XPSA
EXTRUDED POLYSTYRENE FOAM ASSOCIATION

Technical INSIGHTS

Below Grade, Number 7

Getting Practical about R-Values in the Design of Habitable Basements

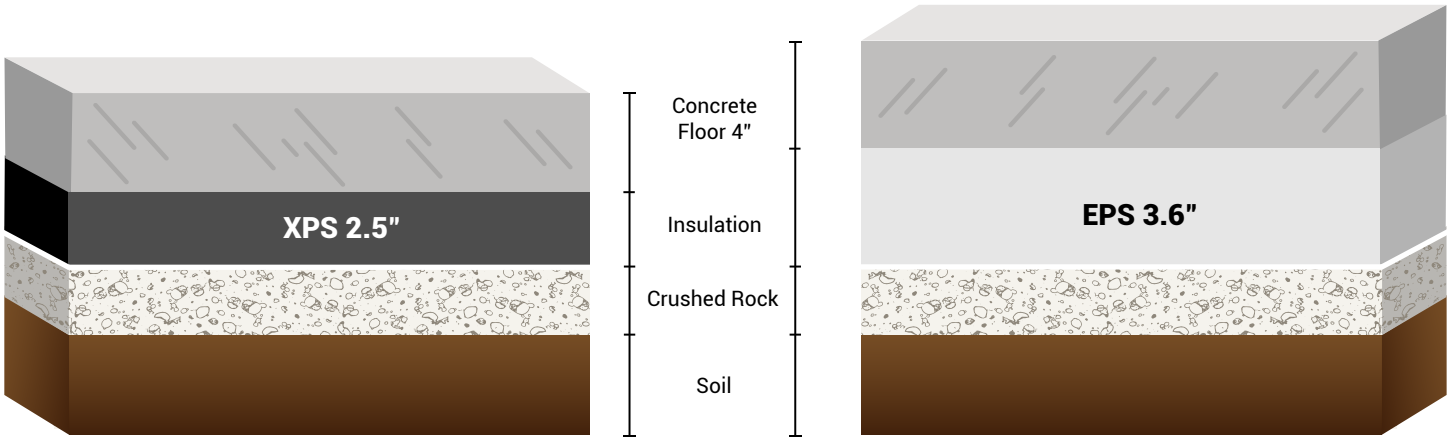

Figure 1: Thickness adjustment for design R-value of R-10 insulation beneath floor slab.

If the goal is to (1) facilitate drainage, (2) to keep temperature extremes outside and (3) to prevent condensation, then what practical measures must be implemented during basement design?

Start with the polystyrene foam insulation thickness. Based on recognized R-values for XPS and EPS, special considerations for insulation thickness adjustments for habitable basement designs are as indicated in Table 1:

Table 1: Insulation Thickness Adjustment Multiplier

Polystyrene	Vertical	Horizontal
EPS	1.24	1.50
XPS	1.11	1.25

In general, the thickness of EPS insulation should be increased by 24 percent to achieve desired thermal performance and to prevent condensation when EPS is placed on the outside of below grade walls. Furthermore, EPS thickness must be increased by 50 percent in below grade horizontal applications (i.e., under the floor slab).

Remarkably, the thickness of XPS insulation needs to be increased by only 11 percent to achieve desired thermal performance and to prevent condensation when XPS is placed on the outside of below grade walls. XPS thickness need only be increased by 25 percent in below grade horizontal applications (i.e., under the floor slab).

More specifically, the following design examples apply to insulation beneath a basement floor slab that requires an insulation design R-value of R-10 and on the exterior side of a basement wall that requires an insulation design R-value of R-20.

Figure 1 shows the EPS and XPS thicknesses required to obtain R-10 design R-value for insulation of a below-grade concrete floor slab. For XPS insulation, 10/5.0 equals 2.0 inches of R-5.0 XPS; adding 25 percent (2.0 + 0.5) gives an adjusted thickness of 2.5 inches for an R-10 design thermal resistance using XPS. For EPS insulation, 10/4.2 equals 2.38 inches of R-4.2 EPS. Adding 50 percent (2.38 +1.19) gives an adjusted thickness of 3.6 inches of EPS for R-10 design thermal resistance.

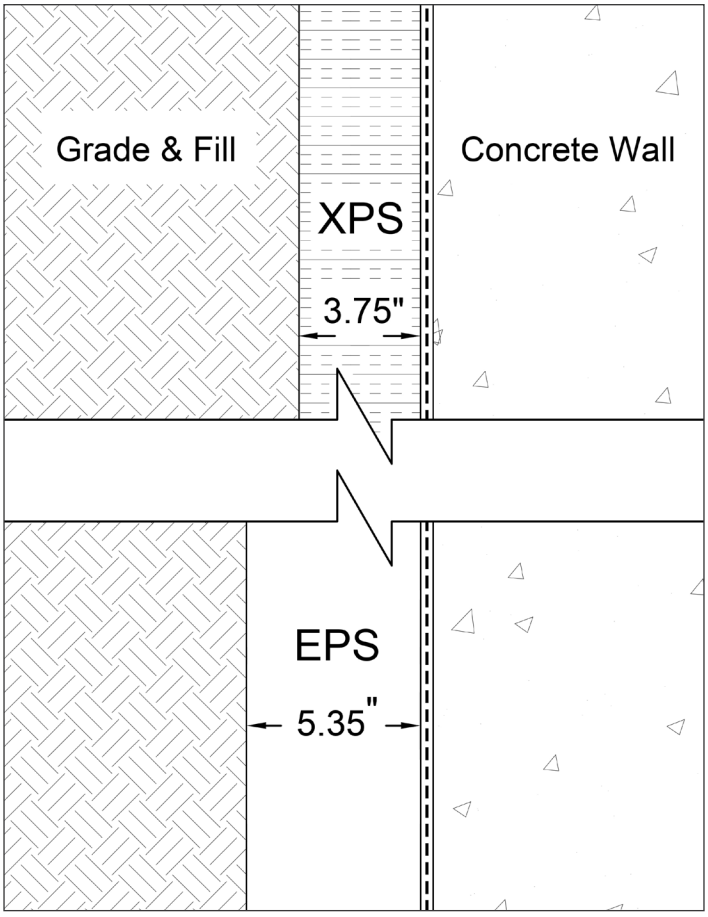

Figure 2: Thickness adjustment for design R-value of R-15 insulation on exterior wall.

Figure 2 shows the EPS and XPS thicknesses required to obtain R-15 design R-value for exterior below-grade exterior wall insulation. For XPS insulation, 15/5.0 equals 3.0 inches of R-5.0 XPS; adding 25 percent (3.0 + 0.75") gives an adjusted thickness of 3.75 inches for an R-15 design thermal resistance using XPS. For EPS insulation, 15/4.2 equals 3.57 inches of R-4.2 EPS. Adding 50 percent (3.57 + 1.78) gives an adjusted thickness of 5.35 inches of EPS for R-20 design thermal resistance.

These thickness adjustments are based on design R-values derived from field data on polystyrene foam insulation in cold climates per the design standard ASCE 32 for frost-protected shallow foundations [1]. The user is responsible to determine if these thickness adjustments are applicable for the local climate zone, rain exposures and other moisture exposure from vegetation or runoff from the building rooftop. While these design values are for frost protected shallow foundations and may not apply to all climate zones, they provide some insights into how moisture absorption affects R-values in below grade applications, including basement insulations.

Don't assume foundation drainage protects thermal control. Rather use right amount of thermal control and plan for the presence of moisture leftover after drainage. Design redundancy with thermal control keeps the basement habitable.

Figure 3: XPS Insulation is a key component of any basement wall assembly. The moisture resistance of XPS makes is ideally suited for below grade applications in the construction of habitable basements. (Courtesy of Owens-Corning)

References

[1] SEI/ASCE 32-01 Design and Construction of Frost-Protected Shallow Foundations, American Society of Civil Engineers, www.asce.org

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