Color and Form

BY
MARK C. BUCHANAN

B.S. ARCHITECTURAL TECHNOLOGY
NEW YORK INSTITUTE OF TECHNOLOGY
OLD WESTBURY, NEW YORK
JUNE 1989

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE MASTER OF ARCHITECTURE
AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
JUNE 1992

Signature of the author

Mark C. Buchanan, Department of Architecture
May 8, 1992

Certified by

Frank Miller, Assistant Professor of Architecture
Thesis Supervisor

Accepted by

John R. Myer
Chairman, Departmental Committee on Graduate Students

1

Color and Form
by
Mark C. Buchanan

Abstract

I have always been interested in painting, particularly in the use of color to describe space, time and emotion. This thesis integrates painterly concepts in the making of architecture. Some issues explored include color complementarity, material color, and the expressive use of color in the design process. By thinking of color as I design I endeavor to enhance the habitable experience and enable color to actively generate the creation of architecture.

The vehicle for color study is the design of a pedestrian bridge in Tacoma Washington. The focus is to produce several schemes exploring color and material and its sequencing along the bridge. The programmatic scope is constrained to maximize issues of color and form making.

The design used various media to visualize the design and explore two color systems. Additive color systems lead to painting, pastels, colored pencil, and plaster casting. The computer facilitated image processing, geometrical modelling, and color/ texture mapping in a "subtractive" color system.

Thesis Advisor: Frank Miller
Title: Professor of Architecture

Painterly - characteristic of a painter or the art of painting, esp. in reference to tonal and color relationships.
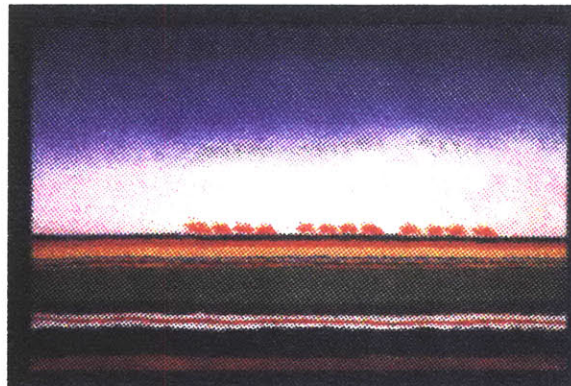
Random House College Dictionary,1982

Acknowledgments
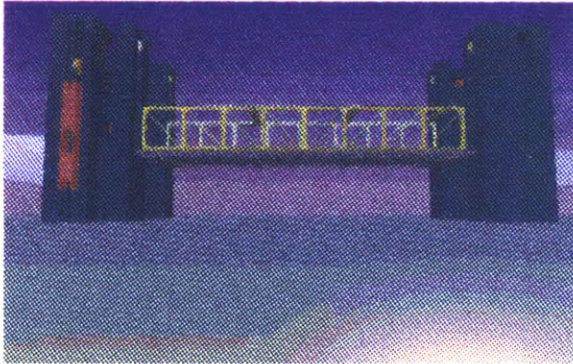
To my mentors...

Departure of ships, Paul Klee.

"When all is said and done, I prefer those who exploit me to those who follow me. The former have something to teach me."

Georges Braque

Contents

"...In studying more closely the spectrum of experience the physical world offers us, the study of color provides compelling insights and discoveries. To study color, in the broadest sense, is to study how we perceive the physical world through our senses."

- Deborah Huff
New York Institute of Technology, 1986.

Foreword

"...all true creation is a thing born out of nothing."
- Paul Klee

Every day we are surrounded by color and light and yet we often take the perceptual experience for granted. In doing so we limit our understanding of the environment. To clarify one's understanding of color there must be a recognition of conventional biases towards color and its "appropriate" use. The ability to look outside of convention stems from a willingness to acknowledge that we don't know everything about color and inquire into new uses for color in architecture. What I ask of myself and the reader is a willingness to suspend our personal tastes and begin to look at color through beginner's eyes.

Introduction

This thesis is an attempt to relate concepts found in painting and architecture. What interests me is the way painters see the colors in their environment. Like the musician who hears music when reading the score artists see color distinctly different than architects. My intention is to use this thesis as a vehicle for describing a painterly notion of color and landscape and formulating a vocabulary for color as an architectural design tool.

Borrowing from: modern landscape painters, the cubists, Paul Klee and Kepes (et al), I endeavor to communicate how color concept can enhance the experience of architecture. Distinguishing what is communicable about the way color is seen by the artist is difficult. Looking outside of interpretation I identified what is autonomous about color in order to illustrate the poetics of an artist's vision. Through the comparison of autonomous and interpretive color applications I recognize my own biases facilitating an explicit language for describing color in my designs.

Recognizing the norms that govern color in architecture enables the informed selection of colors in the design process. While referencing art, architecture, and nature; I clarified color issues in my design through a series of explorations about color and material.
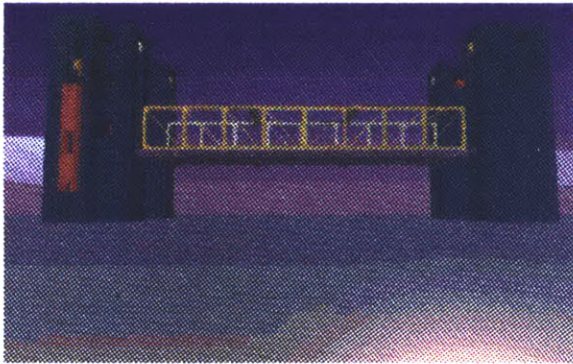
"We now assert, extraordinary as it may in some degree appear, that the eye sees no form, in as much a light, shade , and color constitute that which is to our vision distinguishes object from object and parts of objects from one another. From these three, light, shade, and color, we construct the visual world."

- Goethe, Theory of Colors

"Color- is primarily quality; it is secondarily weight, for it has a brightness as well as a hue. Thirdly, it is also measure, for in addition to these other values it has limits, size, extent- these being its measurable characteristics."

- Paul Klee, Diaries, p. 171

1.0 What is color?

-"**color**" means colors-

Color is reflected light... How we perceive a color ultimately depends on the context. Color is relative to its surroundings. Therefore when looking at color it is important to recognize the color itself and the color relative to its context. Color and context include:

	a.	Quality of light
1. Color itself:	b.	Pigmentation
	c.	Texture
	d.	Size
2. Context:	a.	Surrounding elements and their light / pigment / texture / size
	b.	Proximate and proportional relationships between each material (object and context)

In order to design a message that is distinct, reliable and gets the attention of the observer the designer must identify both the idea and the hierarchy of the information. By grading the efficacy of various means communicating with color I have endeavored to establish design methodologies appropriate to the applications. This thesis applies the methodologies in various stages of the design process and samples from a range of possible approaches. More often than not the design incorporates several readings. Some of the tasks are: conveying semantic and symbolic information, naming, classifying, searching, quantifying, ordering (structuring space), making prominent and pre-attentive, and relaying expressiveness.

The next few pages are a listing and brief description of how color impacts the viewer's perception of a message. This is a generic overview to introduce the reader to some of the concepts described later.

"What is Color?"

1.1 Caveats: (Above all do no harm.)

While in most cases color can work in parallel with other message types, there are some interdependencies:

Interestingly, incorrect color does not hinder recognition, but many objects have expected colors.

A large number of colors will increase complexity and decrease the performance of tasks, therefore keep it simple.

As the complexity of forms increases; the amount of color variations, particularly the amount of hues tends to decrease (if legibility is desired). In other words there is a reciprocity between color and form. As color increases the form is more tame and as form increases in complexity there is more room for color diversity.

Color has relatively low spatial, temporal, and positional resolution. This can impact legibility and our ability to judge size and shape.

Color is primarily foveal and photopic.

Some people have color vision deficiencies (approximately ten percent of the male population).

(The next eight subtopics are derived from a hand-out for; 4.999 Issues of Color in Media Technology, Prof. Walter Bender and Paul Hubel)

Our visual system is susceptible to a variety of messages:

Positional
Facial: Texture, contrast of value, contrast of hue, translucency.
Silhouette: orientation, size, shape

Dynamics: index, path, extent, speed

Other: focus, stereo

The Human Visual System

We process spectral information through two distinct pathways: chromatic and achromatic. These interacting factors can be adjusted to suit the considerations of **legibility and emphasis**. Sustained legibility of large bodies of text is accomplished by a combination of colors whose achromatic contrast is large and whose chromatic energy is of low to moderate level.

legibility
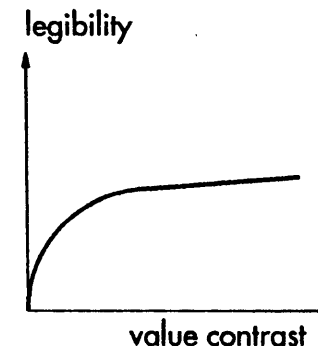
value contrast

The Human Visual System

Conversely, **color is more colorful with less contrast of value**. When achromatic contrast is held between low to moderate levels, high chromatic energy becomes visible. This energy is precisely what can be exploited for purposes of accenting. Highlighting can take the form of warning signals, attention grabbing devices, billboards, all of various levels of emphasis.
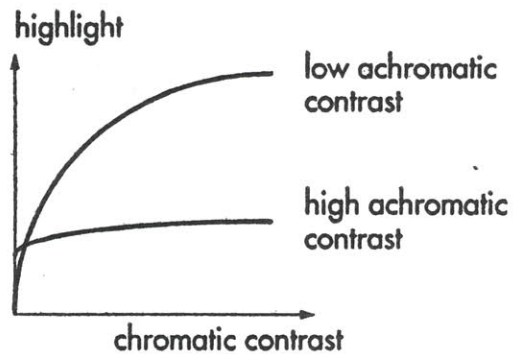
1. 2 Color's uses

1.2.1 Semantic/ symbolic

Color can be used to both represent reality and as a symbol.

Yellow:
ripe (bananas)
yield
"yellow pages" (telephone book)

Red:
stop
ripe (apple, tomato)

Green:
spoiled meat
unripe (banana, tomato)
go

Blue:
cold
sky

1.2.2 Color naming

Color is used as a label

Berlin and Kay researched various color terms and found examples of color names that translated across cultures. These color names are:

monolexemic (single word, not a compound)
first learned
translatable in various languages
generic (e.g. not semantic)
conventional (there is a form of agreement about their labeling)

1.2.3 Classification

Color is capable of grouping objects.

Boynton's 11 colors that are almost never confused:

White, Gray, Black
Red, Green, Yellow, Blue
Pink, Brown, Orange, Purple

(note: most of these colors are Red hue variations)

The Human Visual System

We have less spatial *and temporal* sensitivity to **chromatic** than achromatic stimuli.

contrast sensitivity

achromatic

chromatic

spatial frequency
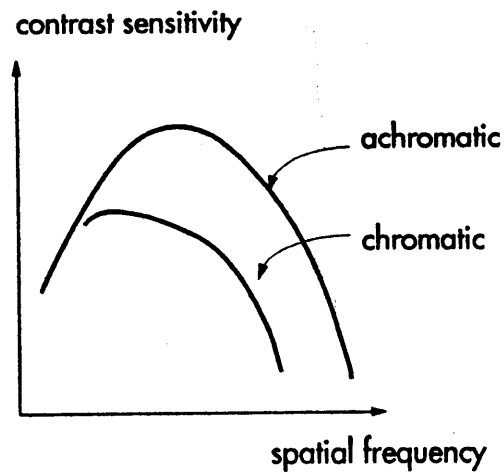
4. Search

Color is a powerful tool in searching.

(from Mackinlay)

More accurate

position
hue
texture
value
saturation
shape
orientation
size

Less accurate

1.2.4 Search

Color is a powerful tool in searching.

For example, if I were to show you a picture of one hundred rectangle and one circle and told you to find the circle you would have to look at all the objects until you found the circle. However if the circle was red and the rectangles green then the task of finding the circle is simple and quick.

(from Mackinlay)

1.2.5 Quantitative

Color can be used to measure.
(Psuedo color is an example)

(from Mackinlay)

1.2.6 Ordinal

Color can be used to sort and order

This is similar to Search however ordinal identification allows for a greater range of **value** and less hue range. A change in value allows for a grouping of objects to a common hue and yet remain distinctly individual within a system of hues.

1.2.7 Prominence/ pre-attentive

Color can be used to get our attention. There is a time for whispering and a time for shouting.

(from Mollitor)

1.2.8 Expressiveness

Color can convey an expressive quality.

This is the main focus of the thesis work. More information and specifics is discussed in later chapters.

The Two Dimensions of Color: Alignment and Amplification

The effect of a color's message is determined by the color's relation to the surround. The specification of this color to color relationship is key to effective communication.

By using computers and various photo montage and collage techniques I address this issue of context and color relativity.

5. Quantitative

Color can be used to measure.

(from Mackinlay)

More accurate

↑
position
orientation
size
value
saturation
hue
↓

Less accurate

Quantitative
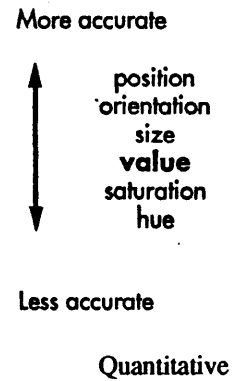
6. Ordinal

Color can be used to sort or order.

(from Mackinlay)

More accurate

↑
position
value
saturation
hue
texture
orientation
size
↓

Less accurate

Ordinal
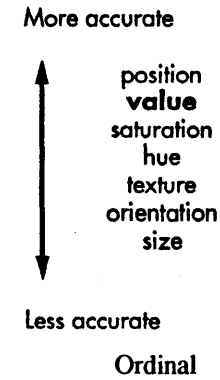
7. Prominence/pre-attentive

Color can be used to get to our attention. There are times for whispering and times for shouting.

(from Mollitor)
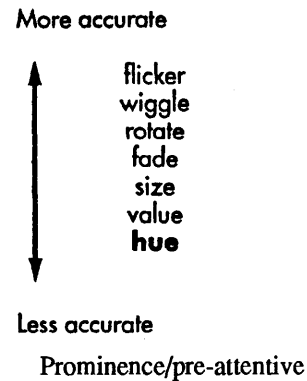
More accurate

↑
flicker
wiggle
rotate
fade
size
value
hue
↓

Less accurate

Prominence/pre-attentive

8. Expressiveness

Color can convey an expressive quality.

loud
↑
↓
quiet ←——→ *wild*

Expressiveness

15
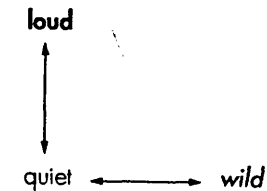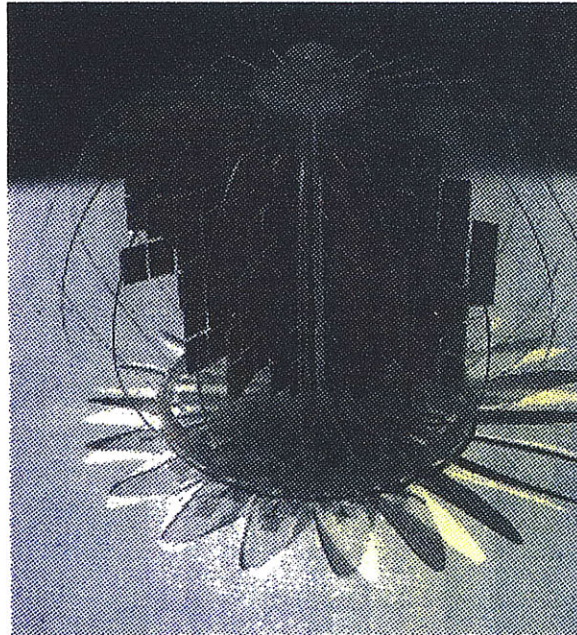
1.3 Color Systems

1.3.1 Color as Pigment

Pigmented color is created from minerals and synthetics. This color system uses red, yellow, and blue as the primary colors. Complementary pairs are derived from combining a secondary color and its primary component. Simply stated, Red is paired with green (green =blue+yellow). Note that a primary color's complement is always the component of the two other primaries:

Primaries: RED, YELLOW, BLUE

Secondaries: Green, Violet, Orange

Complementary pairs:

RED	Green
YELLOW	Violet
BLUE	Orange

HUE	is the name of a color, such as "red".
VALUE	is the amount of tinting, from white to black, added to the pigment.
CHROMA	is the saturation or strength of the pigment -the amount.

The figure to the left is a Munsell color atlas. Munsell notated most of the possible pigmented colors in a three dimensional globe. The north-south axis denotes the value of a color (white on top and black at the southern pole). The distance from the center of the globe to the surface expresses the chroma of a hue (the atlas' core is low chroma, surface is high). The Munsell color notation is considered a standard for color identification.

16

1.3.2 Color as Light

Color is also light. As the physicists would describe; all colors come from white light and the individual hues (wavelengths) can be seen in white light by splitting the wavelengths through a diffuser (a prism). The diagram on the right displays the mixing of colored light. Red, Green, and Blue are the primaries in this system. Combinations of the primaries produce the secondary hues of cyan, magenta, and yellow. Note that all three primaries when combined produce white light.

The CIE Color Standards are the industry benchmark by which all light is calibrated and notated.
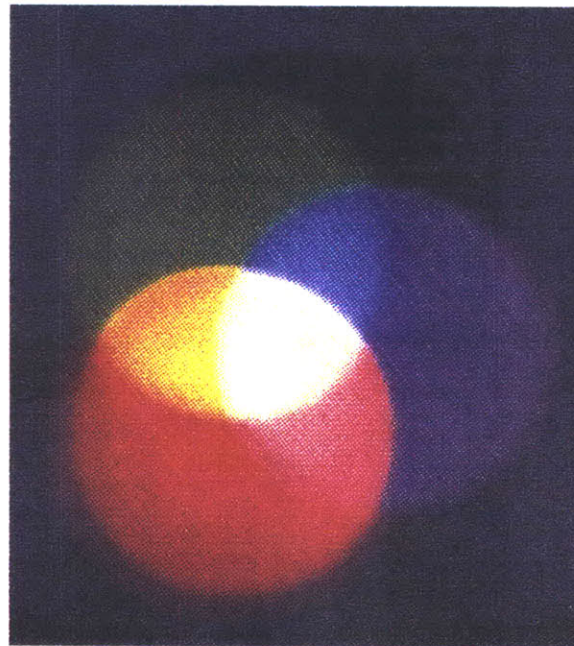
1.3.3 Combining Pigment and Light color systems

I explored the possibilities of combining two systems of color mixing. The initial thesis work is primarily using pigmented mediums in painting, pastels, and colored and achromatic sketches. As the design developed, I incorporated computer geometrical modelling. Color mixing in the computer involves thinking of color as light. The light mixing system can be thought of as a subtractive mixing. That is; red plus blue does not equal violet but rather magenta and red plus green equals yellow.

True integration of both color systems in the design occurs in the placement of my pigmented studies into the computer environment. By scanning in slides and flatwork I developed several "palettes" that were originally created with pigments. These "palettes" influenced the creation of rendering materials for image processing. The process then goes full circle when I print the computer images using a color postscript printer (pigmented thermal wax).

Matching a pigment color to a light color and then matching screen color to printed output was a challenge. In some cases the color remained consistent, in others the output was less desirable.
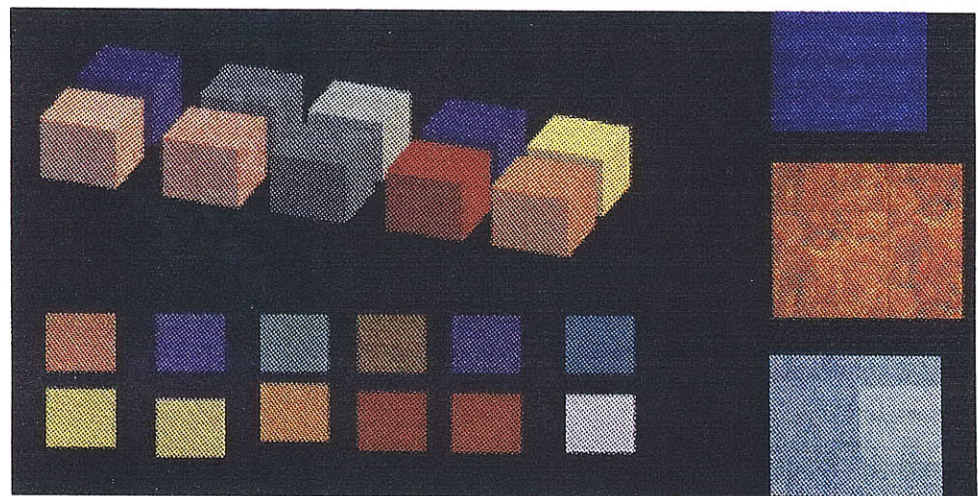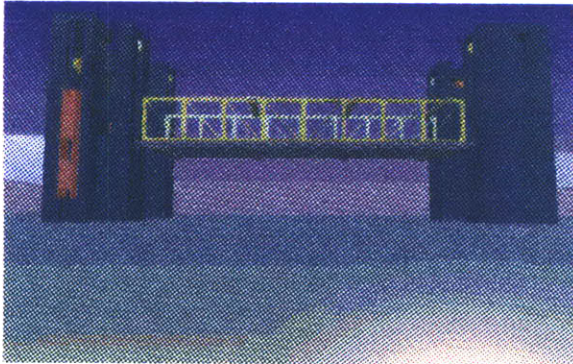
"Art does not reproduce the visible, but makes visible."

- Paul Klee, Paul Klee and the Bauhaus

"The subject: A lemon beside an orange is no longer a lemon, the orange no longer an orange; they have become fruit. Mathematicians follow this law. So do we."

- Georges Braque

2.0 Relating Color and Architecture

What separates the understanding of color in painting and architecture is the fundamental difference between static and transient color perception. The artist Robert Slutzsky, Professor of Architecture at The Cooper-Union explains:

> Surface and concealment, illumination and opacity, in the physical and metaphysical sense have always been the elemental resonating forces of painting and architecture. Oscillating between quantifiable entities and ineffable presences, both mediums employ color. ...In painting, the factive plane supporting a pigmented surface yields to fictive 'content.' Its pulse is measured by the intensity of this generic contradiction between 'actual' and 'virtual' space. Chroma narrates not only its own process of coming to presence, but that of referential illusion too. But if painting is ultimately not only about itself, it nevertheless takes root in color and surface. Perceived ideally in optimum light, actual space, and the absence of distraction it is an affair between a flat object laden with emergent imageries and a willing receptor dedicated to complete contemplation. Here color maintains its permanence i.e.., the color red is consistently read, given, of course, that its redness is psychically defined by its larger configurational contexts.

Simply stated, painting is ultimately responsible to its own canvas. The viewer's relationship to the space created on the canvas is physically seperated and the focus point static. The context (the canvas) is controled by the artist and the colors remain true to the painter's vision. Interaction of colors, is manageable and their outcome predictable. As the painting becomes larger (greater than human height) the possibility to percieve one's self in the painted space increases. This is evident in large paintings and particularly in murals. Also, it is important to recognize that the perception of twenty inches of blue is very different from twenty feet of blue. Our perception is always relative to the context (of a view).

In architecture the viewer is in the context and the interaction of colors is relative to the viewer's perspective. Architecture offers the third dimension for exploring color relationships and the impact of changing loci. The speed with which the viewer moves grately impacts the perception of color. For example; if one were to stare at a yellow and purple vertically striped wall at a standstill the individual color recognition would be high. However, moving at ten miles per hour a thinly striped wall would appear grey. This is due to the optical mixing of two colors brought on by movement. (For more information about optical mixing and after image effects refer to Lois Swirnoff in Dimensional Color).

Robert Slutzsky, on architecture:

Architecture reverses the statics of this ideal object-receptor relationship. There is little in the way of 'ideal' view, for its receptor is mobile and usually motivated by extra-pictorial intentions. Structured not only for visual perception but other perceptions as well, architecture becomes the unavoidable victim of those changing forces that mark its presence, subject to the fickleness of nature and the planned and random use of its participants. At the same time, when not intensifying architectural theatricies, color aids and

On Language:

"Perception involves more than what meets the eye: it involves processing and organization of recorded data. When we name an object, we actually name a concept: such words as 'octahedron', 'collage', 'tessellation', 'dome'each designate a wide variety of objects sharing certain characteristics. When we devise ways of transforming a octahedron, or determine whether a given shape will tessellate the plane, we make use of these characteristics which constitute the grammar of structure."

- Arthur L. Loeb
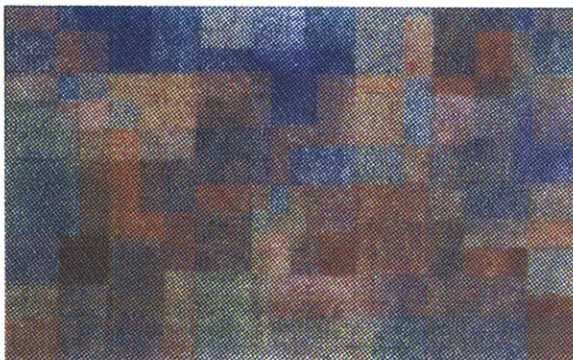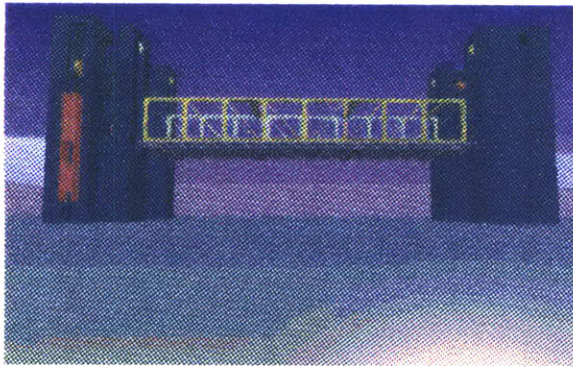
abets the more mundane functions that constitutes the total architectural experience. It promotes the viewer-user's active response, enhancing the legibility of volumetric and planar configurations, architecture being more dependent on drawing (disegno) than color. But even in its relatively achromatic state, built form receives and plays with color in an ambient way, reflecting those sources of illumination that happen to be. Its existence is thus never entirely 'colorless'; 'color' always appears.

Robert Slutzsky, "Painting, Achitecture...Color"

Unlike painting, architecture must remain accountable for the habitable experience. The responsibility to maintain a reality keeps architecture in a dialogue between meaning and physicality. Painting is not bound by social norms of appropriate color selection. "Yet architecture shares with painting color's other propensities, particularly its capacity to serve as a conceptual tool for structuring space (R. Slutzsky)."

There is an omission in the way architects think of color and its use. Many architects use color as a conceptual coding and always secondary in the design process. The issue here is that color can be integral in the design process and inform the making of space. Only a few architects use color as a tool for structuring space and conveying meaning (more later). My question is; "why if architects are professional about form are they not professional about color?" Like two sides of a coin, form and color are integral components that shape perception. This thesis uses various color concepts as a system or

design tool for making architecture.

My process for developing a vocabulary for intelligently communicating color and form is three fold:

(1)   The first step is to catalog various references into specific approaches for using color. By naming the objects and constantly updating their relationships within a vocabulary (system) I am identifying the concepts and creating distinctions that enhance my color communication. - See Arthur L. Loeb quote.

(2)   Secondly, I identify what is interpretive color use from that which is outside of interpretation. Specifically, identifying color descriptors that are subjective or semantic (associative- laden with meaning) from descriptors that are more generic. One of the reasons for doing this identification is to be rigorous and specific in the communication of the interaction of color. For example, when associating yellow with ripe bananas there is a large tolerance for variation in hue, value, and chroma. A banana can appear yellow ("ripe" -association) yet be greenish or brownish when next to a lemon. However when I describe the banana's color as a specific hue, value, and chroma the room for interpretation is greatly reduced. This is helpful when clear communication is desired (note: sometimes it is desirable to be ambiguous).

(3)   Thirdly, I identify conventional associations of specific colors I chose to use in the design of the bridge and my personal associations to the same palette. This process is in endeavor to be accountable for a conventional perception of color in the habitable experience while exploring an expressive color palette that I like.

24

Theo van Doesburg
"The new architecture permits colour to act organically as a direct means of expressing its relations within space and time. The state of balance of organic relations is rendered visible solely through the medium of colour. The task of the modern painter consists in creating with the aid of colour a harmonious whole in the new four-dimensional space-time-field - and not a surface in two dimensions. Colour (and the colour-shy must try to understand this) is not a decorative part of architecture, but its organic means of expression." (1924)
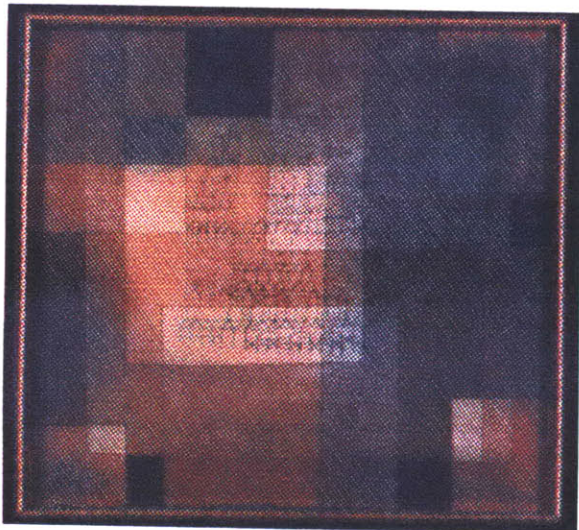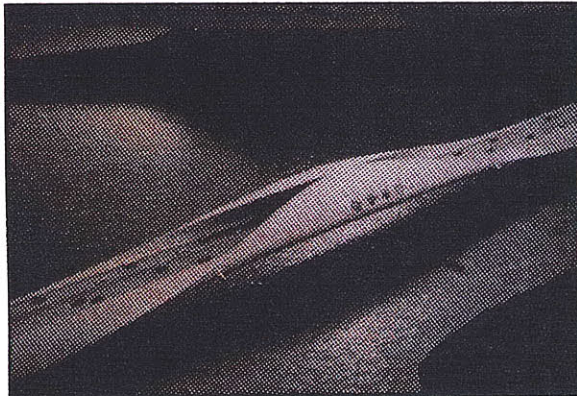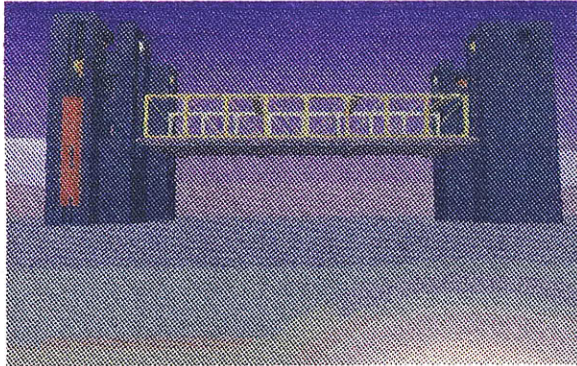
3.0 The Project

3.1 Site Description and Programmatic Constraints

I chose to design a bridge as a vehicle for exploring color issues. The site is in Tacoma Washington spanning across the Thea Foss waterway connecting downtown and the "tide flats" -Tacoma's industrial area. The reason for a bridge is because of its realtively simple program and due to its length, it enables me to design color and form at a range of sizes (human scale to vehicular experience). The intention is to focus on color and incorporate color concept in the design process. This is evident in the following pages of design documntation.

Site Specifics: The Thea Foss Waterway is three and one half miles of continuous shoreline adjacent to Commencement Bay and Tacoma's Central Business District (CBD). Downtown is eighty feet above sea level and the opposite bank is approximately ten feet above high tide. Tacoma has conducted studies and submitted a redevelopment plan to encourage public and private growth and enhance waterway activities.

At the beginning of Thesis I was set on spending considerable time investigating architectural issues such as; the relationship of the bridge to the access along the waterway and the possibility of habitation on the bridge. These issues among others were not addressed. Instead I chose to concentrate on creating design mthodolgies for including color in my design process.

The project

Pierce Transit Intermodal Facility

Historic Ship Moorage

SR 509 Bridge

Albers Mill
- Commercial development w/public site amenities
- Design by Merritt-Pardini and city

Parcel 3
- Mixed use development
- Retail at first floor
- Open space at waterfront

New Washington State Historical Society Museum

...treet to Dock Street
...rad Overpass

...Street
- Improved street and viewpoints
- ...ontinuous bicycle route
- ...reet trees

...hester Osgood Waterway
- ...ffice development
- ...abitat restoration
- ...andscaped path at shoreline

...w boat ramp and
...ndscaped parking

...E. Industrial Shoreline
- Improved public access
- Rehabilitate degraded shoreline
- Street end parks
- Painted graphics on tanks
- Marina development is a possibility if industry leaves

Union Station Connection
- Landscaped Bridge/Park

Union Station Rehabilitation w/Courthouse Addition

South Bridge
- Civic plaza
- Parking below
- Landscaped surface
- Art and amphitheater possibilities

11th Street Bridge
- Restored structure with new paint, color and lighting
- Covered walk
- New stair/ramp to civic plaza
- Elevator to Municipal Dock

Municipal Dock
- Passenger ferry
- Public "destination" use in building
- Improved boardwalk

Continuous Shoreline Esplanade
- Consistent paving
- Landscaping
- Site features

Totem Marina
- Master-planned site with consolidated buildings
- Improved esplanade

Puget Sound Freight Building
- Maritime or commercial use in restored building
- Improved esplanade
- Improved waterside elevation

Thea Foss Waterway · A Vision for the Future

City of Tacoma
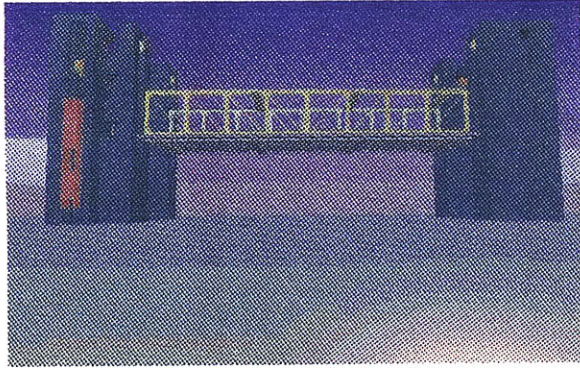
3.2 Bridge Types:
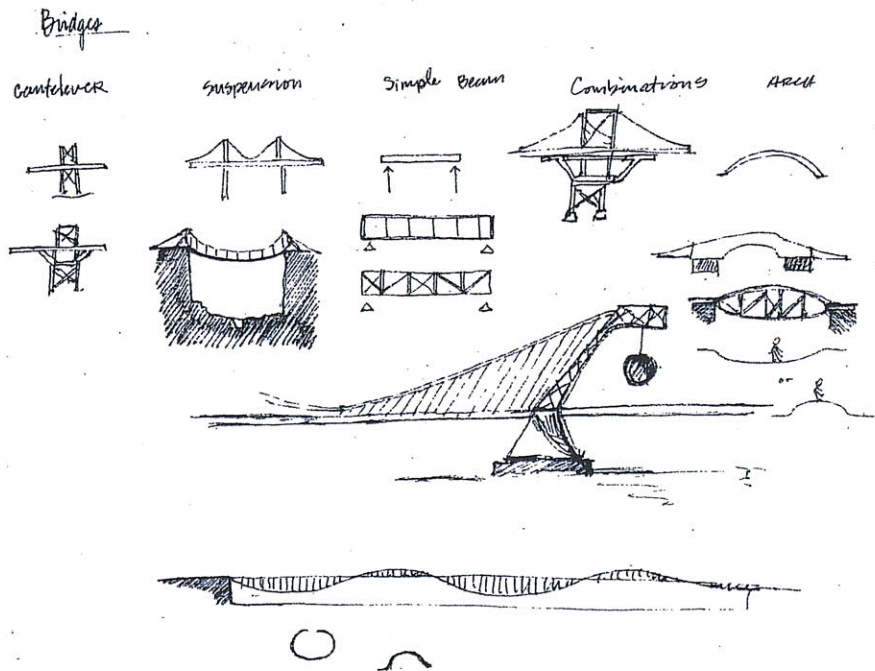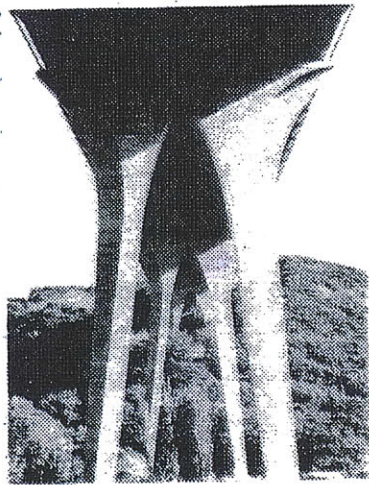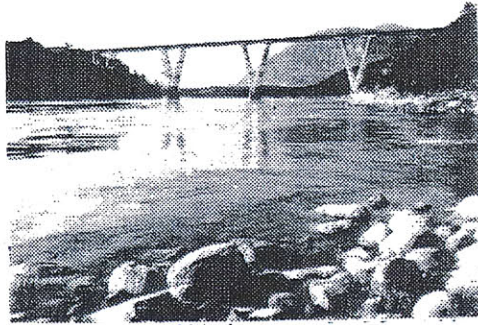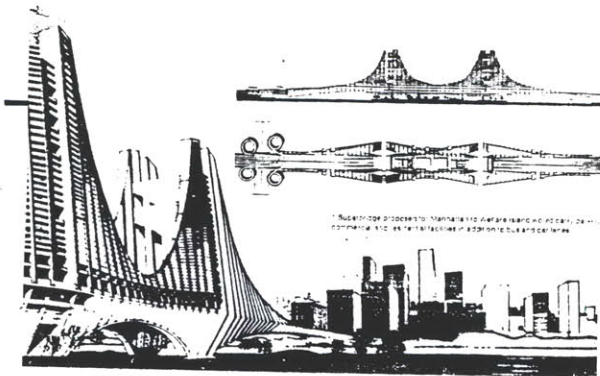
for miles and even intersect to form networks, virtually creating cities over cities. At the present time, such concepts are probably not economical, although future urban growth may require new bridge configurations of this type.

More modest projects

On a more modest scale, air-right bridge buildings, however, are being used. One example is an existing bridge-restaurant spanning I-35 across the Tri-State Toll Road near South Holland, Ill. Others of similar nature also are being constructed in different parts of the United States and Europe. Uses for some of the new air-right bridges range from offices and libraries to tennis courts and parks—indicating the large untapped architectural resources of these structures.

Not only is the space above bridges being used for architectural purposes, but the space below as well. One example is found in crowded Tokyo where the space under a highway bridge (3) is occupied by commercial buildings. Similarly in Osaka, a half-mile portion of a six-lane expressway bridge passes over four stories of commercial buildings. An air gap of several feet between the roofs of buildings and the roadway helps acoustic and deflection control, although the buildings and the bridges are interrelated. Also along this Osaka expressway, a three-lane segment passes through the third floor of a building, the Osaka newspaper plant, further demonstrating bridge building possibilities.

wood

31
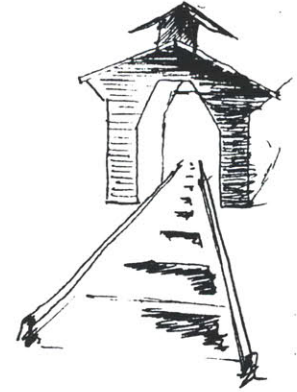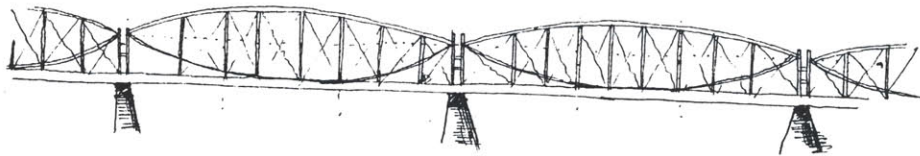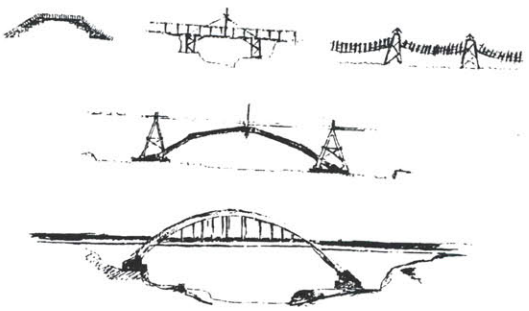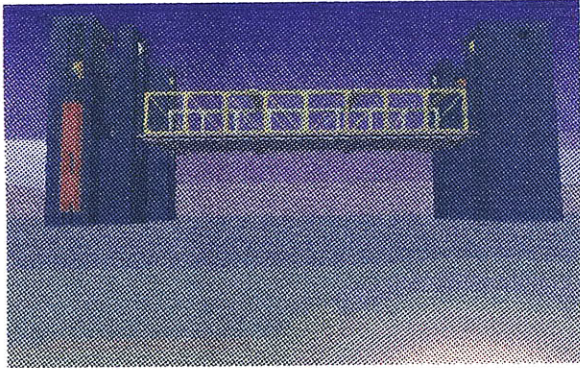
Bridge Transformations ...
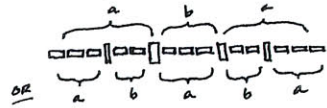
structural rhythms

possible dimensions
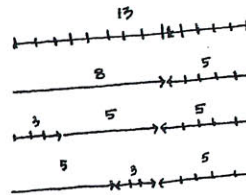
a^{13} or a

$b : a$

$a : b : a$

$b : a : b$

others components
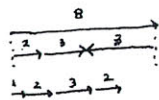
$a : b : b$

$a : b : c : b :$
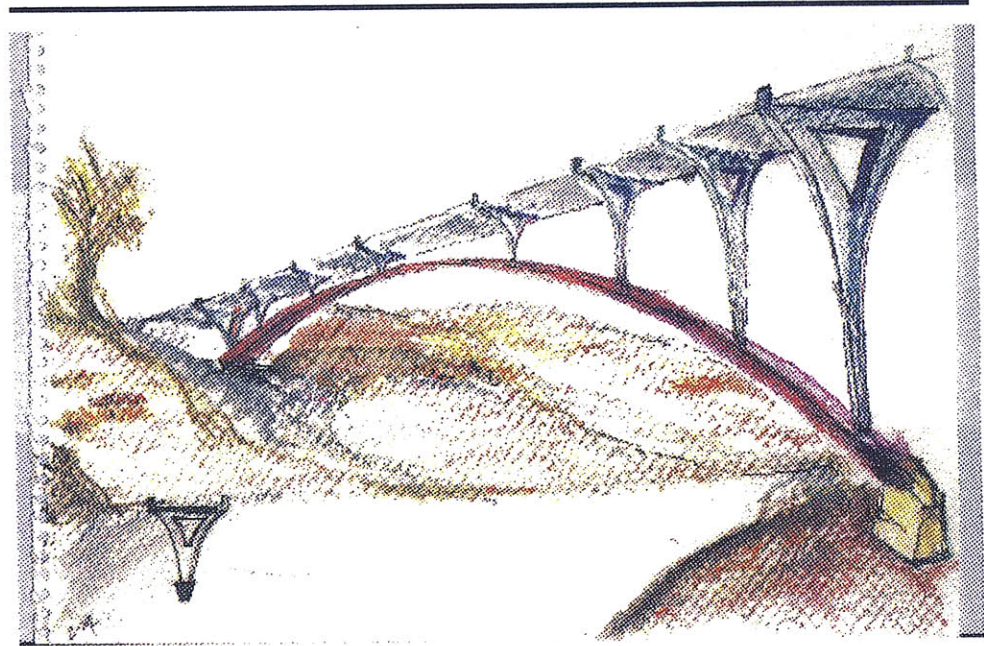
3.3 Schemes

The following pages display three schemes for the design of the bridge in Tacoma. Several color approaches were used simultaneously in each of the three schemes.

3.3.1 Scheme One

The primary focus of the first scheme is the identification of a structural rhythms for color and form. Parametric variation and and the gradation (mixing) of color are the approaches. The attempt is to use color to describe a dimensional relationship of bridge elements.

I referenced the structural rhythms in Paul Klee's work and in The Thinking Eye (P. Klee) as a departure point my design and also to understand the systems Klee used to generate some of his paintings.

STRUCTURAL
RHYTHMS

a:b:a:b:a   A   B   C   B   A

COLOR + MATERIAL ...

A: B: A: etc ...

transparent   translucent   transparent
              screen(s)

a. darker colors   a. light colors   a. middle of span
b. blues   orange   perhaps more
   greens   yellow   centrally located
                      red   [color wheel] colors.
                                          "greyed"
                                       b. light/dark
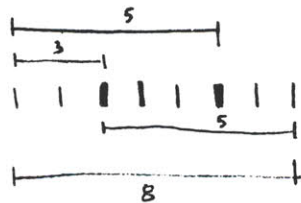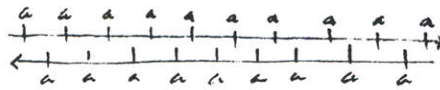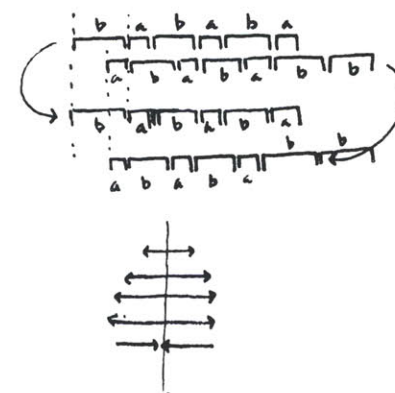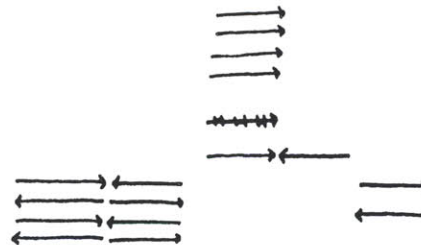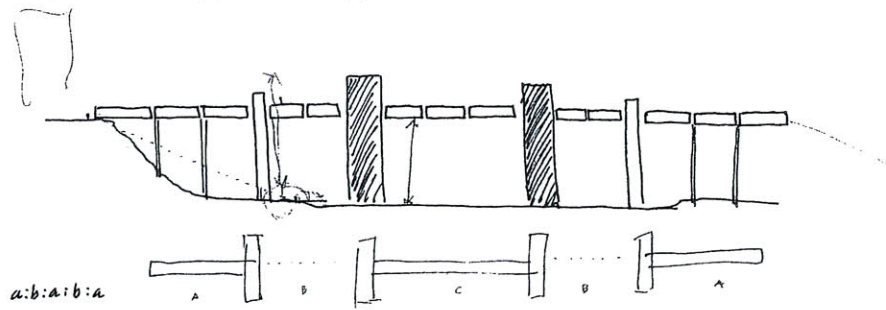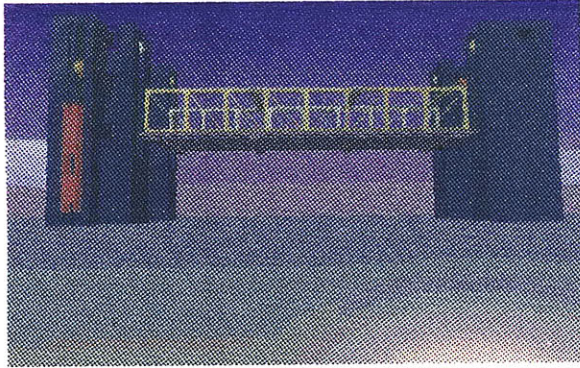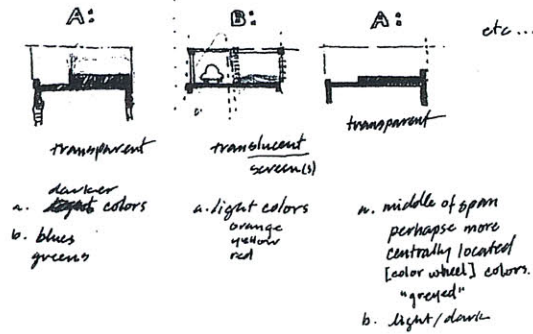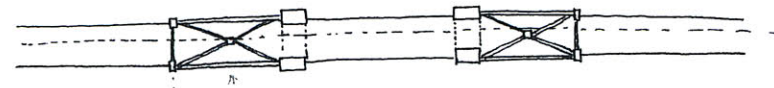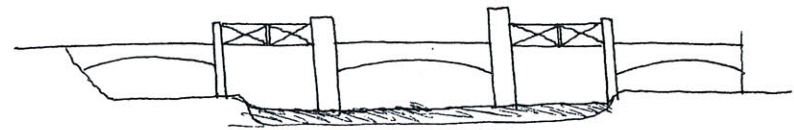
MATERIAL(s)

(a: b: a: b: a:)

a = stone/concrete → heavy

b = iron/steel
    light screens → light.
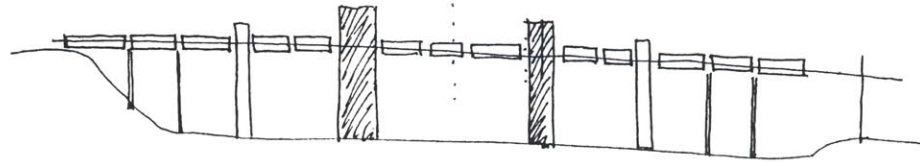
A : B : A STRUCTURE
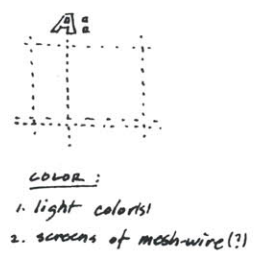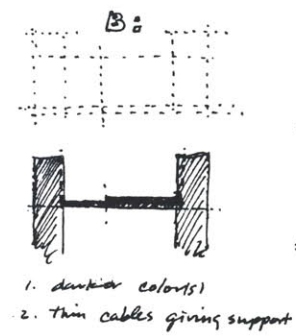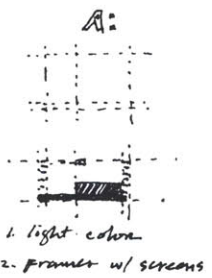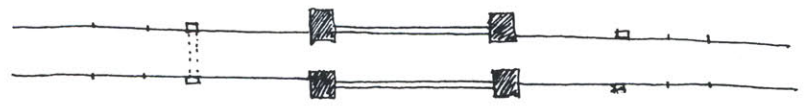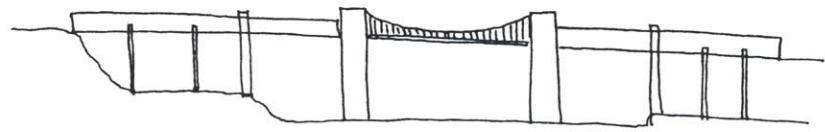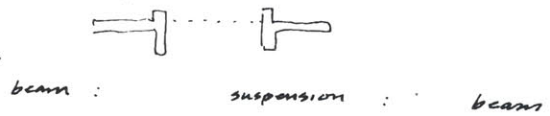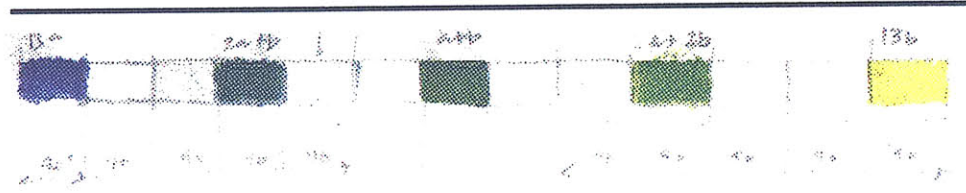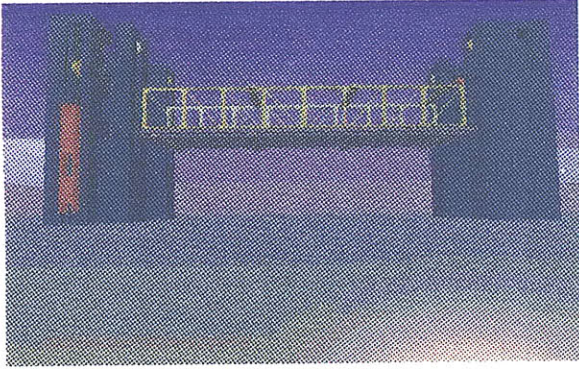
beam : suspension : beams

A:
1. light colors
2. frames w/ screens

B:
1. darker colors
2. thin cables giving support

A:
COLOR:
1. light colors
2. screens of mesh-wire (?)

Color for scheme one:

13 units long

7 steps.   3:5:8:13:21:

40

Value — CHROMA
INC. VALUE
SECTION   CHROMA — HUE
plan

BRIDGE

3 PARTS

A   B   C

2 PARTS

A   B   A

B   A   B
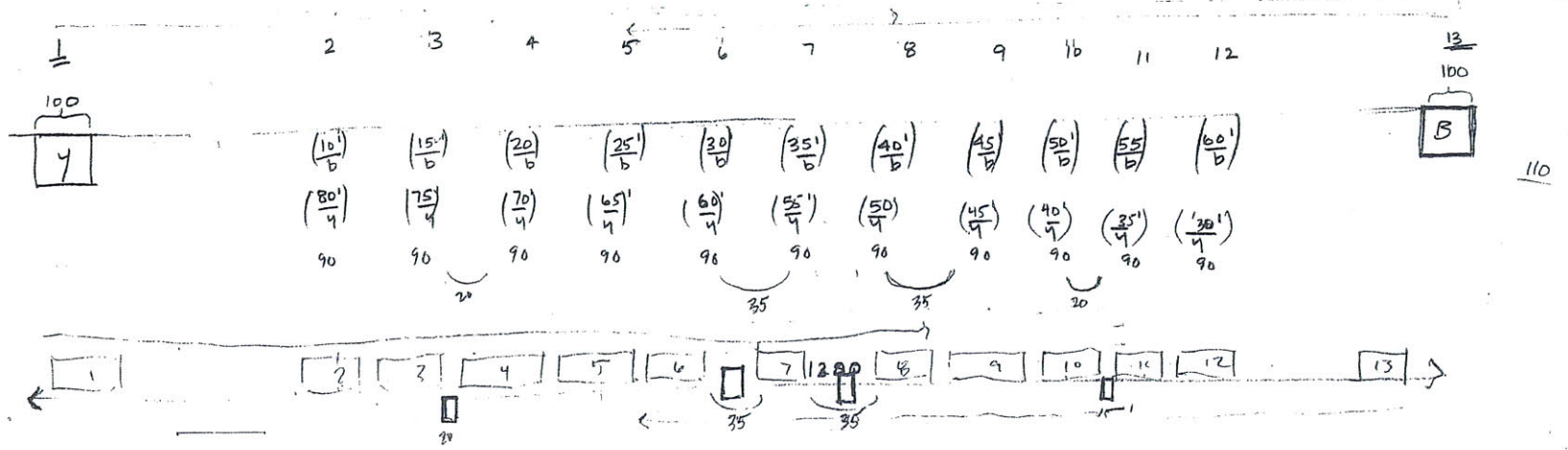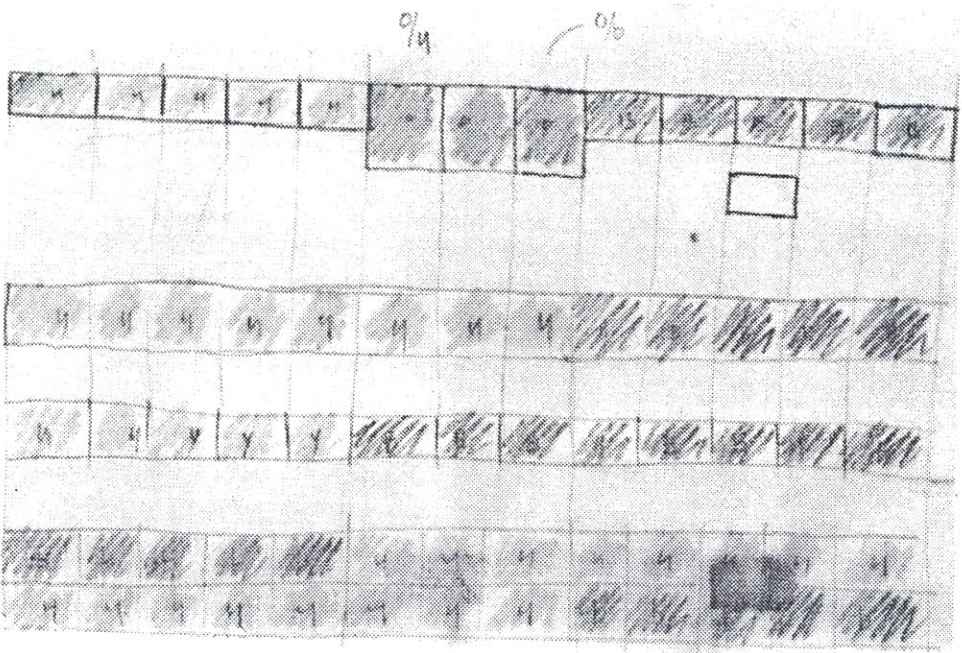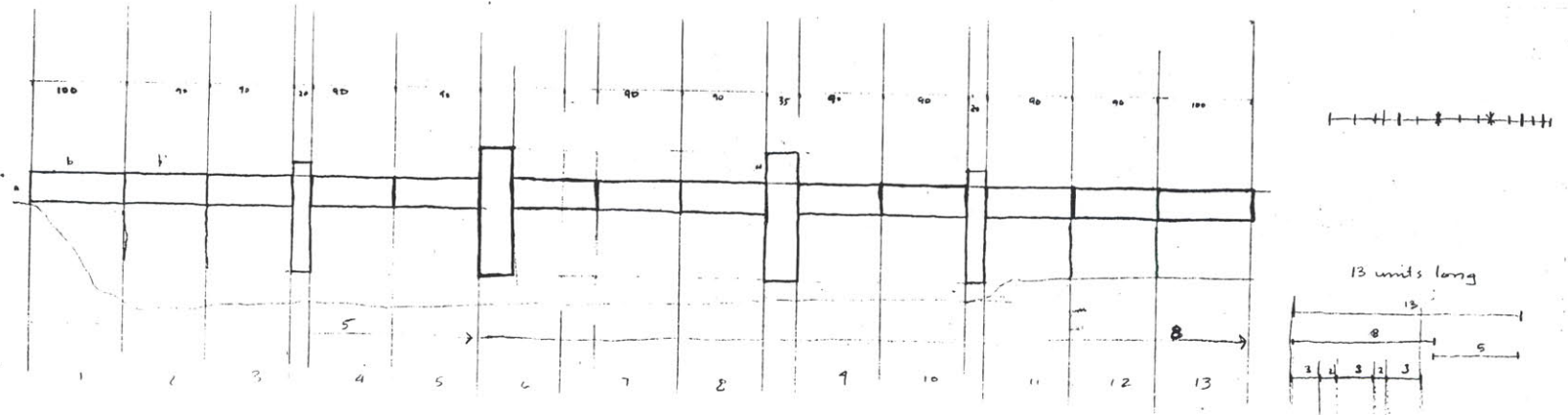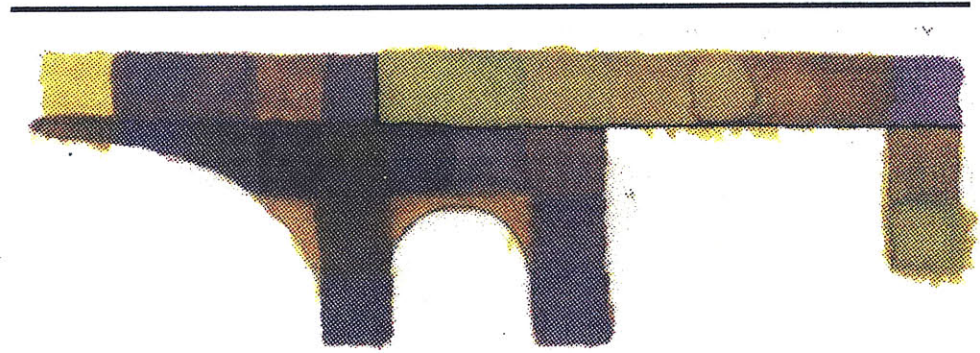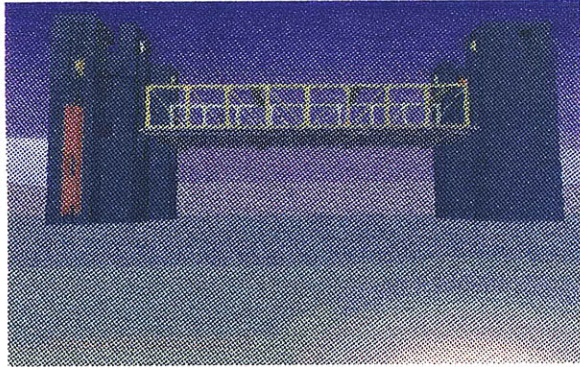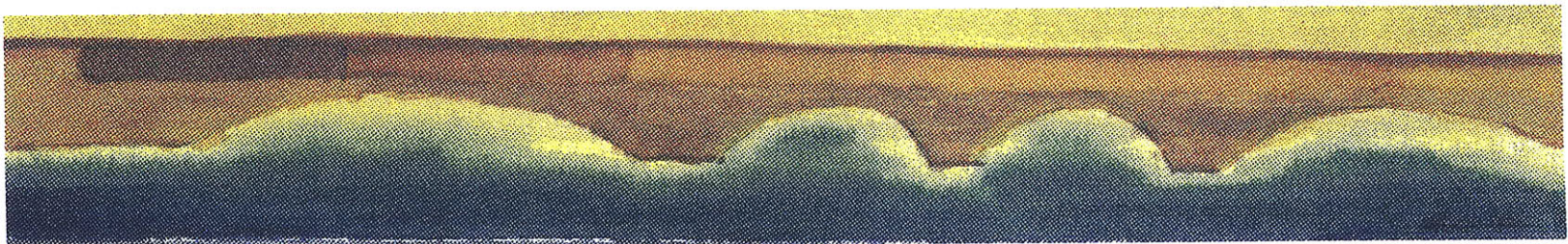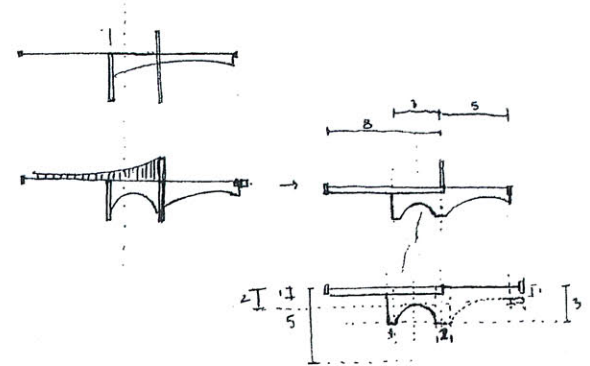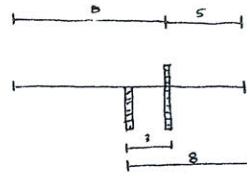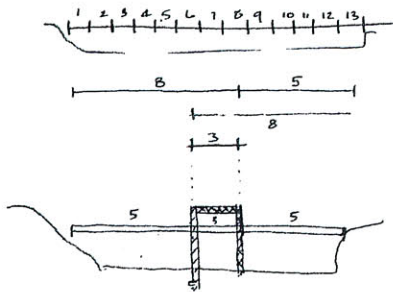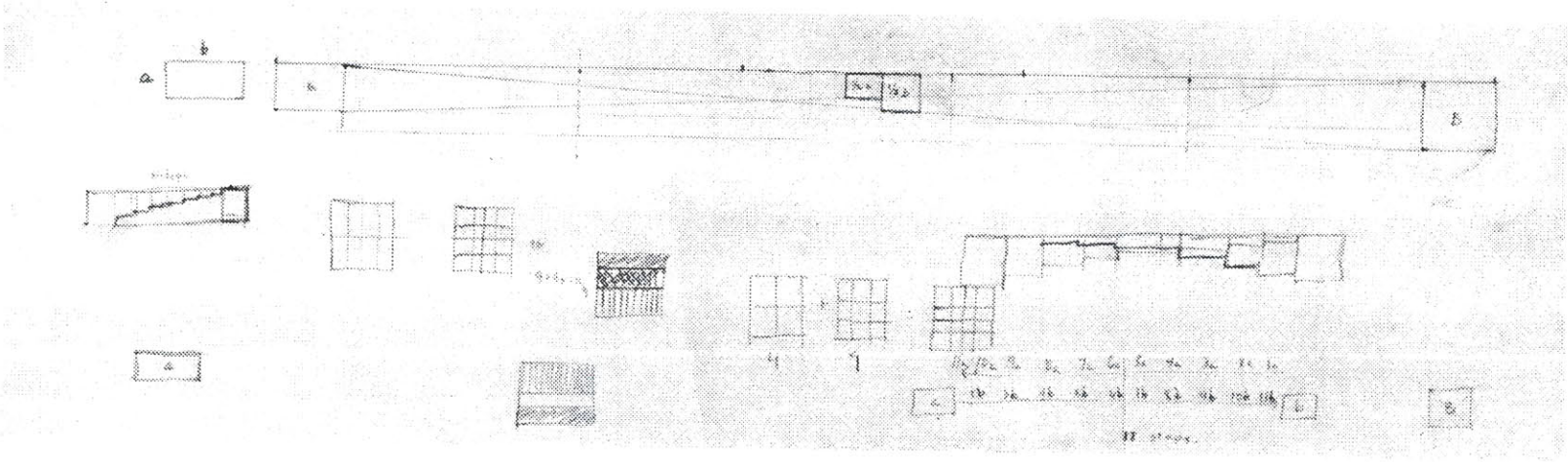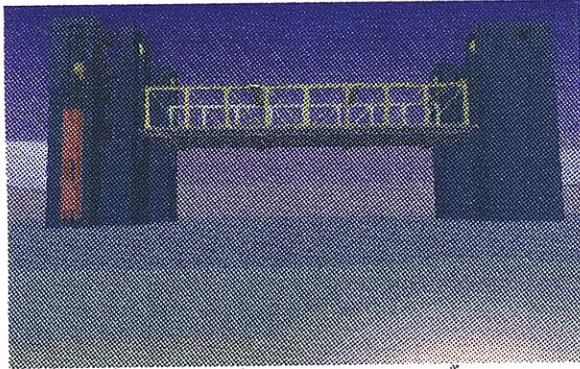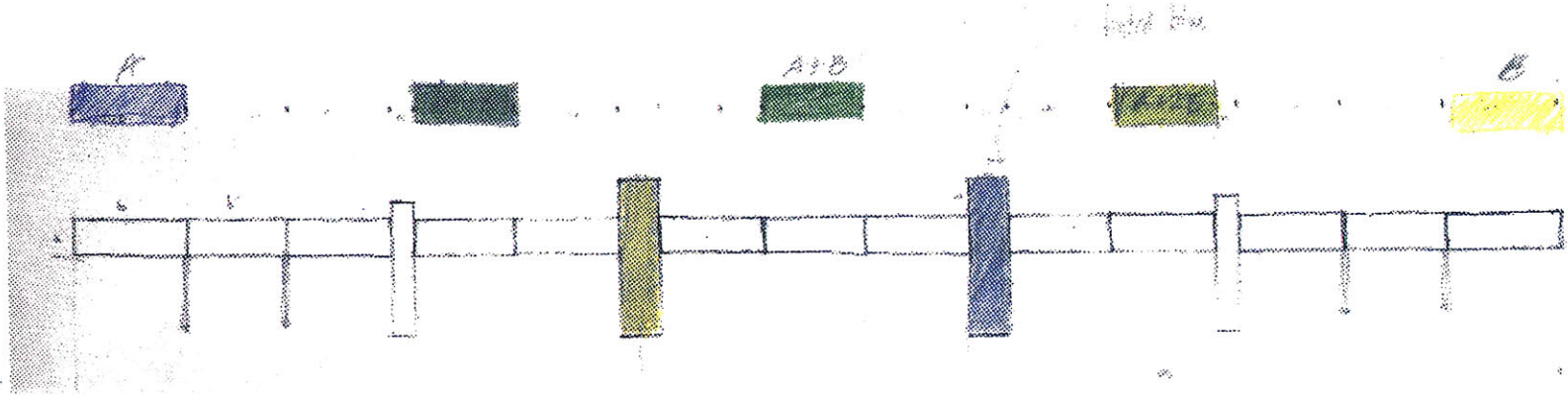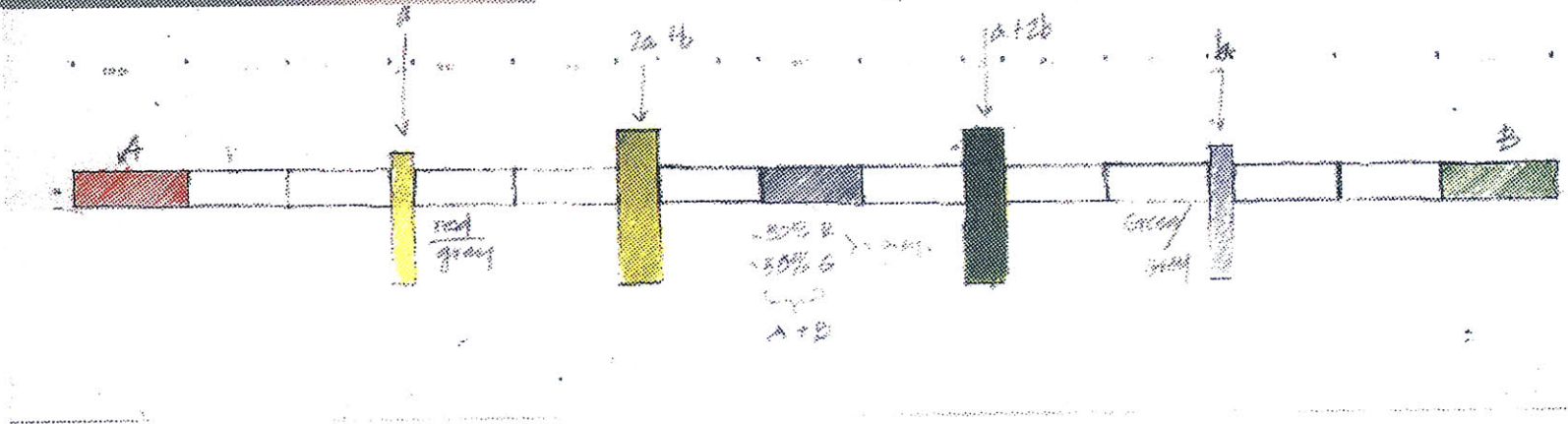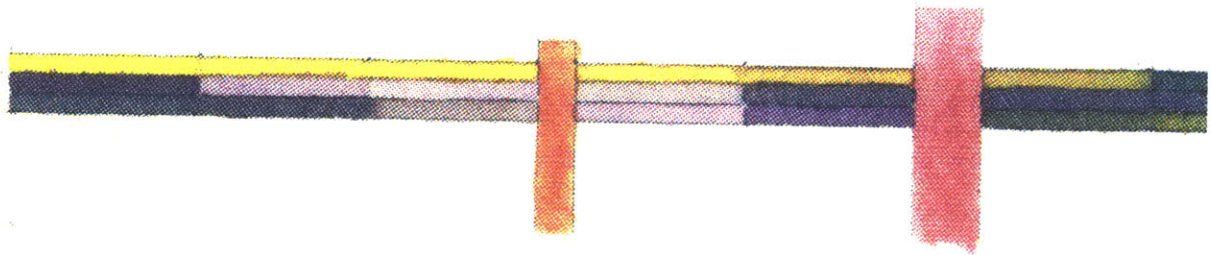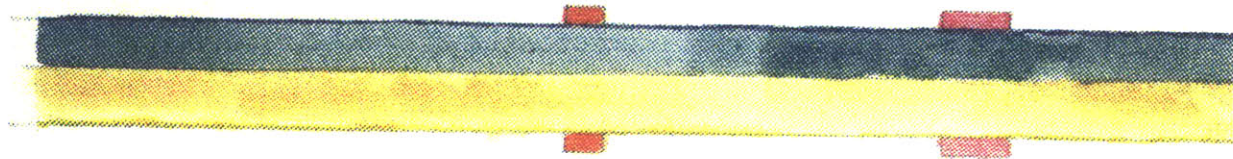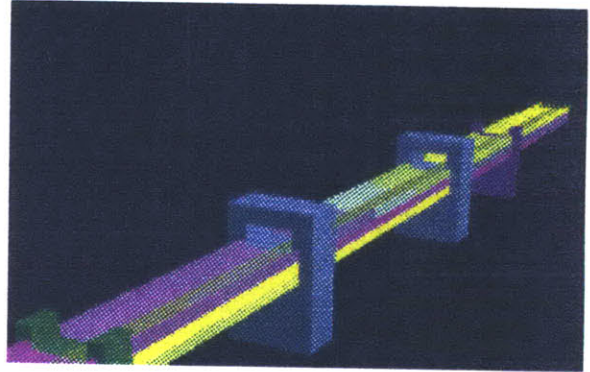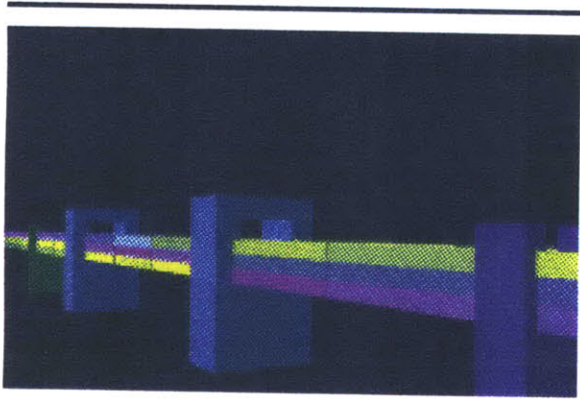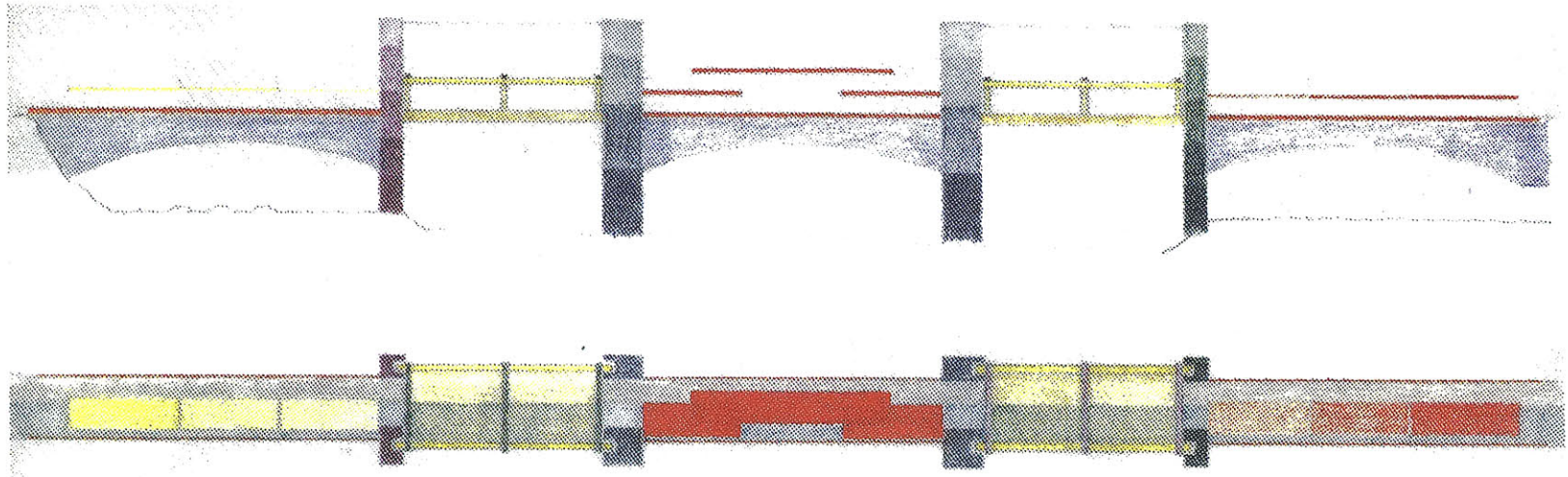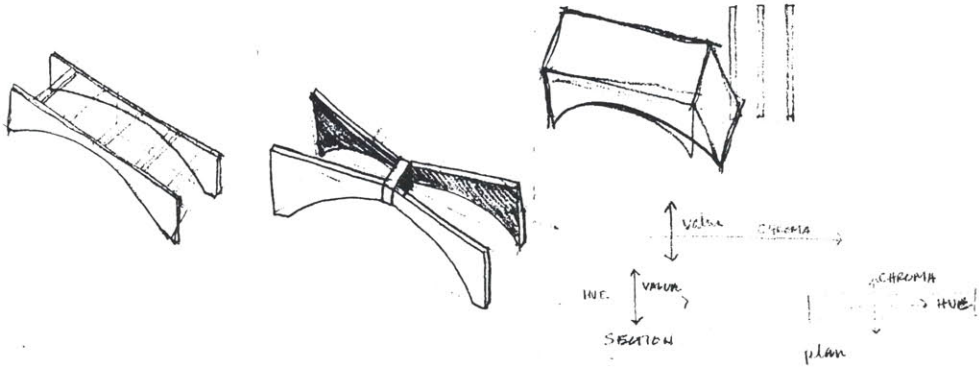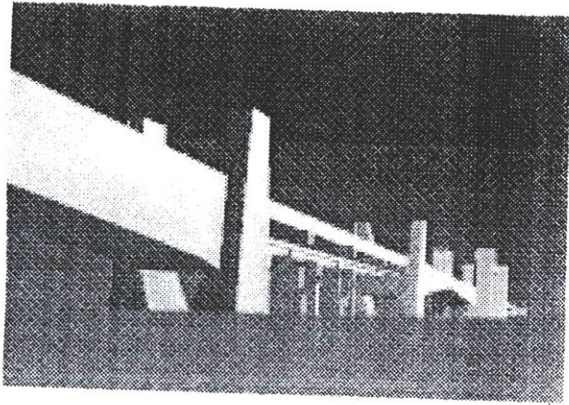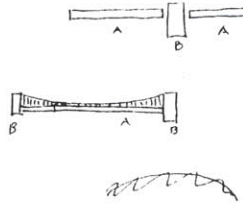
1 PART

Dimensions.

3 DIMENSIONS.

a | b | a   b   a   c

a   B   e

c

a   b   a

46

48

3.3.3 Scheme Three:

The last design pass concentrates on the control of the color and the mapping and sampling of materials. Also, the pedestrian deck and the the car deck are seperated. The change of elevation allows for light to pass through the bridge's structure and allows the pedestrian to see over the cars.

The color explorations were conducted primarily on the computer. Time was spent on mapping color and texture onto the materials assigned to the bridge. Animation was also used to explore motion and the perception of color as speed increases. **A video of the animations is available in the Rotch visuals collection.**

Color saturation was decreased and chroma was lowered in the third scheme.

4.0 "Color Distinctions"

4.1 Methods and Approaches to Implementing Color:

The word distinction is used because it implies a desriptor that is open to new interpretations or revisions to its original state(different from a definition which is fixed). My first step is to create a set of distinctions for the use of color and how it can organize the perceptual and formal experience. The creation of these distinctions comes from collecting references from painting, architecture, and art. I studied: textiles, landscapes, and pigmented castings (i.e.., concrete, sand, and plaster) through 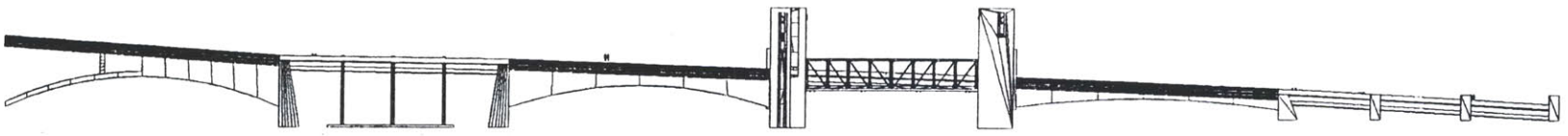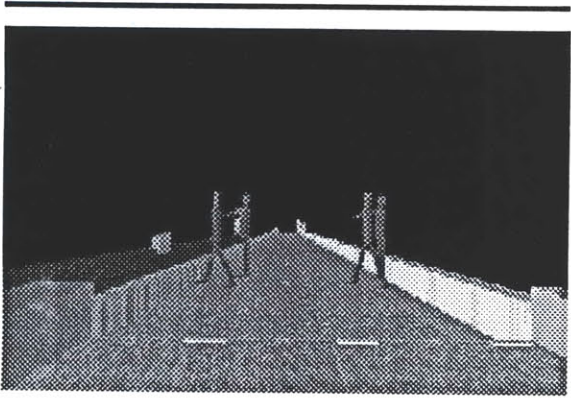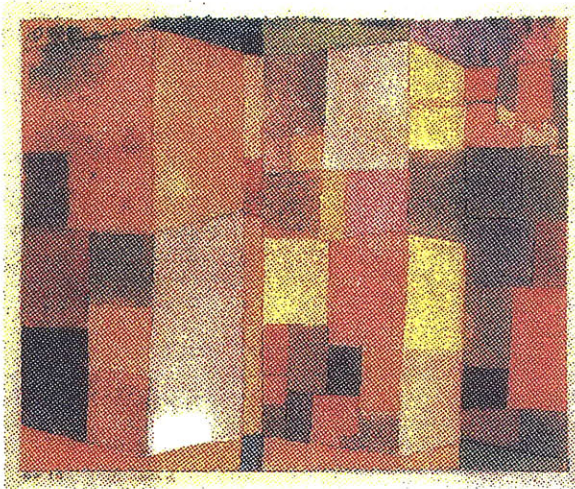painting and study models exploring material and color. From these studies I categorized and created similar approaches to color in the design process.

4.1.1 Choosing color for esthetic reasons

In this process the artist selects color appropriate to the meanings and vision of the composition. Constraints are limited and the reality of the painting is responsible only to itself. Similarly in the built environment all surfaces are treated equal to the painter's canvas. Selection of color may subscribe to some conventional notion of appropriateness, i.e.. fire engine red or salmon pink. However, the artist or architect is primarily concerned with the conveyance of an emotion or style.
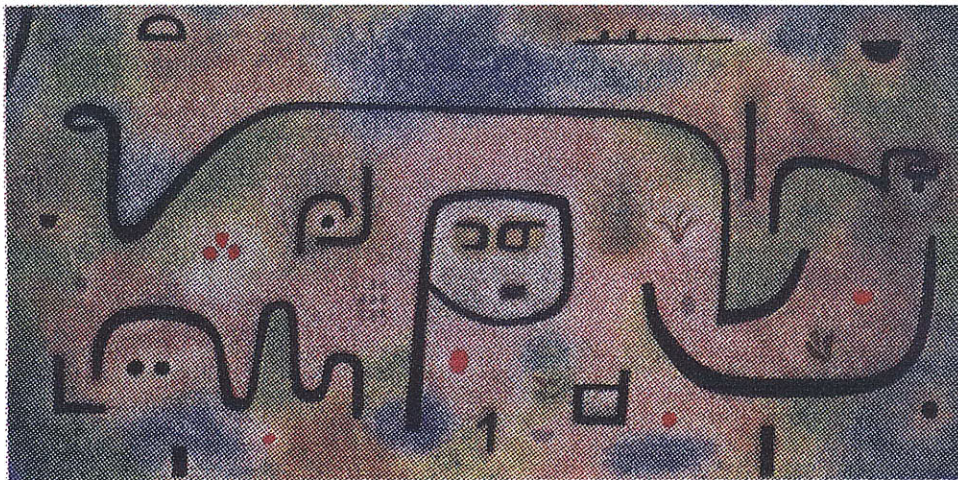
Color Distinctions

4.1.2 Color coding

This refers to assigning a meaning to color that is not inherent in the color itself. There are two separate approaches to color coding:

(1)   One is a mechanical approach to assigning color such as; "all hot water pipes are to be coded red."

(2)   Another approach is to assign meaning consistent with a convention or cultural norm. Nature is often the most popular reference:

For example; snow is a continuous surface and therefore all continuous surfaces should be white. Kandinsky said "green is nature's gray" and most associate yellow as virtual light. However, if the color is abstracted from its reference, i.e.. the landscape the meaning is lost and anomalies will arise. This is why the color green is not always seen as a reference to leaves in an urban setting.

In Van Eyck's Home for Unwed Mother's the colors do not relate to the landscape; consequently the associative meanings are lost. As you enter, the colors express movement through a color rainbow or color wheel. For example, two primary colors are separated by the component of the two; blue and yellow are separated by green and so on.
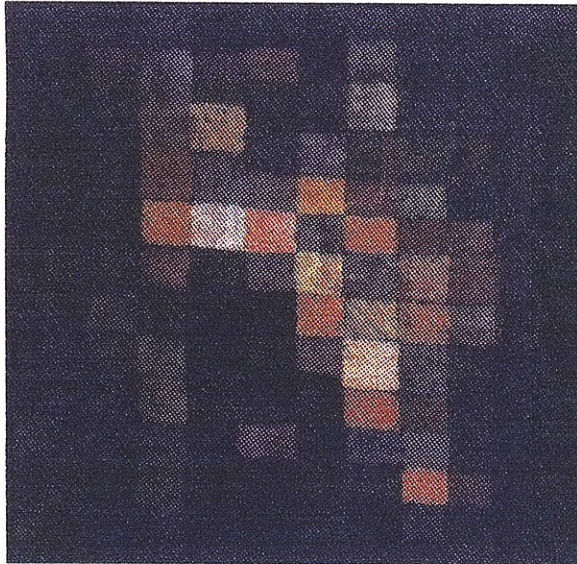
4.1.3 Systematic/structural deployment of color.

Deploying color as a conceptual tool for structuring space.

Borrowing from a painterly notion of color as a method for structuring space on the canvas, one finds examples that can be applied to architecture: Spatial depth, transparency, and light can be communicated through the careful selection of hues with differing values and subtle chromatic changes.

In Louis Barragán's architecture subtle shades of pinks juxtaposed provide a softness and warmth to the heavy plaster walls. Furthermore, when these subtle hues are complemented with highly chromatic colors, the spatial experience is enhanced. Vibrations of color occur and the connection to color concept is immediate.

Color vibration or revving, occurs when the reflected light of two colors produces a third hue. Corbu uses this technique in many of his buildings. For example in the Unité dé Habitatión each room has one colored wall, i.e.. blue, and the rest are white. The color of all walls change relative to the light and proximity to the blue wall. By painting one surface blue, Corbu designed a room where all walls are subtle tints of blue/white enhancing the perceptual experience.

While color and form are bound by the same geometric constraints in Corbu's architecture, Adolf Loos deploys color differently. For example, in the Moller house the ceiling color moves down the wall enhancing multiple readings of the form. This is created by building an exchange between the wall and ceiling through color. Loos paints his architecture so that the understanding of the spatial relationships is enhanced.

I think the difference between Loos and Corbu is that Loos thinks of color as a geometrical form which he deploys techtonically and Corbu thinks of color like a painter interested in the reflective qualities of hues. Nonetheless, both explore systematic color applications.

4.1.4 Color inherent in a material

There are two categories in this distinction; material with consistent color throughout its cross section and color impregnated material.

Consistently colored materials are generally casted, i.e.. pigmented concrete, plastics, and colored metals. Material such as wood, although may have variations in color (e.g.., grain, knots) still has an inherent and consistent color.

Color impregnated materials include frescos, pigmented plaster, and anodized metals. The distinction between this category and materials with painted surfaces is that the process of coloring alters the material itself. For example, the technique of fresco combines two elements, plaster and paint, and produces third element; an amalgam.

Using color inherent materials is one way of thinking about color directly in the design process.

4.1.5 Color theory

The description of color as a number within a convention

Color theorists like Goethe and Johannes Itten created a vocabulary for describing color. Properties such as Hue, Value, and Chroma were assigned to positions on a wheel or triangle as a way of graphically illustrating the relationships between each hue and the result of mixing two colors. Terms were created like; primary, secondary, and tertiary

63
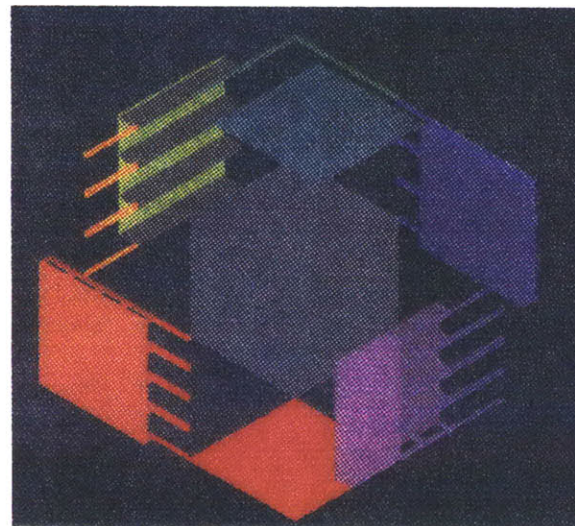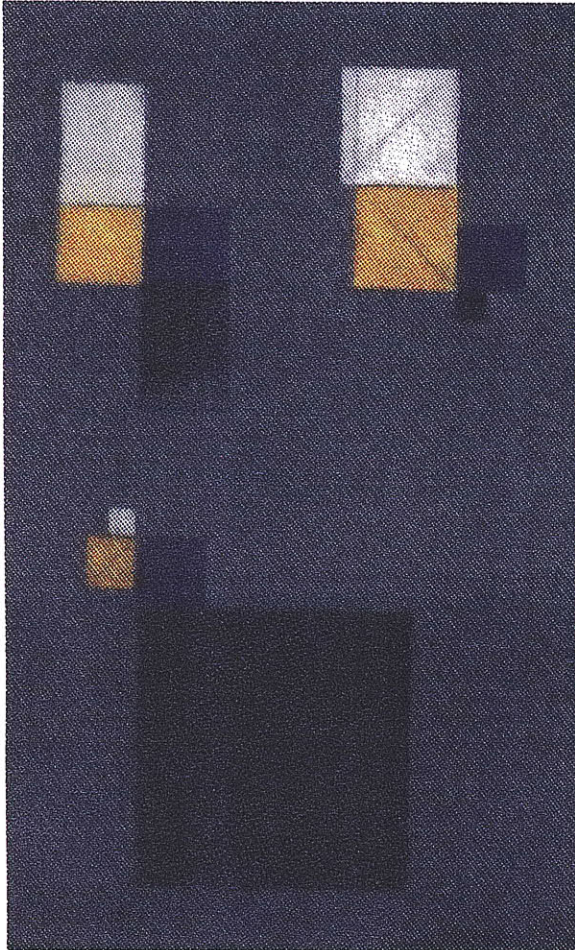
colors. Other's chose to describe color mathematically. A.H. Munsell developed color notation, a system of assigning color a number locating its vectors within a globe or atlas of color.

Painters like Paul Klee and Wassliy Kandinsky used color notation to explore formulaic compositions and 'colored musical scores.'
Color theorists propose that by being able to describe color one has to know color. Therefore through knowledge and description color can be communicated. Communication of a color concept is the purpose behind color theory.

Brouno Taut and Robert Slutzsky are two architects that have used color theory to influence their designs. Slutzsky use color number to generate the geometrical form and determine the proximities and proportions of the colors used. Bruno Taut explores color primaries in relationship to complementary colors in "Uncle Tom's Cabin" in Berlin. Both use color theory to generate architecture.

4.2 Interpretations and autonomous systems:

The process of developing a color vocabulary as a tool for the design process will take three steps:

    (1)   Associative Approach
                 - Identification of norms of color (cultural & regional)
                 - Determining direct associations of a color to:
                 a) Food
                 b) Landscape or nature
    c) Emotional response and perceptual
           understandings

    (2)   Objective Approach
            - An attempt to identify universal aspects not governed by norms.
                 a) Autonomous systems of color (Syntax)
                 b) Syntax vs. Grammar

- distinguishing what is inherent from that which is a conventional specific use.

Grammatical rules (semantics) are created out of one's interpretation of form-use and are influenced by convention and culture.
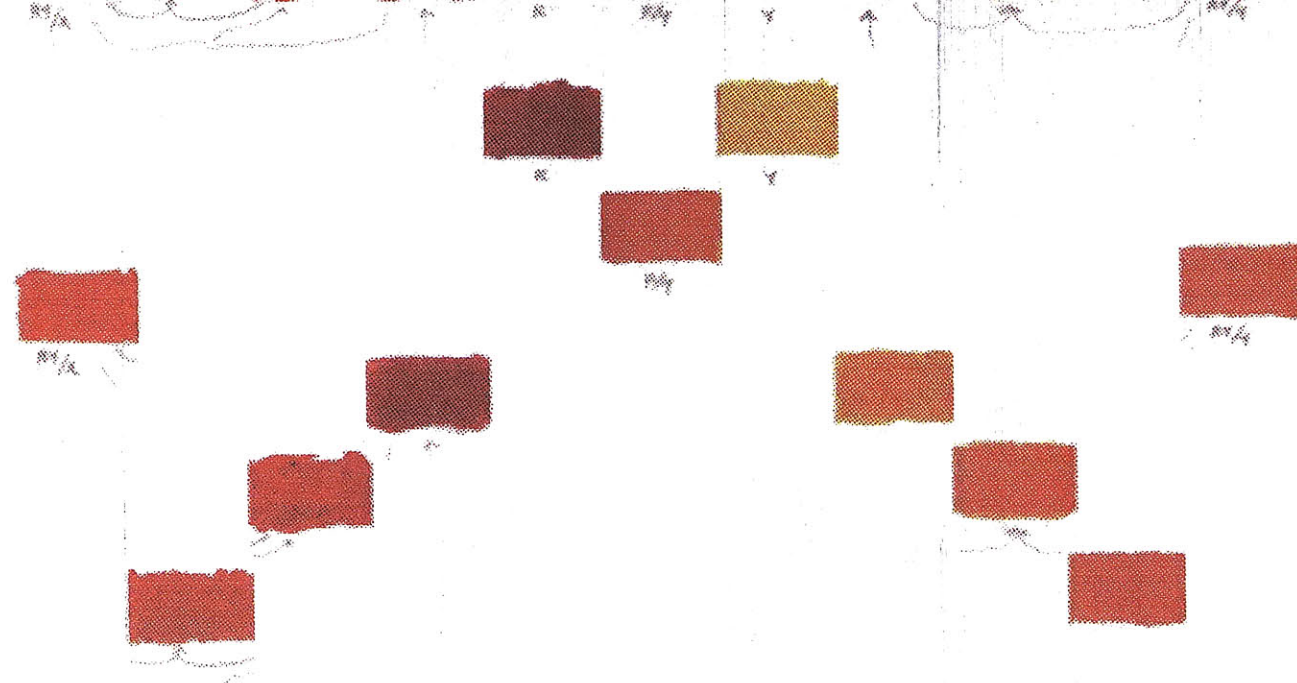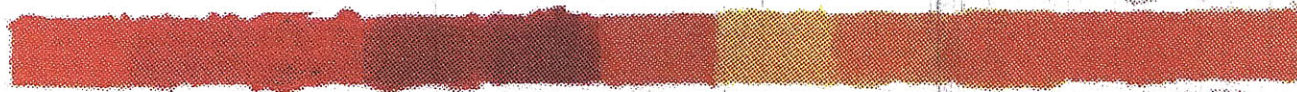
Therefore it is important to acknowledge the domain one is working in so that there is a clear understanding of what is interpretive (grammatical) and what might be considered autonomous (syntax).

What this means to the world of color and architecture is that there are two distinctly different domains for color -Syntactic color and grammatical color.

Syntactic color is the use of color abstracted from meaning and recognized for its normative associations and inherent properties. The domain of "associative color/form" might be understood as a process that includes color concept in form making and is without meanings or associations to habitation.

"Color/architecture" is when colored form is assigned a specific use (such as inhabitation) or a labeling of a type, like "column." The color of the form is subject to conventional understandings of appropriate color selections. In addition, meaning is given to the color that is not inherent to the color itself. The rules for selection of color are interpretive and may be thought of as in the domain of grammars.
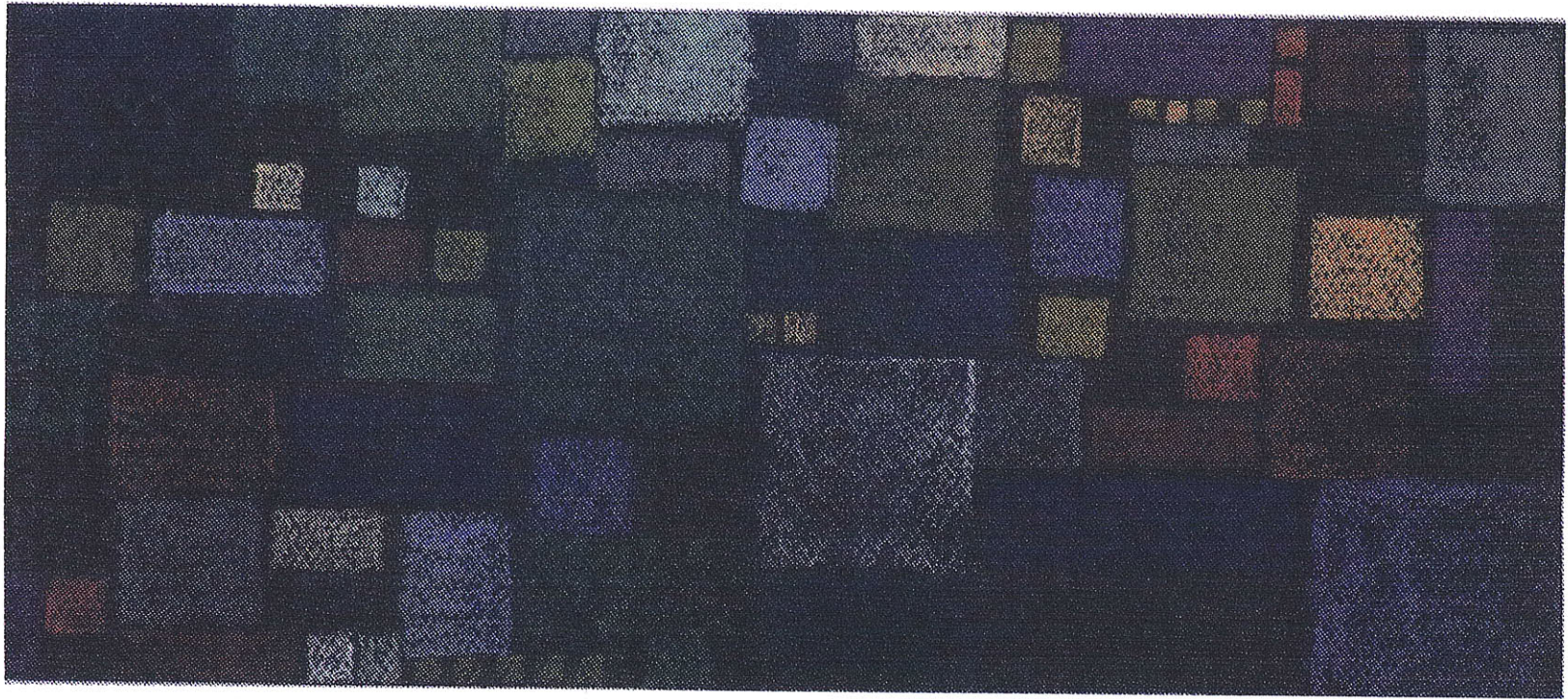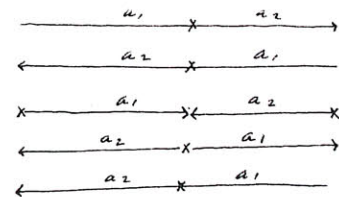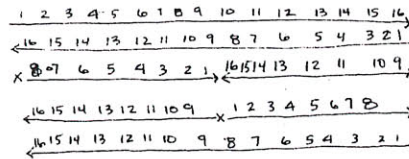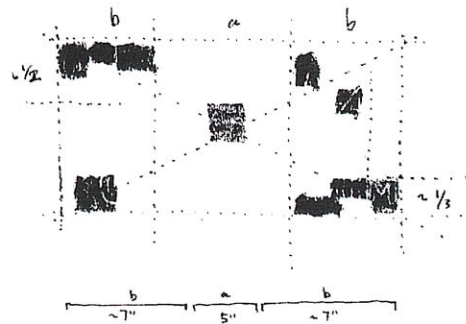

65

4.3 Parametric Variation

Diagram for color study:

| 1 | 2 | 3 | 4·5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 16 | 15 | 14 | 13 | 12 | 11 | 10 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

X 8 7 6 5 4 3 2 1 16 15 14 13 12 11 10 9 X

16 15 14 13 12 11 10 9 X 1 2 3 4 5 6 7 8

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

	a_1	X	a_2	
	a_2	X	a_1	
X	a_1	X	a_2	X
	a_2	X	a_1	
	a_2	X	a_1	
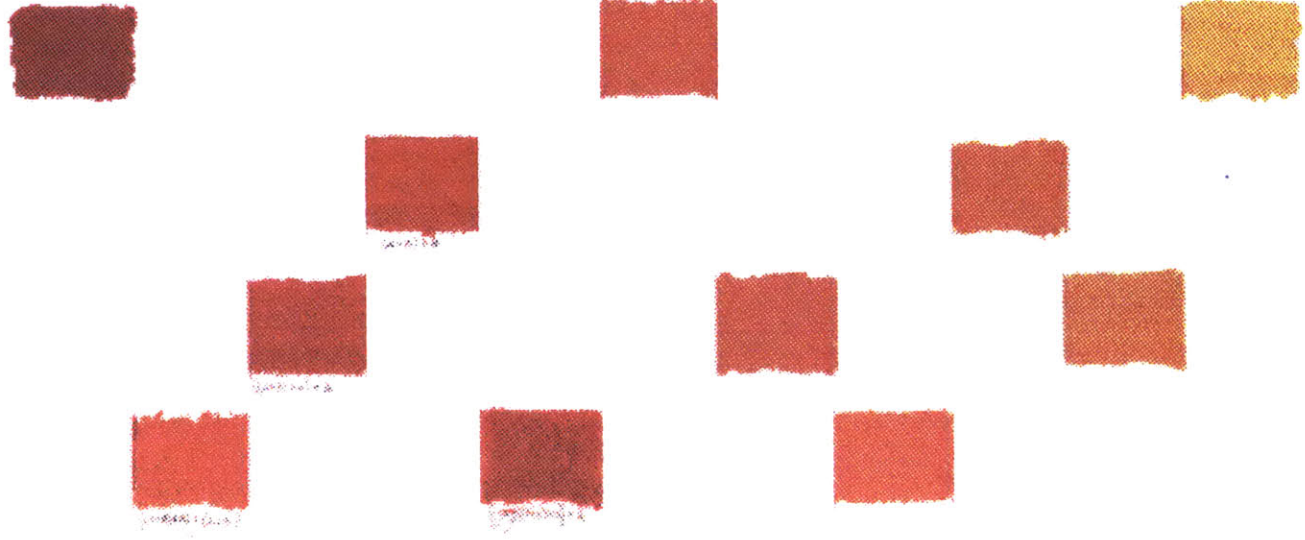
generally the darker colors produce the largest rectangles
and the smaller rectangles, which are bright help
balance the composition.

3·3·92

white and grey rectangles are the exception to this rule.
They are larger than the other bright forms in endeavor to balance the black and give a
reference for which other colors are judged.

68
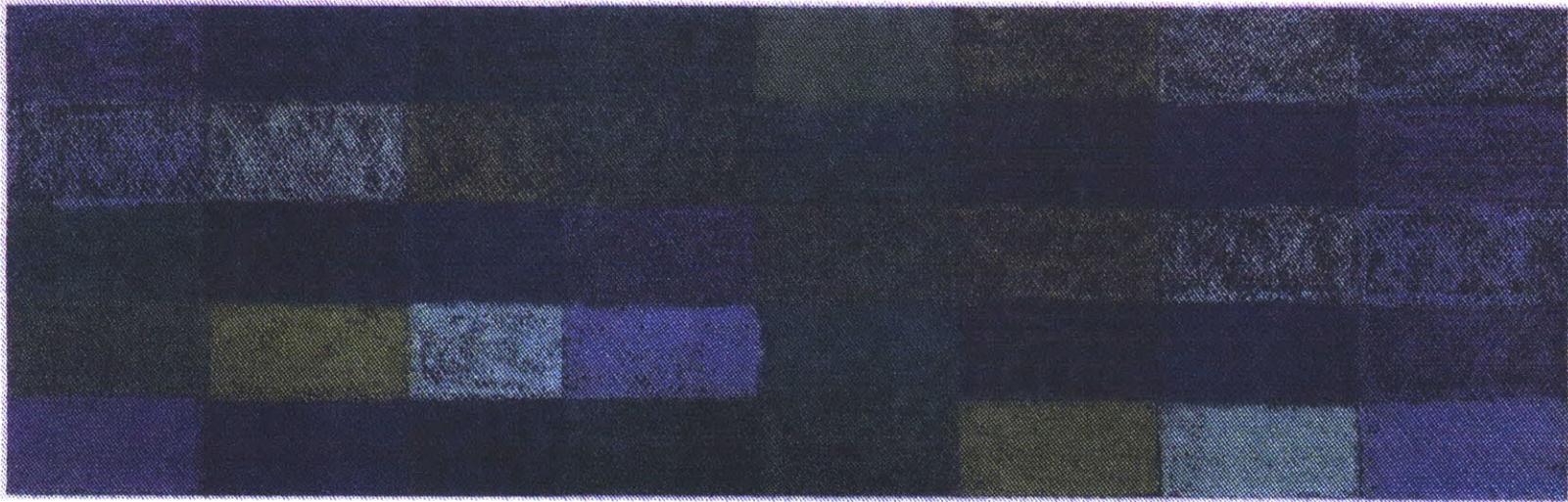
A color study... #2

I begin by limiting the palette to say 8 colors.
The focus will be on the blue spectrum into
green. Grey and white will balance and
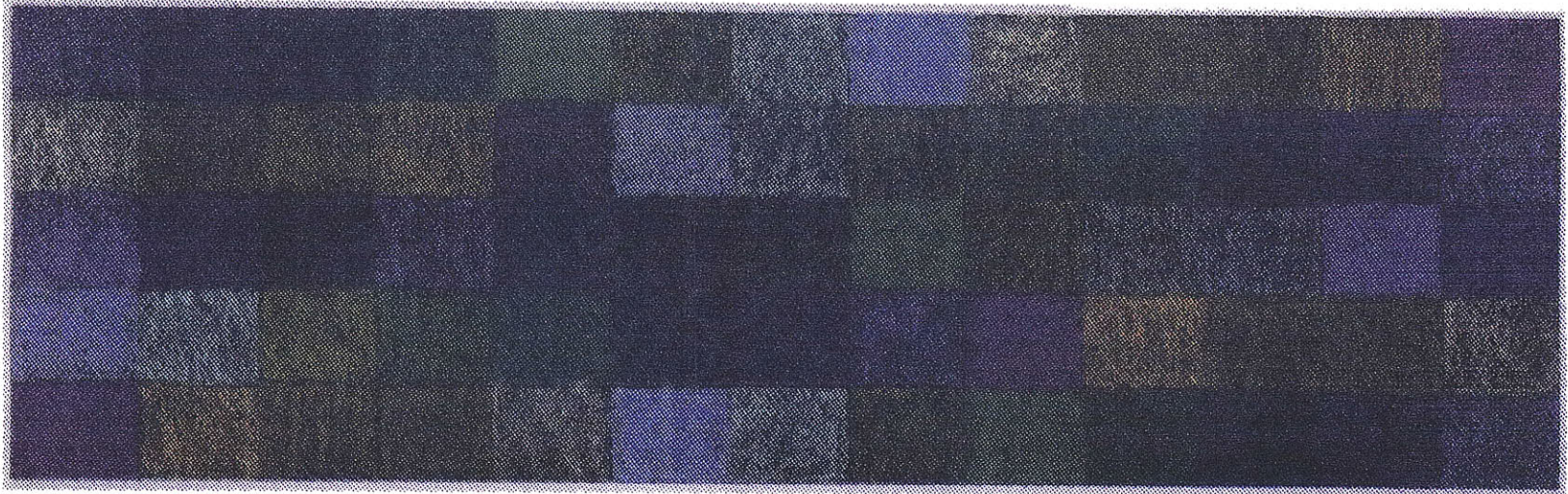black is the underlying color.

B colors...

	1	2	3	4	5	6	7	8	
→	8	7	6	5	4	3	2	1	←
①	4	3	2	1	×5	6	7	8	
	5	6	7	8	4	3	2	1	
→				×					←
	1	2	3	4	5	6	7	8	
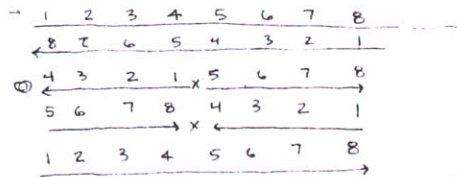
similar structural rythm
as #1 (color study)

more equal rows + squares

COLOR STUDY #3.

Use of the Fibonacci Series
& a connection to the golden Section

& uses 13 colors.

1 2 3 4 5 6 7 8 9 10 11 12 13
1 10 11 12 13 8 7 6 5 4 3 2 1

1 2 3 1 2 3 4 5 6 7 8 1 2

13 12 11 10 9
8 7 6 5 4 3 2 1

13 12 11 10 9 8 7 6 5 4 3 2 1

3
5
8
13

.3 + stack ¼ or ½

Study #4

color study #5

3 + slack = 4 or ½

screen

study 4

dark
1
6

a
b {
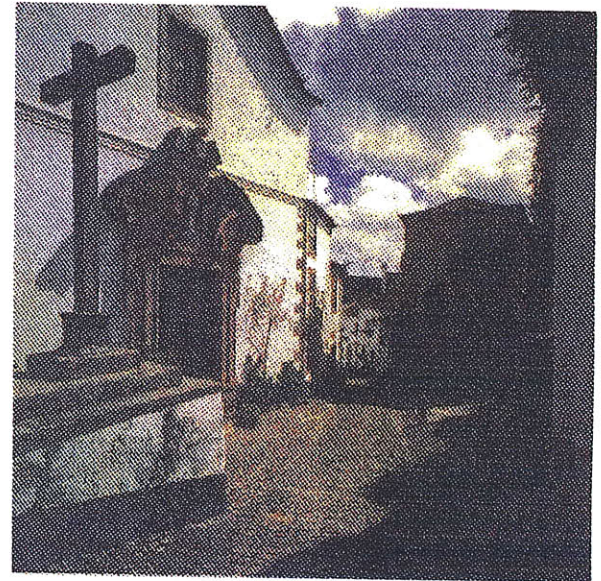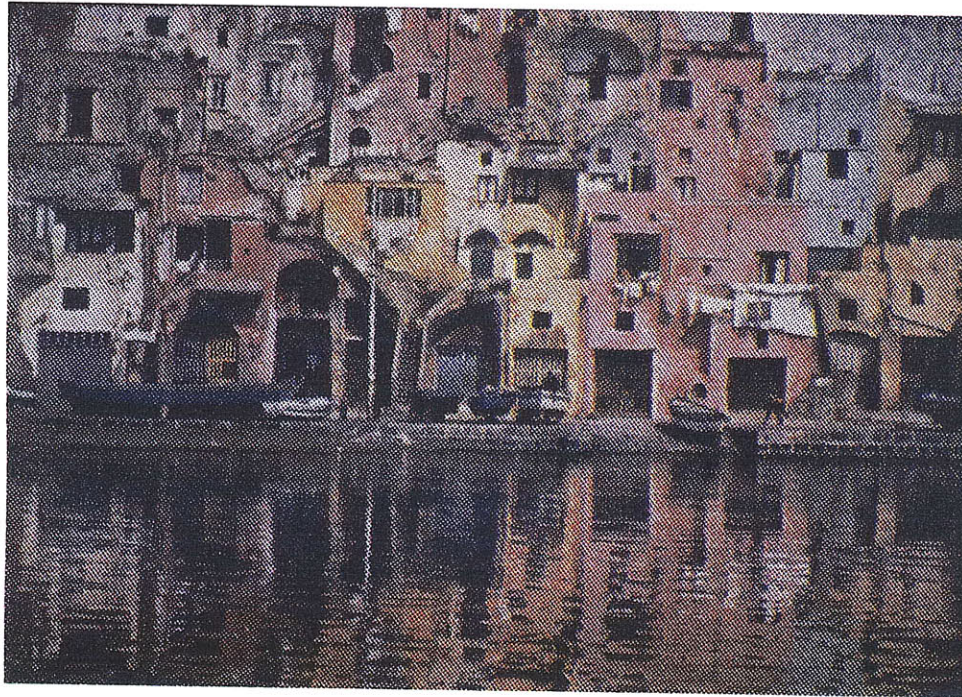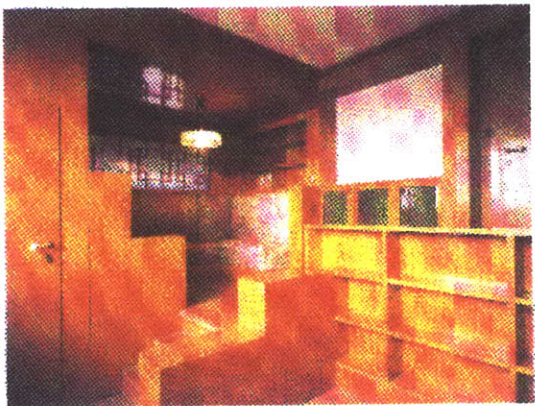3 5 8 2 4 6 8 1 a
1 2 3 4 5 a

light
18

a
8 7 6 4 3 1 1 b
6 7 8 5

color study #5

74
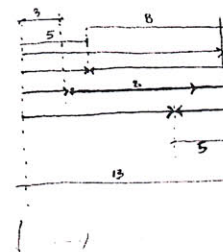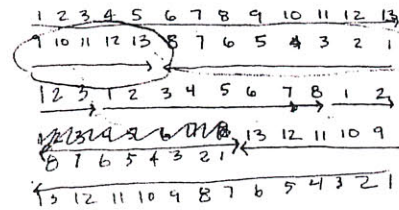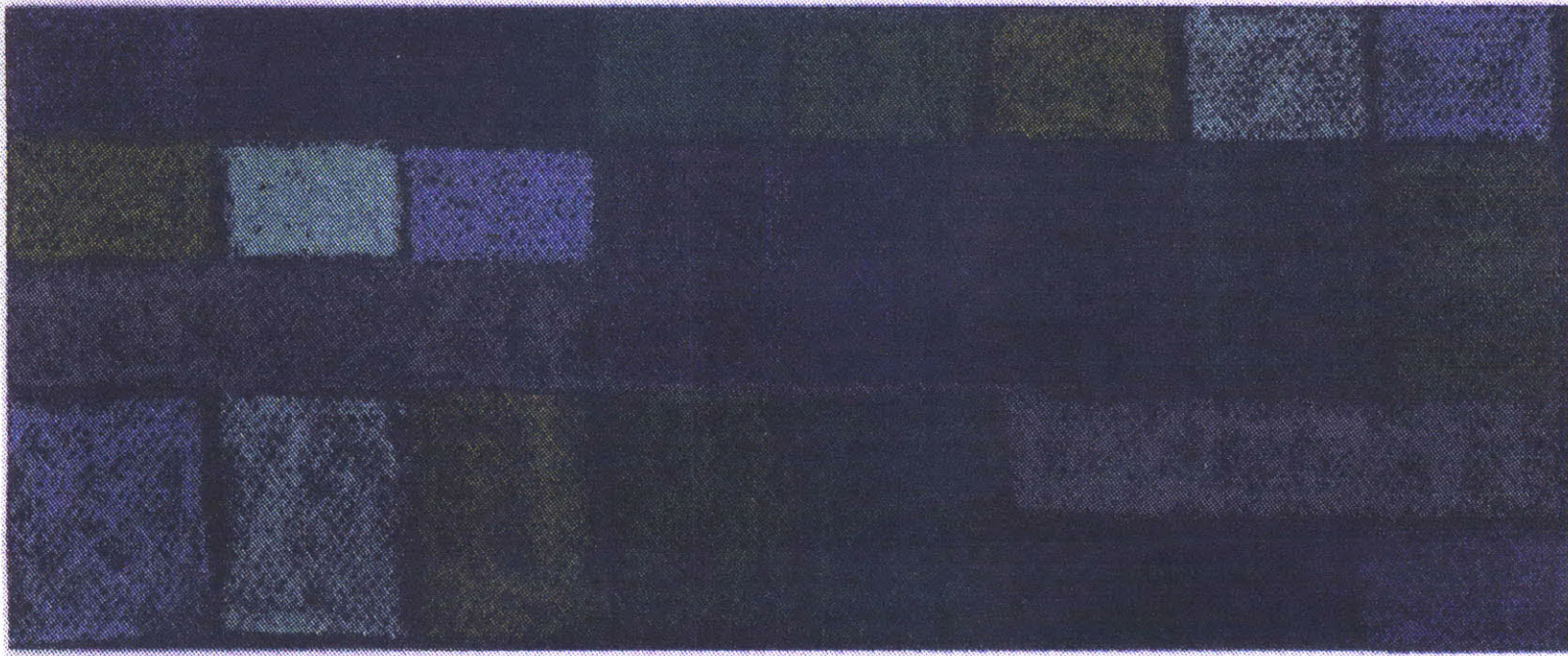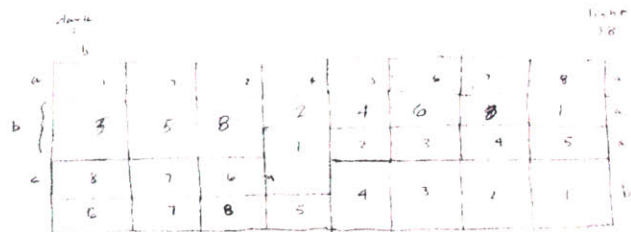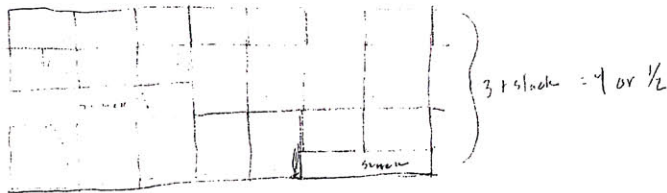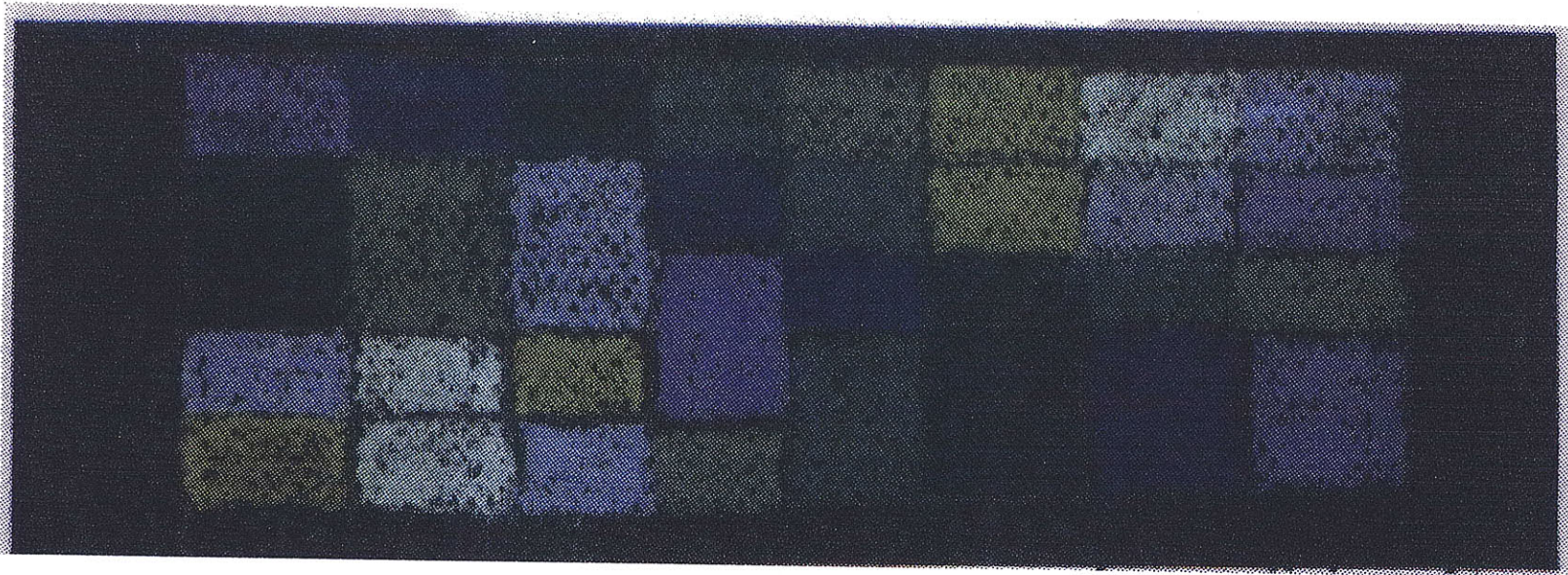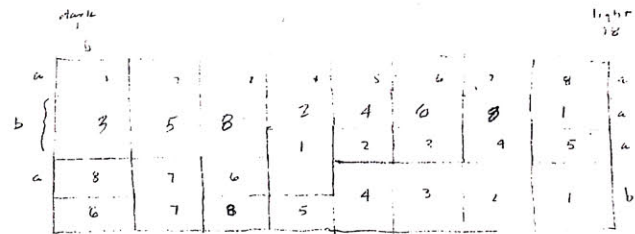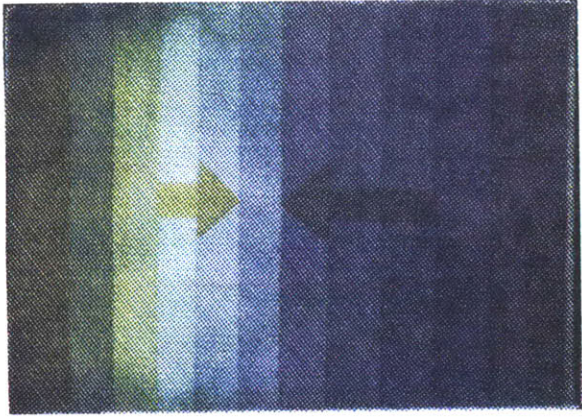
Conclusion

In endeavor to leave the reader with some useful insights into color I have outlined what was successful and what I see missing:

What worked:

1) I had a chance to explore color issues I have been thinking about since my freshman year in college (1985).

2) This thesis is an opportunity to vent my ideas and generate a new approach to using color in my designs. Furthermore I am fortunate to have selected an audience that listens for new color design methodologies and supports a knowledge of color as a part of an architect's education.

3) My color knowledge increased

4) I am now familiar with mixing color in many mediums and the problems that can occur when one designs in several color spaces.

5) Lastly, the larger pocture. Although this is the end of my thesis it is the beginning of a new approach to color in my design process. This is what I wanted out of thesis.

What is missing:

What is missing is a rigorous architectural solution to the bridge. Like the sculptor's armature, the bridge provided a structure that supported the color studies, however the bridge design never lived in the foreground of the composition.

Finally, the reproduction of color in the thesis is not completely accurate. This is to be expected given the technology available, yet perhaps there could have been a little tighter reproduction.

Tips for the next thesis on color:
Technology is still primitive and the output of monitors and printers will vary dramatically -chose your equipment carefully. Aligning the gamut of output devices can be difficult and extremely confusing.

Selected Bibliography

Biren, Faber, ed. Munsell: A Grammer of Color.
New York, NY (Van Nostrand Reinhold Co.), 1969.

Kagan, Andrew. Paul Klee/ Art and Music,
Ithaca, NY (Cornell Press), 1983.

Klee, Felix (ed.). The Diaries of Paul Klee,
Berkeley, CA (University of California Press), 1968.

Maholy-Nagy, Sibyl (ed.). Paul Klee: Pedagogical Sketchbook,
New York, NY (Praeger, Inc.), 1953.

Matthaei, Rupprecht, ed. Goethe's Color Theory.
New York, NY (Van Nostrand Reinhold Co.), 1971.

Munsell, A. H.. A Color Notation.
7th ed. Baltimore, MD (Munsell Color Company), 1926.

Sergio Polano (ed.), "Carlo Scarpa,"
A+U extra edition 10 (1985).

Slutzsky, Robert. cHUbE cHrOME,
Basel, SW (P. Henssler & Co.), 1988.

Swirnoff, Lois. Dimensional Color,
Boston, MA (Birkhauser) 1989.

Spiller, Jürg, ed. Paul Klee: the thinking eye,
New York, NY (George Wittenborn), 1961.

Spiller, Jürg, ed. Paul Klee: Notebooks Volume 2: The nature of nature,
New York, NY (George Wittenborn), 1970.

Illustrations and Source

Unless otherwise noted the source of all illustrations is the Rotch Visual Collection at M.I.T..

Illustrations not cited are the author's.