

**Light in the City**

Kavita Srinivasan  
B.A. Brandeis University, 1998

Submitted to the Department of Architecture and the Department of Urban Planning in partial fulfillment of the requirements for the degrees of **Master of Architecture** and **Master of City Planning** at the Massachusetts Institute of Technology

June 2002



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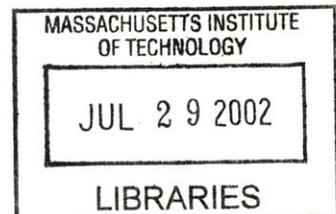
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*fig. 1 (title page) early sketch*

*fig. 2 early collage on expressing ideas of light in the city*

## **Abstract**

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This thesis focuses on enhancing the awareness of light for the pedestrian, and using light as a way of revealing the structure of the city and its relation to the cosmos. It proposes that aesthetic qualities of light inform the design of urban public space.

The qualities of light investigated in the thesis are inspired by artists, architects and public spaces. The proposed qualities combine with the existing vocabulary of light to produce a design proposal unique to the site.

The design proposal is used to reflect on existing light regulations for cities like Boston.

The site for this exploration is a dense urban strip in downtown Boston.

Thesis Co-Advisors: **William Porter**  
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fig. 3 collage depicting site: boston commons (left) to south station (right)  
 Except where noted, all the images in this thesis were produced by the author. See Bibliography for Figure Sources.

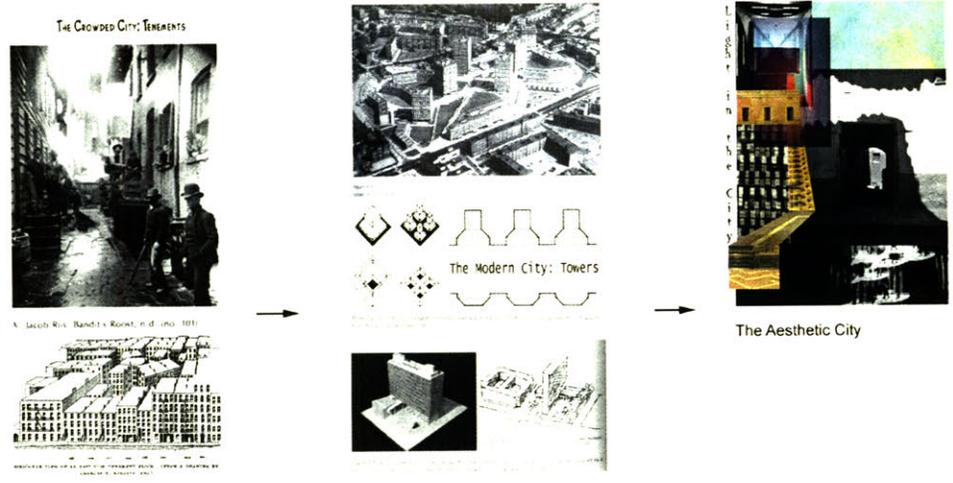


fig. 4 diagram showing evolution of light in the city

## **Introduction**

Consideration to light has always been a factor in shaping the urban built form. Although cities have regulations that safeguard the *quantity* of light received in public spaces, they do not provide guidelines for the *quality* of light.

This thesis looks at applying a greater sensitivity to the aesthetic qualities of light in urban public spaces, drawing inspiration from art, architecture and existing public spaces. The thesis proposes that the current approach to providing light in urban spaces is limited, which consequently limits the experience of light. The uniform treatment of these spaces by light regulations does not recognize the potential for the rich, sequential experience of urban spaces.

Designers can do more than provide sufficient light; they can orchestrate the city light to choreograph a joyous urban experience. This thesis aims to enrich the pedestrian experience in urban spaces by increasing the awareness of both light, and the structure of the city - in relation to itself as well as the larger cosmos.

"Perhaps the future role of the artist will be to act directly as the arbiter of qualities in our lives. Quality not as an add-on, as it is now, but as criteria in all matters of planning." - Robert Irwin<sup>1</sup>

fig. 5 *Untitled, Robert Irwin, 1968*

### **What about light in the City?**

Light is one of the few remaining ways for people living in urban environments to keep in touch with nature. Even this may be denied in parts of highly dense cities like Boston and New York, where light is not readily available. Currently, cities have established quantitative goals and criteria to safeguard the public's access to light. This thesis looks at expressive aspects of light in the city. It aims to establish an artistic agenda for the provision of light using downtown Boston as a case. The premise of the thesis is that the urban public realm can be improved by considering the aesthetic qualities of light. The emphasis will be on revealing the facets of light, and its relationship to the urban built form, to the users of public spaces in order to enrich the urban experience.

Artists and architects are sensitive to the qualities of light in their work. Quantitative tools are employed in service of known qualitative goals. The same approach is not usually extended to the design of exterior urban spaces. This is not as necessary, or possible, in places where the urban fabric is not dense, and there is ample natural light in the exterior spaces. In densely built areas, there is potential for a high degree of control over the light entering the interstitial urban spaces - and it lies largely untapped. It is an opportunity to carefully choreograph the light to be experienced in these urban 'rooms'.

The scarcity of light increases its value. Cities should harness the light available to them to make the urban experience a joyous one. This thesis looks at applying the same sensitivity given to light in art and architecture, to the urban public realm.

Inspiring this thesis are artists, architects and public spaces that display a powerful aesthetic treatment of light. The study of these works yields specific light qualities that are translated into urban architectural proposals. The design is a process of identifying and inventing appropriate moments and locations on the site where these qualities can be realized. It is then used to reflect on existing codes that regulate light in cities.

<sup>1</sup> Robert Irwin, Cullinan Lectures, Rice University, 1978-88.

## Brief history of Light in Cities

### 1) London

Ref: <http://www.trp.dundee.ac.uk>

"Ancient lights" describes a right to access natural light from windows that have existed for a long period of time. This may be used to limit the construction of adjacent buildings, where they would result in a loss of light. As natural light within buildings came to be more and more valued, the right to light became important, as it was one of the few methods available to control what would otherwise be thought of as reasonable development.

### 2) New York City

Ref: <http://www.darksky.org/ida/ordsregs/usamunis.html>  
<http://www.nyc.gov/html/dcp/html/zonehis.html>  
Midtown Development Project

New York City passed America's first zoning ordinance in 1916.

It was prompted by the criticism of the 42-story Equitable Building, built in 1915 on lower Broadway, which cast a huge shadow on neighboring properties and deprived them of light and air. Concerned that skyscrapers would make cities darker places, the 1916 zoning legislation required that buildings be set back to admit light into the streets.



Hugh Ferriss depicted the consequences of these laws in his renderings. He illustrates how an architectural form can be directly shaped by a piece of legislation.

In 1961, there was major revision to the 1916 zoning ordinance. It introduced the concept of incentive zoning by offering a bonus of extra floor area to encourage developers of office buildings and apartment towers to provide public spaces.

However, the incentive zoning led to the compromise of the quality of many public spaces provided under this scheme. Today, zoning is more sensitive to the unique conditions of each development.



### 3) Boston

Ref: <http://www.southboston.com/town/planning/ch114.html>  
<http://cfa-www.harvard.edu/cfa/ps/nelpag.html>  
The Seaport Public Realm Plan; Boston Redevelopment Authority, 1999.



Like many other cities, Boston's impetus to deal with light and its relation to the urban environment stemmed from concerns for hygiene and health. The modern movement in America saw a transformation of the built form from crowded, tenement-style housing to isolated towers surrounded by park.

A driving force for this was the clamor for light and air, and a demand for cities to be healthier places to live in.

The concern for hygiene resulted in quantitative standards for light. Cities restricted the built form to ensure the *amount* of light that the pedestrian received.

fig. 9 *depiction of tenement conditions*

South Boston's approach to light in urban spaces is evident in the zoning ordinances (effective since August 1, 1999). The city directs its efforts towards safeguarding public welfare primarily by restricting night/artificial lighting; the aesthetic qualities of light in public spaces are not acknowledged.

The strong bias towards night/ artificial light (there is very little or no mention of daylight) reveals the quantitative way in which the city prefers to deal with light. A further look at some of the urban design guidelines for the Seaport<sup>1</sup> shows some consideration to shadows cast by new buildings on a case-by-case basis. Light is treated as a black and white entity – it either exists or it does not. This limited attitude to light also limits the experience of light in urban spaces.

New England has a well-established organization that is an advocate for lighting concerns neglected by the city/state. The New England Light Pollution Advisory Group (NELPAG) is a volunteer group for the purpose of educating the public on the virtues of efficient, glare-free outdoor night lighting. Even in the case of this group, which is devoted to advocating 'good' light in the city, the issues addressed only pertain to artificial lighting (particularly at night). There is no mention of the qualitative aspects of light.

This thesis attempts to apply qualitative criteria distilled from the study of artists, architects and public spaces that have shown interesting and attractive qualities of light, to the design of urban public spaces. This is used to reflect on existing lighting codes.

<sup>1</sup> The Seaport Public Realm Plan; Boston Redevelopment Authority, 1999.

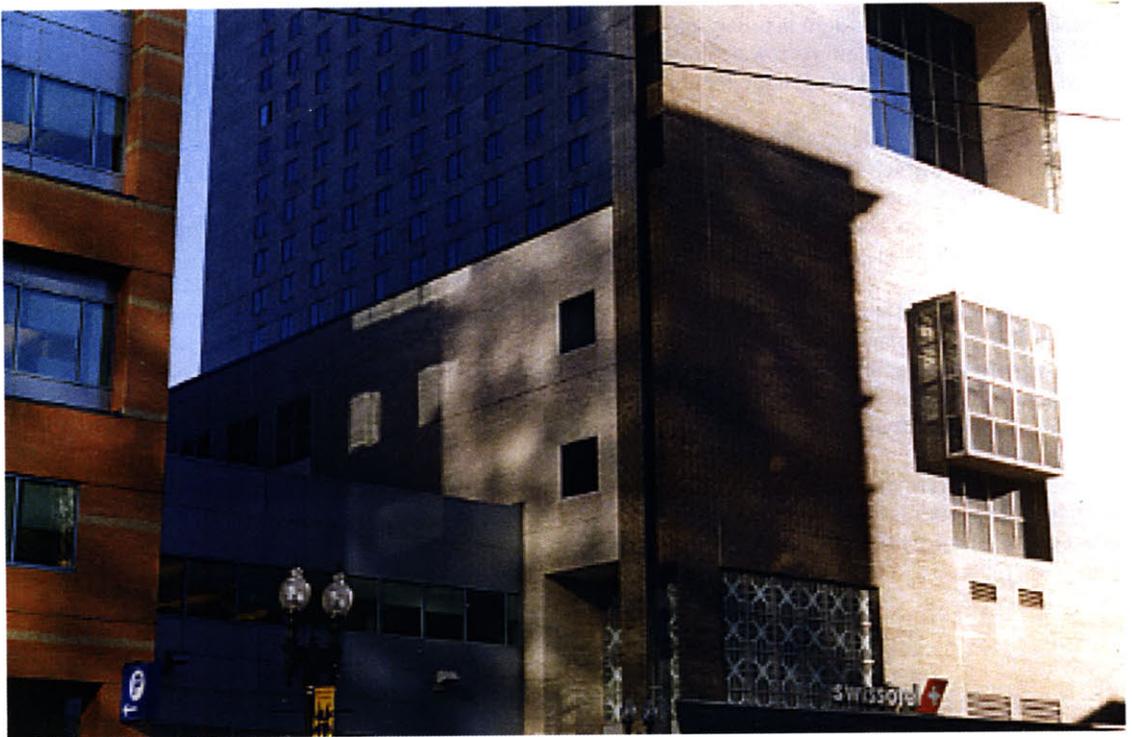


fig. 10 reflections in downtown boston

**Models of Light: Artists**

Cities should consider establishing artistic criteria for light. Robert Irwin articulates this idea clearly in his quote on page 8.

Artistic goals cannot be standardized. They are linked to the specific characteristics of each urban context. Hence, this thesis uses a site in Boston as a way of exploring the idea of establishing artistic criteria for light in urban design.

The following is a list of artists, architects and public spaces that were chosen based on the author's interest in the aesthetics of light they presented. Each entry is accompanied by a synopsis of the light characteristics in their work, and the relevance of their work towards designing for light in urban public spaces.<sup>1</sup>

<sup>1</sup> The author recognizes that the choice of models, due to time constraints, is limited. Further examples might have yielded more qualities of light to incorporate into the design proposal.

**Harry Callahan** – Photographer, USA, 1912-1999



Callahan shows the city as a place of high drama. He creates the aura of a stage setting by making the street surface dark, leaving the viewer in an anonymous, unlit foreground. The facades and frontal view are lit as in a theatre.

To complement the staged effect, light is used to create a dynamic space. The stark, angled, black and white shapes produce strange perspectives and suggest instability. Figures in his photographs are often silhouetted and move silently between large expanses of dark and light, while being tracked by their own shadows.

Shadows are used with edifice to shape the sky and space, thereby creating a street narrative. One is struck by the impression that the movement of people is infinitely linked with the composition of light and sky.

Callahan's images show that the ground itself need not be lit to experience an interesting light quality in a public space.

*fig. 11 Providence, 1969*

**Johannes Vermeer**, Painter, Holland, 1632-1675

The city, as depicted by Vermeer, has a quietude that contrasts with Callahan's portrayal of city spaces. Vermeer uses the same tools to create the opposite effect to Callahan's images: perspective/view and contrast (between light and dark).

The viewer usually faces an orthogonal and frontal perspective that suggests a stable environment. Vermeer's compositions often make use of framed views, through courtyards or gateways, to suggest a narrative and continuity of urban space.

The light in his paintings is even and calm; it does not provoke drama through high contrast and sharp angles like Callahan's images.

Although he uses soft, tonal colors, Vermeer's images are perceived as precise and crisp. His exact depiction of light rivals the perceived precision of photography.



fig. 12 *The Little Street*, 1657-8

**Giovanni Battista Piranesi** - Architectural Renderer, Italy, 1720-1778



Piranesi uses light in tandem with architectural elements to render a place that accommodates monumentality as well as spaces scaled for human occupation. He achieves this through chiaroscuro; the range of grey in the shadows provides an equivalent range of scales in the spaces rendered. Unlike Ferriss's work (following page), Piranesi's drawings do not consist of vast, uninterrupted planes of light and dark. The spaces rendered are more porous; they are broken up into decorated walls and columns that allow light and space to flow between them, making them more habitable.

Light and dark are used as compositional tools to guide the viewer's eye through the image, hence providing a narrative. They also create a hierarchy of the architectural elements by using high contrast to depict dramatic, powerful spaces and a diffuse light to show more prosaic spaces.

Light cuts spaces diagonally, making them more dynamic and dramatic. Yet, the overall effect remains congruent because the direction of light is often in tandem with the architectural composition (eg. being tangential to an arch).

fig. 13 *Mausoleo Antico; State IV, 1761-78*

**Hugh Ferriss** – Architectural Renderer, USA, 1889-1962

The architectural elements in Ferriss's drawings are coupled with large expanses of light and dark surfaces to create an overwhelming monumentality.

Buildings are seen as penetrating into a medium of light; the reverse of light penetrating the building does not occur – making them more massive and uninhabitable.

Both the light and the building in Ferriss's renderings have a solid quality. Light acquires this 'solidity' because of Ferriss's penchant for high contrast over tonality – expressing light as either present or absent.

Buildings fall within a strong hierarchy. This is conveyed by the directionality of light that serves to light only the significant (usually tall) structures while the subservient elements lurk in the shadows. Even then, buildings are only lit partially, leaving the unlit mass to rise infinitely in our imaginations.

The architecture of the buildings in Ferriss's renderings becomes the architecture of shadows. Like Callahan and Piranesi, Ferriss uses the diagonal boundaries between light and shadow to create a dynamic, exciting space.

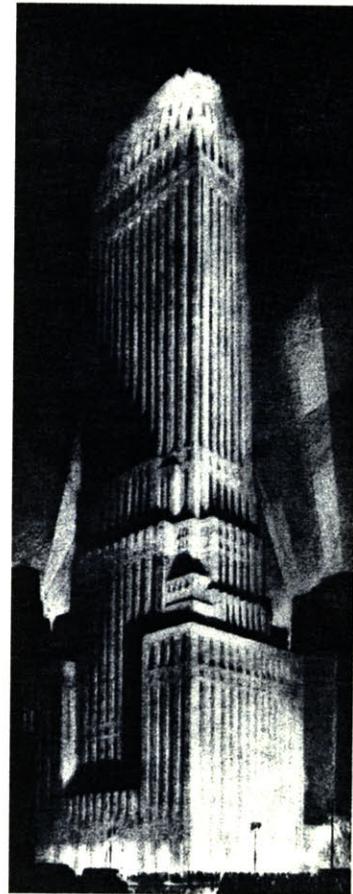


fig. 14 *The Chanin Building*

**Rembrandt van Rijn** – Painter, Holland, 1606-1669

Rembrandt paints light, not objects. The subject of his painting becomes secondary to the light shown. His work is minimal with regard to light, because he uses the least light needed to reveal the intricate details in his composition.

Using warm colors, and prolific tonality to blur edges between lit and unlit areas, he creates an intimacy between the viewer and the subject of the work. The viewer is provoked to peer into the shadows, to discover the rich rendering of textures.

Rembrandt also uses light to move the viewer's eye through the image; this movement through the lit portions usually follows a diagonal path.

The diagonal nature of the path is balanced by the architectural massing.

There is a glow in Rembrandt's paintings that communicates a divine presence.



fig. 15 *Jeremiah lamenting the destruction of Jerusalem, 1630*

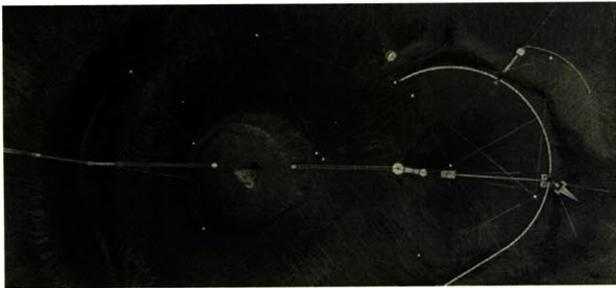
**James Turrell** – Contemporary Artist, USA, 1943 -



Turrell makes objects out of light. He deals with light as a tangible medium. The emphasis is on giving form to volume rather than volume to a form - of revealing light itself rather than using light to reveal surfaces.

Turrell's art focuses on enhancing the perception of light for its audience. It is rooted in the *experience* of the art. He achieves this through the use of color and careful orchestration of light within a controlled environment.

Turrell's light installations glow. This augments the perception of light as a solid.



The Roden Crater project shows sensitivity to larger cosmological lighting phenomena that are linked to the movement of celestial objects.

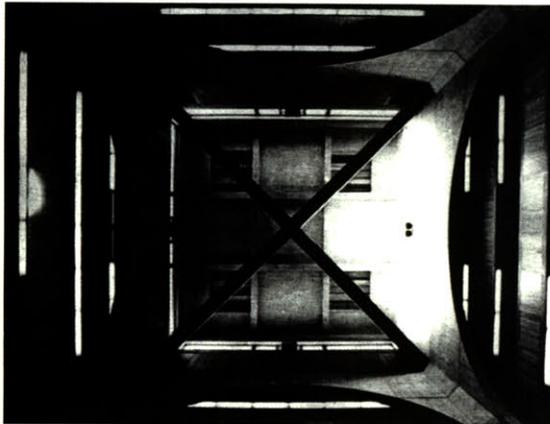
Observers can perceive the connection between their position in relation to the larger cosmos.

fig. 16 *afrum proto*, 1966

fig. 17 *roden crater site plan*, 1992

**Models of Light: Architects**

**Louis Kahn** – Architect, USA, 1901-1974



Louis Kahn uses architecture to explore qualities of light. In his architecture, we see light expressing rhythm and structure, which results in strong, recognizable architectural forms.

Kahn explores direct and indirect light in his buildings. The study of light is coupled with the study of materials, and the expression of one becomes the expression of the other.

Kahn strongly believed that spaces only come to life with the provision of natural light.

*fig. 18 exeter library, new hampshire, usa, 1965-72*

**Luis Barragan** – Architect, Mexico, 1902-1988

Barragan employs a painterly approach to architecture and landscape design. He uses color, light and water to lend a strong, personal aesthetic to the spaces he creates.

In his work, colors *become* forms because of their strong articulation.

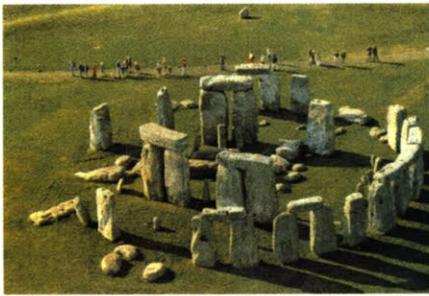
Color is also used to express the beauty of vernacular architecture in a contemporary way.



fig. 19 los clubos, mexcio city, mexico, 1953-64

## Models of Light: Public Space

**Stone Henge**, Wiltshire, UK, Prehistoric, Architect unknown



Although the authentic function of the Stone Henge is still a matter of debate, one thing is clear - it acts as an astronomical observatory for marking significant events on the ancient calendar. It does this by orienting its form as specific responses to the movement of the sun.

**Piazza del Campo**, Siena, Italy, 12<sup>th</sup> century, Architect unknown



This piazza in Siena provides the city relief from its narrow streets and tight spaces. All the roads leading to this opening are tunnel-like, offering only tiny slivers of sunlight, which exaggerate the entry into the expansive plaza. This, coupled with the downward slope of the roads, strengthens the perception of this space as a contained volume. Moreover, there is a feeling of compressed light compounded by the narrow openings onto the square and the warm colors of the paving.

The tower of the flanking Palazzo Pubblico acts as an urban sundial, casting its roving shadow across the plaza and the facades of the surrounding buildings, as the sun moves through the day.

*fig. 20 stonehenge*

*fig. 21 piazza del campo*

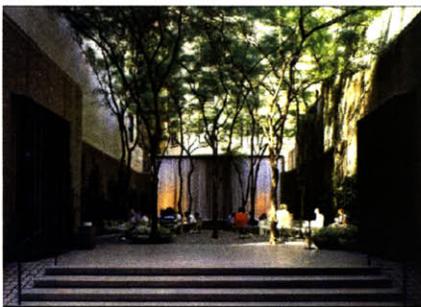
**Subterranean Housing, Matmata, Tunisia, Traditional (undated)**



This urban form responds to the extreme sunlight in Saharan Africa. Both public and private spaces are depressed deeply below ground to avoid direct penetration from the harsh sun. The opening of the pit is just wide for the shadow of the rim to always cast a shadow on the open space below.

The circular arrangement, along with structural advantages, provides even protection against the sunlight, as well as a place for public gathering.

**Paley park, New York, USA, 1967, Zion and Breen**



Paley park is a small oasis located in the midst of Manhattan's dense fabric (East 53<sup>rd</sup> between Fifth and Madison Avenues).

It makes use of water to reflect light into the open space. The surrounding buildings create a shapely view of the sky, providing respite from the unyielding building frontage in this part of Manhattan. The trees enhance the lighting in the square by catching the sunlight in their canopies and reflecting colored light onto the person sitting at ground level. Their slender trunks also create strange wavy shadows on the park paving and building façades.

fig. 22 *matmata housing, tunisia*

fig. 23 *paley park, new york*

## Markets



Markets in many countries have structures that provide shelter as well as light to the pedestrian. In countries of temperate and hot climates, these structures are often screen elements that allow slivers of light to pass through the perforations, but not views. Light acquires a tangible quality that has shape and direction.

Light and material interchange their expected qualities where light becomes the hard, penetrating element and matter (material) gives way to let light pass through. In doing so, the material transforms the nature of the light into a more powerful presence for the viewer.

The images to the left show how the shape of the opening and the choice of material directly affect the quality of light in the space.



fig. 24 *tin roof addition to an existing street in damascus*  
 fig. 25 *a jewellery and fabric shop in rissari, southern morocco*

## Distilling Light Concepts

The study of artists, architects and public spaces yielded the following qualities of light as important characteristics to express in urban design:

<b>Chiaroscuro</b>	Striking contrast of light and dark lend an excitement and drama to the quality of a space, especially with the use of diagonal light. (Ref: Callahan, Ferriss, Piranesi)
<b>Views</b>	Views allow continuity between spaces and a guide to narrative/movement as well as orientation within a space (Ref: Vermeer, Piranesi)
<b>Color</b>	Warm colors with red/earth tones yield spaces that are more intimate and human. Color is also used to express vernacular ideas. The palette of colors is an important way to influence the ambience of a space. (Ref: Rembrandt, Barragan, Turrell)
<b>Intensity</b>	Intensity is used to convey a sense of power when it is strong, or conversely a sense of calm when it is subdued. Intense light is also used to depict special events or places. (Ref: Rembrandt, Vermeer, Turrell)
<b>Shape of the sky</b>	The shape of the sky influences the direction of movement of the audience. Linear slices of sky encourage linear, rapid movement. Open, polygonal sky views impart a sense of stasis and pause. (Re: Callahan, Kahn, Paley Park)
<b>Direction of light</b>	The angle of light and shadow indicate the time of day and year. Significant cosmological events can be perceived and celebrated. (Ref: Turrell, Kahn, Stonehenge, Piazza del Campo)
<b>Light as a solid</b>	When light becomes a tangible medium, it asserts its dominance over matter, and has a powerful and exciting presence for the viewer. (Ref: Turrell, traditional market structures)

### Site Selection

In looking for a site, I was primarily looking for a dense urban setting. After exploring much of Boston, I chose Summer/Winter Street in the downtown area as my site. There are many characteristics which make this a suitable site for an exploration in urban light.

1. It has a high density of buildings.
2. Its orientation is almost exactly South-East -- North-West, which avoids the extreme eastern and western lights.
3. It has a natural progression in topography from the State House to the Fort Point channel.
4. It is anchored on both ends by expansive natural elements; on the north-west by Boston Commons and on the south-east by Fort Point Channel.
5. It houses a variety of scales within its built form. This can provide opportunities for the street to widen into squares and to have a range of 'light experiences' that are defined by their contrast with each other.
6. The commercial and retail activities imply a high level of interface with the public, greater flexibility for the built form, and potential for civic 'events'.
7. It is a linear site (Winter Street and Summer Street) and contains the potential for a sequential experience of design – a narrative.
8. It is pedestrian oriented and experiences a high traffic of pedestrian shoppers and office goes at all times of the year. The large audience warrants dramatic interventions to improve the public space.
9. It has a series of subway stations that provide opportunities to design the pedestrian's first contact with light on emergence from the underground.

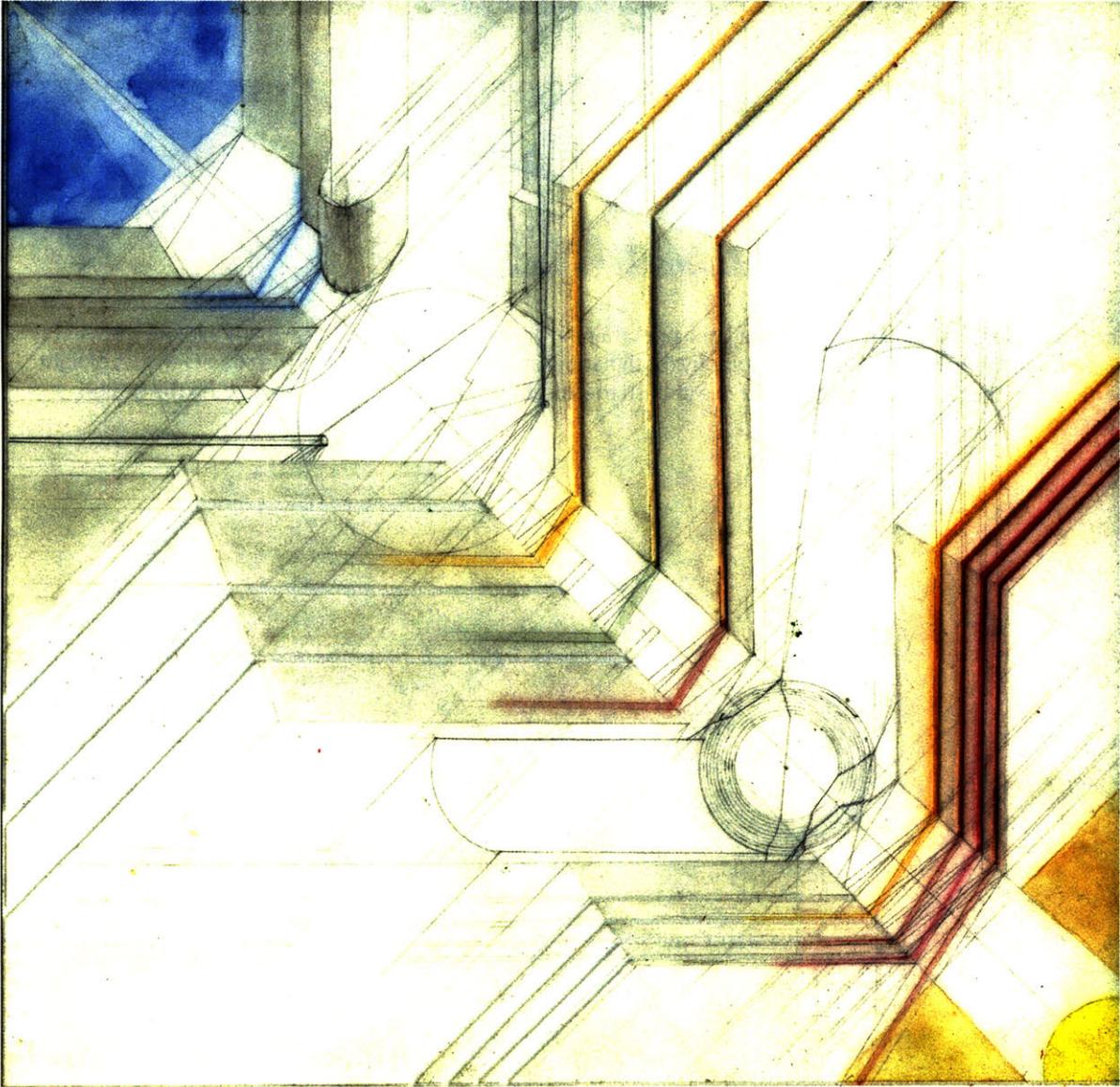


fig. 26 site marked with red line, red circles indicate subway stations, green indicates park, blue indicates water

## Designing for Light in the City

The emphasis of the thesis will be on revealing the facets of light to users of public spaces in the hope that it will enrich the urban experience. The aim is to increase the awareness of light and its relationship with the physical form of the city. This will happen in two ways:

- 1) Consciousness of the internal structure of the city:
  - The design will propose structures at two nodes which will act as orienting markers. The design will afford privileged views of significant city structures to orient oneself in the city. The structures themselves will be lit in ways that suggest their orientation and position in the city.  
Ref: View map (fig. 30 ) showing the existing views, Section of downtown crossing (fig. 69) design, Sketch of towers in South Station area (fig. 79)
  - The design will create light experiences that occur at intervals consistent with city blocks, exposing the rhythm of the city through light. In one location, the rhythm is reinforced by adding an alley.  
Ref: Ground map (fig. 37 ) showing the existing perpendicular intersections of alleys and streets, and the rhythm of the site, Site concept drawings (fig. 27, 88)
  - The design interventions will be a part of a recognizable system consistent throughout the site, yet adapt themselves to the specific vocabulary of their respective locations. The interventions propose varying degrees of change for the existing conditions: from introducing color to redesigning buildings. They also highlight the characteristics of the existing city fabric.  
Ref: Street system diagram (fig. 49) showing the system of surface interventions adapted to three specific locations along the site.
- 2) Consciousness of the city in relation to the cosmos:
  - The design will focus on highlighting the direction of the sun through the use of color, reflection and shadow - and their application in spatial conditions that repeat themselves though the site. This reiterates the movement of the sun through the day at intervals that are in tandem with the rhythm of the city.
  - The design will celebrate the changing of seasons by orchestrating light 'events' at key moments on the site at significant times of the year. These episodes are an expression of the way the built urban form can celebrate its relationship to light and nature.

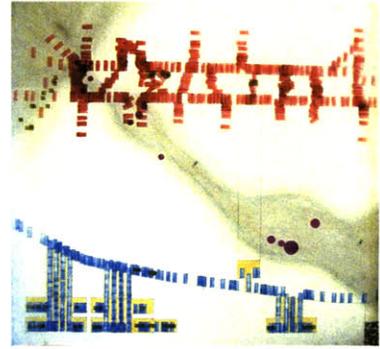
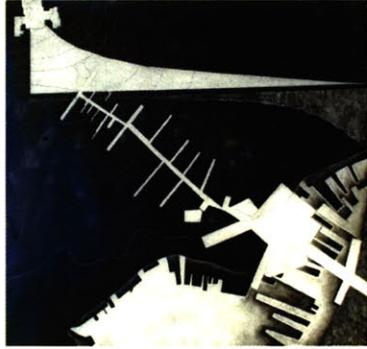
**Mapping Light on the Site**

*fig.27 design concept map (watercolor on mylar, mounted on plexiglass): looking towards fort point channel*



The thesis analyzes selected qualities of light, or pertaining to light, using maps. These maps explore the relationship between the physical geography (both natural and built) of the site and the characteristics of light particular to the site. They are also used to establish the vocabulary of the site, on which to base the design interventions.

*fig. 28 thumbnails of the 6 maps analyzing light on the site: concept, view, shadow, materials, ground and movement*



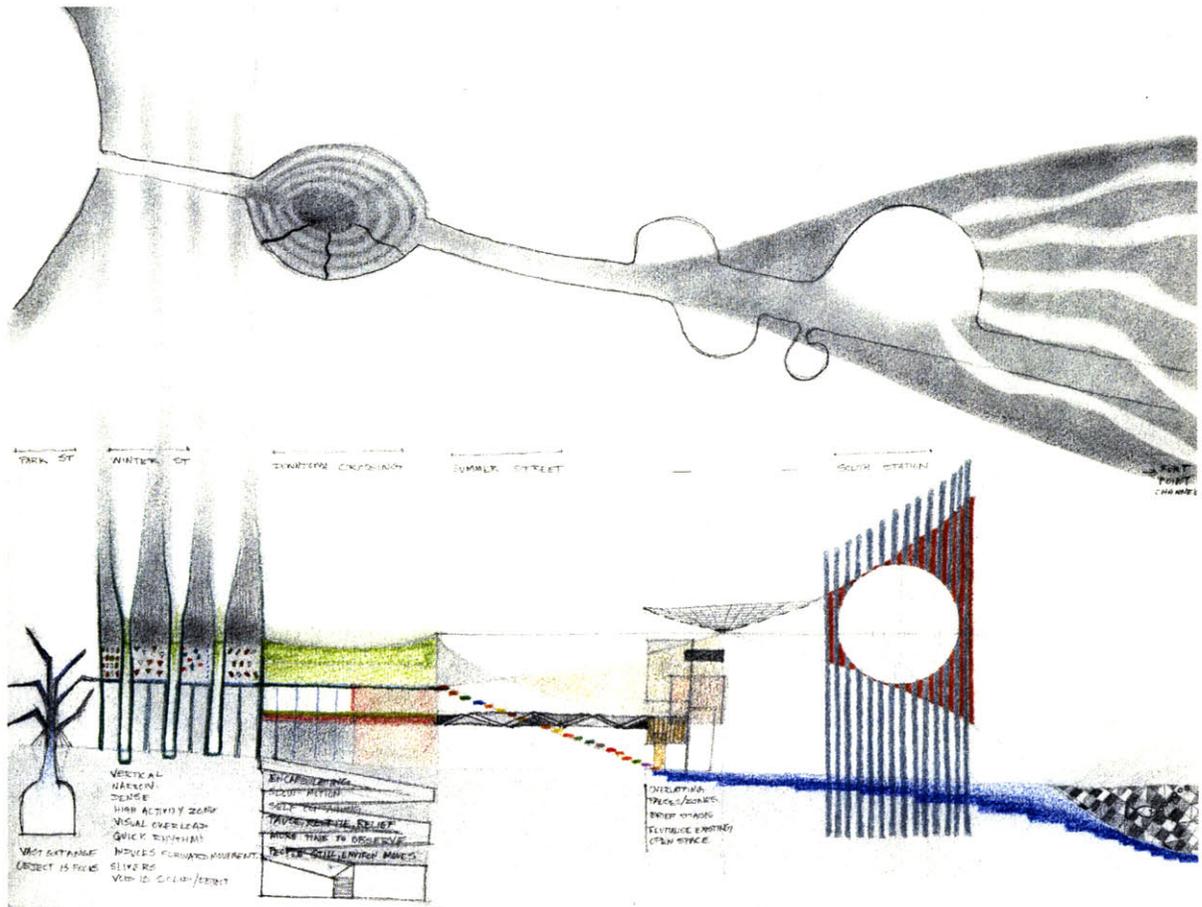


fig. 29 initial concept map for site design

**Concept map (Initial Response)**

The map shows an intuitional response to the design for the site based on the existing conditions. It is drawn with Park station and the Boston commons to the left and South station and the Fort Point Channel to the right. The top diagram is conceived in plan view and the bottom as a section.

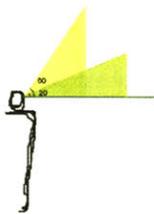
The drawings indicate areas of intensity and repetitive patterns along Winter Street, (Park station to Downtown crossing) which are inspired by the tight conditions, and the alleys that provide relief at irregular intervals along the street. This condition gives way to a more open plaza at Downtown crossing that acts as a container to receive light. The street narrows again, continuing as Summer Street towards the Financial District. It again opens to a wider area in the South Station environs. This open space acts as the inverse of the previous one, directing the flow instead of containing it. The flow splits Summer Street into a fan-shaped series of paths from South Station to the channel.



### View Map

This map shows in plan view, the cone of sight at different angles from eye level for a person standing on the street. The views are at specific moments along the site that currently show interesting views of key buildings, or have the potential to do so.

The spatial composition of the site is implied by the restrictions imposed on the views by buildings at the different angles. That is, the thin slivers of dark green superimposed by wide slivers of light green imply a narrow street canyon of short buildings and a lack of tall building mass, which allows the widening of cone of sight as the view shifts up.



**Key:**

*Dark green -*

Cone of sight at eye level

*Light green -*

Cone of sight at 20 degrees above eye level

*Yellow -*

Cone of sight at 60 degrees above eye level

*Background buildings -*

Key buildings mounted at the back to indicate where views have significance

*Topography Lines -*

Each pencil line represents a 10 foot drop in altitude

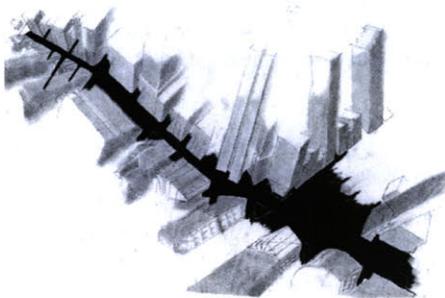
## Shadow maps

The following maps render the ground and facades facing the street as either black or white, depending on whether they receive direct sun or not.

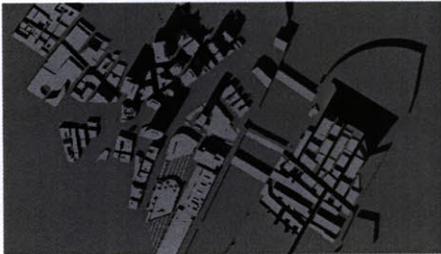
February 13, 1.30 pm - Strange light events: The street is dotted with elliptical lights that are reflections of the sun off windows of a tall building; alleys create white shafts of light across the street.



February 13, 5.30 pm - Most of street is dark at this hour, the drama of light is restricted to the upper sections of the facades of tall buildings that are high enough to catch the low angle of sunlight.



March 21, 2.30 pm (lightscape) - Intersecting alleys/streets cast white beams of light across the site.



June 21, noon (lightscape) - The sun is at one of its highest points during the year, casting very little shadow

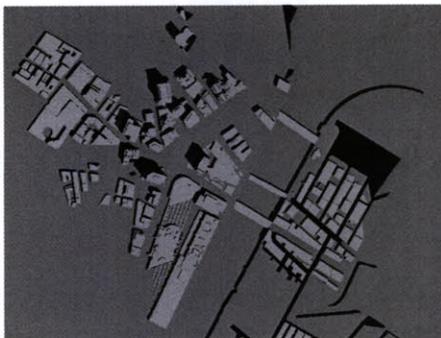
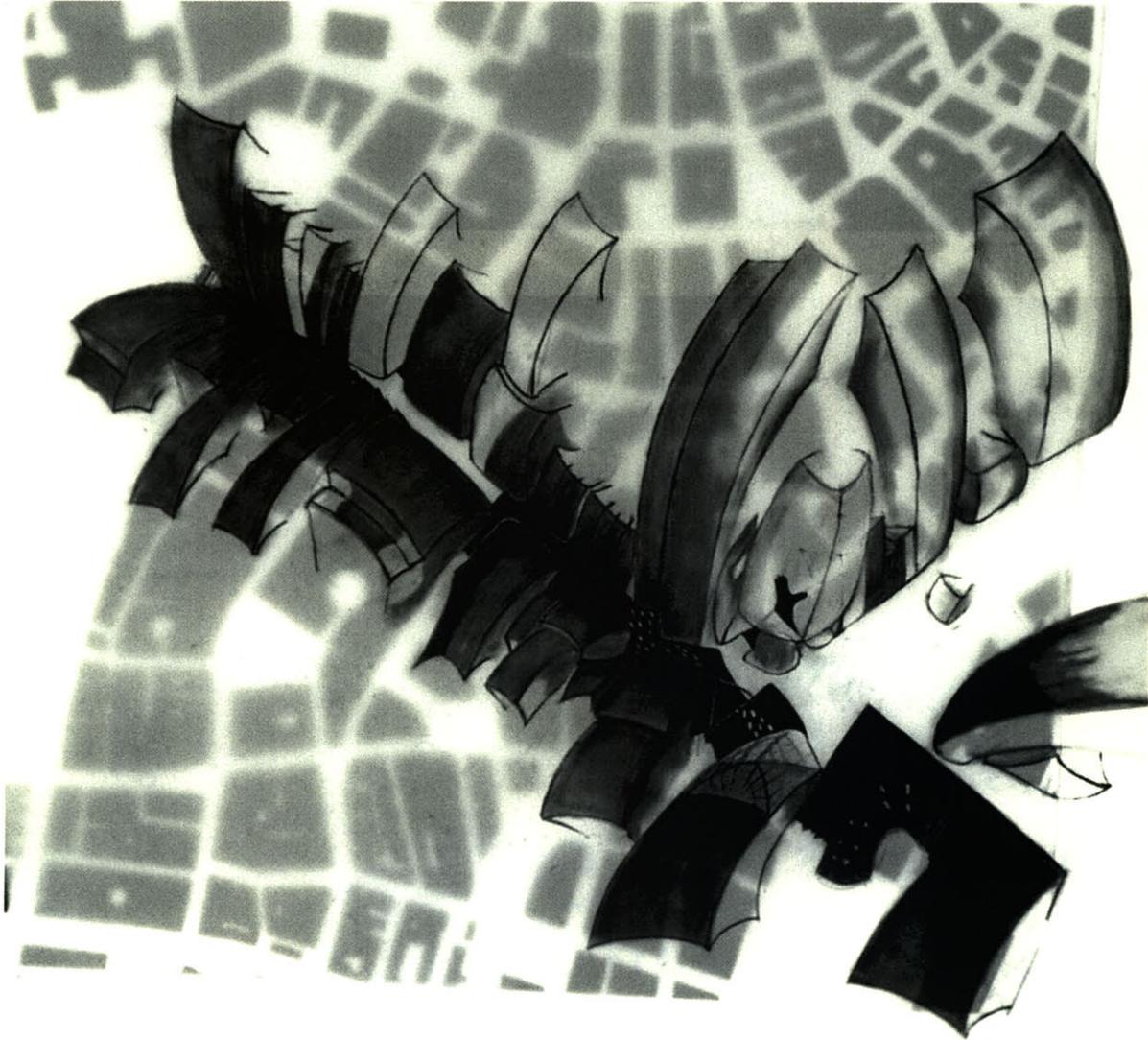
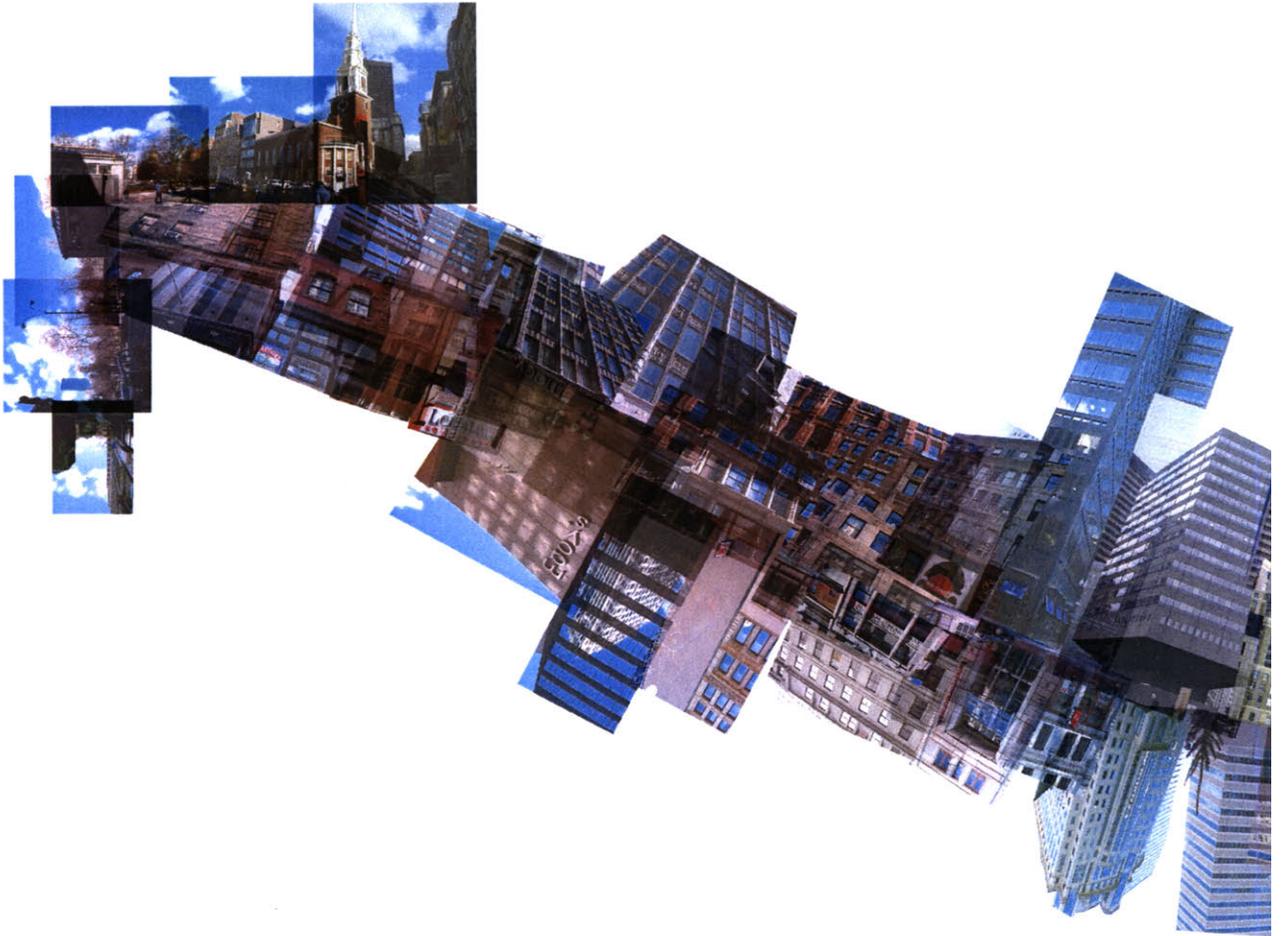


fig. 31 - 34

shadow maps by hand and lightscape at different times of day and year



*fig. 35 feb 13 9.30 – more elliptical window reflections on street; south station area and summer street near downtown crossing are completely lit, indicating their appropriateness to be open spaces that receive light during the peak office hour.*



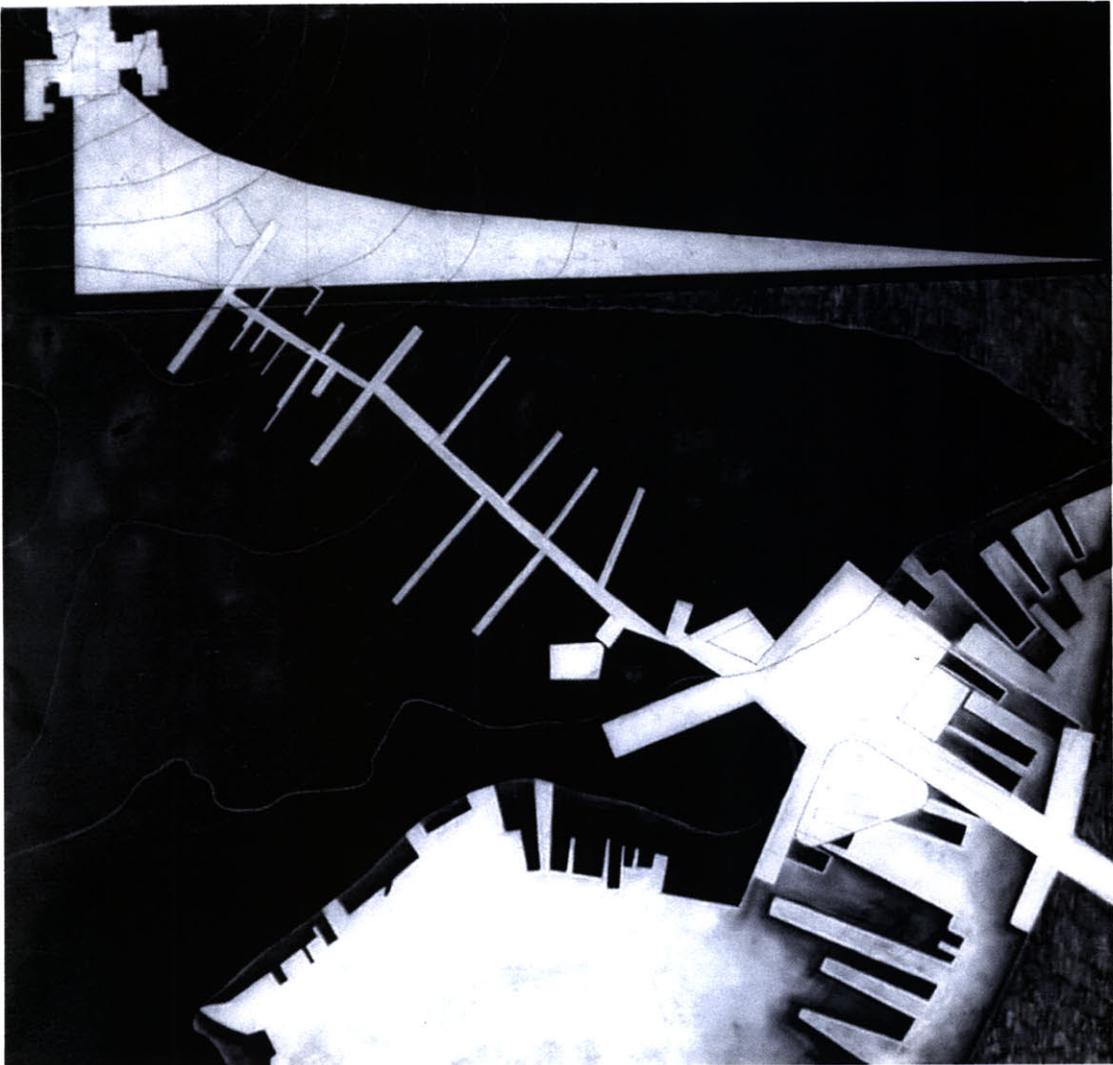
### Materials Map

This map displays the palette of the site moving from Boston Commons (far left) towards Fort Point Channel (far right)

There is a clear gradation from the earthy materials and saturated, warm colors of the old buildings near Park Station, to the glass and metal, transparent, cool colors of the newer buildings near South Station.



fig.36 materials map



### Ground map

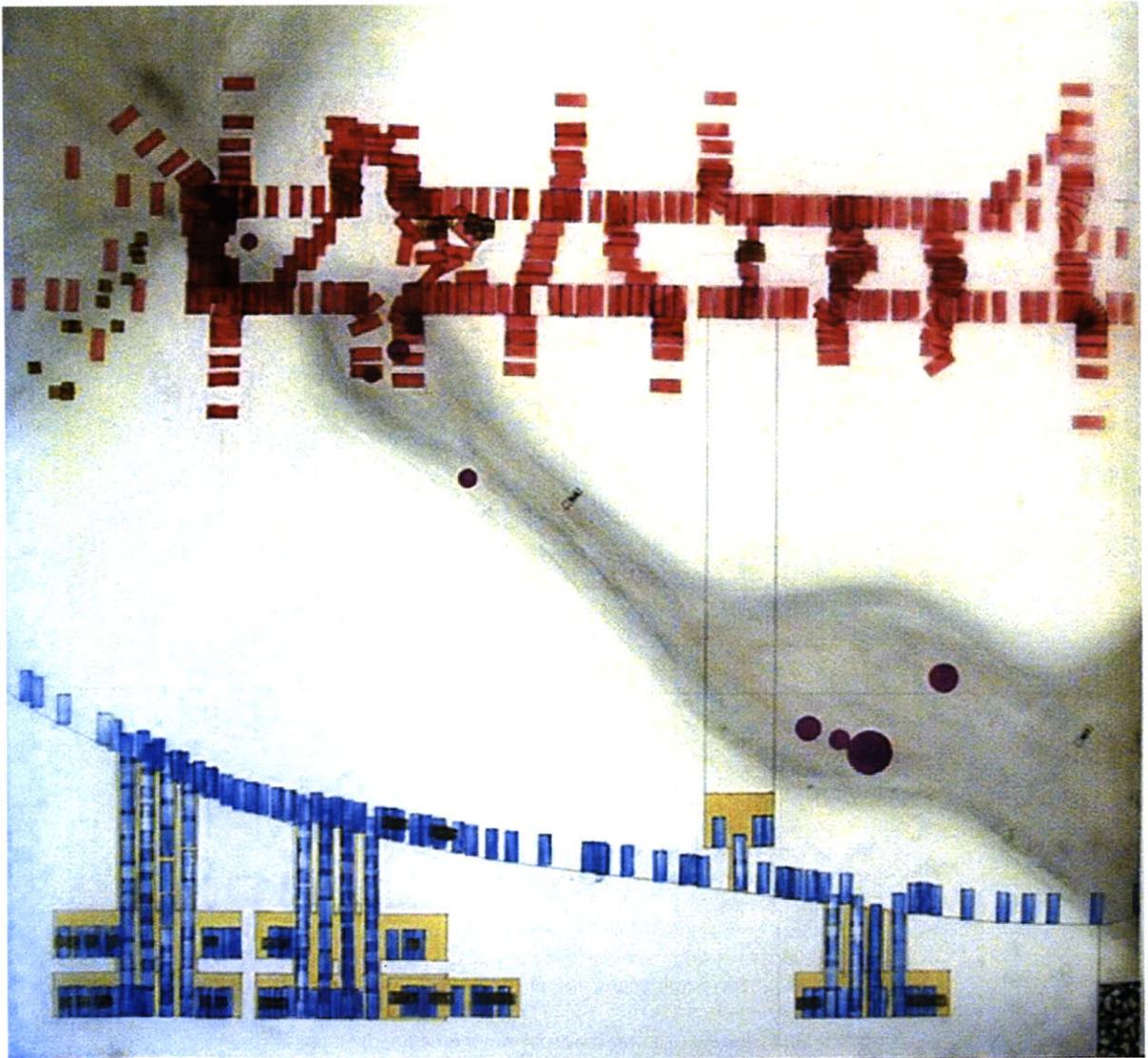
This map primarily shows the rhythm of light experienced on the site due to intersecting alleys/streets that bring shafts of light into the street at different angles depending on the time of day and year.

The topography lines in silver show that the larger slope of Winter Street coincides with a more frequently occurring rhythm provided by the intersecting alleys. The intersecting streets become less frequent towards the Channel as the scale of buildings and blocks increase, and the slope of the land becomes flatter.

The section shows that the land and water can be seen as having an inverse relationship on the site, symbolized by the inverse nature of the Commons and the Channel.

#### Key:

<i>Black -</i>	Original land-mass in plan view
<i>Grey piers -</i>	Land filled in succession (1795, 1825, 1930)
<i>Textured shade -</i>	Fort Point Channel
<i>Topography lines -</i>	The distance between two lines represents a 10 foot drop
<i>Outlined shapes -</i>	Key buildings orienting the experience of walking through the site
<i>White -</i>	Rhythm of light on Summer and Winter streets from intersecting streets/alleys
<i>Top inverted shapes:</i>	Conceptual section of site, white = land (slope is to scale), shaded = water (imagined)



### **Movement Map**

This map shows the intensity, and direction of people moving between Boston Commons (left) and Fort Point Channel (right). The site experiences heavy traffic, especially during office hours, between Park station and South station subway stops.

The movement is largely linear and directed along the site, except in Downtown Crossing and the South Station area, where there are many opportunities to cross and linger in non-linear ways. This suggests the potential to open up, or clearly define these two areas, as plazas that shape a different movement and light in contrast to the streets.

The view of the sky acts as a guide to the movement of people on the site. The places on the site that experience linear, fast movement are also places where the shape of the sky is linear and directional. Conversely, in Downtown Crossing and South Station area, the sky opens up and the movement of people is correspondingly slower, irregular and multidirectional.

The South Station area, in particular, has the most irregular sky shape exposure and movement of people. Downtown Crossing has a clearly defined shape, but could it be exaggerated and made more dramatic to match its function as the commercial and geographic hub of Boston.

*Key:*

(The forward motion of the pedestrian is in the direction of the short axis of the rectangles.)

*Red* - Plan view of people moving on the site

*Blue* - Sectional view of people moving on the site (yellow boxes indicate enclosed spaces such as subway stations or indoor atria)

*Brown* - Places where people sit

*Grey background* - Perception of sky shape throughout the site

*Violet circles* - Subway station sized according to level of traffic



**Design Proposal**

*fig. 39 sketches showing design interventions in brown. shape of the sky is an important element to design, acting as a guide to movement on the site.*



*fig. 40 Winter Street On March 21, 2.30 pm, where shafts of light cut across the street and onto the facing buildings*

*fig. 41 colored corner facades in alleys*

*fig. 42 early photoshop drawing showing painted alley facades bleeding color onto winter street*

### Systems of Intervention

Due to the dense nature of the site, the most dramatic light event that takes place is at the intersection of the alleys/streets along the site. These allow bright shafts of perpendicular light to cut into the street from the southern direction.

The angle of the light and building shadow vary during the day and the year. The repetition of this condition of intersecting alleys and streets gives rise to the possibility of making a perceptible pattern of light intervention along this street.

By modifying the surfaces and corners at these intersections, it becomes possible to 'activate' the light entering the street.

Applying color, either by varying the nature of the surface material itself, or simply applying paint, allows the light entering the street to be colored because of reflection. The bleeding of this color onto the street, and sometimes onto the opposite façade, lends a much stronger perception of this phenomenon. It allows the association between the color of the reflection and the direction of the sunlight - and therefore the time of day. The choice of color reinforces the vernacular palette.





The other strong aspect of light associated with the site is the view of the sky. Its presence is pronounced, as slivers of blue light acting as the seam of the site, sharply defined by the dense building profiles. As mentioned before in reference to the movement map, the view of the sky acts as the guide to the movement of people on the site.



Surface interventions can also play the role of shaping the sky in order to guide the movement of people. Thus surface interventions can play the dual role of introducing reflectivity and color to enhance the perception of the direction of light, as well as provide edges to shape the view of the sky, and consequently guide the movement of people.

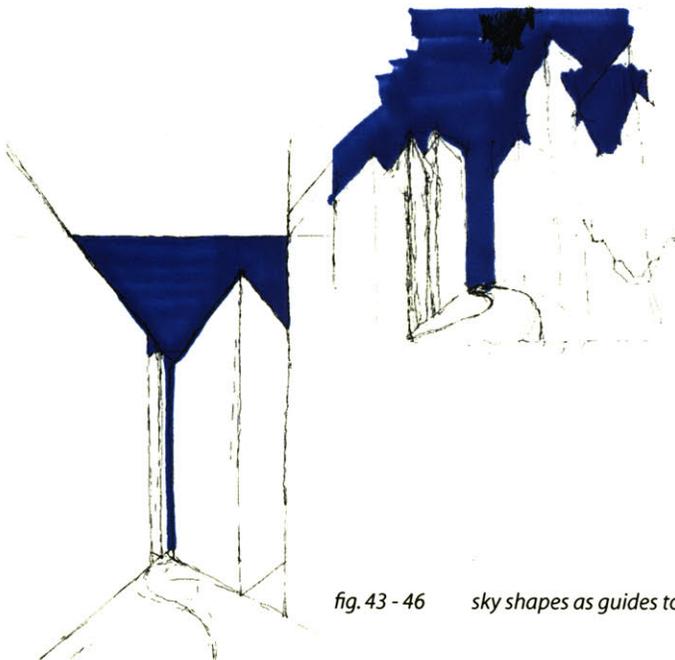


fig. 43 - 46 sky shapes as guides to movement

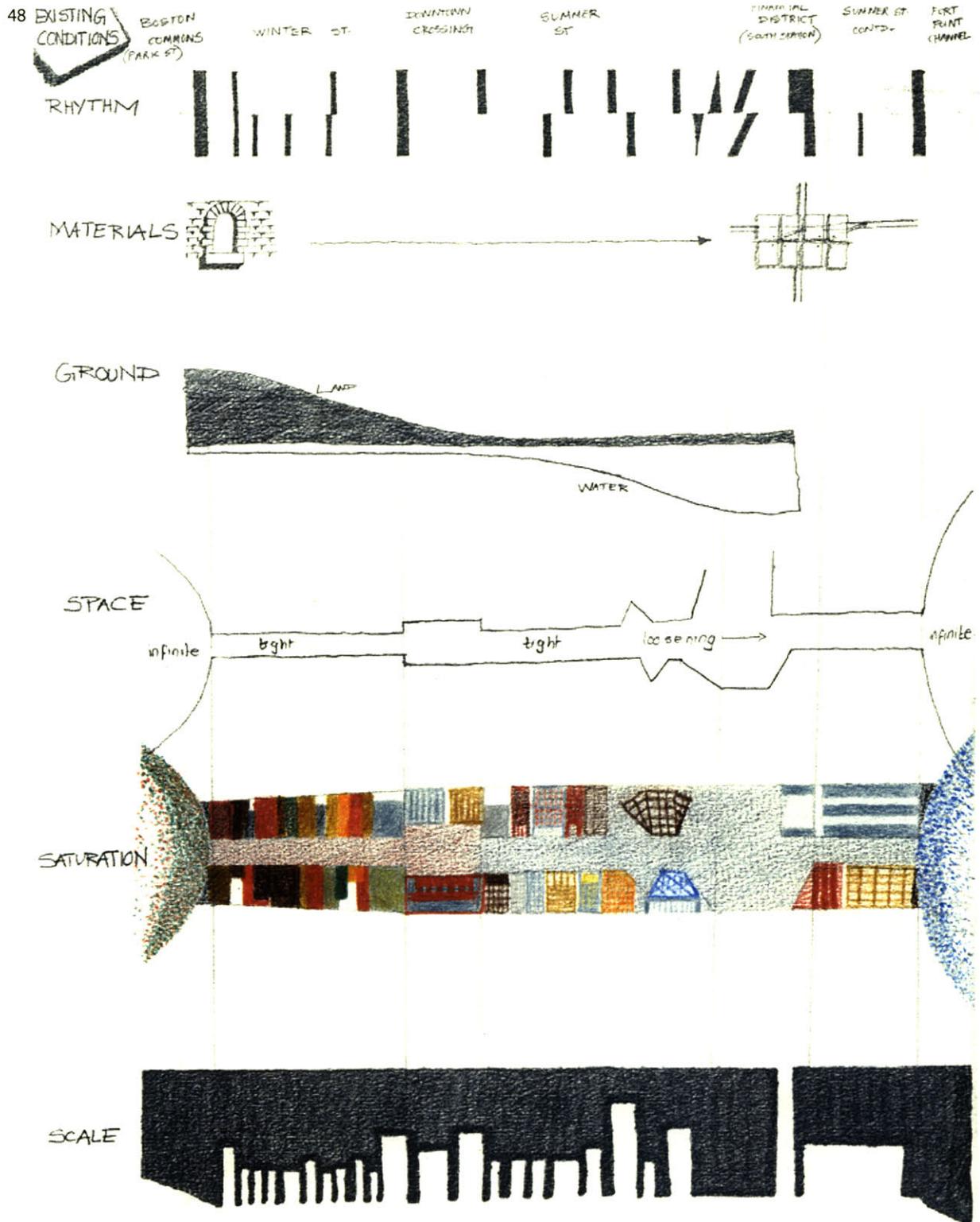


fig. 47 mapping existing conditions

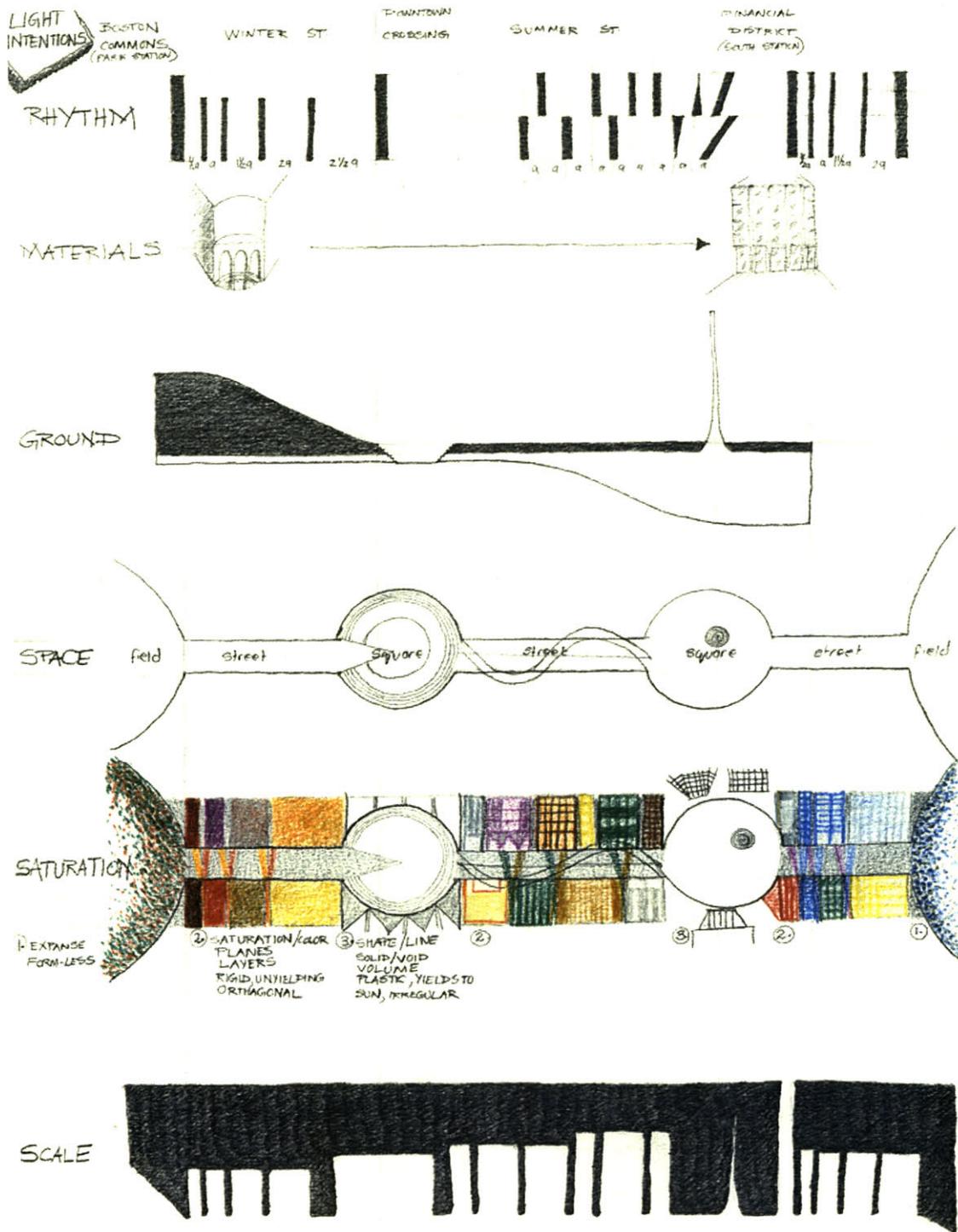
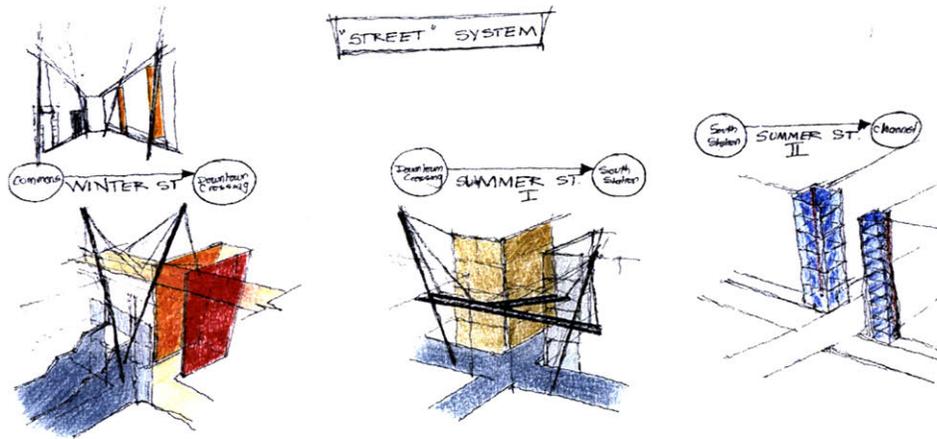


fig. 48 mapping proposed systems



### Elements of Intervention

The surfaces are:

- facades of the buildings at the corners of the intersections  
The facades serve as the activators of light, by introducing color and reflectivity into the light equation.
- ground plane  
The ground acts as the receptacle to showcase the reflected light and shadows. It is also the plane that connects all the surfaces to create a readable continuum of urban space.
- canopy  
The canopy shapes the sky.

The site is divided into fields, streets and squares. The thesis does not make proposals for the field condition. The system of interventions takes on different forms in the streets and squares. In the streets the system follows a more rigid, recognizable pattern and form (using facades, ground and canopy). In the squares it takes on more free forms - a consequence of the squares having unique conditions, more space and drama. These warrant freer expressions of the system.

The facade opposite the intersecting street/alley is articulated in some manner, such as framing an entry to a store. This marks the time of day and year that sunlight hits the site at a perpendicular angle. Since the light travels parallel to the walls of the intersecting alley-facades, it does not reflect color from them, and is white. The lack of color also marks the special orientation of the sun with respect to the site.

The system of surface interventions adapts itself to the vocabulary of its location on the site.

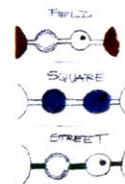
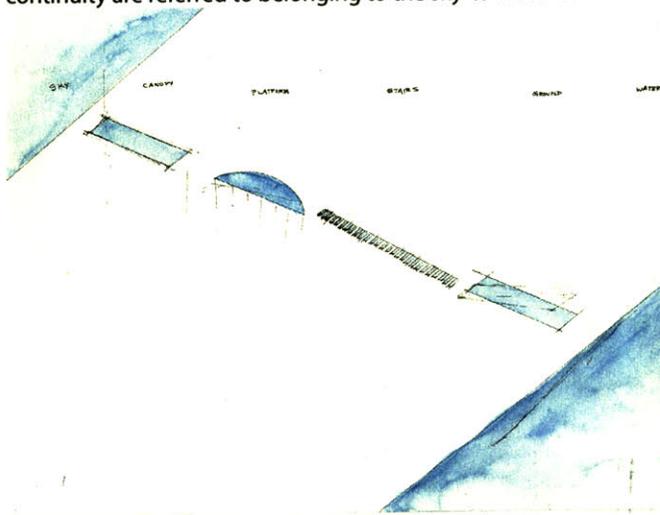


fig. 49 system of surface interventions for the streets

Glass is a continuous element throughout the axis of the site. It is inspired by the role of the sky as the seam tying together the experience in the street canyon. The collection of glass elements that provide this thread of continuity are referred to as belonging to the sky-to-water series.



*fig.50 sky-to-water-series: sky in boston commons, dropping to the canopy over winter street, to the screens in downtown crossing, further dropping to the partial canopies on summer street I, to the ground plane in the south station, to the sidewalks on summer street II, and terminating in the water of the channel*

## Designing for the Site

### Winter Street

Existing:

- The old buildings are made of heavy masonry and warm, earth colors. It is part of the original land-mass of Boston.
- It has the steepest incline on the site. The slope flattens out towards Downtown Crossing. The frequency of the intersecting alleys decreases towards Downtown Crossing, corresponding to the decrease in slope.
- The movement of people is linear.



fig. 51 photograph of winter street (existing)

## Interventions:

## 1. Intersecting facades



Saturated bright colors painted on the corner facades of the alleys on the southern side of the street. This applies to four alleys on Winter street. The colors grade from red to yellow on the east facades and yellow to red on the west facades, when moving from Park Station to Downtown Crossing.

There is some articulation on the portion of facade directly facing the colored alleys, on the northern side of the street to accentuate the perpendicular axis of light penetrating the street.

## 2. Ground plane



Light-colored to catch the colors that bleed from the corner facades of the alleys. Sidewalk widens towards downtown crossing to exaggerate the perspective of the road with respect to the building edge, thereby exaggerating the perception of descent.

## 3. Canopy (covers entire length of street at a height of 60 feet)

Restricts the view of the sky into two slivers along the building edges. These slivers encourage a linear acceleration that corresponds with the slope of the street.



Translucent (glass), to continue the language of the sky-to-water series. Catches direct sunlight, becoming a luminous element during sunny days. Luminous object at night time when lit from above.

During cloud cover, canopy adopts the color of the sky, as though a piece of the sky dropped down.

The canopy becomes narrower towards downtown crossing, following the edge of the widening sidewalk, to allow more light onto the sidewalk as well as emphasize the exaggerated perception of descent.



fig. 52 - 54 sketches showing colored alley walls, reflected light and canopy on winter street design  
fig. 55 design proposal for winter street: photo-montage of model picture on winter street picture

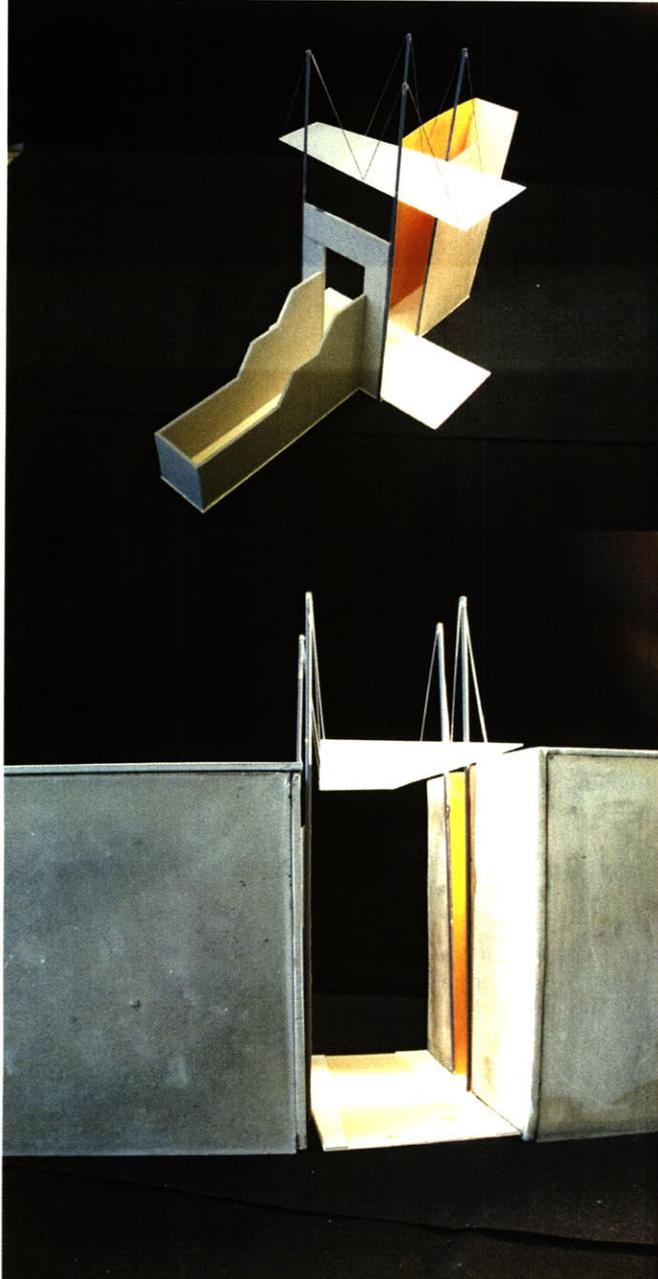


fig. 56  $1/8" = 1'-0"$  model of typical winter street unit of insertion  
fig. 57 effect of system when inserted in existing building fabric  
fig. 58  $1/100" = 1'-0"$  model of all 4 insertions on winter street

### Downtown Crossing

Existing:

- Commercial and geographical hub of Boston. Currently occupied by Macy's and Filene's.
- Acts as the boundary between the smaller scale buildings along Winter Street and the large buildings towards the financial district.
- Topography begins to flatten.
- Shape of sky is wider here than on the streets that approach it. Movement of people is correspondingly slower and less linear.

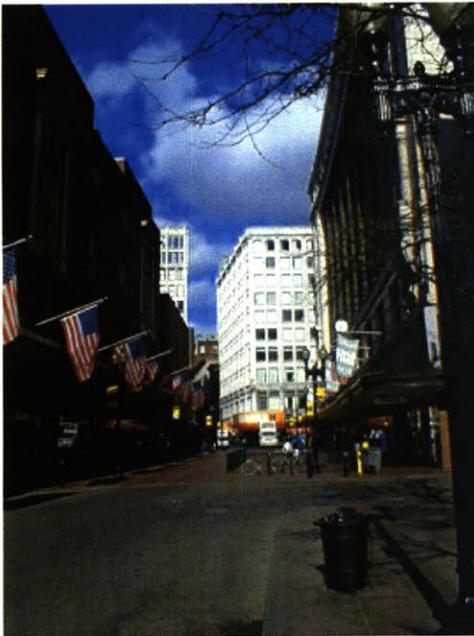


fig. 59

*photograph of downtown crossing looking towards park st.*

Downtown Crossing sees the most dramatic intervention, with the redesign of Macy's, Filene's, the building adjacent to Filene's, and the outdoor plaza. The complete redesign of buildings allows for a more authentic representation of the design ideas, which are less intense elsewhere on their site because they deal with existing buildings. The crossing is a good location for this large-scale intervention because it sees heavy commercial and pedestrian activity, and already suggests a widening of the street.

Since the Downtown Crossing design represents the design for the site in its most intense form, it incorporates the sky-to-water series (present along the length of the site), in its section (which is perpendicular to the site). The series is represented by the atrium (sky) in Macy's, the glass fins (canopy), the glass-panelled screens (canopy), and the translucent floor in the depressed court (water). The screens are at the intersection of the site axis and the Downtown Crossing axis.

The design for the crossing uses a material palette familiar to different parts of the site: concrete walls (Winter street), metal facades (Summer street I) and glass walls and screens (Summer street II).

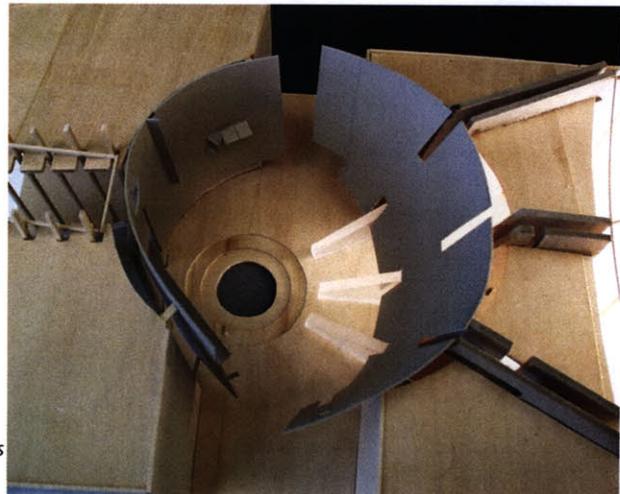


fig. 60 *glass fins emerge as glowing objects from Macy's*

Interventions:

### 1. Intersecting facades

These are represented by 3 sets of parallel concrete walls, running radially from the center of the plaza and into Macy's atrium. (Macy's lies on the southern side of Summer street). The walls are painted on their inner sides, as the Winter street alley corner facades. They also maintain between them, the average dimension of the alleys (20 feet).

Glass fins, which are parallel glass walls with a sloping roof, occupy the space between each pair of concrete walls. They represent the formalisation of the shafts of light penetrating the length of the site by the southern sun. Light is seen as an object. The fins glow when light travels through them from the atrium to the plaza, both during the day and at night. The movement of light is coupled with the movement of people, who are circulated between the plaza and Macy's interiors on escalators inside the glass fins.

The fins vary in length; the longest has its axis oriented towards the south and catches the most intense light.

### 2. Ground Plane

The ground surface is paved to articulate the circumference of the plaza. A circular set of stairs form a 4 foot depression off the center of the plaza, in line with the axis of Winter Street. It affords a direct view of Park station, which acts as the platform for the setting sun on Summer Solstice (June 21).

The ground at the bottom of the stairs/ depressed court is made of translucent glass to allow light to pass from the plaza into the subway station below.

### 3. Canopy

Two screens made of translucent glass panels face each other. They curve around the plaza and shape the sky as an oculus. The circular sky shape encourages stasis and gathering in contrast to linear movements elsewhere.

The surfaces of the screen reflect light off each other, into the spaces on either side of them. They are independent of the buildings behind them, and exist purely to affect the quality of light and shape the sky in the plaza.

The screens are suspended by the concrete walls (see 1) above) and frame projecting out of the buildings. The buildings are metal shells with perforations towards the screens so that light is cast onto the screen from within the building.

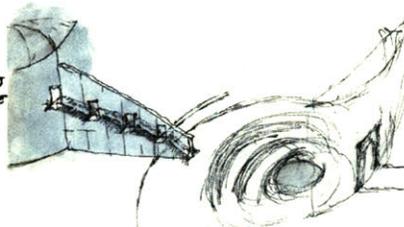
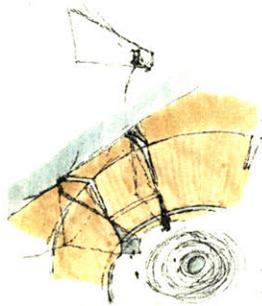
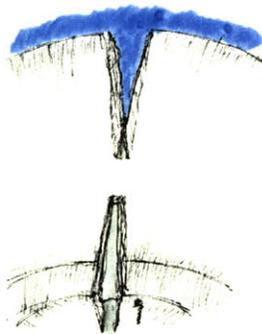


fig. 61 sketch of slits in curved screen to perceive sky and glass fin

fig. 62 sketch of curved facade for Macy's

fig. 63, 64 sketches of glass fins and concrete sheathing

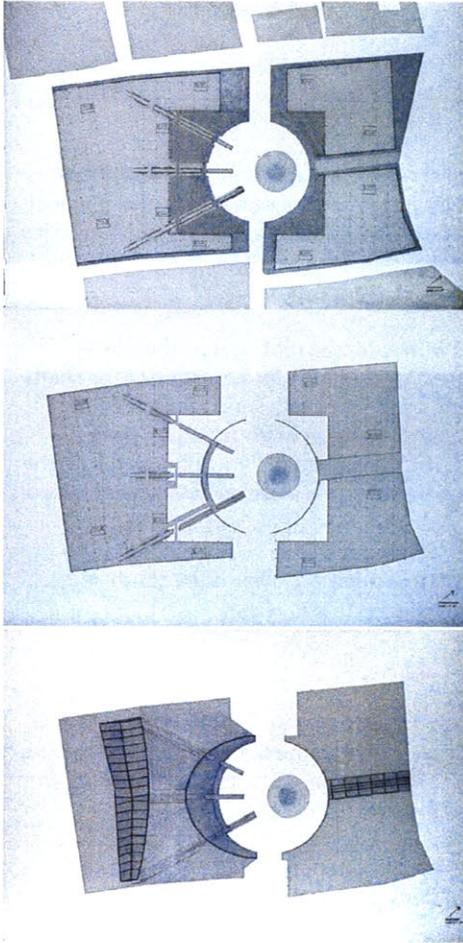
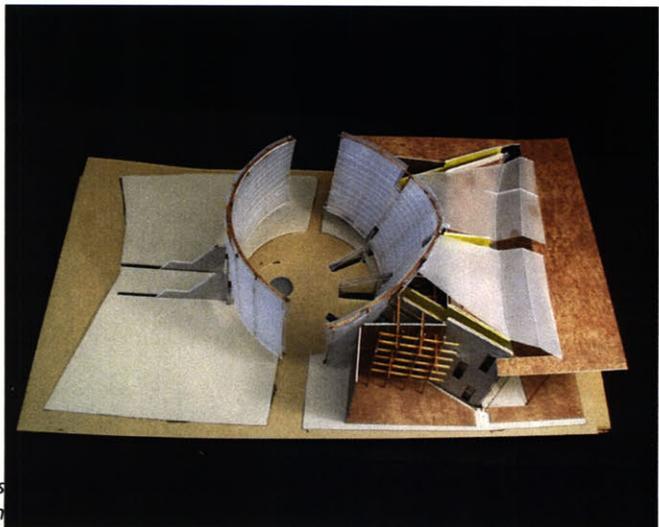


fig. 65 - 67 plans showing downtown crossing design  
(ground floor, second floor, roof)  
watercolor on mylar, mounted on plexiglass  
fig. 68 model showing downtown crossing design



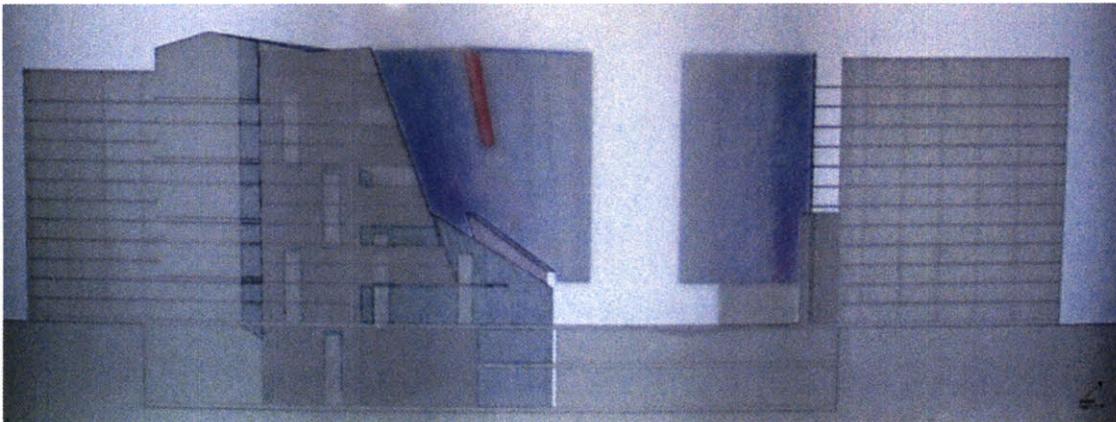


fig. 69 section showing design of downtown crossing: watercolor on mylar mounted on plexiglass

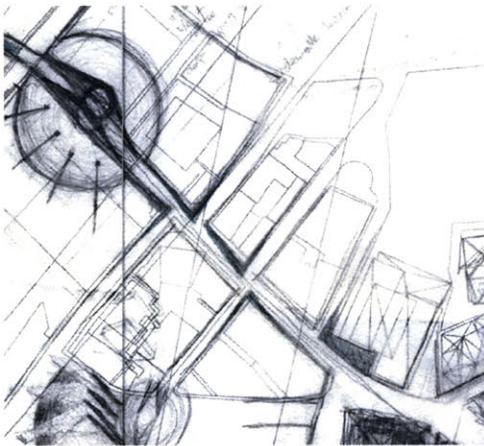
### Summer Street I

Existing:

- Buildings become taller towards the financial district.
- Street bends, creating a narrative, where the shifting view frame strategically reveals buildings.
- The intersecting streets are not all perpendicular, making irregular sky shapes that correspond to the non-linear shape of the street.
- Topography flattens out even more.
- Intersecting streets are less frequent, corresponding to the flattening slope, increase in block size, and increase in building scale.
- The palette includes more metal and glass, hence it is more translucent and cool.



fig. 70 photograph of summer street segment I



Interventions:

### 1. Intersecting facades

Metal scrims are hung from the east and west facades of buildings at intersections; they match the vocabulary of buildings, which transition from saturated earth tones to cool, translucent shades.

### 2. Ground plane

Unaltered because existing asphalt road and sidewalk paving can pick up the reflections of the metal scrims.

Sidewalks follow the shape of the canopies to emphasise the non-linear, winding movement along this street that is shaped by the winding shape of the sky.



### 3. Canopy

Overhangs that protrude from existing building edges to shape the sky where needed, to more clearly define movement on the street.

Translucent, to continue the sky-to-water series.

Glow at night to influence movement after daylight hours



fig. 71 sketch of design interventions in plan: green shows overhangs

fig. 72 sketch of overhang shaping the view of the sky

fig. 73 view of model showing effect of metal scrim, overhang and sidewalk design

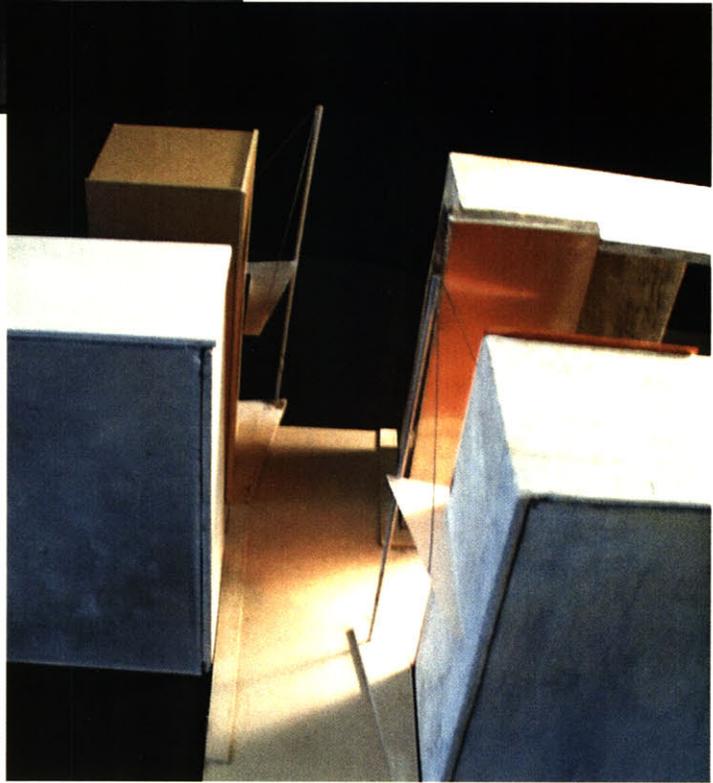
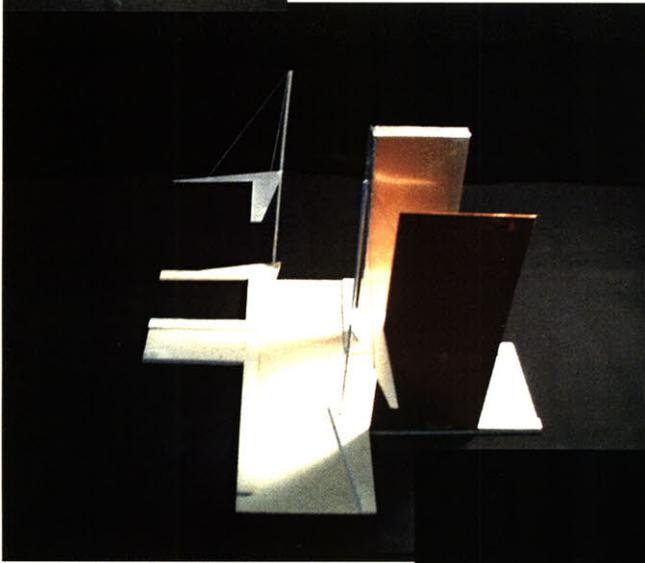
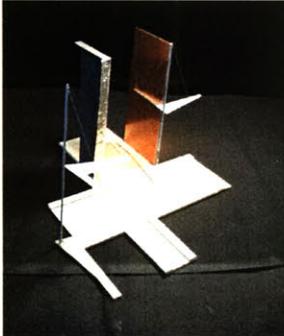
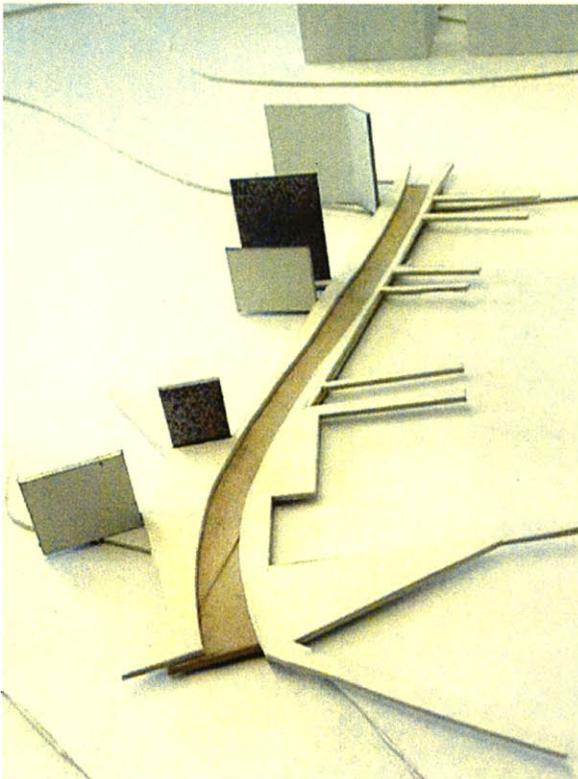


fig. 74, 75 *1/8" = 1'-0" model of typical unit  
of insertion for summer street I*

fig. 76 *effect of system when inserted in  
existing building fabric*



*fig.77 1/100" = 1'-0" model of all 3 insertions on summer street I*

**South Station Area**

Existing:

- Dramatic widening of sky.
- Tall buildings of glass and metal.
- Many places to cross the streets - movement is multi-directional.



fig. 78 photograph of south st. area

### Interventions:

The South Station area is a unique condition like Downtown Crossing. The design intervention includes two towers that act as fulcrum to redirect the movement of people towards the Channel. They act as orienting markers in the city and their unsymmetrical orientations reflect light at different times of day.

#### 1. Intersecting facades

Two tall towers that are wedge-shaped resemble the glass fins in Downtown Crossing. These too, are a formal expression of the shafts of light seen elsewhere on the site.

#### 2. Ground plane

The ground plane is made of glass, to continue the sky-to-water series.

#### 3. Canopy

The towers shape the view of the sky from afar. By holding a piece of sky between them, they act as a gateway for the city.

At the South Station area, the edges of the tall structures do not enclose the sky, but they draw attention along their lengths towards the sky.

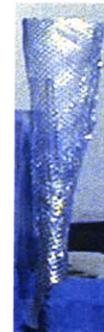
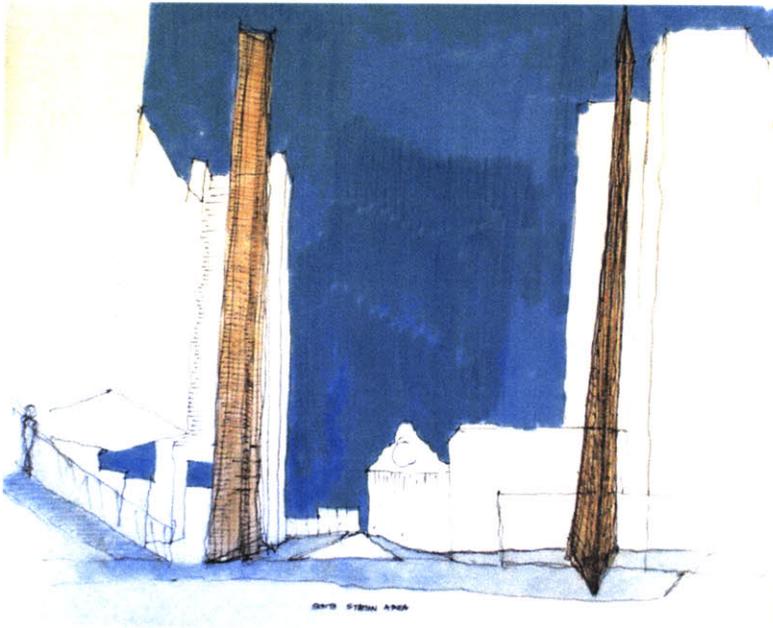


fig. 79 sketch of towers near south st.

fig. 80 early sketch model of tower

### Summer Street II

Existing:

- Street (and sky) is wider than other street segments in the site.
- Tall buildings of glass and metal.
- Historic South Station building
- View of Summer Street bridge and Channel.
- Topography is flat.



fig. 81 photograph showing summer st. II

**Interventions:****1. Intersecting facades**

Glass of varying shades and color form independent facades and corners placed in front of existing buildings; they match the vocabulary of glass and metal buildings in this area.

The corners protrude in a prism-like fashion, to catch the light entering Summer Street.

**2. Ground Plane**

Glass sidewalks to continue the sky-to-water series.

Sidewalks widen towards the channel to create a feeling of descent, corresponding with the land dropping to meet the water. The glass sidewalks appear to terminate in the channel.

**3. Canopy**

No canopy. Sky shape is formed by the building edges, which move back from the road as they approach the Channel, creating more sky exposure towards the Channel. The street experience culminates here, before crossing the bridge to South Boston.

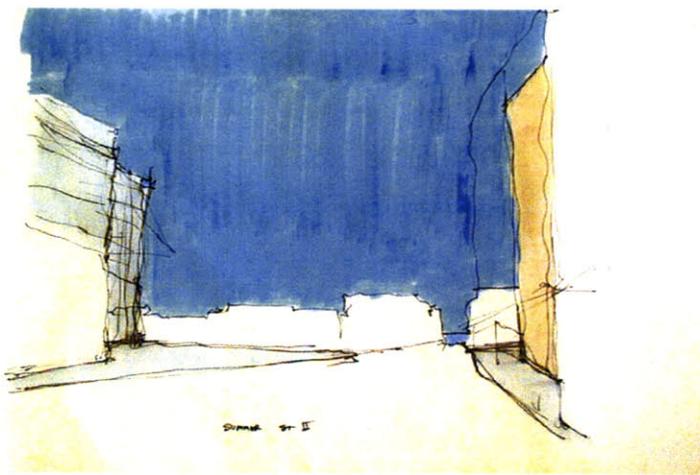


fig. 82 sketch of widening vista

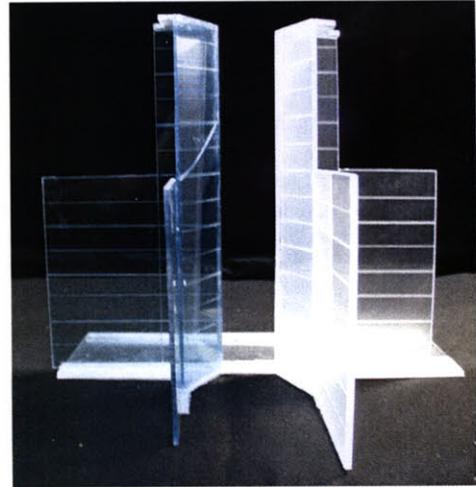
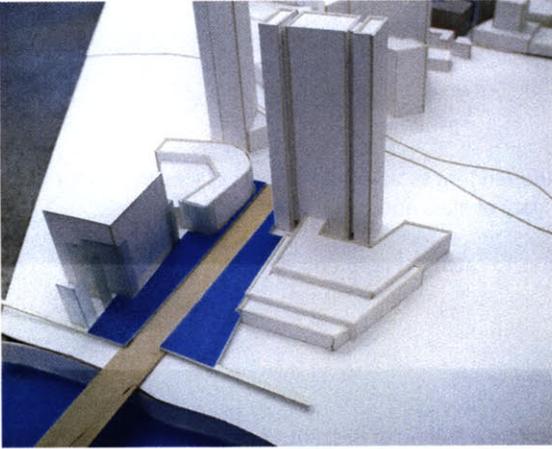
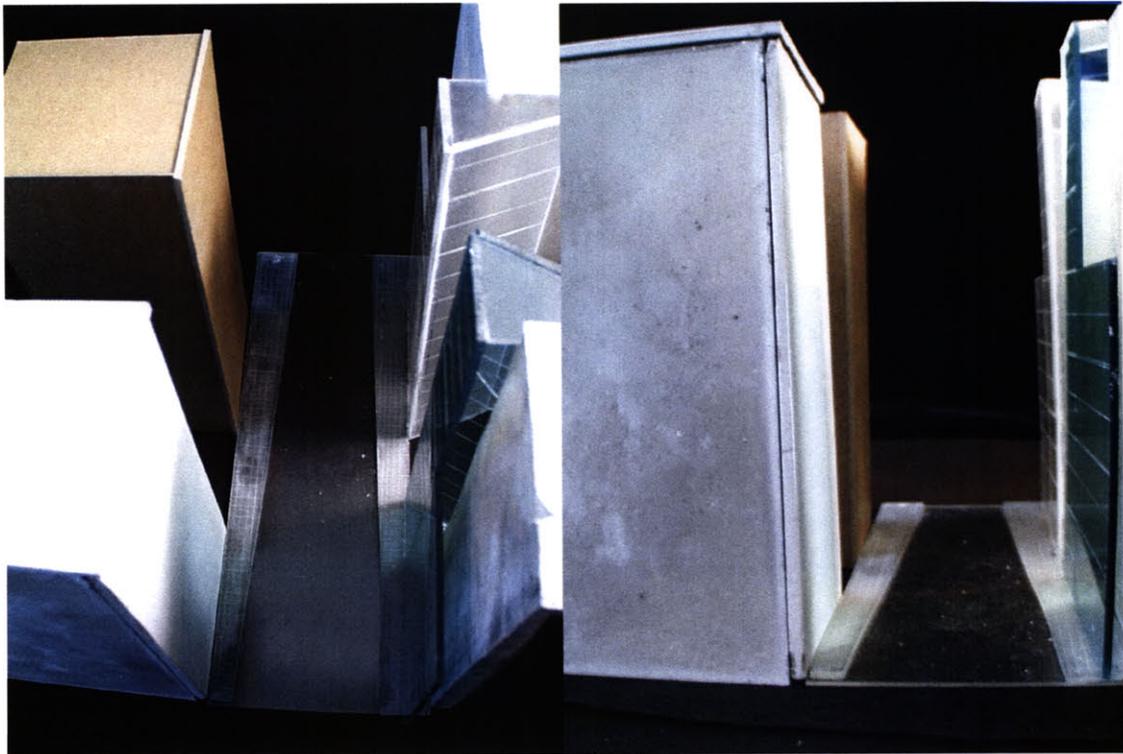


fig. 83 1/100" = 1'-0" model of two insertions on summer street II

fig. 84 1/8" = 1'-0" model of typical unit of insertion for summer street II

fig. 85, 86 effect of system when inserted in existing building fabric



## Conclusion

This thesis considers the aesthetic qualities of light in the design of urban public spaces as a way to enhance the urban experience. The work of artists and architects, and public space designs are used to shortlist qualities of light that inform urban architecture. These light qualities are chiaroscuro, views, color, intensity, shape of the sky, direction of light, and light as a solid.

The light qualities are used in tandem with the existing qualities of the site to create a design proposal unique to this site. Maps are used to analyze site characteristics affecting qualities of light (see 'Mapping Light on the Site'). These maps (except fig. 35: Shadow Map) can be reproduced to analyze the same characteristics on other sites.

The thesis proposes a system of surface interventions that draws inspiration from the vernacular, is specific to its point of insertion on the site, but also provides a continuous urban-scale theme.

The design aims to represent light qualities distilled from the study of artists, architects and public spaces. Each design intervention satisfies more than one light quality. All the design interventions involve three types of surfaces: corner facades of intersecting alleys/streets, the ground plane, and canopies.

The proposed interventions are designed for 4 alley corners intersecting Winter street, 3 street corners on Summer street I, 2 alley corners intersecting Summer street II, glass canopies on Winter and Summer I streets and glass sidewalks on Summer street II, redesign of Downtown Crossing, and two towers for the South Station open area. The interventions at the street corners are generally modest and consistent with the vernacular of the street. The interventions at the plazas are more dramatic.

The proposed interventions at times contradict existing regulation. For example, current laws restrict the height of a building to limit the shadow falling onto a public square. In the design proposal, a tall structure is erected at the periphery of a public square (South Station area) precisely for the linear shadow it casts, which can act as the hand of an urban sun-clock, and hence make pedestrians aware of the passing of time during the day.

The thesis advocates incorporating qualitative criteria of light in public space design.

**The Final Review: May 16, 2002**

The final panel consisted of my thesis committee (William Porter, Anne Spirn and Michael McKinnell), Marlon Blackwell, Carol Burns, Reinhardt Geothert, Kemo Griggs, Seth Riskin, and George Thrush.

The general consensus was that the thesis was original because light-qualities have remained under explored in the realm of urban design. The reviewers agreed that the thesis provoked important questions that went beyond its scope, holding promise for future work in this field. The panel acknowledged the lack of vocabulary in discussing qualities of light in urban design.

The scale of intervention at Downtown Crossing was both criticized for being too large, as well as appreciated for introducing monumentality at an important junction of the city.

**Future direction**

The thesis touched upon the study of materials and their impact on the qualities of light. The project would be made stronger by a more detailed study of materials, especially glass (with respect to this project).

On the planning level, it would be useful to study strategies for implementation. How can artists/architects be better incorporated in the design of public spaces? How can policies support the approach studied in this thesis? What should the new policies for providing light in the city be?

Analytical representations of qualities of light, such as mapping the shape of the sky, would provide useful tools for urban designers to compare different sites, and facilitate the consideration of these qualities in urban design.

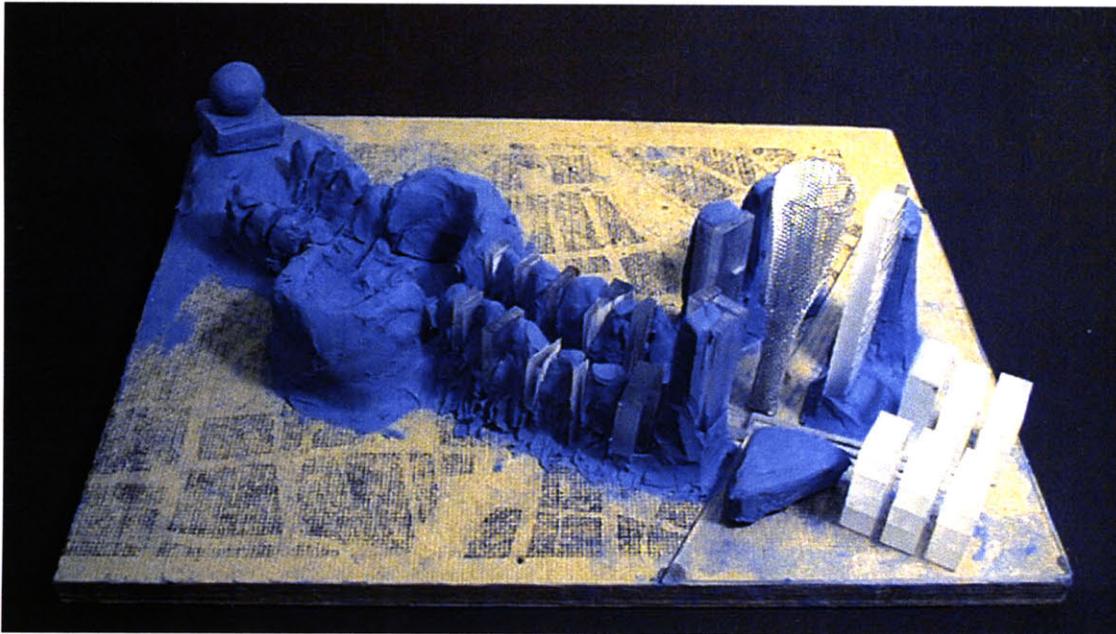


fig. 87 *conceptual model for light interventions on the site  
(state house in upper left and south station in lower right)*

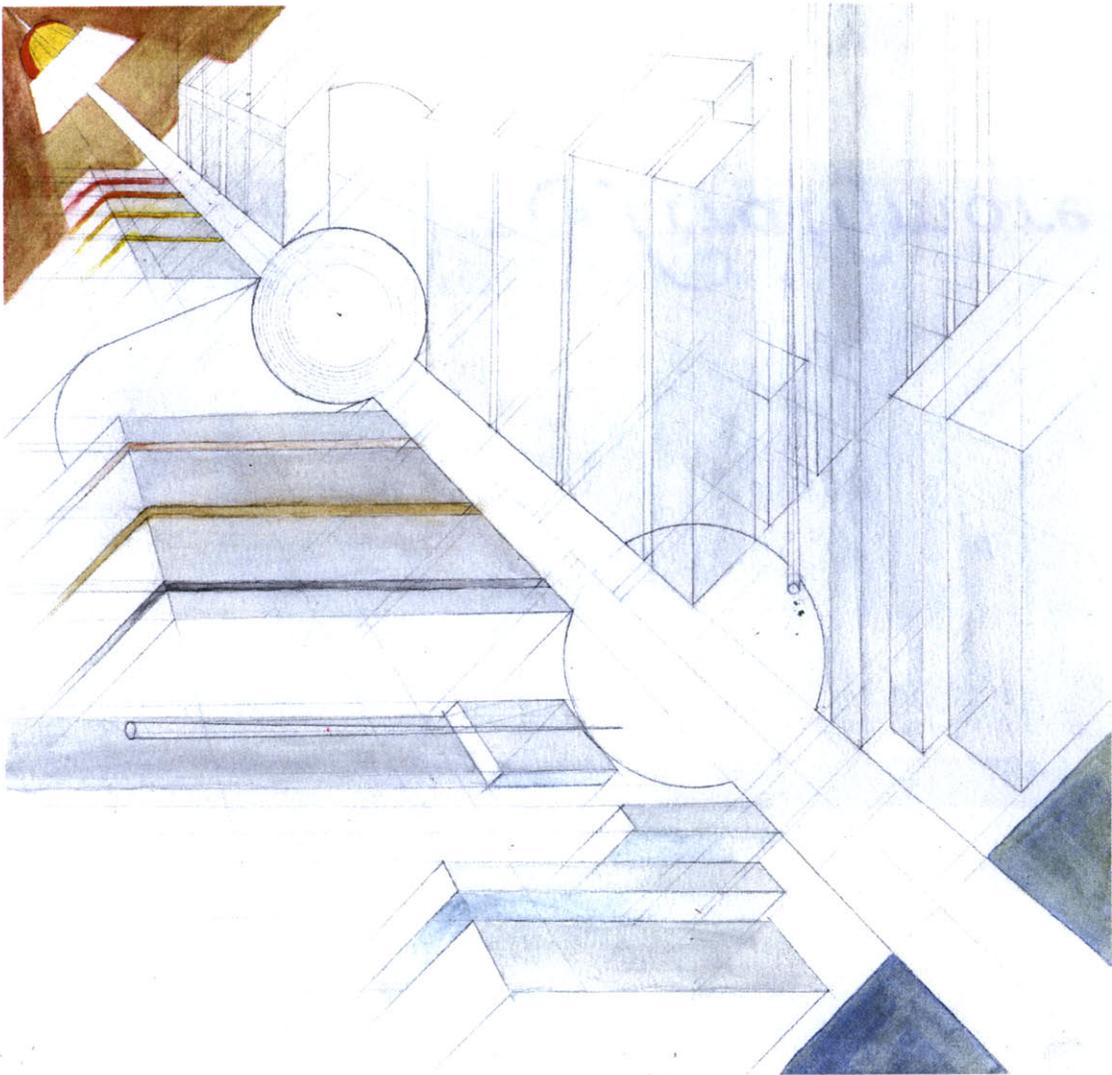


fig. 88 *design concept map (watercolor on paper, mounted on plexiglass): looking towards boston commons*

## Figure Sources

fig. 4	City Evolution (source unknown)
fig. 6	Equitable Building ( <a href="http://www.greatgridlock.net">www.greatgridlock.net</a> )
fig. 7	New York Setback Law ( <a href="http://www.skyscraper.com">www.skyscraper.com</a> )
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fig.20	Stonehenge ( <a href="http://www.astrovirginia.edu">www.astrovirginia.edu</a> )
fig.21	Piazza del Campo ( <a href="http://www.clr.utoronto.ca">www.clr.utoronto.ca</a> )
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fig.23	Paley Park, NY ( <a href="http://www.southampton.gov.uk">www.southampton.gov.uk</a> )
fig.24	Tin roof addition to an existing street in Damascus (Walter M. Weiss, 1994)
fig.25	A jewellery and fabric shop in Rissari, (Walter M. Weiss, 1994)
fig.26	Site map (Atlas, 1998)

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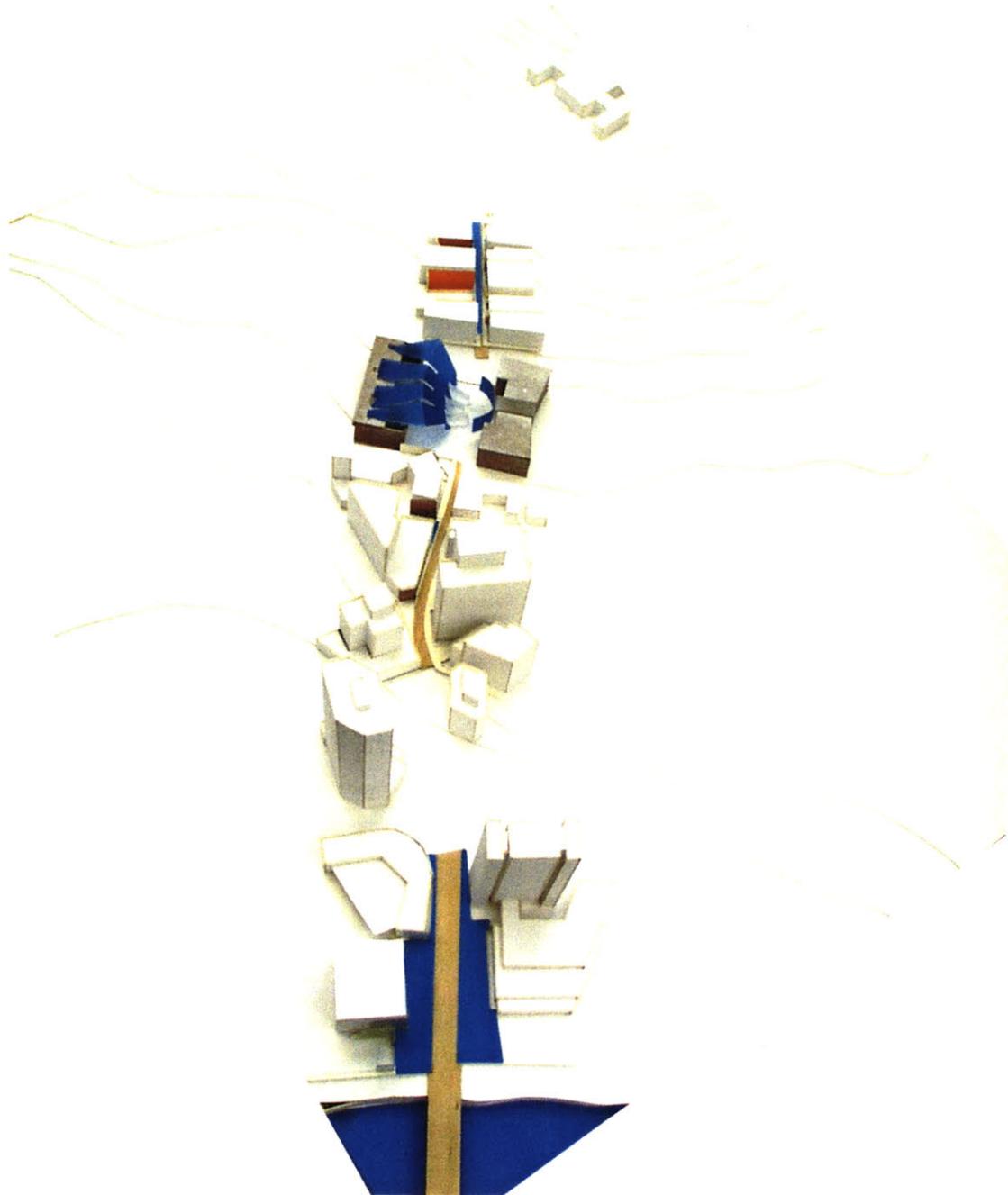


fig.89 site model with design interventions