28 Dollars and 12 1/2 Cents (A Design Build Project)

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INTRODUCTION

28 Dollar and 12 ½ Cents is the amount that Henry David Thoreau paid for materials for his Cabin at Walden Pond near Concord Massachusetts in 1847. Adjusted for inflation this would amount to 640 Dollars and 15 Cents today.

One hundred and sixty-three years later as a part of an interdisciplinary product design elective at the College of Architecture, Texas Tech University in Lubbock, Texas, the students and their professors from three different departments revive Thoreau's sprit of building a sustainable cabin on a budget. This paper is a critical review of the research process and questions whether it is possible to design/build a sustainable cabin on a minimal budget and how this project fits within the architecture curriculum.

Historical precedents for this project are Henry David Thoreau's Cabin at Walden Pond near Concord, Massachusetts and Le Corbusier's "Cabanon" Roquebrune-Cap-Martin, Southern France. Both projects are studies of the minimal spatial needs for living. Furthermore they are examples of structures that successfully relate to their sites and to the environment. Both projects were built under significant budget constraints, which are seldom considered in the design studios of our architecture schools.

In addition to reminding us of the cost – both financial and environmental – of our marks upon the landscape, Thoreau offers the lesson of knowing the value of building something ourselves. Design Build requires students to learn with their hands; to learn about the strength and resistance of a material, the requirements of tectonics, and about structural integrity. Students at the sustainable lab exchanged the computer and the mouse for the nail and the hammer. They learned about the successes and the shortcomings of affordable/sustainable design build through experience – by measuring, testing, and documenting their process of building the Sustainable Cabin.

The Sustainable Cabin building process was started in the summer of 2008. By the end when it was finished in the summer of 2010 more than sixty students worked on the project and was moved to its permanent site on the High Plains north-west of Crowell, Texas. Fully plumbed, and drawing power from its own solar-powered energy source, the cabin is now habitable and serves as an experimental research station in sustainable design and living.

Unlike other design build projects, which upon completion are handed over to a private client, the client of the Sustainable Cabin is the Pease River Foundation, a not-for-profit foundation based in Crowell. By mutual agreement and support, the university and the foundation funded both the Cabin and the site in order that future students visit and study the Sustainable Cabin. The Cabin will serve as a Living Research Laboratory for generations of student to come, testing the successes and shortcomings of the project and possibly upgrading its components as technology continues to develop.

OVERVIEW OF DESIGN-BUILD PRECEDENTS IN EDUCATION AND PRACTICE

Samuel Mockbee's Rural Design Studio, perhaps the most prominent example of an academy-based design-build studio, established an innovative educational opportunity that directly applied designing and building to improve the life of the less fortunate. The Rural Studio showed that cost effective structures, often using unusual materials, could yield provocative spaces and dynamic forms. *Architectural Improvisation, a History of Vermont's Design/Build Movement*[1] documents a seminal architectural initiative that sought a new architecture characterized by organic forms, improvisational processes, hands-on methods, and use of natural materials. The work of Dan Rockhill at the University of Kansas School Of Architecture is another exemplary program. His Studio 804 is focused toward contemporary prefabricated designs which allow for construction cost savings and can be assembled in a shorter time frame than typical housing projects. Today, there are several design-build courses offered by American university architecture degree programs that immerse students in the actual process of conceiving and constructing. Social justice, humanitarian outreach, technical exploration, and sustainable building practices are some of the issues driving this movement.

Design-build, as a logical strategy for constructing things, is not an entirely new concept. Master builders flourished in ancient times and the division of responsibilities for design, construction, management, and finance into separate professions is a recent invention. During the last half of the 20th century, interest in non-traditional building methods, particularly among the middle and upper classes, has grown with the demand for faster construction schedules, tighter cost controls, better quality materials and workmanship, and a streamlining of the professional services associated with construction. In contrast, many of the poorest people living on this planet today, a group that comprises the bottom twenty percent of humanity in economic terms, are design-builders out of sheer necessity. A defining feature of the modern professional design-build movement is a single authority controlling both design and construction. This method can accelerate communication between client and the designer-builder that may reduce the risk of litigation and can increase the speed of procurement and fabrication to keep costs in check.

> "The degree of integration between the designer and constructor is a key component of design-build. Teamwork is important. Providers who can demonstrate established communication channels and relationships among team members should have an advantage in the fast-paced design-build process."[2]

Against the recent backdrop of gloomy global economic forecasts, a potential bright spot in the near future may be the projected increase of U.S. building construction to $60 billion by 2010[3] with the green buildings product market projected to be worth $30-40 billion annually by the same year.[4] An emerging model for contemporary practice emphasizes a complete integration of design and construction, a single authority, to achieve sustainable or "green" buildings.

> "Design-build has shown a steady market penetration in some countries. In the U.S. and the U.K., it grew from less than 10 percent in the early 1980s to more than 30 percent today."[5]

With the total construction market accounting for roughly 13% of the $13.2 trillion U.S. GDP in 2008[6], including all commercial, residential, industrial facility, and infrastructure construction, segments of the architecture profession may increasingly embrace design build as a way to sustain a profitable practice in a changing economy. The AIA estimates that design and construction industries alone are responsible for 10% of US GDP. The most recent economic crisis has tightened credit markets, delayed financing for new construction, and forced layoffs in design and construction. According to the Bureau of Labor Statistics construction jobs are down 10% for the year 2010.

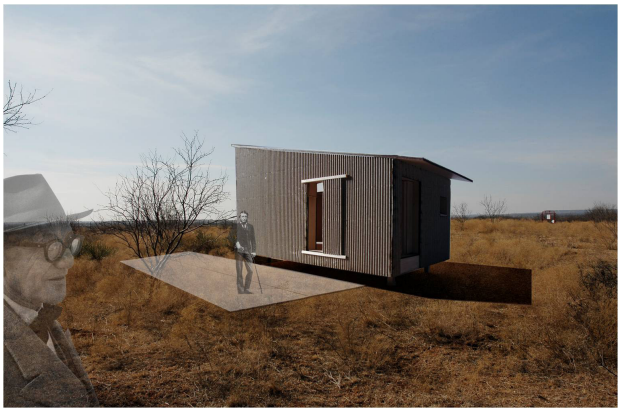
GREEN-DESIGN-BUILD AND THE VALUE OF CRAFT

The green building movement portends to reduce our national dependence on foreign energy, a matter of national security, and create badly needed new jobs, essential to a high standard of living. Green building, coupled with an increase in alternative design-build strategies, may open new career paths for architectural graduates, both in and out of traditional architectural practice. Design studio projects that aim for the same end can provide teaching and research opportunities that enhance student learning about how buildings are designed

and made today, and how they will be conceived and constructed tomorrow. In his book *Shop Class as Soul Craft: an Inquiry into the Value of Work* author Matthew B. Crawford points out that the driving of a nail or the finishing of freshly poured concrete are difficult tasks to download from the internet. Knowledge of the craft of building, the skills required of a manual trade, and the provision of the physical effort behind the hammer and the trowel may once again become noble pursuits of American workers seeking prosperous and rewarding occupations. The green-design-build movement may change the current trend of "assembling" buildings and help to rediscover and promote the craft of "making" built environments. Architectural education, as individual regional schools and as an interconnected global web of university based institutions, can provide important leadership in this transition.

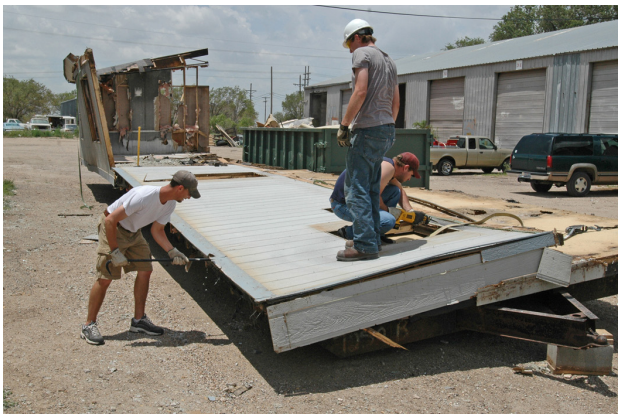
A PREFABRICATED "SUSTAINABLE CABIN" AS A DESIGN-BUILD CHALLENGE FOR STUDENTS

The design/build project presented in this paper was conceived in 2006 as a living laboratory for sustainable living. It is a "Prefabricated Dwelling", built off-site which will be used to test and demonstrate sustainable architectural concepts. It is funded in part by the client-owner, a non-profit organization, and by supplemental grants. The finished design, a 400 square foot self-powered cabin, resides in a remote rural location where it will be rented out for recreational purposes such as hiking and nature photography, and will also accommodate researchers and persons interested in learning about low impact construction and living styles. Its primary purpose is to support research and education in the arts and sciences. The cabin is designed to produce 100% of its electrical power needs using photovoltaic solar panels. It utilizes rain water collection, natural cross ventilation, passive solar design, and composting/gray water systems. Over its lifetime, the cabin will provide data on solar power, sustainable components and materials, and water harvesting technology that will contribute to regional architectural knowledge informing new construction models, and identify effective strategies for retrofitting existing buildings with sustainable building features and systems. An agreement exists between the university and the owner, a non-profit organization, which ensures that future generations of architecture students and faculty can visit the cabin to gather and test performance data throughout its lifetime. The cabin is intended to be updatable over time as new and improved technology and sustainable systems become available. Historical precedents influencing the design are Henry David Thoreau's Cabin at Walden Pond near Concord, Massachusetts and Le Corbusier's "Cabanon" Roquebrune-Cap-Martin, in Southern France. Both projects are studies in minimal spatial needs for living and are examples of structures that successfully related to their specific sites, effectively responded to the environment, and were built under significant budget constraints.

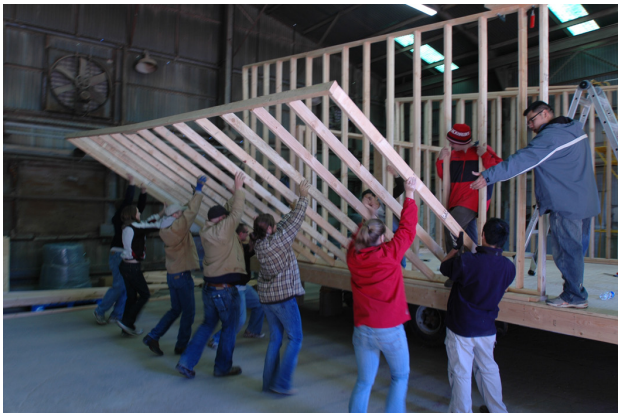


The overall concept (Figure 01) was developed during a faculty development leave by the lead course instructor who is supported by his colleagues which each bring their own specialized expertise to the overall product. The actual building construction is performed by students and instructors, professional trade persons when necessary, and supervised by the lead course instructor. During the actual building process design detailing decisions and onsite innovations are still being made to adjust for competitive pricing from suppliers, and to accommodate products and materials that are donated. Computer generated drawings of record are updated in real time at the building site. Factors that keep costs down are free labor, from students and faculty, donated supplies and labor from vendors and suppliers willing to support the non-profit aspect, and real-time competitive purchasing similar to actual design-build practices. Embedding the college sponsored studio design-build experience within the contemporary academic semester shapes the way the project progresses from concept to finished product. During the summer semester of 2008, five students and two faculty members demolished a

used mobile home salvaging its wheeled chassis. The discarded wood and aluminum components were also recycled. The chassis was modified and structurally reinforced to accept the new building design requiring a certified welder (Figure 02). In



the 2008 fall semester, twelve students and two faculty members secured the floor structure and



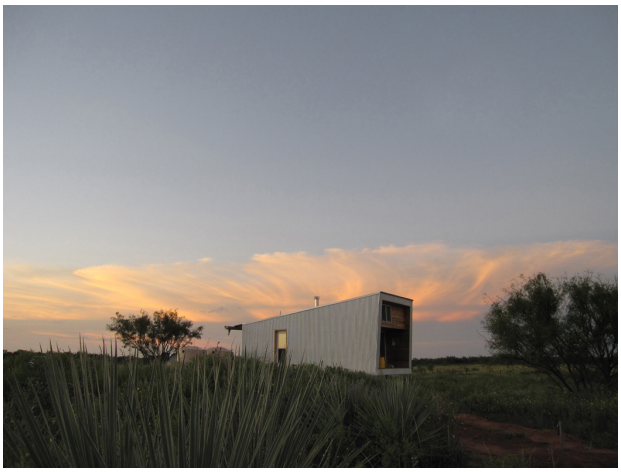
deck to the chassis and started framing the walls. (Figure 03) In the spring 2009 semester, twelve students and two faculty members completed the wall and roof framing and installed exterior sheathing and recycled cotton insulation, a regionally manufactured building product. (Figure 04) In the summer 2009 semester, three students and three faculty members installed electrical wiring and fixtures, roughed in plumbing fixtures, and started interior wood wall and ceiling finish surfaces. In the fall semester of 2009, twelve students and three faculty members completed the remaining prefabrication tasks including interior finishes, doors and windows, exterior cladding, and all plumbing and mechanical systems. (Figure 05) On June 18th of

2010 the prefabricated cabin was transported a 155 miles from the Lubbock warehouse to the land of the Pease River Foundation north of Crowell, TX (Figure 06 and 07).

LESSONS LEARNED IN THE DESIGN-BUILD STUDIO

Ideally, the design-build experience should be a seamless process involving the same cast of participants from start to finish, but this presents a challenge within the traditional academic schedule. Therefore, the sequential stages of construction must connect to the work previously performed, and the work to be accomplished in the following semester. To address the need for this continuity and eventual closure, the course instructors maintain a website that constantly provides students, current and former, with the latest information on project progress. A second challenge is deciding when and where to build. Many campuses may not have on-site locations for construction projects and

students do not have a standard 40 hours a week to work. Because the cabin is based on a mobile building platform, it can be housed in a warehouse located at an industrial park that is within a reasonable distance from the campus. An advantage to this method of building is construction can continue regardless of weather, and the tools and machinery



needed for building can be left on location, more like a shop than a construction site. Students can only put in 6 to 10 hours per week, so the "construction classroom" in a secure warehouse building mitigates the problems associated with a conventional on-site construction schedule. The final location of the cabin is a remote site several hours from the university campus and working at this site to construct the building would prevent student involvement and restrict faculty supervision during a regular semester.

There is an important need in higher education for craft experience or skilled work that combines mental dexterity with manual competence. In *Shop Class as Soulcraft,* Matthew Crawford questions the educational imperative of creating "knowledge workers" that epitomize the separation of thinking from doing that resulted from the assembly line over a century ago. Crawford makes a compelling argument in favor of the intrinsic satisfactions and cognitive challenges of manual work claiming that it raises one's self-esteem, and can help people to remain grounded in an ever more abstract world.

> "The current educational regime is based on a certain view about what kind of knowledge is important: "knowing that", as opposed to "knowing how". This corresponds roughly to universal knowledge versus the kind that comes from individual experience. If you know that something is the case, then this proposition can be stated from anywhere. In fact, such knowledge aspires to a view from nowhere. That is, it aspires to a view that gets at the true nature of things because it isn't conditioned by the circumstances of the viewer. Practical know-how, on the other hand, is always tied to the experience of a particular person. It can't be downloaded, it can only be lived"[7]

Experiential learning can inform a pedagogical process for finding meaning and acquiring knowledge

from direct experience.[8] An example of experiential learning would be going to a real farm and learning through observation and interaction with the farm environment, as opposed to reading about agriculture and animals from a book. The student makes discoveries and performs experiments with knowledge gained firsthand, as opposed to acquiring knowledge by reading about other people's experiences. Experiential concepts rely heavily on the work of John Dewey and Jean Piaget and focuses on the student's direct personal and environmental experiences that emphasize analysis, initiative, and immersion. Experiential learning contrasts with traditional academic learning that promotes information acquisition by studying a subject without direct experience. The noun "craft" refers to a particular kind of skilled work, a trade, the skilled practice of a practical occupation. As a verb "craft" means to construct, to skillfully make something by hand. The design-build studio experience explores the relationship between craft as a *thing* and craft as an *action.* Craft becomes the curriculum*.* In architectural construction things can be physical objects and, have qualities and ideas that require abstract thinking. Putting the student in the position of taking action, the physical and intellectual activity of accomplishing a goal, gives each student the opportunity to appreciate the skill and effort necessary to make architectural design ideas become built realities. Even though it is impossible to gain advanced skill at each of the many trades required to make modern buildings, the design-build course requires students to understand firsthand the value of manual competence, participate in the teamwork of construction, and engage the intellectual rigor of making real world decisions. The *active learning* approach asks students to learn by exploring issues and ideas, asking questions, searching for answers, and reflecting on observations gained from experience. Active learning can result in improved long-term retention and a better understanding of personal knowledge. This approach promotes active participation in a group or team formation with each individual being accountable to the group. Students must develop the ability to work cooperatively, learn social skills, and form a "learning organization" to address the tasks of understanding why and how to apply the various building crafts and skills necessary to complete the given project.

CONCLUSION

In a time when architectural education has become more abstract and theoretical, the relationship of the design architect to the actual building process, as in the case of the design-build studio, adds an important dimension to the education of the young architect and can stimulate and improve student learning. Learning about "what to do to do" is reinforced with "knowing how to do it" inspiring a pedagogical framework that can stimulate learning through analysis, initiative, and immersion. Design-build studios, by the very nature of their relationship to higher education, can create unique connections to funding and support, both private and public, in a way that the profit-based professions cannot. In the fundamental shift from merely provocative architecture to "green building" and sustainable architecture, the design-build movement can play an important role from inside the academy increasing public awareness of the critical issues facing the world today, and to improve graduate preparedness by creating a more meaningful dialogue between educators and practitioners.

As a nation, the U.S. has become a culture removed from the making and fixing of things, particularly things we make ourselves. The historical precedents of other western societies that followed the same course, particularly those beginning in and after the 1400's, are not reassuring evidence that America is on the right track when it comes to stopping the decline in material wealth and the loss of skilled manual labor. The lessons learned from earlier world powers indicate that the preeminent rise of speculative wealth over real wealth may foretell a downturn for American prosperity and a reduction in our ability to sustain livable environments that are ecologically appropriate, economically viable, and socially equitable. Architecture, in the broadest sense, is highly dependent upon the mental and physical well-being of the culture that designs it, builds it, and dwells in it. Architectural education can inspire a new generation of architects that will find the way and the will to advance the building arts and sciences for the betterment of society improving cultural well-being. Design-build courses can be a significant part of the architect's formal education and in reaching out to communities, organizations, and the world at large, become a power voice for positive change.

As Matthew B. Crawford points out in his book there is still a place for craft and it can be educational. While probably most of us in architectural education agree we cannot really complete a building in a semester of an academic year but we can experience the making. The authors would argue that in a time where the profession of architecture has become more abstract the relationship of the architect to the building process and its materials has to be established somewhere. As we suggest it can be done as a design/build project.

ILLUSTRATIONS

Figure 01 Model of the Sustainable Cabin in a photo montage onto its site.[9]
Figure 02 Disassembly of "Double Wide", summer 2008.[10]
Figure 03 Wall framing, fall 2008.[11]
Figure 04 Yellow pine cladding, interior summer and fall, 2009.[12]
Figure 05 Cedar porch south/east façade, fall 2009. [13]
Figure 06 On the road, summer 2010.[14]
Figure 07 Cabin on its site, north-west of Crowell, TX, summer 2010.[15]

ENDNOTES

1 Cohen, Janie. Ed. *ARCHITECTURAL IMPROVISATION: A History of Vermont's Design Build Movement 1964-1977* Robert Hull Fleming Museum, September 25-December 19 2008. University Press of New England Lebanon, NH 2008.
2 *Means Report: International Construction Intelligence, Vol. 16, No. 6, January/February 2004*

3 McGraw-Hill Construction 2008, Key Trends in the US and European Construction Marketplace
4 Green Building Alliance 2006: Green Building Products
5 *Means Report: International Construction Intelligence, Vol. 16, No. 6, January/February 2004*

6 *US Department of Commerce (2008) Annual Value of Construction Put in Place*
7 Crawford, Matthew *Shop Class as Soul Craft: an Inquiry into the Value of Work,* Penguin Press HC. 2009 P 162.
8 Itin, C. M. (1999) *Reasserting the Philosophy of Experiential Education as a Vehicle for Change in the 21st Century*. The Journal of Experiential Education,.22(2), 91-98.
9 Photomontage of model at its future site with the ghosts of Thoreau and Le Corbusier credit U.P. Flueckiger.
10 Photo credit U.P. Flueckiger.
11 Photo credit U.P. Flueckiger.
12 Photo credit U.P. Flueckiger.
13 Photo credit U.P. Flueckiger.
14 Photo credit Denny Mingus.
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