FABHouse Studio

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Make a house that you would want to live in

The range of current explorations and business models for prefabrication of single-houses runs the gamut from the most inexpensive (and probably energy inefficient) manufactured ("trailer") home to entirely customized, very elegant and expensive, but "green" home. The goal of the studio described here was to consider ways in which we might use current prefabrication ideas and capabilities to design a strategy for making houses that would be both cost effective in construction AND cost effective in occupation and maintenance.

Fig. 1. Habitat house used as control; built by Clark County Habitat for Humanity, summer, 2007.

While a Habitat for Humanity house (figure 1) program and budget was used to define the parameters of the immediate project, the result was intended to be a house that any of us might be pleased to occupy or have as a neighbor — avoiding or eliminating any possible stigma attached to living in a Habitat house is always a goal. The volunteer labor that contributes to the low cost of a Habitat house can be translated to sweat equity of more money for another homeowner.

Mass customization as an extension of fabrication has become common in many industries, including that of residential design and construction; Michelle Kaufman's Glide House or the Dwell Houses are examples of recently marketed models that are available to be customized to the desires, site and budget of a client. The "budget" in many cases, however, is far beyond the means of many home buyers—those who would never imagine themselves with a "custom" home. How could this idea be migrated into a less costly market?

The organization of the ten-week (one quarter) studio was as follows:

Weeks 1-3:

- BIM (Revit) tutorials
- Research prefabrication in housing construction
- Model precedent houses in Revit
- Including quantity take offs, energy analysis

Weeks 4-5:

- Individual students developed schemes for houses based on a Habitat for Humanity standard program and a generic site description

Weeks 6-8

Students were grouped to work on components of the overall studio project. Define parameters of the larger project:

- Program: continue to use a Habitat standard program and budget
- Site: define abstract site conditions based on typical Central Ohio urban fabric
- Fabrication/Construction strategy: size of components

- Life Cycle Costs: energy, maintenance

Week 9

Compile data: cost and energy analyses for the projects designed in the studio, compared to the Habitat house

Week 10

Design reviews

Process: Program

Beyond the initial phase of learning the basics of the software and delving into the wealth of material on prefabrication methods, we looked at the central Ohio situation. Meeting with Dawn Stutz, a local (Clark County, Ohio) Habitat for Humanity administrator, the students realized that the nature of volunteer labor and the typical Habitat client held some surprises: the average age of the volunteers is close to 70 — that coupled with the often compromised health of the residents of low income homes made single story houses very attractive. Avoidance of ladders and stairs pays off in many ways. Given the relatively dense pattern of the neighborhoods into these house are inserted, however, relating a single story to the scale of the existing fabric can be a challenge.

In addition, while obviously thankful for their new homes, the recipients are extraordinarily concerned with their privacy — in some cases not even inviting Dawn, after having watched her bring the projects to fruition, into the homes. Privacy seems to be crucial, at least in this locale.

The ultimate projects took account, if not advantage, of these desires. After each student had had a chance to consider a house on their own, we organized ourselves into three groups of four plus a student consultant for energy and cost analyses for all houses.

Process: Site

To define site conditions rather than a single dedicated site, each group was to consider their project as one that could be varied according to a limited number of site configurations deemed typical to the area: flat, facing (meaning the orientation to the street) each of the four compass points. Responses of the three teams varied in relation to the strategies of difference across the site variations.

Process: Costs

The cost of construction, materials, and occupation factored into the design process, being formulated as set of tenets, such as:

- Use used stuff
- Make it small
- Dirt is cheap
- Do it yourself
- Do without

A set of similar tenets was listed in relation to energy efficiency and cost:

- Consider orientation to the sun
- Use the air around you
- Reduce waste

Relative to general environmental issues, a strategy of buying local was also developed, which one might hope would also result in lower cost because of reduced shipping distance.

Process and Projects: Fabrication

The organization was further classified by size of prefabricated components: small, medium, large.

Small: Off the Shelf (figure 2)

This group took on the notion that construction materials are already largely available as prefabricated pieces small enough to be brought to a site by relatively small vehicles — sometimes a critical consideration in a dense setting. These would then be assembled on site into larger pieces that could be replaced and rearranged as needed over time.

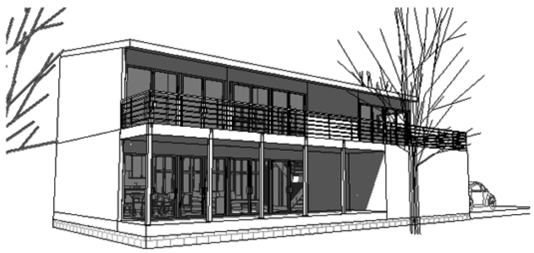

Fig. 2. Off the shelf: two story version

Medium: Squares (Components) (figure 3)

A middle group used components conceived as being assembled in a low-tech factory (potentially staffed by Habitat volunteers): closets, wall elements, stairs. The configuration these elements took in the project was one that minimized footprint and building envelope as cost and energy saving strategy; thus, the name "The Squares." A soon-to-be locally produced material, Rastra block, was the material of choice.

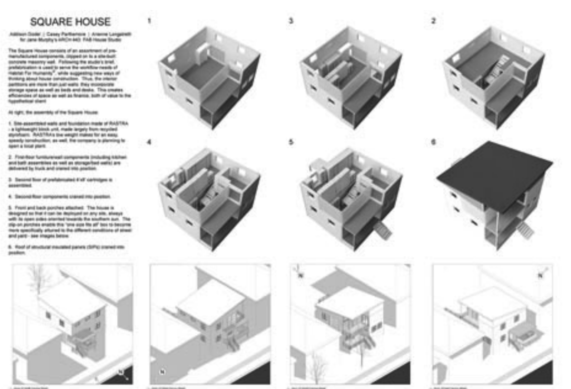

Fig. 3. Squares (Components)

Large: Big Box (figure 4)

This group maximized the size of prefabricated work, erring on the side of the factory built/site assembled model. After debating at some length whether to design using shipping containers themselves or shipping sized pre-fabricated boxes, shipping containers were chosen as the building block.

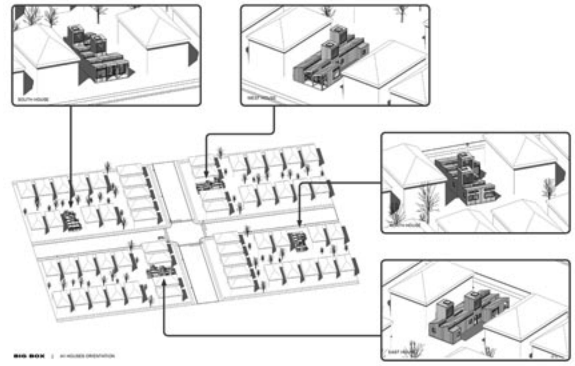

Fig. 4. Big Box

The data

Using Greenbuilding Studio and National Estimator software, each house, including the Habitat house and a project being done concurrently for the Solar Decathlon, were analyzed for material quantities and costs, potentials for solar energy usage and natural lighting and ventilation, once after the mid-review and as we approached the final. The results are summarized in figure 5, below.

While the expertise to evaluate the data in any deep way was beyond the scope of the studio, we know that it is at least all coming from the same sources and therefore are confident that it provides a valid comparison of the projects. Each of the studio project houses was evaluated in only one of its site versions; others may function more efficiently, and in at least one case ("Off the Shelf") many variations were shown, and only one has been quantified through the data.

	Annual Energy Cost	Lifecycle Cost
Habitat House	$3,306	$45,022
Off the Shelf	$3,031	$41,286
Big Box	$2,003	$27,287
Components	$2,634	$35,877
Solar Decathlon	$1,753	$23,881

	Annual CO2 Emissions	LEED Daylight Analysis
Habitat House	17.8	40.4%
Off the Shelf	16.5	99.9%
Big Box	13.5	95.8%
Components	18.3	58.4%
Solar Decathlon	8.8	22.4%

	Photovoltaic Potential	Natural Ventilation Potential
Habitat House	15,023	184
Off the Shelf	16,136	518
Big Box	12,413	655
Components	6,600	789
Solar Decathlon	5,088	200

	Carbon Offset Potential	Water Harvesting Potential
Habitat House	7.4	46,714
Off the Shelf	16.5	47,613
Big Box	15.3	41,159
Components	11.0	35,454
Solar Decathlon	4.0	28,336

Fig. 5. Comparative data on energy and costs for all houses in the studio, plus a Solar Decathlon project.

Critique and conclusion

A critique is needed here of the pedagogy as well as the content of the studio as potential for further research into designing houses for real people.

On a pedagogical level, the studio was successful in terms of its organization, and the experiences provided to the students on the level of exposure to important software developments in building information modeling, as well as in designing with cost and energy considerations integrated into the process.

The weakness of the studio, however, is also a function of those same issues: design itself suffered at the hands of the more mundane issues of the studio. The content holds obvious value, but can it ever be truly the realm of architecture?

As the information directly available to us as we work proliferates, so do the responsibilities to use it wisely — a ten week quarter is a very short time to take on the number of issues we chose; conclusions are far in the future or perhaps are best left for discussion.