A REACTION TO THE
ENVIRONMENT,
IN A BUILT ENVIRONMENT.
ARCHITECTURE 558
Montana State University
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Mark P. Luedtke
DESIGN CHALLENGE

2-3 • Program Statement.
4-5 • Project Goals.
6-7 • Site.
8 • Presentation Requirements.

DESIGN GUIDELINES

9 • Program Requirements.
10-11 • Spatial Requirements.
12 • Program Considerations.
13 • Program Aspirations.
It is the age of the 21st century and people are becoming more aware of the impact we as humans have on our environment.

- A hole in the earth's atmospheric ozone is continuously growing larger.

- We continue to create large amounts of toxic waste.

- Acid rain destroys lakes, rivers, and forests.

- An exponential rate of increase in the consumption of, a limited supply of fossil fuels.

With all of the problems, (both known and unknown), we continue to construct more fossil fueled electrical generation plants and operate toxic-waste producing nuclear plants. For the most part we continue to construct buildings with little or no relationship to their environment. These buildings rely nearly exclusively on modern mechanical systems for heating and cooling, and on electrical lighting systems for illumination. This universal approach to building systems further fuels the need for new power plants and disregards the impacts of such systems on our environment. It is time for people to assess the existing conditions and realize something has to be done. Instead of waiting until life as we know it ceases to exist, we must look at ways of conserving energy and/or alternatives to the ways we are accustomed to producing usable energy, and the ways in which we use this energy.
DESIGN CHALLENGE

Why do we continue to live in built environments which put demands on our environment? Many people are under the impression, this would mean to end lifestyles of which they are so accustomed. Some people blame it on economics, stating that it simply costs too much. Still others claim it is not as important as other factors which make up the design process. All of these factors are valid concerns, but none of them are valid reasons to ignore our environment. The potential of existing technologies, and the vast well of knowledge available on environmentally conscious design, should be as much a part of the design process as the Vitruvian precepts, "commodity, firmness, and delight".

The purpose of this project is to explore alternatives to the traditional suburban home which utilizes few, if any, local building materials and which consume large amounts of energy. It is estimated that nearly 40% of the energy consumption in the United States can be attributed to the heating, cooling, and lighting of buildings. This project will study available technologies which will allow this building to utilize energy sources available in the natural environment. The project is an attempt to minimize both the demand on our fossil fuel reserves and reduce the impact on our environment. The built environment should function independent from human beings, as a functioning organism, providing a delightful habitat, and necessary thermal comfort for extended existence.
PROJECT GOALS

• ENERGY SELF SUFFICIENT

This building will acquire all necessary energy to provide a delightful human experience from the existing environment. The built environment shall provide spatial heating both for human comfort and to allow the built environment to function throughout the seasons of the year without any interaction from humans. Sufficient electrical energy shall be provided enough to create an atmosphere of enjoyment, comfort, and life support not unlike that which modern people are accustomed. The project shall explore both conservation techniques and potential energy from the earth, wind, water, and most importantly the sun.
• SENSE OF PLACE

The design of the built environment shall be an exciting, delightful expression of a human environment constructed within a larger existing environment. The design shall create a comfortable aesthetically pleasing human environment simultaneous with the needs of creating usable energy and conserving energy. The development shall have several levels of influence from the human inhabitants for which it is intended. People should feel, united, and at peace within the built environment and this built environment shall exist in unison with the larger environment of which it is a part.

"Since each sense contributes a slightly different perception of the world, the more senses involved in a particular experience, the fuller, the rounder, the experience becomes. If sight allows for a three-dimensional world, then each other sense contributes at least one, if not more, additional dimensions. The most vivid, most powerful experiences are those involving all of the senses at once."

Lisa Heschong

• DESIGN ARTICULATION

The final design shall be an expression of the sense of place created by the built environment and its ability to function independently in regards to all energy needs. The presentation should be informative, evoke interest, emotion and most importantly be convincing. It is important to convince others that the desired goals have been accomplished and to present the information in such a manner as to make it understood and appreciated.
The site is a northern alpine mountain site, located in the vicinity of Big Sky, Montana. The site is not, and will not, be connected to society’s electrical power grid, telephone lines, gas lines, water systems, or sanitation systems. The site is located five miles from the nearest primitive roadway and fifteen miles from the nearest maintained roadway. Access to the site shall be by any of the following:

- All terrain Bicycle.
- Horseback.
- On foot.
### DESIGN CHALLENGE

#### PRESENTATION REQUIREMENTS

<table>
<thead>
<tr>
<th>MEDIUM</th>
<th>SCALE</th>
<th>MAJOR EMPHASIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locator Map</td>
<td>small</td>
<td>relative location</td>
</tr>
<tr>
<td>Site plan/model</td>
<td>1&quot; = 10'</td>
<td>built form relation to site</td>
</tr>
<tr>
<td>2 Floor plans</td>
<td>1&quot; = 10'</td>
<td>organizational information</td>
</tr>
<tr>
<td>2 Building Sections</td>
<td>1/4&quot; = 1'</td>
<td>technical systems</td>
</tr>
<tr>
<td>1 Interior Perspective</td>
<td>15&quot;x15&quot;</td>
<td>human character</td>
</tr>
<tr>
<td>Model</td>
<td>1&quot; = 10'</td>
<td>character and synthesis of built form and tech. systems</td>
</tr>
</tbody>
</table>
PROGRAM REQUIREMENTS

The built environment will be a retreat and study center for professionals in the fields of architecture, engineering and all related construction disciplines. The built environment will serve as a residence for up to ten persons allowing these people to live in an environmentally aware building. The project will act as a residence and an educational facility in a reclusive retreat atmosphere.

The built environment shall:

- Comfortably and delightfully house ten persons.
- Provide a place of individual study and contemplation.
- Provide a place of group study and interaction.
- Be a functioning example of a built environment in synthesis with its natural existing environment.
- Be self sufficient. Providing for:
  - All electrical needs.
  - Necessary sanitation system.
  - Sufficient on site water.
  - Storage of food items.

"It is not just the financial savings. We grow more in awe of the tenuous hold our lives have on this small planet, more convinced that the sun renews us, in an almost religious way. It has made us profoundly grateful that the sun is up there, the center of our universe, warming us up and keeping us alive. That atavistic sense of the elements that early man knew and felt has become part of our lives."

Jantus Eddy
### Spatial Requirements

<table>
<thead>
<tr>
<th>Spacial Function</th>
<th>Elements Suggested</th>
<th>Suggested Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food Storage</strong></td>
<td>19 cu. ft. freezer</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>dry/cool shelving</td>
<td></td>
</tr>
<tr>
<td></td>
<td>area lighting</td>
<td></td>
</tr>
<tr>
<td><strong>Food Preparation</strong></td>
<td>coffee pot</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>toaster</td>
<td></td>
</tr>
<tr>
<td></td>
<td>19 cu. ft. ref./freez.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>oven/range (wood)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wash basin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dry food storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>area lighting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>task lighting</td>
<td></td>
</tr>
<tr>
<td><strong>Eating</strong></td>
<td>table for ten</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>seating for ten</td>
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<tr>
<td></td>
<td>area lighting</td>
<td></td>
</tr>
<tr>
<td><strong>Sleeping</strong></td>
<td>beds</td>
<td>500</td>
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<tr>
<td></td>
<td>area lighting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>task lighting (reading)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>desk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>drawers (clothes)</td>
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<tr>
<td><strong>Personal Hygiene</strong></td>
<td>toilet</td>
<td>50</td>
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<tr>
<td></td>
<td>wash basin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>area lighting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>task lighting (grooming)</td>
<td></td>
</tr>
</tbody>
</table>
In biology a system is viable because it is rich in interwoven, cooperative subsystems. We're very good at making fingernails or toes or ears, and sometimes these turn out very beautiful. But if there's no conception of the animal itself those things become quite irrelevant, like an appendix."  

Soleri

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>ELEMENTS WITHIN SPACE</th>
<th>SUGGESTED SQ. FT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELAXING</td>
<td>COMFORTABLE SEATING</td>
<td>200</td>
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<tr>
<td></td>
<td>FIRE PLACE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AREA LIGHTING</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TASK LIGHTING (READING)</td>
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<tr>
<td>ENTERTAINING</td>
<td>FIRE PLACE</td>
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<td>AREA LIGHTING</td>
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<tr>
<td>GROUP MEETING</td>
<td>SLIDE PROJECTOR</td>
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<td></td>
<td>PROJECTOR SCREEN</td>
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<tr>
<td></td>
<td>SEATING FOR TEN</td>
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<tr>
<td></td>
<td>AREA LIGHTING</td>
<td></td>
</tr>
<tr>
<td>PERSONAL STUDY</td>
<td>FIVE PERSONAL COMPUTERS</td>
<td>200</td>
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<tr>
<td></td>
<td>DOT MATRIX PRINTER</td>
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<tr>
<td></td>
<td>SEATING FOR TEN</td>
<td></td>
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<tr>
<td></td>
<td>AREA LIGHTING</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TASK LIGHTING (READING)</td>
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<tr>
<td></td>
<td>CONTEMPLATION</td>
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</tr>
<tr>
<td>HORSE CORRAL</td>
<td>FRESH WATER</td>
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<tr>
<td></td>
<td>FEED STORAGE</td>
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</tr>
<tr>
<td></td>
<td>SHELTER (BARN)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TACK STORAGE</td>
<td></td>
</tr>
<tr>
<td>BATTERY STORAGE</td>
<td></td>
<td>150</td>
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</tbody>
</table>
PROGRAM CONSIDERATIONS

• Construction materials and techniques shall be manageable and moveable by no more than two people and light equipment/machinery, due to the remoteness of the site.

• Primary source of energy shall be the sun both for spatial heating and electrical consumption needs.
  • Most reliable source.
  • Most universal source.
  • Little environmental impact.

• Primary means of storing energy shall be mass for thermal energy and batteries for electrical energy.

• Secondary sources to be explored shall be.
  • Potential of wind energy.
  • Potential of water for.
    • Creating usable energy.
    • Storing energy.
    • Transferring energy.
  • The application of proper energy utilization and conservation techniques.

• The built environment shall not alter the existing environment in any significant manner in regard to:
  • Pollution.
  • Hazards to wildlife.
  • Water supply required by existing environment.
  • Drainage patterns.
    • Erosion.
DESIGN CHALLENGE

DESIGN ASPIRATIONS

• Exist in a state of dynamic balance with nature, not domination over nature.

• Utilize the following design patterns.
  • Create a connection to the earth.

  • A sheltering cascade of roofs.

  • Intimacy gradient from most public to most private.

  • Positive outdoor spaces facing south with natural back and distant views, sunny place.

  • Wings of light, with tapestry of light and dark. Indoor sunlight on two sides of every room.

  • Entrance transition, a volume should exist both inside and outside, an entrance room.

  • Building edge should be a zone with a volume to it.

  • Farmhouse kitchen, spacious and communal, with sunny counter and open shelves.

  • Common area at heart of structure with activity pockets, built in seats, stair seats, and something roughly in the middle.

  • Interior should have soft walls, warm colors and variety in ceiling height.

"Living in a solar house is a whole new awareness, another dimension, I have the comfort of a house with the serenity of being outdoors - protected, yet tuned in."

Karen Terry
DESIGN NOTEBOOK

SKETCHES/IDEAS FROM MY DESIGN PROCESS

LEGEND

BS  BATTERY STORAGE
DNG  DINING
ENT  ENTERTAINMENT
FP  FOOD PREPARATION
GM  GROUP MEETING
OD  OUTDOOR SPACE
PH  PERSONAL HYGIENE
PS  PERSONAL STUDY
PV  PHOTOVOLTAIC PANELS
RX  RELAXATION
SP  SLEEPING
SPATIAL ORGANIZATION

BASED ON
- SITE TOPOGRAPHY
- RELATIONSHIP TO SUN
- RELATIONSHIP TO OTHER SPACES

ELEMENTS ARISING FROM ENTERTAINMENT
(ENT. SEEN AS CORE)

ENT. & FP SEEN AS DUAL CORE SPACES

THINKING VERTICAL
GROUPING INTO 3-D

TALL CENTRAL VOLUME
STUDY MODEL BUILT

REFINED VERSION AFTER STUDY MODEL

BREAKING FORM UP CASCADE OF ROOFS

SOUTH FACADE
INTERESTED IN:

- THE SUN AND THE ENERGY IT PROVIDES
  (SUN PATH THROUGH THE SKY/WALK)

- INTERDEPENDENCY OF ORGANISMS IN NATURE.

- PRECARIOUS BALANCE OF THE ENVIRONMENT.

- CONNECTED WITH NATURE.

TOWERS FOR VIEWING ESPECIALLY SUNRISES AND SUNSETS
BALANCE OF NATURE
PARTI DEVELOPED INTO FLOOR PLAN

MAN IMPOSED/STRUCTURED SIDE
- RECTUMER

NATURE SIDE
- ORGANIC
DEVELOPED FLOOR PLANS

First Floor
WANTED VERTICAL VARIATION
RAMPED ACCESS TO ALL STAGES

Options for sun control trying to avoid overpowering overhang

Second Floor
Important that overhang be positive, not negative impact.

Panel shielded from OD space.

Winter heat gain.

Insulation from heat loss.

Primary view considerations hot thermal gain SP.

Mass for thermal storage.

Built into hill for thermal protection.
HOW TO MOVE LARGE ROCKS

CONSTRUCTION MATERIALS
Roof Plan
DRAINAGE & FORM, and SUN EXPOSURE
Primary Concerns

Framing Plan
Checking to make sure I could build it

Study Model Built
Experience the environmental thermal delight

Create indoor space outside

Bring outdoor space indoors

Developed outdoor path and contemplation area

Poll out personal study
More of an environmental experience