Kinetic Index: An Exploration of Site and Program in Flux

by

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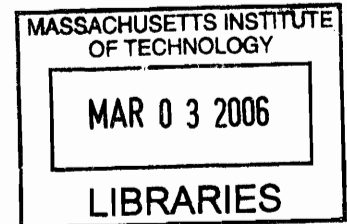Gainesville, Florida

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ABSTRACT

Sites and programs are in constant flux and are affected by environmental, social, and economic forces they encounter. This thesis explores the ways kinetic architecture mediates between the site and programs in flux. Programmatic flux requires the architecture to adapt through overlapping and transformable space while responding to the forces on the site through an understanding of their paths and boundaries. Kinetic spaces are carefully programmed to allow for flexibility over time but are also conscious in preventing under-programmed or unprogrammed space. Site and program interact through the exchange of social and environmental forces that impact each other simultaneously. The forces on the site will not only affect the architecture but the architecture will have an important impact on the reconstructed site and its environment.

Thesis Supervisor: Mark M. Jarzombek

Title: Director of History, Theory, and Criticism of Architecture and Art
    Professor of the History of Architecture

Content

This book is dedicated to my wife, whose hard work, commitment and encouragement enabled me to succeed beyond anything I had ever imagined.

THANKS:

"Will we not attain a more satisfactory insight into the mysterious architecture of the formative process, now widely recognized to be built on a single pattern, by examining and comprehending this single pattern more fully and then looking in to the following question: how does a surrounding element, with its various specific characteristics affect the general form we have been studying? How does the form, both determined and a determinant, assert itself against these elements? What manner of hard parts, soft parts, interior parts and exterior parts are created in the form by this effect? And as, indicated before, what is wrought by the elements through all their diversity of height and depth, region and climate?"[1]

- Johann Wolfgang Von Goethe (1749-1832)

[1]   Johann Wolfgang von Goethe, Scientific Studies (New York: Suhrkamp Publishers, 1988) 55.

Introduction

Architecture is the mediator between site[1] and program[2]. It not only embodies the activities that take place in space but is also subject to forces external to the space. All architecture affects and is effected by motion. Motion manifests itself in the form of biological, environmental, or mechanical processes. As a result, each of theses forces creates a different effect on the architecture, its occupation and function. Architecture should take into account the effects the site will have on the design and the affect the design and its program will have on the site.

Sites and programs are in constant flux, each changing at a different intensity, speed, and direction.[3] This thesis will examine site and program as dynamic processes. Issues that deal with site and program become the driving force for innovation and transformation. Programmatic flux requires the architecture to adapt through overlapping and configurable space while responding to the forces on the site through an understanding of their paths and boundaries.

[1]   For the purpose of this thesis I am defining site as the area under investigation that is subject to the environmental and social forces that act upon it.

[2]   For the purpose of this thesis I am defining program as activities located in space and experienced through motion.

[3]   "Processes have speed (fast or slow), duration (long periods or brief spurts, seconds, days, year), and rhythm (character of repetition, constant or intermittent)"
Anne Whiston Spirn, The Language of Landscape (New Haven:Yale University Press, 1998) 89.

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The Johann Goethe "the father of morphology" compared the difference between a fish that exists for the water and the fish that exists in the water and by means of the water. Goethe states "…a creature we call "fish" is only possible under the conditions of an element we call "water", so that the creature not only exists in that element, but may also evolve there."[1] Architecture can only morph under the condition of an element we call "site". But, what if site could also evolve within the architecture and exist as another layer? We would then be able to take the relationship of site and architecture beyond just the biological process that limits the relationship between fish and water and create a connection that is codependent for survival. Gary Strang states that, "Buildings likewise can be elements of infrastructure that contribute to stable natural ecosystems; they can occupy more than one niche simultaneously."[2]

The theoretical inspiration for this thesis emerged out of the concept of "duration".[3] The use of a kinetic architecture, in this thesis, comes not only from philosophical positions on duration but also from motion, memory, and time. In his book *Bergsonism* Deleuze explains movement as the insertion of duration into matter.[4] The material that duration is inserted into becomes a

1   Goethe 54-55.
2   Gary Strang, "Infrastructure as Landscape," Theory in Landscape Architecture, ed. Simon Swaffield (Philadelphia: University of Pennsylvania Press, 2002) 244.
3   Henri Bergson defines duration in two ways. The multiplicity of conscious states, and the succession of qualitative changes.
Henri Bergson, Time and Free Will (Mineola: Dover Publications, 2001) 90-91,101,104.
4   Gilles Deleuze, Bergsonism (New York: Zone Books, 1988) 94.

divider of space, allowing the architecture to become an object that creates and is influenced by motion. "Duration and location are always specific, always defined by movement and action."[1] Architecture is the device for revealing the imperceptible present and latent forces that occupy the site. Duration acts as a dynamic memory, modifying the past in order to create the present. Architecture should acknowledge the memory of the past while projecting a design into the future through a flexibility that adapts to unrealized events. Duration makes kinetic motion perceivable and understood through the continual distortion of memory.

This thesis uses kinetic architecture as the mediator between a site and program in flux.[2] Kinetics exists somewhere between the realm of the mechanical and the dynamic. Henri Bergson suggests that the mechanism is created from a series of laws that constrains itself to basic necessities. The mechanism often gives way to emergence and an increase complexity of form. Dynamism on the other hand involves transformation, and is developed as a result of known facts that are formulated into a heterogeneous blend.[3] The kinetic is a complex amalgamation of both the mechanic and the dynamic. In sum, response to the site and programs in flux is achieved through the use of kinetic structures that physically transform space.

1   Elizabeth Grosz, <u>Architecture from the Outside</u> (Cambridge: MIT Press, 2001) 119.
2   Merriam-Webster Dictionary defines the kinetic as: of or relating to the motion of material bodies and the forces and energy associated with them.
3   Bergson140, 141.

FIG 1.a North Fork of the Skykomish River

Site

Identity verses Specificity

Sites create a tension between the human desire for habitation and a landscapes embodied force. Sites are subject to cultural and natural forces; they have a geographical location, a history, and climate, position relative to the sun, and countless other factors. Designers and planners tend to think of sites in terms of creating or emphasizing their identity. The problem with this mode of thinking is that identity locks a place into a certain mentality or time frame preventing a place from transforming, adapting or reassessing the past. Bernard Cache compares the difference between an identity of a place and the specificity of a place. "For as soon as one attributes a particular identity to a particular place the only possible modes of intervention then becomes imitation, dissimulation, or minimalism."[1] Attempting to reinforce or reconstruct a place's identity leaves little room for innovative design. The reality is that the identity of a place is never static it is in constant flux, adapting to the natural and cultural environment. By fixating on or attempting to retain a place's identity, society becomes trapped in the past and neglects the potential for change. On the other hand, understanding the specificity's of a place acknowledges the unique factors (natural, cultural, or social) that make up a place's identity. Only by understanding the unique specificities of a place can the evolving identity of a place be found and the potential realized.

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1   Bernard Cache, Earth Moves (Cambridge: MIT Press, 1995) 15.

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FIG 1.b Mississippi River

Forces and Dynamics

Dynamic processes work together as a continuous heterogeneous system. Sites are never static and are in constant flux due to the forces that create them. Everything is eroding or collecting, growing or decaying, expanding or contracting. Whether human or natural, dynamic processes are not the same and inherently have varying intensities, frequencies, and durations.[1] Sites are either contained by nature or civilization. Geography gives shape to the outside; it provides the rupture in scale by which dynamic processes become visible on the site.

When we occupy a 'natural'[2] landscape what is seen is not what is understood. All that exists in an environment is a result of multiple forces interacting simultaneously or in succession. Each of these interactions is specific to location and cannot be accurately assessed regionally. In order to determine what is considered to be the "local" area of study one must base their judgment on an understanding of the origin behind a particular force and that forces area of influence. The above criterion is the foundation to laying out the parameters for a site. For instance, it may be necessary to study the fluctuation in current, tide, and water temperature for a site located along the ocean. However, the range, duration, and intensity at which theses dynamics forces occur are not the same.

1   Spirn 88. "Most landscapes are designed to be sensed through movement, at a particular tempo, for a specific duration, in a rhythm."

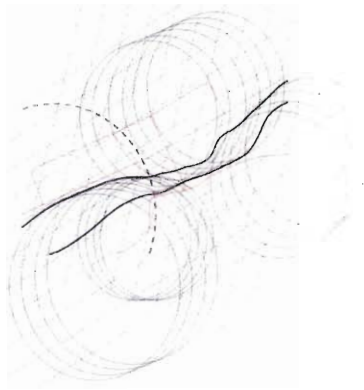2   I use this term loosely to mean, that which is not restrained by man.
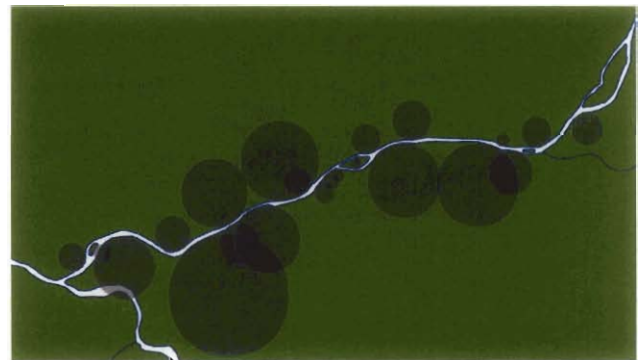
FIG 1.c Wind and River Analysis: Index, WA

FIG 1.d N.F. Skykomish River's areas of influence

Kristina Hill in her essay *Shifting Sites* describes sites as nodes of interaction.[1] She emphasizes the exchange and flow of energy and material rather than a physical geography of a place. Within any environment there exist constant and latent forces.   Latent forces have the potential to occur but are not always present (i.e. floods, hurricanes, and earthquakes), where as constant forces are always present and constantly affecting their environment. For example, a river unless it was to dry up would continuously act as a dynamic force altering its environment. A latent force such as the wind changes direction and intensity and has a completely different affect on a site. The latent potential of a river is realized when it over flows its banks and creates a new path. This new path may remain even after the water has receded to create the new course of the river. Latent forces in a natural environment are what make sites dynamic. When ever possible architecture should attempt to engage the constant and latent forces on the site.

Geography

The geographical location of the site for this thesis is situated in the Cascade Mountains of Washington State. This location is an ideal testing ground for designing an architecture that must respond to a site in flux. This area of Washington has local conditions that vary significantly, even across relatively small distances. Wind direction and intensity vary year round as does the category and strength of precipitation. Most of the high winds and heavy

1   Kristina Hill, "Shifting Sites," Site Matters, ed. Burns and Kahn (New York: Routledge, 2005)139.

FIG 1.e Wind Speed

FIG 1.f Temperature

FIG 1.g Rainfall

rains occur in the winter months whereas the summer brings gentler winds and little rain. These seasonal changes have drastically different effects on the natural and cultural environment. Winter brings ice flooding, ice storms, and heavy snow contrasted by summer's threat of forest fire and drought. Each of these events causes a change to the physical and built environment. By gaining a better understanding of how, when, and where these forces will alter the landscape, designers may create places that are more adaptable and sensitive to the site.
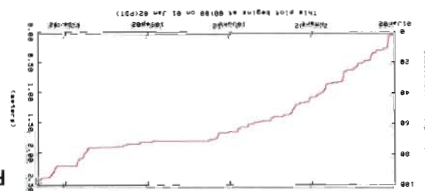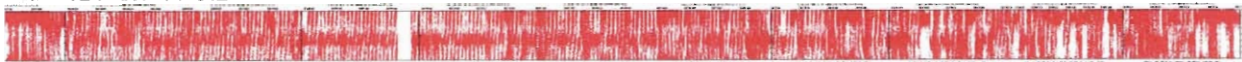
FIG 1.h Wind Direction

Environmental Conditions
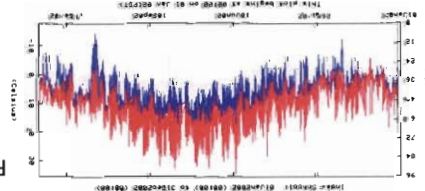
Weather is major factor that influences this area of the country. Prevailing winds come from the north and northeast during the winter and the south and southwest during the summer. The average annual rainfall for parts of the Cascades can exceed 100 inches and at any time during the year there can be a temperature fluctuation of over 30 degrees Fahrenheit. Storms move in rapidly and can change the environment in just a few hours. Unusually warm weather in conjunction with rain can cause extreme flooding during the winter and spring seasons. Drastic differences in sun angle poses an interesting design problem concerning natural light. The position of the sun on the summer solstice is 66 degrees above the horizon and a mere 19 degrees above the horizon on the winter solstice. This thesis attempts to understand these forces individually and how they affect the site as a whole.
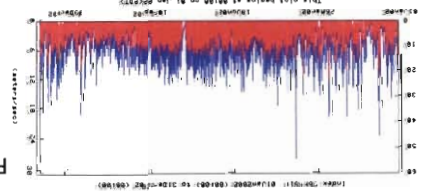
FIG 1.i Regional Map: Index, WA

FIG 1.j Local Map: Index, WA

Index, WA

The town of Index is located about a mile off of Highway 2, one of the two major roads that cross over the Cascade mountain range (the other one being Interstate 90). Located in a valley carved by the North Fork of the Skykomish River it is surrounded by mountains on all four sides, one of them being Mt. Index. Index is mainly a residential community with a convenience store for the residents and the outdoor adventurers that frequent the town year round. Located about one hour and a half east of Seattle it is a hot spot for whitewater kayakers, hikers, rock climbers and campers. In addition to the residential buildings in Index, there is a small church, a fire station, a small town hall, an elementary school, and a museum that is open in summer.

History of Index

Through out its existence, several dynamic processes both environmental and social have affected the town of Index, Washington. Index has evolved from an industrial town to a leisure and recreational town. Along the way several different programs have been introduced, each emerging in succession. In addition, some of the structures in Index have housed several types of programs during the period of their existence. This history of flexibility and adaptability is one of the reasons for choosing Index as my area of research.

The town of Index was founded in 1885 as an ore-mining town.[1] It quickly grew into a major

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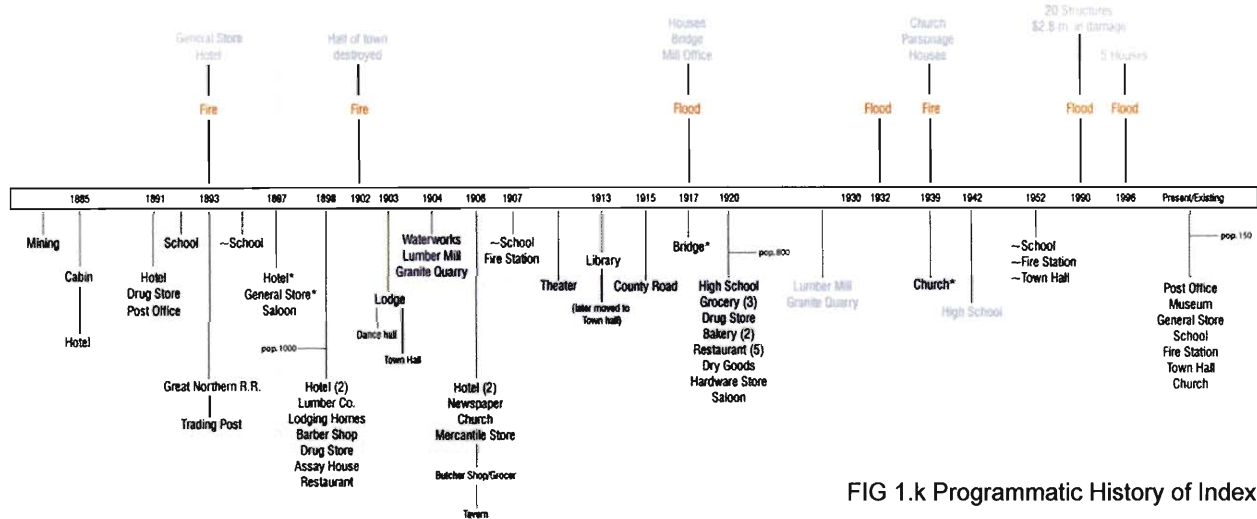1   Ruth Burgstahler, Index: A Historical Perspective 1979: 1.

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FIG 1.k Programmatic History of Index

Timeline years: 1885, 1891, 1893, 1897, 1898, 1902, 1903, 1904, 1906, 1907, 1913, 1915, 1917, 1920, 1930, 1932, 1939, 1942, 1952, 1990, 1996, Present/Existing

Events (above timeline):
- General Store, Hotel — Fire
- Half of town destroyed — Fire
- Houses, Bridge, Mill Office — Flood
- Church, Parsonage, Houses — Flood; Fire
- 20 Structures $2.8 m. in damage; 5 Houses — Flood; Flood

Entries (below timeline):
- 1885: Mining, Cabin, Hotel
- 1891: School; Hotel, Drug Store, Post Office
- 1893: ~School; Great Northern R.R.; Trading Post
- 1897: Hotel*, General Store*, Saloon; Hotel (2), Lumber Co., Lodging Homes, Barber Shop, Drug Store, Assay House, Restaurant
- 1898: Lodge; Dance hall; Town Hall; pop.1000
- 1902/1903: Waterworks, Lumber Mill, Granite Quarry
- 1904: Hotel (2), Newspaper, Church, Mercantile Store; Butcher Shop/Grocer; Tavern
- 1906: ~School, Fire Station
- 1907: Theater (later moved to Town hall)
- 1913: Library
- 1915: County Road
- 1917: Bridge*; pop.800
- 1920: High School, Grocery (3), Drug Store, Bakery (2), Restaurant (5), Dry Goods, Hardware Store, Saloon
- 1930: Lumber Mill, Granite Quarry
- 1939: Church*; High School
- 1952: ~School, ~Fire Station, ~Town Hall
- Present/Existing: pop.150; Post Office, Museum, General Store, School, Fire Station, Town Hall, Church

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trading post and supply depot for the miners in the area. In July 1893 a major fire destroyed the entire town. That same year the Great Northern Railroad laid its tracks through the center of town splitting Index in two with what has been called the "Crescent".[1] The split caused social and environmental impacts on the town that are still evident today. Until the development of electric and diesel locomotives, ashes emitted from coal or wood-burning locomotives posed a constant forest fire threat during the dry summer months. The side of town west of the Crescent was nicknamed "Hamburger Flats" because it is located on a 100-year flood plain that resembles the shape of a hamburger. Numerous floods have caused major loss and damage to this area of town. As a result, Hamburger Flats remains the more economically depressed part of the town.

The mining boom reached its climax around the year 1898. At this time Index supported anywhere from 800 to 1000 prospectors. The town grew significantly with the addition of another general store, lodging houses, hotels, barbershops, drug stores, an assay and several fine restaurants. The following three decades brought major industries to Index. In particular, logging companies moved into the area harvesting in the old growth evergreens that flourished in the valley. Unfortunately in 1902 Index once again caught fire and approximately half the town was destroyed. Businesses quickly rebuilt and Index was soon up and running again.[2]

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1 Burgstahler 9.
2 Burgstahler 15.

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FIG 1.l Index 2006

FIG 1.m Index 1926

At the turn of the century the business district of Index witnessed many welcome additions to the town. A merchandise store, four hotels, a grocery store, mercantile company, and a local newspaper turned the town into a lively community. The school-aged population was also growing and a new school building was constructed to meet the demands. A lumber mill opened to support the numerous logging companies in the area. Granite was found on the mountainside north of Index that later proved to be a major industry for the town as well.

The decades that followed marked a steady decline in the population of Index. Crippled by the First World War in Europe and then by the depression, the population dropped below 800 residents.[1] Mines in the area began closing, the granite quarry ceased operations and the lumber mills shut down. The only industries remaining in town were the logging companies, which surprisingly continued expand their operations in the area. The economic hardships created by Second World War were too much for the town to recover from and the business and industrial sectors eventually folded along with its resident's emigration from the town. Eventually the smaller businesses like restaurants and drug stores left town.[2]

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1   Burgstahler 32.
2   Burgstahler 34.
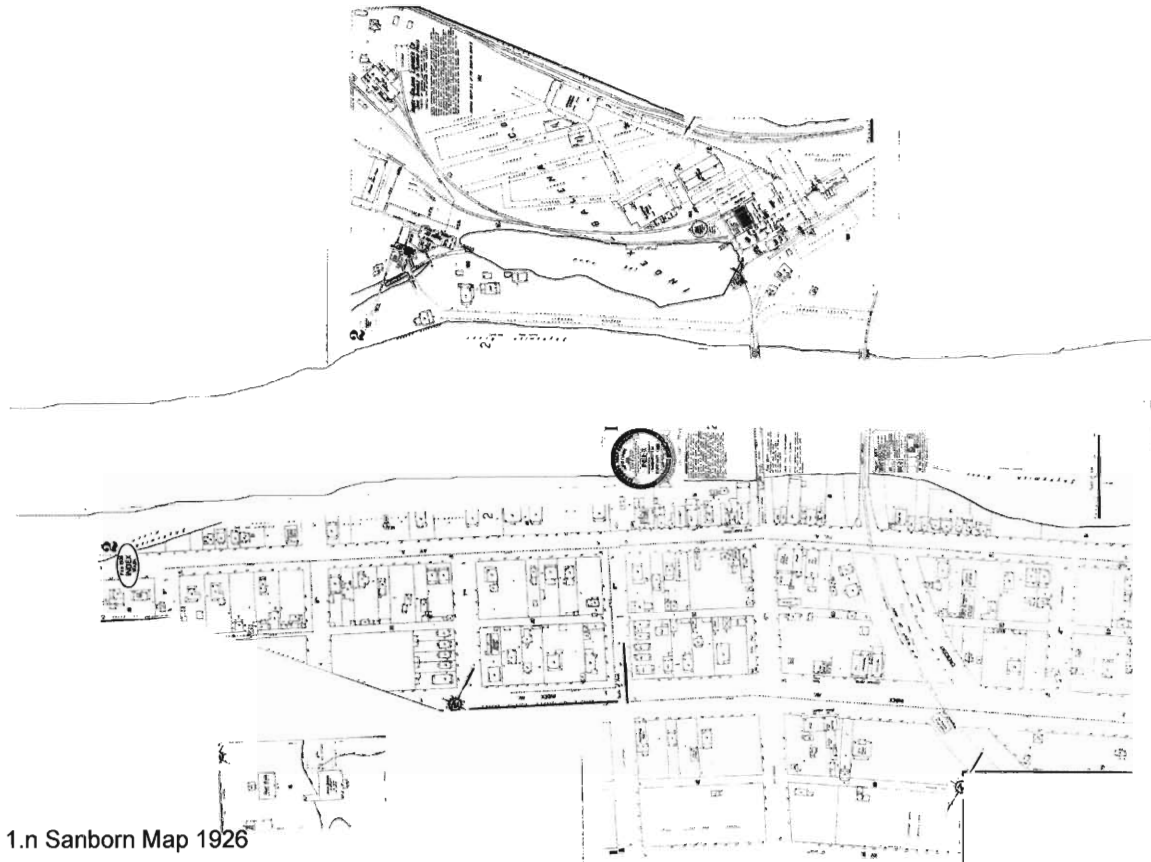
FIG 1.n Sanborn Map 1926

Through out the rest of its history Index became less and less a place of employment and growth and more a recreational area and retreat.[1] The lumber mill was abandoned and torn down and is now a vacant lot. The rock quarry that left a scare on the mountain is now a popular place for rock climbers to visit. Industry has been replaced by eco-tourism and outdoor recreation. A new era for Index had begun.

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1   Burgstahler 35.
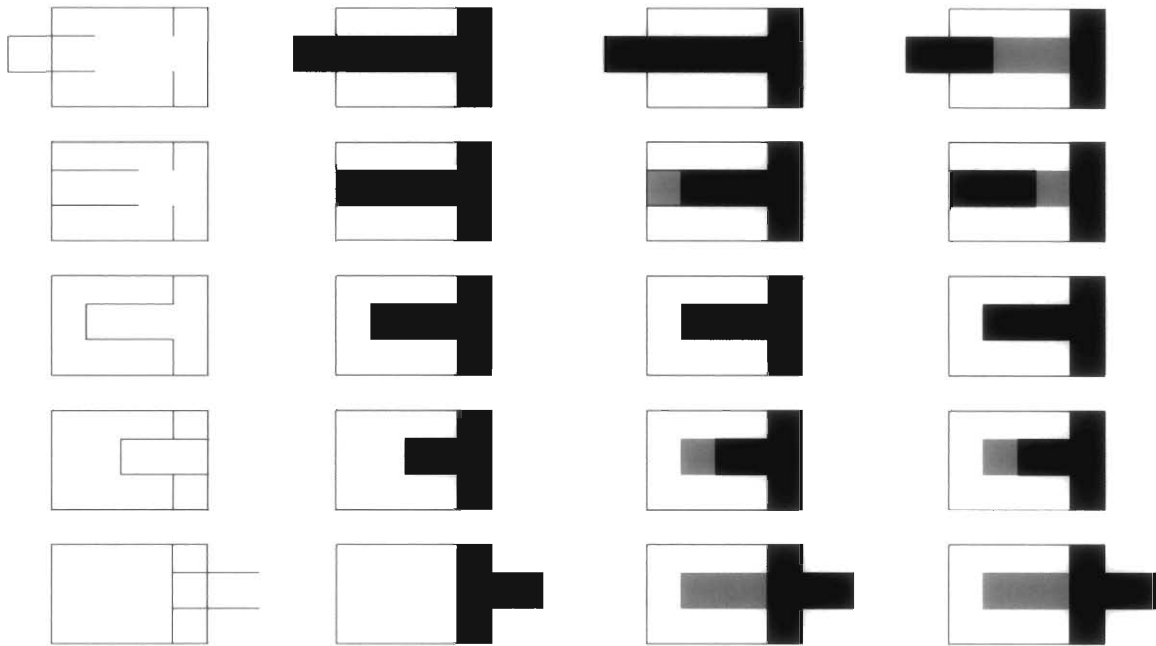
FIG 2.a Dilation Diagram

Program

Program is the internal virtual force that supports architecture. Program is in the space and the space is program. Program along with the forces on the site is the impetus of form. In this thesis, process comes from the "biological and the programmatic rather than the formal"[1] Design of a process requires the ability to envision and anticipate the evolving form rather than a single, finished form. Simultaneous existence between different programs calls for a space that is able to dilate referencing the interiority all the while pushing and pulling against the exteriority. A dilating program implies coexistence among different kinds of program. A project has the ability to expand and contract when two or more programs share a space but are programmatically independent of each other. Difference in "kinds" of program within a site give architecture greater possibilities for interaction and flexibility varying itself qualitatively rather then numerically, proportionally, or through dimension.

Program: Difference in Kind verses Difference in Degree
Duration is the succession of qualitative differences. To occupy durational space is to occupy time itself. Deleuze writes that duration takes on all the "differences in kind" which are capable of qualitative differences.[2] Differences in kind result in programs that are heterogeneous

1   Anita Berrizbeita, "Amsterdam Bos" Recovering Landscape ed. James Corner (New York: Princeton Architectural Press, 1999) 198.
2   Deleuze 31

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Pool
Courts
Climbing Walls

Gymnasium

Direction
Intensity — Wind ---- Pushing
Eroding

River
Rain — Water ---- Carving
Snow Depositing
Collecting
Pushing

Shelter
Town Hall
Parking

Temp.
Space ---- Lyceum ———— Site

Soil
Topography — Geology ---- Sliding
Collecting

Library

Discussion
Presentation
Collection

Direction
Intensity — Light ---- Reflecting
Moving
Penetrating
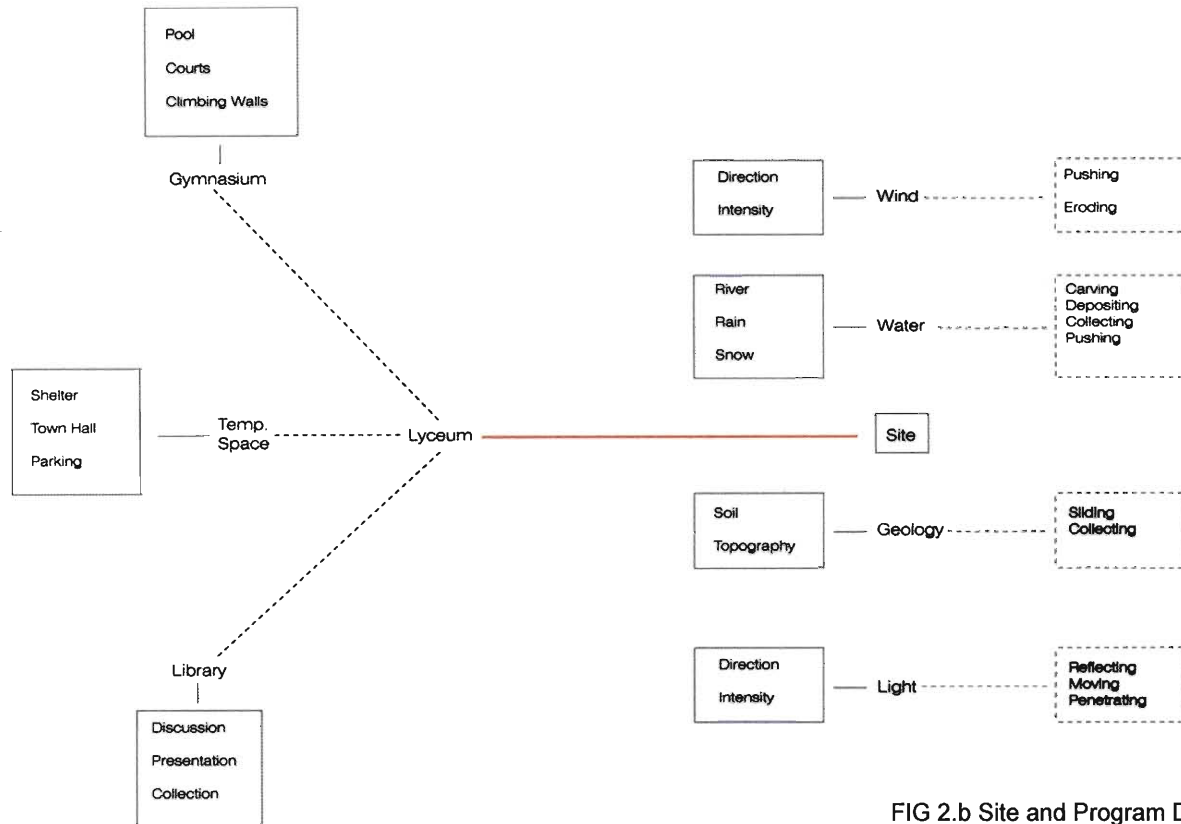
FIG 2.b Site and Program Diagram

in character. "Differences in degree" only lead to homogenous space that varies only in dimension. The heterogeneous and the homogenous can be compared to the difference between a layering of programs and a mere division of space. The homogenous can exist without the heterogeneous where as the heterogeneous uses the homogenous as a building block for differences in kind. "Duration is always the location and the environmental differences in kind; it is even their totality and multiplicity. There is no difference in kind except in duration-while space is nothing other than the location, the environment, the totality of difference in degree."[1] Space and the notation of movement make duration perceivable and experienced. As the demand for program changes, an architecture that varies in "kind" allows the site to be read in new ways enabled by diversity of function latent in the design. For example if a space is designed as parking but is able to become a park and a park becomes a playing field, a playing field becomes a garden and a garden then becomes parking again a cyclical process of maximized use gives space duration and qualitative succession. "Equipping the surface with services and furnishings that can be appropriated and modified by the public enables diverse and flexible range of uses."[2] Giving "places" some indeterminacy and allowing the public to specify "use" gives longevity to public space and promotes adaptation.

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1   Deleuze 32
2   Alex Wall, "Programming the Urban Surface" Recovering Landscape ed. James Corner (New York: Princeton Architectural Press, 1999) 245.

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Modern buildings have limited functionality and very few typologies of architecture are in continual use. Those considered to be always active are for example airports, prisons, and hospitals. These typologies require a presence in order to remain operational. Seasonal activities, events, and programmatic cycles require overlap and space-sharing in order to achieve the same presence. What requires this presence? Can a site generate this continuous presence by combining programs? Taking this into consideration how can the other typologies of architecture, which seem to have moments of inactivity, be some how joined together so that programmatic flux occurs.

Programmatic flux requires an understanding of space and succession. Succession preserves the relationship between different programs through the creation of reversible relations. The melting of one program into the other establishes programs that are independent of each other based on activity. At the same time these programs are dependent on each other with respect to the space they share. The homogenous (space) is dependent on all programs but heterogeneous program differences remain independent of each other. Henri Bergson states that when "we project time into space, we express duration in terms of extensity, and succession thus takes the form of a continuous line or chain, the parts of which touch without penetrating one another."[1] This touching without penetration allows for programmatic succession to occur. If program is defined as the relationship of activities located in space then programmatic flux

FIG 2.c Programmatic over-

Spring Summer

Museum
Hiking
Rock Climbing
Sightseeing
Mine Exploration
Fire
Index
Rain/ Flood
Wind
Winter Sports
River Sports

Winter Fall

FIG 2.d Seasonal Program
Diagram for Index

takes these relations and allows for the reversal, overlap, and coexistence between different programs.

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Morphology

"...the form of an object is a diagram of forces"[1]

One cannot talk about kinetics without also addressing the theory of morphology.[2] The original theory behind morphology explores the way matter generates new forms through the modification of a single part or parts. The morphological process of the proliferous rose shows that where the axis of the rose should have stopped; a new flower emerges to grow past the petals of the original flower. This morphological process is one example where a disturbance has created a shift or an effect to the regularity of the object. The disturbance has created a point of inflection where new possibilities can emerge. Morphology also implies a process, one that observes the past in order to transform the future. Morphology acts as both the collective memory and processes that transform a body.

The theory of Morphology is based on the "principles of structured form and the formation and transformation of organic bodies"[3] Take for example the human body, and imagine its tissue and bone structure. The tissue is flexible and provides a covering for the structure by constantly

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1 D'Arcy Thompson, <u>On Growth and Form</u> (Cambridge: Cambridge University Press, 1961) 11.
2 Morphology, first coined by Johann Wolfgang Von Goethe, includes the principles of structured form and the formation and transformation of bodies.
3 Goethe 57.

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FIG 3.a Proliferous Rose

renewing it-self. Muscle, tissue of a different kind, resides between bone and skin and provides the movement of both. This endogenous force or the function of a building virtually fills the gap between structure and skin. Goethe proposes that structure in its final form is the inner nucleus molded in various ways by the characteristic of the outer elements.[1] Using the theory of morphology as a process one could compare these inner nuclei to the center points of an object or its points of inflection. These points are the virtual fourth dimension, a projects program. These points are virtual in nature, infinite in possibility. Outer elements in this case are the dynamic forces on the site that act on the architecture. Within the architecture, program is the internal virtual force that supports the skin. It is flexible and divides by changing in kind rather than degree. A program in flux implies coexistence among different kinds of program. Mono-programmatic architecture is characterized by differences in degrees, thus being quantitatively different, where as fluctuating programs must be flexible enough to differ in kind, functioning together in a qualitatively different manner. Morphology focuses on the process of development itself rather than the development of a process.

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1   Goethe 55.

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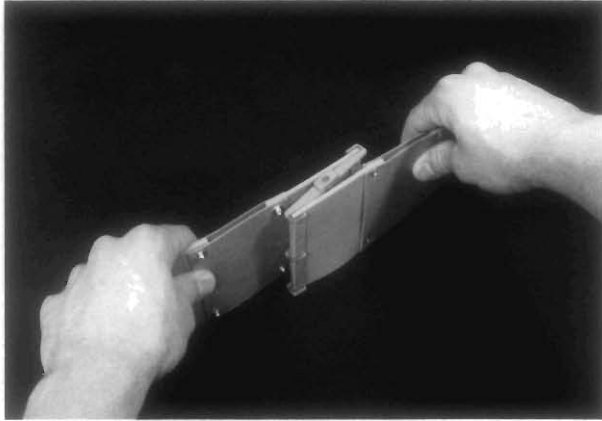
FIG 4.a Kinetic Studies
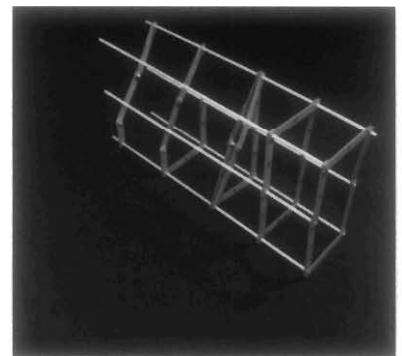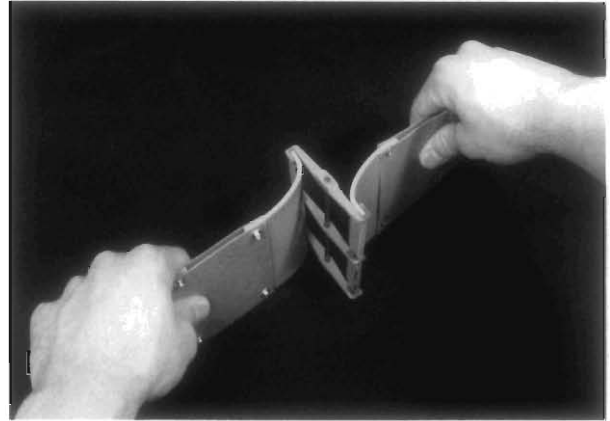
FIG 4.b Kinetic Studies

Kinetics

Mechanism: the system of man
Dynamism: the system of nature

Kinetic architecture attempts to combine the dynamic system of nature with the mechanical system of man. If flux or the need for it configures space then a kinetic system becomes a possible solution that allows for change, emergence, anticipation, and adaptation. A kinetic architecture takes into account the endogenous force(s) that originate in program while adapting to the exogenous force(s) imposed by the site. Kinetics is more than just moving components; it is the dynamic interaction with its environment at each stage, interval, or cycle of transformation. Kinetic forms rely on motion, therefore resulting in designs that are parametric. Kinetics does not begin with form but relies on a process of investigating know facts and deciphered laws. Form emerges out of a process that has come from an analysis of forces and vectors contained within site and program.

Most Architecture contains a certain amount of moving parts in the form of doors, windows and elevators but for the most part this is the extent of physically moving parts in architecture. In his essay *Beyond Kinetic* Michael Fox describes "the way and the means" by which kinetic

structures move.[1] The ways theses structure may move is by "folding, sliding, expanding and transforming in both size and shape." The means by which kinetic structures move may consist of "pneumatic, chemical, magnetic, natural, or mechanical" components. Adaptability is the major proponent for kinetic structure. If flexibility and adaptability are the demands for a project then a kinetic structure may be the solution. "An adaptable space flexibility responds to the requirements of any human activity from habitation, leisure, education, medicine, commerce, and industry. Novel applications arise through addressing how transformable objects can dynamically occupy predefined physical space as well as how moving physical objects can share a common physical space to create adaptable spatial configurations. Applications may range from re-organization of interior space to complete structural transformations that respond to unexpected site and programmatic conditions."[2]

Motion in architecture is either formally expressed either through the representation of movement or through actual moving parts. The representation of movement comes from the abstract and implies a formal morphology of the concept or diagram that starts in complexity and ends in minimalism. Most of the time representational methods of motion in architecture have been abstracted from other objects in motion representing either a combination of movement or a snap shot of motion. The most basic concept of motion is the movement of a body between

1   Michael A. Fox, "Beyond Kinetic" http://kdg.mit.edu/Projects/pap05.html, 3.
2   Fox 7.
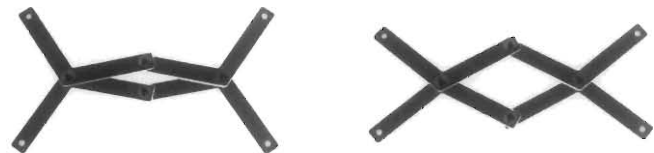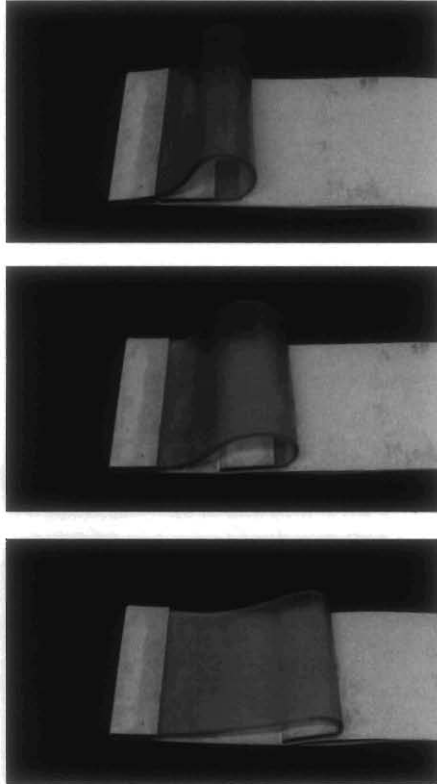
FIG 4.c Kinetic Studies

two states of rest. If this is the case then mere abstraction of motion is inaccurate on all counts. Representation is not only a minimalist abstraction of the original object in motion but also is static and motionless. On the other hand kinetic architecture literally and figuratively establishes the temporalization of space and the spatialization of time by creating intervals of difference or what Bergson would refer to as motion. Jacques Derrida calls these differences spacing, or the becoming-space of time or the becoming-time of space.[1]

Traditionally in architecture space remains constant and time is the catalysts that bring on change in program, activity, or function. In Kinetic Architecture space is not preserved because its dimensions and or proportions may change through out the passage of time.[2] In Kinetic Architecture there is a one to one relationship between space and program where the modification of one has an effect on the other. Therefore, Kinetic spaces must be carefully programmed to allow for flexibility over time but must also be conscious in not producing under-programmed or unprogrammed space.

Although kinetic architecture is characterized by moving parts not everything in a kinetic system can and should move, as this would be nearly impossible and would require a virtual setting with no gravity. The fact that some things have to be static to serve as a foundation brings up

1   Jacques Derrida, "Difference," Margins of Philosophy, trans. Alan Bass (Chicago: University of Chicago Press, 1982) 13.
2   Henri Bergson, Matter and Memory trans. Paul and Palmer (New York: Zone Books, 1991) 143.

the question of permanence in kinetic architecture. With respect to the permanence of physical objects Gilles Deleuze writes that, "permanence has to be born in flux, and must be grasped in prehension...they (objects) gain permanence only in the limits of the flux that creates them."[1] The creation of a foundation is determined by the range and limit that the objects in flux must move in space. These parameters for movement designate the requirement for placement and function of static elements in a kinetic system.

Structure possesses more generative powers than the skin or shell of a building because of its relationship to the interior and exterior. If skin is conceived of first then structure must then follow or support the skin. If structure is designed first then skin has a choice either to adhere itself or pull away from the structure. The potential for interstitial space and or over lap is greater in the latter than the former. Program should create a structure capable of assimilating future demands of the site. "Shape may change while structure remains constant."[2] Shape (skin) is experienced and creates sensations that change. Structure on the other hand creates the space and supports the skin. Structure is the constant that maintains relationships between parts but the skin creates relationships associated with flux of the interior and exterior spaces. A change in structure establishes a new system where as different skin elements can exist within the same structural system.

1   Gilles Deleuze, The Fold trans. Tom Conley (Minneapolis: University of Minnesota Press, 1993) 79-80.
2   Spirn 104.

27
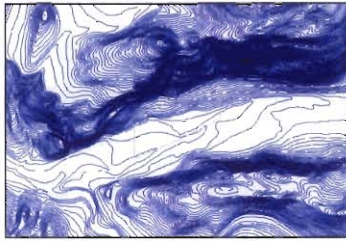
topography   surface geology   land cover
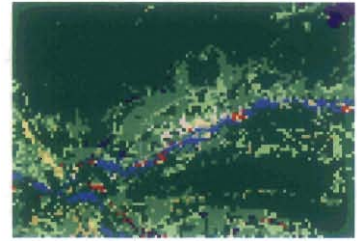
Process of Design

The design began through an analysis of the site and the forces that would influence it. Specific aspects of the area were ascertained and this information was compiled into a map. Factors such as building type, paths, wind direction, topography, soils, transportation corridors, parks and recreational areas were identified. Areas of intense programmatic and environmental activities were located and accessed. For example, half of the residential buildings (orange dots) are located in the 100-year flood plain identified in light gray. This is due in part to the direction of water flow (solid blue lines) at this particular location of the river and the venturi effect created by the narrowing of the river just before the "Crescent".
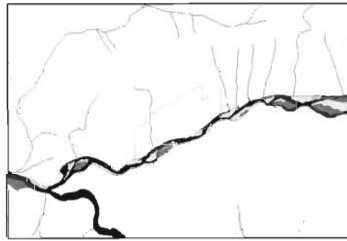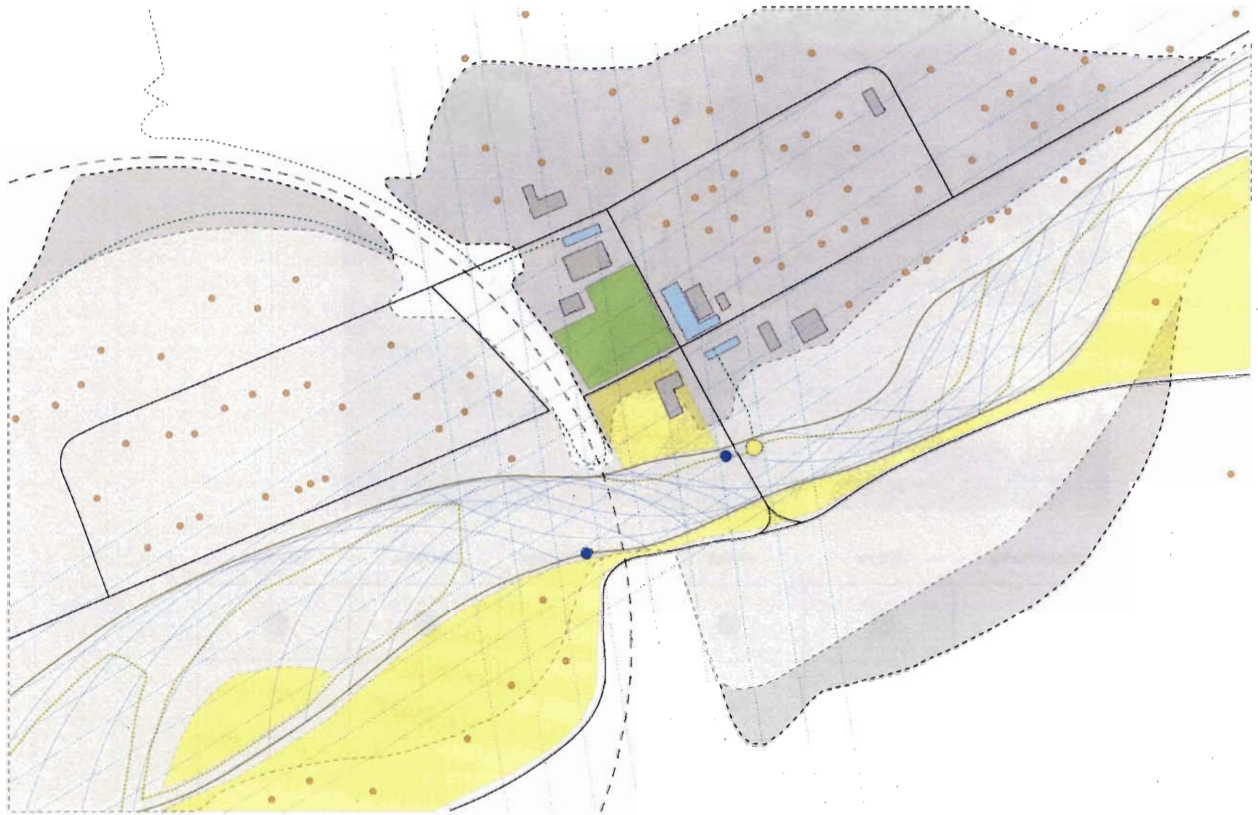
rivers and streams
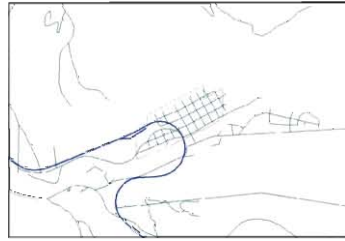
transportation routes

bathing area	⬤
residential building	⬤
kayak boat launch	⬤
walking trail	....
wind path	....
train tracks	— — —
river current	
wildfire area	
100 yr flood plain	
500 yr flood plain	
park	
non-residential building	
parking	

The majority of activity in the town is centered around the park (green). The town's convenience store, Index Museum, elementary school and fire station are all grouped together in this same area. This section of Index is all that is left of a once bustling business district. The designated parking lots (light blue) located near the park are used year round by tourists, rock climbers, kayakers, and anglers. The "site" for this project is located between the park and the waters edge because of the programmatic and environmental conditions that fluctuate in different cycles through out the year.

	Community	Visitors	Hikers	Kayakers/Rafters	Climbers	Travelers
Parking		●	●	●	●	●
Library	●	●	◌	◌	◌	
Meeting Space	●			◌		
Museum	◌	●				○
Sports Court	●	○				
Climbing Wall	○	○			●	
Restrooms/Lockers	◌	◌	●	●	●	●
Boat Launch	○			●		
Pool	●	●			◌	◌

Primary Use ●
Occasional Use ○
Rare Use ◌
Space Sharing

Lyceum:

The idea for a lyceum emerged out of the potential for interaction between geographically diverse communities for the purpose of recreation and education. The first lyceum was founded by Aristotle as a place for learning and fitness. Lyceums have always been characterized by multi-programmatic overlap and were usually located in small towns serving as a central location for town meetings or public lectures. Many of these lyceums were held in school gymnasiums thus adhering to the Aristotelian philosophy of learning and fitness.

The types of programs incorporated into the lyceum in Index were gathered from the existing context. The elements that encompass the lyceum are a library that also functions as a corridor for linking both sides of the town, an indoor sports court that also serves as a town hall an over-flow parking lot, and an exhibit space that also doubles as a rock-climbing wall.
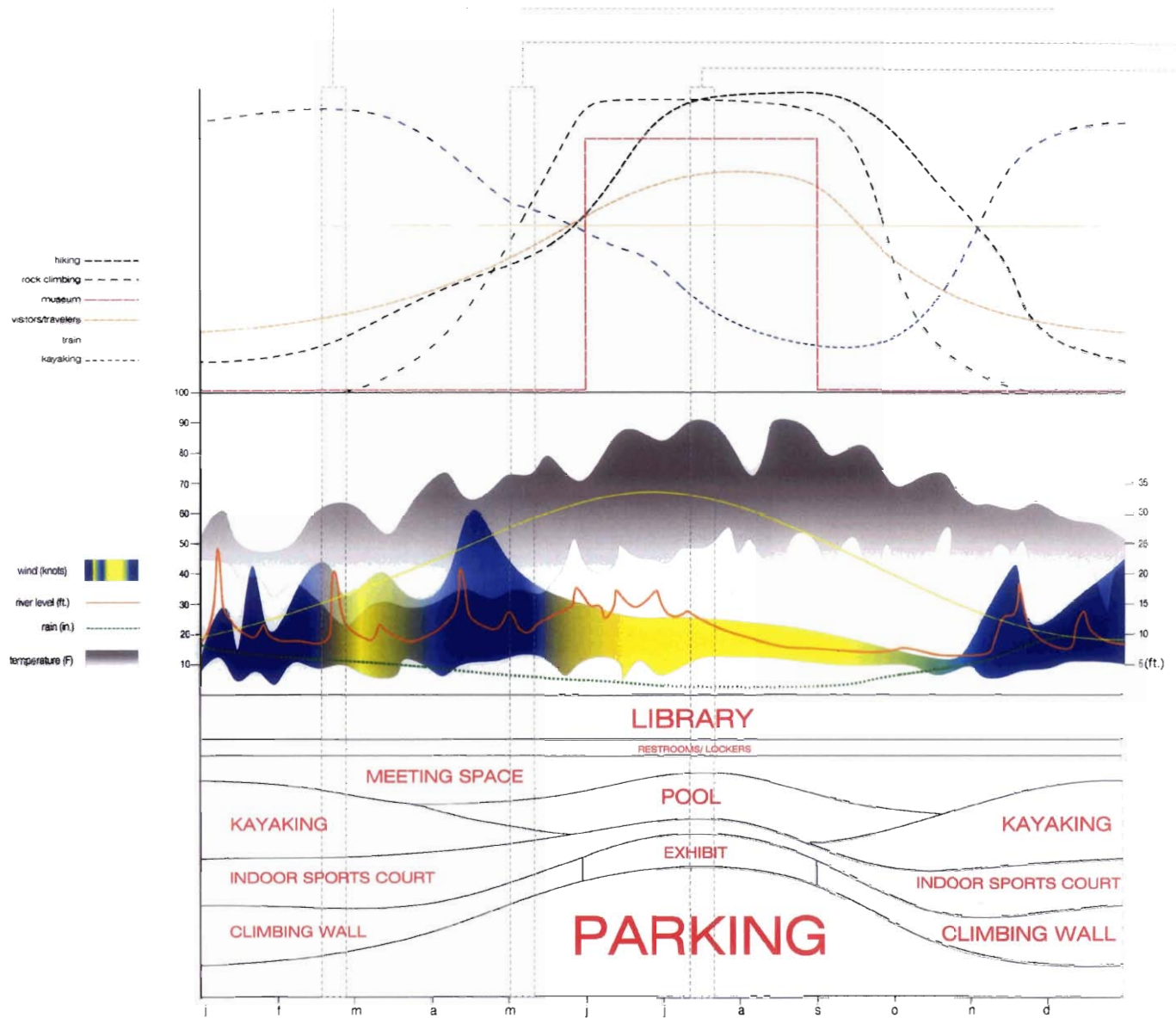
The diagram above was developed by juxtaposing the occupation of the site against the environmental forces. The result was a program that responds to both the use and forces on the site. As the demands for one program decreases or temporally ceases another kind of program takes its place. The annual diagram (on the left) is only an average account based on the seasons. The set of diagrams on the right stemmed from the annual diagram and are a weekly analysis of the site during three times of the year. These diagrams depict how the site functions during the week giving an accurate account of the programmatic requirement of the site.

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Winter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Library							
						Kayak Boat Launch	
Meeting Space						Sports Court	
						Climbing Wall	
Park						Parking	

Spring

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Library						Event	
						Kayak Boat Launch	
						Pool	
Meeting Space	Sports Court						Event
						Parking	
						Climbing Wall	
Park						Parking	

Summer

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Library							Event
Pool							
Meeting Space			Sports Court			Parking	
						Museum	
Park						Parking	

Static Architecture
Dynamic Context

Parking, Pool, Boat Launch
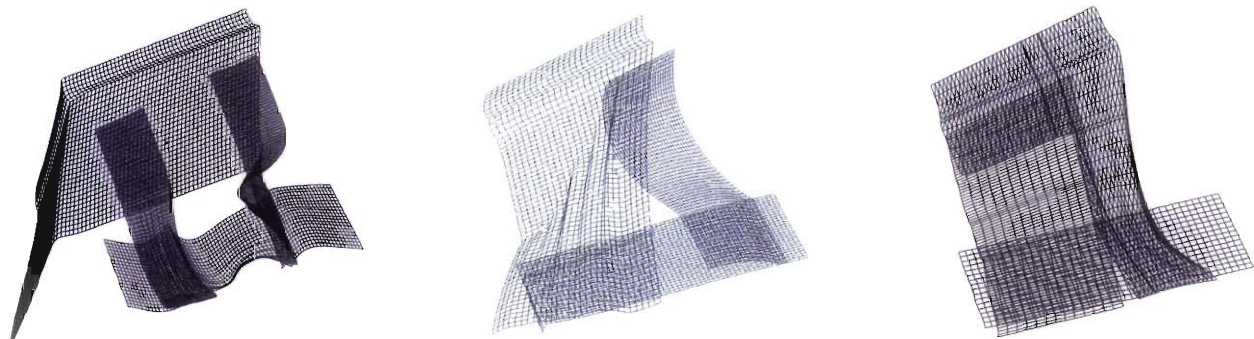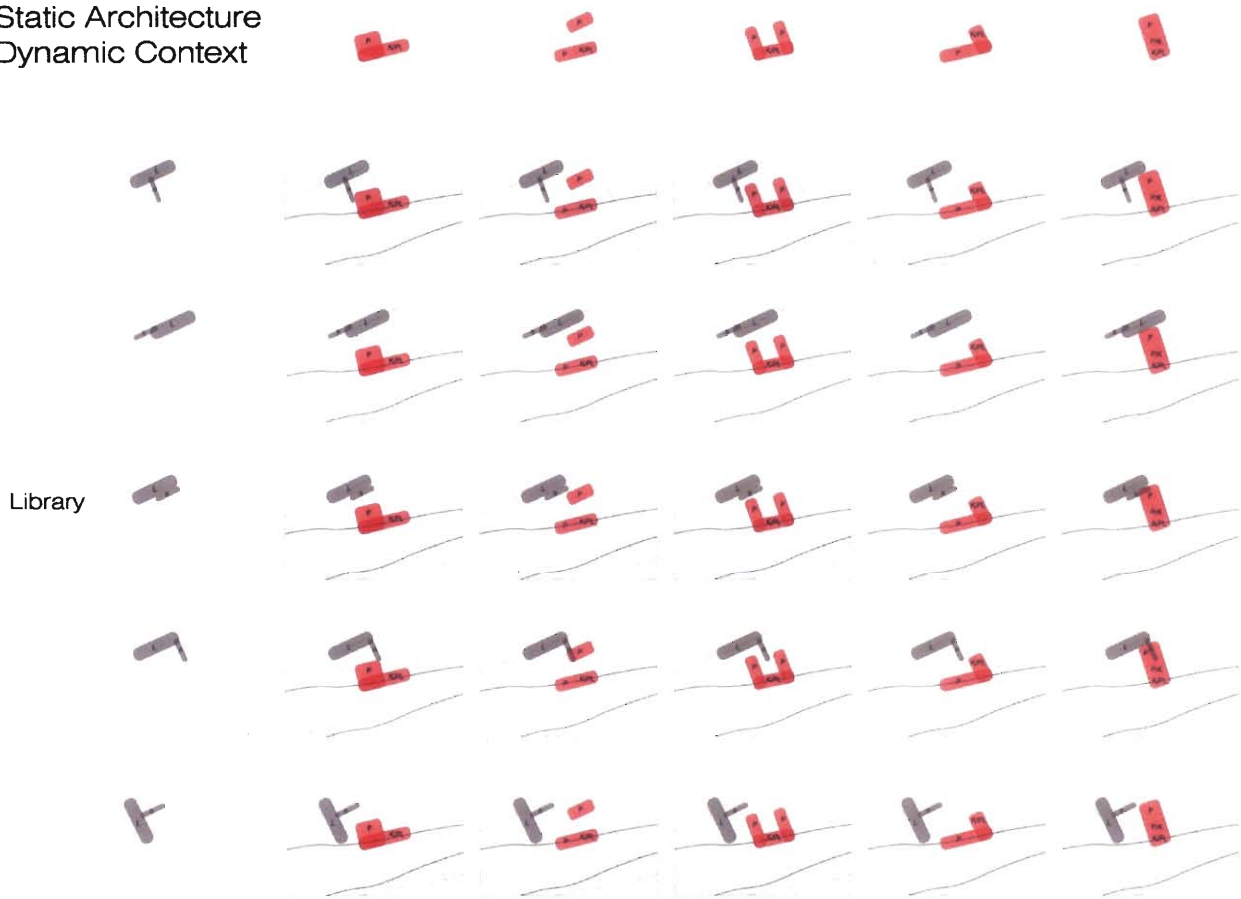
Library

The library was conceived as the link between the two side of Index and the parking as the connector between the water and the park. Together these two programs structured the foundation for the rest of the project. They created the spaces for other programmatic elements to be inserted into.

Gradicule Matrix
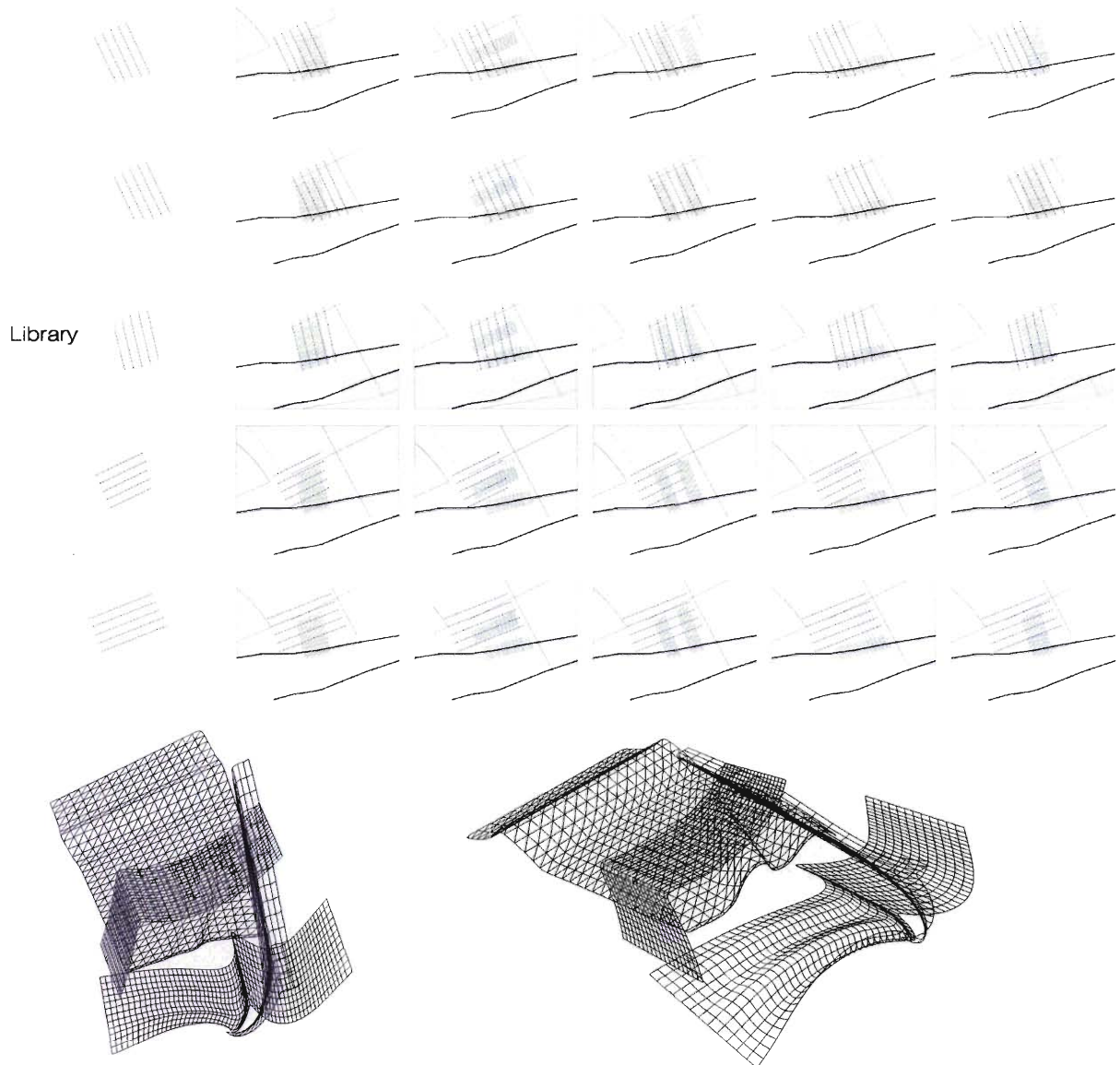
Library

The matrix on the left looks at possible organizational possibilities for the library and parking. The matrix on the right takes these possibilities and converts them into a series of graticules. Each graticule depicts a series of grids that were used to set up the structure between different programs. Samplings of graticules were chosen and were then subjected to the forces of wind and water on the site. The series of distorted graticules represents the physical effects of the site on the structure over time.

Erosion/ Deposition Study

The black and white images above depict a series of landform studies that carefully counter and adapt to the forces on the site. Angular levees function to prevent erosion and flooding. The levees allow the river capacity to hold more volume, while not creating tall retaining walls that block the scenic view of the area. They also create pockets for programs to exist such as park-ing, a wading pool in the summer, and walkways for anglers to access the river. The retaining walls continue beyond the site, protecting the residents down river from floods.

Concept Design

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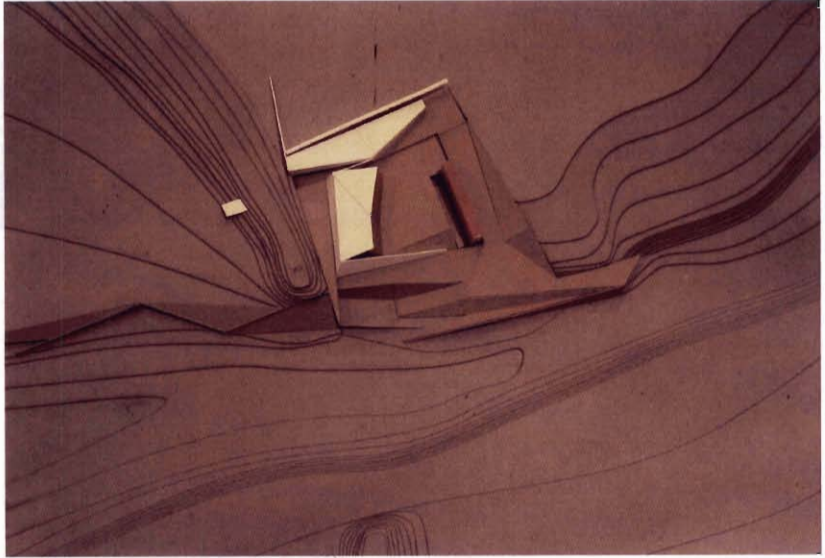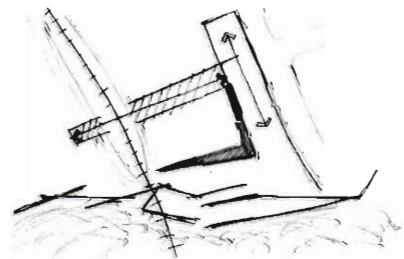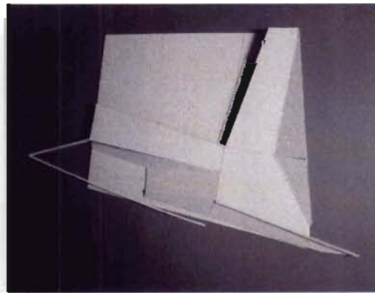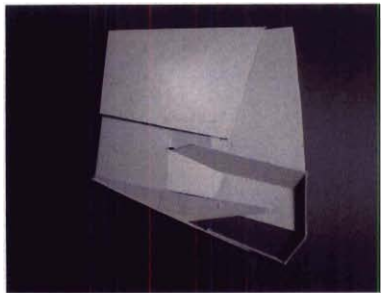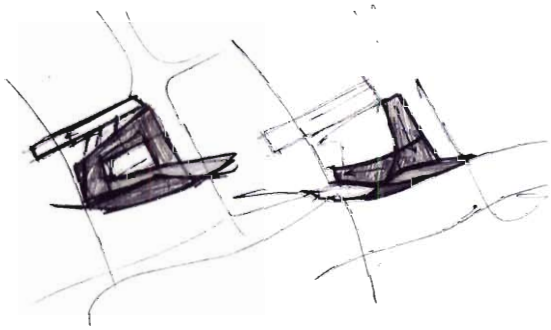
Programmatic Flux
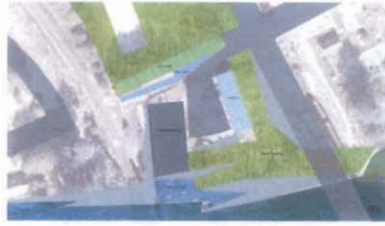
River Levels
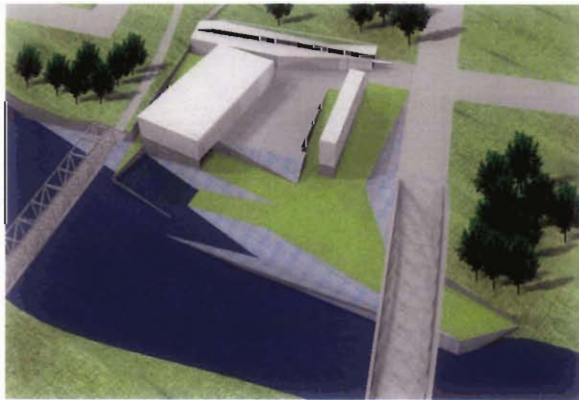
Stage 1: Safe
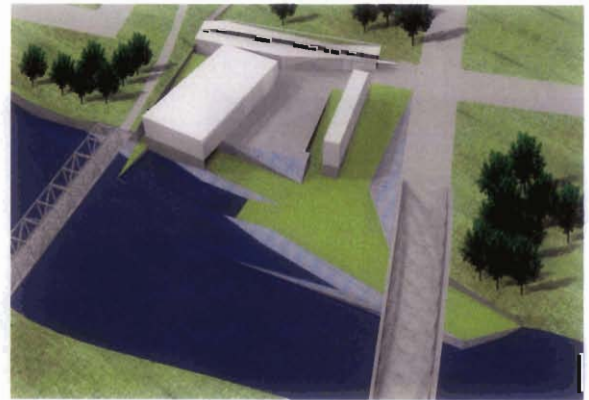
Stage 2: Cautious
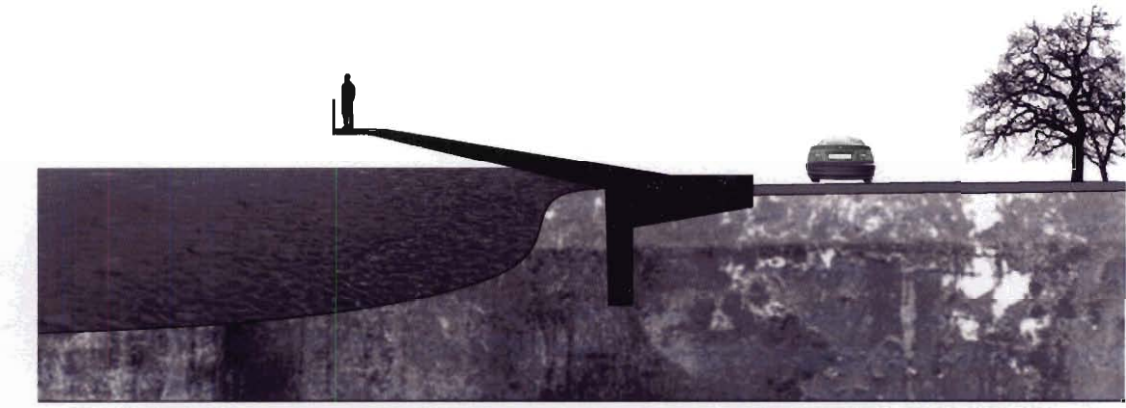
Levee Section
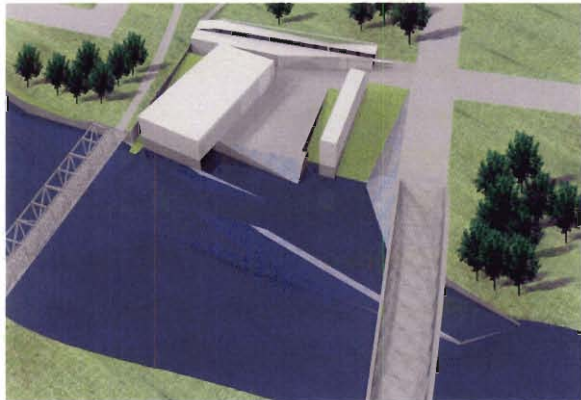
Stage 3: Dangerous

Stage 3: Disaster
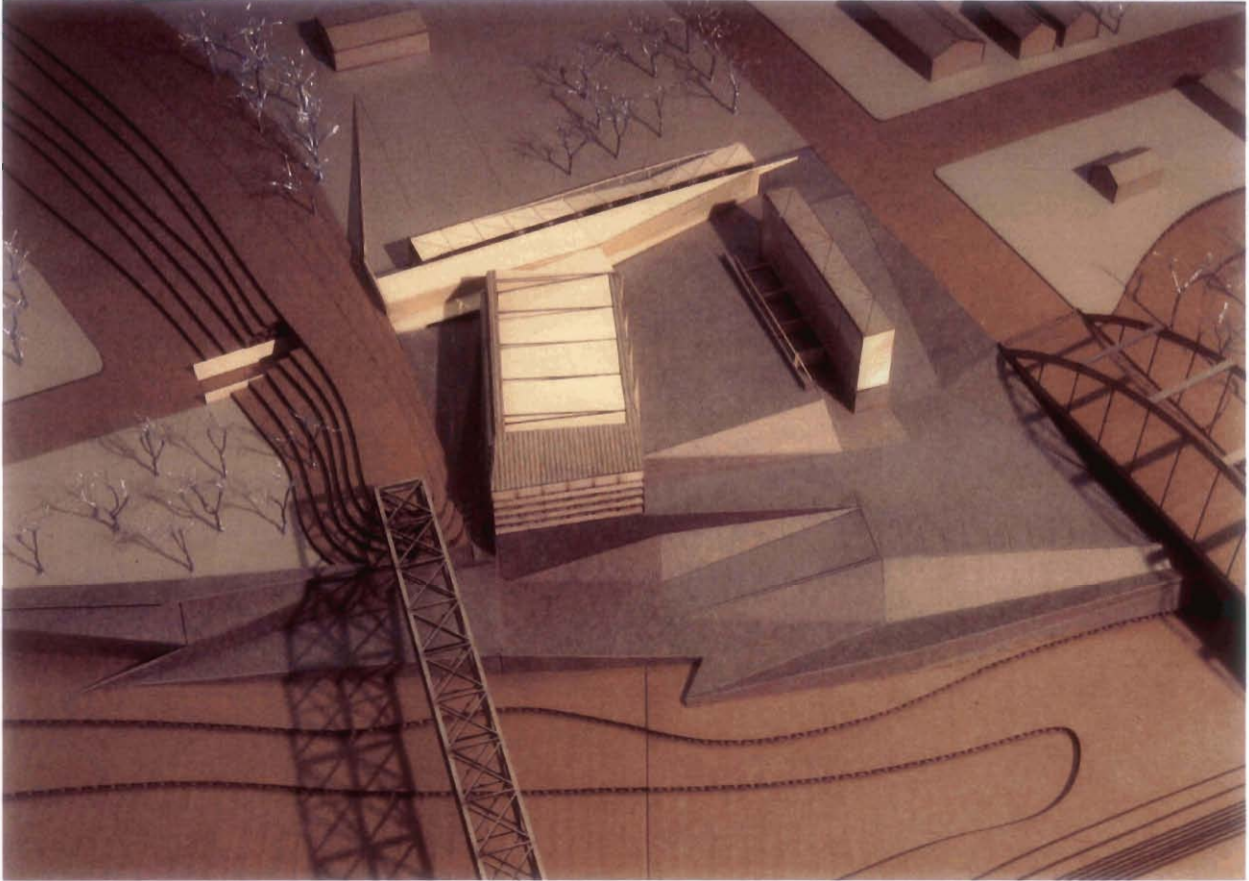
Design Synthesis

The design synthesizes the landform and program studies into a project that is both flexible and adaptable. The library and gym share the corridor that connects both sides of the town. The exhibit space/rock climbing wall replaces the old Index Tavern as the new icon for the town.
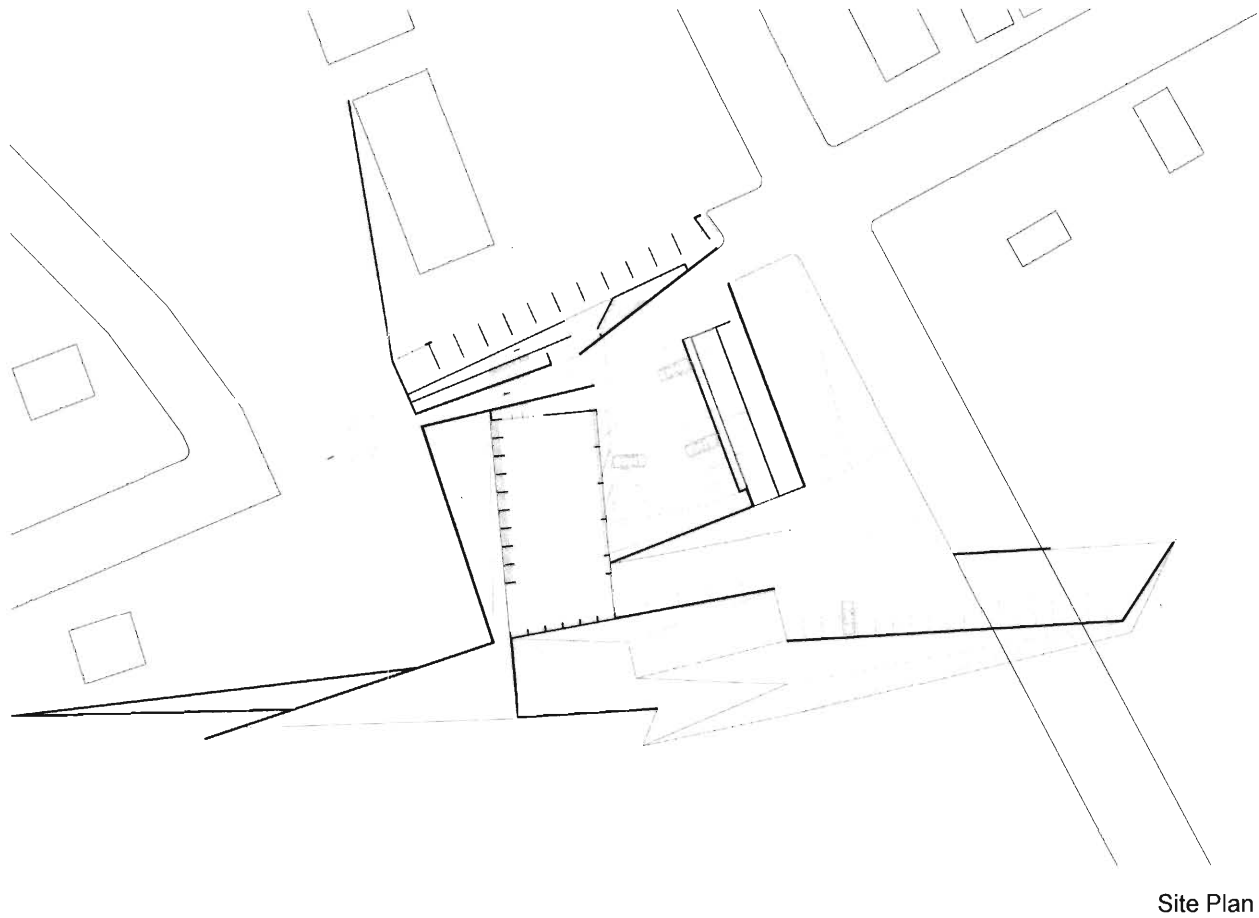
Site Plan

Kinetics is used in three different systems as a way of adapting to programmatic and environmental changes. The indoor sports court uses a kinetic wall system for the purpose of natural ventilation and regulates the temperature by opening and closing rows of operable panels. The vertical climbing wall morphs into a horizontal exhibit space providing a location for the temporary museum that stands up in Index during the summer. The space inside the library is activated by a membrane wall that bellows in response to winds coming from the north.
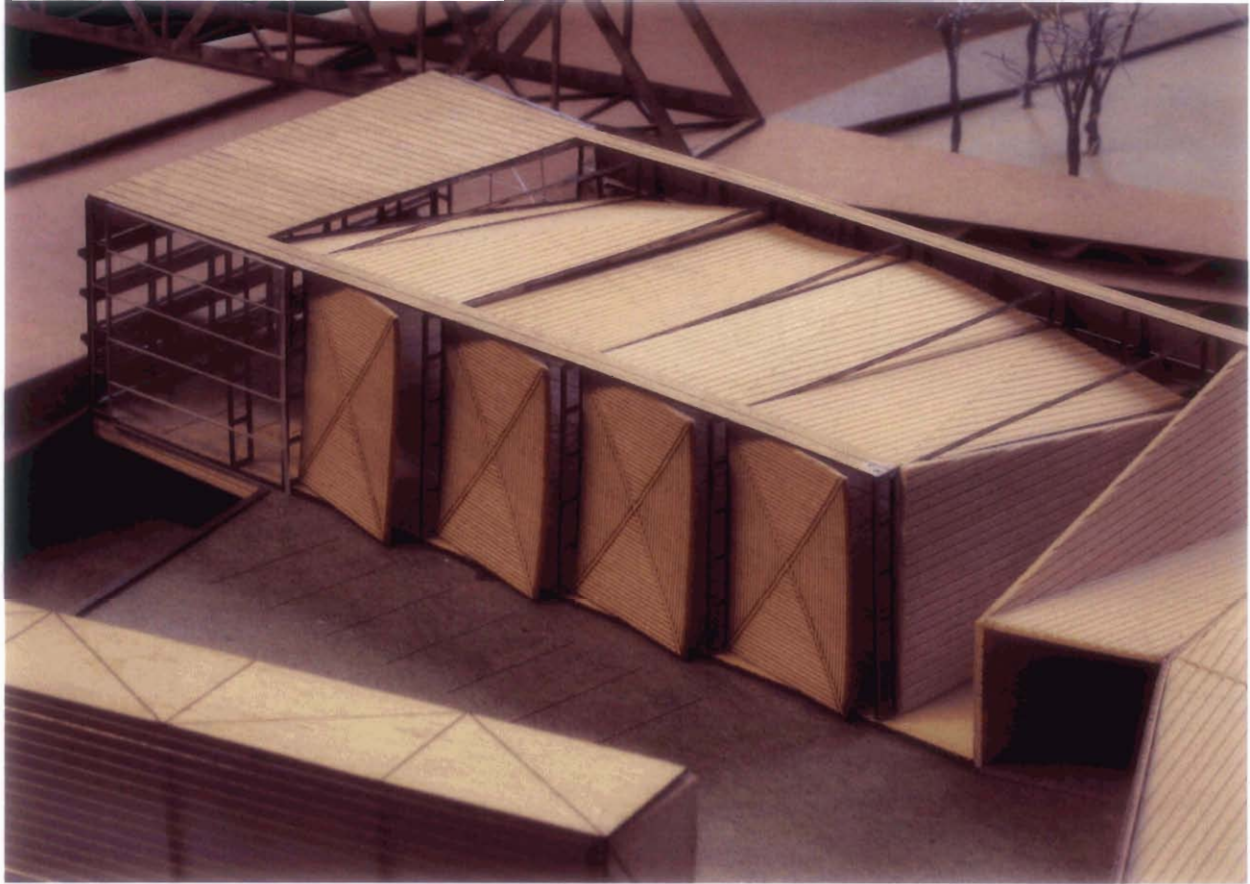
Indoor Sports Court/ Overflow Parking/ Meeting Space

Interviews with residents of the town revealed that there was a need for a place to recreate indoors to escape the inclement weather during the fall and winter months. If needed the indoor sports court can continue to serve as sports arena during the summer months; however, commencing in late spring and through the summer Index supports more outdoor activities. With the sports arena freed up, it is a natural transition to use the space for weekend parking when the city tends to swell with out of town sports enthusiasts. To accomplish this transition the indoor sports court east façade has a series of doors that can open and close to allow cars to park inside. The other kinetic system in this building is a series of louvers that provide natural
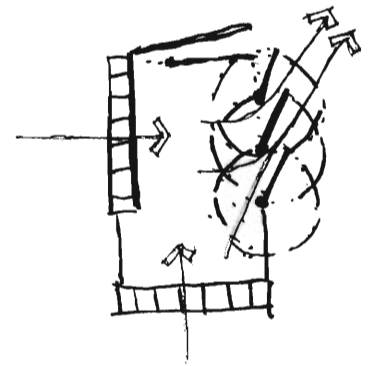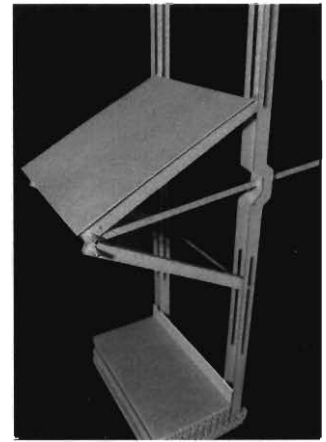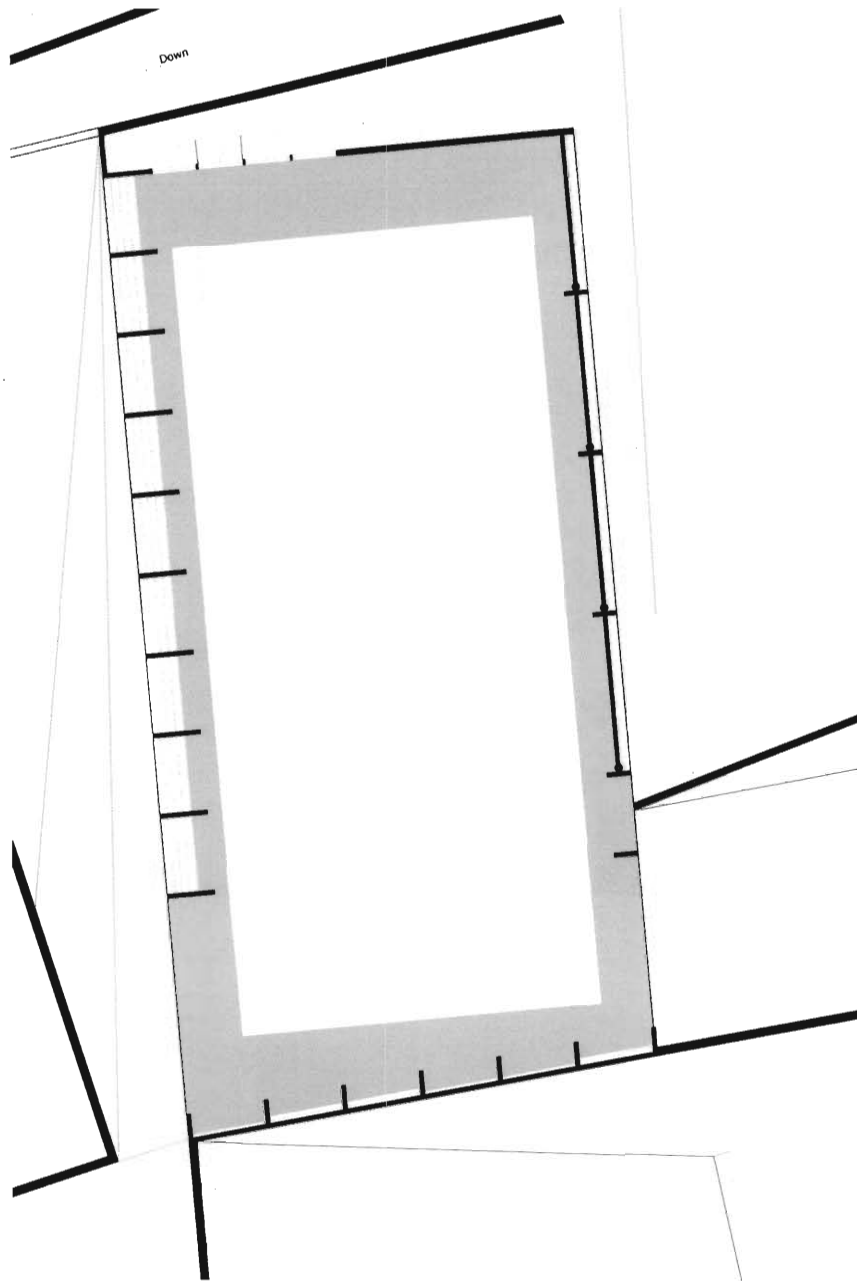
ventilation by opening and closing. This kinetic system faces south and southwest to maximize the prevailing summer winds. The size and flexibility of this space can also provide a location where town hall meeting and public lecture can take place through out the year.
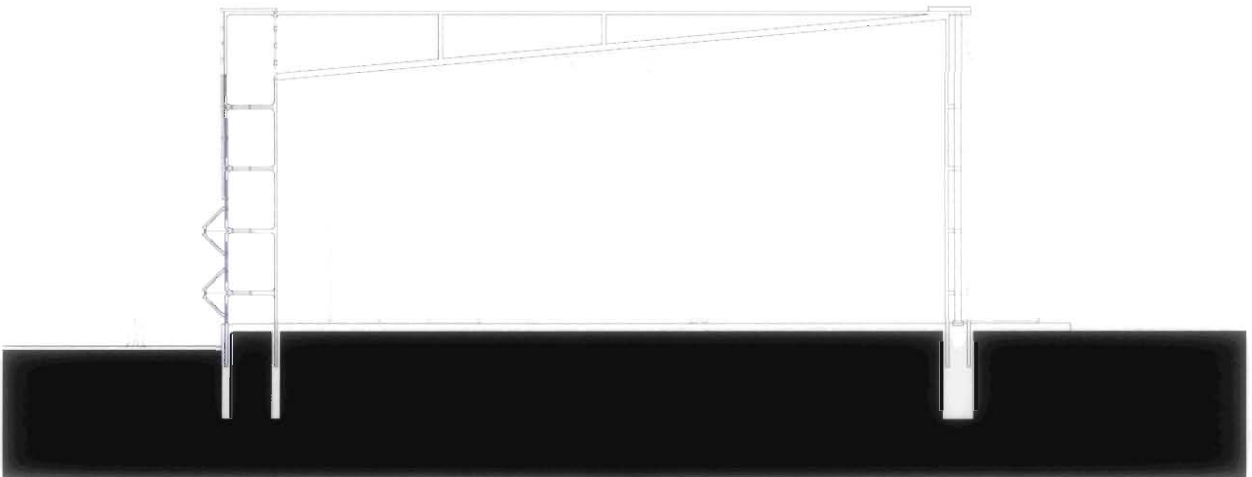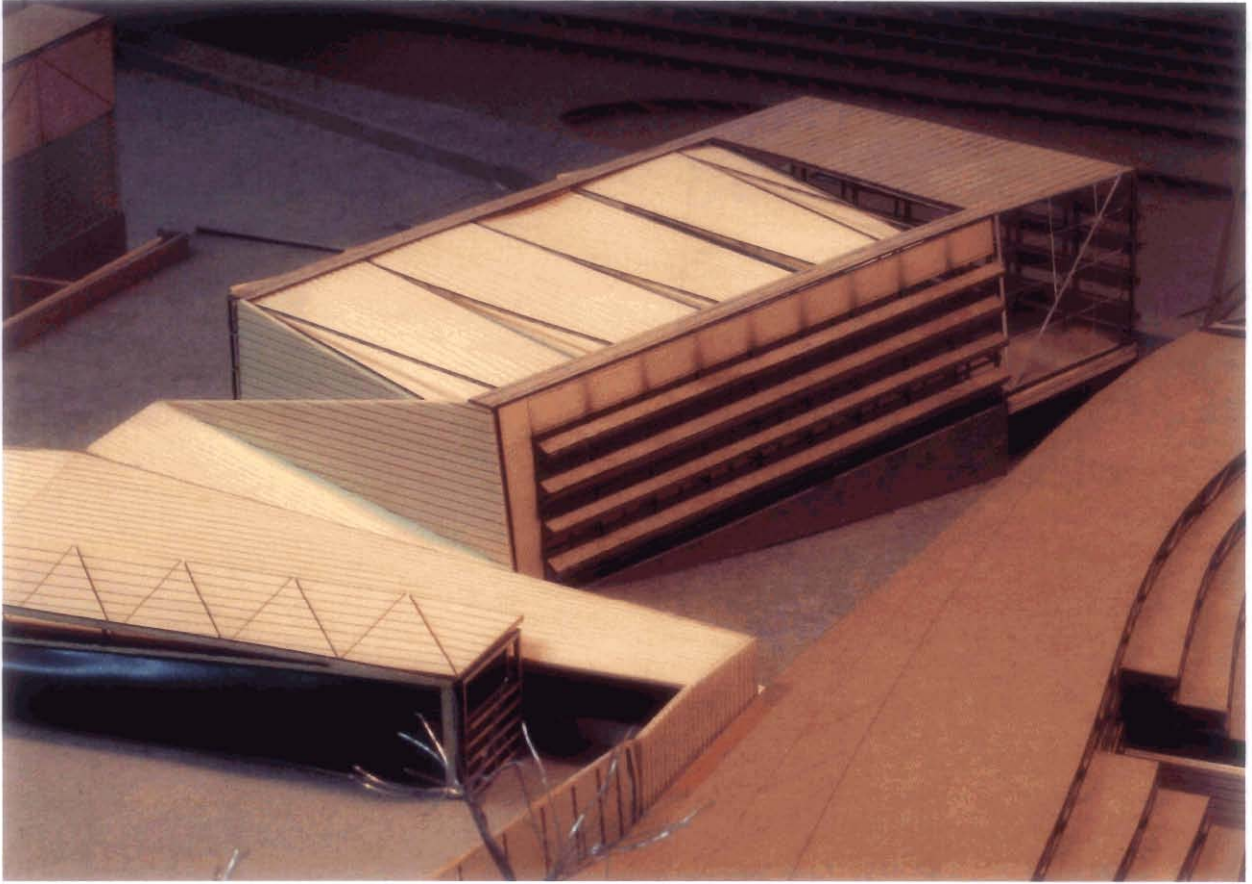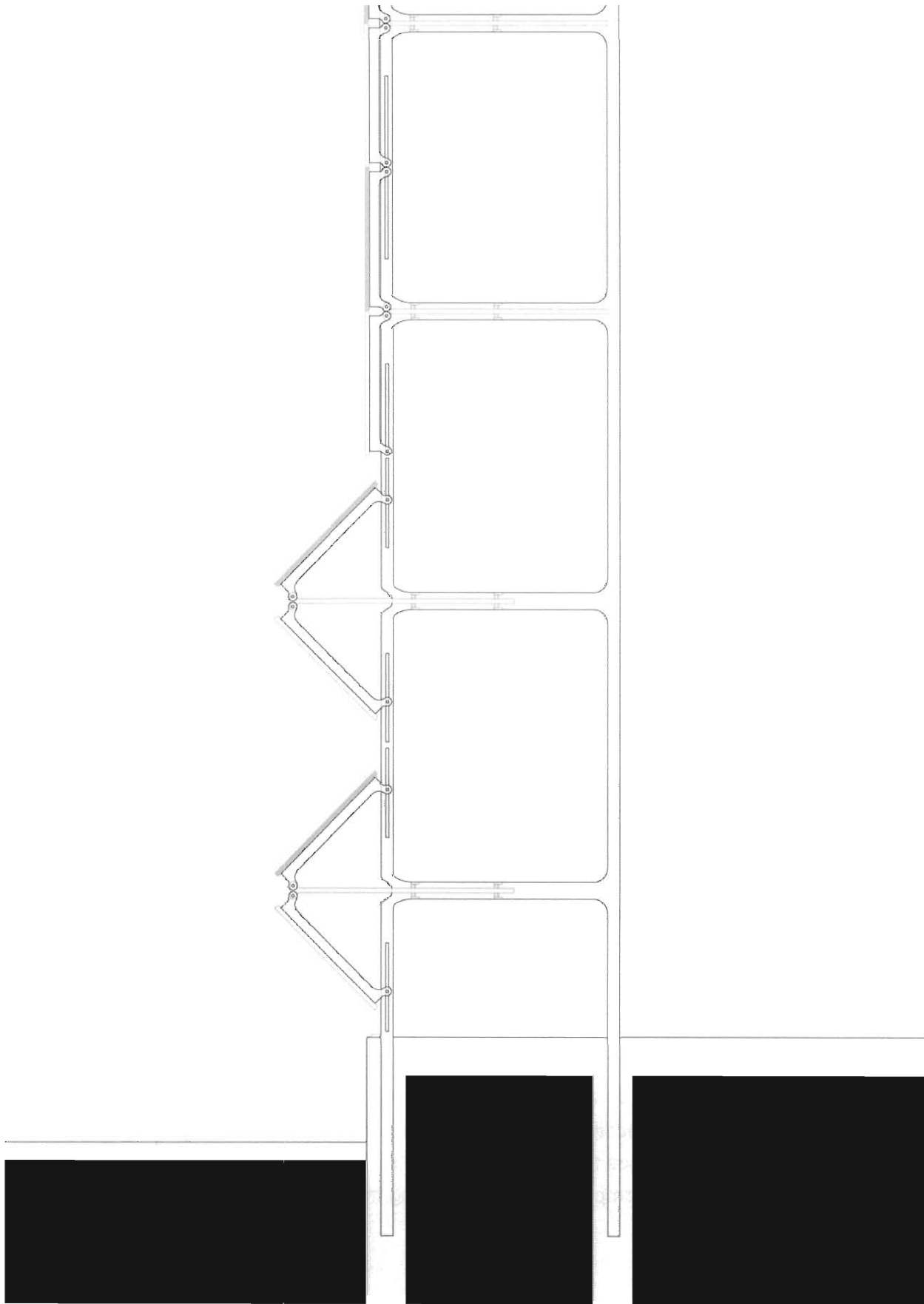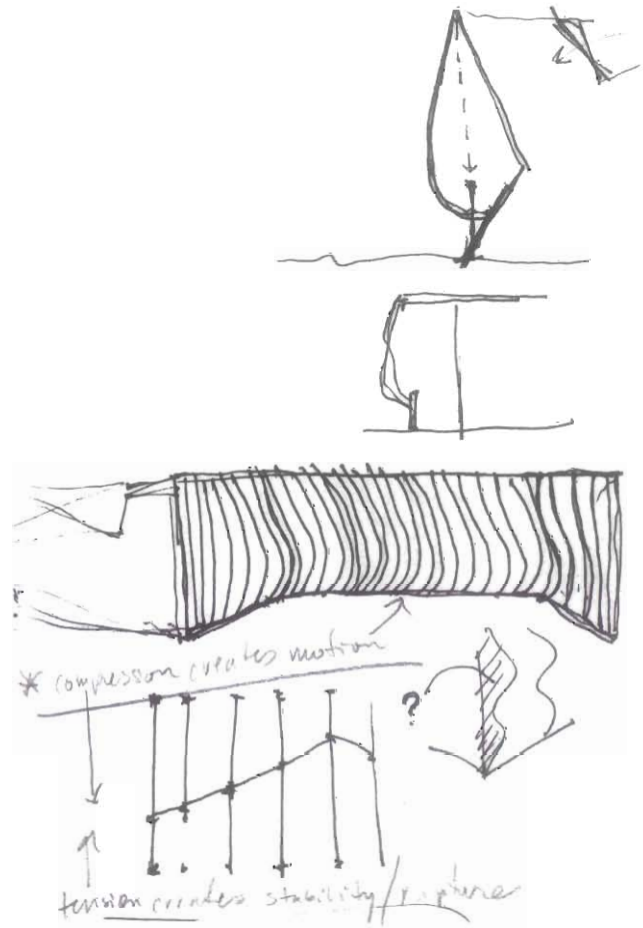
Library

In addition to its primary function, the library also functions as the circulation corridor between both sides of the town. The north façade is composed of a membrane structure that morphs in response to changing wind direction and intensity. The partially draped membrane continually transforms the space that houses the collection of books. The draped portions in the membrane wall are the result of the roof compressing and releasing the tension on the surface.
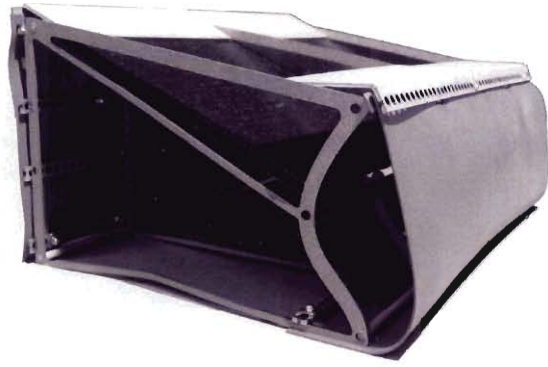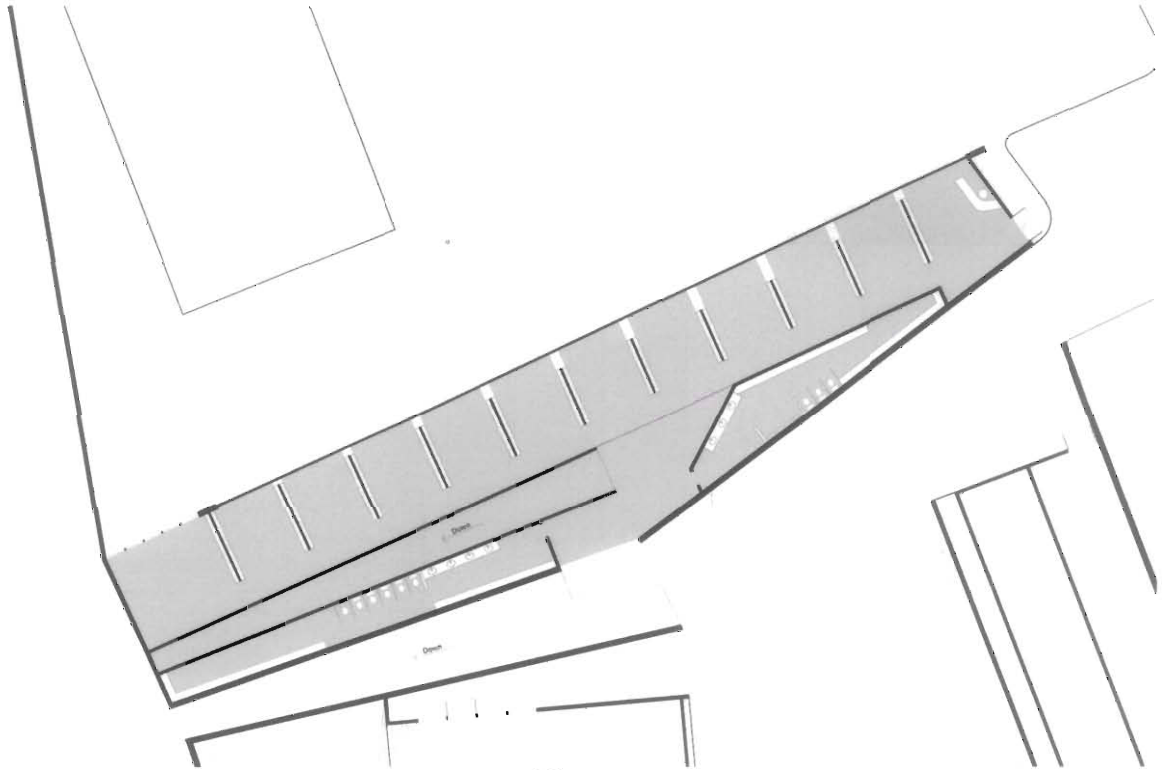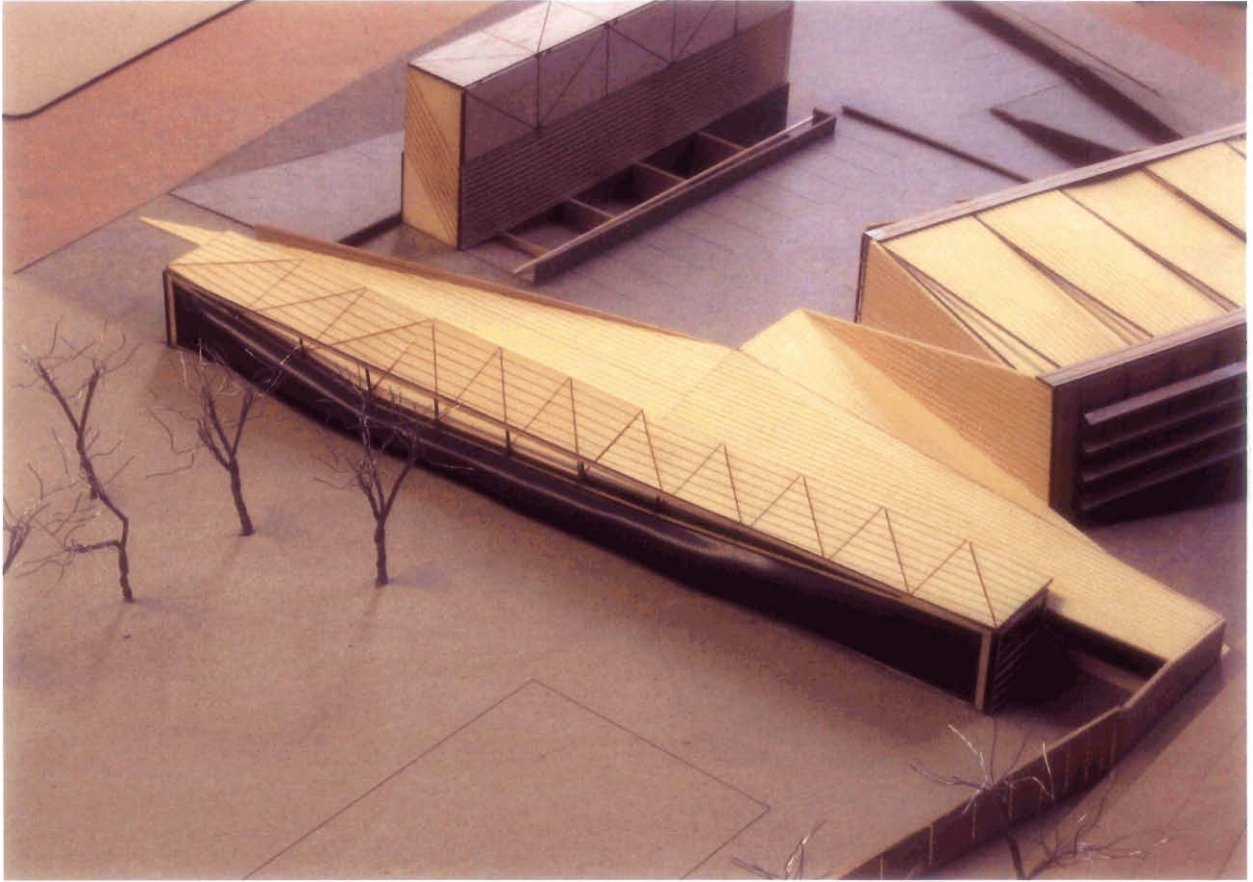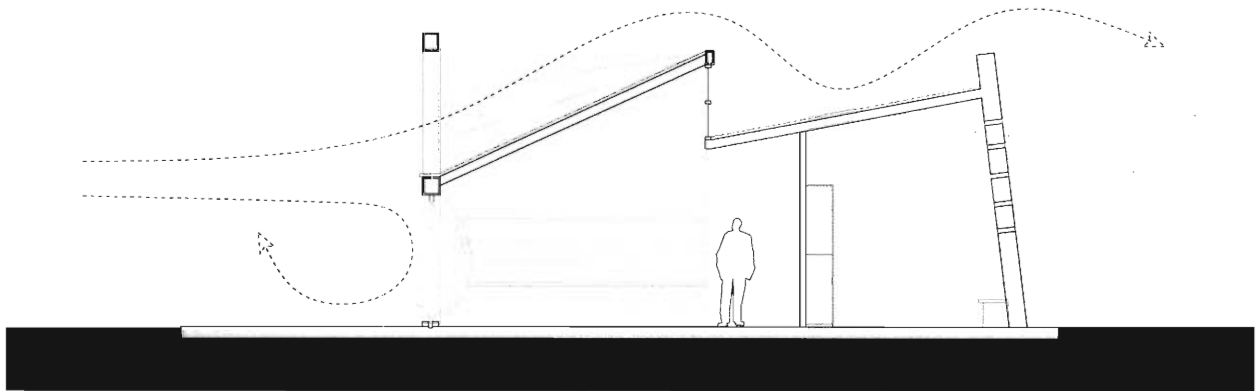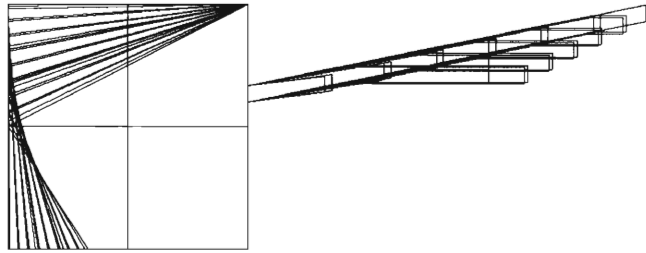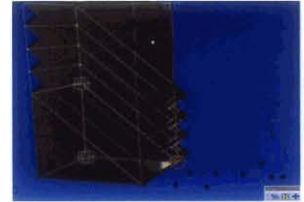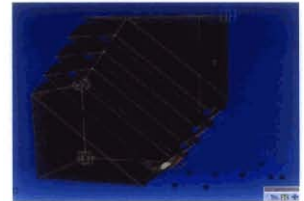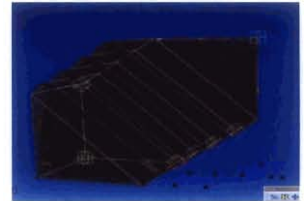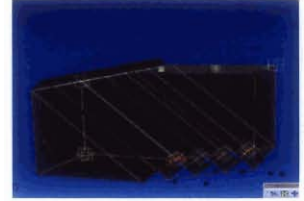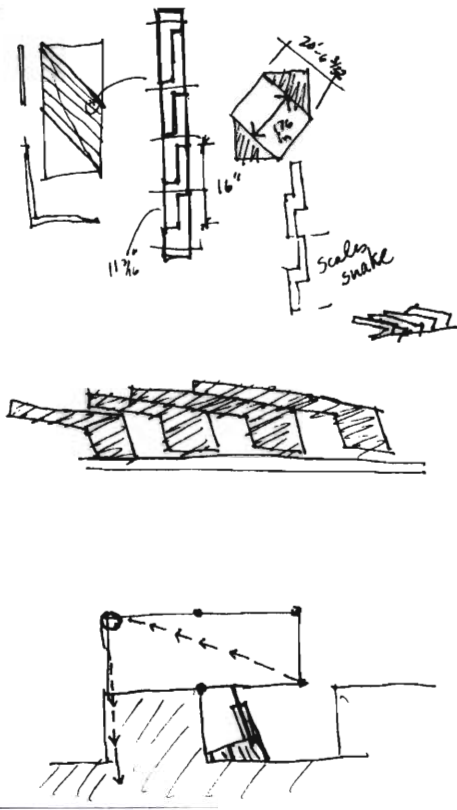
Climbing Wall/ Exhibit

The final kinetic system in this thesis is the climbing wall/exhibit space. In its vertical position the space functions as an indoor rock-climbing wall. In its horizontal position the space can house temporary exhibits. The kinetic system is designed to transform the entire space and not just a portion of a structure. The transformation is cause by the raising and lowering of the river. Theoretically as the river rises the water would fill hydraulic-chambers that lift the wall in place. As the waters recede the structure would lower itself back down into the horizontal position.

climbing wall
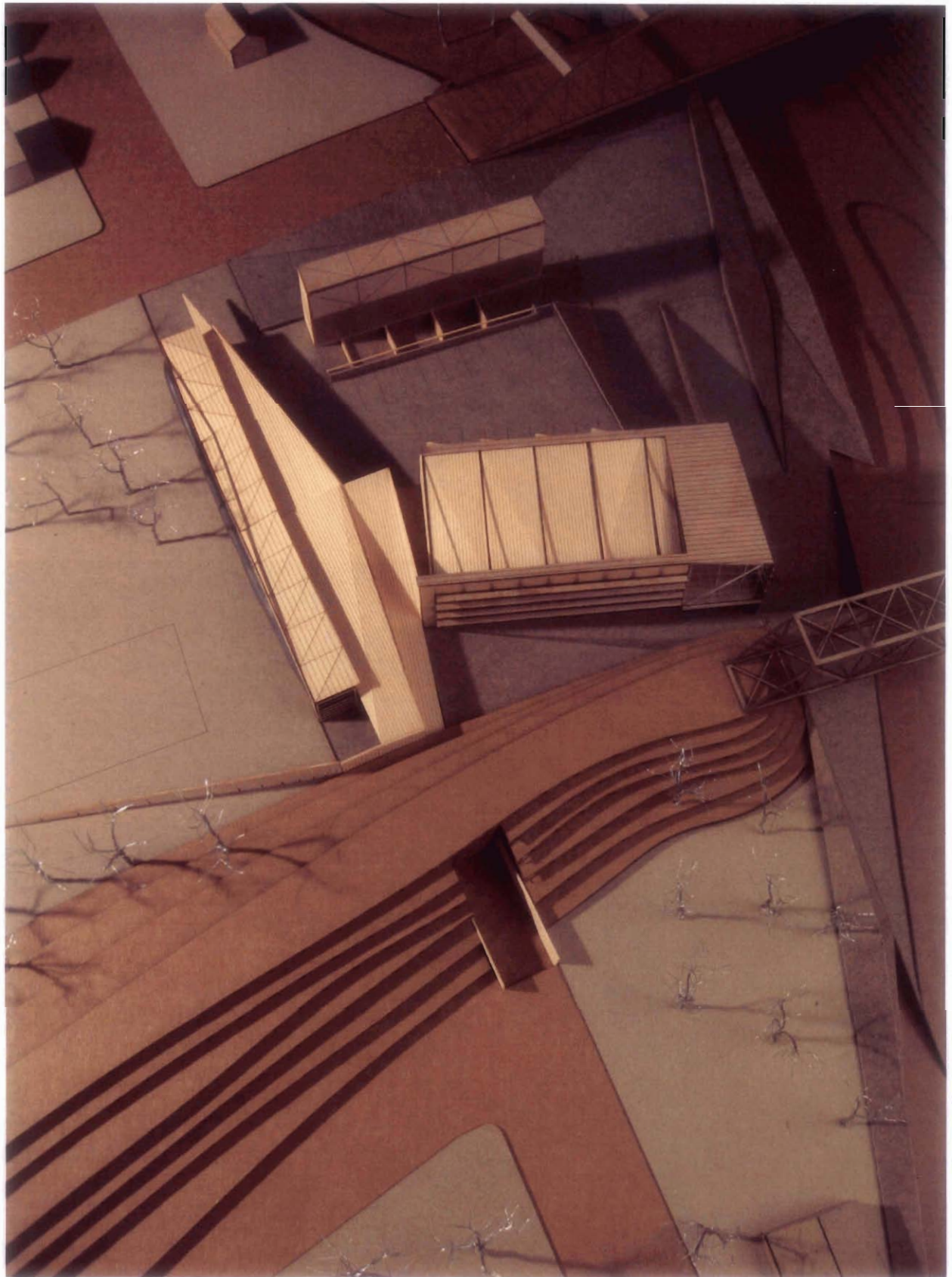
museum

or climb on the inside
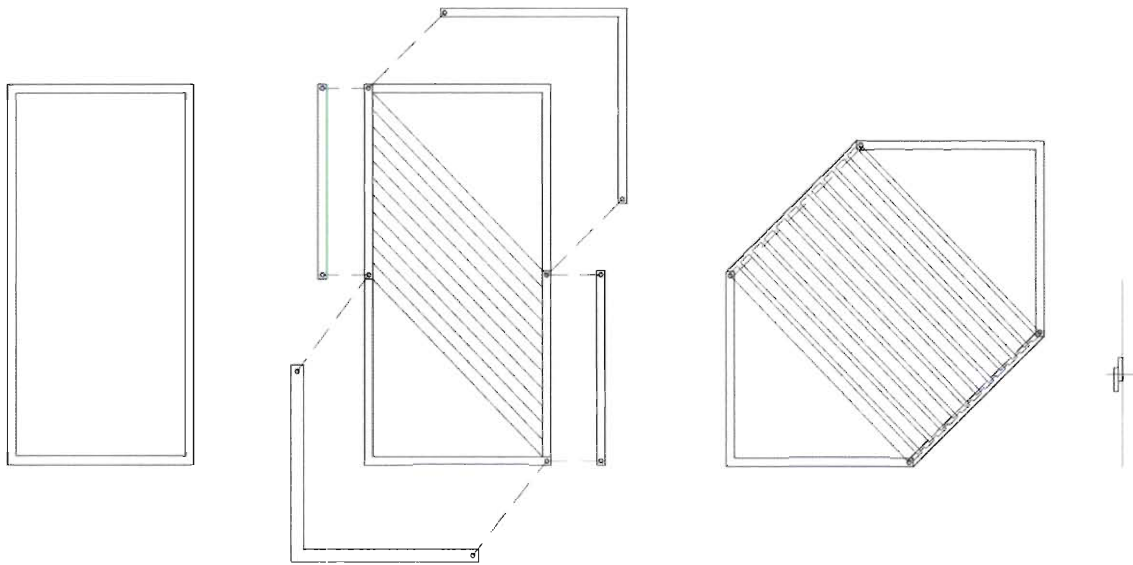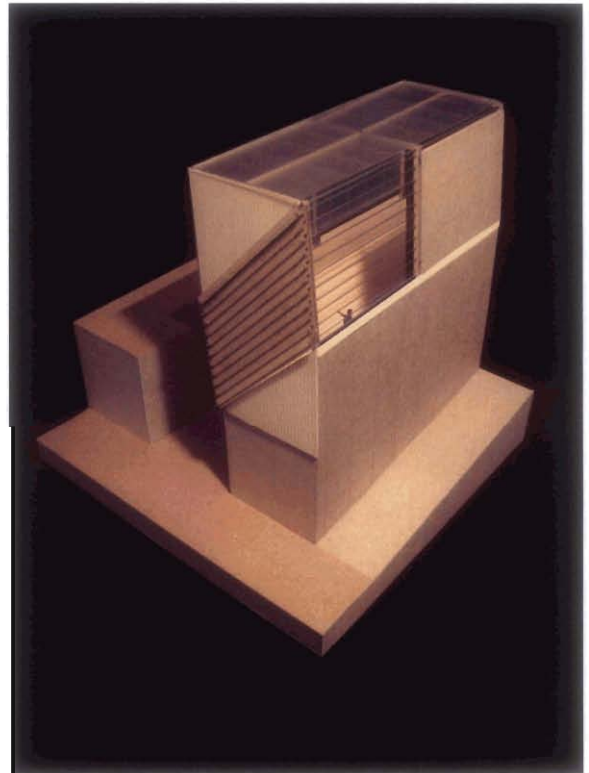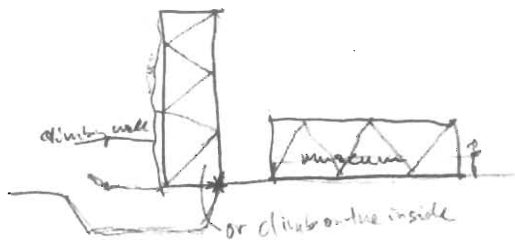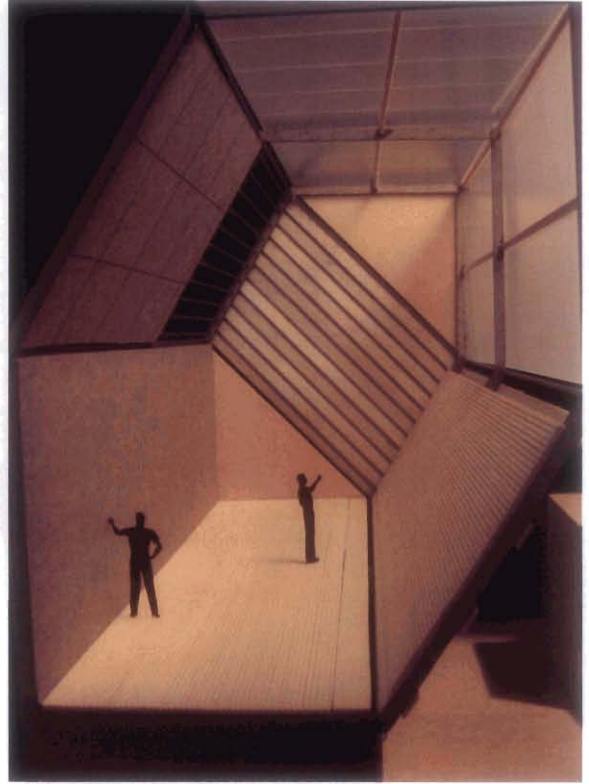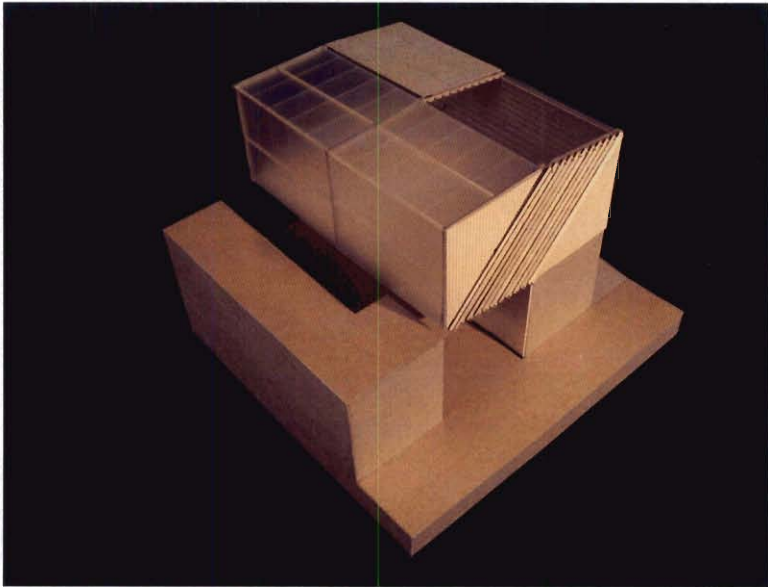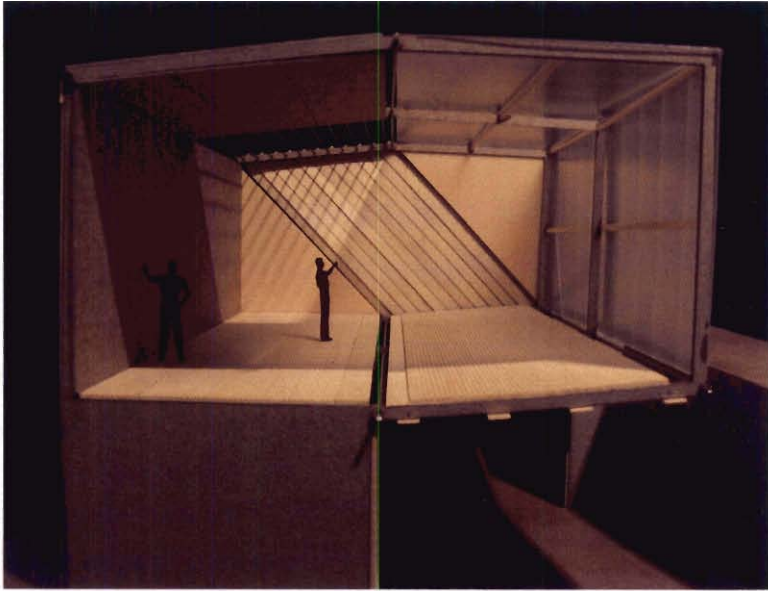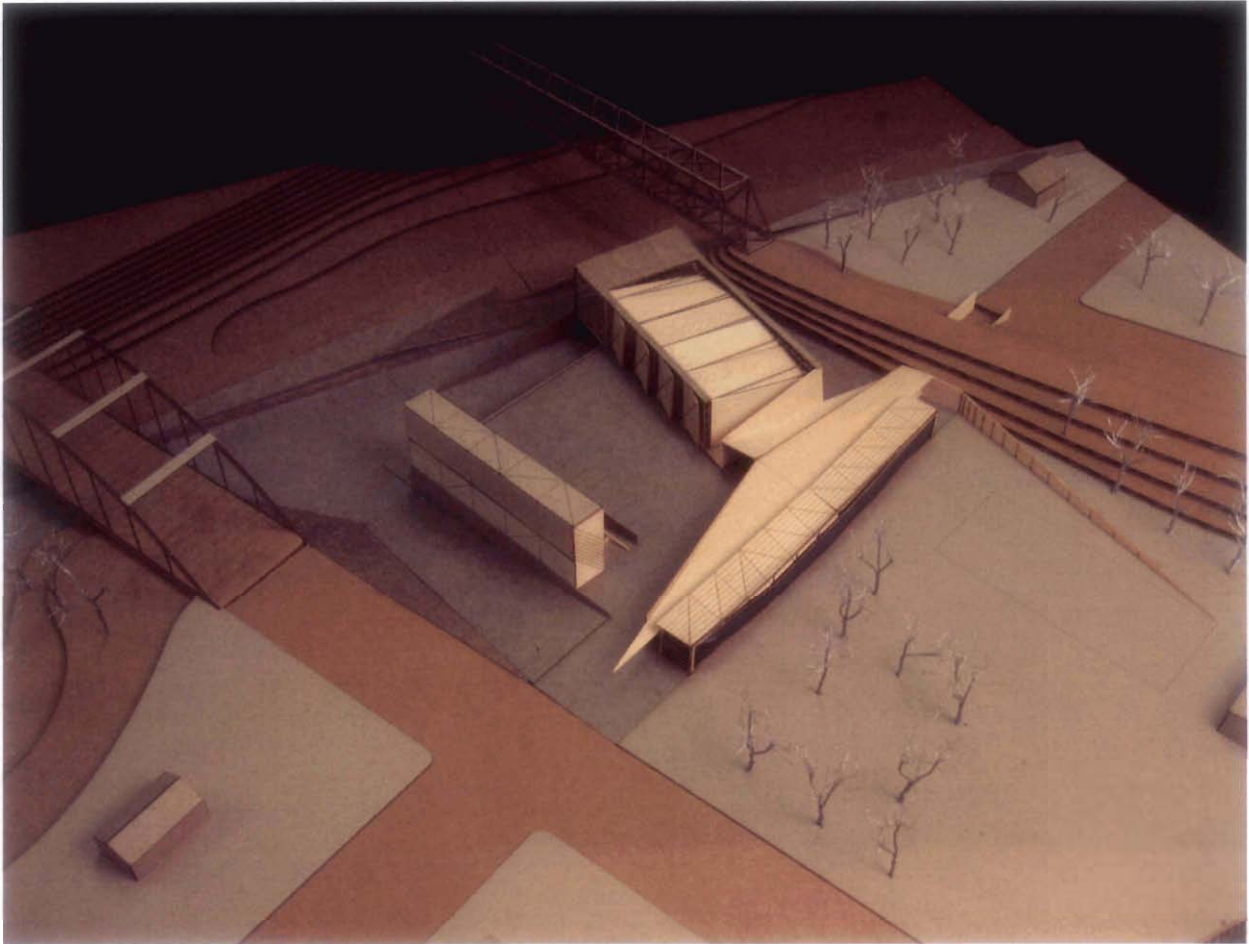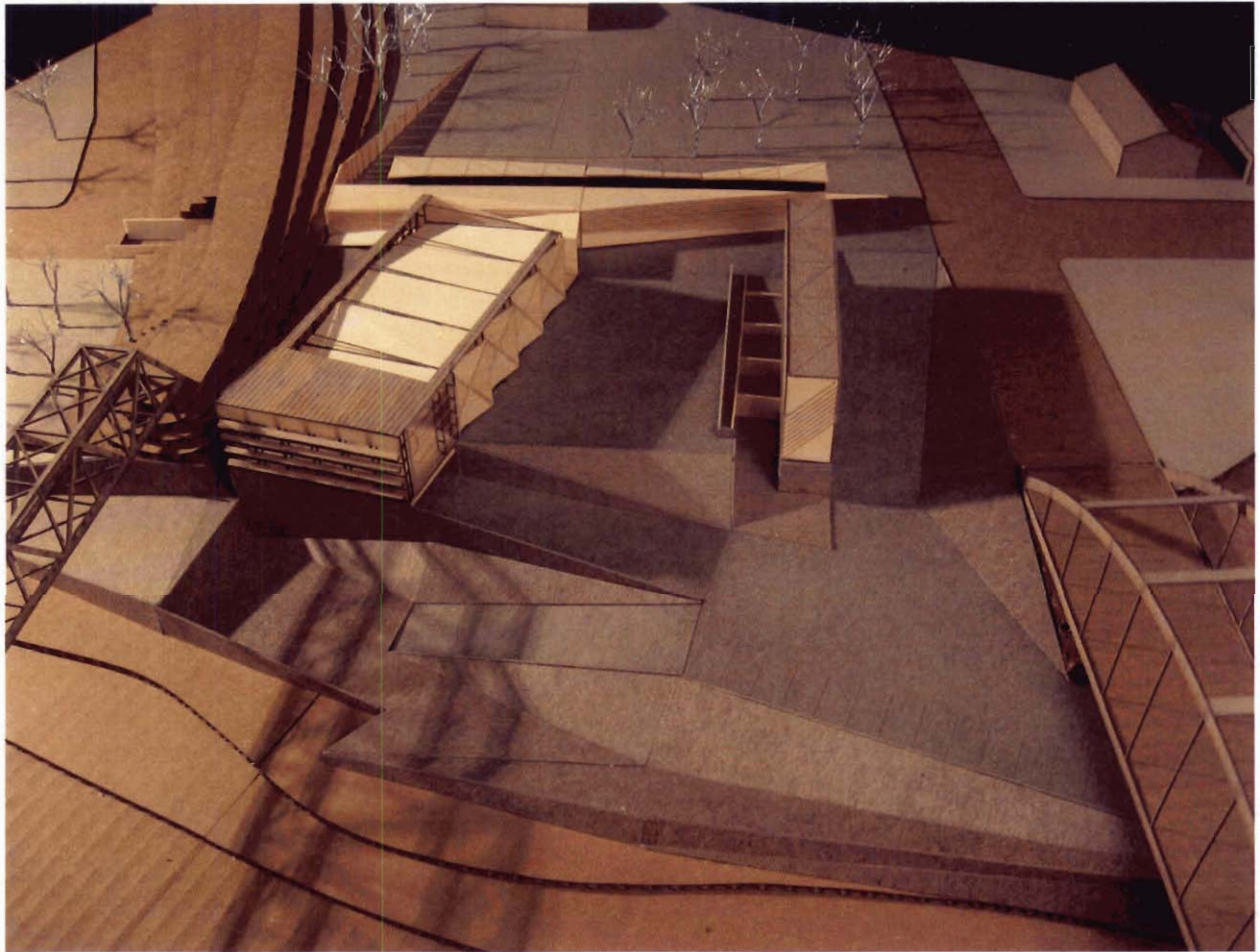
This thesis exploration into the way that kinetic architecture can activate and transform space based on programmatic and environmental forces opens up new potential for the field of architecture. Space does not have to be limited by static forms. Architecture beckons to be like a living/breathing organism that is as adaptable as the environment it lives in.

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Image Credits

FIG 1.b - Anuradha Mathur and Dilip da Cunha, Mississippi Floods (New Haven: Yale University Press, 2001) 23.

FIG 1.e - Snohomish County Public Works: Surface Water Management Division

FIG 1.f - Snohomish County Public Works: Surface Water Management Division

FIG 1.g - Snohomish County Public Works: Surface Water Management Division

FIG 1.h - Snohomish County Public Works: Surface Water Management Division

FIG 1.i - Snohomish County Geographic Information System

FIG 1.j - Snohomish County Geographic Information System

FIG 1.m - University of Washington Archives

FIG 1.n - Seattle Public Library Sanborn Map Collection

FIG 2.c - James Corner and Alex S. MacLean, Taking Measures Across the American Landscape (New Haven: Yale University Press, 1996) 101.

FIG 3.a - Johann Wolfgang von Goethe, Scientific Studies (New York: Suhrkamp Publishers, 1988)