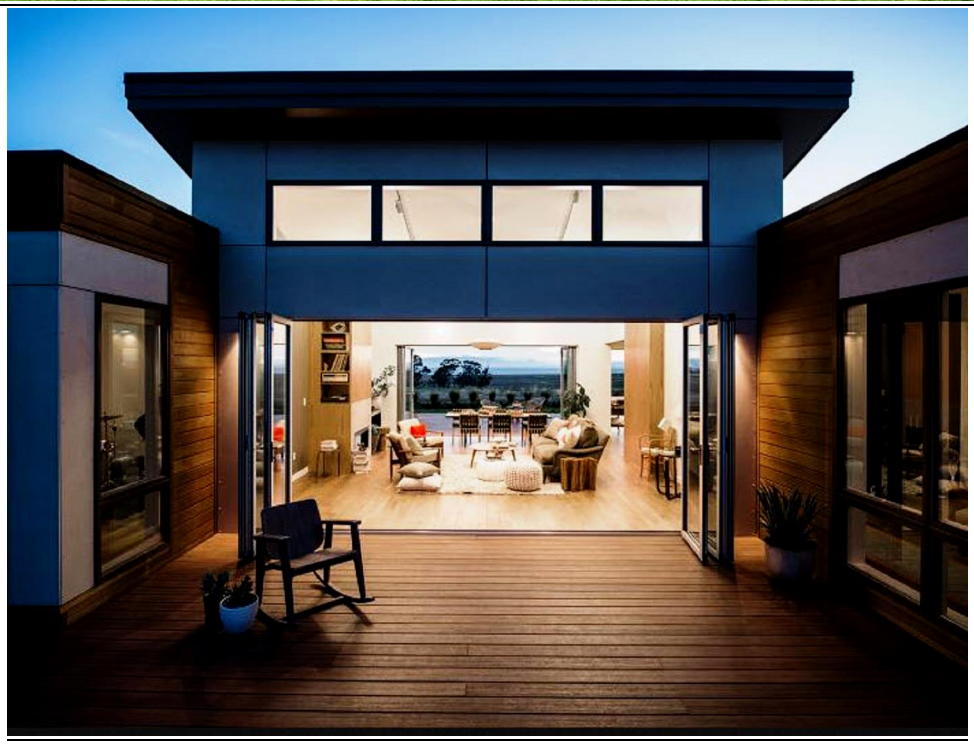
# *SIPLOCK Steel & Zero-Energy Design*

## *SIPLOCK. 21st Century Future Proof Design*
## *Monolithic & Structural Steel I-Beam Construction*





# *Monolithic Steel Construction & Zero-Energy Design.*

***Structural Steel provides unmatched strength, durability and integrity for single and multi-story structures. Roof, wall, steel columns and concrete footings are designed to be a single monolithic structure.***

***The monolithic steel design makes it nearly impossible for hurricane force winds to uplift its roof assembly. Hurricane winds would need to uplift the entire structure for serious damage to occur. Highly unlikely!***
***Add the best available energy technology and resources.***
***Heat Pump, Geothermal, Co-Generation, Solar, Wind, PV and ERV technologies.***

***SIPLOCK is indistinguishable from conventional structures.***
***Perfectly square, level, flat and true. All loads go to steel columns.***
***Walls and roofs accept any siding, roofing and trim materials.***

***SIPLOCK "Is simply Better "***

# *26 Gauge Galvalume® Steel SIP*

**Hurricane, Tornado, Earthquake, Fire, Flood, Termite, Vermin, & Mold Resistant.**

***"All-in One" Wall & Roof assembly.***
***SIP wall and roof panel insulation is continuous from footers, eaves and roof ridge.***
***SIPLOCK is a structurally sound, load-bearing SIP with EPS thermal insulation.***
***SIPLOCK is clad, both sides with 26 gauge steel & Galvalume® corrosion protection.***

## ***Three key design considerations for a passive house.***

1. ***Super high R insulation. (Whole wall R-value)(Critical Requirement)***
2. ***Minimize Thermal Bridging***
3. ***Airtight Envelope***

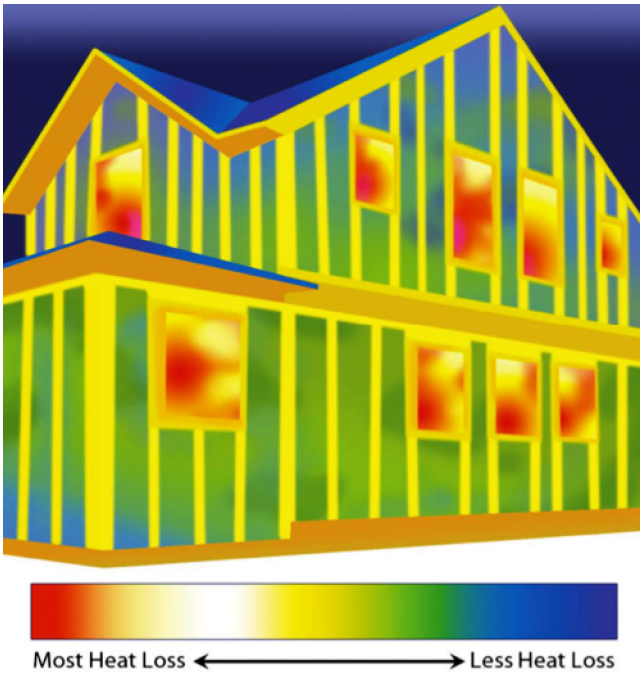
***Ref.*** ***http://www.passivehouse-international.org***

## ***Super Insulated Corrosion Resistant Panel.***

***Constructed of a Modified Expandable Polystyrene resin treated to resist flame spread.***
***Complies with ICC building codes and HUD.***
***R-value is stable and consistent. EPS is a closed cellular material.***
***Contains no CFC's, HCFC's, and formaldehyde. No off gassing. Environmentally safe.***
***Resists rot, fungus, decay, moisture, termites and common insects.***
***Wall panels are 9" thick. 26-gauge Galvalume® steel. Super insulated R38.***
***Roof panels are 11" thick. 26-gauge Galvalume® steel. Super insulated R46.***
***SIP steel clad panels flash one another with a tongue and groove joint.***
***SIPLOCK "Breaks" conductive thermal bridging.***
***IR energy reflective steel clad skin. Super low heat loss and heat gain.***

# *Thermal Bridging in a wall assembly.*

***Oak Ridge National Labs* has stated that the individual R-Value of each product, they evaluated, had very little to do with the R-value of a complete wall assembly. Other studies indicate, more than 30% of a buildings heat loss or gain is from conductive thermal bridging.**
***In tests, a wood wall assembly had significant thermal bridging and air leaks from studs, corners, windows and doors. A wooden roof assembly could expect worse results because of rafter studs, roof and soffit vents.***
***R-Value is a measure of resistance to heat loss by conduction, convection, and radiation of various building materials.***




*Flir, a company that makes thermal imaging cameras, has some great shots of thermal bridging in action on their website. Here's just one example showing the "cold" 2×4's in a wall:*
A schematic representation of what thermal bridging looks like in a typical residential house. The yellow at the studs, and the rim joist locations is not a pretty color for a building scientist, or a homeowner. Even worse, the low quality windows outlined in red represent even more heat loss, low interior surface temperatures and an increased potential for forming interior condensation.

*Thermal bridging can be responsible for <u>30% of heat loss and heat gain.</u>*
*Wood frame studs have a lower insulating value than the batten insulation between them, and if the studs are directly in contact with the inside and outside of a wall, they can act to conduct heat in and out, resulting in added high-energy costs.*

# *Infrared image of a wall portraying the cold areas caused by the studs acting as a thermal bridge (dark lines).*

Richard T. Bynum writes in Insulation Handbook:

In a typical wood stud wall, the wooden studs are thermal bridges, and will create a cold area (compared with the insulated cavity) where the stud meets the interior sheetrock. This is illustrated in the infrared image above where the ñcold spotsò created by the studs show up as dark lines. These cold spots compromise the insulation and lower the effective average R-value of the whole wall. In addition to lowering the total R-value of a wall, the cold spot can lead to condensation problems. If any moisture did manage to get into the wall cavity, the cold wood stud near the sheetrock would be the first surface where water vapor would condense into liquid form.
ñCurrently, most wall R-value calculations are based on experience with conventional wood frame construction, and they do not factor in all the effects of additional structural members at windows, doors and exterior wall corners. Thus they tend to overestimate the actual field thermal performance of the whole wall systems.ò

Since the R-value of the insulation material alone does not accurately indicate the average R-value of the whole wall system, Bynum describes three methods for measuring R-values:

**According to the 2006 IECC, the design effectiveness of all high-energy efficient construction directly affects the HERS rating.**

**Clear wall R-value:** This is the R-value of a wall with just studs and does not include the framing included in windows, doors and exterior corners.

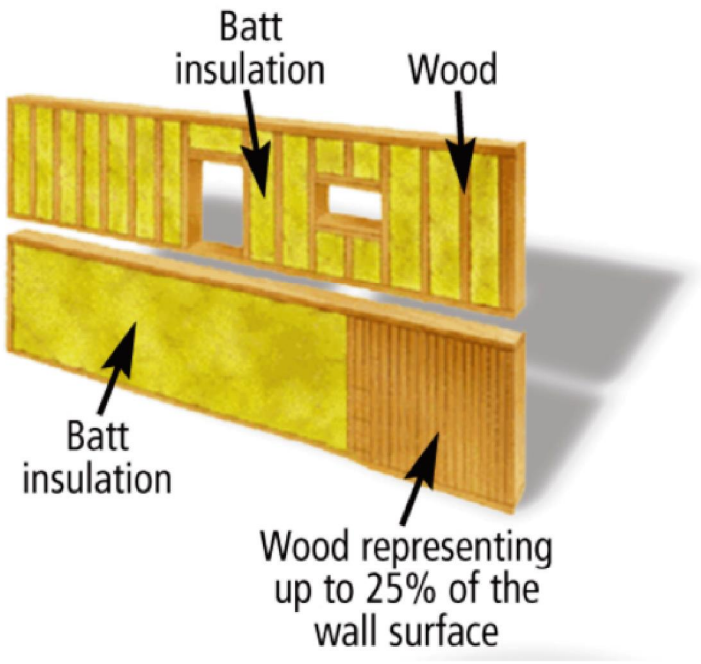
**Center of Cavity R-value:** This is the R-value estimate of the area of the cavity space between studs that contains the most insulation.

**Whole wall R-value:** This is an R-value estimation that includes both the clear wall estimate of R-value and takes into account additional framing like windows, doors and exterior corners.

Bynum makes the statement that ñFor some conventional wall systems, the whole wall R-value is as much as 40 percent less then the clear wall R-value.ò

*References. Bynum, Richard, 2001. Insulation Handbook, McGraw-Hill, New York, NY.*

**ASHRAE** ***tests indicated: A six-inch stud wall, 24" on center with R-19 fiberglass batts tested out with an R-Value of 13.7. Nearly 33% less as a completed wall assembly than the fiberglass insulation.***
***The high R-Value of an insulation material, in a wall or roof assembly, does not equal the total thermal efficiency rating.***




***Building Science Digest 011***
***Thermal Control in Buildings***
***2006-11-02 by John Straube (updated 2011-12-12)***
***Quote:***
***"Filling the voids in concrete block masonry with insulation is not very effective: adding R15 insulation to a 12" block will increase the R-value of the wall by about R2."***
***End Quote.***

***SIPLOCK "Is simply Better "***

# *SIPLOCK "Breaks" conductive thermal bridging.*

***Studies indicate, more than 30% of a buildings heat loss or gain is from conductive thermal bridging.***

***Concrete, concrete block and wood stick frame structures are wrought with moisture, mold, conductive and thermal bridging issues.***

***2012 IECC Energy Conservation Codes***

**Insulation and Fenestration Requirements by Climate Zone**

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

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

***SIPLOCK is a <u>Continuously insulated</u> SIP component.***
***Wall (R38) & ceiling (roof) (R46+3). (Finished roof add +3)(R49).***

***SIPLOCK <u>Meets or exceeds</u> the "Ceiling" (roof) R-Value in Zones 1-8***
***Ref. IECC 2012 International Energy Code***

***SIPLOCK "Is simply Better "***

# *SIPLOCK Air-Tight design.*

***Oak Ridge National Labs stated that 40% of heat loss or gain is due to air leakage!***
***Conventional construction methods suffer considerable heat gain and loss through cracks, poorly weatherized windows, doors, roof ridge, soffit and crawl area vents.***
***Conventional construction methods promote air leakage from electric wall outlets, kitchen, bath and clothes dryer venting.***
***Conventional construction methods waste energy, promote mold and spore growth by the installation of HVAC ducts within non-conditioned vented attics, crawl spaces and basements.***

***SIPLOCK design eliminates energy-wasting air leakage and air quality problems.***
***SIPLOCK eliminates air-leakage, which contribute, to high temperatures, humidity, condensation, rot, mold and spore growth from leaky attics, crawl spaces, rim joists and sill plates.***
***SIPLOCK eliminates heat gain or loss from air infiltration.***
***SIPLOCK airtight closed envelope design eliminates the number one cause of uncomfortable interior humidity, drafts and condensation from roof ridge, soffit and crawl area vents.***

# *Energy Savings.*

***In an independent energy survey, according to the*** **Structural Insulated Panel Association** ***(SIPA), an 180,000 SF senior living facility in Florida is saving thousands of dollars each month. HVAC costs have been verified at $0.025 (2 ½ cents) per SF.***
***A 28,000 SF residence has recorded HVAC costs of $0.018 (1.8 cents) SF.***

***A passive house could expect to use about 1.36KWh per square foot of HVAC conditioned space per year.***
***Reference:***
***http://www.passivehouse-international.org/upload/ipha-brochure/***

***In Florida, for example a Siplock Energy Star rated 2700 sq. ft. home could consume about .42 Kw per hour for HVAC you could expect about a $25 monthly cost for HVAC.*** ***2011 Florida Electric average rate is 12 cents per KWh.***

***A similar home in NY would be about $65 monthly for heating and cooling.***

***The cost of electricity by state. (2011)***
***http://www.npr.org/blogs/money/2011/10/27/141766341/the-price-of-electricity-in-your-state***

***SIPLOCK "Is simply Better "***

## *Construction Advantages.*

***SIPLOCK speeds up construction. Significant savings in labor costs and loan interest.***
***Roofing, siding and interior trades can work simultaneously.***
***Steel and SIP arrive ready to set in place. Reduce construction time.***
***No trades gridlock leading to completion delays.***
***Reduced site material waste, litter, and reduced security requirements.***
***Eliminates added framing, sheathing, insulation and vapor barriers.***
***Walls and roofs are straight and true.***
***Exterior siding and interior drywall lay true, straight and flat.***
***Will not shrink, twist or move.***
***Future proof architectural design.***
***Green Building design.***
***High LEED ratings.***
***Pre-engineered steel and SIP project design.***
***SIPLOCK is clad with 26-gauge sheet steel. Highly resistant to impact.***

## *SIPLOCK is ideal for:*

***Multi-Story Residential, Housing, Apartments, Assisted Living***
***Commercial***
***Industrial***
***Government***
***Military***
***Agricultural***
***Aquaculture***
***Dairy***
***Equestrian, Live Stock, Storage, Shop, Food Processing***
***Disaster shelters***
***Floral Storage***
***Pharmaceutical storage***
***Pavilions***
***Warehouse***
***Manufactured Homes***

## *SIPLOCK is Fire Resistant.*

***ISO tests have shown that no flash over occurs for EPS cored, steel clad panels with a well-designed joint.*** **Ref. ISO 13784.**
***No wood in the walls or roof. Dramatically improves the odds against damage or loss from a fire spreading to the roof.***

***SIPLOCK "Is simply Better "***

***SIP – REFERENCES.***

***A. American Society for Testing and Materials (ASTM) C578: Standard Test Methods for Characteristics of Expanded Polystyrene.***
***B. ASTM D1622 - 08 Standard Test Method for Apparent Density of Rigid Cellular Plastics. Page | 1***
***C. ASTM C518 - 10 Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.***
***D. ASTM D1621 - 10 Standard Test Method for Compressive Properties Of Rigid Cellular Plastics.***
***E. ASTM C203 - 05a(2012) Standard Test Methods for Breaking Load and Flexural Properties of Block Type Thermal Insulation.***
***F. ASTM D1623 - 09 Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.***
***G. ASTM E96 / E96M - 10 Standard Test Methods for Water Vapor Transmission of Materials.***
***H. ASTM C272 / C272M - 12 Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.***
***I. ASTM D696 - 08 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics.***
***J. ASTM D2863 - 12 Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle like Combustion of Plastics (Oxygen Index).***
***L. ASTM E84 - 12b Standard Test Method for Surface Burning Characteristics of Building Materials***
***M. ASTM A653 / A653M - 11 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.***
***N. ASTM A924 / A924M - 10a Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.***
***O. ASTM E18 - 11 Standard Test Methods for Rockwell Hardness of Metallic Materials.***
***P. ASTM E72 - 10 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.***
***Q. ASTM E1996 - 12 Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.***
***Page | 2***
***R. ASTM E330 - 02(2010) Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static***

***SIPLOCK "Is simply Better "***

***Air Pressure Difference.***
***S. Florida Products Approval Number 8086.1, 1" – 4" EPS Wall Panel, Approved Certification for Architectural Structural Insulated Panels up to 4" thickness @ 1 pound density.***
***T. Florida Products Approval Number 8086.2, 2" – 6" EPS Wall Panel, Approved Certification for Architectural Structural Insulated Panels up to 6" thickness @ 1 pound density.***
***U. Florida Products Approval Number 8086.3, 3" – 8" EPS Wall Panel, Approved Certification for Architectural Structural Insulated Panels up to 8" thickness @ 1 pound density.***
***V. Florida Products Approval Number 8086.4, 4" EPS Wall Panel, Approved Certification for Architectural Structural Insulated Panels up to 4" thickness @ 2 pound density.***
***W. Factory Mutual Research Corporation FM 4471 test leakage and moisture penetration test procedure for class 1 panel roof.***
***X. Metal paint testing requirements:***
***1. Metal film thickness. ASTM D 5796.***
***2. Metal Color: ASTM D 1729.***
***3. Specular Gloss ASTM D 523 at a gloss meter angle of 600.***
***4. Minimum pencil hardness of Metal per ASTM D 3363 is "F"***
***5. Solvent Resistance of Metal Passes ASTM D 5402***
***6. Cross hatch Adhesion passes Per ASTM D 3359***
***7. Impact resistance per ASTM D 2794***
***8. Humidity Resistance No blistering, cracking, peeling, loss of gloss or softening of finish per ASTM D 2247***
***9. Cleveland Condensing no blistering, rusting or loss of adhesion of finish per ASTM D 4585***
***10. Water immersion Test per ASTM D 870 with no loss of gloss, blistering, cracking, color change or softening Page | 3***
***11. Salt Spray resistance Per ASTM B 117 no loss of adhesion and scribe creep no greater than 1/8"***
***12. Chemical resistance per ASTM D 1308 7.2 spot test***
***13. Kestermich Test no color change after 10 cycles per ASTM G 87***
***14. Accelerated weathering per ASTM G 87***
***15. Exterior weathering ASTM D 2244 at least #8 chalk rating per ASTM D4214***
***16. Abrasion Resistance per ASTM D 968 Method A "Pass"***
***17. Flame Spread rating per ASTM E 84 Class A or 1***
***Y. Adhesive P 1001U Isocyanate rigid Polyurethane Foam adhesive system***
***1. Tensile Adhesion ASTM D 1623***
***2. Shear Adhesion ASTM C 273***

## *SIPLOCK "Is simply Better "*

***Performance Requirements: Design and construct panels to meet requirements as indicated.***
***A. Structural and Wind load Tests:***
***1. Design panel composition to resist wind load mandated by code, with deflection limit of L/240.***
***2. No permanent damage to panels or connections when subjected to 1.5 times the design wind pressures for both inward and outward.***
***B. Thermal Performance:***
***1. Panels shall produce no post manufacturing off gassing which could result in loss of future thermal resistance and must have a certified Long Term R- Value (LTR).***
***C. Fire:***
***1. Surface Burning Characteristics: Insulated core shall have been tested in accordance with ASTM E 84 and UL 723, NFPA 255 for surface burning characteristics. The core shall have a maximum flame spread of 0 and a smoke developed rating of 175.***
***2. Surface Burning Characteristics: Exterior panel skin shall have been tested in accordance with ASTM E 84 and UL723, NFPA 255 for surface burning characteristics. The exterior shall have a maximum flame spread of 0 and a smoke developed rating of 185.***
***D. Vapor Barrier:***
***1. Water Spray Leakage test shall show no evidence of penetration through the panels or panel joints when subjected to a preload air pressure of 30 psi and a water spray rate of 5 gallons/ psf/ per hour for 15 minutes, per Factory Mutual Research Corporation FM 4471 test procedures for class 1 roof panels.***
***2. Static Water Penetration must exhibit no sign of leakage for a period of 7 days with ponded water at a 6 inch continuous water depth for the duration of the test, per Factory Mutual Research corporation FM4471 test procedures for class 1 roof panels.***

***SIPLOCK "Is simply Better "***