Excavationless Exterior Foundation Insulation Exploratory Study

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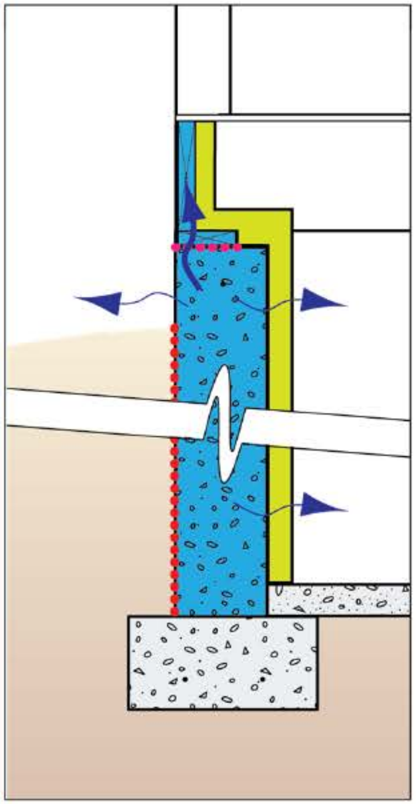
Context

A significant fraction of household space conditioning energy use, particularly in heating climates, can be attributed to lack of insulation on the basement wall and rim joist. Most existing houses have uninsulated foundations.

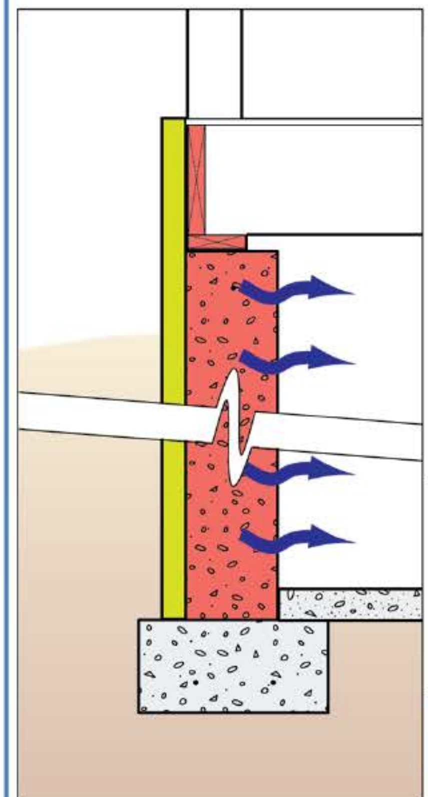
There are two potential locations for basement / rim insulation upgrades:

Interior insulation upgrade



- Many (most?) existing foundations lack moisture control at the foundation face, and lack a capillary break at the sill.
- Interior insulation makes the wall colder, thus wetter. Interior insulation materials have low permeability, so walls stay wet.
- Rim and sill are particularly vulnerable to moisture accumulation and decay.
- Most insulation materials require an ignition barrier, adding to costs.
- Interior approaches that solve the hygroghermal issues (e.g. BSC Hybrid method) are likely expensive.
- But if you don't go that far, it's relatively cheap (if dangerous)!

Exterior insulation upgrade



- Exterior foundation insulation confers multiple hygrothermal benefits, and missing moisture control materials can be added, or their importance to the hygrothermal regime diminished because the wall is warm, and can dry readily to the interior.
- Typical exterior approaches are costly, destructive to the landscape, and disruptive to homeowners.
- A cost-competitive, minimally-invasive technique is needed!

Technical Approach

The project begins with the concept of an "excavationless" exterior foundation insulation upgrade that is cost-competitive with current methods, and involves little impact to existing landscape and site features.

Process:

1. Literature review to establish the building science case for the advantages of exterior foundation insulation vs. interior insulation
2. Presentation and analysis of two exterior, full-excavation exterior insulation upgrades to establish a base case for costs
3. Survey of five typical twin-cities neighborhoods to categorize and quantify typical obstructions
4. Web-based search to identify available materials and technologies that have promise in this type of application
5. Interviews with industry representatives from downselected products and technologies to establish their applicability in the application, along with cost
6. BEOpt analysis to establish energy savings potential

Recommended Guidance


http //www.goliathhydrovac.com/PhotoAlbums/album_1205855977/


http //ncfi.com/geotech.cfm


http //www.thiessenteam.com/shotcrete_concrete_grout/thiessen-cellular-concrete/default.aspx


http //www.conteches.com/Products/Stormwater-Management/Treatment/Filter-Media-Options.aspx

1. Cut a narrow slot trench using air-vac / hydro-vac technology
2. Backfill with one of three potential material candidates:
    1. 4” pourable polyurethane (R26)
    2. 6” Cellular Concrete (R9-R11)
    3. 6” Perlite aggregate concrete (R9-R11)
3. Above-grade foundation and rim techniques are under consideration. Rigid insulation application is one possibility.
4. That could be it. There is the potential to drape waterproofing membranes into the trench prior to backfill if necessary. For the cementitious materials, admixtures that create a hygrophobic concrete can be added to include to make those materials more truly waterproof.

Value

Cost comparison table

Product	Insulation Type	Total R-value (h ft² °F/Btu)	Material cost	Labor cost	Excavation technology	Excavation cost	Total cost *
Rigid mineral wool	Rigid board	10 (2.38" thick)	$689	$3198	Traditional power shovel	$2920	$6807
Extruded polystyrene	Rigid board	10 (2" thick)	$630	$3198	Traditional power shovel	$2920	$6748
Expanded polystyrene	Rigid board	8 (2" thick)	$336	$3198	Traditional power shovel	$2920	$6454
Cellular concrete	Cast in place	9 (6" thick)	$3000	included	Hydro-vac	$2600	$5600
Perlite Concrete	Cast in place	11 (6" thick)	$3529	included	Hydro-vac	$2600	$6129
Polyurethane foam	Cast in place	26 (4" thick)	$3360	included	Hydro-vac	$2000	$5360

For a robust cost / benefit analysis, energy savings predictions are required. BEOpt analysis shows a very small (≈7%) whole-house source energy savings from adding R10 foundation insulation to an uninsulated wall. This value is very likely underestimating the actual savings. For this reason, costs are compared to case study cost data only.

* Cost does not include landscaping remediation, which will likely be higher for "traditional" methods

Market Readiness

- Foundation insulation can have a significant influence on space conditioning energy use.
- Exterior insulation confers many hygrothermal benefits vs. typical interior approaches.
- Homeowners who understand these benefits currently choose exterior insulation upgrades, despite the inconvenience, cost, and landscape damage.
- All technologies recommended here as a potential solution are in current use, though in market sectors other than house foundation insulation upgrades.
- Preliminary cost estimates indicate this method is at least cost-competitive with current exterior insulation upgrade methods. Note that replacement of landscape features is not included in the analysis, so actual costs of traditional methods will be higher.

Pros and Cons

Pros

- Exterior insulation tends to be forgiving of existing envelope defects
- Vacuum excavation methods greatly reduce landscape impacts
- Many landscape features (walks, stoops, decks, etc.) that would be removed for traditional excavation can remain with vacuum excavation
- Process is quick, estimated at two to three days for a simple home
- Pourable insulation materials may be relatively waterproof, potentially reducing bulk water intrusion
- Cost competitive with, and likely cheaper than, current methods of exterior insulation upgrades

Cons

- Method does not address moisture loading from sources such as capillarity from the footing or through the slab
- More expensive than typical interior insulation methods (most of which increase risk of moisture problems)
- Long-term thermal properties are not known; potential for moisture accumulation within pore spaces may cause thermal degradation
- Large obstructions (patio slabs, sidewalks that abut the foundation) will need to be sawcut to the trench width, or removed and replaced
- Extent of waterproofing ability, and durability of that solution, are not well-characterized

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