

Technical Brief

Insulation Options for CarbonCast® Enclosure Systems



Three types of rigid foam insulation are generally specified for precast insulated wall systems: expanded polystyrene (EPS), extruded polystyrene (XPS) and polyisocyanurate (ISO). Each foam has unique properties. The choice depends on performance requirements and project budget. CarbonCast® technology is one of the few enclosure systems that enables the use of any of the three options. The information here will help you decide which type of insulation is best suited for your application.



Left: Proximity Hotel, Greensboro, N.C.

CarbonCast® technology is one of the few enclosure systems that enables the option of any of the three types of insulation.



Right: Carbon fiber grid connectors and EPS insulation

Insulation

Expanded Polystyrene (EPS)

Often known as “white board” or “beadboard,” EPS foam boards are available in a variety of thicknesses and in different densities, with correspondingly different R-values and permeance ratings per inch. EPS foam is produced by placing polystyrene beads into a mold. An inert gas is introduced into the mold and heated. The heating process causes the beads to expand and fuse into one solid piece. The EPS can then be sliced into desired thicknesses. Unfaced EPS foam generally costs less per point of R-value than XPS but has a lower permeance rating. Depending on density, EPS foam will deliver R-values ranging from 3.8-4.2 per inch.

EPS foam is more absorptive than XPS foam; however, EPS foam boards can withstand repeated cycles of wetting and drying without adversely affecting their performance. In addition, they will not support mold growth.

Although EPS has a lower permeance coefficient rating than other insulation types, (0.9-2.5 per inch), the entire precast wall assembly will generally have an overall permeance rating of 1.0 or less based on a sandwich wall panel assembly of 2" concrete – 4" insulation – 2" concrete. (2"/4"/2")

The roughened surface of EPS foam provides a shear value and actually contributes to the structural performance of composite panels. This assembly delivers satisfactory structural, thermal and vapor drive retarding performance for many project requirements.

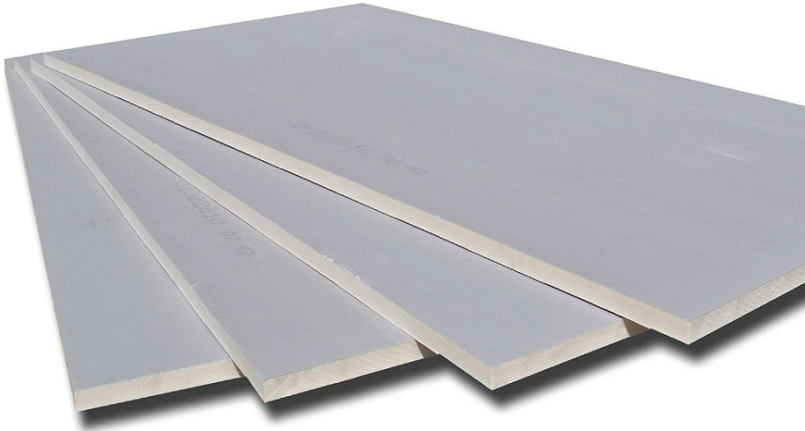
Extruded Polystyrene (XPS)

Extruded polystyrene foam (XPS) is often called “pink board” or “blue board” depending on the supplier. It is produced by heating and expanding polystyrene beads through the use of a blowing agent to allow foam boards to be extruded under pressure, resulting in a lightly compacted, closed-cell matrix. XPS foam boards are available in thicknesses up to 4" and are generally available with a uniform R-value (about R-5 per inch) and permeance rating (0.8) per inch. Its surface tends to be smooth when supplied by the manufacturer. However, it can be mechanically roughened to enhance the bond with concrete and improve the structural shear flow property values.



Insulation Type	R-value/Inch	Permeance
Expanded polystyrene (EPS or Beadboard)	3.8-4.2	0.9-2.5
Extruded polystyrene (XPS)	5	0.8
Polyisocyanurate	6	low

In cases where a high R-value is desired and wall panel thickness is constrained, XPS may be the best choice. And, in uses where high indoor humidity is present (e.g., natatoriums, cold storage facilities, hospitals) and where the wall panel is being relied upon to perform as a vapor retarder, XPS could be a better choice. (Film-faced EPS is also an option.)



Polyisocyanurate (ISO)

Polyiso is a closed-cell, rigid foam board insulation. Polyiso has trillaminate facing on either side. It has a low permeance rating and an R-value of R-6 per inch. It tends to be the most expensive option per square foot for continuous insulation applications in precast wall panels. The facing provides a less-than-ideal surface for adhering to concrete in the wall panel, often resulting in the need for additional reinforcement or connectors. While it does deliver the highest R-value per inch of insulation, most precast insulated wall panels can achieve specified assembly R-value with a slightly thicker layer of lower cost EPS or XPS.

Choosing the best insulation for CarbonCast® panels

As with all building products, architects need to balance price and performance. If price is the main concern, EPS generally comes out ahead. It is generally less costly than the other two options while delivering commendable insulation value. It's also the preferred option if you need to achieve an R-value greater than R-20. XPS provides more insulation per inch, resulting in slightly thinner panels that can provide more usable floor space. Its ability to act as a vapor retarder makes it ideal for high-humidity applications. Finally, ISO is often viewed as a premium option for insulated wall panels. With the proper engineering, it can perform satisfactorily. Its R-value of R-6 per inch is the highest of the three options. If panel thickness is your main concern, ISO may be your top option.

Your AltusGroup precaster can advise you on the best insulation to meet the cost and performance requirements of your project. They have the expertise, experience, supplier relations, and regional knowledge to assist you in which options would be ideal for your next project.

What is Continuous Insulation?

Continuous insulation (c.i.) is defined in ASHRAE 90.1 as "insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope." The thermal performance of edge-to-edge insulated precast concrete sandwich wall panels with no or minimal thermal bridges and no solid zones maintains the R-values for continuous insulation as defined by ASHRAE 90.1, thereby lowering energy costs. The C-GRID connectors in CarbonCast® panels enable continuous insulation between the two wythes of concrete.



How is insulation integrated into CarbonCast® panels?

AltusGroup precasters pour the precast wall panel's face wythe in the form. Before the concrete cures, the rigid insulation boards are set side by side atop the poured wythe. This forms an edge-to-edge insulation layer that qualifies as continuous insulation. Low thermal conductivity C-GRID shear connectors are placed. They extend into the face wythe and beyond the top of the insulation board with a minimum embedment depth of ¾" to ensure adequate anchorage. The back wythe is poured next, allowing the C-GRID to connect the face wythe and back wythe through the foam, providing structurally composite performance and consistent R-values of insulation.

Additional technical information, product specifications and literature available at altusprecast.com. You can also find a listing of AltusGroup precasters close to you or your project.



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Call us today to speak with a technical representative or request a lunch-and-learn program.