

Contemporary Customization

The dry-in house uses as a point of departure contemporary developments in automated manufacturing that provide for greater customization in consumer products. The design proposes a system that once in place, and constraints determined, provides a level of design input on the part of the owner that is currently unavailable in affordable housing in the United States. The design seeks to give the owner the maximum customization "with minimal intervention of the designer". The outcome being the designed interaction of the owner and a contemporary rapid manufacturing platform that has been reformulated much like Droog Design's Signature Vase and Issey Miyake's A-POC (A Piece Of Cloth) clothing line. In these cases the role of the designer is minimized once the design "system" has been articulated. With the Signature Vase a personal expression in the form of one's signature is translated into a highly personal product in which one's signature is subsequently digitized, extruded and ultimately fabricated three dimensionally using stereolithography. In the case of Miyake, a three dimensional weaving technology is used to produce cloth that allows the consumer to fabricate their own clothing, the cloth arrives in stores inscribed with possibilities, the consumer then operates directly on the material and within the system producing many outcomes that meet their preferences (appearance, comfort, size, etc...). In each example the design system uses a readily available fabrication platform as a point of departure and "styles" a design interaction between consumer and product giving the end user a level of customization and personalization previously unimagined in contemporary manufacturing.

Just in Time...

Similarly the dry-in house uses a rapid manufacturing platform as a point of departure to propose a housing system that is able to be customized at a large scale. The contemporary wood plate truss industry in the United States has evolved from an industry of mass standardization to an industry of mass customization. This has been largely driven by consumer preferences for more customization subsequently the market has shifted from the supply of affordable repetitive parts to complex design solutions that demand variety and that can be provided rapidly and at a large scale to builders offering custom designed homes. A typical truss factory produces non repetitive designs at the same cost of a standardized design ultimately bringing to the consumer an incredible spectrum of choices within a predetermined

Dry-In House: a Mass Customized Affordable House for New Orleans

Douglas Hecker
dhecker@clemson.edu
Clemson University

The dry-in house is a mass customized affordable housing system proposed for the reconstruction efforts in New Orleans following Hurricane Katrina. The dry-in house is designed to get families back to their home sites quickly providing the infrastructure the occupants need (shelter, water, electricity) while at the same time providing the opportunity for each of the returning families to customize their new home. The project addresses inefficiencies and redundancies in emergency housing currently provided by FEMA (Federal Emergency Management Agency). It is designed to meet the \$60,000 cost of the currently provided temporary housing, the notorious FEMA trailer and improving upon it by providing a solution that:

- a) is permanent rather than temporary. The house can be finished and further customized over time rather than disposed of.
- b) reoccupies the owner's home site rather than a "FEMA ghetto" getting the community back together and functioning.
- c) is mass customized rather than mass-standardized allowing the owner to have input on the design of their home. The design is a "starter home" rather than an inflexible and over-determined one size fits all solution. This also has the benefit of giving variation to the reconstruction of New Orleans as opposed to the monotony of mass-production.
- d) allows the owners to further customize their home over time with additional exterior finishes and the subdivision and fit out of the interior.



set of constraints. The industry has met the market by transforming itself from a supplier of repetitive building components to a supplier of engineering services, software design and CNC (Computer Numerically Controlled) equipment.

Unfortunately this technology is largely being used to produce meaningless variation for McMansions and condos that do not examine questions of place, technology or program. The technology results in a monstrous expression of the eclecticism and schizophrenia of the contemporary housing market in the U.S. wherein arbitrarily complex floor plans must be reconciled with arbitrarily complex roof designs with little attention to the specificity of place and program. While the underlying technology is rich with possibilities the outcomes produce little innovation. Considered in the context of questions of mass customization in architecture and strategies for bringing design to the affordable housing market (a market that historically had little access to design services) the technology has immense potential.

The dry-in house works backward from this rapid manufacturing platform to bring design services to a group that traditionally has not had access to them by creating a design system. In doing so the house builds upon the tenets of modern housing and expands these ideas to include individual preference and site specificity.

By using existing technologies and systems a more progressive expression of this innovative CNC technology can be realized. The design is structured in such a way that an owner can realize a customized design with minimum assistance of a designer.

By utilizing plate truss technology and associated parametric modeling software, highly customized trusses can be engineered and fabricated at no additional cost as compared to off-the-shelf standardized trusses. In the dry-in house this mass customization technology is employed to create the building section of each individual's house. The truss is not used in its typical manner, spanning over the house; rather, it is extruded in section to form the house itself (roof, wall, and floor). Dry-in House exploits this building technology to quickly rebuild communities in a sensible manner. It allows for an increased speed of design and construction and most importantly it involves the owner in this process. The process has other benefits like reducing waste not only because it replaces the FEMA trailer, which is expensive and disposable, but also since the components are prefabricated precision and quality are increased.

The dry-in house allows the owner-designer to "draw" the section of their new home providing them with a unique design. The design of the section of the house provides them with spatial configurations customized relative to



FEMA

Cost: \$60,000

Generic

Disposable

Mass-standardized



dry-in house

Cost: \$60,000

Contextual

Permanent

Mass-customizable

site conditions, program etc... Because of the narrow lot configuration of New Orleans, the design maximizes the roof as a source for natural ventilation and light for the interior of the house. In addition, the house is one room deep providing cross ventilation in all rooms minimizing reliance on artificial mechanical systems. The timely and efficient off site fabrication of building sections facilitate larger concentrations of volunteers on site at one time, thereby promoting a greater collective spirit among the community and volunteer workforce, a therapeutic event for the community as they participate in the rebuilding of their homes and city. With individualized building sections arriving on site, the construction process is imagined to be more akin to a barn raising, making possible the drying in of multiple houses in less than one day.

Design and Fabrication Process

The design system is web based to allow families to begin the reconstruction and healing process from wherever they have been displaced to from the hurricane and is designed to eliminate the need for the temporary housing provided by FEMA (a trailer) in favor of a permanent housing solution that is built on the homeowner's property. Almost immediately after an emergency the work of reconstruction and healing can begin with the design of one's future home. Once a displaced family's situation has been assessed and it is determined that they qualify for housing, a worksheet and questionnaire is sent to them. The worksheet is distributed in conjunction with a web site where the family can begin to imagine and "sketch" their future home based on personal needs and varying site conditions.

The design has a fixed plan with and a core, a minimum infrastructure for a family to return to their homestead. The plan has been carefully designed to be subdivided in a number of ways and remain functional and efficient. From this fixed plan an owner can design a varied section and roof profile. The fixed plan strategy is proposed as a way of insuring basic design needs of access, ventilation, day lighting, and a footprint that is sympathetic to the context and has a clear layering of space from the public realm to the private realm. The plan is based on 4x8 module so that it is easily subdivided and interfaces with standardized building materials so that owner can subdivide, adapt and customize in the future with a minimum of waste, cutting and labor.

From this fixed plan the owner can test out

various designs considering personal preference and site conditions. Once the owner has some initial ideas they can meet with a designer for a short design session in which a designer works with a family to develop and finalize a design. The design interface is a Flash based web site that is constrained in numerous ways by issues such as constructability, cost, and other constraints while allowing variability in the design section and roof profile. With the Flash based interface simple vectors are used that have handles that can be moved to produce the section of the home. We have worked out a simple method to capture the vector information from the homeowner designed section in order to send the data directly to a regional truss factory (we have identified 7 factories within the New Orleans region that have the technological capability to produce the design).

Once the file has been sent to the factory the engineering is checked using the factories parametric modeling software. The software can be localized to specific conditions by loading up local building codes. When the engineering is complete the software produces the G-code that will be used in the cutting of the truss components, producing a material list and driving an automated jig on the assembly table for the layout and pressing of the truss-sections.

The on site erection process is conceived similarly to a "barn raising". A community based event that brings groups together block by block to "blitz" the construction of each other's homes. As the trusses arrive they can be tilted up and braced while other teams skin and dry-in the frames with standardized flat materials (plywood, insulation, polycarbonate and rubber roofing) that enclose and dry-in the structure. The trusses are placed on 2'-0" centers so that these standardized materials can be attached to the trusses with negligible cutting.

Conclusion

In contrast to the one size fits all approach to emergency housing the dry-in house proposes a mass-customized shell to get residents back to their own home sites in a timely manner. With the dry-in house the owner is supplied with an inhabitable shell that is able to be customized before it is fabricated as well as onsite as the project is fitted out over time. Primarily the dry-in house as its name implies provides a timely dried-in space which doubles as a customized infrastructure for the reconstruction of homes and neighborhoods. This customized infrastructure gets residents back to their property and can then be finished



by the resident over time according to each family's preferences, timeline and means giving the residents a much needed part in the reconstruction effort with a personalized solution.

Keywords:

Mass Customization, Digital Manufacturing, Housing