



Museum of Lighting and Spaces

Peeradet Kangsadalkun

A thesis Submitted in Partial  
Fulfillment of the Requirements  
for the degree of

\*Bachelor of Architecture \*

มหาวิทยาลัยอัสสัมชัญ  
SINCE 1969

Department of Interior Architecture, School Of Architecture

ASSUMPTION UNIVERSITY

2004



Thesis Approved:

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Date (Pisit Viriyavadhana) Dean

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Date (Vatcharat Samakkamai) Chair Person

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Date (Chananya Apiwatphong) Supervisor

## Museum Of Lighting and Spaces

Peeradet Kangsadalkun

(87)

March 2005

For the most part of the history of mankind, from the origins of man up to the 18 century, there were basically two sources of light available. The older one of these two is daylight, the medium by which we see and to whose properties the eye has adapted over millions years. A considerable time elapsed before the Stone Age, with its development of cultural techniques and tools, added the flames as a second, artificial light source. From this time on lighting considerable time. The paintings in the cave of Altamira were created to be viewed under the same light as Renaissance and Baroque paintings.

Light was limited to daylight and flame and it was for this very reason that man has continued to perfect the application of these two light sources for tens of thousands of years.

It is not to be confused with lighting. Particularly if one is lighting technician. And very particularly if one is not a lighting technician but a



lighting planner. The lighting planner plans light. And shadow. Darkness at noon!



Approved:

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Date (Pisit Viriyavadhana) Dean

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Date (Vatcharat Samakkamai) Chair Person

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Date (Chananya Apiwatphong) Supervisor

## **Acknowledgements**

Without certain Information, this book could not have been complete. For this I would like to express my appreciation to A. Chananya Apiwatphong, faculty member of ABAC School of Architecture department of Interior Architecture for being an excellent supervisor and kindly guide me along. Also special thank to the committee for a kind guidance and special advice for such a difficult topic of the project.

Especially thank to Kanokporn Nuchsaeng (P'Ann) Lighting Planner of PALICON PRO - ART LIGHTING LTD for the lighting information sources and the knowledge since the internship period. Without this inspiration and knowledge, this project might not exist.

I would like to express my appreciation to my family member for financing my education and understand the materials that I am studying.

Peeradet K.

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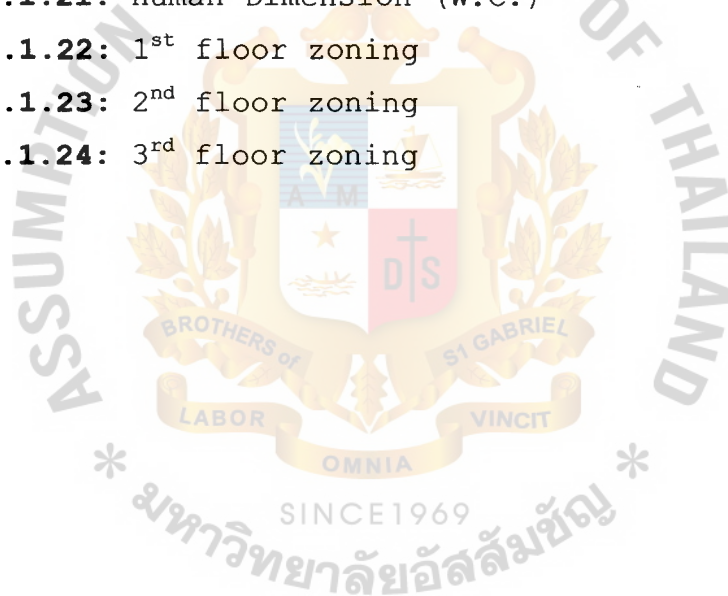
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## **Chapter 1 Introduction**

### **1.1 Project Background**

#### History and Background

- According to mankind history, from the origins to the 18 century, there were two basic sources of light. The earliest is Daylight, which can perceive by human eyes for over millions of years. Artificial light of frame is the second source that has been developed through culture techniques and tools for a considerable time before Stone Age. From this time on, lighting conditions remain the same for a considerable time. Lighting was limited by daylight and flame, which makes man continues to perfect the application of these two light sources for tens of thousands of years.

#### Reasons for studying topic

- As we know that light has always been recognized as one of the most powerful form-givers available to the designer. Yet most of the designer have not understand its importance as the principle medium which puts man in touch with his environment. Light was not only simply applied to structural innovations; but it is also brightening up the structures that were developed to make possible desired lighting and spatial effects.



### Problem and solving

- Most of Thai designer design well with the structural innovation but they have not understood much about lighting. This museum of lighting and space will help improve the sense and the knowledge of lighting design to their work.
- Lighting essential and spaces have played a great role in our life but people don't know much about it.

### The objective of the study

- The objective for studying this topic is to promote and projecting out the powerful of the form-givers of lighting and space.

### Scope of research

- To study the evolution of lighting.
- To study the famous lighting of designers who express their work through various medium, form and detail.
- The analysis of the museum spaces, focus on 3 main importance areas.

1. Visitor area
2. Office area
3. Service and technical area

## 1. Visitor area

- Entrance Hall
  - Information area
  - Ticket booth
  - Bag deposit
  - Waiting area
  - W.C.
- Exhibition area
  - Permanent exhibition
  - Temporary exhibition
- Education area
  - Library
  - Internet room
- Restaurant
- Museum shop
- Conference room

## 2. Office area

## 3. Service section

- Service Elevator
- Storage
- Fixing room
- Technical room
- Dark room
- Security room
- W.C.

## Scope of Project

- Main hall will be major concerned as this space leads the visitor to the other parts. The analysis of this area is to do the design to show the magnificent of the museum.
- Permanent exhibition area will be the emphasis part of the museum that shows the lighting effect in many different ways, listed below:
  - **Phenomenal creation**
  - **Metaphoric**
  - **Connotation**
  - **Sense Perceptions**
  - **Illusion**
    - Adaptation and after image.
  - **Correlate with mood and feeling**
    - \*Color temperature, mesopic vision, photopic vision and sensation.
  - **Participating medium and materials (e.g. glass, etc...)**
    - ⇒ Water, glass, fog, smoke and materials have been affecting the light by the categories:
      - Absorption
      - Reflectance
      - Diffuse reflectance
      - Transmmisivity

- Modifier
- Specular
- Mirror angle
- The restaurant is concern as a part of this museum which will be design to set the different scene of the lighting for the period of the day.

#### Definition of terms

- Daylight: Daylight as a design variable can profoundly influence building orientation, form, scale, the character of interior spaces, and the way that interior space is provide.
- Artificial light: The light with its development of cultural techniques and tools, added the flames as artificial light.
- Space: Accentuation of three-dimensional area and surface structure that form and through direct light from point light sources that can be explained by the term shadow formation.



## **Chapter 2 Research:**

### **2.1 Literature Review**

"I feel, is a great building in its simple, honest, spatial character that is invigorated by the blade of light that penetrates the interior realm. Creating a sense of peace and sanctity", said Tadao Ando

This phrase gave me the idea that might be the concept of my project. As I have studied, the different space structure with different light penetrations creates different effects. The structure and the method of light penetration are two factors that will effect and create great impact for feeling in the space.

"Different methods help different people ..." said Steven Holl. This phrase has made Steven Holl conceive the concept of "A gathering of different light".

From this statement I have studied and got the idea of "A gathering of different light". Many of his works express light in various ways: phenomenal creation, connotation and function utilization.

"All or most spiritual experiences, near death experiences are described with a vocabulary of light. So, for me, this quality to feel light exists, almost like we see it in a dream" says James Turrell.

For James Turrell's statement, I get the idea of how lighting and spaces could create the experiences of both frightening and peacefulness.

"I want to create an atmosphere that can be consciously plumped with seeing, like the wordless thought that comes from looking in fire" said James Turrell.

The creation of the lighting atmosphere allows you to feel it with wordless.

## 2.2 Case Study (Primary Information)

I have studied many of the program topics on lighting in order to correlate with mood and feeling. Finally I decided to do the mock up made of five different spaces of lighting. I found that colors could clearly differentiate between feelings and moods. I choosed black and white spaces together with three primary colors; red, yellow and blue to be experimented.



Figure 2.2.1 White space



Figure 2.2.2 Black Space



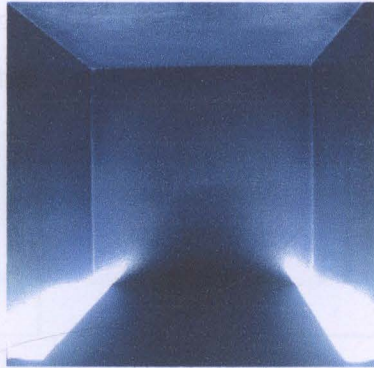


Figure 2.2.3 Blue Space



Figure 2.2.4 Red Space



Figure 2.2.5 Yellow Space

With these mock up models, I have been doing the research of mood and feeling from different people by doing the questionnaire. I displayed the participants different directions of light in one space color and found that one color space with different light source



directions create different perceptions to the participant. (see table below)


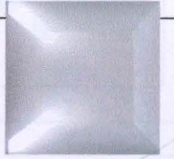
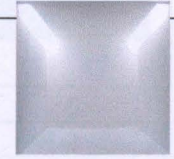
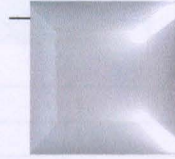
				
enlarge	7	1	4	1
lightness	7	6	5	4
restful	2	2	1	0
serene (clear)	2	1	1	3
frightening	0	0	0	0
peaceful	2	0	2	0
reduce	1	4	5	3
cool	3	2	4	3
active	0	2	0	2
clear minded	6	3	3	2
lonely	1	2	1	1
cheerful	2	2	1	0
uncomfortable	0	1	1	1
warm	0	1	6	0
overwhelmed	2	2	0	1
mysterious	1	2	1	4
wander	0	3	0	2

Table 2.2.1 White spaces

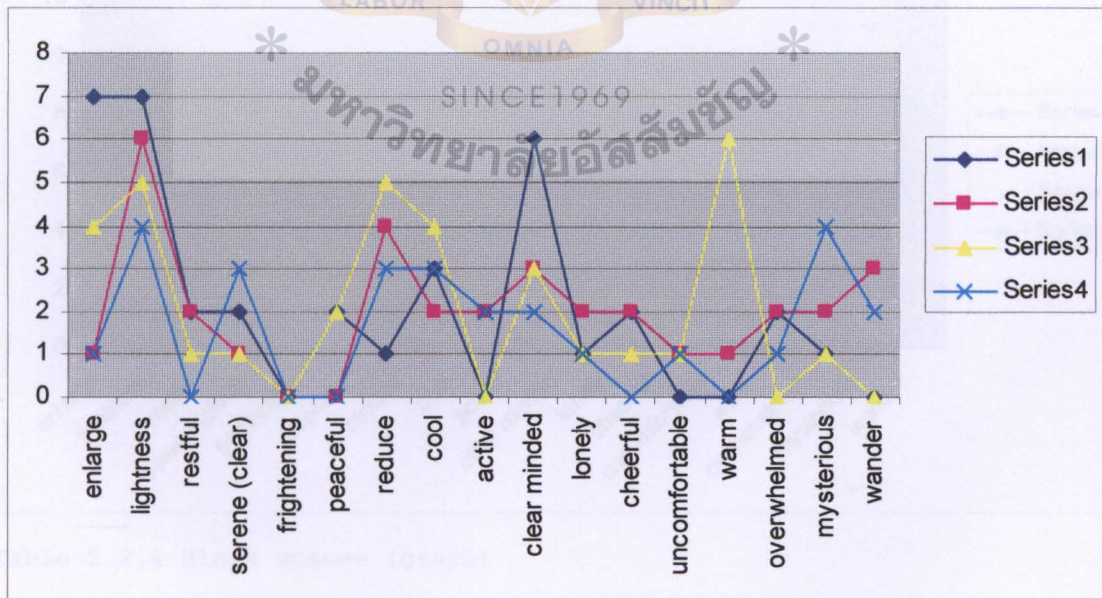


Table 2.2.2 White spaces (graph)



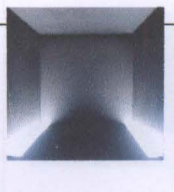
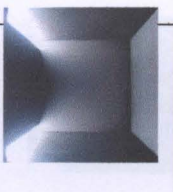
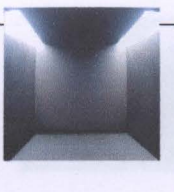
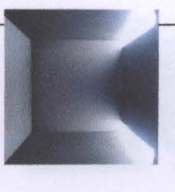
				
enlarge	0	1	5	1
lightness	0	1	2	1
restful	0	1	1	0
serene (clear)	0	1	1	0
frightening	9	7	2	7
peaceful	0	1	0	5
reduce	2	1	3	0
cool	4	3	1	0
active	0	1	1	0
clear minded	0	1	0	0
lonely	8	0	2	1
cheerful	0	0	1	0
uncomfortable	3	7	4	5
warm	0	0	2	2
overwhelmed	1	0	3	0
mysterious	11	4	3	1
wander	3	3	3	3

Table 2.2.3 Black spaces

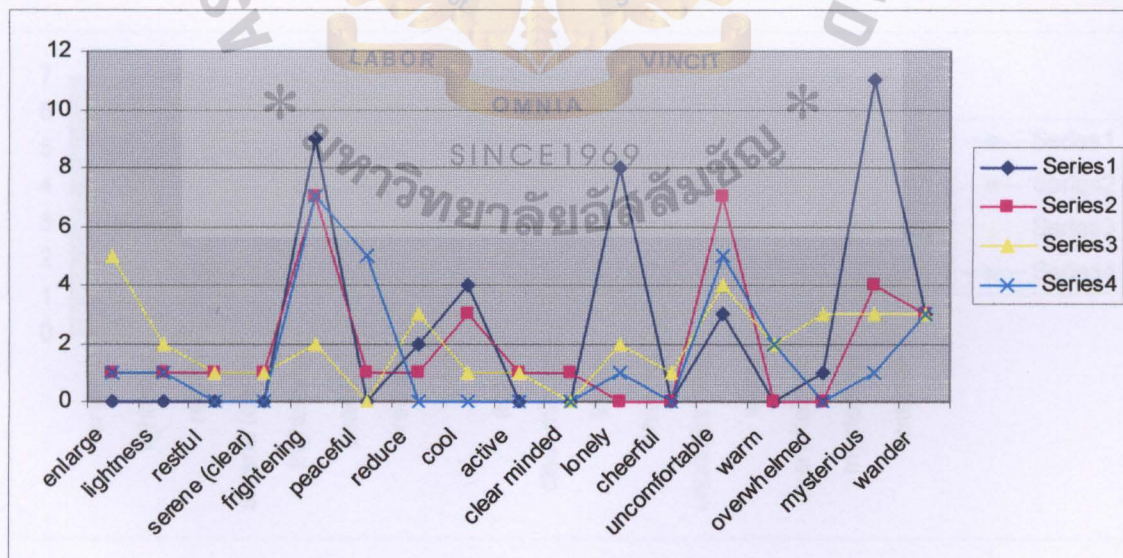


Table 2.2.4 Black spaces (graph)



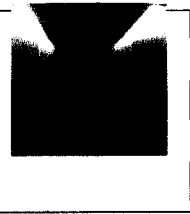

				
enlarge	2	0	5	1
lightness	4	1	4	2
restful	2	1	0	1
serene (clear)	0	0	0	0
frightening	4	3	1	1
peaceful	1	0	0	0
reduce	3	6	3	5
cool	4	3	4	3
active	0	3	2	2
clear minded	2	0	1	0
lonely	3	1	1	3
cheerful	0	1	0	1
uncomfortable	3	3	1	3
warm	1	1	1	2
overwhelmed	2	0	4	2
mysterious	6	3	3	3
wander	1	0	1	3

Table 2.2.5 Blue spaces

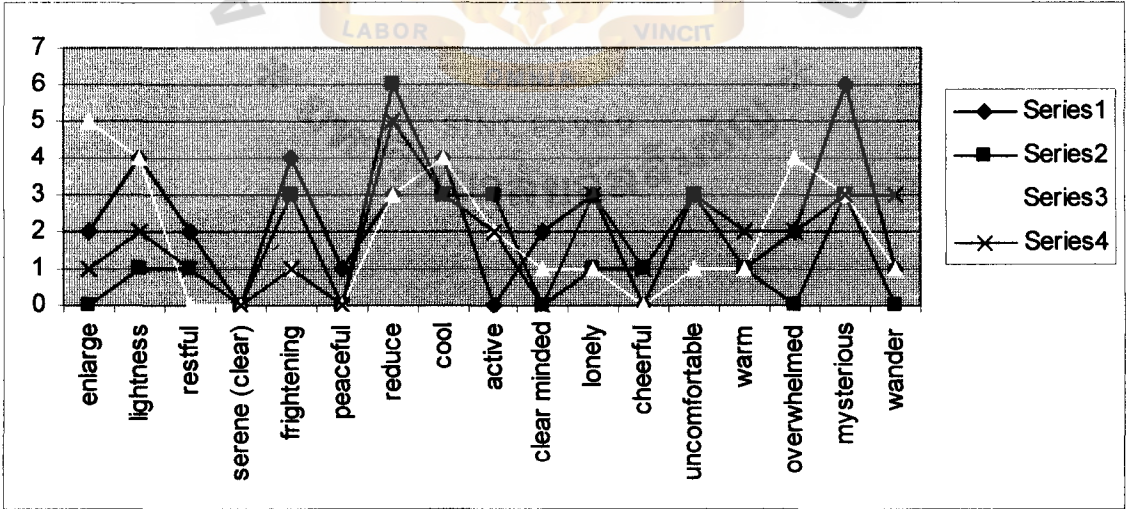


Table 2.2.6 Blue spaces (graph)







				
enlarge	3	3	6	1
lightness	5	3	2	3
restful	0	2	1	0
serene (clear)	0	0	0	1
frightening	6	2	3	2
peaceful	0	0	0	0
reduce	1	4	2	5
cool	2	0	0	2
active	6	2	7	2
clear minded	0	0	1	0
lonely	0	2	0	1
cheerful	6	2	3	2
uncomfortable	5	4	2	5
warm	6	7	4	6
overwhelmed	7	3	6	2
mysterious	2	1	1	0
wander	4	3	3	4

Table 2.2.7 Red spaces

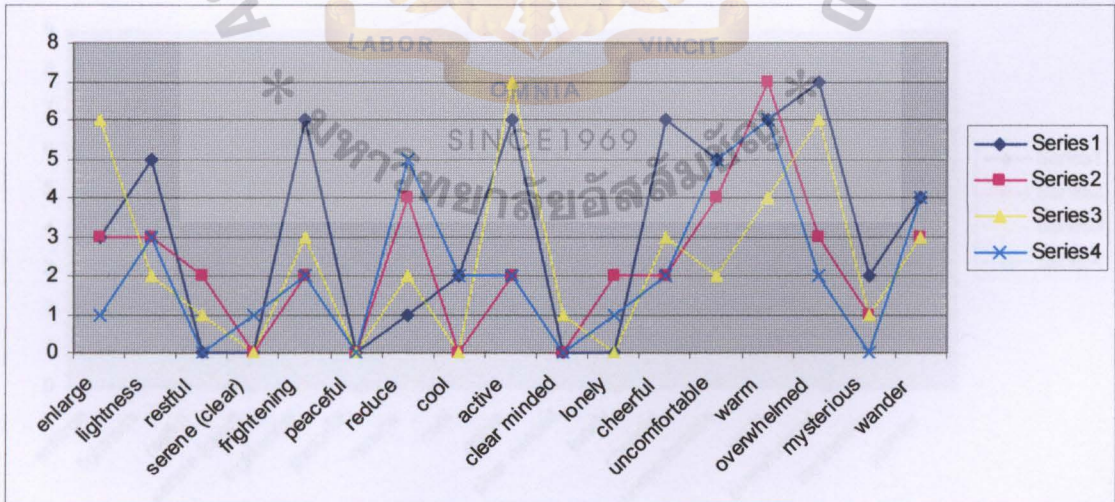


Table 2.2.8 Red spaces (graph)



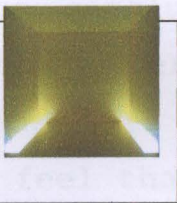
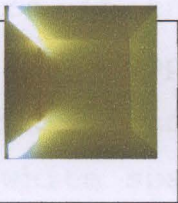
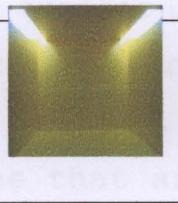
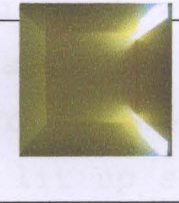
				
enlarge	3	1	7	2
lightness	8	5	5	5
restful	2	2	1	1
serene (clear)	2	0	3	0
frightening	0	0	0	1
peaceful	2	0	2	0
reduce	1	2	0	2
cool	4	4	3	1
active	2	7	6	2
clear minded	3	4	3	1
lonely	2	0	1	1
cheerful	4	4	3	4
uncomfortable	2	2	1	2
warm	2	1	2	3
overwhelmed	3	0	2	0
mysterious	1	5	1	6
wander	4	1	1	1

Table 2.2.9 Yellow spaces

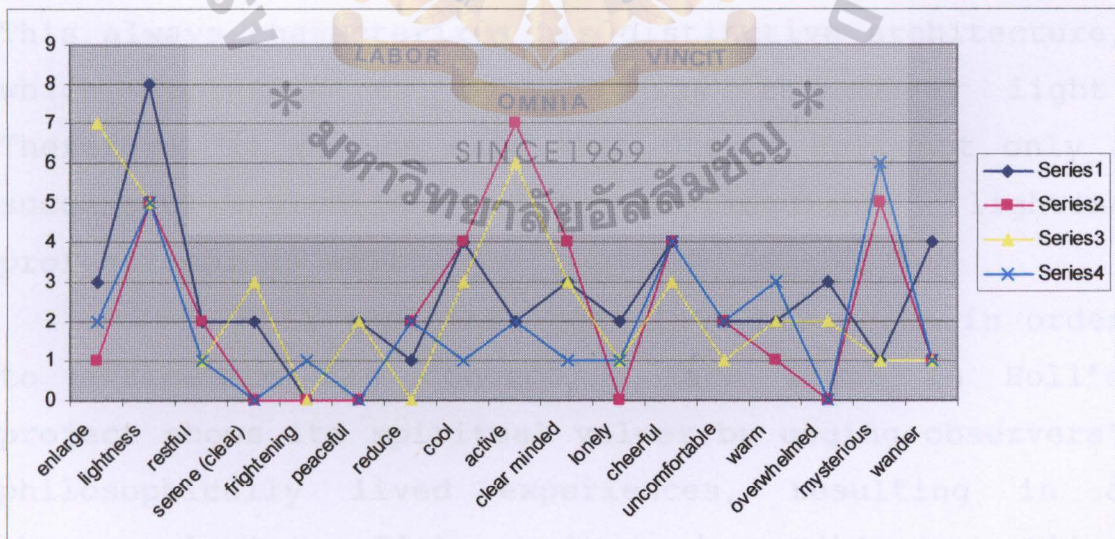


Table 2.2.10 Yellow spaces (graph)

From the conclusion of the questionnaire, I will design spaces under this topic that relate to the result of the same color space feeling. For example, most people feel that white spaces that are lit up seem to become enlarged and more exaggerated than other color spaces. From this I will design the space of the color together with the color light that changing all the time to mix with the color spaces. The result will be of all kind of feeling that mix together.

## **2.2 Case Study (Secondary Information)**

### **Steven Holl**

Steven Holl has been recognized as a premier architect in new minimalism. He expresses his work with a passion of form and detail as well as sensitivity to the spirit of material; He excels at exploiting light to convey his phenomenal concepts and particular ideas. This always characterizes his distinctive architecture, which impresses us by the way it convey light. Therefore, it can be said that Steven Holl not only a successful architect but distinguished lighting professional as well.

Steven Holl exploits light into his works in order to articulate his concept. Each light in Holl's project shows its spiritual values by urging observers' philosophically lived experiences, resulting in a phenomenal state. Although it is impossible to outline all of his historical concepts of light, it is worth giving at least examples and analyzing the role of its

in architectural concept. Holl thoroughly understands that the mystery of light can be eloquently expressed in numerous ways.

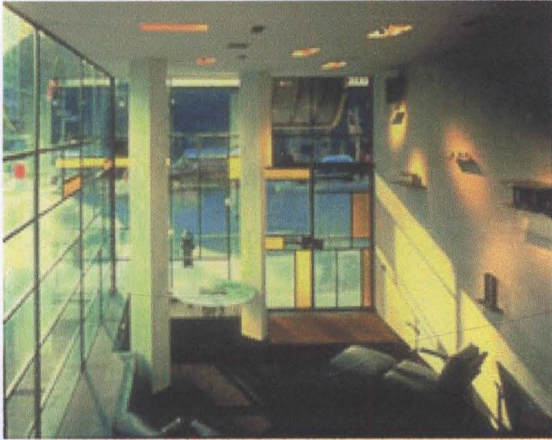
Once again, phenomenal effect is introduced, but integrating in both exterior and interior. Sarphatistraat Office (2000), Netherlands, concludes the intermeshing of light properties and optic phenomena, and the emulating of nature feature; it acts as *nature metaphorical light*. The same role of *displaying light* appears in both projects at the Cransbrook Institute of Science (1999) and Bellevue Art Museum (2001), the latest manifested works of Holl.

#### **Pace Collection Showroom, New York, New York 1986**

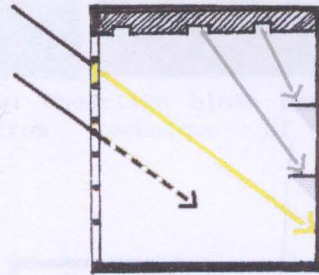
An idea of counterpoint sets the appearance of a façade with vertical lines of mullions against amber glass panels in horizontal. (*figure 2.2.7*) Daylight plays its role in emphasizing the conceptual atmosphere by shadow phenomena that temporarily paints the wall with projection of yellowish panels and patterns of its frame in different angles. (*figure 2.2.6*)

In order to intensify his concept, Luminaire fittings are inserted into the interior architecture. It was the first time that he use this technique in his work. Light sources give themselves volumes to the contrapuntal pattern on ceiling (containing lighting and A.C. set against horizontal plane) and disperse oval light display wall, increasing the silhouette phenomena.





**Figure 2.2.6:** The divergence phenomena contributed by daylight and artificial light.



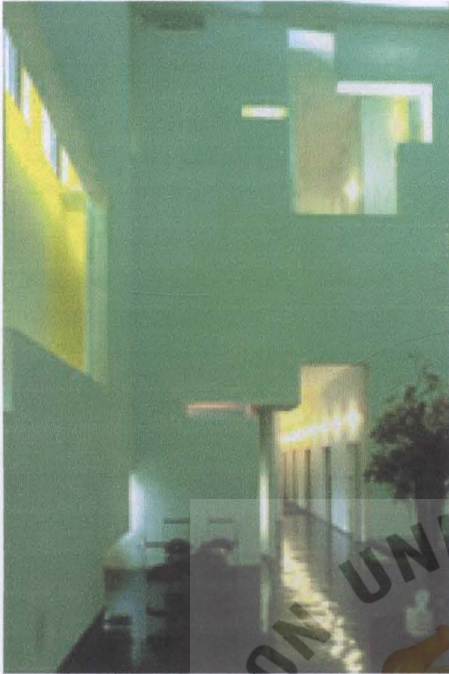
**Figure 2.2.7:** Analytical diagram of light giving in cross section

#### **D.E. Shaw & Co. offices, New York, New York 1992**

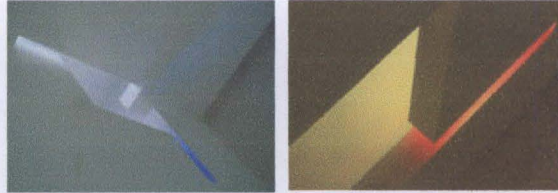
The suspending gypsum wall is perforated rhythmically, allowing metal framing and cut out slots hidden in invisible view. Both daylight and artificial light provide colour in the interior space by reflecting from the hidden coloured metal wall. During daytime, natural light seeps around the edges and through the cut-out slots, while at night, fluorescent lights provide the same effect. (figure 2.2.8)

In this project, apart from the phenomena, Steven Holl first used colour of light but not straightforwardly. He can be regarded as the one to introduce the new shed catalogue of color of light into architecture during that time by his ghostlike blush phenomena. (figure 2.2.9)

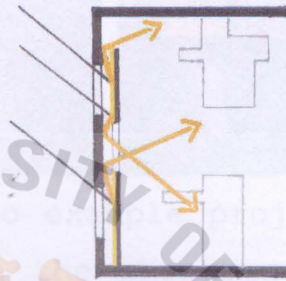




**Figure 2.2.8:** The lobby of Shaw & Co. Office represents visual space in information realm.



**Figure 2.2.9:** Ghostlike blush phenomenon emerging from technique of color projection.



**Figure 2.2.10:** Analytical diagram of projected color light.

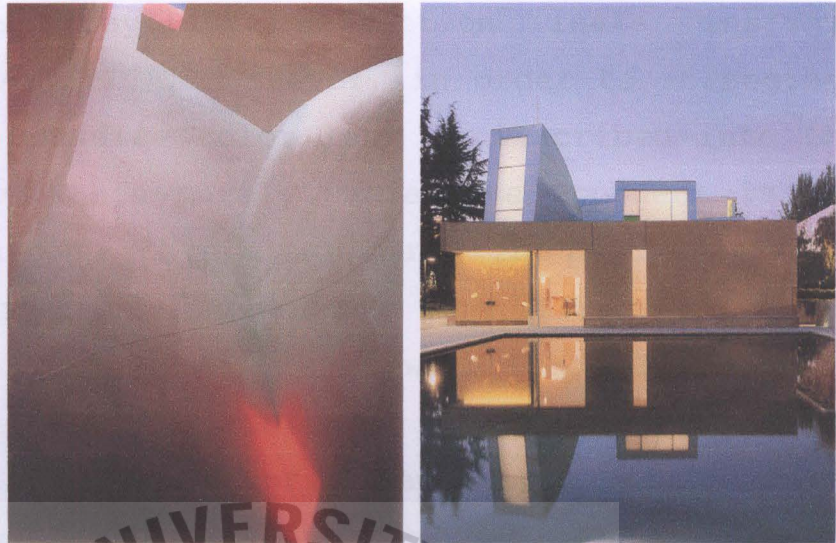
### **St. Ignatius Chapel, Seattle, Washington 1997**

From the Jesuits "spiritual experience", "different methods help different people..." this which postulates that no single method can help, but rather the unity of gathering into one. Apposite to the Jesuits and the tradition of speculation about the image of light of Christ, Steven Holl conceived the concept of "A Gathering of Different Light."



**Figure 2.2.11:** The phenomenal effect of light from color lens first used in Holl's work.

**Figure 2.2.12:** The chapel apparently represents "Seven Bottles of Light in Stone Box."



From the precedent of two example projects, it can be seen that Holl focuses on the phenomenal effect of light. In a further step, he merged phenomena with metaphor. Various analogous volumes of daylight form up into the interior space through the roof voids. Each volume has its different quality uniquely corresponding to a part of the program of Jesuit Catholic worship: the south facing light to the possession, fundamental part of the mass, north light to the mission of outreach to the community, Chapel of Sacrament and east and west space to the main worship space.

For interior space, Steven Holl develops the visual phenomena of reflected color from the D.E. Shaw office project with the psychological law of opponent color. He combined a pure color lens -or stained glass- and a field of opposite color reflection in each volume of light. A large wall acts as a "baffle" encountered inside each large window, a "bottle of light." Each baffle is painted with bright color, contributing to the



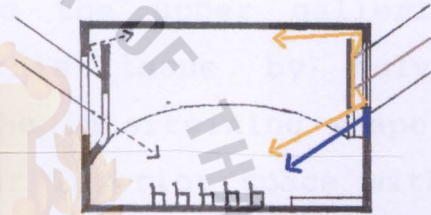
phenomena when daylight reflection leaks insides. (Figure 2.2.14-2.2.17). Moreover, in order to strengthen the effect, a converse color lens is inscribed into the baffle. Although this purely subjective opponent is not dealt with through physiology but, in psychology, it derives mystery and sensation. The first sight of alarming saturated blue lens with a yellow field background can stun new visitors. (Figure 2.2.13) These phenomena are all transitory, depending on the daily movement of the sun and seasonal changes.



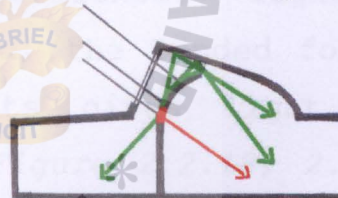
**Figure 2.2.13:** The main body of the Chapel with chromatic blue phenomena of blue lens in yellow field.



**Figure 2.2.14:** The phenomena in main body



**Figure 2.2.15:** Analytical diagram of daylight through color lens and painted wall in main body.



**Figure 2.2.17:** Analytical diagram of daylight through colour lens and painted wall in choir.



**Figure 2.2.16:** The phenomena in choir stall of the chapel.

### **Kiasma, Contemporary Art Museum, Helsinki, Finland 1998**

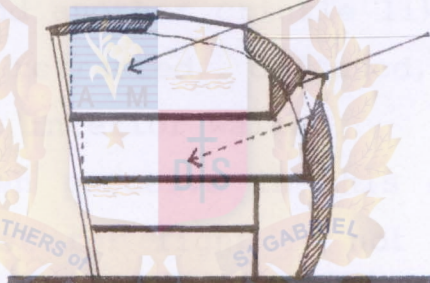
Retrospectively, unlike previous projects, Kiasma is of special concern to natural light in several ways:

- In a conceptual way, the character of horizontal light at high latitudes was taken into account, in order to express the reflectance from waterscape as "urban mirror" linking to Helsinki's Toole heart as if in Alto's words, "extends to Lapland."
- In practical means, to solve the problems of a stacked level art museums, traditionally only allowing natural light into the upper galleries. Steven Holl dealt with this issue by solving architectural form. First, the intertwining shape of building yields the irregular interior space with a curved wall. The curved icy-looking wall with transparent plank allows horizontal light to permeate into galleries. Second, the bended form of building with peeled skylights gives light into interior in several levels. (Figure 2.2.18, 2.2.19, 2.2.20)
- In terms of phenomena, overlapping perspectives were created in extraordinary interior space caused from the intersection of two wings of 'x'. Therefore, the interwoven torsion of space and light is generated. (Figure 2.2.20, 2.2.21)

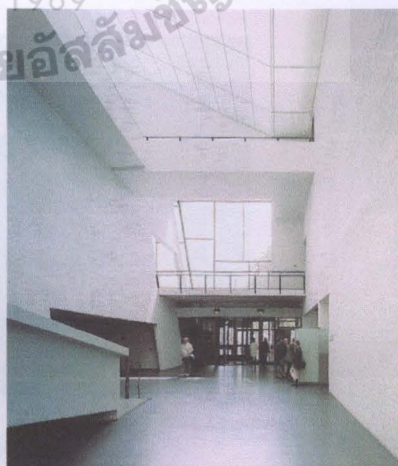
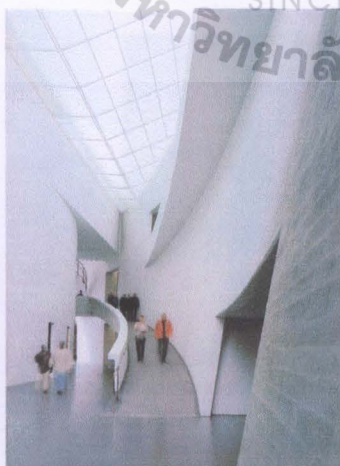




**Figure 2.2.18, 2.2.19:** The skylight of the Kiasma Museum gives light to several galleries inside.



**Figure 2.2.22:** Analytical diagram of daylight given in the Museum.



**Figure 2.2.20, 2.2.21:** The intertwining shape provides overlapping perspectives.



**Cransbrook Institute of Science, Bloomfield, Michigan, 1999**

Steven Holl's aim for this project is to infiltrate the existing buildings by the famous architect Eliel Saarinen, and to create space with the sense of "strange attractor."

The significant lighting design for this project is daylight used as a part of scientific phenomena exhibition. "Light Laboratory," (figure 2.2.22) which was formed up at the extrusion entry, where he experiments with a great number of physical phenomena of light. Seven different types of glass - one convex, another dappled, and another crinkle like and accordion - cast variously refracted, diffused, and prismatic colors on the white interior walls.

Seemingly, we can perceive in this state that Holl deepens his interest for light in not only subjective phenomena but in physical matters to search for the exit of his concept design.



**Figure 2.2.22:** Entrance hall or "Light Laboratory"



**Figure 2.2.23, 2.2.24:** The day lighting and color of materials appear as the Holl's favorite technique.

In conclusion, Holl expresses light in various ways: phenomenal creation, connotation and functional utilization. His development in lighting design reveals that he perpetually quests for the mysterious physical attributes of light and adopts them into this architecture. For Steven Holl's architecture, light is not only the element of architecture, but the architecture is also the formation of light and phenomena.

SINCE 1969

มหาวิทยาลัยอัสสัมชัญ



## **James Turrell**

Turrell's work involves explorations in light and space that speak to viewers without words, impacting the eye, body, and mind with the force of a spiritual awakening. Mention the word 'art' and most people think of a painting that hangs on a wall. Turrell's works are not of this nature and are usually spaces filled with light in such a way that you question the source of the light and your perceptions of what you are seeing.

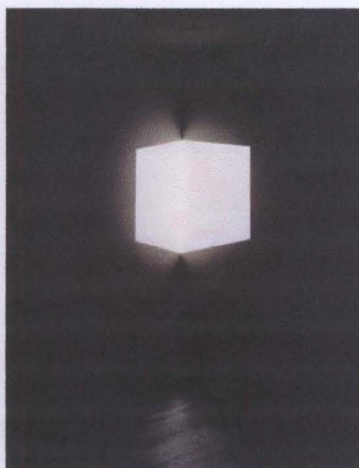
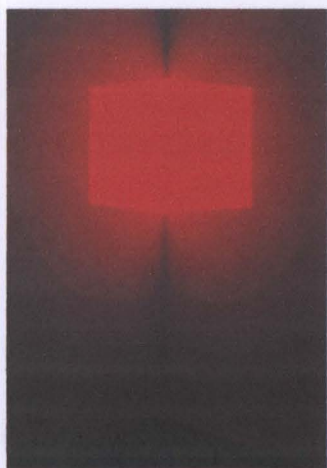
### **Afrum-Proto**

#### **Corner Projection**

"Afrum-Proto" is the first of several "corner projection" pieces developed by James Turrell during the 1960s. Made by aiming the light from a slide projector through a template, the resulting projection is a floating optical illusion in the corner of a room. As the viewer moves around the gallery, he or she will reach an optimal vantage point where the rectangle of light will resemble a three-dimensional white cube. The closer one approaches the corner, the less the illusion holds, until the cube is transformed back into an ordinary projection of light. With a magician's sleight of hand, Turrell creates the illusion of a three-dimensional solid out of light. Echoing principles in theoretical physics and creation myths alike, the work makes connections between energy, matter, and a human perception of these cosmological elements. The experience of the work ultimately depends on where one

is standing and the relationship one has to the work.

Turrell leaves the mechanisms of this illusion in plain sight. This makes the spectacle no less mysterious or believable, as it is the overwhelming surprise of seeing the cube emerge from the wall that makes the largest and most lasting impression. Turrell's corner projections are all the more convincing for the way in which the work functions despite a knowledge of how the illusion is made. Turrell first had the idea for "Afrum-Proto" and similar works while a graduate student at the University of California at Irvine. More interested in the shape and luminosity of the slide projections in his art history classes than the particular images of paintings and sculptures, Turrell's work focused on an aspect of daily experience that often went unnoticed. Later pieces brought some of the color of those initial slide shows back into his work, and the artist has made corner projections in red, blue, and purple.



**Figure 2.2.25,**  
**2.2.26:** The "Afrum-Proto" Corner Projection is the floating optical illusion in the corner of a room.

## **Atlan**

Surprising in its simplicity, "Atlan" is a work that plays on viewers' sense perceptions. Entering a dimly lit room, viewers find what seems to be a deep blue rectangle or monochrome painting on the far wall. As one's eyes adjust to the darkened room, the blue appears to swell in color. Compelling for the way in which the color is evenly and luminously distributed, the viewer is drawn closer to the work for a detailed inspection. Inviting exploration, a surprise is in store for anyone who dares to reach out and touch the work. What at first appears to be a solid rectangle or drawing on the wall is actually an open window onto an empty, light-filled room. It is difficult to discern the volume of the second space, and viewers often reach through the window in an attempt to touch the opposite wall. This window in the wall is like a portal onto another world, providing a view of a limitless space like the ocean or a starless sky. The work's infinite view is ultimately the product of one's own sense perceptions, and the viewer becomes aware of his or her own beliefs and habits of looking.

The initial shock of sticking one's head through what seems to be a solid wall is soon replaced by disorientation and a sense of wonder at how the illusion is constructed. "Atlan" is one is a series of "aperture" or "space division" works that rely on a viewing space (for the audience) and a sensing space



(the light-filled room). The wall that divides these two spaces is thin, making the depth of the window imperceptible from a distance. The sensing space is an empty room saturated with light, creating a visual field called a "Ganzfeld." Comparable to an arctic whiteout, Ganzfelds are visual phenomena where depth, surface, color, and brightness all register as a homogenous whole. The color seen through the window is variable, and the artist has made space-division works in red, pink, green, blue, beige, and gray. Turrell has also constructed room-sized Ganzfelds where viewers are able to walk into a space where the walls, floor and ceiling are seemingly blurred or absent. Proving to be somewhat dangerous - as viewers would lean on walls that didn't exist - Turrell designed works like "Atlan" to provide a window onto these naturally rare, psychological spaces.



**Figure 2.2.27:** The "Atlan" viewers find what seems to be a deep blue rectangle or monochrome painting on the far wall.

## **Tadao Ando**

Ando's approach to form and light were further explored through two unique places of worship; the Church of Light in Osaka 1988. In this building, Ando uses structural tectonics and nature to create a metaphorical relationship to each religion. In the Church of Light he opens a wall with vertical and horizontal slits forming a crucifix that illuminates the interior with natural light creating spatial sanctuaries for introspective meditation. The thoughtful arrangements of stark cast-concrete elements animated with natural light are Ando's trademark in creating spaces.

The main ideas that Ando was trying to communicate in his building is about light and darkness, entry, materials, and the human occupant. I chose to concentrate on the interesting movement and qualities of light that slide across the inside of the church throughout the day.

In the end, Ando created a geometrical and abstract form of cold concrete that contrasts the soft, warm feeling of the furniture and the light, creating a vibrant space in tension and intensity as well as a space of purity and tranquility. It is through the senses and an essence of spirituality that the architectural space affects us.

"The Church of Light, I feel, is a great building in its simple, honest, spatial character that is invigorated by the blade of light that penetrates the



interior realm” says Ando. Create a sense of peace and sanctity.

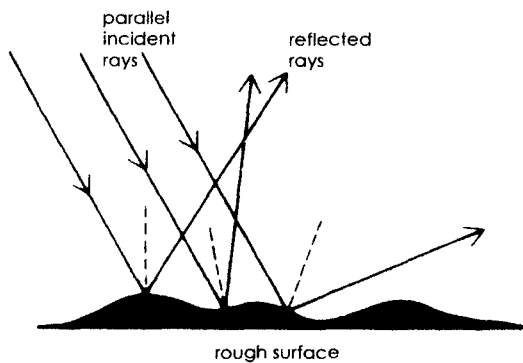


**Figure 2.2.28:** The Church of Light. Create a sense of peace and sanctity.

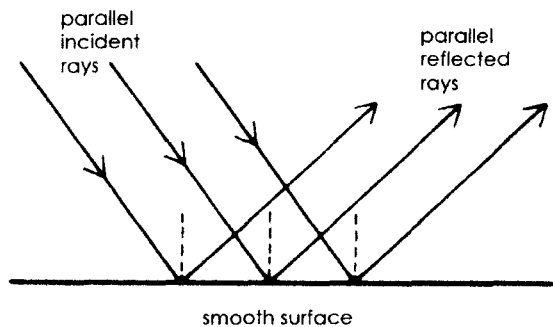
### **Principle Of Light**

#### **Diffuse and Regular Reflection**

A page of a book or the painted wall of your classroom may appear to be smooth. Actually, their surfaces are rough and have many small projections. When light ray strike different parts of these projections, the rays are reflected in many different directions and give rise to diffused reflection (Figure 2.2.29). On the other hand, if a beam of light falls on a very smooth surface, say a mirror, the rays undergo regular reflection (Figure 2.2.30).



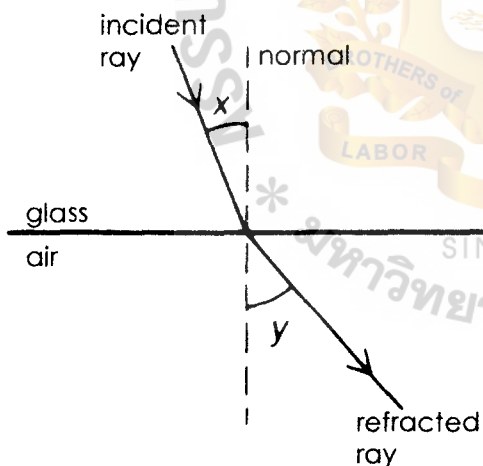
**Figure 2.2.29:** Rough surface



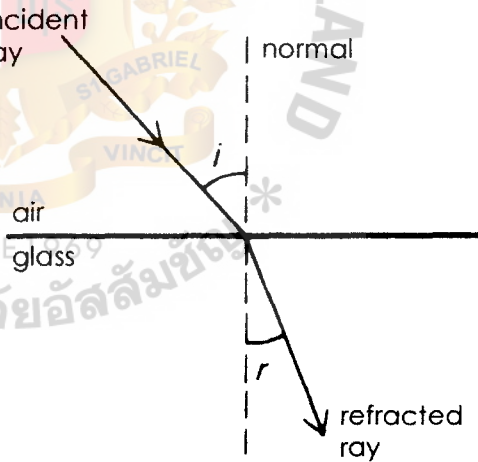
**Figure 2.2.30:** Smooth surface

### Refraction of Light

When light travels from air into glass or water, its speed decreases. A medium is said to be optically dense if it slows down the speed of light. Glass is optically denser than air.



**Figure 2.2.31:** Refraction of light as it passes from glass to air.



**Figure 2.2.32:** Refraction of light as it passes from air to glass.



## Dispersion of Light

When white light (for example sunlight) enters a glass prism, rays of different frequency refract by different amounts. This causes the white light to become separated into its component colors of red, orange, yellow, green, blue, indigo and violet. These colors are collectively known as the continuous spectrum.

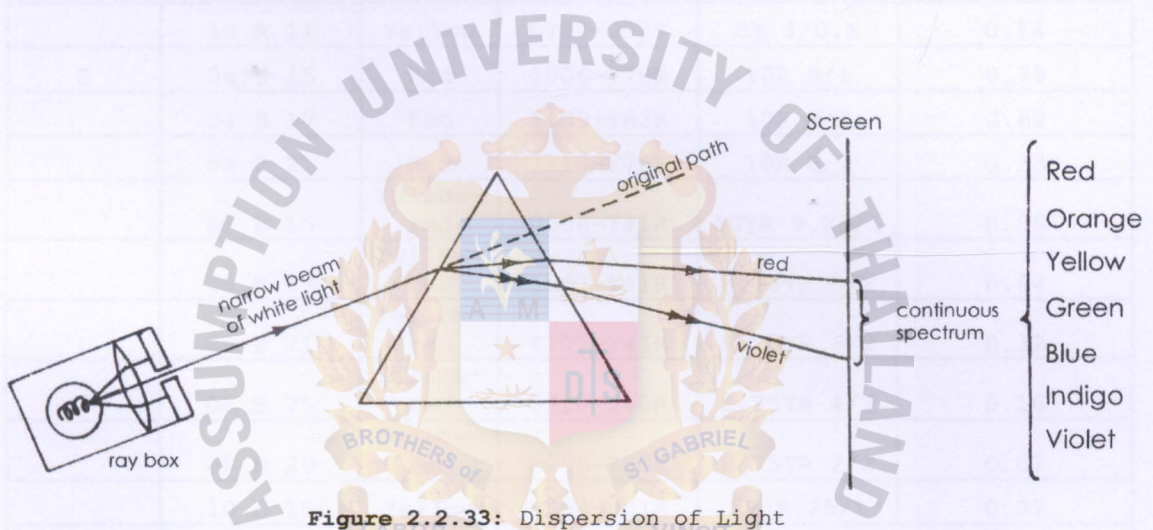


Figure 2.2.33: Dispersion of Light

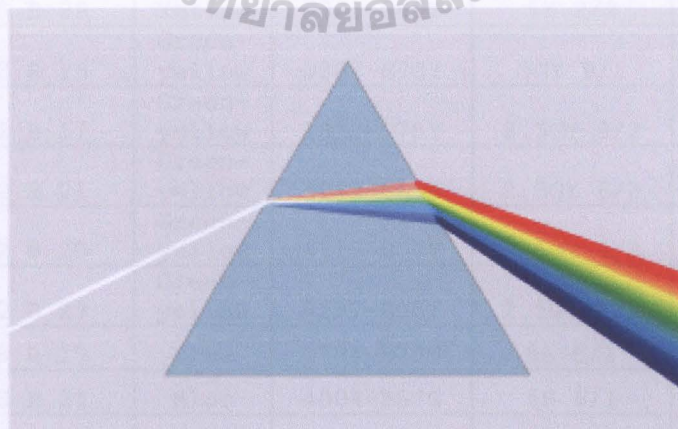


Figure 2.2.34: Dispersion of Light

### References and reflectance for colors

Approximate NCS and Munsell references and reflectances for colours in BS 4800					
Greyness Group	Colour designation	Hue	Approximate NCS reference	Approximate Munsell	Approximate reflectance reference
A	00 A 01	Neutral	1501-Y03R	N 8.5	0.68
	00 A 05	Neutral	3101-Y26R	N 7	0.45
	00 A 09	Neutral	5301-R64B	N 5	0.24
	00 A 13	Neutral	7501-R97B	N 3	0.11
	10 A 03	Yellow	2002-Y03R	5Y 8/0.5	0.60
	10 A 07	Yellow	4302-Y09R	5Y 6/0.5	0.33
	10 A 11	Yellow	6702-G98Y	5Y 4/0.5	0.14
B	04 B 15	Red	0906-Y78R	10R 9/1	0.79
	04 B 17	Red	1409-Y83R	10R 8/2	0.62
	04 B 21	Red	3810-Y76R	10R 6/2	0.33
	08 B 15	Yellow-red	0606-Y41R	10YR 9.25/1	0.86
	08 B 17	Yellow-red	1607-Y41R	8.75YR 8/2	0.64
	08 B 21	Yellow-red	4107-Y41R	8.75YR 6/2	0.32
	08 B 25	Yellow-red	6308-Y40R	8.75YR 4/2	0.16
	08 B 29	Yellow-red	8105-Y53R	8.75YR 2/2	0.07
	10 B 15	Yellow	0504-Y21R	5Y 9.25/1	0.87
	10 B 17	Yellow	1811-Y01R	5Y 8/2	0.61
	10 B 21	Yellow	4011-G99Y	5Y 6/2	0.33
	10 B 25	Yellow	6211-G90Y	5Y 4/2	0.16
	10 B 29	Yellow	8305-G89Y	5Y 2/2	0.07
	12 B 15	Green-yellow	0807-G73Y	5GY 9/1	0.81
	12 B 17	Green-yellow	1812-G75Y	2.5GY 8/2	0.61
	12 B 21	Green-yellow	3915-G65Y	2.5GY 6/2	0.33
	12 B 25	Green-yellow	6313-G57Y	2.5GY 4/2	0.15
	12 B 29	Green-yellow	8207-G53Y	2.5GY 2/2	0.07
	18 B 17	Blue	1704-B78G	5B 8/1	0.62
	18 B 21	Blue	4004-B57G	5B 6/1	0.34
	18 B 25	Blue	6405-B14G	5B 4/1	0.16
	18 B 29	Blue	8205-B06G	7.5B 2/1	0.06

	22 B 15	Violet	1000-N	10PB 9/1	0.81
	22 B 17	Violet	1804-R58B	10PB 8/2	0.60
C	02 C 33	Red-purple	1118-R07B	7.5RP 8/4	0.62
	02 C 37	Red-purple	3531-R17B	7.5RP 5/6	0.23
	02 C 39	Red-purple	5331-R21B	7.5RP 3/6	0.10
	02 C 40	Red-purple	7315-R24B	7.5RP 2/4	0.07
	04 C 33	Red	1019-Y86R	7.5R 8/4	0.62
	04 C 37	Red	3632-Y85R	7.5R 5/6	0.23
	04 C 39	Red	5136-Y87R	7.5R 3/6	0.10
	06 C 33	Yellow-red	1517-Y35R	7.5YR 8/4	0.62
	06 C 37	Yellow-red	4034-Y45R	5YR 8/4	0.23
	06 C 39	Yellow-red	6525-Y40R	7.5YR 3/6	0.11
	08 C 31	Yellow-red	0809-Y32R	10YR 9/2	0.81
	08 C 35	Yellow-red	2430-Y24R	10YR 7/6	0.46
	08 C 37	Yellow-red	4340-Y18R	10YR 5/6	0.23
	08 C 39	Yellow-red	6724-Y22R	10YR 3/6	0.10
	10 C 31	Yellow	0811-Y16R	5Y 9/2	0.81
	10 C 33	Yellow	1122-Y03R	5Y 8.5/4	0.71
	10 C 35	Yellow	2536-G99Y	5Y 7/6	0.45
	10 C 39	Yellow	6921-G95Y	5Y 3/4	0.10
	12 C 33	Green-yellow	1623-G72Y	2.5GY 8/4	0.62
	12 C 39	Green-yellow	6626-G49Y	2.5GY 3/4	0.10
	14 C 31	Green	0609-G12Y	5G 9/1	0.81
	14 C 35	Green	2610-G06Y	5G 7/2	0.45
	14 C 39	Green	6520-G	5G 3/4	0.10
	14 C 40	Green	8007-G05Y	5G 2/2	0.07
	16 C 33	Blue-green	1613-B68G	7.5BG 8/2	0.60
	14 C 37	Blue-green	4326-B57G	7.5BG 5/4	0.22
	18 C 31	Blue	0704-B97G	5B 9.25/1	0.84
	18 C 35	Blue	2516-B05G	7.5B 7/3	0.42
	18 C 39	Blue	6126-B08G	7.5B 3/4	0.10
	20 C 33	Purple-blue	1117-R83B	5PB 8/4	0.63

	20 C 37	Purple-blue	3827-R87B	5PB 5/6	0.23
	20 C 40	Purple-blue	7415-R82B	5PB 2/4	0.07
	22 C 37	Violet	3928-R60B	10PB 5/6	0.22
	24 C 33	Purple	1514-R35B	7.5P 8/3	0.60
	24 C 39	Purple	5431-R49B	7.5P 3/6	0.10
D	04 D 44	Red	2858-Y88R	7.5R 4/10	0.16
	04 D 45	Red	3657-Y93R	7.5R 3/10	0.10
	06 D 43	Yellow-red	2560-Y27R	7.5YR 6/10	0.33
	06 D 45	Yellow-red	4644-Y47R	5YR 4/8	0.16
	10 D 43	Yellow	2163-G97Y	5Y 7/10	0.45
	10 D 45	Yellow	3952-G98Y	5Y 5/8	0.24
	12 D 43	Green-yellow	2954-G64Y	2.5GY 6/8	0.32
	12 D 45	Green-yellow	5043-G54Y	2.5GY 4/6	0.15
	16 D 45	Blue-green	5536-B51G	7.5BG 3/6	0.10
	18 D 43	Blue	3536-B09G	7.5B 5/6	0.22
	20 D 45	Purple-blue	4938-R88B	5PB 3/8	0.10
	22 D 45	Violet	4542-R63B	10PB 3/8	0.10
E	04 E 49	Red	0314-Y91R	7.5R 9/3	0.80
	04 E 51	Red	0963-Y81R	7.5R 6/12	0.33
	04 E 53	Red	1777-Y16R	7.5R 4.5/16	0.18
	06 E 50	Yellow-red	0742-Y32R	7.5YR 8/8	0.60
	06 E 51	Yellow-red	0860-Y50R	2.5YR 7/11	0.46
	06 E 56	Yellow-red	2962-Y43R	5YR 5/12	0.24
	08 E 51	Yellow-red	1178-Y16R	10YR 7.5/12	0.51
	10 E 49	Yellow	0823-G87Y	10Y 9/4	0.79
	10 E 50	Yellow	0848-Y	5Y 8.5/8	0.64
	10 E 53	Yellow	0875-G95Y	6.25Y 8.5/13	0.64
	12 E 51	Green-yellow	0963-G66Y	2.5GY 8/10	0.60
	12 E 53	Green-yellow	1266-G45Y	5GY 7/11	0.44
	14 E 51	Green	1854-G09Y	2.5G 6.5/8	0.34
	14 E 53	Green	2854-G5G	.5/10	0.22
	16 E 53	Blue-green	3049-B50G	7.5BG 5/8	0.22



	18 E 49	Blue	0710-B64G	5B 9/2	0.79
	18 E 50	Blue	0822-B11G	7.5B 8/4	0.60
	18 E 51	Blue	1847-B06G	7.5B 6/8	0.31
	18 E 53	Blue	2959-B	10B 4/10	0.15
	20 E 51	Purple-blue	1548-R89B	5PB 6/10	0.32
	00 E 53	Black	9500-N	N 1.5	0.05
	00 E 55	White	0000-N	N 9.5	0.85

Table 2.2.11 References and reflectance for colors





## **Chapter 3 Project Facts**

### **3.1 Site Analysis**

#### **Location**

The location of this Museum of Lighting and Spaces is located far away from the city. It is located the suburbs of Rungsit and the near by clusters of museums such as The N.S.C Museum which usually is the site for educational field trips.

#### **Building Analysis**

It is a low-rise public building that has three stories. It has a light weight roof structure which can be removed easily without disturbing the structure for the advantage of penetrating the natural sun light into my design. The front façade is a large opening for the sunlight to penetrate during the day time. The condition of the existing ramp already was designed with sky light above to brighten up the ramp.

The disadvantage of the unfinished space theater which was constructed in steps of seating is hard for furthering the design development. Together with the observatory dome that no one can use except the astronomer.

## Chapter 4 Data Synthesis and Programming

### User Behavior

#### Student Behavior



Figure 3.1.1: User Behavior\_Student01

**User Behavior**

## Student Behavior

**Figure 3.1.2:** User Behavior\_Student02



User Behavior  
Student Behavior



Figure 3.1.3: User Behavior\_Student03

## User Behavior

### General Visitor Behavior



Figure 3.1.4: User Behavior\_General Visitor



**User Behavior**

## Staff Office Behavior



Figure 3.1.5: User Behavior\_Staff Office



## Area Requirement

Studio room

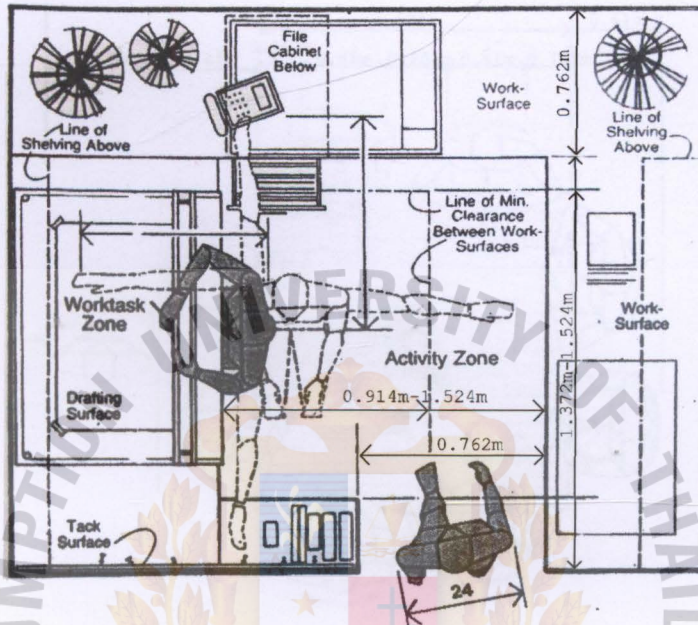


Figure 3.1.6: Human Dimension (studio)

$$(0.914 + 1.524) (0.305 + 1.524 + 0.762)$$

$$= 6.32 \text{ sqm/person}$$

$$6.32 \times 210$$

$$= 1368.2 \text{ sqm}$$

$$+ 586.3 \text{ sqm} \text{ — 30\% circulation}$$

$$= 1954.634 \text{ sqm (6.9\%)}$$

## Area Requirement

### Meeting room

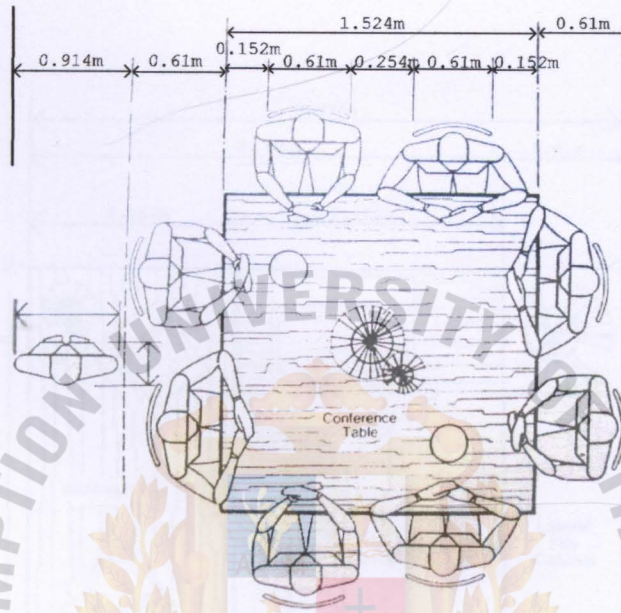


Figure 3.1.7: Human Dimension (meeting room)

$$4.572 \times 4.572$$

$$= 2.61 \text{ sqm/person}$$

$$2.61 \times 40$$

$$= 104.4 \text{ sqm}$$

$$+ 31.32 \text{ sqm} \text{ ——— } 30\% \text{ circulation}$$

$$= 135.72 \text{ sqm (0.48\%)}$$



## Area Requirement

### Office

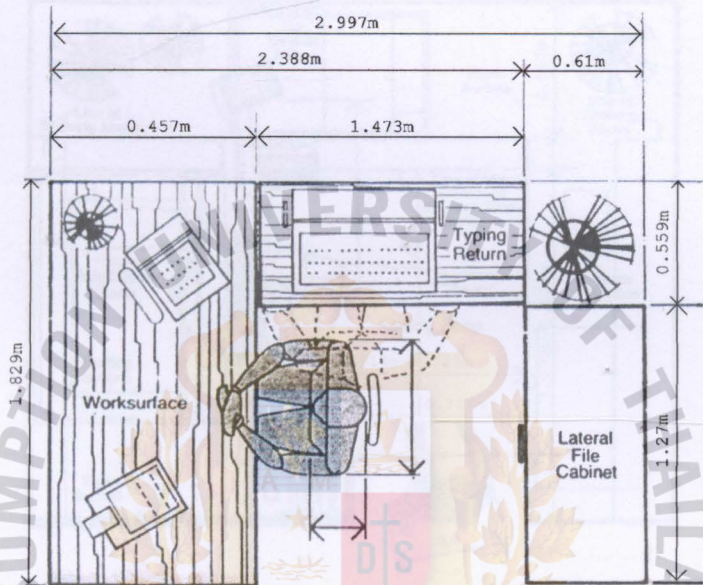


Figure 3.1.8: Human Dimension (office)

$$\begin{aligned}
 & (2.388 \times 0.61) + (1.27 \times 0.559) \\
 &= 5.48 \text{ sqm/person} \\
 & 5.48 \times 40 \\
 &= 219.2 \text{ sqm} \\
 &+ 65.75 \text{ sqm} \text{ ——— } 30\% \text{ circulation} \\
 &= 285 \text{ sqm (1.01\%)}
 \end{aligned}$$



## Area Requirement

### Work Shop

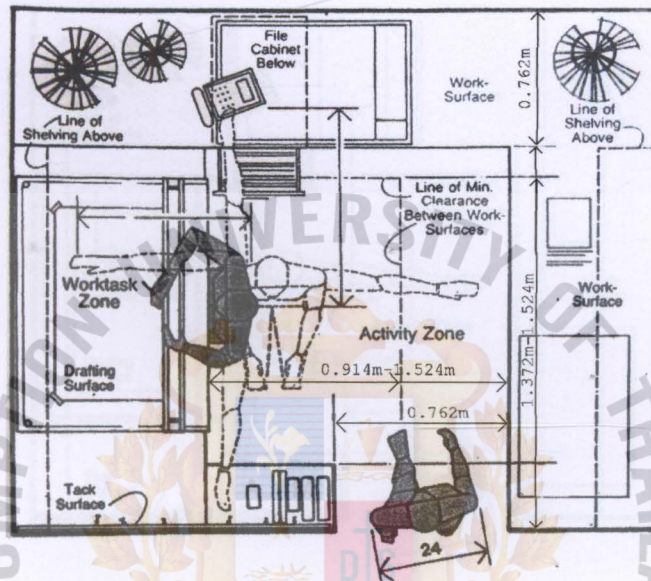


Figure 3.1.9: Human Dimension (workshop)

$$\begin{aligned}
 & (0.914 + 1.524)(0.305 + 1.524 + 0.762) \\
 &= 6.32 \text{ sqm/person} \\
 & 6.32 \times 110 \\
 &= 700 \text{ sqm} \\
 &+ 300 \text{ sqm} \text{ ——— } 30\% \text{ circulation} \\
 &= 1000 \text{ sqm (3.56\%)}
 \end{aligned}$$

## Area Requirement

### Laboratory

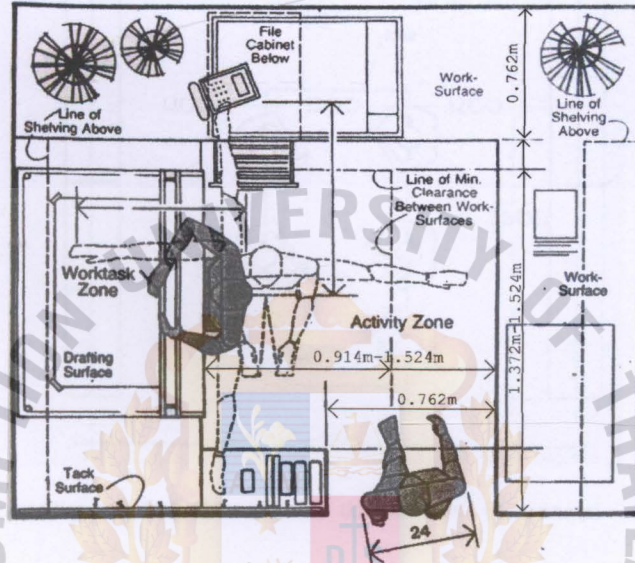


Figure 3.1.10: Human Dimension (laboratory)

$$\begin{aligned}
 & (0.914 + 1.524) (0.305 + 1.524 + 0.762) \\
 &= 6.32 \text{ sqm/person} \\
 & 6.32 \times 48 \\
 &= 303.24 \text{ sqm} \\
 &+ 129.96 \text{ sqm} \text{ ——— } 30\% \text{ circulation} \\
 &= 433.2 \text{ sqm (1.54\%)}
 \end{aligned}$$



## Area Requirement

### Library

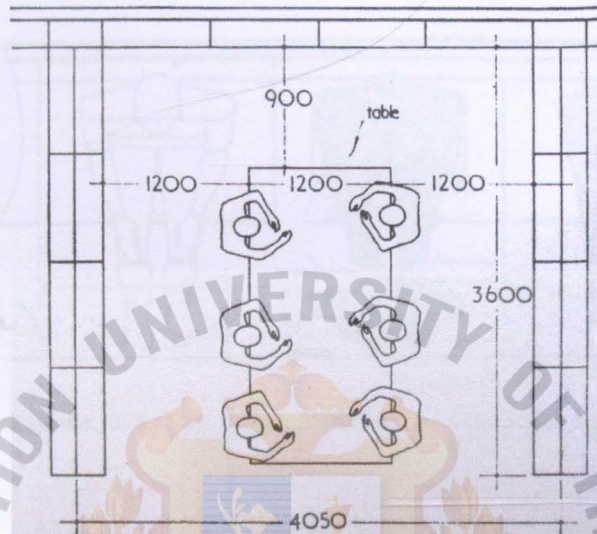


Figure 3.1.11: Human Dimension (library)

$$4.05 \times 4.5$$

$$= 3.04 \text{ sqm/person}$$

$$3.04 \times 84$$

$$= 255.962 \text{ sqm}$$

$$+ 109.698 \text{ sqm} \text{ ——— } 30\% \text{ circulation}$$

$$= 365.66 \text{ sqm (1.3\%)}$$



## Area Requirement

Lecture Room

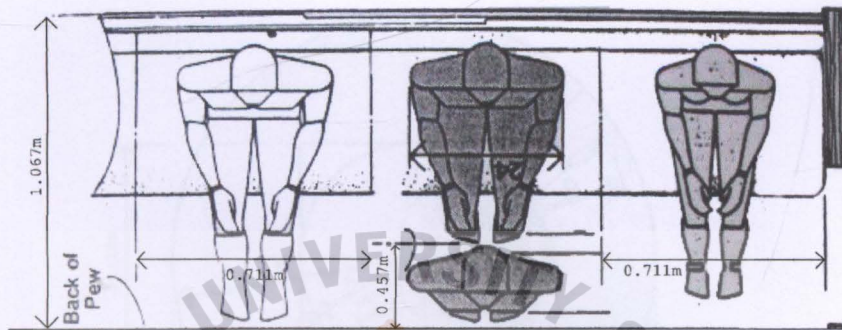


Figure 3.1.12: Human Dimension (lecture room)

$$1.067 \times 0.711$$

$$= 0.76 \text{ sqm/person}$$

$$0.76 \times 260$$

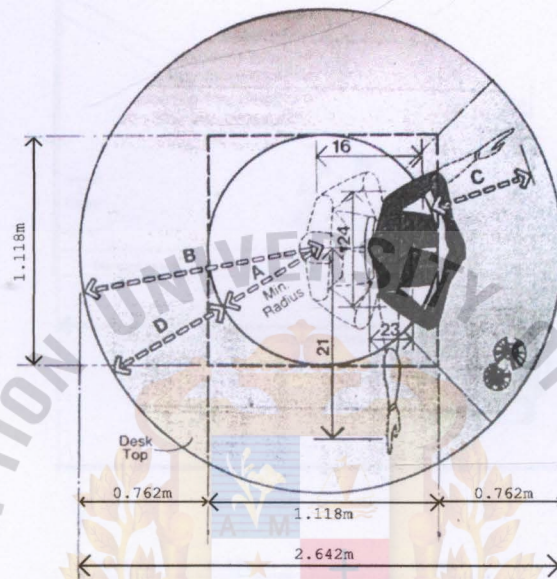
$$= 200.83 \text{ sqm}$$

$$+ 86.07 \text{ sqm} \text{ --- } 30\% \text{ circulation}$$

$$= 286.9 \text{ sqm (1.02\%)}$$

## Area Requirement

### Ticket and Information



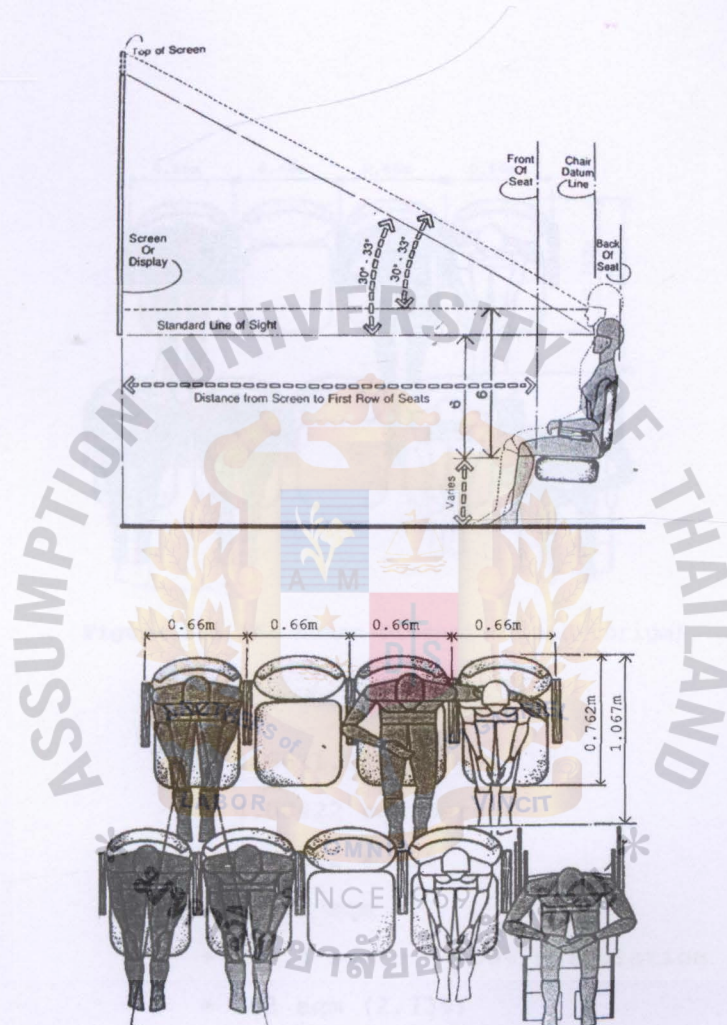
**Figure 3.1.13:** Human Dimension (ticket and information)

$$\begin{aligned}
 & 2.642 \times 2.642 \\
 & = 6.98 \text{ sqm/person} \\
 & 6.98 \times 14 \\
 & = 100.8 \text{ sqm} \\
 & + 43.2 \text{ sqm} \text{ — 30\% circulation} \\
 & = 144.0 \text{ sqm (0.52\%)}
 \end{aligned}$$



## Area Requirement

### Space Theater



**Figure 3.1.14, 3.1.15:** Human Dimension (space theater)

$$= 4.00422 \text{ sqm/person}$$

$$4.00422 \times 300$$

$$= 1209.6 \text{ sqm}$$

$$+ 518.4 \text{ sqm} \text{ ——— } 30\% \text{ circulation}$$

$$= 1728 \text{ sqm (6.14\%)}$$



## Area Requirement Auditorium

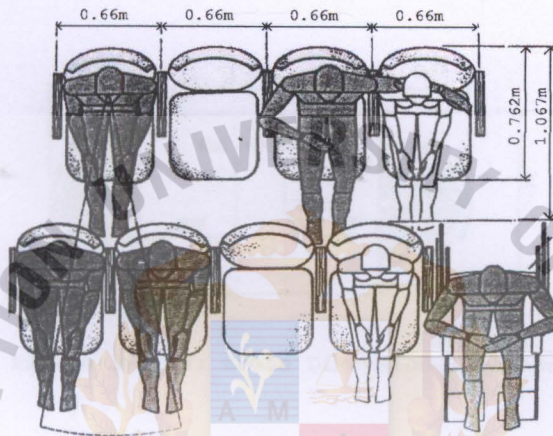


Figure 3.1.16: Human Dimension (auditorium)

$$0.66(1.067+5)$$

$$= 4.00422 \text{ sqm/person}$$

$$4.00422 \times 135$$

$$= 537.6 \text{ sqm}$$

$$+ 230.4 \text{ sqm} \text{ --- } 30\% \text{ circulation}$$

$$= 768 \text{ sqm (2.73\%)}$$

## Area Requirement Restaurant

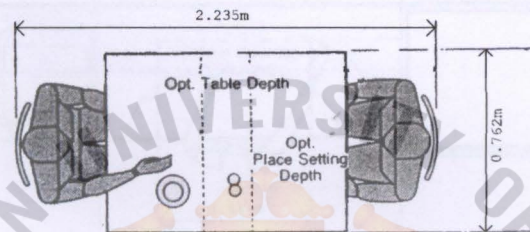


Figure 3.1.17: Human Dimension (restaurant)

$$\frac{1.372 \times 2.381}{2}$$

$$= 1.63 \text{ sqm/person}$$

$$1.63 \times 300$$

$$= 502.74 \text{ sqm}$$

$$+ 215.46 \text{ sqm} \text{ --- } 30\% \text{ circulation}$$

$$= 718.2 \text{ sqm (2.55\%)} \quad 9$$



## Area Requirement

### Kitchen

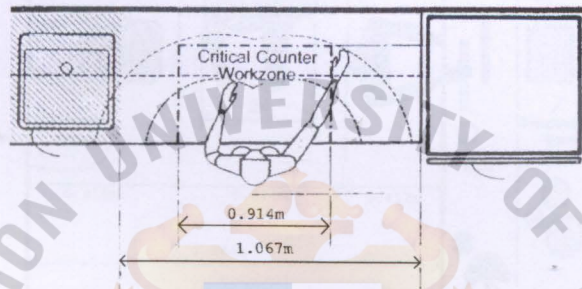


Figure 3.1.18: Human Dimension (kitchen)

$$0.914 \times 1.61$$

$$= 1.47 \text{ sqm/person}$$

$$1.47 \times 58$$

$$= 85.26 \text{ sqm}$$

$$+ 36.54 \text{ sqm} \text{ --- } 30\% \text{ circulation}$$

$$= 121.8 \text{ sqm (0.45\%)}$$



## Area Requirement

### Museum Shop

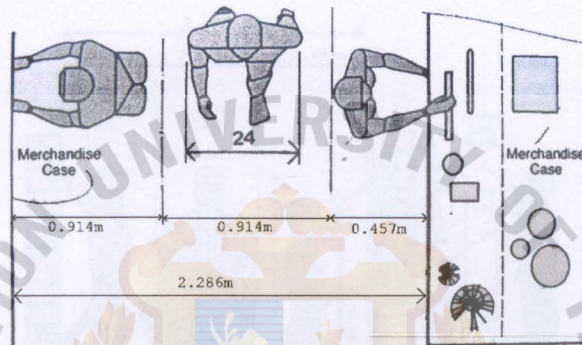


Figure 3.1.19: Human Dimension (museum shop)

$$\begin{aligned}
 & 2.286 \times 0.6 \\
 & = 1.3716 \text{ sqm/person} \\
 & 1.3716 \times 38 \\
 & = 50.4 \text{ sqm} \\
 & + 21.6 \text{ sqm} \text{---} 30\% \text{ circulation} \\
 & = 72 \text{ sqm (0.25\%)}
 \end{aligned}$$

## Area Requirement

### Book Store

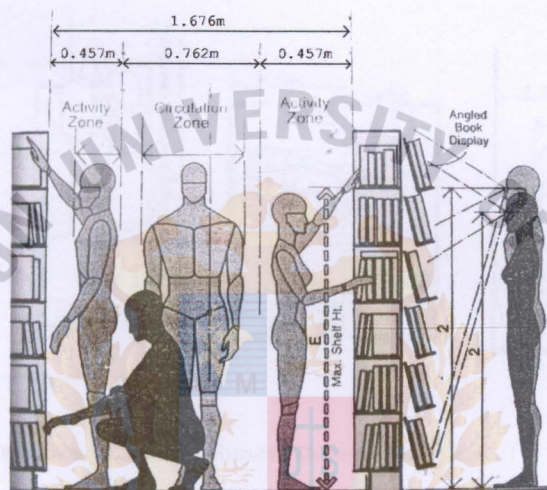


Figure 3.1.20: Human Dimension (book store)

$$1.676 \times 0.6$$

$$= 1.0056 \text{ sqm/person}$$

$$1.0056 \times 50$$

$$= 50.4 \text{ sqm}$$

$$+ 21.6 \text{ sqm} \text{ ——— } 30\% \text{ circulation}$$

$$= 72 \text{ sqm (0.25\%)}$$



# Relationship Diagram Main Circulation

## Area Requirement

W.C.

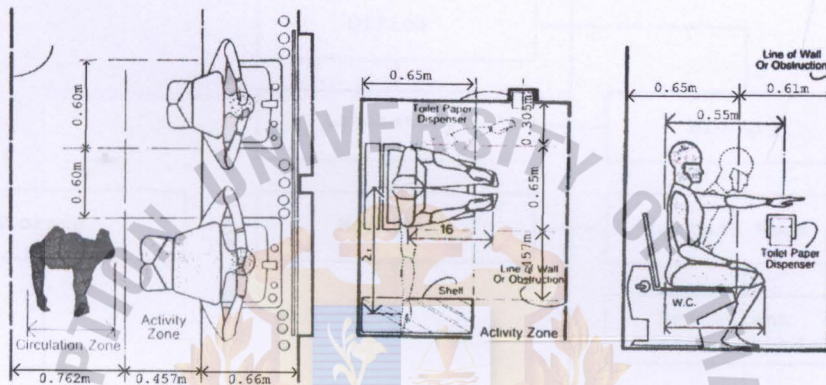


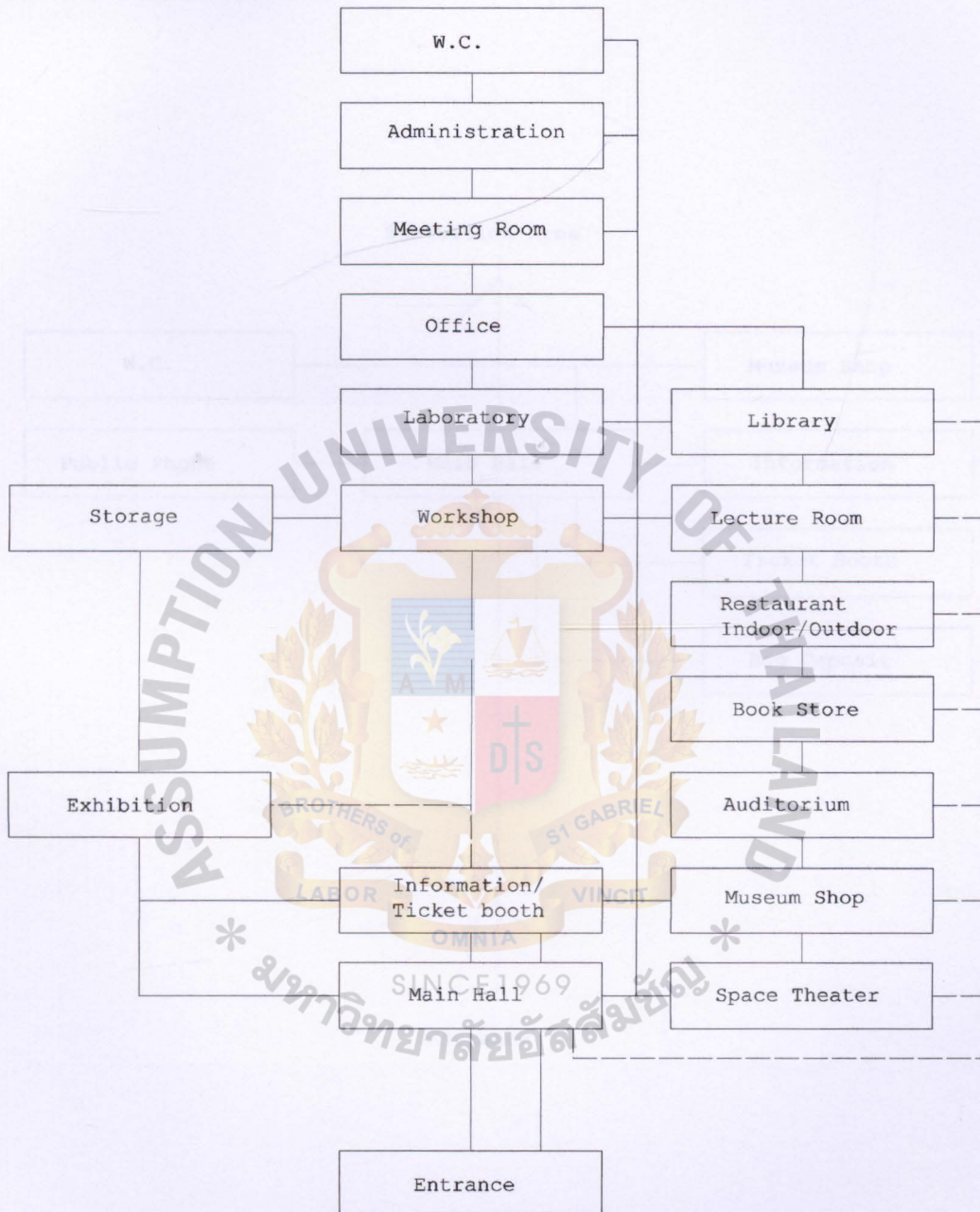
Figure 3.1.21: Human Dimension (W.C.)

$$\begin{aligned}
 & (1.50 \times 1.372) + (1.117 \times 0.7) \\
 & = 2.838 \text{ sqm/person} \\
 & 2.838 \times 100 \\
 & = 289.8 \text{ sqm} \\
 & + 124.2 \text{ sqm} \text{ --- 30\% circulation} \\
 & = 414 \text{ sqm (1.47\%)}
 \end{aligned}$$



# Relationship Diagram

## Main Circulation

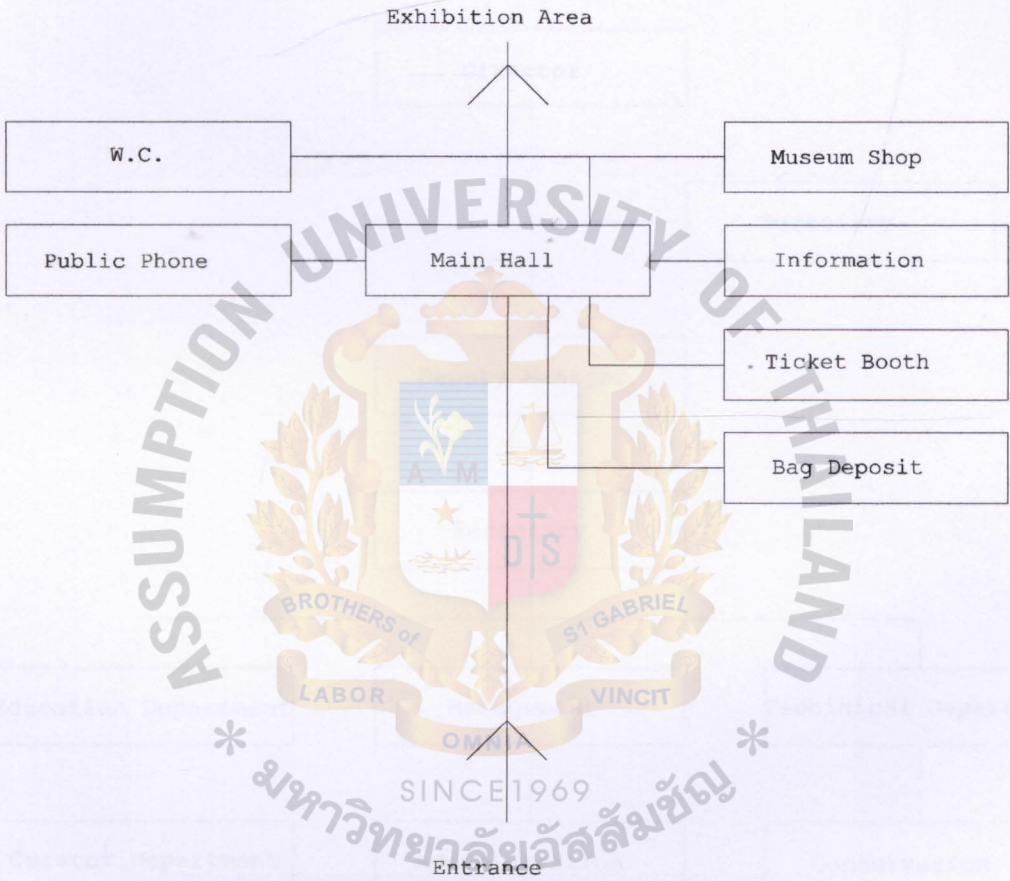


----- Customer Circulation

————— Staff Circulation

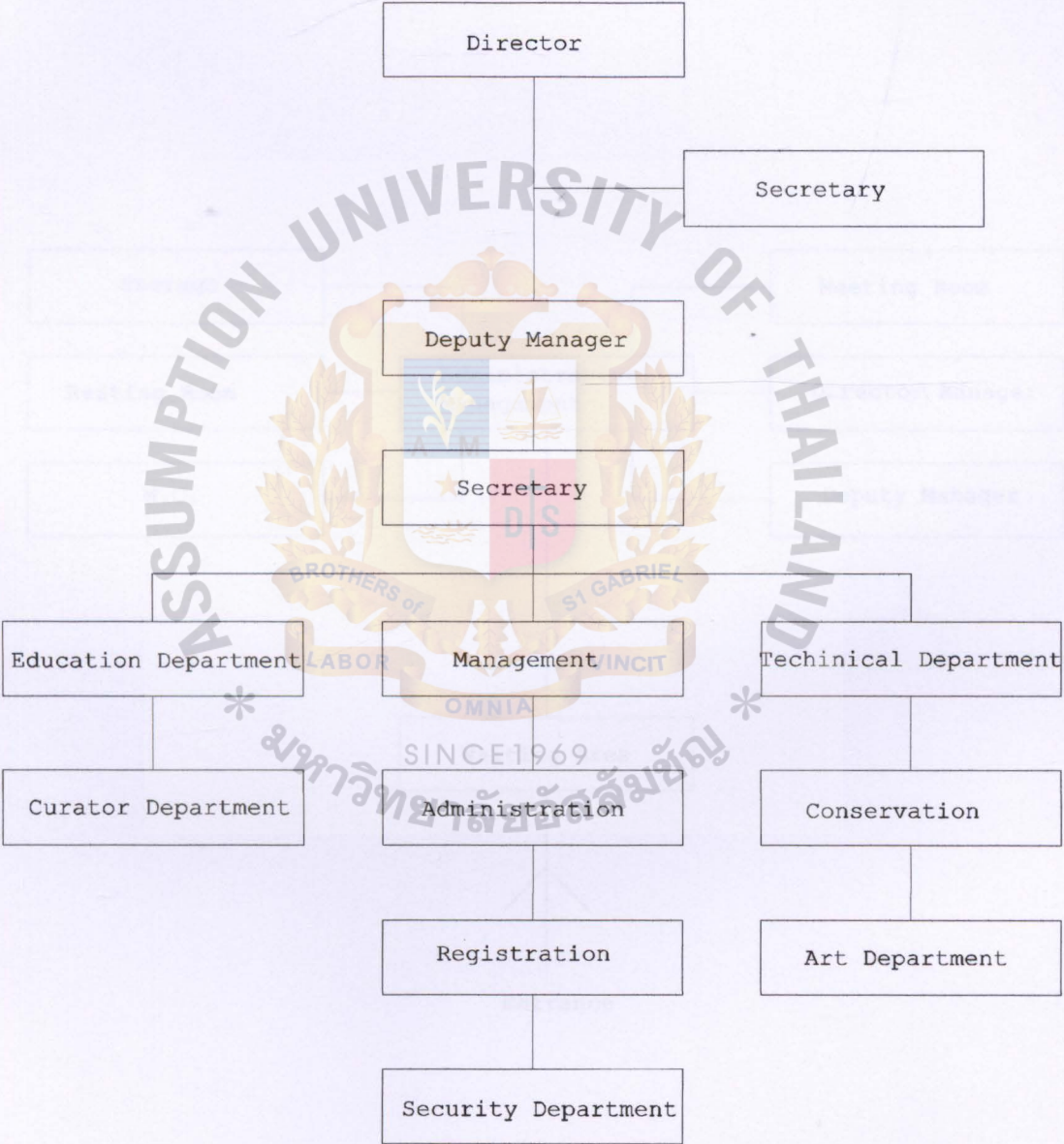
Relationship Diagram

Main Hall





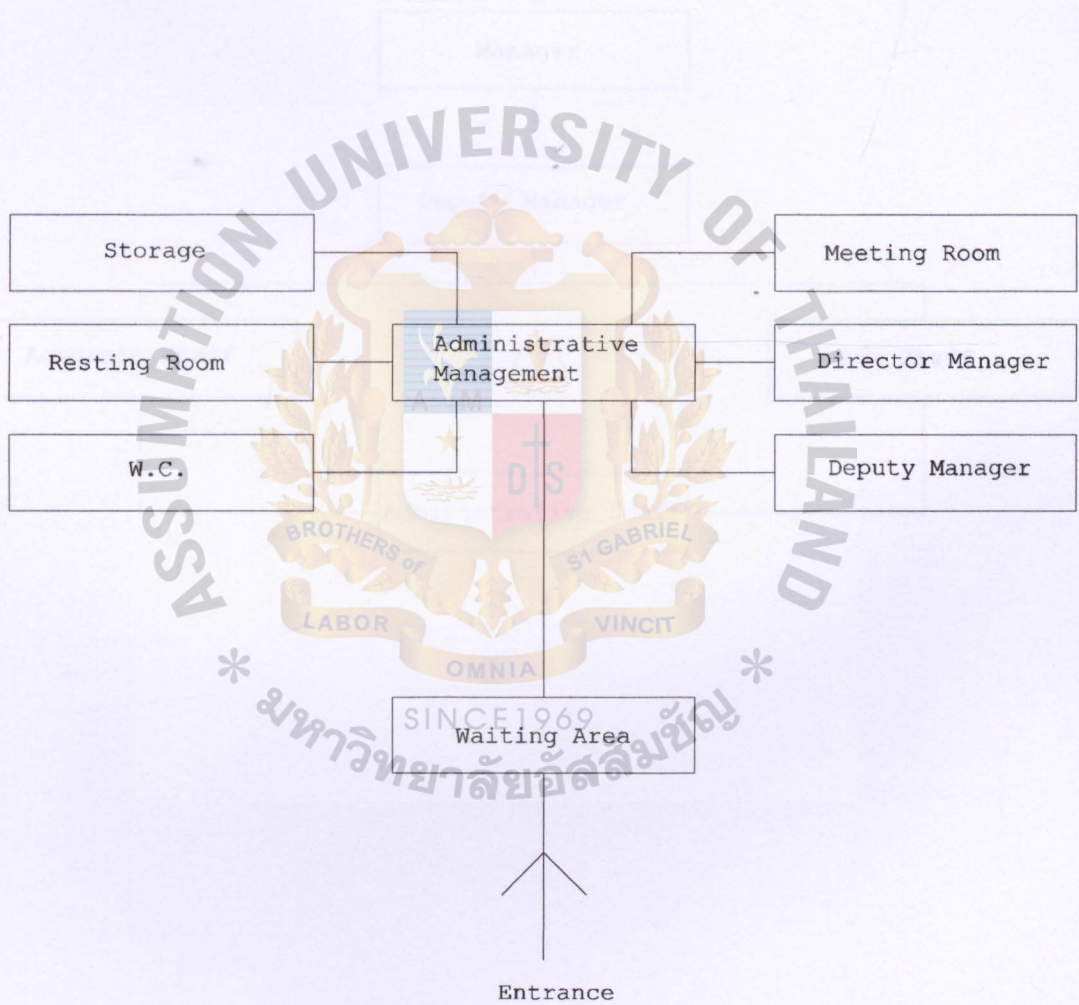
**Relationship Diagram**  
Museum Office Division



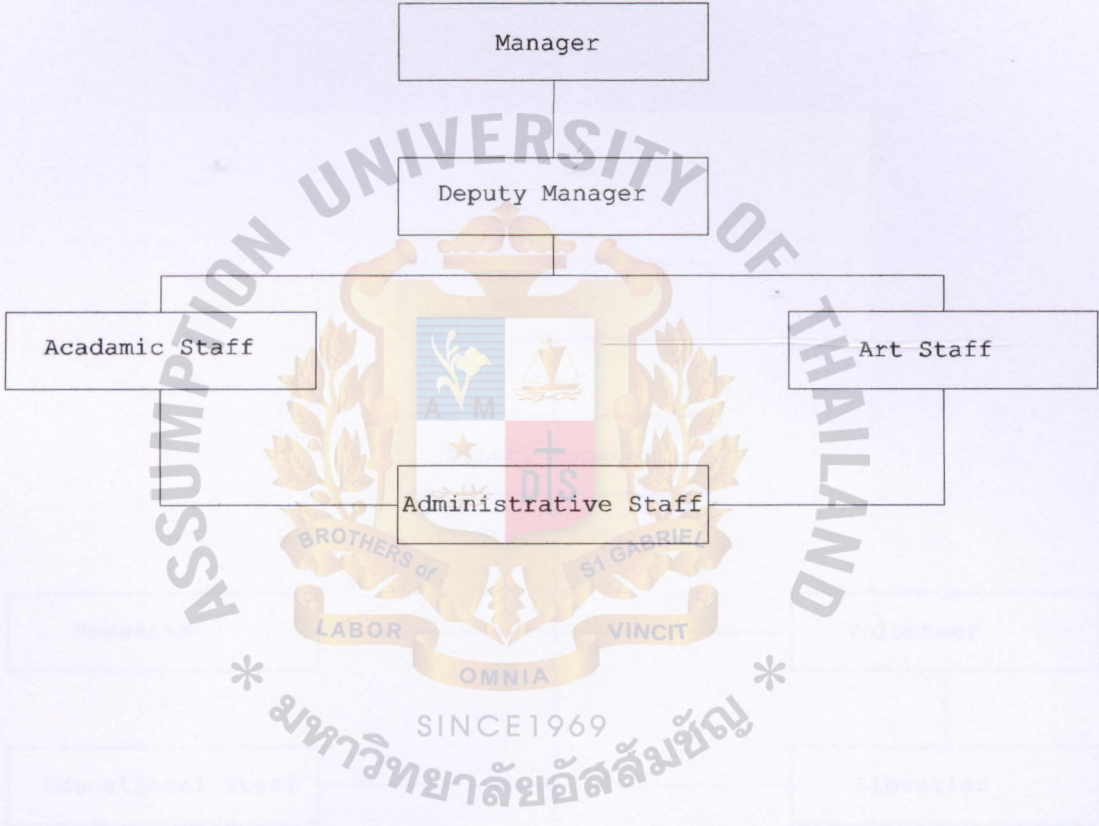


# Relationship Diagram

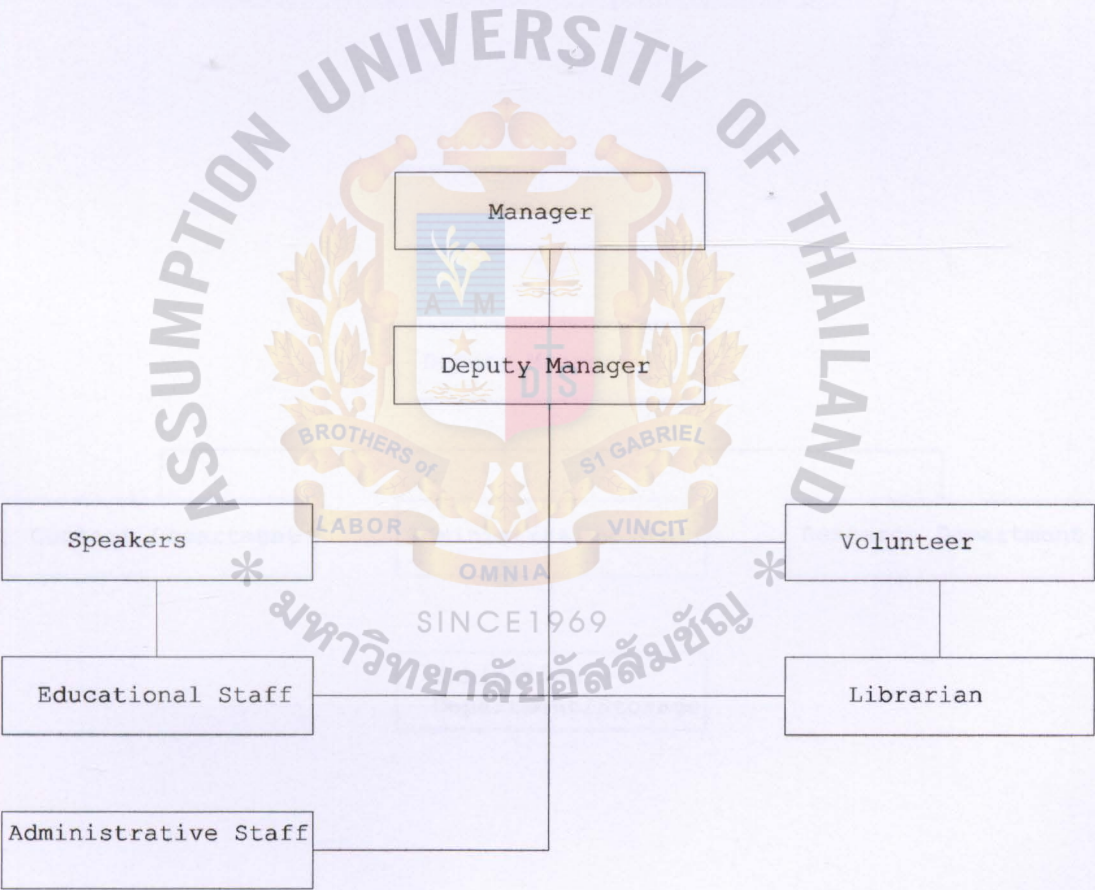
Management Office



**Relationship Diagram**  
Research Office

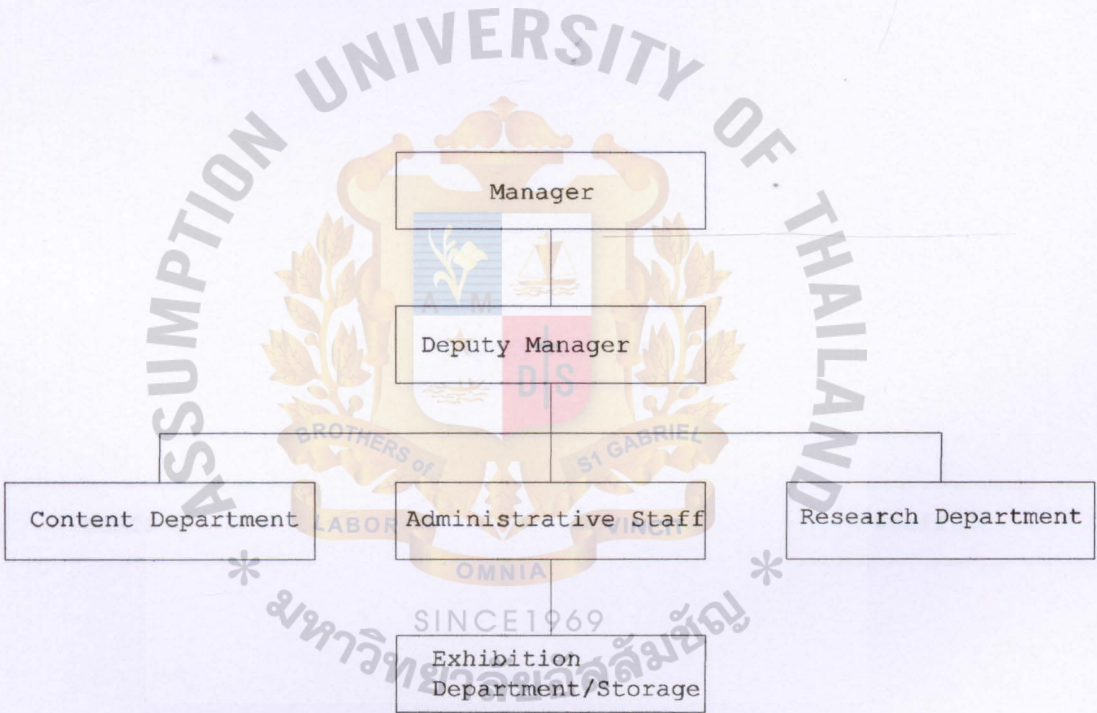


**Relationship Diagram**  
Education Office





**Relationship Diagram**  
Administration and Storage Office

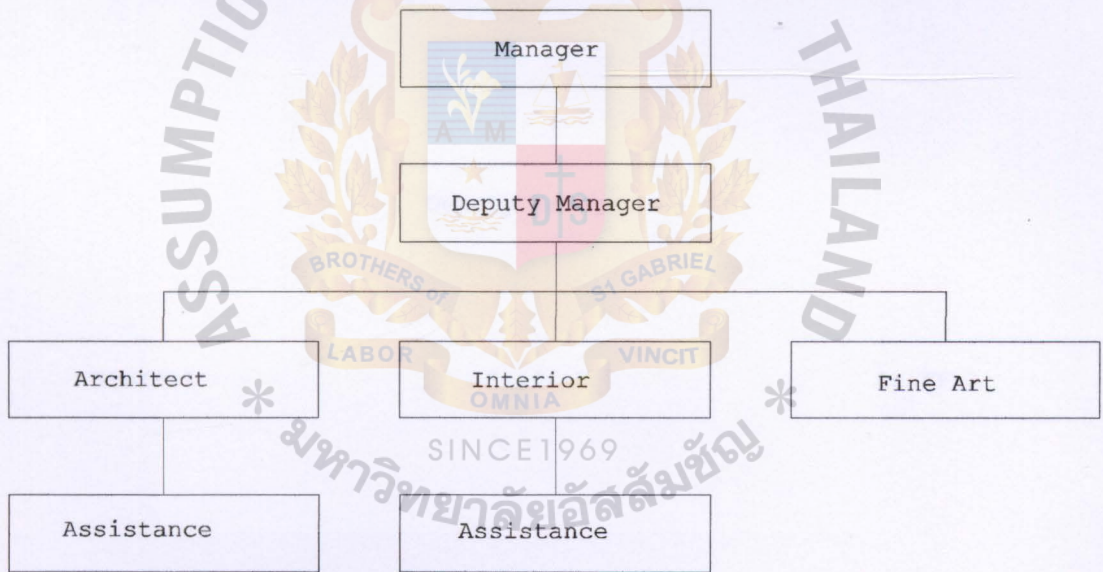


**Relationship Diagram**  
Conservation Office



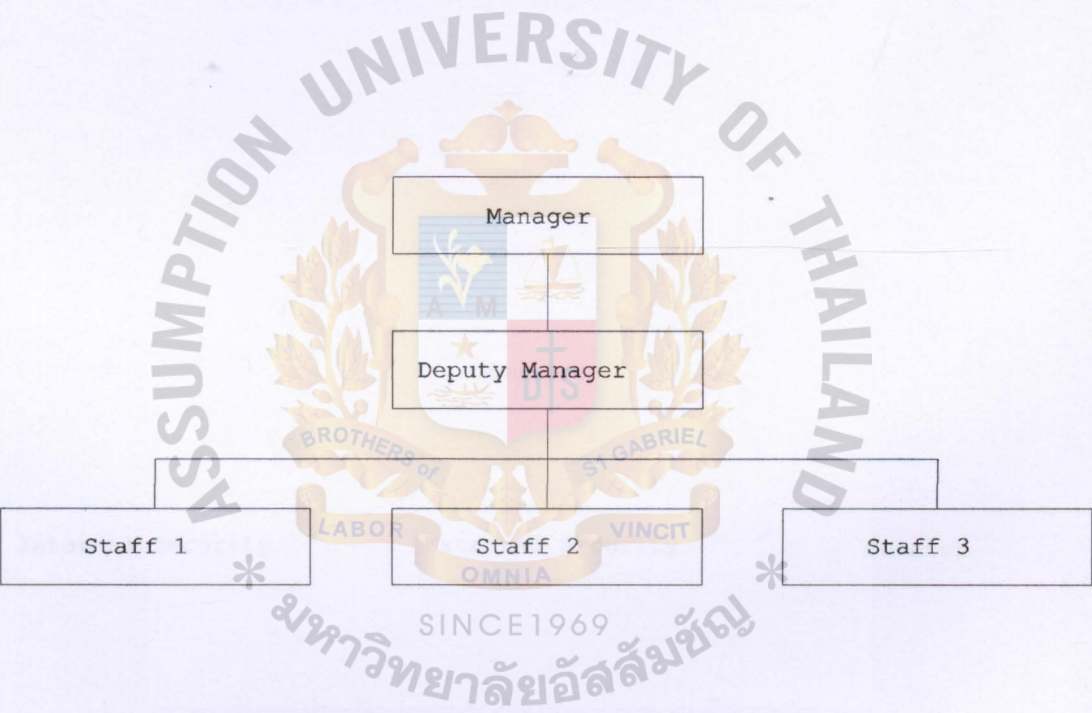
# Relationship Diagram

Art and design Office





**Relationship Diagram**  
Technical Office



**Relationship Diagram**  
Security Office



Figure 3.1.1. Security Office



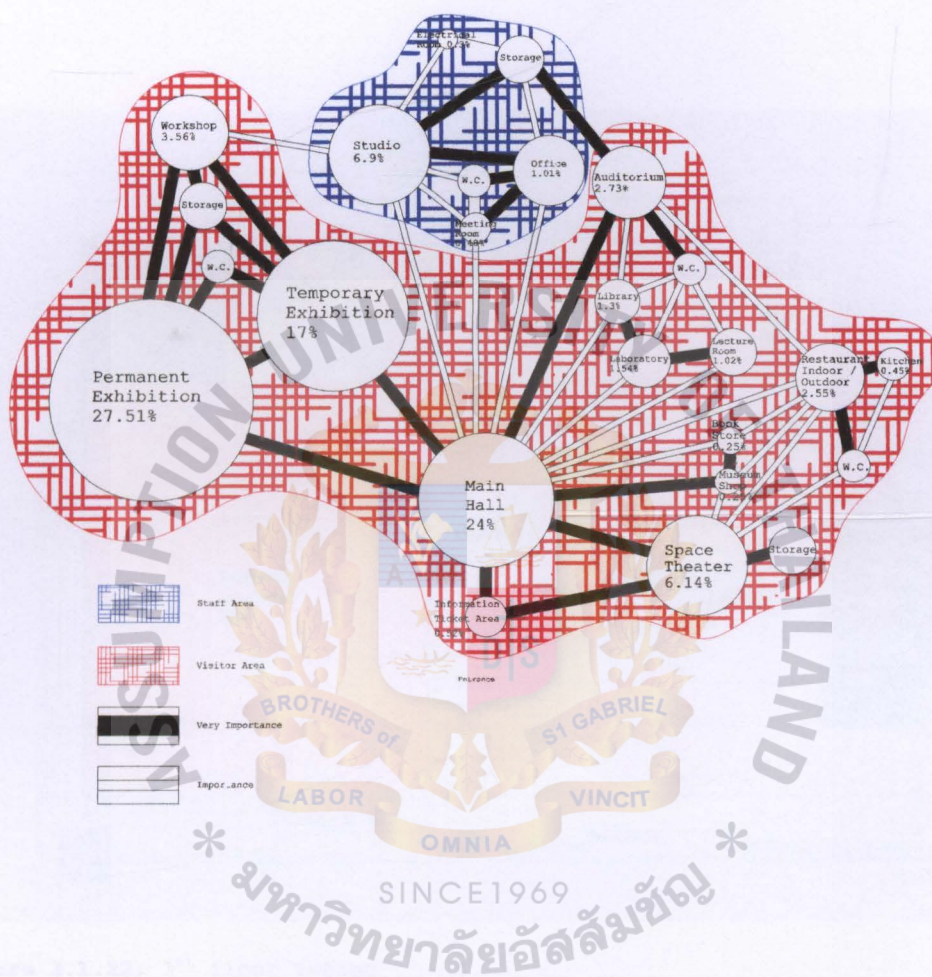
Matric Diagram

<div><div></div>Very Importance</div> <div><div></div>Importance</div> <div><div></div>Not Importance</div>	Entrance	Main Hall	Information/ Ticket booth	Space Theater	Auditorium	Museum Shop	Book Store	Lecture Room	Laboratory	Library	Restaurant Indoor/Outdoor	Kitchen	Permanent Exhibition	Temporary Exhibition	Workshop	Office	Meeting Room	Studio	Storage	Electrical Room	W.C.
Entrance																					
Main Hall																					
Information/ Ticket booth																					
Space Theater																					
Auditorium																					
Museum Shop																					
Book Store																					
Lecture Room																					
Laboratory																					
Library																					
Restaurant Indoor/Outdoor																					
Kitchen																					
Permanent Exhibition																					
Temporary Exhibition																					
Workshop																					
Office																					
Meeting Room																					
Studio																					
Storage																					
Electrical Room																					
W.C.																					

Table 3.1.1: Matrix Diagram



### Bubble Diagram



First floor Zoning

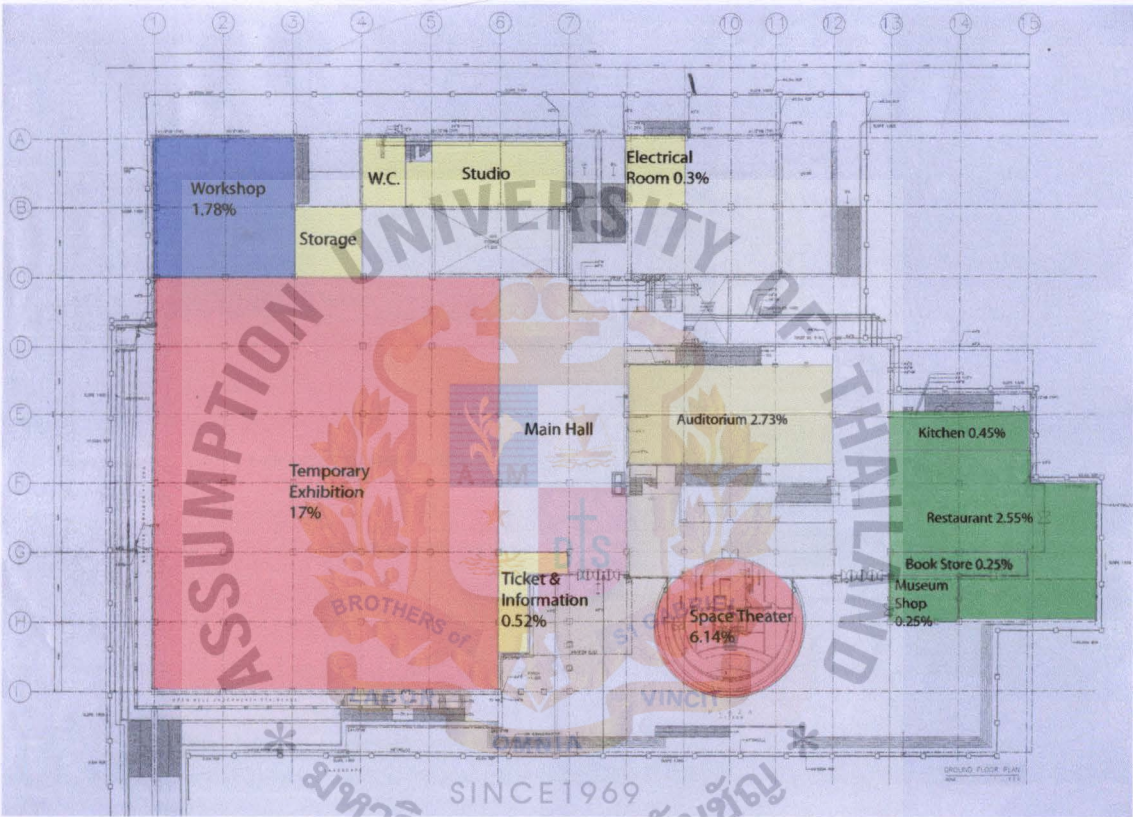


Figure 3.1.22: 1<sup>st</sup> floor zoning

Figure 3.1.23: 2<sup>nd</sup> floor zoning



## Second floor Zoning

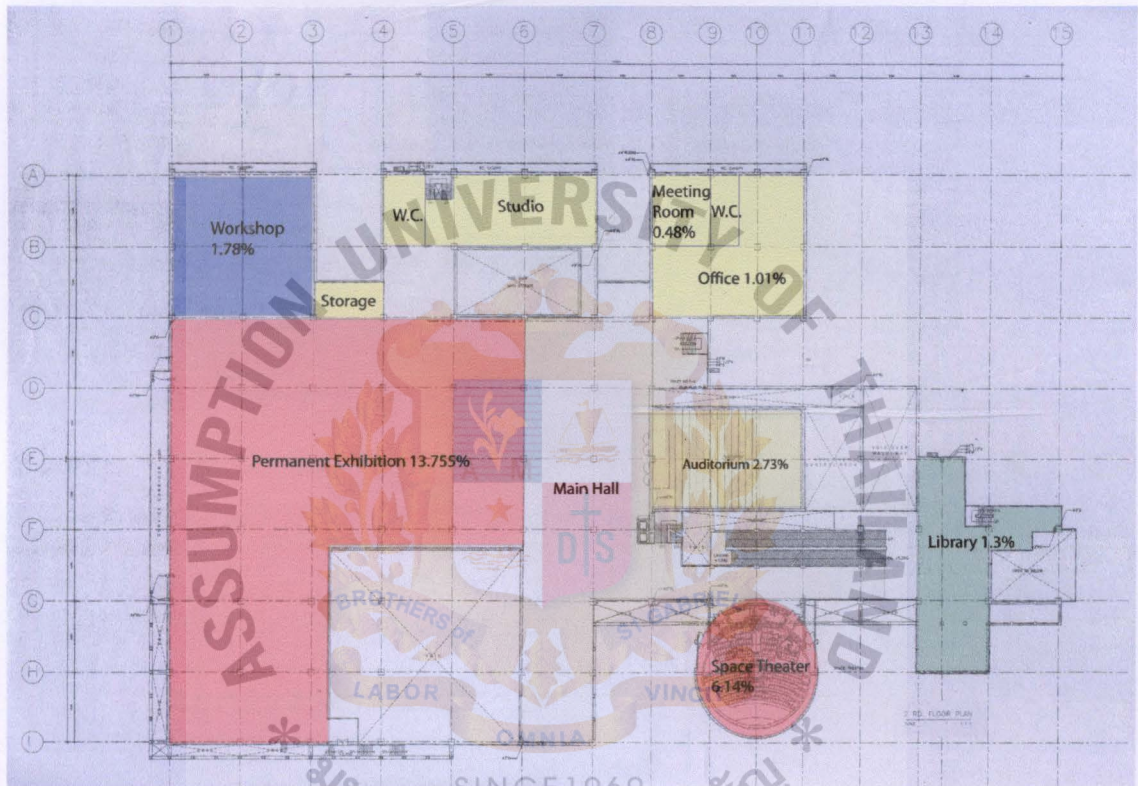


Figure 3.1.23: 2<sup>nd</sup> floor zoning



Third floor Zoning Solution

Concept

'A Gathering of Different Light'

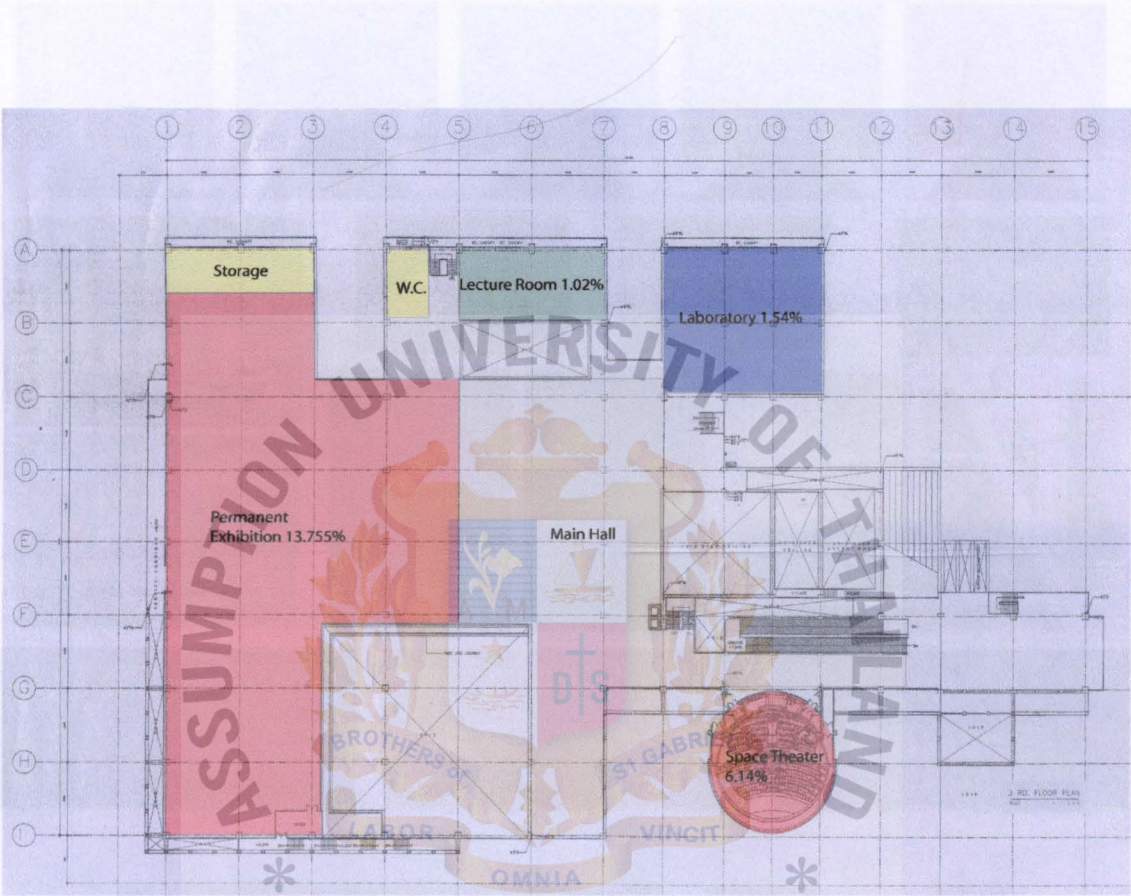
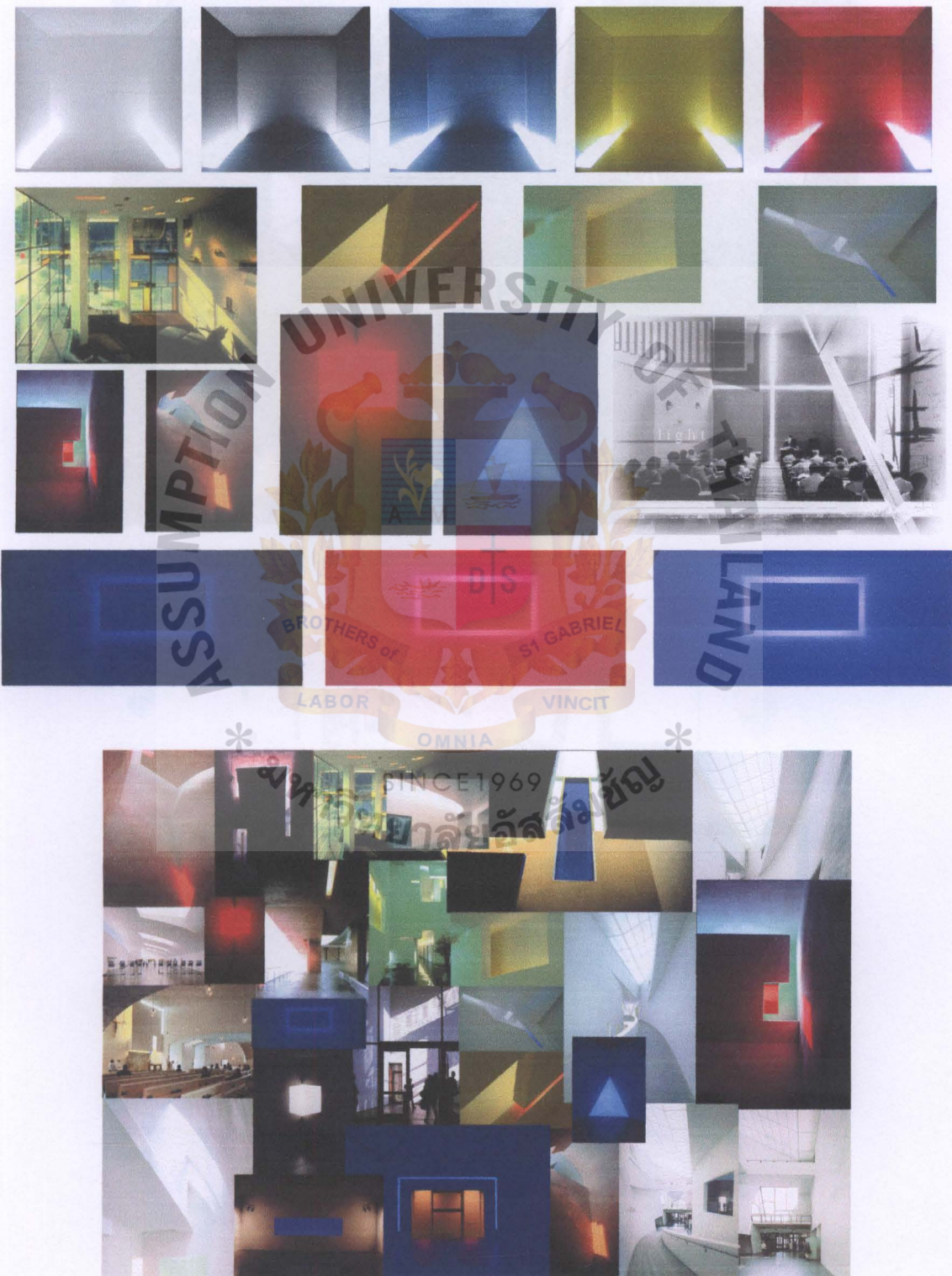


Figure 3.1.24: 3<sup>rd</sup> floor zoning

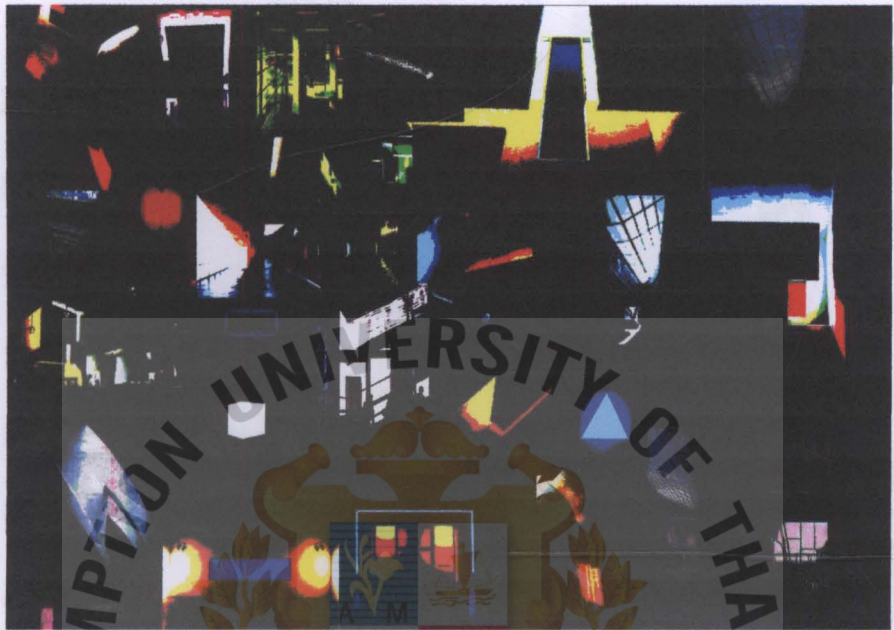


Chapter 5: Design Solution  
Concept

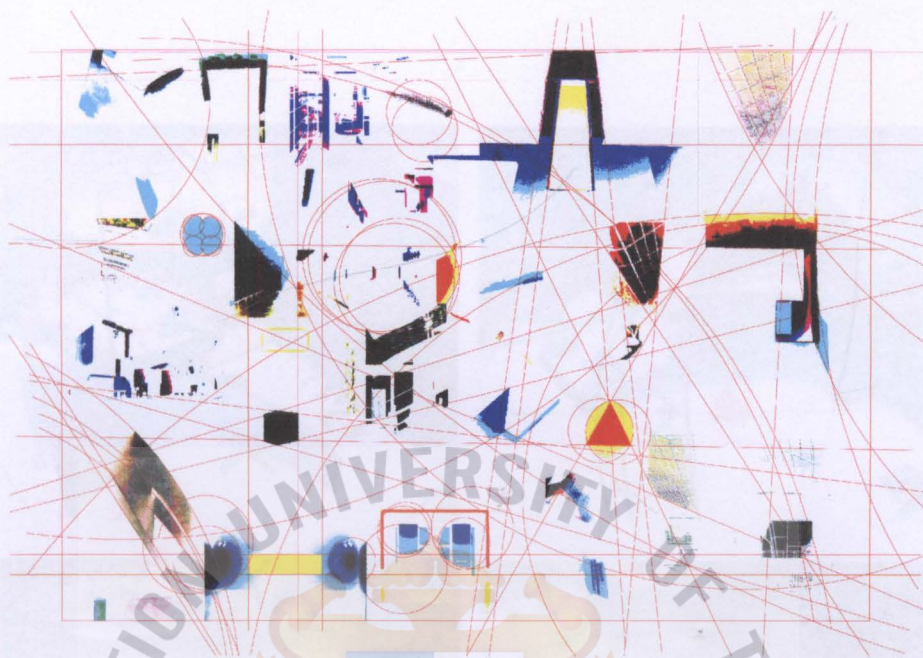
'A Gathering of Different Light'



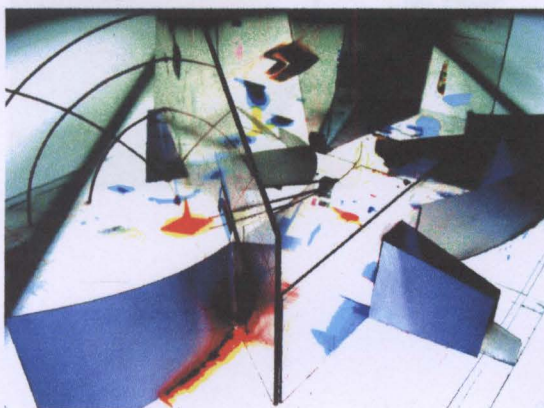
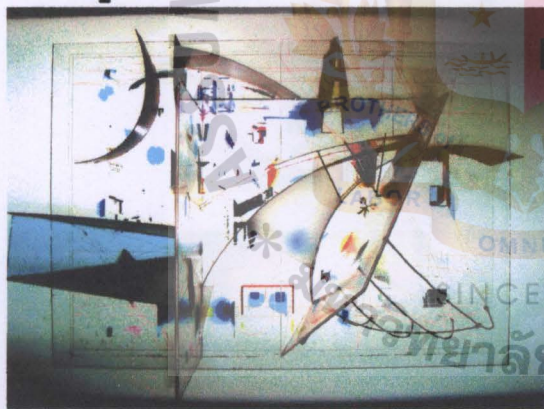




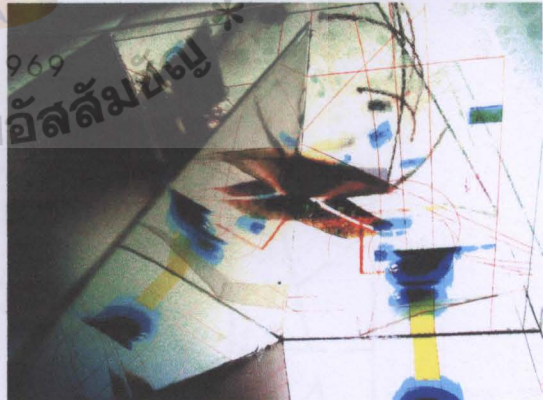
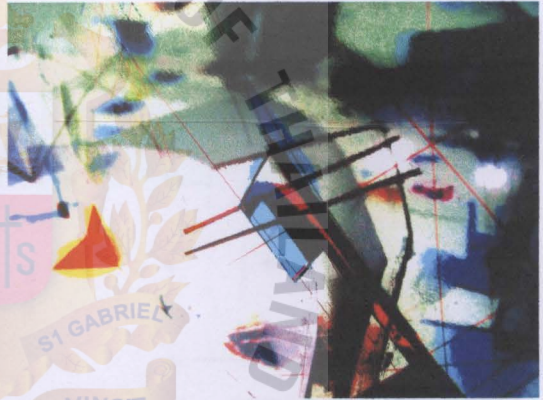
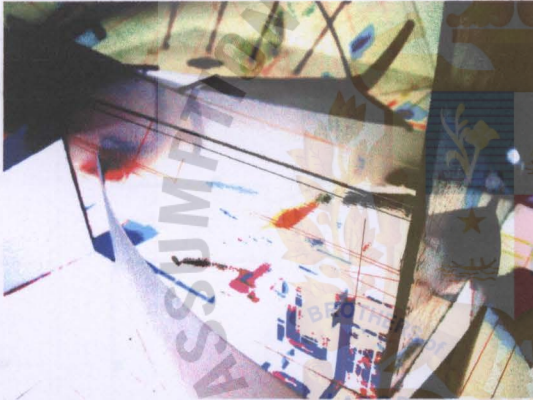




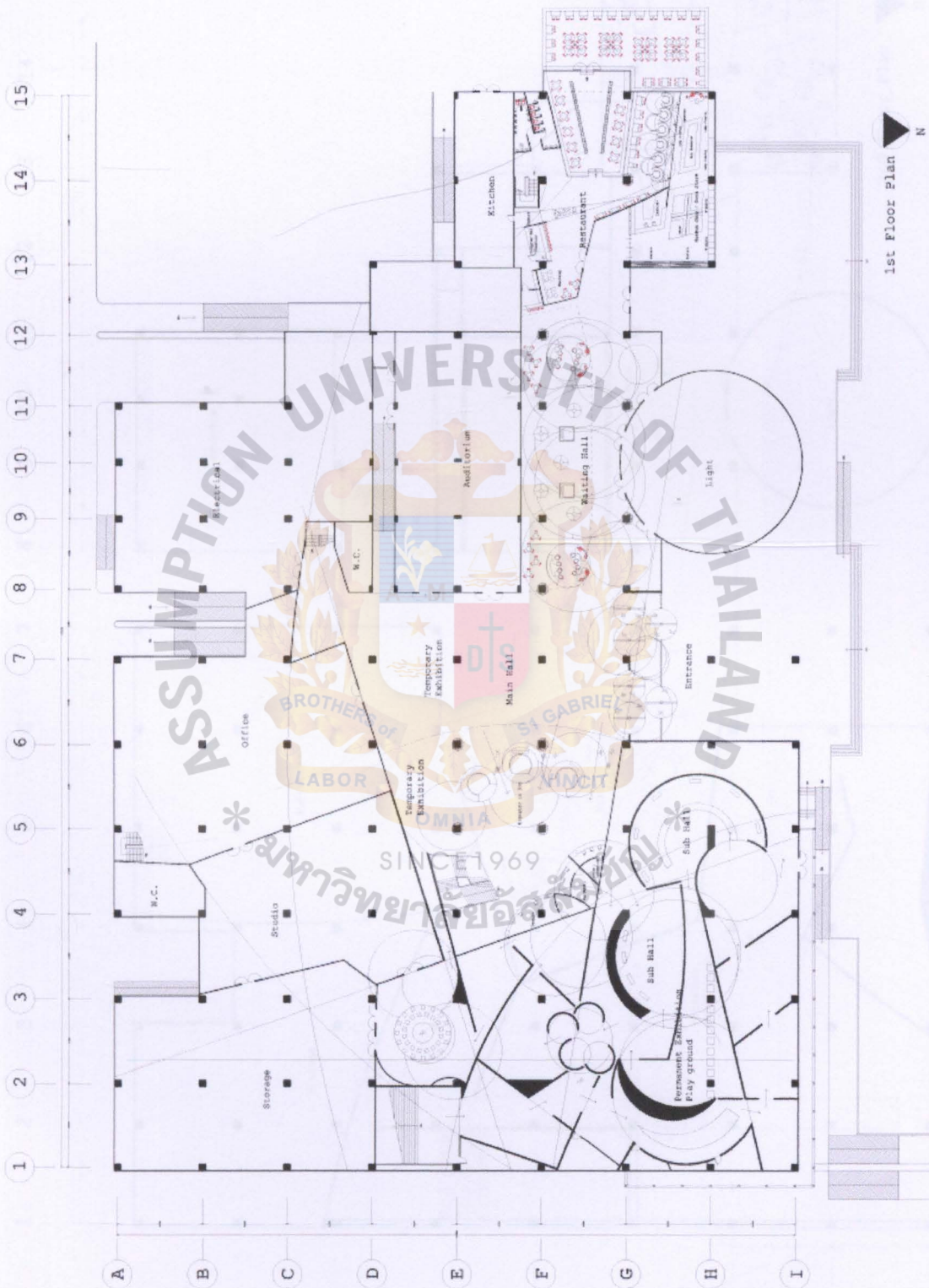
Concept Model





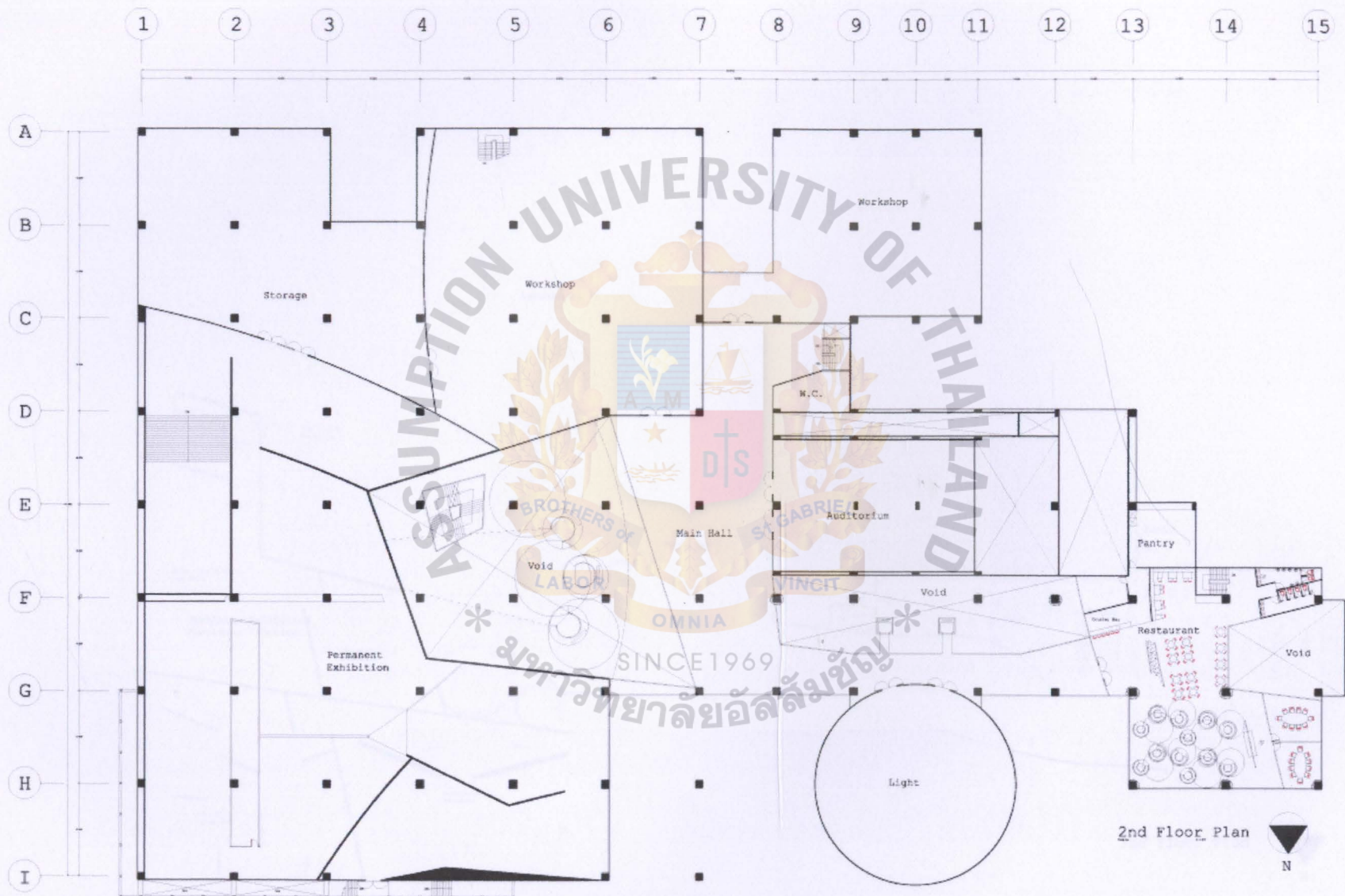


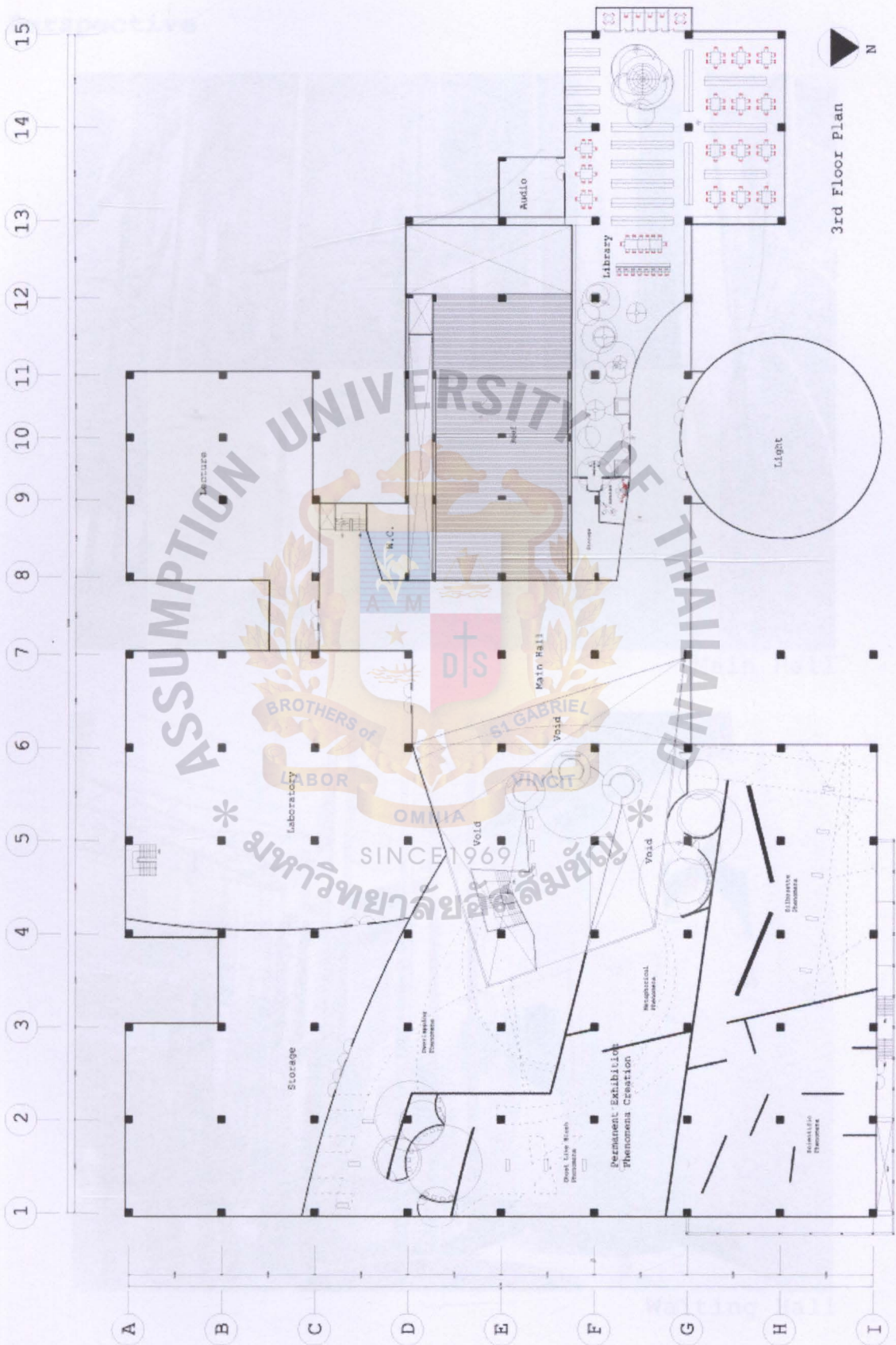




1st Floor Plan N





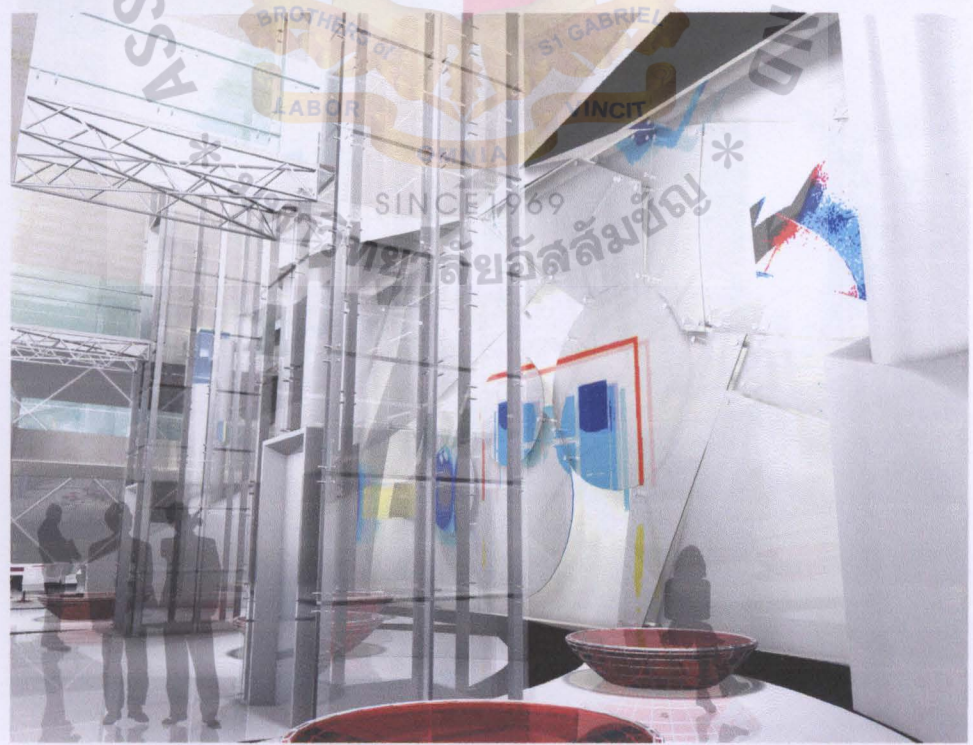




Perspective



Main Hall



Waiting Hall





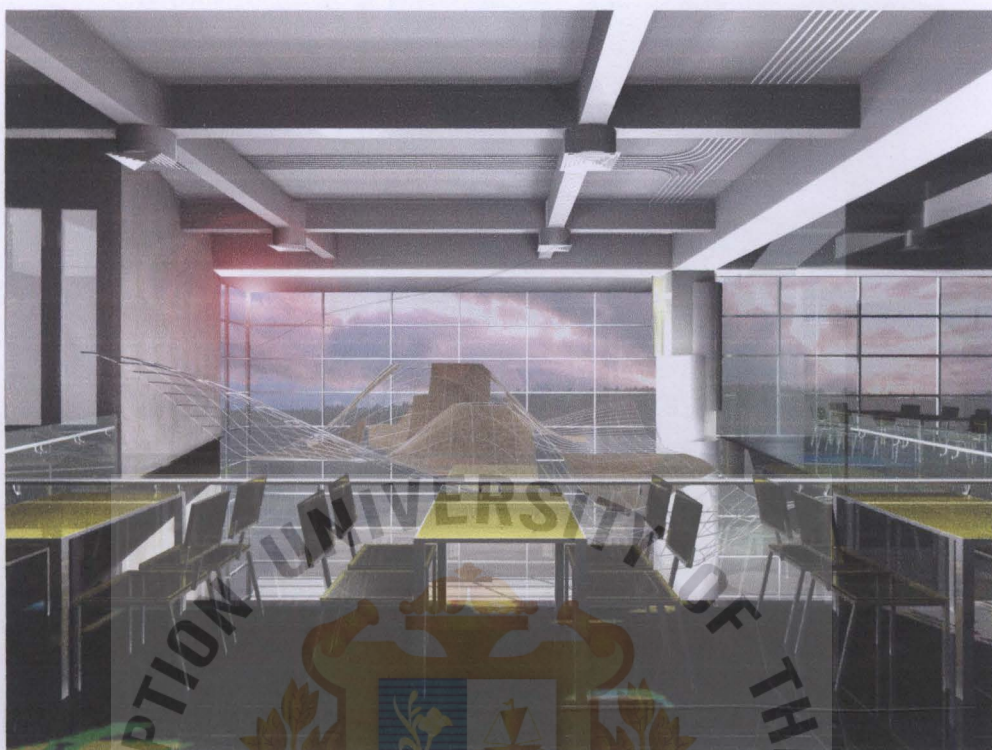
Waiting Hall



Restaurant

Library





Restaurant



Library



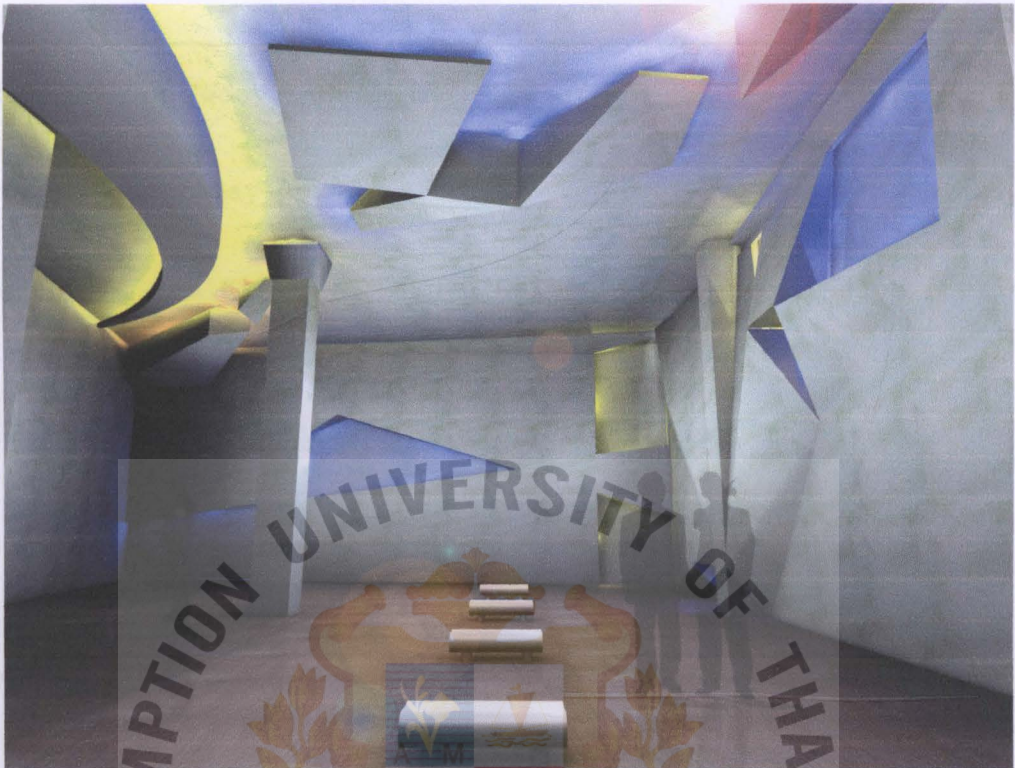


Library

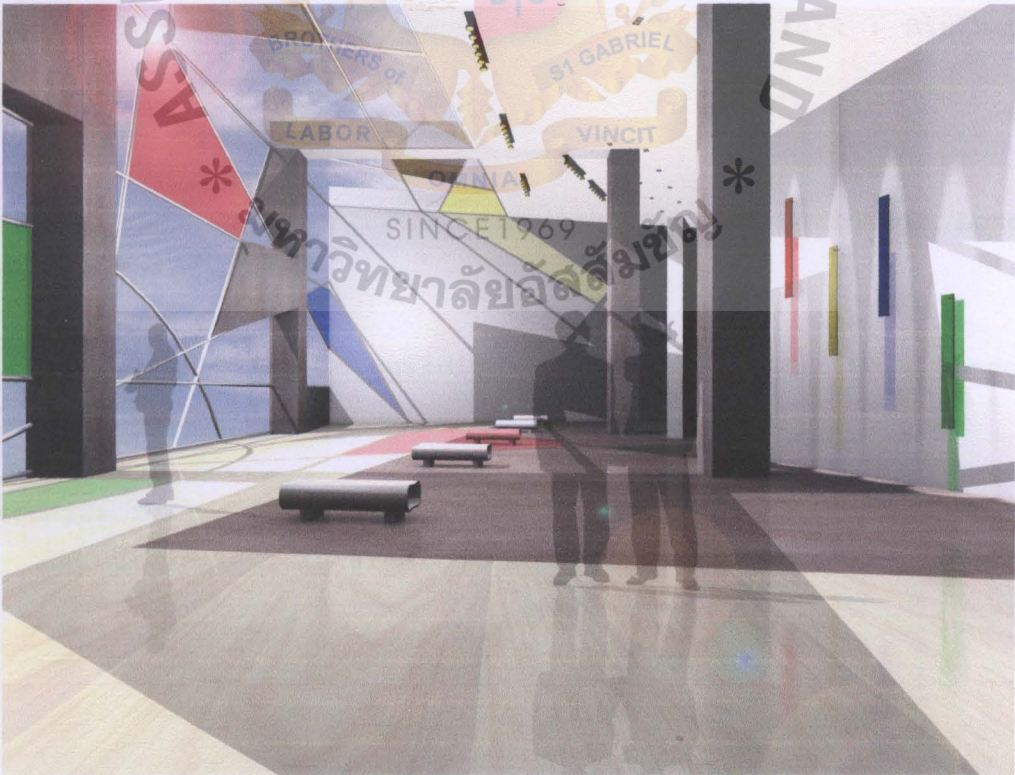


Exhibition Space





Exhibition Space



Exhibition Space

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## Web resources:

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<http://www.stevenholl.com/>

James Turrell:

<http://csw.art.pl/new/98/turrell.html>

<http://www.pbs.org/art21/artists/turrell/index.html>

<http://www.pbs.org/art21/artists/turrell/clip2.html>

<http://www.pbs.org/art21/artists/turrell/card2.html>

<http://www.pbs.org/art21/artists/turrell/card1.html>

<http://www.artcritical.com/DavidCohen/SUN34.htm>

[http://www.calendarlive.com/music/swed/cl-turrell\\_has90ckf,0,1666036.photo?coll=cl-home-more-channels](http://www.calendarlive.com/music/swed/cl-turrell_has90ckf,0,1666036.photo?coll=cl-home-more-channels)

[http://www.ark.fi/ark5-6\\_96/turrelle.html](http://www.ark.fi/ark5-6_96/turrelle.html)

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<http://www.sonomacountymuseum.com/docs/jt.html>

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<http://www.pulitzerarts.org/dialogue-ando.htm>

[http://architecture.mit.edu/~barandon/4.203/overview page.htm](http://architecture.mit.edu/~barandon/4.203/overview_page.htm)

General:

<http://www.pulitzerarts.org/dialogue-serra.htm>

<http://www.pulitzerarts.org/dialogue-kelly.htm>

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imajo/akari/akarimuseum/folder2/ledlighting-e.html](http://www.city.yokosuka.kanagawa.jp/speed/mypage/m-<br/>imajo/akari/akarimuseum/folder2/ledlighting-e.html)

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