Development Services

From Concept to Construction

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APPEAL SUMMARY

Status: Decision Rendered

Appeal ID: 23487	**Project Address:** 4833 NE 8th Ave
Hearing Date: 2/26/20	**Appellant Name:** Ben Valentin
Case No.: B-002	**Appellant Phone:** 3234592062
Appeal Type: Building	**Plans Examiner/Inspector:** Preliminary
Project Type: residential	**Stories:** 2 **Occupancy:** R-3 **Construction Type:** V-B
Building/Business Name: NA	**Fire Sprinklers:** No
Appeal Involves: Erection of a new structure	**LUR or Permit Application No.:**
Plan Submitted Option: pdf [File 1] [File 2] [File 3] [File 4]	**Proposed use:** Residential Dwelling Unit

APPEAL INFORMATION SHEET

Appeal item 1

Code Section	ORSC Section R317.1
Requires	ORSC Section R317.1: Protection of Wood and Wood-based Products Against Decay: Wood building materials shall be protected against decay in the listed locations through either natural durability or preservative treatment. Specific locations which could apply to the specific detail include: (Sub-Section 317.1(1)) Wood structural floors must be protected against decay when closer than 12 inches to exposed ground in crawl spaces. (Sub-Section 317.1(3)) Wood on a concrete or masonry slab which is in direct contact with the ground must be protected against decay unless it is separated from the slab by an impervious moisture barrier. (Sub-Section 317.1(7)) Wood framing members attached directly to interior of exterior concrete walls below grade must be protected against decay except where approved vapor retarder is applied between the concrete wall and framing members. (Section 317.1.2) Section 317.1.2 goes on to add that all wood in contact with the ground shall be approved pressure-preservative-treated wood suitable for ground contact use.
Code Modification or Alternate Requested	The intent for this appeal is to be permitted the use of plywood material in lieu of concrete for a slab on grade floor assembly.
Proposed Design	We are proposing a plywood slab floor assembly applied similar to a conventional concrete slab assembly, however omitting the concrete and instead utilizing plywood. This assembly has been

used in other jurisdictions, including attached example case study “A Basement Floor Without Concrete” from the Journal of Light Construction, and the GBA article "Another Take on a Concrete-Free Slab".

Slab Assembly, from interior, see attached detail:

Finish Floor (T&G hardwood)
(2) layers 3/4” plywood, perpendicular cross staggered
10 mil polyethylene vapor & moisture barrier
4” continuous rigid/GPS insulation under entire plywood slab
4” crushed gravel
Grade

Reason for alternative The primary reason for this construction method is to reduce the quantity of concrete used during construction. Buildings contribute 39% of all greenhouse gas emissions globally, and of that, 28% of these emissions are due to embodied carbon of the building materials. (See Architecture 2030. “Why the Building Sector.” Architecture 2030, 2018. https://architecture2030.org/buildingsproblemwhy/.) Of that, concrete boasts accounts for nearly 7% of all global carbon emissions, therefore reduction of concrete in particular has a significant effect on reducing a project’s Global Warming Impact. (See Harvey, Chelsea. “Cement Produces are Developing a Plan to Reduce CO2 Emissions.” Scientific American, July 9, 2018. https://www.scientificamerican.com/article/cement-producers-are-developing-a-plan-to-reduce-co2-emissions/.)

In addition to reducing concrete, the proposed alternative meets all code requirements for protection of wood building materials. In the proposed assembly, there is no wood or wood-based materials in direct contact with ground or any other moisture exposure to the plywood that could cause decay. The issue of any moisture/decay to this assembly is completely addressed by use of a robust vapor barrier, which puts this assembly in compliance with section R317.

Demonstration of compliance with specific sub-sections of R317:

(Sub-Section 317.1(1)) The wood floor is not located over a crawl space, and is not in proximity to exposed ground with proposed detail, therefore wood protection is not triggered per this paragraph section.

(Sub-Section 317.1(3)) The wood slab is not located over a concrete or masonry slab in direct contact with the ground. It is, however, directly located over rigid insulation which is in direct contact with the ground. But the wood slab is separated from this rigid insulation by a continuous moisture barrier, which qualifies for the exemption noted in this paragraph section. Furthermore, this assembly would be superior to the example noted in Paragraph 3 (of wood atop a concrete floor in direct contact with the ground) because, in addition to the continuous vapor and moisture barrier, rigid insulation is a better moisture barrier than concrete.

(Sub-Section 317.1(7)) Although the proposed assembly does not explicitly locate framing members below grade (but rather on top of grade), a vapor retarder is proposed between the concrete stem wall and wood floor framing (i.e. plywood floor). Therefore it meets the exception for protection, and in fact is superior because the wood in this assembly is not below grade.

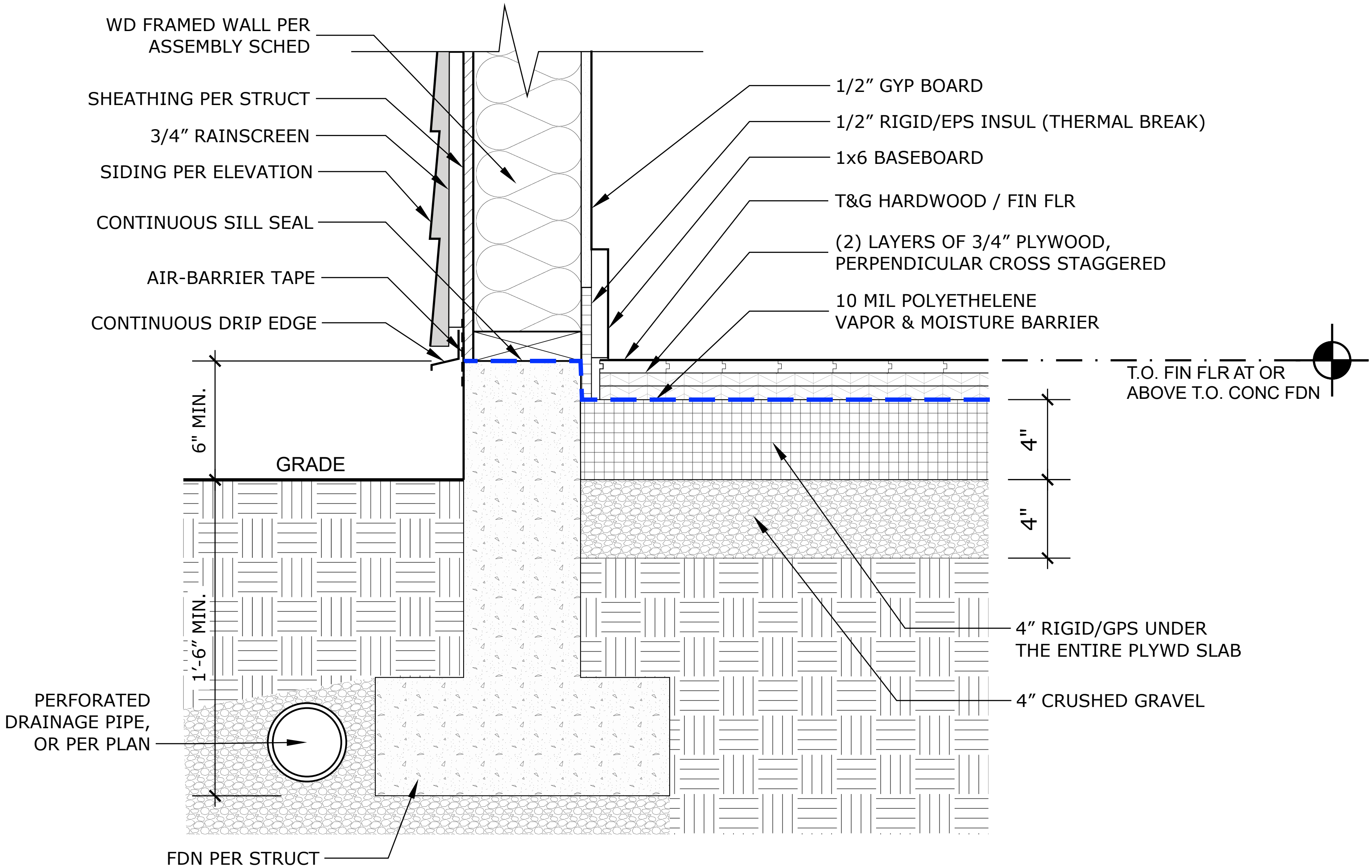
(Section R317.1.2) The wood slab floor of the proposed assembly does not place the wood in direct contact with the ground, but it is located over a continuous vapor and moisture barrier AND continuous rigid foam insulation. Therefore the wood slab does not need to meet the pressure-preservative-treatment requirements of this section.

APPEAL DECISION

Floor slab with use of plywood in lieu of concrete: Granted as proposed.

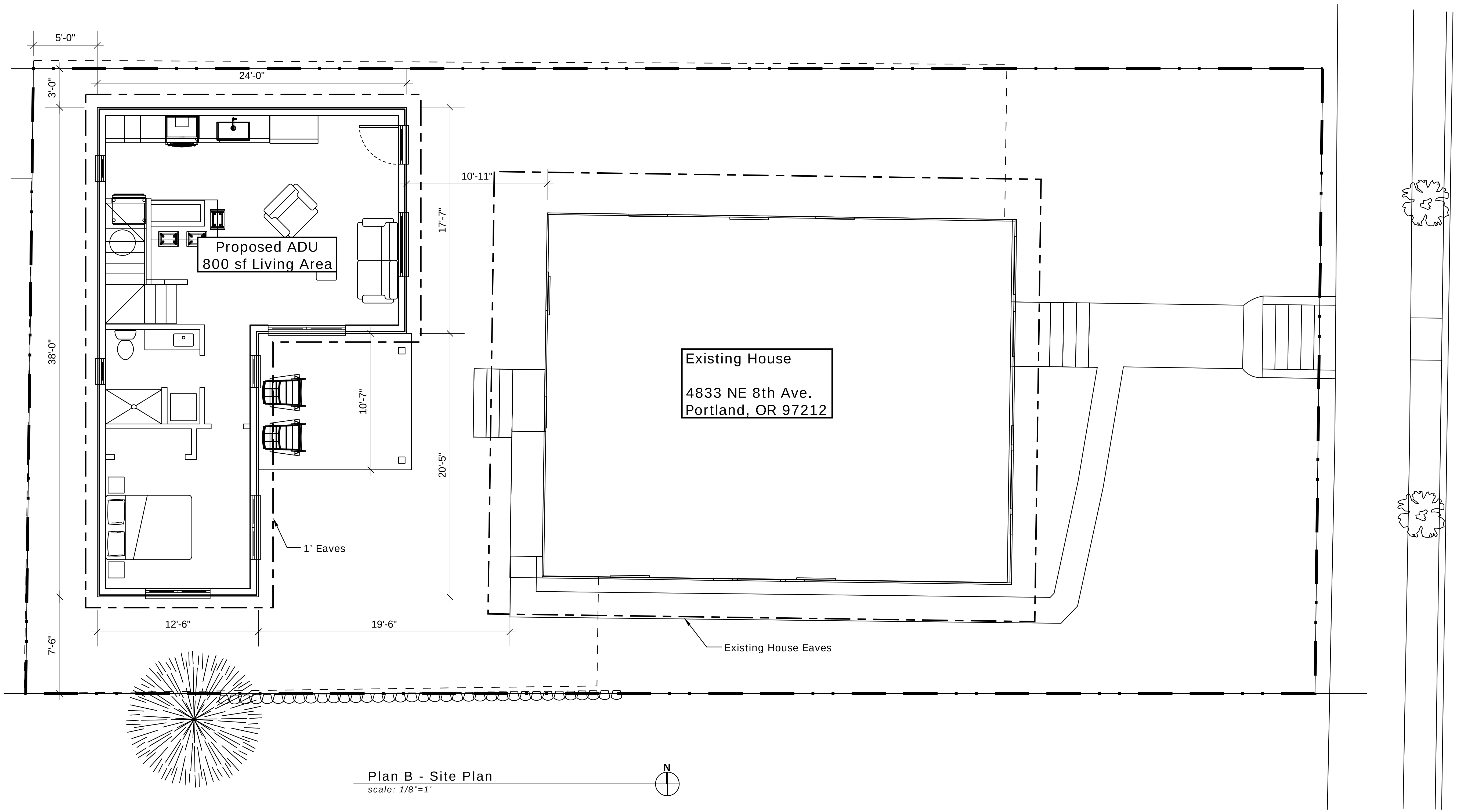
The Administrative Appeal Board finds that the information submitted by the appellant demonstrates that the approved modifications or alternate methods are consistent with the intent of the code; do not lessen health, safety, accessibility, life, fire safety or structural requirements; and that special conditions unique to this project make strict application of those code sections impractical.

Pursuant to City Code Chapter 24.10, you may appeal this decision to the Building Code Board of Appeal within 90 calendar days of the date this decision is published. For information on the appeals process, go to www.portlandoregon.gov/bds/appealsinfo, call (503) 823-7300 or come in to the Development Services Center.



1 FLOOR DETAIL

NTS

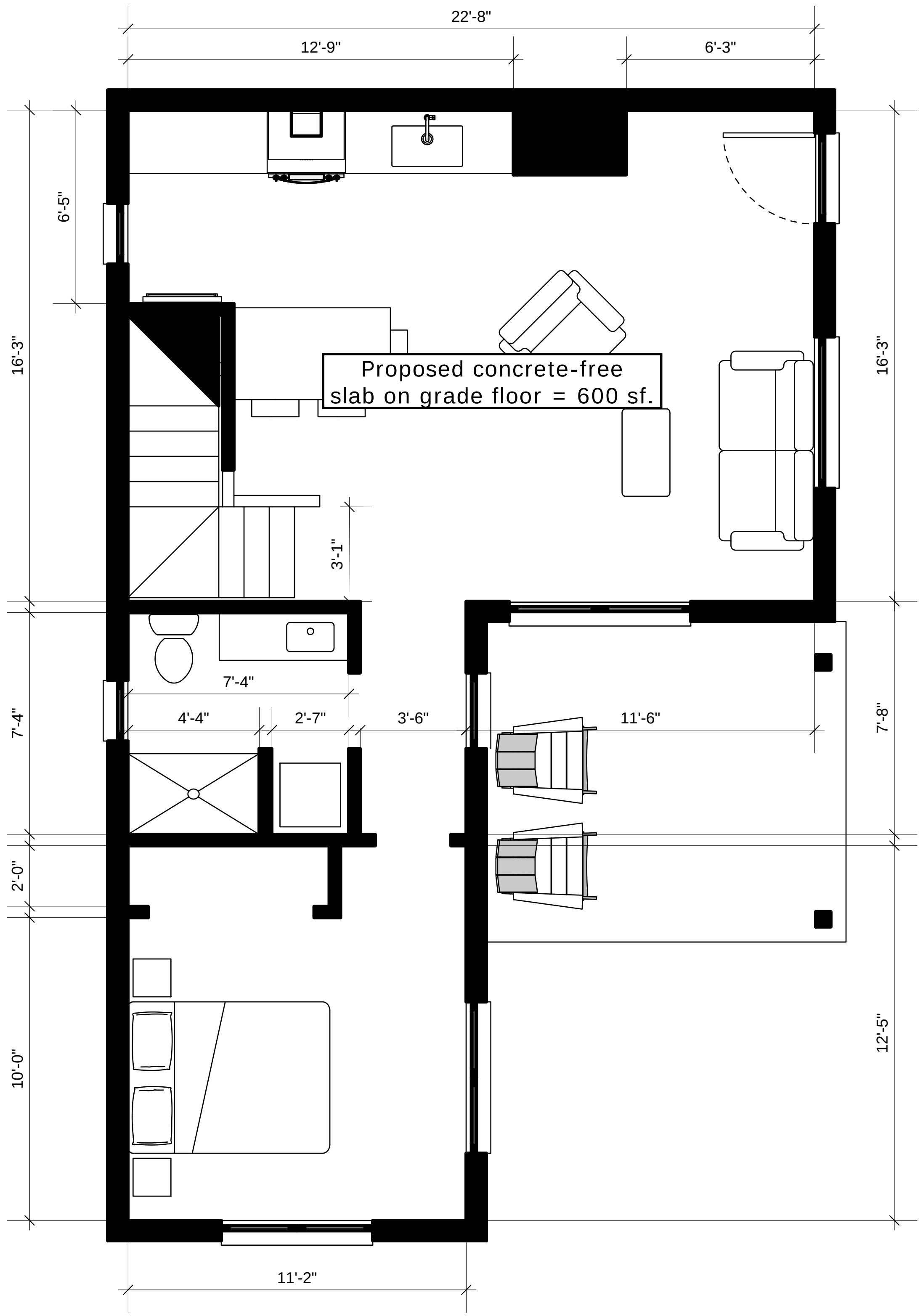


Site Plan

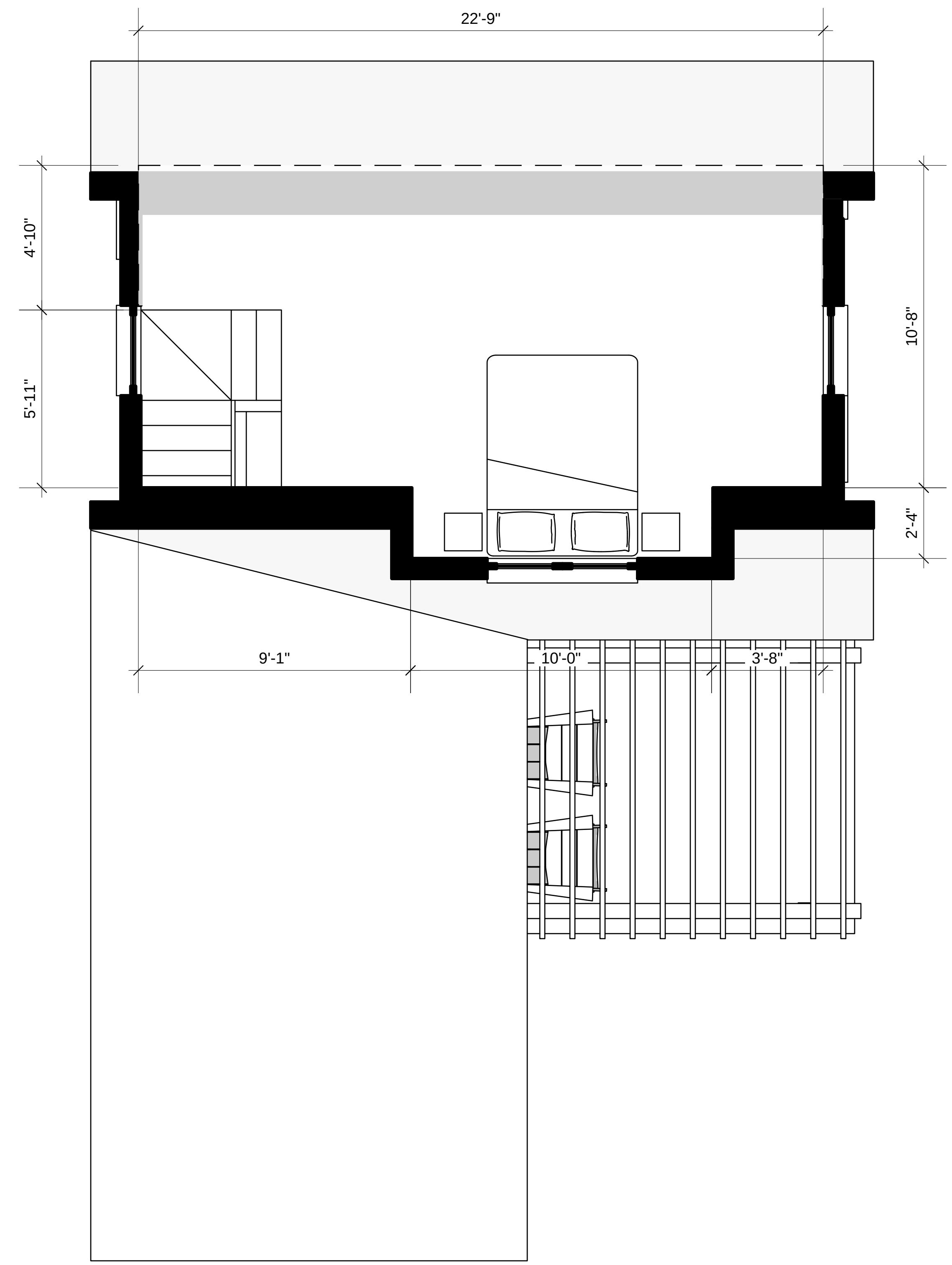
February 13, 2020

4833 NE 8th Ave. Portland, OR 97212

BIRDSMOUTH



1 Plan B - Main Floor
scale: 3/16"=1'
N



2 Plan B - 2nd Floor
scale: 3/16"=1'
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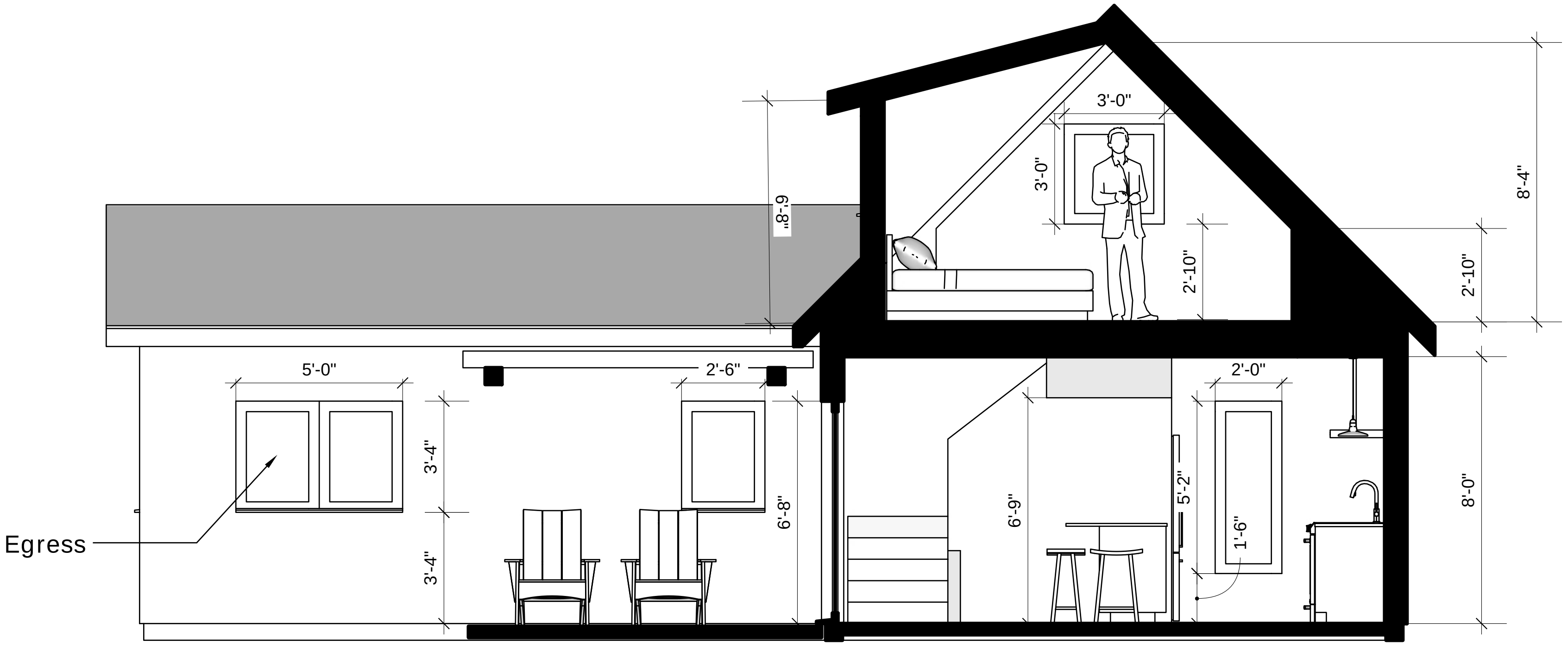
Schematic Floor Plan

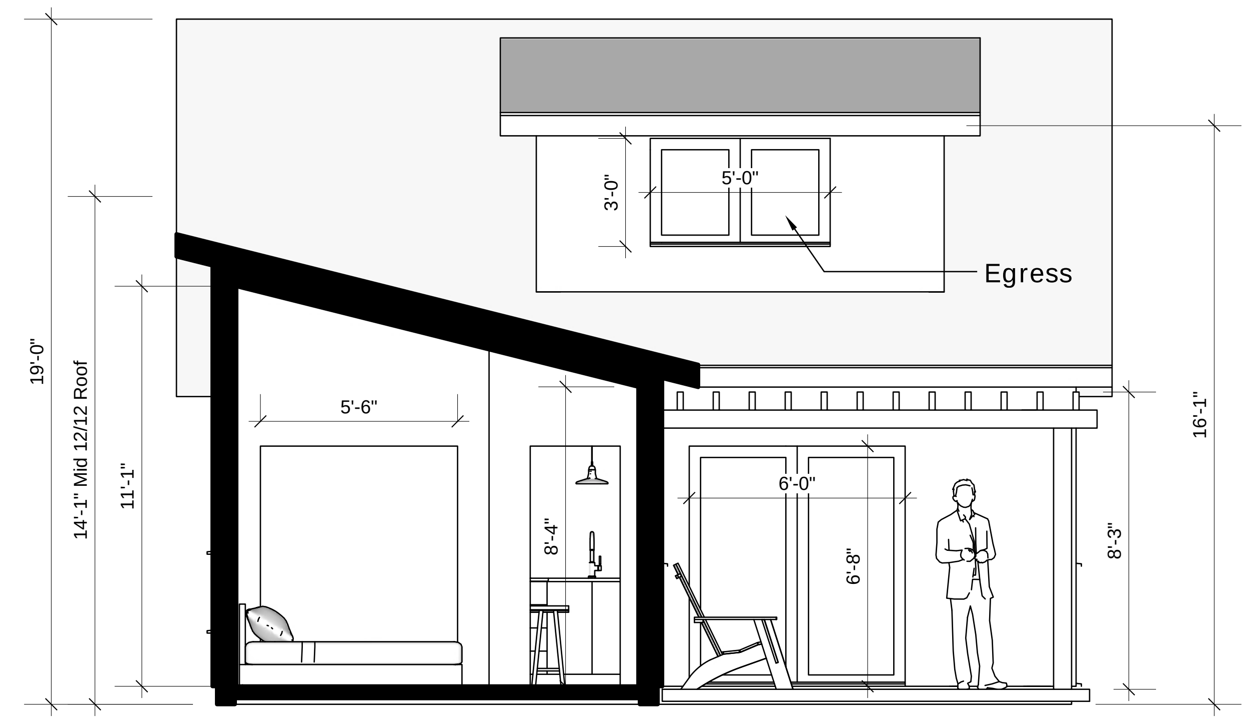
February 13, 2020

4833 NE 8th Ave. Portland, OR 97212

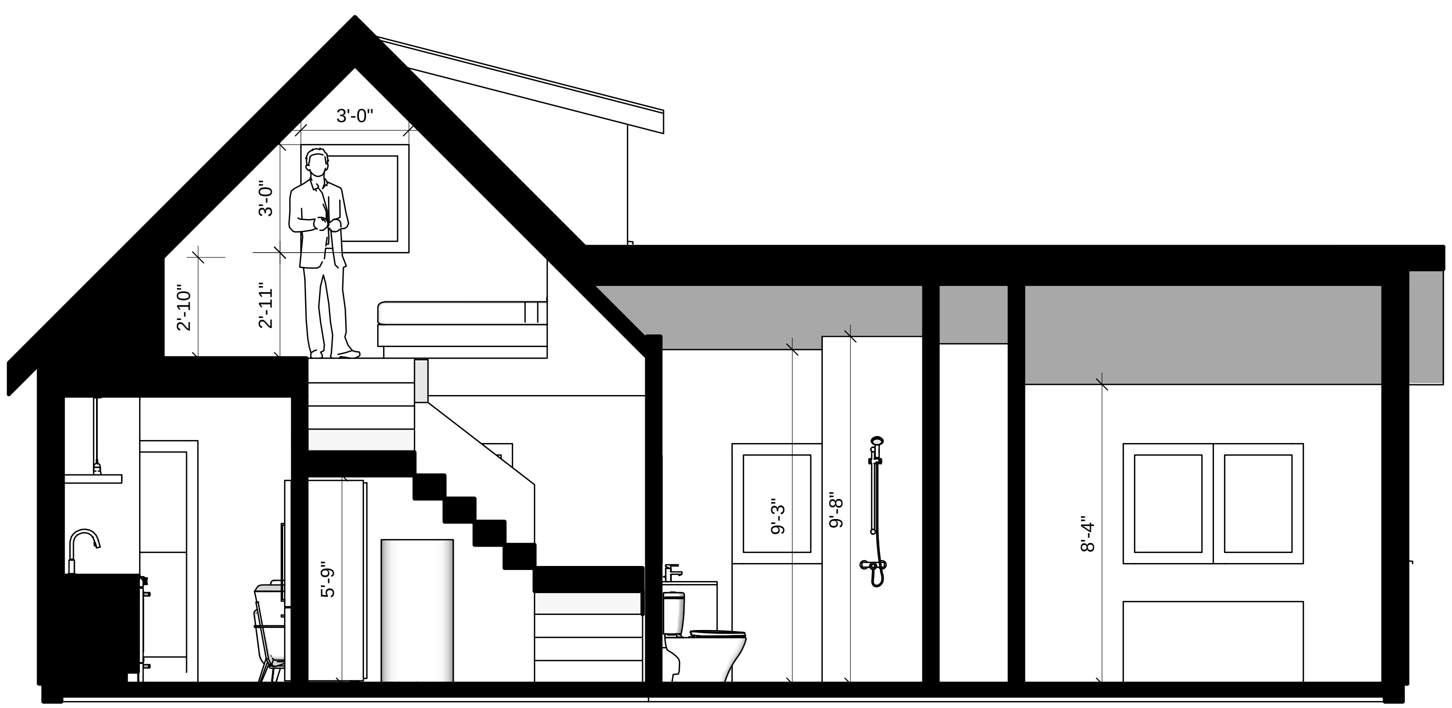
BIRDSMOUTH LLC



1 Section - Looking West
scale: 3/16"=1'



2 Section - Looking North
scale: 3/16"=1'



3 Section - Looking East
scale: 3/16"=1'

4 Section - Looking South
scale: 3/16"=1'

Schematic Building Sections

February 13, 2020

4833 NE 8th Ave. Portland, OR 97212

BIRDSMOUTH

A Basement Floor Without Concrete

With the right prep work, a double layer of OSB might be better than a slab

BY STEVE DEMETRICK AND STEVE BACZEK

Photos by Roe Osborn except where noted

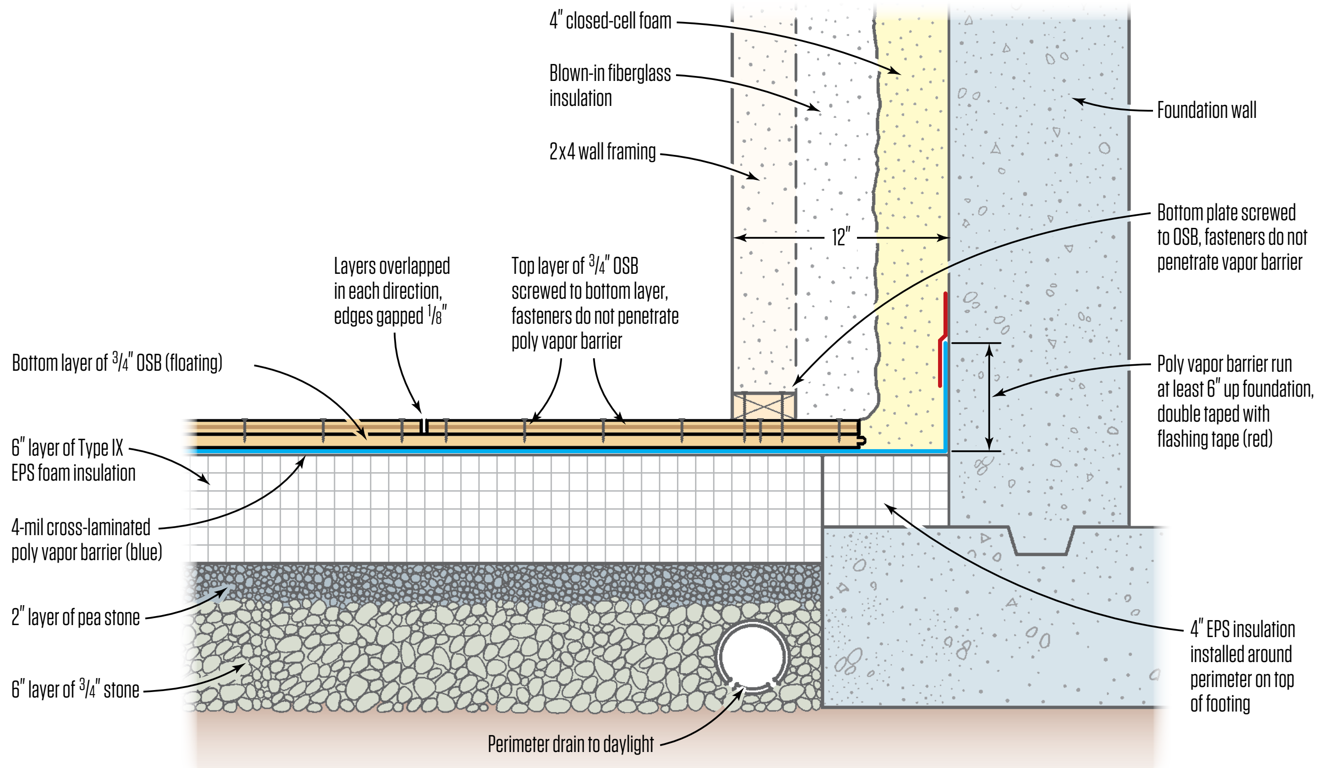
A couple of years ago, we (Steve Baczek, architect, and Steve Demetrick, builder) joined forces on Rhode Island's first certified Passive House. As successful as that affordable project was, we agreed that the best aspect of the project was the ongoing dialogue that started between the two of us. When we were recently asked to design and build another Passive House for a client, we began by questioning everything we did on the first project, from the foundation up—both successes and challenges.

"DO WE NEED THE SLAB?"

One of the first things we looked at was the basement-floor assembly, which in most Passive Houses is a heavily insulated, concrete-slab system. Typically, the slab is covered with carpet, laminated flooring, or tile. But this particular client wanted a hardwood floor in the finished basement, so the assembly below that floor needed closer scrutiny. With a concrete slab, there is usually some type of sleeper system that supports floor sheathing, and then the hardwood floor is installed on top of that. But we've seen these assemblies grow in section, which can restrict headroom in the basement, and all those built-up layers can equate to a lot of extra cost.

Hardwood floors are also very sensitive to moisture, and a concrete slab adds a tremendous amount of moisture that needs to dry off (a conservative estimate would be at least 500 gallons of water in the concrete for a 4-inch slab of this size). The fact that a Passive

Floating OSB Floor



The basement of this extremely tight house was to be finished with a hardwood floor, so pouring a concrete slab posed many challenges, including the introduction of hundreds of gallons of water that would have to dry off as the concrete cured. Instead, the design team decided to put down two layers of OSB underlayment subflooring. The insulated base below the subfloor would be the same as for a slab, including a 4-mil cross-laminated polyethylene sheet that doubled as a moisture barrier and vapor barrier. The two overlapped layers of OSB would sit on top of the poly without being fastened to the structure below.

Illustration: Tim Healey

House is an extremely airtight structure would only complicate the drying process. In the face of all these challenges, we finally found ourselves asking, "Do we really need the slab?"

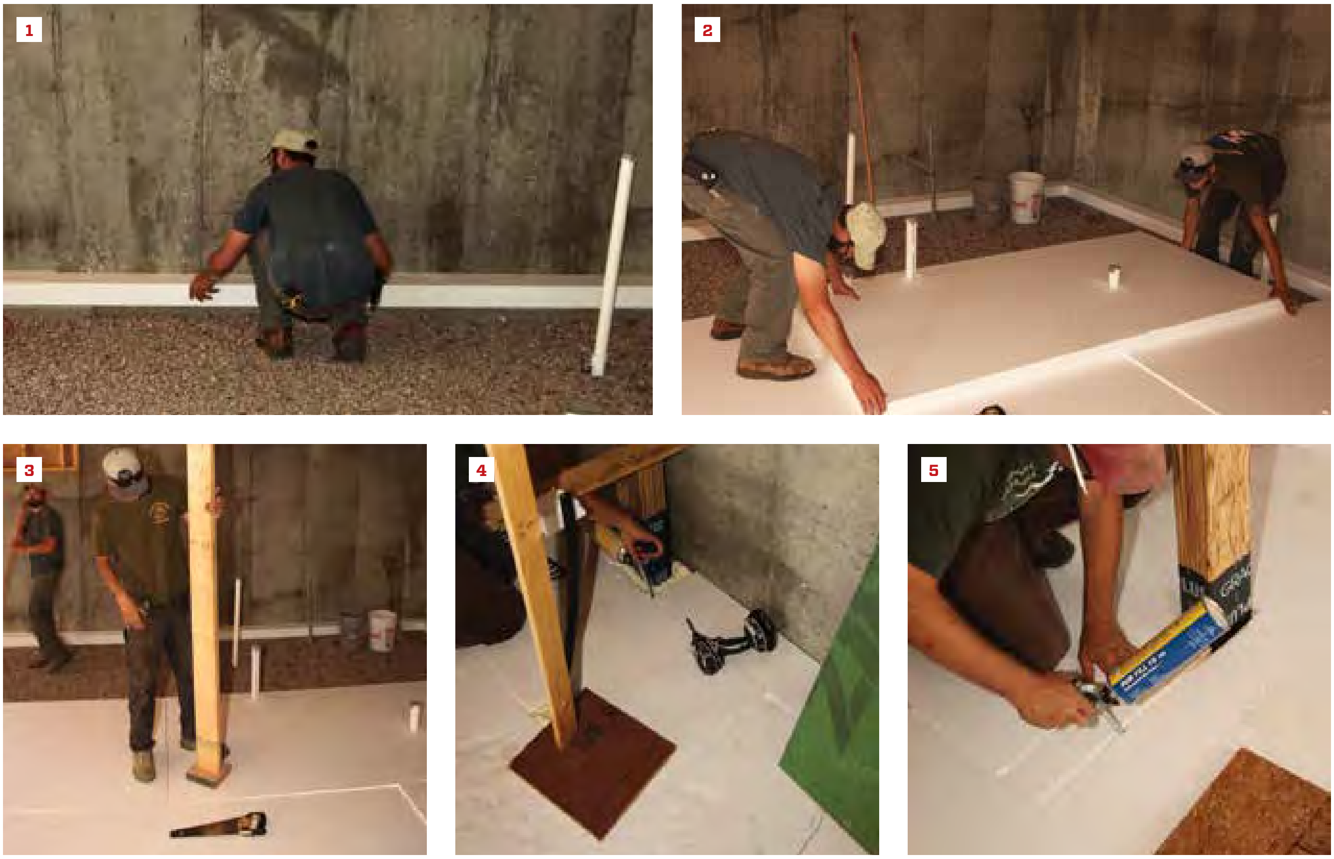
In the building industry, installing a basement slab is accepted as standard procedure. But in some projects, a slab can pose more challenges than benefits, especially in airtight homes. In fact, the only real advantage we could see was the thermal storage that a slab can provide. But a Passive House operates at such low heating and cooling loads that even that benefit would be negligible.

DESIGNING WITHOUT A SLAB

As our discussion continued, we speculated about what a basement floor system might look like if we eliminated the concrete slab. We realized that everything we would normally install below a slab would be essentially the same (see Floating a Basement Floor, above). We'd need the same stone base and perimeter drain, and we would install the same Type IX EPS foam insulation, which would satisfy our thermal requirements. And with a compressive rating of 25 psi, the rigid insulation would offer plenty of support for the wood flooring and the basement partitions.

The most important detail that would carry over from a sub-slab installation was the polyethylene vapor barrier that's installed over the insulation to control ground moisture and vapor movement. The polyethylene sheet would also provide the necessary air barrier for the building envelope.

For a subfloor, we decided on using two layers of 3/4-inch AdvanTech OSB layered in a staggered pattern to ensure that joints would not align between the layers. Basically we would create a 1 1/2-inch



Installing the insulation. After compacting and raking the stone base perfectly flat, the crew put down 4-inch-thick insulation on top of the perimeter footing **(1)**. To fit the sheets of insulation around the numerous plumbing pipes and support columns, their locations were plotted on the sheets and corresponding holes were cut out **(2)**. The level of the insulation was checked using a story pole and a laser level **(3)**. When all the insulation was in, low-expansion foam was injected in all the voids around the pipes and columns **(4)**. Blocks of insulation that had been removed for installing the sheets were foamed in as well **(5)**.

OSB "raft" that would float on top of the assembly and provide a structure for installing the hardwood floor.

STONE AND FOAM

We began by installing the perimeter drain and radon vent in a 6-inch-deep bed of 3/4-inch stone, all inside the concrete footing. Over this, we added a 2-inch layer of pea stone. The smaller stone was easier to rake and level out. After an initial raking, the stone was compacted and checked for the proper elevation using a preset laser level and a story pole with a wide base. The final level of the stone was 2 inches below the top of the footing.

The rigid EPS foam insulation came next, and we started by fitting the 4-inch pieces around the perimeter of the basement on top of the concrete footing **(1)**. We filled in the field of the basement floor with 6-inch EPS, staggering the ends of the 4-by-8-foot sheets to provide more uniform support for the layers of OSB.

There were two rows of columns in the basement that required some puzzle fitting of the EPS foam. We cut slots in the foam so that we could fit full sheets around the columns. We then cut rectangular plugs to fill in the slots, but left plenty of room to shoot in expanding foam. Straight cuts in the 6-inch foam (such as for the column slots) were done easily with a circular saw or reciprocating saw. For long rips, we cut the sheets on a table saw, flipping them to cut through from both sides. We made the rip cuts as precise as possible for tight joints between the sheets.

The finished basement would have two bathrooms, as well as a laundry room with a floor drain and a drain for the washing machine, so there were numerous plumbing pipes that we had to cut

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Polyethylene seals the system's base. Sheets of 4-mil polyethylene were stretched out on top of the insulation layer. The poly sheet is cross-laminated to be very resistant to puncture. The sheets were cut long enough to extend up the wall 6 inches at either end. After snapping a line on the foundation wall, the crew tacked the poly to the wall with small pieces of tape **(6)**. The sheets were carefully smoothed out and cut for each plumbing pipe **(7)**. A neoprene gasket with the appropriate size opening was fitted around each pipe **(8)** and taped to the surrounding sheet **(9)**.

around for the installation of the EPS foam **(2)**. One crew member worked ahead of the installers, taking measurements and plotting out the hole locations and sizes. Those coordinates were transferred to a sheet of foam and holes were cored out using the proper diameter hole saw. One of the tub-drain locations had not been finalized, so we simply cut out a large void (about 12 inches square) to be filled in later. One of the beauties of this system is that a hole like this can be easily filled and blended in with the rest of the system one layer at a time.

The holes were oversized slightly to provide room for the nozzle on the foam gun. The installers then fit the cored pieces into place. As each sheet of rigid insulation was installed, the elevation of the top of the foam was checked with the same laser level and story pole used before, with a second reference line for the foam **(3)**. Wherever there were spots where the top plane of a foam sheet didn't align with the rest of the floor, the crew lifted out the problem piece and tweaked the level of the pea stone below until the plane of the foam was perfect.

The final step to the foam layer was filling in any voids with low-expansion foam sealant **(4)**. To provide better access for the foam gun at the columns, we removed the filler blocks. After sealing around the columns, we slipped the blocks back into place and sprayed foam in around them **(5)**. To keep the expanding foam from lifting the blocks, we placed a wide scrap of OSB over each one and wedged a length of strapping against ceiling framing to hold the block in plane with the rest of the foam layer. After the expanding foam cured, we trimmed away the excess with a hand saw to complete the thermal layer of the assembly.

Taping the columns and seams. The bottom of each column had been wrapped with peel-and-stick membrane prior to the floor system being started. Once the poly was down, it was sealed to the columns using waterproof tape **(10)**. The crew laid out the poly sheets so the seams broke near the lines of columns wherever possible; as they taped the seams, the crew carefully unrolled the tape with the backing split to keep the roll centered on the seam **(11)**. Thoroughly rolling all the waterproof tape ensured maximum adhesion **(12)**.

POLYETHYLENE ORIGAMI

The next step in the assembly process was installing the polyethylene air/vapor barrier. This is the most crucial part of the assembly, so we paid attention to making it as close to perfect as possible. We did a quick sweep of the EPS to check for debris or sharp objects that could puncture or wear through the polyethylene. We snapped guidelines 6 inches up the foundation walls and unrolled lengths of the sheets long enough to extend up the walls to our snapped lines. The poly we used is called Tu-Tuf by Sto-Cote. It's only 4 mil thick, but it is cross-laminated, making it very puncture resistant.

We stretched out the poly over the EPS foam and carefully tacked an edge to the line on one side with a piece of tape every few feet **(6)**. Working from the snapped line ensured that the sheet would stay straight and square to the room. After tacking the sheet to the line, we carefully pushed it down against the corner between the foundation and the perimeter insulation. We slowly and deliberately worked our way across each sheet, smoothing and stretching it flat as we went.

Once again we had to deal with the plumbing pipes. We located and carefully cut each plumbing penetration, one by one, so that the poly lay perfectly flat around each one **(7)**. We fit each pipe with a neoprene flanged gasket sized for the pipe's diameter **(8)**. We then taped the gasket to the polyethylene using 3-M All-Weather Flashing Tape **(9)**. After taping each penetration, we went over the taped connection with a roller to ensure maximum adhesion.

We treated the structural posts much like the plumbing penetrations, minus the gasket **(10)**. The base of each column had been

The first layer of OSB goes in. When the poly sheet was completely installed and sealed, the crew snapped a line 54 inches from the back wall of the foundation **(13)**. The first course of subfloor sheets was then set on the snapped line **(14)**. Because the subsequent courses had to be driven together to engage the tongue-and-groove edges, solid backing was created by putting a 2x4 against the back of the first course and then screwing down scrap blocks that rested against the foundation **(15)**. The rest of the courses then went in, with the crew measuring carefully to maintain proper spacing between sheets **(16)**.

wrapped in Vycor, so after meticulously cutting the poly to fit around each column, we sealed the poly to the Vycor wrap with flashing tape. The flashing tape came with a split-paper backing, which facilitated installation at each column.

The polyethylene came in 9-foot widths, so we had to overlap successive pieces and tape those seams. We cut the strips of poly lengthwise so that the seams landed close to each line of columns. This minimized waste and made the cutting, fitting, and taping around the columns go much more quickly.

Taping the seam was a bit of an art form. The super-tacky tape had to unroll without wrinkles and with the center of the roll tracking over the seam. The quickest method was to split the backing over the seam while slowly unrolling the tape **(11)**. After the tape was stuck down, the seams were properly rolled, again to provide the best adhesion **(12)**.

FLOATING THE OSB FLOOR

Before installing the first layer of 3/4-inch AdvanTech, we snapped a chalk line 54 inches out from the back foundation wall **(13)**. Then we cut the sheets for the first course and set them in place with the groove edge on the line **(14)**.

Each sheet of AdvanTech is clearly labeled with the instruction that a 1/8-inch gap must be maintained along all edges, so we ripped a pile of 1/8-inch-thick strips to use as spacers between the end seams of the sheet. Maintaining the 1/8-inch gap along the sides requires the sheets to be driven together—albeit gently—to engage the T&G edges.

With the first layer "floating" and unattached to the layers below, we needed something to drive against. First we placed lengths of 2x4 in the gap between the edge of the sheets and the foundation. With the 2x4 touching the edge of the sheet, we

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Second layer locks the sheets together. The second layer of subflooring was installed perpendicular to the first in a pattern that maintained double overlapping seams **(17)**. This layer was screwed to the first with 1 1/4-inch screws that would not penetrate to the poly sheet below. Screws went in every 6 inches at the edges and every 12 inches in the field. When both layers were finished, the poly was secured to the wall with two rows of waterproof tape **(18)**. Partitions for the finished basement were installed with the plates screwed to OSB subfloor below **(19)**.

Photos 18 and 19 by Steve Demetrick

placed scraps of OSB against the foundation every couple of feet and screwed them to the 2x4 **(15)**. That gave us a solid edge to drive against.

For each successive course, we staggered the end seams much like we do when framing a first-floor deck. The crew meticulously measured and adjusted each sheet to maintain the proper gaps and alignment **(16)**. As with the previous layers, the sheets had to be cut to fit around the columns and the plumbing.

We ran the second layer of OSB perpendicular to the first layer and screwed it down with 1 1/4-inch screws. We positioned the sheets so they would overlap the seams on the first layer by at least 2 feet in both directions **(17)**. When the second layer was completed, we went back and double-taped the polyethylene permanently to the foundation wall **(18)**.

The floating OSB subfloor was completely solid with no give at all, and the basement partition walls went in easily **(19)**. We screwed the plates to the OSB with fasteners that would not penetrate through to the polyethylene barrier. All in all, the installation went pretty much as planned with no unforeseen challenges, and we came away assured that this type of basement-floor system would make sense for any kind of energy-conscious building. It was also cost-effective. Installing the AdvanTech cost a little more than pouring a slab, but was much less expensive than prepping for a finished hardwood floor over concrete.

Steve Baczek, of Reading, Mass., is an architect specializing in energy-efficient design and certified passive homes. stevenbaczekarchitect.com

Steve Demetrick is a residential builder and remodeling contractor in Wakefield, R.I.

Green Building Blog

Another Take on a Concrete-Free Slab

Northern Minnesota designer Randy Williams omitted the concrete under the floors in this new house–an interesting new trend among builders of green homes

By Kiley Jacques | February 3, 2020

Randy Williams of Willcon Inc. recently contacted me regarding a project he is wrapping up in northern Minnesota. I was intrigued because he has eliminated the concrete slab foundation altogether, which, given the material's carbon load, is a design decision I fully support. There were additional aspects of his approach that were equally interesting, including his use of cutting-edge products in a residential building market generally unfamiliar with them; his success building directly off insulated concrete forms (ICFs); and his choice of a plenum truss for running duct work. To inform his decisions, Williams had several conversations with Steve Baczek and Jake Bruton, both of whom are experienced in the science of the "slabless slab." Ultimately, in lieu of a slab-on-grade foundation, Williams used two layers of 2-in. Type IX EPS, a 6-mil. reinforced poly vapor retarder, and two layers of 3/4-in. AdvanTech subfloor.

In large part, Williams's approach was a response to the clients' desire for a heated floor. "I wanted a system that didn't need heat in the floor," he explains. "In our climate, the heat moves downward and warms the ground, not just the upper living spaces. The system I used creates a warm floor without having to incorporate a heat source."

Though similar to Michael Maines's frost-protected shallow foundation, Williams's approach starts with excavating down 5 ft. Additionally, Maines puts sleepers on top of the EPS foam, and his flooring extends to the exterior walls. Here the floor system butts up to the double bottom plate of the wall framing. "My concern with Maines's method was moisture," says Williams. "We couldn't build it fast enough to get it shelled in before the floor assembly would get wet. With two layers of AdvanTech, two layers of foam, and poly, we would have trapped in all of that moisture. So we built up the stem wall and had everything dried in by the time we set the floor."

Foundation and floor system

After excavating, Williams compacted the soil using both water and mechanical forces over a three-day period. Furthermore, the site sat for a month before construction got underway during which time several rainfalls aided compaction. Sand was the substrate of choice. Why not gravel? “We could have used all crushed rock but the sand compacts more tightly,” Williams notes, adding that it was unwashed and locally sourced. Footings for ICFs were poured and cured; and drainage was handled with corrugated pipe covered with gravel and a filter membrane.


INTELLO

On the interior, a layer of gravel was put down as part of the radon mitigation system, followed by sand topped with rock fines, one layer of 2-in. EPS foam, a layer of 6-mil. poly, the second layer of EPS, and two layers of AdvanTech glued and screwed with 2-in. square-head decking screws. A small gap was left around the perimeter to allow for expansion, and the vapor retarder is sealed to the bottom plate.

To achieve an 8-ft. finished ceiling, Williams combined a double-bottom plate with insulation over the ICF foundation. He explains that he went over the top plate with tape to connect to the ceiling air-barrier. "In this climate, we need something a little more closed than OSB for a vapor [retarder], so I chose Intello—its variable perm rating means it will open, if needed, and still get a decent air tightness value."

To protect against the possibility of a burst pipe, Williams added floor drains in the wet areas, which included the mechanical room with washer/dryer and water heater. There he laid a porcelain tile floor over Schluter-DITRA to waterproof the assembly; the edges of the Schluter membrane go up the wall. The same treatment was given to the master bathroom with one difference—he used a curbless shower so water will find its way to the shower drain. And in the kitchen, he added a floor drain beneath the refrigerator.