

## RE: PLACE - contextual off-site fabrication and the infill of existing communities

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*Suburbia is the hinge, the connection between past and future, between old inequalities and new possibilities...to preserve, renovate and infill the suburban neighborhoods of the past can make a suburban city more egalitarian and sustainable.'*

In the fall of 2007, a fifth year studio at the University of Tennessee was co-taught by a professor of architecture and a designer with Clayton Homes. Clayton Homes is a Berkshire-Hathaway company and the nation's leading producer and retailer of manufactured and modular homes. In addition to sales and manufacturing, the company finances and insures homes, and develops land and communities. Until recently, the company held numerous land-lease community developments where residents owned manufactured homes and leased lots from Clayton. In 2007, the company sold these communities to instead focus on building subdivisions of modular single-family homes to sell as developed lots. In both approaches, home sites are typically green fields, or undeveloped land. Growing homebuyer and municipality interest in environmental issues, however, is creating a demand for not only ecologically-minded homes but also ecologically-minded home sites. Furthermore, sustainability includes conservation of cultural resources as well as natural resources. The combination of intensifying renewal of existing urban neighborhoods and impending restrictions on green field development presents unique and challenging opportunities for the off-site homebuilding industry.

### Tools of Engagement

A collaborative studio, entitled *Tools of Engagement*, investigated 1) the way housing design communicates cultural beliefs particular to a time and place and to a program and its participants; 2) the material and technological context informing design and construction processes and how these are present or absent in resultant architecture; and 3) the social, economic and regulatory context that informs and restricts land-use practices.

These issues were addressed in two hypothetical projects. The first, *The Tortoise and the Hare*, was a two-week team charrette to design an addition to an existing and active railway bridge to accommodate pedestrians and cyclists. The augmented infrastructure would connect existing communities on opposite banks of the river, including a university district and an underutilized but redeveloping industrial area. The second, twelve-week project and the subject of this paper, *RE:PLACE - contextual offsite fabrication for existing communities*, investigated design and construction processes in the context of a post-war neighborhood, its housing stock and the historical and cultural conditions that shaped it. To propose designs that promote cultural and environmental sustainability in existing neighborhoods, students focused on three specific tools of engagement:

- Planning instruments and housing typologies
- Spatial composition and inhabitation
- Fabrication and construction systems

This paper details outcomes of the collaborative investigation and the reactions of industry specialists and neighborhood participants. Both proposals and criticism illuminate the opportunities and challenges posed by urban infill development for the offsite homebuilding industry and for existing communities.

In the southern United States, manufactured housing has lifted home ownership and is responsible for 30% of the growth in new homeowners.<sup>1</sup> The typical manufactured house is today located in a newly created subdivision on a privately owned lot. How can current homebuilding technologies respond to

sustainable imperatives related to site selection? Can the physical, cultural and social places that already exist accommodate the deployment of these technologies? What innovative or historical spatial practices arise when joining offsite fabrication and existing communities?

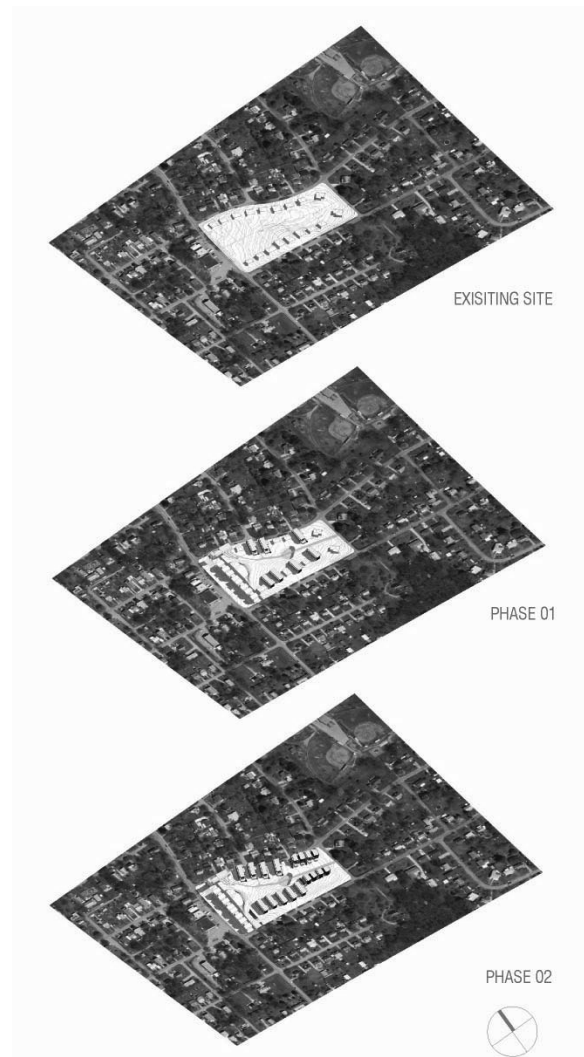


Fig. 1. Aerial view of portion of South Haven showing model block as existing, as of phase 01 and as of phase 02 (proposed). Re-Assembling Suburbia proposal by 5th year student Michael Davis.

### The Brief

*The unique qualities of suburban places are wedded to topography, social history, economic history, and vernacular architecture. Knowledge of how their historic cultural landscapes have evolved can often help establish priorities for current interventions.*

### Context

The community of South Haven in Knoxville, Tennessee provides the context to explore the potential combination of offsite fabrication and infill development. South Haven represents communities across the United States borne of a similar era and context which gave rise to Levittown – like South Haven – is characterized by small single-family, one-story homes centered within small, privately owned plots in low-density “bedroom” developments. Typical homes, 800-1000 square feet in area, relied on new mass-production systems and included 2-3 bedrooms and a relatively open kitchen, dining and living area. Households ordinarily owned one car, storing it beneath a carport.<sup>v</sup> Developments like that of South Haven began with the return of WWII soldiers and the urgent need for housing. The Federal Housing Administration (FHA) offered “production advances” to developers and supported banks subsidizing young families, the anticipated homebuyers. The program generated unprecedented housing construction and ten million new homes in the US between 1946-1953.<sup>v</sup>

During this period, zoning and building codes were largely abolished and planning for the community as a whole was seldom considered part of the housing developers’ processes, and was thus left to government.<sup>v</sup> Few of the limited amenities that originated in the bedroom community of South Haven operate today and public transit is infrequent; in fact, no households currently report using public transportation to commute to work. The neighborhood has not seen significant investment for several decades and 93% of the 1,854 homes were built before 1980. The median household income is \$28,291 and renters make up 31% of households.<sup>v</sup> The neighborhood association recently undertook an inventory of maintenance problems in hopes of shoring up declining property values and addressing resident complaints. Yet, the aging neighborhood retains much that is good.

It is in close proximity to an increasingly vibrant central business and cultural district, is home to mature trees and beautiful topographic features, and maintains a small but active group of community organizers. While South Haven is not initially perceived to contain the rich historical fabric of turn of the century streetcar neighborhoods, it represents an important period in America and a specific

history, culture, and place that should be valued, preserved and refurbished.

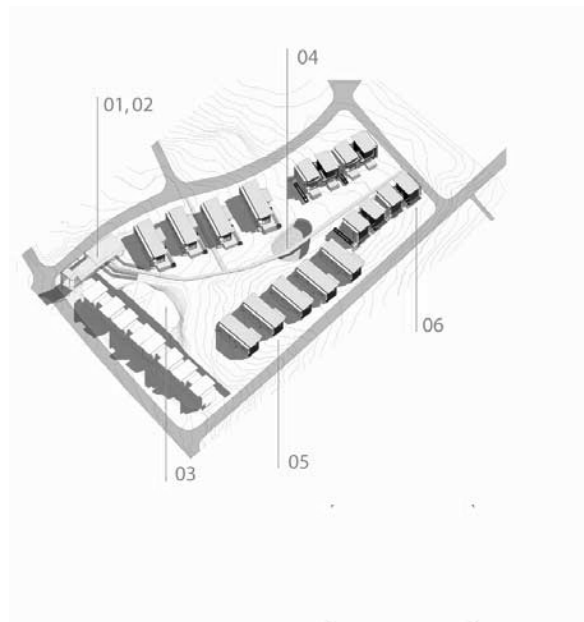


Fig. 2. Site plan of model block by 5th year student Michael Davis indicating site amenities 01) and 02) the Treehouse and Garden [co-housing common house and community garden] 03) the Cave [below grade bike/car vehicular parking and heat sink 04) the Pond [constructed wetland] 05) the Dual Density unit with existing house as A.D.U. 06) the Stitch unit re-assembled using components after disassembling the Dual Density unit.

#### *Site and Program*

A representative block within the neighborhood contains eighteen existing homes and plots (typically 60' wide x 130'-180' deep) on which to focus. Students were required to double the density of this block to accommodate a minimum of 36 households. Decisions to retain, augment, or replace existing homes, property lines and plot sizes, zoning regulations, ownership models, housing typologies, and infrastructure were left to individuals. Throughout the design process, students extrapolated concepts for the model block to surrounding blocks to consider the impact of development strategies on the entire neighborhood. The goal was to approach infill development at the scale of the household, block, and neighborhood -- specifically, sensitively and simultaneously -- and to demonstrate viable economies of scale to attract volume homebuilders (who, like Clayton Homes, often operate as producer, retailer,

and developer) and moderate income inhabitants.

Students were urged to think critically about the nature of contemporary inhabitation and community. Analysis of the existing homes and neighborhood -- and the context that produced them -- provided a lens through which to question traditional allocations and arrangements of space. Communal/private and interior/exterior spatial relationships were emphasized, as was the potential for cohousing programs, to address the doubling of the average US house size since 1950 and the waning of community connections.<sup>100</sup> Finally, students were introduced to shared programs associated with co-housing -- common eating, work, guest, recreation, and infrastructure -- as a first phase and potential catalyst for future commercial, cultural and environmental initiatives.

#### **Research**

##### *Field Studies*

The class traveled to Los Angeles, California to experience significant planning patterns and architectural works. The temporal context and influence of war-time materials and assembly methods giving rise to the Eames House was studied, as was its live/work typology. The communal spaces of the Schindler-Chase two-family residence; its integration of spatial, aesthetic, and edible vegetation; and its philosophical underpinnings were mined, as were the then experimental construction techniques. A walking tour of pedestrian mid-block paths in Venice Beach, past Johnston Marklee's Sale house attached to Morphosis' 24-6-8 accessory dwelling, and a visit to Pugh + Scarpa Architect's Solar Umbrella House demonstrated further planning and spatial lessons, as did a guided tour of a recently completed modular residence on an infill site in Santa Monica, designed by Ray Kappe and manufactured by Living Homes. Office visits to Morphosis and to Pugh + Scarpa revealed how each firm leverages digital technology and direct to fabrication methods in their work, further experienced during tours of recent projects including the CalTrans Building and Colorado Court. Throughout one tour, Gwynne Pugh emphasized the impact of regulation over the incorporation of new technologies and the availability of affordable housing, urging students to engage in local planning boards as he does.

Visits to local manufacturing facilities included Clayton Homes own manufactured and modular housing plant and a plate truss manufacturer. These provided insight into current automation processes and capabilities. Students also attended Clayton Homes' annual 2007 industry home show to witness the installation and assembly of new modular home models in the convention hall, and to witness the marketing environments that target retailers and homebuyers.

A field trip to an outlying stick-built development under construction provided first hand experience of a cleared site approach; viewing the type and degree of modification to model home types in response to sites and buyers and hearing the developer's perspective on risk management, including control over the range of sales prices to ensure income level parity and the codification of aesthetics on independently owned sites, including choice of mailboxes and plant species.



Fig. 3. View of the rear of the Dual Density unit and the existing house reconfigured as an Accessory Dwelling Unit. Re-Assembling Suburbia Proposal by 5th year student Michael Davis

### *Precedent Analysis*

Precedents were assigned to emphasize the three primary components: planning instruments and housing typologies; spatial composition and inhabitation; and fabrication and construction systems. For two weeks, students analyzed historical and emerging, local and global perspectives on these issues at a variety of scales.

### *Planning instruments and housing typologies*

"We need a system that promotes the kind of world we want."<sup>6</sup>

Planning regulations that permit two or more units per site and multiple types of occupancy - and the impact on architectural projects they spawned -- were investigated. Seattle's requirements for density, lot coverage, setbacks, height limits, access easements, and uses. This research was applied to analysis of cottage house developments, including Convent Avenue Studios (Rick Joy Architects, Tucson, Arizona), Moriyama House (Office of Ryue Nishizawa, Tokyo, Japan), and The Cotton District (Dan Camp, Starkville, Mississippi). Other development patterns and housing typologies were studied for their individual and collective, universal and regional characteristics. These include: Philadelphia triplets and row houses, carriage houses, accessory dwelling units (ADUs), and London mews housing, Danish co-housing, and single- and two-family American typologies. Spatial, political, socio-cultural, and economic intangible context were integral to the analysis as were their impact and reliance upon natural and infrastructure systems.

### *Spatial composition and inhabitation*

*No matter where one cuts open each house, the period itself has been imprinted.\**

Defining future, meaningful homes is impossible without evaluating the nature of "inhabitation" and "dwelling." Past, present and theoretical modes were critiqued for relevancy and studied for their embodiment of individual and collective ideals and conceptions of dwelling. Traditional allocations of space, the relationship of spaces to one another and to nature, and their relationship to the activities they accommodate were questioned -- in both South Haven houses and precedents. Precedents included dwellings from the Arts and Architecture Case Study program, Frank Lloyd Wright's prairie homes, Le Corbusier's machines for living, homes by Louis Kahn and Clark & Menefee, Eastern projects like Makoto Masuzawa's 9-Tsubo Houses, and recent work by Atelier Bow-wow and Tezuka Architects. The nature of dwelling in relation to flexibility and specificity; permanence and impermanence; prospect and refuge; individual and society; symbol and meaning; tradition and innovation were investigated to develop programs for communal and individual, and interior and exterior domestic space.

*Fabrication and construction systems*

*We are concerned with the house as a basic instrument for living within our time...The house that above all takes advantage of the best engineering techniques of our highly industrialized civilization.*

In conceiving and delivering Levittowns, Levitt and Sons adopted war-time industrial production methods, including the assembly line process, standardized parts, specialized work crews, and internal links to materials and supply chains, in order to deliver affordable housing. While the result was largely uniform and a variety of criticisms resulted, there is little question that for many, the manufacturing process made home ownership financially viable. Mass production housing technologies have continued to evolve yet architects remain largely removed from the process. The studio learned from the systemic thinking and well-oiled methods currently practiced by manufactured and modular homebuilders, and studied obstacles and ambitions associated with historic efforts to mass produce and prefabricate housing. These include efforts by Lustron Homes, catalog homes by Sears and by Knoxville architect George Barber, and projects by R. Buckminster Fuller, Walter Gropius and Le Corbusier. The use of digital technology to aid construction and fabrication in recent residential projects by Anderson Anderson Architects, William Massie, Kieran Timberlake Associates, and Living Homes provided further inspiration – in both the built works and theoretical texts.

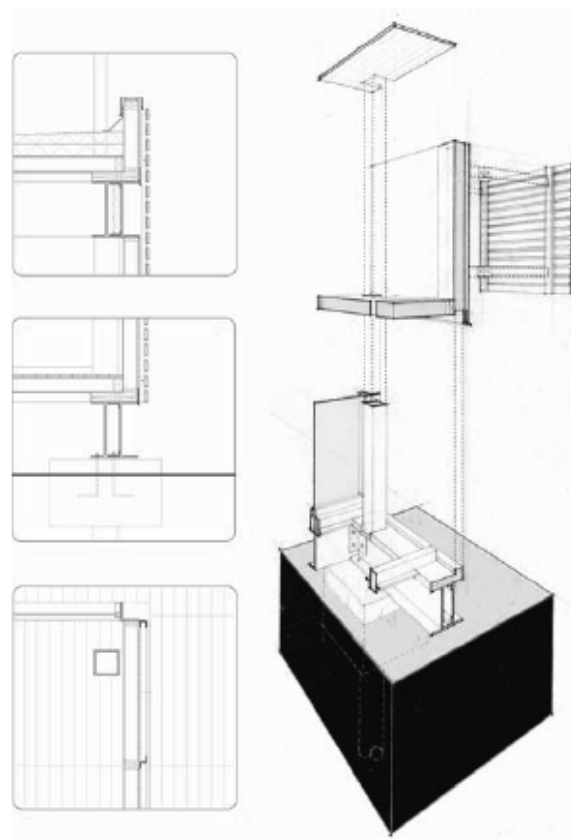


Fig. 4. Detail of Re-Assembling Suburbia Proposal by 5<sup>th</sup> year student Michael Davis showing kit of parts assembly using a panelized construction system.

### Studio Proposals

The deployment of the three main components as tools to leverage the socio-cultural, temporal and technological context of the place produced a range of density patterns, spatial typologies, construction approaches and experiential environments. Below is a brief description to convey the spirit and range of proposals generated by the studio.

#### 01 Re-Assembling Suburbia

Post-war emphasis on efficiency and economy guides the design for phased-growth and overlaps with regard to existing blocks and houses. Poetic, functional and communal infrastructure is handled within the block in elements termed the Pond, Cave, Treehouse, and Garden. Two new housing types are introduced -- the DUAL DENSITY unit is a kit of parts that leverages existing houses as ADUs. The units' kit of parts can later be disassembled and reassembled into STITCH units. Based on the row house typology,

STITCH units further increase density as original houses are replaced over time. The site is transformed in phases, from isolated houses to a connected community network.

## **02 An Exploded Garden Suburb**

Without significant demolition, the existing fabric of single homes and lots precludes a large, central neighborhood green. The approach thus explodes the public green, and disperses its amenities across the community by reclaiming the underutilized interiors of blocks. High density units comprised of nine modules each replace four homes per block with 20 apartments/condominiums. These sit above community functions, potential mixed-use commercial space once density increases. The ground level community spaces form a network of parks, interlaced with existing block patterns. Private gardens are reduced but preserved and existing houses are augmented by transitional filters to mediate new spatial relationships at the site's interior.

## **03 Community Infrastructure**

Centralized infrastructure – power, water, transport, and waste – is subject to distribution inefficiency and losses. Handling of infrastructure within neighborhoods through systems symbiotic with the natural world can increase sustainability of resources, culture and community. In the spirit of the village well, this proposal introduces infrastructure to the neighborhood, site and plot to foster interaction. Social, ecological and technological networks create a framework for dense housing that replaces the former houses. The network coalesces around a courtyard and hearth at the scale of the individual dwelling, the social and service core of the home. Modular sections are assembled around these site-built cores.

## **04 Land of One's Own**

Land ownership is engrained in the American psyche. This proposal preserves but shrinks individual property lines when introducing 200% more housing. Particular attention is paid to the demarcation of private and communal land and to the notion of "claiming" and "sharing" land through visual occupation and negotiation. Nine existing houses are retained and placed in dialogue with nine new duplexes, ten new single family homes, and a newly created alleyway. New structures are

modular wood construction informed by the expression of joints. This occurs at the scale of the detail and the units whereby adjacent units respond to one another structurally, spatially, and experientially, through the use of interlocking modules.

## **05 Garden + Tower + Technology**

Le Corbusier's tower in the green is transformed to increase density, preserve open space and activate community landscapes. Three slender towers penetrate and balance one another across a block's inner green. At ground level, towers and existing houses define shared and private terraces while discrete gaps between existing houses form gateways to the site's interior and a community garden, playing field, urban forest and water retention gardens. One- and two-story flats are dispersed across seven porous levels. Modular common spaces punctuate and cantilever from the vertical public zone and culminate with a solar sky garden.

## **06 HOME: Stability + Change**

This proposal considers the fluidity of community -- constantly forming, decoupling and reforming relationships at varying scales and in response to daily and seasonal shifts and cultural and personal preferences. The proposal replaces but originates with the former homes, leveraging previously underutilized gaps between houses to provide semi-public amenities: work units, communal kitchens and community pass-throughs. Timber frames hold prefabricated panels – both floor panels and wall screens which can be reconfigured inside and out, in response to changing site and user demands. The activities and rhythms reverberate throughout the community through subtle but constant reorganization.

## **07 The Deliberate Loft**

The Deliberate Loft targets renters of commercial and residential space. Its concept springs from the flexibility and adaptability inherent in warehouses convertible for a range of uses as demand dictates. Lofts line one side of the existing block; the common house and community amenities wrap the corners and modulate occupancy and scales in relation to surrounding blocks. A modular, rotating service core, panelized components, and access from both the inner court and public street permit

inhabitants to transform units to suit changing needs without compromising the privacy of and uses by other residents. Current single use zoning is replaced by fluid, form-based zoning.

### **08 The Pastoral Landscape Tomorrow**

A compact structure with three 1-3 bedroom live/work apartments around a three-sided inner court is configured such that it can passively and actively harness water and power for its inhabitants and power a shared vehicle. The structure is intended to replace three post-war houses at a time as adjacent lots can be consolidated. Compactness and self-sufficiency ultimately translate to the restoration of a vast pastoral landscape that furthers community self-reliance by restoring agricultural land for community sponsored agriculture. Structures are built with 2x8 paneled timber wall and floor sections and assembled on-site over site-cast foundations that incorporate a cistern and thermal labyrinth.

### **Industry and Community Criticism**

Students prepared all graphic material digitally to facilitate projected presentations to large groups and to aid the organization of verbal presentations. Graphic presentations emphasized a clear progression of ideas from urban, neighborhood, block, unit, to detail; diagrammed solutions for ease of comprehension; and clear representations of proposals together with existing conditions and anticipated phasing.

The studio concluded with formal student presentations at Clayton Homes' national headquarters the following summer. The audience included Clayton representatives from departments of engineering, design, operations, marketing, and communities, as well as the neighborhood's City Council representative, the past president of the South Haven Neighborhood Association, and a new resident/homeowner. Students' thoroughness, inventiveness, and graphic and verbal clarity were commended and the presentations elicited an insightful debate over the future of residential home design, home ownership models, the role of homeowner's associations, responsibility for common spaces, homebuyer preferences, site acquisition strategies, and the potential impact future environmental regulations could have on the economic viability of infill modular housing.

In subsequent comments shared via email, the Clayton team applauded students' ability to answer impromptu questions, drawing upon knowledge of the material and technical issues in particular. Many cited a lack of concrete sources and the absence of market analysis as a primary weakness of the studio and encouraged the inclusion of economic and demographic data in future investigations. An engineer from Clayton advocated for future collaborations with the university that would add business (marketing, accounting and logistics) and engineering departments to the team.

The joining of representatives from these two groups, Clayton and South Haven community members was particularly relevant based on a meeting that took place one year prior which included several of the same participants. That meeting was an attempt to reconcile the neighborhood associations' refusal to support a lot owner's variance requests that would have permitted installation of a Clayton double-wide manufactured home on her lot. The neighborhood was not opposed to off-site fabricated homes in general but was uncomfortable with the selected model's suitability, citing inappropriate size and siting of the home for the lot in question. They were concerned that the act would set an undesirable precedent for future development.

Clayton has in fact tested "appropriate" modular models for infill development in East Knoxville, and in places including North Carolina and Kentucky, but has yet to operate in the infill market. The president of Knoxville's community housing agency noted that "Clayton has come up with a great infill design. They have the ability to design porches, foundations, and roof pitches."<sup>10</sup> Stylistic debates when discussing any infill too frequently focus on imitation of that which exists, often overshadowing more critical debate over restrictions on housing type and income diversity, density, and the social and technological infrastructure to support community.

The issue of off-site constructed infill remains largely a hypothetical debate, due to manufacturers' skepticism as to the viability of markets in existing communities – challenged by the need for new processes of land acquisition and the missing economies of scale – both simpler and more profitable in green field development areas. These issues, more

than a perception of low buyer demand for in- or near-city accommodation, dominated discussion. To this, City Councilman Hultquist offered that perhaps policy makers need to lead the effort through impact fees, incentives, and assemblage of "critical mass areas" through planning initiatives. Likewise, some of the concerns surrounding economic viability could be addressed through alternatives to detached single family homes.

The studio sought solutions to increase density, to diversify uses and housing types, to innovate spatially and materially in response to contemporary society, and to do so within readily available means of manufacture and production. They sought these ends, in many cases, while resisting the creation of a clean slate, instead finding inspiration in a seemingly ubiquitous fabric. Their proposals were explored through a unique block and extrapolated throughout the surrounding neighborhood, but these efforts are part of a larger quest to find sufficient room in existing places where meaningful, productive and sustainable lives can be lived.

### Postscript

The opportunity for building on lessons from the *Tools of Engagement* studio with a multidisciplinary team of students is newly underway in *The Norris House Reprise*. Led by a materials research specialist, a planning researcher with historic preservation expertise, and the architecture professor from the *Tools of Engagement* studio, a team of students from architecture, engineering, planning, history and business departments, will undertake the design of a new Norris House preceded by those built in the 1930s by The Tennessee Valley Authority (TVA) during its first major undertaking, the Norris project. Norris Dam is the centerpiece of the project, yet the agency simultaneously strove to create a model cooperative community, and Norris is now regarded as one of the first planned sustainable communities in the country. Original Norris Houses incorporated new technologies and local materials and represented the sustainable house of the day. The studio's pedagogical process will again include historical research of the unique context and evaluation of emerging and available technologies to design 21st century insertions to the community which resonate with the physical, socio-cultural, temporal and technological landscapes inherent in the

original. The New Norris Project proposal was selected by the US Environmental Protection Agency's People, Prosperity, and the Planet (P3) program and awarded \$10,000 to address challenges to sustainability in the developed and developing world. Results from the project will be exhibited at the annual National Sustainable Design Expo on the Mall in Washington D.C. where the project will compete for awards up to \$75,000 from the EPA to continue the study. Clayton Homes has again offered to support student research through workshops and critiques.

### Acknowledgements

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### Endnotes

<sup>i</sup> Hayden, Dolores. *Building Suburbia: Green Fields and Urban Growth, 1820 - 2000* (United States: Vintage Books, 2003): p. 245.

<sup>ii</sup> See "The State of the Nation's Housing 2002," Joint Center for Housing Studies of Harvard University.

<sup>iii</sup> Hayden. p. 235.

<sup>iv</sup> In his article, *Postwar Metropolitan Development: Housing Preferences and Auto Ownership*, John F. Kain of Harvard University reports that in 1945 auto ownership was .69 per household, which increased in 1950 to .92 and again in 1960 to 1.16. See *American Economic Review*, Vol. 57, No. 2 (May, 1967): p. 223.

<sup>v</sup> Hayden, pp. 131-132.

<sup>vi</sup> Hayden, pp. 131-132.



<sup>vii</sup> Information taken from 2000 US Census data for census tract 22, comprised largely of South Haven residents and area.

<sup>viii</sup> The typical house in South Haven is approximately 1,000 square feet and 68% of the houses were built before 1960 (source: 2000 US census data). The average square footage for a single family house in the US was 1,500 square feet in 1970 and grew to 2,469 square feet in 2006. This information was taken from the NAHB's Report on Selected Characteristics of New Housing; <http://www.nahb.org/page.aspx/category/sectionID=137> last accessed Sept 08, 2008.

<sup>ix</sup> Hayden, p. 241.

<sup>x</sup> Matsukuma, Hiroshi, "The Appeal of a Vernacular Modernism" *The Japan Architect*, Vol. 22 (Summer 1996-2): p. 08.

<sup>xi</sup> Herbert Matter, *What is a House?* from "The Prefabricated House," *Arts and Architecture*, July 1944.

<sup>xii</sup> Knoxville Business Journal, "KCDC teams with Clayton on city housing," published May 21, 2007.

<http://www5.knoxnews.com/news/2007/May/21/kcdc-teams-with-clayton-on-city-housing/>

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