

DESIGNhabitat: design/research + design/build:

Expanding the Design//Build Model

Justin Miller, Auburn University

David Hinson, Auburn University

ABSTRACT

This paper presents the evolving work of the DESIGNhabitat program over its past eight years. This program has been responsible for the research, design, and construction of several high quality energy efficient homes for Habitat for Humanity homeowners throughout the state of Alabama.

Over the past decade the design/build studio has moved from the fringes of design education to become a significant pedagogical tool utilized in the curriculum of architecture schools across the country¹. As schools have become more experienced with this model of teaching, the goals pursued by some schools have expanded (beyond the enhanced learning experiences gained from hands-on experience and community service) to include specific design-based research objectives. These research goals have increasingly centered on improved building performance with (in the case of the DESIGNhabitat program) the inclusion of simulation as a critical component of the program design.

This integration of research into the design/build studio model is evidenced in the prototypes designed and constructed by university teams competing in the solar decathlon, as well as in design/build studios engaged in varying combinations of design/simulation/fabrication at a range of scales from the component scale to full working prototypes. These studios rely upon and simultaneously (through builds and fabrications) test the limits of current tools and technologies. Further, there are studios that have leveraged the predictive capacity of digital tools available to the profession to engage in design research. These studios use simple, yet powerful digital tools to simulate the performance of preliminary designs in order to test an array of potentials prior to any build phase - in

essence a design/simulate/build studio model. These studios often serve to test particular hypotheses, or demonstrate integrated design strategies to audiences beyond the discipline of architecture . and are frequently requiring a greater degree of inter and multi-disciplinary collaboration.

These research driven design/build studios also expand student learning experiences in practice environments that require varying degrees of collaboration and consultation, and introduce students to tools and technologies that are novel in architectural education. The work of these studios tests specific propositions, and/or demonstrates specific effects of a particular design process, and in doing so it often extends the research agenda beyond known capabilities and make requisite the ability to exchange information with a variety of collaborators and consulting specialists.

INTRODUCTION

The DESIGNhabitat program is an ongoing collaboration between the School of Architecture and the Alabama Association of Habitat Affiliates. From its inception in 2001, the partnership has been a vehicle for applying the energy and talents of the School of Architecture to the challenge of designing and constructing high quality affordable housing.

In addition to exploring design options that Habitat could not pursue on its own, the School of Architecture utilized the DESIGNhabitat program as a methodology of teaching. The program has used the research focused design//build studio format to pursue answers to significant questions related to the development of prototype designs and the design and construction of high-quality, energy efficient, affordable housing in the state and across the southeast region.

This paradigm of “learning from doing” has long been an integral part of the School’s culture and is seen as a means to both train architects-to-be with the skills to succeed in practice and as a way to cultivate the values of community engagement, leadership, and service envisioned by the late Samuel Mockbee in his call for educators to prepare “citizen architects”.

Perhaps the most significant impact of the program has been on the students involved in the program over the last eight years. These future architects have gained significant insight and understanding into the challenges of creating high-quality affordable housing aimed at a specific place and region, the importance of research as a design tool, and have experienced, first hand, a powerful model for professional engagement and action in a field of practice where their talents and passion can have tremendous impact.

Through several rounds of the DESIGNhabitat program the research agenda has focused on regionally responsive design strategies, fabrication methods, and energy efficiency in the context of Habitat for Humanity’s cost structure and volunteer labor pool. These rounds have involved structured research and design phases preceding the construction of prototype homes as well as the structured research, design, and simulation of house prototypes.

The DESIGNhabitat program is now in its fourth round of

design-based research. **DESIGNhabitat 1** focused on development of a new prototype home aimed at improving the cultural and climatic “fit” relative to HFH homes built in the early-20th Century neighborhoods common to communities across Alabama. **DESIGNhabitat 2** and **DESIGNhabitat 2.1** centered on a study of the potentials and limitations of incorporating prefabricated construction strategies into the Habitat home-building process in the post-Katrina recovery process. **DESIGNhabitat 3** is currently underway, and is focused on incorporating the insights of the first two phases and an added emphasis on advanced energy conservation strategies. Each round of the DESIGNhabitat program has resulted in the unveiling of not only new questions related to the feasibility of the design proposals, but also questions related to the evolving pedagogy of research in design//build studios.

The DESIGNhabitat program began via a request that the School of Architecture help address the problem of community resistance to the construction of Habitat for Humanity homes in some older, early 20th Century neighborhoods in Alabama. Over the course of several months of planning, faculty of the school and HFH leadership established a set of design objectives for the DESIGNhabitat student team:

Design a “simple, decent home” and one that will “inspire the soul”, and be responsive to the cultural context of the Alabama communities where the home will be constructed.

Be responsive to the organizational culture of Habitat (“volunteer-builder friendly”) and to HFH’s budget of \$50,000 to \$60,000 (2009). The design must be replicable by Habitat affiliates.

Conserve energy via design strategies that are tailored to the climate of the region.

Incorporate building systems and materials strategies that lower the long-term maintenance costs associated with home ownership.

Incorporate appropriate sustainable design principles, including passive solar design strategies and lower the homeowner’s dependence on energy consuming heating and cooling appliances.

These initial objectives have provided a framework to guide

subsequent design research as well a means to open up new questions with regard to the program in terms of actual output and teaching methodologies.

DESIGNhabitat 1



Fig. 1 DESIGNhabitat1, Opelika, AL, 2002.

The aims of the DESIGNhabitat 1 Studio (2002)³, as noted above, were to help Habitat understand how to build homes responsive to the region's culture, architectural traditions, and climate as a means to improving both the contextual "fit" of these homes and their energy performance.

The DESIGNhabitat 1 Studio was structured as a two-semester effort: a semester of pre-design research (in a seminar format) followed by a semester-long design/build studio. In the first semester, sixteen 3rd and 4th year architecture students and four students from Auburn's construction management program worked in teams to research Habitat's process and culture, analyze the communities where the prototype home might be built, and identify the energy conservation and construction system options that would realize the established design objectives. The first semester was organized as a research seminar, the focus of this effort was to develop a clearer understanding of the project objectives and the means by which those objectives could be pursued.

The second semester of the project began with an intensive 5-week design charrette in which four student teams developed a 3-bedroom prototype home that responded to the goals for the project established in the research phase. Each proposal included an estimate of construction cost. The four proposals were presented to the Habitat advisory group in a "super jury" event and one of the schemes was selected for construction as the initial

"DESIGNhabitat House". The students quickly shifted from design to construction teams and completed the construction of the home in eleven weeks. Following on the construction of the initial prototype house, the School has helped HFH affiliates build five "copies" of the DESIGNhabitat 1 house across the state. The DESIGNhabitat 1 Studio has influenced the construction practices of affiliates throughout the state. (See Figure 1.)

DESIGNhabitat 2



Fig. 2 DESIGNhabitat2, Greensboro, AL, 2006.

The DESIGNhabitat 2 Studio (2006)⁴ sought to extend the investigation of the questions that framed the 2002 studio and added the challenge of incorporating factory-produced modular approaches into the Habitat model. Originally envisioned a solution with narrow application, the prefabricated/modular construction approach of the DESIGNhabitat 2 project was dramatically re-framed by the Gulf Coast hurricanes of 2005. Facing a dramatic shortage of volunteer labor in the wake of these storms, modular construction became a significant element of Habitat's response strategy in the region, and Habitat for Humanity International stepped forward as the main project sponsor of DESIGNhabitat 2.

The students and faculty of the DESIGNhabitat 2 team worked with advisors from the Alabama Association of Habitat Affiliates (AAHA), and a major modular housing manufacturer, Palm Harbor Homes to develop their proposals. The DESIGNhabitat 2 initiative had four objectives:

Capitalize on the systems-built industry's expertise re:

production process, resource efficiency/conservation, and quality control;

Integrate the energy performance research developed to date into the DESIGNhabitat 2 home;

Explore the benefits of this strategy for Habitat affiliates struggling to build homes with limited volunteer resources, and;

Immerse students in the challenges and opportunities of affordable housing design, and cultivate an ethic of service and community engagement as an integral part of their professional values.

The DESIGNhabitat 2 Studio was again structured as a two-semester effort: a semester of pre-design research (in a seminar format) followed by a semester-long design/build studio. In the first semester, students began the project with a semester-long pre-design research effort intended to immerse the team in the specific design opportunities and constraints associated with factory-based construction. The students also sought to identify the “leading edge” of design innovation (including energy-performance, materials and construction systems, and building configuration) relative to modular design and construction – both inside the industry and within the professional design community. The goal was to understand the potential of prefabrication and modular construction in rural areas, where volunteer labor is limited, in the aid of providing more affordable housing to these often poorest areas of the state. Again the effort of this research phase was to develop a clearer understanding of the project objectives and the means by which those objectives could be pursued.

The team began the next semester with a month-long charrette intended to generate alternative prototype home proposals incorporating the lessons of the fall research phase. In mid-February, five proposals were presented to a panel of project advisors (Habitat leadership, modular industry representatives, and faculty) who selected one of the schemes to advance to design development and construction.

Over the following 8 weeks the students worked closely with Palm Harbor to refine the design of the factory-built components and to develop the details and construction strategy associated with the site-built center section of the design. The modular sections of the design went into

production in mid-April at Palm Harbor Home's plant in Boaz, AL and were then shipped to the home site the following week. The student and faculty team then began a two-week “blitz build” to complete the site-built components of the home. (See Figure 2.)

DESIGNhabitat 2.1



Fig.3 DESIGNhabitat2.1, Greensboro, AL, 2008

The DESIGNhabitat 2 House, completed in 2006, featured a hybrid approach of factory-produced components and site-built sections. As successful as that project was, many aspects of modular product remained to be studied. A team of 6 students and two faculty from the School of Architecture began planning a follow up semester long design/build modular research studio for the spring of 2008.

As the second in the series of modular home designs, the DESIGNhabitat 2.1 project was developed in response to the lessons gained from the first cycle of design, construction, and analysis of the DESIGNhabitat 2 house. More specifically, the 2.1 project team set out to explore a series of questions:

Could the on-site man hours be reduced even further if a higher proportion of the living space was factory built?

Would the cost premium for modular production rise proportionally, or would the logic of the factory-based economic model allow that extra area to be built at only slightly higher cost?

Can the production logic of the modular process generate its own unique set of design potentials –

potentials not inherent in the design/cost equation of site-built homes?

The 6-student team began the semester by re-visiting the un-built schemes developed in the 2.0 Studio (2006) to see if they could provide a viable starting point for the second house. Two of the schemes were determined to be good vehicles for pursuing the goals that framed this second round, and the students worked to incorporate the best features of each into a new design.

While the 2.0 house featured relatively simple factory-produced elements (and a more complex, site-built center bay); much more of the design features of the DESIGNhabitat 2.1 house rested on what the students could achieve via the factory-produced modules. Consequently, translating the DESIGNhabitat 2.1 scheme into units which could be factory-produced and transported to the site required a more complex level of pre-production coordination between the students and the modular manufacturer.

Working with the modular manufacturer to understand all the fabrication and assembly details - from the hinged roof and hinged attic walls to the eaves and marriage line details - became the focus of the team's efforts over the course of the spring of 2008. The modules went into production at the Nationwide Custom Homes plant in Arab, GA in early May, and the students utilized the summer of 2008 to complete the site-built components of the design. (See *Figure 3*.)

DESIGNhabitat 3

The DESIGNhabitat 3 Studio was structured as a one semester design research effort. The studio worked within the program framework of a design build studio, however the studio leveraged predictive modeling and simulation software that had not been utilized in previous DESIGNhabitat programs in order to push further the research into energy conservation methods applicable to Alabama HFH Affiliates. The studio developed in response to a grant program designed to provide financial incentive for affiliates to construct more energy efficient homes (minimum standard of Energy Star certification). This incentive grant is funded by the Home Depot Foundation and administered through Habitat for Humanity International via its state support organizations. In collaboration with Alabama's state support organization

(the Alabama Association of Habitat Affiliates - AAHA) the DESIGNhabitat 3 studio developed a set of prototypes house designs aimed at providing affiliates with designs that would exceed the requirements of the incentive grant. Additionally the DESIGNhabitat 3 program sought to continue research into prefabrication strategies for Habitat homes, specifically focusing on issues questions posed by previous DESIGNhabitat programs.

The DESIGNhabitat 3 team was comprised of 15 (3rd + 4th year) architecture students and one faculty member, along with advisors from the Alabama Association of Habitat Affiliates (AAHA) including the AAHA Sustainable Building Specialist.

The DESIGNhabitat 3 initiative was designed with three primary objectives:

- Integrate energy performance expertise developed in prior phases of the DESIGNhabitat program into the DESIGNhabitat 3 prototypes;

- Exceed the energy efficiency requirements of the HFHI and HomeDepot Foundation incentive funding (Energy Star baseline);

- To expand upon prior research into the mix of site and prefabrication delivery methods that were viable Habitat affiliates in the state and region and provide strategies for their incorporation in the DESIGNhabitat 3 prototypes and test these against the parameters of HFH construction cost framework and energy performance.

The students began the semester with a four-week re-design of the DESIGNhabitat 1 prototype for a state affiliate and prospective homeowners. This applied design research immersed the team into the design strategies and solutions the prior DESIGNhabitat team had developed and served as an introduction to the DESIGNhabitat program. Following a five week design research phase, the modified DESIGNhabitat 1 schemes were presented to AAHA and the Gadsden affiliate and prospective homeowners. The presentation to prospective homeowners and supporting affiliate members was instructive and helped focus the research agenda upon energy performance and prototype development aimed at meeting the incentive grant requirements. (See *Figs. 4,5*.)

Following the presentation to HFH parties, students spent one week conducting research into the energy performance metrics and rating systems, which would be utilized in evaluating the prototype designs that the teams were gearing up to design. This one week intensive research phase was continued as the students, working in teams of 3, began to design prototypes for 2, 3, and 4 bedroom homes.

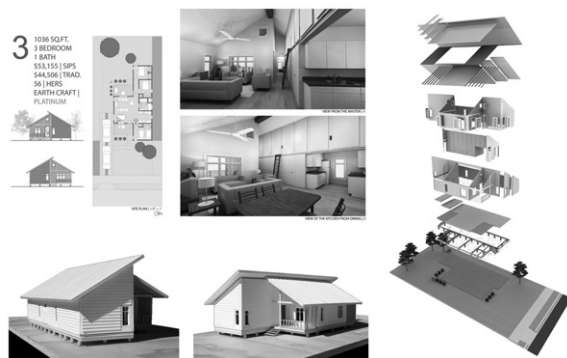


Fig. 4 DESIGNhabitat3, AL Prototype, 2009.

Recognizing that a design/build studio without a build phase does not quite measure up, the studio sought to utilize all means available to simulate the build phase. In doing so the students worked in close collaboration with the AAHA Sustainable Building Specialist. Students ran their designs through several design iterations informed by a series of simulation cycles. For the students this required both a degree of precision and depth of material and systems knowledge and (research into those systems) than had been required of them in their previous design studios. At the same time this modeling and simulation allowed the students' design work to be informed and reformed by predictive performance data. The students found and demonstrated to state affiliates, at the AAHA state conference, that achieving the energy rating required to receive incentive grant funding, was possible and practical within the constraints within which Habitat builds. While the simulations of the student work exceeded project goals, they maintain validity only if they can be tested. It is in this light that the design/build studio model's expansion is only valuable as a research venue if the work is built (tested) and subsequently verified. Currently in progress, the DESIGNhabitat 3 prototypes are being refined in anticipation of construction by HFH affiliates this year.⁵

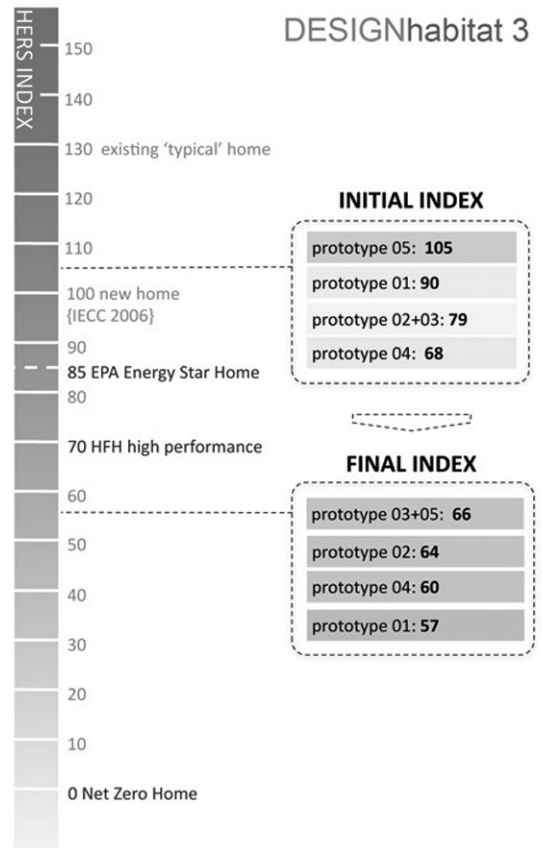


Fig. 5 DESIGNhabitat3 Prototype Designs. Energy Star Metrics, HERS INDEX, 2009.

CONCLUSION

As the design/build studio has migrated from the margins of architectural education to become a significant fixture of many leading architecture schools, the goals of these programs have expanded beyond the enriched student learning experiences gained from hands-on learning and community service to include specific design research objectives. In this context, the design/build studio offers a venue for faculty and students to explore a specific question, or to provide a demonstration and evaluation of a design strategy to a broad audience. In these studios, research-driven design initiatives provide opportunities to

consider the place of research in studio, and in the context of a professional design education in general.

The DESIGNhabitat program, among other initiatives, illustrates the potentials for advancing academy-based design research via the vehicle of the design/build studio, and provides an illustration of what design-based research can mean. By foregrounding the questions found in research-driven design/build studios, the faculty and students involved are able to produce design insights that translate much more broadly than the lessons of a single structure. The key components of this version of design-based research include

- *The goals driving the design of these studios are organized around a clear set of questions – questions that while informed by the project and client attempt to look beyond the single project/client.*
- *The design/build stage of the projects are preceded by a significant amount of analysis of prior phases and pre-design research to frame the goals of the subsequent round of work.*
- *These initiatives are not “one and done” exercises. Rather they are designed as multi-year projects designed to allow the faculty and students involved to work through the full-cycle of researching, designing, building, evaluating the outcome of their work and – most significantly - responding to their findings with a new round of design explorations and research questions.*

While not all schools can make the long-term the commitments needed to support a research-driven design-build studio program, the DESIGNhabitat program provides an illustration of how a small but growing number of schools have begun to see the design/build studio as a means to pursuing a sustained design dialogue in important arenas of design research. As the model expands to include new studio tools and software the design-build studio can provide a fertile “testing ground” for pursuing answers and insights to questions of significance beyond the context, or the reach, of the traditional studio.

ACSA Annual Meeting (RE building), the recent issue of the JAE focused on the topic, and the increasing (and varied) number of design/build initiatives launched by architecture colleges and schools throughout the United States. Auburn University's School of Architecture is home of the Rural Studio, Urban Studio, and the DESIGNhabitat program; additionally schools from across the Southeast and US have participated in service learning design build studios across the areas of the gulf coast most impacted by hurricanes Katrina and Rita.

2. *Service learning*, as defined by M Duckenfield and L. Swanson in, *Service learning: Meeting the Needs of Youth at Risk*, National Dropout Prevention Center, 1992, is a teaching method, which connects meaningful community service experiences with academic learning, and has been championed by some as a model for education reform at both the K-12 and higher education levels.
3. The DESIGNhabitat 1 house has been replicated by 4 HFH affiliates across the state, and the construction strategies of the project have been adopted by many others. The DESIGNhabitat 1 project received a HUD Secretary's Silver Award for Affordable Housing Design and an ACSA Collaborative Practice Award.
4. The DESIGNhabitat 2 project received an AIA Alabama Honor Award, an AIA Housing Award, an AIA Education Honor Award, and an ACSA Collaborative Practice Award.
5. The DESIGNhabitat program received the 2009 ACSA/AIA Housing Education Award.

In addition to bringing significant additional financial and human resources to Habitat, the collaboration has earned significant recognition for the School, including state and national AIA design awards, a HUD design award, two ACSA Collaborative Practice Awards, and an AIA Education Honor Award.

6. For an overview of the history of design/build hands-on learning in architectural education see “Community Centered Design/Build Studio: Connecting the Past & the Future of Architectural Education” by David Hinson, presented at the ACSA Technology Conference, March 2002.
7. www.cadc.auburn.edu/soa/design-habitat/index

NOTES

1. This assertion is evidenced by the dramatic increase in the number of faculty presentations devoted to design/build initiatives at academic conferences like the