ENTEK Enterprises, LLC

Structural Insulated Panel System - SIPS

Mission Statement

We will lead the industry towards a new standard in building strong, affordable, energy efficient, and environmentally friendly structures which are easily constructed and provide a healthy environment for their occupants.

Strategic Model

Taking labor out of the field and bringing it into the controlled environment of the factory is an already proven strategy as demonstrated by Henry Ford with the automobile to Shuck & Sons with conventional wood framing. Standardized designs will facilitate the employment of mass production techniques in order to minimize production costs and produce consistent, high quality products. Superior materials (i.e.: foam and steel) will result in systems that far out-perform conventional construction. Tract housing provides both standardized designs and volume sales in order to reach maximum efficiency. Partnerships with selective businesses, industry, and government can reduce wasted duplication in infrastructure, planning, production, and R&D, as well as economic incentives and support. The accumulated benefits of this technology will result in lower energy use nationwide, preserving fossil fuel resources, reducing demands on natural wood products, and helping to improve environmental quality. Economic benefits will accrue to ***all*** *parties: from manufacturer, to developer, to consumer, to society as a whole.*

PRODUCT HANDBOOK

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INTRODUCTION

Thank you for the opportunity to introduce ourselves, our company, and our product. We are manufacturers of panelized building systems for both residential and commercial use. Our factory pre-fabricated panels are constructed from EPS (expanded polystyrene) foam and galvanized steel. This combination of materials provides an optimum mix of strength and insulation. To give you some examples, think of holding a Styrofoam coffee cup filled with 180 degree coffee with no problem at all, or think about the most thermally efficient device in your house -- the refrigerator -- which is likewise made of foam and steel. These panelized systems are generically called SIP’s (structural insulated panels.) The most widely used type SIP’s have thus far been made of foam sandwiched between sheets of OSB. Such wood products are susceptible to moisture and insect damage and have characteristically undergone large price fluctuations. Our system avoids all these and other shortcomings of wood (e.g. warping, splitting, swelling), yet accepts the application of all standard siding and roofing products (e.g. stucco, hardy board, metal roofing, tile roofing).

Since similar construction has been around for 25 years or more, we don't lay claim to inventing the product. Nevertheless, over the last several years we have refined design details and the manufacturing process so as to produce a consistent, high quality panelized building system. One of our guiding principals has been to endeavor to take as much labor out of the field as possible and perform it in the factory under controlled conditions. By employing mass production techniques, we can economically fabricate our panels to very close tolerances, typically 1/32" for steel and 1/16" for foam. The resultant wall sections which are built up from these panels are easily and rapidly fashioned together on site to produce a highly insulated, strong, airtight, and durable building shell. Contractors can save time, energy and money by reducing overhead, liability, capital investment, crew size, cycle times, and call backs. Owners will enjoy ongoing savings from significantly reduced heating and cooling energy costs (R30 walls, R50 roof).

Other benefits include the following. The foam is non-outgassing which is hugely important to chemically sensitive individuals (OSB products can often produce negative reactions). EPS is a totally inert product which does not promote the growth of spores, mildew, and other allergens which can likewise be harmful to sensitive individuals. The foam (which is essentially a matrix of closed air cells) is an excellent inhibitor of sound transmission. The panels, while more than 1 1/2 times stronger than comparable wood frame construction, are lighter and easier to handle. EPS is non-flammable and our system inhibits the chimney effect of fires which could start within the wall or roofs of conventional systems. To further clarify, the foam will burn given a high enough ignition temperature (although with less toxic byproducts than conventional wood building systems) but it will not continue to burn unless such ignition is applied continuously to the product. If this seems not clear enough, we'd be glad to elaborate on this with you. Finally our open design allows easy access to the face of the panels for insertion of mechanicals (wiring, conduit, pipes, hose bibs, ducts, etc.)

Given all the above, we feel that our product will sell itself since it offers many advantages over conventional construction while introducing few if any disadvantages. We are always available and committed to answering any of your questions, addressing any of your concerns, and finding solutions to any problems that could be encountered along the way.

Bill Ertman
President

PRODUCT DESCRIPTION

1.1 COMPONENTS

1.2 APPLICATIONS

1.3 THE MATERIAL: EXPANDED POLYSTYRENE (EPS)

1.4 PHYSICAL PROPERTIES

1.5 MOISTURE RESISTANCE

1.6 FIRE RESISTANCE

1.7 STRENGTH

1.1 Components

E^3 SIPS is a state-of-the-art, well-engineered building system that incorporates tubular steel and expanded polystyrene (EPS) foam, providing complete wall and roof sub-systems. EPS foam possesses unparalleled insulating characteristics, as well as superior fire and moisture resistance. Tubular steel makes the system stronger structurally than conventional wood construction.

ENTEK's E^3 SIPS system is not attractive to termites or other pests, and does not support the growth of fungus, bacteria, or other microorganisms. It will not mildew or rot.

Galvanized 18-gauge 1" X 2" steel tubes provide strength and rigidity. The tubes are recessed in the EPS foam on both interior and exterior sides, and are secured with self-tapping screws. Additional support is provided by base and top angles of 18-gauge steel on each panel.

Galvanized steel is corrosion-resistant, and unlike wood it will not warp, twist, or bow.

1.2 Applications

E^3 SIPS panels provide an alternative to conventional stud wall and rafter systems for both residential and commercial applications. They offer superior strength and durability, unprecedented insulating characteristics, and ease of installation. Panels of up to 20 feet in length are joined at the base and top by steel angles and a top plate or track, producing an integrated system.

Roof loads are carried by ridge and purlin laminated beams, as well as by intersecting wall plates. Corners, both interior and exterior, are stabilized by steel angles and brackets that are Tek-screwed to the tubular steel support members.

Using different sized panels, a building of almost any shape or size can be designed and built efficiently.

1.3 The Material: Expanded Polystyrene (EPS)

The most unique material employed in the E^3 SIPS system is expanded polystyrene, or EPS. It is a polymer, impregnated with a foaming agent. When exposed to heat, it creates a uniform closed-cell structure that is highly resistant to moisture penetration and provides excellent insulation.

EPS has been in use since 1951, and has been found to be tough and resistant to vibration. It is of low density, and can absorb strains due to building movement or settling. Under normal conditions of use, its compressive strength and toughness exceed design requirements.

With a fire retardant, EPS is much less combustible than wood. It requires a temperature of 915˚F for self-ignition, compared to 500˚F for most kinds of wood (*Flammability Handbook for Plastics*).

In studies, EPS foam has been shown to be extremely resistant to moisture retention, gaining over an average of nine years less than 0.1% assumed stabilized value of moisture by volume. Even in a situation of use at -10˚F over 20 years, and without a warm side vapor barrier, the moisture gain as a percent of volume was only 2.32% (*Dynatech Research and Development Study of Cold Storage Warehouses*).

Extensive tests have also been conducted to determine whether thermal decomposition of EPS presents a toxic hazard. The National Research Council of Canada has reported, "The maximum toxicity index obtained from the combustion of polystyrene was of the same order as that from wood. Thus, on a weight basis, the potential hazard due to toxic combustion is about the same as that from wood."

EPS contains no formaldehyde or CFCs.

With its low density, the EPS foam used in the E^3 SIPS system is, after curing, 98% air. No other insulation material possesses these unique air-filled structural characteristics.

EPS is, in short, an excellent building material that has, with advances in technology, become practical to produce and utilize.

1.4 Physical Properties

Thermal Conductivity (k value)
0.24 @ 40˚F, 9 PCF density

Thermal Resistance (r value)
4.17 per inch of thickness @ 40˚F

Coefficient of Thermal Expansion
.000035 [in./(in.)(F.] (ASTM D-96)

Thermal Performance
4.35 R/1" @ 25˚F, 3.85 R/1" @ 75˚F

Sound Absorption (STC[2])
0.36 @ 1000 CPS
0.54 @ 2000 CPS
0.38 @4000 CPS

1.5 Moisture Resistance

EPS insulation is closed-cell polystyrene foam, with a high degree of dimensional stability under moist conditions, even with submersion in water or burial in wet clay soil. Almost all moisture gains in EPS foam are either surface or interstitial and have limited effect on thermal values (94% R-value retention with 5.0% moisture gain, in percent by volume). Even when moisture gain is caused by unidirectional and continuous vapor diffusion, EPS foam is far more resistant to adverse thermal impacts than are other forms of insulation.

1.6 Fire Resistance

With exposure to flame, EPS foam ignites at a temperature of 600 - 650˚F, as compared to 500˚F for Douglas fir. It shrinks away from flame sources without burning, and ceases to burn with removal of the flame source.

Drywall of 1/2” or 5/8” provides the necessary rating as required by the Uniform Building Code. ASTM 119 load-bearing assembly is available for one hour application.

EPS foam contains 0.0833% of the combustibles present in wood. The by-products of combustion are carbon dioxide and carbon monoxide, but in concentrations less than that of an equal volume of wood.

1.7 Strength

The EPS foam panels, with tubular steel, meet or exceed all building codes for normal construction. A standard wall height of 9’ can easily sustain an axial load of 2,250 lbs. per lineal foot, with 40 PSF wind load.

Uniform horizontal roof loads of 40 PSF, the standard, are easily sustained by roof panels with appropriate purlin or ridge beams 10’ on center.

All building plans, custom or standard, are accompanied by section drawings approved and stamped by a structural engineer.

DESIGN CHARACTERISTICS

2.1 Overall Design of Panels

The E^3 SIPS system is a panelized load-bearing wall and roof system consisting of 1" X 2" 18-gauge galvanized steel tubing and 4" to 12" thick expanded polystyrene (EPS) foam. The EPS is delivered to ENTEK's factory in pre-cut slabs. Grooves are cut into the EPS, and the steel tubing is inserted. The resulting panels are combined into sections with 1½" X 2" steel angles along the top and bottom. Half inch #8 plated screws secure the angle to the tubing, and assembly is complete.

E^3 SIPS "load-bearing walls" can be used instead of concrete block or stud wall construction. The roof panels are also structural members, and can be used to replace trusses, steel joists, or roof rafters. The wall may be covered with standard siding, and the roof with ordinary roofing materials. Thus, the EPS panels are totally compatible with traditional building materials and techniques.

2.2 Material and Component Specifications

<u>Panels</u> (For information on properties of EPS foam, see Section 1.4)

Weight:	±2 lbs./square foot
Length:	4' to 40'
Width:	48" (typical), with width tolerance of ±0.0833"
Thickness:	7½" for wall panels, 12" for roof panels
Insulation:	Standard R-30 for walls, R-50 for roofs

<u>Steel Tubing</u>
18-gauge galvanized G90, 1" X 2" or 2" X 2"

<u>Steel Sheeting</u>
18-gauge galvanized G90

<u>Steel Angles</u>
18-gauge galvanized G90

<u>Fasteners</u>
(1) #8 half inch self-tapping screws, per Intercorp. specs.
#14 seven inch and 12 inch IPF screws, per Dekfast specs.

Caulking

Standard caulking is used as a sealant where needed.

2.3 Advantages Over Conventional Systems

Insulation and Comfort

•Highly resistant to moisture and condensation buildup.
•Airtight. With required HRV exchanger, air is filtered and clean.
•Materials do not degrade or provide habitat for mold or insects.
•Minimal need for use of heating and cooling systems.

Structural Integrity and Design Flexibility

•Structural capabilities can be easily adapted to design requirements.
•Materials do not bow, rot, expand, shrink, or rust.
•Compatible with traditional construction materials.
•Highly fire-resistant.

Speed of Assembly

•Finished panels stack and transport easily.
•Window and door openings are set in factory.
•A typical 1200 sq. ft. house requires 12 wall and 20 roof panels.
•Single-story structure can be erected by a 4-man crew in one day.
•Minimal waste of material and need for site cleanup.

Low Initial Cost and High Resale Value

•On a cost per "R" value basis, the least expensive building material.
•Roughly 50% reduction in labor costs, through ease of assembly.
•Reduced costs for HVAC hardware, through superior insulation.
•Lending policies provide incentives for energy-efficient structures.
•High resale value, through materials' resistance to degrading.

Low Maintenance and Operating Costs

•Up to 75% reduction in energy consumption for heating and cooling.
•No mold or termite problems.
•Possible reduction in fire insurance rates.

ASSEMBLY

3.1 General

This section covers the proper methods for construction of buildings using the E^3 SIPS system of EPS foam panels. In order to obtain full effectiveness of the characteristics of the system, these directions must be observed.

Builders should study the appropriate schematics before assembly. Panel drawings are viewed from the exterior. Note that the exterior face of each panel has the logo and leading edge overlap metal.

Schematics provided show an element number for each panel in the floor plan. This number appears on the top end of each panel.

3.2 Stages of Assembly

Unloading

Unload the container at the job site, stacking the panels for each floor so that they are in the necessary sequence for erection of the structure. Protect the panels from high winds and sharp impact.

Panels should be set starting at one corner of the structure and proceeding in a counter-clockwise direction.

Preparation of the Foundation

The foundation is generally a conventional concrete slab. First, verify that dimensions of the slab are in accordance with contract documents and consistent with shop drawings. These dimensions should be within tolerances specified by the design professional and by acceptable construction practices. Locate any conduit stub-ups and drill holes in the base plate.

Panels are attached to the foundation using 2X wood plates or steel channel track with anchor bolts or powder shot pins. Steel track should be set in a waterproof inhibitor such as roofing felt or foam tape. A design professional will specify the size and spacing of anchors, based on building code requirements.

Base plates or track are then caulked and set to building dimensions and secured to the slab using anchors, as per design schematics. Be sure the plates are level and the corners are square. If the foundation is not level, shim and grout with cement to obtain a level base plate or track. **Do not try to obtain a level wall by shimming the panels**.

Once the bottom base plates or track are set and level, verify each panel dimension along the base plate. Nail or screw attachment plates to both sides of the base plates, as shown in the wall anchoring schematic. Attachment plates must fall at each panel joint and each steel stud in the panel.

Erection of Walls

Once the base track is fastened to the foundation, apply adhesive in the track. Consult the floor plan to determine the sections and sequence for erection of walls, using the element numbers. Starting in a corner, position a wall panel in the track, temporarily brace it, then secure it with Tek screws as per the schematic.

An adjacent wall section is then positioned and secured to the previous section with adhesive around the keyway. The wall is then plumbed and temporarily braced, and a top plate of 2X12 steel track or C-track is then fastened to the cap angles as per the schematic.

Partitions are connected to the exterior walls or to other partitions using 18-gauge steel corner angles or flat 20-gauge, with dimensions as per the schematic.

Note that **some panel openings are assemblies consisting of two or more panels**. These are shipped disassembled and must be assembled on site. Refer to the design information provided and assemble these sections before setting them into place. As with all assembly, carefully check the unit for overall dimensions and squareness before setting it into a wall section.

Top Plates

Sections are tied together using 2X wood top plates or C-channel steel top track. Cut the top plate or track on site to allow overlap to the center of the next panel section's steel stud at 16" or 24". Fasten attachment plates to the top plate or track so that they fall at each panel joint and vertical stud in the panel. Drill the top plate or track to match any conduit or wiring chase locations in the assembled section, before attaching the plate or track to the panels.

Caulk the 2X plate or track and attach the top plate during erection of the walls. The top plate is permanently secured to the wall sections after the floor or roof system has been set, thus loading the wall.

In cutting the top plates or track, observe the following guidelines:

•Where a section joins another wall section, overlap the top plate or track to the next section at 16" or 24" (center of stud).
•Where a wall section joins a corner, the section's top plate should overlap onto the corner to the full width of the corner on one side, and the width of the corner minus wall thickness on the other side.
•Where a wall section abuts another wall section, overlap the top plate the full thickness of the abutment.
•The gap between adjacent top plates (cutting error) must not exceed a half inch.
•Top plate joints must be staggered so that they do not fall directly over panel joint, but fall over the center of an inner stud.

<u>Exterior Finishes</u>

Exterior walls may be finished with any type of standard siding, including Portland cement plaster, masonry veneer, siding, plywood, shingles, or particleboard. Cement must be applied in accordance with Uniform Building Code (UBC) Section 4708, 4709, and 4710. Masonry veneer must be constructed in accordance with UBC Section 2410. Siding, plywood, shingles, and particleboard must be constructed in accordance with UBC Section 2517g. Except for exterior plaster finishes, a weather-resistant barrier must be applied to all weather-exposed surfaces in accordance with UBS Section 1717a.
Wall openings are provided, using structural lintels and wood jambs in accordance with UBC Section 2528g7. The perimeter of the

opening is framed in wood and the sash or frame is then installed using standard methods of fastening and caulking.

Roof

After the wall sections are erected, plumbed, and braced, the roof sections are installed. First, attach the rafter end seats to the top of the walls. Then, the load-bearing beams are placed and fastened. Finally, the roof panels are lifted into place and fastened. The schematic provides guidance to each step.

Interior Walls

Electrical switch and outlet boxes are field chased into the panel and screwed to the sidewall of the steel tubes or to intermediate steel bridging. A horizontal electrical wiring chase is cut into the EPS at the factory, and wiring is then installed in accordance with local building code requirements. **Do not cut the steel tubes**.

The interior of the wall shall be finished with gypsum wallboard in accordance with UBC Section 4711.

3.3 Quality Assurance

On Site Inspection

The panels are checked for dimensions before shipment, but should be inspected for damage and spot-checked for dimensions as they are unloaded and stacked. Small cuts or nicks will not affect the integrity of the panel. Damage to the metal will, however, affect the panel's strength and integrity, and a panel with damaged metal components should be rejected.

On Site Modifications

In general, any changes deemed necessary on site must be cleared with the manufacturer, with the following exceptions:

•Bends may be straightened in the horizontal metal components at the top and bottom edges of the panel.
•Bends or dents in the leading edge overlap metal can be straightened.
•Damaged electrical boxes can be repaired, using a hot knife or other acceptable cutting tool. Do not exceed the box dimensions, and where possible, locate the box beside a vertical steel channel for screw attachment. The boxes should have recessed "ears" or brackets behind the wall cladding.
•If the wiring or conduit chases provided are not used, vertical chases may be cut into the EPS foam with a hot knife or other acceptable cutting tool. Vertical chases must be cut no less than 2" from any vertical steel tube. Do not exceed half the panel thickness in depth or 2" in width when making these cuts. Horizontal chase cuts may be extended behind the vertical steel tube by drilling with a 1" bit near the mid-depth of the panel.

CODE COMPLIANCE

4.1 UNIVERSAL BUILDING CODE REFERENCES

4.2 FIRE RESISTANCE

4.3 STRENGTH

4.4 H.R.V. EXCHANGERS FOR AIR-TIGHT STRUCTURES

4.1 Universal Building Code (ICC) References

The E³ SIPS system is compatible with all requirements of the ICC. Most applicable to the use of the panels in construction is Chapter 23, General Design Requirements, and Chapter 27, which concerns the use of steel in construction.

4.2 Fire Resistance

Resistance to fire is one of the great advantages of EPS foam. In two major tests of this material:

•A room fire test was conducted on June 22, 1981 by Underwriters Laboratories, Inc., in accordance with the International Conference of Building Officials Research Committee (Criteria for Foam Plastics) under Section 1717 of the 1979 UBC. The tests were conducted on an 8" thick panel assembly (File R9512, Project 80NK15909).

•A Standard UL 723 Test for Surface Burning Characteristics of Building Materials was conducted on July 9, 1981 by Underwriters Laboratories, Inc. (File R9523, Project 80NK15908). The test indicated that the presence of steel tubing and adhesive in the material have a negligible effect on surface burning, and that existing fire tests of EPS can be extended to include this product.

4.3 Strength

•E³ SIPS meets or exceeds the requirements of ASTM 578-87A. See Radco Listing #1143 and 1080, Evaluation Report #4525.

•The steel tubing conforms to ASTM-45Y.

•The steel angles conform to ASTM A446 Gr. A.

•All local building code requirements, such as for spacing and load bearing, are observed during design of a specific project.

4.4 HRV Exchangers for Air-Tight Structures

Heat Recovery Ventilator (HRV) exchangers are required in all air-tight structures.

Further, there is a growing body of evidence that the air we breathe indoors is often more polluted than the outside air in large industrialized cities. As an integral part of E^3 SIPS, ENTEK recommends use of the Lifebreath® HRV and Turbulent Flow Precipitation (TFP) air cleaner.

The principle of TFP was discovered by anti-pollution researcher Dr. Francis Dullien, who discovered in one of his experiments that when particle-laden air is forced through a narrow passageway, the particles are repeatedly flung against the internal walls. By using a pleated fabric in the airways, it is possible to trap the particles as they are flung out of the airstream without forcing the air through a filter.

An HRV with TFP air cleaner provides safe and healthy indoor air while remaining compact, quiet, and efficient.