

BILDS: A Developing Model for Residential Design-Build Education

Design-Build education in architectural schools prepares students in ways that cannot be replicated in the classroom. Educators have understood this for decades, and almost every school has experimented with Design-Build at some scale and at some point in its history. “Active learning” in which students interact with instructors, peers, and the environment can lead to deep understanding and has recently become a buzzword as applied to learning settings in all grade levels. Hands-on learning, an important component of active learning has been demonstrated by researchers to be a superior way to develop critical thinking skills. Collaboration, also gaining steam in the higher education world, has long been a critical part of the field of architecture and is fostered, indeed required, in Design-Build curricula. So we who run Design-Build programs have been leading the way with a pedagogic model that is being applied to a spectrum of disciplines because of its potential to develop critical thinking skills and deep learning.

Recognizing these benefits, the Department of Architecture at the University of Oregon has a long and distinguished history of Design-Build education. Our students have designed and built a woodshop, a commercial-duty bridge, a heavy-timber kiln shed, an interpretive park, and any number of pavilions and smaller scale remodel projects, all for non-profit organizations. But never before have we involved students in residential construction. While placing great value on these mostly more modest projects, I thought it was time for our department to embark on a program that designs and builds residential structures. There are a number of lessons to be learned from residential Design-Build projects that are not typically found in less complex projects. There is the value of learning directly about energy efficiency. There is the value of understanding fundamental daily human activities as they relate to the built environment. There is the potential of contributing to knowledge about housing, a critical human need. And there is the opportunity in every project to collaborate with landscape architects, interior architects, code enforcement agencies, realtors, and the entire panoply of persons and agencies that must interact to bring a project to a satisfactory conclusion.

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Figure 1: Kiln Shed - Photo by Erik Lubbock



Having decided to pursue a residential Design-Build curriculum, the question became “at what scale and with what focus would the University of Oregon most effectively participate?” There is a wide range of options, from the high-tech and relatively high cost annual Solar Decathlon competition to the highly innovative and very low cost Rural Studio at Auburn University, now working on \$20K housing prototypes. These are both very useful realms to explore and extremely educational for students, but I concluded that the most important work is to be done in the middle – at the very heart of the materials and systems used for more than 90% of the housing in North America. It is here, exploring innovation right in the heart of the ordinary, that innovation in materials, systems, and design will make the most impact. If serious changes to the housing industry are to be made, ecologically minded builders and designers must make an impact on the speculative single-family detached site-built houses that currently constitute the largest category of all housing produced on the continent. In 2013, the most recent year for which statistics are available, more than a million dwelling units were produced in North America, approximately 65% of which are single-family houses. This single-family construction alone represents 1.625 billion square feet and over \$200 billion of economic activity based on the current median new single-family house size of over 2,500 square feet. More important than the economic cost, however, is the potential reduction in the continental carbon footprint if just minimal reductions can be achieved in energy and material use. Furthermore, the students involved in these Design-Build efforts are most likely to be working in their professional careers on projects that employ standard construction practices.

A focus on standard construction fits well with the history and values of the University of Oregon and with my own interests. Architectural education at the university was founded 100 years ago as part of The School of Architecture and Allied Arts. From this beginning, with architectural training set in a collaborative studio environment and shared with landscape architecture, planning, and the arts; the emphasis has been on practical application combined with elegance and beauty. The School has a long and rich history of research and development of passive solar strategies. The department has a long-standing reputation for research and teaching in the area of sustainable design and has been ranked among the top 5 nationally

Figure 2: Photo by Eugene Register Guard

for many years. Design-Build projects have been an integral part of the curriculum for more than six decades. My own work – in teaching, writing, and professional practice – has been influenced by my connection with the School and its setting in the Pacific Northwest. My writing and teaching have focused on wood light-frame construction, a system that originated in the US and has endured, indeed has been dominant, for over 150 years. I also have a deep appreciation for the evolution of local building traditions and believe that there are significant lessons to be learned from the vernacular of a region. Putting all of these thoughts together, I concluded that a Design-Build curriculum at the UO should emphasize sustainable design while helping to meet the demand for affordable housing. The resulting product should be low-cost while exploring the best practices of sustainable design and providing elegant spaces to meet the practical needs of families at the lower end of the income spectrum.

It is no small task to set up a residential Design-Build program at a university, even when the tradition of Design-Build is well established. So I applied for and was awarded a grant to provide the time and resources to study existing programs and explore the potential for integrating such a program into my own department. My intention was to develop a program that would express the values of the school, would fit reasonably into the existing curricular structure, and would have the ability to be repeated year after year.

Armed with this modest grant, I set out identify existing Design-Build programs across the country with missions most similar to my own. At that time, there were several respected and well-established programs that were producing one house each year. These included Studio 804 at Kansas, the first-year graduate Design-Build program at Yale, and the URBANbuild program at Tulane. I took an extended road trip to visit these schools, and at each I was graciously hosted and educated about their programs. Common elements included:

1. Access to inexpensive land
2. Collaboration with local non-profit organizations
3. A focus on small-scale, affordable housing

Curricular patterns, risk management, and project management varied considerably, but all had similar donation strategies.

Returning with a deeper understanding of the potential and challenges, I set out to develop a similar program – the only in this climatic region – at my own university. These are exciting programs. They inspire students, and the multiple benefits make them easy to sell to academic and community members. Armed with a rough definition of my own proposed program, I was able to enlist promises of cooperation and support from my department, the university, local code agencies, non-profit organizations, material suppliers and design and construction professionals.

The result is OregonBILDS, BILDS being an acronym for “Building Integrated Livable Designs Sustainably.” It is admittedly a forced collection of words, but each one does have meaning. “Building” and “Design” identify the organization as a Design-Build program. “Integrated” is intended to convey both the collaborative nature of the enterprise – engaging a wide range of professionals and student majors – and the intention to integrate designs within their neighborhood context. “Livable” highlights the emphasis on meeting the practical needs of the low-income buyers above all other considerations. And “Sustainably” underscores the importance of striving to meet the highest standards of energy conservation and material resourcefulness while balancing these goals against cost.

In this nascent program, students design an affordable dwelling one term, and these

384 Hope Loop Move in ready Summer 2014
 Eugene, Oregon Offered at: \$175,000

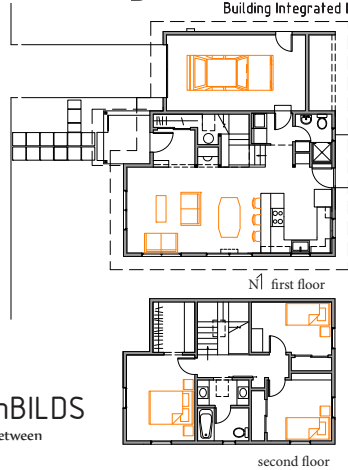
Designed and Built for thermal efficiency leading to lower utility bills



A very livable
 1280 ft² 3 bedroom 2 bath
 single family house
 located on an 1/8 Acre
 neighborhood lot
 with a private backyard

- Large Connected Living and Dining Spaces
- Social Kitchen with Energy Star Appliances and morning light
- Built-in furniture and casework
- Front porch
- Transitional Entry
- Attic Storage
- Good south solar exposure
- Attached single car garage
- Bike path access

Oregon **BILDS**
 Building Integrated Livable Designs Sustainably



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 a design-build collaboration between

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and/or other students construct the project during the following two terms. Taking advantage of the existing curricular structure, students can move in and out of the program with ease. So not only can students learn from building what they design, but they also can build first and then bring this experience to the design studio. University architecture, landscape architecture, and interior architecture students work side-by-side with construction technology students from our local community college. All are encouraged to find practical ways to combine simple, off-the-shelf materials in ways that are respectful of the environment and fully support the lifestyle of the target “affordable” market. A primary objective is to find a balance between “affordable” and “sustainable”. While all of the parts are perfectly ordinary, the ensemble should be anything but.

The most critical component of building such a program is the land, without which nothing can proceed. Initially, it appeared as if OregonBILDS would be able to work on university-owned property – designing and building starter houses for new faculty. During winter term, 2012, I led a studio that designed a modest market-rate house for this purpose at the edge of campus, but soon after the studio had concluded, the university administration decided that this campus land should not be used for housing at that time. Having established a relationship with the university development office, I was able to enlist its enthusiastic assistance to find another

Figure 3: Promotional Flyer - Trinity Real Estate

land donor. A donor was found, and another studio class designed houses for this parcel. But in the end, the infrastructure costs of this land turned out to be too great, so the donation was abandoned, and I resumed the search. This was in April, 2013.

Soon thereafter, I found a community partner with a parcel of land that would make the entire enterprise work. This land was owned by a public non-profit agency, HACSA (Housing And Community Service Agency), dedicated to providing housing for low-income residents within the county. The land, a 1.27-acre parcel in an existing low-density residential neighborhood, had been purchased by the agency over a decade earlier with the intention of building low-density multi-family housing. Realizing that the capital and political costs of proceeding with the multi-family initiative would be too high, the agency was interested in discussing how my program would help achieve its goals without the political battles. We reached an agreement in which HACSA would subdivide the land and donate it one lot at a time to OregonBILDS for the cost of the subdivision and a small donation back to its own housing non-profit arm.

Illustrating the importance of the land donation, OregonBILDS was able to raise over \$100,000 of start-up donations in the next four months. And with this and all of the critical components of the program already in place, we were able to jump-start the program fall term of 2014, just 5 months after basic agreements about the land had been reached. The fundamental academic schedule of the program is this:

- design the site and building during fall term, producing site plan and building plans sufficient to apply for and acquire a building permit.
- Submit plans to the city at the end of fall term, allowing winter break for plan review and permit issuance.
- Frame, enclose, rough-plumb, rough wire, and insulate during winter term.
- Cabinets, trim, painting, interior finishes, and landscape during spring term
- Sell the property over the summer and use the funds to repeat the cycle.

While trying to involve students in as many aspects of design and construction as possible, there are some tasks that must be performed by professionals. These include structural engineering, electrical wiring, plumbing, and most aspects of the mechanical work. Even so, students are able to observe this work in progress and learn a great deal by interacting with the professionals. Other tasks, while legal to be performed by students, are not practically done by them. Excavation, roofing, and drywall all fall into this category, but in each of these cases some small part of the overall task can be and is performed by students. The foundation for the main structure, for example, was formed and poured professionally, but students later poured and formed the porch foundations.

We have now successfully cleared the logistical hurdle of completing one cycle of designing and building. What have been our pedagogical goals while doing so? I will use the subtitle of this conference, “thinking while building”, to describe this. I love this phrase “thinking while building” because it is provocative. Do most builders think much at all while building? If so, what are they thinking about? And if we were able to answer this question, how might adjustments to these thoughts improve the quality of the built environment? Ultimately, our goal should be this grand – to influence all builders and designers to think more carefully and conscientiously about their actions.

But practically, our efforts will principally influence the thoughts of our students hoping and expecting that they will transfer these thoughts and knowledge to others. What are they thinking? Principally, I believe, they are appreciating the tactile and cognitive experience of putting things together. This is probably the first time

they have nailed a plate to a stud – especially in a production setting, and the knowledge of how this feels, how long it takes, and how difficult it is to accomplish well and efficiently informs their understanding of what they, as designers, will be asking builders to do. This kind of thinking by itself is profoundly useful. It will make our students better designers by merely increasing their knowledge of the construction process.

But can we go beyond this? Can we prompt our students to think critically of the construction process? How much material is being used here? Could this task be accomplished more efficiently with less waste or more effectively with a different material? Is the design itself getting the most out of the builder or out of the material? To get our students to think in this way, to ask these questions, we have to get them first to understand standard or “best” practice. Only then can the system be questioned.

“Best practice” is a moving target and may be taught to students by either studio instructor or a construction professional. In one example, students in the studio had designed a central line of structure for floor joists across a number of supports. For efficiency of structure, different beam sizes were specified depending on span. This strategy was reasonable and could be considered “best practice” from a material use point of view – each span utilizing only the minimal amount of wood required. When it came time to build, however, the framing contractor on site suggested making the entire 28-foot length out of one dimension beam – wasting a little material for simplicity of construction. This was clearly the correct direction in this case, and the change was made, and the students learned a lesson.

In another example, the students had specified advanced framing, taking care to align window rough openings with studs on standard layout. When it came time to frame the windows, the framing contractor wanted to add non-structural cripple studs under the subsill at the side of each opening – essentially adding extraneous framing members based on historic framing practice. The instructor pointed out the waste of material, the need for extra labor, and the diminished insulation. The framing contractor conceded that the cripple was not needed or useful, and the students who were there for the discussion had learned another valuable lesson. In an ideal Design-Build environment, this kind of thinking, this kind of discussion, extends to decisions in a range of settings and at a range of scales.

Other lessons are more fundamental. Is there value to Design-Build students in learning basic skills like painting? There is not much controversy about how best to paint a window stool. Depending on the situation, there is a process, a best technique that almost all professional painters would agree to. So not much thinking needs to be applied except by the inexperienced student. An astute student would recognize that there is a best practice and wonder how this relates to painting other surfaces. A good student would extend this thinking to all the other hundreds of acts that must be performed to build a house, about how they need to be coordinated, and about how they change from region to region and must be adjusted from project to project. A good student will recognize the complexity of the entire process, the value of experience, and will consider how she or he can act in a professional design capacity to get the most out of each circumstance.

How do we as educators best facilitate this thinking while building and thinking about building while designing? It is my experience that the most effective method is to engage the students with professionals. In studio, there should be presentations by and dialogue with builders, contractors, energy consultants, and architects who specialize in residential work. On the site, there should be workshops and short

presentations by the general contractor and as many subcontractors as possible. Thinking is promoted by discussion based on engagement, and engagement is inspired by those with experience.

Another pertinent question is how to convey the results of the thinking while building to others. How do other students learn of the insights garnered by their peers on the construction site? How are realizations by contractors communicated to others in their field? How is the quality of the design conveyed to the lay public? These are important questions because the affect of the knowledge gained in the educational exercise will be minimal if not conveyed to others. There are certainly mechanisms in place such as print and electronic media to disseminate this information, but its effective use is an emerging art. The excitement around educational Design-Build programs can be infectious, and the leveraging of this excitement can have a profound effect on the efficacy of the effort.

OregonBILDS has essentially completed its inaugural year of operation. Students have designed a house and garden. These and other students have built the entire project, and it has been marketed and sold. We have partnered with two local non-profit housing agencies, with the local community college, with city government, with the local utility, and with the local homebuilder's association. We have successfully solicited in-kind and cash donations from a long list of local contractors and material suppliers. We have affordable building lots in place to sustain the program for another eight years. So, by most measures, we should count our first year of operation a success.

But this was the first year, and in a sense, the entire operation was an experiment. So it was inevitable that we would take some missteps. There is definitely room for improvement, and we would be negligent to ignore the shortcomings and not examine every aspect of the program to seek opportunities for correction. A self-critical list of areas for future development based on this past year would include:

- Building schedule – probably our greatest constraint on quality and educational exploration. We were a slave to the 20-weeks of classes for construction
- On-site delivery of instructional content – Not enough time or resources were able to be dedicated to proper on-site training of students. Safety was not compromised, but efficiency and quality suffered at times for lack of training.
- Communication – It was very difficult to communicate the details of process between independent groups of students. One group of students would end their work session and then return after three other groups had continued that same work. Communication is key and was reasonable but not excellent.
- Program management – The program suffered from multiple turnover of personal assistants to the director, so the director spent too much time being a gofer when he could have been teaching.
- Promotion and marketing – There was not enough of this because there was not enough staff this first year.
- Recording of process for benefit of future groups – There was also not enough of this because of lack of staff.

While acknowledging that we can do better, we can also take pride in the progress we made. First and foremost, just completing the project within a year I view as a tremendous accomplishment. Counting the community college students, we had over 80 students enrolled in our classes. With these students, we designed a house and garden and then constructed them within two 10-week terms. We had our work highlighted in publications at the university level, school level, in the local



Figure 4: Dining/Kitchen from Sitting Area



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newspaper, and on the local TV news. We sold the property to an income-qualified family for virtually the asking price of \$175,000, and from the sale we will realize proceeds sufficient to carry the program through another year.

Our greatest accomplishment, I believe, is the design of the house itself. It meets all the mandatory market needs for local affordable housing plus it is extremely energy efficient, has an abundance of storage, and is designed for flexibility with multiple options for future simple expansion or conversion. In addition, it has passive solar design with light-filled rooms, delightful custom cabinetry, and a highly developed edible landscape with irrigation.

How can success with such an educational opportunity enable our department and our university to effectively articulate our mission and our strategic priorities within the rapidly transforming contexts of both higher education and the architectural profession? The answer, I believe, is to build on the admirable start we have made by broadly publicizing the work – the process and the product. This can and should take the form of both print and social media designed to reach diverse audiences. People of all walks do respond to this work because it is both practical and creative. The work can be disseminated within the academic world through conferences and/or competitions. The work has the potential to attract to our school students with interests and backgrounds that align with our mission, and through the synergy of their efforts as students, the work will get more robust, and even stronger students will be recruited. These students in their professional roles as future practitioners and educators are our hope to move the dial on the quality of the single-family residence that has no indication of losing its grip as the dominant housing type in North America. Working with other universities to develop similar programs can have a multiplying effect. Nova Scotia BILDS would look quite different than OregonBILDS but could have a similar profound effect on the quality of the environment.

Figure 5: A&AA Review