Design Phase 3

NOTE: MARBLE 1 = MARBLE 2

SCALE: 4'-0" / 2'-0"

MARBLE 1 = MARBLE 2

NORTH

GREAT VANITY TOP (MARBLE 2)

GREAT VANITY TOP (MARBLE 2)

TUB (CLASSIC) (MARBLE 1)

SHOWER PAN (MARBLE 1)

SHOWER WALL 2 (MARBLE 2)

LEVEL 1 (MARBLE)

6'-0" = 1'-0"
The solution for this project is to build it. The joke in our studio was that we were just building a model...but the scale was one inch equals one inch. And through building we learn about the way we design and how that works in the built environment. Despite our inexperience, with a few exceptions of students who had done construction for summer jobs, we jumped in, eager to try everything (except for that shoveling.)

Our "model building" began in October, but with demolition and clean-up. We spent a week or two cleaning out the barn. There were still four sheep living in the lower level, along with several feet of compacted sheep droppings on top of the existing concrete floor. It was so hard that we used a jackhammer and a pick to break up the layers. Once we had reached the bottom, the concrete had to be broken up and removed because the new floor needed to be at a lower elevation plus having a new smooth surface.

Once the barn had been cleaned out, we began removing siding. Originally we thought that we would be able to reuse the siding, but broke and splintered in the removal. When the siding was removed, it was time to remove the floor boards and level the floor. There was a considerable elevation change, so it was decided put in
new floor joists, and the old black walnut floor joists were removed later and planed done for other uses. The decking was then layed and glued and nailed in place.

Several layers of roofing material had to be removed. Because of the high ceiling we had to construct part of the second level and some temporary scaffolding in order to work on the roof. The rafters were in good condition, although a bit uneven, but not enought to necessitate a new structure. Extensions were added to the end of the roof rafters to have a longer eave. Care was taken to remove all of the old handmade square nails before the new roof decking was placed. Exterior wall framing was beginning at this time. Wall frames were to on the outside of the post and beam structure, like a skin. Earlier in our material research we had seriously considered using stress skin panels because of their high insulation value and the time that would be saved, but the cost was much higher than the standard stick built wall system.

As walls were being framed in, there were many meetings to decide on the window arrangements, standing right in the space. It was great to be placing the windows exactly where they should be
according to the inside viewer. Some interior walls were also being built because they were needed structurally to support parts of the second level. The reading loft floor on the second level was constructed before the kitchen walls went in, therefore a column had to be placed temporarily. Later a special column housing shelves, cabinets and a appliance garage replaced it. In several cases, as in the kitchen the final plans had not been developed, and walls were not built until later.

The autumn days were kind to us, and so were able to postpone enclosing the barn. But as the days got colder more of the polystyrene insulation covered the walls. But it wasn't until January that the barn was entirely enclosed. Brrrr. Because winter was approaching, it was more essential to get the roof shingled. A metal roof was suggested, but again it was cheaper to use asphalt shingles, and the lifetime of the metal did not last any longer. The shingle chosen was an imitation shaker shingle. Only have of the roof was shingled before Christmas break, and then the snow struck, but the roof was covered with the felt. Shingling was finished in January on a couple of warm days once the snow had melted.

Once the ground had thawed, Larry, the excavator came to dig out along the east
wall. New walls and a drainage tile needed to be put in before it could be filled and excavated for the driveway. While excavation was going on outside, inside we were finishing interior walls and beginning to put in the batte insulation. But at this point, the lower level walls had not been built, and it was necessary to block off the winter garden/stair opening.

The stair from the main level to the second level was finally constructed around February. It was decided that the old walnut floor joist would be used for the stringer and treads. The landings were joined by pegs in the spirit of the past joinery. When the stairs were completed it finally started to feel like a real house.

A window schedule was compiled and a quest was made to Amish country to order windows and look at kitchen cabinetry. Closets and bathrooms were framed in and then the electrical work began. Tony Shideler is licensed to install the wiring and he had a few students helping him drill through studs an run wiring. Outside, the first concrete pour on the east side was being done. I've learned never to underestimate the force that wet concrete has, after several blowouts in the formwork. The drainage tile was put in, emptying into the pond. After the east wall was sealed, insulated, and backfilled
excavation in the basement began. Tony hired an Amish man with a bobcat to excavate the basement. It was done in two days, but it had been dug too deep, so we spent a day filling in the basement floor with bricks (rubble from the old house). But before the slab preparation began, the second concrete pour for the column footings was done. The beams had to be jacked up and the stone footing removed. A deeper footing was dug and the formwork was built. After the bricks, the vapor barrier and pea gravel went in and was leveled and sloped in the garge for drainage. The water line and sewer lines were layed out in the basement floor. Then on an early Friday morning, John and Mark Kemble came to help us pour and finish the concrete slab. It went rather smoothly thanks to the Kemble brothers.

Inside we began to finish exterior walls by putting up the vapor barrier and then cleaning and spraying the walnut timbers with Timbor, an insecticide. Most of the electrical work was done at this point, but plumbing and HVAC had yet to be purchased and installed. To date, the plumbing has only be roughed in and the HVAC has been purchased.

As exterior walls were being finished, carsiding was being put up on the angled
ceilings. This task was quite tedious and sometimes difficult because of the length of the ceiling, the unsquare corners, and just the sheer volume. The staircase from the main level down to the basement was the other wood construction underway. After a few heated discussions among studio members, the second stair design was chosen by Tony. It seemed to be a compromise between what two different groups wanted. It was constructed also with the walnut joists.

In preparation for the vertical metal siding, furring strips were put up over the polystyrene insulation, and windows opening were cut out. Finally, after a seven week wait, the windows finally arrived. That was a really exciting day. We did run into a problem, though, because windows were not designed to have a 2-inch insulation and 3/4-inch furring strip thickness on the outside of the wall. The furring strips had to be removed from around the windows. The windows were that next step in making the barn really look like a house. We did not get jamb extensions though and so the windows could not be entirely finished. Some of the doors also arrived, although some of them were not what the studio had envisioned.
The last part of construction that our studio was able to do was the drywall, although we were unable to finish sections by windows (no jamb extensions) and plumbing walls (not finished or inspected.) But the drywall that is up goes a long way to making the rooms look like rooms. And our last day of work was spent cleaning up, again.

I'm sure I have missed a few of the steps in between the cleaning sessions, but it was five months of construction, after all.
Design Solution
As I come to the end of this project I am filled with so many different feelings. Because we did not complete the drywall and finish work, I feel a bit sad that we will not get to see the house completed. And in my mind there is a tiny twinge of feeling that we failed, because it was our goal to complete the house. But it was also our goal to experience real life with all of the real life setbacks and cancellations and back orders. If I look at pictures from the first day to where we are today, it is pretty incredible. The frustration comes from saying "what if's" and wishing it was done!

I loved the idea of the project, but I can't say that I loved working on it. In discussions with other Barnitects, I have come to the conclusion that I didn't have enough ownership of the project to be able to love it. There was always the frustration that even though there were always great suggestions made to the client about details, colors or materials, it didn't really matter how much effort was put into it, it probably wouldn't get done that way. But that too is real life, and so that is part of the education, hard though it may be.

Educationally speaking, there is no other way I would have learned about so many different things in one project. Not even counting actual construction, which is really just a small part of it, I learned so much about project management and people and communication.

In our project, I would say that our biggest failure was our lack of communication between everyone, peers and clients. It doesn't matter how big or small a project may be, it's failure or success will always depend on communication. If I were to make suggestions for future studios in design-build, I would recommend that they use the model of our design development: individual, small group and group charette phases. I would emphasize that there cannot be too much communication, and that weekly meetings are imperative, both with and without the client. An updated schedule would be helpful for trying to finish within a certain amount of time,
because it lets everyone know what has to be done and eliminates wasted time. I would also recommend a rotation of working groups every once and awhile, although sometimes this happens more naturally than other times. And for this size group of people, I really would urge the entire group to do things together in a social setting outside of studio because it relieves some of the tension that builds during the weekdays...it humanizes everyone and develops a team attitude. And lastly, I would encourage anyone to try design-build who has any desire to create, touch, learn and experience the manifestation of an idea.

I thought that this length of a project might kill my desire to build after we were done, but it has not, in actuality, it has made me want to build for myself. I really look forward to doing some more detailed carpentry, because I am no longer intimidated by the tools and materials. It only takes imagination, thought and expression to bring something to life.
October 28, 1994

Mr. and Mrs. Anthony Shideler
Albany, IN

Dear Tony and Suzanne,

We have completed the preliminary material take-off and costing phase of work on your new house project and feel very positive about the results. While numerous issues of substitution and supplier negotiation are still ahead of us, what we present to you here is essentially a worst-case scenario. Most prices have been calculated at retail and some quantity estimates were made deliberately high. While shortfalls and omissions are a part of any project, I believe the total contains sufficient contingency to account for such additional costs. The basic house has been calculated with quality materials but there may naturally be areas where you wish to add additional budget to include certain luxury or specialty items.

There are a number of issues you will want to consider which I'll attempt to summarize below.

**Costs.** Attached are spreadsheets of building materials and costs which we will review with you at our meeting. The two-page summary outline of specifications may help you better follow what was actually priced. There are, of course, a number of final selections to be made by you in specialty areas, but we have tried to list options whenever possible. Please feel free to contact me with any questions.

**Liability.** As I mentioned on the phone, Larry Cistrelli, who deals with insurance and risk management for Ball State sees no problem with the project as students work within the design studio course. His letter to me on the subject is attached. Medical insurance, if needed, will be decided directly with you.

**Tools and equipment.** In general, we will supply all basic hand and hand-held power tools and building equipment. Some specialty equipment, like scaffolding, we should be able to borrow at no cost, while other pieces may have to be rented for short periods. I am assuming that these costs will also fall within your budget unless you decide otherwise. For example, if we mill the casework and base ourselves to save on the enormous cost of these materials, we would expect that special cutter blades and/or a router would be provided by you. Even equipment like a small backhoe I may be able to borrow at no cost to do the simple foundation and septic excavations. These decisions we would make together, but always with an eye on total costs. I would ask you to consider allowing us the use of your existing travel trailer on site for some time during the winter for water, toilet, and possible phone and computer set-up.

**Subcontractors.** To date we are assuming most phases of construction would be completed by us, with the following exceptions:

- electrical connections to meter base and wiring of breaker box (by Tony)
- removal of existing roof material (Al Tuscano?)
- construction of new roof (Al Tuscano said with a couple of helpers, a conventional roof could be completed in a weekend)
Some important issues to be addressed are sustainability, new technologies for building materials, and what makes a house a "home." Other important issues would be dealing with a real budget, real clients, real materials and construction and realistically taking a project to completion. Preparing the knowledge of what it takes to accomplish each phase.

The main theme of either project would be to push the invisible limits of mid-western housing in terms of design and technology. In either project it would be taken in combination, including research, design development, construction drawings, mechanical and structural
research as well as completing mock-ups and the actual one site work. It would also include obtaining building permits, doing cost analyses, computing energy consumption and obtaining building permits. Doing cost analyses, computing energy consumption and obtaining building permits, doing cost analyses, computing energy consumption and obtaining building permits.

The McNiece house would be located in a local neighborhood, while the McNiece house in Muncie, or a home renovated to a home in Albany, Indiana, income house in Muncie, or a home renovated to a home in Albany, Indiana. And the McNiece area. Depending on approval, the project will either be a low-income family residence in Muncie, Indiana, or a low-income family residence.

2. 4000 sq. ft., Land size, over 2 acres

SIZE: 2. 2000 sq. ft., Land size, one quarter acre

LOCATION: 1. Muncie, Indiana, Funded by a Lilly Endowment

BUILDING TYPE: Single-family residential (possibly a low-income home)

PROPOSED PROJECT: The Exploration of Technology, Design and

Budget Realized Through Design/Build

NAME: Sarah Marshall

August 30, 1994

Preface: San Mendelson

and Thesis Preparation

Facilities Programming

ARCH 452
2) The users will be a family of four or five, they will also be the clients in the case of the Albany barn. Additional clients of the Muncie Home Ownership Foundation, funded by a Lily endowment, will be involved in the Muncie home. The communities for either home will be a small to medium-sized Midwestern town.

3) The purpose of doing design/build is to fulfill a desire and need for hands on experience in construction; closing the gap between the architect and the builder. I feel that the architect has a bigger responsibility than is taught in school and I desire to include the idea of the master architect/builder in my education. My goal is to travel through an entire project, experiencing as many phases as possible, increasing my knowledge of how plumbing, HVAC, electricity, structure, roofing, drainage, finishes, etc. really work.

4) My interest in building developed out of frustration due to my lack of understanding about how all the components of architecture fit together, but my pursuit of design/build began with a fourth-year studio taught by professors of the Yestermorrow School of Design. I was hooked after that; the sense of understanding and accomplishment was unlike projects presented on boards to a jury.

5) Along with design/build, I would like to emphasize the inclusion of sustainability, and adaptable reuse if possible. Working on thesis with a team of students will be challenging to reserve individuality, but the resource of so many different interests and specialties will broaden the possibilities of this project. Working with a team of designers and reporting to a client will be good practice for the “real world.”
Beaming with pride

Ball State University.

One of the students, Sarah Marshall, met us at the make-shift front door in the barn's north wall.

"Each student drew up a house plan, and then the class took all the plans and discussed them," she said. "We formed five groups comprised of those who had deep insight into the problem and we refined them. We submitted the five plans to the Shideles and worked with them to combine the plans into one set.

"Stud framing and an open stairway suggest entry to a spacious hall, the core of the house that opens to original rafters above and to the lower level. The latter, where sheep huddled on the day of our visit, will eventually be the winter garden.

Sarah led the way to the kitchen area in the northwest corner. She pointed out an informal eating area that looks out over fields and trees along the river. The Shideles like to cook and entertain so the kitchen opens partially into the living room.

"Above the kitchen is a loft for reading or reflecting. It seems to be suspended over the eating area and the living room and has a view out those windows.

"We all had located the living room in the southwest corner overlooking the pond," said Matt Dubois, who had stopped pounding nails to join us. "Large windows face the pond and the fields. The rooms soar to the rafters above."

"The sunsets are fantastic," added Marshall, explaining that rooms were geared to views south and west.

A spacious, open dining room fits neatly next to the kitchen and living room. One wall is strongly angled.

See BARN on Page 2B

Tony and Suzanne Shidele's barn near Albany (Top photo) is in the process of being turned into a house. The Barnitecture Project, which began last fall, is being done by Bruce Meyer's class of fifth-year students in Ball State's College of Architecture. Above, a student works on the inside of the barn.

By NANCY MILLARD
Special Feature Writer

Back in the 1940s when the sturdy barn was built on a gentle slope near the Mississinewa River, the farmer never dreamed that 12 architecture students would transform it into a contemporary house turned into sunsets.

The stately old barn, built of black walnut that was probably felled on the site, is taking on new vigour, despite being well into the second half of its second century.

Structurally sound, the hand-hewn beams and secondary supports are as sturdy as ever. But now they are highlighted as integral to the design of Tony and Suzanne Shidele's house near Albany.

The Barnitecture Project — conducted by Bruce Meyer's class of fifth-year students in Ball State's College of Architecture — began last fall when the Shideles agreed to let the class convert their old barn into a house. Their nearby house was destroyed by fire a year ago.

The students designed and are doing most of the actual construction of the house except for cabinets, dry-wall finishing and plumbing. Tony Shidele is overseeing the wiring. No surprise, since he is the director of a statewide Purdue University mechanical engineering technology program being taught at
Barn

Continued from Page 1B

In the center hall a horizontal half wall repeats the same acute angle, like an arrow, leading the eye to window views of the pond. An original ladder to the loft above was left significantly in place, harking back to the barn's initial function.

"The whole concept of the angle is to create a new symbol of home in place of the barn's 10x10-foot grid," Matt said.

"There really wasn't a square corner in the barn. Everything was slightly off, even the floors, which we had to level by about 6 inches. What we're building has to be squared for appliances and cabinets," Douhan said.

The master suite occupies the east side of the structure. "Master bedroom, dressing room, bath and sitting room," said Marshall, describing what the studs will enclose. Above these rooms there will be two bedrooms, a bath and sewing room that looks down from a balcony onto the center hall and through the stairway, providing glimpses of the winter garden.

"More than two-thirds of the house is open space," said Douhan, pointing up to the rafters. "The heat will flow upward and in a conduit across the center peak of the barn and back down. In summer it will be just the reverse with cool air."

While we explored the structure, other students scurried about, measuring, pounding, installing wiring. They appeared relieved that the weather had turned warmer.

"Not until Jan. 26 did we have the place closed in," Douhan said. "We had some really cold days in here. But November and December were warmer, so we got a lot of the outside work done."

"So far we're ahead of schedule," Marshall said. "Sometimes what we designed doesn't work, so we call a little meeting and say, 'look guys, come up with a better way to do this.' This project is a learning situation, so when something doesn't work, we figure out another way to do it. It takes twice as long to build this way, probably. That's why we decided in the beginning not to charge for our labor."

The design/build project is quite unique, the students said. "While some architects actually design and build," Marshall said, "most have professional builders do the construction."

"This way we learn what works and what doesn't because we've tried it. I'd do it again, but not with 12 others."

The Barmitecture project should be finished by graduation, she added.

"We're going to have an open house so our parents and friends can come see what we've been talking about all year."

Don't let

Ten reasons to prevent child abuse and neglect

1. Child abuse and neglect can be fatal.
2. Child abuse stifles a child's normal growth and development.
3. Child abuse is a red flag for many social insti-
4. Child abuse continues to multiply.
5. Child abuse victims are six times more likely to become abusive parents than non-abused.
6. Treatment center while critical are often ineffective in altering parental behaviors.
7. Prevention programs targeted at parents may become abusiv

Don't let
Building with Panels

Architectural consultant Steven Winter discusses the technical and design issues involved in structural insulated panel construction.

Abstract

Structural insulated panels are being used increasingly for the roofs and walls of lowrise buildings. Characteristics of this technology are reviewed, including structural performance and energy efficiency.

Structural insulated panels (SIPs), also known variously as foam-core panels, stressed-skin panels, and sandwich panels, are an alternative to conventional "stick-built" systems for constructing the building envelope.

SIP technology is not new. It was utilized in residential construction as early as 1952, when architect Alden B. Dow, son of the founder of the Dow Chemical Company, began designing SIP homes. The first of these (2), built in Midland, Michigan, utilized SIPs for exterior walls, interior partitions, and roofs; they are still occupied today.

According to a recent study prepared for the Structural Insulated Panel Association (SIPA), a trade association representing about 100 companies, SIP production in the U.S. in 1991 was 15 million square feet, equivalent to all the walls and roofs of about 4,000 homes. This rate is expected to grow, according to the study, to levels ranging from 50 to 112 million square feet by the year 2000, depending on the aggressiveness with which the industry markets its products.

The SIPA study surveyed more than 100 architects around the U.S. to determine their attitudes about specifying SIPs. Most respondents said that they would consider using SIPs but had concerns about product availability, design limitations, and high first costs. Manufacturers maintain that these concerns are unfounded, and that architects need to be better informed about SIP availability, design flexibility, and life-cycle cost effectiveness.

Although product types vary in the industry, all SIPs have two exterior skins adhered to a rigid plastic foam core (1). Panels are available in a variety of sizes and thicknesses depending on application requirements, from two inches to eight inches thick, and in sizes from the standard 4 x 8 feet to 8 x 24 feet. This is ideal for their primary application: exterior walls and roofs of low-rise residential and commercial buildings.

The skins of a panel can be of the same or differing materials. The faces are usually oriented strand board, waferboard, plywood, sheet metal, or gypsum board. The foam cores are composed of expanded polystyrene (EPS), extruded polystyrene, or polyurethanes/polysocyanurates. Expanded polystyrene is most commonly used because of its low cost and simple manufacturing process; however, EPS cores must be made thicker to compete with the higher insulating properties of other foams.

SIP Construction

Panels are used in construction either as generic elements or as parts of a packaged unit. "Generic" panels are produced in varying thicknesses and with different material combinations, but in standard sizes, such as 4 feet by 8 feet. Each panel has explicit physical properties and strength characteristics, and the manufacturer sells them to builders and others without knowledge of the end application. This is quite similar to the way plywood panels are sold to builders.

Material strength and properties are provided with load tables and other standards, but the builder is responsible for cutting the material and properly installing it.

When a manufacturer sells a precut building package or unit, the procedure is quite different. The plans of the entire building are analyzed and panels are specifically designed for each wall, roof, or other application. The manufacturer, often with CAD-generated shop drawings, cuts each panel to precise dimensions, including openings and odd geometries. Edges, angles, and all other configurations are cut in the factory. All the panels required for an entire building are then packaged and shipped, as much as 800 miles or more, to the construction site.

When architects design buildings based on SIP construction, whether or not panels are precut
For hundreds of years, metal roofing has proved successful on buildings around the world. Several aspects of traditional, field-fabricated metal roofs combine to account for their long-term success, including the durability of materials used (copper and stainless steel), steep-slope application that assures prompt drainage, and watertight joints fabricated by soldering or lock-jointing in place. Also, the relatively short panel length of 8’ to 10’ commonly used in these roofs reduces problems associated with differential thermal movement of the metal components.

To reduce the cost of traditional field-fabricated metal roofing, the industry introduced preformed metal roofing panels with a variety of standing seam profiles. These systems use less expensive materials (steel and aluminum) and their installation techniques considerably reduce labor costs. The roofing panels and system accessories are generally proprietary designs. Although preformed systems were initially limited to industrial-type, pre-engineered metal buildings, standing-seam preformed metal roofing is now commonly used on many building types where aesthetics and performance are critical.

Unfortunately, several characteristics of preformed metal panel systems make them less reliable than traditional metal roofing systems. For example, most preformed metal roofing panels are prepainted or coated, therefore the metal pieces cannot be soldered together to provide watertight connections. Although panel lengths of 50’ or more reduce installation costs, thermal movements and stress concentrations within such systems can be significant. Designers who acknowledge these conditions—and take care to address them—have used preformed systems successfully. Many designers who specify these systems, however, do not fully understand their performance characteristics and material capabilities, and are not familiar with proper detailing practices.

**Characteristics of Preformed Metal Roofing**

Preformed metal roofing systems are generally categorized as *architectural* or *structural* systems, depending on appearance and performance characteristics. Architectural metal roofing systems, like traditional field-formed roofs, are applied over continuous, steeply sloped, solid decks. The panels are usually 12’ to 18’ wide with 1½” high seams, and are available in standing seam or batten seam configurations.

Unlike traditional metal roofing, the seams on architectural systems are not usually folded or locked together and will leak under a static head of ponded water; manufacturers commonly refer to them as “water-shedders.” Most manufacturers recommend a minimum slope of 3/12 with a roofing underlayment (such as 30 lb asphalt-saturated felt paper) installed on the deck, below the metal roofing pans, to prevent leakage through the panels from entering the building. The panels are usually flat between the seams, without corrugations or stiffening ribs, and are usually made of 24 or 26 gauge steel or 0.032” aluminum. The flat portion of the panel can be field-bent to lock onto metal hook strips or other pieces of metal, to hold down panel ends at eaves, ridges, or valleys. For the most part, architectural systems retain many of the characteristics of traditional metal roofing systems, and they can provide a satisfactory alternative to them.

Structural metal roofing systems are applied over substructural purlins; solid substrates are not required by the system manufacturers. The panels range from 12’ to 24’ wide, with 2¼” to 3” high seams, and are made of 22 or 24 gauge steel or 0.040 aluminum. Because of their corrugations, field bending of structural panels is difficult, and most joints at panel end laps, eaves, valleys, ridges, and penetrations are simple lap joints gasketed with sealants. The metal pieces are lapped and fastened with exposed screws. Manufacturers typically recommend 1/4 in/ft minimum slope for structural metal roofing systems, and refer to them as “water barriers,” because the seams are locked together after the panels are installed. The same minimum slope is recommended by the National Roofing Contractors Association for monolithic membrane roofing (such as EPDM, PVC, and built-up roofing). Structural systems depart from traditional metal roofing applications and are marketed as an alternative to other low-slope roofing materials.

Long panels and exposed fasteners in end laps or at flashing details result in several thousand fasteners throughout the roof, which create maintenance problems in structural systems. Thermally driven expansion and contraction of panels cause stress concentrations at fasteners, particularly when the panels are restrained against free movement. In time, the fasteners loosen and dislodge, or the fastener holes in the panels elongate.
Wood Protection Detailing

Wood structures consultant Gerald E. Sherwood presents detailing criteria to avoid decay in wood frame buildings.

Wood has dominated as a building material for low-rise construction because of its economy, beauty, workability, and availability. With our present environmental emphasis, it also offers the advantages of being a renewable resource and having a low energy requirement for production and manufacture. Like all building materials, however, wood requires some special detailing for optimum performance. Details presented in this article are primarily aimed at prevention of decay that can occur under certain conditions of moisture, temperature, and oxygen supply.

Designers and builders have learned basic methods of detailing to prevent decay, as demonstrated by the existence of wood structures in the United States that are 300 or more years old. Unfortunately, changes in techniques are often made in developing popular designs that do not adequately consider wood protection. Also, our transient society has led to the copying of designs in various geographic locations that have different climates and different requirements for wood protection. This article presents the basics of why wood decays as well as specific construction details for decay prevention.

Basics of Wood Decay

Wood decomposes as a result of fungi feeding on it. Spores of decay fungi are almost universally present in the air. These spores have four basic requirements for growth: a food source, water, a temperature between 40 F and 100 F, and oxygen. Cellulose in wood provides the food source. Most wood contains some water held in its fibers, but fungi require free water, the quantity that exceeds the amount held in the fibers alone. Free water is water that is able to move freely in its liquid state; it must be supplied by leakage, condensation, or capillary rise, and not, for example, by high ambient relative humidity. The condition in which wood contains about 30 percent moisture by weight results in fiber saturation. So moisture contents higher than this must exist for fungi to have access to the water.

When wood is dried below fiber saturation, growth of fungi stops even though existing decayed wood is not removed. At temperatures below 40 F or above 100 F, fungi go dormant, but will return to active growth if temperatures return to favorable levels. If wood is immersed in water, buried in the ground, or placed in other situations where the oxygen supply is cut off, decay cannot progress.

Decay is often referred to as “rot” or sometimes as “dry rot.” The term “dry rot” is misleading since water is required in all cases for decay to advance. Material may be dry when decay is found, but the existence of decayed wood indicates that excessive water has been present at some time.

Effects of Climate

Details shown in this article are recommended for all geographic locations; however, they are more critical in some than in others. Potential for wood decay is most prevalent in regions where high humidity and rainfall occur. While the advance of decay may be slower in dry regions, the same general construction details will assure prevention of decay in all regions. Relative severity of decay in various geographic regions is based on the amount and number of days of rainfall.

Very dry climates like the Southwest allow designers and builders to “get by” with some construction practices that would present a definite hazard in the Gulf Coast region. An example is the practice of using no roof overhang in California, where rainfall is light; this can cause serious maintenance problems in Florida, where rain occurs almost daily. Similarly, naturally durable woods such as redwood and cedar can be left unfinished in dry climates, but in humid climates will be discolored by mildew and may undergo excessive dimensional change from cycles of wetting and drying.

General Principles of Wood Protection

Moisture content of wood at the time of construction can have a direct effect on service life. Wood framing and sheathing materials should have a moisture content of 19 percent or less prior to being enclosed in a structure. Higher moisture contents may trap moisture (within stud walls, for example) and promote decay. Wood siding, exterior millwork and trim should have a moisture content of 15 percent or less at the time of installation. Higher moisture contents may result in excessive shrinkage, with the consequent opening of joints that allows water to enter.

Exposed members must be sloped so water will not stand and soak in. Joints between members should be caulked or spaced for drainage and air drying. It is particularly important to protect end grain from exposure to water, because water is
Most single-family houses in this country are built without the involvement of architects. Can the profession play a greater role by designing housing as a kit of parts that anyone can build?
That's the thesis behind the Home Erector System, an experimental project under construction at Rensselaer Polytechnic Institute's Center for Architectural Research in Troy, New York. According to Walter Kroner, director of the center and the progenitor of the HES house, "The guiding force behind the house's technology is: can an killed person build it?"

By saving labor costs through their own sweat equity, people willing to build a house themselves can reduce the initial cost of home ownership by 20 to 30 percent, Kroner maintains. According to census data, as many as 20 percent of all the single-family houses in the U.S. are currently owner-built by people acting as their own general contractors, or actually pounding their own nails. Thus, there appears to be a ready market for the HES house, which would simplify construction and provide variable floor plans occupants could adapt to their lifestyles.

Because the HES house is also designed to be easily disassembled, it can shrink as well as expand, making it responsive to changes in family size. The HES house can range from a single-story studio residence of 770 square feet to a two-story house of 2,020 square feet. The plans also accommodate shared housing arrangements.

The HES house is designed so that it can be assembled by two people, from existing off-the-shelf components. No special tools are needed for construction. To demonstrate that the house can be built by novices, the prototype is being constructed by RPI architecture students.

Kroner explains that the HES house being built is more than a demonstration project because research on materials, finishes, and mechanical and electrical systems is ongoing. Most of the materials and equipment for the demonstration house were donated by manufacturers. The frame is six-inch post-and-beam on a 12-foot module. The structure is purposely redundant so that a second floor can be added to a one-story house. Floors, walls, and roofs are stressed skin panels. All of the connections are screwed and bolted so they can be easily undone. Predrilled connection plates for the timber frame are not a standard item, but are designed, says Kroner, so they can be easily manufactured by low-skilled labor.

Interior walls are untaped and painted gypsum board. Electrical conduit is routed above plenum ceilings through plastic troughs that are actually exterior gutters put to a new use, or through steel studs used as channels. Hollow baseboard containing electrical conduit is also used. Plumbing is a flexible plastic pipe system, with plastic couplings akin to garden hoses. On the day of my visit to the HES house, project manager Jean Stark-Martin and students were installing a veneer hardwood floor that fits together in sheets and is held down with removable baseboard. With completion of the HES prototype RPI will test its performance and will investigate marketing the system.

Michael J. Crosbie
# ARCH 403 THESIS FALL 1994 MEYER SHIDELER RESIDENCE DRAFT SCHEDULE

<table>
<thead>
<tr>
<th>SEP 5 - 9</th>
<th>SEP 12 - 16</th>
<th>SEP 19 - 23</th>
<th>SEP 26 - 30</th>
</tr>
</thead>
</table>
| Interview client; begin program  
Complete conceptual design- AIA  
Indiana Day Review | Program review with client  
Begin preliminary design | Complete preliminary designs  
Preliminary design review with client  
Identification of design element strengths | Final design responsibilities identification  
Design modifications  
Presentation charette  
Client design review |
| Technology alt's briefing  
Complete primary framing base doc's | Complete site survey; verify rough  
dim's primary framing; utility survey  
Technology teams begin final spec's &  
cost anal.  
Begin structural analysis-consultant  
Complete CAD prime frame input | Provide tech briefs to class | Preliminary subcontractor meetings  
Begin supplier specs outline |

<table>
<thead>
<tr>
<th>OCT 3 - 7</th>
<th>OCT 10 - 14</th>
<th>OCT 17 - 21</th>
<th>OCT 24 - 28</th>
</tr>
</thead>
</table>
| Final design review with client  
Design development decisions primary: finish materials, equipment; cabinetry; lighting; HVAC; plumbing; electrical | Complete design development including draft specifications;  
Begin Code verification | Complete:  
Construction documents  
Specifications  
Complete Code verification  
Construction management schedule  
Contracts Preparation  
Tool acquisition plan  
Primary material orders prep  
Final utility connections plan | Final Bidding / pricing  
Preparation of final client presentation |

<table>
<thead>
<tr>
<th>OCT 31 - NOV 4</th>
</tr>
</thead>
</table>
| Client project review  
Client decision |
Water systems
Supply piping: general: polybutylene, 3/4"; risers sized as needed for fixtures; Connections: polybutylene pressure fittings
Sanitary waste: 2" and 4" PVC drains and vents; Connections: PVC glued - pipe cleaner and solvent, towels to clean; pipe cutter or hack saw & rasp, file or sandpaper; through roof vent flashing caps; toilet base fittings, clean-outs as needed
1/4" per foot fall continuous
Septic system: tank, leech field perforated piping, clean-outs, etc. - special design
New Well: 4" steel-cased drilled with capacity for domestic and geothermal heating; submersible pump with polyethylene supply to house; ballast tank, pressure valve, cut-off;
Connections for rented water softener; connections for geothermal heating-supply and return
Hose bibs as shown on plan, polybutylene;

Fixtures:
Kitchen: stainless steel kitchen sink- min. double basin, possible triple or separate salad sink; "delta" style faucet controls, polished chrome-plated brass; kitchen set to include soft and hard water supply, spray hose, tall goose necks on swivels;

Guest (1/2) bath: porcelain steel lavatory w/ faucets and fittings, cast porcelain flush-tank toilet
Master Bath and Dressing: 2 porcelain steel lavatories, cast porcelain flush-tank toilet, fiberglass or acrylic whirlpool tub with ceramic tile surround; separate fiberglass shower with glass door and side panel(s); all faucets and fittings for lav’s, tub and shower;
Upper Level Bath: porcelain steel lavatory, cast porcelain flush-tank toilet, separate fiberglass showertub with curtain rod; all faucets and fittings for tub and shower;

Wall, Floor, Roof and Foundation systems
exterior walls: foam-core panels- walls @ 6" nominal thickness (5-1/2) w/ drywall interior
splines: 2 x 6 panel-panel, window & door
double 2x's ledgers all four sides? interface on south with decking?
pole barn nails or screws, caulk, foam

interior partitions conventional at: 2 x 4 @ 16" o.c., single 2x4 sole and double 2x4 plate w/ 1/2" drywall

main floor sub-floor system (foamcore or standard framing shimmed on existing)
standard underlayment: 5/8 CD ply + 3/8 OSB or 3/4" ply w/ 1/4" luan for all but oak T & G: w/ 2-1/2" white oak T & G, underlay with 5/8 min ply: NOTE - adjust underlay of areas adjacent to oak for depth of finish material; all underlayment screwed and glued if not foam core
second floor framing conventional: 2x8 or 2x10 @ 16" o.c. according to spans w/ joist hangers between double or triple 2x12 beams -long spans with built-up glued and nailed 2x beams w/ 1/2 plywood centers as needed; 2x ledgers (not joist hangers) fixed to existing oak beams where used in lieu of new beams; second floor partition framing set on plywood layer only with underlayment to sole

Interior Finishes
Walls: painted 1/2" drywall except as noted
Ceilings: under roof- 3/4" SPF car siding or equal if foam core roof panels used; 1/2" painted drywall in all other interior spaces except as noted; 3/4" SPF car siding may be used as suspended ceiling in zones for access to mechanical systems running beneath upper floor structure; all SPF surfaces to be finished with polyurethane

Lighting: (interface with HVAC electrical) balance built-ins with switched outlets for lamps

Stairs: (structural and finish) base bid-carpeted dimension lumber; alternate-oak treads, risers and carriages on dimension framing

Doors: 1-3/8" x 6'-8" pre-hung hollow core luan painted except as follows: solid cores at: guest 1/2 bath main floor, master suite if no double-door "lock"; trim to be painted SPF 2-1/4"; hinges brass-plated loose pin, rounded corners
Window trim: interior jamb extensions and casings of 2-1/4" SPF (style to be determined) stained light oak and coated with polyurethane 2 coats, sanded between coats; finishing nails countersunk and filled after urethane

**Base:** 3" oak or SPF with 3/4" cove or quarter-round, finished as w/ window trim all areas except baths, kitchen, laundry, mudroom; alternates: vinyl cove or ceramic

**Cabinetry, fixtures, specialty hardware:**
All **baths**: toilet tissue dispenser, towel bar(s), mirrors and/or mirror cabinets, base cabinet under lav's
**Kitchen cabinets and countertops**: to be determined with client, calculate minimum solid wood doors and fronts, Formica countertops; alternates - custom cab's and cast tops
Book shelving, dressing room storage units, pantry shelving, closet shelving and hanging rods
**Locksets**: brass-plated privacy and passage on interior; solid brass on exterior doors with deadbolt

**Exterior Finishes, Windows and Doors**
**Siding, soffits and trims**: vinyl, steel, or aluminum to be determined (no wood siding or trims)
**Windows**: Anderson vinyl-clad wood double-hung (preferred by client) or casement (according to sizes)
**Doors**: prehung painted steel clad solid core 3'-0" x 6'-8" with magnetic gaskets; specialty doors (e.g., full-lite french) may be Anderson vinyl clad; garage doors with remote opener - painted insulated metal

**HVAC Electrical**

**Heating:** "Water furnace" geothermal heat pump; gas-fired forced air alternate- upflow furnace with central AC (est. 3-4 tons)
Dual-duct supply-return ducting; all ducts all steel - no duct board, spiral wire or accordion duct; insulation as determined by design

**Electrical:** 440 -volt 200 amp service (underground preferred);
aluminum to meter base and base to breaker box; all copper interior wiring;
b breaker box near meter base and convenient from interior;
exterior breaker for any compressor
plastic junction, duplex and switch boxes; all duplex outlets grounded;
GFI outlets as required by code adjacent to water supply areas
switch, duplex, and phone/coax outlet plates white or ivory plastic telephone, coaxial cable, door bell outlets and wiring as per plans

**Passive solar:** interface with interior / exterior teams for - window treatments, shuttering and floor finish / thermal mass

**Stove(s):** base bid- cast iron in public area; alternates- masonry/tile in public area, smaller stove in master suite and/or upper level public loft
Class A flue (for non-masonry solutions) (three-wall, stainless inner) through roof
Hearth material of tile or brick to provide for wood carrier or other storage and to extend as required by code
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ITEM</td>
<td>TYPE</td>
<td>QUANTITY</td>
<td>UNIT PRICE</td>
<td>LOWES</td>
<td>WOLUCHAR</td>
<td>TOTAL</td>
<td>TOTAL</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>FURLOW</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Single Doors - pre-hung luan hollow core 30&quot;</td>
<td>12</td>
<td>$20.99</td>
<td>$36.00</td>
<td>$38.00</td>
<td>$251.88</td>
<td>$432.00</td>
<td>$456.00</td>
</tr>
<tr>
<td>4</td>
<td>Single Doors - pre-hung luan hollow core 32&quot;</td>
<td>6</td>
<td>$21.99</td>
<td>$37.00</td>
<td>$38.00</td>
<td>$204.94</td>
<td>$322.00</td>
<td>$340.00</td>
</tr>
<tr>
<td>5</td>
<td>Single Doors - pre-hung luan hollow core 36&quot;</td>
<td>4</td>
<td>$22.99</td>
<td>$40.00</td>
<td>$41.00</td>
<td>$191.96</td>
<td>$312.00</td>
<td>$330.00</td>
</tr>
<tr>
<td>6</td>
<td>Single Doors - pre-hung luan solid core 36&quot;</td>
<td>1.00</td>
<td>$49.99</td>
<td>$132.00</td>
<td>$82.00</td>
<td>$49.99</td>
<td>$132.00</td>
<td>$82.00</td>
</tr>
<tr>
<td>7</td>
<td>French Doors - pre-hung 60&quot;</td>
<td>3.00</td>
<td>$550.80</td>
<td>$396.00</td>
<td>$639.00</td>
<td>$1650.00</td>
<td>$1188.00</td>
<td>$1917.00</td>
</tr>
<tr>
<td>8</td>
<td>Hardware - bed/bath - Kwikset</td>
<td>13.00</td>
<td>$9.99</td>
<td>$9.47</td>
<td>$10.99</td>
<td>$123.11</td>
<td>$142.87</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hardware - hall/closet - Kwikset</td>
<td>13.00</td>
<td>$9.99</td>
<td>$9.47</td>
<td>$10.99</td>
<td>$123.11</td>
<td>$142.87</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Hardware - exterior doors - Kwikset</td>
<td>6.00</td>
<td>$24.98</td>
<td>$23.55</td>
<td>$26.99</td>
<td>$149.77</td>
<td>$158.19</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Gaskets - Oak 1 1/2&quot; x 21&quot; foot</td>
<td>1436</td>
<td>$1.35/LF</td>
<td>$1930.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Baseboard Oak 3 1/4&quot;x8&quot;</td>
<td>642</td>
<td>$12.00</td>
<td>$2.32/LF</td>
<td>$963.00</td>
<td>$1489.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Finishing nails (5D)</td>
<td>25b</td>
<td>$4.38/5lb</td>
<td>$1.18/LB</td>
<td>$21.90</td>
<td>$29.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Floor Mount Registers - 4&quot;x12&quot; (brown)</td>
<td>5.00</td>
<td>$5.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Mouldings</td>
<td>48 IF.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Stair stringer 2&quot;x12&quot;x12&quot; dim. lumber</td>
<td>48 IF.</td>
<td>$19.08</td>
<td>$18.45</td>
<td>$75.32</td>
<td>$73.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Risers 2&quot;x8&quot;x12&quot; dim. lumber</td>
<td>27.00</td>
<td>$8.24</td>
<td>$9.36</td>
<td>$155.62</td>
<td>$63.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Treads 2&quot;x10&quot;x12&quot; dim. lumber</td>
<td>27.00</td>
<td>$12.40</td>
<td>$12.69</td>
<td>$83.70</td>
<td>$85.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Railing - oak</td>
<td>142 IF.</td>
<td>$42.96</td>
<td>$42.96</td>
<td>$597.50clf</td>
<td>$848.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>(ALT.)Hand railing-oak(12' lengths)</td>
<td>142 IF.</td>
<td>$25.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>(ALT.)Hand railing-oak(12' lengths)</td>
<td>142 IF.</td>
<td>$1637.00</td>
<td>$1437.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Oak parapet cap - dim. lumber 1x6</td>
<td>47 IF.</td>
<td>$27.75</td>
<td>$27.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Balusters - oak 34&quot;</td>
<td>71.00</td>
<td>$3.70</td>
<td>$3.50</td>
<td>$252.70</td>
<td>$418.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Newels - oak 48&quot;</td>
<td>23.00</td>
<td>$29.55</td>
<td>$27.75</td>
<td>$679.65</td>
<td>$1673.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Closet rods - 1x1/4&quot;x8&quot;</td>
<td>5.00</td>
<td>$6.96</td>
<td>$6.96</td>
<td>$34.80</td>
<td>$34.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Pantry Shelving (8' lengths) Red Oak 3/4&quot;x12&quot;x6&quot;</td>
<td>50 IF.</td>
<td>$8.50</td>
<td>$8.50</td>
<td>$42.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Closet Shelving (8' lengths) Red Oak 3/4&quot;x12&quot;x6&quot;</td>
<td>50 IF.</td>
<td>$8.59</td>
<td>$8.59</td>
<td>$42.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Linen Shelving (4' lengths) Red Oak 3/4&quot;x12&quot;x6&quot;</td>
<td>4.00</td>
<td>$8.59</td>
<td>$8.59</td>
<td>$34.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>(ALT.)Closet shelving Pine 1x12x8&quot; (rough)</td>
<td>5.00</td>
<td>11.99</td>
<td>11.99</td>
<td>59.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>(ALT.)Linen Shelving Pine 1x12x8&quot; (rough)</td>
<td>4.00</td>
<td>11.99</td>
<td>11.99</td>
<td>47.96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Drywall 1/2&quot; 4x8'</td>
<td>7407 SF.</td>
<td>$0.30</td>
<td>$0.30</td>
<td>$2244.00</td>
<td>$1083.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Switch plates - single switch</td>
<td>27.00</td>
<td>$0.59</td>
<td>$0.59</td>
<td>$15.93</td>
<td>$18.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Switch plates - double switch</td>
<td>10.00</td>
<td>$0.69</td>
<td>$0.69</td>
<td>$6.89</td>
<td>$9.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Switch plates - triple switch</td>
<td>2.00</td>
<td>$1.93</td>
<td>$1.93</td>
<td>$3.86</td>
<td>2.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Outlet cover - dual - plastic</td>
<td>88.00</td>
<td>$0.17</td>
<td>$0.17</td>
<td>$14.96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Outlet cover - floor dual</td>
<td>4.00</td>
<td>1.79</td>
<td>1.79</td>
<td>7.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Appliance outlet cover</td>
<td>2.00</td>
<td>1.09</td>
<td>1.09</td>
<td>3.86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Phone plate cover</td>
<td>0.59</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Lighting allowance</td>
<td>74 fixtures</td>
<td>1425.00</td>
<td>136.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Bathroom Medicine Cabinet-oak 18 x 30 x 6</td>
<td>2 cabinets</td>
<td>68.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Smoke detectors - First Alert - professional</td>
<td>7.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Carpet (including installation &amp; tax)</td>
<td>1923 SF.</td>
<td>$20.00</td>
<td>$20.00</td>
<td>35700.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Tile (medium quality vinyl)</td>
<td>189 SF.</td>
<td>$20.00</td>
<td>$20.00</td>
<td>35700.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Wood flooring (white oak)2 1/4&quot; 8sg</td>
<td>39 SF.</td>
<td>$2.50</td>
<td>$2.50</td>
<td>729.00</td>
<td>29.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Towel rings (oak)</td>
<td>4.00</td>
<td>5.39</td>
<td>5.39</td>
<td>21.56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Towel bars 24&quot; oak</td>
<td>8.00</td>
<td>5.39</td>
<td>5.39</td>
<td>43.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>KITCHEN &amp; BATH CABBS &amp; TOPS</td>
<td>6500.00</td>
<td>6500.00</td>
<td>15.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>Toilet paper dispensers-oak</td>
<td>4.00</td>
<td>3.79</td>
<td>3.79</td>
<td>15.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
<td>I</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------</td>
<td>-------</td>
<td>-------------</td>
<td>---------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>59</td>
<td>Drywall primer -Promar 200 Latex</td>
<td>25 gallons</td>
<td>$13.49</td>
<td>SHERWIN WILLIAMS</td>
<td>NORMS</td>
<td></td>
<td>$337.25</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Paint - Latex flat Coating</td>
<td>20 gallons</td>
<td>$14.79</td>
<td></td>
<td></td>
<td></td>
<td>$295.80</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>(alt.) Drywall Primer - Valspar PVA</td>
<td>25 gallons</td>
<td>$10.99</td>
<td></td>
<td></td>
<td></td>
<td>$274.75</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>(alt.) Paint - Flat Latex Valspar</td>
<td>20 gallons</td>
<td>$16.99</td>
<td></td>
<td></td>
<td></td>
<td>$339.80</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>(alt.) Paint - Eggshell Finish</td>
<td>20 gallons</td>
<td>$19.99</td>
<td></td>
<td></td>
<td></td>
<td>$399.80</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>Polyurethane</td>
<td>1 gallon</td>
<td>$39.88</td>
<td></td>
<td></td>
<td></td>
<td>$32.88</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>GRAND TOTAL (OF BOLD #5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$29731.68</td>
</tr>
</tbody>
</table>


## Appendix

### Residential Cost Estimate

**Owners Name:** Anthony & Suzanne Gusler  
**Address:** 602 E.R. Edgewater  
**City, State, Zip Code:** Albany, Indiana

**DATE:**

<table>
<thead>
<tr>
<th>Class of Construction</th>
<th>Residence Type</th>
<th>Configuration</th>
<th>Exterior Wall System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy</td>
<td>1 Story</td>
<td>Detached</td>
<td>Wood Siding - Wood Frame</td>
</tr>
<tr>
<td>Average</td>
<td>1.5 Story</td>
<td>Semi-Detached</td>
<td>Brick Veneer - Wood Frame</td>
</tr>
<tr>
<td>Custom</td>
<td>2 Story</td>
<td></td>
<td>Stucco on Wood Frame</td>
</tr>
<tr>
<td>Luxury</td>
<td>2.5 Story</td>
<td></td>
<td>Painted Concrete Block</td>
</tr>
<tr>
<td></td>
<td>3 Story</td>
<td></td>
<td>Stone Veneer - Wood Frame</td>
</tr>
<tr>
<td></td>
<td>B-H-Level</td>
<td></td>
<td>Solid Brick (Luxury)</td>
</tr>
<tr>
<td></td>
<td>Tri-Level</td>
<td></td>
<td>Solid Stone (Luxury)</td>
</tr>
</tbody>
</table>

**Living Area (Main Building):**

<table>
<thead>
<tr>
<th>Level</th>
<th>Square Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Level</td>
<td>2000 S.F.</td>
</tr>
<tr>
<td>Second Level</td>
<td>950 S.F.</td>
</tr>
<tr>
<td>Third Level</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2950 S.F.</td>
</tr>
</tbody>
</table>

**Living Area (Wing or Ell):**

<table>
<thead>
<tr>
<th>Level</th>
<th>Square Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Level</td>
<td></td>
</tr>
<tr>
<td>Second Level</td>
<td></td>
</tr>
<tr>
<td>Third Level</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

** Costs per S.F. Living Area: **

<table>
<thead>
<tr>
<th>Cost per Square Foot of Living Area, from Page (Exp. 1.1)</th>
<th>( $ 52.40 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basement Addition: 80% Finished, 20% Unfinished</td>
<td>+ 13.25</td>
</tr>
<tr>
<td>Roof Cover Adjustment: Type, Page</td>
<td></td>
</tr>
<tr>
<td>Central Air Conditioning: Separate Ducts or Heating Ducts, Page</td>
<td>+----</td>
</tr>
<tr>
<td>Heating System Adjustment: Type, Page</td>
<td>+ (4) 1.58</td>
</tr>
<tr>
<td>Main Building: Adjusted Cost per S.F. of Living Area</td>
<td>( $ 71.82 )</td>
</tr>
</tbody>
</table>

**Total Cost:**

\[ \text{Total Cost} = (\text{Cost per S.F. Living Area} \times \text{Living Area} \times \text{Town/Row House Multiplier}) \]

\[ \text{Total Cost} = (\$ 71.82 \times 2950 \times 1.0) = \$ 215,571.00 \]
**REPLACEMENT COST**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Improvements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A) Paving &amp; Sidewalks</td>
<td>1402</td>
<td>$1402</td>
</tr>
<tr>
<td>(B) Landscaping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(C) Fences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(D) Swimming Pool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(E) Miscellaneous - Deck</td>
<td>1021</td>
<td>$1021</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>$241,360</td>
</tr>
</tbody>
</table>

**ADJUSTED TOTAL BUILDING COST** $241,360

**INSURANCE COST**

<table>
<thead>
<tr>
<th>Insurance Exclusions</th>
<th>Total Building Cost Less Exclusion</th>
<th>Location Factor</th>
<th>LOCAL INSURABLE REPLACEMENT COST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ADJUSTED TOTAL BUILDING COST** $243,782

**LOCAL INSURABLE REPLACEMENT COST** $243,782

---

**SKETCH AND ADDITIONAL CALCULATIONS**

- Rec. Room Kitchen: $7560
- Sidewalk/Patio: 3.2 x 10.5 = $1401 (1401 x 10.5)
- Garage - Custom 2 Car, built-in: $1315
- Kitchen - hardwood cabinets: 2(8 x 10) + 2(4 x 10) + 2(3 x 10) + 2(2 x 10)
- Marble/stone Countertop: $15 x 2015 = $3015
- Refrigerator/Freezer: $1200
- Dishwasher: $1756
- Water Heater: $1110
- Water Softener: $410
- Water Filter: $4710

**ADJUSTED TOTAL BUILDING COST** $243,782

**LOCAL INSURABLE REPLACEMENT COST** $243,782