Energy Code Compliance

Montana

Best Practices Newsletter

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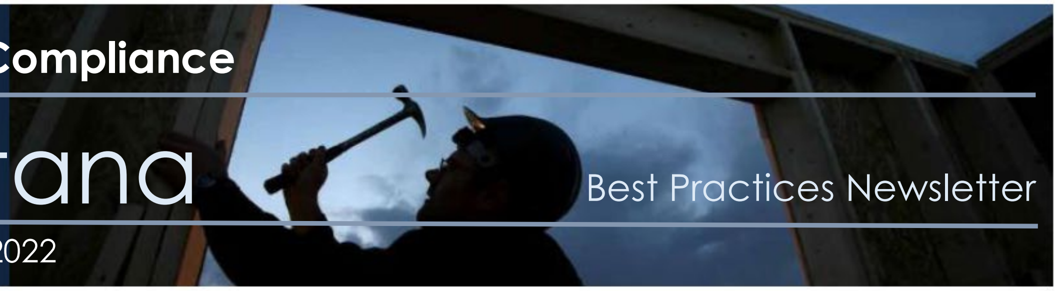

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Exploring No-Concrete Slabs

The high imbedded carbon cost of manufacturing concrete combined with the high cost of concrete itself has led more and more architects and designers to explore ways to reduce the amount of concrete used in energy-efficient, high-performance homes. One way is to replace the concrete in foundations, where most concrete is used. In the past, concrete alternatives were mostly limited to pressure treated (PT) lumber and/or steel alternatives. While PT basements and crawlspaces have been used successfully for quite some time, there is a common reluctance to build this way because both owners and builders are still unsure of the durability of such structures over time.

Recently, I've noticed that a number of building-science experts, architects, and designers have been employing new techniques to build. One such technique is *no-concrete slabs*. The moniker is somewhat of a misnomer, as the technique still requires concrete for footers and stem walls, but the slab portion of the assembly replaces concrete with EPS foam and a "floating" plywood or OSB subfloor. This assembly eliminates some of the more undesirable traits of a concrete slab, including moisture issues, limited finish flooring options, and the unforgiving nature of a slab, which includes the impact on the bones and joints of an aging population.

As you may imagine, building a structure utilizing a concrete-free slab requires a few changes in assembly order, as well as forethought on mechanical systems that normally would be embedded or run below a concrete slab. The changes are not complicated; however, they do need to be well thought out and planned before construction time. Radon mitigation can be handled below the assembly, just like a concrete slab.

The Basics

Construction of the no-concrete slab oddly enough starts with concrete footers and concrete stem walls. The construction of the stem wall is typical, with most contractors using insulated concrete forms installed to code depth and the manufacturer's specifications. The slab itself is typically divided into six layers, beginning with excavating down to undisturbed soil or incorporating compacted engineered fill, depending upon soil type. For free-span structures with no internal bearing points, nothing more is needed with this layer. If a bearing point is needed, a concrete footing could be used at this point.
An interesting alternative is to use an EPS product designed for load bearing in the insulation layer. Montana manufacturer

Big Sky R Control provides a product called Geofoam that is designed to act as a lightweight fill with compressive characteristics that could act the same as a concrete footing. According to the [manufacturer's technical manual:]

> "EPS geofoam is available in a range of compressive resistances. A project designer can choose the specific type of EPS required to support the design loading while minimizing cost. Several different types of EPS geofoam can be specified on a single project to maximize savings. For example, higher strength EPS geofoam can be used in high applied stress areas while lower strength blocks are used in areas where the applied stresses are lower."

A structural engineer should be consulted for design considerations should the internal design require load bearing points.

Layer two should provide a capillary break. This is typically created with a 4-inch layer of crushed stone with no fines. This layer should also contain perforated pipe that will later be attached to an exhaust outlet and act as either an active or a passive soil gas (radon) ventilation system and any mechanical systems that would normally run under a concrete slab.

Layer three consists of sand or gravel that will allow the builder to level for the layers to follow. This step seems to be the most challenging for builders, as this layer must be perfectly level in order to produce a level and even finished floor. If the layer is not level and flat, voids under the layers above could cause bouncy or sagging floors. Full contact is needed with the foam layer that will be placed above this layer.

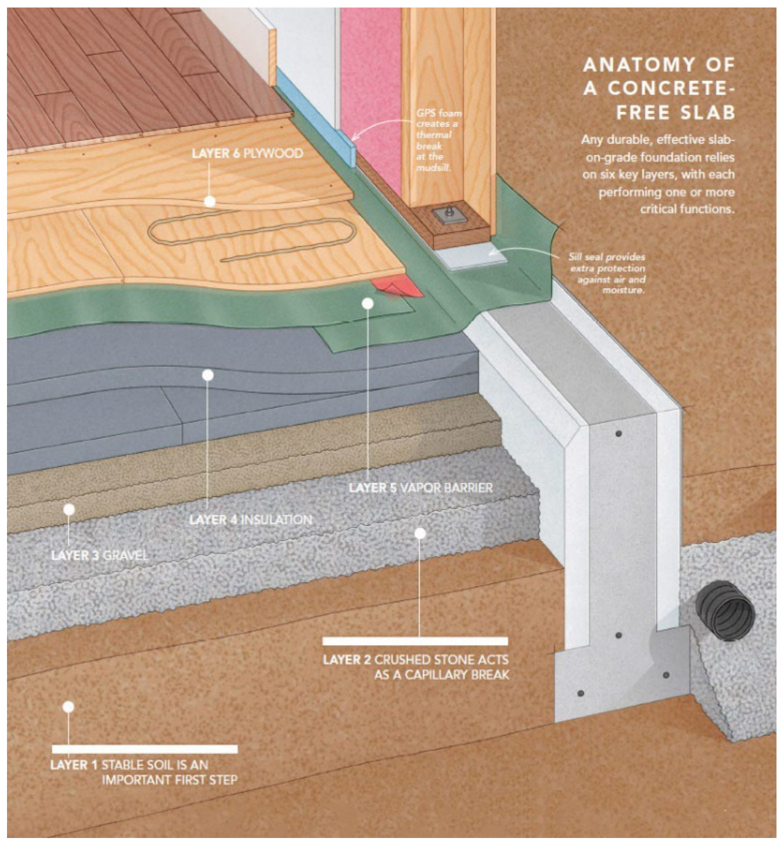

Illustration courtesy of Fine Homebuilding Magazine

Layer four is the EPS insulation layer. The typical assembly is two layers of 2-inch EPS with opposing seams. The 2018 IECC, while not covering these types of assemblies, does require at least R-10 insulation under the slab and R-5 for heated slabs, and the insulation must extend continuously for four feet vertically or horizontally. At an average of R-5 per inch of EPS, the no-concrete slab more than meets the energy code requirements. The vertical insulation requirement is met using insulated concrete forms or foam installed after the stem walls are poured.

The fifth layer is the continuous vapor barrier layer, consisting of 10-mil polyethylene sheeting that will act as a Class 1 vapor barrier. This layer will protect the building from moisture being drawn in from the ground, which can cause a host of issues, including rot and mildew. This layer can be run under the mud sill. All seams should be properly overlapped and taped.

The assembly is completed with a subfloor that consists of two layers of ¾-inch plywood or OSB subflooring installed in opposing directions with staggered seams. Advantech OSB seems to be the subflooring of choice among builders primarily for its water-repelling ability.

Assembly Challenges

Moisture was one of the biggest concerns expressed in a webinar about the no-concrete slab. You can find a link to the webinar online in the references section below. Concrete actually benefits from being wetted during the construction process, whereas the no-concrete assembly creates a container to hold moisture should it rain after the floor was assembled and before the building envelope is complete. An old adage of builders is that no matter what climate you live in, it will rain. To overcome this challenge, most builders have the building dried in before assembling the floor. The polyethylene sheeting can be partially installed by running strips under the mudsill and extending to the interior to be joined to the main poly sheeting installed under the subfloor after the building is dried in.

Another challenge is dealing with the local building department for permits and inspections. As with any new assembly type, the code does not specifically deal with this assembly and instead assumes a concrete slab. Having a stamped engineered drawing will help with this challenge.

General unfamiliarity is also a challenge. Designers hoping to use this concept often have trouble finding a builder willing to work through the challenges to learn something new.

Benefits

Perhaps the biggest benefit of the no-concrete slab is that it does not require any special skills or tools to create the finished project. The wooden subfloor, like a concrete slab, floats over the layers below making it quick to install. There are more options for a finished floor with fewer moisture concerns than there are for a concrete slab, and the floor, if the sublayers are installed properly, should not crack or heave.

The jury is still out concerning cost. In the webinar I attended, some reported a small cost savings, while others reported a slight increase in costs in materials and labor over a concrete slab.

Conclusion

The no-concrete slab is a new and interesting building technology that may suit Montana's dry climate and well-drained soils rather well. It seems to provide a number of energy-efficient benefits compared to other foundation systems that would benefit those of us living in this cold climate. The foam manufacturing industry expertise and supply is available in Montana, a particular benefit in this time of challenging supply chains. However, with any new technology or technique, there may be at least a perceived risk that most will want others to take before diving in.

References

Jacques, Kiley. No date. Building a Concrete-Free "Slab"-on-Grade Foundation. Fine Homebuilding. finehomebuilding.com/project-guides/insulation/a-concrete-free-slab-on-grade-foundation

Salinger, Josh. Assembling a Concrete-Free Slab. Fine Homebuilding. February/March 2022. finehomebuilding.com/project-guides/insulation/concrete-free-slab

Jacques, Kiley. 2020. Another Take on a Concrete-Free Slab. Fine Homebuilding. February 3. greenbuildingadvisor.com/article/another-take-on-a-concrete-free-slab

Salinger, Josh. 2021. The Concrete-Free Floating-Plywood Slab Assembly. Green Building Advisor. September 5. greenbuildingadvisor.com/article/the-concrete-free-floating-plywood-slab-assembly

Pontolilo, Brian. 2020. The BS* + Beer Show: Concrete-Free Slabs. Green Building Advisor. April 18. greenbuildingadvisor.com/article/the-bs-beer-show-concrete-free-slabs

Big Sky R Control. No date. R-Shield Geofoam. rshieldinsulation.com/geofoam

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