SURFACE MINE RECLAMATION
- CENTER FOR ENERGY EDUCATION

by TERESA A. KUMMER
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Architecture Thesis
Critiques—
Stan Mendelsohn
Jack Wyman
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Abstract
ABSTRACT

A mineral surface mine provides economic and social needs for today's society. Economically, the mineral resource provides energy which is sold to the consumer. Socially, the consumer uses the energy to make his human environment more comfortable. This in itself is not the issue raised by this thesis, rather, the concern lies in what happens to the natural environment, the vegetation, soil, water, and animal life which inhabited the area prior to being disturbed by surface mining. The question is how can society continue taking what it needs from the earth, and not destroy the environment which exists there. The answer is reclamation.

Reclamation as defined by Webster's New collegiate Dictionary is "the act or process of reclaiming." Reclaiming is "to rescue from an undesirable state." Through careful reclamation, land disturbed by mining, can be returned to a similar or sometimes superior state.

This thesis deals with providing a reclamation plan prior to commencement of a surface mine operation. The plan involves the design of an educational facility in which people of all ages can learn about and experience the different forms of energy used in today's society.
Design Approach Goals
DESIGN APPROACH GOALS

The design approach for a center for energy education as a reclamation plan is based on design principles developed from the basic interrelationships of the environment, energy, architecture, man, and wildlife. These principles [see section titled Design Principles] were researched and developed to best augment a design approach which incorporates the following goals.

- Encourage local surface mine operations to look for alternative reclamation solutions, not just the traditional return to original contour.
- Encourage the use of other surface mine sites for the education of local populations, including education concerning mining operations.
- Provide a means to educate the local population about alternative energy strategies.
- Provide a means to allow the local population to experience energy in a naturalistic as well as architectural manner.
- Provide a facility which encourages continued research and development of new energy strategies.
Design Principles
DESIGN PRINCIPLES

The design principles for a center for energy education are:
- Use the environment as a design tool to enhance an architectural solution.
- Utilize energy architecturally and naturally rather than mechanically.
- Use energy concepts and environmental examples to architecturally enrich the human experience.

These are based on the interrelationships of the environment, architecture, energy, man, and wildlife. These interrelationships are examined on two levels. One, the overall mine site, approximately 240 acres, and the other, the immediate site including the education facility, approximately 4 acres.

OVERALL SITE

On the overall site scale, the most important interrelationship is between animal habitats and man. An animal habitat is made up of three areas, water, wetlands, and woodland. Water is a basic life-support element. It supplies refreshment to animals, often serves as a form of protection, and supports aquatic life. The wetlands are a transitional area located between the water and woodland. It provides open space for animals and supports bird life. The woodland is the "house" or shelter for the animals with its heavy brush and trees. [see Fig.1]

When introducing man, careful consideration must be given so the equilibrium of the habitat is not upset. The careful placement of observation towers or lookouts within the habitat can introduce man with a minimal effect on the animals and their habitat. [1] Locating walking trails, and observation areas away from the waters edge, obvious shelter areas, and in the center of the wetland areas will reduce the impact of man on the animals. Good locations are along the edge of the woodland areas and along the borders of the site. Penetration into the animal habitat should be left to the hiker to do at his discretion.

IMMEDIATE SITE

The interrelationships of environment, architecture, energy, and man are important at the immediate site for the design of the educational facility. An understanding of what each of these terms mean is necessary before their interrelationships can be discussed.

Environment is defined as "factors and conditions influencing an organism" in the Webster's New Collegiate Dictionary. However, this thesis assumes it to mean the natural environment-vegetation, soil, water, excluding only the animal life.

Architecture literally means the design and construction of a building. Here, the general terms of architec-
ture apply. This means that architecture does not necessarily mean a "building."

Energy is the ambiguous term given to describe the processes and effects of heating or cooling. These processes and effects can be natural (sun, wind, earth, and water), or mechanically produced.

Man, as a generic type, needs only food, water, and shelter to survive. Anything more is advantageous.

The interrelationships between environment, architecture, energy, and man are shown graphically in Fig. 2.

These are paired into six combinations for discussion. The six combinations are environment-architecture, architecture-energy, energy-man, man-environment, man-architecture, and environment-energy.

ENVIRONMENT-ARCHITECTURE

The environment-architecture relationship is actually three separate relationships. Environment as stated before encompasses vegetation, soil, and water. The method in which archi-
gration, [see Fig. 5] or by total integration. [see Fig. 6]. Architecture interacts with soil or earth by placing architecture on top of earth, [see Fig. 7] placing it above the earth, [see Fig. 8] burying it in the earth, [see Fig. 9] or by partial or full earth berming. [see Fig. 10] Lastly, architecture interacts with water in a similar way by total separation, [see Fig. 11] partial integration, [see Fig. 12] or by full integration. [see Fig. 13]
An example of the environment-architecture interrelationship working in a design situation is the underground house. Here all the relationships mentioned are used to allow for minimal impact on the environment and provide thermal comfort within the structure. [2]

ARCHITECTURE-ENERGY

The architecture-energy relationship begins by dividing energy into heating and cooling. Heating can further be divided into direct, indirect, and isolated systems. Cooling can be divided into shade and ventilation. [see Fig. 14]

Each of these subdivisions of energy interact with architecture in a special way.

Shade cooling is achieved by being integral with the architecture. [see Fig.
Ventilation cooling is provided in two ways. One is allowing cool air to filter through the architecture. [see Fig. 18] The other is a thermal chimney in which cool air is brought in at a low level and the hot air rises and leaves through the chimney. [see Fig. 19]

Heating energy is attained by the architecture through direct, [see Fig. 20] indirect [see Fig. 21], or isolated systems. [see Fig. 22]
The architecture-energy relationship can also be referred to as energy conscious architecture. The relationship illustrates how energy can be utilized within a structure without mechanical equipment. I.E. natural ventilation, shading devices, and direct, indirect, and isolated solar gain systems. [see APPENDIX D]
ENERGY-MAN

The energy-man relationship is similar to the architecture-energy relationship, however, in this combination man is the energy receiver instead of architecture. [see Fig. 23]

Cooling is divided into ventilation and shade. Ventilation is provided by winds moving through vegetation, [see Fig. 24] or blowing directly on man, [see Fig. 25] Shade is provided by vegetation or other elements found in nature. [see Fig. 26]

Heating in relation to man is either direct [see Fig. 27] or indirect [see Fig. 28].
The relationships described remain constant whether the cooling and heating energy is provided naturally as illustrated, or mechanically. As an energy saving approach, more natural energy should be used to provide thermal comfort for man.
MAN-ENVIRONMENT
MAN-ARCHITECTURE

The environment man-architecture relationship is similar to the environment-architecture relationship described earlier. Man uses both the environment and architecture as a means to provide shelter (one of his basic needs). [see Fig. 29] His methods are through vegetation, earth valleys or caves, [see Fig. 30] and architecture. [see Fig. 31]

In an architectural design problem, these relationships when combined can result in an exciting organic-architectural solution possible, located within the earth and with minimal impact on the environment.

ENVIRONMENT-ENERGY

The last of the relationships is the environment-energy one. Energy, as before is divided into cooling and heating. Environment is divided into
vegetation, earth and water. [see Fig. 32]

Cooling energy is achieved environmentally by allowing natural breezes to move through vegetation or across water.

[see Fig. 33] Heating energy can also be attained by using natural elements such as vegetation and water as heat respositories. [see Fig. 34]
SUMMARY

The following design principles developed from the interrelationships described above. They support and encourage the use of the relationships within the educational facility as architectural as well as educational tools.

- Use the environment as a design tool to enhance an architectural solution.
- Utilize energy architecturally and naturally rather than mechanically.
- Use energy concepts and environmental examples to architecturally enrich the human experience.
Program
EDUCATION:

* auditorium - indoor facility for multimedia presentations, lectures, seminars, or discussions.
* amphitheatre - outdoor facility for informal lectures and discussions.

INTERPRETATION:

* exhibitions - energy devices and strategies.
* workspaces - research and experimentation.
* offices - support facility for visiting professionals.

HOUSING:

* living areas - residences for visiting professionals with energy devices and strategies exhibited.

EXPERIENCES:

* Wildlife - water habitat
  - wetland habitat
  - meadow habitat
  - woodland habitat
  - grassland habitat
* energy - sun
  - water
  - vegetation
  - wind
  - mining operation
  - architecture
* observation - wildlife habitat
  - mining operation
Overall Site Analysis
Design Schematic
OVERALL SITE ANALYSIS
DESIGN SCHEMATIC.

Two separate site analyses were developed to accomplish the goals of this thesis. One, for the overall reclamation plan of the site, approximately 240 acres. The other, for the immediate site of 4 acres chosen to site the Center for Energy Education.

The original overall site plan slopes downward from the southwest to the northeast, where a swamp is located. [see Fig.35] To the east lies a county road to the south several roads which penetrate the site. At present, no surface water is located on the site.

The mining plan of this site commences in the third year of the mine operation, (this site is actually only one-fiftieth of the total mine) in the northwest corner and progressing in a linear fashion until reaching the southeast corner. [see Fig.36] A ridge, in mining terms a overburden heap will be located along the northern border, and a final cut pond will be located along the lower southern edge. [see Appendix B]

Upon completion of mining, reclamation traditionally follows the same pattern as mining, returning the land to within 20% of its original contour. In this thesis, one of its design goals is to encourage reclamation of different forms. Using the design principles and the interrelationships in which they are based (as described in the previous chapter) as a foundation for design, a reclamation plan concerned with the placement of contours, vegetation, water, wildlife, and architecture can be developed.
Contours enhance the natural environment and provide a diverse habitat for wildlife. High central contours achieve diversity in landscape, protection for wildlife, natural water runoff northward into the swamp area and southward into the final cut pond, and maximum solar access for its southern slopes. Low surrounding contours provide grazing land for wildlife and a relationship eastwardly with the county road. [see Fig. 37]
Vegetation plays a vital role in achieving good reclamation. Plants of the proper species can be placed carefully to buffer from winds, allow solar access in winter, and shade in summer. Coniferous trees placed on the northwest to central slopes will buffer the overall site from northern winds. Deciduous trees located along the southeast to central slopes will provide summer shade, winter solar access, and cooling effects of the summer breezes. [see Fig. 38]

Water on a reclamation site usually occurs where the final cut is made. For this particular site, the water is located on the south side (final cut pond) where it can be utilized for summer cooling. (warm summer breezes flow over cool water) Water is also introduced by the reclamation plan on the western side to provide water within the wildlife habitat. [see Fig. 39]

The wildlife habitat is located in the northwest section where it is buffered by contours and vegetation from the road on the east and the architectural development on the south. [see Fig. 40]

The last concern is architecture and where best to place it. The southern portion of the site prevailed because of the southern slope which affords protection from northern winds, access to solar radiation, water views and cooling effects, and minimal penetration of vehicular traffic. [see Fig. 41]

Combined, these concerns provide a strong reclamation plan for this mine site. [see Fig. 42]
Immediate Site Analysis
Design Schematic
IMMEDIATE SITE ANALYSIS

DESIGN SCHEMATIC

Site characteristics, interrelationships (environment, energy, architecture, and man), and design principles (use the environment as a design tool, utilize energy architecturally and naturally, use energy concepts and environmental examples to architecturally the human experience) provide a means to develop a good schematic design. [see Fig. 43]

The immediate site for the Center for Energy Education is approximately 4 acres in size located in the southwest section of the overall site. [see Fig. 42] Site characteristics developed by the overall site reclamation plan include a southerly slope toward water, extreme solar access, contours which easily adapt to underground construction and a wealth of vegetation.

The Center for Energy Education is a facility in which people of all ages can learn about and experience energy issues and strategies. The characteristics of this site are highly qualified to demonstrate architecturally and naturally energy issues and strategies. [see Appendix D]

Within the context of the Center, energy issues and strategies will be presented in three phases, the Education, Interpretation, and Housing.

PHASE ONE

Education is the emphasis of the Center, thus this phase is the most important. Architecturally, this phase consists of an auditorium in which multi-media presentations, lectures, seminars, and general discussions can occur. The auditorium facility is in two parts, an indoor auditorium and an outdoor amphitheatre. [see Fig. 44]
PHASE TWO

Phase two, interpretation, is divided into architectural energy and environmental energy. Architectural energy will direct the visitor through a series of energy experiences within architecture. Environmental energy releases the visitor into the natural environment to discover energy within.

Architecturally phase two consists of indoor spaces for research and experimentation for visiting professionals, and hands on experience for the average visitor. [see Fig. 45] No outdoor experiences are organized, all discourses are left to the visitor.

PHASE THREE

Housing provides practical applications of energy strategies as well as residences for visiting professionals. This area is separated from the main education/interpretation components to provide privacy for its residents. It is however, available for inspection by the interested visitor. [see Fig. 46] Together these phases form the Center. Here, with the help of trained individuals, the layperson can come to increase his knowledge of the area of energy and to learn how he can utilize energy strategies within his own home or community.
Conclusions
CONCLUSIONS

In summary, this thesis has developed an approach to the design of an energy education facility. Using the ideas and concepts of environmental education combined with energy considerations and strategies this thesis could readily be developed into a living project. Projects exist similar to this in the Community Awareness Centers. This have an emphasis on environment, but one could be developed which had energy as its prime subject.

Communities near coal mine operations are the most severely effected by society's demand for mineral resource energy. This is the primary group which should be given the first opportunity to experience an energy education facility. Here they can begin to understand the methods and processes of not only surface mineral resource mining, but alternative energy approaches. The secondary target group is the children of society. They are the future and if they have an understanding about energy, they can be a part of implementing alternative energy tomorrow.
Interviews
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF RECLAMATION
Jack McGriffith
19 March 85

Main Points:

- At this time there are no recreational facility on an Abandoned Mined Land site.
- AML basically reclaims to eliminate environmental problems or hazards.
- Money is from title 4 tax which states that a coal company has to pay 35¢ a ton into the Federal Surface Mines Fund and states are allotted so much each year.
- Current active mines present a reclamation plan before mining begins. A bond is also posted.
- Many active mines are going to residential reclamation.
- Possible site for recreational facility in Jasonville, Greene County, Fryer Tech.

21 March 85

Main Points:

- Through calls made I found that the site the state is proposing a recreational facility for the Greene-Sullivan County area.
- Sandy soil good for outdoor recreation. Preliminary.
- Permits released included: Peabody and Amax Coal each 5000 acres for wildlife, fishing, forest, and water.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Sue Masey
21 March 85

Main Points:

- Deal mainly with environmental problems.
- Tax coal mine operators
- Department of Mines and Minerals Conservation
- Reclamation forms are mainly parks, water, fishing, picnic, and camping.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF RECLAMATION
Jack McGriffith
4 April 85

Main Points:

- Two divisions are fighting for the same area. Recreation wants an off road use, Forestry wants forest (they get last say)
- Procedure of Reclamation unwritten format general method of going through the departments
- OSM (Office of Surface Mining) recommended consulting firm HNTE Engineering Firm.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF RECLAMATION
ABANDONED MINED LANDS-JASONVILLE, IN.
Tom Thomas
17 April 85

We traveled to an abandoned mined land of Peabody Coal Co. located approximately 15 miles from Jasonville, near the Greene Sullivan State Forest (also surface mine) The mine has been abandoned for about 20 years and has a growth of trees and grasses. However there are several locations where no growth has occurred due to the acid in the soil and there are several
acid lakes in which no life exists.

Plans for this site is to reclaim some of the land back to an off road vehicular use and also to plant those areas of no growth. the Division of Forestry and the Division of Recreation are fighting out the reclamation plans within their departments right now. Forestry wants forest growth, Recreation wants more recreational activities. At the present time there is an extreme problem with trash dumping in the mine area, and I feel an off road use would only encourgae this practice.

At this time, no indication has been made as to when reclamation will start.

Tom also took me to another abandoned site. This time the site was actually the storage and preparation area of Greene-Sullivan State Forest Mine. On site there was slag heaps left from the coal piles and a slurry pond, left from the washing of the coal resembling black mud. No growth can be found and the entire area is surrounded by an acid lake. This particular site is a high priority due to some leakage of acid water into the dam area nearby and the unstableness of the soil.

Conclusions:

In retrospect this trip to Jasonville was long and tiring and had little informative value. I did however take several pictures which will help explain and illustrate an unclaimed coal mine site. My questions concerning time spans, procedures, and expense went unanswered. I looked at their inhouse design department and gained little knowledge as to the design is approached and handled. In fact, I was amazed to see that any work had actually been completed.

Future Plans:

I feel that now is the time to call the Coal Companies and ask questions of them.

AMAX COAL CAMPANY
Gary Doxtater
22 April 85

Main Points:
- Basic linear mining patterns are used.
  Open cut- initial cut of mine
  Box cut- Final cut of mine
- Back to original contour most common reclamation.
- Prime problem area is the ramp which is needed to remove coal from the pit.
- Average seam size is three and one-half feet.
- Todd Lewis also a good person to talk to about mining. He is the in-house landscape architect and planner.

26 April 85

Also present for this interview was Todd Lewis

26 April 85

Also present for this interview was Todd Lewis. Conversation with both was taped and considered to be very valuable. Site evaluation and design can now progress forward in a positive direction.
Informative Points:

- Showed a mining plan for a proposed surface mine site and reclamation plans for the site after mining.
- Reclamation will occur by returning the land to original contour and planting vegetation. Future plans for a natural wildlife and fishing refuge are also being considered.
- Access to the site will occur through roads used for mining traffic. After more consideration I feel entry would be best off of the county road running on the east side of the site.
- Drainage occurs naturally on the site now and after mining, the drainage will be approximately the same.
- Some areas will receive topsoil but in most cases it is not necessary. The ridges are often cut off the top of the spoil banks to allow for easily planted vegetation.

Future Strategies:

The development of the site analysis in the form of evaluating its potential for vegetation (forest), wildlife, energy building factors, and water possibilities is the next important step.

The initial design development with placement of "zones" or "areas" in a specific place on the site.

The interrelationships of the different "zones" is also important.

ENVIRONMENTAL AWARENESS CENTER
UNIVERSITY OF WISCONSIN-MADISON
Phillip Lewis
10 June 85

We discussed what the center was for and what is doing for the community right now. There is a study of urban constellations in which data is being gathered to better deal with the urbanization of our country. Locally several projects are on the boards and much is being done to preserve Wisconsin's natural environment.

Mining towns, Ely, MN. and Mineral Point, WI. were discussed.

Received copies of the newsletters put out by the Center. [see References in Appendix D]
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ARCHITECTURAL THESIS PROPOSAL

My personal areas of interest are those of conservation, energy, and housing and community design. Conservation includes primarily measures to preserve and avoid the degeneration and destruction of our most valuable resource, the land. Energy encompasses a set of principles concerning the logical use of the elements; heat from the sun, insulation from the earth, cooling from the breezes and shade. Each of these principles are used to produce energy strategies which maximize their advantages and minimize their disadvantages. Housing and community design includes combining conservation and energy strategies which can be utilized in superstructures as well as bermed and underground spaces.

Each year the conflict between land as a storehouse for mineral resources and land as a life-support system intensifies. Yearly, one million acres of prime farmland is lost to land development. This includes the construction of roads and recreational areas as well as urban expansion. Comparably, 2.3 million acres of land has been disturbed by coal surface mining since its beginning. [1] The number of acres of land lost to mining is significantly less than the amount lost to urban development, yet when the land is disturbed for its mineral resources little is considered for what the land will become after the mining is completed. Whereas, land lost to urban development is utilized by the community in the form of roads or housing. Often even if a surface mine is reclaimed, recovery of soil fertility and productivity may be delayed or never achieved. In many areas away from the mine, especially in mountainous terrain, landslides, increased water runoff and water pollution may occur. Land lost to surface mining also results in the displacement of people who have called a particular region of land home. Frequently reclamation, usually at a great expense, can minimize the negative impacts of surface mining. However, satisfaction with the mining company and their reclamation results vary among the individuals and groups involved.

In my thesis, I wish to address the issues involved in surface mining reclamation. My supposition is that with the proper pre-planning of a surface mine that involves consideration and anticipation of reclamation from the beginning, the processes and methods used in mining will be improved as well as helping to create more significant environmental results. An example of this would be if the process of excavation of the mineral anticipated the end environmental result, such as a recreational area or housing development. Within the environmental development which is the reclamation of the mine, I wish to explore and utilize different energy strategies. These would be made up of the basic principles mentioned concerning the elements. Energy strategies are a form of energy conservation and reclamation is land reuse or a form of conservation.

The advisory group whom I will be utilizing throughout my thesis will include representatives from state and federal agencies, the mining industry, and the community. The federal and state agencies will include the Department of the Interior, Department of Natural Resources, the Illinois Department of Conservation and the Department of Energy. Industrial sources include Amax Coal Company, Black Beauty Coal Company.
and Peabody Coal Company. The state and federal agencies and the coal companies will supply me with a broad range of views concerning surface mining techniques and procedures, and guidelines and regulations concerning reclamation. The community individuals and groups will contribute the human impacts and concerns of the coal mining and reclamation. It is through these sources of information and existing reclaimed surface mines that my project can be evaluated.

The specific site for my proposed thesis has not yet been determined; however, it will be located in the southern part of Indiana, Northern Kentucky, or the Illinos area.


ADENNA

The loss of productivity, aesthetic value, and cultural values of the land are the effects of surface mining if reclamation is not performed. The costs are socially borne by the community near the mine site as well as future generations not necessarily located near the mine. The public, acting through the government, can ensure that effects are taken into consideration by requiring either reclamation or some type of compensatory payments.

The Surface Mining Council and Reclamation Act of 1977's major objectives were to establish a national program to protect society and to ensure that reclamation occurs as contemporaneously as possible with mining.

The surface mining process can be planned at any site so as to integrate reclamation. The reclamation I will be researching and developing is that of an energy conscious recreational facility. The facility will include a recreational park and support facilities. Energy considerations will be explored and incorporated into the facility. My supposition is that a surface mine which anticipates reclamation in the form of an energy conscious recreational facility can utilize the methods and techniques of surface mining to sculpture the land to be best responsive to energy and environmental issues and considerations.

I am planning to research recreational development on previous surface mines as well as those which incorporate energy strategies. This research will help me design the best possible recreational facility for the site I choose. I am interested in a surface mine or segment of one approximately 100 to 500 acres in size and located in a semi-mountainous region, such as Northern Kentucky.

My goals for thesis include examining many energy strategies and their implications in my thesis project as well as in my future design work, showing one successful strategy of reclamation for a surface mine, and refining my own research-design-development process.
SURFACE MINING & RECLAMATION

SURFACE MINING PROCESS

Surface mining for coal in the United States started as early as 1886, using horse-drawn plows, scrapers, wheel barrows, and carts. Today, most of the time and effort in a mine operation goes into the removal and handling of the overburden (earth covering the coal seam). In some areas up to 40 yards of overburden are removed per ton of coal.

Power shovels were the first large pieces of equipment used in surface mines. These machines operate from the floor of the pit, scooping upward through the bank of overburden and casting spoil (leftover earth) to the side. The depth of the cut was limited to the height of the boom and overburden layers were easily mixed, making segregated reclamation difficult. Power shovels are being replaced or used with a dragline. Draglines operate from the ground surface, dragging a large toothed scoop across the overburden bank and casting spoil to the side. Since the machine is located above the pit, depth is limited only by the height of the spoil pile. Draglines also allow better segregation of overburden layers. In recent years, requirements for land reclamation have forced the introduction of additional mobile equipment. Front-end loaders, bulldozers, trucks, and wheel scrapers are used as support equipment.

MINING METHODS

The choice of mining method depends on the geology and topography of the mine site. Where the coal lies in thin, nearly horizontal seams under high steep hills and mountains, contour mining is used. Where the coal lies in thick seams under shallow overburden, open-pit mining is used.

Contour Mining begins at the coal outcrop on the side of a hill or mountain. The area is cleared of trees and surface debris, including topsoil. The solid overburden is drilled, fractured using explosives, and removed. The coal is then removed by loading trucks and hauled from the site.

Area Mining also begins with surface removal. After removal of the topsoil and subsoil, an initial cut is made down to the coal and the spoil is cast into a stockpile to one side. This cut (referred to as the box cut) is extended across the full limits of the mine and coal is removed as in contour mining. Additional cuts are made parallel to the first, with the spoil of each succeeding cut being placed in the previous mined out pit. [see Fig.1]

Open-Pit Mining requires large mobile scrapers or shovels and trucks to remove overburden from a relatively large area and stockpile it around the edges of the mine. The coal is then removed using large shovels and trucks. [see Fig.2]

RECLAMATION

The Surface Mining and Reclamation Act of 1977, uses the term reclamation to mean "restore the land affected to a condition capable of supporting the uses which it was capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood, so long as such use or uses do not present any actual or probable
hazard to public health or safety or pose any actual or probable threat to water diminution or pollution, and the permit applicant’s declared proposed land use following reclamation is deemed to be impractical or unreasonable, inconsistent with applicable land use policies and plans, involves unreasonable delay in implementation, or is violative of Federal, State, or local law." [1]

Contour Mining in the past, cast overburden down the slope below the coal seam, creating unstable slopes that were prone to erosion and landslides. This procedure has been replaced by more environmentally acceptable haul-back procedures; newly excavated overburden material is hauled back along the cut to a point where coal has been removed and used to refill the cut area for reclamation.
Topsoil or other suitable material is saved and respread over the surface of the replaced and graded spoil, and the area is revegetated.

Area Mining's former practice included leaving the spoil in a valley configuration, with an open final cut that frequently filled naturally with water, forming a long narrow lake. Today, reclamation requirements include smoothing the surface to conform to the surrounding topography, refilling the final cut, replacement of topsoil, and revegetation. These requirements have led some mines to the introduction of wheel scrapers for topsoil handling and large bulldozers for regrading of spoil piles and topsoil.

Open-Pit Mining abandoned the open pit after coal removal. Modern practice requires the backfilling of the pit with spoil material, regrading, replacement of topsoil, and revegetation. Frequently the volume of spoil material is less than the volume of the hole left by coal removal, and the pit cannot be filled completely but will be regraded to fit into the surrounding landscape.

REFERENCES


**ENVIRONMENTAL EDUCATION**

It is within the capability of man to destroy an environment, and it is also within his capability to renew and rebuild it. The problem lies within human attitudes toward commitment for a humane environment. Environmental education, in which aesthetic and ethical values are correlated within ecological approaches and applied to environmental problems, is a way to increase human commitment.

The main environmental problem discussed in this thesis is the destruction of land. A proper approach is necessary for good reclamation of land. Proper land use is provided in nature in discerning patterns of the landscape. These patterns, identified and mapped can serve as form determinants guiding the "built patterns" of people. These patterns include:

- Patterns which threaten human survival.
- Patterns that offer hope for survival.
- Patterns replenishing the spirit offering hope and happiness.

Art, aesthetics, and design offer an outstanding opportunity of wisely designing spaces in a manner that provides quality "built" environment for people without destroying critical patterns within the environment essential for survival, happiness, and well being.

If environmental quality is to be restored, public re-education of the life giving natural values is essential. A suggestion as to how to approach this re-education is to create imaginative "process" demonstration center. Community Awareness Centers would serve as informational centers, simulation labs, and environmental museums. Centers that through process would continually present clear pictures and concepts about people and the environment of that region. The prime goals of a community awareness center would be concerned with portraying that regional landscape patterns provide a source of strength, spiritual health, and wisdom for the individual patterns expressed within the center. [1] An example is the Environmental Awareness Center at the University of Wisconsin-Madison-Director Phillip Lewis. [2]

The design of an environmental awareness center involves several principles:

- Provide a rich, attractive, diverse and natural environment, including areas for mind stimulation.
- Provide a number of different habitats, for example a woodland, wetland, and pond, so there is an opportunity to study each habitat individually or in combination with each other.
- Create habitats which imitate the species composition of typical semi-natural habitats.
- Concentrate on growing and attracting common species of animals and plants.

Along with the experiential aspects, an environmental education center requires a number of support facilities. The most important is an area for teaching capable of sheltering a group of visitors. Storage and lavatories must also be provided. Outdoors, provisions must be made for interpretation signboards and temporary advertisements of events and natural changes within the center. Observation towers and trails are also necessary. [3]
Examples of successful environmental education facility are the William Curtis Ecological Park, London [see Fig.1], and the Lavender Pond Ecological Area, Surrey Docks, London.

Upon examining the approaches toward environmental education, a supposition is that these approaches could also be applied to energy education. A facility specifically designed to allow individuals to experience energy in a naturalistic and architecturally manner will encourage that individual to utilize his knowledge in his own environment.

REFERENCES


ENERGY ISSUES

Energy design involves combining natural energy and mechanical energy. Natural energy is in the form of sun, wind, geothermal, and water. Mechanical energy is an intensification of natural energy through mechanical means.

SOLAR ENERGY

Solar energy design involves nature's simplest laws: the radiation of heat, the conduction of heat through materials, and the convection of heat. [see Fig.1] [1] Manipulation of these can be done through passive or active solar systems. Passive solar is achieved without mechanical systems such as collectors and fans. Passive collection is done in three ways, direct, indirect, or isolated gain. [see Fig.2] Active systems collect by means of solar collectors, heat storage unit, pumps and fans, and a back-up heat supply. [see Fig.3] [2]

WIND ENERGY

Wind energy can be harnessed by windmills or used in its natural state. Windmills were originally used to pump water from the deep well, today, they are used to supply electricity to a building.

Wind utilized in its natural state is called ventilation. Ventilation can be provided by allowing a natural air flow through a structure or by utilizing the thermal chimney effect. In both cases the law, hot air rises, is the primary initiator of air movement. Ventilation is used as a cooling phenomenon. Wind also has a cooling effect after moving through vegetation or across water.
**GEOTHERMAL ENERGY**

Geothermal energy involves utilizing the earth's natural constant temperature to warm or cool a structure. Geothermal energy is in the form of water in the earth and the earth itself. Earth is utilized through building underground structures. [3] Here the structure can remain at a relatively constant temperature year round. Underground water can supply a heat pump with warm water in which to heat the air. Geothermal technology is still very young but becoming more advanced rapidly.

**WATER ENERGY**

Water can be used as a heat energy collector or a cooling device. Water can collect heat and store it for later use within a structure. Water can provide cool water in which to cool a structure.

In almost all these forms of energy, a natural phenomenon is combined with a mechanical device to provide that energy to the structure. Some examples of good energy design are Milton Keynes

REFERENCES


[9] V. Olgyay, Design With Climate
Appendix E
RESPONSIVE ENVIRONMENTAL ARCHITECTURE
ISRAEL

ABSTRACT

Information in the areas of climatology and energy considerations of Israel was gathered in several ways. First, I visited Israel for a period of five weeks from 10 October 1985 to 14 November 1985 where I visited the Technion-Israel Institute of Technology and Haifa University, Haifa, and the Desert Research Station in Sede Boker. [Appendix A] Secondly, I received published literature from the people I spoke with.

At the Technion, I spoke with Edna Shaviv of the Architecture faculty. She was most helpful in the area of solar energy issues and solutions. Next, I spoke with Dr. Milo Hoffman of the building Research Station at the Technion. He was helpful in explaining solar applications in residential construction.

At the Desert Research Station, I spoke with Yair Etzion, the Director of the Architecture Unit. He spoke of present projects at the station. They included a greenhouse constructed of Qualex glass which contains a liquid capable of retaining solar radiation for use at night, a system for distilling water through solar radiation, and an experimental solar house. The solar house was constructed of adobe which was made of native sand. The house was designed by architect Mike Kaplan and built by Larry Ma'ayan both of the Desert Architecture Unit. Located on the south wall are three different solar collection systems. [see Fig. 1] Firstly, a conventional passive solar window with operable glass and shading devices. Secondly, a clerestory which uses a northern wall as the collection mass, and lastly, a series of vertical kinetic prisms. The prisms are constructed of adobe also and the faces of each prism are painted dark brown, white, and the color of the interior space. When the dark side is exposed the adobe mass is absorbing, and when the white face is exposed, the radiation is reflected. The kinetic wall was designed by Professor David Faiman. This is the only known example of this type of
solar collection in the world. All elements within the house are carefully monitored and documented for future use.

The last source and perhaps the most beneficial was Arie Rachamimoff. He is the former director of the Architecture Unit at the Desert Research Station. Today, he is practicing architecture and teaching in Jerusalem. He discussed his design philosophy and showed several of his projects. He believes that architecture is integral with energy conscious design. Energy conscious design has four basic areas. Site considerations including location and climatic conditions, density of buildings, the individual building, and the building details including natural lighting, materials, shading, and vegetation. These issues evaluated and developed from an energy conscious design. [1] Some examples of Rachamimoff's work are the Education Facility at Sede Boqer, the Mitzpe Ramon community south of Sede Boqer in which he won the competition sponsored by the Ministries of Housing & Construction and Energy & Infrastructure and the Israeli Association of Engineers and Architects and many projects in Jerusalem.

In evaluating the spoken word and written literature of the above mentioned people, my report is concerned with responsive environmental architecture.

INTRODUCCION

Responsive environmental architecture results from combining climate and energy considerations with building design. (Building will be used throughout this report as a general term identifying a design project not necessarily a 'building'.)

Climate and energy encompasses a large set of parameters which are environmental variables and not under human control. These include site assets and constrains, solar patterns, wind direction, and temperature variations. Manipulation of climatic parameters can be done through a second set of parameters. These parameters are under the control of the designer. These design parameters include the general layout which for example may be oriented to minimize the impact of wind velocity or to maximize solar access. Other design parameters include the area of the outer envelope, size and location of openings, shading devices, color and texture of the building, and the thermophysical properties of the building. (2)

CLIMATIC PARAMETERS

Climatic parameters are examined and evaluated through site analysis. Here the designer discovers the assets and constraints of his site and how each can work to develop a good design solution. For example; where are the site slopes and how do they relate to solar access and favorable and unfavorable wind directions, does the site have water and can it be utilized in
some way by the project, and where is the site vegetation and what are the species? The solar pattern responds to the regional conditions, site characteristics and the project program. It takes into consideration the solar altitude which defines the length of the shade of the project buildings and therefore determines the solar envelope of each building. On the southern slopes the shade becomes shorter and on the northern slopes the shade becomes longer. This creates the constraints and options that define the distances between buildings. Vegetation can be integrated into the solar envelope as an organic element which improves climatic conditions. For example, evergreens can be introduced to provide protection from the wind, solar radiation, and to reduce glare. Deciduous trees can provide shade in summer and allow radiation access in winter.

Wind direction, temperature variations, and ventilation are the last of the climatic parameters to be discussed. Wind direction is a natural phenomenon which cannot be stopped but it can be manipulated. By using man-made elements such as berms, wind breaks, and the project buildings as well as natural elements such as vegetation, the wind direction can be altered to best provide for the desired site conditions.[see Fig. 2] Temperature variations out of doors cannot be altered, however, internal temperature comfort is controllable through thermal mass, solar radiation, internal heating/cooling equipment, and ventilation.

Ventilation can control internal temperature in three ways. First ventilation controls by mixing the inside and outside air. In summer, mixing is desirable when the outside temperature is lower than the inside, it is undesirable when the reverse is true. In winter, mixing is undesirable, and is better known as infiltration. Second, by creation localized air motion, ventilation helps the evaporation of perspiration and improves internal comfort in summer. This is most important in hot, humid climates. Lastly, ventilation can remove excess humidity. Often, particularly in winter, the internal house relative humidity is higher than the outdoor one. Ventilation can remove the excess water vapor and prevent condensation.[3]

An example of architectural design with an emphasis on proper ventilation is the Islamic Rushaan. The Rushaan was designed for a hot and humid climate and provides good internal ventilation, as well as preventing excess glare and allows uniform and pleasant daylighting. The Rushaan is built of softwood which absorbs the humidity and hence the air entering the house is drier than the outside air. The building is also ventilated from all sides including the floor.[4] Also designes with ventilation as a main concern is the Egyptian Malkaf [5] and the Iranian wind towers designed to capture the breeze and provide ventilation in hot climates. [6]

More examples of vernacular architecture with attention toward ventilation and evaporation is the Egyptian Meshrabeyn. Like the Islamic Rushaan, it provides internal ventilation, pleasant daylighting, and prevents excessive glare. The differing element is the window treatment. In the Meshrabeyn, the window is designed with niches around it. Water jars are placed in the niches and the evaporated water cools and humidifies the fresh air.
In Spanish and Indian architecture, light lattice work lets the breeze in where it blows over an internal water pool or fountain. The air cools by evaporation and humidifies. Obviously, the last example would only apply to hot, dry climatic regions.

DESIGN PARAMETERS

Design parameters include the general layout and orientation of a building, color, texture and material of the building, size and location of openings, and shading devices.

The first design parameter, the general layout is dictated by the climatic parameters, the amount of incident radiation on the building envelope and by local wind patterns. The orientation of a building must reflect the best possible solution for internal comfort. Thus, the orientation of a building must provide solar radiation in the desired amount, ventilation for cooling and aesthetic value. All these combine with the program to provide the general layout of a building.

Color, texture, and building materials all effect the amount of solar radiation absorbed or refracted from the surface of the structure. Ventilation is also assisted or hindered according to texture and material. The aesthetic value and thermal comfort of the building will be altered as these elements are manipulated. For example, light colors, particularly white reflects most of the solar radiation and remains cool. Dark colors, notably black absorbs solar radiation and heats up. The effect of color decreases with the increase in insulation and shading devices. The effect of color on the horizontal (roof) surface is more significant than the vertical (wall) surfaces.

In Mediterranean architecture, white color is used as a means to reduce summer heating. This stems from the fact that homes are not well insulated. A disadvantage to the white paint is that it creates excessive glare which annoys pedestrians and creates many reflection between buildings. An increase in insulation or shading of the buildings would allow more freedom of color thus reducing the unpleasantness of glare and reflections.

The physical properties of building materials which effect their thermal performance are the ability to conduct heat and the ability to store heat. It is important to have insulated external envelopes so to delay the transfer of heat from the outside into the inside space (summer) or to delay the inside heat from escaping to the outside (winter). This insulation combined with thermal mass allows for storage of solar radiation to be used at night or cold winter days. Thermal mass can be located in the outside envelope or in the internal elements such as partition, floors, ceilings, and stairs.

In a climate such as Haifa or Tel Aviv, Israel, both are located on the Mediterranean Sea, the thermal mass is even more important in summer to reduce maximum internal temperature without mechanical means, than it is needed to store energy in winter.

A building made of walls in which the insulation is on the outside with a layer of thermal mass on the inner side cools slower than a house in which the order is reversed. When the insulation is on the inside, it reduces the effect of the thermal mass of the walls.

A study conducted by Edna Shaviv
of the Technion in Haifa, Israel, involved four case studies in which the location of the thermal mass within the building was altered. Case 1 had a light external wall and lighter inner partitions, Case 2 had a heavy outside wall and light inner partitions, Case 3 had a light outside wall as in Case 1 and heavy inner partitions. Cases 2 and 3 have the same U-value and thermal mass, the only difference being the location of the thermal mass. Case 4 had a heavy outside wall with heavy inner partitions. Here the U-value of the external wall is the same as in all the other cases, but the thermal mass is more.

The results showed firstly, that summer and winter energy savings were larger when the thermal mass was in the outside walls, however the differences were rather small. In conclusion, if traditional design calls for an external skin of light insulated structure, the thermal mass can be arranged inside the building, by using concrete walls and floors or other heavy materials. Secondly, the addition of thermal mass improves the winter and summer. [3]

Examples of thermal mass buildings can be found in the cliff dwellings in New Mexico of Mesa Verde in Colorado, where the cave openings are to the south. The Indian Pueblos were built of heavy adobe. These were designed to keep the hot sun out during the day and use the heat absorbed in the walls for warmth at night. The Mediterranean building is mostly heavy in order to preserve the night coolness for use during the daytime.

The last design parameters mentioned are the size and location of openings, and shading devices. Openings should be located on a specific side of the building according to their desired purpose. Example, openings which are primarily for solar radiation should be located on the south, southeast sides. Those for aesthetic value should be located accordingly.

Shading devices can be integral with the building or separated from it. Integral devices are roof or window overhangs and mechanical window shading. Vegetation and neighboring buildings are examples of shading separate from the house.

CONCLUSION

Responsive environmental architecture results from combining and developing climatic and energy considerations with building design. One cannot ignore either in a good design solution. Israel is a country where climatic, environmental, aesthetic, social and political needs demand a responsive architecture. This makes for a challenging design problem for present day Israeli architects.
REFERENCES


INTERVIEWS

Arie Rachamimoff, Former Director of Architecture Unit-Desert Research Station, Sede Boqer, Israel, presently an architect in Jerusalem, 12 November 85.

Yair Etzion, Director of Architecture Unit-desert Research Station, Sede Boqer, Israel, 11 November 85.

Dr. Milo Hoffman, Professor-Building Research Station-Technion, Israel Institute of Technology, Haifa, Israel, 30 October 85.

Edna Shaviv, Professor of Architecture Technion-Israel Institute of Technology, Haifa, Israel. 27 October.
Prof. Ben-Tovim

Description of interest & structure

Two Divisions

Research: 60-70 people

Quality control & testing: staff 70-80 people

- Building sites and construction plants around Israel
- Consulting
- Carrying out projects
  - Construction management - economy
  - Technology & building materials
  - Acoustics
  - Climatic & energy
  - Performance specs. Baker structures

Testing - dynamic - earthquake

3 Areas for us

* Climatology & Energy  Dr. Milo Hoffman

Areas

- Building climatology - passive aspects - contribution in Bldg. design
- Urban climatology

Urban climatology
- Average 30°C high humidity
- Tropical humid climate
- Good ventilation
- Shading

Hospital Bnei Zion

North after 4 - Wind NW - N
30° between day and night

Arch zipper

Release for south window
Night open - day closed

Comfort 22-24°C
PARTITIONS MASS / MODULE FLOOR AREA

CONCLUSIONS
BIG MASS INSIDE MORE DIFFICULT TO COOL
TOO SMALL

SOLAR NEIGHBORHOOD

WIND FROM NORTHWEST
IN DESERT LAND
MUST PREVENT FROM GOING INSIDE DURING WINTER.

MEASURED WIND DIRECTION
WINTER - SE OF EAST.

HEATING OF BOMBS IN GREENHOUSES
HEATING FROM UPPER WINDOW.

GREENHOUSES AREN KHAMIMOFF

14 STOORY BUILD JERUSALEM

SOLAR VERANDA
BIG AND LAHAN

TROUBLE WALL

Instead of trouble wall use light wall with insulation - better performance.

VENTILATED - 12 %
SEALED - 13 %
Whole external facade no heating

GALILEE AREA
WIND TURBINES - ELECTRIC
DEAD SEA
SOLAR POND
DESSERT RESEARCH

ARCHITECTURE - HISTORY

OTHER UNITS
- human developmental desert
- applied solar applications - economics

solving problems of the region
- climatology
- thermal comfort

Deserts
- not aware of 'desert'
- very little rainfall - dew big form
  200 mm rain. - very hot (further dawn)
- Guai - mountain snow
- Gara - churrid desert
- each region needs consideration

Actual Work
- temp range 32°-18-17°C average 25°C low humidity 30-40%
  - considered comfortable
* - environment conscious design
  - insulation
  - shading
  - ventilation

- thermal time constant
  - peak heat in building when lowest temp outside.
  - lower average with insulation

- air infiltration - more wind in B
  - example - auditorium
    - (use in project design)
      - fast cooling
    - choose system B - add air to cool
  - building are concrete
  - 10 yrs ago - no insulation was used
    - humidity design - cool - never below zero.
  - level of workmanship - reduces the R values.
    - very hard to build according to standards

Solar Energy
- most energy 1944 - cost conversion for solar plant - 300 kw first
  - panels - most solar energy
  - institute
DEsert RESEARCH cont
- every bldg a solar bldg.
  - adobe bldg / solar
    - efficiency 95%

- Solar Building
  - space htr. - water htr. - solar
  - photovoltaics - applicances
  - passive is better than active
    - no pumps, compressors
      - no separate storage

- Shading
  - direct beam
  - reflection - refraction
  - diffused
  - sunlight - bring in only diffuse
  - smaller windows

ArChitectural REsearch
  - knowledge remains within secretive
  - build a model
  - consultant

DEsert REclamation
  - hydrology - water resources
    - aquifer - western saudi arabia under desert
      - 200 yrs.
      - mixes with sweet water for agriculture
    - recharge rate of water use 90% - comes from the sea of galis
  - meteorology - dust - sand
    - mathematical models for desert storms.
  - algae - production as food supplements
  - agriculture - build a greenhouse
    - storing heat - computer controlled
      - high, capital crops.
      - keep ahead.
  - architecture - environmental design
  - desert ecology - center - try to preserve ecology
      - but not destroy land.
  - saline wells -
    - soil - preservation
  - sociology - human behavior
  - flood prevention - clay soil
  - desert animals
DESERT RESEARCH INSTITUTE cont.

- Qualtex - different thickness
  - double pane glass
    - collects heat that is used at night
- Greenhouse - absorbs
  - accelerate growth
- low level of water - evaporation - condensation - runs to tank.
- adobe material construction

SOLAR HOUSE

- 2 bedrooms
- living room - used to be heated by direct gain
  - phase changing materials
  - show to collect maximum
  - show to loose minimum
  - mud construction - 2nd generation
  - phase changes

82'-83' $10,000 per box
$18 per box

Iranian concept
- cooling tower - intercepts air at higher levels.
- cooling of area through evaporation.

- stone heat in north wall - insulation panels
- dish type like - water heater.
- collector - lower angle of collector - added mirror.
A. FACHMINOV 12 September 21 NOVEMBER 85

Yemin Moshe 194, Nacon St. 2 1 RUS # 21
77-80 Institute - practicing in Jerusalem
Projects - education facility in Sede Boker
Neighborhood south of "Solar Community"

Proper way of living in a desert:
16 yrs. Timna - Jerusalem - Tel Aviv - urban renewal - improvement in existing
8 yrs. Tel Aviv

Energy Conscious Design
- Site consideration - location climatic considerations
- Jordan valley north
- Mediterranean west - wind
- Sede Boker south - cool and dry

60-70% desert

- Density - distance between

Settling the Desert

- Institute

- Individual house
- Respond to building to the climatic condition
- Enlarge windows - Jerusalem - northern side
- Open spaces - maximum ventilation
- Winds - north-west

- Building details
- Natural lighting
- What materials
- Shading device
- Vegetation - element to improve comfort? Nubakirian

- The Negev
- Challenge of a Desert
- Harvard Pr...
200 BCE - 600 AD
French Culture
Upper Negev
Persian Gulf / Mediterranean
Regional urban housing design principles
- Water 5 inches a yr.
  - run-off water - surface area
  - orchards in the Negev valleys
  - wine making plants
- Built cities
  - chief and storms
- 20 ft. less - thick walls - patios
  - arcades south-east
  - small windows - ventilation

Sudies
Mediterranean desert - humid -
Hot dry desert

Massada - royal palace - northern slopes.
- enormous climatic benefits:
  - attaching block to wall
  - thermal mass of mountain
  - shaded breezes
  - strong storms from south
  - lower
  - recreation, rubble
  - upper - top
  - water collection no problem

Herodion
- extended hill to create unroofed - palace
- north-south axis
- own shade when he wanted

 Nabataean city
- water collection valley
- walled city - reduced glare - dust storms
- individual house
Islamic Architecture
- 13th c.
- Residential, mosque, burial
- Outside: massive small chord openings
- Inside: arcades open spaces soft-open

Kibbutz: eliminating desert feeling all together.
Peristyles: covered walkways cooling during the night define orientation
Residential
- Large open inside windows

Sede Pekah Solar House
- Chg. north wall from south clerestory

Michael Caplan
Mitzpe Ramon - competition

Crater South of Sede Boker
2500 above sea level
coldest city
lots of winds

Environmental conditions as generators of housing forms
strong winds
sun wind, temperature.

Site analysis
wind - north-west
terrain - slope westward
sun exposure.

Solar pattern

Historic current and
Chaco Canyon Pueblo Bonito
repetitive pattern around pano
Baghdad

Architecture for the Poor
sharp edges outside
soft edges inside

public/private exteriors.

* The Impact of Climate on Planning
and Building
A Zilin

Solar balconies
landscaping design

Education Facility Sede Boker

* Sun Rhythm Form
Ralph Knowles

beams, pergola