Building America Case Study
Technology Solutions for New and Existing Homes

Interior Foundation Insulation Upgrade—Madison Residence

Madison, WI

PROJECT INFORMATION

Private residence, basement renovation

Madison, WI

Builder: TDS Custom Construction, Madison WI

Designer: Moisture / thermal management: TDS Custom Construction

Architectural: John Gibson, Gibson/Darr Architects

Building Component: Envelope: Foundation Wall

Application: Single family home, retrofit (also suitable for multi-family)

Project year: 2011

Climate Zone 6A (applicable to most climate zones. Termite risk must be assessed)

PERFORMANCE DATA

Cost of Energy-Efficiency Measure (including labor):

Walls—dimple mat and SPF: $7,000

Slab—demo existing, new granular fill, perimeter draintile, sump, SPF, slab: $14,500

No energy model was created. Air tightness increase of 7% post-retrofit.

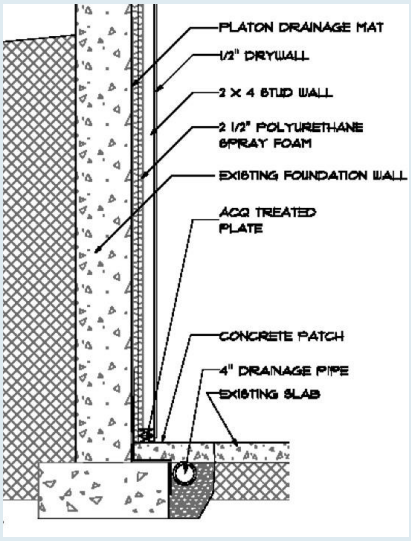
The owners of this 1916 home in Madison, Wisconsin performed a basement insulation upgrade as a part of a larger renovation project. The owners have a growing family, and perceived the basement as a substandard space that had potential as living space. In addition, they wanted to improve the energy and moisture performance of the house, and to accommodate a future addition and kitchen renovation.

The existing foundation was made of mortared limestone rubble, and there was evidence of vapor diffusion and limited bulk water intrusion. It was assumed that no waterproofing was installed on the exterior. The designers chose to install an interior upgrade. The wall upgrade included a dimple mat attached to the rubble wall, draining to a new perimeter draintile and sump system. The dimple mat, in turn, was covered in high-density spray polyurethane foam (SPF), which extends from the floor to the top of the rim joist. The draintile installation required partial floor demolition. In addition, several new columns were required, each with a new footing. Since the demolition was going to be so extensive, the decision was made to demolish the entire slab, and to excavate the subgrade approximately eight inches. This allowed for the installation of new granular fill for a future radon mitigation system, and two inches of SPF in addition to a new slab, without loss of headroom. Since the slab was going to be insulated from the ground, the decision was made to add radiant heat in the floor.

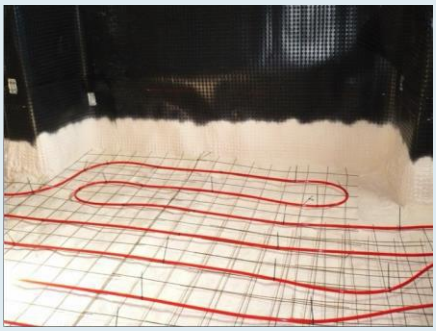
This project used an interior foundation insulation approach. This is the most common side of the foundation to insulate, since it is accessible without excavation. This project employed a number of strategies to ensure the success of the approach:

- Dimple mat conveys inbound moisture to draintile
- SPF insulation is airtight, ensuring indoor air does not contact foundation wall surfaces.
- Slab demo allowed insulation to be placed below the slab, saving energy and allowing radiant heating installation.

"Do No Harm—It doesn't get any riskier than this."
Sam Breidenbach, TDS Custom Construction



Wall section showing the insulation and moisture-management components of the system



SPF foam and radiant tubes for the new slab. Note dimple mat installed on the wall.

Foundation wall, after installation of all moisture and thermal management layers. The space is now ready for finishes.

All images courtesy of Sam Breidenbach

Photo showing finished basement space. Extensive moisture management and insulating efforts result in a warm, dry living space below grade.

Lessons Learned

- Homeowners are focused on the "house beautiful" finished result, and not the technical issues associated with getting there safely. They must be educated and convinced of the need to spend extra money for robust construction techniques.
- Obtain an energy audit, which found significant air leakage in the rim joist area on this project.
- Insulating on the interior side of basement walls can be risky, because the wall will be unable to dry to the interior. Because of this, contractors must be knowledgeable in building science principles to propose and construct high-performance, robust assemblies that do not compromise durability or health, while maximizing energy and moisture performance.

Looking Ahead

Most foundation insulation upgrades are made on the interior side because of the relative ease of access to the interior surface. However many of these upgrades are risky from a moisture management standpoint, employing air-permeable insulation materials, moisture-susceptible framing, and interior vapor retarders that essentially ensure moisture-related failure. This project highlights a robust approach. Contractors need to be educated about the relevant building science issues in below-grade spaces, so they can educate their clients about why spending more money on the front end will avoid many problems in the final project.

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