AC 2008-4: THE CENTER FOR THE BUILT ENVIRONMENT AT IPFW AND THE NORTHEAST INDIANA GREEN BUILD COALITION AND HABITAT FOR HUMANITY COLLABORATE TO CREATE A SUSTAINABLE RESIDENTIAL CONSTRUCTION PROJECT

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The Center for the Built Environment at IPFW and The Northeast Indiana Green Build Coalition and Habitat for Humanity collaborate to create a Sustainable Residential Construction Project

Abstract

Senior students in the Construction Engineering Technology program at Indiana University Purdue University Fort Wayne have collaborated with members of the Northeast Indiana Green Build Coalition and Habitat for Humanity to design and build a sustainable residence. Participants from all three collaborating groups worked together and the house will be completed in April, 2008. Habitat has long wanted to produce sustainable homes and to support that end, we are producing a DVD of this design-build process for Habitat for Humanity's use throughout the United States.

Introduction

We are currently faced with global problems here on earth. Actions that we take "here," regardless of where "here" is, affects everywhere else too. Intuitively, we can all understand that. The air that we breathe is the air belonging to the thin layer of atmosphere surrounding our planet earth. If we hold the concept that the resources of the earth are ours to do with as we please, and that we are wholly unconnected to them, then we use resources and discard them without any thought. Imagine the change that would take place if we held the concept that we are not only the stewards of the earth's resources for present and future generations, but are also intimately connected to them, and that the choices we make about them can make the difference between destroying and benefiting the earth for all of its present and future inhabitants.

In the United States we have created a way of living to which the people of many other nations aspire. But it would take more than the resources of two planet Earths to provide enough energy to support and sustain the way in which we currently live if everyone were to live as we do. Other countries are rapidly acquiring the ability to do just that. China is building right now at such a rapid rate that they have to construct one coal plant per week in order to supply enough electricity to provide the new buildings with energy.[1] But buildings, commercial, industrial, or residential, no matter where they are constructed, consume more energy and material resources than any other area of consumption.[2]

For many years, Habitat for Humanity has wanted to change the way they build homes to make them sustainable. The word "sustainable" includes environmental, social, and economic parameters—what is referred to as the triple bottom line. Sustainable includes the idea that we must not use resources today at the expense of future generations. Our use must not compromise theirs.[3] The Executive Director of Fort Wayne's Habitat for Humanity expressed how difficult this change would be because they are volunteer based. It is a massive endeavor to think about having to train and re-train an entire volunteer force the size of Habitat's. Seniors enrolled in the Construction Engineering

Technology, Bachelor's degree program, through the Center for the Built Environment (CBE) at Indiana University Purdue University Fort Wayne (IPFW), are collaborating with members of the Northeast Indiana Green Build Coalition (NEIGBC) and our local Habitat for Humanity chapter to design and build a sustainable residence.

One of the ways in which sustainable construction is different from conventional building is that it depends on so much front-end collaborative, integrated design work. During the earliest stage, the focus is on building relationships between the people who represent the different competencies, and on working together to achieve the design goals for energy efficiencies. Because we would like to do something to help educate the populace about sustainable design and construction, we are filming the process and are producing an educational DVD for use by Habitat for Humanity groups throughout the United States.

Sustainable homes have been designed and built for Habitat families in other locales, so we aren't the first ones to do this. But the training would take place, the build would happen, and then when it came time to build the next home, so many staff members and volunteers were different that it was as if no training had happened at all. Our intention is that as turn-over occurs in Habitat for Humanity volunteers, board members, and staff, re-training in the sustainable building process will be facilitated by using the DVD that is being produced here. In this way, we will be able to assist Habitat for Humanity in their desire to ensure that every home they build is sustainable. Habitat helps families who ordinarily wouldn't be able to own their own home do just that. There are a number of different parameters Habitat uses to determine whether a family qualifies for the program.[4]

The Project Participants

Northeast Indiana Green Build Coalition members, experts in different sustainable competencies, came to the classroom to talk with students about their individual areas of expertise. One member, an architect, talked with the students about site energy mapping. An energy specialist talked about how to orient the home on the site so that summer shading and winter sun could be captured and so that summer breezes could be invited and winter wind blocked. A solar expert talked about capturing the sun's energy using photovoltaic panels and a solar hot water heater. We also had members make presentations to the class about water resources, building envelope (walls, roof, and windows), Insulated Concrete Forms (ICF), and sustainable landscaping. The Executive Director of Habitat for Humanity and their Project Manager also came to the class to explain how Habitat has traditionally built homes.

We invited the Habitat family that will be buying this home to come to class as well. This family came from Burma originally, and they are here in the United States as political refugees. In order to get a clear idea about design attributes the home should have, the students asked the Belloc family questions about their lives in Burma, what their home had been like and what they enjoyed doing. Mrs. Belloc told us that her family had been lucky in that the Burmese home they had lived in had a metal roof, and they were able to have this "expensive house" because they had inherited it from an

uncle. She also told us about the day her father had been called in to the central political office for what he was told would be a mediation session. When he arrived he was shot and she never saw him again. She told us that she immediately joined the army, and from then on she lived in the jungle and her house was made primarily of bamboo. She described to us how the roof was constructed of large leaves that were woven together, and then layered row by row on top of each other. The whole house could be quickly assembled and just as quickly taken apart when they moved from one area to another. She said that a roof made of leaves is very cool in the jungle and lasts for about five years.

We also found out that they are extremely uncomfortable with tall trees in close proximity to their home. They expressed a desire for a vegetable garden space because Mr. Belloc likes to grow their vegetables. They talked about needing a door that would close the kitchen off from the rest of the house because (she said, with a grin), their food tastes delicious, but smells stinky when it's cooking! They don't like carpeting and would like hard surface floors if possible. They need one of the bedrooms removed as far from the living space as possible because Mr. Belloc works nights and sleeps during the day. Mrs. Belloc's life is extremely active—she works part time for the Fort Wayne school system as a translator for the teachers and Burmese parents and children. Much of the remainder of her day is spent on the phone. She said that she often has a home phone in one hand and her cell phone in the other because she is called on to translate for the Burmese immigrant population so often. She is also asked to go to doctor's appointments with people and at times, must rush to the emergency room to help people communicate. Her days are filled with service to her fellow immigrants, all of whom are here as political refugees.

The Students' Work

The students working on this project are enrolled in our two-semester Senior Capstone course. Their challenge involves working on a project that will enable them to utilize as many of the skills and as much of the knowledge as possible that they have acquired during their four years in the Construction Engineering Technology bachelor's degree program. To that end, they spent the first semester conducting research about all aspects of sustainable construction, participating in a design charrette, designing and producing a set of prints, estimating and scheduling the project, and choosing and specifying materials to be used in the project. They also conducted site research and work. They did an inventory of the trees on site as well as existing shrubbery and marked them as to species. They surveyed the site and marked the location of trees that would be staying on the lot.

During the second semester of this course, the students have refined the design, prints, estimate, and specifications. The students are staking the foundation and are intimately involved in building the house as well. Students are making the concrete counter tops for the kitchen and bathroom. The bathroom counter was constructed in the lab at school, and the kitchen counter is cast in place at the jobsite.

The integrated design process, also called a charrette, took place early in the fall semester. In this process, *we work toward reaching a set of goals by optimizing relationships—in people and systems*.[5] We started by setting the goals that we wanted to achieve and gathering as many of the "systems representatives" at the table as possible. Our students and faculty members from the Center for the Built Environment at IPFW, the family that will be purchasing the home through Habitat, and others from the Habitat staff, board, and volunteers, together with a diverse group of NEIGBC members representing all competencies of the building process, worked together to design the most sustainable residence possible.

The design charrette produced several good options. Students took those designs and began working with them to find a design that incorporated all of the natural energies available on site and used as many of the energy efficiencies from the charrette options as possible. The site design the students produced is shown in Figure 1.

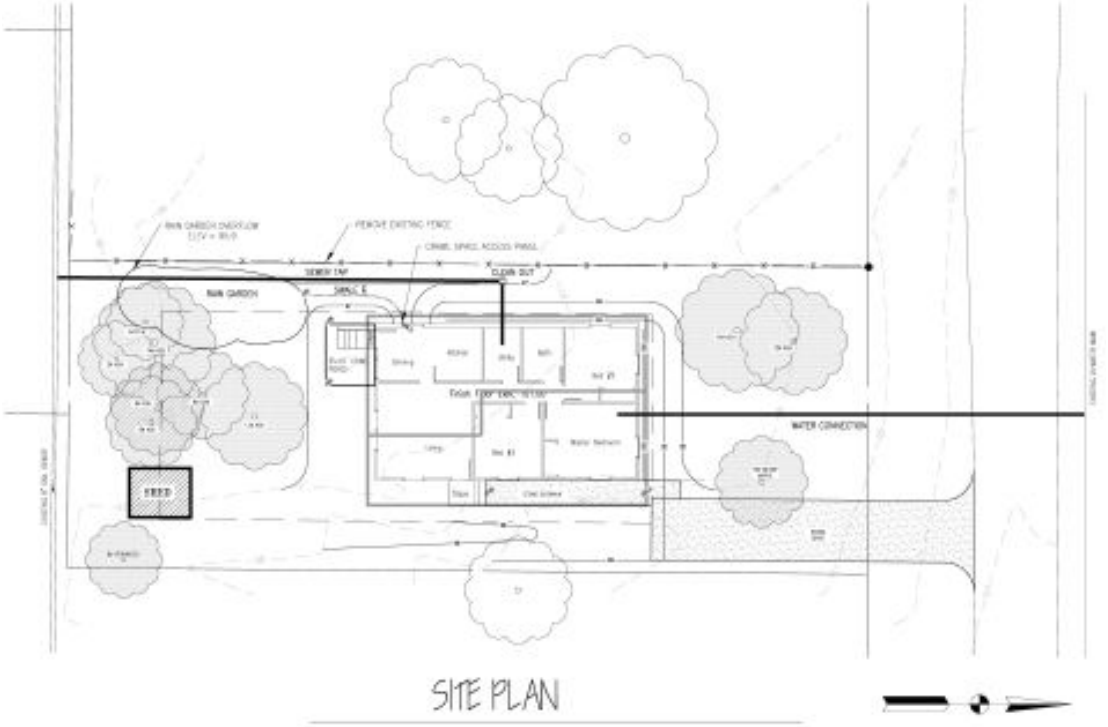

Figure 1

The ground slopes to the south-west. There are mature trees that are approximately 30' tall on the south side of the lot. There are also a couple of mature trees on the northwest side. Rainwater from the gutters will be channeled to a rain garden that we're building in the low area on the southwest side. The rain garden is sized so that all of the water that falls on this lot will stay there and be handled by the rain garden. None of it will move

into the city storm sewer. In a city that has experienced three "100 year floods" in the last five years, this is important!

The street is on the north side of the lot, and orienting the living areas of this home to take maximum advantage of the passive energies available is one of the most important features of the design. The typical layout of a home with the front door and living room facing the street was rejected. Instead, to take advantage of the passive warmth from the sun in the winter, the living area is situated on the south side of the house, with the main entrance placed on the east. As much of the south side of the house is glazed as possible to provide passive heat by capturing the winter sun, and will provide passive cooling by the shade trees during the summer.

We're using insulated concrete forms to build the 4' high crawl space. Because the ground slopes so much on this lot, we'll be able to have an exterior entrance door to the crawl space on the southwest side of the structure. The walls of the house are being built using staggered stud 2 x 4 wood framing. The exterior wall will be constructed with 2 x 4, 24 inch on center on the outside of the exterior wall, and 2 x 4 16 inch on center on the inside of the exterior wall. In this way, almost all thermal breaks will be eliminated and walls will easily achieve R 40, as will the ceiling and attic. Staggered stud framing is shown in figure 2.

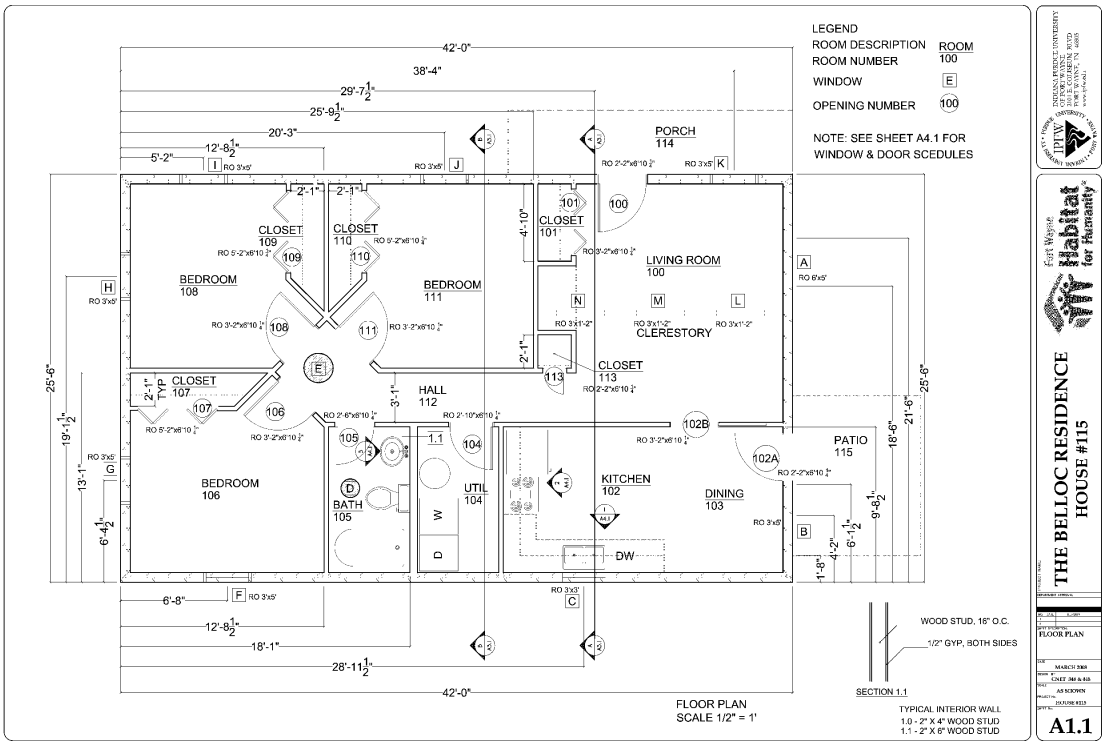

Figure 2

Daylight is provided for this home in a couple of ways. At the peak of the living room is a three-window clerestory that faces east, and there are two solar tubes—one in the bathroom and another in the center of the hallway off of which the bedroom doors open.

These features mean that it will be unnecessary to turn lights on most days until the evening hours. Another feature of the clerestory windows is that they are operable with a hand-crank, which creates a nice exhaust of heat during warmer weather. See figure 3 for the elevations and clerestory features.

The HVAC system that will augment the passive heating and cooling is WaterFurnace's Envision, a 500% efficient geothermal unit. Another local company is making the energy efficient windows for the home. The counter tops are concrete (made by the students), flooring is tile containing a high percentage of recycled content in all of the living areas. Bedrooms are floored with carpeting made with 25% recycled content. Cabinetry is made from rubberwood, a very eco-friendly product. All interior materials are either no or low volatile organic compound (VOC) content. The paint is from Sherwin Williams Harmony line, which has no VOC's.

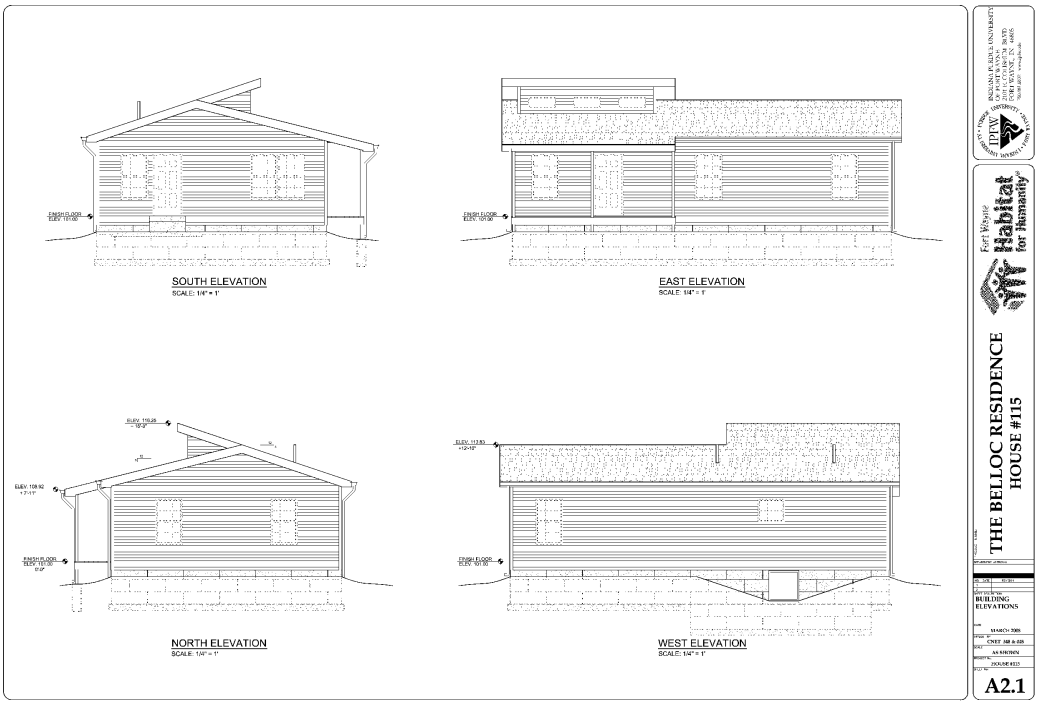

Figure 3

This project has not only been extremely instructive for students, but has also made a deep contribution to our society by furthering our knowledge of sustainable design and construction, and also by helping Habitat for Humanity build energy efficient homes. The DVD of the process of this project is being sent out to Habitat locations throughout the United States in May of 2008.

[1] Peter Fairley, *Technology Review,* MIT, January 2007.

[2] U.S. Department of Energy, Energy Information Administration, March 2001, *Monthly Energy Review*, and Lenssen and Roodman, 1995, "Worldwatch Paper 124: A Building Revolution: How Ecology and Health Concerns are Transforming Construction," Worldwatch Institute.

[3] William McDonough and Michael Braungart. The Hannover Principles. Hannover, Germany: City of Hannover, 1992.

[4] To find out more about how the Habitat for Humanity program works, you can go to www.habitat.org.

[5] Although the word "charrette" is French and describes the cart that was wheeled around to pick up student designs in schools of architecture, it has come to mean something completely different in the common parlance of the design and construction world. An integrated design charrette is like a large brainstorming session that values myriad voices. I have found the best description of assets charrette team members should have in Peter Senge's book The Fifth Discipline, New York: Doubleday, 1990.