American Home: Shelter Optimized for Climate

Karen Kentile

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How is a home influenced by its direct landscape, as well as its surrounding terrain? How can we make our built environment more unified in language? How can we start with the home..? How can I take up less space, but still be a part of the larger environment that I am entitled to? How does one design in the landscape? How does one design in the city with the landscape in mind? Does material comfort define us? Why does it require so much space? Could recycling materials make up for their toxicity? Why would anyone given such freedom want to be confined? Should I design a tent? Could we be nomads? Could we want a less solid structure to call a home? What to do with glass? Am I challenging our understanding of enclosure? Our extensive use of it? Can we cultivate and grow a home? Do I just want to hide the exterior in the landscape and make the interior similar, large spaces.. Is permanence and the promise of a sanctified family home desired? How can I enhance the American Home without redefining it? Why is this important? Can walls suggest building upon freedom? Will I be infringing upon the rules set up to protect our national parks? Do I want to take away collections and appliance? Do I want to organize them? Do I want to live lightly on the land or last a while? Am I trying to make a hut feel lavish?
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Abstract

“The aerie of the eagle, the woven cradle of the oriole, the tunneled retreat of the field mouse, are all homes in the truest sense.” (Keeler, 1)

As an American culture, we conduct dwelling in relation to landscape. In aggregate, the built becomes the landscape. It is widely acknowledged that contemporary dwelling and landscape building practices are overstressing the global environment- an “unsustainable” situation. Architecture can play an important role in developing much more energy conscious houses and realigning home to healthy landscape. Making a design project of energy and dwelling can enhance the value of both.

Most important is understanding the interface in which the built and the organic coincide. Establishing place as a reflection of the natural environment involves researching materials, useable energy, and spatial landform relative to a site. With the strength of a formal strategy which pursues low impact design in several separate environments of the United States, the small footprint home is purely consequence.

In my research I am interested in two interdependent and overlapping topics: residential energy consumption and dwelling in relation to landscape. This overlap, I contend, produces new opportunities to create relevance for architecture in the defining of the American Home. As the landscape has figured so prominent in the construction of our culture, it has also impacted the locus of the American construction of home.

Architecture attuned to building form and energy production and consumption can, in turn, suggest an alternate landscape for the country.

For the purposes of this thesis investigation, dwelling type will be limited to a series of rural, off-grid houses. This provides for a better focus and control in which to study a range of characteristics pertinent to specific limitations. With these limitations, the experiments can go more in depth and detail more critically.
Home

The house and the home are both cultural constructs and the most personal of environments. The concept of dwelling as landscape at a personal scale is fundamental to identifying place. Both as a culture and as individuals, the way that we conduct dwelling impacts not only our daily lives, but also the larger environment we inhabit.

Home

In his book, *Home: A Short History of an Idea*, Witold Rybcynski writes that the idea of the home begins with recognizing the house as having an intimate interior (1). This idea coincides with an, “atmosphere of domesticity,” resulting from actions and ceremonies of a family (1). Home-ness both requires and yields a devotion to this atmosphere (2).

Home is also characterized by a desire to separate private and service spaces from public gathering spaces. Rybcynski explains that contemporary notions of the home include the Dutch dwelling, for the feminization and usefulness of a space, and also the English Georgian style home which first, “combined domesticity, elegance and comfort,” most successfully. Such terms and relationships were introduced in response to family dwelling over a period of time. The idea which was finally established as comfort became recognized as a, “feeling of well being, not something that could be studied or quantified” (3). The idea of home as a personal environment and internalized culture is most essential to the larger project.

The relationship of the house to the natural environment is also a basic component of its identity in American culture. Since the home has been a reflection of intimate family nature, the program offers an important articulation of human activity finding its place in the natural environment. Many cultures have attempted to accommodate their lifestyles in the landscape, even separating from the urban realms which symbolize modern society. This has its roots in the 18th century. For instance, the English have had high regard for the countryside since the Romantic Movement and have thought of their dwellings in the city to be houses while in the country, their homes (4). This has set up an ideal where we understand home as separate from the city culture that framed it.

1) Rybcynski, 43  2) Rybcynski, 75: It is the devotion to the home which defines it.
3) Rybcynski, 125: comfort is described as an idea that formed from human feeling.
4) Rybcynski, 105: places the feeling of home in an isolated atmosphere, where family and comfort can thrive.
a) Smeins, 26-27, 35-36, 46.
b) Smeins, as quoted on 51.
c) Frank Lloyd Wright.
To find a freedom among differences has always been the goal of articulating the American style home: maintaining a value “of the country, for the country” (Smeins, 35).

Country homes in the United States have been introduced in another light. The 19th century included an increase in industrialization as well as an increase in immigration. Cities started to become more congested and were perceived to be dirty and less healthy. Europe experienced a surge in population coming from the poorer rural areas to the city for employment, which resulted in outbreaks of disease and sickness. The mid-19th century America responds with the generation of suburbia as a remedy for the cleanliness/superiority of what is now known as the “white collar” class. This ideal was latched onto by real estate development, which continued to define the detached single-family home based on potential investments. This set up a pre-determined ideal for the size of one family, property, and even home life. And so the house outside of the city became an icon (a).

An American “style” of architecture in the execution of house in nature has been under investigation since it was idealized for the nuclear family and given the position of expressing national identity in the 19th century. Smeins discusses in his book Building an American Identity the ‘competition of nationhood’ between immigrants, architects addressed the difficult task of unifying a people of dis-similar interest and background (a). To find a freedom among differences has always been the goal of articulating the American style home: maintaining a value “of the country, for the country” (a). Can a house have an internalized environment as well as relate to the larger country?

The physical and atmospheric characteristics of the United States vary as easily as its cultural diversities. While houses are epitomized by the character of the people who live in them, geography and climate have also fabricated the history of society (a). To quote Frank Lloyd Wright in his landscape-focused architecture, “Buildings, too, are children of Earth and Sun” (c). Perhaps that is why the ‘picturesque’ type home had evolved as a reflection of nature and the human emotions related to it. Evolving from the preceding paintings, the home was seen as a part of nature and not separate from it (a). As said by Montgomery Schuyler, “a building is an organism of which the architecture is… the expression of its functions and conditions” (b). Settling on the land has celebrated the beauty of the American countryside.

Most interesting to the fast growth of suburban neighborhoods, towns, and sprawl in the United States are the externalities of wasteful fabrication and the debt of pollution expended by energy usage. This is due to the technologies available which provide sys-
tems for the balance of comfort that were not achieved in smart design or construction. It was the economically sensible application of building and the absence of conceptual design which came to be recognized as American houses. Essentially the city culture has applied its easiest and fastest techniques to the construction of home building in the suburbs. This did not express an awareness of the natural landscape and the need to maintain its purity. It did, however, introduce the countryside separate from the city as a site for further habitation. Here I will be investigating the [rural] more untouched landscape for the sake of arguing for an alternate human impression.

When provided a rural building site, it is crucial to consider the home as part of the land. It is important in this case to acknowledge an interface through design. This can be best exemplified by analyzing several sites with different climates, landscapes, and local resources, and by responding to this by way of design. From the natural, a building can achieve materialistic and spatial wholesomeness, but also an attention to the energy that is available without utilizing a city grid. The built project, then, would manifest the site in nature itself. Also, by articulating the delicate balance of nature to intimate home life, people can become more in touch with their effect on the environment.

Materials

Where the interior our homes meet the landscape should not signify a break in genetic makeup. The home is the space, made safe by the envelope, but not necessarily synthetic in material. “The house is bound to the land it occupies since it orchestrates arrival to and passage across the land,” says Deamer in The Millennium House (a). How are we introducing and passing through the land tomorrow? Inside should be a continuation of the natural, dimensioned by the discipline of its builders. Local materials in their thermal and physical embodiment become an interpretation of their climate. The foundations and masonry, for example, can be born of local stone and the interior and exterior finishes from a nearby landscape can age with the surrounding terrain better than plastics which never decompose. Locally developed resources will essentially create a timeless pallet which can provide a feeling of being embedded in the landscape. Perhaps not all building materials of contemporary culture will be avoided, depending on their availability and chemical fit. Looking at the manufacturing and construction of each material will help to show how much embodied energy is used in build-
ing and lessen the waste in construction. The more raw and unexposed to chemical altering, the more material creates a comfortable interface with the environment.

Performance

Materials In themselves cannot make up the entirety of the home, especially when a space is made habitable by providing comfort. Mechanical systems must be considered a crucial attribute to the physical environment of the home in ventilation air and water supply. When ‘machinery’ for active energy was introduced, it further assisted in the performance of chores and soon the house lost its spatial sense and became more engineered to accept this. It has been difficult for architects to incorporate bulky mechanics as part of a larger concept, but it is important not to forget the basic organs which make up the house in its spatial articulation. As the home is dictated by the nature of people, and landscape is directed by climate, the technical services are how the home functions.

Making an argument for self-sufficiency includes only producing the amount of energy that the dwelling needs, and minimizing the toxicities in active generators and their production. By finding the estimated energy required for the average single-family detached household, there exists a control with which to ensure the availability of this energy off-grid to further operate with the environment. This can be attained by locating useful atmospheric conditions to generate a low net energy house which functions with its own direct resources. An investigation of several existing climate-oriented building can test these ideas, as well as implementing software in the testing of future design proposals. Becoming familiar with new applications of energy technology can help to redefine the requirements for human activity at home.

Form

When configuring also according to the fragility of one specific climate, the needs of both people and the natural environment can avoid being compromised. To ensure this, the home requires a spatial relationship to the landscape that will push an architectural identity. By proposing a compact layout restricting itself to the needs of the ‘reconstituted family’ (6), wasted space can be avoided. The home has inevitably become a form based on need instead of geometry (7). This form can ultimately provide for a spatial under-
A home’s formal strategy should push for an interpretation of living in the country by remaining minimal in construction materials and human impact.

standing of the necessities of the home without overpowering the uniqueness of a landscape. Peggy Deamer shares her idea of nature encroaching on the home in more of her book. Here she states, “The traditional house was conceptually a square with sides that held out the landscape. Through time, the square has evolved into an X that allows nature to work itself into the form. Eventually the X will also dissolve” (8). This ideal helps to summarize the response of architecture to the shifting cultural acknowledgement of the environment.

A home’s formal strategy should push for an interpretation of living in the country by remaining minimal in construction materials and human impact. A new interpretation of the living countryside will be exemplified by remaining spatially compact for the home’s interior. This will maintain the American ideal of simple elegance and comfort. As Rybcynski supports, it is easier to perform chores and execute domesticity in a smaller home, and it actually becomes more comfortable when simply minimizing but maintaining the needed materials of a larger house (9). Organizing sequence and programmatic planning based on the necessary functions of the home should help to begin a proper analysis. Furthermore, a study of existing dwellings based on spatial compactness or relative programming can continue to push this concept in architecture. As people configure their living arrangements according to their needs and cultural means, their world may be accommodated. This is why it is essential to programatically develop what would work best for the internal space and external environment. The spatial landscape can simplify the view of daily life based on a new concept of home.

Technological advancements may help to develop a light footprint on a delicate ecosystem. Incorporating a minimal square footage with passive or active energy for the lifecycle strategy of the dwelling’s performance can ultimately lower the carbon footprint of the home in significant numbers. The study of low energy can ensure that the house is not creating a high toxic impact on the landscape, as in essence becoming a part of it and coexisting. Statistics can provide a general understanding of average necessities throughout different parts of the U.S. and narrow even further to needs per square foot. These facts should be able to balance better with passive design strategies to express less of a need for an energy grid and more dependence on natural energy available. This investigation most importantly involves the study of specified climate information per developing site which can activate an internalized machine that can run on the provided organic complements.
The goal is to exhibit in a house the investigation pursued within [four] separate climates. The home should maintain a symbol of freedom for the American homeowner by celebrating the landscape in a way which will also impact it as little as possible. Being introduced to such solitary places will inherently heighten one’s awareness of their personal carbon footprint, and practice this awareness in their daily lives.

Site

Home as a personal place is given Identity based on a series of variables; a similar way in which a particular landscape can demonstrate the internalized logic and uniqueness within a larger natural environment. Since the natural terrain and climate differs greatly across the country, the United States can provide dynamic propositions of the home. For this reason, I have chosen four climates of varying atmospheric and landscape conditions to exemplify the dynamics of this study. In turn, this introduces a new position for the cultural home through the interface of dwelling design.

First, attempting a relationship with the climate of the northern Adirondack Mountains in New York can provide a template for colder climates. There are temperatures in Saranac Lake, for example, that show a regular low in response to several attributes of the location such as humidity and elevation which signifies it as one of the coldest parts of the country (11). The cold and snow are probably the most influential weather characteristics. Wind speed depends on location around the mountains. There is not a significant amount of direct sunlight and so it is a challenge to maximize the intensity of it for heating. Temperatures of underground are around 47 degrees year-round. These factors define a very unique site in itself which requires the home design to keep warm and dry, relating to the particular place of study.

The mountains also provide for an interesting geological makeup and exclusive spaces. They are geologically the oldest part of the Appalachian range. They were lifted, folded, and broken by the tectonics of the earth during the Tertiary period and then carved by glacial ice erosion 1.6 million years ago. The peaks have some younger rock types exposed at the top because of this. Also carved
The distinctive qualities of such a place create an attractive setting for a new spatial tectonics and materialistic house design.

out are long linear valleys, curved ridges and radial drainage patterns off of the higher elevations from rainwater and snowmelt (12). For this reason, the geological makeup and tectonics of the terrain also share an abundance of natural building materials, especially in masonry and details. The distinctive qualities of such a place create an attractive setting for a new spatial tectonics and materialistic house design.

Kansas weather is equally as interesting in its varying temperatures and sparse precipitation. This argues a less evident goal for climate response, although the wind speeds are some of the highest velocities in the states. Mostly dry, the site in the Smoky Hills still hosts some prevailing grass and vegetation. Comfort levels are less static because of the dynamics of this climate, with often cold winters but otherwise manageable temperatures throughout the year. This poses a challenge for maintaining a fluid environment as part of a building proposal.

The landscape of this state is responsive to the climate information provided. Several regions within Kansas characterize the rolling hills or lowlands of the terrain worn by wind and glaciers. The settlements have also been determined by what is beneath the surface. There has been much mining throughout to provide for local energy, minerals, and building materials because of the valuable materials in the ground. The abundance of limestone, for example, can be utilized in building design both as a quality modulated characteristic but also as an extension of the land enveloping it.

Opposite points can be addressed in the environmental aspects of the Salt River area in Maricopa County, Arizona. The air is arid and consistently warm in temperature. Around the valley, the precipitation rate can be below 7 inches a year, contributing to a dry environment. As the temperatures rarely drop to in January, winters are considered mild. This could also be attributed to the 80% average sunshine throughout the year, making conditions especially hot in the summers. The extreme heat and lack of moisture produces a distinctive atmosphere for this site that needs to be addressed in the buildings which inhabit it.

Also, the forming landscape reflects this in physical characteristics, providing dry grounds and little vegetation in many parts of the countryside. The mountains that run northwest to southeast transition from the northern plateau introduce the lowlands and river val-
leys in between. At certain times of year, this basin and ridge region has enough flowing water to plant crops in some areas. The river system itself introduces another potential to the physical environment as it provides a lush environment directly at its banks. Also important to the geology is the historical volcanic activity of the site. These make up much of the mountainous areas and have therefore had an effect on the exposed and excavated materials (13). This site proves itself a unique location for physical and genetic architectural counterpart.

Perhaps a very humid, hot climate can help to round-out the existing variables. While Florida’s weather is constantly hot and humid, the Everglades and surrounding areas are of the most difficult to sustain human activity outside during much of the summer. The sun is too hot to be exposed to for long periods of time, so it is important to protect from this in dwelling design. Different cooling tactics from those in Arizona need to be implemented because of the humidity in Florida and the abundance of water.

The Lake Okeechobee area changes its physical appearance and experience throughout the year. Since there is a profusion of wetlands and relative plant growth, building proposals in this landscape also become a challenge and an isolated entity. The waters rise and fall up through the Everglades and affect the quality of the ground surface. For this reason building on or sub-surface is not plausible as a cooling strategy, but there are studies for alternatives.

Designing for each climate should express distinctive reasoning based on local facts. This is essential to the argument of establishing home in the country. There are great examples of passive suggestions provided by several sources, but educational climate analysis software can also be efficient in formalizing basic comfort strategies in architecture pertinent to a specified site. Site is the greatest influence for a passive architecture of uniform language and a naturally articulated countryside.

It is my goal to manifest the character of each particular site into a personal place. Compiling proper and relative research for four climates can test a set agenda for a new American Home. By prioritizing climate and contextualizing the natural environment, domestic life can be re-introduced as an internalized part of the landscape.
Active energy: technologies employed to convert [solar] energy into another more useful form of energy (1).
- Natural energy converted into home energy using active mechanics.

Activity: a specific deed, action, function, or sphere of action (2).
- The occurrences among humans as they undergo their daily routines with natural energy.

Builtscape – A landscape contextualized by the built environment.

Function: The natural action or intended purpose of a person or thing in a specific role: the function of a hammer is to hit nails into wood (2).

Harmonized: In agreement in action, sense, or feeling (2).
- Of the same language and physical/spatial reading

Machinery – The systems integrated into a building so as to maintain comfort for inhabitants (HVAC)

Passive energy (climatic energy): doesn’t involve the use of mechanical and electrical devices.

Private space – Spaces designated for privacy.

Program – In architecture, the use of a place or building.

Service space – Spaces used for the storage and maintenance of a particular building.

Sustainable: Capable of being maintained at a steady level without exhausting natural resources or causing severe ecological damage (2).
## Schedule for Design

### Plan A (x 4)

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<thead>
<tr>
<th>Step</th>
<th>Plan A</th>
<th>Alternative Plan</th>
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<td>Energy performance test</td>
<td>![X]</td>
<td>![X]</td>
</tr>
</tbody>
</table>
The Home

Today in America

1) Deamer, 108

2) D&R International, 2-5, 2-7, 2-8, sourced from EIA, A Look at Residential Energy Consumption in 2005, June and October 2008, Table US-1 part 1, Table HC 1-1-2, Table US-1 part 1, Table US-14 and Table US-4.

2005 Delivered Energy End-Uses for an Average Household, by Region (million Btu per household)

<table>
<thead>
<tr>
<th>Type</th>
<th>Northeast</th>
<th>Midwest</th>
<th>South</th>
<th>West</th>
<th>National</th>
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<tbody>
<tr>
<td>Space Heating</td>
<td>69.8</td>
<td>56.5</td>
<td>20.9</td>
<td>25.2</td>
<td>39.3</td>
</tr>
<tr>
<td>Space Cooling</td>
<td>4.6</td>
<td>6.3</td>
<td>14.7</td>
<td>7.7</td>
<td>9.8</td>
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<tr>
<td>Water Heating</td>
<td>21.8</td>
<td>20.2</td>
<td>15.8</td>
<td>20.8</td>
<td>19.0</td>
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<tr>
<td>Refrigerator</td>
<td>4.5</td>
<td>5.1</td>
<td>4.9</td>
<td>4.4</td>
<td>4.8</td>
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<tr>
<td>Other Appliances &amp; Lighting</td>
<td>23.7</td>
<td>26.8</td>
<td>25.8</td>
<td>24.9</td>
<td>25.5</td>
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<tr>
<td>Total (1)</td>
<td>120.5</td>
<td>113.5</td>
<td>80.9</td>
<td>77.6</td>
<td>95.0</td>
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Note(s): 1) Due to rounding, sums do not add up to totals.

2005 Residential Delivered Energy Consumption Intensities

<table>
<thead>
<tr>
<th>Census Region</th>
<th>Per Square Foot (thousand Btu)</th>
<th>Per Household (million Btu)</th>
<th>Per Household Members (million Btu)</th>
<th>Percent of Total Consumption</th>
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<tbody>
<tr>
<td>Northeast</td>
<td>51.6</td>
<td>120.5</td>
<td>47.0</td>
<td>23%</td>
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<tr>
<td>Midwest</td>
<td>46.9</td>
<td>113.5</td>
<td>46.0</td>
<td>28%</td>
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<tr>
<td>South</td>
<td>37.5</td>
<td>80.9</td>
<td>32.1</td>
<td>31%</td>
</tr>
<tr>
<td>West</td>
<td>43.5</td>
<td>77.6</td>
<td>28.1</td>
<td>18%</td>
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<tr>
<td>Type</td>
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<tr>
<td>Detached</td>
<td>39.8</td>
<td>108.3</td>
<td>39.7</td>
<td>73.9%</td>
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</table>

2006 Residential Primary Energy End Use

- space heating 26.4%
- space cooling 13%
- water heating 12.5%
- lighting 11.6%
- electronics 8.1%
- refrigeration 7.2%
- wet clean 6.2%
- cooking 4.7%
- computers 1%
- other 3.6%
- adjust to SEDS 5.7%
home utilizing energy grid

home utilizing local off-grid energy
The Home

Today in America

Spatial Study

1) Wentling, 3
2) Deamer, 108

WENTLING'S ANALYSIS OF COMPONENT BLOCKS FOR YOUNG SINGLE PARENT HOUSEHOLDS EXPRESSES A SIMPLIFIED SPATIAL REQUIREMENT FOR THE HOME TO PRESENT.

COMMUNITY COMPONENT
COOKING, EATING, GATHERING

SQUARE FOOTAGES:
COOKING = 175
EATING = 40
GATHERING = 500

PRIMARY PRIVACY COMPONENT
MAIN BED AND STUDIO

SQUARE FOOTAGES:
BED & BATH = 220
STUDIO = 80

SECONDARY PRIVACY COMPONENT
GUEST OR CHILDREN'S BED

SQUARE FOOTAGES:
BED & BATH = 185

THE MATURE FAMILY HOUSEHOLD INTRODUCES COMPONENTS WHICH EXPAND THE HOME PROGRAMMATICALLY FOR THE LUXURY OF CULTURAL FORMALITIES.

Basic components of the household can be estimated to 1200 ft² and so be minimal in extra open space but spatially sound.

14 cubic feet = the amount of air breathed in 1 hour.

125 cubic feet

1,000 cubic feet

2) D&R International, 2-8, sourced from LBNL, Residential Heating and Cooling Loads Component Analysis, Nov. 1998, Figure P-1, P-1 and Appendix C: Component Loads Data Tables.

### 2006 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

<table>
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<tr>
<th>Energy End-Use</th>
<th>Natural Gas</th>
<th>Oil</th>
<th>LPG</th>
<th>Other Renew.</th>
<th>Site En.(2)</th>
<th>Other Total</th>
<th>Electric (3)</th>
<th>Percent</th>
<th>site Total</th>
<th>Electric</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Heating (4)</td>
<td>3.13</td>
<td>0.60</td>
<td>0.23</td>
<td>0.08</td>
<td>0.41</td>
<td>0.33</td>
<td>4.78</td>
<td>44.3%</td>
<td>1.05</td>
<td>5.51</td>
<td>26.4%</td>
</tr>
<tr>
<td>Space Cooling</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.85</td>
<td></td>
<td></td>
<td>0.85</td>
<td>7.9%</td>
<td>2.70</td>
<td>2.70</td>
<td>13.0%</td>
</tr>
<tr>
<td>Water Heating</td>
<td>1.08</td>
<td>0.10</td>
<td>0.06</td>
<td>0.01</td>
<td>0.42</td>
<td>1.67</td>
<td>15.5%</td>
<td>1.34</td>
<td>5.29</td>
<td>2.59</td>
<td>12.5%</td>
</tr>
<tr>
<td>Lighting</td>
<td>0.76</td>
<td></td>
<td></td>
<td>0.76</td>
<td></td>
<td></td>
<td>0.76</td>
<td>7.0%</td>
<td>2.41</td>
<td>2.41</td>
<td>11.6%</td>
</tr>
<tr>
<td>Electronics (5)</td>
<td>0.53</td>
<td></td>
<td></td>
<td>0.53</td>
<td></td>
<td></td>
<td>0.53</td>
<td>4.9%</td>
<td>1.69</td>
<td>1.69</td>
<td>8.1%</td>
</tr>
<tr>
<td>Refrigeration (6)</td>
<td>0.47</td>
<td></td>
<td></td>
<td>0.47</td>
<td></td>
<td></td>
<td>0.47</td>
<td>4.4%</td>
<td>1.50</td>
<td>1.50</td>
<td>7.2%</td>
</tr>
<tr>
<td>Wet Clean (7)</td>
<td>0.07</td>
<td></td>
<td></td>
<td>0.38</td>
<td></td>
<td></td>
<td>0.46</td>
<td>4.2%</td>
<td>1.22</td>
<td>1.30</td>
<td>6.2%</td>
</tr>
<tr>
<td>Cooking</td>
<td>0.22</td>
<td>0.03</td>
<td></td>
<td>0.23</td>
<td></td>
<td></td>
<td>0.48</td>
<td>4.4%</td>
<td>0.7</td>
<td>0.98</td>
<td>4.7%</td>
</tr>
<tr>
<td>Computers</td>
<td>0.07</td>
<td></td>
<td></td>
<td>0.07</td>
<td></td>
<td></td>
<td>0.07</td>
<td>0.6%</td>
<td>0.21</td>
<td>0.21</td>
<td>1.0%</td>
</tr>
<tr>
<td>Other (8)</td>
<td>0.00</td>
<td>0.15</td>
<td>0.00</td>
<td>0.19</td>
<td></td>
<td></td>
<td>0.34</td>
<td>3.2%</td>
<td>0.61</td>
<td>0.76</td>
<td>3.6%</td>
</tr>
<tr>
<td>Adjust to SEDS (9)</td>
<td>0.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.37</td>
<td>3.5%</td>
<td>1.19</td>
<td>1.19</td>
<td>5.7%</td>
</tr>
<tr>
<td>Total</td>
<td>4.50</td>
<td>0.70</td>
<td>0.47</td>
<td>0.08</td>
<td>0.43</td>
<td>4.61</td>
<td>10.79</td>
<td>100%</td>
<td>14.65</td>
<td>14.65</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Aggregate Residential Building Component Loads as of 1998 (1)

<table>
<thead>
<tr>
<th>Component</th>
<th>Heating (quads) and Percent of Total Loads</th>
<th>Cooling (quads) and Percent of Total Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof</td>
<td>-0.65 [12%]</td>
<td>0.16 [14%]</td>
</tr>
<tr>
<td>Walls</td>
<td>-1.00 [19%]</td>
<td>0.11 [10%]</td>
</tr>
<tr>
<td>Foundation</td>
<td>-0.76 [15%]</td>
<td>-0.07</td>
</tr>
<tr>
<td>Infiltration</td>
<td>-1.47 [28%]</td>
<td>0.19 [16%]</td>
</tr>
<tr>
<td>Windows (conduction)</td>
<td>-1.34 [26%]</td>
<td>0.01 [1%]</td>
</tr>
<tr>
<td>Windows (solar gain)</td>
<td>0.43 [ - ]</td>
<td>0.37 [32%]</td>
</tr>
<tr>
<td>Internal Gains</td>
<td>0.79 [ - ]</td>
<td>0.31 [27%]</td>
</tr>
<tr>
<td>Net Load</td>
<td>-3.99 [100%]</td>
<td>1.08 [100%]</td>
</tr>
</tbody>
</table>

a) Kerosene and coal are assumed attributable to space heating.  
b) Comprised of wood space heating, solar water heating, geothermal space heating, and solar PV.  
c) Site-to-source electricity conversion (due to generation and transmission losses) = 3.18.  
d) Includes furnace fans.  
e) Includes color television and other office equipment.  
f) Includes refrigerators and freezers.  
g) Includes clothes washers, natural gas clothes dryers, electric clothes dryers, and dishwashers. Does not include water heating energy.  
h) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.  
i) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential buildings sector, but not directly to specific end-uses.

j) "Loads" represents the thermal energy losses/gains that when combined will be offset by a building's heating/cooling system to maintain a set interior temperature (which then equals site energy).
Climate 1: New York

Mount Morris, Franklin County

1) http://geology.com/

http://www.shaded-relief.com/

2) Cushing, landform diagrams.

Adirondack uplift (2)

faulting

glacial erosion
Climate 1: New York
Mount Morris, Franklin County

http://instruct.uwo.ca/earth-sci/fieldlog/Grenville/Adirondacks.htm
http://www.nyfalls.com/maps-topo-100000.html#Tupper_Lake

time zone: UTC+5
latitude: 44.17° N
longitude: 74.48° W

YA - anorthosite-igneous rock type
YGB - gabbro-diorite (iron rich)
YG - granite
YCH - charnokites
Y-UI - ultramafic rocks
YGG - granite gneiss
YPG - paragneiss

YC - marbles (stromatolitic at some localities in the Balmat area)
YMV - amphibolites (metavolcanics)
YQ - quartzites
YMI - migmatites
CP = Cambrian Potsdam Sandstone unconformable on Grenville age rocks

2000 ft, site plan: 80' topos

section A

section B

section C
Climate 1: New York
Mount Morris, Franklin County

Site & Geology
- time zone: UTC+5
- latitude: 44.17° N
- longitude: 74.48° W

Inventory of Carbon and Energy

Hardwood
- makeup: air dried / roughsawn
- embodied energy (MJ/kg): 0.50
- availability: managed forests

Softwood
- makeup: sawn trees
- embodied energy (MJ/kg): 0.50
- availability: managed forests

Aggregate
- makeup: gravel and stones
- embodied energy (MJ/kg): 0.083
- availability: most local sites

Flagstone
- makeup: local stone
- embodied energy (MJ/kg): 1.29
- availability: most local sites

Granite
- makeup: local stone
- embodied energy (MJ/kg): 11.0
- availability: see geological map

Cobblestone
- makeup: local stone
- embodied energy (MJ/kg): 1.29
- availability: most local sites

Blown Cellulose
- makeup: recycled paper/other
- embodied energy (MJ/kg): 0.94
- availability: see geological map
By investigating the characteristics of this climate, building tactics can be established to execute a responsive home. This way, the building can be a spatial argument with close attention to materials that allow it to be a part of the natural landscape.

It is important to also explore the comfort levels within the seasonal changes provided, because this will help determine the performance of the home in terms of utilizing or protecting from the outside weather.
Climate 1: New York

Mount Morris, Franklin County

time zone: UTC+5
latitude: 44.17° N
longitude: 74.48° W

Suggested Passive Strategies

- using trees or earth as wind protection can be effective and contextualize with the natural landscape

-suggested location for shelter in cold climates -should shift in response to local wind patterns etc.

- having a buffer zone between sunspace and living quarters can help keep warm

- permissible range of orientation for south glazing

(2) 5) Lechner 123
(3) Lechner 114
(4) Lechner 122

- comfortable temperatures can be maintained through passive design by submerging some of the home into the landscape.
Climate 1: New York

Autodesk Ecotect Analysis Program Studies

Tested Formal Strategies

1200 ft² double story 1200 ft² single story

- one south window
- north-south windows
- east-west windows

Additional Passive Tests

- thicker walls with insulation

<table>
<thead>
<tr>
<th>Granite</th>
<th>Concrete Block</th>
<th>Timber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best</td>
<td>Okay</td>
<td>Worst</td>
</tr>
</tbody>
</table>

Additional Climates

- Metal roof
- Clay tile roof
- Earthen roof
Grandma’s House
Donna Kentile
Tupper Lake, NY

1/16" = 1'

floor plan

1/64" = 1'-0"

site plan

10° F

section a

47° F

open community

private sleeping
Skrudas Residence

Studio Granda
Raykjavik Iceland 64° N

Decker, drawings and photos.

- open community
- semi-private service
- private sleeping

- section showing bottom floor below frost line for insulation supplement, as well as public and private spaces around core

- inside to outside spaces relative to circulation
- simplified idea of sleeping quarters to shared hearth
Nearpoint House
Workshop for Architecture and Design
Anchorage Alaska 61° N


- main spaces in relation to circulation

- open community
- semi-private service
- private sleeping

- summer and winter sun angles
- northern wall insulation strategy

Decker, drawings and photos.
Kansas’ landscape is characterized into several different regions. These regions help to distinguish the patterns of the state’s terrain between borders, as each hold a different spatial quality, material makeup, and weather impact which evoke a particular sense of place.

Below expresses a more detailed profile of the Smoky Hills, within which is the area under further investigation.
Climate 2: Kansas
Saline River Valley, Smokey Hills, Ellis County
http://www.greenspec.co.uk/embodied-energy.php

Foundation & Structure          Additive Finishes
Limestone block
makeup: calcite and aragonite
embodied energy (MJ/kg): 0.85
availability: supplied in Phoenix

Sandstone
makeup: local stone
embodied energy (MJ/kg): 0.79
availability: state-wide

Aggregate
makeup: gravel and stones
embodied energy (MJ/kg): 0.083
availability:

Sand and gravel
use: foundation construction
embodied energy (MJ/kg): 0.083
availability:

Shale
use: bricks and cement
makeup: local stone
embodied energy (MJ/kg): 0.03
availability: state-wide

Climate 2: Kansas
Saline River Valley, Smokey Hills, Ellis County
http://www.greenspec.co.uk/embodied-energy.php

Site & Geology

Saline River Valley, Smokey Hills, Ellis County
time zone: UTC+6
latitude: 39° 07' 59" N
longitude: 99° 07' 30" W

Site plan: 40' topos

1000 ft

section A

section B

section C

Climate 2: Kansas
Saline River Valley, Smokey Hills, Ellis County
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Site plan: 40' topos

1000 ft

section A

section B

section C

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Site plan: 40' topos

1000 ft

section A

section B

section C
Climate 2: Kansas
Saline River Valley, Smokey Hills, Ellis County

- **Foundation & Structure**
  - **Sandstone**
    - Makeup: local stone
    - Embodied energy (MJ/kg): 0.79
    - Availability: state-wide
  - **Limestone block**
    - Makeup: calcite and aragonite
    - Embodied energy (MJ/kg): 0.85
    - Availability: supplied in Phoenix
  - **Aggregate**
    - Makeup: gravel and stones
    - Embodied energy (MJ/kg): 0.083
    - Availability: 
  - **Sand and gravel**
    - Use: foundation construction
    - Embodied energy (MJ/kg): 0.083
    - Availability: 

- **Additive Finishes**
  - **Shale**
    - Use: bricks and cement
    - Makeup: local stone
    - Embodied energy (MJ/kg): 0.03
    - Availability: state-wide

---

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Saline River Valley, Smokey Hills, Ellis County

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http://www.greenspec.co.uk/embodied-energy.php
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Climate 2: Kansas
Saline River Valley, Smokey Hills, Ellis County

time zone: UTC+6
latitude: 39°07'59"N
longitude: 99°07'30"W

1) http://www.city-data.com/city/Kansas-City-Kansas.html
2) Lechner, 81.
3) Lechner, 187.
4) Lechner, 114.

- wind direction can be shifted using vegetation or deflecting walls
- maintain solar orientation

-suggested location for shelter in climate of hot summers / cold winters
-should shift in response to local wind patterns etc.

- prime technique if home needs 3 square feet of mass for each square foot of glazing (4)
Climate 2: Kansas

Autodesk Ecotect Analysis Program Studies

- 1200 ft² double story
- 1200 ft² single story
- one south window
- north-south windows
- east-west windows

Best
Okay
Worst

Additional Passive Tests

- sub-surface heating
- thicker walls with insulation

Materials:
- Sandstone
- Limestone Block
- Concrete Block
- Metal roof
- Clay tile roof
- Earthen roof
Kansas Longhouse
Rockhill and Associates
Douglas County, Kansas

- floor plan showing cooler north wall and southern sun exposure
- exterior is finished with local limestone on corrugated metal siding
- sod roof increases insulation
- insulated wall on north side with built-ins for storage and insulation
- winter and summer sun paths with floor reflection to warm interior

- idea of circulation zones around major spaces
- open community
- semi-private service
- private sleeping
Villa in Archipelago

Tham & Videgård Hansson Architects
Stockholm, Sweden 59° N

- timber construction expresses the natural materials of the site
- reflective quality of glass is a response to the lake at the south (1)

- open community
- semi-private service
- private sleeping

- floor plan showing southern sun exposure and form in response to western winds
- framework for wind support
- interior envelope within

- each interior space has its own wooden deck complement

- diagrammatic section showing lateral support for the windy climate (1)
semi-private service
private sleeping

- trough to collect water and discharge into steel funnels at east and west
- also acts as a spine for each end and the external envelope of the home
Climate 3: Arizona

Salt River, Maricopa County

- Time zone: UTC+7
- Latitude: 33° 22’ 52” N
- Longitude: 112° 18’ 47” W

1) http://www.shaded-relief.com/
2) Smiley: diagrams of land formations relative to the state of Arizona.

Landform types in Arizona:

- A. Lava flow
- B. Inverted topography
- C. Lava mesa

[Map of Arizona showing landform types]
Climate 3: Arizona
Salt River, Maricopa County

Site & Geology

3) http://services.usgin.org/azgs/geologic-map-arizona.html

time zone: UTC+7
latitude: 33° 22' 52" N
longitude: 112° 18' 47" W

Geological map of larger site in Gila County - contents (3)

Qm - moderately bedded gravel and sand, and basin-floor deposits are primarily sand, silt, and clay

Qo - Coarse relict alluvial fan deposits that form rounded ridges or flat, isolated surfaces that are moderately to deeply incised by streams. These deposits are generally topographically high and have undergone substantial erosion

Tsy - consolidated conglomerate and sandstone deposited in basins during and after late Tertiary faulting; includes lesser amounts of mudstone, siltstone, limestone, and gypsum

Tv - compositionally variable volcanic rocks include basalt, andesite, dacite, and rhyolite

Xmv - Weakly to strongly metamorphosed volcanic rocks. Protoliths include basalt, andesite, dacite, and rhyolite deposited as lava or tuff, related sedimentary rock, and shallow intrusive rock

Yq - Brown to maroon, resistant quartzite and minor conglomerate of the Mazatzal Group

Yd - Dark gray to black sills (intrusions mostly parallel to bedding) in strata of the Apache Group and irregular to sheet-like intrusions in other rocks

Yg - granite with large microcline phenocrysts, with local fine-grained border phases and aplite

Ys - Red-brown shale and sandstone, buff to orange quartzite, limestone, basalt, black shale, and sparse conglomerate
Carbon is released throughout the lifecycle of a material through its initial extraction manufacturing, and transportation to building site. This is recognized as the material’s embodied energy.

This index includes locally found materials only. This is why conventional building materials are not listed as part of this investigation.
Climate 3: Arizona
Salt River, Maricopa County

By investigating the characteristics of this climate, building tactics can be established to execute a responsive home. This way, the building can be a spatial argument with close attention to materials that allow it to be a part of the natural landscape.

It is important to also explore the comfort levels within the seasonal changes provided, because this will help determine the performance of the home in terms of utilizing or protecting from the outside weather.

2) With much testing, it is proven that people would rather interiors to correlate with the clothing tempered for the outside weather, rather than remove layers (Buchanan 30).

By investigating the characteristics of this climate, building tactics can be established to execute a responsive home. This way, the building can be a spatial argument with close attention to materials that allow it to be a part of the natural landscape.

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Climate 3: Arizona

Suggested Passive Strategies

1) Lechner, 96: interpreting solar charts and orientation.
2) Even ten feet underground approximates a warmer temperature than the surface because it increases wind protection and insulation performance.
3) Lechner, 200-205. Vertical ventilation is most efficient (Lechner 2)
4) Lechner, 87.
5) Lechner, 111: passive solar building with massive walls.

Passive Design Considerations (cooling):

- comfortable temperatures can be maintained through passive design by submerging some of the home into the landscape (2)

- surface of the ground can be cooled dramatically by adding shade and evaporative cooling. (3)

- avoid placing materials in front of window which would provide a good angle for UV penetration (4)

- temperature swing with low-mass walls
- temperature swing with high-mass walls

example outdoor temperature

comfort zone

- suggested location for shelter in hot and humid climates
- should shift in response to local wind patterns etc.

Salt River, Maricopa County

time zone: UTC+7
latitude: 33° 22' 52" N
longitude: 112° 18' 47" W

Salt River, Maricopa County

latitude: 33° 22' 52" N
longitude: 112° 18' 47" W
Climate 3: Arizona

Autodesk Ecotect Analysis Program Studies

Best  Okay  Worst

1200 ft² double story  1200 ft² single story

- short edge south
- north-south windows
- east-west windows

Additional Passive Tests

- evaporative cooling
- sub-surface cooling
- trees for shading
- thicker walls with insulation

Rammed Earth
Concrete Block
Brick Masonry
Metal roof
Clay tile roof
Earthen roof

3: Arizona

Metal roof
Clay tile roof
Earthen roof

- trees for shading
- thicker walls with insulation
Douglas and Ruth Murcutt House

Glenn Murcutt
Woodside, South Australia

Fromonot, drawings and photo.

- main spaces (garden as one) with circulation between

- section showing south wall as buffer, roof overhangs for shading and water collection

- plan showing south wall as buffer, roof overhangs for shading and water collection

open community
semi-private service
private sleeping
Mountain House

Rick Joy Architects
Tucson, AZ

1) Grayson
2) Joy, 135

Its location in a small valley with ridges protectively flanking it in the Sonoran Desert.

The north and south walls stand sixteen feet high and two feet in thickness. (2)
Anasazi Cliff Dwellings
Native Americans known as Pueblo Peoples found home in the mountains
Arizona, Colorado, New Mexico, and Utah

http://www.sagarmatha.com/galleries/UnitedStates.html
http://www.mountainsofstone.com/mesa_verde.htm
http://www.thefurtrapper.com/Hole_Rock.htm

Historical Precedent

sectional diagram- not to scale

stones directly from cliff site
[window] left open for view and ventilation
Climate 4: Florida
Moonshine Bay, Glades County

1) Randazzo, diagram of landscape.
Climate 4: Florida
Moonshine Bay, Glades County

Time zone: UTC+5
Latitude: 26° 52' 30" N
Longitude: 81° 07' 30" W

Site & Geology

Qu- unfossiliferous, variably organic-bearing sands to blue green to olive green, poorly to moderately consolidated, sandy, silty clays
Tt- limestone, sand, clay
Qh- sand, clay, organics
Qm- limestone, sand
TQsu- shelly sediments, limestone, sand, clay or mud
Qa- limestone, coquina, sand
Qbd, TQd- sand
TQuc- sand, clay
Thp- sand, clay, dolostone,

1) Randazzo, chart.
www.usgs.gov

Geological map of larger site contents (3)

section A

section B

section C

- darker section is deepest contour of cut
Climate 4: Florida
Moonshine Bay, Glades County

Building Materials
http://www.greenspec.co.uk/embodied-energy.php
http://www.dep.state.fl.us/geology/geologictopics/minerals.htm

Foundation & Structure

Southern Yellow Pine
use: timber framing
makeup: local trees
embodied energy (MJ/kg): 9
availability: state-wide

Crushed limestone
use: road aggregate/masonry
embodied energy (MJ/kg): 0.62
availability: state-wide

Sand and gravel
use: foundation construction
embodied energy (MJ/kg): 1.0
availability: state-wide

Additive Finishes

Clay
use: brick, cement, and lightweight aggregate
embodied energy (MJ/kg): 3.0
availability: most local sites

Gumbo Limbo
use: light framing, wind protection, live fence posts
embodied energy (MJ/kg): 7.4
availability: state-wide
By investigating the characteristics of this climate, building tactics can be established to execute a responsive home. This way, the building can be a spatial argument with close attention to materials that allow it to be a part of the natural landscape.

It is important to also explore the comfort levels within the seasonal changes provided, because this will help determine the performance of the home in terms of utilizing or protecting from the outside weather.
Climate 4: Florida
Moonshine Bay, Glades County

- Walls and vegetation can be used to alter wind direction so as to maintain orientation (3)

- Oblique air stream covers more of the room (2)

- The surface of the ground can be cooled by allowing breezes to run underneath the building (1)
- Keep trees tall enough to shade and allow breeze (6)

- Suggested location for shelter in hot and humid climates

- The shading from trees depends on the species, pruning, and maturity of the plants. Transmission can be as low as 20% in the summer and as high at 70% in the winter
- Vines are effective sun shading devices (5)

- If inlets and outlets cannot be the same size then the inlet should be smaller to maximize velocity (4)

- Many windows on all sides

- High canopy trees to block east and west sun but not wind (6)

1) Lechner, 200-205.
2) Lechner, 187.
3) Lechner,
4) Lechner, 191.
5) Lechner, 145.
6) Lechner, 244.

Time zone: UTC+5
Latitude: 26° 52' 30" N
Longitude: 81° 07' 30" W
Climate 4: Florida

Autodesk Ecotect Analysis Program Studies

Best
Okay
Worst

Additional Passive Tests

- Limestone block
- Brick Masonry
- Timber
- Metal roof
- Clay tile roof
- Earthen roof
- Trees for shading
- Thicker walls with insulation

1200 ft\(^2\) double story
1200 ft\(^2\) single story

- Short edge south
- North-south windows
- Short edge south
- East-west windows

- Long edge south
- North-south windows
- Long edge south
- East-west windows
Marika-Alderton House
Glenn Murcutt
Yirrkala Community, Eastern Arnhem Land, Northern Territory

Fromonot, 218.

- open community
- private sleeping

circulation with major spaces

excess shading for daily sun path

- house section showing breeze patterns, winter and summer sun angles and a cool underside
Holmes Residence
Dwight E. Holmes
Tampa, Florida

Hochstim, drawings and photos.

Spatial & Material Precedent

Done House Passive
Glenn Murcutt
Mosman, Sydney, New South Wales

- section showing passive water collection
- cooling
- natural lighting

Fromonot, drawings and photos.

Holmes Residence Spatial & Material Precedent
Done House
Glenn Murcutt
Mosman, Sydney, New South Wales

Fromonot, drawings and photos.

- section showing passive
  - water collection
  - cooling
  - natural lighting

Public & private
Courtyard as interior
Protection from south sun

“4 conditions to achieve a sustainable society,” and how to go about these. –Do not take more out of the crust of the Earth than can be replaced. –Do not use man-made materials which take a long time to decompose. –Maintain the conditions of nature to keep its production & its diversity. –Use resources efficiently & correctly to stop being wasteful.


Graphs showing energy use for construction and operation, an analysis of some building materials and their embodied energy, then the square footage of potential single family homes with their construction and operational footprint (99). Diagram of use of water resources or the movement of Qi (50). Details regarding the composition of active and passive solar systems (279), and the environmental outcome after the application of some natural materials (240).


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Sets up specific parameters for designing and environmentally sound home. Includes precedent examples which produce and conserve their own energy, and lastly has an example of a 4-house project within different climates which relate to the landscape in a materialistic and compact way.


Geological survey in Phillips County, Kansas and the construction materials which are directly derived from their geological makeup.


Visuals including a US map with variations in magnetic for sun exposure, etc.


Beautiful examples of houses in different sites built including different aspects which allow them to be relocated, redesigned, or potentially adapted to alternative climates. The major argument is that these homes are self-fabricated using local resources and machinery.
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Diagrammatic examples of underground house types and how to site them according to weather and climate. Deep underground temperatures in the United States along with regional issues of earth sheltered designs. Included diagrams of heat flows below grade and materials that will be available etc.


Provides some detail on the materials and techniques applied to green homes, with examples.

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Building at this moment in architectural time (10). [A] project is unique in its universality; referentially broad vs. unique and singular- open to variation (12). Site is generic in that it is typical of nature (12). Nature is a system, not a place (13). The final product is no more real, rich or rarified than the investigation leading to it (14). ‘Reconstituted households’ are discussed on page 44. The role of the house changes, and its secondary use is of longer duration.. provide the closure and security of dwelling (53). [We] should not separate from historical materials completely, as this new age continues to move forward & break away further from the first, most basic building blocks transposition is developed (Cache 18).


American homes have utilized the raw materials available on site. The designing of colonial homes have been influenced by their founders. The freestanding homes were developed by the rich or the peasants (cottages and hovels), and the middle class would crowd in cities and town centers. Cheap land on an expanding frontier and an inexhaustible supply of wood for building.
**Bibliography**


“Stop thinking about the city and the suburbs and the exurbs and the rural areas as separate entities and really consider them as united ecosystems.” (38)


Simpson, John W. *The Weathering and Performance of Building Materials.* New York, Wiley-Interscience 1970. Introduction of various building systems, light and heavy cladding and their tendencies to weathering. Also mentions geometry, orientation, detailing, and different types of pollution that can effect materials, as well as what happens with chemical attacks.


Spiegel, Ross. *Green Building Materials : A Guide to Product Selection and Specification.* Hoboken: J. Wiley & Sons, c2006. Details the cause of indoor air pollution, the impact that buildings have on the earth through their use of resources, and new ways in which to help such dire issues.


Shelter optimized for climate
As an American culture, we conduct dwelling in relation to landscape. In aggregate, the built becomes the landscape.

This book addresses Architecture’s role in the energy crisis, recognizing that residential buildings account for 53.7% of the built environment and their grided energy produces over 21% of United States’ carbon emissions*. This thesis begins to implement a process for design which can essentially optimize shelter based on climate, and further develop a local context for dwelling.

To cover a range of conditions, four different sites were chosen across the country and sampled in landform, geology, materials, and climate data. Then, this information was entered into [Ecotect] environmental analysis software to study the efficiencies of basic shape, sectional relation to ground, and glazing for surface areas. Ecotect measures thermal influences, such as solar gain and ventilation, to clarify a smart design approach for dwelling form in each climate. A baseline model was established for each, a stripped-down shape with equal ratio of glazing per surface area and an on-grade foundation structure. This was then compared to the optimal design, which builds upon the analysis, as well as performative devices to cater to thermal comfort throughout the year. Testing and diagramming such strategies is essential to clarify effective design. Each house has further been articulated in a formal and spatial argument which manifests its passive environmental performance.

Other design criteria was applied to maintain a low-impact appeal for the larger project. Each dwelling remains under 1,200 ft² and utilizes advanced framing techniques, while each envelope assembly is specific to local weather patterns and materials. HVAC is avoided by taking natural ventilation and thermal comfort measures for potential inhabitants. Keeping a basic form for each design will ensure less time and materials apply to construction, and on-site renewable energy and water sources are suggested for zero energy.

We have the ability to build our way out of this problem. Architecture takes the first step.

For the purposes of this thesis investigation, dwelling type will be limited to a series of rural, off-grid houses. This provides for a better focus and control in which to study a range of characteristics pertinent to specific limitations without being subject to existing built context.

The aerie of the eagle, the woven cradle of the oriole, the tunneled retreat of the field mouse, are all homes in the truest sense.” (Keeler, 1)
To find a freedom among differences has always been the goal of articulating the American style home: maintaining a value “of the country, for the country” (Smeins, 35).
**New York**

Mount Morris, Franklin County

- **time zone**: UTC -5
- **latitude**: 44.17° N
- **longitude**: 74.48° W

### Site

**Climate 1: New York**

- **latitude**: 44.17° N
- **longitude**: 74.48° W

#### Energy

- **Delivered energy** in 1200 ft² home (average): 7,068.5 Btu/hr

- **Space Heating**: 3.03% (passive energy performance)
- **Space Cooling**: 1.16% (passive energy performance)
- **Appliances/Lighting**: 2.5% (passive energy performance)
- **Water Heating**: 1.16% (passive energy performance)

#### Comfort Levels

- **Relative Humidity**
  - **Jan/Feb/Mar/Apr/May/Jun**: 50% E-W Glazing
  - **Jun/Jul/Aug**: 50% South Glazing
  - **Sep/Oct/Nov**: 95% South Glazing

- **Temperature**
  - **Jan/Feb/Mar/Apr/May/Jun**: 70°F
  - **Jun/Jul/Aug**: 80°F
  - **Sep/Oct/Nov**: 70°F

- **Wind Speed**
  - **Jan/Feb/Mar/Apr/May/Jun**: 20 mph
  - **Jun/Jul/Aug**: 20 mph
  - **Sep/Oct/Nov**: 20 mph

- **Sunlight**
  - **Jan/Feb/Mar/Apr/May/Jun**: 50% E-W Glazing
  - **Jun/Jul/Aug**: 50% South Glazing
  - **Sep/Oct/Nov**: 50% South Glazing

- **Degree Days**
  - **Jan/Feb/Mar/Apr/May/Jun**: 7,000
  - **Jun/Jul/Aug**: 0
  - **Sep/Oct/Nov**: 0

### Additive Fines

- **Coalite**: wildlife nest site
- **Aggregates**: most local sites
- **Flagstone**: availability: most local sites

### Foundation & Structure

- **Hardwood**
  - **Embodied energy (MJ/kg)**: 11.0
  - **Availability**: most local sites

- **Concrete**: 80% E-W Glazing
- **Stones**: 60% East Glazing
- **Bridges**: 25% South Glazing

### Building

- **Building envelope**: split face bricks
- **Global orientation**: NE

### Site Plan

- **Mount Morris, Franklin County**
- **Site plan**: 80’ topos

### Geology

- **Mountains in the Balmat area**
- **50 mi from site**

### References

- **Lechner**, p. 47.
The baseline model shows the chosen shape for this climate, while relatively it remains on grade and has an equal ratio of glazing for surface area on each wall. This will provide a product to compare against in an energy analysis.
Having the interior floor land beneath the frost line can maintain higher temperatures during winter weather.

An efficient fireplace can act as a secondary heat source as well as a centralized hearth for the home.

Orienting the greenhouse on the south facade can build up solar heat for the interior of the home during all times of the year.

By anticipating the snow load and utilizing its mass as a supplemental insulation layer, snow can help to keep heat inside.

While the greenhouse acts as a buffer zone during both warm and cold weather, it opens up to provide cross ventilation.

The greenhouse also has its own ventilation system so that it can function to grow plants and sustain life.

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Kansas

Saline River Valley, Smokey Hills, Ellis County
latitude: 39° 07' 59" N
longitude: 99° 07' 30" W
time zone: UTC+6

site: http://www.greenspec.co.uk/embodied-energy.php
materials: Lechner, 81, 114, 187.
climate conditions: Leichner, 66.

Climate 2: Kansas Site & Geology

Smoky Hills, within which is a detailed profile of the Kansas landscape. Below expresses a more in-depth treatment of utilization or protection from the outside weather. It is important to also explore the comfort levels within the seasonal climate to be a part of the natural landscape. By investigating the characteristics of this climate, building tactics can be developed that enhance the comfort and weather impact which make the particular region unique.

Kansas’ landscape is characterized by several different geographic regions. Each region has its own distinct climate, flora, and fauna. This diversity of environments helps to distinguish the patterns of the state’s natural resources from those of neighboring states.

Foundation & Structure

<table>
<thead>
<tr>
<th>Material</th>
<th>Make-Up</th>
<th>Embodied Energy (MJ/kg)</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>gravel and stones</td>
<td>0.083</td>
<td>foundation, construction</td>
</tr>
<tr>
<td>Limestone Block</td>
<td>limestone and dolostone</td>
<td>0.083</td>
<td>bricks and cement</td>
</tr>
<tr>
<td>Seed and gravel</td>
<td>sustainable wood</td>
<td>0.083</td>
<td>site plan: 40' topos</td>
</tr>
</tbody>
</table>

Additive Finishes

<table>
<thead>
<tr>
<th>Material</th>
<th>Embodied Energy (MJ/kg)</th>
<th>Makeup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shake</td>
<td>0.083</td>
<td>wood and natural fibers</td>
</tr>
<tr>
<td>Sand and gravel</td>
<td>0.083</td>
<td>wood and natural fibers</td>
</tr>
</tbody>
</table>

The home in terms of utilizing or protecting from the outside weather.

Climate: Kansas

Temperature

- Average morning humidity: 40%
- Average afternoon humidity: 60%
- Peak solar radiation: 200 W/m²
- Mean daily wind speed: 6 km/h
- Annual sunshine: 69%
- Cooling degree-days / year: 981
- Heating degree-days / year: 5,802

Comfort

- Relative humidity: 40% to 60%
- Temperature: 20°C to 25°C
- Wind speed for effective ventilation: 10 km/h
- Sunscreen:
  - 100% shade line
  - 80% shade line
  - 60% shade line
  - 40% shade line

Evaporative cooling: 100%
Comfort ventilation: 80%
Thermal comfort zone: 60%
Thermal comfort zone: 40%
The baseline model shows the chosen shape for this climate, while relatively it remains on grade and has an equal ratio of glazing for surface area on each wall. This will provide a product to compare against in an energy analysis.
Southern glazing allows the sun's rays to heat the interior during the winter season, while an operable curtain system creates a buffer zone when outside temperatures are too extreme.

The roof overhang prevents too much solar exposure during warm, summer weather.

Cross ventilation

- intense breeze (20+ mph)
- mild ventilation

average box fan ~ 2000 CFM = 10 mph
(www.hansenwholesale.com/ceiling-fans/ceiling-fan-wind-speed)

The heat stack acts as a ventilation system fed by extreme but common Kansas winds when cross ventilation would be too intense for living space.

Water collection

Solar heat - winter

Heat stack ventilation

Buffer zone - day, night

Shading - summer

Energy Provided by Passive Tactics

Baseline Optimized

Energy Provided by Passive Tactics

Summer cooling

Winter heating

form

performance

(top center) Floor plan 1/16" = 1'
(bottom center) South elevation 1/16" = 1'
(bottom left) Section B 1/16" = 1'
By investigating the characteristics of this climate, building tactics can be established to execute a responsive home. This index includes locally found materials only. This is why conventional building materials are recognized as the material’s embodied energy.

Carbon is released throughout the lifecycle of a material, which is a direct extraction of a nonrenewable resource (mining) and energy use during extraction, transportation, processing, construction, and eventual disposal. For any single material, the embodied energy is calculated as the energy required to produce the material, through its inherent makeup, as well as the energy used to transport it and to build the end product.

For example, sandstone deposits in basins during and after late Tertiary faulting; includes lesser amounts of mudstone, siltstone, limestone after late Tertiary faulting; includes lesser amounts of mudstone, siltstone, limestone. This index includes locally found materials only. This is why conventional building materials are recognized as the material’s embodied energy.
The baseline model shows the chosen shape for this climate, while relatively it remains on grade and has an equal ratio of glazing for surface area on each wall. This will provide a product to compare against in an energy analysis.

Douglas and Ruth Murcutt House

- Glenn Murcutt
- Woodside, South Australia

Mountain House

- Nick, Joy Murcutt
- Tucson, AZ

process

Hotest day (average) : August 1

*Ecotect Analysis Software

precedent

(Study 1) -Grayson, drawings. -Joy, drawings and photos.

(Study 2) -Proneton, drawings and photos.
Prevailing east-west winds in the Phoenix area provide a strategy for operable windows across the living spaces.

As the parasol provides shade for the living and outdoor space, it also acts as a buffer zone holding some solar and radiant heat above the roof surface of the house.

On windy days in this climate a heat stack can help pull heat from the dwelling as well as establish a structure for the operable shading device and water collection.

The rammed earth walls of this southwest dwelling absorb the heat from outside during the day and slowly release it at night.

Energy Provided by Passive Tactics

Baseline Optimized

-summer cooling
- winter heating

Baseline Optimized
structure

program

primary zones

Annual Sun Chart / Aerial View

Site plan 1/64" = 1'

Sectional Perspective (not to scale)
It is important to also explore the comfort levels within the seasonal variations in the outside weather. It can be a spatial argument with close attention to materials that allow it to be established to execute a responsive home. This way, the building design can take advantage of natural ventilation, high thermal mass, and evaporative cooling with night ventilation. The home in terms of utilizing or protecting from the outside weather can be established to execute a responsive home. This way, the building design can take advantage of natural ventilation, high thermal mass, and evaporative cooling with night ventilation.

### Weather & Comfort

- **Basic Climatic Condition**
  - Range of comfortable temperature: morning minimum temperature to average daily temperature to afternoon maximum temperature.
  - Range of comfortable humidity: average morning humidity to afternoon maximum humidity.
  - Cooling degree-days / year: 4,095
  - Heating degree-days / year: 199

- **Degree Days**
  - Heating degree-days / year: -180
  - Cooling degree-days / year: 1,078

- **Sunshine**
  - Average daily sunshine: 80%
  - Peak solar radiation: solar intensity per hour

- **Wind Speed**
  - Mean daily wind speed: 6.7 mph
  - Wind speed for effective natural ventilation: 10 mph

- **Relative Humidity**
  - Average morning humidity: 20%
  - Average afternoon humidity: 60%

- **Temperature**
  - Average daily temperature: 20°C
  - Morning minimum temperature: 16°C
  - Afternoon maximum temperature: 22°C

- **Horizonal ft = 1200 btu/day**
  - Vertical ft = 1600 btu/day

- **Shade Line**
  - Natural ventilation

- **Evaporative Cooling**
  - Mean daily wind speed
  - Wind speed for effective natural ventilation

- **Thermal Comfort Zone**
  - Too hot
  - Too cold
  - Comfortable

### Climate 4: Florida

- **Time Zone**: UTC - 5
- **Longitude**: 81° 07' 30" W
- **Latitude**: 26° 52' 30" N

### Moonshine Bay, Glades County

- **Time Zone**: UTC +5
- **Longitude**: 81° 07' 30" W
- **Latitude**: 26° 52' 30" N

- **Site Plan**: 2' topos
- **10,000 ft**

### Building Materials

- **Southern Yellow Pine**
  - Use: framing
  - Availability: state-wide
  - Embodied energy (MJ/kg): 0.62

- **Clay**
  - Use: brick, structural, organic materials
  - Availability: state-wide
  - Embodied energy (MJ/kg): 1.0

- **Sand and gravel**
  - Use: road aggregate, masonry
  - Availability: state-wide
  - Embodied energy (MJ/kg): 9

- **Lightweight aggregate**
  - Use: brick, cement, and masonry
  - Availability: state-wide
  - Embodied energy (MJ/kg): 7.4

### Building Materials and Site

- **Florida State**
- **50 mi**
- **1000 MPH**
- **600 MPH**
- **200 MPH**
- **100 MPH**

- **www.usgs.gov**
- 1) Randazzo, diagram of landscape and geology chart.
The baseline model shows the chosen shape for this climate, while relatively it remains on grade and has an equal ratio of glazing for surface area on each wall. This will provide a product to compare against in an energy analysis.
The double envelope allows for a buffer between extreme weather conditions and a comfortable interior climate. The double skin also allows the space to be shaded without heat conduction through the walls. Dual layered enclosure system; the north side has a larger zone between the layers that is inhabitable and interactive.

Water is collected into a tank on the top floor because of the height of the dwelling; this way it can be distributed efficiently.

The double envelope allows for a buffer between extreme weather conditions and a comfortable interior climate.
**Arizona Wall**
- Thin roof shingles
- 2" x 4 frame at 2' oc
- 2" x 6 beams at 4' oc
- Wood sheathing
- Vapor barrier
- 4" Insulation
- 1/2" rammed earth
- Vapor barrier
- Operable awning
- Windows

**Florida Wall**
- Corrugated metal roof
- Vapor barrier
- Wood sheathing
- 1 x 1 frame at 2' oc
- 6 x 12 beams at 4' oc
- 4" insulation
- 8" operable louvers
- Wood vertical supports at 8' oc
- 2' hopper windows
- 4' structure
- 1' wood supports
- 6 x 12 frame at 8' oc
- Separate from envelope
To find a freedom among differences has always been the goal of articulating the American style home: maintaining a value “of the country, for the country” (Smeins, 35).
(top row)
Arizona Design | Hand-built wood model

(bottom row)
Florida Design | Hand-built wood model

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Survey involving what women prefer spatially for home management, and diagrams showing important gathering spaces and adjacent rooms. Provides organizational diagrams for necessary living spaces.


“Stop thinking about the city and the suburbs and the exurbs and the rural areas as separate entities and really consider them as united ecosystems.” (38)


Examples of houses which imply an off-the-grid lifestyle and some details of how they achieve this.


Introduction of various building systems, light and heavy cladding and their tendencies to weathering. Also mentions geometry, orientation, detailing, and different types of pollution that can effect materials, as well as what happens with chemical attacks.


Details the cause of indoor air pollution, the impact that buildings have on the earth through their use of resources, and new ways in which to help such dire issues.


Finish materials along with furnishings and spatial layouts of idealized homes.


Karen Kentile
141 Demars Blvd. Tupper Lake, NY 12986  518.651.4295  kkentile@syr.edu

Education

Syracuse University School of Architecture
Bachelor of Architecture  Anticipated: May 2012
Thesis Title: Shelter [Optimized] for Climate
International Study: Florence  Fall 2010
Tupper Lake High School: Tupper Lake, NY
Advanced Regents Diploma  2003 - 2007
Highest Honors, 3rd in Class

Professional

Andrew Chary Architect PLLC: Lake Placid, NY  Summers 2009 - 2010
Intern - Drafting, Producing SDS, DDs, CDs; computer modeling, layouts
Documenting existing conditions, on-site finish detailing and photography
John Gillis Cabinetry: Tupper Lake, NY  Fall 2008 - present
Drafting, documenting existing conditions; computer modeling, representation
New York State Department of Environmental Conservation  Summers 2005 - 2008
Lake Eaton Campground: Long Lake, NY
Head Lifeguard

Awards & Leadership

Dean's List Syracuse Architecture  2007 - present
SUOC Vice President, Treasurer  April 2009 - present
Caving Trip Leader
Bausch & Lomb Honorary Science Award (University of Rochester)  2007
Well's College Leadership Award  2007
National Young Leaders' Conference, Washington DC  2006

Skills

Digital: ArchiCAD, AutoCAD, Rhino, V-Ray, DesignCAD, KCD, Adobe CS5, Vectorworks
Physical: Hand Drawing, Drafting, Crafted model building; laser cutting and 3D printing
Ceramic sculpting, Conversational Italian

Affiliations

American Institute of Architecture Students  2007 - 2010
Architecture Student Organization  2007 - 2008
Syracuse University Outing Club  2008 - present
NCARB: IDP Enrolled  397.5 hours