POLYISOCYANURATE "R"

by Charles W Ostrander, PE

Raising the R with Masonry Cavity Wall Insulation

The top two reasons to use a masonry cavity wall in the 21st century are:

A) It is the best, redundant wall system to handle water penetration
B) It is the best system to maximize the thickness of rigid insulation, thus building a "highly" energy efficient wall system.

Masonry materials alone do provide beneficial thermal properties; it is only when combined with rigid insulation that the energy performance of the masonry cavity wall is maximized. Architects and engineers are turning more to polyisocyanurate rigid insulation to achieve maximum thermal performance.

"The building envelope is the essential first step in achieving much needed efficiency improvements – especially since the envelope decisions often last for the life of the building while HVAC and other systems may be replaced many times over the building's life expectancy," states Jared Blum, president of the Polyisocyanurate Insulation Manufacturers Association. "We are pleased ASHRAE has recognized the cost effectiveness of additional roof and wall insulation in all commercial buildings and are equally encouraged by ASHRAE's goal of improving the nation's minimum commercial building energy efficiency standard by at least 30 percent."

Extending Roof's Insulation into the Wall System

Among the newer high performance rigid insulations for masonry cavity wall is polyisocyanurate, a closed cell rigid foam core bonded in-line during the manufacturing process to an impermeable trilaminate foil facing material.

A variation on the elements of polyurethane coatings and insulation, polyiso was originally manufactured as a superior class 1, fire-rated roof insulation in the US during the late 1970s. Polyisocyanurate has now become a continuous thermal control material of both the roof and wall system. Polyiso roof insulation is different from vertical wall polyiso application and has different facers.

Volatile energy prices and concerns about the built environment's role in climate change have placed an emphasis on the importance of increasing energy efficiency while reducing the collective carbon footprint. Analysis from Bayer Material Science researchers discloses that the energy/Global Warming Potential (GWP) associated with making, installing and disposing of polyiso is minimal compared to energy savings and GWP prevented during the life cycle of polyiso's performance in the building envelope. Polyiso is free of Chlorofluorocarbons (CFC) and Hydrochlorofluorocarbons (HCFC). No ozone depleting chemicals are used in its production. The Bayer Material Science study, Energy and Environmental Benefits Insulating Commercial Buildings with Polyiso by Jerry Phelan and George Pavlovich, explores the value of increasing polyiso beyond currently used thickness and combines life cycle principles contained in ISO 14040 with rigorous building energy simulation modeling and reveals cumulative energy savings of approximately 10 – 22 times the amount of incremental embodied life cycle energy in the polyiso product.

A model retail building in Chicago was used under three insulation levels: R-15, R-20 and R-30. Based on the Whole Building Energy Analysis models, the energy savings from adding more polyiso insulation are relatively significant. Savings after 30 years by adding R-20 versus R-15 total 15 million megajoules (MJ), while savings from adding R-30 versus R-15 are about twice that amount, or over 30 million MJ. From an energy savings viewpoint, there is also an incentive for going from an R-20 wall to an R-30 wall, as the incremental insulation saves more than 15 million MJ after 30 years. (The joule [J] is the derived unit of energy in the International System of Units. It is the energy exerted by a force of one newton acting to move an object through a distance of one meter.) I feel that I'm back in high school physics class .

Another plus: The break-even point for GWP prevention happens starting at one year for increasing insulation from R-15 to R-20 and starting at two years for increasing from R-15 to R-30.

R-Value per inch of Polyisocyanurate

Polyisocyanurate	R-Value (aged)*
1"	6.7
1½"	10.5
2"	14.4
2½"	17.8
3"	21.2
3½"	24.6

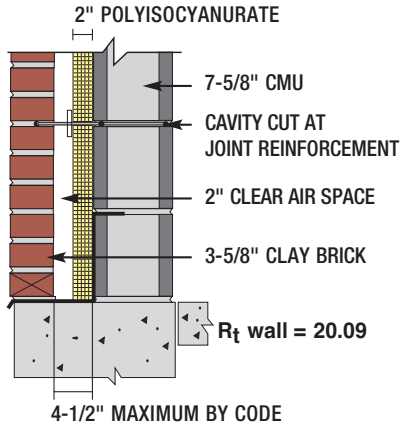
*Can vary with manufacturer.
ASTM test method C518 at 75ºF

Calculated R-Value with Polyisocyanurate

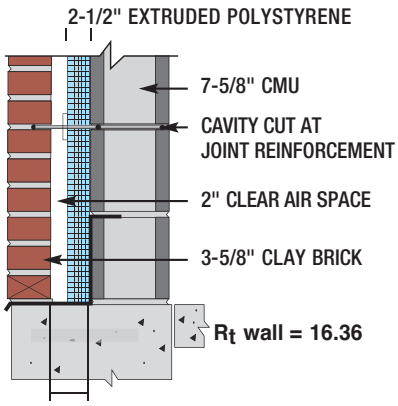
0.68	inside air surface
1.6	7⅝" CMU
14.4	2" polyisocyanurate
2.8	2" reflective air space
0.44	3⅝" clay brick
0.17	outside air surface
Rt=20.09	total wall R-value

A cavity wall with 2" polyiso has an R-value of 20.09. See detail 1 for wall cross section.

DETAIL 1



DETAIL 2



The Polyiso Cavity Wall System

The R-30 wall substantially exceeds code and exceeds existing expectations, saves expected energy costs and saves on the size of HVAC system required. Polyiso's high R-value/inch of thickness guarantees a very cost efficient high performance thermal wall system. Its foiled surface provides a reflective air space acting as an additional barrier as it retards radiant heat (irrespective of heat flow direction) and thus reduces thermal transfer.

That is value engineering for the life of the building. Polyiso insulation provides a superior R-value in cavity wall applications. Polyiso should not be used for below grade applications.

The Polyiso Edge

A material's resistance to water vapor is determined by testing the product via ASTM E96, a measure of water vapor transmission, resulting in permeance ratings (perms). Typically, polyiso foil-faced sheathings have very low perm ratings of less than 0.03.

Besides its superior R-value, polyiso is manufactured with zero ODP, CFC free, EPA compliant and contains no VOCs. It is lightweight and can be cut with a knife or saw. It usually comes precut from the manufacturer to fit between the horizontal joint reinforcing at 16" oc or 24" oc. The factory cut sheets are available in 16" x 96", 24" x 96" and 48" x 96", for the various thickness of insulations. The 48" x 96" full sheets are used for brick veneer on steel stud applications. And it reduces thermal bridging at the framing members.

Green Benefits

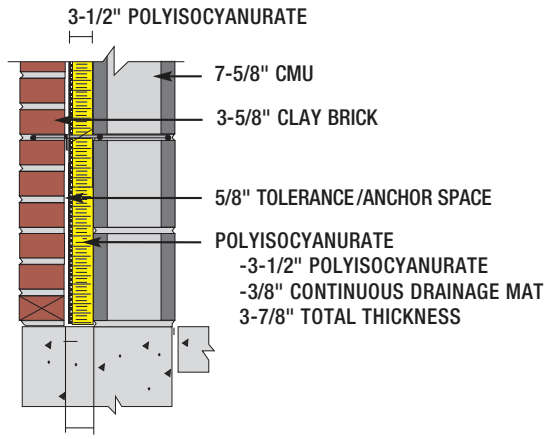
Besides the environmental benefits of optimizing energy performance (now up to 19 LEED points), polyiso includes recycled content in its manufacture. The percentage of the recycled material by weight depends on the individual manufacturer and the thickness of the product. Many facers on polyiso products contain up to 100% recycled materials. Two polyiso manufacturers in the greater Chicago area – DOW Polyiso in Charleston, IL and Hunter Polyiso Panels in Franklin Park, IL are well within the USGBC's LEED programs' 500-mile limitation for regional products reducing transportation costs.

Code

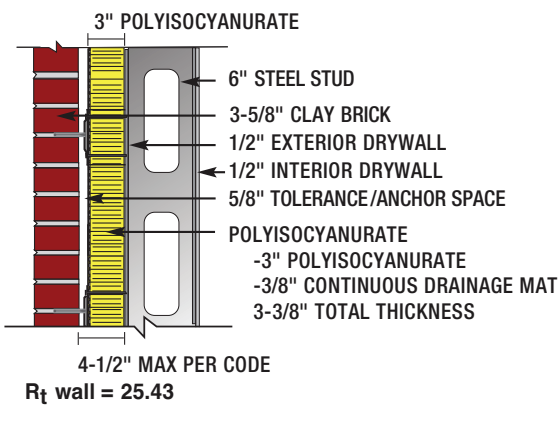
Now that I've discussed putting more and better insulation in cavity walls, let's talk about another important item – the building code and its requirements for cavity walls in the ACI-530 (now titled TMS 402-8).

Masonry Building Code under 6.2.2.8.2:
"A 4½" (114 mm) maximum distance between the inside face of the veneer and outside face of masonry or concrete backing shall be specified. A 1" (25.4 mm) minimum air space shall be specified."

DETAIL 3



DETAIL 4



For **steel stud backed, 6.2.2.7.4** states: "A 4½" (114 mm) maximum distance between the inside face of the veneer and the steel framing shall be specified. A 1" (25.4 mm) minimum air space shall be specified."

To keep the air space totally drainable to the base flashing and weep holes, a couple of proprietary products use a hybrid drainage system. It is factory applied and is a continuously adhered mat on the rigid insulation. This facilitates the maximum amount of rigid insulation to be installed with a 100% drainage system to the flashing. It is nonworkmanship related to keep the mortar from bridging the air space. (See Details 3 and 4.)

Install 16" or 24" insulation panels against the CMU backup wall with an expandable, "low rise" vapor barrier sealant, like Dow's "Great Stuff," or NP1 on the head and bed joints of the insulation with wall ties at the insulation joints. If an interior finish of drywall is needed with furring for perimeter electrical rough in, a 1½" drywall channel (DWC) will conceal 95% of most electrical rough in with a ⅝" drywall finish will add R-1.52 to:

- Detail 1 becomes an R_t wall of 21.61
- Detail 2 becomes an R_t wall of 17.88
- Detail 3 becomes an R_t wall of 29.98

Explore your options.
Reach beyond minimal code requirements.

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