roof gardens
a study of the senate avenue parking facility
emily roberts may 2000
roof gardens

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la 404 comprehensive project
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may 2000
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I would like to thank my parents for being the most influential people in my life. It is because of you that I have come this far in my education. Thank you for always believing in me and for teaching me to believe in myself.
Inflated land prices often make the creation of green spaces unfeasible in an urban setting. Rooftops comprise hundreds of acres of potential green space that are currently being ignored. This inefficiency of spatial utilization is creating deserts of hardscape that leave a void in the human need for interaction with nature.
Indianapolis, along with many major urban centers in the United States, has the potential to become a more environmentally friendly and inviting area. Developing roof spaces as gardens is one step that can be taken toward fulfilling this potential. Because of the cost of retrofitting existing buildings to support a garden, these developments are often unfeasible.

Parking facilities are logical sites to consider as possible roof garden areas, due to their high load bearing capacity. The Senate Avenue Parking Facility, located at 220 North Senate Avenue in Indianapolis, Indiana, is the site for which I have designed a roof garden. This location has unique access and proximity to existing city buildings and attractions.

The theme running through the garden's design is one that brings visitors in touch with the natural heritage of Indiana. The Indiana Historical Society, located just west of the site, is linked to the garden visually, as well as thematically. Areas for relaxation, movement, visual and intellectual stimulation, have all been provided for.
significance of the study of roof gardens

In the upcoming century, landscape architects are going to deal with more reclamation projects than ever before. Rooftops are valid areas that should be recognized as areas to be reclaimed. As urban densities continue to increase, there is going to be an increased need for more green space. By utilizing rooftops, the need can be fulfilled without paying the inflated prices of city land.

Green Laws, that are currently being upheld in Germany, require the replacement of green space for every square foot that is consumed by the development of hard structures. This kind of legislation is improving the quality of life and the environment in the European country. Hopefully, the increased understanding and acceptance of roof gardens from their success will filter to the United States. This will enable laws to be passed here that will require the development of roof gardens when a new building is constructed. As landscape architects, it is our responsibility to improve the public’s awareness of the possibilities and benefits roof gardens offer.

Pollution created by city life is a constant strain on the environment. By increasing the amount of vegetation in the urban area, some of this pollution can be filtered. Also, by having more green space available within a short distance of commuters and residents of the city, they will be less inclined to use an automobile to reach and open space.

The energy needs of buildings that consume natural resources, as well as economic demands, can be limited by the addition of plant material to a roof. The vegetation creates an insulating effect for the roof.

Landscape architecture is a commonly misunderstood profession. Due to the large range of work done by landscape architects, many people are unclear of the significance of a landscape architect. By creating a roof garden in an urban space that is accessible to the public, it will become an example to the public of one of the aspects of the profession. By providing a need and appreciated amenity for a city, landscape architecture will also be viewed as a needed and appreciated profession.
The use of roof tops as garden locations has existed for over 6,000 years. The ancient ziggurats of Mesopotamia, and the Hanging Gardens of Babylon, are examples of some of the first roof gardens created. There is a greater need today than ever before to utilize this ancient practice. With increasing land prices, a rising population, and increasing levels of pollution, roof spaces need to be valued for the potential they hold for providing green spaces in urban centers.

During the fall semester of 1999, I was able to travel to Boston, MA, to attend the centennial celebration of the American Society of Landscape Architects. During my stay in the city, I visited many sites. One of my favorite experiences was stepping onto the rooftop of an apartment building in the North End of Boston. From this viewpoint, I could enjoy panoramic vistas of the skyline and the harbor. It was this occasion that sparked my interest in the study of roof gardens.

This project recognizes the current inefficiency of spatial utilization within an urban setting. Acres of undeveloped land are among our city streets, hidden on the rooftops of office buildings, parking structures, and residential dwellings. These sites present opportunities to improve economic, aesthetic, and environmental conditions in the cities of today. Of the existing roof sites in cities, parking facilities represent a category that has been engineered to sustain a heavy load. This characteristic increases their feasibility for supporting a garden development.
introduction

The site selected for the roof garden is the top floor of the Senate Avenue Parking Facility. It is located at 220 North Senate Avenue, in Indianapolis, IN. The garage is five floors high, with a detailed exterior. This site is a prime location for a roof garden development due to its proximity to the downtown business area, local attractions, and unrestricted views of the skyline.

As a theme for the site, I have chosen to represent the natural regions of Indiana. This theme relates the garden to an adjacent building to the west, the Indiana Historic Society. The regions are representative of how the land appeared before western advancement. The garage is a north-south oriented rectangle. Interpreting this shape as the state of Indiana, the regions have been located on the site according to where they appear on the state.

The riverine system is also represented in the design. It acts as the main circulation system. Paths have been placed on the site as they are actually located in the state. A secondary circulation system has also been included to resemble the grid pattern of roads across the state. The paths are narrower than the rivers, and offer a different experience of the garden.

A stylistic approach to representing the natural landscapes has been taken in order to adhere to the specific needs of a roof garden. A low maintenance garden that would add a minimal amount of weight to the structure has been designed. Signage has been included in the design to aid the visitor in interpreting and learning about the natural heritage of Indiana.
introduction

definition

A roof garden:

Is a planted open space

Provides human enjoyment or environmental enhancement

Is separated from earth by another structure

benefits:

environmental

plant material:
filters air, absorbs runoff

economic

\(\downarrow\) energy needs, \(\uparrow\) property value

aesthetic

creates place to be enjoyed physically and visually

psychological

allows for a connection with nature
Site Analysis

Senate Avenue Parking Facility

The senate avenue parking facility has many qualities that make it an optimal location for a roof garden pedestrian access

Pedestrian access is granted to the structure through welcoming entrances located at three of its four corners.

There is an underground connection to the government center

Strong pedestrian activity currently exists near the site views of city

The garage is located four blocks northwest of downtown Indianapolis, and offers unobstructed views of the skyline

opportunity for public example of LA

This site will be accessible to the public, is visually accessible from taller buildings in the downtown area, and offers a great opportunity for gaining recognition for the profession of landscape architecture

in proximity to many attractions

A variety of user groups are already drawn to the area by a wide variety of attractions in close proximity to the site

View looking northeast at the parking facility from the canal
Access

There are four areas that grant access to the top level of the facility. Three of the four are equipped with elevators. The entrances to the site are welcoming, and not typical of many parking facilities. In addition to the street level entrances, the southwestern corner entrance is attached to the government center via an underground tunnel.

Signage

A signage system exits for the city of Indianapolis that indicates points of interest in the area. Also, the canal has a signage system of its own. By including the roof garden on these signs, awareness will be created for the public. Also, by using design elements on the roof that can be viewed from the street level, attention will be brought to the garden.
The drainage system currently being used by the facility can be retained for the garden. Flow must be directed toward the existing seven drains. The central area of the garage, which is currently the ramp location that allows for automobiles to gain access to the site, will be brought to the same, relatively level grade as the rest of the surface.

Proper materials will compose the necessary layers to supply proper drainage for the roof garden. This issue is discussed in greater detail on page 62.
I estimate that this level of the parking facility holds an average of 990,000 lbs. of automobiles a day. I came up with this number by multiplying the number of parking spaces by the average weight of a car (3,000 lbs.). After speaking with a structural engineer, Tory Emery, I was assured that my design would not harm the structural integrity of the facility. The load that it was engineered to sustain is justification for its ability to support a roof garden.

The parking facility is a composition of columns, beams, and a reinforced six inch concrete slab. The heaviest of objects should be placed directly over columns and beams.
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<tr>
<th>Material</th>
<th>Weight</th>
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<tr>
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<tr>
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<td>145 lbs/ft³</td>
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<tr>
<td>gravel</td>
<td>120 lbs/ft³</td>
</tr>
<tr>
<td>Grodan planting medium</td>
<td>25 lbs/17 ft²</td>
</tr>
<tr>
<td>(for shrub border)</td>
<td></td>
</tr>
<tr>
<td>Top soil</td>
<td>3850 lbs</td>
</tr>
<tr>
<td>(for shrub border)</td>
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</table>
Roof gardens are unique in the fact that they are often more exposed to the effects of wind and sunlight than sites located on the ground.

The Senate Avenue Parking Facility's top level is five floors above the ground, making it susceptible to wind currents. The Indiana historic Society, located just West of the site, does little to shield the site from these currents.

The site is exposed to full sunlight throughout the day. Elements will need to be included in the design to create comfortable micro-climates for year round use.

Wind currents pass above and below the garden level. This will make plants more susceptible to low temperatures than if they were planted in the ground. A layer of insulation separating the plantings from the supporting concrete slab helps to protect them from freezing temperatures near their roots.

Wind screens will block wind flow for a distance of ten times their height.
site analysis

Views

View looking east from edge of the roof. A buffer will be provided here so that users are kept away from the edge, which will screen the views of the parking lots.

View looking east from middle of garage roof. This is an example of the attractive views offered from the center of the site.

View looking west at Indiana historical society. This offers a visual connection to the canal and the historic society, and will be utilized.

The parking facility is located just northwest of the downtown area and offers wonderful views of the skyline. This is a unique aspect that will help make the roof garden a destination.
These are some views that show the character of the areas surrounding the site.
program

goals

To create a garden that is suitable for a roof structure without compromising design

To create an educational and social place to be enjoyed by users of all ages

To represent the natural regions of Indiana

The garden atop the senate avenue parking facility is one that will bring people in touch with nature, landscape architecture, as well as the natural heritage of Indiana. This garden will be inviting to users of all ages, offering spaces and activities that can be enjoyed by a diverse group. By creating a mixture of comfortable microclimates that relate to seasonal changes, the garden will offer enjoyment year round.
program

elements

café
- will draw people in and make the visit more comfortable

play area
- some kind of feature that allows for interaction with children and adults

educational elements
- interpretive signage will educate the public about the regions of Indiana

diverse microclimates
- types of sheltering features will vary the sun and wind exposure in different areas

restrooms/storage
- will allow people to stay for an extended period of time
- will make maintenance of the garden more convenient

intimate spaces
- a variety of social spaces will invite a variety of user groups and sizes.

gathering space
- this will allow the garden to be a versatile, functional space that can be used for gatherings of a large size.
The user group of this site will be diverse. The garden will accommodate the interests of all ages and walks of life. Sitting spaces, microclimates, and accommodations have been included to cater to people of all ages.

During the afternoons of the business week, this can be a destination for people to escape their business or educational environment. During their lunch hour, users will have the opportunity to enjoy the garden and casually dine. Also during this time, school children may visit the site for a learning opportunity. The representation of the natural regions of Indiana is a learning tool that schools should take advantage of.

People who come downtown for a sporting event, shopping excursion, or site-seeing, may also seek out the garden. This destination will offer a relaxing environment that allows for unique views of the city. The canal, often times already directing this user group, is located along the western edge of the parking facility.

Special events will also attract a variety of users. Whether it be a gathering that is waiting for the fireworks to begin, or a small musical attraction, this site can accommodate many activities.
land regions

Northwestern moraine
Grand prairie
Northern lakes
Central till plain
Black swamp
Southwestern lowlands
Southern bottomlands
Shawnee Hills
Highland Rim
Bluegrass

Riverine system underlain
The concept for the design addresses the ten natural land regions existing in Indiana, as well as the riverine system. The regions are to be located on the garage, as if it were the state of Indiana. Therefore, when the riverine system is located according to its pattern across the state, natural borders will be created between most of the regions. The natural regions that make up the state of Indiana are: Northwestern Moraine Region, Grand Prairie Region, Northern Lakes Region, Central Till Plain Region, Black Swamp Region, Southwestern Lowlands Region, Southern Bottomlands Region, Shawnee Hills Region, Highland Rim Region, and Blue Grass Region.

A gathering space has been planned for the center of the site, terminating on the northern end with a café. The central location gives the visitor the experience of walking through a represented natural region from any one of the entrances. I estimate that the majority of the users will enter from the southwest corner, due to its proximity to the canal, and link to the government center. This area is where three 'rivers' intersect, creating an impressive gateway.

A circulation system will be created by using the river system as pathways. Also, grid-like walks will dissect the landscape, representing the roads in the Indiana landscape. Paving patterns and colors will be used to differentiate the two circulation systems, as well as path width and retaining wall style.
**Design Concept**

**Wind screens** will be located in the design. One will be along the western border of the garden, and one will be 120’ to the east. The western wind screen will be twelve feet high, in order to serve protection for a distance of 120’. The second screen is located just before the plaza, to make a more pleasurable space. These screens will allow views through them.

A **visual Buffer** is needed on the eastern border to inhibit views of the unattractive parking areas just east of the garage. These parking lots are at ground level, so if visitors are kept a moderate distance from the edge, and not given the ability to look over it, there view of the ground will be screened and directed toward the skyline.

**Alternative materials** will be used to represent the natural regions of Indiana. This is to lower maintenance, represent the regions in a stylistic fashion, and to represent them in a uniform manner. Also, many species that occur naturally in different areas of the state would not survive the harsh conditions of the roof environment.
This is approximately where the regions are located in the state of Indiana. The void in the center is space allotted for the plaza.

This is a representation of the major rivers across Indiana. They will act as the circulation system through the site. The black lines are pathways that represent the roads across the landscape.
master plan

Northwestern morainal
Southern bottomlands
Southwestern lowlands
Central till plain
Bluegrass
Shawnee Hills
Highland Rim

north

Emily Roberts  Landscape architecture final comprehensive project  2000
The Shawnee Hills Natural Region ranges from a karst landscape, to the rugged terrain of the Knobstone Escarpment. Sinkholes perform the task of supplying water to the life that exists below the surface topography. The limestone bedrock has been fractured and dissolved, to create underground caves. Sinkholes are also important in shaping the landscape, by eventually becoming plugged, and creating a pond or swamp.

The Knobstone escarpment section has the most rugged and dramatic elevation changes in the state of Indiana. This area has the largest Siltstone glades found in the state. These glades are natural clearings in the forest with a substrate of siltstone or other rock. These areas usually top steep slopes with a near level surface.

To represent this region, I created concave features that symbol the sinkholes. These elements will also have a blue spiraled sculpture in the middle of them, to depict the water funnelling down to the hidden landscape below.

The steep topography of the Knobstone section is seen through mounds, with flat stone caps atop them to symbolize the glades.
A large part of the Bluegrass Natural Region is defined with hilly topography and dense, forests. Cliffs are rare in this region, and streams commonly drape the valleys. In this area, as many as a dozen different trees can dominate a stand. Some dominants include American beech, white ash, sugar maple, and red oak.

To represent this region, I created the hill topography by mounding high density foam, and filling the landscape with elevation changes. An evergreen groundcover will be the top layer of these features. A blue stream of metal will snake through some of the valleys in order to symbolize the common streams in the region.

The forests are depicted by using tall, aluminum pipes to represent the vertical element of trees. A variety of colors will be used to emphasize the variety of tree species dominant in the region.
The Shawnee Hills Natural Region is composed primarily of sandstone and limestone cliffs. These massive vertical and near-vertical statues of bedrock have served as shelters for prehistoric Indians, settlers, and wild animals throughout history. Many members of the fern family have found there home on these walls as well.

I represented this landscape by dissecting a cliff, and placing it in a lawn. Half of the cliff is limestone, and half sandstone. Some evergreen vegetation has been placed in hidden planters to represent the fern that naturally grows. A stone veneer has been placed over a skeleton to minimize the weight brought to the roof structure. The design also helps to direct views, and create a dominating scale of nature.
The Southwestern Lowlands Natural Region is characterized by windswept sand dunes, modest hills with wide valleys, marshy forests, and prairie. The sand areas are located along the banks of the Wabash River, were tall grasses and drought loving wildflowers. The southern section of this region was not flattened by glaciation. Upland and flatwood forests, as well as prairie cover the landscape.

I chose to represent the mostly barren sand ecosystem along the Wabash by creating ‘dunes’ with a material that resembles the color and texture of sand. These will run parallel to the river, as the region does. A topographical progression from south to north will symbolize the affect glaciers had on part of this region. Forests will be depicted with the same style as other regions, aluminum pipes.
The southwestern bottomlands Natural Region is characterized by bottomlands forest and swamps. The climate of this area resembles that of the gulf coast, as opposed to the Great Lakes. Frequent flooding of rivers are the lifeblood for this ecosystem. One of the distinctive features in this region are the stands of bald cypress and swamp cottonwood that reside in the plentiful swamps.

To depict this region in the roof garden, a swamp is symbolized. Blue fescue is used to represent the water and humid atmosphere. This plant is hardy and evergreen. Aluminum pipes that flare out at the bottom give the form of the bald cypress. Other pipes are common to the rest of the garden, and represent the other trees indicative to the region.
This natural region is part of a larger region that at one time covered one third of North America. This region is a relatively flat landscape, blanketed with tall grass prairie. Common grasses were big bluestem and prairie cordgrass. 

"Everywhere, as far as the eye could read, there was nothing but rough, shaggy red grass, most of it as tall as I....As I looked about me I felt the grass was the country, as the water was the sea. The red of the grass made all the great prairie the colour of wine-stains....And there was so much motion in it; the while country seemed, somehow to be running."

Willa Cather, My Antonia (1918)

To represent the grassy plains, I have included Eastern Gamma Grass, Switchgrass Little blue stem, and Indiangrass. The vegetation is planted in rows, separated with strips of rock. This north-south alignment will emphasize the east-west motion of the grass from the wind. Pieces of sculpture are between the planted strips that will also react to the wind flow. Also, these sculptural elements will represent the grass during the period of the year that the grasses have been cut back.
The Central Till Plain Natural Region is the largest natural region in Indiana. It was covered by the last glacial period, and largely reshaped. What is seen today is a gently undulating landscape. At one time it was thickly covered in forest, but today agricultural development is the common cover.

For my design, I represented the region as it was before the advancement of western expansion, while forests still blanketed the landscape. Once again, high density foam has been used to form the undulating forms, and spreading vegetation covers them. Aluminum 'trees' represent the once plentiful forests.
The Black Swamp Natural Region, which extends further eastward into Ohio, is an extremely flat land, contrasting from its undulating surroundings. Clays and siltloams, having poor internal drainage, line the bottom of the swamp. The dominant species in the thick, forest swamp are American Elm, black ash, red maple, and silver maple. Today, much of the region has been drained for agricultural purposes.

For the representation of this region on the roof, back river rock is used to symbolize the water. Vertical aluminum pipes, as well as 'fallen' aluminum pipes are used to represent the tree cover.
The Northern Lakes Natural Region is a combination of forests, prairies, lakes, marshes, and bogs. This diverse ecosystem once provided great sustenance for Native Americans. Today, much of the water that once created this web of landscapes has been drained for agricultural purposes.

I have represented the landscape that existed before European advancement. I chose to include areas of wetland, bog, and forest. The wetland representation is located on the southern border of this area. Blue stones will represent the water, with small pockets of vegetation.

Further back, a ribbon is used to symbolize the bog ecosystem. A structure is used that 'hovers' over the blue rocks beneath it, with English ivy growing amidst it. As bogs float on the water beneath them, this landscape will seem to float above the 'water' below it.

The forest area is placed to form a backdrop to the other sections. These forests will have red, white, and black pipes to represent the tree cover. This is due to the fact that the dominated species were red, black and white oak.
The Northwestern Natural Region is the smallest region in the state, located in the northeastern corner. The most unique characteristic of this region are the great sand dunes. Winds off of the lake sweep across the sand, creating beautiful patterns with the tiny particles.

In order to represent this region, a dune-like structure has been covered with a material that is stationary, yet appears as sand. Ripples have been made in it to mimic the effects of the wind. Small pockets of vegetation have been included to symbolize the immense variety of vegetation found in the area.
The plaza is centrally located in the design. While traveling to the space from any of the entrances, a user will have to experience at least one of the ten represented natural regions. Another reason for locating the plaza at the center of the site is to create the atmosphere of being surrounded by vegetation. This will strengthen their connection to nature, which usually suffers in an urban environment.

A café is located on the northern end of the space. This structure also includes restroom facilities, an indoor eating space, and storage space for equipment. This space is created for passive and social activities. Paving patterns, comfortable seating, and moving water create a space to be enjoyed.
The plaza is oriented in a north-south direction, with views being directed toward the east, to the downtown skyline.

Water features that also perform as view screens, help frame the view of the downtown area.

Five terraced areas offer seating and viewing areas, facing an eastern direction.

A row of honey locust offer shade to create a more comfortable environment. They also are located to screen some of the westerly winds. In addition to the trees, a glass wind screen has been included on the western border of the plaza, following the contours of the terraces.
Four common stones occurring in the Indiana landscape are represented in this area. Granite, shale, sandstone, and limestone are displayed as a part of the water features, and in the paving pattern. The stones are ordered in a progression from dark coloring to lighter. They are surrounded by a neutral paving material to emphasize the change in coloration. Also, grass cell is used to create turf areas that break up the hardscape.

The structural layout of the parking facility dictated where many of the elements have been located. The stone boulders are directly placed over columns, as well as the trees. The terraces are centered over beams, in order to best support their weight.
This element of the design creates movement, directs views, and educates the public about the various types of stone found in Indiana.

Interpretive pavers that supply information about the stone being represented.

Emily Roberts  Landscape architecture final comprehensive project  2000
Alternative Representations of Regional Landscapes

Due to the limited growing conditions available on this site, a variety of materials are used to express vegetation and water. Many of the species that are found in the natural regions depend on the unique micro-climates occurring in a specific area. Recreating a climate for the success of many of the species that should be included to represent the regions is impossible. Therefore, to create coherent, low maintenance, lightweight garden, I am using a stylistic representation of the regions.

The trees in the design are aluminum pipes, creating the vertical element in the landscape. The size and colors of the trees will correspond to the species they are representing. Also, slight changes in shape, such as a flare at the bottom to represent the bald cypress, will depict certain species. This use of material will considerably reduce the amount of weight added to the garden.
Alternative Representations of Regional Landscapes

**Groundcover**

To create a unified, low maintenance design that will be interesting year round, two plants are used to represent the majority of the groundcover found in the natural regions. The term 'groundcover', in this case, is referring to the shrubs and herbaceous plants found in the various regions.

Purple leaf winter creeper is used to cover the ground plane in the Highland Rim, Bluegrass, Shawnee Hills, and Central Till Plain natural regions. It grows to a height of eight to twelve inches, so it does not take away from the sculptural topography. Also, it is an evergreen plant, turning a deep reddish-purple in the winter. This variety is not susceptible to winter burn, and can survive in a colder hardiness zone than is present in central Indiana.

English ivy covers the river canopies, and drapes the water features in the plaza. This specific variety is also evergreen, and does well in cold climates.
Alternative Representations of Regional Landscapes

The original prairie existing in the Grand Prairie Region is composed of many grasses that are difficult to contain, and grow to towering heights. For the roof garden I chose species that would grow to an average height of three to five feet, and create an attractive blend of color. These grasses will do well in this environment, due to the fact that they will be exposed to full sunlight, and do not require a lot of irrigation.

Eastern Gamma Grass
Switchgrass
Big Blue Stem
Little Blue Stem
Indiangrass
To create the variation in topography desired for the design, high density foam is used to shape the landscape. This serves two important purposes. First, it greatly decreases the amount of weight that would have been added to the roof if soil were used. Also, it insulates the plant material above it from the cold roof surface during winter.

On top of the foam, a material called grodan planting medium is used to support vegetation. This material is weed free, and also very light weight.
Alternative Representations of Regional Landscapes

**w a t e r**

The use of water in a design requires additional maintenance, and can cause damage to the underlying support structure if leakage occurs. Due to this fact, a minimal amount of water is used in the design. Alternative materials to symbolize water are stone, paving, and plant material. This offers a more creative interpretation of the regions.

River rock

(colored pavers  colored stones  blue fescue)

(used in Black Swamp)

recycled glass

(represents rivers)

(used in Southwestern Bottomlands)
Alternative Representations of Regional Landscapes

r i v e r s

The river system in this design plays an important role of creating a circulation pattern. This makes a creative and functional element of the design. In order to create a 'river' feel, dimensions, colors, materials, and sun exposure were all taken into account.

The river paths vary in width, as actual rivers do. The average span of the paths is twenty feet. A Blue paving pattern has been used to symbolize water. A small ribbon within the river paths is made of colored stone, which more accurately traces the river's path as it appears across the state. Fish, composed of recycled glass, are inlaid in this ribbon. The species of fish will change from region to region, representing the different species found in Indiana.

A canopy, with a curvilinear form that parallels the river, offers shade in many areas along the path. This is to give the river paths the benefit of offering shade and shelter when desired. S grounds, due to the width, meandering path, and comfortable microclimate, visitors will be drawn to this circulation system, as opposed to the 'road' circulation system.
Alternative Representations of Regional Landscapes

stone work

The use of large amounts of stone in a design add to the weight of the design dramatically. Because of this, stone is placed over a column or beam of the structure, or it is created using a veneer of stone. The cliff walls of the Shawnee Hills and retaining walls along the river are made with a light weight skeleton and stone veneer.
Alternative Representations of Regional Landscapes

**signage**

Signage is an important aspect of this design. It is used to convey information about the natural regions and other natural heritage represented. They will also explain what the various elements in the landscape signify.

The majority of the signage is in two forms. One kind is naturalistic, being carved on the face of stone. This type of signage is located along the river's circulation system. The second type of signage is located along the road's circulation system. These are plates laid on the top surface of those retaining walls.

Interpretive signage along the river circulation system

Interpretive signage along the road circulation system
The success of a roof garden depends greatly on its construction. It is a collection of layers, assembled to provide protection for the underlying roof structure, as well as a healthy, safe environment for plants and people. A full inventory and analysis of the structure is the first step in a roof garden design process.

For the site of the Senate Avenue Parking Facility, I have chosen specific materials that will contribute a minimal load, while instilling the garden's integrity. Some of the unique materials in construction are grass cell, Grodan planting media, and high density foam.

The four essential layers necessary for a roof garden are the drainage system, filter fabric, planting medium, and mulch. All of these components must be present in a roof garden, while many alternative materials are available to create each one.
construction

- mulch
- planting medium (grodan planting medium)
- filter blanket
- drainage medium (grass cell)
- protection board (waterproofing)
- concrete slab (6")

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Construction

Insulation

Insulation is a layer of roof gardens that supplies benefits to the underlying building, as well as the above garden. Usually, it provides an additional layer of insulation to the roof that lowers the heating and cooling needs of the supporting building. In this case, the supporting building (a parking facility) does not demand much heating and cooling. The insulation layer protects the plants from cold temperatures that the supporting slab is subjected to. Air can flow under the supporting layer, causing its temperatures to drop below freezing. This is the same concept of bridges freezing before roads do. Usually plant roots are protected by the insulation of deep soil. In this case, a layer of insulation is needed to protect plants from being exposed to freezing temperatures.

Protection Board

A layer is placed between the waterproofing membrane and the above components of the garden. This is a protective board to guard the waterproofing during construction and maintenance. This is a permanent addition to the garden and should be loosely placed on the waterproofing material. Any penetration into the waterproofing layer will ruin its effectiveness. An 8-millimeter polyurethane film has been used in this design.
drainage layer

The drainage layer is a vital element of any roof garden. It creates a system for water to move through the site, without being impaired. The material used must be rot proof and able to sustain the garden’s weight above it. Usually, the existing location and size of drains existing on a roof can be utilized for the design. Flow must simply be directed toward them.

The drainage medium I have selected for this garden is Grass-Cell. This is a honeycomb shaped plastic material that is conventionally used to hold soil for the turf used under vehicles. When this product is turned upside down, it creates a layer for water to move easily through. In addition to this quality, it is extremely light weight. Often times gravel is used as the drainage medium for roof gardens. Gravel weighs 120 lbs./ft$^3$, while Grass-Cell weighs only 6 lbs./ft$^3$. 

(Grass-Cell, protection board, and rigid insulation)
In order for the drains to be kept free from sediment, it is important to include a filter fabric in the design. Small particles in the planting medium, specifically silt, must be filtered out of the percolating water. Filter fabric is used for this purpose. It is placed directly above the drainage medium. This material must be light weight, rot proof, easy to install, and permanent. The standard product used as filter fabric in roof gardens today is made of polypropylene fiber, which resembles felt.
Options for planting media vary greatly, ranging from average, ground soil, to a soilless media. Special light weight soils, silt-free soils, and special soils amended with various nutrients are available. The loss of organic material in soil is a specific concern for roof gardens.

The alternative I chose for a planting medium is Grodan planting medium. This product is made of rockwool fiber, and is often times used in hydroponics. The material is very light weight. The weight of soil necessary to sustain an average shrub border (17ft²) is 3850 lbs. The same area, using Grodan planting medium, is only 25 lbs. When attempting to minimize the weight added to a structure by the garden, this product is a sound alternative.

Grodan planting medium allows water to pass through it easily, creating a well-drained environment. It is weed free, but does not include plant nutrients. Due to this, plant food and fertilizer will have to be added to the beds. Nutrients added to the irrigation system will also supply the vegetation with its needs.

Most of the planted areas in the garden consist of ground cover. These areas need only a depth of 8"-12" of planting medium.
The top layer of the roof garden is mulch. This addition is important for insulating the soil from heat and cold, supplying organic material, and to slow evaporation. This material should be annually maintained in order to replenish the nutrient supply. A depth of half of an inch should be maintained throughout the year.
Roof gardens are going to be an important part of the future of landscape architecture. Everyday, fewer and fewer sites are available for green space development in urban areas. Those sites that are built upon will have to be reclaimed by developing their roofs into pieces of the landscape. This practice has the potential of improving our environment, making the city a more inviting area, and aiding our economy.

The roof garden in this project has successfully been designed to attract a broad user group, educate the public, and provide a work of art for the city. By combining modern art with the natural history of Indiana, the landscape can be viewed from a different perspective. This unique development also allows for people to recognize one of the aspects of landscape architecture. It shows the public the potential that roof sites hold, specifically those of parking facilities, for the development of a landscape.

Creating a successful roof garden takes a lot of planning and consideration. All sites are different and will require specific needs. No standard design can be applied to these intricate puzzles. Although this is true, roof gardens do have similar needs. The four essential layers consist of a drainage layer, filter fabric, planting medium, and mulch. The prime goal is to create an environment that will be able to sustain the needs of plants and users, without compromising the condition of the supporting structure. My design has achieved this goal.
bibliography

Design Theory


Significance of Roof Gardens


Design and Construction


bibliography


http://www.roofmeadow.com/roof6.htm

http://www.zinco.de/evorteil.htm

http://www.nyarm.org/jan99/0115.htm

http://ecosci.com/hydroponics/

http://greenwonder.com

Case Studies


bibliography

Natural Regions of Indiana:

Deam, Charles C. Grasses of Indiana. Indianapolis: Indiana Department of Conservation, 1929.


Plants:

