There is a need to integrate well-designed housing into the urban fabric and rehabilitation of neighborhoods to create long-term value. The information involving energy efficient technology and its adoption to high-density urban neighborhoods will be thoroughly documented and disseminated.

The SIS seeks to address these needs by incorporating into the educational program a team of inner-city high school students to work with the upper-level college students to design sustainable houses. This will show the residents of Alton Park, the city government and the building industry that the idea of sustainability implies a comprehensive, long-term approach to energy conservation and property values. It will also show the public energy efficient design options by offering commercially available solutions to consumers and the building industry.

Building affordable and energy efficient housing in an urban context proves the work can serve as a prototype for future growth. Continuous expansion of the city boundaries is not possible or sustainable. This work generates alternatives to urban sprawl by providing available alternatives to traditional suburban development and potentially attracting those who otherwise would not consider urban housing. The SIS uses the Department of Energy's "Energy Star" guidelines for commercial buildings as the benchmark for power consumption with a long-term goal to exceed these performance criteria. The work shows that innovative housing is a means to stop urban devaluation.

BACKGROUND INFORMATION

The University of Tennessee College of Architecture and Design (UT CAD) is the only school of architecture in the state. It has a special mission to serve the principal cities of Tennessee with quality education, research and public service initiatives related to all aspects of architecture. Campus partnerships with business and government provide both jobs for graduates and solutions to the economic and social needs of Tennessee and the nation.

The City of Chattanooga and CNE has created available choices to sprawl by increasing housing densities, providing electric vehicles for public transportation, and sensitive community growth. For the last twenty years, Chattanooga has made a concerted effort to create meaningful, sustainable change. Vice President Al Gore named the city a "Sustainable City."

CNE has an outstanding, ten-year record of restoring many inner-city neighborhoods by the renovation and construction of various housing types. CNE is the principle organization in the city addressing the housing needs of lower income home buyers.

The Howard School for Academics and Technology is an inner-city public high school and is one of the oldest in Chattanooga. The school has agreed to work with UT to start this innovative program through its vocational arts classes by working with the SIS in the design and construction of solar houses. The curriculum at Howard covers the fundamentals of urban design and architecture in various courses. The SIS partnership benefits Chattanooga by integrating the research into the community and provides fieldwork for these high school students. The partnership benefits the SIS by reinforcing the ethics of responsible design for the revitalization of our cities.

The SIS seeks to engage and teach students to help solve the problems of urban devaluation and the general deterioration of inner city neighborhoods. The mission of the SIS has evolved to address the following:

Education: To establish and continue the participation and education of residents of the neighborhoods in the design process. The future users of the housing are targeted for involvement, especially those now in high school. The Howard high students will take part in the construction process. It is expressed hope of the SIS to involve college students with inner city high school students in a unique mentoring relationship to the benefit of the city and the educational agenda.

Energy Conservation: Little research exists showing the results of energy-efficient solar housing targeted to urban home buyers. A vast amount of information exists about solar-energy technology and benefits, but very little addresses a reduction of a low-income homeowners' energy costs, especially in the South. This work will be done through research from the UT CAD and done with Oak Ridge National Laboratories.

Urban Design: There is a lack of work that integrates energy efficient housing into the urban design and rehabilitation of neighborhoods in the south. Energy conservation is a long-term value. The freedom of choice to give up a car is also a valuable savings that fits into the notion of long term value. The information gathered over years involving these changes to urban neighborhoods would be thoroughly documented and disseminated.

TIME PERIOD & CURRICULUM

The structure of the SIS class work is as follows:

Schematic Design During the fall semester 2000, the UT and Howard students will design various schemes for the Alton Park neighborhood. The best work will be chosen by evaluators from the community.

Development During the spring semester 2001, students refine the schemes to include cost estimates and design details. The project is made into a workable solution during this phase.

Research Concurrent to the schematic design and development, the materials research will test and evaluate the technologies planned for construction.

Construction Beginning in May 2001, the project coordinator, Taylor Bowers, will supervise the students in building two of the schemes.

This is the same structure that followed to complete the first two houses, except the involvement of the Howard students. It will remain a model for later work. The studio has proven that energy-efficient solutions can contribute to both the sustainable and the economic revitalization of cities. The Studio In Sustainability has infrastructure to use the findings to teach, research and teach the public about urban housing on a local, regional, and national scale.

CASE STUDY 1

Research

The first house was designed in a fourth-year level studio. The constraints were a narrow site with an assumed east-west orientation that CNE had recently acquired. Twelve schemes were submitted individually at the end of fall semester, 1997. One was chosen that best addressed the criteria:

Energy conservation

Site constraints

Materials

To address these issues the structure of the studio was created to guide the students through a series of exercises that stressed rational solutions. The problem in this initial house was that only generic site information was available. All that was known was the site was to be long and narrow and on an east west axis.

Because the SIS had to assume a site the class divided into three teams of four and began to study three inner city neighborhoods. CNE had acquired property in these areas and was working to restore them. Each was once a lively, working class neighborhood that was built to serve nearby manufacturing and industry. Also, each was characterized by architectural elements since lost. From their studies that includes historical, photographic and diagrammatic analysis, the students identified the automobile, electronic media and thermal control as the things most responsible for change in way the people live. The SIS identified these three factors as the generators of form for the modern suburban house. Studied relative to the older neighborhoods of Chattanooga the following was learned:

The shift in the design aesthetic from pre to post World War II was complex and varied. The SIS concluded the following:

1. Older, pre World War II, houses were closer to the street, accommodated pedestrian traffic with sidewalks and were designed from a building module in the range of 24",36" and 48". These numbers determined the window patterning, room size and proportioning systems (height to width and length).

The automobile generated the suburban plot of large front yard, driveway, relatively small side yards and large backyard. Houses were designed to serve the automobile through the relationship to the street and through the modulations of the structure. In the modern, suburban house, which the SIS identified as post World War II, the building module doubled in size to an 8 and 16 foot module that accommodated the car and the larger lot sizes of the green-field, tract developments. In addition, the standardization of materials allotted the 4 x 8 foot (48" x 96") sheet size as the basic unit of construction, homogenizing the housing aesthetic.

The SIS found that the scale of the older housing was smaller and intensely relative the setbacks of the street and the close proximity of the adjoining house. Modern housing was detached from it surroundings by the car and the expanded module. Zoning ordinances evolved to meet the needs of suburban, tract housing. The application of these new codes to urban situations ironically placed restrictions on the growth of inner city Chattanooga.

2. Thermal comfort became a determinant of the post World War II housing aesthetic by sealing the house from the outside and eliminating the front porch as a cooling device. The house no longer was designed as a response to specific regional weather criteria but instead became a generic house (the SIS defined this as a gen-house) that was benign to temperature, seasons, and site. Furthering this gen-house was the proliferation of large grading machines that flattened the landscape. The modern site became universally flat. The SIS concluded that Frank Lloyd Wright's dictum: "of the hill, not on the hill," became inconsequential since bulldozers accommodated more housing per acre by removing the hill.

The SIS also concluded that housing became enslaved to cheap energy that made the interior condition more important than the response to the exterior conditions such as climate.

3. Given the detachment made by the car and thermal control, most notably, a constant, year-around temperature, the house grew to be vessel for consumerism. Specifically, electronic media devoured the interior of American life. Through television, and now the computer, people no longer need to participate with the exterior world. The traditional house was built around either the fireplace or kitchen as gathering points for family life. Television, the telephone and the computer, possibly in each room of the house, fosters individualism and decentralization. This condition fragments the design scheme into an inwardly focused series of cells.

The result of media proliferation is consumerism on a vast scale. The house serves the role of filtering and storing vast amounts of *stuff* bought at the thousands of strip malls and shopping centers. These retail markets gain power through advertisement and communication in media sources, mostly electronic, and creates a paradox of never having enough yet having too much. The SIS concluded that electronic media decentralized the interior by removing a place for gathering.

The SIS concluded that any gen-house could be anywhere.

Design

This work addresses the above findings.

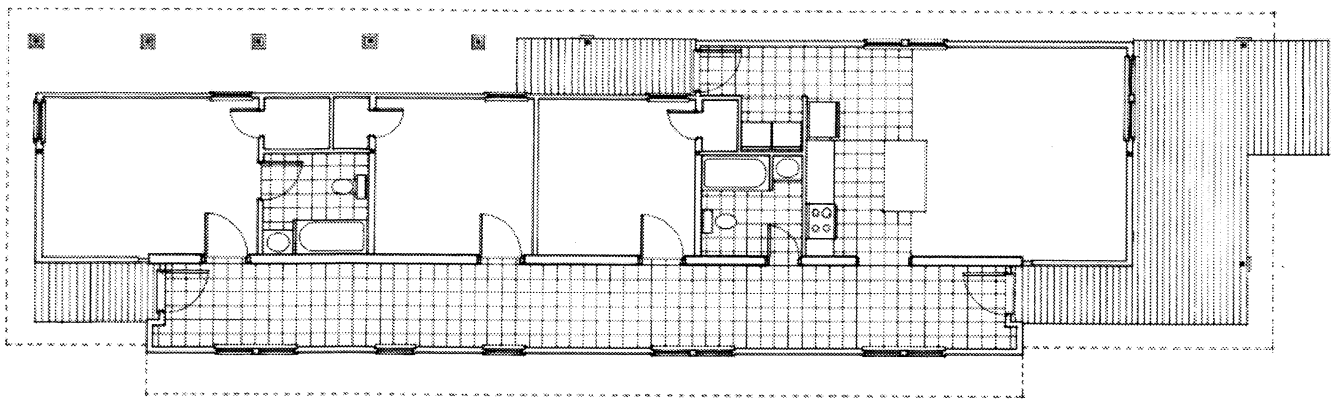

Fig. 1 Plan of House 1.

Fig. 2 Photo describing the use of modular materials that determined the length, width and breadth of the house as it fit into the narrow site conditions. Structurally insulated panels were used to test and confirm the added benefits of thermal control of this product. The SIS used materials that offered an option to traditional, stick built construction methods.

Fig. 3 Photo of House 1. The Final cost was approximately $75.00/sf for 1400 sf. The house was sold for $55.000.00 in the fall of 1999.

CASE STUDY 2

The second house came from a third-year level design studio. Again, the constraints were a narrow site but with an assumed north-south orientation. Fourteen schemes were submitted individually at the end of fall semester, 1998. Four were chosen that best addressed the criteria:

Energy conservation
Site constraints
Materials
Budget

Research

Here, the curriculum will be discussed as it relates to the structure of the semester. It first must be noted that a small, single family house does not fit well into structure of upper level studios at the University of Tennessee. The themes of upper level design at UT are generally for large scale building programs. Much time was spent in the details of the work to compensate for the small scale of the work. Exact drawings, precise area calculations and a thorough discussion of materials is critical to successful work. Students were unaware of the difficulties that accompany a small program and feel most design work can be done quickly. Much time is spent refining the work and understanding the relationship of materials to qualities of space. This project was moved to a third-year level design class and was fulfilled with the aid of a supporting course to cover design development.

Readings covered design theory as well as topics ranging from sociology to technology. The studio met three days a week from 1:30 to 5:30 PM and began with almost 2 hours of discussion of the reading material and topical issues. For example, Monday would be devoted to the sociology of the city and urban design issues; Wednesday would be devoted to technical discussions of energy conservation and material uses; Friday would be devoted to design theory such as transparency and collage. Each discussion was inter-connected, and great care was given weave these issues together into a comprehensive program. The idea of a small house then became a means to look at larger issues of architecture and how students' approach to design fit into a greater whole.

In this case various differences arose that forced the class to study closer:

The cost was an original design determinate for the student design projects. House I was estimated to cost 75.00/ ft2. It was critical to the success of the program to lower this to 65.00/ft2 or lower. Materiality became an important design determinant.

The house was designed and built on a narrow site that could not fit a typical low-income house. The site did not offer much southern exposure but allowed a window wall as a low cost energy control. This condition determined the parti.

Design issues growing from the research of the first project was used to determine the spatial conditions of the second. Use of the porch, private exterior spaces and a strong relationship to the existing context were studio issues discussed throughout the semester.

Design

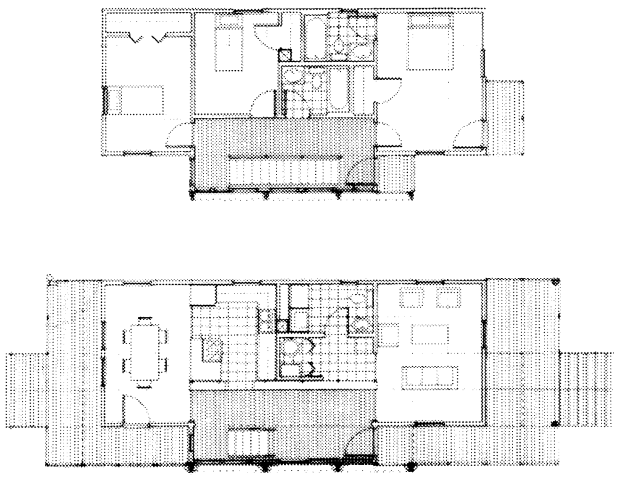

Fig. 4 Lower level plan of House 2.

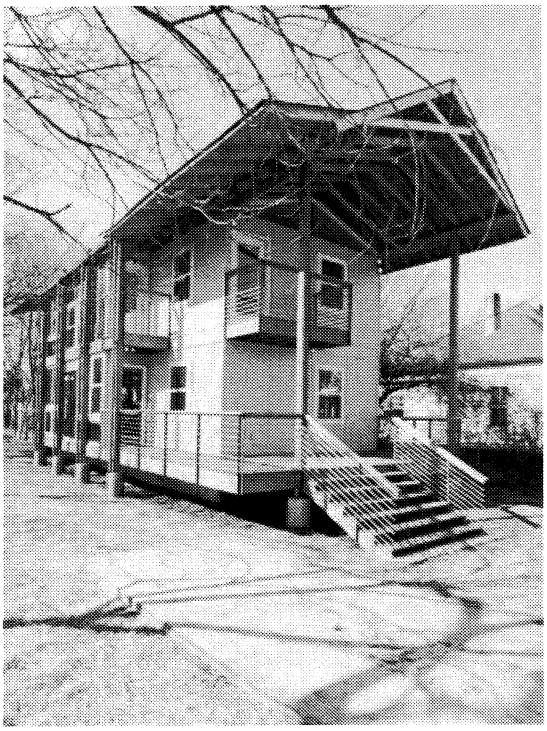

Fig. 5 This photo illustrates the use of a front porch to create an exterior room that also aids in the control of interior temperature. It also had an oversized stair platform and created a place for gathering and participating with the street and community. The addition of a porch was intended to be an economical use of space. House 2 used a back porch intended for exterior dining.

Fig. 6 Exterior photo showing the rear elevation of the house in context.

Fig. 7 Interior photo of window wall.

Fig.8 Construction crew of House 2

House construction began with a crew of eight when the semester ended, in mid-May. It was 80% completed through August, when the semester ended.

An important component of the work was to explain to builders and the public the actual cost of such a project. To address the concerns of liability and benefits that must be met in a payroll, a contractor was hired by CNE as an intermediary. Other student design-build hedge the final costs by disallowing labor and setting up a program where time is donated for college credit. In this the students were earned a three-hour elective credit. Importantly, the students were paid a wage of $7.00/hour. The time was carefully documented and monitored by the students so that the budget could be better controlled. This was an important learning experience for cost control and management. Project manager, Taylor Bowers who, along with professional subcontractors hired by CNE finished the work in the fall.

The Final cost of House 2 was approximately $65.00/sf for 1450 sf. The house was sold for $55,000.00 in the spring of 2000.

CONCLUSIONS

Architect designed housing using innovative materials can be cost-effective and competitive with standard developer work. It was found that labor costs were almost half the final costs.

Design must be localized. Neighborhoods must be studied to address the unique characteristics. A study of the history of the neighborhood to include zoning and material uses is important. Work that is responsive to a neighborhood is critical. Residents respond negatively to generic housing.

Some response to the climate is needed. Regardless of the blind dependence on thermal control, natural heating and cooling is needed. The heating and cooling costs are being confirmed, but anecdotal evidence is very positive.

CURRENT WORK

Two houses in a different neighborhood from the first are now being designed this semester. They will be finished in the summer of 2001. Inclusive to these will be the addition of inner-city high schools students to the design and construction teams. In an effort to be more inclusive to the needs of a specific neighborhood the residents will help build the houses. The same formats for the structure of the semester are being used in addition the same goals and objectives.