2016

What Does It Take to Build a High Performance Home?

CASE STUDY: BUILDING 1639 NW SCOTT HENRY PLACE IN BEND, OREGON

JIM GUILD, JIM GUILD CONSTRUCTION LLC

Why keep building homes in the same, tired way? Homes should not fall apart after a few decades; they should thrive for centuries. Homes should enhance our lives; they should be constructed with respect for our planet. Homes should embrace the latest technologies without sacrificing beautiful design.

At Jim Guild Construction, we strive to lead the way toward this manner of building.

"The main tenet of design thinking is empathy for the people you're trying to design for. Leadership is exactly the same thing - building empathy for the people that you're entrusted to help." ***David M. Kelley, managing partner IDEO & Stanford University Professor***

"Design is not just what it looks like and feels like. Design is how it works." ***Steve Jobs***

Top Quality, Ornate Work

- We start each building off with a square and level, strong foundation.
- Our work incorporates storm water drainage systems.
- Access to under-floor areas for insulation, heating/cooling, duct work, plumbing, ventilation of below-floor spaces (including slab work that may be incorporating radiant heating) is provided.
- This allows for any custom, creative framing that may be needed.
- It can possibly be used for thermal mass along with structural requirements that have architectural value.
- During the back-fill stage, we do several things below grade, on the exterior of core retaining walls:
    - We have a waterproofing membrane that is permanently adhered to cover surfaces that eliminate moisture leakage from exterior to interior surfaces.
    - We have perforated plastic pipe specifically fabricated to collect and reuse water that may seep down to the footing/stem wall joints around the exterior home footprint and eventually drain into our required stormwater catch basin.
    - All of our rain gutter downspouts are connected to this system and this moisture is also directed into our catch basins.
    - Our backfill is clean and specifically used to expedite quick drainage away from the home's foundation.
    - Our stormwater catch basins are required by the City of Bend. They are engineered for size based upon the footprint of the roof's square footage. The basins have to be located on each home's individual lot. They are designed to

capture then percolate this stormwater run-off through gravity, back to the existing water table.

- We designed our catch basins as architectural landscape features, serving two purposes at once:
    - For the catch basins at 1639 Scott Henry Place, we used the existing slope on this lot, which drops dramatically on the western edge. These catch basins are twice the required size, because of the grade change and how the excavation created a larger cavity than we needed.

Excavation Work

- We do excavation work that isn't just for excavation, but to retain important lot features (greenscapes, slopes, adjoining lot characteristics, and street and/or sub-division improvements that are in place or will eventually be).
- We salvage on-site rock features and products for re-use.

Rough Framing Materials We Do and Do Not Use

- I'm not a fan of OSB (oriented strand board) in spite of its lower price point. I don't believe these plywood products are as structurally sound as real plywood (especially when shear wall engineering is involved), and I think there is off-gassing of all the glue involved with its production.
- I don't like the weight of the products.
- I think chances of higher moisture content in OSB could lead to future mold and other dangerous air quality issues.
- I know that manufactured I-Beam framing materials are generally built with OSB.
- I know that "Edge Gold" subfloor plywood is OSB and believe this product is a superior subfloor product.
- Rough framing materials for wall framing, various roof framing, and decking is always KD DF and almost always number one or better grade, which we always hope is sustainably harvested (I can't verify this for all framing products).
- KD (Kiln-Dried) is now required by building codes (18% or less moisture content).
- I do value the use of wood chips in moisture manufactured OSB, I-Beam materials, and structural timbers, and I like to use certain manufactured wood products for their superior structural value in the framing phase of home building.
- We use galvanized ring shank nails with our nail guns.
- We use a lot of screws and GRKs (structural, heavy duty impact driven), along with nails.
- We always nail all shear walls horizontally, which includes the required nailing schedules at the correct depth and with all required blocking. I believe this shear pattern is stronger and allows for a more consistent shear wall for multiple floors and for connecting to our foundations. This is also the beginning phase of limiting (if not eliminating) exterior air infiltration.
- It also tends to flatten out the exterior/interior planes of wall and roof lines, which makes siding and roofing product installation more consistent.

*A note concerning probable code changes for structural shear walls (I think this will happen sometime soon): California has required for the last 20+ years that any vertical shear wall connections over four feet high have to be four inches thick instead of two inches thick, because of the loss of structural integrity of those vertical members (pieces splitting apart because of too many nails). This will add some cost to materials, but I think what is more significant is the lower insulation efficiency (because of thermal bridging and twice the thickness of framing member) in the wall cavities. This will happen every four feet on the center of the framing wall.

- We make a major effort to keep all of our framing materials dry and under tarps. This is also so that the wood doesn't get baked by the hot sun.
- I try to order framing material (2' x 6', 2' x 8', 2' x 12') in long lengths (16', 18', 20'). I believe that longer lengths are a better quality of dimensional wood (not necessarily in 2' x 4's though).

- I try to order these sizes in close to full units (how framing materials are brought to the lumber yards), which tends to keep long lengths in better shape.
- If we have 9' walls, I'll get 18' lengths. If we have 9' and 10' walls, I'll get 20' lengths.
- I generally use the same header thickness and lengths (3 ½ x 7 ¼ or 3 ½ by 5 ½), which lets me order long lengths of this material as well.

*One thing that happens with this type of material ordering is that our lumber supplier (Miller Lumber) is happy to deliver wood this way because it is easier and less expensive for them. Wood prices are not based upon what lengths you buy, but on B' prices. It's faster for them to load material on their trucks. I can off-load these large pieces with our heavy equipment (forklift), not by hand, and can stage these loads where we want. If by chance I need to return wood, larger pieces are easier for Miller Lumber to accept.

Exterior Wood Product Details

- Fascia, barge board, deck framing materials (including ledgers and joists), soffit materials:
    - A lot of paint grade 2x, 5/4, 4/4 trim is made up of finger-jointed, moisture tolerant wood species including cedar, cypress, and/or some types of pine species. With a rough sawn (RS) surface and a primer, these products simulate a real cedar look.
    - We are fabricating our own tongue and groove exterior paneling, with an assortment of detail patterns (V-groove, fine-line, bead-board).

*I find poplar (from East coast timber stands) to be an exceptional exterior paneling product: knot free, long lengths (14' and 16' lengths are common). Poplar is extremely stable, easy to straight-line, takes router edging well, sands great, doesn't split, and paints well.

*On 1639 Scott Henry, we used a great batch of redwood that I procured several years ago that had been milled years ago and stored away in a warehouse. For the redwood, we used Penofin's oil exterior finish for redwood. It allows the wood to age beautifully and brings spectacular color and tone out.

*Notes on the above-mentioned details:

- We spend a lot of time preparing for the various stages. I don't like having to overlap each sub-contractor stage as this lets one group complete their phase (which is more efficient and helps minimize mistakes and oversights), clean up their job space, and move whatever materials are not needed out of the way.
- When framing begins, the various phases of construction are replicated, from cutting, assembling, shearing, standing, rolling floor joists, to cutting and assembling roofing systems with minimal pick-up framing ever needed.
- We also purchased a truckload of large boulders that, with the temporary access road we had built on lot #6, we were able to set in place around our storm drain swales. This

feature has become a prominent landscape detail that is easily seen from all three decks that look out on it.

- All our gutter downspouts are plumbed to the buried drain pipes and all the moisture that lands on our roof system is easily collected and diverted to these required basins. The City of Bend now requires that framing materials cannot exceed 18% moisture content (below 18% is considered kiln dried by industry standards). This has come about because of shrinkage issues with "green wood," which includes drywall warping, mold, and general sloppy wood connections that occur with wood shrinkage and cause structurally engineered shear connections to not work correctly.
- Because of moisture content requirements, it is important to get a home framed, sheared, and roof-sheeted as quickly as possible. Getting our framing "dried in" is as important as any other phase while building.
- One thing that is always a problem is water sitting and pooling on our sub-floor material. It is important to squeegee this rainfall and/or snow accumulation off our plywood decking as soon and as much as is possible.
- I make every effort to keep all our framing materials covered with tarps until they're installed. This is why I keep our job sites extremely organized and orderly. Everything is thoughtfully planned out regarding the order of construction, the delivery of materials, and the ease of accessing these products by our framing crew.

Concrete Notes for 1639 Scott Henry Place

- We have a major retaining wall feature because of space restrictions of the lot and the house footprint. This added approximately $15k to $20k to the cost.
- The front and side concrete sidewall is to allow easy access to the south and west portions of the lot (including the large storage space that is under the house). This sidewalk has radiant heat to deal with snowfall, which added approximately $8k
- The garage is an expensive feature of this home because there are sections of the home built underneath it. The concrete floor is suspended by a metal framing product used primarily in commercial builds. Because of this added cost, and the way we always detail our garages similarly to the rest of the home (the window and door casing, drywall finish and paint), the 306 square foot cost of the garage and the 140 square feet added space under the garage floor where we have solar equipment and storage; this 446 square feet should be added to the home square footage of 2105, which totals 2551.
- On Google maps, which we viewed at Brooks Resources on 1/15/2016, it shows the retaining walls we were required to build. The image is a great view of this very expensive feature.

Framing Details

- We meet framing details that are way above code. One of our building inspectors made the comment that building codes are the minimum requirements that builders need to meet to pass state building codes. Oregon does have seismic and shear requirements that have come into line with the long-standing code requirements of both California and Washington State within the last five to ten years.
    - We have 8" exterior walls with 2 x 6 studs, 16" on center with ½" shear plywood.
    - For framing, we have double top-plate framing walls, single bottom plates with interior 2 x 4 studs, staggered to the exterior 2 x 6 studs.

*Notes about staggered stud framing:

- We use what is called "thermal bridging" with our plates, which means that the exterior and interior spaces are in direct contact to each other with the wood plate.
- The "thermal break" we have utilized means the studs do not touch the interior and exterior spaces.
- The framing for our exterior windows and doors is what we call a "buck system," where the rough framing for these openings contacts both exterior and interior spaces. This assures a solid connection to keep these openings square, plumb, and consistent with the 2" x 8' wall thickness.
- With Earth Advantage calculations, these thermal bridges are mitigated with the added wall thickness as well as the blown-in fiberglass insulation system we used. We knew before we started that with our system we used Earth Advantage standards. With the exterior framing, we achieved R-30 with blown-in insulation.

Roof Framing Details

- We wanted to achieve an R-50 insulation in our roof system, which meant we needed a 13" depth framing.
- Our plans had called our TJIs (*see end of document for links to further documentation on TrusJoist products), which are expensive and time-consuming to build, for what we refer to as a "cut" roof as opposed to a "truss" roof. With three major hips that are part of the roof framing, the T6Is require a difficult connection with metal hangers. We also had to deal with a complex venting system with our vaulted ceilings, so using real 2" x 12' long fir framing lumber was a much better product to use. It also required carpenters who knew how to construct a roof system in the more traditional framing style.
- Vented roof systems that are insulated are required by city code. Between my insulation contractors, my roofing contractors, and myself, we developed the ventilation design that incorporates convection to bring fresh air from exterior vents (that are part of our roof soffit system), along the underside of the roof sheathing, and then out at our roof hips and ridges with a roof venting product known to work with metal roofing. This eliminates the possibility of mold and rot in this section where moisture, heat, cold, and humidity have to be dealt with.

- Eave overlaps (gable-end, rafter tails, porch roof systems included) are enclosed with a poplar wood tongue and paneling we fabricated at our shop. We are able to prime and pre-finish this wood product before installation, saving a considerable amount of time and money, especially with the height of those overhangs on the steep lot.
- We were given an R-49 insulation value by Earth Advantage
- The 5/8" plywood sheathing for the roof is more expensive for the product, but less expensive to install than OSB. I also am always worried about this glue-based OSB product that has such close proximity to moisture, heat and cold temperature changes that might damage its structural integrity.

Window, Door, and Siding Weatherproofing Details

- Bend city codes (which are based upon the state-mandated Uniform Building Code Standards) require weather, water, and air protections to minimize or eliminate pollution into our home's interior space.
- For the house wrap, we use Tyvek, with a vertical texturing that, if moisture actually gets behind your exterior siding, lets gravity pull the moisture down toward the ground. That is taped at its laps with a special tape product.
- Door and window flashing is a specific product that is reasonably simple to install and replicate (we use a DuPont product).
- We are using a product made of hard plastic that is installed at the time of prepping the window and door openings. This pan is simple to install, and it is virtually impossible for any moisture that somehow gets past the flashing membrane to reach the interior space with these pans underneath the window and doors. Frankly, this pan should be a code requirement.
- We flash our windows and doors slightly different from most builders. Our stucco siding contractor has to have doors and windows flashed in a very specific way in order to meet his stucco product warranties. We've decided to flash all of our openings the same way whether we have stucco, metal, or wood siding. The added cost is minimal and we keep our continuity in installation throughout the home.

Window and Exterior Door Products

We used exterior, metal-clad wood window and patio doors made by Weathershield with an average U-value of .28. We ordered 4 9/16" paint-grade jambs with these windows, for cost-savings. We knew we would have jamb extensions for these windows, but we weren't sure what species of wood trim we were going to use at the time of this order.

- This product is less expensive than a stain-grade interior product. The metal-clad exteriors of these windows is a tried and true product for our temperature extremes and changes in Central Oregon, and should always be a standard product for this quality of house.
- Our entry door is made of the same wood species as our internal doors and interior window and door casing and jamb extensions (white oak, "riff" cut).

- Our garage door is an insulated door product with a laminate exterior that simulates a stained cedar.

Exterior Siding and Trim Products

- We have three different exterior products, each chosen for specific reasons:
    - Durability and longevity
    - Impact on environment
    - Renewable product
    - Complementary to each other product, including color and texture
- Other than the redwood siding, there should be no maintenance required on either metal or stucco siding and no re-painting.
- 2" x 10' cedar fascia and barge boards help connect to metal roofing, metal siding, or redwood siding, with color, tones, and texture.

Metal Roofing

- We use metal roofing which works with our solar array. The array is mounted on a metal racking system and bolted to our metal roofing rather than having to penetrate a composition roofing material. We chose metal roofing for five reasons:
    1. Recycled material (steel)
    2. Contemporary design
    3. Color complementary to metal siding
    4. Venting system for our roof ventilation works well with metal flashing
    5. Long lasting product that deals well with both heat and snow

Exterior Decks and Railing

- These have a steel super structure for an industrial look and simplicity of installation.
- We replicated a steel post and header for the front entry roof as well, to keep an industrial look.
- We used "Trex" plastic decking for four reasons:
    1. Recycled product (a blend of 95% recycled wood reclaimed from factory waste and plastic film)
    2. Long lasting, no maintenance product
    3. Dark tone works with the rest of the color pallet
    4. The underside of this decking is visible on two of these decks, eliminating any painting
- We've found that with the dark tone, snow melts considerably faster and makes snow removal simpler.
- Deck railings are all metal.
    - Eliminates maintenance of wood rails, which takes a lot of effort
    - Powder coating of metal railing matches steel super structure
    - The light and simple design of the railing and caps is extremely important to the overall appearance of the home

    - The front railings are the same and for the same reasons
- Deck stairs
    - Metal stair framing keeps the continuity of the three decks and was reasonably simple to build and install
    - This stair system allows us to help step this home down the extreme grade change from the top floor to the middle floor, to the bottom floor and then down to the natural grade of this lot

Solar Array

- We have a 5.13 KW solar array with Solar World 285w panels.
- To get the state and federal tax credits, the solar array has to be 75% efficient, which is calculated by our solar company before design work starts.
- We have the array where it is because of this requirement, but the placement is also to meet my desire to have the array fit handsomely with the roof line of our home, with the mounting system perpendicular to our ribbed roofing material, allowing an extremely clean and strong connection.
- With the creation of a storage space underneath the garage floor, we have a very convenient, isolated space for the battery back-up system and the inverter machinery that the solar system utilizes.

Interior Products and Process

- Insulation:
    - We ended up with R-30 exterior wall systems, R-49 roof systems, R-60 flat roof systems, and R-25 floor systems.
    - We always insulate all our interior wall systems, partly for noise reduction and partly to increase overall insulation quality.
- Heating and Cooling
    - We installed a 98% efficient, gas-fired, forced air heating system with both fresh air intake and exhaust systems mechanically controlled.
    - Our ducting system is flex ducting that is insulated, with the majority being under our floor systems.
    - The crawl space has an electronic ventilation system, and our structural pony walls that support the lower and middle floors are all insulated.
    - The return air ducting system is in both the interior wall framing and under this insulated crawl space.
    - An air conditioner is located on the north side of the house where the majority of my utility panels and venting systems are located.
    - Plumbing and electrical details are part of the whole energy efficient home design, and in order to reach Earth Advantage Platinum status, mechanical, electrical, and plumbing layouts all need to be coordinated to minimize exterior wall penetrations and heat loss because of thoughtless venting and drafting systems.

- Mechanical Room Details
    - The room is essentially a subterranean space with two walls that are 4’ to 8’ below surface grade.
    - It is centrally located, allowing the plenum and the return air ducting to be a reasonably short distance from the forced air heating unit.
    - We have an on-demand, gas-powered water heater here for the same reason as the heating system.
    - Our mechanical machinery for the tri-level residential elevator is located here, right next to the elevator shaft, making this system extremely convenient.
- Drywall Features
    - We used 5/8” drywall throughout the home, which allows for a flatter, cleaner drywall installation. Lightweight, but structurally sound, 5/8” is a great upgrade that doesn’t add much expense.
    - We selected a clean, simple hand-texture finish for our drywall, which fits well with our contemporary design features.
    - This drywall finish really requires top-notch framing as flaws in framing are easily seen with this particular finish.
- Painting
    - We wanted to have as little “dippling” (small bumps of paint that occur when back-rolling the sprayed-on paint) as possible, which meant the painter had to prime and final coat the drywall as lightly and yet as thoroughly as possible.

The Residential Elevator

- The home needed to have doors on both sides of the elevator in order to reach all three home levels easily.
- We decided on a hydraulic system instead of a chain-driven system (which is somewhat more economical) for the quiet, the smoothness, and the upgrade.
- Since our subdivision has such substantial grades on so many lots, we want homeowners to at least think about having their home elevator-ready. This entails having the elevator shaft built to work with a specific elevator type, but not necessarily a specific brand. Residential elevator companies are realizing it isn’t that difficult to build their elevators to fit in their competitor’s shaft sizing. This will also probably bring a little competition among the residential elevator proposals.
- With a shaft in place, and residential doors required to enter the shaft, I would recommend using this vertical space for a closet until a client is ready to install their elevator. It would be relatively simple to install a floor system that is attached with screws and, when it’s time, just disassemble the floor system.
- The assembly of the residential elevator is essentially bolting parts together, including the lift system, the actual elevator car, the electrical hydraulic wiring, and the hosing.
- Our elevator will accommodate a wheelchair as well.

Painting and Staining

- The primer and top coat paint are low VOC primer and no VOC wall/ceiling paint.
- The stain and finish-coat products for all of the cabinets, casing, base board, interior doors, door and window jambs, and closet shelving are no VOC.

Interior Cabinets, All Windows and Doors, Woodwork, Doors, and Shelving: Designs and Details

- Cabinets designed and built "in-house"
    - The cabinets are custom, using NAUF (No Added Urea Formaldehyde) plywood with a white oak "riff" cut veneer — these sheets cost approximately $185/sheet. The NAUF label means there is no formaldehyde used in the plywood lamination. Formaldehyde is a proven deadly carcinogenic product that we refuse to bring into our homes.
    - We chose the wood, species, and type of sawing because we had selected Lynden doors, made in Tacoma, Washington, for our interior doors and their product was the white oak riff cut. They're from the Northwest, which we liked.
    - We chose the frameless, clean look of edge-taped plywood doors, cabinet boxes, and drawers for the contemporary style we feature in this home.
    - Shelving and cabinet boxes are made with pre-finished white maple plywood, not the typical melamine paneling, which is actually deadly particleboard.
    - We featured an extraordinary number of drawers instead of the more standard shelving style of most lower or base cabinets.
    - All of our window jamb extensions, door and window casing, and base is white oak riff cut. This wood product is grown mainly in the Northeast and we buy our material as what is referred to as "rough-sawn." The material, for the most part, is straight edged and slightly planed by our wholesale wood distributor before we bring it to our shop. We continue customizing this material to the various lengths, thicknesses, and widths that make up our trim package. We sand our material and put different router edges on our pieces at our shop, which saves a dramatic amount of time.
    - Another reason I supply all our casing, jamb extensions, base, and other wood products for our "finish" phase is the continuity in quality as well as having the right amount of product. In stain finish projects, the most frustrating part for a carpenter is to not have enough material, or to have to use an inferior piece of wood and hide it inside a closet. For example, in our case, where the grain is visible through our finishes, we can "grain match" material.
    - Interior doors are Linden doors.
        - They are a flat-panel laminated white oak riff cut product that is CARB (California Air Resources Board) compliant.
        - I opted for an upgrade on the core, which causes the veneer to stay consistently flatter and smoother.
        - They are solid core doors which are considerably heavier and less prone to warping.

        - The wood jambs are clear vertical grain (CVG) hemlock firs, which I use whether the jamb will be painted or stained. It is a superior product and worth the added cost.
    - We used Emtek door hardware with a lever handle with a brushed nickel finish.
    - We build all our closet packages at our shop, and our shelving is all adjustable, using the Hafele brand hardware. It is a signature feature of ours for custom-built shelving. We use ¾", pre-finished white maple veneered plywood and it makes the cost of this interior painting much more economical.

Flooring

- We used only two products for our flooring: ceramic tile and pre-finished cork laminated flooring. The cork flooring was chosen for four specific reasons:
    1. Renewable resource
    2. Simple installation, includes no noxious finishes
    3. Sound and comfort
    4. Color palette
- The tile flooring is from Italy, and has repeatedly been mistaken for wooden plank flooring. The durability, the ease of installation, the color and texture, and the timeline of having this flooring in place before we do our finish work, all make tile a great product for this house.
- We were able to install both tile and cork flooring before we installed door casing, which sped up both installations tremendously.

Countertops, Backsplashes, and Countertop Fabrication

- We chose "Eco Crush," a locally developed and made recycled glass and concrete composite product that is extremely durable and has a hardness comparable to granite or marble.
- We chose to use a simple but higher-end tile backsplash instead of the same "Eco Crush" product that could have been fabricated and installed by our fabricators.
- We used the same fabricators who do our natural stone countertops because they are very good at templating our countertop (replicating our various cabinet countertop slopes), in cutting out our sink and valve openings for under-counter mounting and matching our countertop product seams (grain-matching as we do with our natural wood products). They also are excellent in finishing our countertop edges, including smooth finish openings and countertop front edges.

Plumbing Fixtures

- Bathtubs, water closets (toilets), sinks are Kohler, Toto, and Emkay brands.
- Valves are Hansgrohe, Grohe, or Elkay.

Appliances

- Refrigerator: Fisher & Paykel

- Dual-fuel oven/cooktop: Miele
- Dishwasher: Miele
- Microwave: Kitchen Aid
- Kitchen overhead vent: Faber
- Washer/Dryer: Electrolux

Electrical Fixtures and Notes

- Elan and Kichler fixtures are among several brands.
- We continue to install CAT 5 cable wiring for phone/internet outlets, as it is superior for wireless communication systems.
- The home features completely LED lighting, both in the interior and on the exterior.
- We have what is called a "critical load panel," which is powered by the battery back-up system that is part of our solar array. This panel is activated if and when our electrical grid stops functioning, and it provides electrical power to critical locations (kitchen, mechanical, bathrooms, garage door, etc.) for up to three days.
- We installed a PV charging outlet for electric vehicles in the garage.

Gas Fireplace

- More aesthetic than practical, we have a gas fireplace in the living room that actually puts out radiant heat (some don't).

Under Floor Space

- We ended up with a large storage space under the master bedroom, which has an access door from the exterior.
- It is an unconditioned area, but with the ducting for the home here, and the insulated walls, this is an extremely effective storage space.

*For further reading:
http://www.woodbywy.com/document/TJ-9000/
http://www.woodbywy.com/document/tj-4000/
http://www.trex.com/products/decking/