A Platform for Consumer Driven Participative Design of Open (Source) Buildings

by
Thomas John McLeish
BArch, BS Environmental Design
Ball State University, 1995

SUBMITTED TO THE PROGRAM IN MEDIA ARTS AND SCIENCES, SCHOOL OF ARCHITECTURE AND PLANNING, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE OF

MASTER OF SCIENCE IN MEDIA TECHNOLOGY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY
August 29, 2003

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Author:

Thomas John McLeish, Program in Media Arts and Sciences, August 29, 2003

Certified by:

Kent Larson, Director, Changing Places, Principle Research Scientist
MIT Department of Architecture and MIT Media Lab

Certified by:

William J. Mitchell, Professor of Architecture and Media Arts and Sciences
Dean of the MIT School of Architecture and Planning, Head of the MIT Program in Media Arts and Sciences

Accepted by:

Andrew B. Lippman, Chair, Departmental Committee for Graduate Students
Program in Media Arts and Sciences

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Thomas John McLeish

Submitted to the Program in Media Arts and Sciences, School of Architecture and Planning, on August 29, 2003 in partial fulfillment of the requirements for the degree of Master of Science in Media Technology at the Massachusetts Institute of Technology

Abstract

Homes in the future will contain many new and complex activities, becoming centers for work, commerce, learning, proactive health care, distributed energy production, etc.. The baby boomer and GenX population are demanding choice and tailored solutions in all products they buy, including homes. The combination of societal and market forces will require new ways of designing, building, and integrating technologies into places of living. The housing industry, however, is poorly prepared for this future, creating mostly generic low-grade, inflexible, disruptive-to-upgrade, and high-maintenance products. Few are tailored to the unique and changing needs of its occupants. The industry lacks a process that will lead to the customization of homes that respond to the unique values and needs of occupants, and architects/engineers play no significant role in the creation of most places of living. To address these problems, I propose that a new model for design and construction that places the consumer in the center of the design process. In this model, developers become integrators offering a process for customization; architects create design engines and computational critics rather than a single design; industry provides tailored product and service information directly to the consumer at the point of decision; and fabricators receive data to manufacture customized cabinetry-like components for just-in-time delivery and assembly. To demonstrate and test the viability of this approach, I have built a participative design platform for non-experts that could be used by consumers to drive informed customization of their home. Central to this process is an interface that allows consumers to access sophisticated design tools without requiring them to think like an expert designer - providing the information and visualization needed to make informed decisions about adjacencies, form, materials, appliances, etc.. This approach could be extended to include the configuration of customized technologies and services. If adopted by industry, such a strategy could create powerful incentives for innovation.

Thesis Advisor: Kent Larson, Director,
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Thesis Readers:

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Dean of the MIT School of Architecture and Planning, Head of the MIT Program in Media Arts and Sciences

Reader:

John D. Macomber, Chairman, George B. H. Macomber Company
President and CEO, BuildingVision, Inc., Senior Lecturer, MIT Department of Civil and Environmental Engineering

Reader:

Michael Schrage, Research Affiliate
MIT Media Lab

Acknowledgments

I would like to acknowledge the efforts and presence of the following people who helped me realize this work.

My fiance, *Brittny Cargle*, without whose patience and support I would surely have whithered away.
My advisor, *Kent Larson*, who has provided me the opportunity to be here.

The rest of the House_n for a brilliant team effort:
Jennifer Suzanne Beaudin
Jacob Hyman
Stephen Intille
Chuck Kukla
Tyson Lawrence
Ron MacNeil
Jarmo Suominen
Emmanuel Munguia Tapia
Reid Williams

The support of the Media Lab Community:
John Difrancesco
Matt Mankins
Deva Seetharam
H. Shrikumar

House_n visiting research staff:
Il Du Goh
Beng-Kiang Tan

BT:
Steve Whittaker

Harvard GSD:
Jeffrey Huang
Mark Meagher
Thomas Schroepfer

And the undergraduate help:
Stephen Form
Amy Dandola
Jennifer Gaugler
Evelyn Kapusta
Kihyo Kim
David Moore-Pitman
Ran Tao
Leon Wang

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Introduction

Situation

In the future, homes will contain the most complex activities of any building type. The home is increasingly becoming a center for work, commerce, and learning. With the pending crisis in health care, homes must become proactive environments for keeping people healthy and autonomous. In addition, the baby boomer and GenX population are demanding choice and tailored solutions in all products they buy, including their place of living [3].

Despite this convergence of market and societal pressures, the housing industry creates homes that are mostly generic low-grade, inflexible, disruptive to upgrade, high maintenance. Few are tailored to the unique and changing needs of its occupants, and architects/engineers play no significant role in the creation of most places of living. Few new homes can properly accommodate increasingly complex activities and work patterns, adapt over time as family, financial and health conditions change, and accept rapidly evolving technologies and services developed by innovative companies. Current approaches to housing fail to meet the challenges of the future. The housing industry is highly fragmented, dependent on increasingly scarce skilled labor, and only competitive locally. There are few of the incentives for innovation found in most other industries [8,9].

Problem

The industry lacks a process for tailoring the physical space, technologies, and services to respond to the unique values and needs of the resident.

Four perspectives on the problem:

Problems in the housing industry are best illustrated by viewing this from four perspectives: consumer, developer, manufacturer, and designer.

Consumer

While consumers have come to expect a higher performance to price ratio in the products they buy each year, they have the opposite expectations of housing. While there is a tremendous range of options for consumer products from cars to PDAs, there is a relatively little choice in new housing. The homeowner has the most intimate knowledge of their values and needs, but there is no vehicle in residential construction that allows them to convert this knowledge into a realized design. Few homeowners have expert design skills: the ability to read abstract representations of space such as line drawings in plan, elevation, and section; the ability to intuitively sense scale and proportion; the ability to imagine tactile qualities of materials used in construction; or the ability to disseminate the complex coordination issues involved in getting something built [2,9].

Developer

Developers create most of the new homes and condominiums in the United States. The time required for approvals, permits, financing, and construction insure that a design is complete long before a consumer enters the process. Since conventional construction involves fully-entangled systems (wires and pipes in walls and ceilings), cost-effective customization is limited to a few elements that are superficial and easy to change. With conventional construction, the additional coordination and the risk of error and delay often makes even superficial customization impractical. Most developers would like to offer meaningful customization for very clear reasons: they could enlarge their market and charge higher prices.

Manufacturer

Most manufacturers of products and services for the home strive to develop a direct channel of communication to the homeowner. This is reflected in the many websites that allow customers to go through a design and selection process to develop tailored solutions. In development housing, however, the customer is not in the loop. A 300-unit condominium building, for example, with likely have 300 refrigerators of a single model. In this process, a manufacturer has no opportunity to present innovative products to the buyer. Product innovation comes from an understanding of the needs of their customers and having a path to market for innovative products [17]. Currently, many layers of construction bureaucracy exist between the homeowner and manufacturers, stifling interaction with the consumer [16]. There is little feedback to the manufacturer on how their product is used, and little incentive for innovation[9]. Developers select products mostly on the basis of initial cost, rather than quality, performance, and lifetime cost.

Designer

Architects are skilled at developing customized solutions for those few who can afford the time and expense involved with creating a home that directly reflects their desires and lifestyle. Essentially no development housing in the U.S., however, involves an architect working directly with the homeowner. The tremendous time involved for custom design at this scale makes such services prohibitively expensive. While there may be an architect-of-record on a housing project, their role is largely limited to the development of generic floor plans, exterior elevations, contract documents, and construction administration.

Hypothesis:

Individuals want (and need) tailored environments and services that respond to their unique needs and values. A design tool that places the individual in the center of the (infill) design process, directly linking consumers and manufacturers, can:

a) result in cost-effective customization of plan, form, finishes, appliances, technologies, and services.
b) be a catalyst for creating innovative products and create a path to market.
c) provide developers with a competitive advantage.
d) provide designers with access to a currently unavailable market.

Solution:

I propose a new model for design and construction that places the consumer in the center of the design process. In this model, developers become integrators offering a process for customization; architects create design engines and computational critics rather than a single design; industries provide tailored product and service information directly to the consumer at the point of decision; and fabricators receive data to manufacture customized cabinetry-like components for just-in-time delivery and assembly.

To demonstrate and test the viability of this approach, I have built a participative design platform for non-experts that could be used by consumers to drive informed customization of their home. Central to this process is an interface that allows consumers to access sophisticated design tools without requiring them to think like an expert designer - providing the information and visualization needed to make informed decisions about adjacencies, forms, materials, appliances, etc.. This approach could be extended to include the configuration of customized technologies and services. If adopted by industry, such a strategy could create powerful incentives for innovation.

Opportunities:

Opportunities for developing a means to put the consumer in the center of the residential design and construction process can be found in new technologies developing across a variety of disciplines.

Technologies

1. Visualization - Powerful yet affordable graphics engines are capable of delivering compelling visualization of complex geometries in real time.
2. Object tracking - Can replace the keyboard and mouse with a more natural interface for non-expert users.
3. Databases - Vast storage capacities afford development of easily accessible libraries.
4. AI - Advancements in algorithms enable machine learning that can extract knowledge from developing systems.
5. Fabrication - Computer-controlled fabrication reduces necessary communication between designer and producer [9,10].

Supply Chain Management

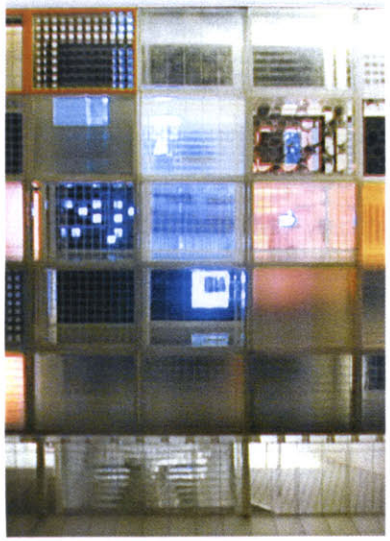
New technologies in construction are changing the way we build. The commercial building industry is moving toward parametric 3D solid models tied to databases available to the architect, consultants, contractor, and owner in real time, thereby managing complexity in design by reducing redundant communication.

Common Stategies and Standards

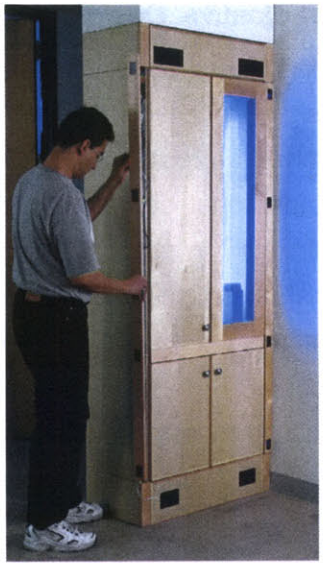
New concepts in construction documentation and management are emerging as a result of changing technologies. The Open Source Building Alliance is establishing interface standards among manufacturers, modeled in the spirit of open source code [12]. The Industrial Foundation Classes (IFC) have been developed as a standard object-oriented model for the description of buildings; an XML schema capturing that model has been written to take advantage of the inherent properties of XML (ifcXML) [6]. The IFC are being integrated into many professional CAD tools, shifting their function from a means to efficiently draft a set of construction documents to that of accessing and manipulating a living object model of an entire project, through the life of the project.

Participative Design

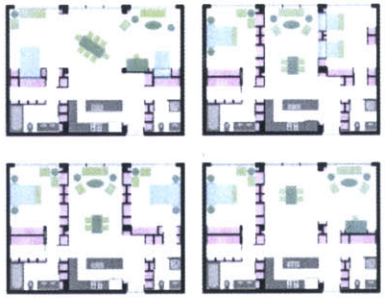
There is a distinction between the traditions of participatory design in architecture and product design. In architecture, it usually involves a group of interested lay people working directly with a professional designer to develop design concepts for civic buildings. In product design, it typically involves representative members of the target user group participating with industrial designers rather than relying on simple feedback from focus groups. The second definition has not applied to architecture, because there are not situations were homeowners (or arguably clients of commercial buildings) contribute to the design of houses for future generations of homeowners. In the model I propose, participatory design involves concepts borowed from both: consumers are directly involved with the design of their own homes via expert systems, and their choices can then be communicated to designers and manufacturers to help influence future product and service offerings.



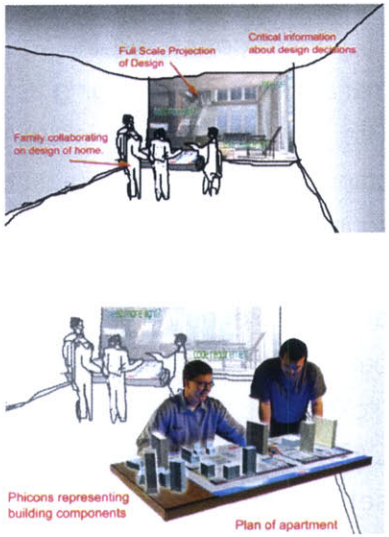
A multifamily residential development that allows customized design through Open Source Building chassis and infill components.



Rapid and efficient assembly of personalized design through integrated infill components



Base plans produced by expert designers using integrated infill components in multifamily residential developments which address specific design programs. These designs may be customized with continued expert involvement through computational critics.



A tool for the consumer enabling them to drive customized design of the residence in an OSB (Open Source Building) development using OSB infill components, guided by computational critics.

Vision for Consumer Driven Participative Design of Open Source Buildings

I describe a participative platform that allows consumers to drive informed customization of their home in an Open Source Building (OSB) residential construction industry. In this model, developers become integrators offering a process for customization; architects create design engines and computational critics rather than a single design; industry provides tailored product and service information directly to the consumer at the point of decision; and fabricators receive data to manufacture customized cabinetry-like components for just-in-time delivery and assembly.

A developer in Cambridge, MA realizes that the generic apartment strategy that is standard in the industry did not fully address the changing market demand. Their potential buyers generally broke down into three categories: a) young professionals looking for affordable, efficient space, b) families with children looking for smaller additional bedrooms and larger living and kitchen space, and c) "empty nesters" who desired higher quality, more generous spaces, and room for lots of furniture. This last group is particularly interested in accessible spaces, assistive technologies, and other features that will allow then to remain healthy and autonomous as long as possible.

With a desire to create multi-generational housing, the developers adopt an agile strategy that allows an apartment to be tailored at the point of sale, resulting in faster sales and higher prices. After purchasing a site in for a customizable "loft" condominium development, their architect rapidly configures the building envelope according to design criteria provided by the developer. This calls for a standardized "chassis" with open bays 13 feet wide by 28 feet deep. Each bay contains floor and ceiling finishes, power and data connections, plumbing risers, and distributed HVAC systems serving each bay. The architect configures the form of the building and exterior infill façade modules according to the requirements of the building's context. Prior to placing the lofts on the market for sale, the developer proceeds through planning and zoning approvals, contract documents, and construction. Meanwhile, the developer specifies the range of options available to buyers for interior fit-out, appliances, technologies, and services, working with companies to provide a range of options appropriate for the market. The participating companies have a relationship with the developer and provide products and services according to pre-established guidelines. With a highly efficient chassis, the building goes up quickly. Large structural modules arrive on site as shipped from a Canadian factory on flatbed trucks, and are stacked to fill the building volume. Meanwhile a small team of skilled assemblers make necessary connections between them to accommodate fire safety, plumbing, power, and data. Within the span of a few days the building envelope is complete. The real estate broker, specializing in customization, has a room in their nearby branch office where customers can rapidly work through the design/configuration process for a personalized environment. With the design complete, an order is placed with each of the participating fabricators and suppliers, who provide just-in-time delivery of components for rapid installation in the loft.

Manufacturer Scenario

After years of almost exclusive focus on cost reduction for housing construction products, with little emphasis on quality and innovation. Manufacturers begin to something new. They start to communicate directly with homebuyers through an innovative mass-customization process increasingly adopted by developers. Enabled by industry agreement on a few key construction standards and sophisticated supply chain management and fabrication technologies, manufactures are rapidly bringing innovative products and services to market to establish a competitive advantage. As homeowners are provided with a high degree of choice and carefully presented information at the point of decision in the process of home design: Manufacturers compete based on quality, durability, performance, design, and cost. Within a few years, the industry is transformed with these attributes:

a. Manufacturers develop products and services with standardized interfaces to other products.
b. Tier-1 housing suppliers evolve to deliver larger assemblies of integrated sub-components to the project site.
c. Manufacturers cultivate relationships with developers/integrators who will present their products.
d. Manufacturers cultivate relationships with consumers who will evaluate, select, and use their products.
e. Manufacturers supply information to the consumer to present and simulate their products in context.
f. Manufacturers fabricate the integrated components on demand.
g. The residence is assembled with these components using minimal on-site labor.

Designer Scenario

The process of acquiring a new home has been binary: 1) an architect and/or builder is retained to create a place of living tailored to specific needs and values, or 2) a buyer selects from available generic homes created by developers. All but a tiny percentage of new housing falls into the second category . The constraints of professional practice make it prohibitively expensive for an architect to provide design services for each buyer of a mass-housing development. Recently, a third option has become available.

A small architectural firm has found a highly profitable way to bring their design skills to the mass housing market. Rather than creating a single design, they create and license design engines and computational critiques to developers. These new tools result in hundreds of design solutions created according to the personal design values of the firm, embodied in their rule-base design algorithms. This has opened up a huge new market for the designers, and dramatically improved the quality of design of the mass-housing projects that has licensed their intellectual property. Other designers, realizing the potential, are now creating their unique design engines. Developers are beginning to offer a range of design engines to their customers, often resulting in both traditional and hyper-modernist solutions within the same development.

Consumer Scenario

A couple is moving to Boston to be closer to the parents, who are now retiring. Their children are nearing the age for college. They use a real estate search engine to identify a new condominium development in Central Square that offers the location, range of choice, and amenities that they are looking for.

Visiting the building, they see open lofts spaces of various sizes that are available for sale. In the agent's office, they use a new design interface to explore design options and amenities including playing out scenarios for how to transform the apartment when the children leave home. They evaluate the carefully tailored information and coordinated choices to make decisions with confidence. With the purchase price and final design set simultaneously, the interior fit-out order is placed, payments are made as required directly by the affiliated mortgage company, and the couple moves in three weeks later to a finished apartment.

Past Work

From consumer interface to information management, there are many examples of commercial products and academic research that relates to consumer driven residential design.

A brief description and critique of related projects:

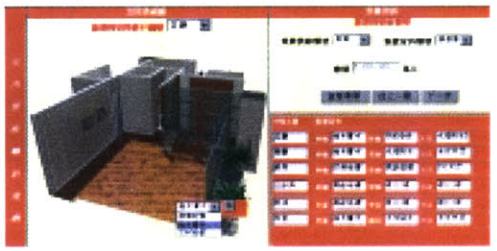
Developer Tools for a Consumer Designing a Residence

Chien and Shih worked with the Kindom Construction Corporation in Taiwan to implement WIDE-Kindom[14]. The prototype focuses on the residential customization process, but it does not provide support to architects, consultants, or contractors. It is primarily a visualization tool for designing an apartment within a specific Kindom development. It allows a user to to select interior finishes, equipment, and apartment layout. Buyers explore different options of finishes and kitchen and bathroom equipment. They can also choose from pre-designed layouts that are suitable for a specific apartment. The tool also has a Feng-Shui critic, although it is implemented in a different package and it is not clear how it integrates with the editing and visualization tool. The results are displayed via screen in VRML, pre-rendered still images, or plan. The pre-rendered images are taken from a perspective outside of the unit and the VRML renderings are very abstract. The process for editing the design is awkward, and may be difficult for a non-expert to comprehend.

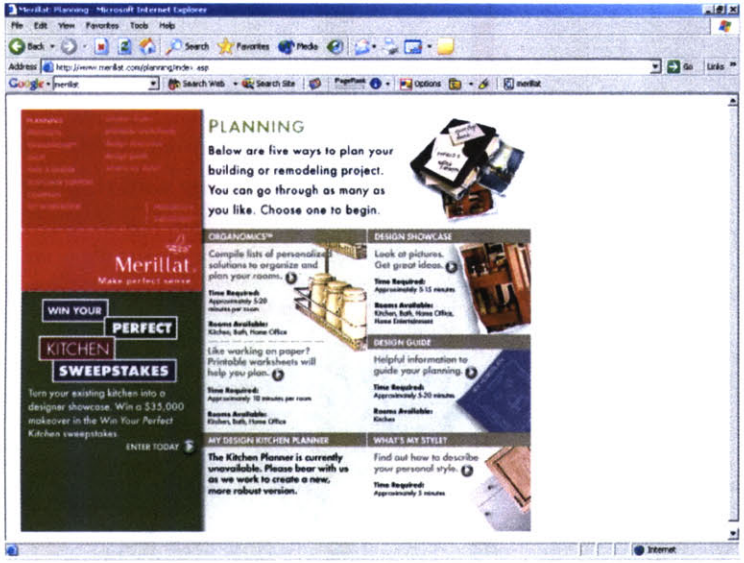
WIDE-Kindom consumer interface for visualizing and modifiying an apartment interior [figure from 14].

The apartment with a different flooring selection [figure from 14].

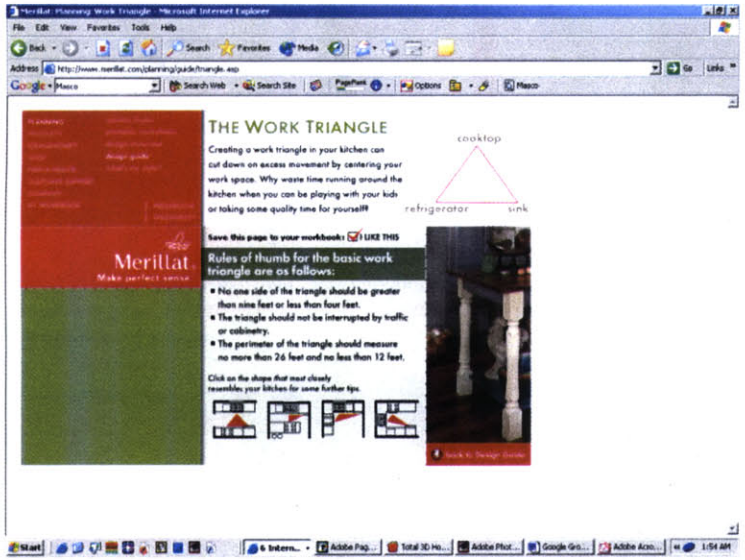
The apartment from a different perspective, with original flooring selection [figure from 14].



The apartment from a different perspective with different flooring selection [figure from 14].



Merillat planning home page.



Interactive kitchen design rules.

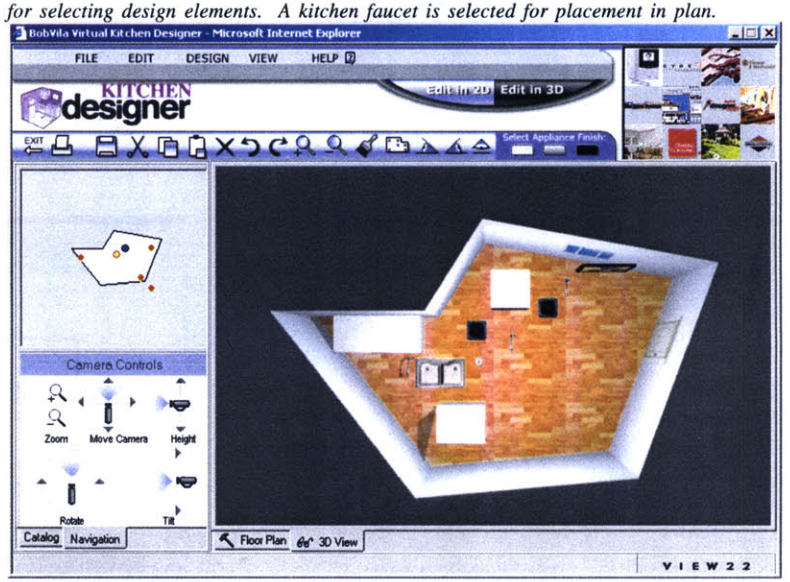
Manufacturer Tools for a Consumer Designing a Residence

Merillat is a manufacturer of custom-fabricated kitchen cabinets. The company has produced a set of design tools to help a consumer better understand their products. While many manufacturers have developed similar tools, Merillat's is among the best. They offer a series of worksheets to help the consumer document specific issues about their current kitchen. They offer images of potential design solutions that may or may not address documented concerns. General kitchen design rules are offered, as well as a tool for suggesting a style based on a series of questions. Previously, they included a design tool that offered a variety of visualizations for seeing product use in context, but this has since been removed and replaced with a promise of future availability. While the Merillat website is a good first step, many features are lacking that most users would find essential. There is no evaluation of design solutions, no mechanism to delineate existing conditions, no way to document the design, and no link to the purchase and fabrication of a design.

Designer Tools for a Consumer Designing A Residence

Bob Vila has a series of web-based home design tools you run in a web browser. One example is a tool to help an individual design a kitchen. A user chooses items from a menu to be placed in a design, with controls for the viewpoint. The design space is fairly unconstrained, and there are no guides to help avoid impractical or even illegal solutions.

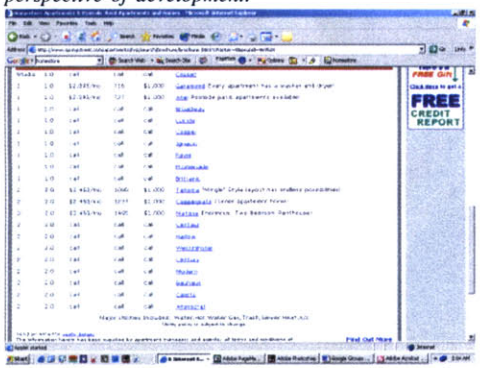
Interior perspective of kitchen design, shown below, in Bob Vila's software with menu for selecting design elements. A kitchen faucet is selected for placement in plan.



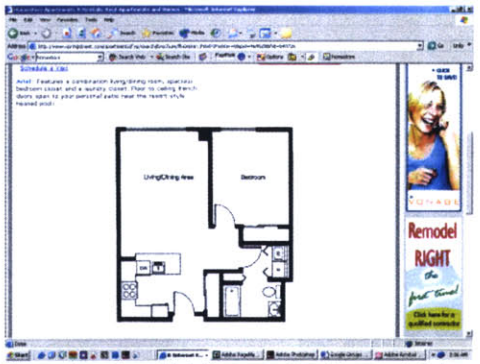
Plan perspective of kitchen design in Bob Vila's software with camera controls for viewpoint.

HomeStore.com property listings.

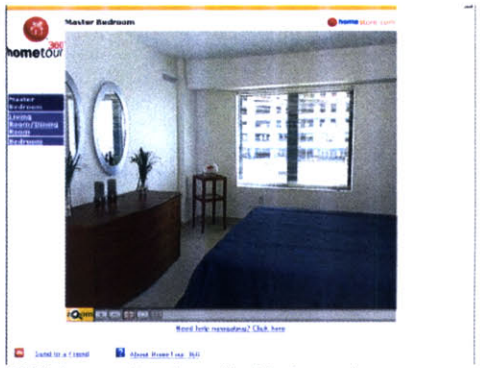
Cambridge Park Place listing with exterior perspective of development.



Apartment unit types available at Cambridge Park Place.



Floor plan of an "Ariel" type unit with some labels.



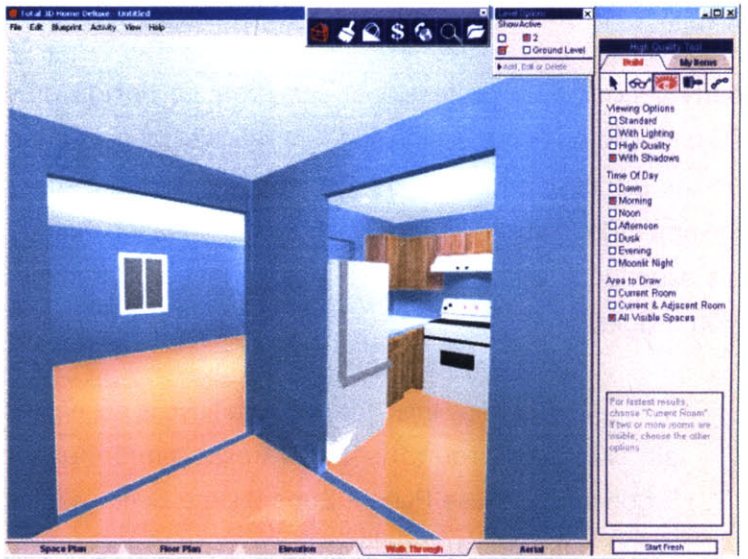
"360 degree virtual tour" of bedroom in an unidentified unit.

Realtor Tools for a Consumer Seeking a Residence

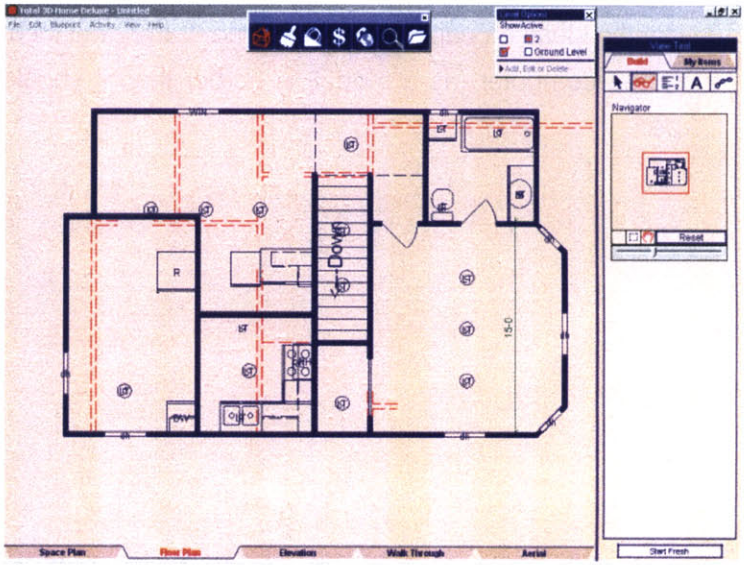
Homestore.com® is a commercial website to assist a consumer in finding a residence. A client begins by entering a city and state, followed by a budget. This is followed by a list of available spaces. Currently, one such listing is Cambridge Park Place. The listing for this development presents us with a series of images both from outside the building and inside an individual unit. Each type of unit has a different name. Calling up a unit type reveals a floorplan of that particular unit. One can take a "360 degree virtual tour" of three different rooms in an unidentified unit to get a feel for the quality of the space. This is typical of web based tools for marketing development properties to consumers. No customization is possible so there are no design or visualization tools. There is little effort to solicit user input other than a location and a budget; There is little feedback on how a particular design might meet a specific consumer need.

Consumer Grade CAD Tools

Available at any local software store, many tools have been developed to help homeowners design their home. 3D Home Architect® Deluxe 2.0 by Broderbund is an example of such software. With this software, you begin with a plan view of a design then drag and drop architectural elements from a menu and select finishes in a perspective view. One can subsequently view those designs in a 3D walkthrough and in high-quality renderings. This tool provides starting points, a library of parts to manipulate in design, and a variety of visualization techniques. It ties to certain manufacturers through off-line catalogs, provides a budgeting spreadsheet with material labor cost estimator, and the ability to print designs. The software, however, has some crippling faults. There is nothing to guide a user in selecting a starting point other than square footage and style, and nothing to differentiate how the spaces within those options might accommodate particular life-styles and activities. The visualizations offer little variety in lighting simulation, such as time of year and hour. The ties to industry are for appliances, furnishings, and finishes, but not to the core architectural aspects of the home, for example walls, windows, hardware, or doors, nor to the labor force that would be involved in fabricating them. The budgeting feature is extremely suspect because pricing is tied to local markets and product selection, and is not fully automated. While final plans can be saved and printed, there is limited guidance on how to turn the final plans into a real home. The last section of the manual covers "The Order Plans Activity". This consists of instructions on how to get the individual's design to a 3rd



Interior perspective of home design, shown below, in Broderbund software.



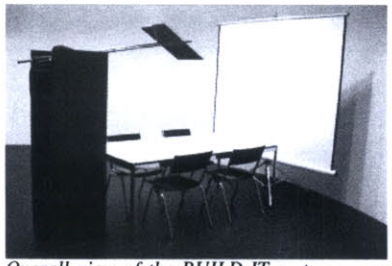
Plan of home design in Broderbund software.

party vendor so a professional can produce design drawings. Discussions on home design software like this appear frequently in on-line discussion forums. I have included such a discussion in the appendix. I asked Lance Hirsch, who started the thread, about his experience with a consumer grade CAD tool, Punch! Super Home Suite™.

> "I will say this - the software I use is not easy at all. My background is Software Engineering and Ergonomics. I use Punch! Super Home Suite. Simply laying out walls and getting them to snap together at corners or ends is quite difficult IMO [in my opinion]. I've got the ideas on paper and in my head -translating them to the computer (as a model) is harder than it should be."

Commercial Grade CAD Tools

The CAD tools used by professional designers, like AutoCAD or CATIA, are overly complex and abstract for the layperson, as they are designed for the specific needs of the professional working within standard industry practices.



Overall view of the BUILD-IT system.

Group collaborating around plan with supporting perspective visualization.

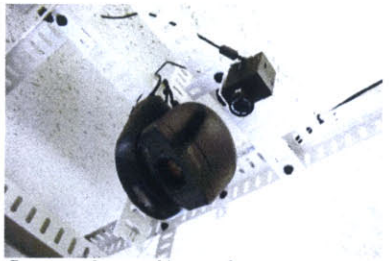
User binding physical "brick" to a virtual design component.

Detail of user manipulating machine on the floor of the factory.

Collaborative Design Tools

M. Fjeld explores human and computer interaction with BUILD-IT[4]. This system provides a tangible interface coupled with strong visualization for use in design. A table and projections are used to facilitate cooperative design in a group (see images left). Bricks are used to control design elements in a manufacturing center. The target user group is comprised of design experts and sales people. It therefore does not address the specific needs of a non-expert, nor is it tied to a means of production .

J. Rekimoto has also developed a continuous interactive work surface, that can be used, for example, to design a seating area (see images right). Items are selected from a catalog and dragged into a shared workspace, 3D images are projected onto an adjacent wall. A *PropCamera* is used to control the 3D view of the furniture layout [15].



Cameras for tracking and tag identification in Rekimoto's work surface.

Large screen presenting "PropCamera" view.

"PropCamera" manipulation on work surface. We see the tag on the camera.

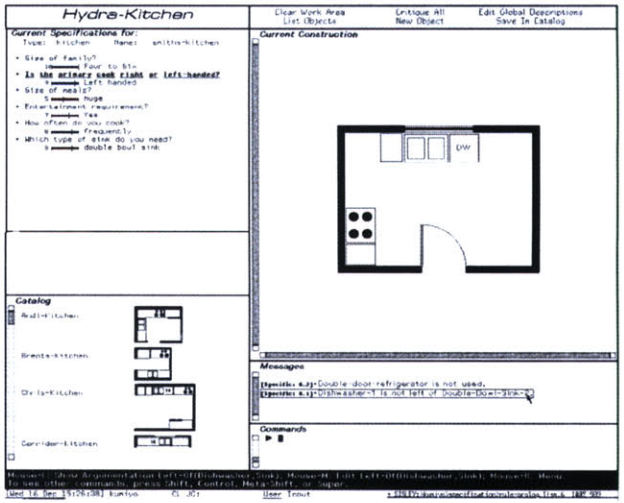
Tagged catalog from which virtual chairs are selected.

The Augmented Urban Planning Workbench developed by Ishii and others at MIT provides a rich variety of design visualization, simulation, and manipulation tools for collaborative design at an urban scale [7]. The work specifically addresses the issues of multiple modes of representation in design: drawings, physical models, and digital models. It is perceptually accessible to the expert and nonexpert alike, although critical analysis comes from the participants, not from the tool. It shares with this effort the use of the design experience as a vehicle for learning, and has been used successfully in a design studio course for Urban Planning at MIT DUSP.

The Augmented Urban Planning Workbench in action with a group of students [7].

Participative Design Tools

Gerhard Fischer and his colleagues at the University of Colorado have spent over a decade studying design tools and embedded critics[3]. The HYDRA-KITCHEN (see image next page) is a domain specific (kitchen) tool to assist an expert designer. It provides a variety of tools to critique the current state of the design. In it there are generic, specific, and interpretive critics that evaluate a kitchen design against an architectural program for that space. As it is a tool for experts, it does not offer rich perceptual support for a non-expert making design decisions. Visualization is constrained to simple diagrams. The HYDRA-KITCHEN is also not tied to a means of production, although it is possible to imagine an embedded critic which could tell you whether your design is buildable or not.



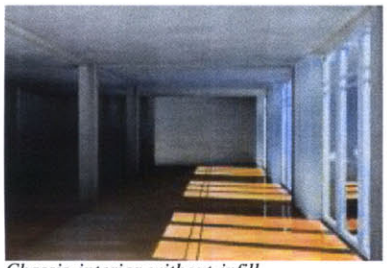
HYDRA-KITCHEN interface [3].

In 1975 Nicholas Negroponte proposed and developed a design tool that began to outline the specifications of this proposal. Without the supporting hardware and software, it was impossible to realize such a system at that time [11].

The Geometric Description Language (GDL) is scriptable language for describing virtual objects [5]. These objects contain all of the information necessary to completely describe building elements as 2D CAD symbols, text specifications, and 3D models for calculations and presentations. GDL distinguishes itself from other electronic object descriptions in that it requires little programming experience. There are essentially two different types of GDL objects: The first is a highly parametric building element used in a general way to explore design and when using customizable objects. The other is a brand specific object produced by a building component manufacturer containing all the variations of the object including the brand specific information in 2D, 3D and database information.

The developement of the Industrial Foundation Classes (IFC) is the result of an effort to create an open source object-oriented model of the built environment [6]. Because of widespread support of XML, an XML-based description of IFC (ifcXML) is under development. And because of its use in supply chain management, an implementation that shares ground with ifcXML is being developed that has a smaller footprint for use in rapid transactions, the aecXML. Many professional CAD producers are including support for this emerging open standard into their software. This allows cross platform independence of work using these standards. A building described in ifcXML can be viewed and manipulated by any other software that supports it, whether it is visualization-specific, simulation-specific, or an accounting and take-off package.

Foundations: Open Source Building



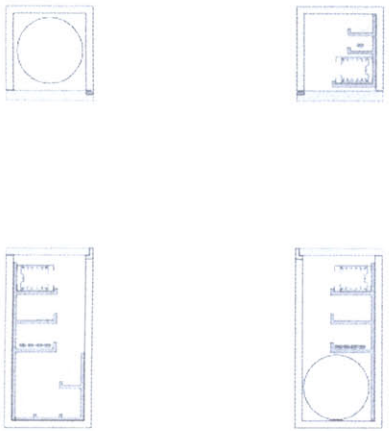
Chassis interior without infill. Rendering by K. Larson.

Chassis interior with infill type A. Rendering by K. Larson.

Chassis interior with infill type B. Rendering by K. Larson.

Section detail of infill and volumetric chassis connection. Image by T. Lawrence

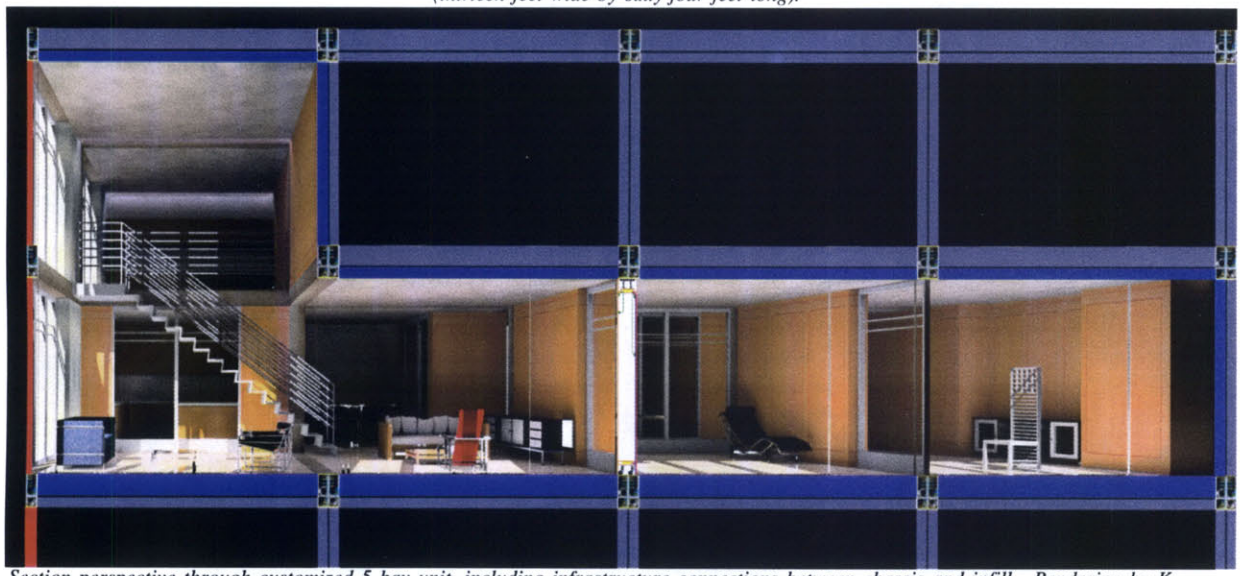
Open Source Building (OSB) is about standardizing construction interfaces - where work meets work - in such a way that building coordination is greatly simplified [12]. In the conventional process, a millwork fabricator must field-measure the location of prior construction elements before starting fabrication. This is essential because of the high probability of a difference between that what was built and what is on the design drawings. While this work is not dependant upon the ideas set forth as OSB, it builds upon them. It assumes the existence of basic OSB standards. OSB describes interface standards that will reduce the degree of complexity in residential construction. These interfaces are designed to address two types of coordination, coordination in building infrastructure, and coordination in the customizable substance of a residence. It integrates building infrastructure into the chassis of the building, including power, data, HVAC, plumbing, and fire safety systems. The building interior is built from infill components that plug into the chassis as necessary to fulfill the requirements of that component. This decoupling of infrastructure from infill through interface standards enables customization of residences [10]. OSB does not need to exist for this platform to work, but it does require a means of resolving complex coordination issues in the field.



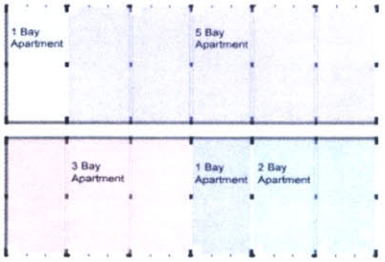
Chassis detail showing integrated power, data, HVAC, and fire safety.

Volumentric chassis modules designed to be thirteen feet by sixty-four feet in dimension, so that two modules side-by-side fit precisely over the parking column grid. This is approximately the maximum size object that can be efficiently carried over the highway (thirteen feet wide by sixty-four feet long).

Hotel under construction using similar technology.



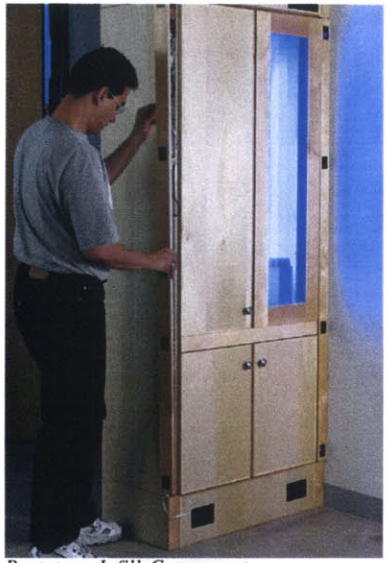
Section perspective through customized 5 bay unit, including infrastructure connections between chassis and infill. Rendering by K. Larson and T. Lawrence.



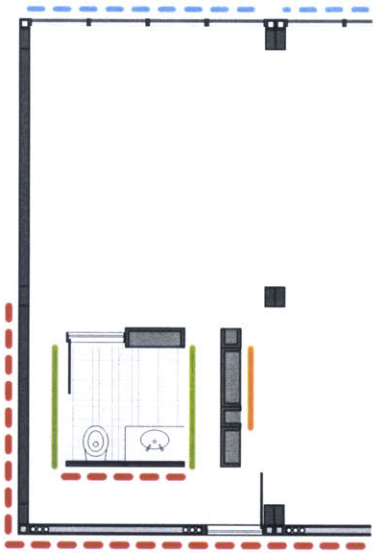
Floor plan of residential development illustrating a variety of size configurations. Image by J. Suominen.

Design/Implementation

Perspective view of proposed development that uses OSB chassis and infill modules for customized residences.



Prototype Infill Component.

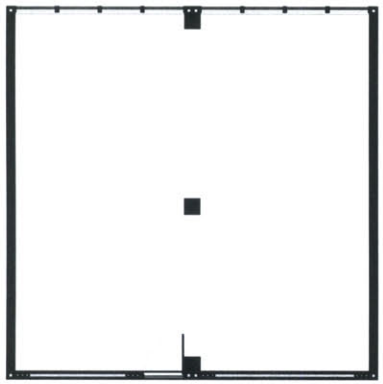


Expert perspective description for training of computational critic.

Potential homeowners using consumer interface to design a condominium.

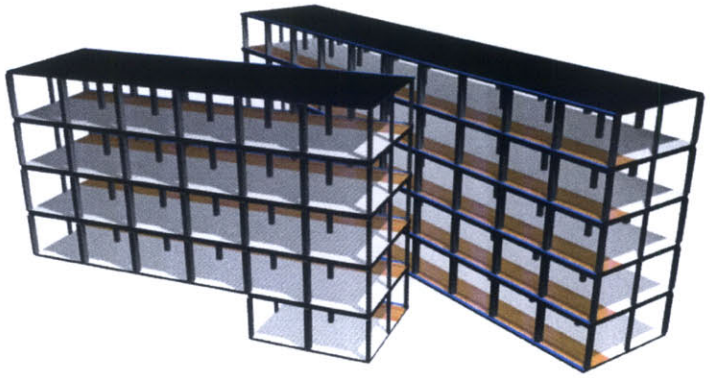
To demonstrate and test the viability of a new model of residential design and construction, this work involved the following:

- The design of a prototypical chassis for open loft condominiums.
- The schematic design of a building envelope for a site in Lafayette Square, Cambridge, MA.
- The design and fabrication of a full-scale infill component prototype complete with sensing, power, data, lighting, etc.
- The design of a library of infill components.
- The simulation of the output of a computational design engine that suggests an initial design to the user.
- The training of a computational design critic.
- The development of an interface for consumer driven participative design, with the following components:
    1. *Data management system*
    2. *Digital table*
    3. *Scale models of infill components.*
    4. *Optical tagging system to track the identity and location of infill components.*
    5. *Real-time 3D visualization system that responds to the identity and location of scale infill components.*
    6. *Integration of a design critic to provide feedback to the user to iteratively refine an initial design.*
- The creation of a scenario for a condominium fit-out.
- The evaluation of this new model of residential design and construction by experts in the profession.



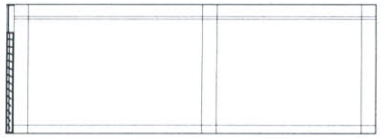
Floor plan of a typical unit comprised of two adjacent volumetric chassis modules.

Compared to floor plans in an existing development, this unit is neither unprecedented or unusual.

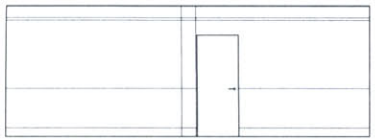


Perspective view of proposed development "chassis". Here we see use of half length volumetric modules due to site constraints. The resulting design has single-loaded corridors and a substantial atrium.

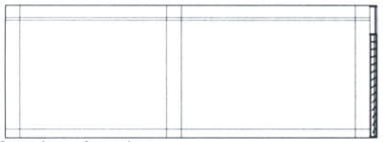
Interior façade elevation.



Interior elevation.



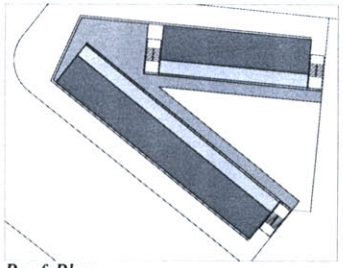
Interior wet wall elevation.



Interior elevation.

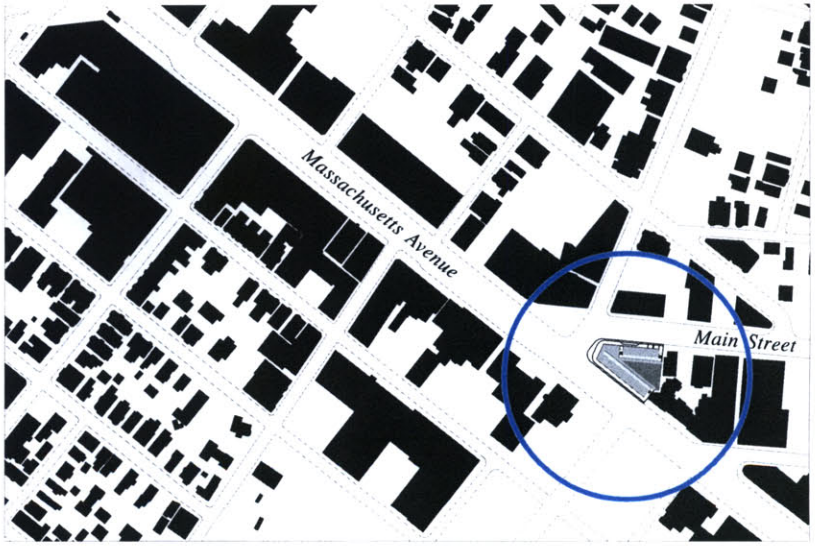
Chassis Design for Open Loft Condominiums

Building on the work of House_n graduate student Tyson Lawrence, a building "chassis" has been developed. This consists of volumetric modules designed so that two modules side-by-side fit precisely over the parking column grid. Creating open loft spaces, they stack to provide – in one efficient, highly-insulated assembly – structure, ductwork, power, signal, plumbing connections, mechanical attachments for infill, HVAC (or its infrastructure), floor finishes, and ceiling finish. Although not the focus of this thesis, façade studies indicate a strategy for customized exterior modules thirteen feet wide by ten feet tall that plug into the chassis.

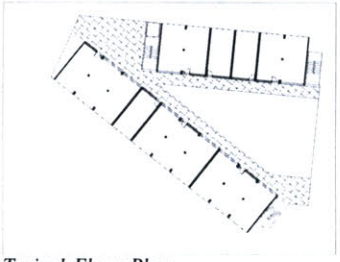


Roof Plan

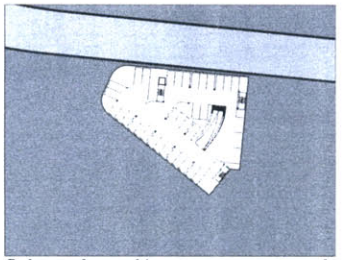
Ground floor plan with retail and atrium.



Condominium development site location, Lafayette Square, Cambridge Massachusetts.



Typical Floor Plan



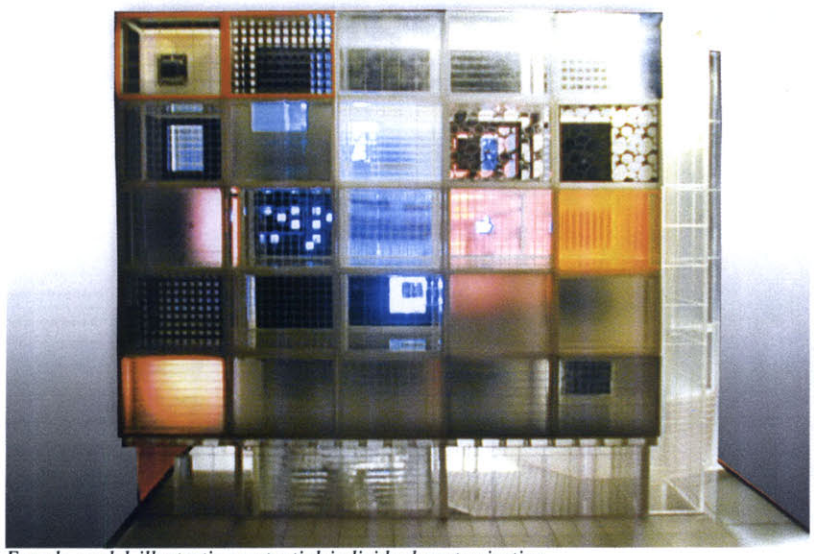
Sub-grade parking garage, note column grid and parking spaces.

Schematic Design of a Building Envelope For A Site In Lafayette Square, Cambridge, MA

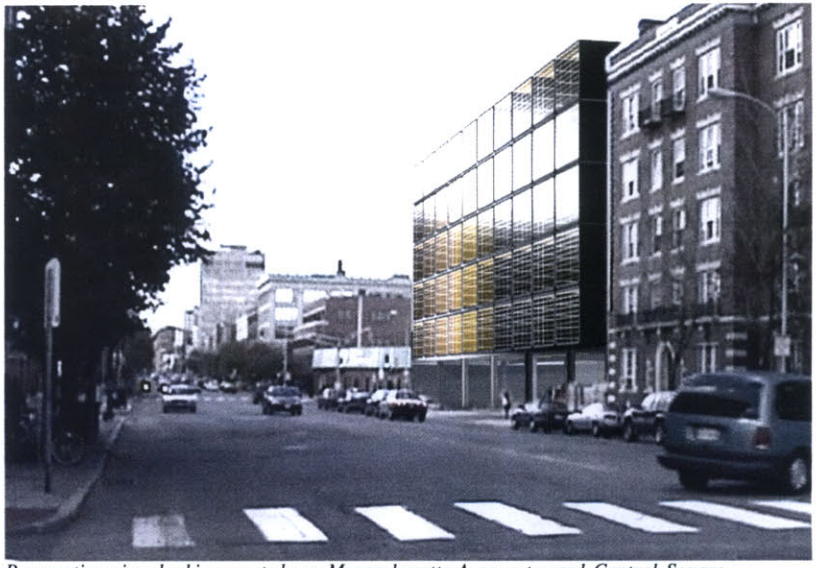
An open loft condominium was designed schematically for a site in Lafayette Square, Cambridge, MA. Illustrations on pages 36 to 39 illustrate the site plan, parking grid, massing, sample customized floor plans, exterior perspectives, and façade studies.

Marketing material using potential personalization as a means of attracting consumers.

Plan view of typical floor plan showing potential condominium layouts using infill components.



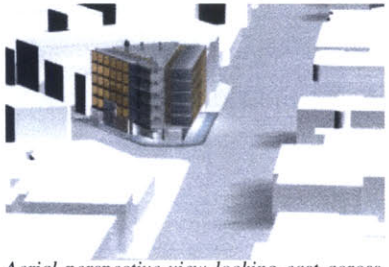
Façade model illustrating potential individual customization.



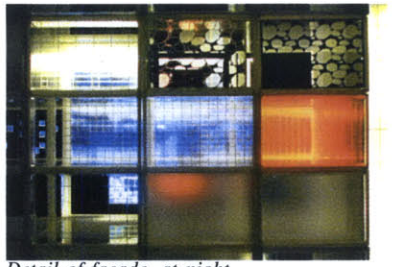
Perspective view looking west down Massachusetts Avenue toward Central Square.

Section through model showing single-loaded corridor and stacked units

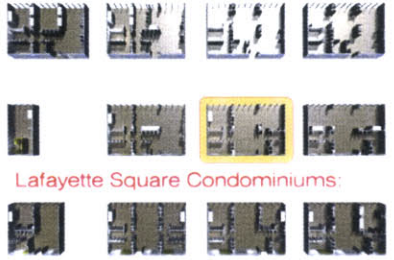
Condominiums and retail, at night.



Aerial perspective view looking east across Lafayette Square.



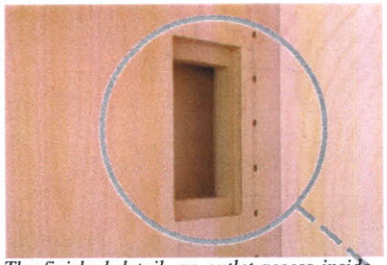
Detail of façade, at night.



Marketing material.

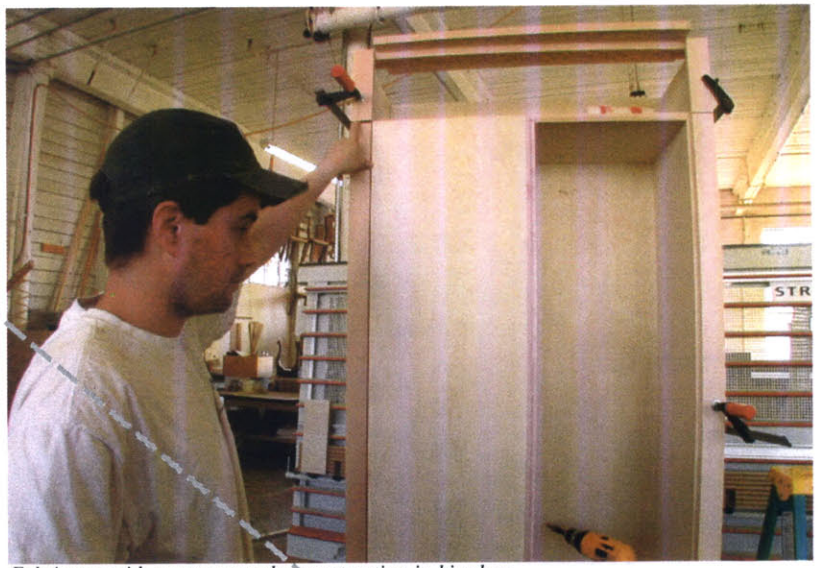
Fabricator referencing design drawing. Photo by Ron MacNeil.

A jig produced for implementing the detail. Photo by Ron MacNeil.

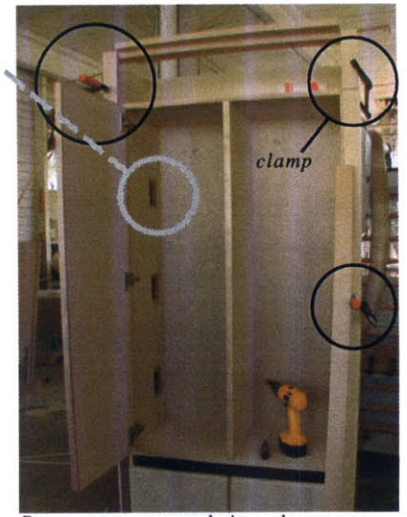


The finished detail, an outlet recess inside the cabinet. The faceplate was added later.

Cutting a fine edge. Photo by Ron MacNeil.



Fabricator with prototype under construction in his shop. Photo by Ron MacNeil.

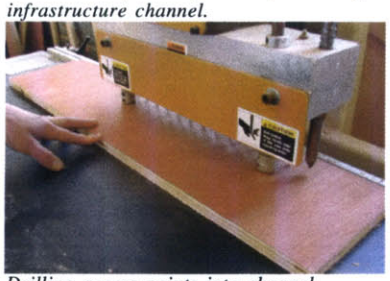


Prototype near completion, clamps are used to temporarily hold pieces together to check assembly alignment. Photo by Ron MacNeil.

Full-Scale Infill Component Prototype

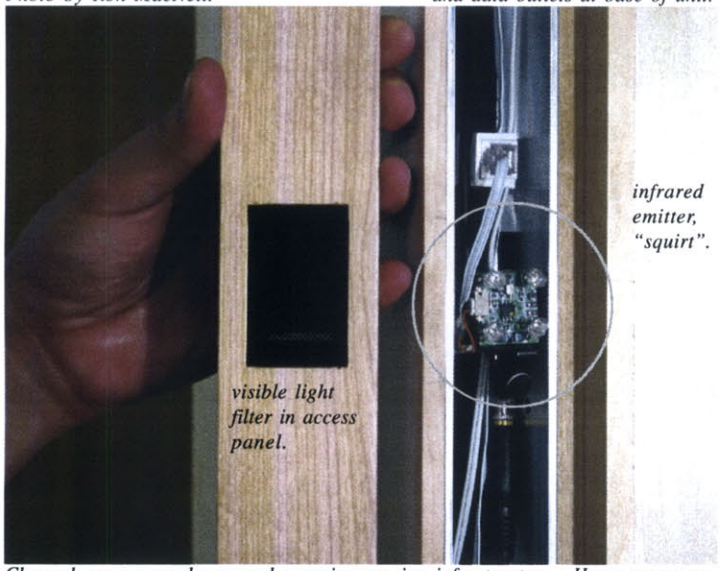
Working with the entire House_n research group, a full-scale prototype of an infill component for the "Place Lab" was designed and fabricated. My role was that of project manager, which involved coordinating the design effort and developing the fabrication drawings for the millwork contractor. The components to be installed in the "Place Lab" will approximate the detailing of the infill components I describe in this document. The prototype integrates power, data, sensing, and lighting technologies. Design drawings for this prototype can be found in the appendix.

Fabricator referencing detail for sensing infrastructure channel.

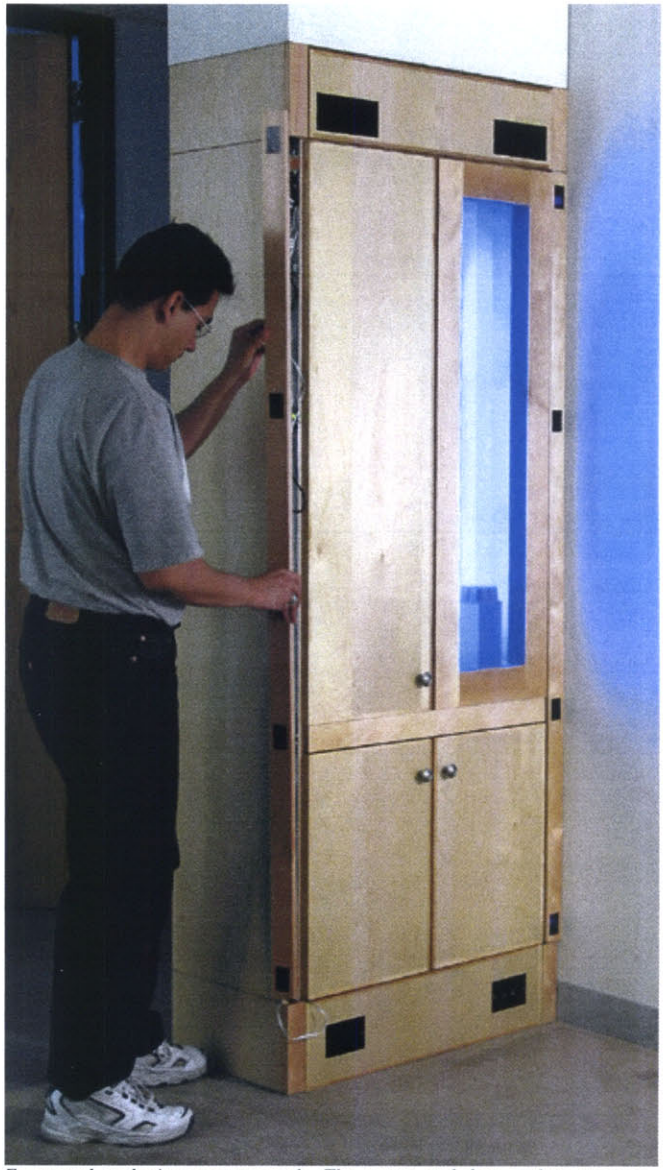


Drilling access points into channel. Photo by Ron MacNeil.

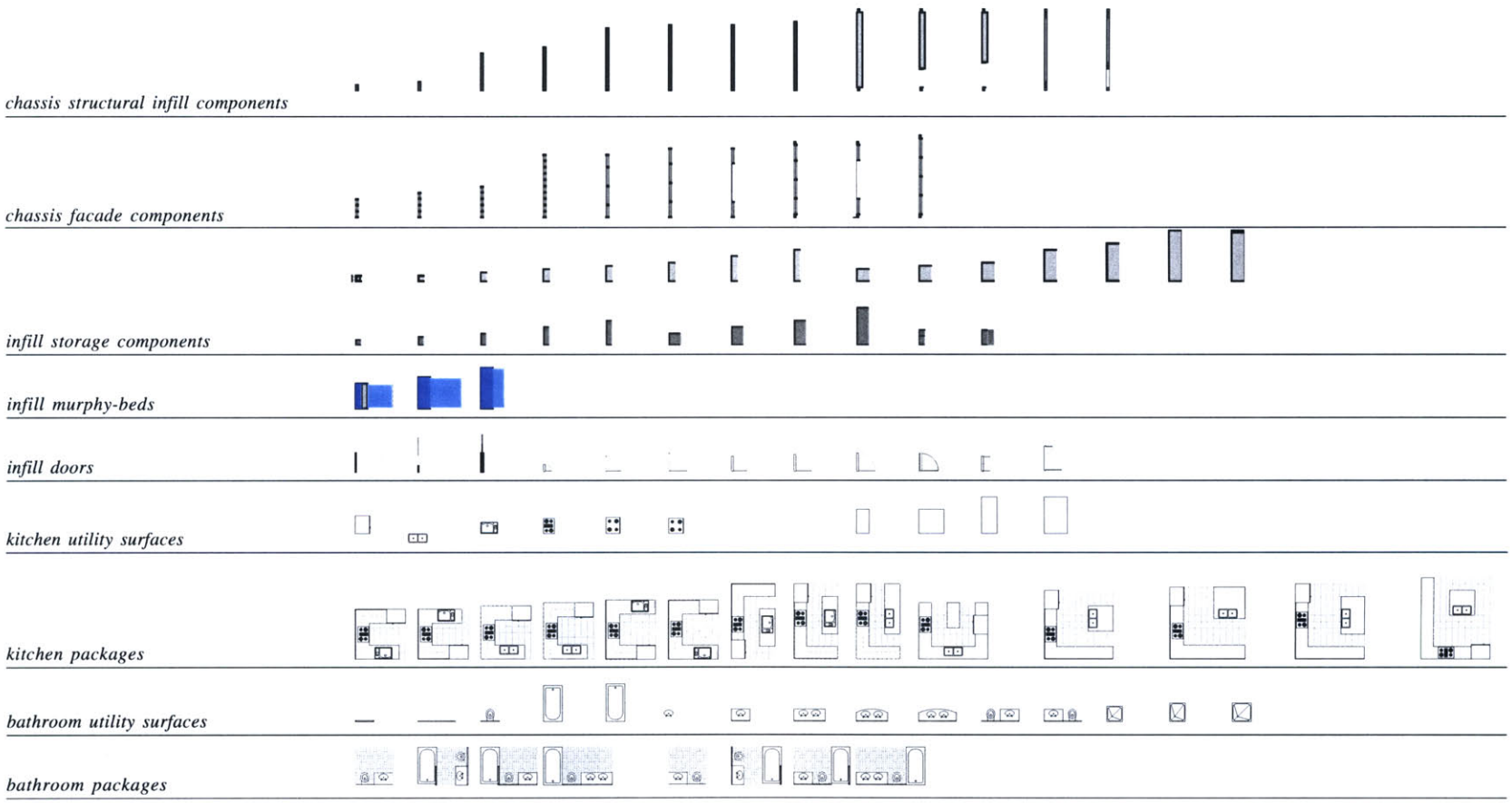
Access panels removed, power and data outlets at base of unit.



Channel access panel removed exposing sensing infrastructure. Here we see an infrared emitter plugged into the "one-wire" network.

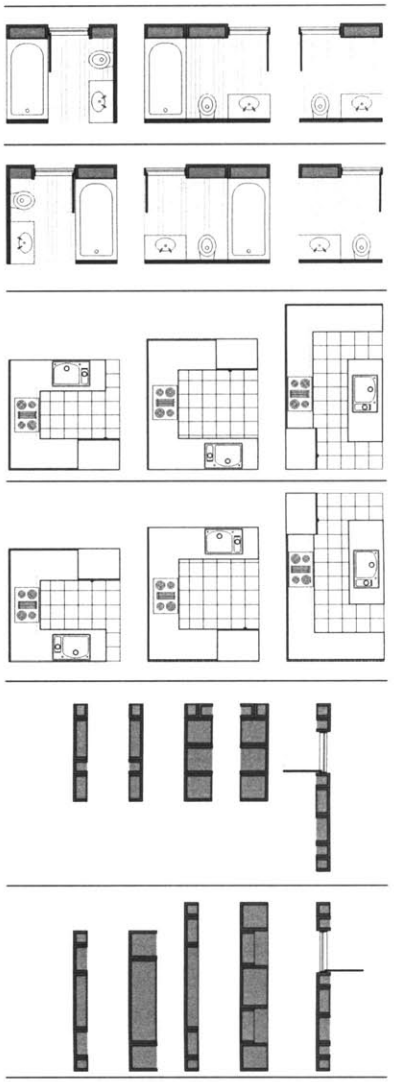


Emmanuel replacing access panels. The power and data outlets are now visible at the base of the unit.


chassis structural infill components
chassis facade components
infill storage components
infill murphy-beds
infill doors
kitchen utility surfaces
kitchen packages
bathroom utility surfaces
bathroom packages

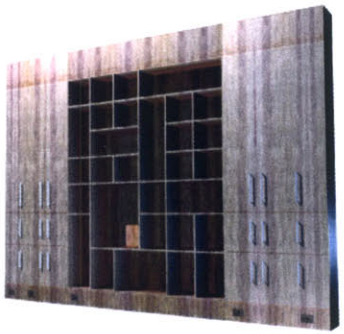
Design of a Library of Infill Components

Based on lessons learned from the prototype, I developed a broader set of infill components and packages for use within the volumetric chassis using the same basic details as the prototype (pages 42 - 45). This library was developed through interviews with contemporary developers and mill workers. The components have a variety of functions, serving as partitions, cloth storage, book shelves, kitchen cabinetry, work units, etc. They can be produced with a variety of finishes. These basic units were aggregated into larger assemblies: kitchen packages, bathroom packages, etc. The full set was pared down to twenty two for use within the proposed development.

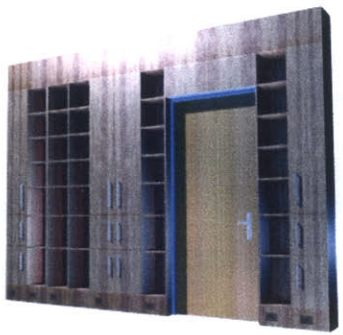


The architectural infill packages are constrained to a few selections of bathrooms, kitchens, and partition/ storage/millwork. In combination, these offer many design possibilities.

Documentation as necessary for fabricating the components was produced, including plans and elevations, and finish types for each component. This documentation was produced using AutoCAD, and the result is a set of line drawings (see appendix for drawings at 3/16" = 1'-0" and 1/8"=1'-0" scale). Content for use with the consumer interface was produced for each component type. This includes a 3D model and a variety of component type skins for use by the graphics engine, a physical model with associated visual tag for the table surface, and a 2D graphic for use within the graphic interface. 3D Studio MAX was used to

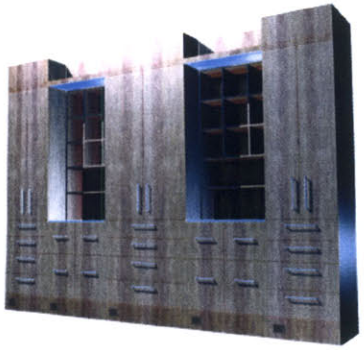


i_group0000_012x144



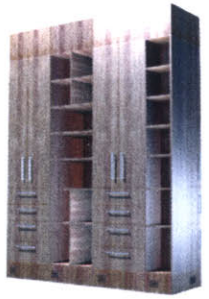
i_group0002_012x144

i_group0000_024x120



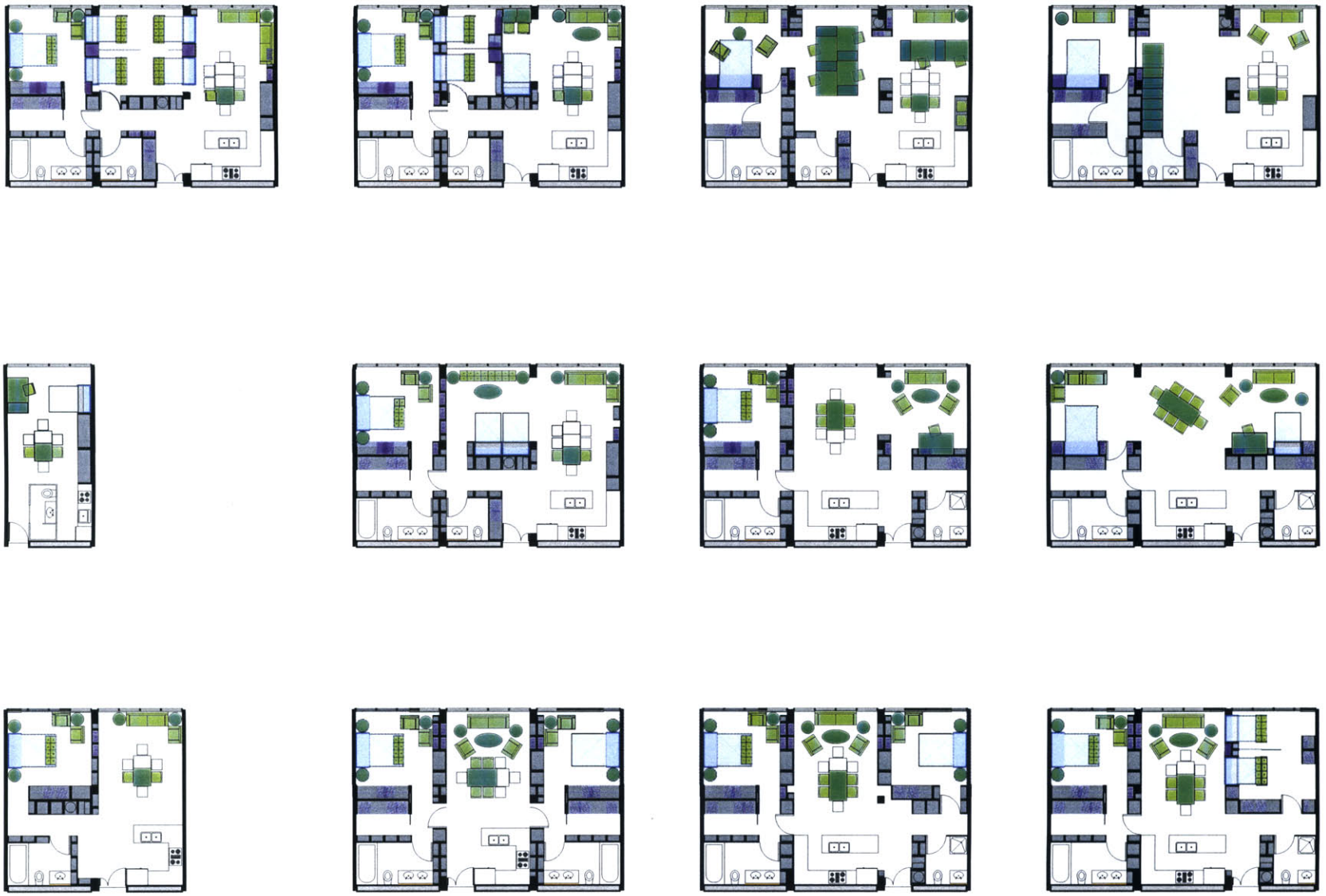
i_group0000_024x144

i_group0002_012x084



i_group0002_024x084

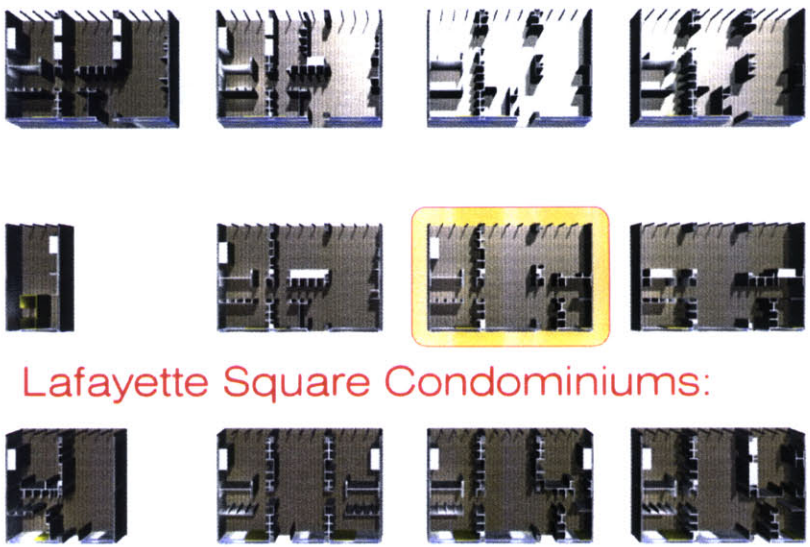
produce geometry from the AutoCAD documentation, this geometry was exported to an .X file for use with the Direct X based graphics engine. Component skin types have an associated texture map with which to render the components, these were produced using Adobe Photoshop and Adobe Pagemaker, and were tested in 3D Studio MAX.



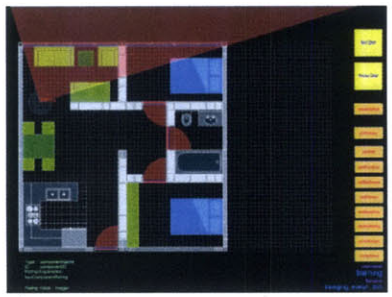
Base plan options for a residence in this development as designed by an expert using agreed upon infill components and packages. These are to be the starting point for a consumer wishing to customize a residential design within this development.

Design Engine (Output Simulation)

Work by Jennifer Beaudin explores the process of helping a consumer develop a program through reflective practice [2]. A program so developed could be captured and used in generating an initial design, as well as supporting a computational design critic. This process is simulated in this implementation. I have assembled a suite of condominium designs that fulfill different residential programs, and provide a series of questions for the consumer. "How do you feel about guests in your home?" "Do you intend to work from home?" "How do you cook?" "How many people will live in your home?" Responses are interpreted by a designer, and an initial condominium design is selected.

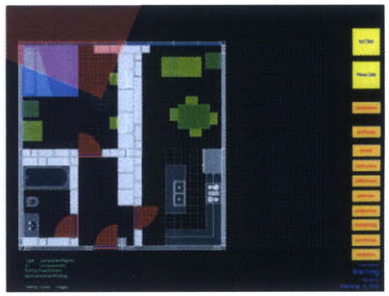


Base plan options aerial perspective.



A

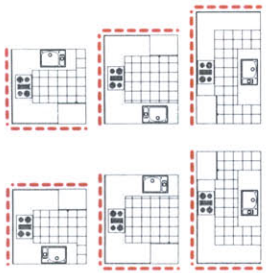
B



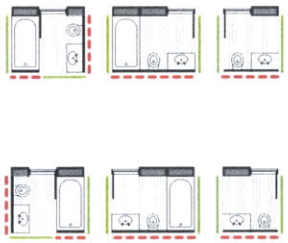
C

Sample of designs produced for computational critic training.

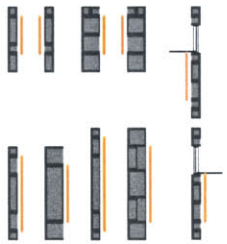
Component rating interface for training computational critic.



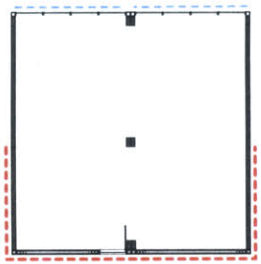
Kitchen group wet wall adjacencies (dashed red line).



Bathroom group wet wall adjacencies (dashed red line) and enclosure (solid green line).



Storage group accessibility (yellow line).



Chassis windows (dashed blue line) and wet wall (dashed red line).

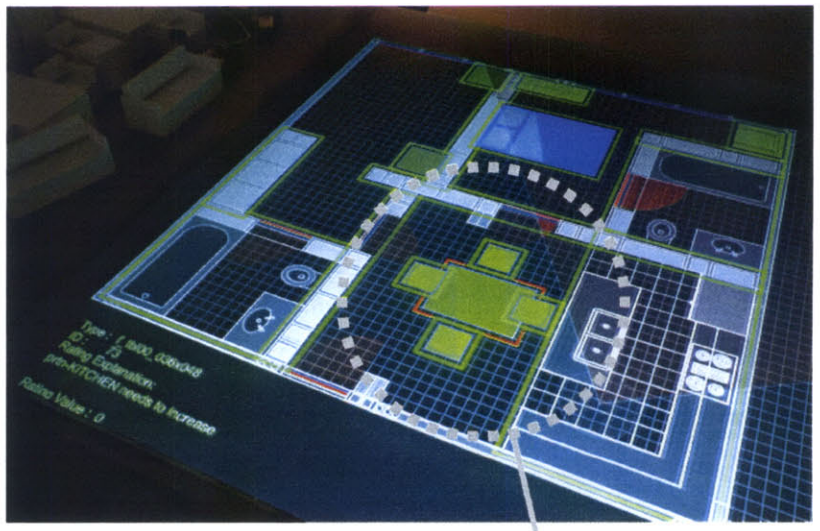
Design Bias

1. [kitchen] Indicated sides must be against a wall. At least one must be against a wet wall.
2. [kitchen] Must have line of sight from center of kitchen to a window.
3. [bathroom] Indicated sides must be enclosed. At least one must be against a wet wall.
4. [infill] Storage must be accessible.
5. [bedroom] Must have windows.

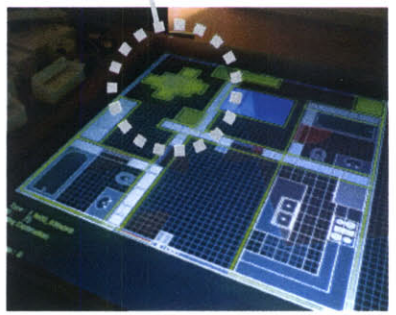
The computational critic trainers were given the above bias with which to rate components in the training set of designs.

Computational Design Critic Training

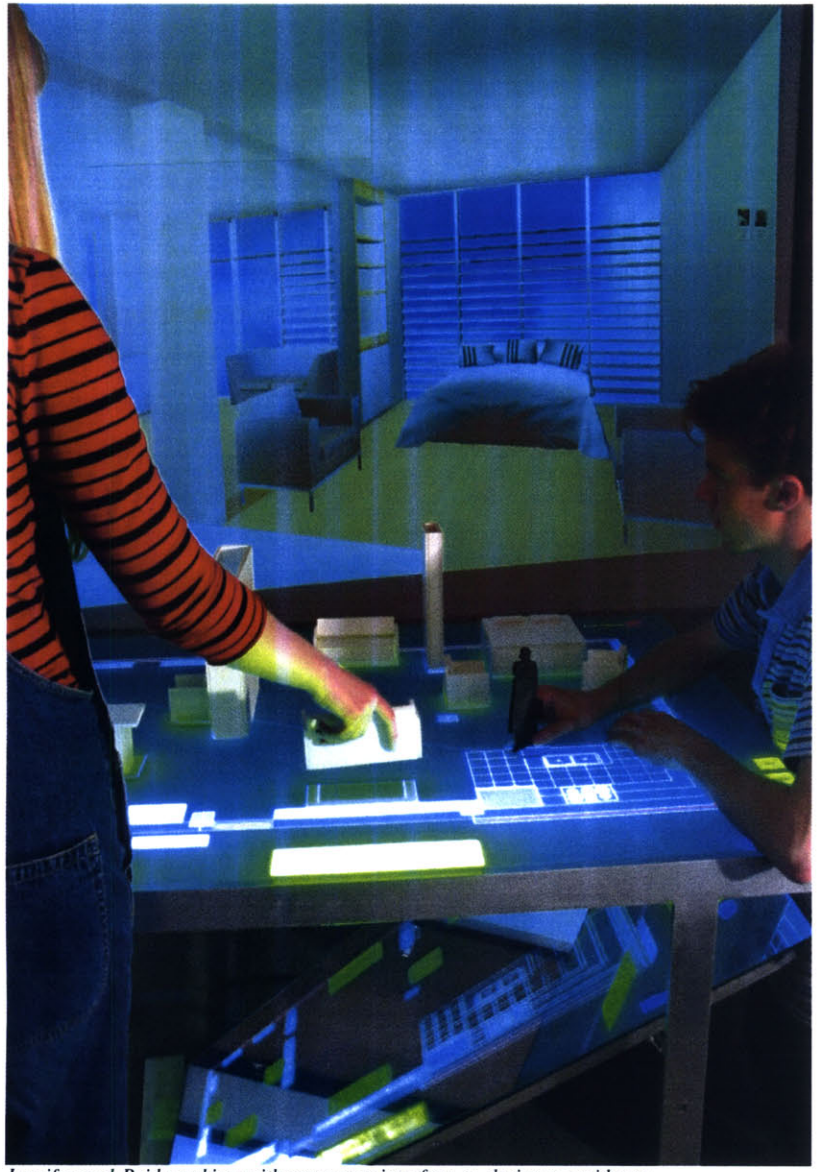
Reid Williams has developed a computational critic that is trained through example. Several attempts were made to implement such a critic for use with the consumer interface with varying degrees of success. We took the limited set of components the developer is going to use and produced a training set of 226 designs, these designs were produced by individuals with varying degrees of design experience which may accurately reflect actual consumer performance. These designs were then evaluated. To evaluate the designs, I developed a specific set of guidelines (design bias) for evaluating the designs. The design bias was applied to each of the training set of designs. In case A, we see a design which has some problems. Here, the kitchen package is not against a wall, so the kitchen component is rated as "bad." In case B, the bathroom is "bad." In case C, we see a design that meets all criteria for this critic. This attempt to train a design critic was largely unsuccessful. There were too few designs to effectively capture the design intent, and the features captured by the critic proved limiting. Two later efforts were more successful. The first focused on just evaluating the bathroom, and the second incorporated a circulation feature.



This photograph shows the tangible interface with the critic system being used. The current critic evaluates the privacy of the dining area with respect to the kitchen. To the left of the kitchen (which is in the lower right hand corner of the photograph) is the dining room table with a poor rating, which is indicated by a red outline. In the lower left hand corner is the explanation. The explanation "prtn-KITCHEN needs to increase" indicates that the absolute total rotation of the shortest path from the table to the nearest kitchen should increase. Photo and text by R. Williams.



Now the dining room table and associated chairs have been moved into the room in the upper left hand corner. The shortest path to the kitchen now has more turns, satisfying the critic which wants a private dining area with respect to the kitchen. Photo and text by R. Williams.



Jennifer and Reid working with consumer interface to design a residence. Photo by Kent Larson.

Interface for the Non-Expert Designer

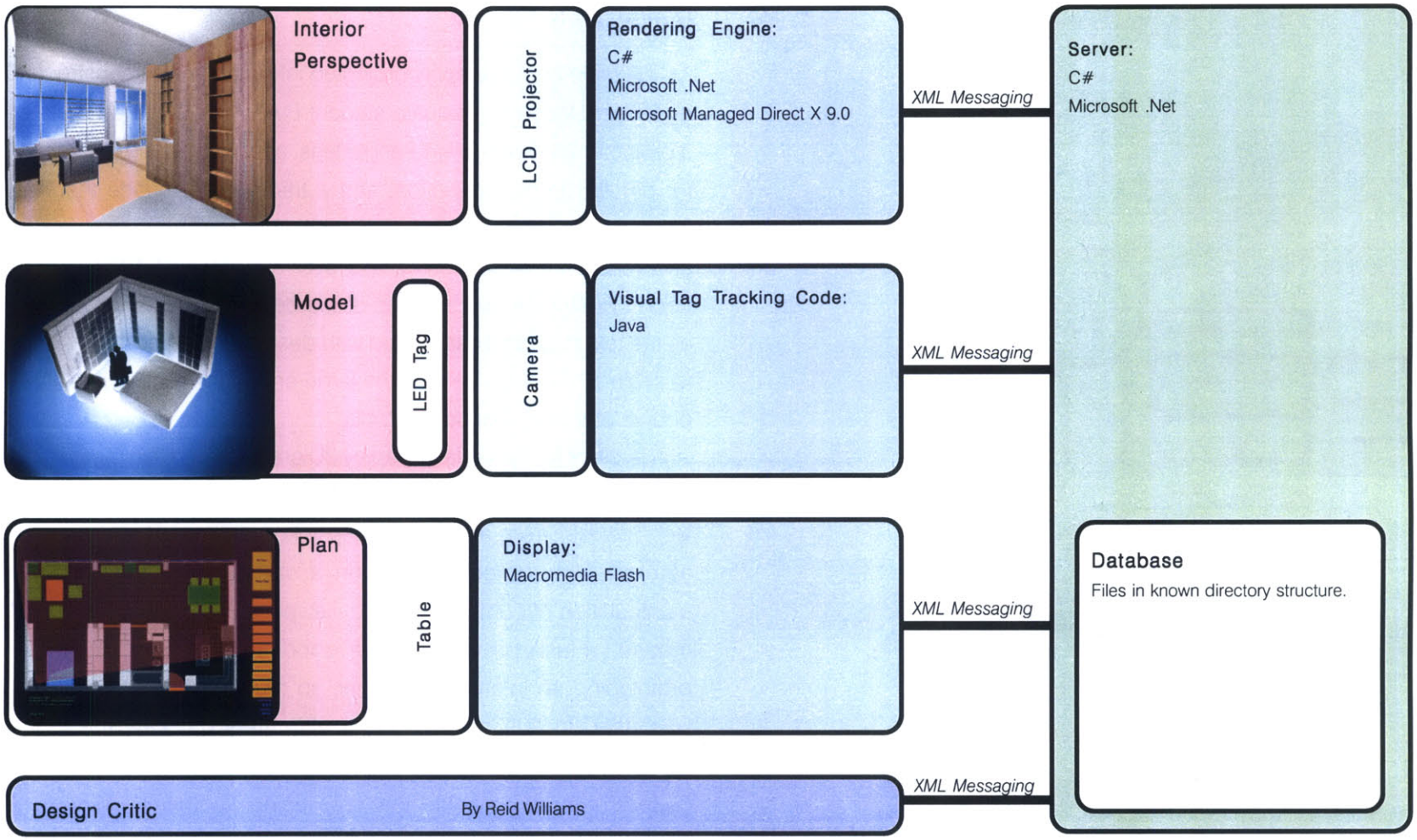
A user interface for the consumer has been built. It plays the central role in enabling consumers to design a residence. It provides information that allows users to make informed decisions about a design. It works within the constraints imposed by the developer, using product information and options provided by the manufacturer. The interface includes a 2D interface to present the plan view of the design, scale models of components to edit the proposed design, and a real time 3D rendering engine to display the design in a full-scale simulation projected on an adjacent wall. It poses questions from a designer to encourage critical thinking, displays design evaluation provided by the critic, tracks decisions made in the course of the design, and stores design files.

Consumers manipulate physical representations of design components within a plan proposed by the designer and developer. The 2D plan and full-scale projection reflect that manipulation in real time, and design critics evaluate the design state and send information about their evaluation. It supports a participative design process in facilitating a group with different interests and expertise working together to produce a design. The information about decision-making can then be reviewed at a later point, and future designs can evolve from what is learned.

Data management system

To support the subcomponents of the consumer interface I have written a server that ties the object tracking, 2D interface, 3D projection, and data structure together via XML. The system works in real time. When a tagged object is moved, all visualizations are updated immediately. The system has a client-server architecture; a central server which manages client connections, design states, a design database, and a component database. There are several types of clients which log on to that server. Currently each module of the platform is a separate client. Modules communicate with a standardized XML messaging. Each client maintains a design state and communicates with the server to maintain synchronicity. The slowest chain of command is that from the tracking client to the 3D client, due to the amount of processing required at those two nodes, latency between moving an object and corresponding movement in the perspective averages less than 200Ms.

I had hoped to use ifcXML for communication and writing out design states. The documentation proved too dense to implement in the time available. However, what was ultimately used resembled the Industrial Foundation Classes and its concepts. Future work could include a further examination of an ifcXML implementation.



The server manages clients and maintains the design state. Each client has its own asynchronous internal design state to support its function. These states are updated by simple, common, XML messages.

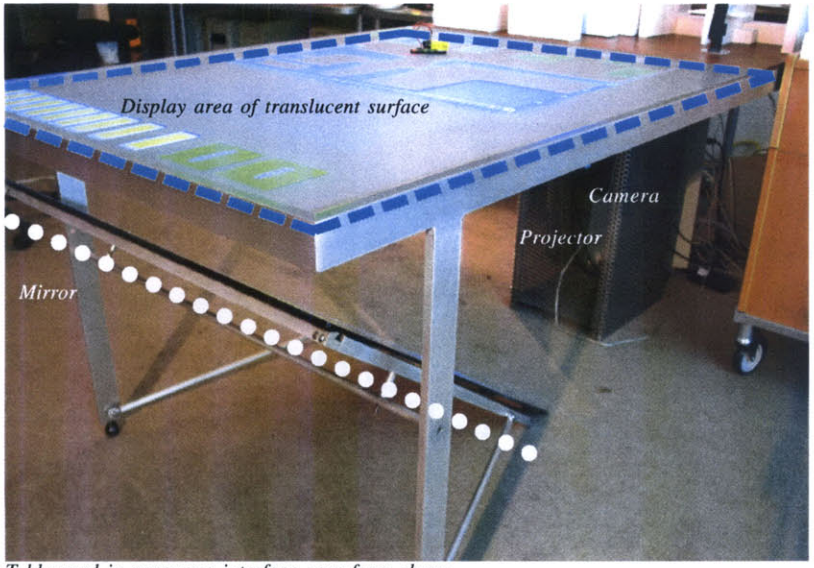


Table used in consumer interface seen from above.

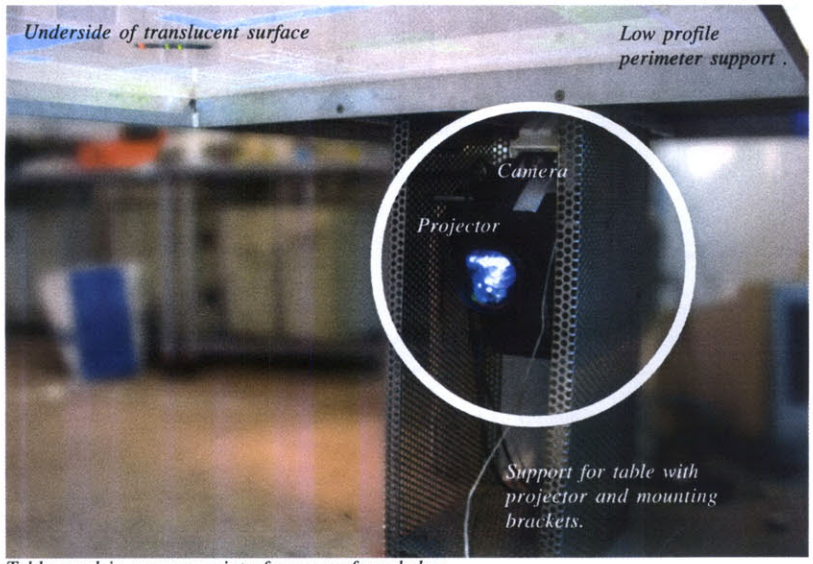


Table used in consumer interface seen from below.

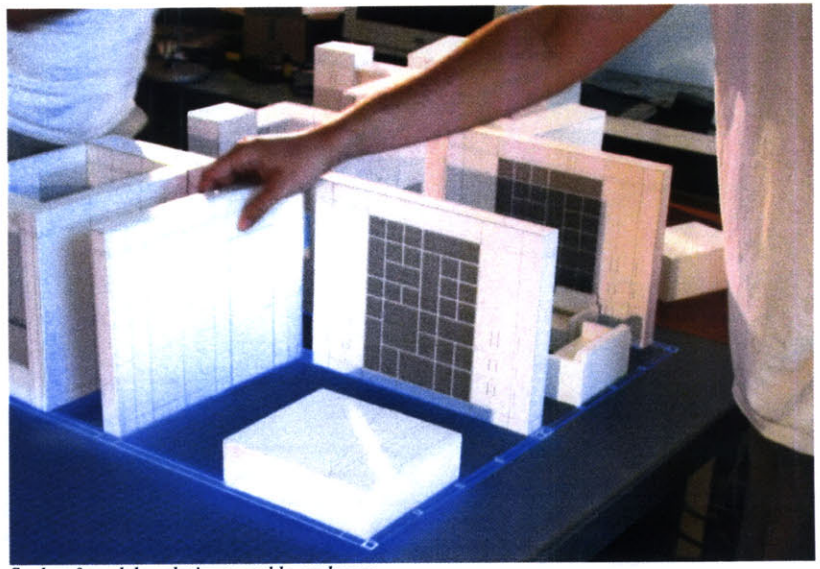
Digital Table

A table built to display projected information was constructed by former House_n graduate student Byron Stigge. It consists of a projector fixed with a wide-angle lens, a mirror shaped to account for parallax in the projection, and a translucent surface that has been treated for best diffusion of light. The projection from below at a resolution of 800x600 pixels over a surface of 48"x36". It is upon this surface that the plan of the design is displayed, as well as the text message associated with design evaluation. The plan is to scale, 1" = 1'-0", so that it is large enough to facilitate multiple people standing around the table.

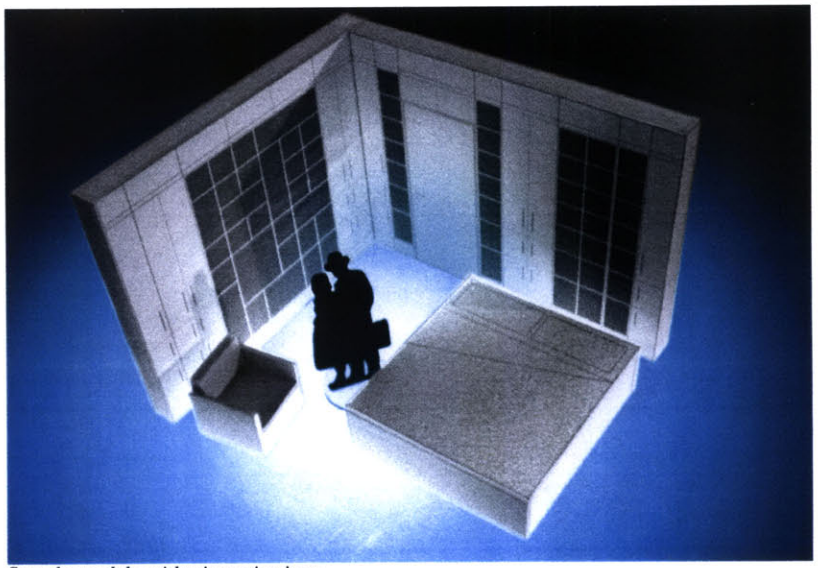
A client for the table to display 2D graphics and text messaging was written in Macromedia Flash. This client can be run within a web-browser from any web accessible machine. This client can also be simultaneously run on a stand-alone machine for manipulation of components and viewpoint using a keyboard and mouse. Flash proved to be a good environment for rapidly prototyping an interface, however, so much code (action script) was used in this project that it ultimately outgrew the Flash programming environment. There was no easy way to manage the code. Future work would look into using another development platform.

Scale Models

An optically tagged physical model of each infill component, a limited selection of furniture, and a human figure was created. A full listing can be found in Appendix D. Models are placed on the table in positions that correspond with the plan. Projected plan representations are at the identical scale of the physical objects so that registration between the two is consistent. These models dictate the position and orientation of the infill components, furniture, and viewpoint in the interface. The level of abstraction associated with the models is fairly low, they look just much like the objects they represent. Future work will look at differences in level of abstraction, and consistency between the model in physical form and virtual form. For this work we assume that consistency is important.



Scale of models relative to table and user.



Sample models with viewpoint icon.

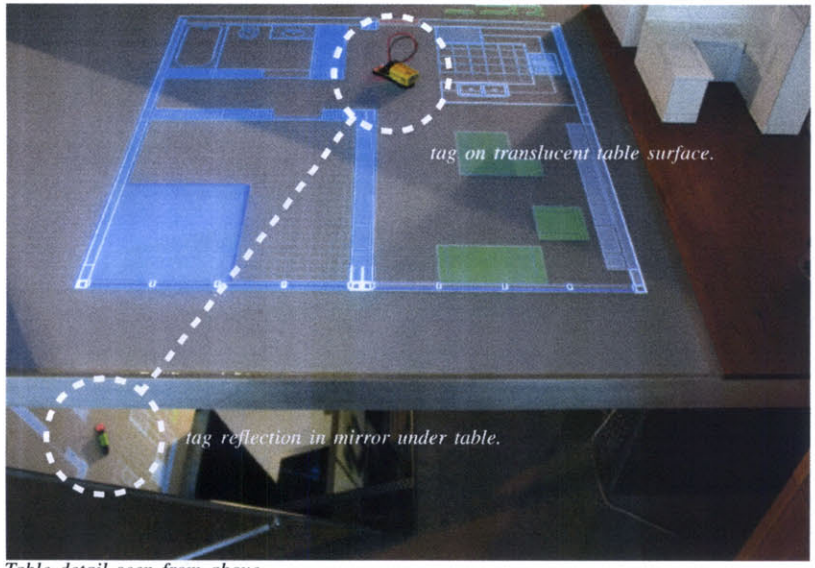


Table detail seen from above.

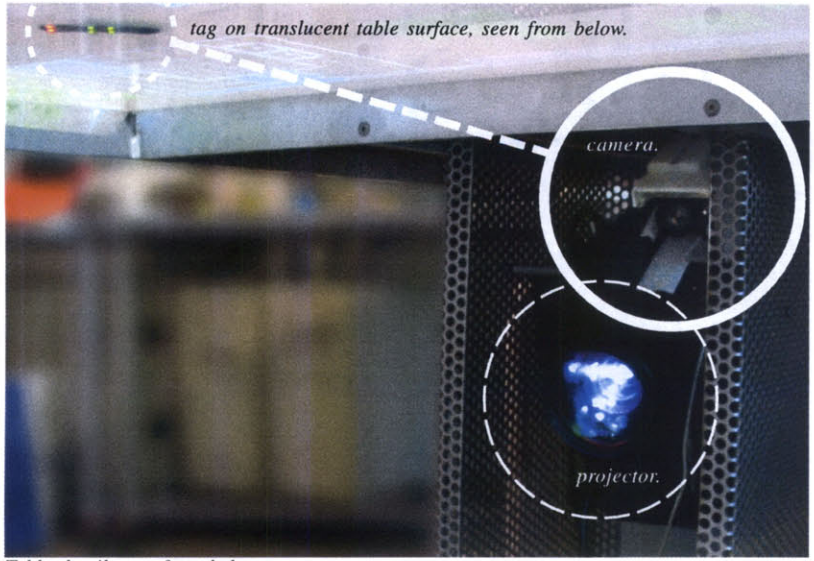
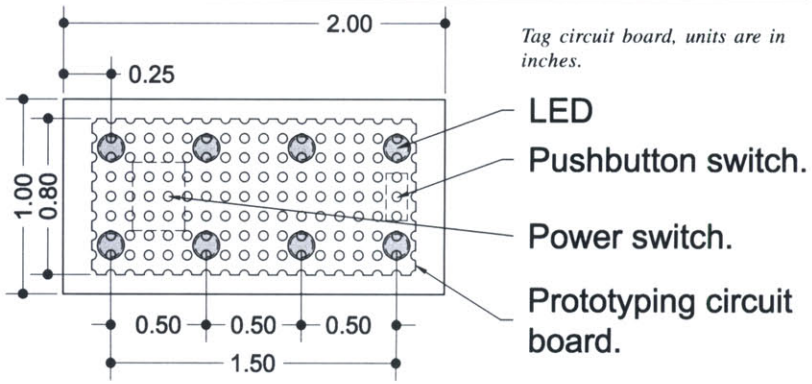


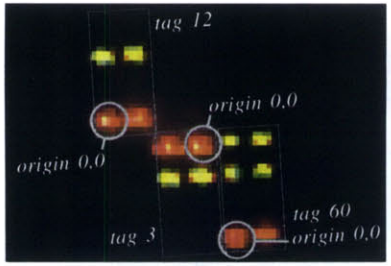
Table detail seen from below.

Optical Tagging System for Scale Models

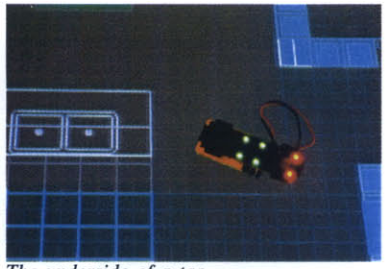
A client for optical tag tracking was written in Java. Maintaining synchronicity between the physical objects, the projected plan representations, and the 3D rendered perceptual image requires that each object be precisely identified and located in 2D space. To do this, each model has an embedded visual tag. This tag is seen through the surface of the translucent table by a camera. The camera exposure is controlled in hardware so the brightest points in the camera image are the tags, despite the fact that the table is illuminated by a projector. Each LED fills several pixels of the image, the LEDs are either red or green. Several types of LEDs were evaluated before deciding upon those currently used. Some green LEDs with the best spectrum distribution were selected for accurate color recognition. The tags are all on a plane approximately equidistant from the camera, which constrains the variation in size, so scale is not a problem. Each tag in this implementation consists of 8 LEDs. Closest to the component origin are 2 red LEDs, followed by 1 to 6 green LEDs. The green LEDs are treated as bits for



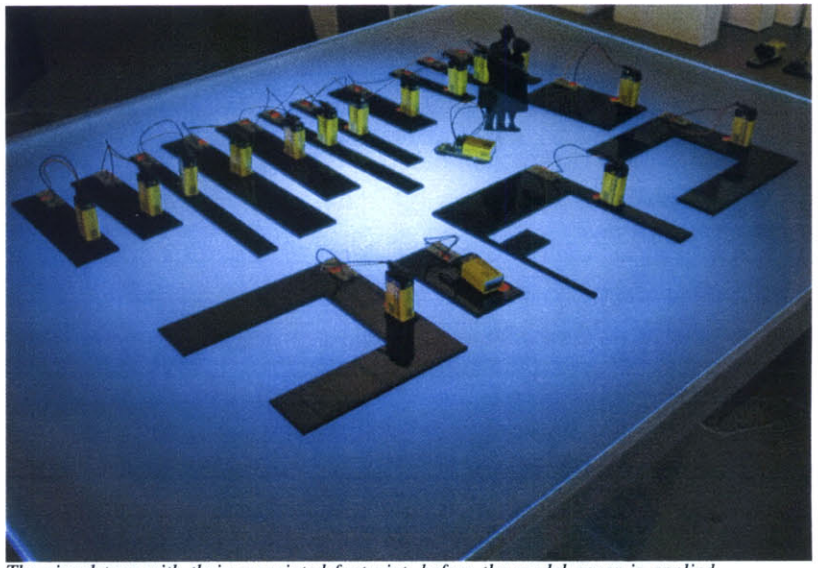
Tag circuit board, units are in inches.



In this camera image of prototype tags, notice the number of pixels per LED, and the red pixels around the green LEDs. Tag ID, outline, and origins have been added.



The underside of a tag.



The visual tags with their associated footprint, before the model cover is applied.

icon	tag number	block name	binary tag	tag bottom	tag top
	48	b_0000_072x084	110000		
	49	b_0001_072x084	110001		

Each model has an ID number and a name. This number is represented in binary across the green LEDs. "tag bottom" is what the camera would see; "tag top" is from above.

identification. The red LEDs are used to discern position and orientation, the green LEDs provide a unique ID, and are used in orientation calculation providing 63 unique tags. 0 is not used because there is not enough information to deduce an orientation. Adjacent tags sometimes produce a "phantom" when the red LEDs on one tag are next to the green LEDs of another tag. This is resolved through a collision detection algorithm, only one tag can be in a location at a time.

Stephen Intille wrote the code which returns an array of all tags found: ID, position, and orientation. A second module uses that array to maintain the design state, monitors the tags while accounting for noise in the tag data, and resolves phantom tags. Significant changes to a component or the viewpoint will cause an update of that component or viewpoint. Currently all components snap to a ¼" grid on a 30" by 40" portion of the table. The angular snap is constrained to 90 degrees for the components, and 3 degrees for the viewpoint.

This implementation has some advantages over similar work. The scale of the tag is relatively small, the number of tags is relatively large, the motion of opaque object above the table, like models

A variety of LEDs were evaluated for brightness and spectrum.

or hands, does not occlude the tag.

It has limitations as well. Each tag requires a portable power source, which currently limits the smallest size of the associated physical model to no smaller than a nine volt battery. The battery is the most expensive part of the tag. Tests with retro reflective tape failed due to the scattering of light at the table surface. Currently a maximum of any two of the 63 tags can be tracked at a time, but the number of tags that can be tracked at a time promises to be relatively large.

With a better camera and optics, greater resolution can be achieved on the table. This implies one could also use smaller tags, or a greater number of LEDs and hence 'bits' on the current size tag. LEDs which are bright enough to be visible in a well-lit room have been tested, but were not pursued because the ambient light level overpowered the table projection as well as the projection on the wall. Infrared LEDs may prove to have advantages over visible light LEDs.

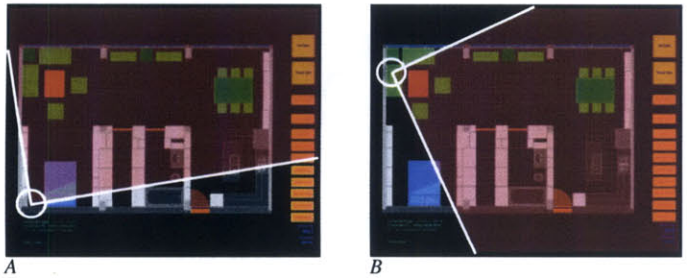
Certain elements of the table detrimentally effect the tag tracking. The table is not rigid enough to sustain proper registration of the image and tracking during practical use. The thickness of the mirror causes multiple phantom reflections alongside the primary reflection. The acute angle between the mirror and the underside of the table results in multiple reflections as the underside of the table has its own reflective property. The projector reflection from the underside of the table creates a hotspot on the table where no tag data can be read.

Perspective A.

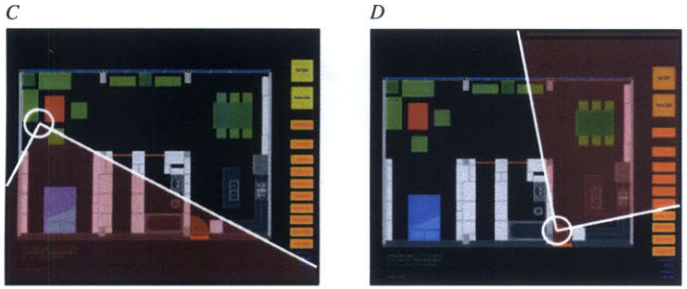
Perspective C.

3D Graphics Engine

In addition to the plan and models used with the table, a full scale perspective is projected on an adjacent wall. The field of view for the projected perspective corresponds to the field of view



Viewpoint positions and viewing angles for perspective images on this and preceding page.



of the wall as seen from a user standing at the table, hence some sense of it being full scale. This has limitations. If the user moves from the ideal viewpoint, the illusion is lost. The viewpoint for the perspective is determined by a scale figure of a couple placed on the table. Turning or moving the figure caused the view to move,

Perspective B.

Perspective D.

moving components on the table cased components in the perspective to be moved. Changing component finishes is also reflected in the perspective. The image is as high-quality as possible, while still allowing real time response.

The client for the 3D perspective is a Direct X based graphics engine running in a windows form. The resolution for the display is 1024 pixels by 768 pixels, and the framerate is 30 frames per second. Moved components slide and rotate from the old position to the new one, which keeps things from popping in and out of the screen in a jarring way. Also, the last component moved glows briefly after repositioning, so it is obvious that something has been altered. The quality of the rendering was important to the success of this project. I developed a simple and streamlined graphics engine using C# and managed Direct X 9.0 for the Microsoft .Net Framework.

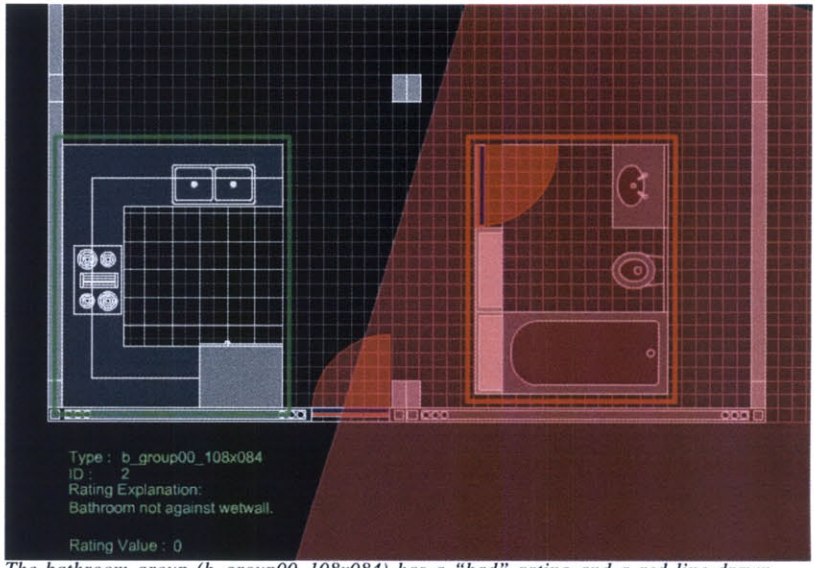
Future work for the Rendering engine includes better texture management, memory-use optimizations, and implementing a variety of lighting effects, such as shadows. The use of customized shaders has been made simpler than in the past with Direct X 9.0, and ATI, as well as other companies, are producing tools to make writing these shaders relatively easy. This promises better quality graphics, and high quality lighting simulations in real time. Direct X 9.0 and ATI were chosen specifically for these reasons, although time constraints prohibited implementation of custom shaders.

Computational Design Critic

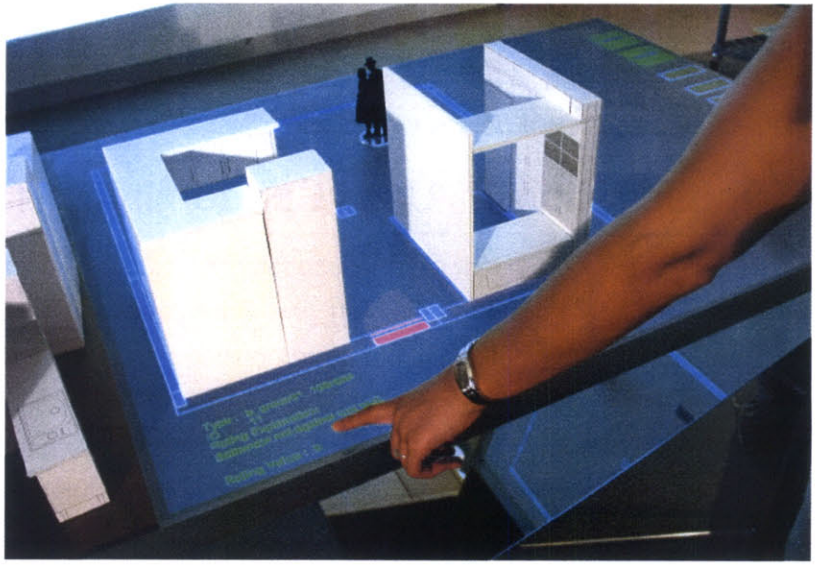
There is also a client for critiquing design components, which is a modification of the table top Flash client.

The designer is consulted via the consumer interface during the design process to evaluate a design. A 2D plan of the current design is studied by the design expert at a remote location. If something is wrong with the design, then the components at fault are selected, and a text message explaining the fault and a potential remedy is entered. The designer sends the message to the consumer. The consumers see the text message and a colored box drawn around the components, at which point they can choose whether or not to react to the guidance. A more efficient means of handling designer consultation is to use a computational critic, which would perform as the design expert in guiding a consumer through the design process.

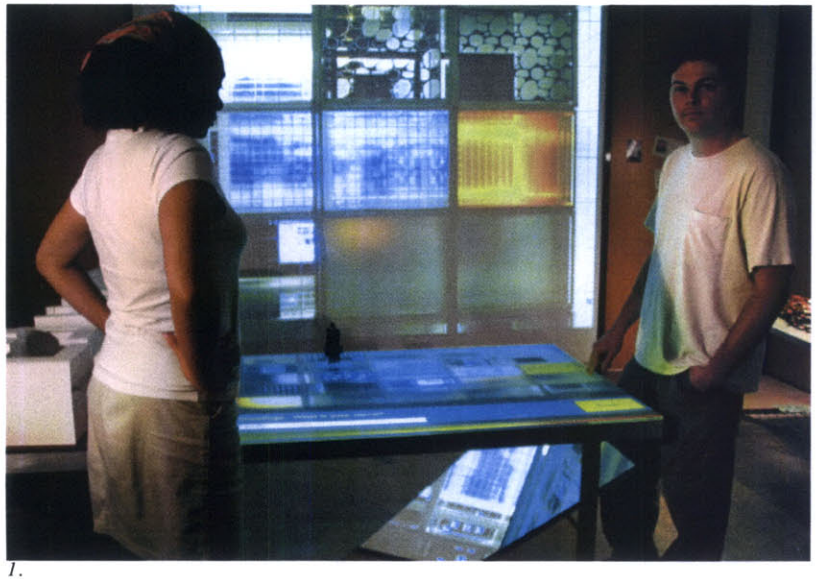
From the standpoint of this implementation of the consumer interface, it does not matter whether there is a human or computational critic providing feedback to the consumer about the design. The question raised in this work is how to give the consumer the feedback. The text message and colored box have limitations. It is not always clear which component is being evaluated. If more than one component is being evaluated, only one message is being displayed, and the colored boxes are obscured by the physical models in use on the table.



The bathroom group (b_group00_108x084) has a "bad" rating and a red line drawn around it, the explanation is found in the lower left corner. The kitchen group is "ok".

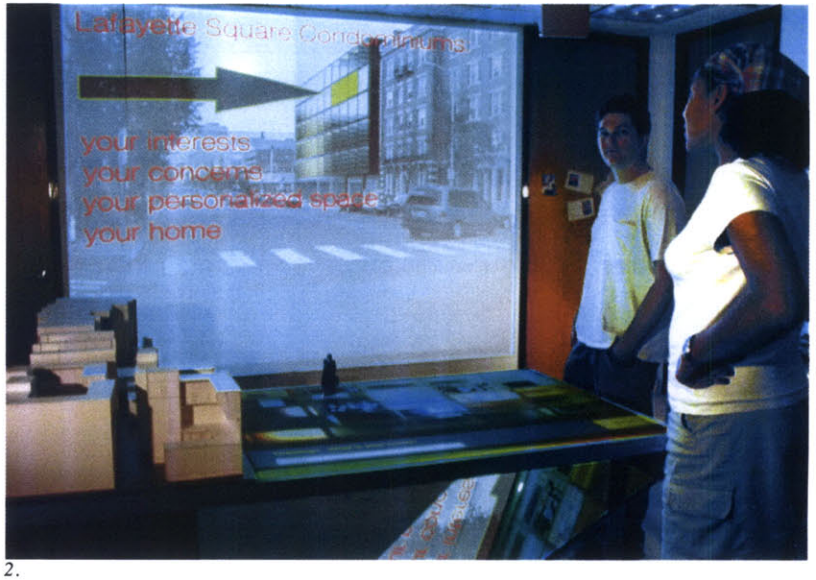


Design critic feedback to consumer interface.



1.

A young couple, Matt and Brittny, are interested in purchasing a new condominium in Cambridge Massachusetts near public transportation and the MIT and Harvard campuses. A developer is marketing customizable homes in that area.



2.

Matt and Brittny approach the developer interested in purchasing a home. The developer presents them the "Lafayette Square Condominiums", and its ability to accommodate personalized design to suit their life-style.

Demonstration of Use: Condominium Fit-Out

In this chapter, I present a demonstration of consumers using the interface. Two consumers, Matt and Brittny, approach a developer, the author, seeking customized housing. I guide them through a series of questions to establish a residential program. Simulating a design engine, I select an initial design which addresses their program and load it into the consumer interface. They use a figure to virtually navigate the design. They discuss the design in terms of the program. I suggest the proposed design is too large and that they start from scratch with a smaller unit. A new design is developed in an iterative design sequence. I suggest various infill packages to use in their design. Simulating a computational design critic operating from a remote location, a computer terminal adjacent to the table, I give them feedback on the design they are producing. We conclude with a final design. Documentation produced in that process is presented.

3.

4.

The process begins by addressing a few questions to get the consumer thinking about these issues; how they affect them presently, and how they might affect them in the future.

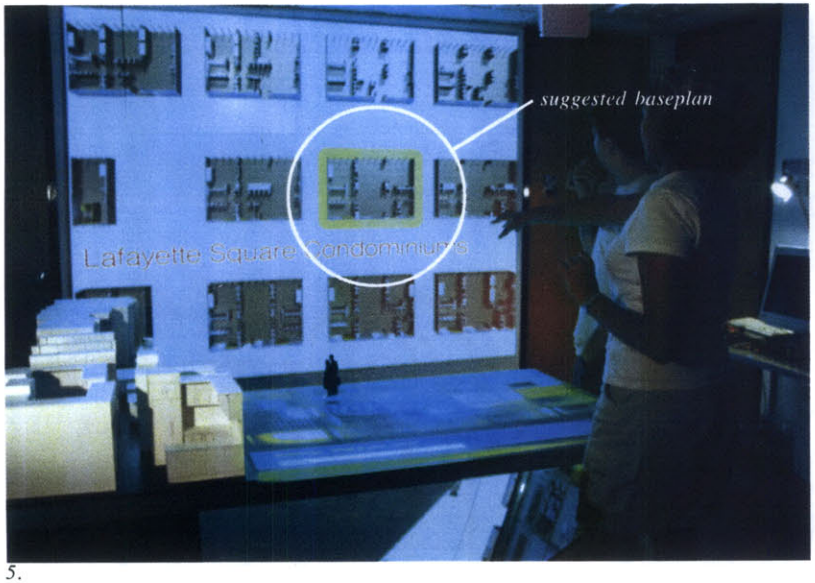
How do you feel about guest in your home?

Do you intend to work from home?

How do you cook?

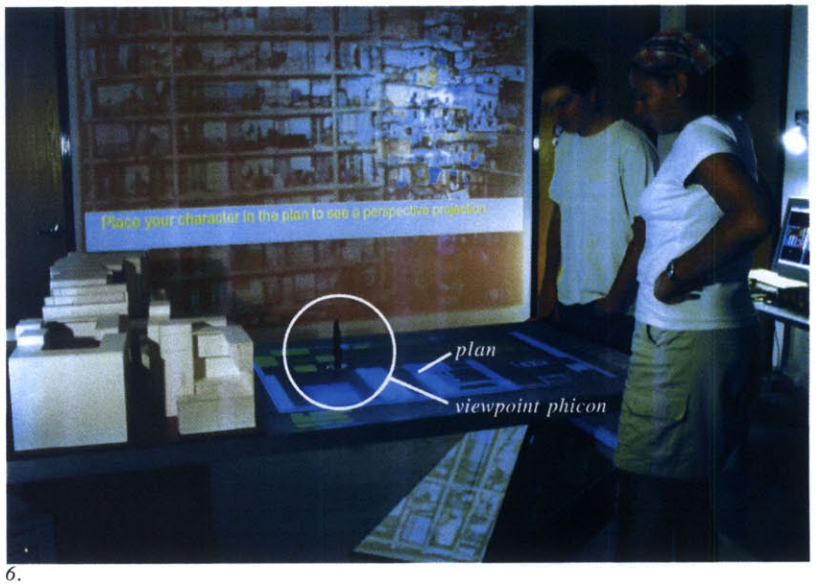
How many people will live in your home?

They are seen discussing the images and comparing them to their own situation. Here Brittny is talking about cooking, and her desire for a larger kitchen than the one she is currently living with. She also brings up some of the techniques she would like to be able to use that her current kitchen does not accommodate.



5.

The developer interprets the answers and presents a base plan as provided by one of the designers that is closest to meeting their needs. This is shown in the context of similar base plans that are less successful.



6.

The base plan is loaded into the consumer interface and a plan shows up on the table. By placing their viewpoint icon into the plan, a perspective from that viewpoint is projected onto the wall. They then begin a walkthrough of the design.

Ideally a design critic would evaluate the responses to the questions, develop a residential building program, and present a base plan reflecting that program.

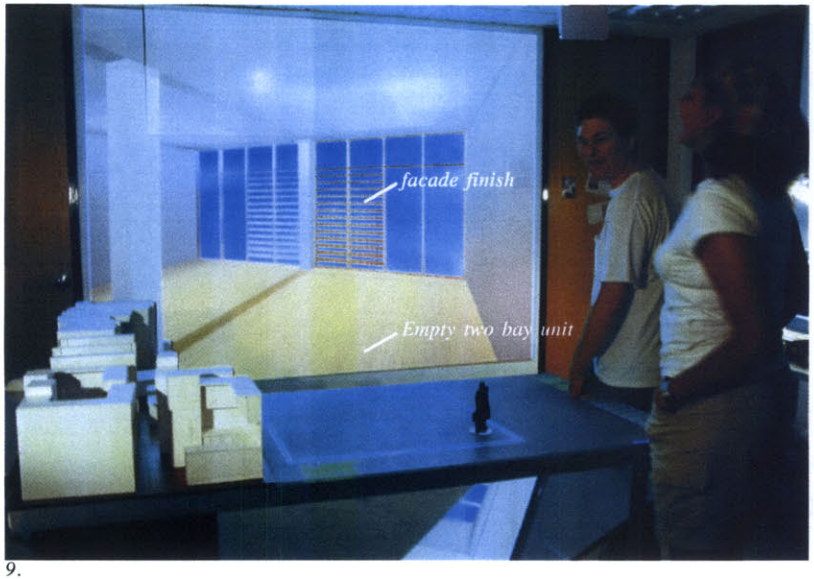
7.

Matt is moving through the living spaces, the bedroom and living room area with a seating area. Issues raised during the question session are discussed while moving through the spaces.

8.

Brittny is evaluating the kitchen.

At this point any number as of yet unimplemented simulations could be run. In an ideal world, one would have spent weeks collecting data about how they use their current space. That data would be used in simulating activity in a new design. They would play through the data, acting out various scenarios of use.



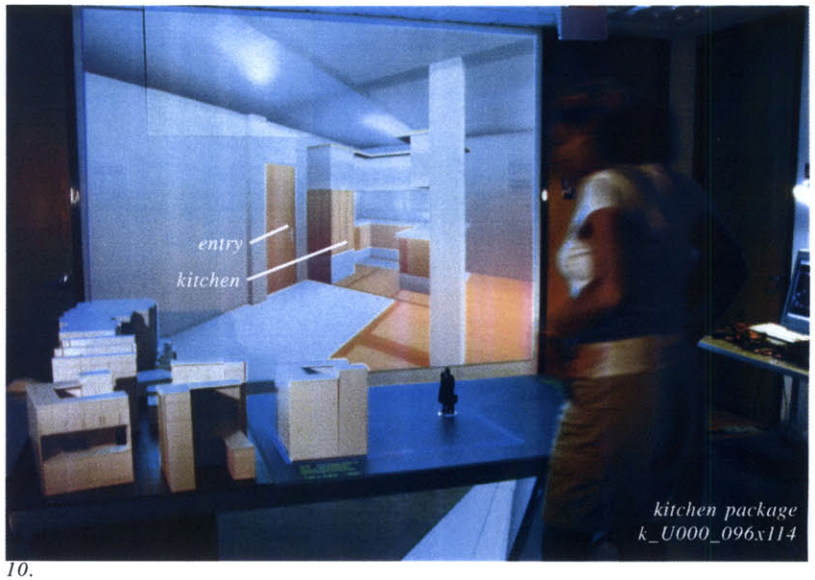
9.

They decide the proposed unit is too big, and want to start from scratch on a smaller one.

An empty two bay unit is loaded into the interface.

The form of the facade is fixed, but the choice of finish is not. They can not agree on a single finish, so half is brushed aluminum, and half is deeply stained wood. While they consider enclosing the columns in millwork, they instead opt for the default finish, a solid warm neutral tone.

Finish options are presented by the developer, who toggles through them using a 2D interface on another machine. Finish and form decisions can be easily modified at any time during the process.



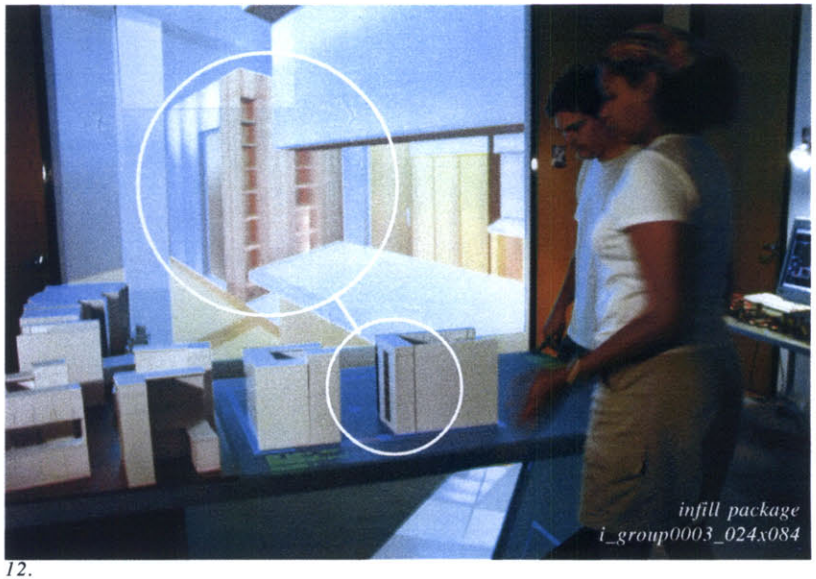
10.

They pick out a kitchen. They start with the smallest kitchen, because it was the closest kitchen model. Then they moved up to the largest kitchen available for this package. They wanted the kitchen close to the entry, so they then selected the mirror of their original selection. They view a couple of kitchen finish options, and settle on a simple wood and aluminum finish that goes with the facade selections they have made.

11.

Then they select a bathroom package and place it within the design. A designer observing the process from a remote location notes the component is in an inappropriate location, and so rates the component as 'bad' and explains a possible solution, "move the bathroom against a wet wall." Brittny then moves the bathroom against the wet wall.

The design critic message is displayed on the table with suggested solution.



12.

Wanting ample storage near the entry they select a deep infill package as a hall closet that will also enclose the bathroom.

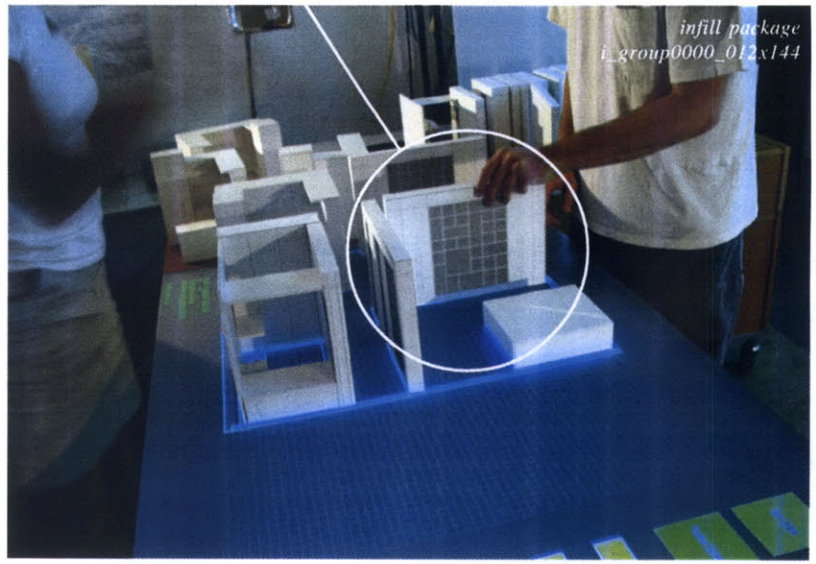
13.

14.

To help with the design, furniture elements are added.

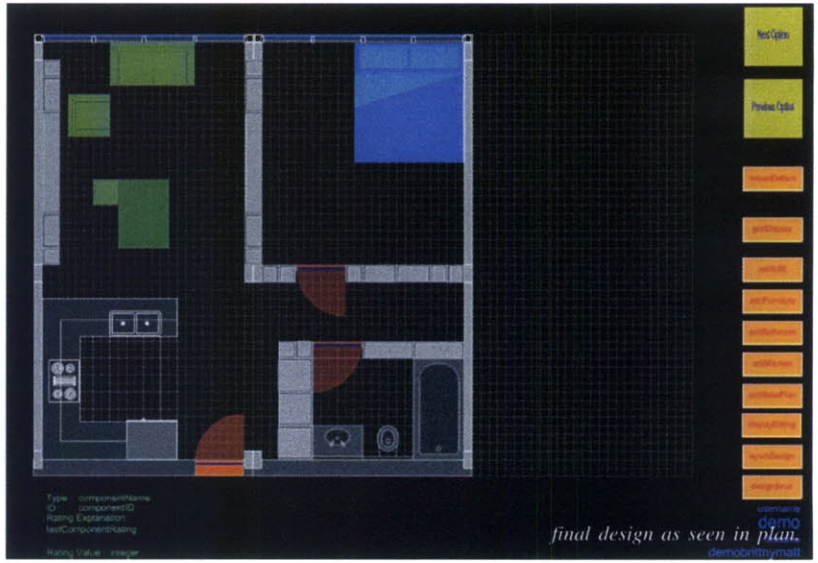
This helps the consumers identify with the scale of the space, as well as giving them some daily activities around which to design.

Brittny reads quite a bit, and has accumulated a library that she wants to keep with her. An infill package with considerable bookshelving is selected to partition the bedroom from the rest of the space.

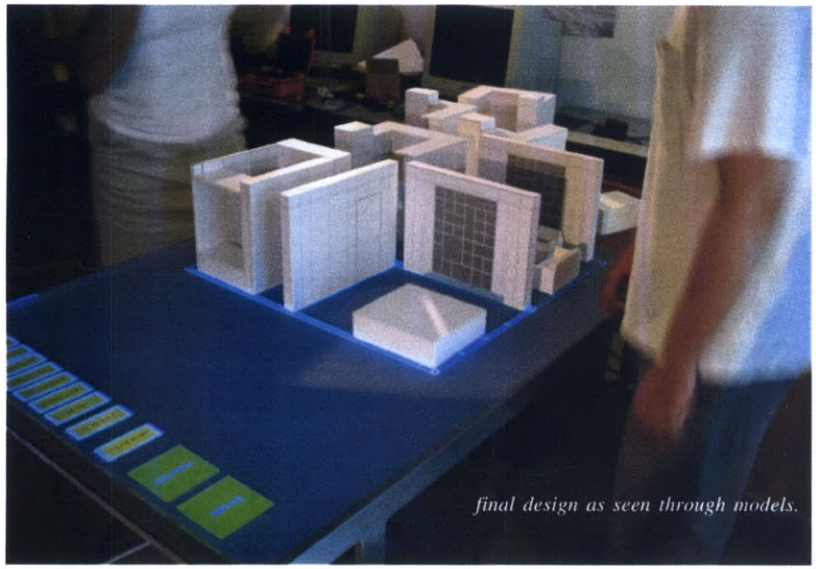


final design as seen in perspective.

15.



final design as seen in plan.



final design as seen through models.

They decide to use another book shelving unit in the living room, where other furniture items have been added to help give a sense of the activities in the space.

The design critics have no outstanding conflicts to resolve, and they are satisfied with what they see. They decide that this will be the final design.

Having gone through this process, the consumers are satisfied with the decisions they have made and are ready to purchase.

```
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Design file data.

At this point, he manufacturer and developer have a list of components, their relative position and orientation, and finish options. Component types that begin with c are significant to the developer, as those are building elements; those that begin with either 'k', 'b', or i are significant to the manufacturer, as those describe predefined infill packages. Component types that begin with 'f' are furniture elements, which may not be significant to fabrication, but are for evaluation of design process once a design is complete.

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```

Because all of the coordination has been worked out by the developer, designer, and manufacturer ahead of time, this information is all that is needed to begin fabrication of the condominium.

Evaluation

Although this work could only be fully evaluated if implemented by industry, qualitative feedback from experts and stakeholders in the field was found to be useful.

The evaluation process consisted of interviews with a developer (Ling Yi Liu), a fabricator and designer (Andy Tolliver), a researcher (Michael Schrage) and construction professionals (George Swetz and John Macomber). Andy Tolliver is a fabricator of custom millwork in New England with whom I worked on the "Place Lab" infill prototype. Ling Yi Liu is a partner in Oaktree Development, a New England development company specializing in multifamily residential development. George Swetz is a Vice President with Skanska U.S.A. Building, an international contracting company. John Macomber is the Chairman of the George B. H. Macomber Company, President and CEO of BuildingVision, Inc., Senior Lecturer with the MIT Department of Civil and Environmetal Engineering. He is at once intimately involved in the activities of a large New England construction company, and an expert on the impact of information technologies on the industry. Micheal Schrage is a research affiliate at the MIT Media Lab, and author of "Serious Play", an examination of how the world's leading companies model, prototype, and simulate to innovate.

The interviews were conducted in three parts. First, I engaged each evaluator in a discussion of their background, knowledge base, and experience or perceptions of the residential construction industry. Second, I made a paper presentation of the concepts embodied in my work. Finally, I demonstrated the consumer interface and took each through a scenario of its use for the design of an apartment. The interviews were structured this way to help focus the discussion on concepts in addition to an evaluation of the interface. The interviews that Ling Yi Liu and George Swetz gave were follow-up to a previous demonstration of the tool. Ling Yi Liu was interviewed in his office; the others were interviewed here in the lab.

"I think the first challenge when you deal with a consumer is that they need to see, touch and feel. And they can't visualize, they're not architects. If fact, most of them don't have much vision. So how do you sell them something that they don't know?"

"You have to have some sort of slop." (tolerances in construction)

"The fit-out in any customization one has to come up with those rules of where that slop is. Once you have the slop, then everybody can design on their own and improve on their own knowing that they've got to be able to adjust plus or minus a couple of inches."

"I'm very curious in how one could really take somebody through a customization process with this type of thing. Understanding that tying to a manufacturer is going to be a chicken or the egg situation, because why would they want to do it if they don't have thousands of units? But who is going to build thousands of units assuming that there is this type of system, when it doesn't exist yet?"

"They question I have, and we've struggled with this, is the stacks, the plumbing stacks issue. I personally don't know how to effectively even adjust the location of the sink due to drain, supply, and vent issues, very, very, tight constraints. I think that, to me, is the biggest challenge of any flexibility."

"Ok, we have this volume, I would love to try to use your tool to see if we could get our wives to make certain choices, even my kids. " (an open loft type condominium he is considering building)

"See if they give some opinions based on suddenly the availability of a visualization tool, and some design rules, like you can't move your bathroom from this wall to that other wall because you just can't. But if you had something like that, whether they could play around, and they'd come up with something that they really liked. Because if they really like it they're willing to pay more for it."

" That to me is a fascinating question."

John Macomber

"It would seem to be to be true that, if you do this right, this turbo charges the career of one designer and is very poor for the idea of lots of designers billing by the hour to reinvent the wheel...I think that is the way of the future, but that's not what they taught you in design school."

"Somewhere in here, could be somebody who is also making your kit of parts beautiful."

"For a multi-site developer, the deal is about the land. Having a better design, or saving 10-20% of the manufacturing cost of the house doesn't really matter to them, it's not what drives them. Pulte and those guys, they're trying to flip land, fundamentally."

"It may be that, companies who think about themselves as manufacturing companies are the ones who will take a tool like this, more than people who are multi-site tract developers."

Micheal Schrage

Micheal is interested in how models, prototypes, simulations, and shared spaces support interaction between "innovators" and adopters: consumers. Specifically how they get consumers to better articulate, not in words, but in interactions what it is they really want and are prepared to pay for. He felt that the real value of these tools is that it makes people aware of choices even before they make them.

"So one of the advantages of these tools is not just that it lets you make choices, but that it makes you aware of the kind of choices that are in the ...continuum of choices."

The range of simulations that could be explored and expressed are encouraging. He was concerned about the clarity of the design critic rules as expressed to the consumer, and the unit of evaluation it embodied. He would also like to see the ability to "play back" the development of a design, and a variety of abstraction in the models.

George Swetz

George Swetz has over 15 years of construction experience, with special expertise in planning and design management. He quickly tuned in to the use of the interface as a marketing tool.

"It would be interesting to find out...from somebody who actually does as a job, the marketing of the units. How they think they might use the tool, because in some ways they would end up .. being the tutors of the actual consumers that do the purchasing."

From a more construction management perspective, he expressed concerns about how this platform handles building code issue. He imagined a system not unlike what is used in commercial office towers.

"...the systems furniture market has that stuff now. The only thing...is they want a licensed electrician around to make sure tat when it all snaps together it makes sense."

A critical aspect of the current construction process is occupancy, or when a resident can legally move into new construction.

"From the certificate of occupancy point of view, how do you get the occupancy for the whole building versus the actual unit that you're configuring at that particular point in time? Because you've got to get a full one and then you've got to get a particular one for the actual unit." A requirement for getting a certificate of occupancy is functional fire safety systems. "How do you make sure the building is fully sprinklered, as an example, because the sprinkler system will change based upon how you divide the space?"

Andy Tolliver

Andy works primarily with architects and designers, although he does occasionally work directly with a homeowner. In those instances, he will take some component of a design, for instance a kitchen, and work out the floor plan, elevations and details with the client. He felt the vizualization capabilities of this platform would help a great deal, as in his experience many clients cannot get a sense of anything from a 2D plan.

"You are really capitalizing on different people can visualize in different ways. Lots of clients cannot get a sense of anything from a 2-D plan, but would work really well with the physical models, or how could you not understand this virtually lifesize 3-D walkthrough where you can completely manipulate the walkthrough." "I want it for the showroom."

He appreciated the way design options were used in the platform, because residential clients are overwhelmed when presented with an open design problem.

"Often times people, especially with residential clients, can be overwhelmed if you say, 'Here is an open space, do with it as you will.' If you say here are a dozen options for this open space, anybody can flip through the options and adjust it to their lifestyle and work within those parameters and have much better success." "Here you have a group of professionals who have worked on the space and come up with pertinent questions and a number of designs that work really well in the space, and you can choose what best fits your lifestyle. Instead of a consumer dealing with an

architect and a designer and then with me it allows them customization without all the headaches and the potential for error that go when you're passing information from one person to the next to the next and then going back to the customer and saying, 'Is this what you want?'"

The implementation of the infill reflects his practice. He requires little from a designer has experience with. Once the types of details that particular designer prefers is established, he can work from a simplified set of drawings.

"That I could take into a software like cabinetvision so that it wouldn't be a matter of going through each job and counting up, if the components were already in there in the different sizes. Here is the list of twenty cabinets that are in this unit so that at least I know what the boxes are, that would save a lot of time and again potential for mistake."

He felt the documentation produced in the design process would save a lot of time and reduce the potential for mistake.

"...it would relieve the burden of field measurements." "I like to wait until it's drywalled and not only measure, but template everything and mark out... Whatever is going to be important, so that I don't mess it up translating it back at the office." "Because you go from the architects plans to the foundation guy to the framer to the drywaller, you can quickly lose many, many inches." "I've grown up in this industry, my dad's a contractor, I've been around these jobs my whole life and I think its just carelessness on the part of certain people. I also think that there is a lack of respect or sort of almost disgruntlement is the right word for it, 'well this architect doesn't need the window right here' or 'I don't need to look at the plan, I'll just come in two feet and put it there.'" I find certain people don't follow drawings as closely as they should. Which I don't understand because I love having really detailed drawings because it means that I don't have to make a lot of decisions, I don't have to be responsible for decisions."

His greatest concerns were the integration of the infrastructure into the components.

"Once the integrating it and knowing the waste line always comes up in a certain point in these kitchens and the supplies always come up at this point and you need this much slack in your soffit space to make up for whatever discrepancies there might be in the ceiling, after that, the possibilities are endless."

And reaching an economy of scale in production.

"[Are] there going to be dozens of units like these incorporating this system?"

Conclusion

This work presents a new process for residential design centered on the individual - not the expert. In this model, developers become integrators offering a process for customization; architects create design engines and computational critics rather than a single design; industry provides tailored product and service information directly to the consumer at the point of decision; and fabricators receive data to manufacture customized cabinetry-like components for just-in-time delivery and assembly. To test and evaluate this work, a novel solution to object recognition and tracking has been developed. Qualitative feedback from a variety of professions indicated that this work addresses generally recognized problems in the industry, and proposed plausible, if schematic, solutions that should be further developed and evaluated.

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[17] Stefan Thomke and von Hippel, Eric. "Customers as Innovators: A New Way to Create Value", Harvard Business Review, April 2002, pp.5-11.

[18] R. Williams. Training Architectural Computational Critics by Example. Master's thesis, Massachusetts Institute of Technology, 2003.

This thread has been modified from its original form, headers and redundant message streams have been omitted.

1 Lance Hirsch Jan 1, 2000
|-2 .CTS. Jan 2, 2000
| \-3 Oscar M Torres Jan 3, 2000
|-4 Kaylyn Munro Jan 3, 2000
| \-5 Lance Hirsch Jan 3, 2000
| |-6 Kaylyn Munro Jan 4, 2000
| \-7 Richard Morrison Jan 5, 2000
|-8 Kadd Jan 4, 2000

All messages from thread
Message 1 in thread From: Lance Hirsch (lhirsch@attglobal.net)
Subject: Home Design Software anf the need for an architect
View this article only Newsgroups: alt.architecture Date: 2000/01/01

Greetings,
I am not a regular poster to this group. My wife and I plan on having a home built later this year or early next year. We have several tracts of land available, all with wonderful views. I have two distinct areas of inquiry. One is Home Design Software and the other is the role of an architect when we have our own ideas about design.
I'm familiar with the popular Home Design Software such as those titles from Broderbund and Sierra. There was a recent review in PC Magazine of four or five titles. I believe IMSI (?) received Editor's Choice. I'd like some reccomendations about what software to use to take our ideas and put them on paper or disk for a builder or architect to use. I am familiar with Auto-Cad and quite computer literate and would be willing to use software that is not intended for the mass market. I'm particularly interested in software that can print templates for model building.
I'm not naive enough to think I can sit down with $100 worth of software and turn blue prints over to a builder. However, I'm hoping that Home Design Software can help me communicate with an architect and a builder. Would an architect welcome a client with his own plans or dismiss them as amature? I know this is a broad question, but what will an architect do for me apart from the design? In other words, if I know the design and arrangement for the house, what does an architect do? I'm hoping that I can find software that will help me design a home, including electrical, plumbing, and possibly structural issues and I can have an architect review it and create the detailed plans. Not only would this give me the sense that I was living in a house that I designed (which I want), but I could hopefully save $xx,xxx a five figure fee or at least a big chunk of it.
M questions are coming from a total lack of experience with architects as opposed to being doubtful about what they can do. In other words, I hope I'm not offending anyone by asking this. :)

Lance

Message 2 in thread From: .CTS. (probepro@mindspring.com)
Subject: Re: Home Design Software anf the need for an architect
View this article only Newsgroups: alt.architecture Date: 2000/01/02
Lance,
I'll be watching your thread closely, since I am in a similar situation. I just

ordered the IMSI Floor Plan 3D software. I've used other home design software before with OK results. This will be my first custom built home. An architect will be essential to the process since I'm literally starting from a blank page. I do not expect to use any existing floor plans. I'll use IMSI software to get my ideas on paper. I expect the architect to make recommendations regarding spaces, lighting, structures, materials and all the things that I have forgotten or don't even know of. I would expect the architect would work with an engineer, and hand-off their product to a general contractor.
I have an unusual design. It's a loft style (few inside walls or hallways), single family, single level building with an atrium. I doubt their are prepackaged plans for this type of building, so I will be relying on the judgement and knowledge of an architect. Ultimately, the architect is responsible for the design, which is the single most important feature of any structure. There are no second chances. I've got to get the design right from the outset.
Good luck, Chuck

View this article only Newsgroups: alt.architecture Date: 2000/01/03
Chuck and Lance,
The questions you have raised about architectural design are not uncommon. First of all to you and anyone else out there, don't be afraid to ask questions. As design professional, I encourage my clients to ask a lot of questions. Second, what you are considering doing is not uncommon. Many clients that I have dealt with have come to me with either a sketch of some sort or like in your case a drawing generated through some kind of cad program. Keep in mind sometimes the cad program they are using is fairly primitive compared to what the industry uses. Nonetheless, it is still valuable to have some sort of basis because it helps communicate to the architect or designer what the client is visualizing. The job of architect or designer is to translate the clients needs and wants into a design that is not only functional and has architectural appeal, but is also cost effective to build. I do not believe it is the job of the architect or designer to dictate to the client his or her design values but rather to work in concert with them. The designer is then to use their knowledge and experience to make recommendations that will help shape and bring about the final product.
Now you also have options as to the type of design professional that you make work with. Obviously an architect is the first that comes to mind. However, there are also residential designers who are just as competent. One of the main differences between the two is price. With an architect you can expect to pay between 6% and 13%, maybe more, of the cost valuation of the home. With designers such as myself, expect 2% to 5%, of the cost valuation. However, as in any industry you will be sure to find both good and bad architects and designers. So before making a decision on who to choose, I would interview several and get lots of references. These should not only include past clients but also builders who have worked with their drawings. By doing this you will be able to make an informed decision. Good luck!
Oscar Torres Design Services NW dsnw@integrityonline.com

Message 4 in thread From: Kaylyn Munro (kaylyn@idir.net)
Subject: Re: Home Design Software anf the need for an architect
View this article only Newsgroups: alt.architecture Date: 2000/01/03
You may like to visit the American Institute of Architects site and see the section at http://www.aiaaccess.com/ ....it explains alot about what architects do for people in your situation. Frankly, you don't need an architect for home design...very few homes are actually designed by architects. An experienced draftsman can provide the drawings you'll need if indeed all you need is the drawings or 'blueprints'.
How do architects view a situation like you propose? It varies...depending on whether what you design is amateurish or not. I have been asked to do 'just

the mechanicals' on a 6000+ square foot house that was ludicrous in both design and concept. The owner thought $500 dollars would just about cover our fees, though the fees for the proper design and detailing of the project of a project of that scope should have been in the upper 5-6 figure range. We did not view the situation as workable and didn't accept the job. Under the conditions, we couldn't provide a good job for our client. I have also seen quite good designs by owners, but I refer them to a contractor who can offer drafting services, which is what they need. Currently, the majority of architects are inundated with work, they don't need to take on odd drafting jobs for small fees.

I wish there were software for lay folk to layout an entire approach to medical treatment and surgery and so the surgeon could 'just do the cutting'. Probably save alot of money there too. Why pay someone for providing expertise knowledge gained in years of training and experience!!

Good luck with your project!

Kaylyn

Message 5 in thread From: Lance Hirsch (lhirsch@attglobal.net)
Subject: Re: Home Design Software anf the need for an architect
View this article only Newsgroups: alt.architecture Date: 2000/01/03

Thanks to everyone has respnded and who will continue to respond.

Based on the answers I have recieved via e-mail and here, it looks like an architect is an option as opposed to a requirement. Regarding home design software, I evaluated several and chose one.

I think every person needs to evaluate their own strengths to determine best how outside help can help them and if it is needed. I didn't include all the relevant information about myself, but I doubt I fit the profile of the average client for an architect. I have a background in Computer Science and have worked in the Civil Engineering field including structural and geotechnical (soil) engineering. The home I live in now was designed by my father who has designed and built other homes, although he is not a builder by trade. This is probably my biggest influence; the fact that my father and others in my family have designed and built homes or contracted to have homes built without feeling the need for an architect. I have also worked around home construction sites when I was younger as well as built smaller structures on my own. I have a *general* knowledge of several aspects of home construction such as foundations, framing, HVAC, electrical, plumbing, roofing, et cetera. I am by know means an expert in any of these areas and I am well aware of my limitations - a little knowledge is a dangerous thing. However, I feel that I could identify most potential problems before construction begins as well as those that come up after construction. Another factor is that a well trusted relative would be hired to be the contractor for construction, so regardless of my knowledge or perceived knowledge of construction, I have a trusted individual who will be looking out for me. Another factor is that I have been studiously aquiring knowledge the last six years on design, new materials and techniques, and construction. If nothing else, I have at least boosted my confidence that I'm not totally ignorant. Magazines, television, and the internet are all w onderful places to learn new things and see examples to get ideas.

But what about the actual design of a home and the answer to my question, "What does an architect do?" I got very few specific answers. The http://www.aiaaccess.com/ page did give specific answers but not very convincing ones. At least not convincing for me. However, if someone had absolutley no clue about home design and construction, I would say that an architect is mandatory. At one time I thought drawing a floor plan was all you need - where are the walls, doors, and windows going to be - and that's al you need. I vividly remember the first one room building I built. My dad looked at the plans and asked me where the light switch was going to be. To make a long story short, that simple question woke me up to the intricacies of even the

simplest of structures. My point is that for all of those people who would never consider where light switches will be (as well as outlet placement, sewage lines, drainage, permits, plumbing layout, structural integrity, utility hookups, noise, cost, etc.) they need an architect. I don't think I do. However, having said all of that, I will most likely have an architect review my plans. I plan on living in this house for a long time and will be investing a considerable amount of money. If an architect can look at my plans and make suggestions that I agree with or find obvious errors, I'd be happy to hire one.

What follows is a few specific responses:

Kaylyn Munro <kaylyn@idir.net> wrote in message news:3870A7A9.9487E18F@idir.net...

> I wish there were software for lay folk to layout an entire approach to medical
> treatment and surgery and so the surgeon could 'just do the cutting'. Probably
> save alot of money there too. Why pay someone for providing expertise knowledge
> gained in years of training and experience!!

Software and expert systems are spreading into many professions such as medicine, law, auto repair, facilties management, and psychology. The current mass market software does a lot and their features will doubtless grow. I'm sure there are high dollar packages that do even more. My financial advisor used to charge me several hundred dollars for asset allocation advice. He just plugged some numbers into a propretary software package or spreadsheet. Now that software is widely available for free and what used to be the exclusive realm of a licensed professional is now available for free to anyone. Software has and will continue to absorb "expertise [and] knowledge gained in year of training and experience" by architects for us lay folk. When will the software that architects use become available to lay people?

Richard Morrison <richardm@spambegone.best.com> wrote in message news:3871030f.1115231140@nntp.best.com...

>Most responsible residential architects will welcome your ideas, but
>you will miss a large part of the value of an architect if you go into
>the process with a fixed conception. I'm sure your design will be as
>good as any first year architecture student's. (Get my point?) I would
>suggest that if you want the best value, get some independent ideas
>first, before you get fixated on the one you've come up with. You can
>always go back to that if you want. Your words indicate that it is
>more important to you to have YOUR design than a GREAT design. You
>should be absolutely clear (at least with yourself) that this is the case.
>A good architect should be able to give you design that reflects you
>and your ideas, so that you have a sense of "ownership", but is far
>better than you could design on your own.

I do understand that I want MY design as opposed to a GREAT design, but GREAT is subjective. I will of course think that MY design is GREAT! Others presumably won't think so. I may look at what is considered GREAT by the AIA and others and not like it as I am ignorant of a professional's guidelines as to what constitutes greatness in architecture - but I know what I like. Ignorance is bliss. This is really the crux of my question. What does that first year architecture student learn in succesive years that make him capable of designing a better home than I could? Any physical limitations in my design can be spotted by builders or tradesman (if not me) before the design is finalized. That leaves aesthetic properties which again is subjective and functionality which is common sense that one aquires from living in, working in and on, and generally using homes and other structures. I generally agree with your comments and will seek out an architect - but I'm not expecting much. I will keep this group updated with my progress (or lack thereof). Perhaps I will make a web site about my adventures (a la Tracy Kidder's

House).
The other comments in Richard Morrison's response (that I didn't quote) were also informative and helped me arrive at my conclusion to consult with an architect.
Lance

Message 6 in thread From: Kaylyn Munro (kaylyn@idir.net)
Subject: Re: Home Design Software anf the need for an architect
View this article only Newsgroups: alt.architecture Date: 2000/01/04
Lance,
I appreciate your posting back to the responses given. Often folks just take the info and run! Even though I am a designer who does do residential design, I think that the act of designing making a home is one which a great many people could do for themselves if they have even some of the experience and awareness that you obviously do. It may not be, as you noted, what the architectural journals would like to publish, but is often a damn site better than the spec homes builders knock up. It is an unfortunate fact of the modern age that the traditions of vernacular or folk construction has been mostly lost to the generic one type-fits all banality of suburbia. It has dulled our culture and rendered a great many blind to the richness of our physical world. In some way, I think you are engaged in a bit of folk building, given the fact that your experience and interest has been gained through information initially passed on by your father. A short history to be called a folk tradition, but hey, its got to start somewhere!!!
Why isn't the software available to architects available to lay folk? Well, it is. You too can buy AutoCAD or one of the other 'big' programs'. Thing is, it is just a slightly sharper pencil than the products available to the 'amateur'. It is also something like learning Russian in terms of developing a modicum of fluency and control. It does not automate the design process unless the designer tells it to. Even then there is no software that integrates the study of history, design principles, theory, technical construction or legal issues, etc etc in anywhere near the way required of the human brain in the practice of architecture. I personally hope that there never is such a thing...not because of concerns about my livelihood so much as a strong feeling that design is a highly creative and human act best done by people communicating among one another. Certainly, the tools developed to assist the design process and create more accurate data for evaluation are extremely useful...but they are simply more sophisticated electronic versions of circle templates, triangles, and slide rules. They don't 'do' design on their own.
I should have noted that the AIA thing is a bit glossy, but it is, as you noted, a place to start. I would recommend along with some of the other posters that you find an architect early on. I suggest to any client who approaches me that the talk to at least two-three other architects and choose the one with whom they feel the most comfortable...that they just like and feel that they can work with well. I would suspect that you might be able to find one, or a very competent and design sensitive builder , who would ask you questions like 'where does the light switch go' as you go along without taking away the fun of designing your on your own. (I've worked with several builders who bring as much or more design talent and experience to a project as I do, I love working with them as the product is always better with more good heads than one!) Perhaps you can offer services in kind (barter) for some of the early discussions.
I do hope you consider a web-page, or at least continued discussion here as you progress through the project. I'm very curious as to what you've got in mind and how it will shape up.
Good luck, again,
Kaylyn
Message 7 in thread From: Richard Morrison

(richardm@spambegone.best.com)
Subject: Re: Home Design Software anf the need for an architect
View this article only Newsgroups: alt.architecture Date: 2000/01/05 "Lance Hirsch" <lhirsch@attglobal.net> wrote:
> This is really the crux of my question.
>What does that first year architecture student learn in succesive years that >make him capable of designing a better home than I could?
> > I'll attempt to answer your question, mostly because others will be reading this, and may find it helpful.
The answer is subtle, but significant. They gradually learn to concurrently juggle a myriad of variables including structural requirements, code constraints, daylight and wind factors, energy compliance, mechanical systems, user requirements, topography, neighborhood character, contractor limitations, costs, material limitations, functionality, etc., etc. while maintaining a commitment to creating a sense of "delight" in the final product. It is easy to lose that original vision — you'll soon see how quickly your original concept starts to erode when costs, product availability, the contractor, the engineer, lack of foresight, sudden "inspirations", and/or the building code start demanding changes.
However, in the same way that some people are quite happy with Ripple (especially if they've "brewed" it themselves), but others see a major difference between a good and a _great_ wine, this erosion will not bother some people. Yes, there is a certain amount of subjectivity to aesthetics (as with wine evaluation), but the evaluation of a connoisseur is not completely subjective. Great, even very good, residential architecture is usually easily recognizable even to amateurs. There is nothing wrong or immoral with pleasant square footage. It is just sad when, for probably the same price, people could have gotten so much more. Ignorance may be bliss, but ignorance is still ignorance. (BTW, if you haven't read it already, I highly recommend "The Not So Big House", by Sarah Susanka.)
This ability to juggle such a multitude of variables and still produce something wonderful is arrived at after years of practice, professional and peer critiques in architecture school, and years of hard knocks. (I am, of course, willing to admit that some professional architects still haven't become completely proficient at this.)
Also, architects develop professional _judgement_ over the years. For example, is it worth paying extra for kiln-dried lumber? Should rafter bays with rigid insulation be vented? Is a glu-lam or a laminated veneer lumber beam a better choice for a specific application? How much deflection in a beam is appropriate or tolerable in a certain area? Is filter fabric over a perforated foundation drain going to be a problem?
There is a misconception that a good architect is costly. (i.e. every dollar spent on an architect is one dollar less that's available to spend on the house.) The reality is that, like a good accountant, a good architect can SAVE you money, often more than their fees.
Creating acceptable square footage is a no-brainer. But even after twenty-five (full-time) years, designing really wonderful houses continues to be an incredibly difficult challenge. Which is why I am still beguiled by it, I guess.

Richard Morrison, AIA, ASID
Architect-Interior Designer
Menlo Park, CA
Message 8 in thread From: Kadd (kadd@fiestanet.com)
Subject: Re: Home Design Software anf the need for an architect
View this article only Newsgroups: alt.architecture Date: 2000/01/04

All of the above posts are very pertinent to you needs. Here is a few things I would like to add:

1: Check with your local minicipality to see if you are required to have an architect. Some towns require them while others do not. You may be required to have a structural engineer rather than an architect for the production of plans.

2. If you have a very complex design, you may be well advised to have an architect. This will help in the translation of the design ideas to the contractor. Many residential designers would be adequate for this too, especiall those who specialize in custom home design.

3. If your design is not very complex, you could look at a draftsman. You will still want one with experience in custom home design. You can also work with a contractor to perform a "Design/Build" home. That way you work with the contractor from "birth to death" in respects to your house. This could save many thousands of dollars in the overall cost because he can tell you where to cut and where to spend in regards to the design. It is much cheaper to change it on paper than it is in the field.

4. Sometimes architects look at designs as a new award for their "I love me" wall. You (sometimes) have to deal with their egos and the attitide of it is my way or no way. Not all are like that, but there are alot of them out there. However a good architect or designer will be able to take your ideas and maybe refine them to fit with "industry standards". Such as your floor plan but with their comments regarding the exterior, creating more "curb appeal". The way I operate my office is that you (the client) have to live in the building, not me. I may not like the design, but as long as you are happy with it in the end, my job was done right. Sometimes with architects and custom home designers they like to incorporate what I like to refer as "wasted real estate" that is curved walls, funny angles etc... Ever try to hang a picture on a curved wall? They look nice from the street, but not always very functional.

5. The pricing that was quoted earlier is very accurate. Many architects or custom home designers will charge either a percentage or a price per square foot. In this area (Phoenix) that is anywhere from about $4 to $12 p.s.f. while drafting services or contractors range from $0.75 to $2.00 p.s.f. for virtually the same service. The main difference is the architect or custom designer has name recognition (i.e. Frank Lloyd Wright) The contractor or drafting service may not.

6. I welcome ideas from clients either sketched on a napkin or in a cad format. Sometimes the cad format is a little easier because I am able to import your ideas right into my cad software and go. If you are looking at low end cad packages for your design use, make sure that you have one that has either .dwg or .dxf output options (for autocad). That is the industry standard and most all major cad packages can read a .dxf file. The better quality of the ideas I am presented with, the better the overall design and happiness of my client in the long run, this will sometimes even effect my pricing. If I know what they

Read the rest of this message... (21 more lines)

Message 9 in thread From: Dave Pierce (dpierce@voyager.net)
Subject: Re: Home Design Software anf the need for an architect
View this article only Newsgroups: alt.architecture Date: 2000/01/11
Check out SoftPlan at http://www.softplan.com/ I don't know what your $$'s are but if your serious about designing your own home, and have a decent knowledge of building and or design practices this is the program you need. Unlike the $100 programs this one will run you about $2800 but it will do everything you need to do. including 3D views from your 2D drawing. Let me know what you think. I just purchased it myself.
Dave

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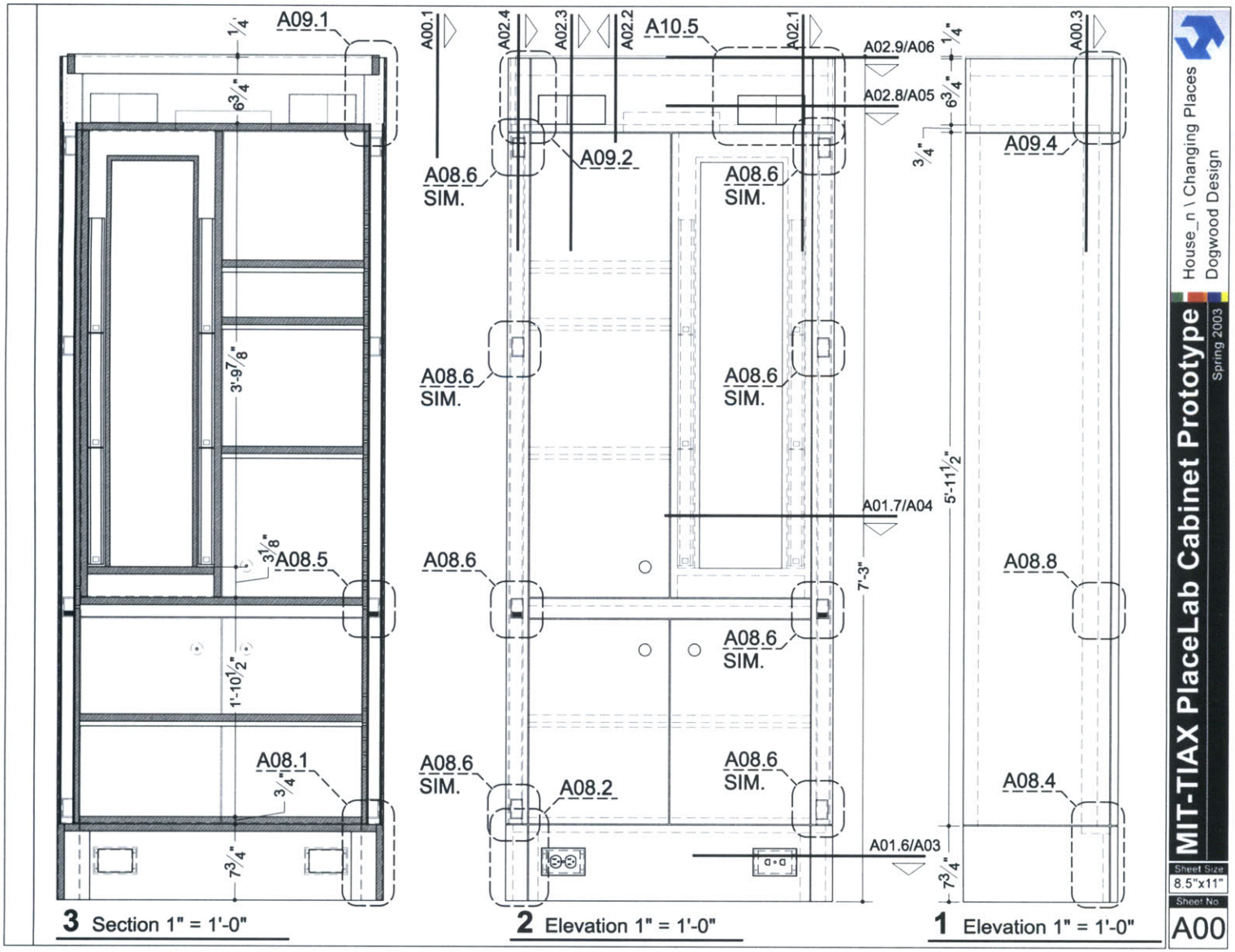
A01_Horizontal Sections/Details
A02_Vertical Sections
A03_Horizontal Section through Base
A04_Horizontal Section through Typical
A05_Horizontal Section through Crown
A06_Horizontal Section at Ceiling
A07_Details at Channel Face Plate+Shelf.
A08_Details at Channel Face Plate: Base.
A09_Details at Channel Face Plate: Crown.
A10_Details Face Plate: Crown.

Drawn By: TJMcLeish
April 24, 2003

MIT-TIAX PlaceLab Cabinet Prototype

Spring 2003

House_n \ Changing Places
Dogwood Design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House_n \ Changing Places
Dogwood Design
MIT-TIAX PlaceLab Cabinet Prototype
Spring 2003
Sheet Size
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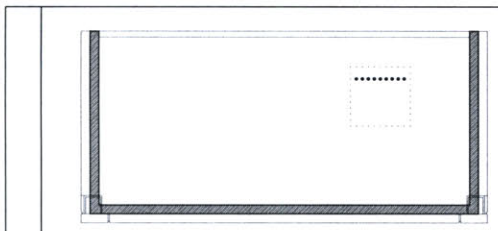

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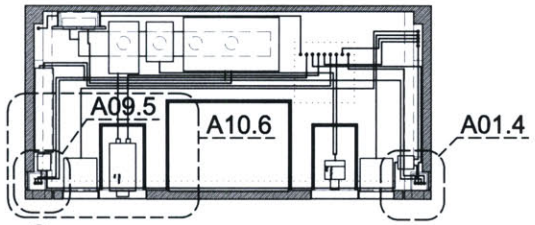

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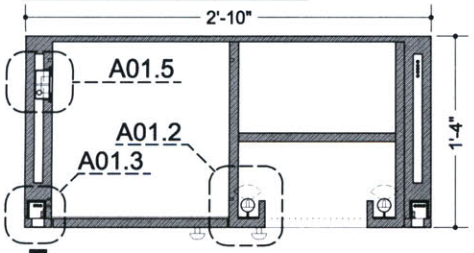

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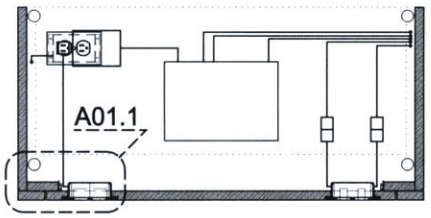

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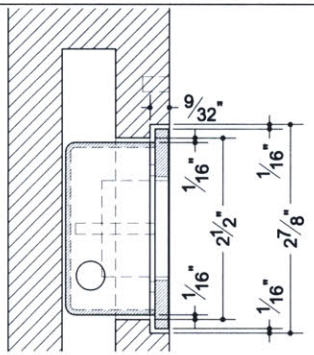

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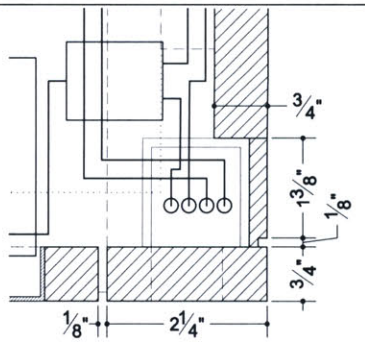

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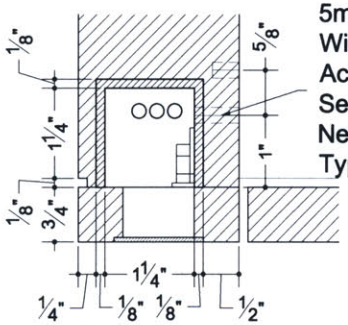

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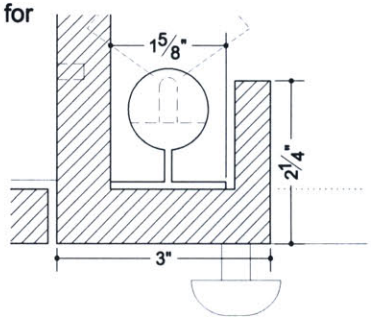

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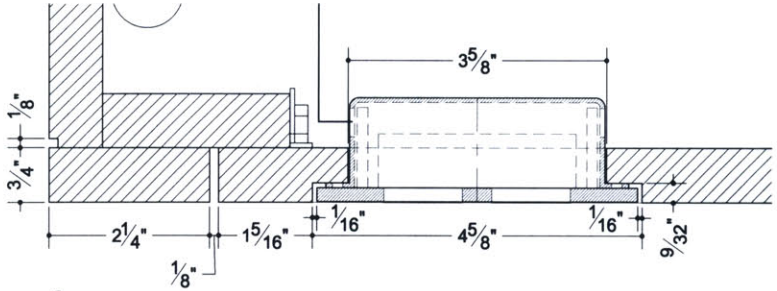

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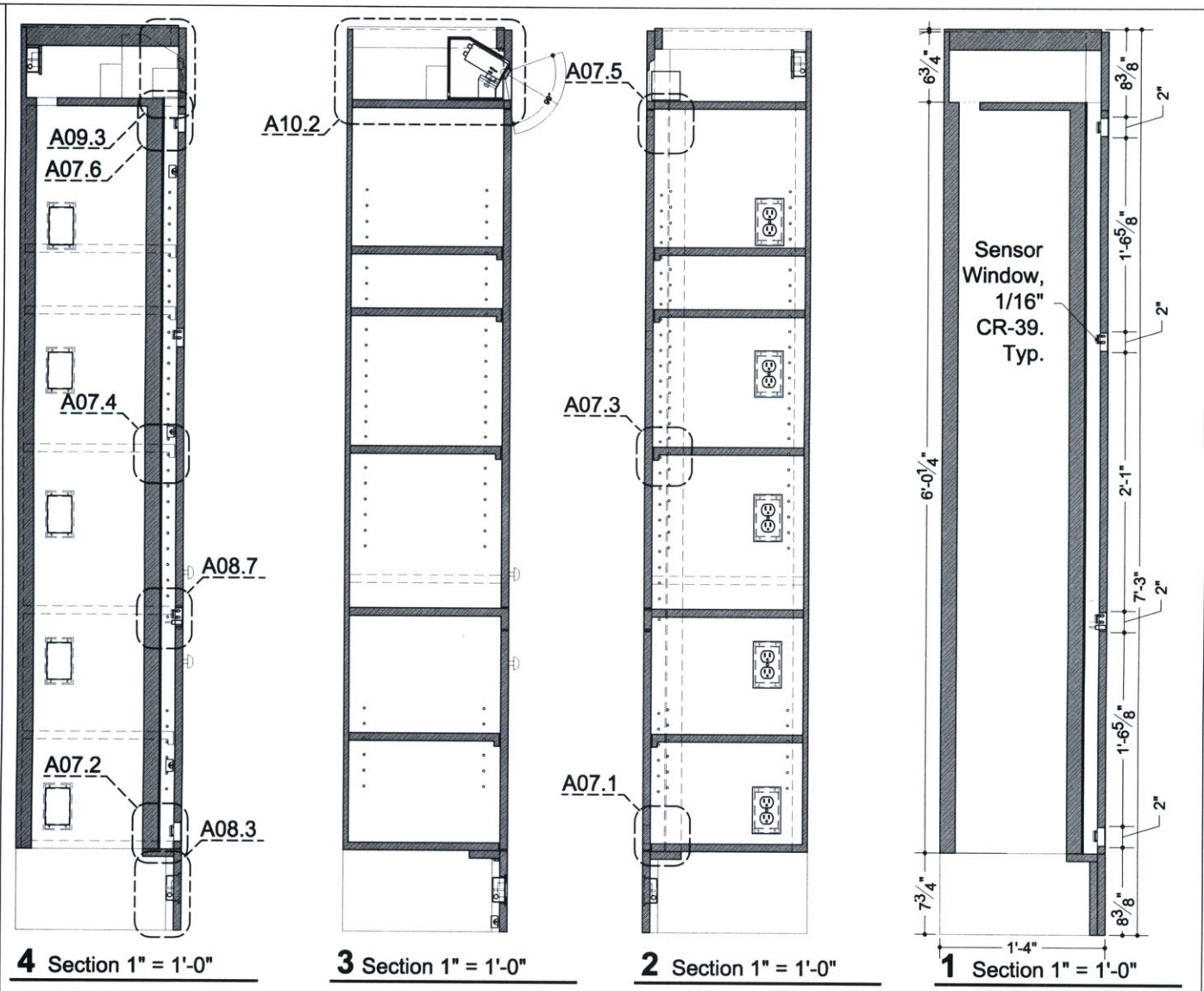
Sheet No.
A01



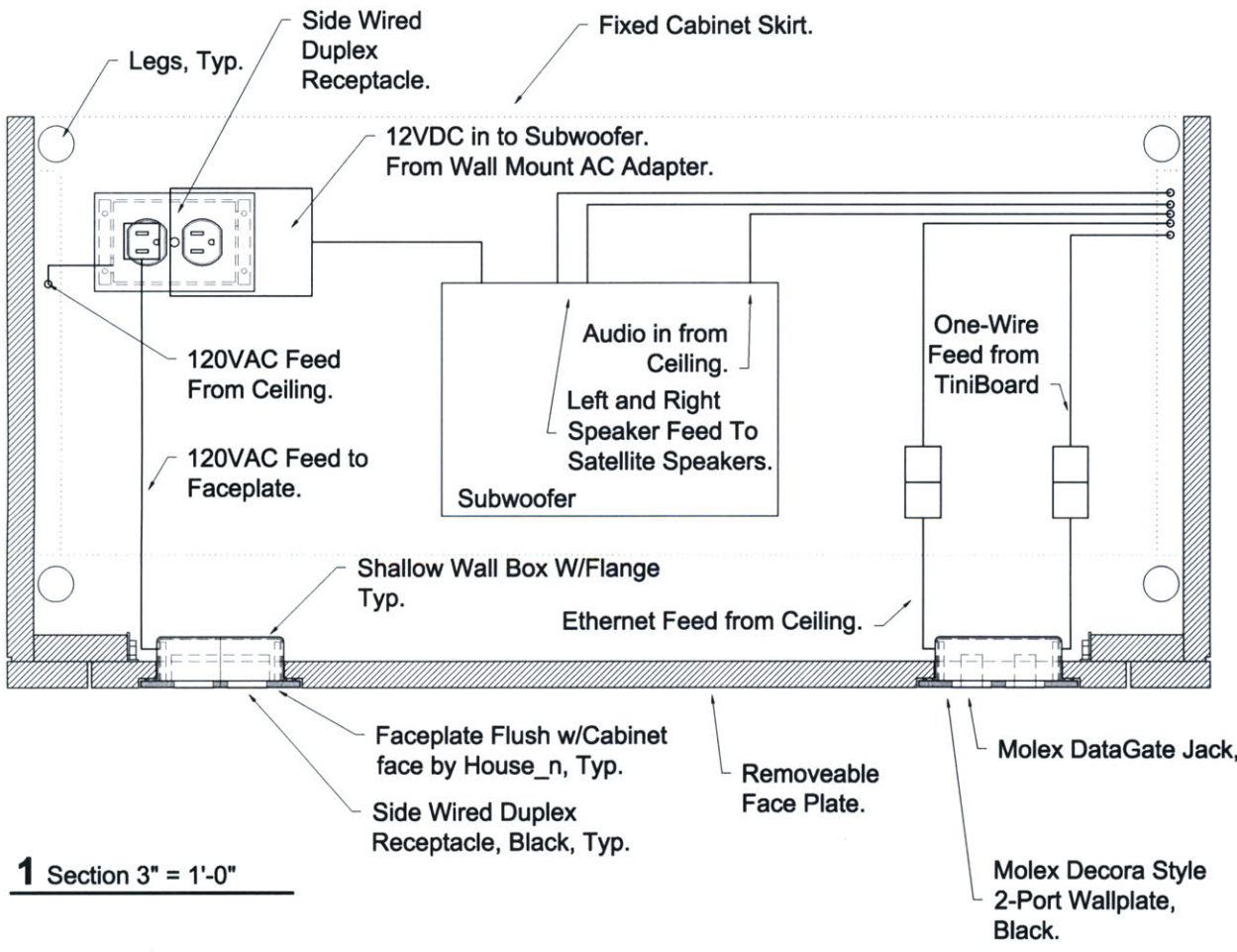
House_n \ Changing Places
Dogwood Design

MIT-TIAX PlaceLab Cabinet Prototype

Spring 2003

Sheet Size
8.5"x11"

Sheet No.
A02



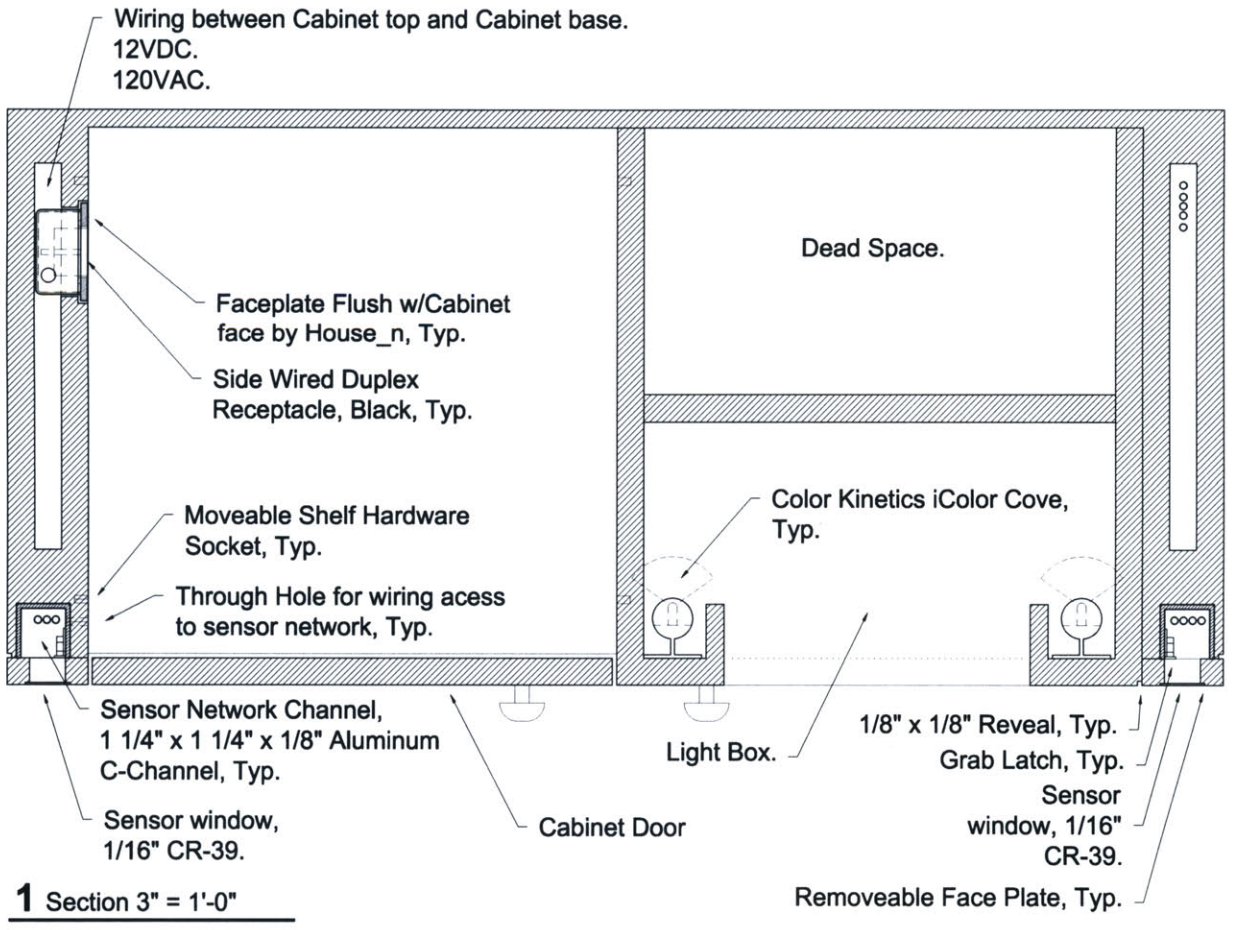
1 Section 3" = 1'-0"

House_n \ Changing Places
Dogwood Design

MIT-TIAX PlaceLab Cabinet Prototype
Spring 2003

Sheet Size
8.5"x11"

Sheet No.
A03



1 Section 3" = 1'-0"

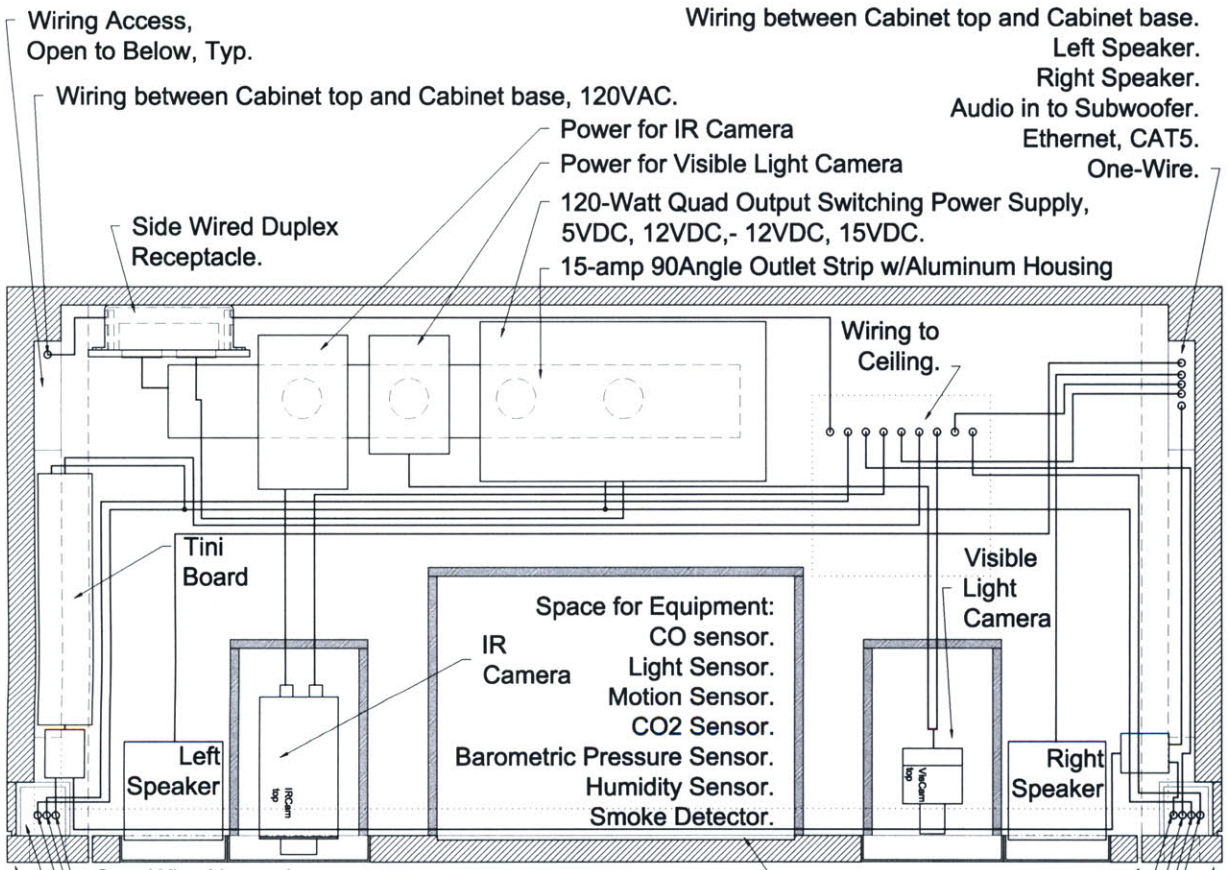
House_n \ Changing Places
Dogwood Design

MIT-TIAX PlaceLab Cabinet Prototype

Spring 2003

Sheet Size
8.5"x11"

Sheet No.
A04



1 Section 3" = 1'-0"

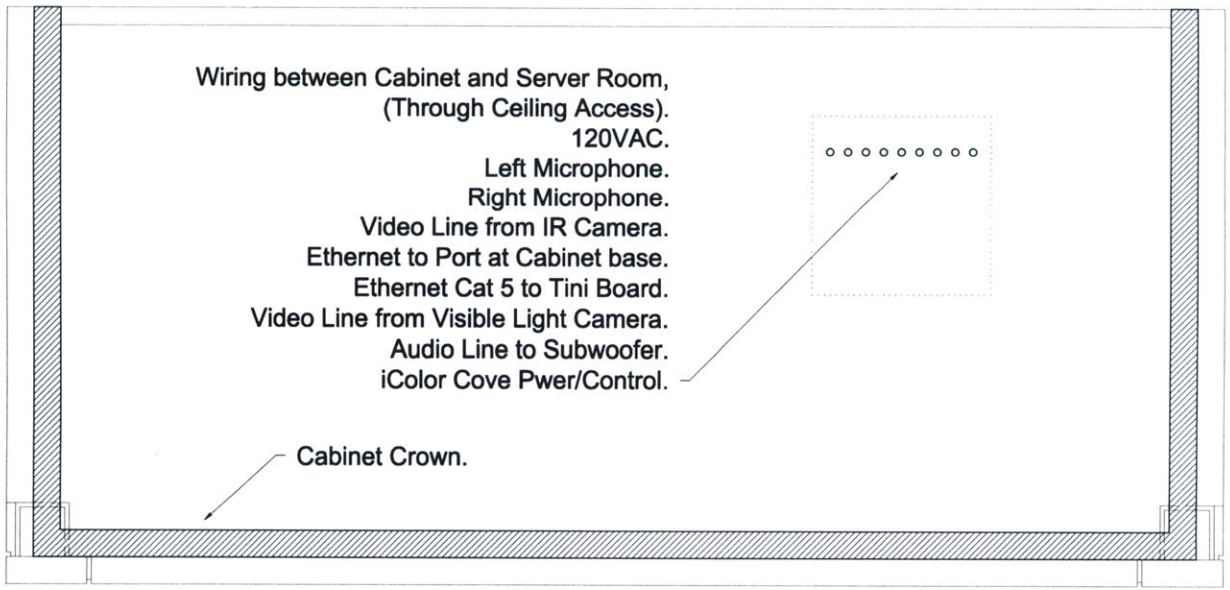
House_n \ Changing Places
Dogwood Design

MIT-TIAX PlaceLab Cabinet Prototype

Spring 2003

Sheet Size
8.5"x11"

Sheet No.
A05



1 Section 3" = 1'-0"

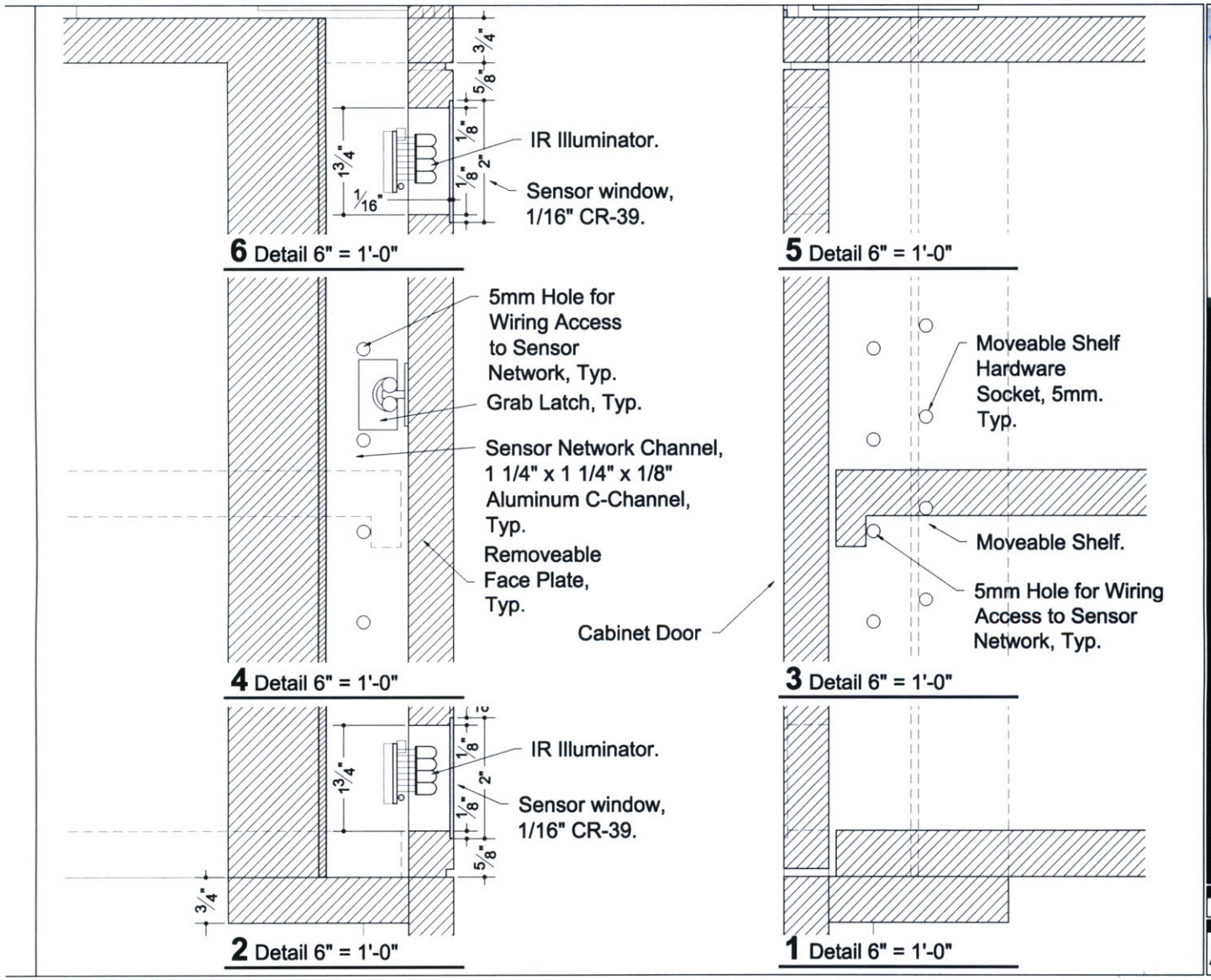
House_n \ Changing Places
Dogwood Design

MIT-TIAX PlaceLab Cabinet Prototype

Spring 2003

Sheet Size
8.5"x11"

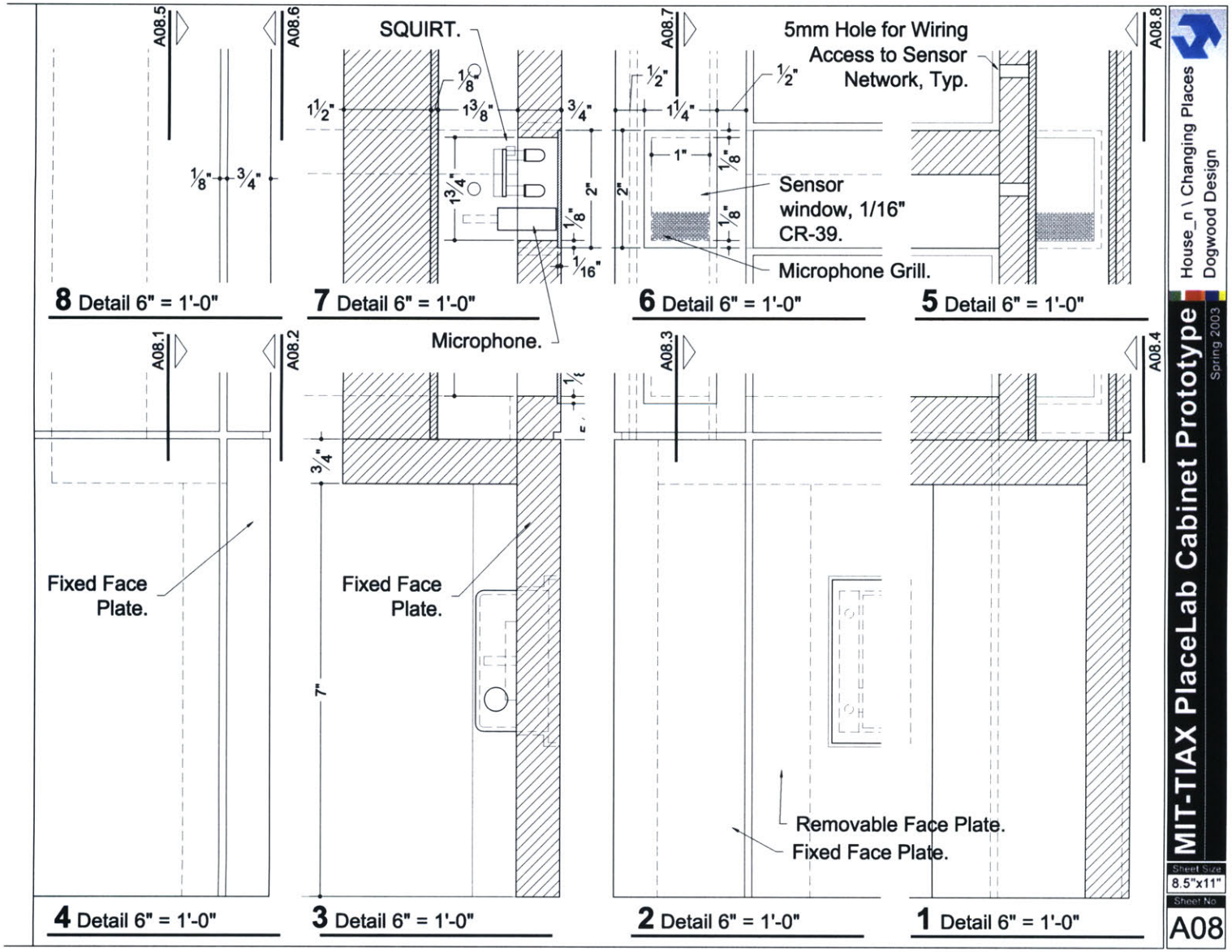
Sheet No.
A06

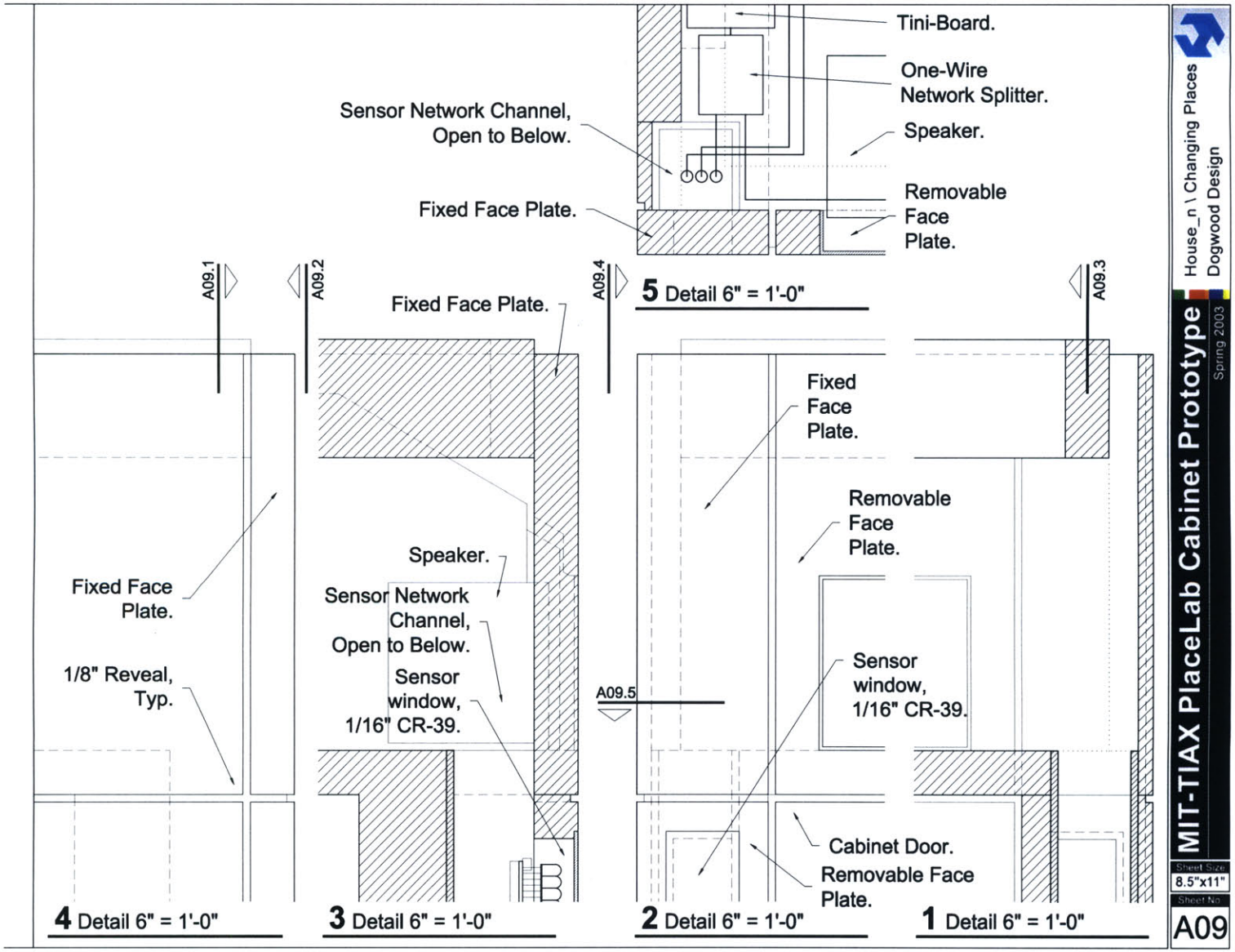


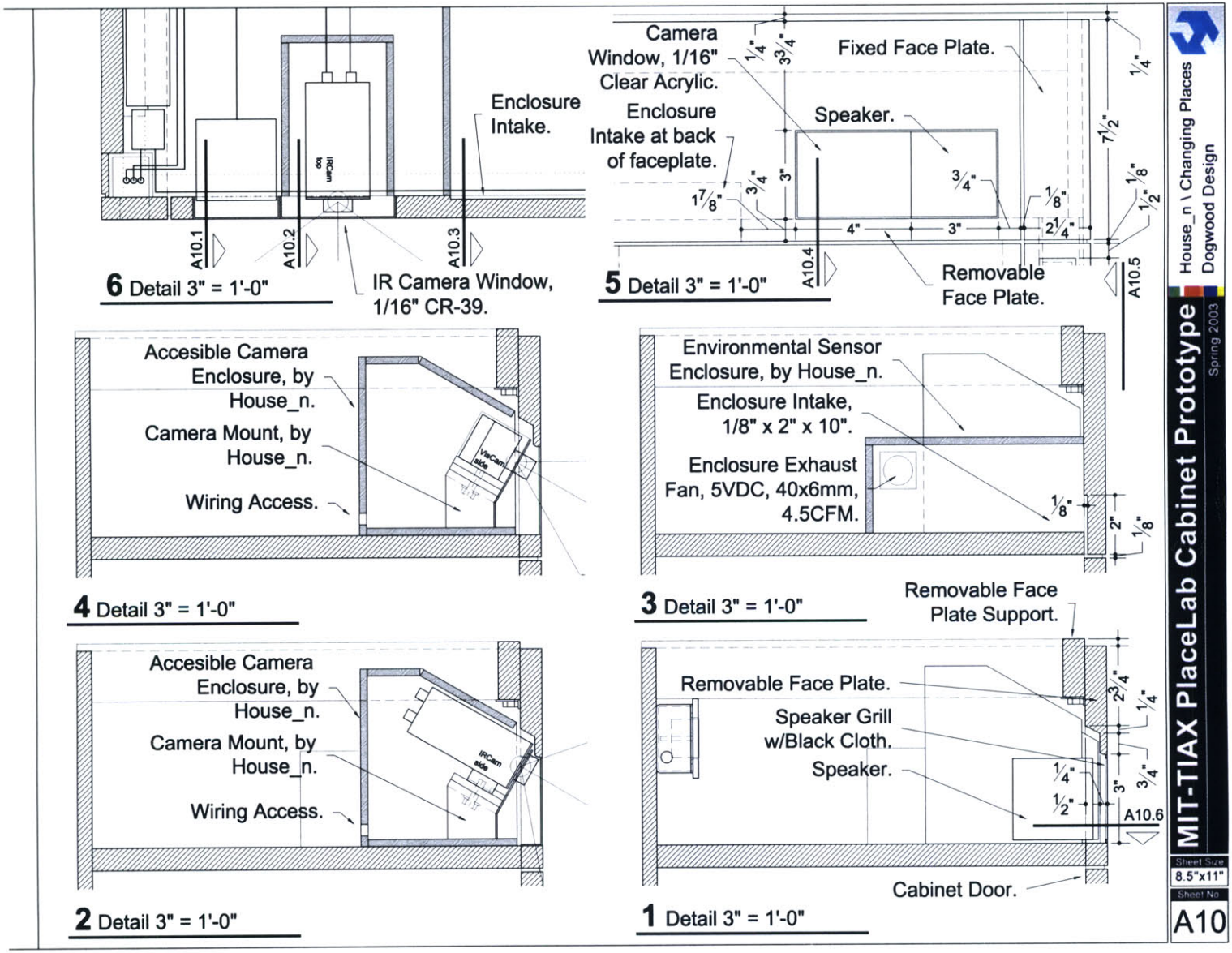
House_n \ Changing Places
Dogwood Design

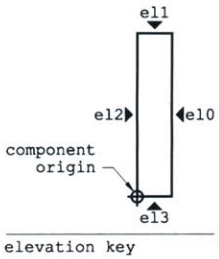
MIT-TIAX PlaceLab Cabinet Prototype
Spring 2003

Sheet Size: 8.5"x11"
Sheet No: A07

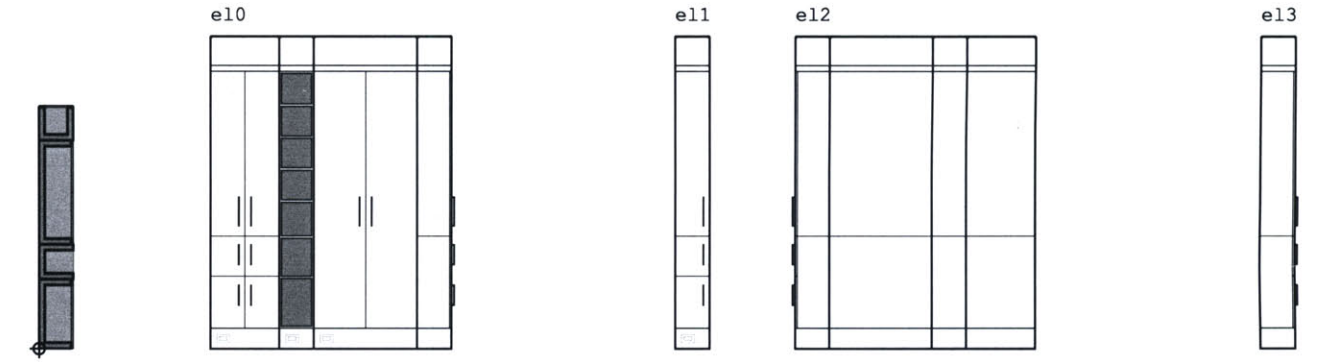

A08.5
A08.6
1/8"
3/4"
8 Detail 6" = 1'-0"
SQUIRT.
1/8"
1 1/2"
1 3/8"
3/4"
1 3/4"
1/8"
2"
1/16"
Microphone.
7 Detail 6" = 1'-0"
A08.7
A08.8
1/2"
1/2"
1 1/4"
1"
1/8"
2"
1/8"
Sensor window, 1/16" CR-39.
Microphone Grill.
6 Detail 6" = 1'-0"
5mm Hole for Wiring Access to Sensor Network, Typ.
5 Detail 6" = 1'-0"
A08.1
A08.2
Fixed Face Plate.
4 Detail 6" = 1'-0"
3/4"
7"
Fixed Face Plate.
3 Detail 6" = 1'-0"
A08.3
A08.4
Removable Face Plate.
Fixed Face Plate.
2 Detail 6" = 1'-0"
1 Detail 6" = 1'-0"
House_n \ Changing Places
Dogwood Design
MIT-TIAX PlaceLab Cabinet Prototype
Spring 2003
Sheet Size
8.5"x11"
Sheet No.
A08


Tini-Board.
One-Wire
Network Splitter.
Speaker.
Sensor Network Channel,
Open to Below.
Removable
Face
Plate.
Fixed Face Plate.
A09.1
A09.2
A09.4
A09.3
5 Detail 6" = 1'-0"
Fixed Face Plate.
Fixed
Face
Plate.
Removable
Face
Plate.
Speaker.
Sensor Network
Channel,
Open to Below.
Fixed Face
Plate.
1/8" Reveal,
Typ.
Sensor
window,
1/16" CR-39.
A09.5
Sensor
window,
1/16" CR-39.
Cabinet Door.
Removable Face
Plate.
4 Detail 6" = 1'-0"
3 Detail 6" = 1'-0"
2 Detail 6" = 1'-0"
1 Detail 6" = 1'-0"
House_n \ Changing Places
Dogwood Design
MIT-TIAX PlaceLab Cabinet Prototype
Spring 2003
Sheet Size
8.5"x11"
Sheet No.
A09

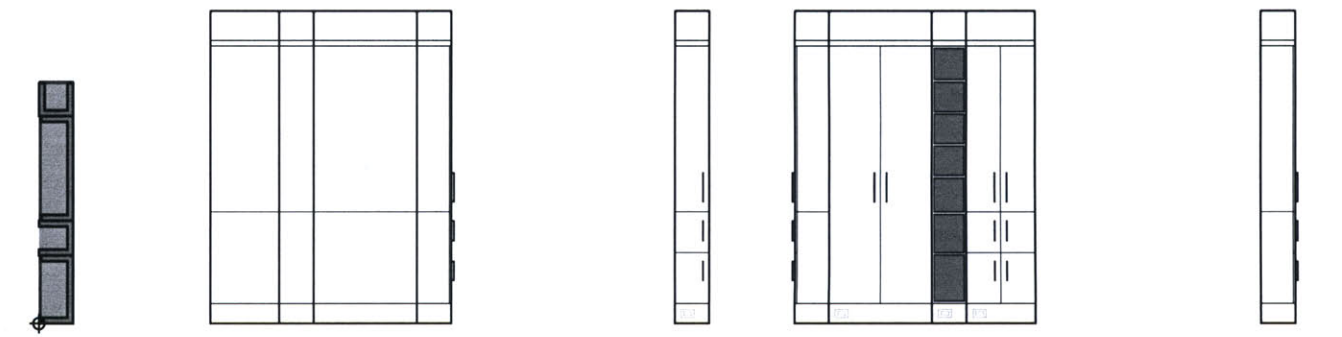

Enclosure Intake.
IRCam
A10.1
A10.2
A10.3
IR Camera Window, 1/16" CR-39.
6 Detail 3" = 1'-0"
Camera Window, 1/16" Clear Acrylic.
Enclosure Intake at back of faceplate.
Fixed Face Plate.
Speaker.
Removable Face Plate.
A10.4
A10.5
5 Detail 3" = 1'-0"
Accesible Camera Enclosure, by House_n.
Camera Mount, by House_n.
Wiring Access.
VisCam side
4 Detail 3" = 1'-0"
Environmental Sensor Enclosure, by House_n.
Enclosure Intake, 1/8" x 2" x 10".
Enclosure Exhaust Fan, 5VDC, 40x6mm, 4.5CFM.
3 Detail 3" = 1'-0"
Accesible Camera Enclosure, by House_n.
Camera Mount, by House_n.
Wiring Access.
IRCam side
2 Detail 3" = 1'-0"
Removable Face Plate Support.
Removable Face Plate.
Speaker Grill w/Black Cloth.
Speaker.
A10.6
Cabinet Door.
1 Detail 3" = 1'-0"
House_n \ Changing Places
Dogwood Design
MIT-TIAX PlaceLab Cabinet Prototype
Spring 2003
Sheet Size
8.5"x11"
Sheet No.
A10



elevation key



i_group0002_012x084



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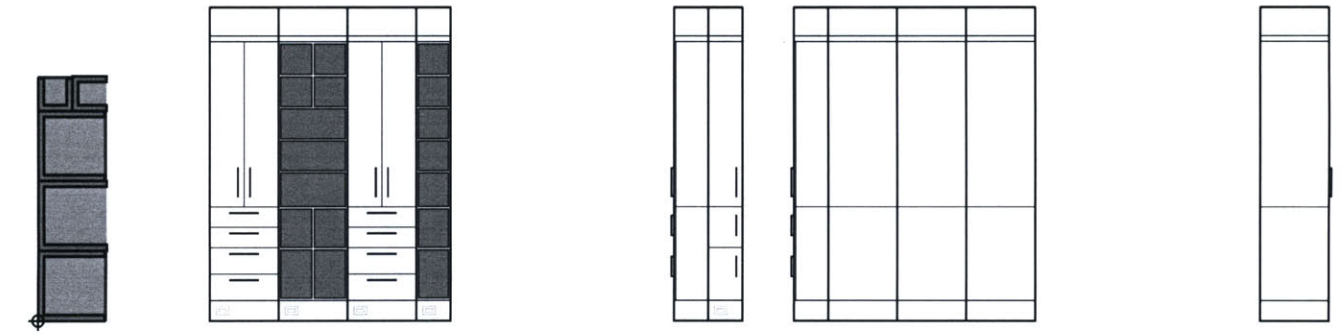

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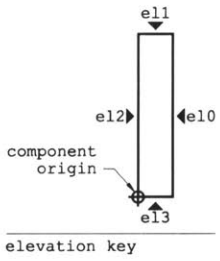
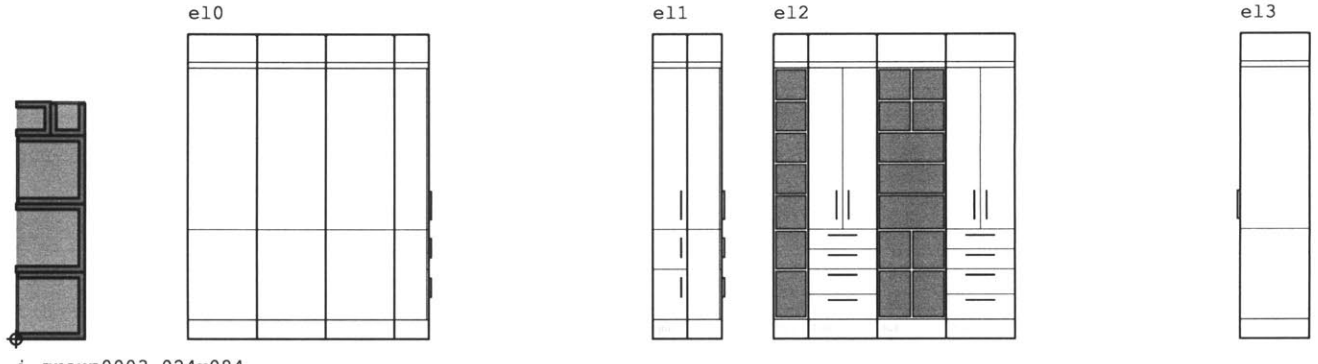


elevation key



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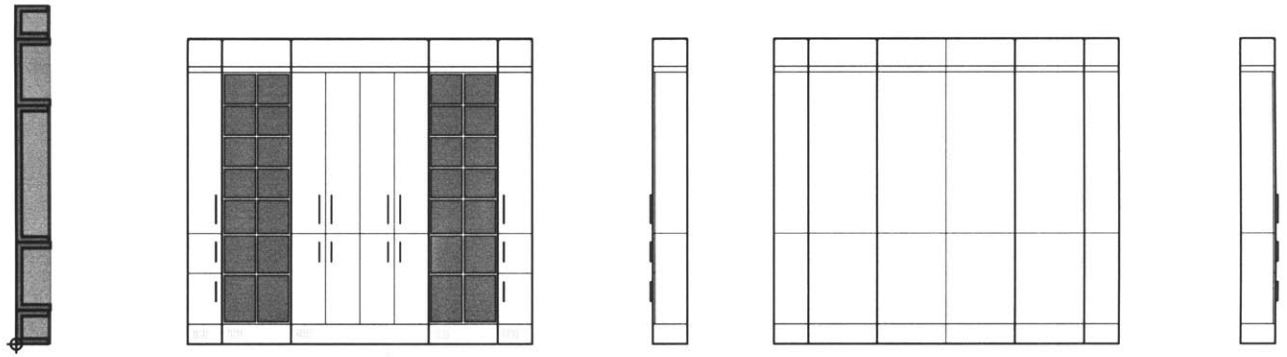

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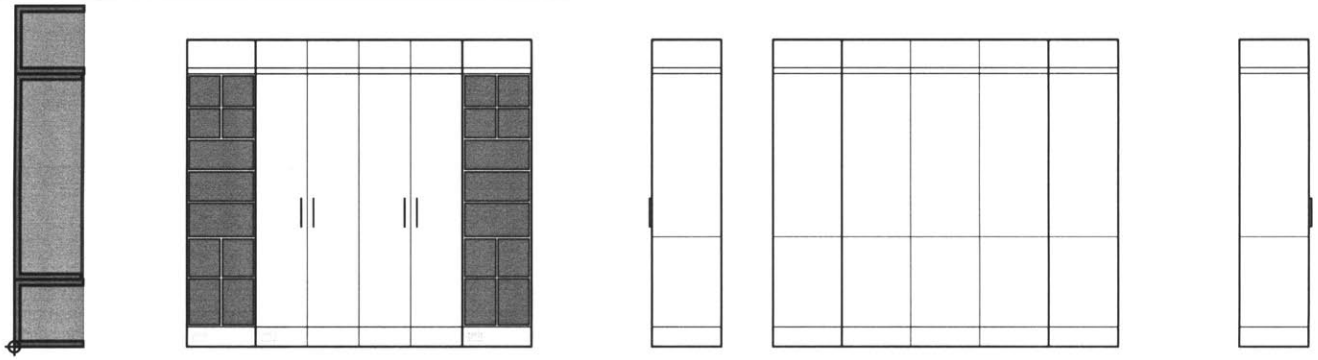
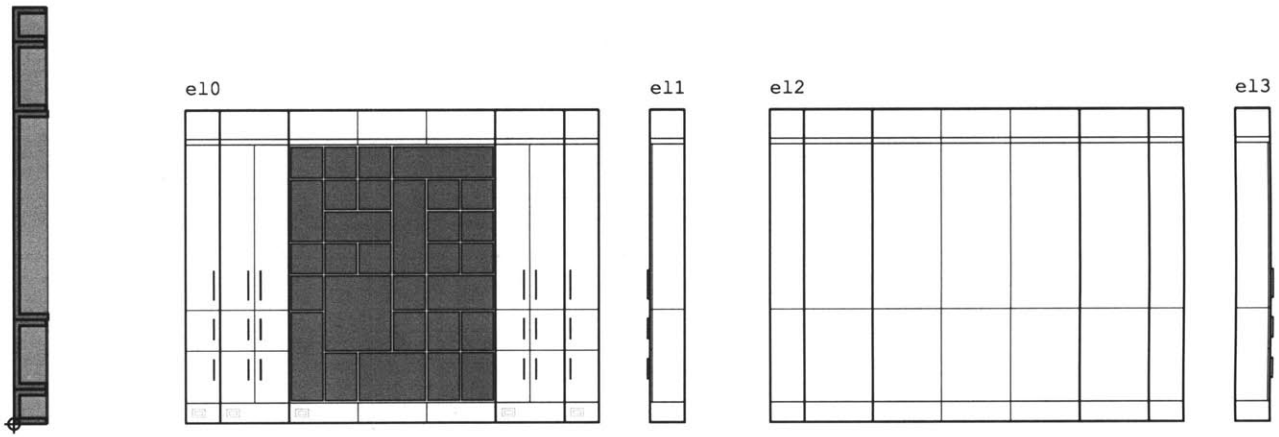


i_group0000_024x120



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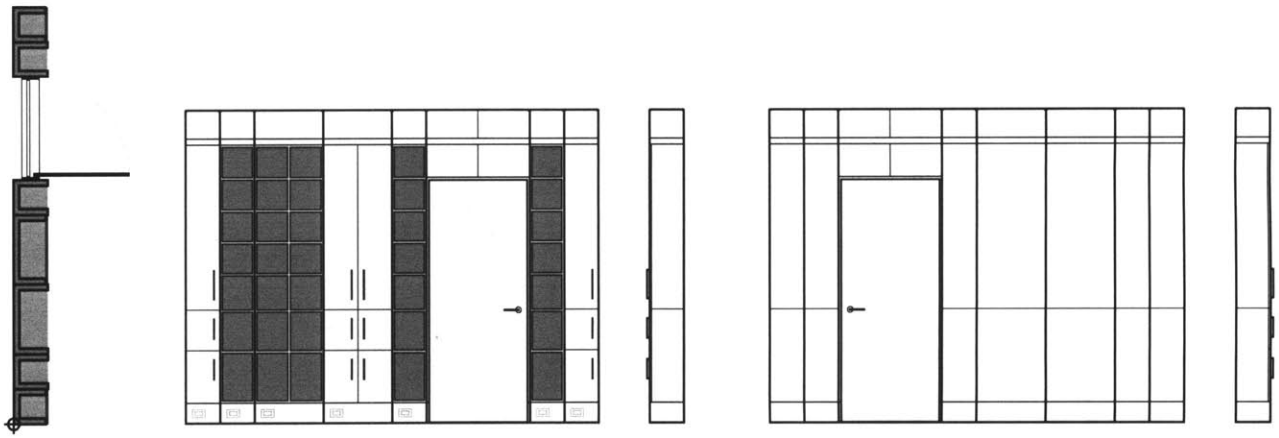

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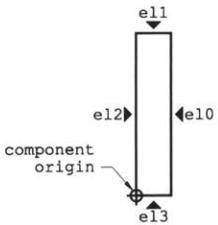
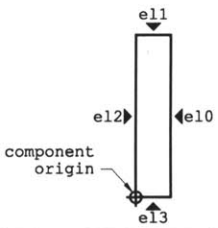
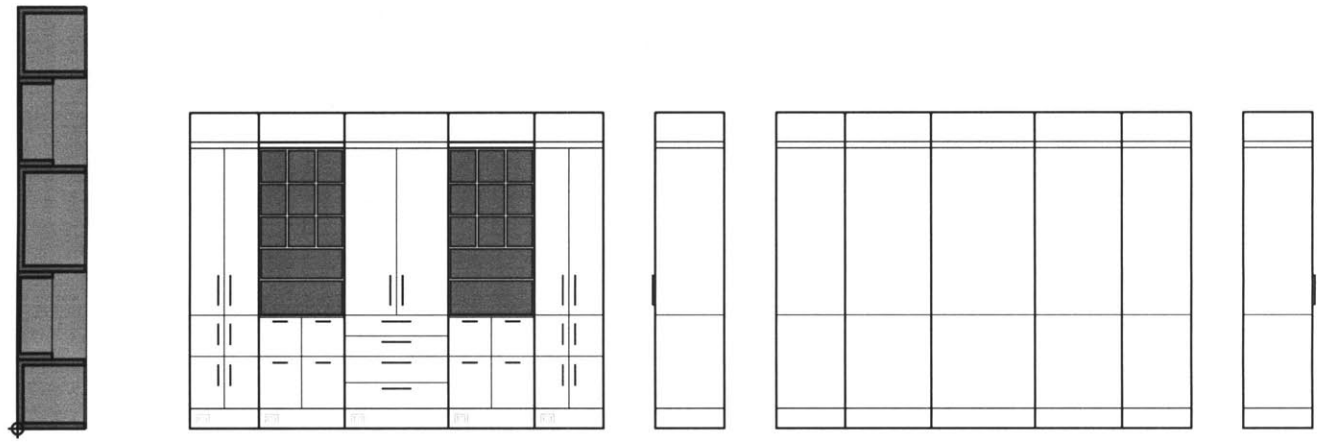


elevation key

i_group0003_012x144



elevation key



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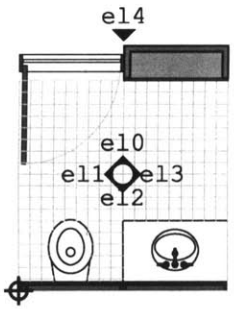

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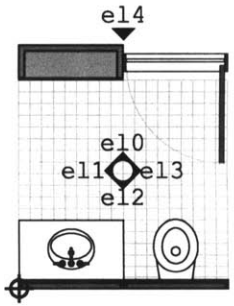

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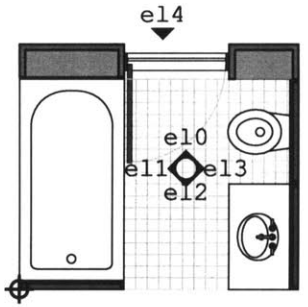
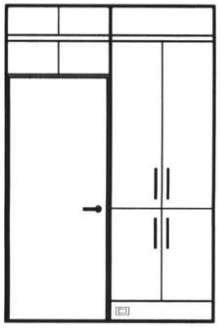
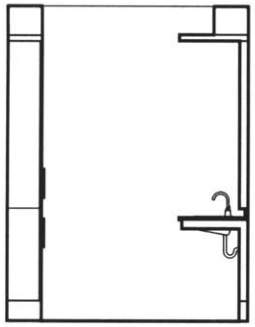


b_group00_096x084

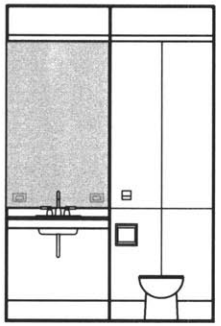
el0



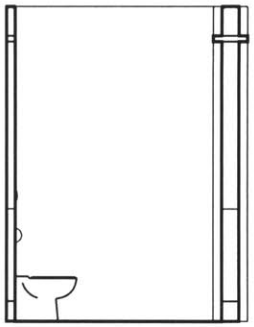
el1



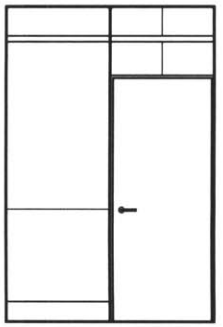
el2

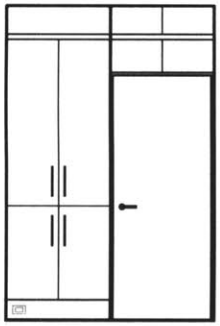


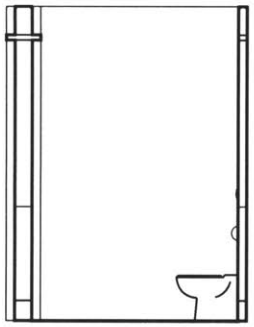
el3

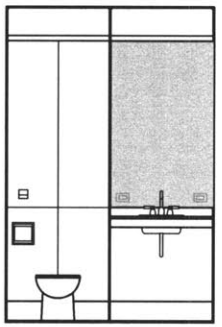


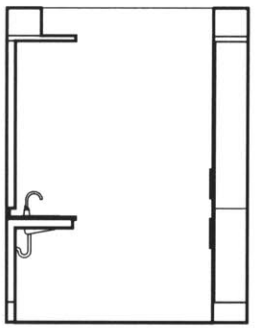
el4

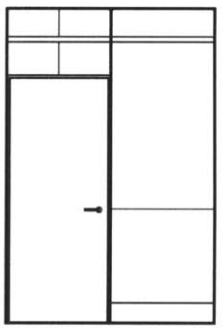


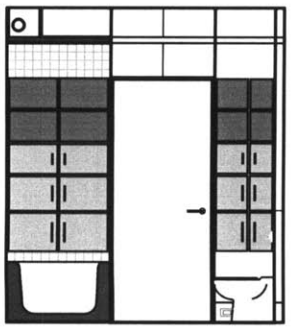


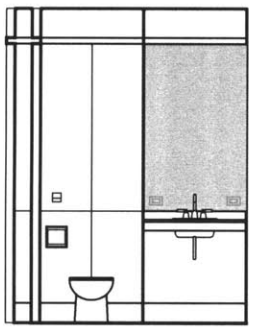


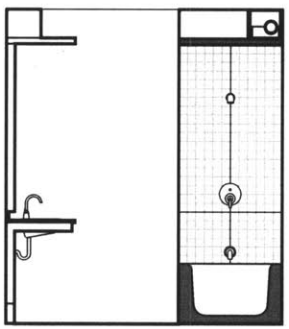


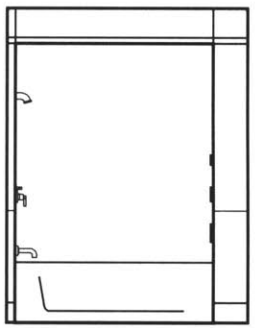


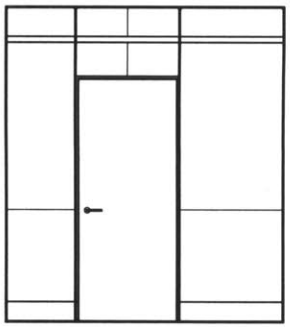


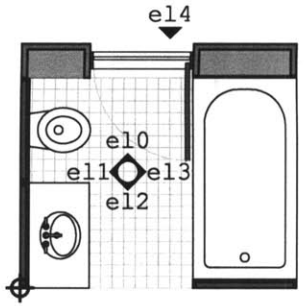












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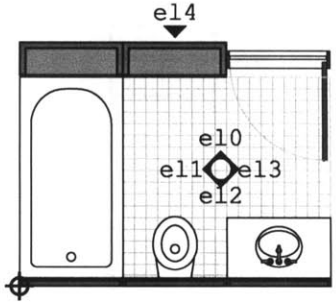

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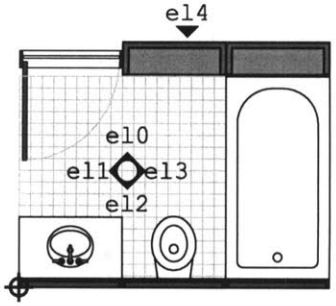
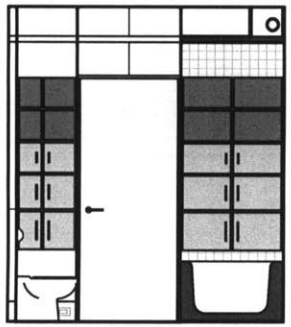


b_group00_096x084

el0



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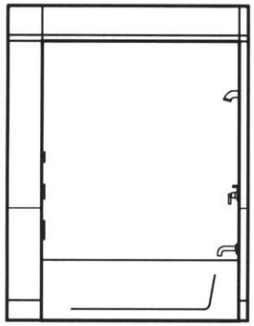

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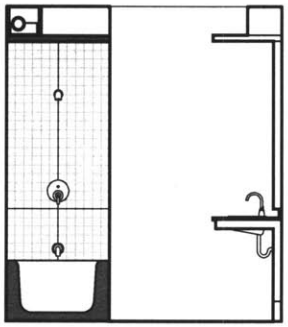
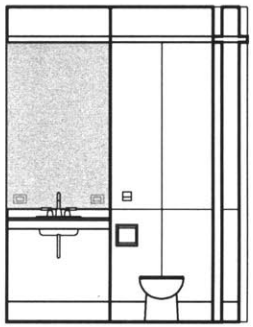
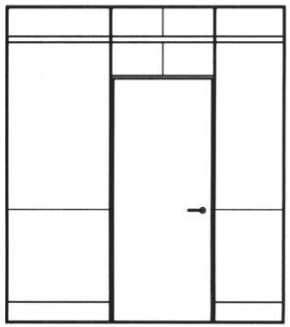
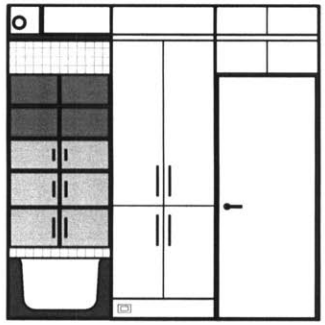


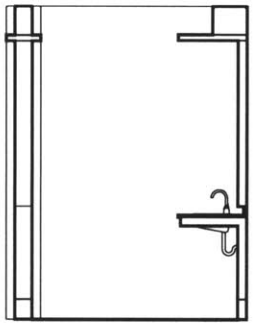
el3

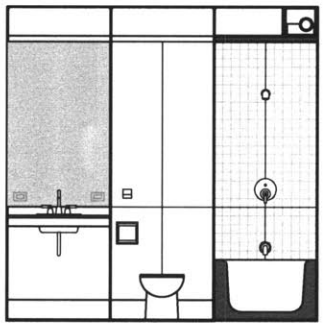


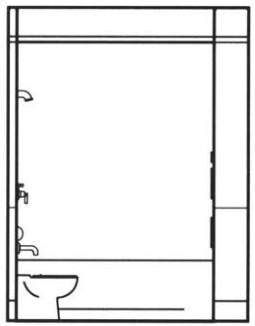
el4

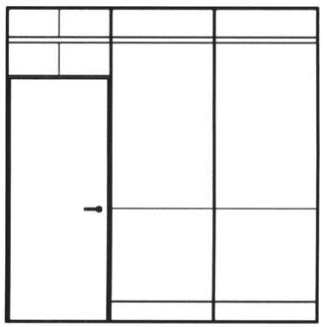


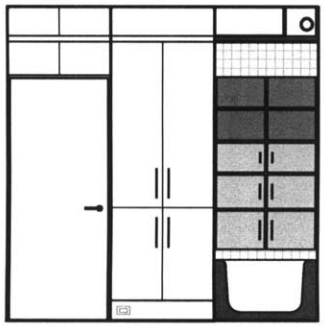


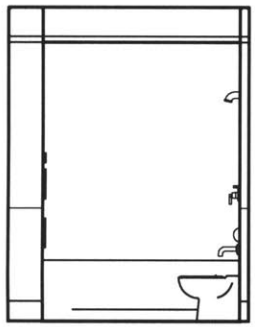


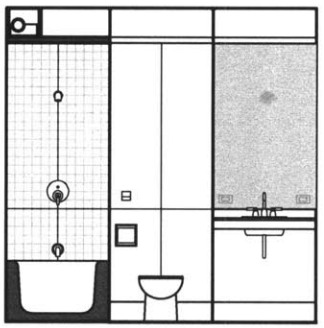


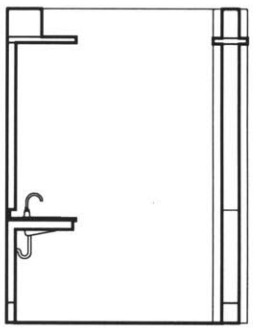


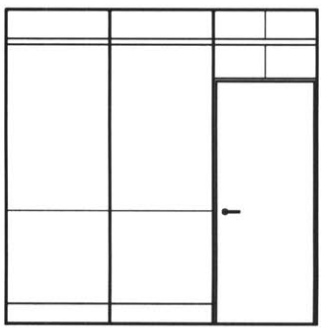


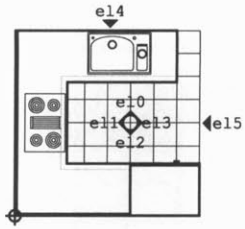




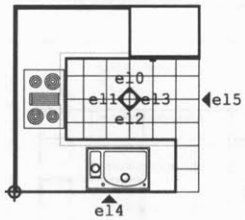




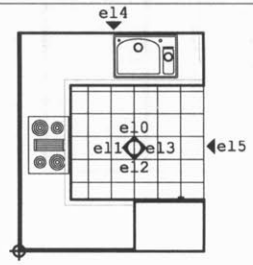




k_U000_096x096

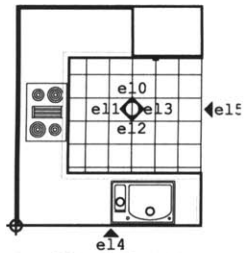


k_U001_096x096

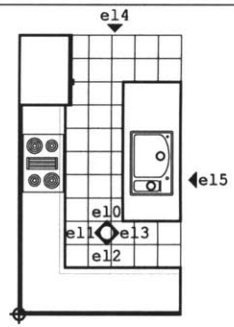


k_U000_096x114

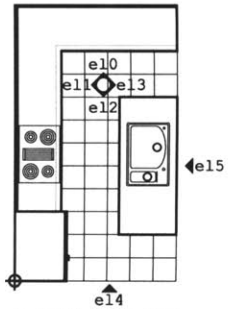
e10
e11
e12
e13
e14
e15



k_U001_096x114



k_L000_084x144



k_L001_084x144

el0
el1
el2
el3
el4
el5

Not Used (21 tags)

icon	tag number	block name	binary tag	tag bottom	tag top
-	00-02	-	-	-	-
-	13-15	-	-	-	-
-	26-31	-	-	-	-
-	42-47	-	-	-	-
-	54-55	-	-	-	-
-	62	-	-	-	-

Viewpoint (1 tag)

icon	tag number	block name	binary tag	tag bottom	tag top
	03	-	000011		

Furniture (9 tags)

icon	tag number	block name	binary tag	tag bottom	tag top
	04	f_chr02_018x018	000100		
	05	f_chr00_030x030	000101		
	06	f_chr03_018x048	000110		
	07	f_chr00_030x060	000111		
	08	f_tb01_024x024	001000		
	09	f_tb00_036x048	001001		
	10	f_tb00_048x072	001010		
	11	f_bed00_078x054	001011		
	12	f_bed00_084x078	001100		

Infill (2 sets of 10 = 20 tags)

icon	tag number (set 1)	tag number (set 2)	block name	binary tag (set 1)	binary tag (set 2)	tag bottom (set 1)	tag top (set 1)	tag bottom (set 2)	tag top (set 2)
	16	32	i_group0002_012x084	010000	100000				
	17	33	i_group0003_012x084	010001	100001				
	18	34	i_group0002_024x084	010010	100010				
	19	35	i_group0003_024x084	010011	100011				
	20	36	i_group0000_012x120	010100	100100				
	21	37	i_group0000_024x120	010101	100101				
	22	38	i_group0000_012x144	010110	100110				
	23	39	i_group0000_024x144	010111	100111				
	24	40	i_group0002_012x144	011000	101000				
	25	41	i_group0003_012x144	011001	101001				

Bathroom (6 tags)

icon	tag number	block name	binary tag	tag bottom	tag top
	48	b_0000_072x084	110000		
	49	b_0001_072x084	110001		
	50	b_0000_096x084	110010		
	51	b_0001_096x084	110011		
	52	b_0000_108x084	110100		
	53	b_0001_108x084	110101		

Kitchen (6 tags)

icon	tag number	block name	binary tag	tag bottom	tag top
	56	k_L000_084x144	111000		
	57	k_L001_084x144	111001		
	58	k_U000_096x096	111010		
	59	k_U001_096x096	111011		
	60	k_U000_096x114	111100		
	61	k_U001_096x114	111101		

Button (1 tag)

icon	tag number	block name	binary tag	tag bottom	tag top
	63	-	111111		

Message Source and Handling

TrackingClient		ControlClient+TrackingInterpreter		Server		DisplayClient	
loginClient	→	*loginClient*	→	handleLoginClient	←	loginClient	
logoffClient	→	*logoffClient*	→	handleLogoffClient	←	logoffClient	
handleAcknowledge	←	*handleAcknowledge*	←	acknowledge	→	handleAcknowledge	
loginParticipant	→	*loginParticipant*	→	handleLoginParticipant			
handleAcknowledge	←	*handleAcknowledge*	←	*acknowledge*			
There are two types of Control Client; one is viewed on screen, the other tracks tags on a translucent table. Both communicate with the display clients, this includes 2D and 3D Viewing Clients, through the server.		handleParticipantAdd	←	participantAdd	→	**handleParticipantAdd**	
		participantUpdate	→	handleParticipantUpdate			
		handleParticipantUpdate	←	participantUpdate	→	**handleParticipantUpdate**	
		designListRequest	→	handleDesignListRequest			*
		handleDesignList	←	designList	→	handleDesignList	*
		designLoad	→	handleDesignLoad			
		handleDesignLoadBegin	←	designLoadBegin	→	**handleDesignLoadBegin**	
		handleDesignStats	←	designStats	→	**handleDesignStats**	
		handleComponentAdd	←	*componentAdd*	→	**handleComponentAdd**	
		handleDesignLoadEnd	←	designLoadEnd	→	**handleDesignLoadEnd**	
		componentAdd	→	handleComponentAdd			
		handleComponentAdd	←	componentAdd	→	**handleComponentAdd**	
		componentActivate	→	handleComponentActivate			
		handleComponentActivate	←	componentActivate	→	**handleComponentActivate**	
		componentUpdate	→	handleComponentUpdate			
		handleComponentUpdate	←	componentUpdate	→	**handleComponentUpdate**	
		componentDelete	→	handleComponentDelete			
		handleComponentDelete	←	componentDelete	→	**handleComponentDelete**	
		componentOptionsRequest	→	handleComponentOptionsRequest			*
		handleComponentOptions	←	componentOptions	→	handleComponentOptions	*
		setComponentOption	→	handleComponentSetOption			
		handleComponentSetOption	←	componentSetOption	→	handleComponentSetOption	
		componentTypeOptionsRequest	→	handleComponentTypeOptionsRequest			*
		handleComponentTypeOptions	←	componentTypeOptions	→	handleComponentTypeOptions	*
		componentSetTypeOption	→	handleComponentSetTypeOptior			
		handleComponentSetTypeOptior	←	componentSetTypeOption	→	handleComponentSetTypeOptior	
		environmentTypeListRequest	→	handleEnvironmentTypeListRequest			*
		handleEnvironmentTypeList	←	environmentTypeList	→	handleEnvironmentTypeList	*
		environmentUpdate	→	handleEnvironmentUpdate			*
				environmentUpdate	→	**handleEnvironmentUpdate**	*
		designSave	→	handleDesignSave			
		designUnload	→	handleDesignUnload			
		designEnd	→	handleDesignEnd			
		logoffParticipant	→	handleLogoffParticipant			
		handleParticipantRemove	←	participantRemove	→	**handleParticipantRemove**	*
		critiqueListRequest	→	handleCritiqueListRequest			*
				critiqueList	→	handleCritiqueListRequest	*
		critiqueRun	→	handleCritiqueRun			*