The Story of the HOUSE | lite system
"Less calories, more taste, your site, your vision..."

By

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SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN ARCHITECTURE STUDIES
AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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May 5, 2004

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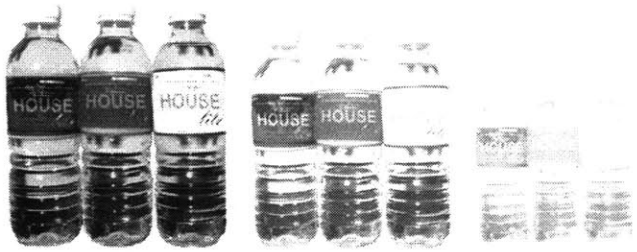
lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



'mass-customized' water bottles

The Story of the HOUSE | lite system:

"Less calories, more taste, your site, your vision..."

Advisor
Andrew Scott
Associate Professor in Architecture

Reader
Paul Lukez
Assistant Professor in Architecture

Reader
Axel Kilian
PhD Candidate in Architecture

An almost true story
with


Betty

Fred

Fred and Betty Litefoot

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THE STORY OF THE HOUSE | LITE SYSTEM:
"Less calories, more taste, your site, your vision..."

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CHRISTIANNA RABER

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN ARCHITECTURE STUDIES AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Abstract

Dwelling is one of architecture's oldest questions. We know it well without realizing it. While there are new technical challenges, dwelling continues to remain a constant need over time. Eeva-Liisa Pelkonen, in her book **Achtung Architektur!!**, teaches a key lesson that proceeds from the following:

> *Transformation of the image into a functioning and tactile thing emphasizes the Architectural... since works of architecture are not supposed to move.*

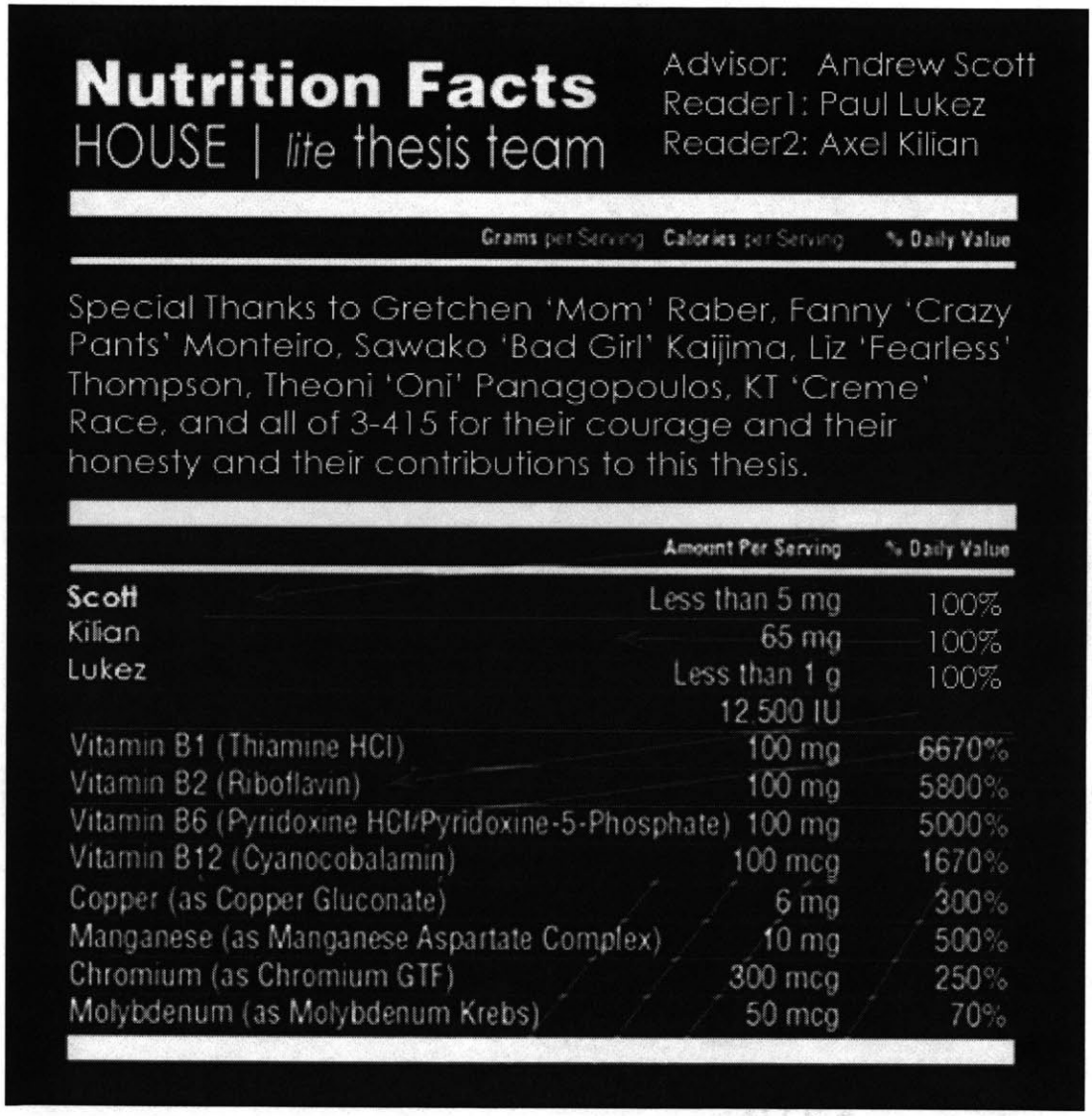
We are a conservative nation, and even more so as we reflect our values onto the facades of our houses. Mobility and *Architecture* with a capital *A* have rarely gone together in history. One desires stability in one's house.

HOUSE | lite proposes to design a product you can order, build, and then rebuild, as you like: a variety of living choices that arise from a small array of generic parts. Panels plug into matrices. Systems weave smartly into a compact and evolving footprint. There are never two HOUSE | lite dwellings exactly alike. And if they are ever the same, they too will change.

Thesis Advisor: Andrew Scott:
Title: Associate Professor of Architecture MIT

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

Do you have all the facts?



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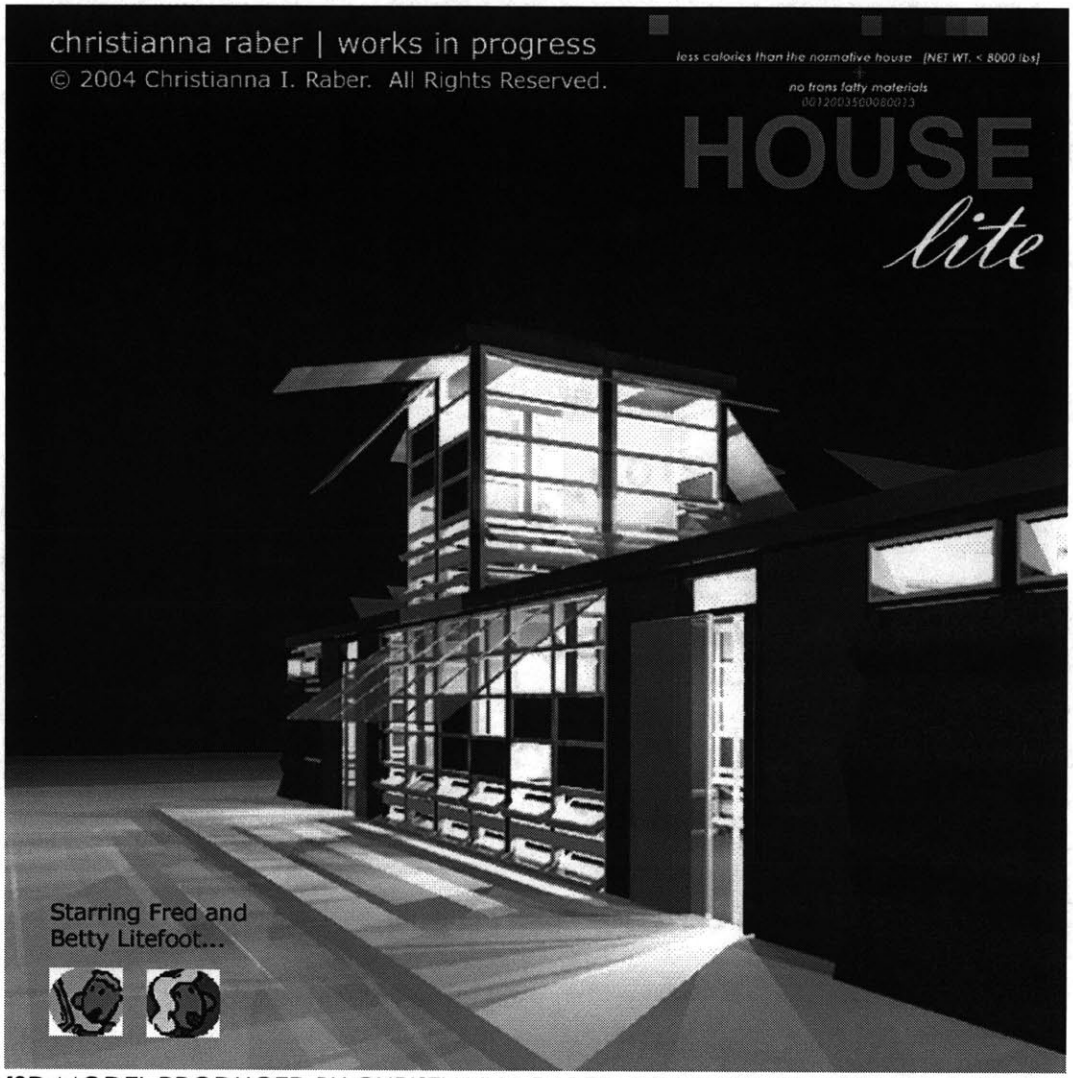

[3D MODEL PRODUCED BY CHRISTIANNA RABER: RENDERED BY MATTHEW OSTROW]

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

less calories than the normative house [NET WT. < 8000 lbs]

no trans fatty materials

0012003500080013

HOUSE *lite*

Patient : The United States Housing Industry
Rx number : 20040203004
Rx *lite* : Build *lite* houses at a rate < 4% per year for 100 years
Drug brief : Less calories, more taste, you provide family

We will give you a good house system...

Live well. Live *lite*. Remake your house for as long as you live. This thesis describes designing a house to be built by IKEA for the United States. I started with these values. Remember these, because they will help you:

l i t e contents:

1. smart + cheap (high quality) as possible
2. small and 'stackable' as possible
3. 'eco-effective' and lightweight as possible

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

this thesis should be printed on 20 pound watermarked pH-neutral paper
the size of this thesis is officially 8.5 X 11 inches

- - - - - - - - - - - - -

I. Background Research
- Case Study Zero: The McMansion
- Case Study One: Suburbs of Washington, DC
- Case Study Two: History Manufactured Housing
- Case Study Three: Trailer Homes of Today
- Case Study Four: IKEA and Home Depot
- Case Study Five: Mass-customization: rapid prototyping takes us to a new market

II. Material Research
- Studies in boat-building and the automotive industry

III. Design Research with Fred and Betty Litefoot
- HOUSE | lite Instruction Manual and the AEKI™ Showroom Experience,
- - - HOUSE | lite Furniture, HOUSE | lite system basswood final model

Featuring Our Clients | Fred and Betty Litefoot:


Betty


Fred

With Corporate Sponsorship By:

HOUSE *lite* + aeki™

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

lite contents:

1. smart + cheap (high quality) as possible
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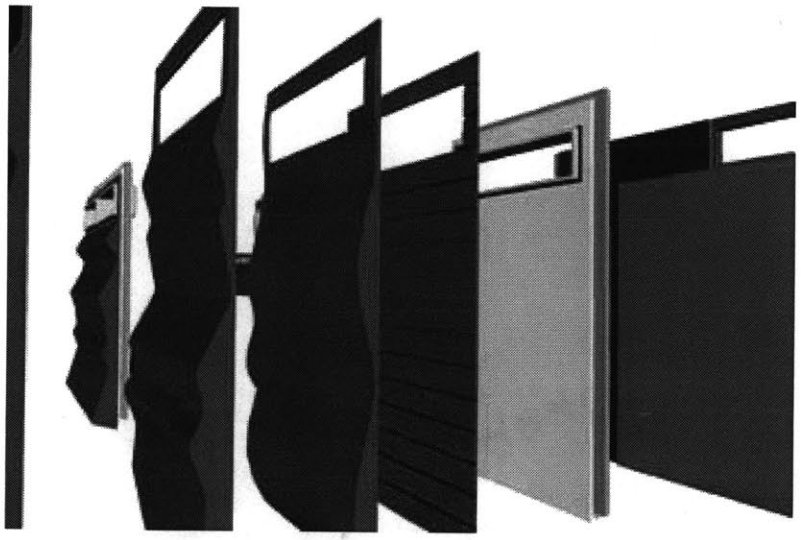

Is this system flexible, modular, or both?
Do panels stack nicely into a standard means of transportation?

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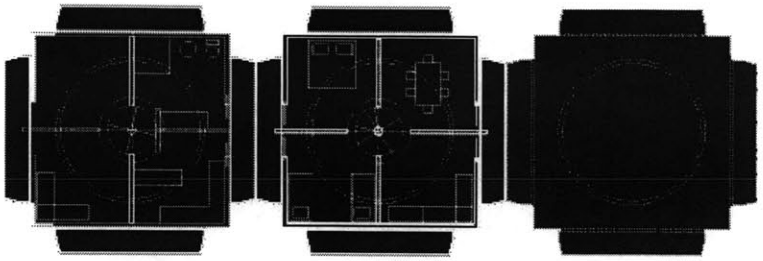
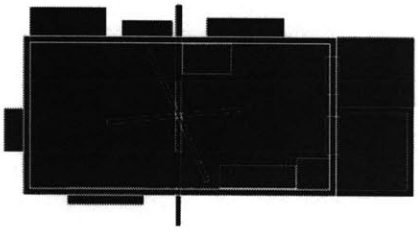
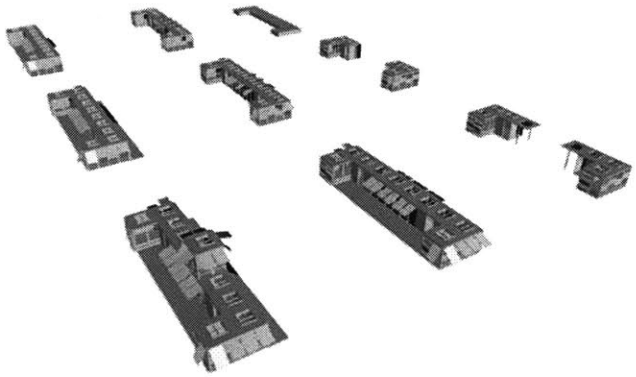


Which is more flexible, the first or the second?

Which weighs more, the first or the second?



initial drawing studies of modules vs. kit of parts



Does the system allow for growth over time? It should.

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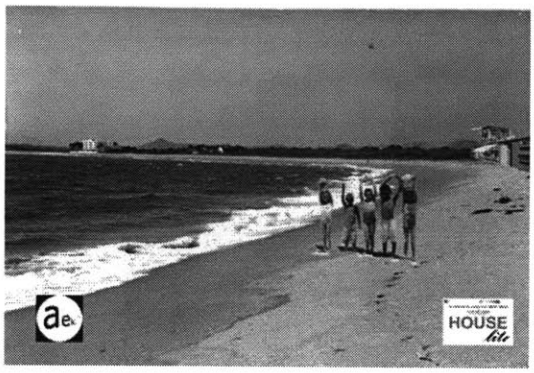
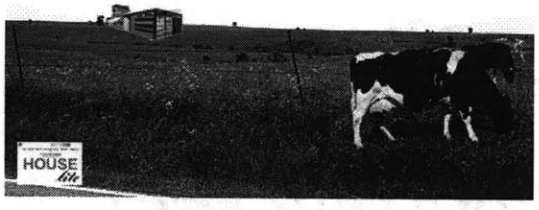
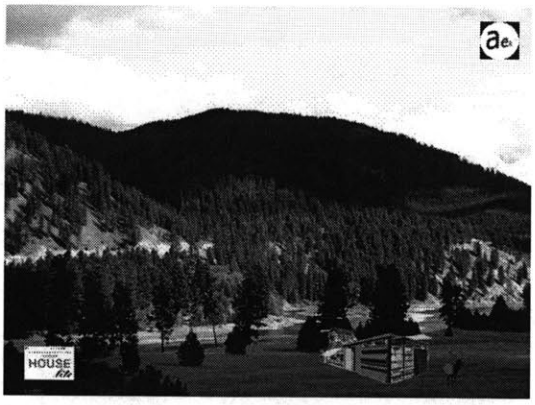


HOUSE | lite by the sea



HOUSE | lite in the country



HOUSE | lite in the mountains

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CASE STUDY ZERO |
The McMansion

Current modes of dwelling, to cite the paradigm of the McMansion, are heavy on contemporary urban and suburban landscapes. Current rates of construction of developer-built housing have reached alarming levels and deserve attention. Construction rates in this country even out at about 6%, and residential construction 4.8%, a rate which exceeds our country's population growth, by at least a factor of 2. (globalinsight.com) I mean, seems a bit excessive, right?

This proposal constructs a new alternative to the 'McMansion' blight infecting the American landscape. This backdrop for my thesis is personal in nature, but certainly not unique to most Americans.

sample McMansion [not to scale]
big house , small photo

sample McMansion sandwich [not to scale]
available anywhere, deforested USA

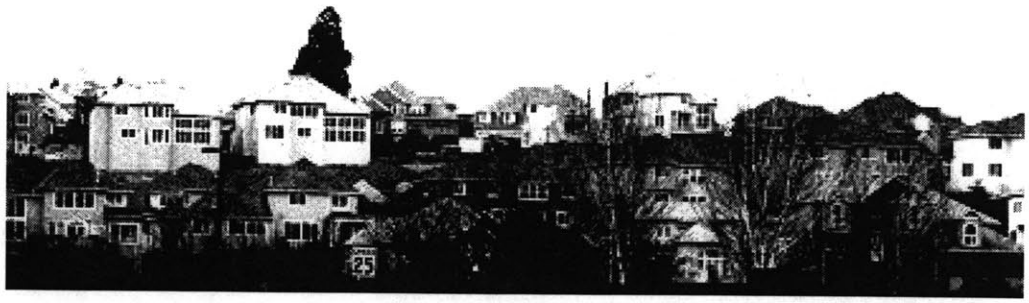
lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

m c M a n s i o n
noun. "mik-man-shun" A large, opulent house, especially a new house that has a size and style that doesn't fit in with the surrounding houses. (ex: those nauseating large suburban homes called McMansions built from cookie-cutter developers that seem to pop up everywhere like McDonald's restaurants)

"In a world of bloated S.U.V.'s and rambling McMansions, there are times when smaller is better." —Steven E. Brier, "Nikon's New Digital Camera Fits Easily in a Pocket," The New York Times, August 16, 2001

"... What character their history and ecology might offer is being strip-mined to make way for anonymous residential projects, monolithic office towers, climate-controlled retail complexes of questionable design and awkward transportation systems — all in the abused name of progress. We are talking here of the march of mini-malls and 'McMansions.'" —Sam Hall Kaplan, "Search for Environmental View of Design," The Los Angeles Times, 1990 (wordspy.com)

This proposal tries, with vision, to design what today's manufactured housing solution should look like and why today's society might actually buy into it. HOUSE | lite proposes to give the consumer the maximum amount of choice possible. HOUSE | lite proposes to design a product you can order, build, and then rebuild, as you like: a variety of living choices that arise from a small array of generic parts. Panels plug into an evolving footprint.



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As a native resident of Alexandria, Virginia, I have watched the quality of our collective suburban environments deteriorate from lush to over-built in a matter of less than a decade. Brand new suburbs now sprawl out irresponsibly into rural outskirts where before there were only rolling hills.

In my own community, developer homes build aggressively to all available property lines, blind to the value of existing trees, local ecologies, and a host of irreplaceable community assets. Each year without fail, I return during academic breaks to be sickened by tragically out of control growth and irresponsible destruction of community.

Developers, with deeper voices and even deeper pockets, have inserted so many tired volumes into suburban communities all over Northern Virginia, if not the United States. As designers and architects, there exists a viable range of skills to prevent such detritus and disease within our collective social fabric. Some situations are beyond repair and with luck some will solve themselves.

With some imagination it is possible to think of placing, structuring, and packaging new and feasible alternatives to the McMansion monstrosity. Dwelling is arguably one of architecture's oldest questions. We know it well almost without realizing it. While there are some new technical challenges, dwelling continues to remain a constant over time.

As John Habraken articulates, in his book the "The Structure of the Ordinary," answering the question of dwelling in the modern age is a multi-layered one that begins with the body. The concept of dwelling breaks up into an ascending hierarchy of dependency: the body, the chair, the room, the building, and the road network. This level of clarity is a powerful way of rethinking the very structure of our dwellings and our communities.

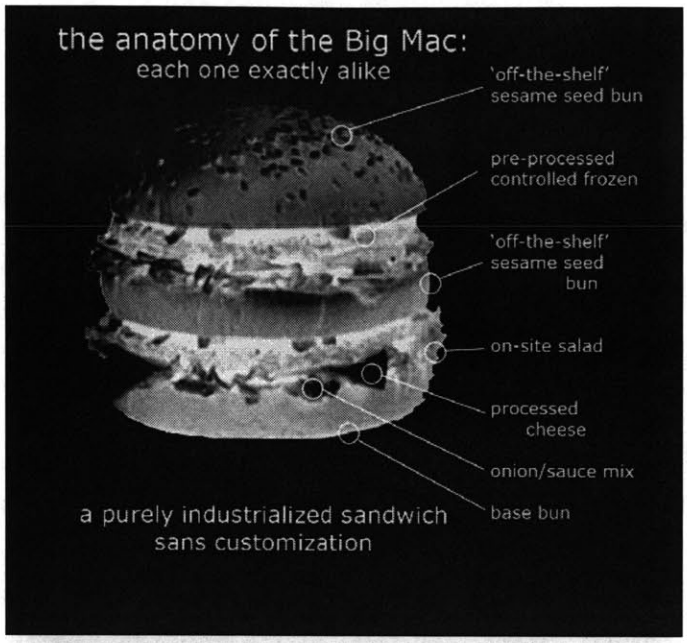
Habraken answers the questions of dwelling in the 21st century in his 'five levels' in *The Structure of the Ordinary*. This strategy addresses the specific weaknesses of the suburban McMansion typology: (1) geometric/spatial inefficiency (2) high energy use (3) weak organizational structure (4)

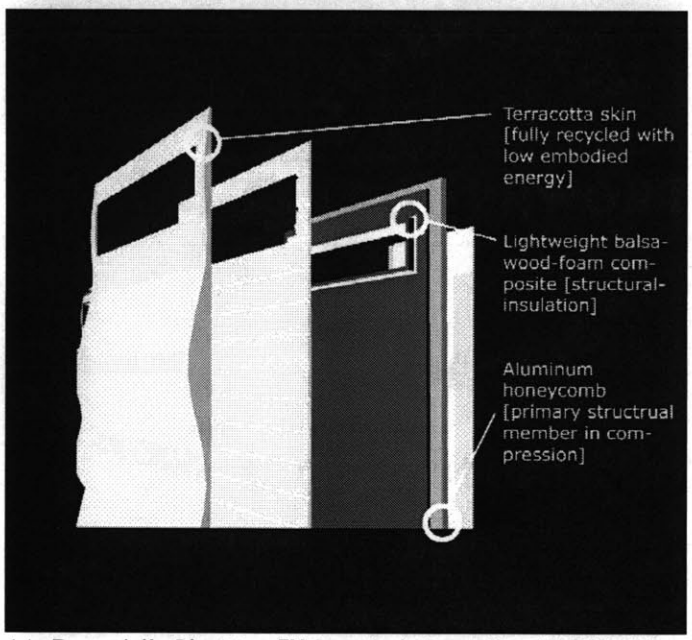
blindness to infrastructure (5) no site/community interaction (6) lack of collective identity.

Can't we rethink all traditional assumptions of what it means to be a house? Can we not legitimately question notions of what a 'single-family' is today? Can we not modify and offer a viable dwelling alternative for the new average American citizen? A few new questions: Could one imagine constructing a prototype in partnership with IKEA, an 'off-the-shelf' and customizable house that one buys in the same aisle where you buy your light bulbs?

Are old typologies of houses in the United States outdated in light of the way family and working situations have evolved and continue to evolve? Could we consider new ways to service houses? Could houses be completely recyclable as a consumer product in the same way that sailboats and automobiles want to be? Are there new materials that could revolutionize the way we live and dwell?

In case you are wondering, I believe the answer to all of these will be and continues to be yes. We just need to think them through.





McDonald's Big Mac™ Sandwich vs. the HOUSE | lite sandwich panel: Let's get more LITE!

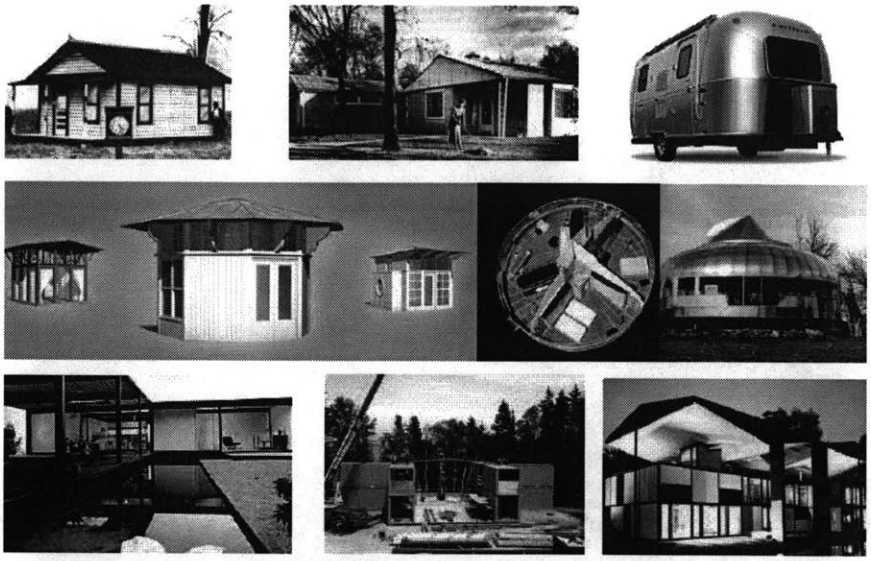
lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

CASE STUDY TWO |
A brief history of manufactured houses

Fred and Betty know that dwelling is arguably one of architecture's oldest questions, from Laugier's primitive hut to Palladio's villa designs. Dwelling, we know it well almost without realizing it. While there are some new technical challenges, dwelling continues to remain a constant over time. Eeva-Liisa Pelkonen teaches us an important lesson in her book *Achtung Architektur!!,* one that proceeds from the following:

> *Transformation of the image into a functioning and tactile thing emphasizes the architectural. The transformed element, which now serves a practical purpose, maintains an unreal and imaginary quality, since works of architecture are not supposed to move.*

We are a conservative nation, and even more so as we map our values onto the facades of our houses. Mobility and Architecture with a capital A have rarely gone together in history. But the mobilization of the industry of housing, this, now this is an entirely interesting story with much more exciting social ramifications.



[a brief and selective history of manufactured housing in the 20th century: images taken from the world wide web]

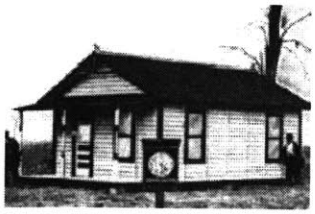
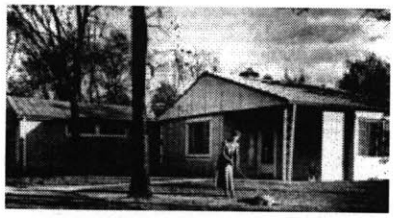
lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

Developers and real estate agents (with limited social visions) dominate the housing industry today. But the United States consumer marketplace has proven again and again throughout its history that it does have an appetite for bold invention and exploration, even when it collides with the very sacred: one's own house. The United States Government and the Manufactured Housing Institute of the United States define a 'manufactured home' as the following:

> n. *a single-family dwelling constructed entirely in a controlled factory environment*

This definition does not suggest the powerful social underpinnings behind such housing proposals. Designing one house is one thing. But do you want to see several thousand just like it? No. The game is just that. It is a fun game often called 'mass-customization' today in the automotive industry.

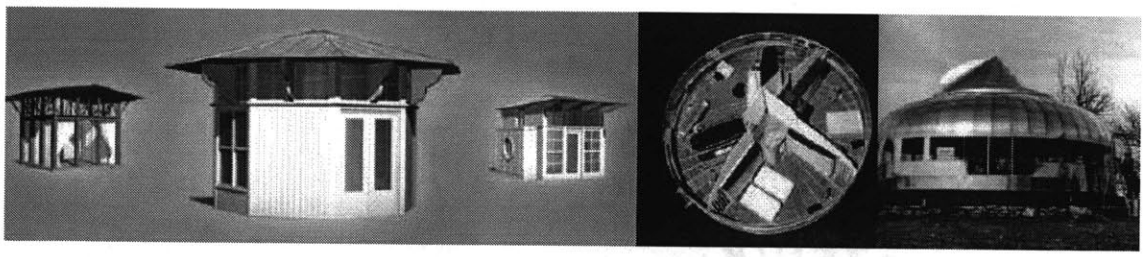
In the United States, however, the housing industry remains shackled to the ever-changing winds of society, culture, and technology. With the dawn of industrialization and mass production ushered in by the Civil War in this country, the beginnings of what would be manufactured houses in the early 1900s began, with a mind to house 'every man.' Manufactured houses offered and still do offer a way to make a profit in the home-building industry.


Can you identify the Sears House or the Wichita House?

Forces that exploded into World War I then diffused and gave rise to the first Sears Kit Houses, a relatively successful foray into the adventure of manufactured housing. Many aims of manufactured housing then in 1908 remain the same. One year after (1907) Pablo Picasso painted his well-known painting *Demoiselles D'Avignon*, the Sears Roebuck Company debuted their first kit house. The goals of this house were affordability, modularity, portability, and an aesthetic aspect, among others.

World War II brought one of the United States' greatest housing shortage crises, opening the door for new housing solutions. The Lustron house, appearing in 1946, and R. Buckminster Fuller's wacky dome and Wichita houses, of about the same time, proved to be more interesting as concepts then viable market solutions. HOUSE | *lite* recognizes 8,000 lbs marks the weight of R. Buckminster Fuller's Wichita House and that it is a mark to strive for.

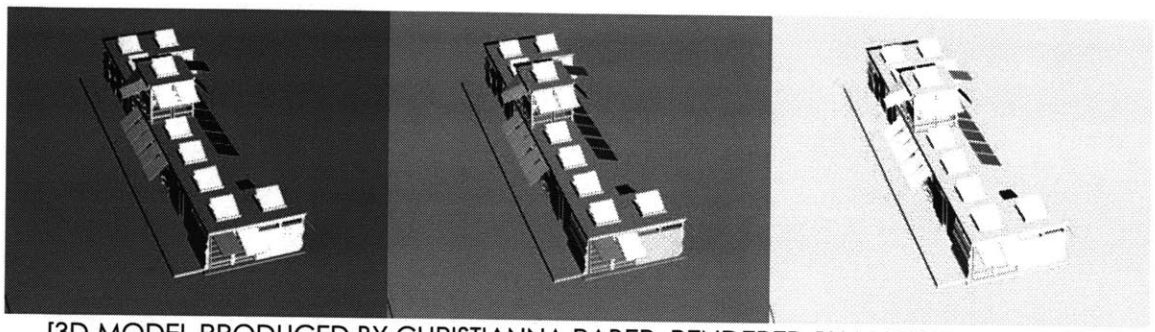


Can you identify the 'better-selling' product?
Can you identify the better house?

Though one of the most ingenious and inventive people in recent architectural history, Fuller's Wichita House proved perhaps 'too custom' to be mass-produced and was plagued by some significant structural problems. Acorn Houses, now Deckhouse, Inc. of Acton, MA, first developed around the 'flat-pack' transport strategy in 1945. Though almost all of these thoughtful inventions proved unsustainable in the marketplace, they show the rich and storied history of the house-building industry.

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

They show an American appetite for invention that lives far outside the traditions imported to, but not incompatible, with the house as symbol. Does this image below look like a house 'should' look? If it does not, is that a problem?



[3D MODEL PRODUCED BY CHRISTIANNA RABER: RENDERED BY MATTHEW OSTROW]

Architects everywhere before and after Le Corbusier have weighed the impact of mass production, the car, and the plane on our profession and on the building industry. Jean Prouvé was designing 'modern, demountable' structures in 1937 for the French military and the Exposition de l'Habitation in Paris 1939 (though the joinery proved expensive and overly-designed for the general public). Architects today still extract lessons from the aeronautical and automotive industries, just as we still dream of new chances to bring prefabrication to the building industry.

We are now 2004 going on 2005. Chaos theory states a butterfly flapping its wings on the streets of Tokyo affects the weather and the NYSE in Manhattan. The new global economy is interdependent. Often in today's world, the microscopic leads to the macroscopic. Now more than ever, Guy DeBord's 'immateriality' reigns over the material solidity of sight, and time, more than place, shapes our day-to-day lives.

Heidegger suggests that the notion of dwelling is more than the simple act of standing still in one's house. Dwelling is a deliberate metaphysical

act of *dasein*, a 'being-in,' that offers a psychic connection with one's house and the objects within it. We must look for new ways of house-building with a degree of intelligence, a sense of adventure, and with Heideggerean-like connections to technology.

New opportunities exist today within the post-industrial population that is not opposed to 'doing-it-themselves' with hardware and paint bought at Home Depot. There exists a house for the Gen X-ers that are happy to buy 'kits of parts' from Ikea catalogs. There exists a custom chair for the newly dubbed 'bohemian bourgeoisie,' or 'bobos,' who joyfully buy designer things within their reach from the pages of their *Design Within Reach* catalogs.

America accepts the idea of pre-fabrication in their homes if, and this is a 'super- monumental' 'if:' only if they are to directly participate in the process. This is an attitude very particular to the American populace. Democracy, especially with regards to the choices in the making of a space as private as a house, is deeply ingrained in the American psyche.

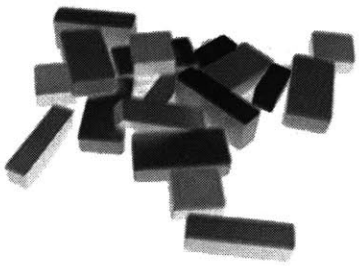
The American public, and rightfully so, remains wary of mass-produced designs. We all want to be part of the building process, and we all want a house that is not like the one next door. We all want a house of our own that is also part something of ourselves. Some products today attempt to do this. Their performance has yet to be judged. Michael Graves sells his 'Pavilions' on Target online with a limited number of 'custom' options: color, material, size. This is but what the car and fashion industries are doing today. The leading edge of 'Architecture' needs more to be where the car industry is going next week.

theordInarymadeextraordInary | habraken's objectIve

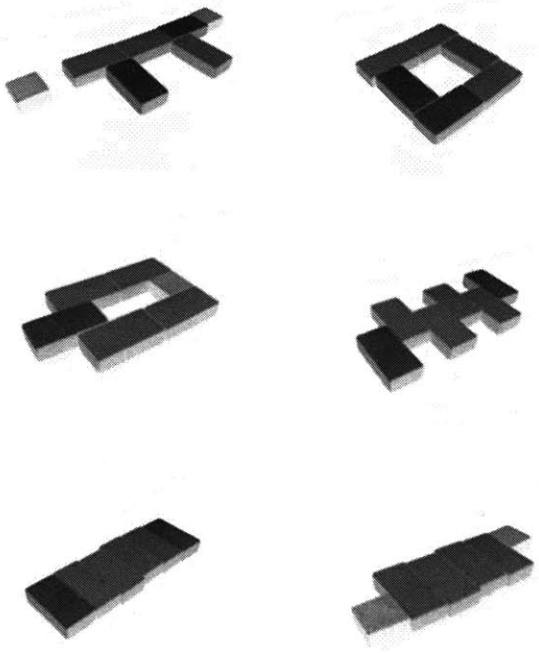
As John Habraken states, to answer the question of dwelling in the modern age is a multi-layered act that begins with the body. The concept of dwelling breaks up in a clear order: the body, the chair, the room, the

building, and the road network. This level of clarity strikes a way of rethinking the very structure of both our houses and our cities.

HOUSE | lite imagines an original pre-manufactured product for a new kind of homeowner: a product that is not fixed and pre-determined, a designer product you can assemble, just as you like.



pile of blocks
based on simple 2 X 4 modules



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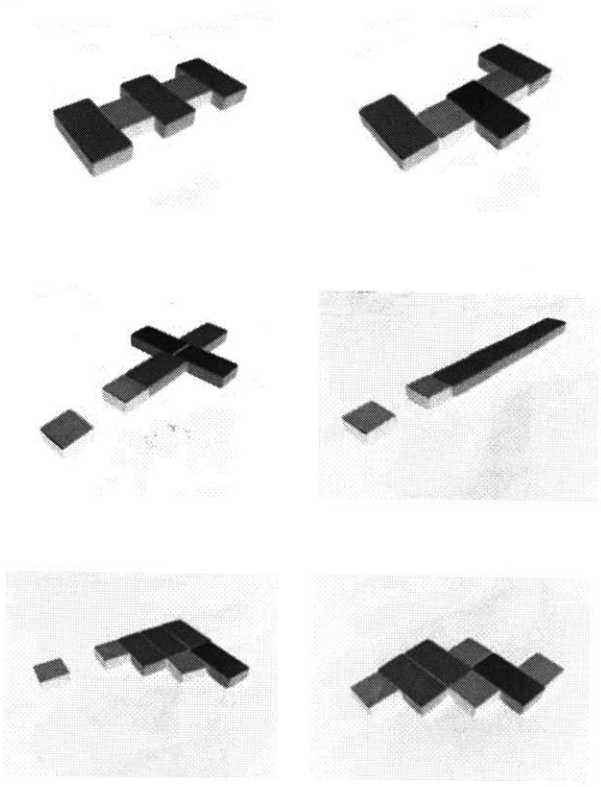


minimum programmatic elements
- - - > maximum variation and versatility

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

HOUSE | lite is a rethought set of life-size Lego's only different. HOUSE | lite imagines itself highly mutable in today's buyer-driven real estate market. The HOUSE | lite proposal applies a glue for a largely broken circle of relationships that often exists between designer, client, and builder, even from architect to architect.

There will be a moral to my story, though, so be careful:

We can do better.
We should do better.
We really should do better.

CASE STUDY THREE |
Manufactured Housing: another name for Trailer Homes

The average HUD Code manufactured home price (home only) is just over $54,000, depending on the retailer and convenience options. If you include the garage and foundation, the costs would be around $70,000. (www.census.gov)

From the U.S. Census Bureau, 2000 Census, the average sales price of a site-built home in the USA is about $195,800 with the land price added in. The median house cost of a 'owner-occupied housing unit' in Cambridge, Mass is $ 331,600, for a median 2.25 household members, it has an average number of 5.95 rooms, an est. avg. 892.5 sq ft, with an average 3.23 (!) vehicles, built on average in 1939, and moved into [on average] in 1991.

My own walkup apartment in Cambridge is a one story walkup, timber frame structure, clad recently in vinyl-siding. It is 3 floors and 5000 square feet, complete with cellar, on a lot approximately 50' x 150' deep. It weighs approximately 100,000 lbs. If I go to onlineconversion.com http://www.onlineconversion.com/ this means 100000 pounds = 44.6428571 ton [long], so my house likely weighs 44.64 tons!

The majority of the US' population lives in its cities. This is no surprise when you consider the relative density of urban Washington, DC with that of rural Manassas, VA. What shocks, however, is despite the relative weights of density, a staggering 8% of the US population lives not in site-built custom homes, but manufactured homes...

> *A recent survey finds that 19 million people -- **8 percent** of the U.S. population -- lives in 9 million manufactured homes, as opposed to "site-built" homes, as the trailer trade refers to traditional houses.*
>
> *For some reason, the South is still the stronghold of manufactured homes. Texas leads the nation in annual sales, with 38,000 in 1997, followed by North Carolina with 34,000. Michigan, ranked No. 9, is the only Northern state in the Trailer Top 10. (source: www.consumeraffairs.com)*

If that does not shock you, just consider that this 8% figure will likely grow as internet shopping and buying hits its peak in the coming years...

> *41% of new home shoppers will use the Internet as a home search resource. (source: www.newhomesource.com)*

From the Skyline Manufactured Homes website one extracts...

> *Nomad Model 2520 – North Trail Lite... Retail Price approximately $30,000*
> *This trailer is (27'11"Lx8'Wx10'T)*
> *Unloaded vehicle weight is 4550 lbs*
> *(source: www.skylinehomes.com)*

Why do we care about the unloaded vehicle weight? This house will certainly house people right? Sure, but the cost of trucking it to the chosen site is the hidden pain in this product's price. This brings us back to Pelkonen's observation... 'Architecture is not supposed to move.' When we consider manufactured housing it is merely the parts/bits, it is the components that move in transit. The house is still in the end. We hope.

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

It is impractical transportation-wise to build in large modules. If we keep the modules small, we can pack more tightly. And this efficiency in energy and transport gains huge. The real cost of construction is in time spent in-between labor and transport. These costs are not only fiscal costs, but, I underline, they cost energy.

Let's look at what a decent minority (8%) of the United States is doing today to shelter themselves...

> *To sleep at a trailer park costs approximately $27-32 per night*
> *This is based upon a four person maximum and air conditioning is extra!*
> *You can buy a trailer lot at a yearly rate of $1450, however dock lots are $1500 and lake lots are $1800, not surprising that most people want a lake lot.*

What are boat-builders doing these days?

> *For $65,950 at Island Packet Yachts, for example...*
> *You can buy a 27' modern sailing yacht that you can take anywhere. No parking fees. Wind-powered when the wind is good. And some even evade tax collection because they have no earthen address.*

Now let's talk about a new system prototype for new kinds of suburbia that use existing retail distribution channels to get HOUSE | lite to market. .

CASE STUDY FOUR |
The Home Depot, IKEA, and the new AEKI™

[note* in order to make a design scenario I have invented AEKI™, an imaginary company]

Back to our friends... Let's face it, Fed and Betty are pretty normal.

They shop Home Depot for paint and tools. They shop AEKI™, of Greece, for cheap but well-made furniture.

Home Depot is a shocking success story because the company is only 15 years old. They began in Atlanta in 1979, and they are already the #2 retailer in the USA grossing over $58 Billion in sales. Only WalMart does a better job of doing what Home Depot does. The secret, just in case no one else has told you yet, is sales Volume with a capital V. This is also the McMansion mantra. More is always more, whether we're talking wasteful practices or fake plastic columns. We are up against a lot at Home Depot.

Like any good architect/designer should, I took some notes from the field. I scheduled an Interview with Gene Kelly, Store Manager, Home Depot Somerville:

> *03/01/04 – Home Depot visit – 3:00p – 5ish-p*
> *03/02/04 – Home Depot revisit – browsing literature and site*
> *03/03/04 – 10 am – (617) 623-0001 Interview with Gene Kelly, Store Manager, Somerville*

So let's ask some good questions:

1. *Customer education and services seem to be the cornerstones of your company. What is the ratio of company revenue for services vs. off-the-shelf goods?*
2. *What are the most recent ecologically minded products that your store is carrying? How well do these products sell?*
3. *My thesis describes an ecologically-minded, self-growing house, and suggests that large retailers would be a fantastic vehicle to allow such a product to penetrate the market. What would you say to such a product?*

But Gene definitely did not want to talk to me . . . And as I suspected, he

directed me straight to their online store, where I could buy stuff, and not learn anything. I was determined to understand why Home Depot is doing so well, and why they earn $58 billion in annual revenue! I looked instead to his company's literature.

Home Improvement 1-2-3, a book which dictates a significant part of construction in the United States, also flies off Home Depot's shelves. I had to order my copy from *amazon.com* because it was out of stock, a practice their literature assures you will never happen. It was published almost 10 years ago. Our planet has learned many things in ten years. I think they should take the effort to publish a new book. The positive thing, though, is that there is a two page 'Environmental Improvement' section at the beginning.

These notes describe small improvements which make your house more environmentally friendly and effective. True, it is only 2 pages out of 480. But just the fact that Home Depot sees this information as marketable and important is a hopeful sign for mainstream building practices in our country. This portion of the American population most needs architecture and the values that design brings to the table.

Home Depot is the US' second largest retailer, behind WalMart at $58 billion in annual revenue . . . They know how to make money and they are good at it. But design is almost non-existent in their stores.

Positive and prudent business practices apply to the entire home improvement industry. They are important, because business teaches us that staying afloat is just as important as swimming fast or beautifully. Home Depot's desire for wealth far outweighs their desire to deliver quality product, making them your typical 'big box' shark.

There are some valuable notes from Inside Home Depot, a book that is part propaganda, but part truth: a good business can work in any market, the customer is always number one, a product is always delivered from shelf to home w/ complete installation, satisfaction guaranteed, intensive trainings 'boot camps' are practiced, ingrained 'bleeding orange' mindset (lawsuits brought by women on several counts), promotion of 'going for the gold' (sponsoring their people), employees 'well-paid' (but typical retail rates to me), great value placed on teaching the customer their

culture, community involvement to promote brand-awareness, and above all, relentless expansion and aggressive growth.

[So I took one last field visit to Home Depot (5/1/04)...
After getting lost repeatedly, I gave up that day on Home Depot]

IKEA®, of Sweden, operates a very different business with different values. Their values are almost as experience-driven as they are profit-driven. Their company values design, because 'design' is what makes them different from the Home Depot's of the world. An article from *Business 2.0* in October of 2002 "*How Ikea Designs Its Sexy Price Tags*," by Lisa Margonelli speaks to a process that IKEA continuously hones into a slick market-savvy science:

0. *pick a price*
1. *choose manufacturer*
2. *design product*
3. *ship it*
4. *sell it*

Sound simple? It does not get any simpler than that. Ikea's products look good, but typically cuts 'cost-corners' in their joinery and their hardware, their connectors. This occasionally makes their products unstable. And many of the materials they use are not based on ecological choices.

But certainly IKEA does more for design than their indirect orange competitors. At present, they are the most logical fit for a HOUSE | lite distributor. And with any luck, a product like a HOUSE | lite product could rub off on both IKEA and Home Depot.

DESIGN EXERCISE ONE |
Fred and Betty Need Their First House

Fred and Betty long for flexibility. And they just don't see it being offered in the marketplace today. Let us say there is system . . . let us design a system . . . it uses technology we know, but adds a couple kicks . . .

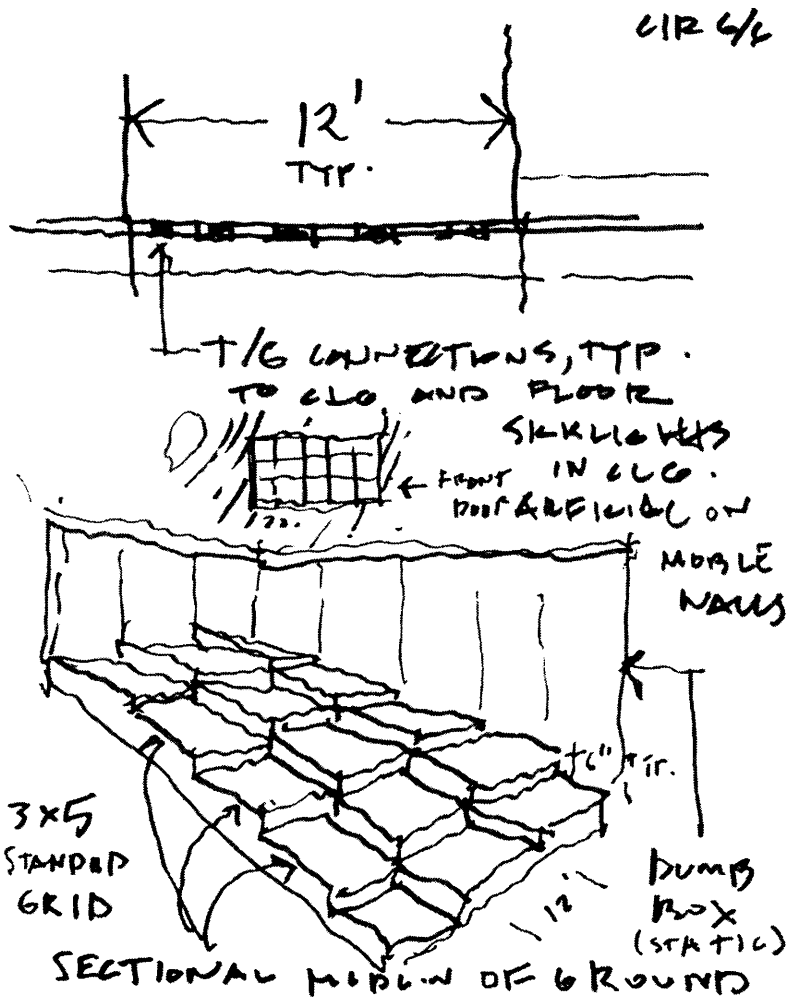
HOUSE | lite system

[4', 8', 16' length panels made with modified sandwich panel system]

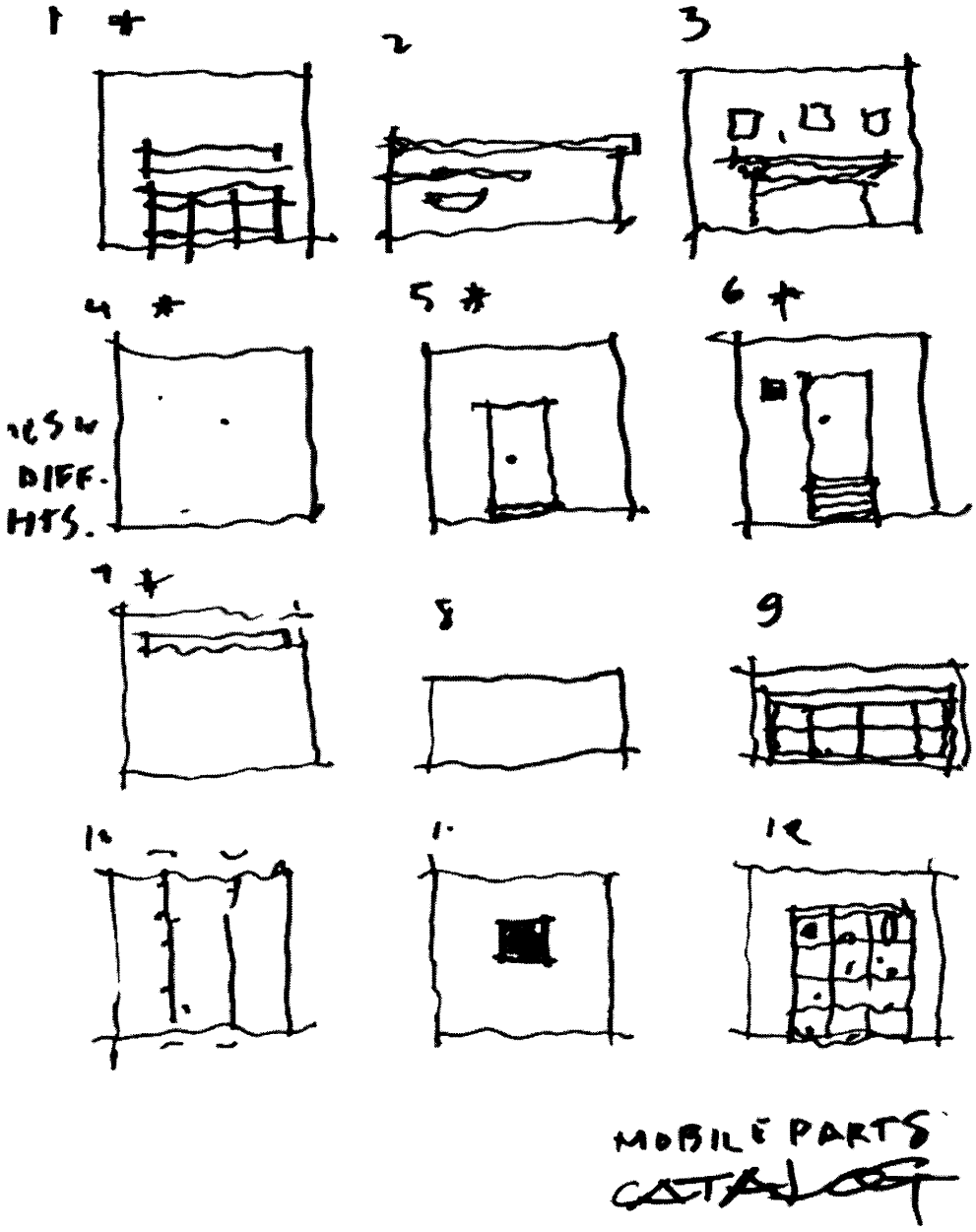
client:

1) *choose site*
2) *choose circulation shape [i.e. linear to max views, or circ. for compact]*
3) *decide number of rooms and L x W x H of each room*
4) *choose color and custom fiber panel shape, window and roof louvers*
5) *locate sliding doors, roof shades and gutters, drains (slope always away from the spine)*

[Initial design sketches for HOUSE | lite system]



lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



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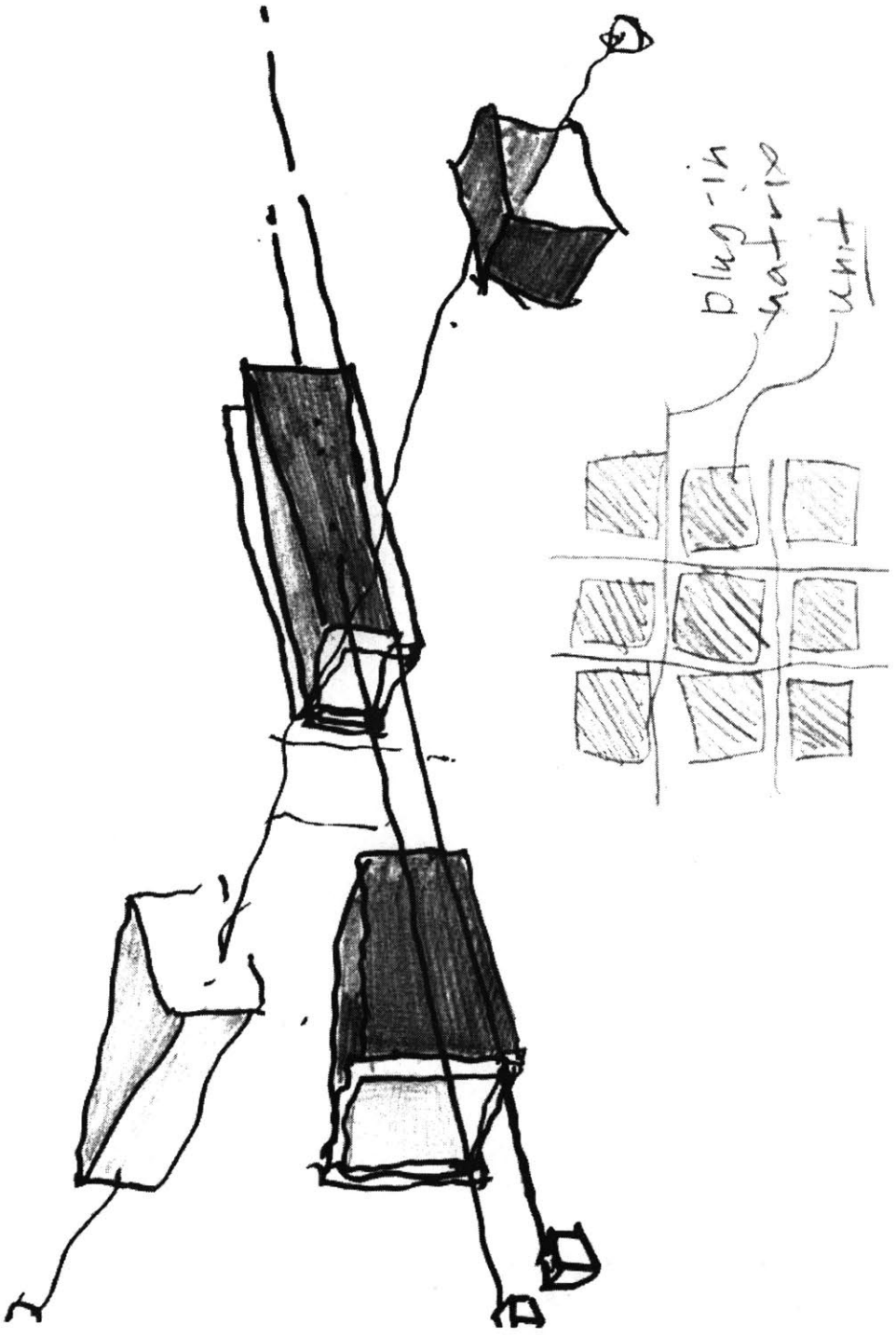

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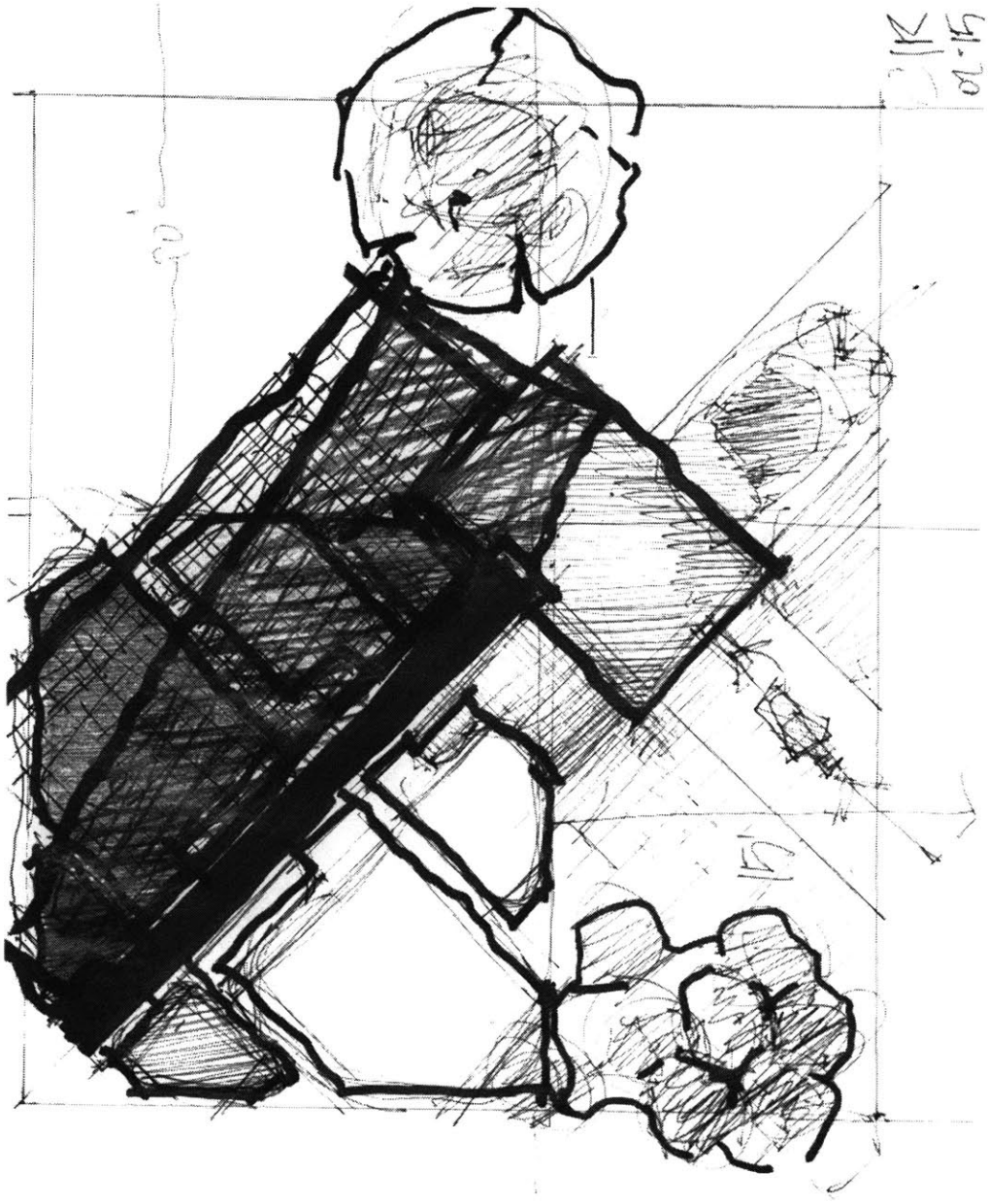

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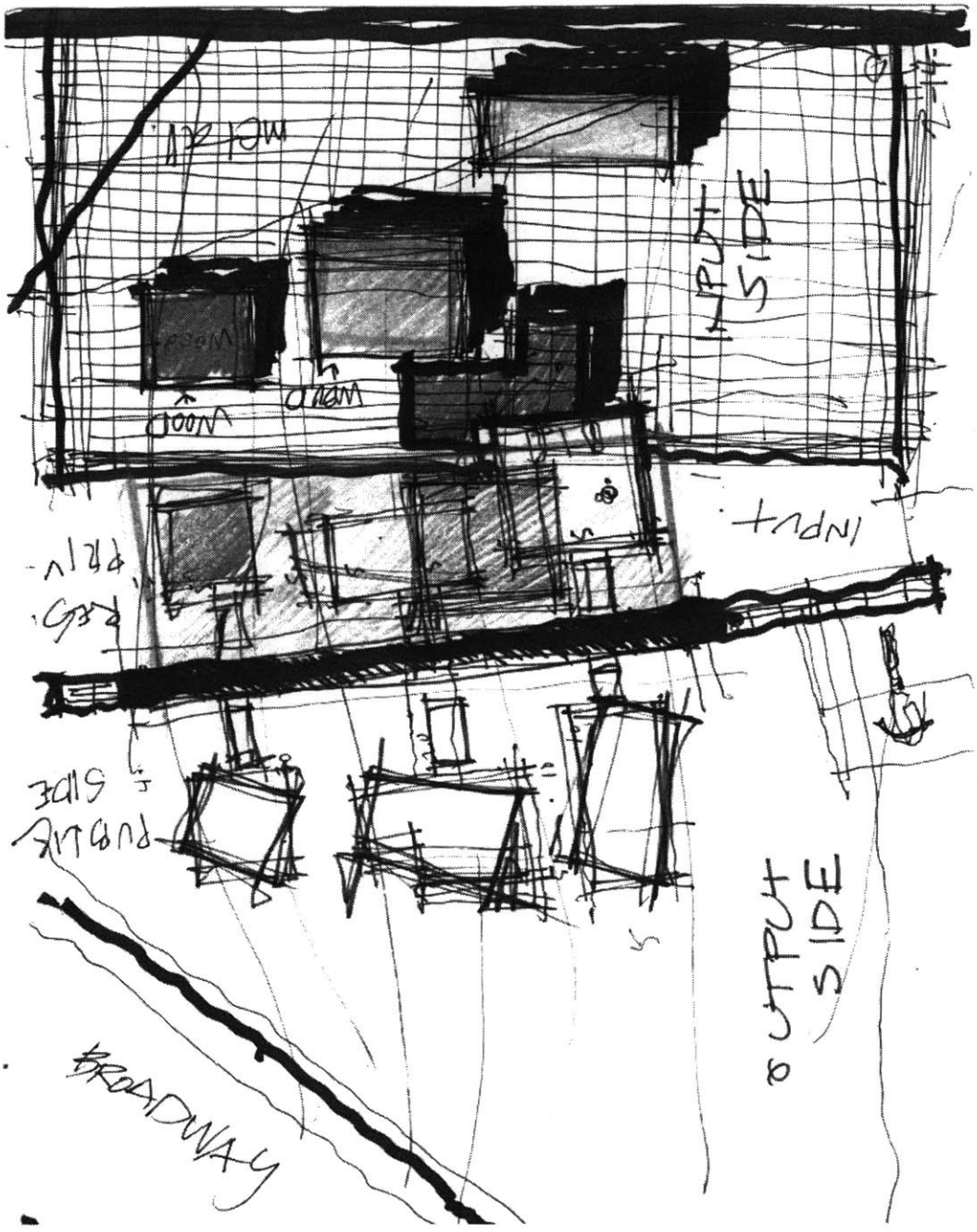

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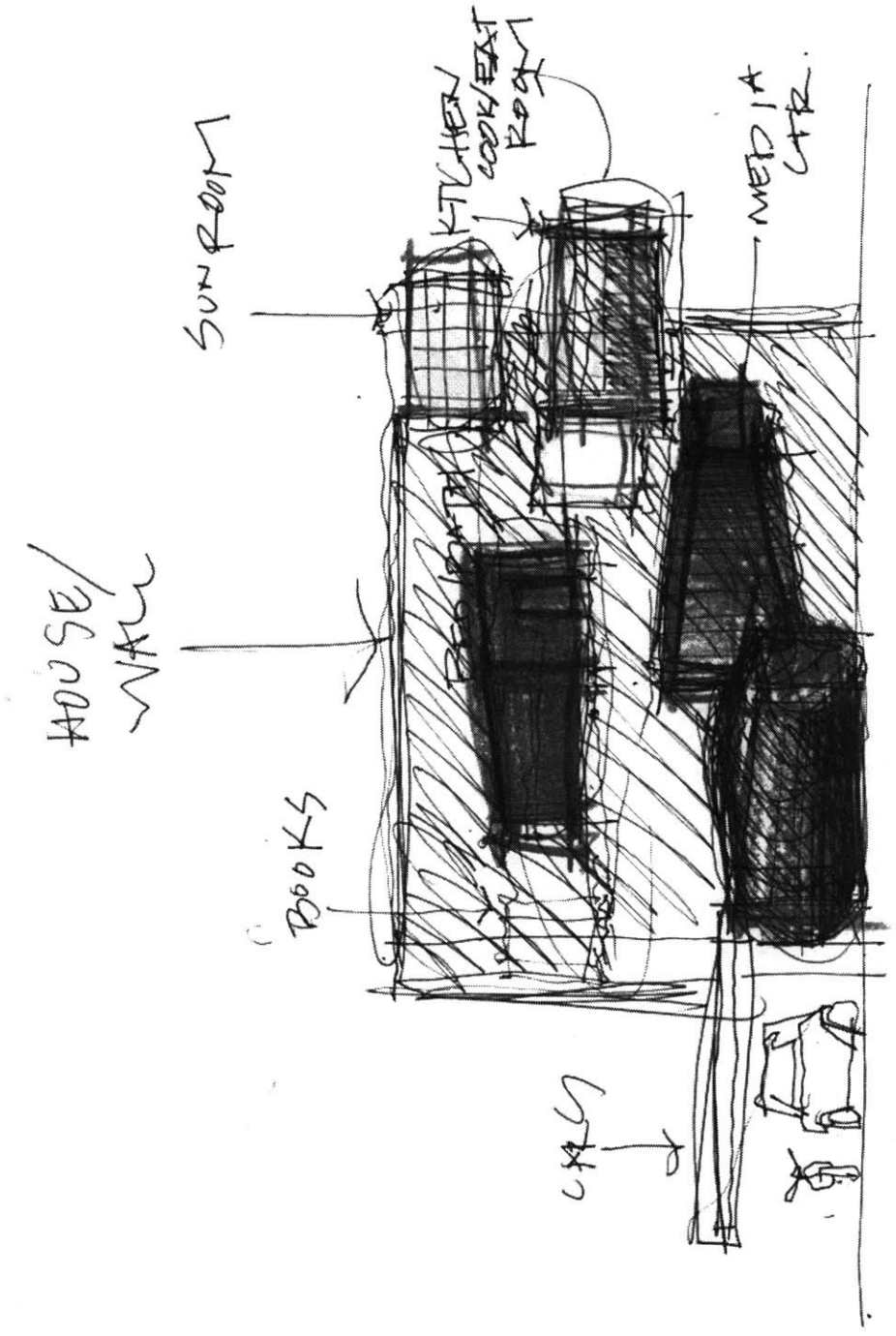

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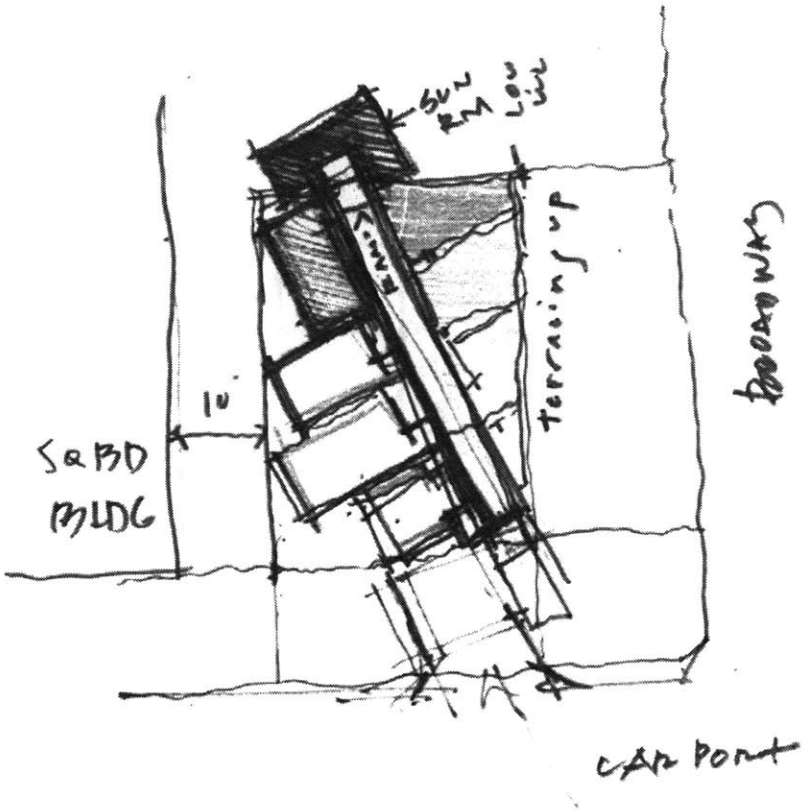
MATERIAL SELECTION |
WHAT THE INDUSTRY IS DOING IN 2004...

Everyone in the architecture and building industry should know the dimension wood construction system by now. If they do not they are lucky or quite blind. This method of building, developed in Chicago in the 1830s, called 'balloon-framing,' redefined housing-building for the next 100 years.

Today, labor to build a wood stud or 'balloon-frame' house is the super cheapest because the system is so pervasive. But we can do better, right? Steel studs some say? Steel stud construction is faster, lighter, some say safer, and often it's recycled. But pollutants from steel mills are still bad at the moment, and often these studs are recycled at a high environmental price...



lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

From www.planetark.com/dailynewsstory.cfm/newsid/18981/story.htm
USA: December 11, 2002. WASHINGTON:

> *Air pollution from steel mills causes genetic damage that fathers can pass to the next generation, researchers in Canada reported. It is not clear if the genetic damage could harm anyone's health, but tests on mice showed that those allowed to breathe air from near a smoke-belching steel mill had fewer pups and hose pups had more genetic mutations than their country cousins. The findings, published in the Proceedings of the National Academy of Sciences, suggest that steel mill workers and people living near those mills should be checked for damage to their health, said the researchers, at McMaster University in Hamilton, Ontario.*

The message is fairly clear. Neither the balloon frame nor the steel stud system, on the whole, are good for the environment. Today scalable systems, hybrid systems, panel systems, and particularly composites and 'sandwich' systems offer higher standards and high performance from minimal materials. They appear slowly in the construction industry today.

What about composite panels? Structural Insulated Panel systems (or SIPs)? They are less than 10 years old to the industry, by most accounts. They are a less wasteful, more lightweight system. This happy anecdote from the DOE's "I Have a Dream House" in Atlanta, talks up a house built as part of their Build America program:

> *Compared to a conventionally framed structure, the combination of timber framing and structural insulated panels offers many advantages:*
>
> *1. higher R-values for better insulation*
>
> *2. straighter more rigid walls*
>
> *3. continuous nailing or fastening surface, horizontally and vertically, on the exterior and interior.*

> *The home's design is based on Building America's "whole-house" systems engineering approach, which considers a house as a complete system instead of separate components. The walls, roof and floor are structural insulated panels*

(SIPs), factory-built walls with foam insulation sandwiched between layers of oriented strand board, which improves energy efficiency by providing built-in insulation. This technology, which tightens the building envelope, allowed the builders to downsize the heating and cooling equipment, which will benefit the homeowner through lower utility bills. SIPs also reduce construction waste and increase labor productivity. [Friday, July 27, 2001]

The Chesapeake Bay Foundation, the first-ever "platinum" LEEDS building in the USA, with its grey-water toilets, marine-grade plywood, solar strategies, and site-friendly parking strategy, uses the SIPs system:

Wanting to "tread lightly on the land" and to set an example for others, the foundation's leaders and architects sought to make the new headquarters building as "green" as possible. The result is a low-resource-consuming, minimally polluting facility. Another result is the first-ever "platinum" rating from the U.S. Green Building Council Leadership in Environmental Engineering Design (LEED) program. The center opened in late 2000 to widespread acclaim. In recognition of Earth Day 2001, it was selected as one of the year's top ten examples of environmentally responsible design by the American Institute of Architects' Committee on the Environment. [architectureweek.com/2001/0418/environment_2-1.html]

If they are already doing this today, we can still do better, right? Let's look outside of architecture. Let's look at boats.

LESSONS FROM BOAT BUILDING: |
INDIRECT TRANSLATIONS

Fred and Betty own a small Sunfish™ sailboat. They think sailboats are elegant and minimally-engineered pieces of architecture. Like bicycles, there is a great deal for architecture to learn from their simplicity.

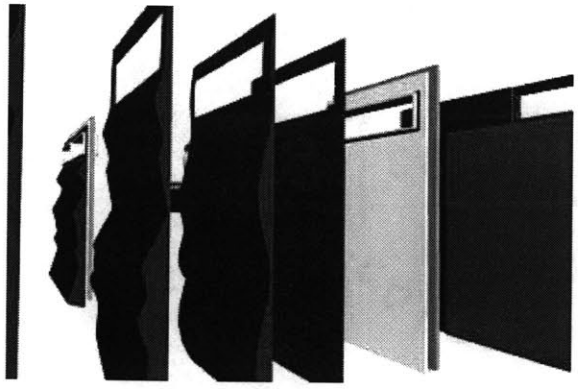
Ultra light materials are often experimented with in America's Cup racing boats to provide faster, lighter, sleeker racing yachts. In this industry, there

are many interesting techniques that offer poetic translations into architecture and building.

Like any industry, not all of their practices are good or safe ones. Nor do their techniques translate directly. We do not need to make buildings that look like boat hulls, keels, or masts. Nor do we need boats that look like log cabins. But those practices at the leading edge of each discipline do offer amazing lessons for analysis. Here are just a few:

> *"...**Composites bring high tech** to the America's Cup" STANFORD - Once considered more art than science, yacht racing has gone high tech, depending on scientists as much as sailors. The 28th Defense of the America's Cup will be the first in which all competing yachts are made of composite materials, according to the organizing committee. The owners of four yachts competing for the right to defend the cup for the United States have called upon Stanford aeronautics and astronautics Research Prof. Stephen Tsai to choose their composite materials to mold into hydrodynamic designs. [03/03/92 CONTACT: Stanford University News Service (415) 723-2558]*

The word is architecture is now COMPOSITES, a material set that we have learned mostly through the automotive and the boat-building industries. In architecture, however, we do not worry so much about hydrodynamics but aerodynamics. The goal is typically that buildings sit in the earth, not within a viscous body of water. And typically aerodynamics are not the primary concern in the architecture business either (unless we talk skyscrapers). Weight, however, matters in boats, just as it should in houses.



lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

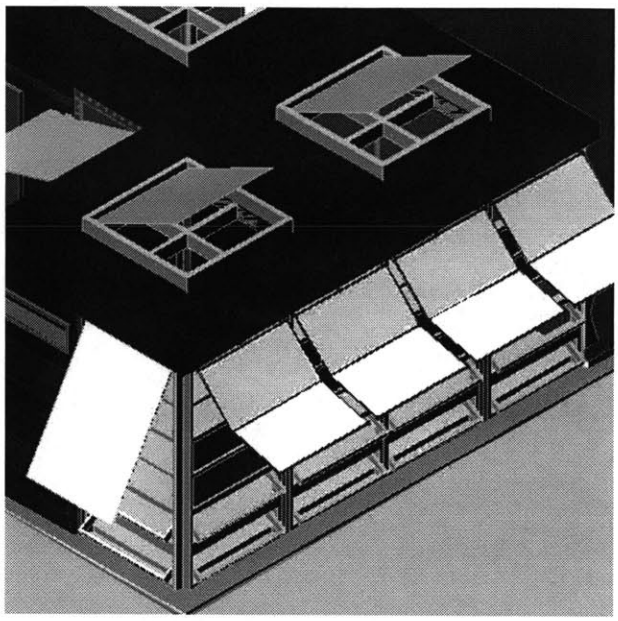
Prefab and lightweight materials have several great advantages. They can be transported and erected on site cheaper, quicker, and with greater precision. They offer greater strength and stronger joints. And they offer the potential for new form-making:

> *...Prized by the aerospace industry for their strength and light weight, composites are graphite fibers embedded in a resinous matrix that solidifies when heated. Composites give yachts light weight for speed and strength to withstand slamming waves. Thanks to composites, the new, space-age yachts are 10 feet longer, 33 percent lighter and have 50 percent more sail area than the traditional 12-meter class boats used in Cup racing between 1958 and 1987.*

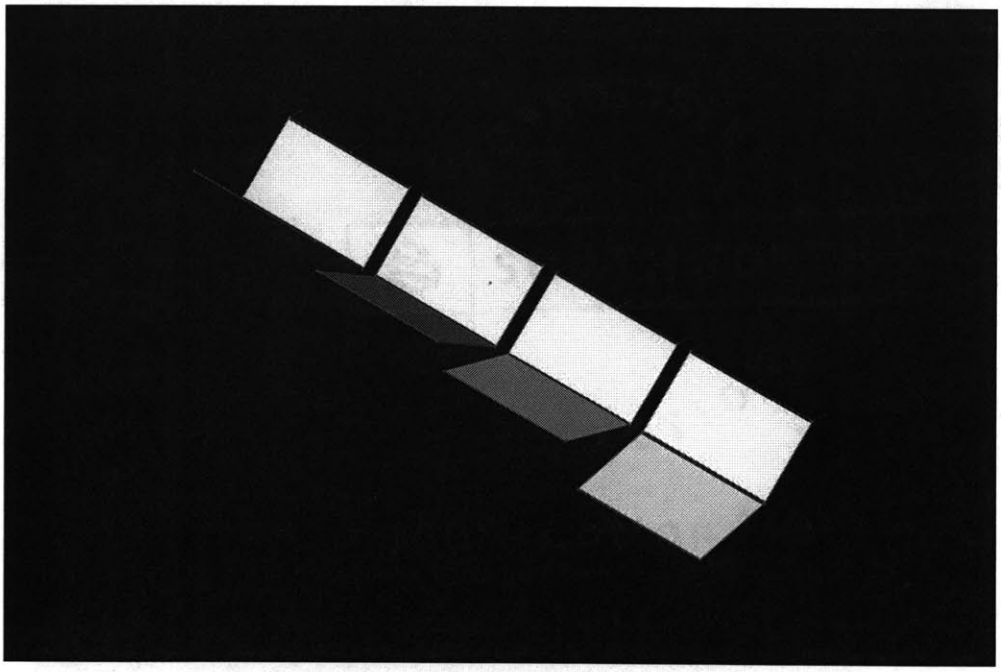
Composite materials offer complex, fast, and exciting construction techniques to architecture that we have only begin to imagine:

> *Built with a sandwich technique used in aircraft construction, the hull is made of a man-made honeycomb core nestled between two skins of composite material. The honeycomb minimizes the boat's weight while providing stiffness. Composite hulls are shaped in molds, which are either male (the composite is molded over a form), or female (the composite is placed inside the form). A female mold produces a smooth outer hull surface... Tsai's engineering team picked and tested the composites used to build four high-tech yachts belonging to the America3 (A3 or America Cubed) Syndicate, which supports research at Stanford and MIT.*

The possibilities for mass-customization are great and forthcoming in Architecture.

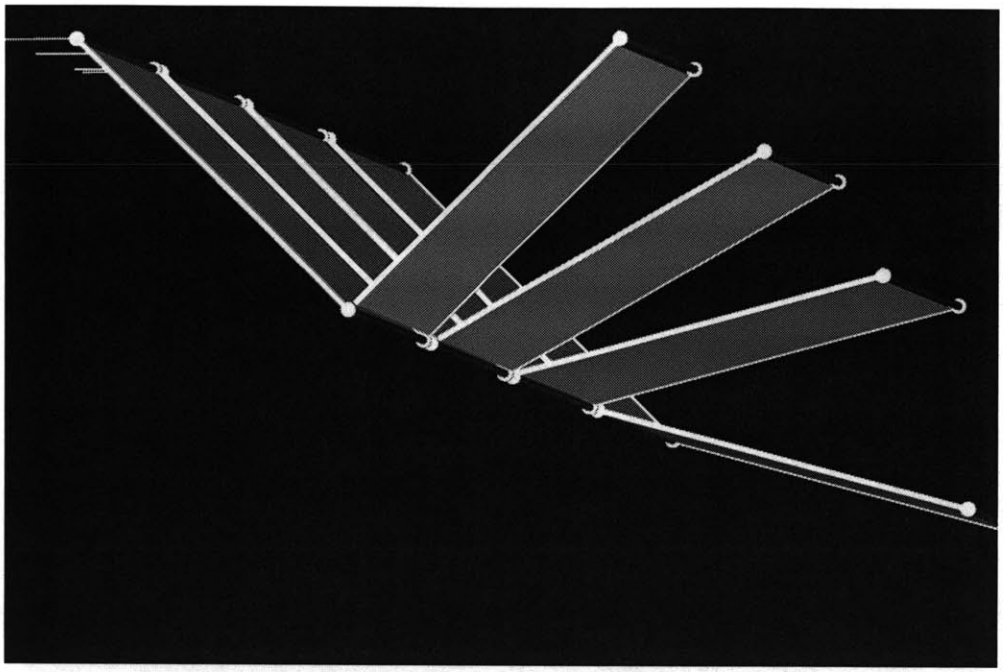


prefab HOUSE | lite louver system in context
[THE FOLLOWING 3D MODELS PRODUCED AND RENDERED BY THE AUTHOR]

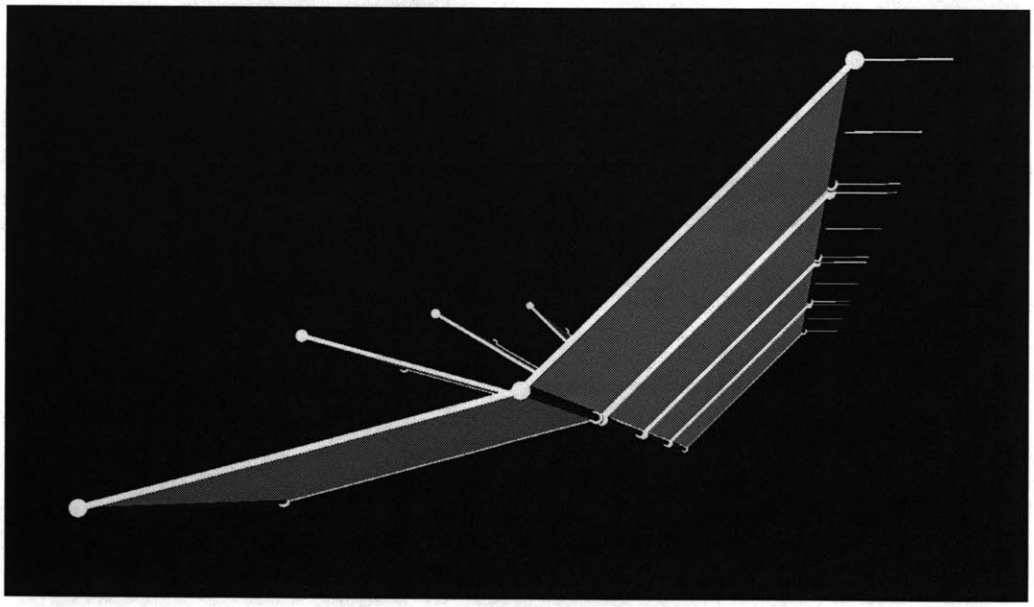


[1] axonometric degrees of freedom

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



[2] perspective fan array



[3] perspective from below

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

MASS-CUSTOMIZATION: |
Design takes us to a new marketplace

The modern dream of architecture and design, for quite some time, has been to offer quality objects, products, and spaces to the masses at affordable prices. To this end, the possibilities for mass-customization ARE great and they have arrived. New rapid-prototyping machines create new opportunities for experimentation and innovation with great economy:

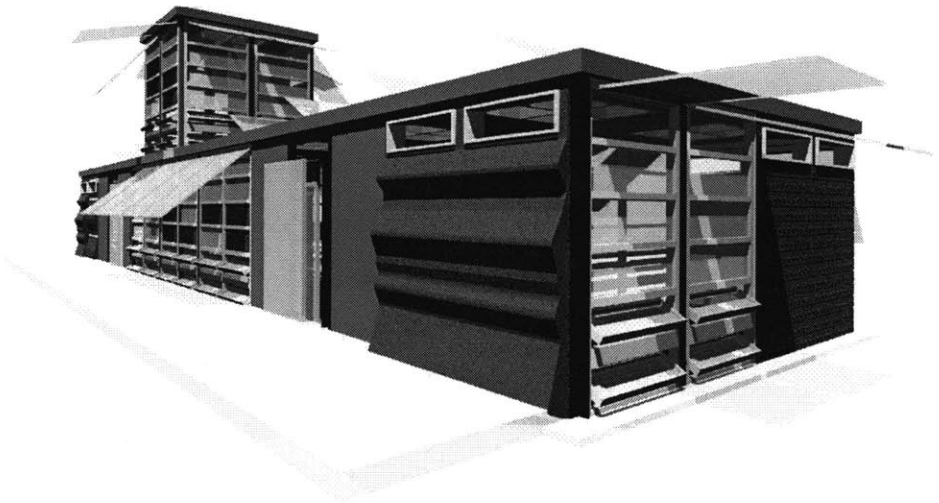
> *Mass Customization [emerged] in the last decade as a solution to address the new market realities while still enabling firms to capture the efficiency advantages of mass production.*
>
> *Mass customization meets the requirements of increasingly heterogeneous markets by producing goods and services to match individual customer's needs with near mass production efficiency.*
>
> *This proposition means that individualized or personalized goods can be provided without the high cost surpluses (and, thus, price premiums) usually connected with (craft) customization. To deliver mass customization, firms have found new ways to interact with their customers during the process of co-designing and configuring a customer specific solution. [Google search: mass-customization]*

Projects acquire a new richness as they fold in the intentions and the whims of the consumer. Mass-customization allows the architect designer to deliver a product that flirts with mass-production and with custom details at the same time. It is the middle territory between two long-standing design traditions. Because of its hybrid-nature, its invitations to chance and random events, the architecture takes on the more organic nature of a system. Its form is a function of its system's mechanics.

Architecture is almost always built with materials that are dead, with a system which is inflexible and resists additions. Mass-customization or MC, as I will refer to it, allows a house to grow and change over time. Because the joints and the connections are systematized, they can be universal.

And though site will change from house to house, one could imagine adding to or subtracting to a house built with HOUSE | lite in exactly the same fashion, all around the country.

But the real potential of MC is the economic door it opens to mainstream society. Individuals who can currently afford only to consider a Nomad Model 2520 – North Trail Lite, deep in West Texas, might be able to buy a HOUSE | lite System, if it sold roughly for the same price as the trailer at $32,000. This allows architects, designers, and everyone to reach new marketplaces with their products. And this is wonderful. This is how we hope to reach consumers like Fred and Betty.



[3D MODEL PRODUCED BY CHRISTIANNA RABER: RENDERED BY MATTHEW OSTROW]
HOUSE | lite system designed for and by Fred and Betty

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

THE HAPPY ENDING FOR FRED & BETTY |
THE REAL STORY OF HOUSE | LITE:

There are never two HOUSE | lite dwellings exactly alike. And if they are ever the same, they will change. HOUSE | lite conceives and packages itself with a strategy. Market research shows the average American wants to displace (i.e. move) or change their own living situation every two years. But why does changing have to mean moving? Nature teaches us many lessons about the critical relationship of structure, materiality, and growth.

Nature, in the case of the chameleon or the cherry blossom, is able to change or to adapt to avoid death or danger. The metaphor of natural change seems a useful tool for the house. What if one did not have to move in order to radically change the way they dwell? What if one's house is an organic system of flexible parts?

Today's automotive industry covets the concept of the 'AUTOnomy platform,' a 'skateboard' that can accept different passenger, engine, and storage housing configurations. Could a person not have more autonomy with his or her house, or more plainly, shouldn't a house be at least as smart, and hopefully a good deal smarter, than the car she just bought?

Fred and Betty think so. And this is their story.

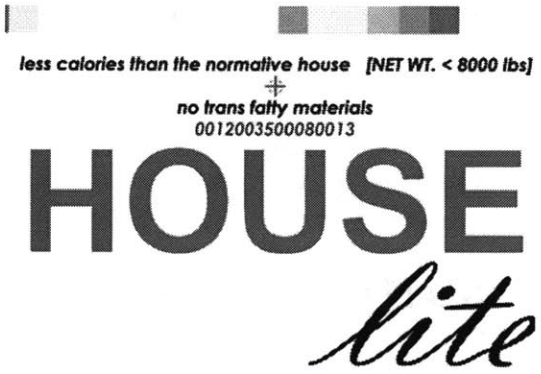
Fred and Betty Litefeet are ready. They are ready to move out of their cold Cambridge apartment into their own house. They live in a tight one bedroom near the river. It has been near three years, and, like many of their married friends, they long for a house with real trees and the yard, etc, etc, etc. Fred and Betty have at least three real options. Number one is to take out a loan and put a down payment on something they can almost afford. Number two is that they can carry on their current

situation. And number three is that they can build their own house. 'And building our own house would be ridiculous,' Fred and Betty think... is it always? Does it have to be?

On my way to the store today, Betty thought, I will make some brownies. I haven't had brownies in forever. Cruising down the aisles, eyeing the endless arrays of brownie confectioneries, Betty knows there are many choices. This mix is oil, eggs, water, and takes less time. But this one, just add water, that's the easiest!

Later that evening, watching TV with her husband, Fred and Betty enjoy their brownies. She reads the back of the package. An ad for a HOUSE | lite product sold at AEKI™, the leading Greek home store with a store in Cambridge. There is some info that leads to a website, a hotline, and the ease of buying, owning, and selling, etc, etc, etc. It seemed easy enough. Whatever. Let's go to bed. I am sick of thinking about the whole house thing.

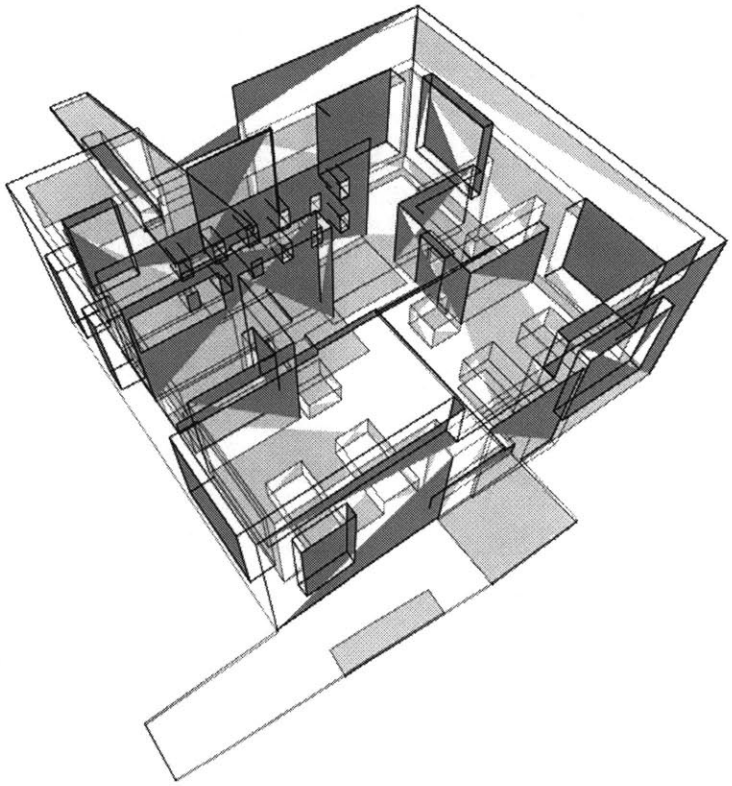
But the next morning Betty was still thinking about the HOUSE | lite ad of last night. It seemed like such a great way to get exactly the house you want, to your order. Betty was ready to explore this as an option, but Fred was doubtful. A house that advertised itself on the back of a box of brownie mix, that's kind of unconventional. Eventually, Betty decides, it is worth a go. So they go. They go to AEKI™ to explore.



the original design-it-yourself house!

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

leading distributor of HOUSE | lite systems



the HOUSE | lite vision station
@ the AEKI™ showroom

Fred and Betty pick up a notepad as weave through the store to make their way to the 'vision station' above...

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

AEKI™

The HOUSE | lite System

IN | CONSTRUCTION MANUAL

~

PAGE ONE

~

Your HOUSE | lite system is guaranteed by the manufacturer for the first year following construction.

~

[4', 8', 16' length panels made with a modified sandwich panel system]

~

HOUSE | lite user reference timeline

As we progress through the manual, you should have these in mind...

0 | choose site

1 | choose circulation shape

2 | decide L,W, and H of overall house

3 | choose number of rooms and LxWxH of each room based on 8' module

4 | program spaces and arrange with circulation

5 | locate sliding doors

6 | locate roof shades and gutters, drains (slope always away from the circulation spine)

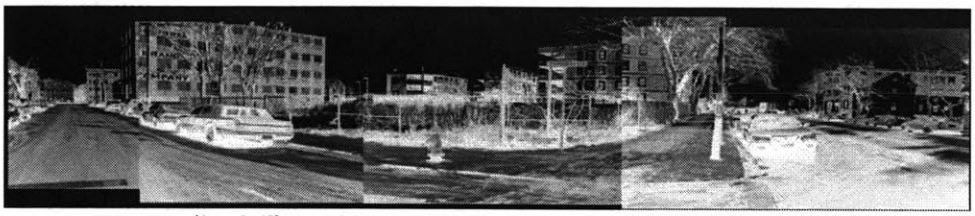
7 | count number of components of each type needed, add extra stock if desired

8 | estimate total cost, lead times, and total construction time with LITE checkbook

9 | order non-custom furnishings

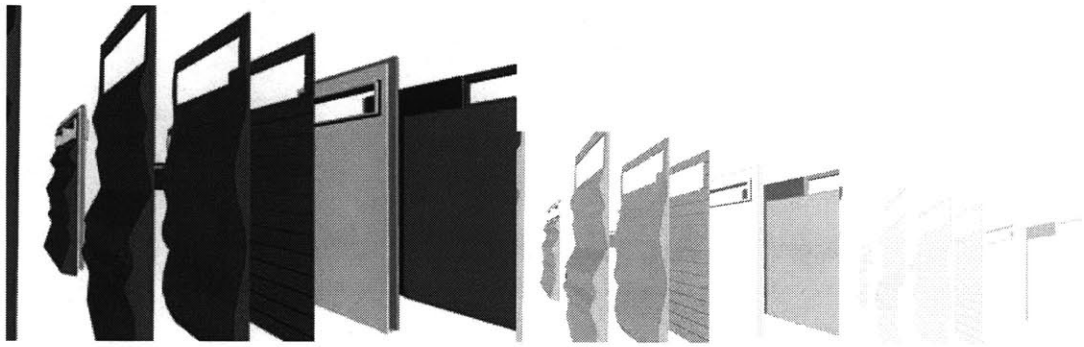
10 | move in!

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



corner site | **'linear'** house | the site of Fred and Betty's vision

Fred and Betty eye this corner lot in Cambridge. It is at the corner of Broadway and Boardman Street. That's where HOUSE | lite comes in...



perspective rendering of the house | lite system:
588 HOUSE | lite panels
fit nicely into one standard 16-wheel truck

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

'linear' | fred and betty's house

'S' |

'O' |

'U' |

'L' |

As per design, HOUSE | lite encourages you to make your own plans...

'LINEAR'

DESIGNER	CHRISTIANNA RABER 2004

This house goes well with a thin site or elongeated panoramic vistas, particularly waterfronts. The 2 story perch is a space for meditation, stargazing, or studio workspace. The house has two distincts wings, for separation of noisy from quiet spaces.

Special features : low-voltage lighting, courtyard, front and rear porch, 2 story workspace, bipolar wings for noise and quiet. All HOUSE | lite system houses can be reconfigured, added to, or subtracted from.

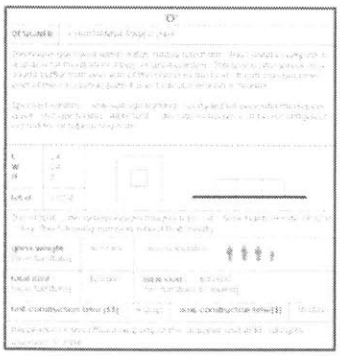
L W H	48' 16' 16'
tot sf	704 sf

The HOUSE | lite system weighs roughly 6 lbs / sf. Slow builds at rate of 32 sf / day. The following numbers reflect that reality.

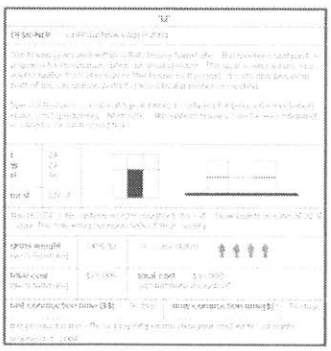
gross weight : [w/o furniture]	4224 lbs	accomodates :	
total cost : [w/o furniture]	$35,200	**total cost :** $40,200 [w/ furniture included]	
fast construction time [$$]:	11 days	**slow construction time[$] :**	22 days

Some pre-made HOUSE | lite plans...

O



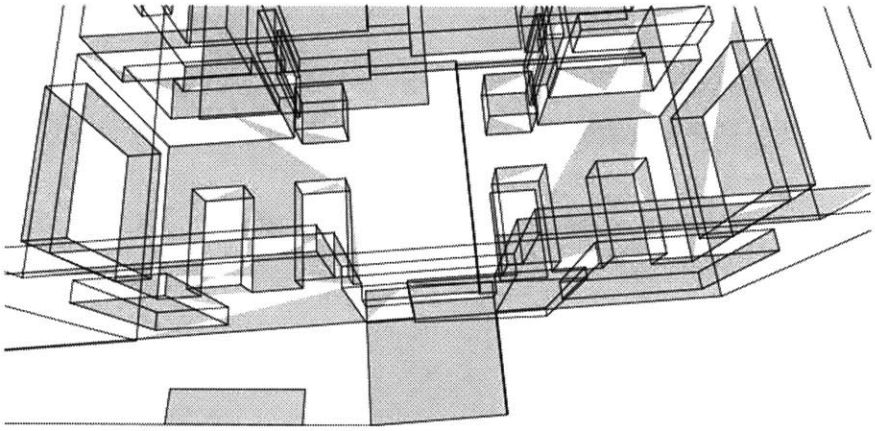
U



L

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

They pull into the AEKI™ garage, excited but cautious of the challenge ahead. Both Fred and Betty know AEKI well. Fred knows the chair 'zone' very, very well. He is a frequent buyer, actually, of many chairs and desk accessories he will never, ever use. Betty has been many times through the pillows and textiles 'zone' on her way to the HOUSE | lite 'zone.'



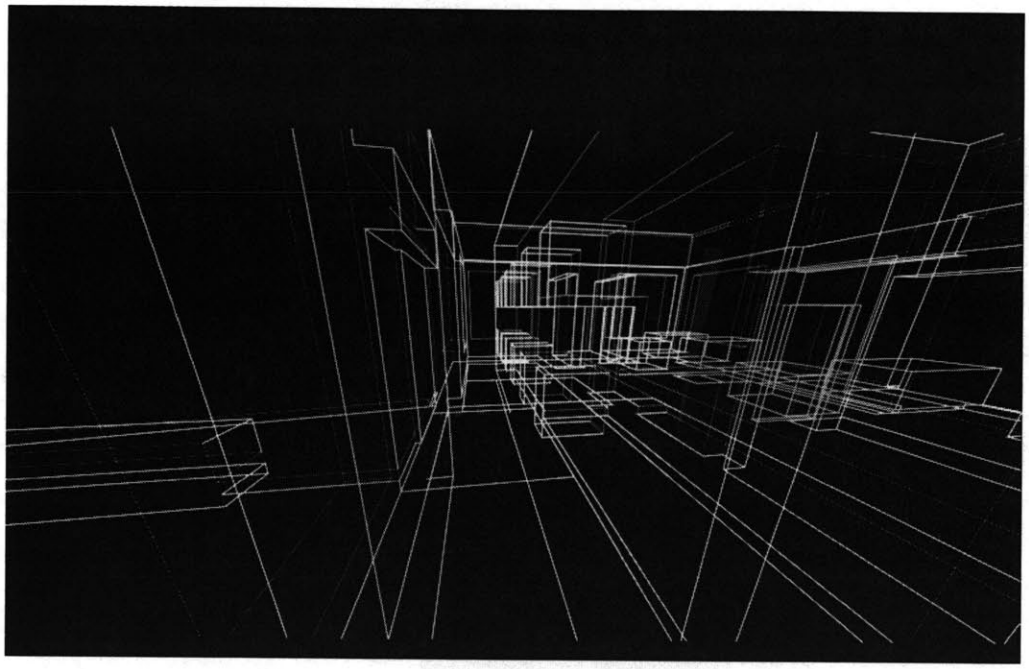
exit from the
HOUSE | lite vision station

She dreams of pillows she will never, ever need. In fact, you might say, they knew +*AEKI as well as they knew their own house. So many products. So many products. But not one AEKI product actually builds you a house. Why not?

But then Fred grabs Betty's arm. Look over there, he gestures. A sign hovers just above – HOUSE-lite: the make your own 'made-to-order' house.

Betty smiles at Fred and they make a quick line for the computers. There is another couple there too. They seem to calmly negotiate the task before them. Fred and Betty, however, are still skeptical. Faced with no better option, they brave giving this thing a chance. The first display is the entry screen with an image of a strange fabric thingy and the simple text HOUSE-lite: made-to-order and delivered to you.

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



entry along the LITE wall
HOUSE | lite vision station

Next is a list of five questions: how many bedrooms, bathrooms, finishes desired in bath and kitchen, L x W x H of each space, their adjacencies, and location in the contiguous United States. The database then spits out a final cost! It estimates a construction time! It instantly prints your custom set of schematic plans! It puts you in contact with the in-house contractor to get the deal rolling. The only thing asked of you is find your own land. And the database offered names, some numbers to help with the land as well.

We near the end of our story, and we know what *lite* is for the HOUSE | lite system.

Just how many scenarios can we imagine? HOUSE | lite hypothesizes that the more flexible we make our system, the more scenarios we make possible, the more successful our houses will be in the exciting times ahead. We will remember from the very beginning:

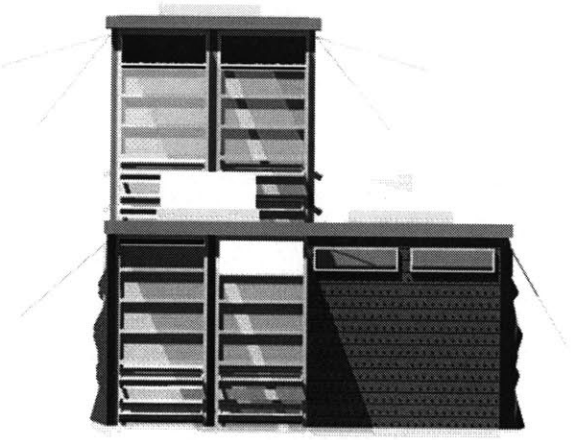
lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

Lite :

1. cheap (but quality) as possible
2. open-ended, small as possible
3. 'eco-effective,' lightweight as possible

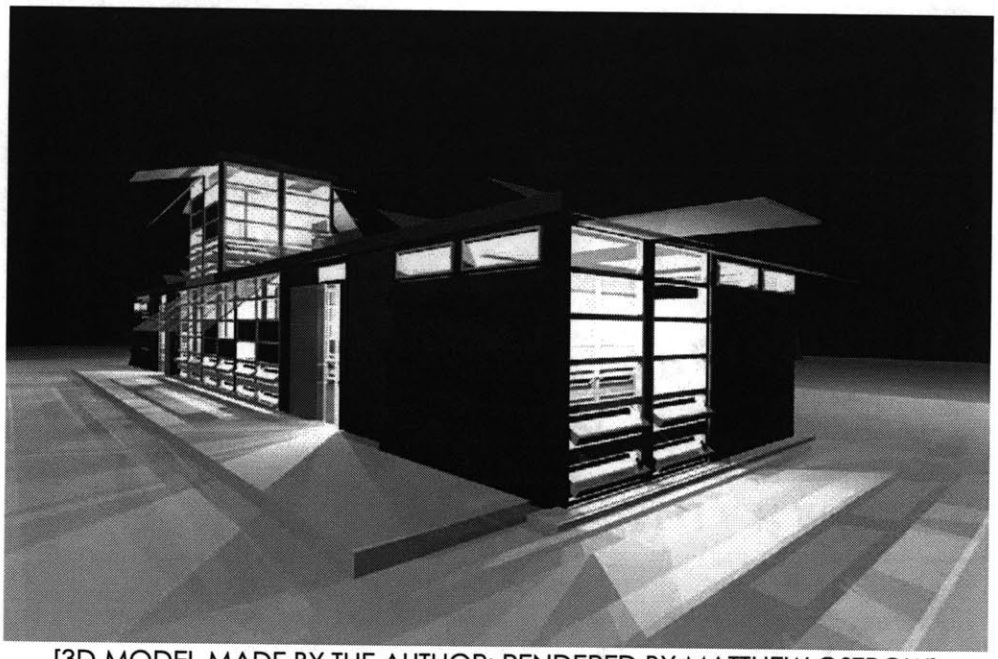
One can easily sketch out sixty-eight slightly different scenarios that could also use similar systems:

Permanent house 1
Permanent studio
Permanent office
Permanent commercial space
Permanent storage
Guest house
Temporary school classrooms
Temporary office space
Temporary rooftop squatting



[3D MODEL MADE BY THE AUTHOR: RENDERED BY MATTHEW OSTROW]

Temporary structure
for parties 10
for weddings
for bake sales
for fundraisers
for celebrations
for funerals
Chapel/Church
Temporary gypsy camp
Traveling art exhibitions
Temporary dance studio
Temporary artist's studio 20
Temporary art gallery
Temporary cafe
Temporary internet cafe
House for a recluse in the woods
Peacetime housing for military
Temporary urban vacation home
Building site trailers
Film production trailers
Temporary Trailer park upgrades
Emergency housing facilities 30
Public housing facilities
Attractive pool cabana
Attractive greenhouse



[3D MODEL MADE BY THE AUTHOR: RENDERED BY MATTHEW OSTROW]

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

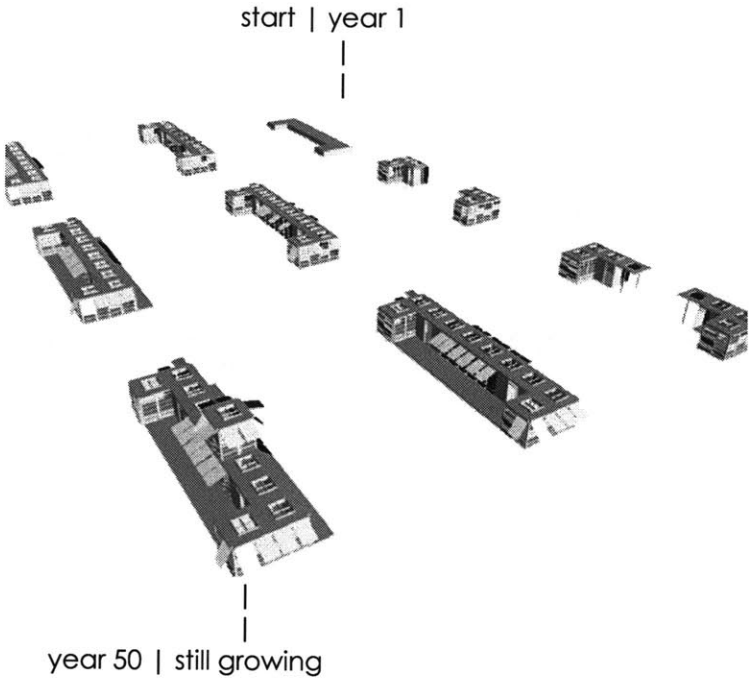
Extra storage
Extra workspace
Temporary In-law suite
Book mobile station
Blood mobile station
Temporary car showroom space
Practice room for the band 40
Campground palace
Above ground 'basement'
Ground level 'attic'
Temporary Boathouse
Temporary Poolhouse
Tennis shack
Golf clubhouse
Urban community center
Senior housing
Second home in country 50
Temporary pavilion
Backyard gym
Backyard teahouse
Backyard clubhouse
Very large kite
Mini-airplane hanger
Circus tents
Rodeo tents
Girl/Boy Scouting Jamborees
Tailgate parties 60
Rehab shelter
Retreat
Sanctuary
Relief work shelter
Medium sized bus shelter
Large taxi stand
Tourist information booth
An incredible house 68

I think this is very much where architecture is today. We are at the very beginning of an exciting and slow learning curve. We are discovering many exciting tools. We have many doors opening to us in the manufacturing world, the computational world, the industrial design world, the entertainment world, the technology and others.

As we embrace all these avenues they will help our designs, our landscape, our buildings, and our planet on our way. They will preserve all the life that we love. They will keep people like Fred and Betty happy.

Let's catch up again with the Litefeet, shall we?...

Six months later, Fred and Betty are ready to move into their own new HOUSE - lite. Their prefab home assembled in one week and six days, but it took 5 months and 2 and ½ wks to find the perfect lot in West Cambridge. But that's normal. And it would have taken years to renovate an existing house. Fred and Betty are pleased. They have great house that is well-designed, eco-friendly, and made to their order, and changes over time with their life and their lifestyles.



Fred and Betty's HOUSE | lite system
growth over a 50 year period to the state at bottom left

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

Fred and Betty approach the house with awe and some nerves. How did we make this? Can we do it again?
What will we do next, Betty? Will our house grow over time?

[I think it will grow, so start small!]

THE END

Still let's zoom in a little closer . . . five years later . . .

How are Fred and Betty doing in their new home? Let's have a look.

6.10am –
Betty wakes up having hit the snooze button three times. She is a graphic designer for a small firm in Cambridge. She has a tele-conference with London at 7.00am EST this morning and she needs caffeine. She needs it in a bad way. [The house is atomized so that her computer is a healthy distance from her bedroom]

6.55am –
Exiting her simple but comfortable bathroom, Betty is showered and dressed, coffee almost in hand. She feeds the dog, makes her way to the library just across the courtyard.

7.00am –
As Betty is talking up her clients in London, Fred wakes to some sun seeping into the room. Fred is a lawyer for a small box downtown. One day of the week, and some nights, he will work out of home. This morning, he chooses his red power tie from the rack.

7.30am –
In their cook/eat room, Fred finds that Betty has made the coffee. Thank God. He flips on the morning news just across the counter. Thirty minutes later he shoots outside to his Harley and hits the road.

8.30am –
An hour and a half later the tele-conference with London is finally over. Thank God. Betty was well-prepared, so it went good. Now it was time to check in with the main office and do some brainstorming for the next project. Though it is a small room, the skylight and the window make it feel quite large.

11.00am –
Call from Betty's Mom. She is OK, thank God, but she misses Betty. She wants to send her socks.

12.00am –
Lunch is peaceful. No hassles. The living room and cook/eat room are actually one room. This makes it open and spacious. She makes a salad with her dog Chip in tow. Like the rest of the house, the lighting and appliances are low-voltage. This makes them safer and more efficient. The orientation of the house causes soft afternoon sun to stream into this space.

1.00pm –
Fred phones to remind her of Chip's anti-virus/anti-worm protection. She listens to the call over speakers integrated into the walls. When she finishes she just flips a switch. Then she throws some laundry from the machine to the dryer.

4.00pm –
Betty finishes her work day. She heads for her good little city car goes for a drive. On her way to yoga class, groceries, and then plans a swim for later in the evening. Traffic is bad, her car tells her, and so she redirects and gets there on time.

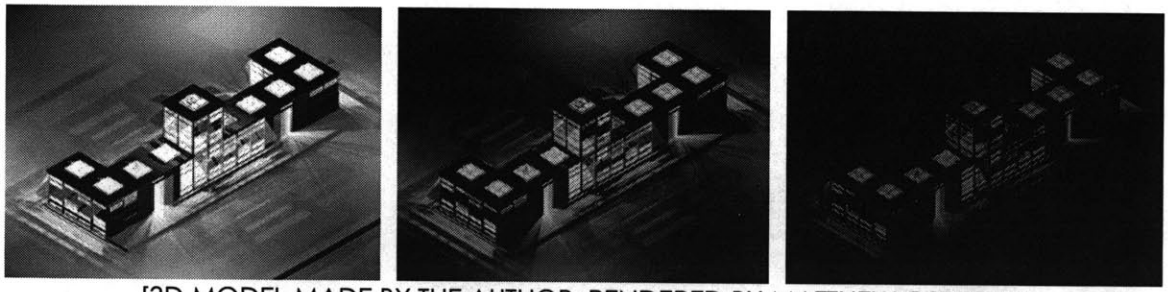
6.30pm –
Fred arrives home. They eat dinner. Watch Sex and the City reruns. They let Chip out to his invisible fence.

7.30pm –
The sun goes down and the house radiates with fluorescent moonlight and soft low-voltage lighting. The windows are open for good cross-

ventilation, so Fred and Betty manage to use less AC.

10.00pm –
Long day. Betty crosses the hall and collapses in bed. Fred reads from his miniature smart light embedded in the ceiling.

10.30pm –
All lights are going out. It is 2009 and it is slightly warm outside...



[3D MODEL MADE BY THE AUTHOR: RENDERED BY MATTHEW OSTROW]

What again is lite?
I put forward this concept as 3 elements. One is being small and cheap (1). Two is open-system (2). Three is being 'green' (3). These three simple things offer a great deal to the American landscape. They are the *better* building blocks of designing better and more earth-friendly houses in the US.

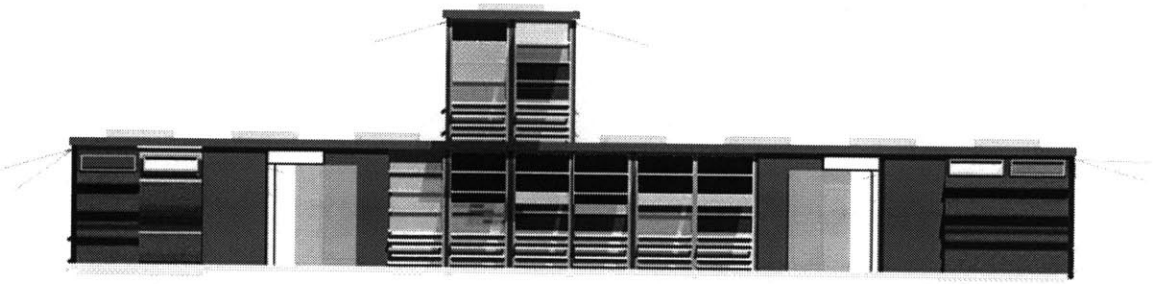
The US housing industry risks over-saturation in the next ten years. McMansions will eventually disappear of their own accord. But in medicine, doctors initiate simple solutions which prevent more serious long-term problems. Many housing construction practices in the United States are sick at micro as well as macro levels right now. They need simple prevention sooner rather than later. If we act swiftly and responsibly, architect's can offer real alternatives.

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

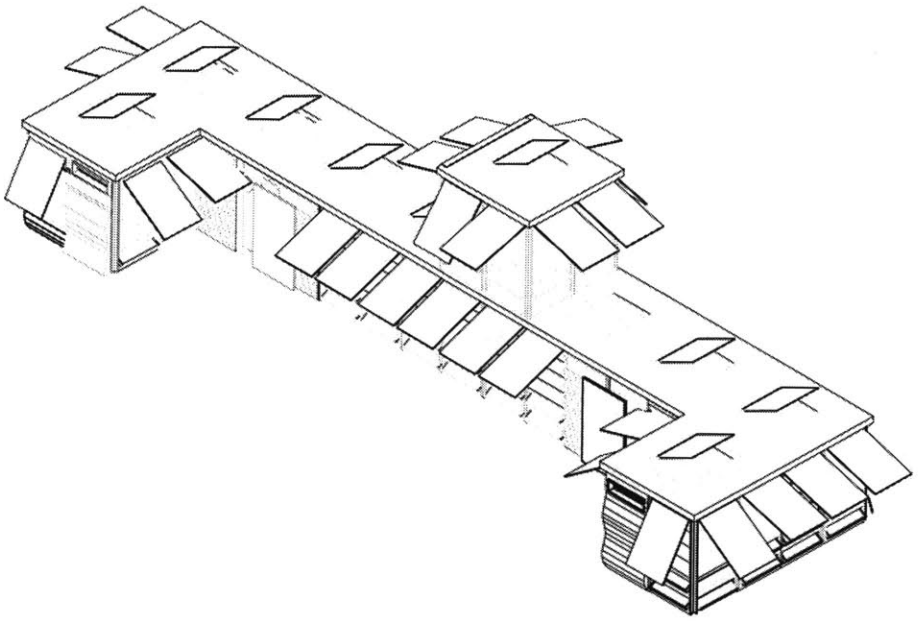
My design for the HOUSE | lite construction system is my prescription for this problem. . . Many times we try to attack what we can see, when in reality the problem is that which we cannot see. The most serious problems facing us today are those problems you rarely or never see. Dealing with these problems, to visualize, imagine, and solve them, with abstract and often indirect methods, is key. We need to alter our visions constantly with time, geography, and global sensibility. We should start right away.

Know what you shall do tomorrow.
We can do better.
We really should do better.

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

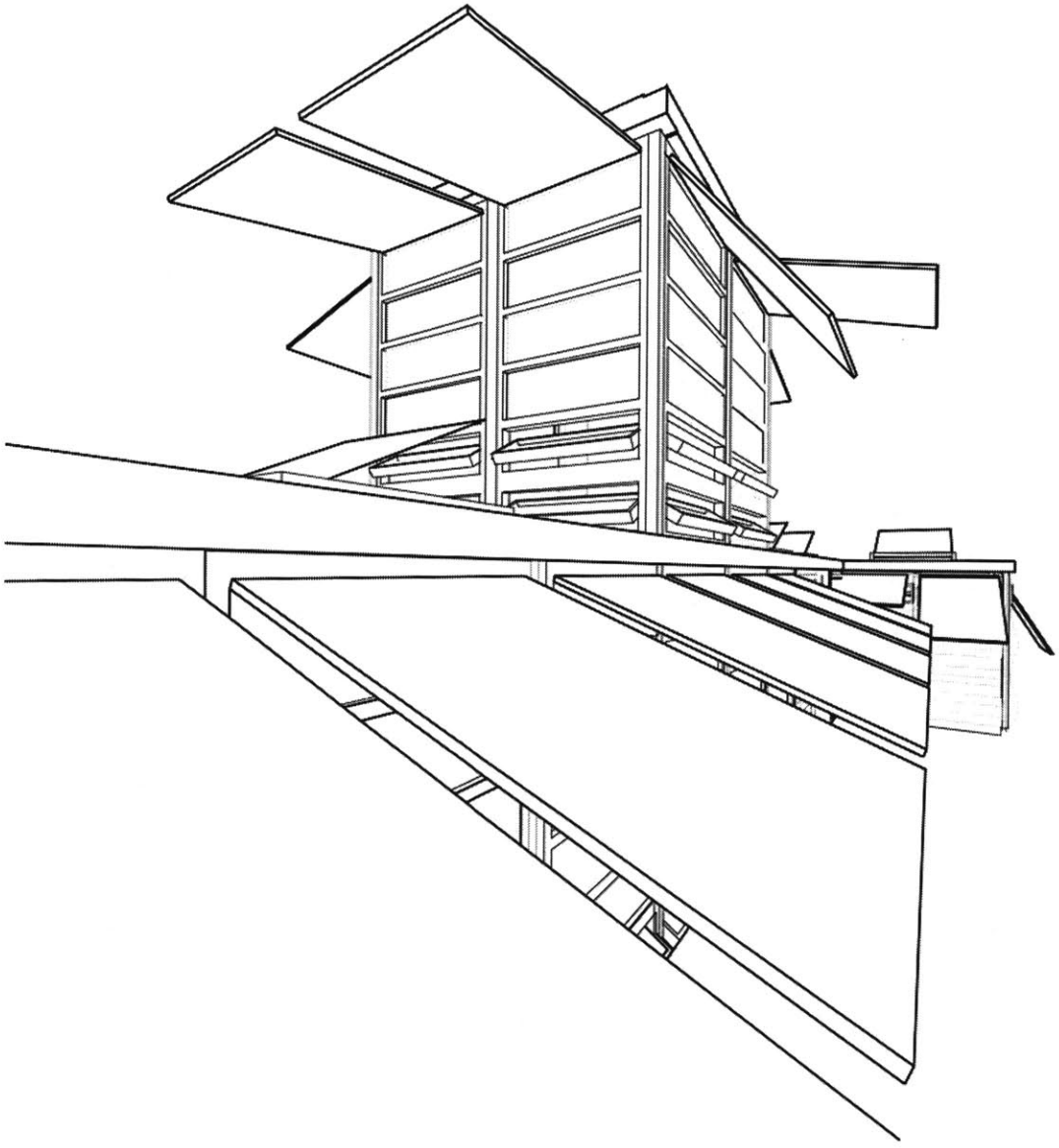


[3D MODEL MADE BY THE AUTHOR: RENDERED BY MATTHEW OSTROW]
HOUSE | lite system | linear variation
front elevation
not to scale



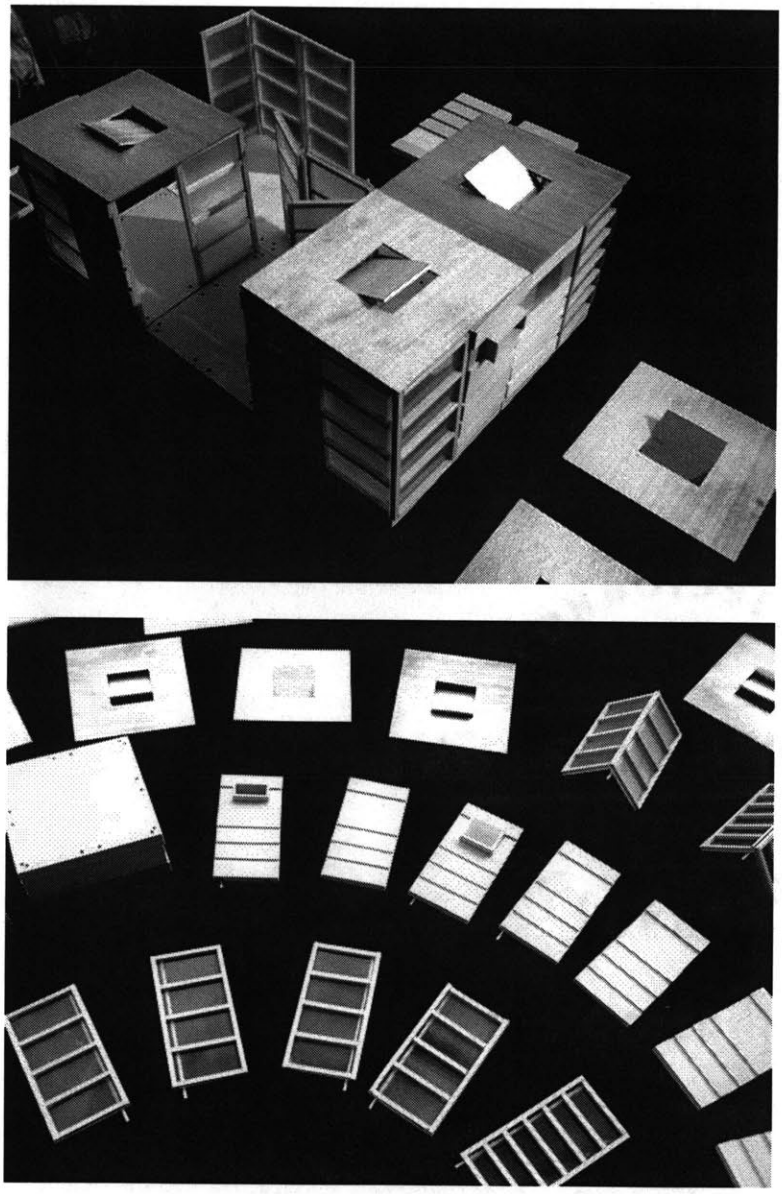
[3D MODEL MADE BY THE AUTHOR: RENDERED BY MATTHEW OSTROW]
HOUSE | lite system | linear variation
axonometric of roof system and louvers
not to scale

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



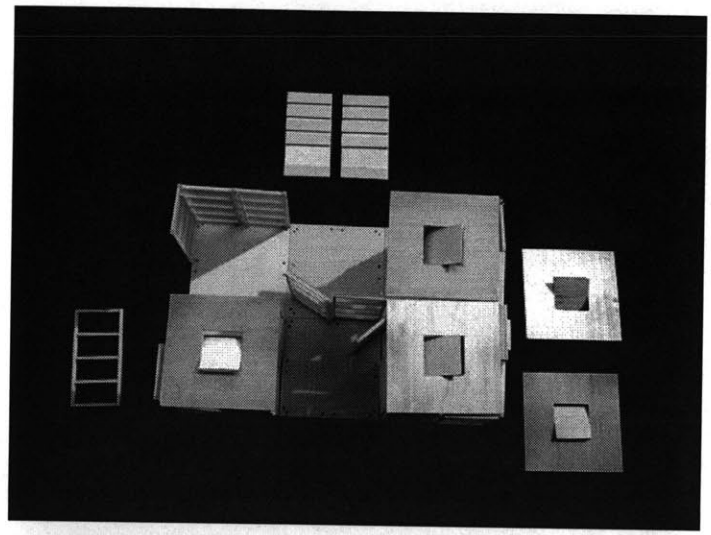
[3D MODEL MADE BY THE AUTHOR: RENDERED BY MATTHEW OSTROW]
HOUSE | lite system | linear variation
perspective from above
not to scale

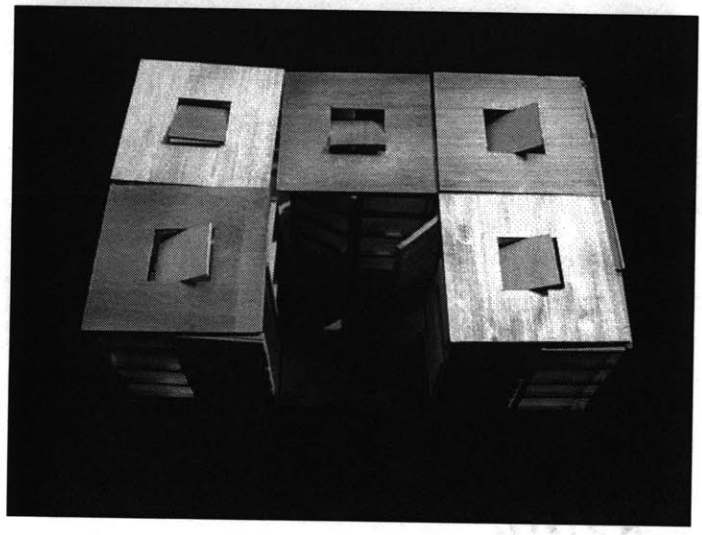
lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



HOUSE | lite system
Images of final basswood model

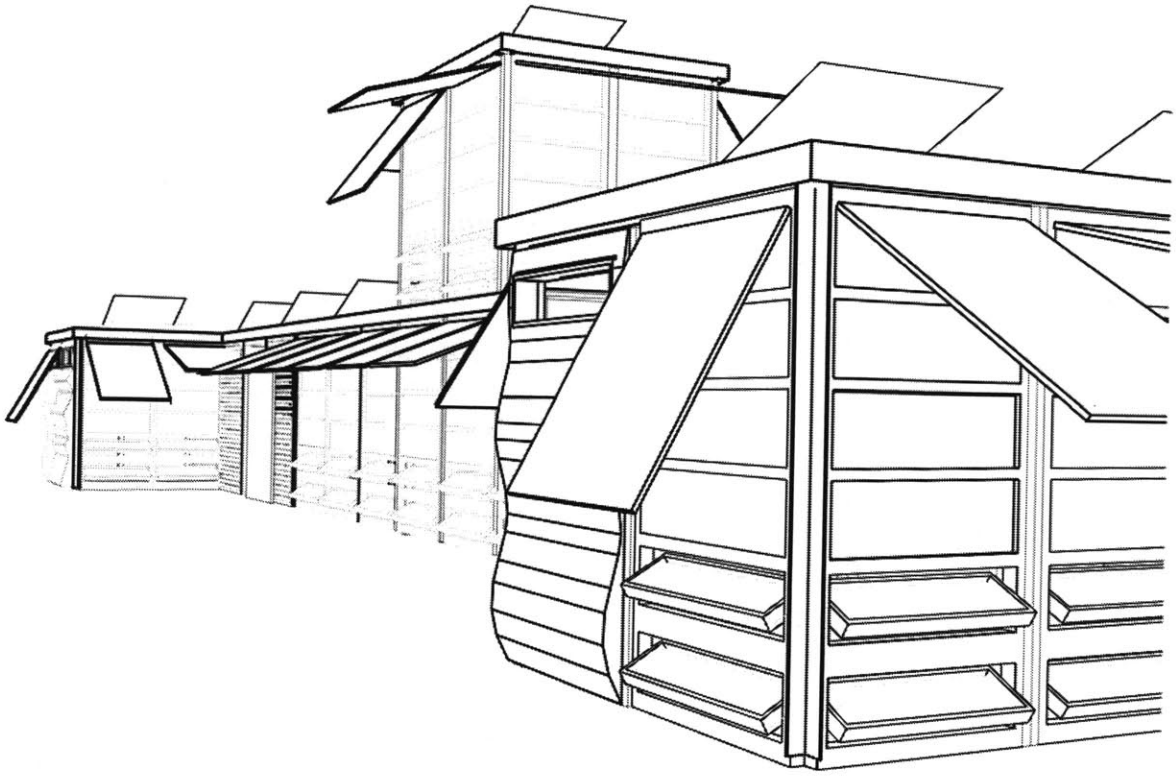
lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight





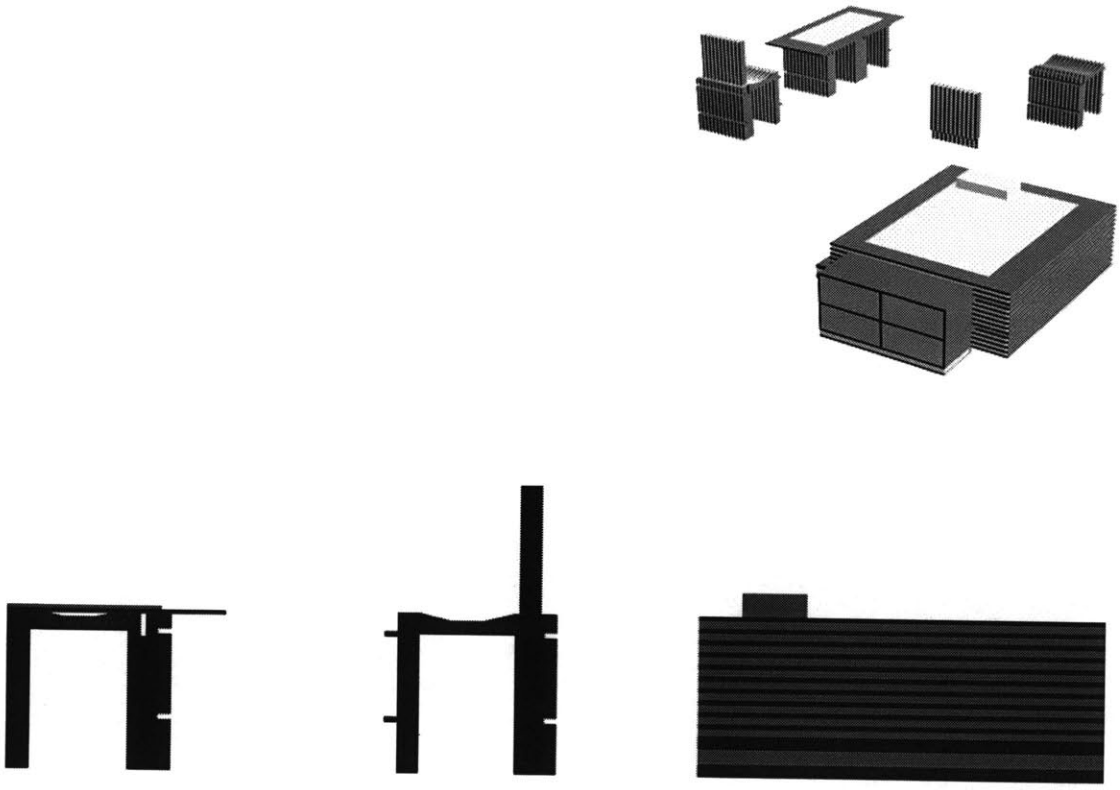
HOUSE | lite system
'note: this is a very small house...'

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



[3D MODEL MADE BY THE AUTHOR: RENDERED BY MATTHEW OSTROW]
HOUSE | lite system | linear variation
perspective from front
not to scale

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight



explorations:
interlocking flat materials and shapes
HOUSE | lite furniture system
not to scale

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight

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Words at http://www.wordspy.com
Manufactured Housing Institute USA at
http://www.manufacturedhousing.org/default.asp

THANK YOU
I thank many people for the energy and the effort that went into this thesis. They should receive great karma.

THE REAL END.

lite: 1 'smart' | cheap (high quality) 2. open-ended 3. 'eco-effective,' lightweight