

Revealing Expressive spaces - transformation of a former quarry to a dancers' retreat center

an investigation on the relationships between movement and spatial perception

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Submitted to the department of architecture in partial fulfillment of the requirement of the degree of Master of Architecture at the Massachusetts Institute of Technology.

February, 2004

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Signature of author _____

Pearl Pui Wan Tang
Department of Architecture
January 16, 2004

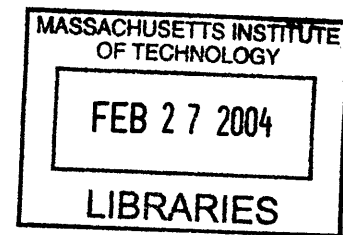
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ABSTRACT

Dance and architecture are two disciplines of creativity that share a special relationship. Movement and space are the common grounds for the two disciplines. Movement defines space in dance, while at the same time; movement manifests the experience of spatial qualities in architecture. It is through our movement that we read the expressive and dynamic quality of spaces in architecture and in nature. It is also through movement that we orient ourselves within and identify ourselves with an environment.

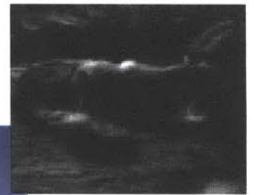
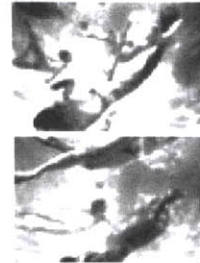
To think about space created for and by the body as the common linkage among dance, architecture and landscape, a dancers' retreat center is used as the program for design investigation. Spatial concepts as perceived in dance are employed to inform the design of architecture and landscape. The goal of this thesis is to find an architectural solution for the dancers' retreat center that informs the users of dance and allows dance to inform the definition of the spaces in architecture and landscape. Mutual influence and exchange of ideas between the two disciplines occur in this reciprocal dialogue. The project is aspired to accommodate different performance scenarios and to create permeable volumes of spaces that allow fluid movements between architecture and landscape.

Thesis Supervisor: William Lyman Porter

Norman B. and Muriel Leventhal Professor of Architecture and Planning

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Introduction

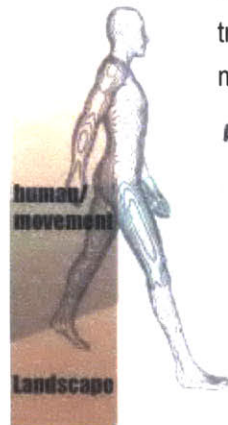
The thesis is an exploration of the making of spaces in architecture and landscape through the ideas of dance. Both creative processes involve the conception of ideas, the development of the ideas, and the emotional and intellectual experience the work evokes from the observer or user. The two processes influenced each other in a reciprocal manner. The quality of spaces in the piece of architecture influenced the perception of users and expressiveness of the dance, while the act of dancing and different performance scenarios influenced the definition of spaces in that piece of architecture and landscape.

There is a close relationship between dance and architecture. Movement, space and time are the common grounds for the two disciplines. Movement defines space in dance, while at the same time; movement manifests the experience of spatial qualities in architecture. It is through our movement that we read the expressive and dynamic systems in architecture and in nature. It is also through movement that we orient ourselves within and identify ourselves with an environment.

The thesis is an investigation on how to associate man with nature through movement in architecture. Sensory mappings of light, view and texture at the site are used as means to generate a variety of architectural spaces that would evoke an acute human perception of natural forces. Boundaries between architecture and landscape are treated as permeable interfaces. The project is also a study on how artificial materials can be transformed into experiences of nature and how natural materials can be integrated with architectural elements.

Dance points of reference
culture / local setting
contact / release
invisible boundary
absence / presence
topography

Nature



Architecture providing points of reference
changing perception
providing platform of contacts
defining boundaries
connecting spaces
transforming landscape

The program chosen is a dancers' retreat center. The project accommodates a variety of performances spaces both in architecture and in landscape, and provides opportunities for both dancers and the general public to express themselves in a natural setting. As dance is a human behavior inherent in all of us, it can be the activity of one unobserved individual or a highly stylized performance performed by a specially trained group for the rest of the public. In this project, dance is defined in the broadest sense to include all cultures, styles, degrees of skill and sophistication.

The project operates on the distinctions between intention and incident, surface and depth, opacity and permeability, and invites interplay between its divergent parts. The traditional relationships of performance and practice with the public are questioned and rearranged, and the roles are reconsidered, expanded and multiplied. These interfaces are the fields upon which the fluid exchanges between generation and resonance, instantaneous and delayed, projection and implosion, are played out.



Project Background

- o Interpretation of Movement and Dance
- o Site Study

Movement

In this project, movement is the central element that ties the different aspects together (dance, architecture, landscape, nature). Movement defines space in dance, while at the same time; movement manifests the experience of spatial qualities in architecture. It is through our movement that we read qualities in nature and landscape. The project is a study on how one perceives space and landscape through movement, and how that perception induces and influences the movement.

“Movement is the ART OF BECOMING. But the process of becoming is a constantly shifting experience. The notion of movement, of dance is that there is a moving towards something, a something that is fixed. And yet this movement, this system of gestures, this dance keeps discovering that there is no something, that the something is not fixed, but keeps changing.”

- by Gopin, Aberrati



Many choreographers have been studying human body movement in order to understand its physical features and to find an effective way to express emotional images through body movement. One of the most significant theorists is Rudolph Laban (1879-1958). He proposed *Laban's Movement Analysis*, which is a very important theory of movement and influenced many choreographers and dancers even today.

Laban's Movement Analysis

Laban Movement Analysis is a system and a language for observing, describing and notating all forms of movement. A movement analyst can use this language to describe and interpret human movement from the gesture of a hand in conversation to the complex action of a skilled athlete. The ideology behind L.M.A. as it is practiced today encompasses four main categories:

BODY -- *sensing*

deals with principles such as the initiation of movement from specific body parts, the connection of different body parts to each other, and the sequencing of movement between parts of the body.

EFFORT -- *feeling*

concerns with movement qualities and dynamics, and is subdivided into Weight, Space, Time and Flow factors.

SHAPE -- *intuiting*

relates to the way the body interacts with its environment. There are three modes of shape change: Shapeflow (growing and shrinking, folding and unfolding, etc.), Directional (spokelike and arclike) or Shaping (molding, carving, and adapting). It refers to the expressiveness inherent in the form which movement takes.

SPACE -- *thinking*

the study of moving in connection with the environment and is based on spatial patterns, pathways, and lines of spatial tension. Space Harmony acts as a framework for Space, Effort and Shape in the form of established scales of movement within geometric forms. These scales can be practiced in order to refine and broaden one's range of movement.



fig. 1.1 ballet position of epaulement

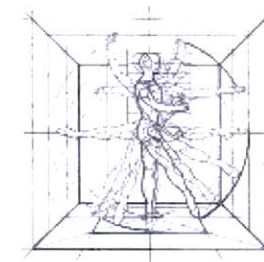


fig. 1.2 Laban's concept of Kinesphere



fig. 1.3 Laban's attempt to describe human movement as a dynamic geometric form

It is also essential to understand "Effort" (the use of energy in space and time) as it is the driving force behind movement. It is associated to the inner impulse, a movement sensation, a thought, a feeling or emotion, from which movement originates; it constitutes the link between mental and physical components of movement.

Laban's Theory of Effort

Laban's Theory of Effort is another theory proposed by Rudolph Laban. In the theory, Laban stated that there are 4 elements that constitute effort.

WEIGHT --sensing, intention, "what"

- strength and power of movement (firm movement, fine touch movement)
- the way a mover senses and adjusts to pulls of gravity. Moving with lightness can be delicate, sensitive, with easy intention. Moving with strength can be bold, forceful, with determined intention.

SPACE --thinking, attention, "where"

- a design of posture; directivity of posture and movement
- a mover's thinking, or attention to spatial orientation
- flexibility encompasses the 3-dimensionality of space, with an open and broad awareness of spatial possibilities. Directness is focused and specific, with attention to a singular spatial possibility.

TIME --intuition, decision, "when"

- sudden movement Vs sustained movement
- sustained movement is continuous, lingering or indulgent in its unfolding; sudden is unexpected, isolated or surprising.

FLOW --feeling, progression, "how"

- carefulness Vs easiness that can be seen in movement, free Vs bound
- free is an external releasing of energy, bound is contained and inward, resisting the flow.

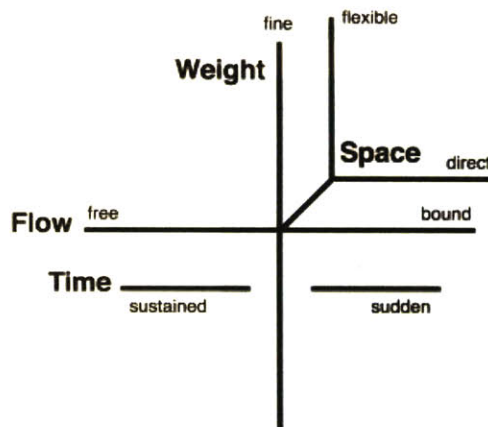


fig. 1.4 Laban's diagrams of effort

Among these 4 elements, the former three are the most basic ones of equivalent relationship and the flow element controls the total combination of the other three in a temporal sequence.

Combination of two factors:

| | | | |
|---------------|-----------|-------------|--|
| SPACE, TIME | awake | where, when | alert |
| WEIGHT, FLOW | dreamlike | how, what | bodily feeling, hazy fantasies |
| SPACE, FLOW | remote | where, how | small pensive, visual, projecting outwards |
| WEIGHT, TIME | near | what, when | earthy, rhythmic |
| SPACE, WEIGHT | stable | where, what | steady, balanced |
| TIME, FLOW | mobile | when, how | getting on, progressing |

Relationships between effort and shape:

Laban observed the relationships between qualities of effort, spatial placement and shaping and found characteristic tendencies. Shaping refers to the way the body forms itself in space. Because qualities of Effort are associated with thinking, feeling, sensing and intuiting, relationships between shaping and Effort form meaningful qualities.

| EFFORT | | SHAPE | |
|---------------|--------------------|------------------------|-------------------------------|
| motion factor | component | quality | direction |
| space | flexible / direct | spreading / enclosing | sideward / outsideward across |
| weight | light / strong | rising / sinking | upward / downward |
| time | sustained / sudden | advancing / retreating | forward / backward |
| flow | free / bound | growing / shrinking | scattering / gathering |

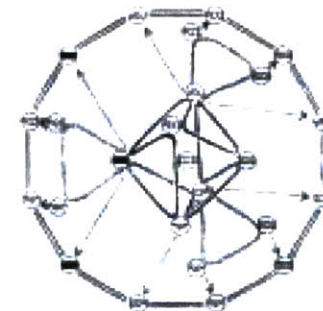
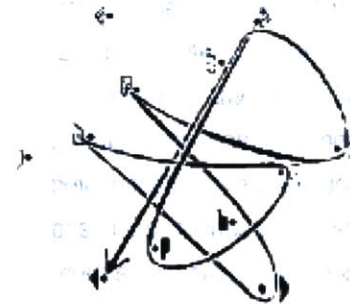


fig. 1.5 Laban's diagrams of movement

Dance

Why one dances?

Dance is a basic instinct inherent in all of us, we naturally move according to music, rhythm and beats. Using dance and the movement of body to convey meaning was evident in primitive man and is still evident today as the first behavior learned by children.

In our advanced and specialized age of information and technology, the innate reflex of our bodies to respond to rhythms and emotions has become suppressed and consequently, the movement of our bodies are subordinated and relegated to an instrument of control and work. We are becoming more and more separated from the expressive and creative movements in everyday life.

In order to revive that instinct in our body, and to reconnect our body with our mind through movement, an environment in which both dancers and the general public can freely express their feeling and communicate to one another through movement is essential.



fig. 1.6 scenes taken from the Songs of the Wanderers by Lin Hwai-Min

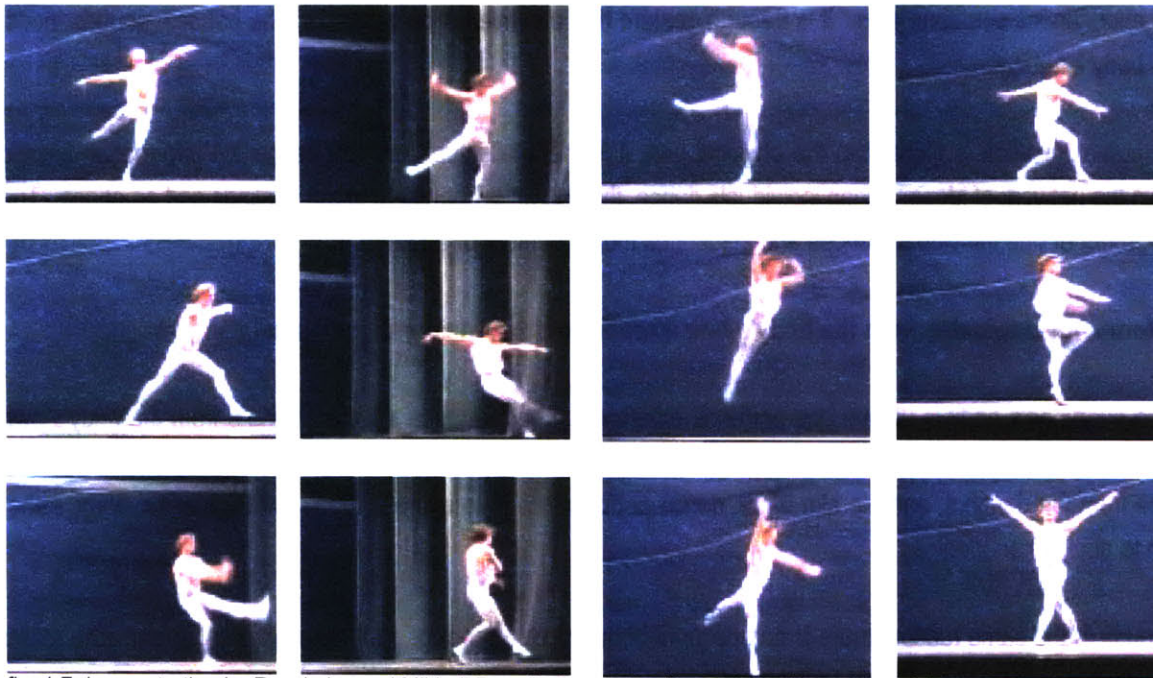


fig. 1.7 demonstration by Russia borned Mikhail Baryshnikov, a significant Ballet figure in the 21 century

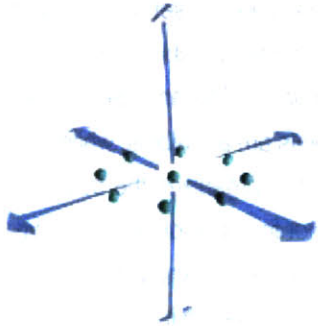
Dance as a form of language

Dance is not about a recited set of fixed steps and movements. Instead, it should be viewed as a form of language. The animated bodies and the movements are alphabets, while choreography (how one organizes the bodies in relation to space or to one another) is the syntax behind. The value of a language is determined by the context in which it appears, while dance is greatly influenced by the time and space it occurs. In the case of dance, the most important thing is how a person speak the language, not what he say.

The same analogy applies to architecture. Individual spaces are the components (alphabets) in a building, while the spatial organization and the linkage (physical or conceptual) between spaces are the syntax. There is no definite or linear sequence in navigating through different spaces in a building, different ways of navigation result in different experiences. It is like in language, there is no specific fixed order of alphabets, different arrangement results in words of different meanings.

Intertwine dance with the act of drawing (points, lines and planes) to generate new dance movement

A ballet dancer is trained to imagine lines, planes, and vectors in order to know precisely where he or she is in three-dimensional space. Classical ballet connects coordinates in established ways, which has allowed it to develop a high degree of formal and technical complexity.

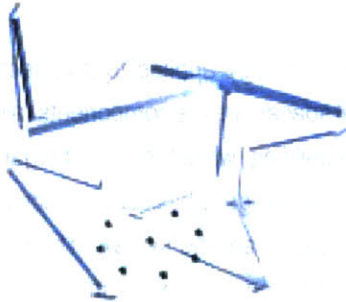


Classical ballet evolves from a clear center; movements are in a established order and orientation.

Some modern choreographers try to break this convention by proposing a system of serial movements within a network of polycentrally arranged nodal points. Equal importance is given to all the points, non-linear movements can be incorporated and different body parts can move towards the points at varied rates in time.

Dance as a form of communication between individuals

Dance occurs when two or more people engaged in each other's rhythms and synchronize. During the process, one experiences someone else. It is through gesture that a conversation happens - the pauses, sounds, nods, and body language.



Some modern choreographers tried to break this convention by proposing non-hierarchical movements within a network of polycentrally arranged nodal points.

The communication is more than the physical part, it is the intellectual part that keeps the information flowing within the network of ideas. When individuals dance, there is an exchange of ideas, feelings and emotions. The movement of one individual induces and influences the movement of another.

Performance originates from the body's own experience / knowledge of individual dancers

Since everyone's body is unique and performs differently, a performance should originate from the body's own experience and knowledge, although traditional dance performances assume a universal model. The work should come from the dancers, and the aim of the dance performance is to express the knowledge of the body, rather than to achieve an ideology.

Because of the same reason, there is no one ideal body type for dancing. Individual physical possibilities rather than physical capabilities should be focused.

The main ideas for the thesis are evolved based on the above definitions and assumptions for dancing. The building is configured to accommodate a variety of performance spaces in both architecture and landscape setting, each of which has a specific sensual quality. The quality of spaces in the piece of architecture influenced the perception of users and expressiveness of the dance, while the act of dancing and different performance scenarios influenced the definition of spaces in that piece of architecture and landscape.

These performance spaces are placed in a polycentric manner and there is no established order in moving through the spaces, different ways of navigation results in different series of movements, and thus different experiences. The spaces are connected by both physical and conceptual (visual, implied) linkages.

The building is designed for the use of both dancers and the general public. Dance is defined in the broadest sense in the project, to include all degrees of skill and sophistication. It can be the activity of one unobserved individual or a highly stylized performance performed by a specially trained group for the rest of the public. The boundary between performing and viewing is blurred and roles between dancers and spectators are configured to shift.

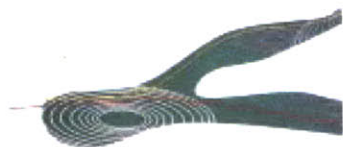
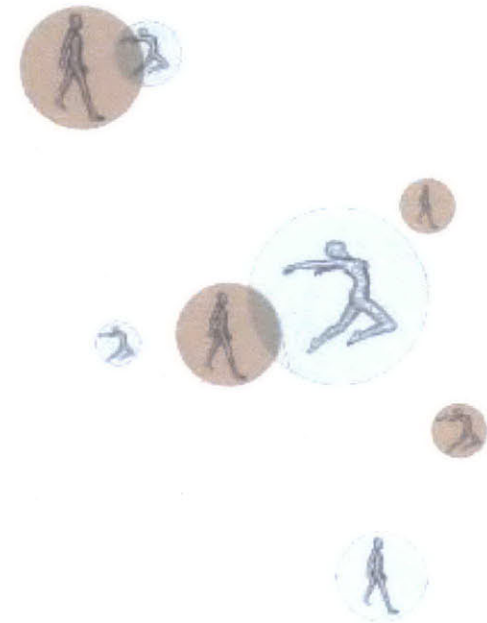


fig.1.7. nodes and links in a polycentric dynamic system

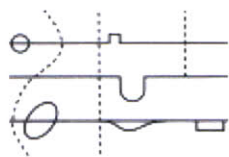


fig.1.8. 'Royal Air Force': Night Raid over Berlin



fig.1.9. three models of polycentric arrangement: radial mononuclear, semireticulated multihierarchical and reticulated polynuclear



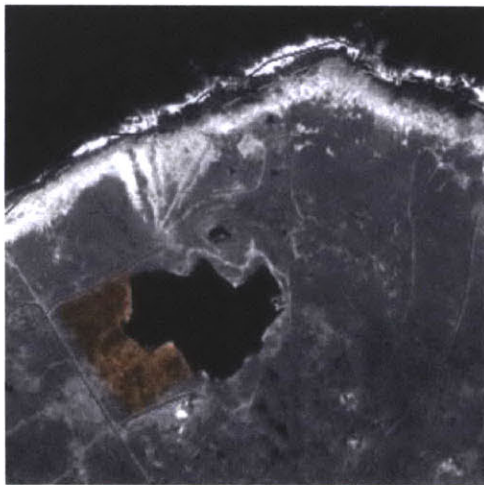
fig.1.10 Laurence Stern. The novel as city



Project Background

Interpretation of Movement and Dance

- **Site Study**



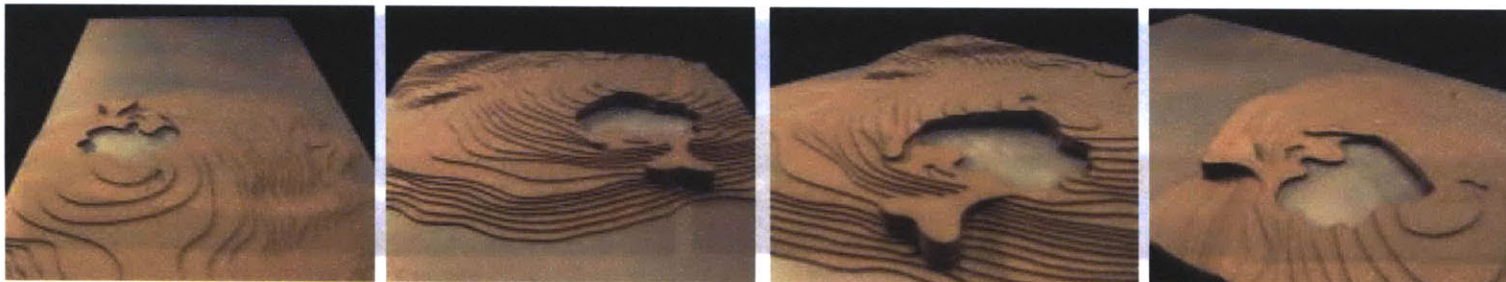
Site

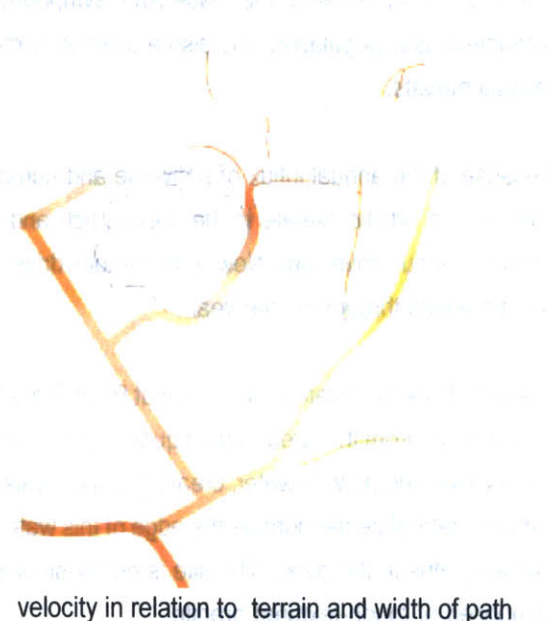
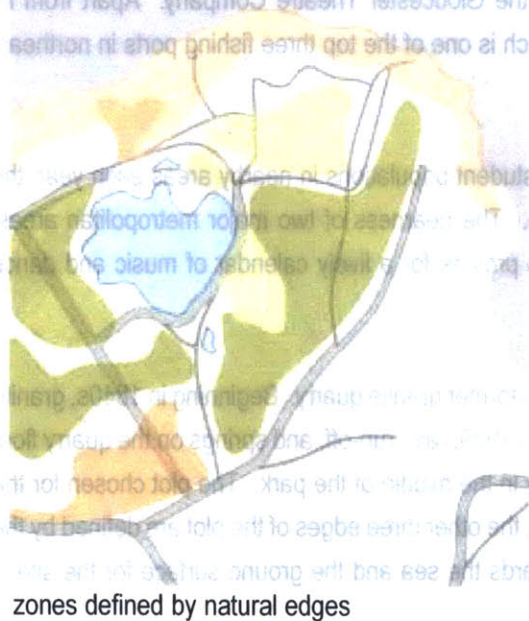
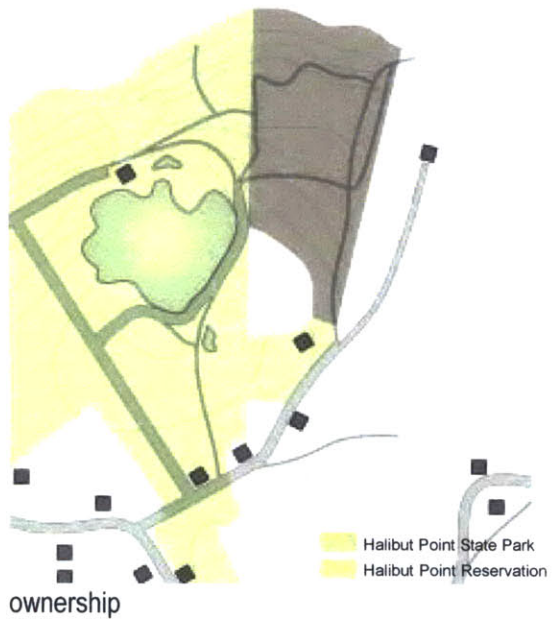
Halibut Point Park, Gloucester, MA

The area chosen is in the city of Gloucester, Massachusetts. The city has a very rich history in art and culture. It is long renowned among artists for the purity of its light and has traditionally been the home of internationally known painters like Winslow Homer, Edward Hopper and Fitzhugh Lane and sculptors like Walker Hancock. The city is now home of the Cape Ann Symphony and the Gloucester Theatre Company. Apart from its sizeable artistic population, it is also a working harbor which is one of the top three fishing ports in northeast Massachusetts.

Because of the annual influx of a diverse and numerous student populations in nearby areas each year, the cultural and artistic climate in the area is rich and active. The nearness of two major metropolitan areas, Boston (1-hour drive) and New York (5-hour drive) helps provide for a lively calendar of music and dance performances throughout the year.

The site chosen is located within Halibut Point State Park, a former granite quarry. Beginning in 1840s, granite was quarried from this area. When quarrying ended here in 1929, rain, run-off, and springs on the quarry floor quickly filled the pit with water, creating a calm water body in the middle of the park. The plot chosen for the dancer's retreat center borders the edge of this water body, the other three edges of the plot are defined by the existing paths in the park. The site is gently sloping towards the sea and the ground surface for the site is composed of rough-textured granite.





The reason for choosing the site is because it is an interesting junction of different axis of natural forces. Its physical setting offers an inspiring environment with rich sensory qualities, for people to retreat and to reflect on oneself and one's natural connection with the surroundings.

Physical features of the site:

- A diversity of spaces formed by the enclosure of natural systems (light, texture, vegetation) and existing structures (path, edge of quarry)
- Rich surface textures: clam, fluid, reflective water surface exists side by side with course, solid, opaque granite surface
- The nature of the terrain where the plot is located is predominantly gently sloping towards the sea, with a high elevation of 210 feet and a low elevation of 134 feet. The gradient of slope is around 2%.
- The characteristics of the surroundings in terms of views in to and out of the site create the parameters that will govern placement of programmatic elements, and thus patterns of movement.



site section



Site History

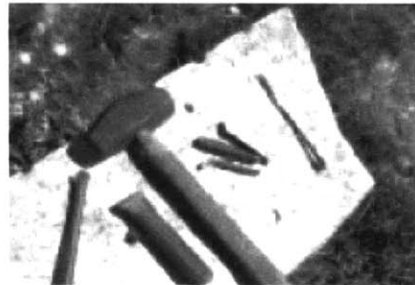
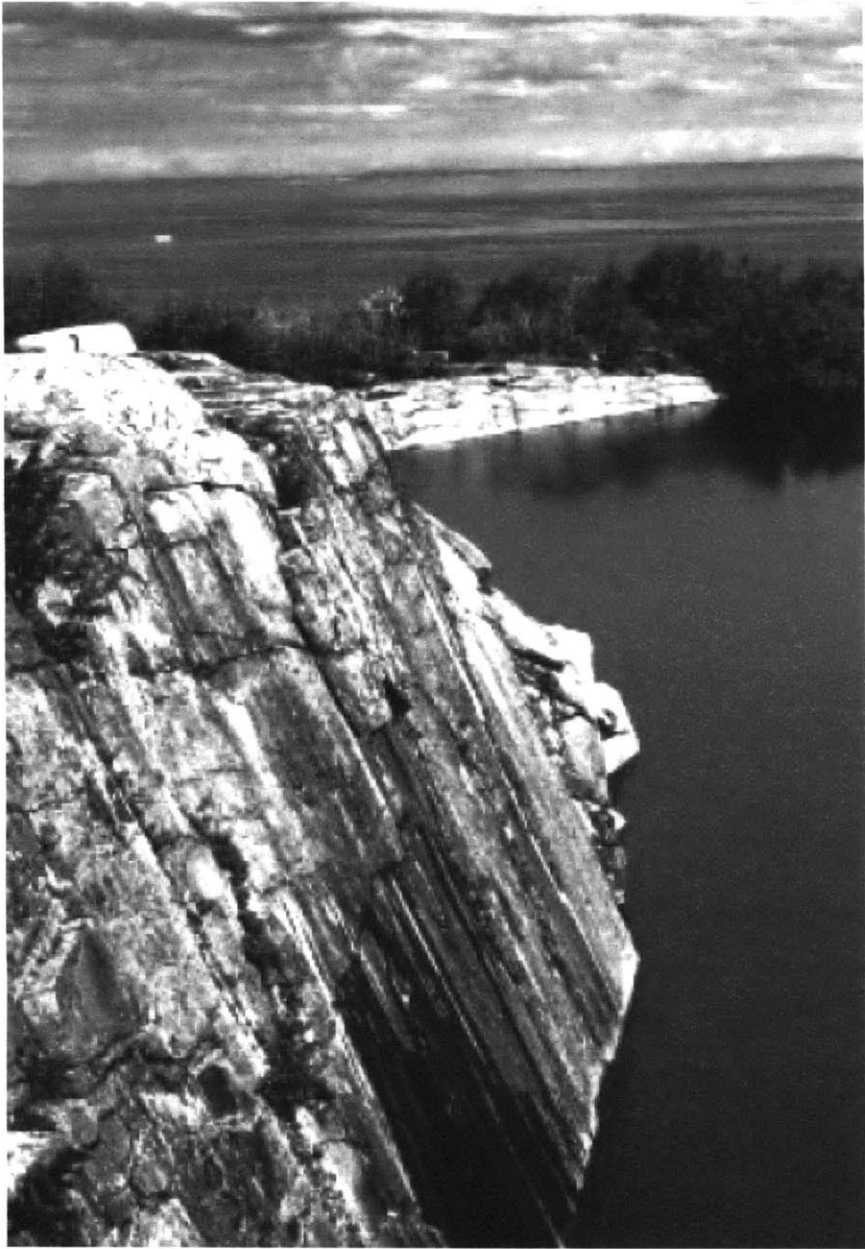
The area was first used by groups of Pawtucket Indians who migrated seasonally to the coast to harvest its plentiful supply of wild fruits, fish and game. With the arrival of the first settlers late in the 17th century, the shallow soil was used for farming and cattle grazing.

Beginning in the 1840, granite was quarried from this area, first on a small scale and primarily along the coast, and then on a much larger scale when the Rockport Granite Company acquired the Babson Farm quarry and expanded its operation. Until the mid-19th century, quarrymen kept their working area dry by removing water by hand, a bucket at a time. Later, some quarries installed wind-powered pumps. At its deepest point, the Babson Farm quarry is about 60 feet deep.

Cape Ann granite weighs 168 pounds per cubic foot. Moving stone from the floor of the quarry to the surface posed a major challenge to 19th-century technology. Borrowing techniques that were used on large sailing ships, quarrymen devised an arrangement of blocks-and-tackles and pulleys called a *derrick* to hoist the heavy stones. Before steam engines became available in the 1860s, derricks were powered by hand. Steam engines made it possible to hoist and move larger blocks of granite from the quarry floor.

With the growing preference for steel-framed buildings and for asphalt and concrete road surfaces, the Rockport granite company collapsed in 1929 and quarrying was ended. Rain, run-off, and springs on the quarry floor quickly filled the pit with water.

The orange-brown granite across the quarry is called seam-faced granite. It was colored over many thousands of years as water seeped through the naturally-occurring cracks in the granite, causing the iron-containing minerals in the granite to oxidize/rust.





Process

- **Mapping exercise 1 - study of naturally defined spaces on site**

Mapping exercise 2 - light and shadow analysis, solar projection analysis

Mapping of naturally defined spaces on site

This initial exercise was used as a tool to begin deriving spatial and formal relationships, with qualities at the site.

The exercise based on the first impression on the site, and spaces that are defined by natural boundaries such as edges of the quarry, edges defined by vegetation and path, were mapped in relation to one another.

The elliptical spaces were generated by the undulating outline of the quarry. The green ones are on water and are partially enclosed by the quarry wall, while the blue ones are on the ground surface and are defined by the quarry edge. The grey volume is bordered on two sides by an existing pathway; its presence helps to contain the site on one side. The red shapes are devised according to the existing movement pattern; they show possible connections among the defined spaces.

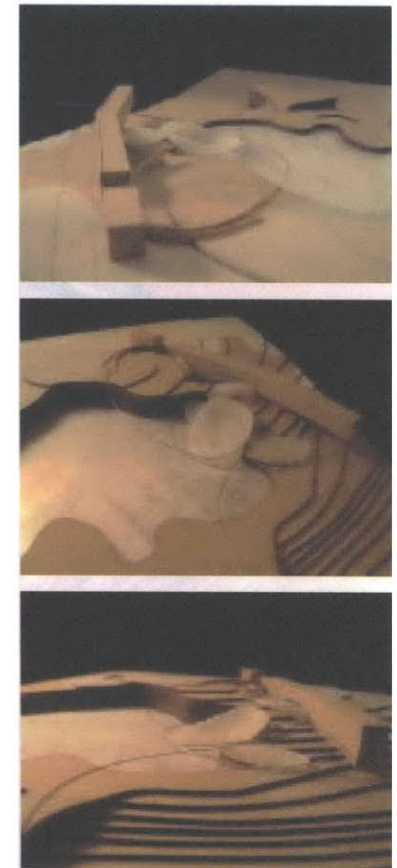


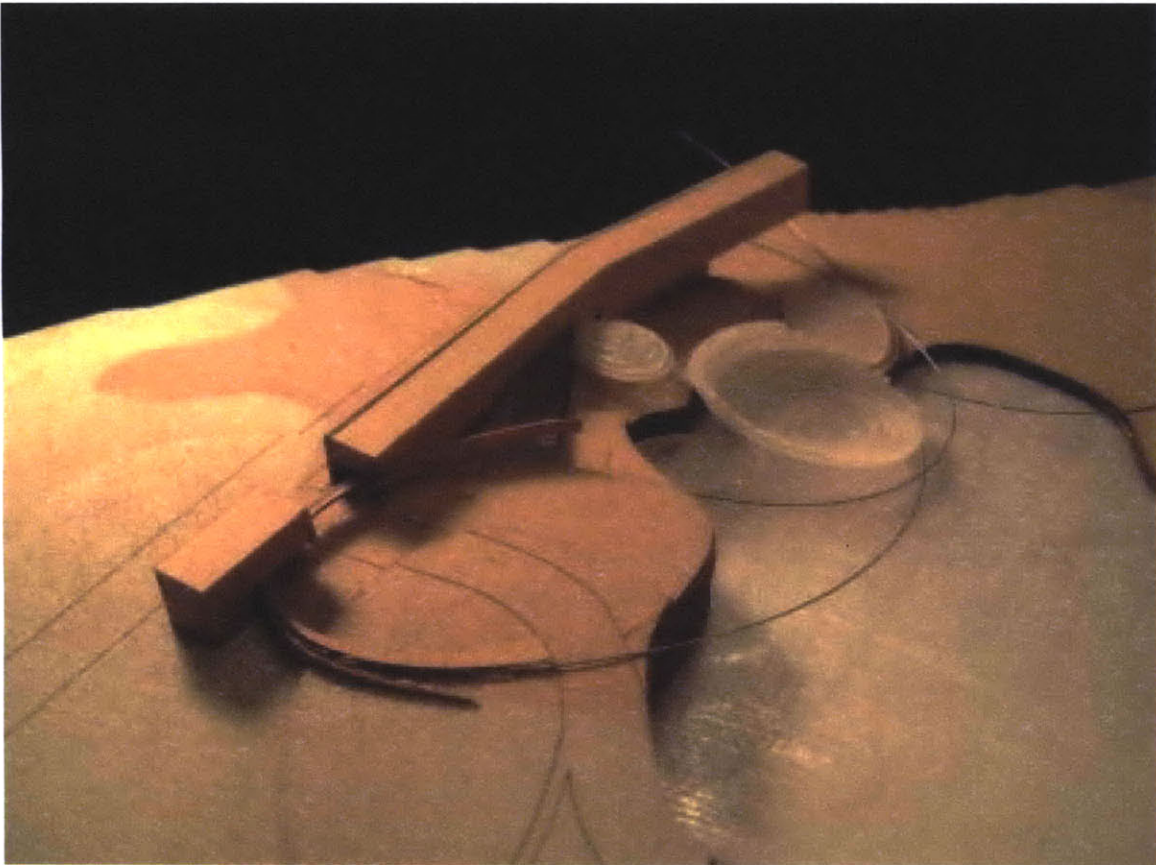


The study was then used in conjunction with the program placement and in connection with the initial massing organization study.

The shapes and volumes were transformed to become spaces with a variety of spatial qualities, for different types of performance to occur. The main building accommodation was placed along the road on the west side of the site; open plazas and semi-enclosed platforms were defined by landscape elements and the edge of the quarry. A floating theatre was created on the water surface.

The spaces relate to one another through either physical or implied links (represented by wires in the model), movement along the links creates another form of spaces.







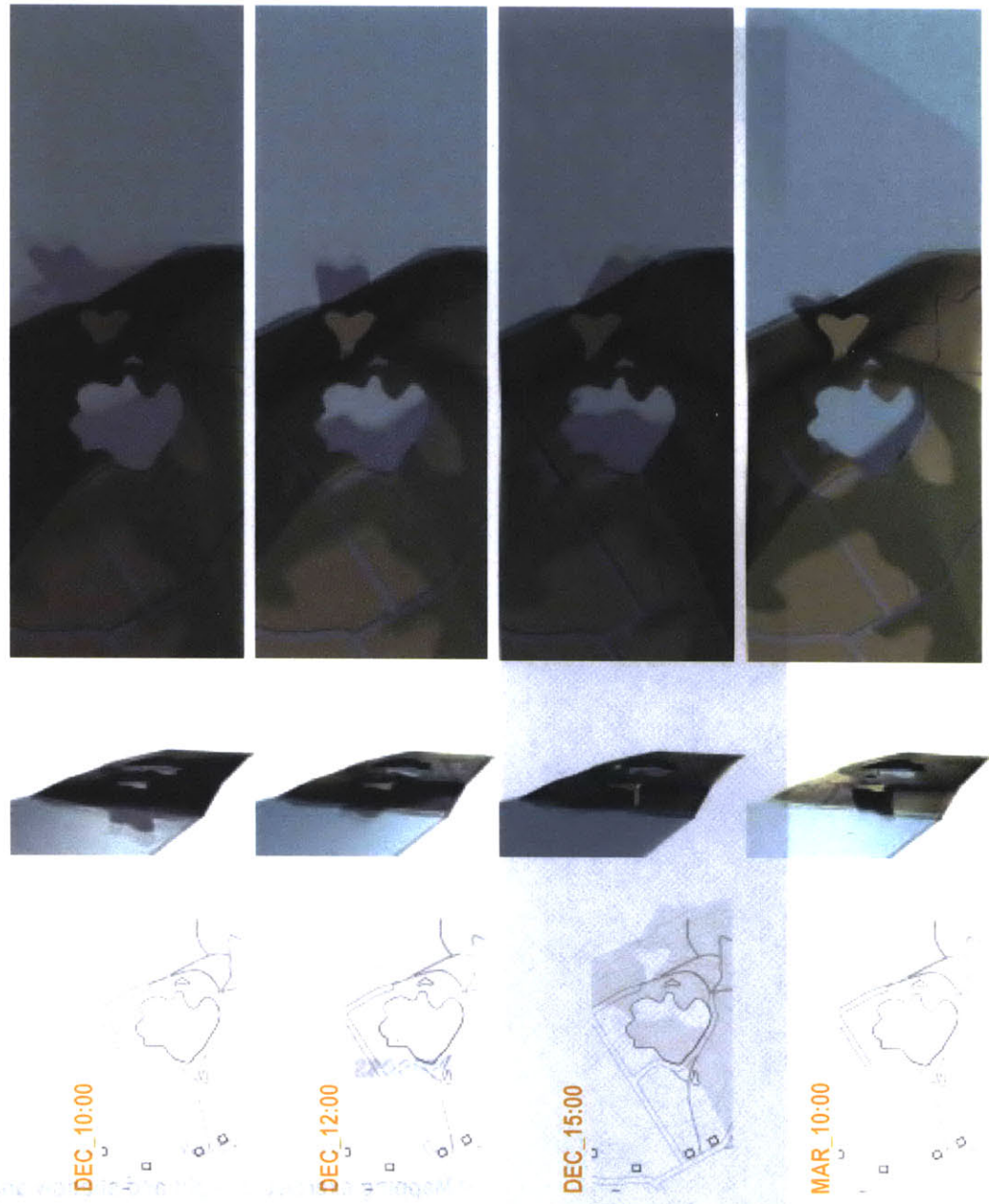
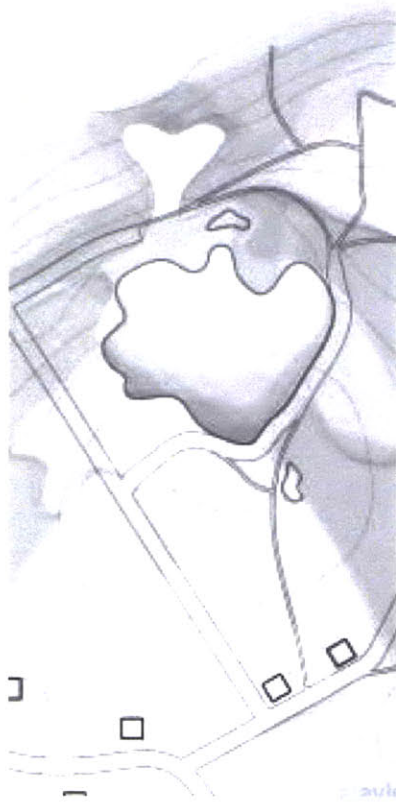
Process

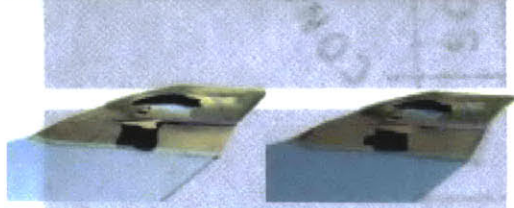
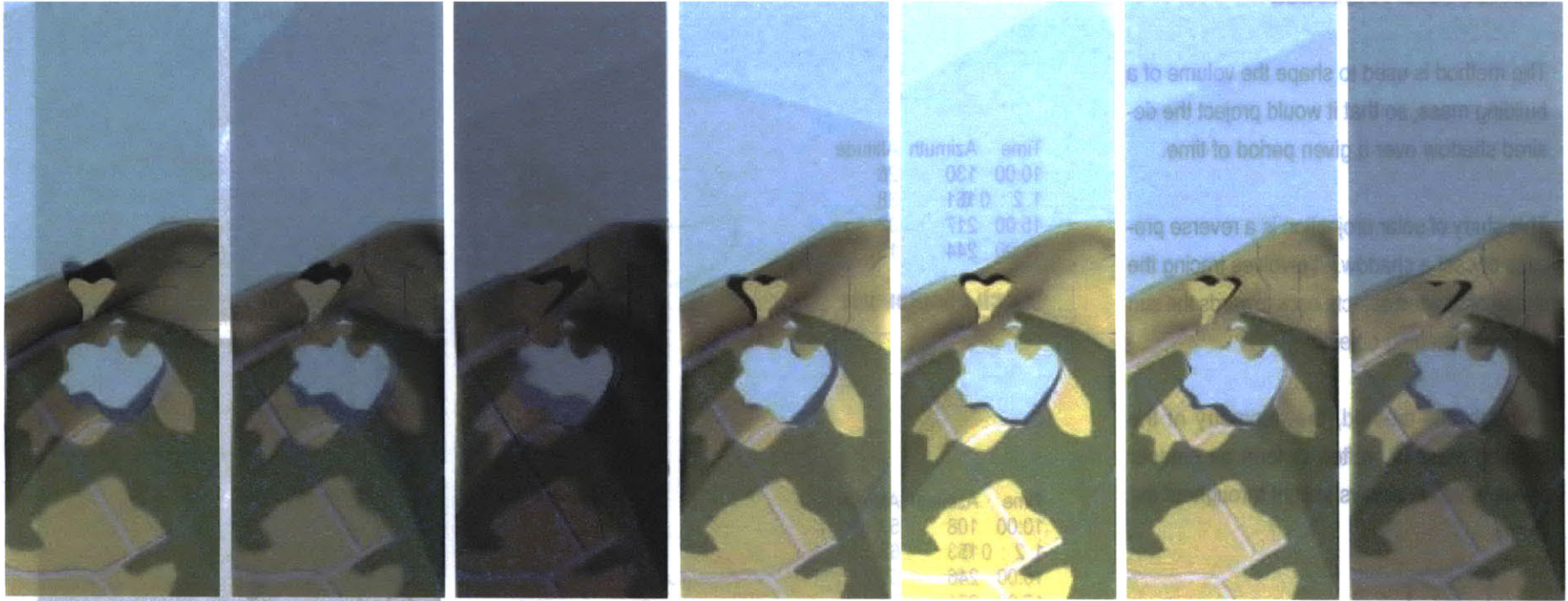
Mapping exercise 1 - study of naturally defined spaces on site

- **Mapping exercise 2 - light and shadow analysis, solar projection analysis**

Mapping of shadow on site

Light is an essential element for all kinds of performance. The overall lighting condition of the site is analyzed by overlaying the shadows cast throughout the year. The spaces always in light are potential stages while the spaces always in shadow are potential audience areas.





MAR_12:00

MAR_15:00

MAR_17:00

JUN_10:00

JUN_12:00

JUN_15:00

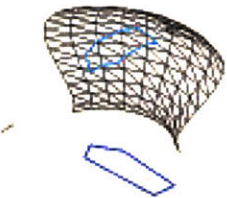
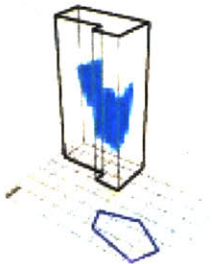
JUN_17:00

Inverse Solar Projection

The method is used to shape the volume of a building mass, so that it would project the desired shadow over a given period of time.

This study of solar projection is a reverse process of cast a shadow. It involves tracing the shape of shaded objects back towards the sun and onto shading objects.

Through this method, the geometry of the building mass is crafted to form an outdoor space which is always in light throughout the year.



| Time | Azimuth | Altitude |
|-------|---------|----------|
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| 12:00 | 101 | 38 |
| 15:00 | 217 | 33 |
| 17:00 | 244 | 16 |

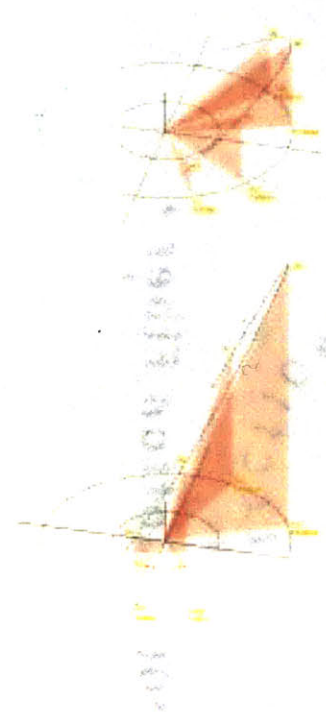
March / September

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| 12:00 | 153 | 68 |
| 15:00 | 246 | 55 |
| 17:00 | 271 | 33 |

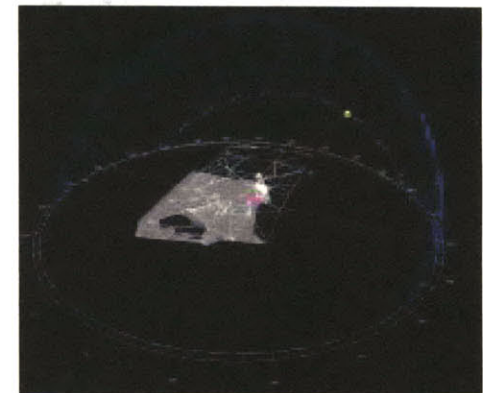
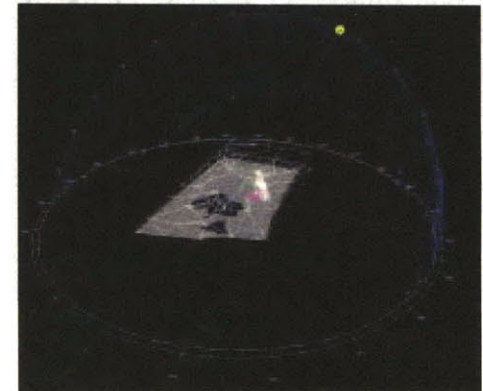
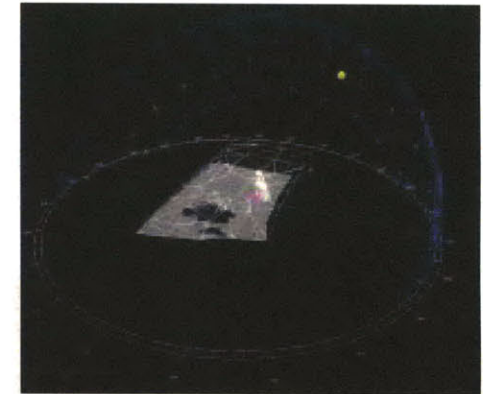
June

| Time | Azimuth | Altitude |
|-------|---------|----------|
| 10:00 | 143 | 17 |
| 12:00 | 107 | 25 |
| 15:00 | 216 | 17 |
| 17:00 | 238 | 1 |

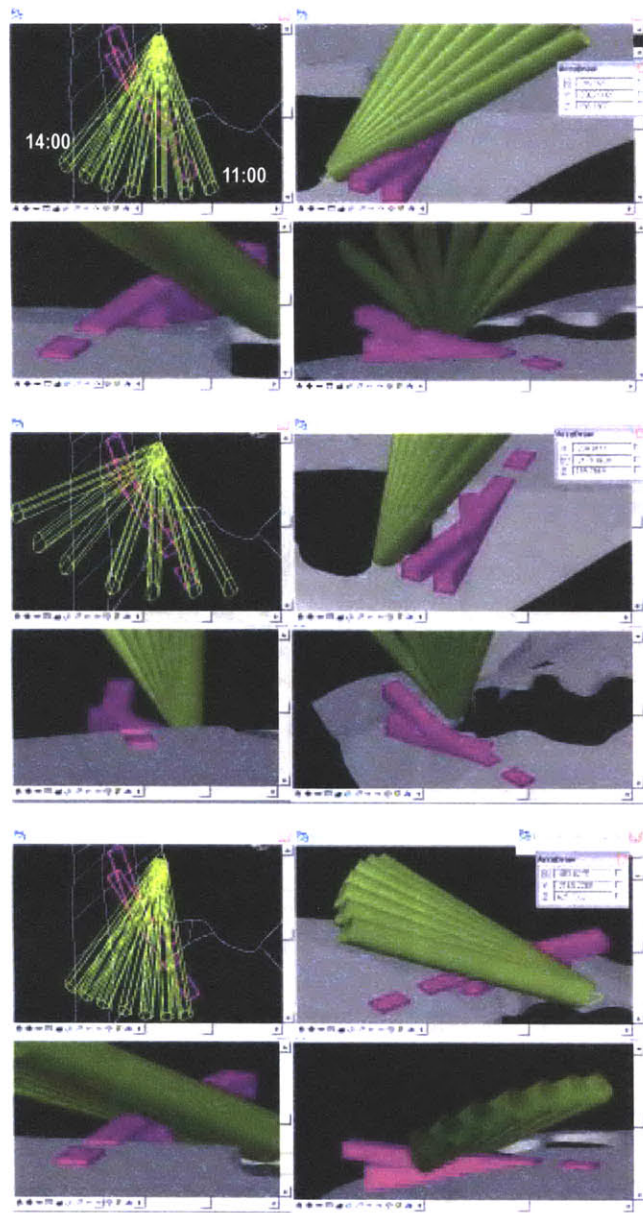
December



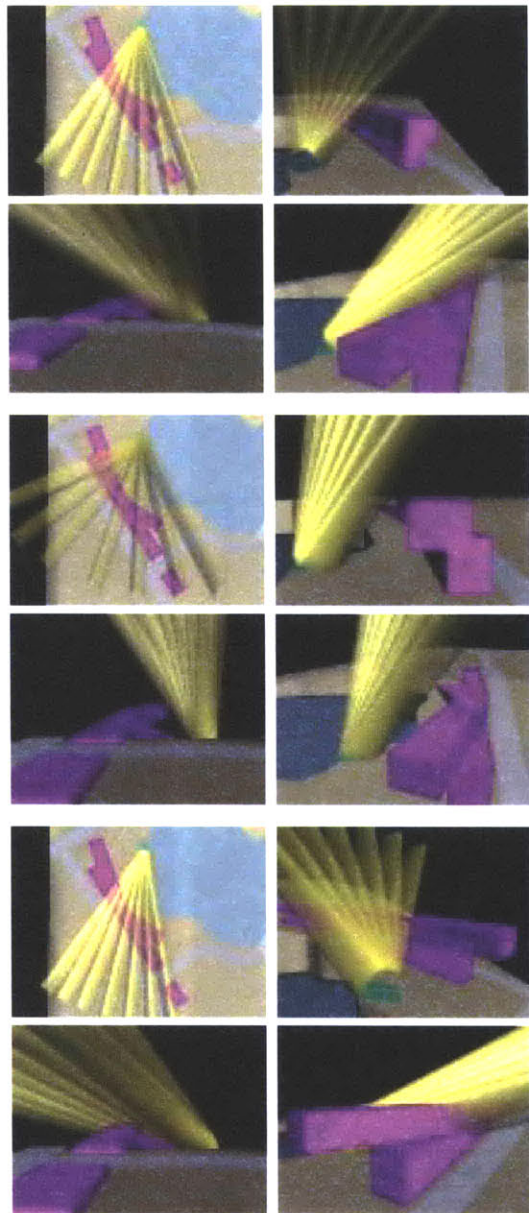
sun angle



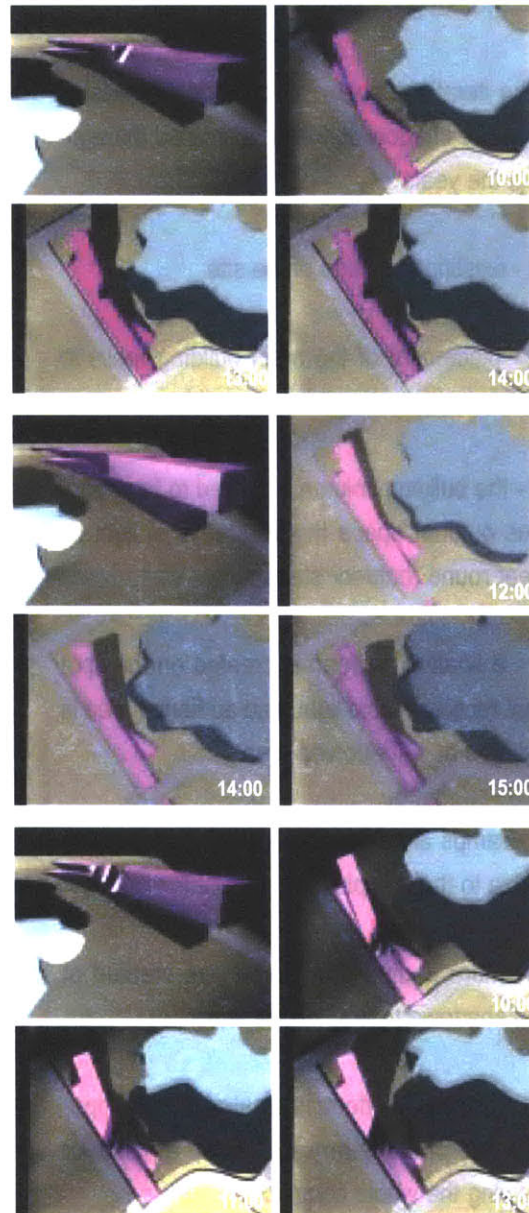
sun path



projection of shape towards sun every 0.5 hour from 11am to 2pm



condition of intersection between the light cones and the building mass



shadow conditions of subtracted volume at different times

Massing and shadow build-up

The iterations show the build-up of massing and the shadow condition it created throughout the year.

0 - existing condition of the site

1 - placement of the main building mass to define/contain the site on one side.

2 - the building volume is carved to form various outdoor space that is always in light all year round (outdoor stages).

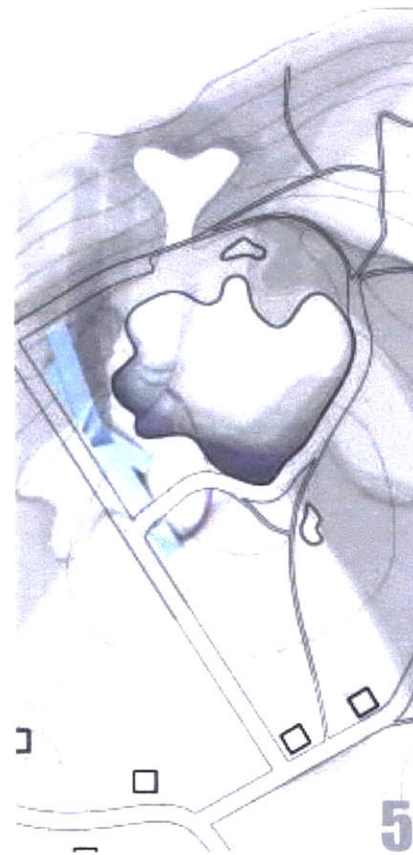
3 - a floating platform is created on the spot that received most light, and audience area is created at a shadowed area.

4 - ramps are created to define the entrance plaza to the complex.

5 - more audience platforms are created at the shadowed areas above water

6 - a viewing platform is created on the opposite side of the quarry, to provide a place for viewing the whole complex.







Final Proposal

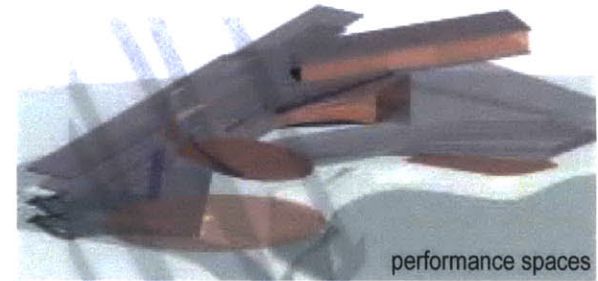
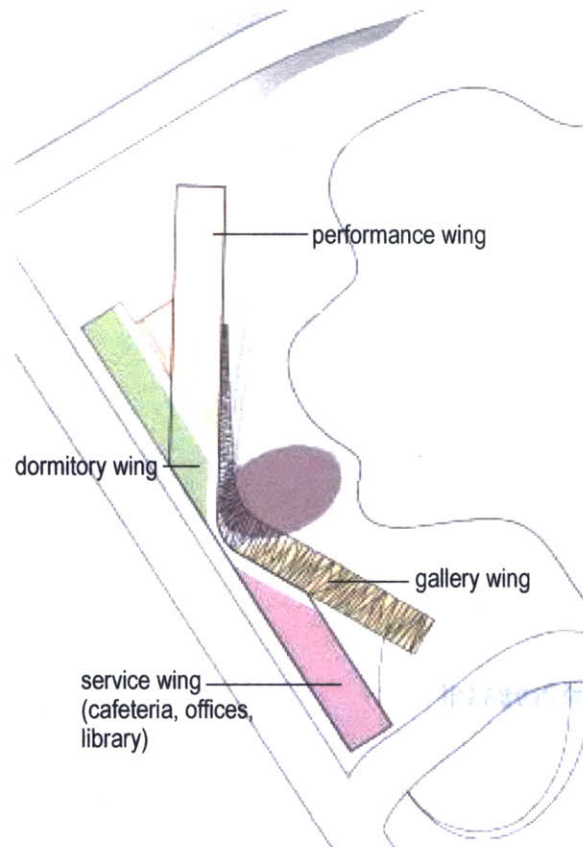
Program Organization

The programs are organized into 4 wings: performance, dormitory, service, and gallery. They are mediated by a semi-outdoor theatre.

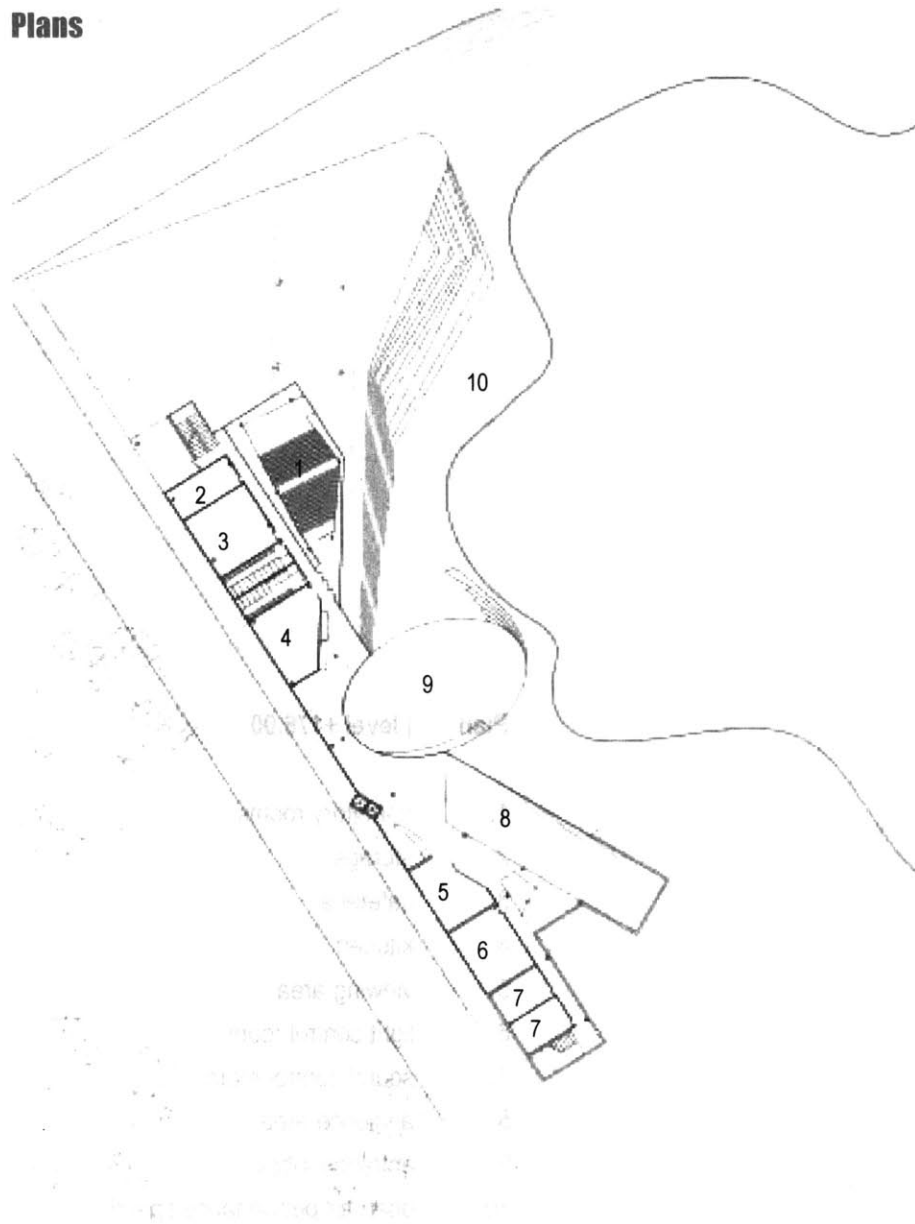
The performance wing consists of 4 practice studios, a 450-seat indoor theatre and its supporting spaces. The dormitory wing consists of 20 rooms for the use of both dancers and the general public. The service wing consists of a cafeteria, administrative offices and a library. The gallery wing consists of exhibition spaces for displaying information and history of the quarry.

Both the gallery and performance spaces need to have a visual preference and are arranged at the prime locations around the quarry; while the dormitory and service spaces are placed as a backdrop behind, along a service road.

The indoor/ outdoor performance and audience spaces are arranged in a non-sequential, multi-nodal manner on various levels to allow interwoven movement patterns to occur. Movements are induced by both physical and visual linkage among the program elements.

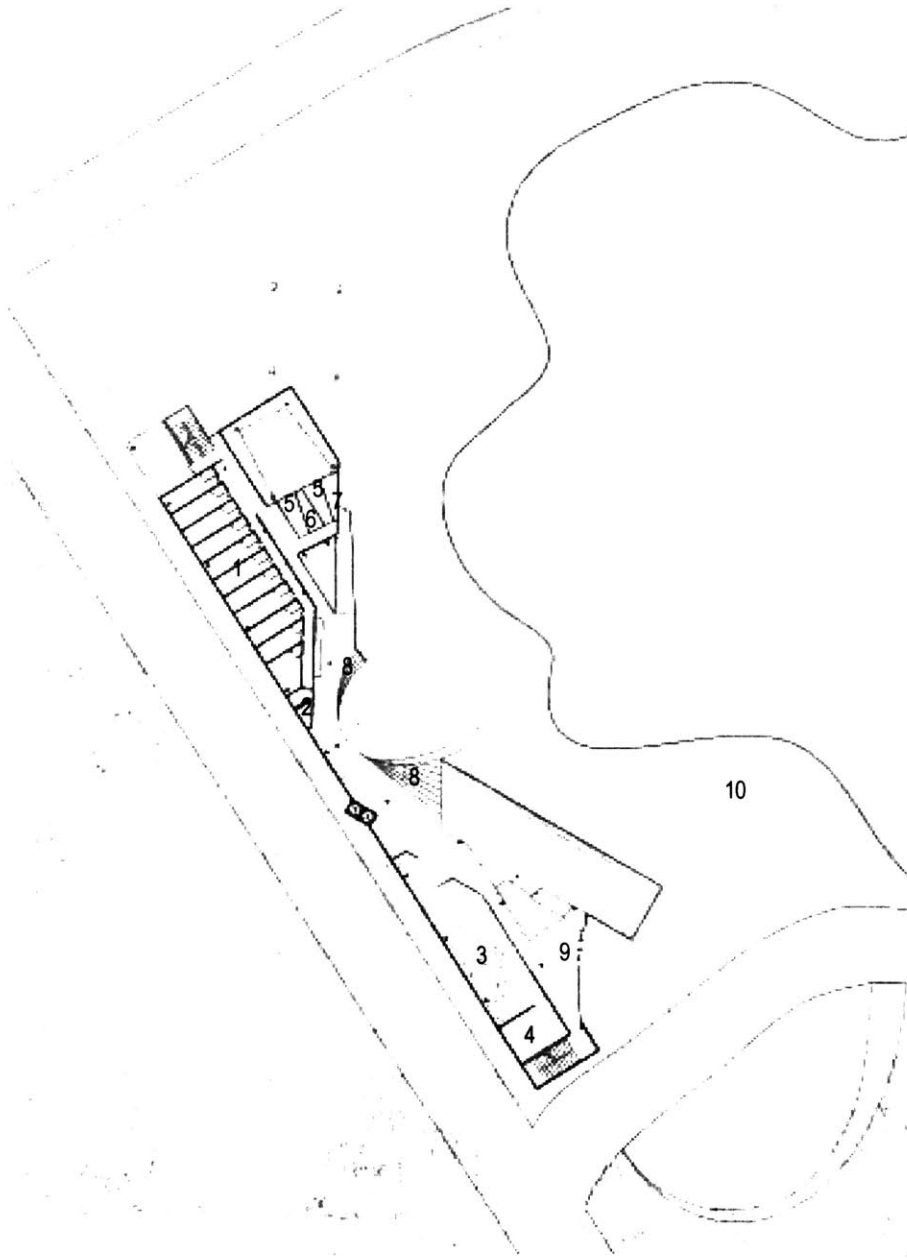


Plans



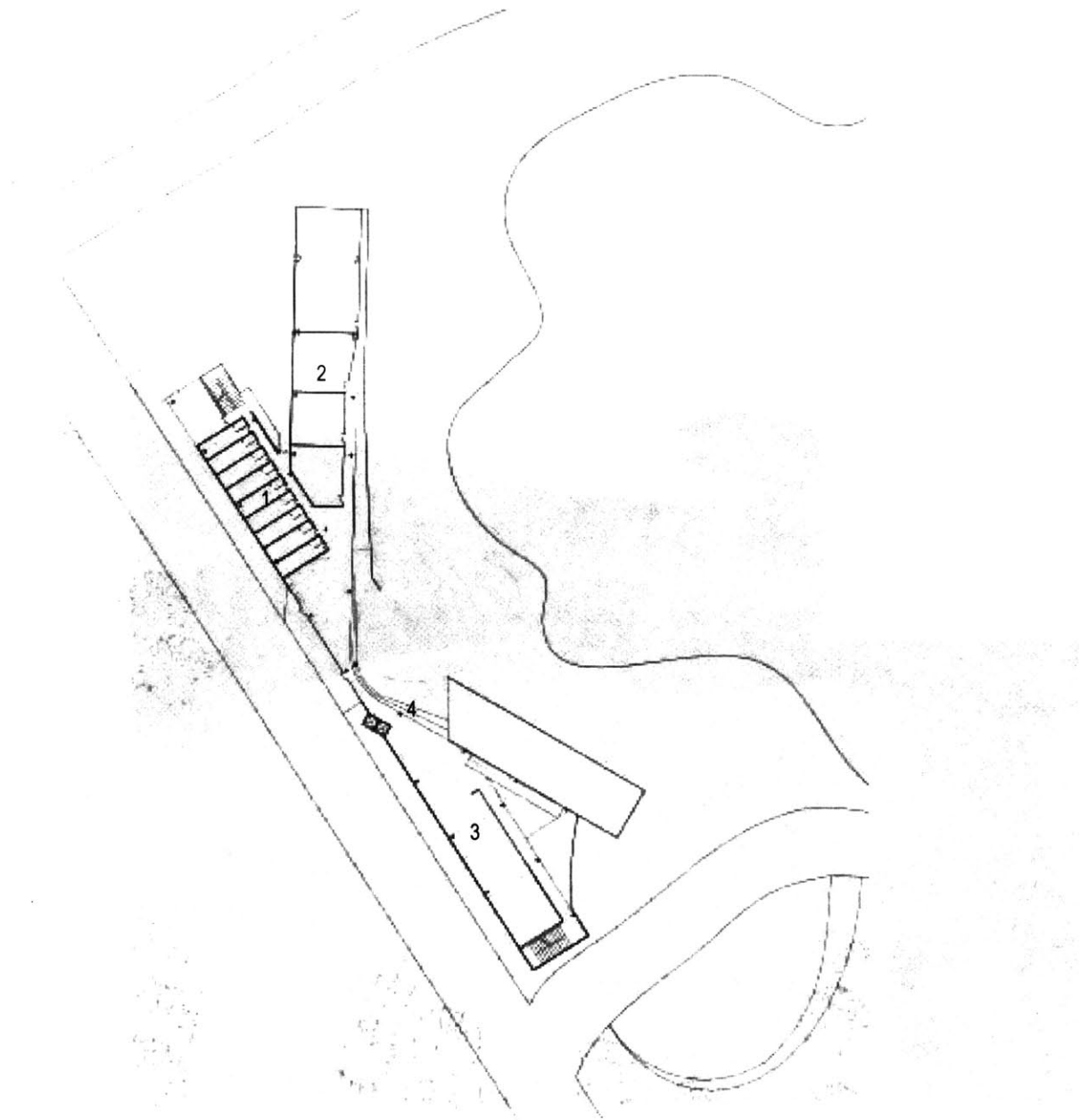
Plan | level +165.00

1. Indoor theatre
2. storage
3. rehearsal studio
4. cloak room/ concessions
5. information center
6. administration office
7. office
8. gallery for history of quarry
9. semi-outdoor performance space
10. open-air performance space



Plan | level +176.00

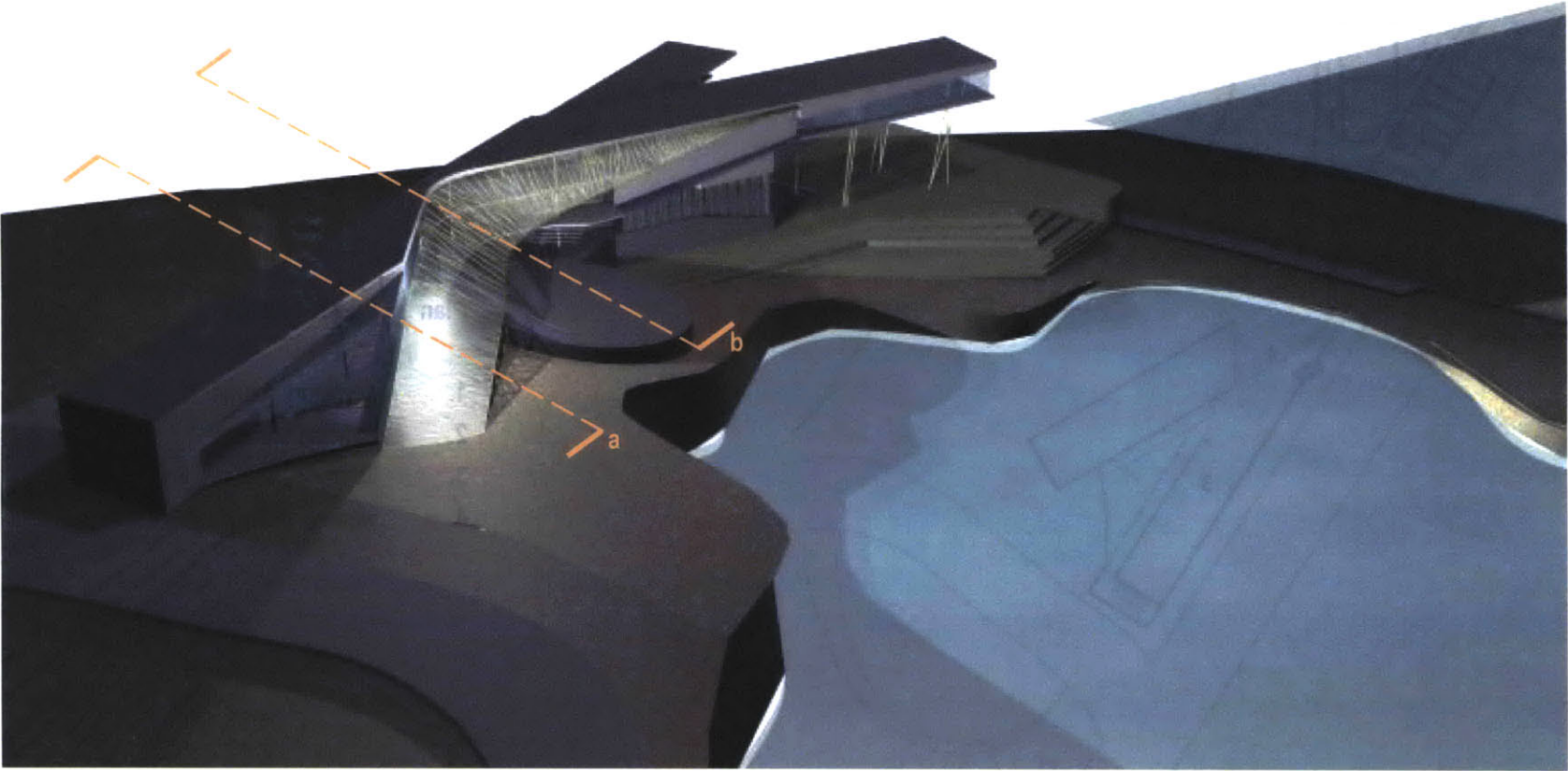
1. dormitory rooms
2. storage
3. cafeteria
4. kitchen
5. viewing area
6. light control room
7. sound control room
8. audience area
9. entrance lobby
10. open-air performance space

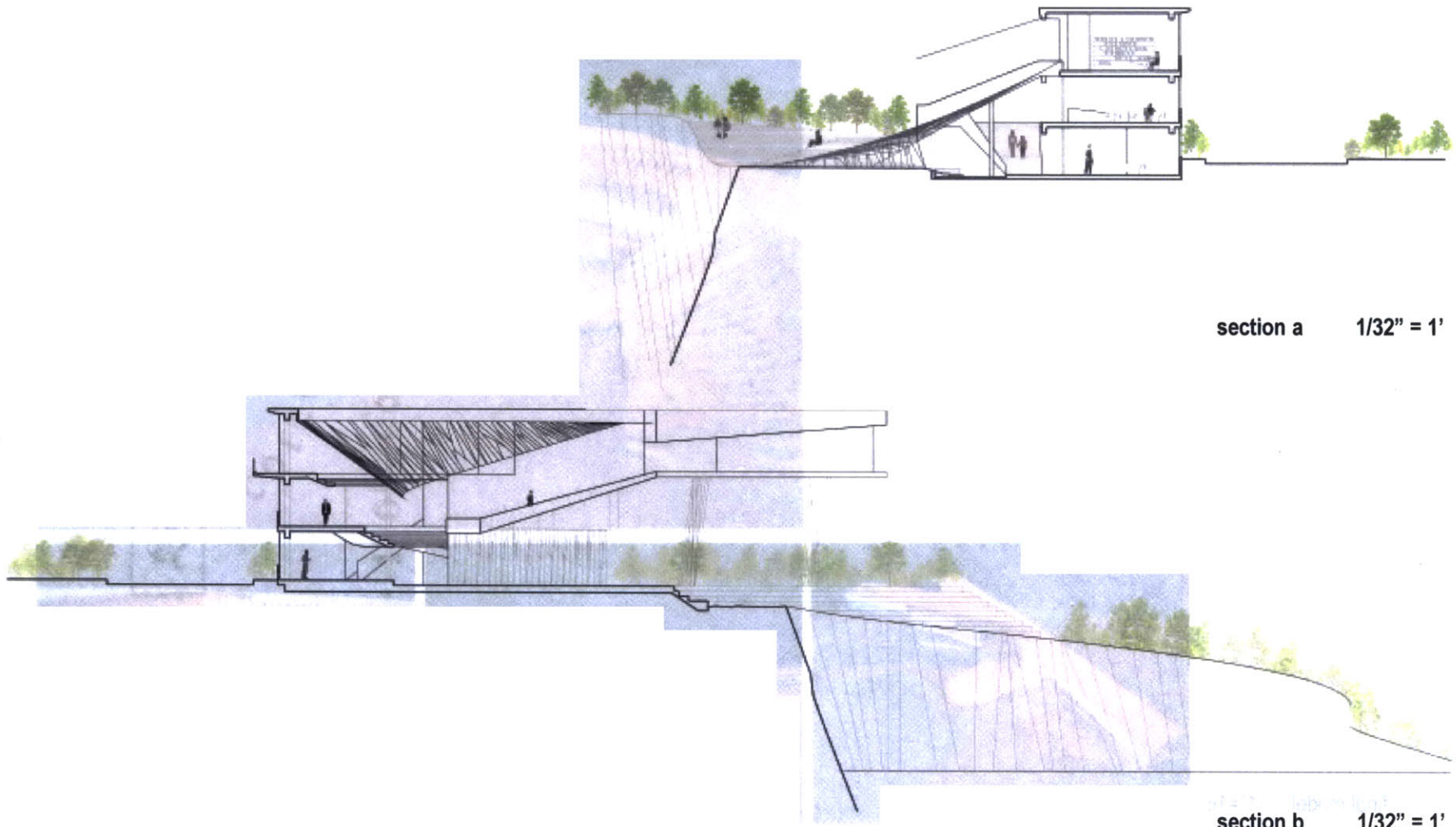


Plan | level +198.00

1. dormitory rooms
2. dancing studios
3. library
4. viewing area

Sections

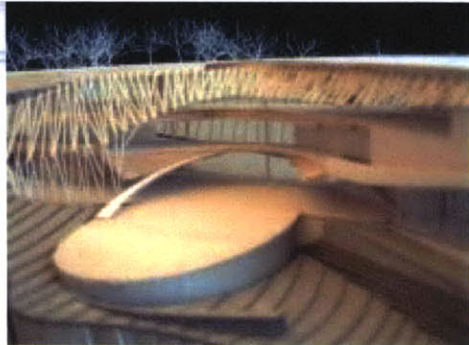
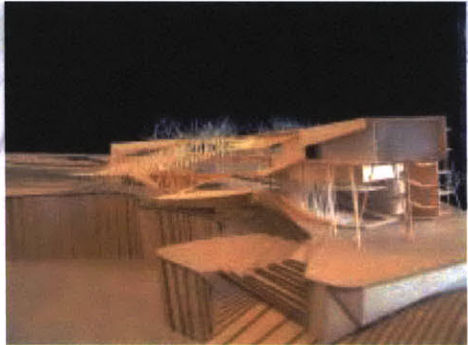
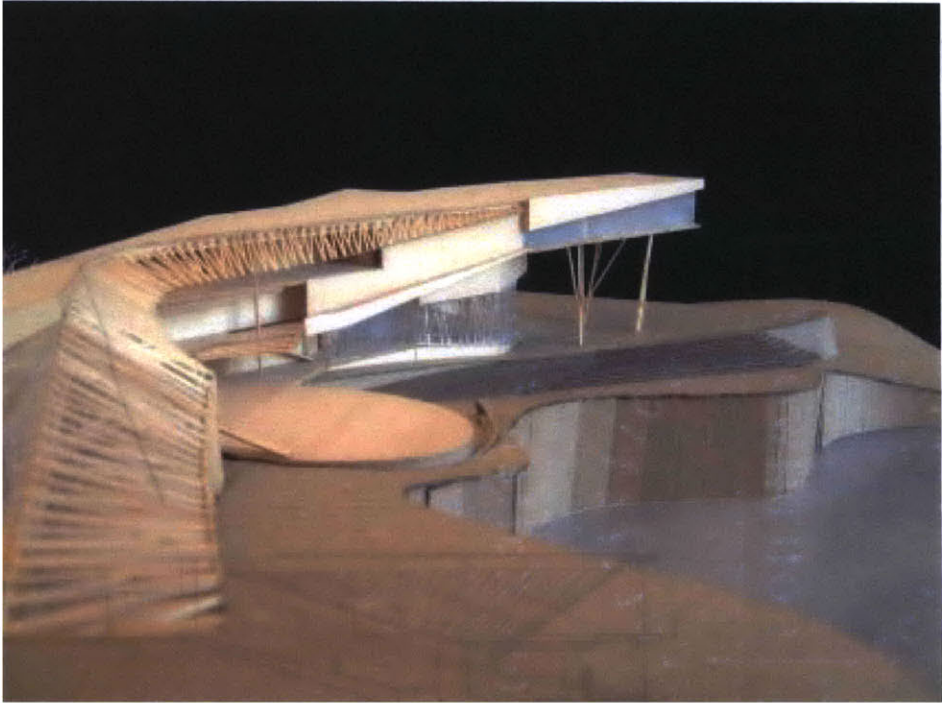




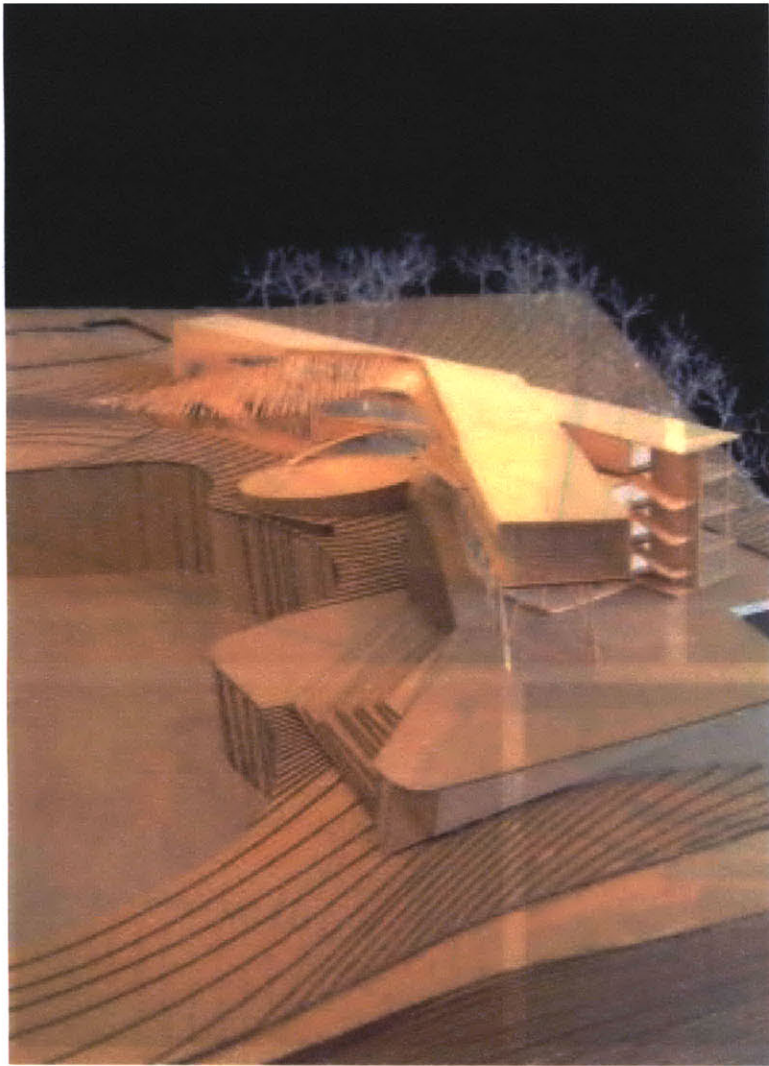
section a 1/32" = 1'

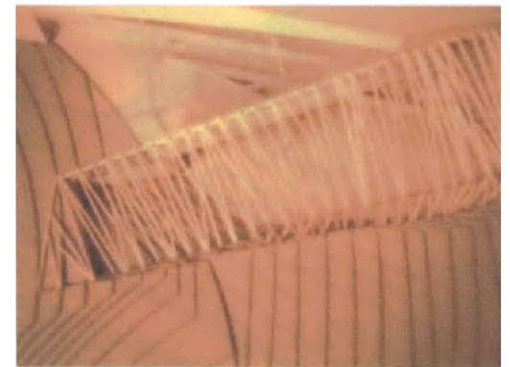
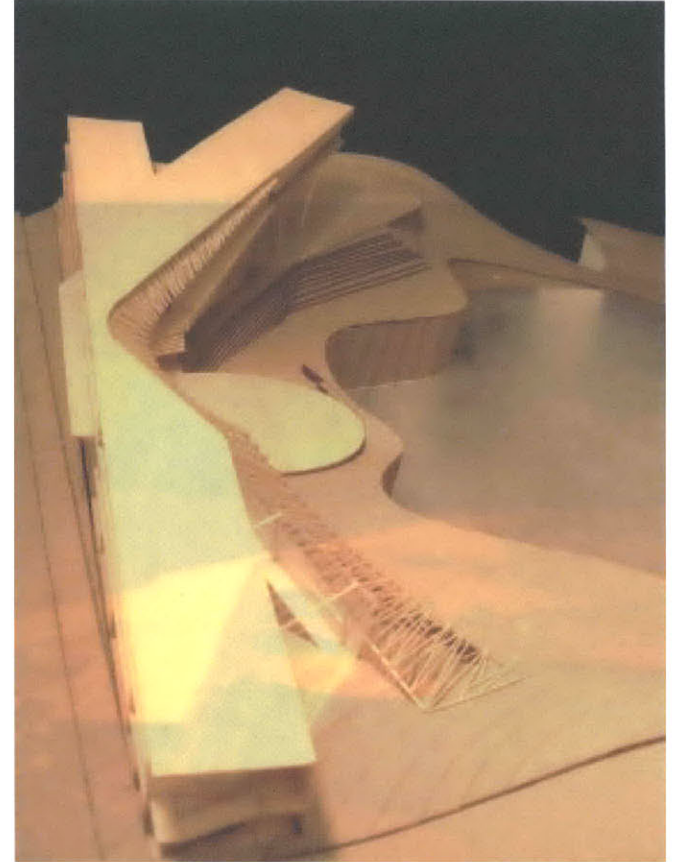
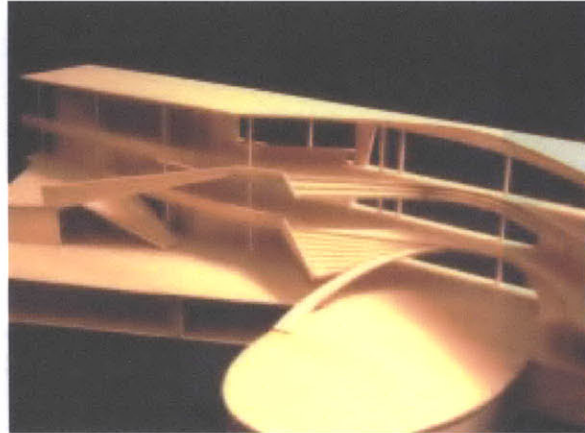
section b 1/32" = 1'

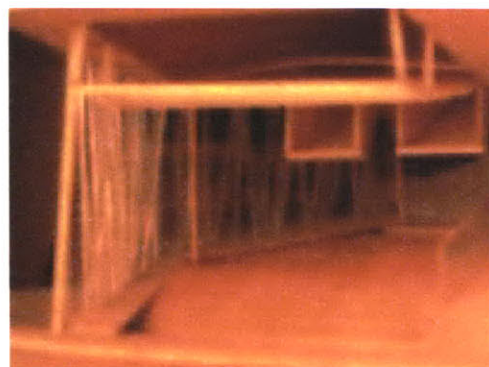
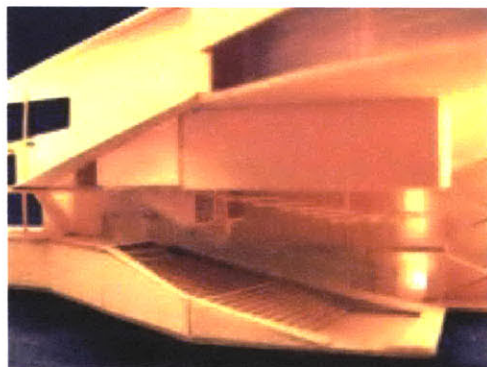
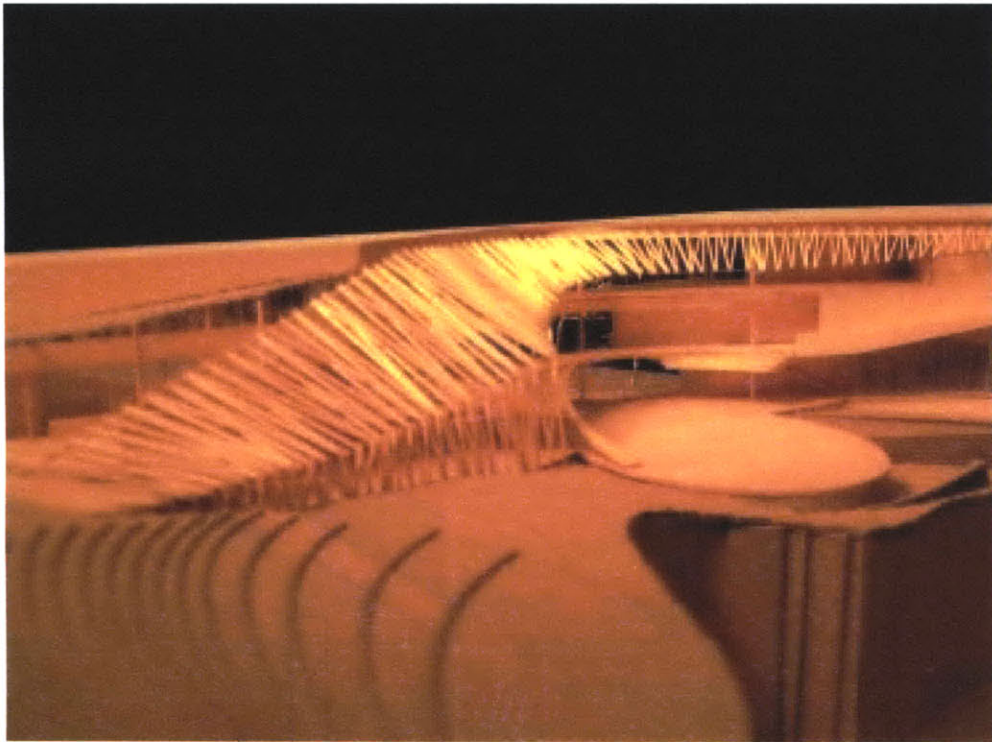
Model



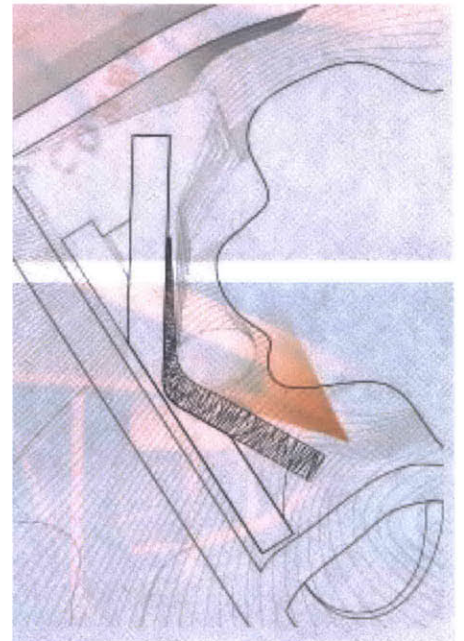
final model 1"=16'

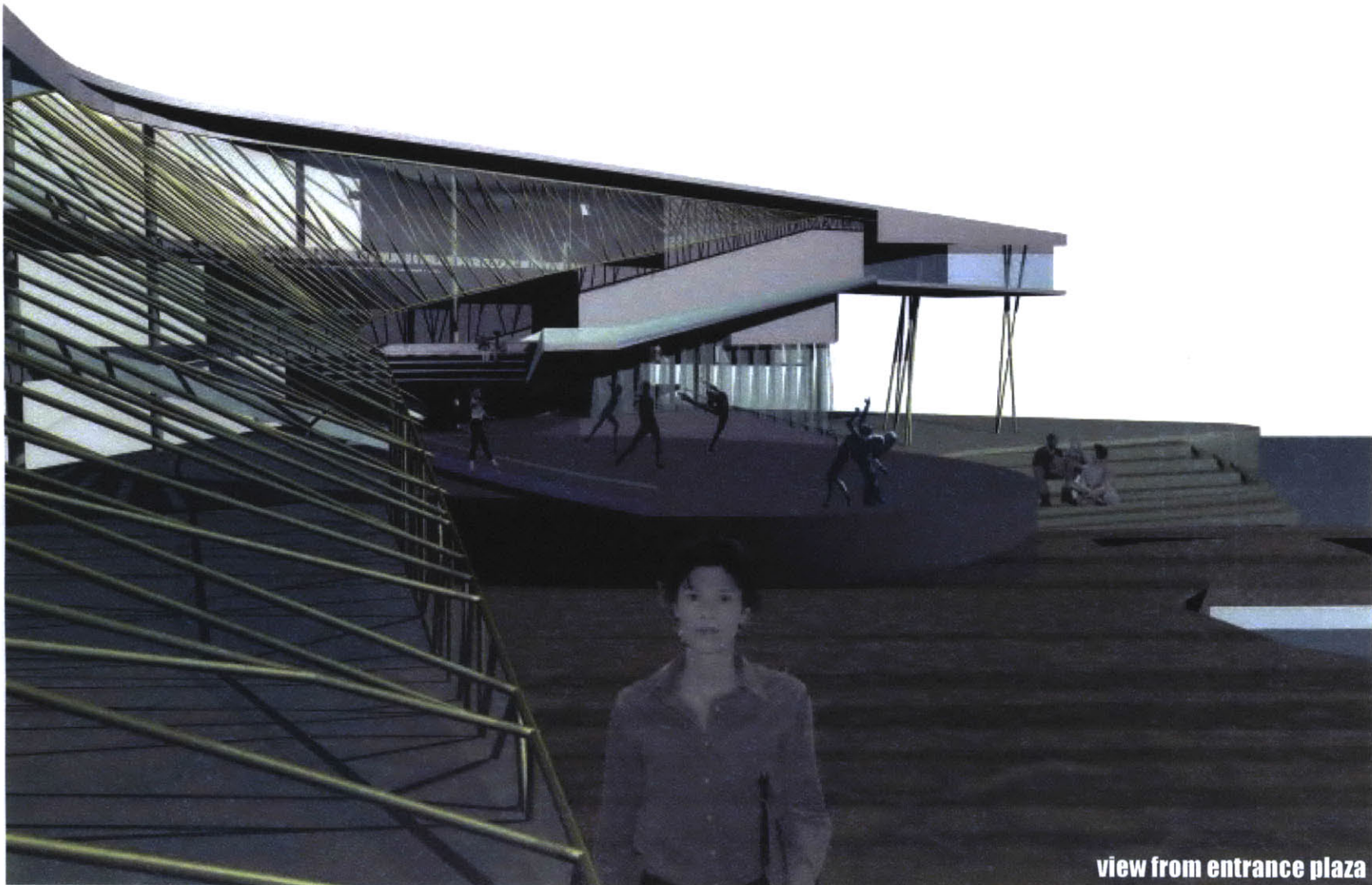




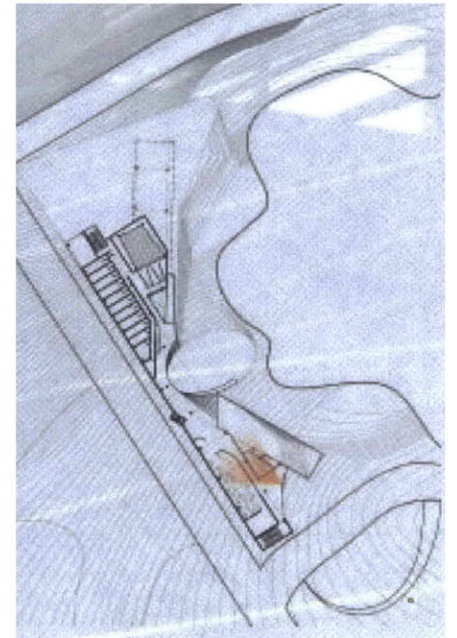


Perspectives



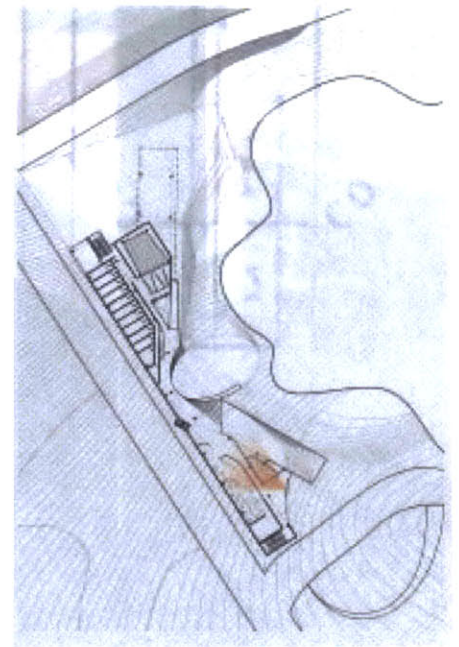


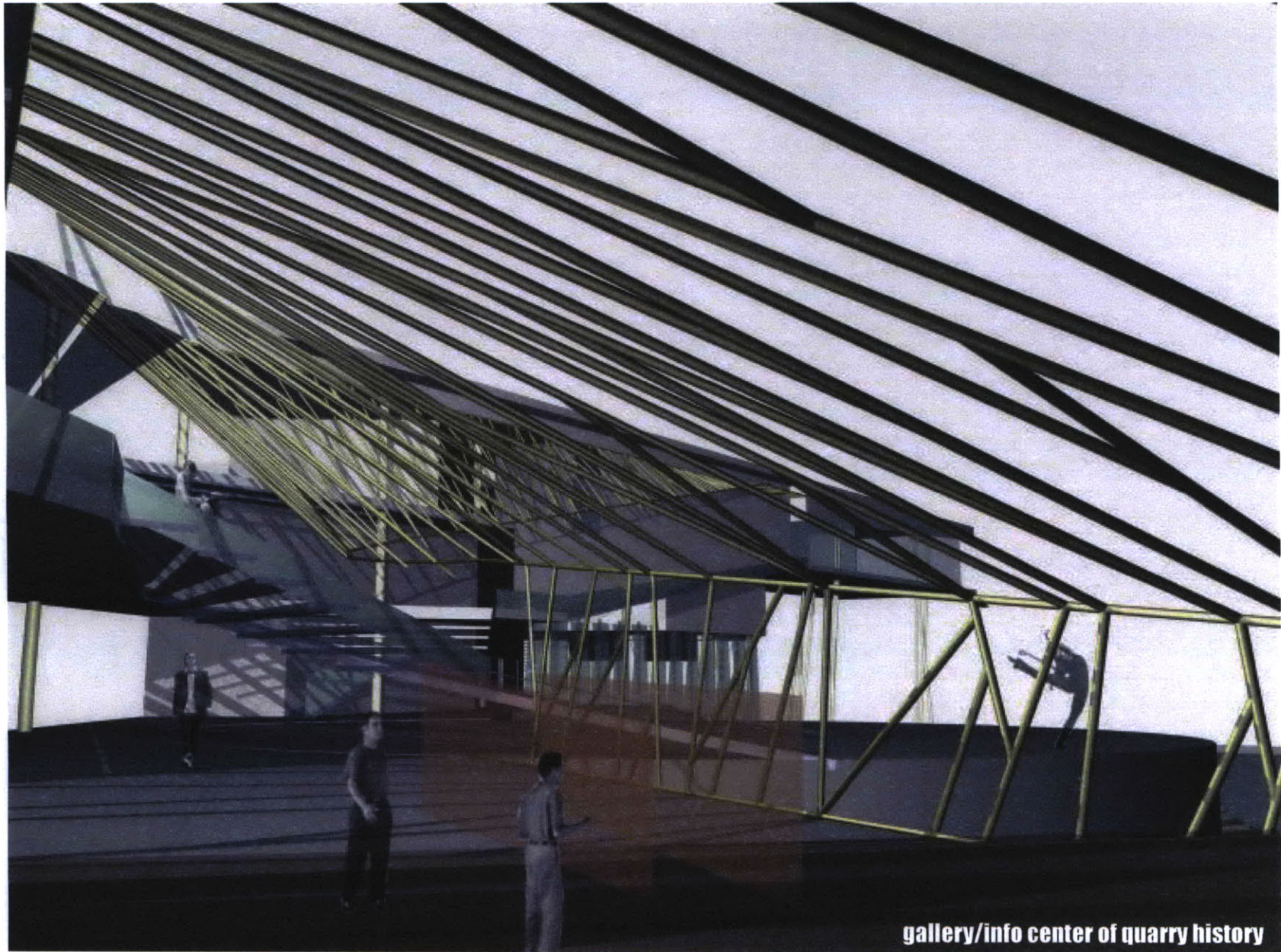
view from entrance plaza



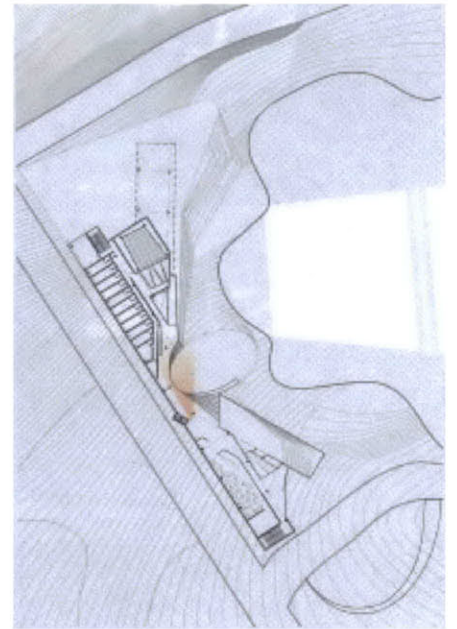


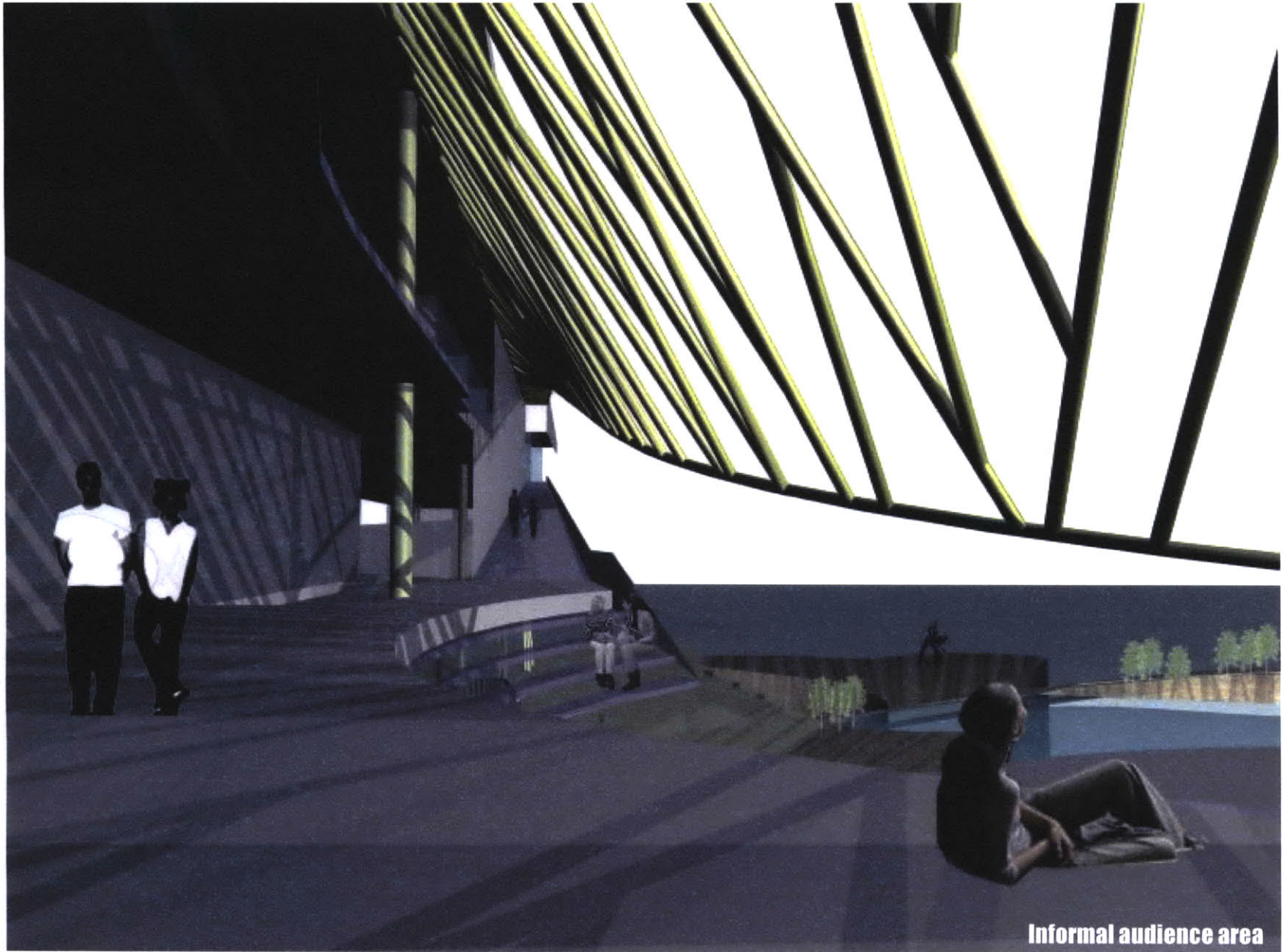
entrance lobby



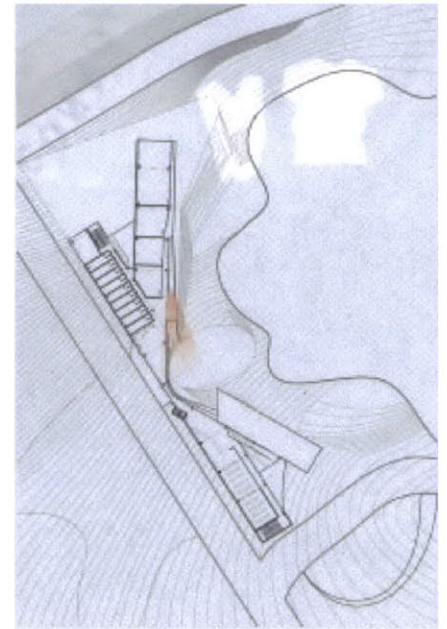


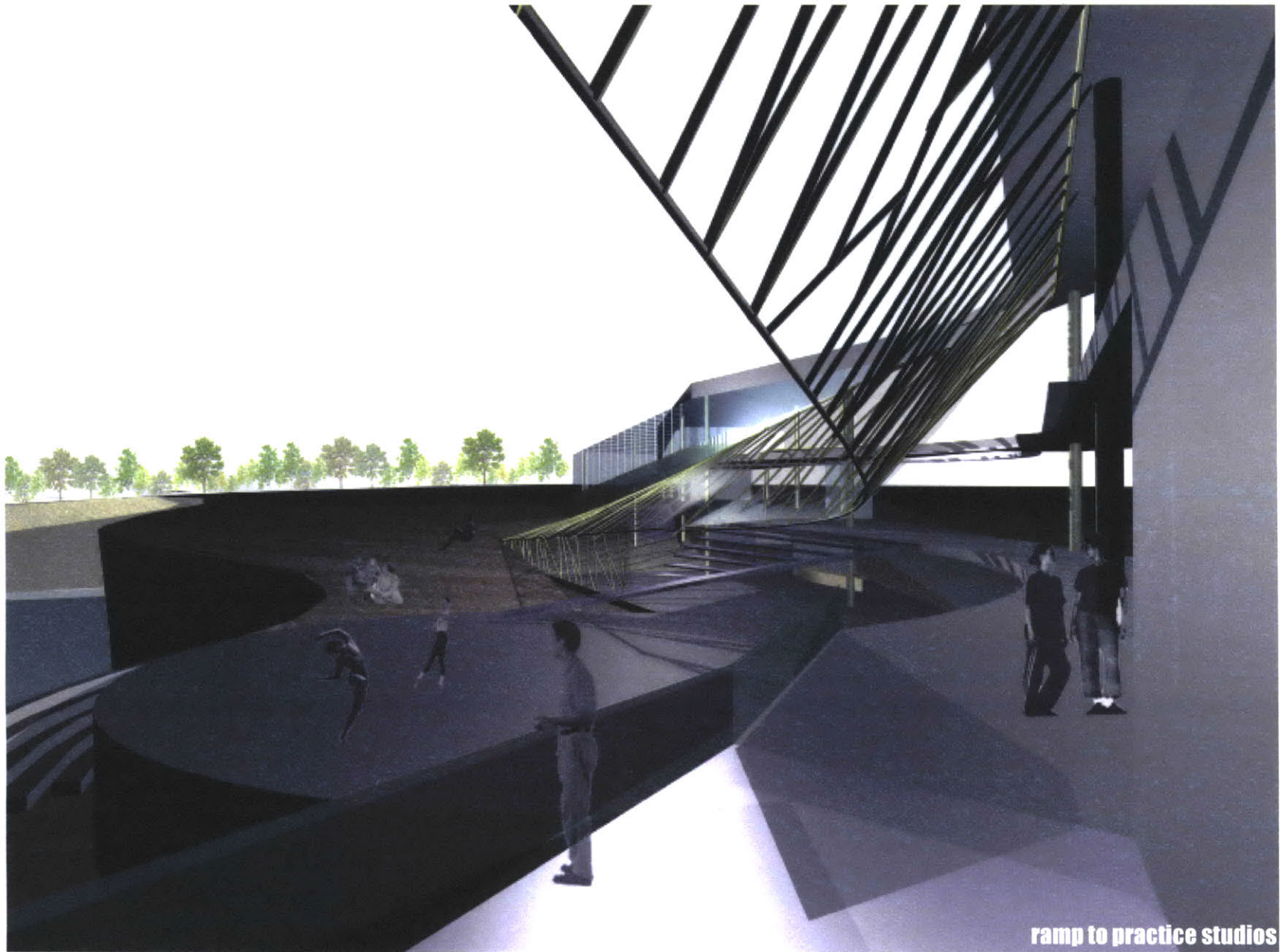
gallery/info center of quarry history

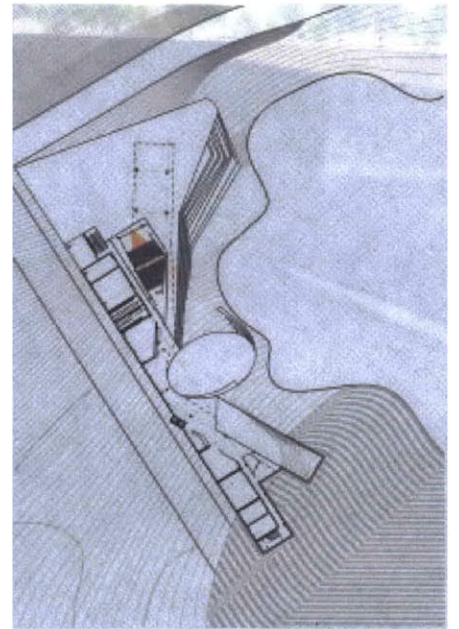


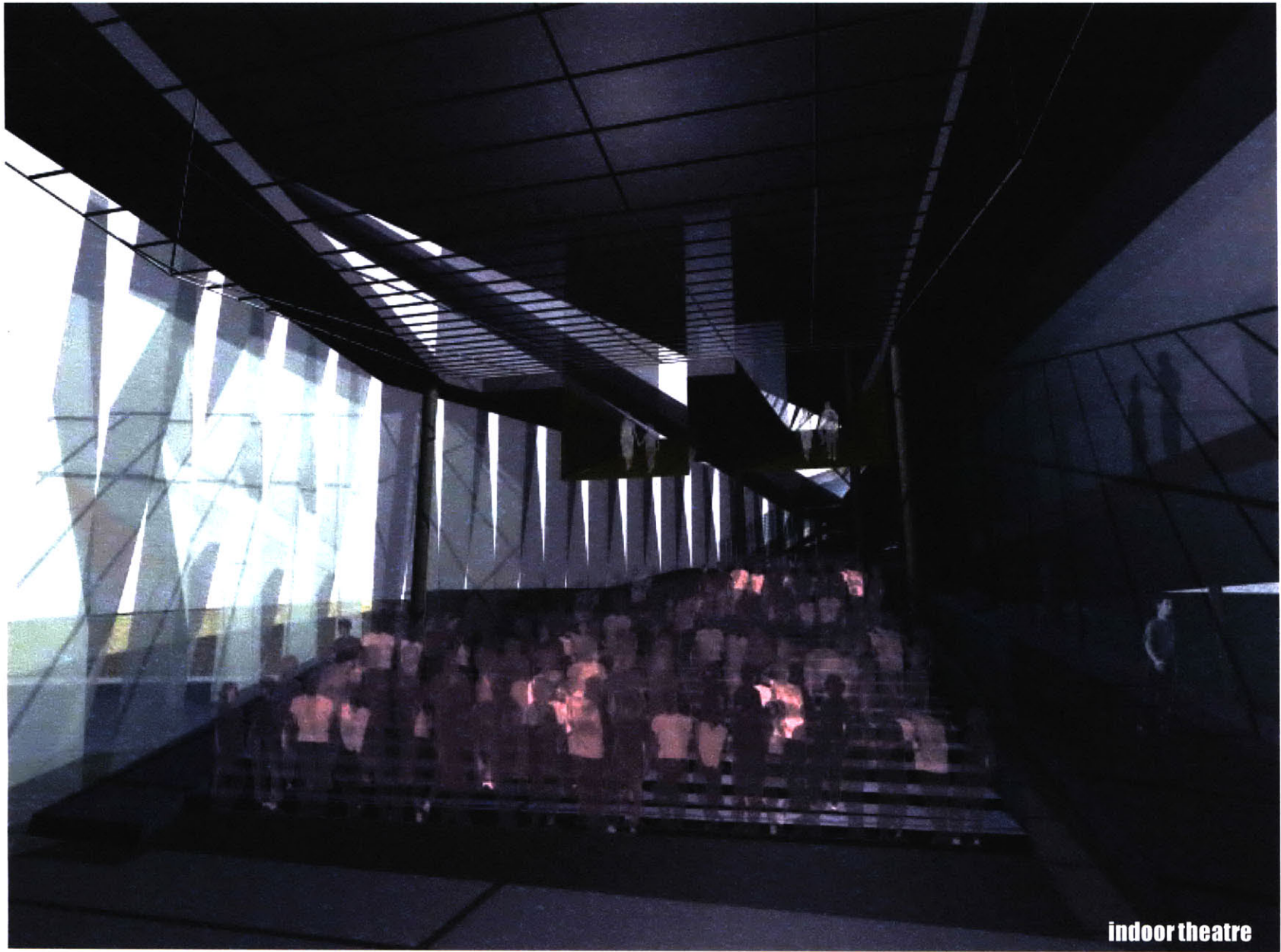


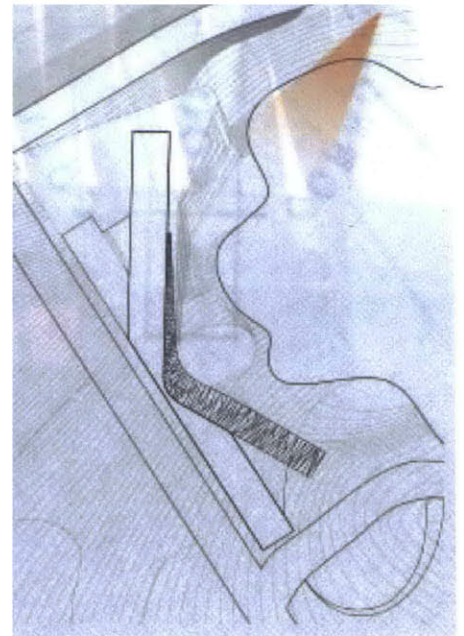
Informal audience area





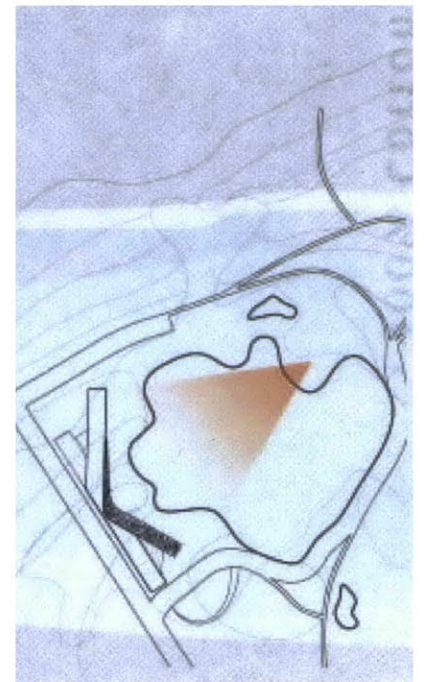


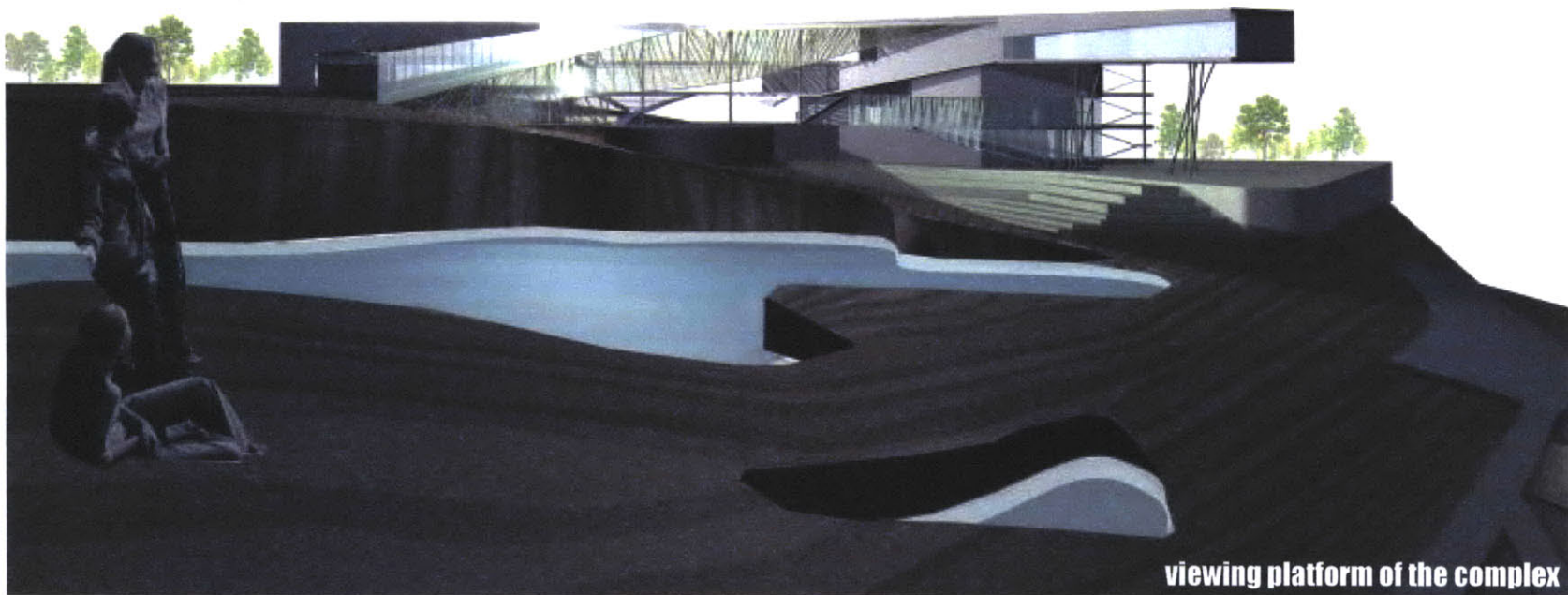






outdoor performance spaces





viewing platform of the complex

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List of Figures:

- fig. 1.1 to fig. 1.5. Newlove, Jean, LANBAN FOR ACTORS AND DANCERS, Routledge, New York, 1993.
- fig. 1.7, fig. 1.9. Gausa, Manuel, HOUSING: NEW ALTERNATIVES, NEW SYSTEMS, Boston: Birkhauser, 1998.
- fig. 1.8. Royal Air Force, NIGHT RAID OVER BERLIN, Urban Visions, 1993.
- fig. 1.10. Stern, Laurence, THE NOVEL AS CITY, New York - Normadesign, 1992.
- fig. 1.6. SONGS OF THE WANDERERS by Lin Hwai-Min (movie clip)
- fig. 1.7. DANCER & THE DANCE by Mikhail Baryshnikov (movie clip)

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