The dove—rich symbol of Peace and Love—used here to denote the striving toward a lifestyle free from concern from acquiring material things. It speaks of living in a spirit of joy and becoming simply free and loving.
College of Architecture and Planning
Ball State University

Architectural Thesis
March - November 1975

James Troutwine
OUTLINE

Acknowledgements
Abstract
Process
  I. Program
    1. Project Description
    2. The Site
    3. The Clientele
    4. Goals and Objectives
    5. Criteria
      A. Programs
      B. Proposed Functional
      C. Space Requirements
    6. Architectural Design Criteria
    7. A Philosophy
    8. Growth
  II. Analysis, Analytical and Intuitive
  III. Schematics
  IV. Design Development
  V. Design Refinement
  VI. Design Presentation
Bibliography
ACKNOWLEDGEMENTS

This process was only possible by the collective efforts of many personal friends, colleagues, and family. I wish to largely thank my father for his financial support. I am also grateful to my roommates for their time and consideration, Jerry Smith for his time in processing all of the color photographs, and Ron Voss, Constance Winter, and Kathy Emmer for their guidance and moral support. I am lastly grateful to Anthony Costello and John Russell (both faculty at the College of Architecture and Planning) for having been two concerned critics during this design process.
ABSTRACT

Peace and love, both in concept and in practice have seemingly been pursued throughout man's history. Many men have put forth their lives that the world would someday be a more peaceful place to live. Wars have been fought to end all wars, and today many world powers have stock piles of nuclear armaments enough to kill every living thing 5-50 times over.

Peaceful resistance occurring through the many ages of man, poses some alternatives to this type of thinking. This decade alone exemplifies more than enough, the need for this kind of thinking. The past seventy odd years have seen many men and women devoting their lives to the peaceable struggle(s) to cause change within an establishment. Men and women alike from all countries of the world have and still are struggling pacifically with the issues of international, national, and domestic concern, war, and the multitude of isms that exist within all societies.
This movement, especially since the U.S. involvement in Southeast Asia, has been increasing in size and scale. Proponents of this movement are operating within all major U.S. cities with factions involving people of smaller communities.

Sometime in the early 1970's the planning of one such faction began to materialize within Muncie, Indiana. Today, some five years later, such a center does exist and function, some seventeen and a half miles to the north, northwest of Muncie in a rural setting. The designer, having spent six months in residency in the existing "center for peace and life studies" studying and developing himself to a better understanding of this lifestyle proposes the following. His skills and interests combined, have helped him set forth this thesis. A proposal for a "peace and life center", an extension to the existing foreseeably in the 1980's.
THE PROCESS

"The process is the product and the product is the process" - Gandhi.

The intent of this book is to record the process. The process having been 28 weeks in duration cannot be described into any great detail. The intent is then to present the process in a brief form, presenting the designers' skills and lack of skills of an architectural problem. For the most part this book will entail a graphic portrayal of his design process, employing what is thought to be some of the designers' many skills.

I. PROGRAM

The program is to describe the center, the program endeavors to set the parameters of the problem, describing specific aspects of the proposed center, the users, their needs, characteristics and functions, the support functions, and exterior relationships. The program is also significant in that it defines a set of values pertinent to the understanding of the design. Additionally the program can be viewed as a useful tool for the design
process, implementing attitudes and ideas continually throughout the process and beyond.

1. Project Description

The project involves several scales, from a planning point of view to an architectural scale. Initially the project set about to plan for a community of users, vibrant in their usages of the site from campgrounds to a caretakers residence and a chapel. Preliminary design relates this concern. It was also an initial concern that the county planning authority were considering a nature Reserve in the area that would create greater water related recreation, had the Mississinewa River been dammed up stream.

During the process it was seen necessary to redefine some of the initial parameters, creating a more refined focus on the proposed center. The new focus allowed a closer look at the overall building system, which would be a
carry over to the other building types. The redefined focus was carried into final design development and lastly presentation (see presentation photos).

2. The Site

Located 17.5 miles north-northeast of Muncie, across the Mississinewa River from the town of Wheeling, bordered on the north by the northern boundary of Delaware County. The 52.7 acre site has 40-45 acres of gently rolling terrain in crop production annually. The silt loam soil provides average or better yields of corn or soybeans in alternate harvests. An abandon gravel pit occupies approximately three acres northwest of center of the crop land. The "Olive Branch Cemetery" 1812-1963, occupies three to four acres of the northwest corner of the site. South of all the crop land, cemetery and gravel pit is a variably sloping (12-25%) wooded river escarpment. On the west the slope is a
consistent 10% increasing to a 20-25 slope, dissolving into a drainage gully at a 10-12% slope, and continuing eastward at a variable 10-15% slope. The entire length of the escarpment is wooded with a variety of second, third, and fourth growth deciduous trees. The woods vary in height between 40 to 60 feet. Their density changes seasonably with almost total penetration physical and visually in the winter season, to dense foliage almost unpenetrable physically and visually in the summer. The woods running the width of the site (east and west) are 150' to 250' wide. The southeast portion of the site, some 10 acres, is highly susceptible to annual spring flooding by the river. This portion of land constitutes a very poor soil, a genesee loam, too high a risk for crop production and too soft to build upon. The Mississinewa River provides the vegal southern meandering boarder of the site.
Unique features of the site include the site's seasonality which affects the spatial and visual characteristics. The crop land also affects these characteristics especially during the growing season of corn. Also another unique historical feature of the site is the hedge row of osage-orange bordering the entire east boundary.

Access is along the west boundary line, a gravel road, which provides some enticing and surprise vistas as the approach is made toward the existing panelized pre-fabricated/octagonal structure. Views and vistas from this structure vary seasonally and directionally. The existing structure allows a spacious view to the north and obscured views through the woods to the south.

3. The Client, Clientele

To speak of the client is to talk about man in general, his characteristics, patterns, beliefs, needs, etc. The proposed center is
unique in that the client cannot be considered
an individual from a user-need point of view,
philosophically to be consistant with the goals
of the community, the client must remain as a
community of users. The concept of individual
tends to break down the community, as each isolated
functioning individual pursues his/her own goal
and defaults the community goal. It is important
although to consider a variety or multiplicity
of uses or functions to accomodate the group's
needs. Past experiences have also shown that in
order to accomplish goals, whatever in nature,
group action will open and establish a/the new
means. The client includes all age groups,
races and sex.

4. Goals and Objectives

An environment that relates it's design,
construction, utilization, and maintenance on
respect for factors already inherent in, or about
the site.

An environment created with lessened
dependency on our technological consumerism
culture with a greater emphasis on biological
integration and a complete symbiosis with nature.

An environment that utilizes passive energy
systems to their fullest extent in conjunction
with existing backup energy systems.

An environment employing client/user skills
in the construction process.

An environment that allows for continual
change, interaction of indoor/outdoor activities.

An environment employing natural forms,
materials, textures, and colors.

5. Criteria

A. Programs
Interaction of people and their ideas and
feelings is the bases of exchange between
all people. Programs focusing on these
common concepts constitute a direction and
a means, which is inherently a process.
This process is continually learned and on
going. This process is implemented at the
existing "peace and life center" through a
variety of the programs listed below.

College retreats - personal development and
growth.

Religious education for adults - sharing and
celebrating joys of Christian living.
University courses - field studies and initiation of simple living life styles.

Family weekends and camps - reunions of families in the larger community and spiritual family development.

Meditation days - days of silence/isolation to reflect.

Request retreat and recreational days - interested groups.

Weekends for group study of peace and global consciousness.

Weddings - natural setting for the union between two individuals.

B. Proposed Functional
Initially in the overview, four different building types were considered. Preliminary studies were made in both plan and section, a residence (caretaker's residence), housing, dormitory (villages), religious (chapel), and social (the center), the building type which was pursued through to presentation. The center was focused upon considering it constituted a viable study incorporating all aspects of the three other building types. Focus on the center allowed for a greater indepth study of the "architecture" considered.

The center was conceived to utilize the slope of the natural terrain in conjunction with the existing center. The proposed center as well as the three other building types were programmed to follow a phasing continuum. The proposed center involved three phases,
each self sufficient energy wise and functionally in relation to the existing center. 20-70 square feet per person was assumed based on some local building codes.

C. Space Requirements

Phase I - Feasibility
Multi-purpose/game room - 600-800 sq. ft.
Storage/unit - 50 sq. ft.
Restroom - men and women combined - 70 sq. ft.
Mechanical-solar-methane - 100 sq. ft.

Total 800-1000 sq. ft.

Landscaping considerations
Excavation
Planting/replanting

Phase II - Acceptance
Multi-purpose - 1800-2000 sq. ft.
Storage/unit, moveable divider units - 100-200 sq. ft.
Restroom - 70 sq. ft.
Food service - base on a period/organized scheduling base on 40-50 seated
Kitchen - 250 sq. ft.
Dining - 600 sq. ft.
Food storage - 50 sq. ft.
Mechanical-solar-methane - 100 sq. ft.

Total 2970-3270 sq. ft.

Landscaping considerations
Excavation
Paving/drainage
Retaining walls
Planting/replanting

Phase III - Continuance
Multi-purpose - 1600 sq. ft.
Storage - 100-150 sq. ft.
Restroom - 70 sq. ft.
Discussion/small assembly - 600 sq. ft.
Mechanical-solar-methane - 100 sq. ft.
Total

2470-2520 sq. ft.

Landscape considerations
Excavation
Decking
Paving/drainage
Retaining walls
Planting/replanting

Support considerations Phase I, II, and III
Vehicular access/ circulation
Parking - 40-50 cars
Pedestrian circulation
Service access into food service
Existing utilities - water, electric, communications
Maintenance
Towers - solar (wind optional) - access, foundation
Agricultural - share cropping, gardening

6. Architectural Design Criteria

I. Site

A. Natural amenities
Sun/shade/path/intensities
Wind/direction/min and max magnitude
Vegetation/types/size/characteristics/age/location
Climate/types/duration/possibilities
Slope/percentage/quality/consistency
Drainage/water table/flood plain

B. Man oriented amenities
Views/seasonal effects/feelings
Soil permeability, compactability
Orientation, natural/existing

II. Buildings

Orientation/natural and man-made
Site integration/slope/woods/agriculture/water
Viability
Flexibility/versatility
Form/rectangular/amorphil/curvilinear
Scale/man/nature
Color(s), texture
Aesthetics
Materials/availability/cost/weight/location/shipping
Costs/fees/construction/material/transportation
Building type/post-frame/pneumatic/tented/etc.
Materials - wood/concrete/steel/glass/plastics
sizes - dimensioned/cast/pre-fabricated/milled
type - quality/finished/unfinished/color/quantity/units/lengths
Character/spatial/functional
form/expression/aesthetics/penetration
technologically/systems/mechanical
detailing/simplicity
lighting/natural/artificial
Construction methodology
process
duration/climatic factors/terrain
quality/skill/unskilled/materials
implementation/machinery/manpower/access
means
finances/loans/grants/gifts
manpower/skilled/unskilled/availability
equipment/size/availability/usages
enthusiasm/cooperation/coordination/consideration

Maintenance
programs/seasonal/monthly/weekly/daily
personal/experienced/unexperienced
implements/tools/availability
repairs/how often/accessibility

7. A Philosophy

A design philosophy is a philosophy not only of form, function, and aesthetics, but a philosophy subservient and accommodating to nature and the site. The building is thought of as the host of nature. A guest that is welcome if it can accommodate the continuance of the life of the site. Architectural applications are viewed as man's interpretation of the nature of this site.

8. Growth

Growth is inevitable in every life situation. Growth causes change, and change is probably the most consistent aspect of life we can rely on. Growth will also affect the proposed center in some predictable and unpredictable ways.

The character of the center is susceptible to changes in concept and atmosphere as new users employ it.

A change of ownership will also effect change.
Normal life-death cycle of all living things from plant life to man's will effect growth and change within the center as well as within the users.
II. ANALYSIS, DATA, AND INTUITIVE

Site analysis, through an investigation of the obvious site characteristics, began to define some parameters. The parameters imposed some definite constraints to the designer's intuition. Charts and graphs only further indicated that optimum building locations could be located on known soils, terrain, and significant amounts of the natural energy amenities.

An intuitive-subjective analysis of the site diametrically oppose this calculation, and research data. Intuition, although not a traditional quality of men, intercepted many of the hard and fast data known on the site. A sense of the quality and character of the wooded slopes, the unique and appropriate existing center, the seasonality of the agricultural land and the suprise laden access road all overshadow the "facts and figures".

Compromises were made throughout the process, and both the intuitive and the analytical were considered. Intuition excelled in locating the building site and analytical considerations in a sense "fine tuned" the
building on the site.

The following is thence presented as a brief photographic portrayal of the continued design process implemented in this study.
BIBLIOGRAPHY


Baker, Donald G. and Haines, Donald A. Solar Radiation and Sunshine Duration Relationship - Basic Computations, University of Minnesota, Agricultural Experiment Bulletin 262, 1969.

Black, Paul. Indianapolis Center for Advanced Research, Inc. Affiliated with Indiana University - Purdue University at Indianapolis, Indiana.


USDA. Soil Survey of Delaware County, Indiana. Purdue University. 1962.

General Energy


Solar


Wind


Dempster Industries, Inc. Beatrice, Nebraska


Windworks. Mukwonago, Wisconsin.

Methane


Construction Types


Communities

Solar

Focusing Collectors
- Can obtain high temperatures between 500°C - 3,500°C
- Rounded plate glass w/ deposit of silver give a good reflective surface - reflecting nearly all light striking
- Design: Focusing may be accomplished w/ glass lenses or with curved mirrors of glass, metal, or plastic
- Parabolic mirrors focus parallel rays of sun into small area to give high intensity

A. Advantage
- Does not need continual adjustment
- Utilization of ray's from outside rim & near the bottom

Disadvantage
- The curvature makes construction a bit more difficult

B. Disadvantage
- Long focus requires adjustment be made to follow the sun
- Long focus means mechanical difficulties for heavy receivers

C. Advantage
- A loss in optical efficiency in radiation losses
do a flat reflecting surface
- If made of plastic - it can't bear much focused radiation

D. Shows that a spherical collector could be used if focusing not be sharp

Specifications
- The more perfect the optical precision, the sharper the focus & thus on a smaller area of receiver = less heat loss . . . . less perfect collectors require collectors of larger area
- The cheaper concrete mirrors widely used precision mirrors are old army surplus parabolic mirrors
- The efficiency of heat input to receiver depends greatly on the specular reflectivity of the collector, proportion of its shape & capability of receiving sunlight
FULL COLLECTORS ARE MANUFACTURED AS WELL AS ALUMINUM COLLECTORS. IN APPLICATION OF AN ALUMINIZED NICALON THE HEAT ABSORPTION IS GREATLY INCREASED.

MULTIPLE MIRRORS - MOSAIC 1" OR MIRROR SET IN A CLOTH MOUNT - ARE AVAILABLE COMMERCIALY. THE REFLECTIVITY IS 90% AS COMPARED TO 85% OF THE ALUMINIZED PLASTICS. THEY WITHSTAND SCRATCHING WEAR AND 5 YEARS OF EXPOSURE.

SPHERICAL COLLECTORS

- PROVIDE A FAIRLY GOOD FOCUS
- CAN BE CONSTRUCTED OF ALUMINIZED INFLATABLE PLASTIC

CYLINDRAL COLLECTORS

- CIRCULAR COLLECTORS ARE NECESSARY FOR PRODUCING VERY HIGH TEMPERATURES. BECAUSE RECEIVING TARGET CAN BE SMALL & THE CONCENTRATION RATIO IN FOCUSING CAN BE LARGE.
- ADVANTAGES
  - CYLINDRICAL COLLECTORS CAN BE MADE INFINITELY LONG, & NEED NOT TRACK THE SUN ALL DAY (BUT TEMPERATURES ARE LOWER).
  - EX. A CYLINDRICAL COLLECTOR 6" WIDE WITH A RECEIVING TARGET OF 1" WIDE, THE CONCENTRATION RATIO 72.
  - BY LENGTHENING THE CYLINDRICAL RECEIVING TARGET... THE CONCENTRATION RATIO REMAINS THE SAME (CONSTANT).

- A LONG CYLINDRICAL COLLECTOR CAN RECEIVE MORE SOLAR ENERGY IN A SINGLE UNIT THAN A CIRCULAR COLLECTOR.
- CYLINDRICAL IS MUCH EASIER TO MAKE BECAUSE REFLECTING MATERIAL CAN BE ACCURATELY FITTED TO CYLINDRICAL FORM.
- CROSS SECTIONS MAY BE EITHER PARABOLIC OR CIRCULAR
  - PARABOLIC SECTION GIVING SHARPER FOCUS
  - CIRCULAR SECTION HAS ADVANTAGE OF LESS FREQUENT ADJUSTMENT IN TRACKING THE SUN.
- IF ALIGNED ALONG THE EAST-WEST AXES (AS PROPOSED) THE COLLECTOR WILL REQUIRE LITTLE ADJUSTMENT EXCEPT FOR THE EARLY MORNING & LATE AFTERNOON PERIODS.
- ENERGY WASTE CAN BE ELIMINATED BY MINIMIZING OR HAVING THE COLLECTOR LONG ENOUGH THAT THE UNILOMINTED ENDT OF THE RECEIVING ONLY A SMALL PART OF THE TOTAL.
- ADJUSTMENT WEEKLY IS EASIER WITH THE CIRCULAR CROSS SECTION AS COMPARED TO THE PARABOLIC SECTION.

BY, CITED BY LEE, PETER & DUFFIE

USING A PARABOLIC COLLECTOR OF ALUMINUM - 6' x 12'
& MOUNTED 48" ABOVE TO A 40" ANGLE W/ THE HORIZONTAL
THE RECEIVING PIPE WAS SURROUNDED & THE PIPE WIND季 TO MAINTAINED A CONSTANT WATER PRESSURE & TEMPERATURE RANGING BETWEEN 90° & 115°.
There is an optimum pipe size which would minimize air heat loss due to the insufficient size of the receiver.

Efficiencies varied from about 25% to 90% when receiver temperatures were significantly above the surrounding air temperature.

Factors involved are:
- Losses caused by reflection
- Imperfect shape
- Absorption
- Radiation
- Conduction
- Convection

- Ability of the glazing material to transmit the sun's radiation is very important (see equation).
  Transmittance depends upon:
  - Thickness of glazing
  - Composition

**NEW DELTA FOCUSING SOLAR COLLECTOR**

**ABSTRACT:**

- Achieves a 2:1 solar concentration gain for both direct & indirect/diffused solar energy
- Requires no thermal insulation as flat plate collectors
- A single collector on a average sunny day will collect approximately 20,000 BTU's throughout a year.

**INTRODUCTION:**

- The characteristics of flat plate as well as focusing panels come from the configuration of the collector, similar to small greek letter "DELTA" (§).

- Does not require pruual solar tracking
  1. Flat collector that provides both optical & concentration for both direct solar & diffuse sky radiation.
  2. Achieving a high-ambient-temperature-collector plate temperature at low ambient temperatures.
  3. Both sides of the collector plates are used to collect energy.
  4. Required no thermal insulation - eliminating material
  5. Designed as independent structures, field, roof, wall

**OPTICAL CONCEPT:**

\[ \frac{A_0}{A} = \frac{A_0 - A_{s0}}{A_0 - A_{s0}} \]

\[ A_0 = \text{area of the collector} \]

\[ A_{s0} = \text{solid angle seen by the energy collector} \]

\[ A_0 - A_{s0} \]

The highest order optical system operating in air has an 8.6 degree aperture. This means that the solar collector sees incoming energy over 10 degrees, instead of 1 degree in such a system. With perfect optical efficiency (i.e., reflectance or transmissivity = 1.0) a 90° by 180° external field of view solid angle will result in a maximum concentration ratio 2:1.

- The black surface at the collector decouples concentrated direct solar & diffused sky energy.
The FES solar model delivers the same amount of direct solar & diffuse sky radiation as a flat plate collector except that the FES solar model is concentrated on the collector plate by a factor of 3:1, 1.8-2.0 flat plate gain at maximum gain 2:1, can be maintained or even adjusted for angles 3:1. Radiant heat inside to remain at 2:1 can be maintained. Even greater concentration is possible.

Implementation of the optical design

The aperture consists of 3 cylindrical surfaces of diff. radii.

The upper section of cylindrical reflective surface (cone) is so arranged that any ray entering aperture as above an elevation of angle α passes through aperture, becomes directed to the lower cylindrical cavity as this means that in the ideal case for perfect reflectivity, the direct solar radiation coming from a solid angle subtending 90° in elevation by 180° in azimuth has an optical concentration ratio, defined by AB/BD.

The front of the collector receives radiation as if a flat plate collector. So, total optical gain is 1+1.73.

For winter heating, the collector can remain @ 90° vertical angle from the angular to vertical equinox. In the summer, if desired to be used for cooling (solar cooling), it is permissible to tilt the collector back to 30° from vertical elevation to maximize its performance. The collector weight = 150 lbs. It's this tank can be accommodated by a single pedestal.

A precise design configuration calls for a fixed vertical elevation of 55° for a typical flat plate collector for a 41° north latitude. It's output would be down after 12-24 - 1/3 smaller appearance.

College Mechanical Construction

The college is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.

The wall material is a rigid monolithic construction supported by horizontal struts from & near the south.
CONCLUSIONS & ECONOMIC CONSIDERATIONS

- 6'x6' flat plate collectors had a similar efficiency to a flat plate collector of twice the area on the [first] instance, appearing more promising, but also providing improved efficiency.
- With high fluid temperatures, full collectors and a unit should generate 20,000 Btu's per summer day on a flat roof.

**Field Costs/Condition**

- 4.90 $/sq ft/20 yr./aluminum
- 3.00 $/sq ft/20 yr./copper

**Material & Assembly Labor Cost Breakdown** for flat plate models Z.

<table>
<thead>
<tr>
<th>Material</th>
<th>Labor Cost Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>10.02/1/12</td>
</tr>
<tr>
<td>Alum</td>
<td>10.24/1/12</td>
</tr>
</tbody>
</table>

Assembly & erection labor costs.

**Total Costs**

<table>
<thead>
<tr>
<th>Labor Cost Breakdown</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.02/1/1</td>
<td>$10.02</td>
</tr>
<tr>
<td>10.24/1/1</td>
<td>$10.24</td>
</tr>
</tbody>
</table>

Data from May 1975
Peace & Life Center concept
Peace & Life Center - perspective

View of North Court

Thesis 1975
James Troutwine