

ARCHITECTURE DEPARTMENT

MASTER OF ARCHITECTURE PROGRAMME

CHINESE UNIVERSITY OF HONG KONG

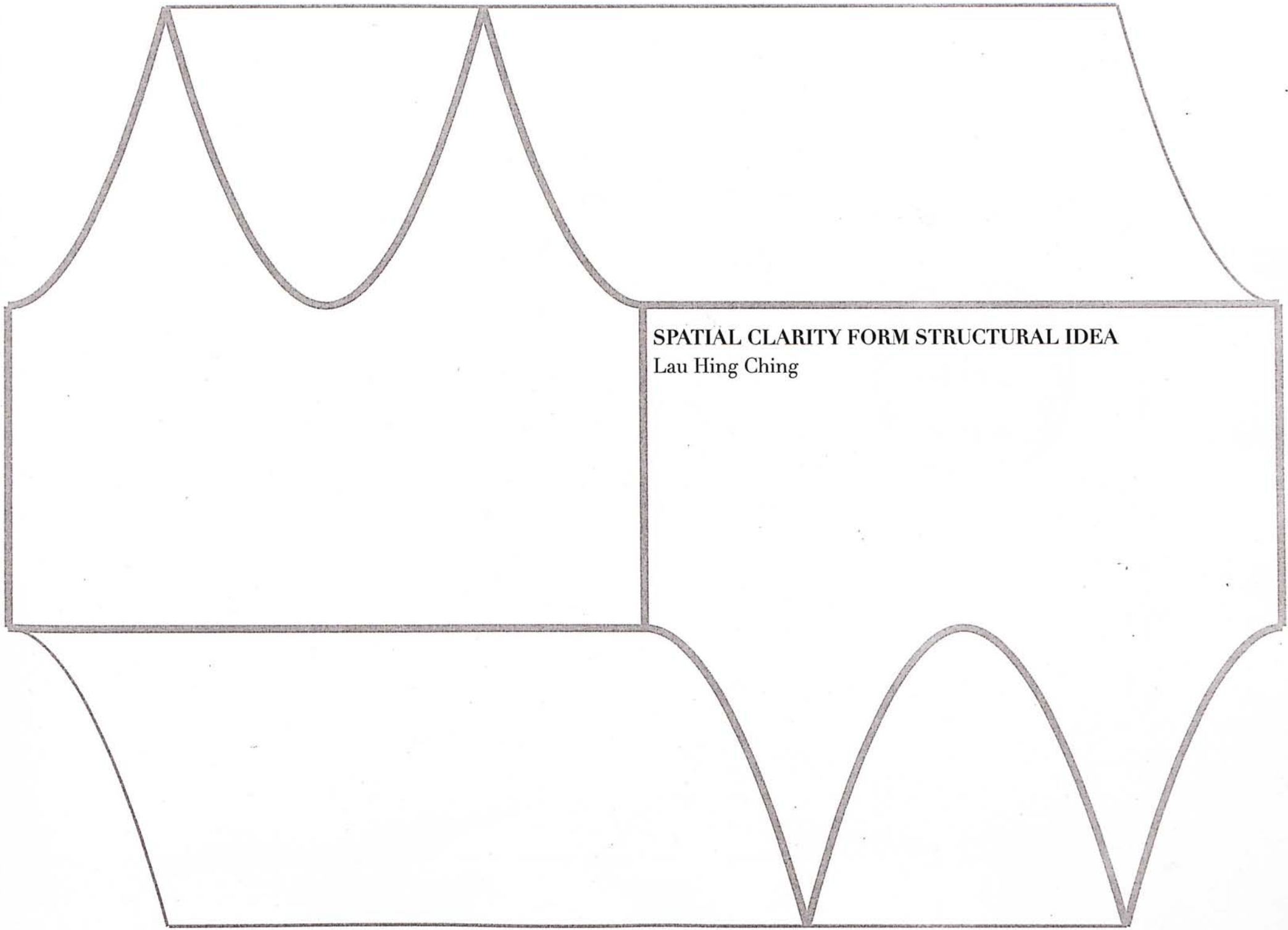
2010-2011

DESIGN REPORT

SPATIAL CLARITY FORM STRUCTURAL IDEA

LAU Hing Ching

May 2011



SPATIAL CLARITY FORM STRUCTURAL IDEA

Lau Hing Ching



SPATIAL CLARITY FORM STRUCTURAL IDEA

2010-2011 CUHK ARC
M2 Thesis Booklet
Lau Hing Ching 0903217
Advisor - Zhu Jingxiang

Thesis Statement

What structure means to architect? A purely technical component? A necessary evil?

The thesis "**Spatial Clarity from Structural Idea**" aims to raise architects' perception of structure as an integral element in design. Structure is the organization of the load-bearing elements. The continuous advancing building technology and material science allow detachment between "Form" and "Function" in building, which provide larger design freedom for architects, but at the same time forcing architects leaving the role of master builder in the old days. The rational concern on "Structure" and "Space", on one hand avoids young architects falling following the arbitrariness seeking a signature style, on the hand encourages the cooperation and competition between architects and other building professionals.

| | |
|----|--|
| 4 | Prolog |
| 5 | Preliminary Study - Tree & Human Body |
| 7 | Case Studies - Christian Kerez |
| 12 | “Function” |
| 13 | Program |
| 17 | Site |
| 18 | Structural Idea |
| 20 | Museum Design |
| 27 | Epilogue |
| 28 | Appendix |
| 33 | Reference |

Prolog

Modern Architecture started from the Industrial Revolution has dominated the architecture development all over the world. It fully captures its age's spirit: architecturally it used the 'new' material and technology at that time - glass, concrete and metal, and developed the specific spatial ideas of simplicity, flowing qualities and free plan. Socially its advocating of simplicity and industrialization increased the production rate which solve the social problems from the unprecedented increasing population. As that age development direction was clear. Efficiency judged the value of architecture.

Contemporary age is characterized by its diversity. Syntactic composition, or exploration on forms, materials as expressions or spatial qualities, architects and theorists specified in each aspect has fruitful contribution in the the architecture development. Technology and material are even more advanced and still improving that we can break the frame of platonic forms and move to the unknown invention. The public is willing to put more resources on architectural projects. Everything is possible now but we have less time to get know of our world. Change occurs every minute and the situation become promiscuous. People are easy falling to seek a signature style which can be a recognition factor.

Intuition is important for architect's creation, but without consideration and knowledge it becomes arbitrariness. We now do not have the major direction like those days in modern architecture period. Architecture is not a pure design, it is something in between design and convention. We cannot everytime following our intuition and produce a marvelous building. We need directions, especially for the young architects.

We are still living in a modern age. For modernism to go even further, we can have focus on the archaic nature modernism about more basic and radical than modernism was and seeing. Honesty, between form and function, facade and interior spatial qualities, primary material expression, etc, is often stressed in modern architecture. Improvement of material science and structural technology somehow separates them from the architects and become independent professional subjects.

The load-bearing elements are the most concrete part in

the building. They create "space" directly, like light creates shadow. The coherence between "structure" and "space" happened as a matter of course. And because of this, "structure" got less attention. The relationship should not be cause-result but they affect each other. When structure can be much complex than before architects become specify to space creation and leave the building structure to structure engineers. This separation sharpens the efficiency of "structure", but at the same time purify its role to load bearing only. Somehow since space happens coherently with the "structure", this separation also limited the space creation of architects.

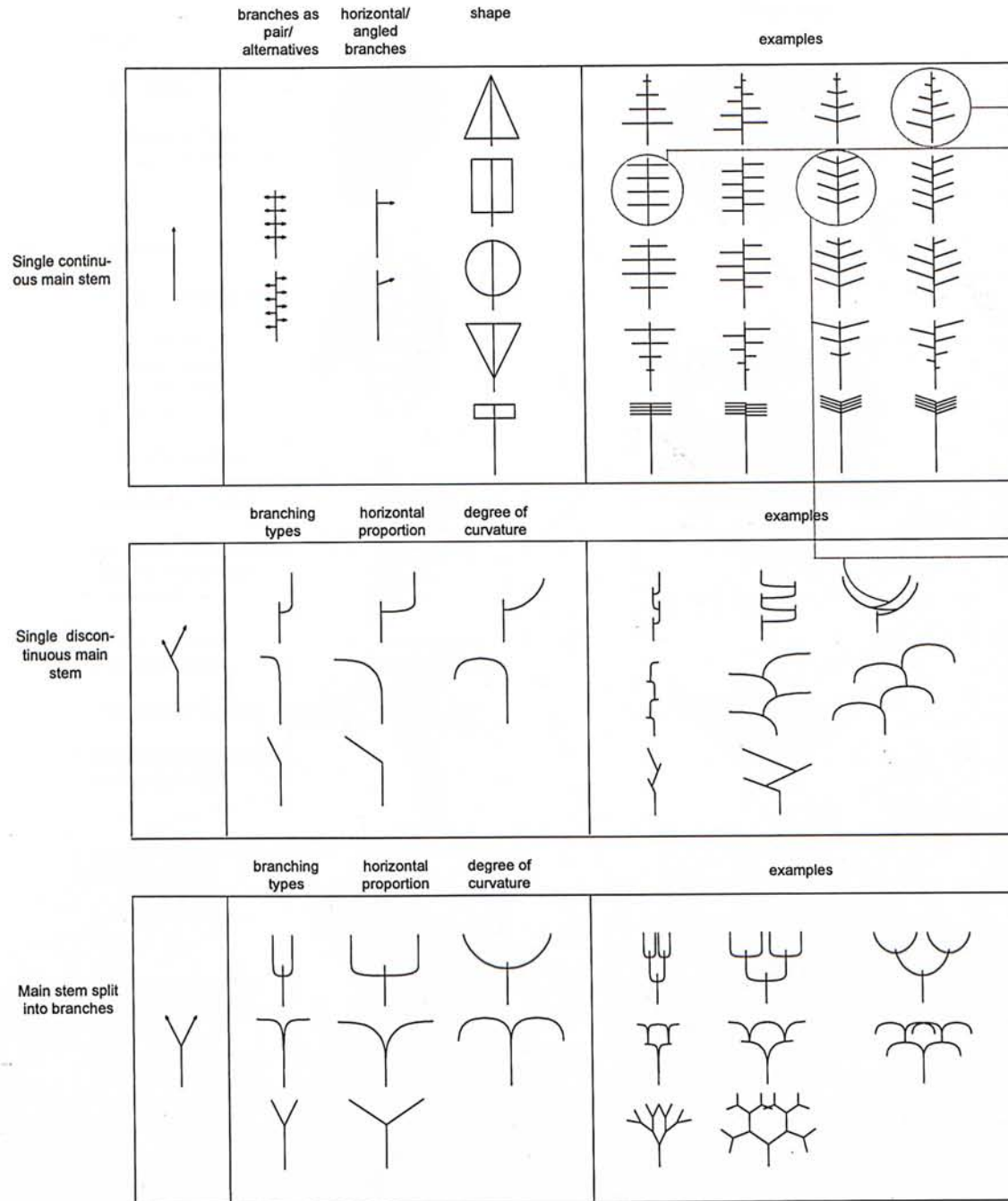
Architects, as the master designer of the building, and the leading role of the construction team, do have the responsibility to improve the situation.

Preliminary Study - Tree & Human Body

The thesis began on the research on nature - tree and human body. They represent the highest achievement of plant and animal. Development of organisms is a pure function driven process. These two organisms adopt very different living pattern, and hence very different forms and structures resulted.


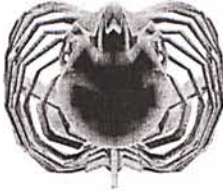




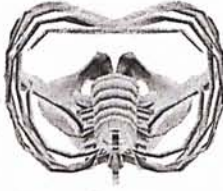



















As the tallest organism in the world, tree provides very good structure examples on how to build height. It also illustrates how to use simple rules to generate complexity, e.g. the branching and rooting system. The nature did not decide every tree; it decided the mechanism of tree growing responding to different environment. The idea of mechanism can be borrowed for scripting design. By varying the parameters, different variations can be produced.

Different parts of tree, for example root, woody stem, young stem and leave, although responsible for different functions, still share the similarities in structure. All of them can be represented by "Y" shape, with different scales and proportion. "Variation" is used to describe the case.



Human body is a complex, but clear system. It is complex because it is composed with numerous different components; it is clear because systems in different levels can be clearly observed. For locomotion and release of forelimbs, human body has a even more differential system than tree: Skull acts like a block to protect the brain; rib cage protects lungs and heart but allow small movement for breathing; arms and legs works as level for fast movement... Components of different scale and form work for different purpose, constructing multi-structural systems. "Differentiation" can be used to describe the case.

The study on tree and human body cannot directly reflected in the building design, as they have different function purposes from building design. But they provide the concept of "variation" and "differentiation": differentiation is a scalar, a range.

| | Iso view | Plan view | Section view |
|---|---|---|---|
| Skull - volumetric protection of brain, housing of eyeballs |  |   |   |
| Rib cages - linear > volumetric protection of lungs and heart, allow movement when breathing |  |   |   |
| Vertebral column - volumetric > linear support of main body, allow considerable movement |  |   |   |
| Pectoral girdle - superficial & linear attachment of muscle, hanging of arms |  |   |   |
| Pelvic girdle - volumetric/ superficial support of limbs, protection of organs and foetus |  |   |   |
| Limbs - linear > linear allow of flexible movement |  | | |

Case Studies - Christian Kerez

Christian Kerez is a contemporary Swiss architect. As an architect, Kerez tried to create something that is architecturally comprehensible. He tried to establish a new basis for every projects, asking the right question in terms of architecture and design, in order to prevent his projects become normalcy. All of the projects start with very simple, basic question about essentials of architecture: What is a connection between floors? What are stairs?

In his design process, his first concern is put on conceptual level. He avoids the sensual aspects of architecture (construction, materials, colours...), and focuses on abstract spatial aspects. He is interested in the issue of reduction in fundamental laws, different from the minimalism which is reduction of form or shape. He believes that in the age of such careless and carefree surfeit, the simplicity that is rescued from adversity is the greatest luxury.

Then he works on the spatial organizations - arrangements of rooms. He is interested in distinguishing space floor by floor, i.e. section. He starts from load-bearing structure to emphasizes both differentiation and unity. He considers the supports (load-bearing structure) as important in defining space as wall. He believes a decision based on engineering concerns is much more compelling than drawing on the rules of proportion or other aesthetic formulates.

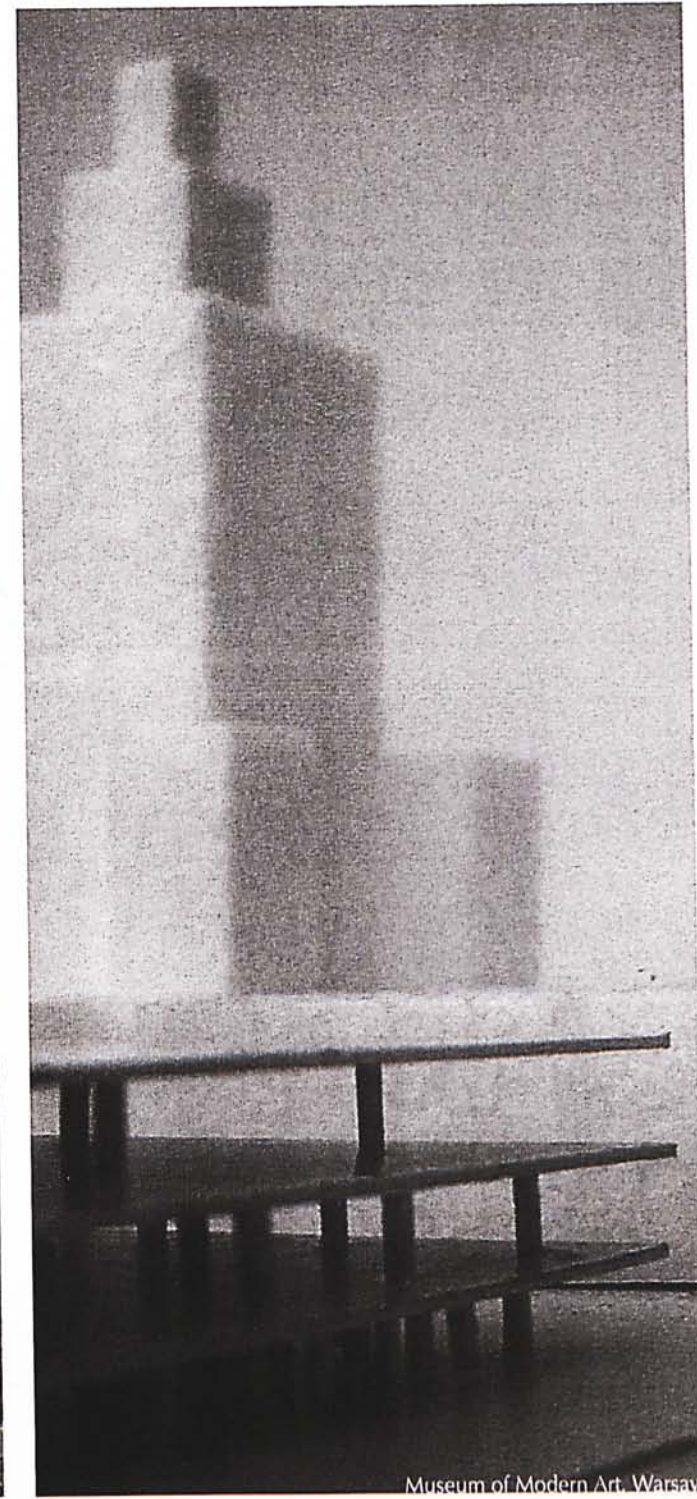
He is interested in the rules of design, which cannot determine in advance how something will result but do make what results comprehensive. A specific project is ultimately a random variation or a sample of rules. This can also be applied to the following analysis: it is not aimed to produce architecture form the observations, but to cultivate the sensibility to appreciate the cases architecturally.

Two cases from Christian Kerez are selected for study - School building in Leutschenbach (9 723 m²) and Museum of Modern Art in Warsaw (29 460 m²). This two case studies focus on "How structure differentiates space".

When space is divided and differentiated, each space becomes unique and provides identity and rich experience to the users. The differentiations respond to the "function" of the space contains. The integration of "Structure", "Space" and "Function" will produce a honest, humble architecture with nice quality.

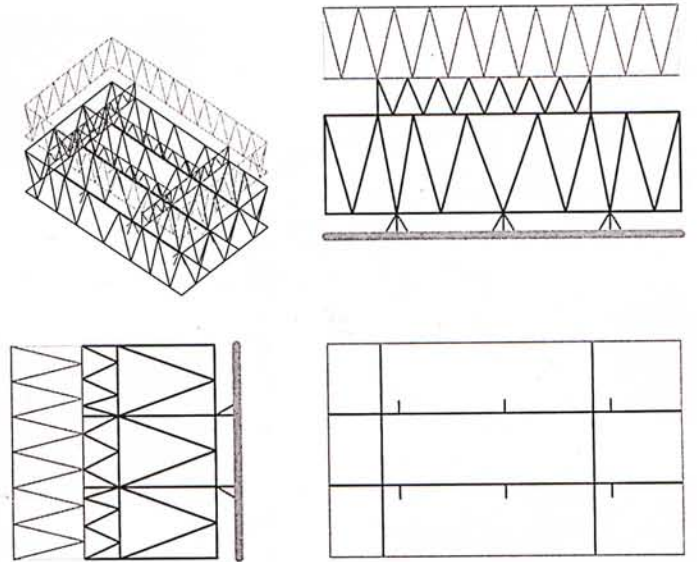
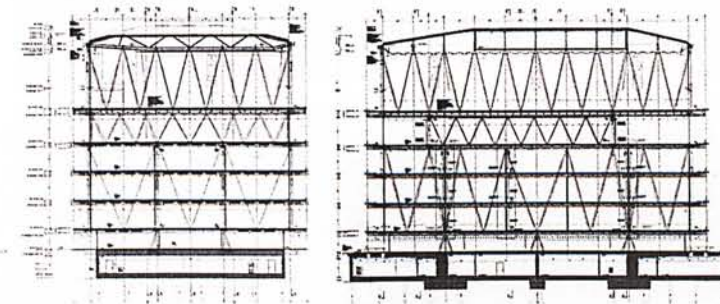
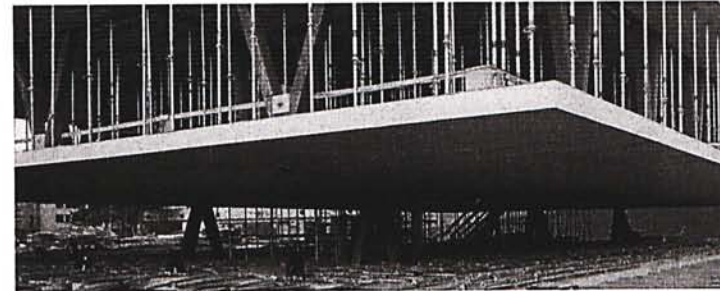
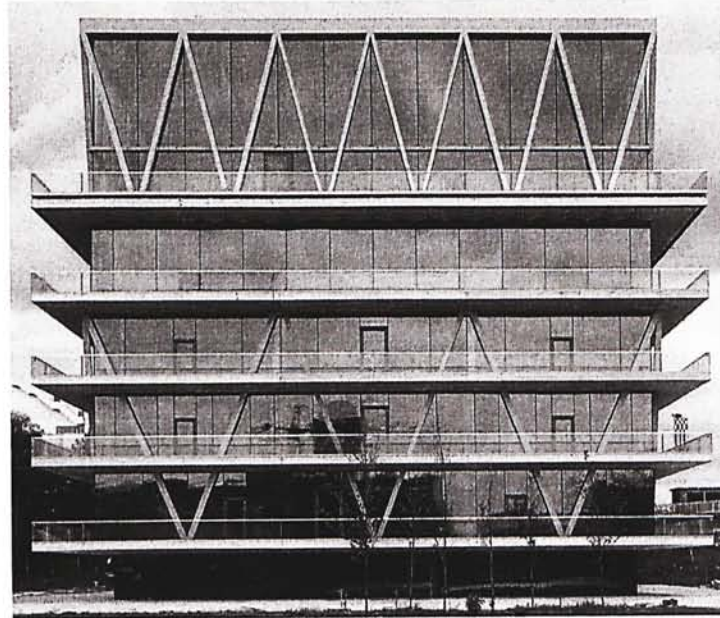


School Building in Leutschenbach

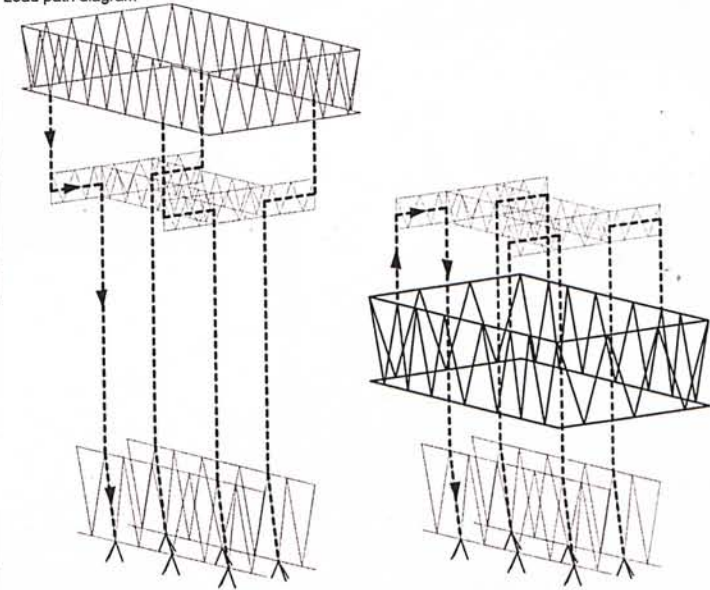


Museum of Modern Art, Warsaw

In school cases, spaces still share same characteristics (truss as common structural element), variation happens between levels (similar to "Tree"). If you are a visitor, when you approach the school, you will simply see a cube as the first impression. But when you walk closer to the ground floor, you will find the transition from exterior to interior is so natural as there is no supports at the peripheral area. Then the relatively low ceiling height shifts your focus to the heavy upper volume. You find the staircase in the darkness of center core, climb to the upper classroom floors, and discover that each floor although share similar spatial arrangement(a recreational space connecting all the classrooms), the views and "columns" change every floor. When you arrive to the forth floor of library and auditorium, the view is blocked and appears as a light box. Space is surrounded be continuous trusses. When you finally arrive the highest floor which is a gymnasium, the spatial qualities is a contrast to the lower floor: space is open to the city horizon, surrounded by the continuous trusses of taller and slimmer members.



Load path diagram



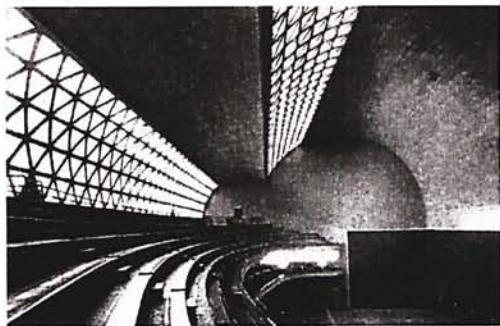
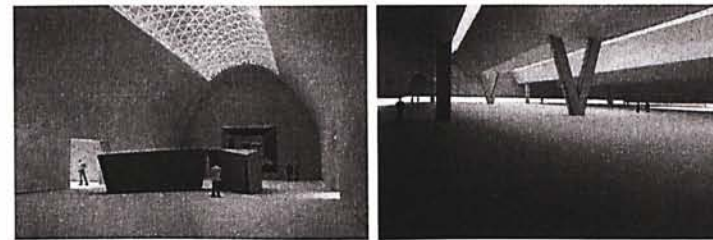
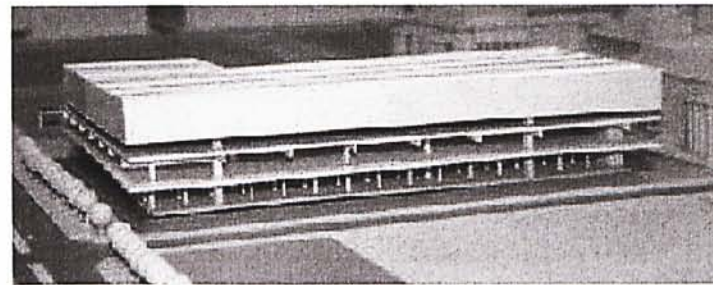
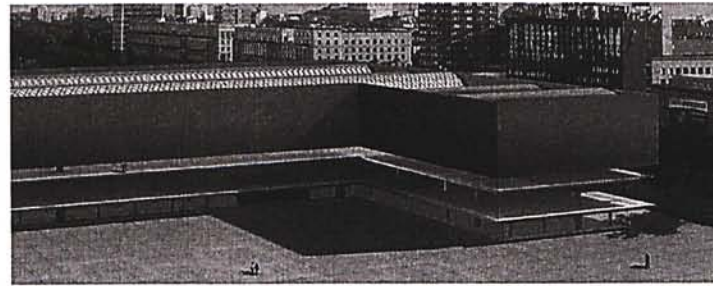
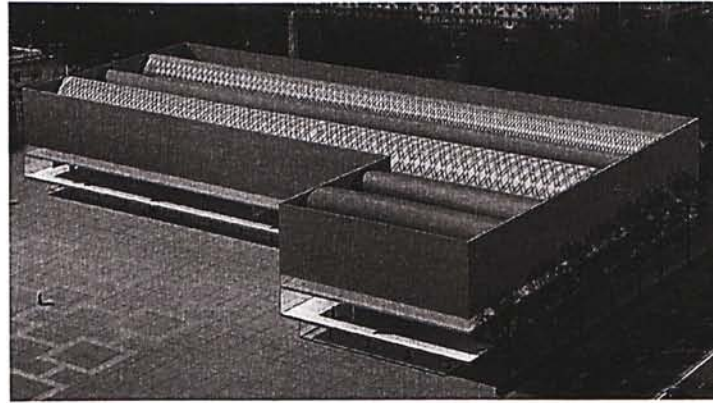
Gym Study model

Classroom Block



In museum, multi-structural systems fit multi-program use, and hence very different spatial qualities ("Human Body"). At the plaza you can already see a float concrete box. The lower floors are translucent to connect to the city. The ground floor is full of thin columns with regular grid. You can go in the shops only from the plaza. When you climb to the first floor, you arrive at a centric space connecting to all rooms. Space is dominant by the rough beams, ceiling, and the short columns. The highest floor, which is an exhibition area, is an enclosed space with minimal supports. Vaults allows light dropping in from the top.

The project can be traced to a respect to a Spanish structural engineer Eduardo Torroja (1899-1961). He was a pioneer in the design of concrete-shell structures.



Eduardo Torroja - Fronton Recoletos. Madrid, 1935

Vault

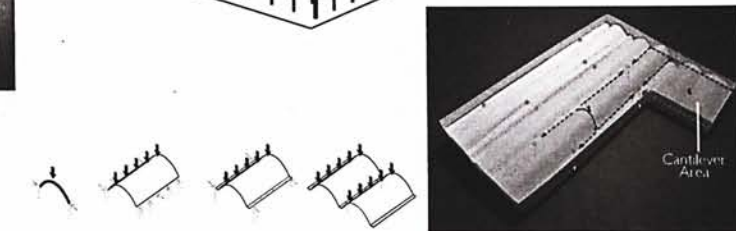
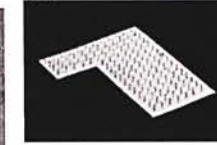


Load path diagram

Beams



Slab



Cantilever Area

| | | | | | | | |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Plan | 1B | GF | 1F | 2F | 3F | 4F | 5F |
| Sections | | | | | | | |
| Perspective view (Structure only) | | | | | | | |
| Structural plan | | | | | | | |
| Structure as space defining elements Tension structure with cable Case of the space | | | | | | | |
| 1st level zoning - Trusses | | | | | | | |
| 2nd level zoning - Walls | | | | | | | |
| Programmatic zoning | | | | | | | |
| Circulation Vertical circulation Horizontal circulation | | | | | | | |
| Usable space Common Classroom Laboratory Recreation spaces Cinema | | | | | | | |
| Functional Space | | | | | | | |
| Organization | | | | | | | |
| Vertical Trusses | | | | | | | |
| Horizontal Plates | | | | | | | |
| View | | | | | | | |
| Movement (Doors & Staircases) 1) Light Control 2) Surface Control 3) Outdoor Door frame size variation Recreation area Cinema | | | | | | | |

Plan: 1B, GF, 1F, 2F, 3F, 4F, 5F

Vertical Trusses: Arrangement, Monitor axis

Horizontal Plates: Heavy ceiling, Grid for lighting, Heavy ceiling, increase length, Focused ceiling, increase length, Focused ceiling, increase length, Smooth ceiling, continuous to exterior

View: Arrangement, Monitor axis

Movement (Doors & Staircases): Door frame size variation, Recreation area, Cinema

| | | | |
|--|-----------|-----------|-----------|
| Plans There are 2 types of business which are not typical | GF | 1F | 2F |
| Sections | | | |
| Structural Plan Plan of structure, relating walls to horizontal | | | |
| Celling Plans Plan of structure, relating walls to horizontal | | | |
| 1st level zoning Different types of forms (horizontal) | | | |
| 2nd level zoning Lands of 2nd level to be treated as an atrium | | | |
| Programmatic zoning Used Space Cinema Recreation | | | |
| Site The Place of Culture The building is a site and even the whole site is a site The existing site with the existing building The site of the new building The site of the new building with the existing building The site of the new building with the existing building and the site of the new building | | | |
| Model views | | | |
| Vertical elements 3 levels of floor with different heights Different heights of different levels Different heights of different levels Different heights of different levels Different heights of different levels | | | |
| Horizontal Plates Other columns, trusses, fixed with walls Sports & Music Events with a fixed Commission support axis Sports & Music Events with a fixed Commission support axis | | | |
| External view Smooth ceiling, with flat lighting Focused ceiling, heavy beams Smooth ceiling, with flat lighting | | | |
| Previous Scheme Ground connection Sports & Music Events with a fixed Commission support axis | | | |
| Horizontal Plates Sports & Music Events with a fixed Commission support axis | | | |
| View Sports & Music Events with a fixed Commission support axis | | | |
| Comparison w/ previous scheme The previous scheme The previous scheme The previous scheme The previous scheme The previous scheme | | | |

Plans: GF, 1F, 2F

Vertical elements: 3 levels of floor with different heights

Horizontal Plates: Other columns, trusses, fixed with walls

External view: Smooth ceiling, with flat lighting

Comparison w/ previous scheme: The previous scheme

Followings are the observation:

Structural elements are visible, and distinguishable from the additional partitions. Structure system is considered as a whole composed of cross-levels elements rather than simply stacking.

The school is constructed by frameworks of truss. On ground level, supports is contracted into a minimal core area. Classrooms are housed in a three-story steel framed structure, which is hung from the projected frame at the forth floor. Gymnasium is surrounded by a continuous frame structure resembling that of the classroom block, crowning the whole building.

The structural system in museum conducted supporting columns with three different thickness: the thick ones support the vaults at the exhibition level. The medium ones, work with the thick beams, bear the ceiling first floor. Finally the slimmest ones support the slab ceiling plate of the ground floor.

Structure provides the basic identity and limit to the space zoning, while additional partitions are required to further sharpen the space. In this way certain flexibility is allowed for later alternation.

In the school the allocation of the vertical structures, and the nature of the slant member of truss define very much of the basic spatial quality:

At the ground level of school, the six tripods locate in the center of the plan work with the additional panels, forming a condensed service area.

The trusses at the classroom blocks suggest three linear zones, while additional panels subdivide the external spaces to become classrooms. As additional panels are removable, flexibility is allowed for the extension of classrooms.

The projecting frame subdivides the plan in different way, reserving two larger spaces at the ends, which becomes the auditorium and the library.

The surrounding frame at the highest level provides the hugest space for the gymnasium use, while additional panels is used to provide the linear service

area at north.

In the museum three sizes of the columns result their different density allocation in the three levels, forming different spatial qualities for the programs:

On ground level the slimmest columns distribute evenly, form an universal space. Additional panels divide the space for functions like cafe, shops and restaurants.

At the first level the number of columns are reduced. Formation of rooms follows the distribution of the thick beams. Rooms are formed at outer zone and a centric public connecting space is resulted.

At the second level that is for exhibition use, number of columns is reduced to minimum. Linear zoning is suggested by the vaults.

Structural elements (both vertical and horizontal parts) expressed differently on different levels, contributing to the different spatial identities. Additional partitions work with the structural elements to strengthen this. Controlling of the views and lights, as a respond to the site context, also contributes to this 'difference'.

In the school truss dominants the structural expression in the whole building, with variations in different levels:

At ground level the supports are expressed as short, bulky tripods, responding to the upper truss frame.

The three levels of classrooms share a complete truss frame: The bottom of the trusses expressed as V-shaped "columns" at the first level, disconnected slanted "columns" are shown in the second level, and inverted V-shaped "columns" connected at top are shown at the third level.

Both of the circulation space at the forth level and the gymnasium at the fifth floor have a continuous truss surrounding the space. But the one in forth level is short and thick, and translucent panels are used; and the truss in gymnasium is tall and slim, incorporated with the translucent glass panels to bring in the city horizons.

In the museum multi-structural systems results differen-

tiation in spatial qualities in the three levels:

At ground level slim columns and flat ceiling slab form a very pure and clean space connecting to the outside ground;

The first level columns are relatively short and thick, with the heavy beams and the corrugated ceiling, forms a contrasting rough, primary space.

The second level is characterized by the vault with natural lights on top, overcoming the long spans. The surrounding solid wall created an isolated space for the exhibition use.

Differentiation in spatial qualities happens vertically. Basically each floor shares the same spatial identity.

Linear circulation (corridor) is avoided. Re-creation area is used as connection platform.

Courtyard/ outdoor space is not incorporated in the building design, which may be because of the climate of the places.

These observations, or rules in face cannot determine how something will result, but make what results comprehensible in retrospect. A specific project in fact is ultimately a random sample, or variation of rules. With the rules you can consist your works through and through. But to avoid diluting the clarity and determinacy of a project, it has to remain open to outside influence.

“Function”

“Form follows function”. This is the famous slogan of Louis Sullivan, and became the doctrine of Modern Architecture. “Form”, and “Space” as well, are descriptions of physical creation of architects, but one is focusing the expression while the other is focusing on the void. “Function” is the standard for judgment. Without “function”, “form”’s existence is weak. This is the basic factor differentiates architect from artists.

“Function” has scales. It can refer to specific activities, like reading, eating, resting, shopping, etc. It can also refer to the combination of the different activities. The society already develop different combinations of certain activities to become “building types”, like house, office, library, museum, school, etc.

“Function” has levels. The previous paragraph stands on the users’ view, but sometimes the users may not be the clients. For example in private housing, the client is developer, which is a merchant who aims to earn profit. Architects need to get balance between the client (developer) and the user (buyer).

In some cases the architecture itself becomes the “function”. (The extreme case is monument). Take Guggenheim Museum in Bilbao as an example, it is a museum but the building itself is also an attractive point for the visitors.

“Function” can be the inspiration, or guideline, for architects to design building. On one hand we should provide the corresponding spaces for certain activities to be happened, on the other hand we should challenge the present pattern of these “function” to provide better, diversified environments for the society.

In Rem Koolhaas’s observation on Manhattan, he raise an attention against the honest relationship between “form” and “function”: “As a vehicle of Urbanism, the indeterminacy of the Skyscrapers suggests that in the Metropolis no single specific function can be matched with a single place.” When functions become complex and exceed certain scales, the relationship between “form” and “function” becomes unstable, which results two features in the Manhattan Skyscrapers: 1. Segregation between the building’s interior and its outer skin; 2. Stacked independent floors in a single building.

When “functions”, or “program” are detached from “form”, we should have larger freedom for our design. The skyscrapers in Manhattan already proved that the program has a larger flexibility to adopt spaces. What still limiting us is our preconception of the “models” of the developed building types. It is difficult to go beyond the “models”, as we have already lived in them since we born. Architect need to has strong observation ability, in order to judge the present environment for “function”.

According to this observation, internal program should have an objective logic to organize themselves physically, while the external form of the building can contribute into iconographic requirements respond to the site context. But it is hardly to avoid any architects’ consciousness or subjective preference when arranging the internal program. At this point, Christian Kerez’s concern on structure, as a guideline to formulate form and space, somehow can reconnect this indeterminacy between “function” and “form”.

Program

When considering the program. The focus moved to the public buildings in Hong Kong. Hong Kong Heritage Museum, Hong Kong Central Library and Central Piers, all these public buildings have a discordant historical appearance which less responding to the internal program. The hottest project now in Hong Kong is the cultural district development in West Kowloon. The thesis therefore adopt "museum" as the primary program for the design.

Museum Plus (M+)

In the West Kowloon Cultural District there is only one single proposed museum - "Museum Plus (M+)". M+ is "an innovative platform for interpreting and presenting visual culture through ways and means that goes beyond those normal presentations in traditional museums." Its main theme is "Visual culture", which includes, not only visual arts (e.g. installation, painting, photography and sculpture), but also architecture, design (e.g. fashion, graphic and product design), moving images (e.g. film, video and television) and popular culture (e.g. advertising and comics).

The proposed gross floor area for M+ is 125000 m², providing 30000 m² exhibition space to Hong Kong.

Thesis Design's Program

The thesis is NOT going to adopt M+ as the program. When comparing with the other museums in Hong Kong, M+ is an unprecedented cultural development. And even comparing with the international museums all over the world, it is still a relative huge cultural development project, which really makes people question if Hong Kong can accommodate the museum. Also the theme is too complex for the thesis.

A museum of smaller scale, 15000 to 20000 m², is proposed. The museum will incorporate with education purpose to complete the program. To sustain the cultural development in Hong Kong, cultivation of cultural sense should start from the kid ages, which may be the one of the main weaknesses of present Hong Kong education system. The theme will be narrowed to "Movie images", a very valuable culture in Hong Kong.

Museum Plus (M+)

Missions




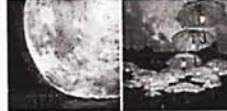
"The missions of M+ is to focus on 20th and 21st century visual culture, broadly defined, from a Hong Kong perspective and with a global vision. With an open, flexible and forward-looking attitude, M+ aims to inspire, delight, educate and engage the public, to explore diversity and foster creativity."

Proposed facilities:

- Exhibition galleries and Back-of-house
- Dedicated Outreach and Education Centre
- Library and Archive
- Screening Facility
- Bookstore
- Artists-in-residence Studios
- Amenities Including Catering Facilities and Shops
- Outdoor Space

Theme - Visual Culture

- A fluid concept, board area, offers flexibility and scope to explore new aspects and rejuvenate itself in respond to changing circumstances.

| Design | Moving Images | Popular culture | Visual arts |
|---|---|---|--|
|  |  |  |  |
| architecture, urban planning, fashion, graphic, industrial, etc | film, television, digital art, media art | toys, gaming, comics, clothing and fashion, mass media, etc-media art | painting, installation, photography, sculpture, print making, drawing, ceramics, etc |

Area

| | First Phase | Subsequent Phase (s) | Eventual Sizes |
|---------------------------|----------------------|----------------------|-----------------------|
| Site: | | 37500 m ² | |
| Gross Floor Area: | 81000 m ² | 44000 m ² | 125000 m ² |
| Net Operating Floor Area: | 49000 m ² | 26000 m ² | 75000 m ² |
| Net Exhibition area: | 20000 m ² | 10000 m ² | 30000 m ² |

Interim Centre

- To provide a platform for training of professional staff for M+
 - To provide art education to the public to cultivate and develop audience and build and sustain public interest in visual culture
 - To perform research functions with a view to laying a solid foundation for M+
- The Former Clubhouse of the Hong Kong Yatch Club (Grade II historic buildings) at Oil Street in north point was the originally proposed site for the interim Centre but was abandoned because of the size of building and the pollution problems.

Comparison with other regions

| Population/no. of museum | | No. of museum (2002) |
|--------------------------|------------|----------------------|
| US: | 30560 : 1 | London: 203 |
| Japan | 172110 : 1 | Los Angeles: 52 |
| Beijing | 99174 : 1 | New York: 107 |
| HK | 290410 : 1 | Paris: 211 |
| | | Tokyo: 121 |
| | | HK(2006): 24 |

Local Museums Study

| | | Exhibition Space | | Total Area | | | | | | | |
|---|--|---|---|---|---|--|--|---|---|--|---|
| Hong Kong Maritime Museum | Lel Cheng Uk Han Tomb Museum | Law Uk Folk Museum | Tung Wah Museum | The Hong Kong Racing Museum | Hong Kong Correctional Services Museum | Sheung Yiu Folk Museum | Police Museum | Hong Kong Museum of Medical Sciences | Museum of Ethnology | Po Leung Kuk Museum | Art Museum, CUHK |
| 2005 | 1957 | 1990 | 1971 | 1996 | 2004 | 1984 | 1988 | 1996 | 2000 | 1998 | 1971 |
| Non-profit private museum operated by a Board of Directors. Features the maritime history of Hong Kong and thematic exhibitions related to the shipping industries. | Featured artefacts including ceramics, bronzes and related relics unearthed at the historical tomb of the Eastern Han dynasty at Lei Cheng Uk. | Features artefacts and daily utensils at the historic Hakka house, Law Uk, in Chai Wan. | Operated by the Tung Wah Group. Features the history of the Tung Wah Group of Hospitals and medical services provided by the Group with artefacts, photographs and documents. | Museum operated by the Hong Kong Jockey Club. Features the history of the Hong Kong Jockey Club and the history of horse racing in Hong Kong. | Government department museum. Features history and provision of the Correctional Services Department. | Features artefacts including farming tools and a lime kiln at the historical Sheung Yiu village. | Government department museum. Features the history of the Hong Kong Police with artefacts, photographs, guns, drugs and the history of the Triads etc. | Run by Hong Kong Museum of Medical Sciences Society. Features the history of medical services in Hong Kong and artefacts related to medical sciences. | Private museum. Features themes of ethnology and folk culture, in particular that of China, with artefacts and photographs. | Museum operated by the Po Leung Kuk. Features the history of the Po Leung Kuk and the care and protection of women in Hong Kong. | University museum related to the Fine Arts Department of the university. Features exhibitions of Chinese antiques, Chinese painting and calligraphy and contemporary art. |
| 140 m ² | 185 m ² (93 m ²) | 230 m ² (124 m ²) | 368 m ² | 378 m ² | 480 m ² | 500 m ² (450 m ²) | 570 m ² | 700 m ² | 757 m ² | 820 m ² | 1000 m ² |
| | | | | | | | | | | | |



| | | | | | | | | | | | |
|---|--|--|---|---|--|--|--|---|---|--|---|
| University Museum and Art Gallery, HKU | Sam Tung Uk Museum | Flagstaff House Museum of Tea Ware | Hong Kong Heritage Discovery Centre | Hong Kong Railway Museum | Hong Kong Film Archive | Hong Kong Space Museum | Hong Kong Science Museum | Hong Kong Museum of History | Hong Kong Museum of Art | Hong Kong Heritage Museum | Hong Kong Museum of Coastal Defence |
| 1953 | 1987 | 1984 | 2005 | 1985 | 2001 | 1980 | 1991 | 1998 | 1991 | 2000 | 2000 |
| University Museum. Featured exhibitions on art, history and culture related to the University's educational role. | Features artefacts and daily utensils at the historic Hakka walled village, Sam Tung Uk, in Tsuen Wan. | Features Chinese teaware and introduces the custom of tea drinking in China, Chinese ceramics and seal carvings. Exhibits were donated by the Dr K.S. Lo Foundation. | Features archaeological finds, monuments and built heritage of Hong Kong. | Features trains and the history of railway transportation at the historical old Tai Po Railway Station. | Features the history of film in Hong Kong with film shows, exhibitions and maintains an archive on films for public's access and research. | Features artefacts of space mission and technology with sky show and omnimax show programmes at its planetarium. | Features various themes of science and technology, such as meteorology, life science, motion, water and wave, telecommunication, etc. with interactive exhibits. | Features the history of Hong Kong from the prehistoric period to the 20th century and other themes such as folk culture and the natural environment of Hong Kong. | Features Chinese antiques, painting and calligraphy, historical pictures and contemporary HK art, with temporary exhibitions on classical art and modern / contemporary art of the world. | Features the heritage of HK with thematic galleries on the New Territories heritage, Cantonese opera, paintings and calligraphy by Professor Chai Shao-an and other temporary exhibitions. | Features the history of coastal defence in Hong Kong with a theatre and historical trail. |
| 1100 m ² | 2000 m ² (1300 m ²) | 2985 m ² (603 m ²) | 4948 m ² (1337 m ²) | 6500 m ² (6380 m ²) | 7200 m ² (214 m ²) | 8110 m ² (1600 m ²) | 13500 m ² (7250 m ²) | 17500 m ² (8135 m ²) | 17530 m ² (6019 m ²) | 32000 m ² (7500 m ²) | 34200 m ² (8135 m ²) |
| | | | | | | | | | | | |

International Museums Study

Exhibition Space Public Facilities: Library, Theater, Cafe, Shops... Office, Meeting Rm Terrace, Courtyard Others: Lobby, Storage, Mechanical, etc

| | | |
|---|---|--|
| Center Pompidou 1977 Modern and contemporary creation, where fine arts would exist alongside music, cinema, books and audio-visual research. 103305 m ² (8/F 60000 m ² public space) The National Museum of Modern Art The Children's Gallery The Public Reference Library ("BPI") The Kandinsky Library The cinema and performance halls The Music and Acoustic Research Institute ("IRCAM") | Quai Branly Museum 2006 Indigenous art, culture and civilizations from Africa, Asia, Oceania and the Americas. 25100 m ² (4750 m ² for permanent collection) Exhibition Media library Theatre - Claude Lévi-Strauss Vegetable frontage 800 m ² Garden 17 500 m ² | Asian Art Museum 1966/2003 Asian art and culture. 18500 m ² Gallery (2/F & 3/F) 2900 m ² Gallery (G/F) 850 m ² Education Resource Center Samsung Hall 3 multi-purpose classrooms |
| | | |

| | | |
|--|--|---|
| San Francisco Museum of Modern Art 1935 Modern and contemporary art 22500 m ² Galleries (4 Floors) Visitor Education Center, 700 m ² Museum library 280-seat Theater A multiple-use event space 1 classroom with seating capacity for 100 Conservation studio | Exploratorium 1969 A museum as "educational center" of science, art, and human perception. 11000 m ² Multimedia Learning Center with library 150-seat McBean Theater 9 wired classrooms Life science laboratory Phyllis C. Wattis Webcast Studio | The Museum of Modern Art, New York 1929/2004 Modern and contemporary art 58529 m ² |
| | | |

New Museum of Contemporary Art, NY
2007
Modern and contemporary art

5450 m²

Exhibition area 1120 m²
Education area and classroom 137 m²
Theater 130 m² Shop 38 m²
Office 230 m²
Cafe 108 m²
Multi-purpose Room 130 m²
Terrace 82 m²

de Young Museum
1895
Fine Arts
(19th - 20th Century Art, American Art, Africa Art, Pacific Art)

29300 m²

Permanent Collection Galleries 7320 m², Other 1100 m²
Temporary Exhibition Galleries 1200 m²
Education Areas 2000 m²
Auditorium / Lecture Hall 390 m²
Conservation Facilities 1320 m²
Tower Observation Floor 250 m²
Sculpture Garden 3500 m²
Children's Garden 4750 m²

International Museums Study

Glass Pavilion at the Toledo Museum of Art

2006

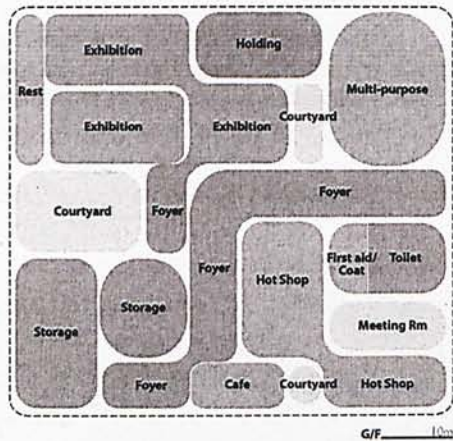
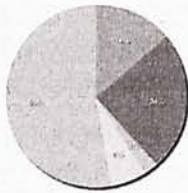
The Glass Pavilion was designed to serve two complementary roles: as art museum and as studio.

3910 m² (+3910 m² for basement)

Galleries 540 m²

Multi-purpose Hall 300 m²
Hot-Shops (x2) 335 m²
Cafe 85 m²

Courtyards (x3) 253 m²



21st Century Museum of Contemporary Art

2004

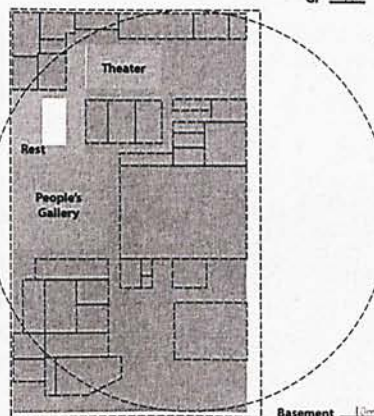
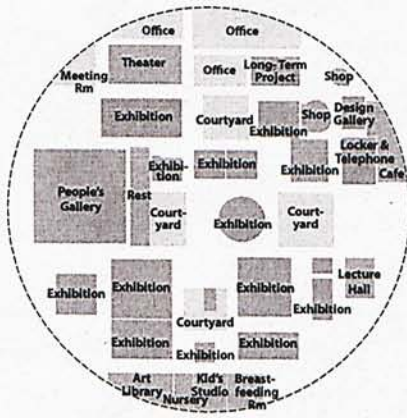
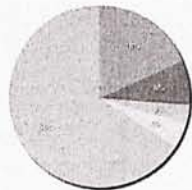
Contemporary art and creations from wide-ranging fields related to art, including music, the performing arts, and film.

18100 m²

Galleries (14 Spaces) 2056.7 m²
People's Gallery 1458 m²

Art Library 165 m²

Theater 225 m²
Kid's Studio 125 m²
Media Lab
Shoo, Cafe 230 m²
Courtyards (x4) 657 m²



Museum for the Iberê Camargo Foundation

2008

Modern and contemporary art (Iberê Camargo and artists from Brazil and abroad)

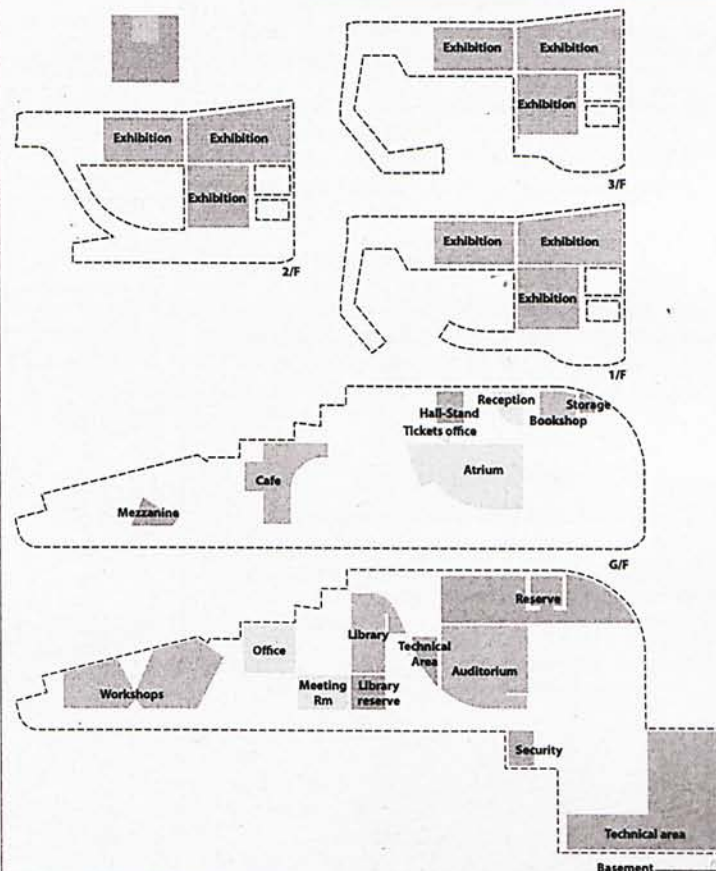
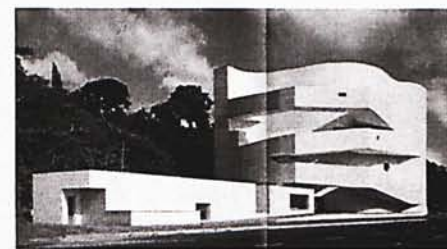
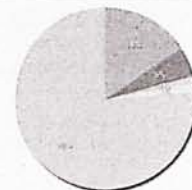
8250 m²

Exhibition area (9 spaces) 1300 m²

I Studio for Education Programme 70 m²

Library 60 m²

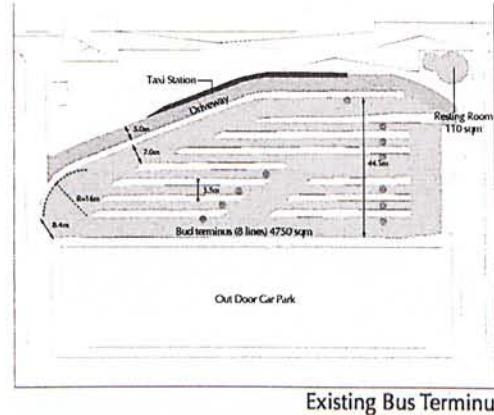
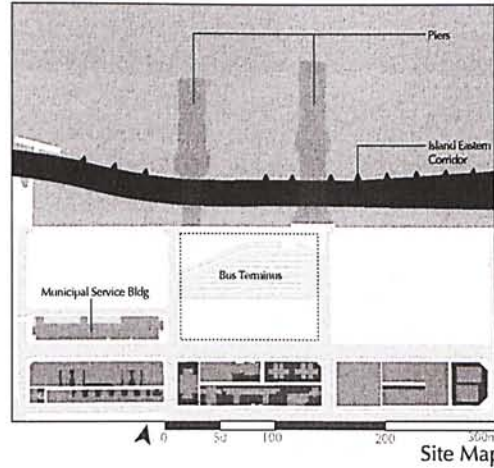
Research and Documentation Centre
I Studio for printmaking 70 m²
Auditorium (100-seat) 134 m²
café, shop and underground parking
Green Space 12000 m²



The bus terminus near the North Point Pier was selected as the site for the project. This site is a transport node, which contains bus terminus, piers and taxi station, plus MTR station just at the opposite side of the road.

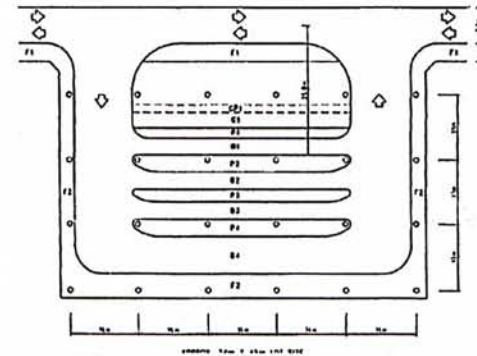
The project does not respect the site by creating an architecture with similar geometries or heights with the nearby buildings, but absorbing and improving the existing transport program. A detail study on the requirement of bus terminus and driveway was done to make sure the proposed layout can be available.

The existing bus terminus has a traditional parallel bays layout, which is a very clear arrangement for the passengers and operators. Yet it wastes the stacking spaces, since each bus lines need to have 2 stacking spaces which may not always in used. Instead, the "Central Stacking Layout" or the "Central Island Passenger Platform" are very efficient layouts for bus stacking area and passenger platform. The requirement will be a big site with wide column spacing and more than one ingress and one egress is needed.



Site Photo

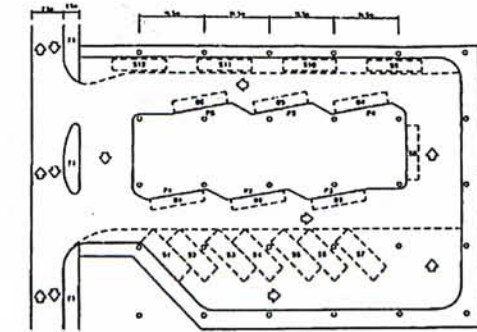
Transport Department - Transport Planning & Design Manual



Traditional Parallel Bays

One route (or maximum two) per bay is a very clear arrangement to passengers and operators;

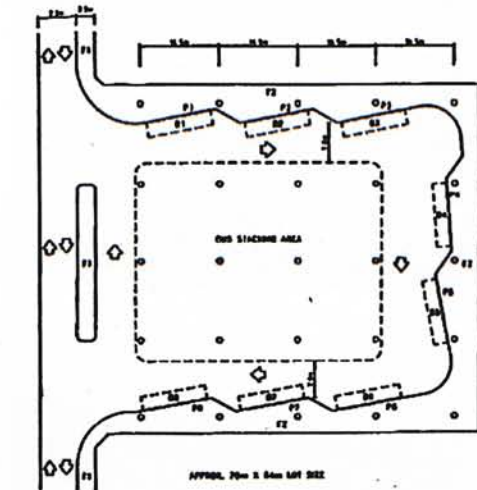
Unless with stairs or escalators to second level, passengers have to get across the bus bay or driveway of the PTI



Sawtooth Bus Bay, Central Stacking

Efficient use of stacking spaces;
 Passengers do not have to get across bus traffic;
 Possible to provide air conditioning for queuing passengers;
 Facilitate bus-bus interchange;
 Buses park at precise locations, hence not obstructing other buses;

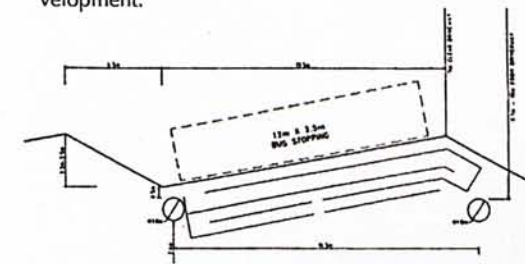
A big site, probably with more than one ingress and one egress, needed;
 In general, longer walking distance for passengers;
 Very wide column spacing for bus maneuvering needed.



Central Island Passenger Platform

Efficient use of platform space because passengers queuing for more than one bus routes could be arranged for one island platform;
 Possible to provide air conditioning for queuing passengers;
 Possible to provide passenger facilities such as kiosk or information desk in the island platform;

A big site, probably with more than one ingress and one egress, needed;
 Segregated pedestrian walkway need to be provided to link up the central island with the station or development.



Structural Idea

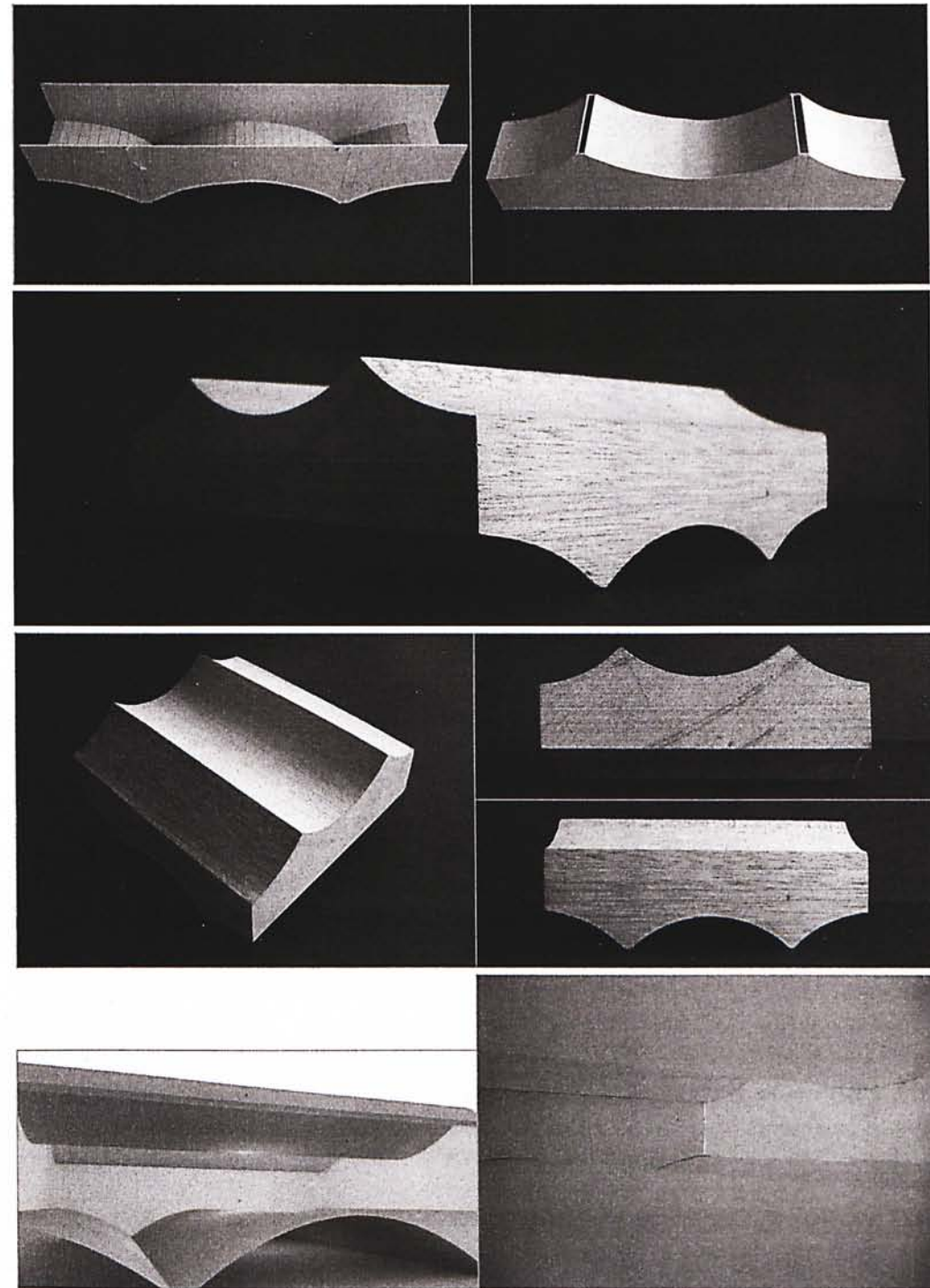
The basic unit is a combination of "vault" and "curved roof".

The bottom part is made up of one vault connected with 2 "half vault" by the vertical wall(s) across them. The vertical wall on one hand holds the shape of the vaults, on the other hand acts as a beam transferring the load in edged vaults to the ground.

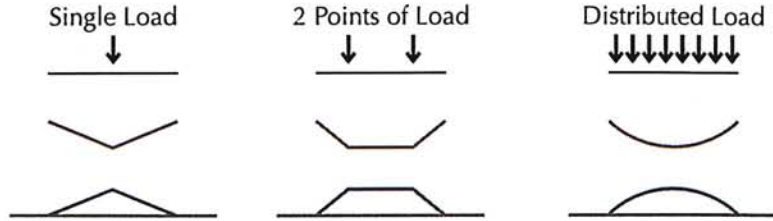
The curved roof is very much like the shape of the inverted vaults. The weight of the middle roof will be counter balanced by that of the edged roofs. Again the shape is held by the vertical walls. The load will be transfer to the rib then to the walls. The folded ceiling help overcoming the span.

When the roof and the bottom part are combined in a way that the direction of the vaults is perpendicular to that of the inverted vaults, stiffness can be formed in 2 directions. The 2 pairs of vertical walls forming the envelop prevent each other from rotation.

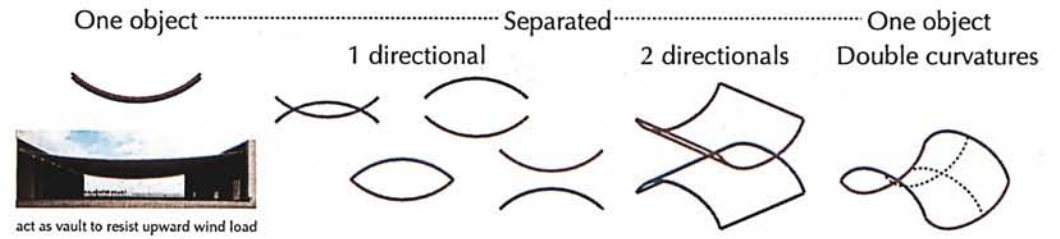
When consider the basic unit as building, we can play attention to several characteristics. The basic unit has released large ground area, minimizes the support into 2 lines. These 2 lines separate the middle zone from the other two to become a long vault with 2 entrances at the ends. Basically the structural idea create a single close space, with curved floor and curved roof. The floor and roof are vaults with perpendicular directions, so the space does not has a clear direction sense. The ribs, both at the roof and the floor, suggest the zoning inside the space. The distance between the roof and floor can determine the zoning, too. Without that the geometry of the basic unit is strong, which make it stand out when putting in the urban fabric.



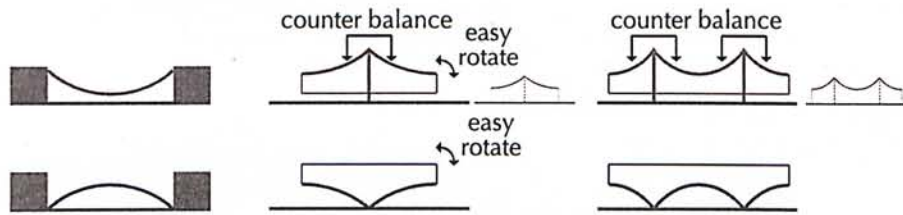
Load Condition



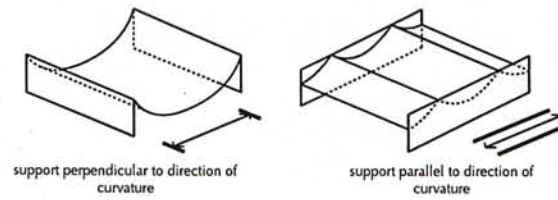
Combination of Compression (Vault) & Tension (Suspension)



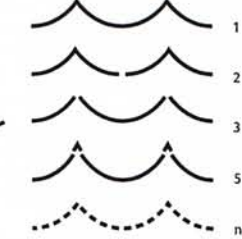
Ground Condition



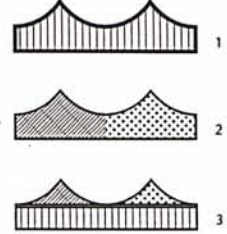
Support Orientation



Formal Reading

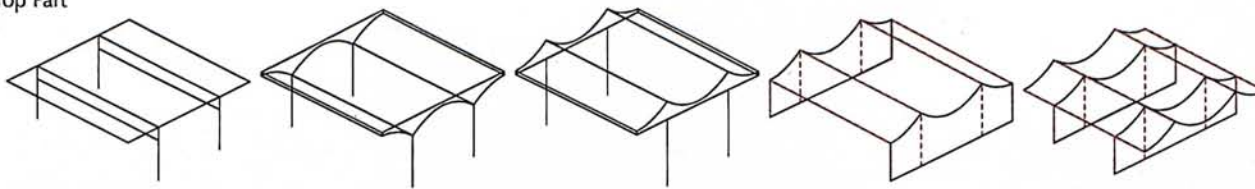


Spatial Reading

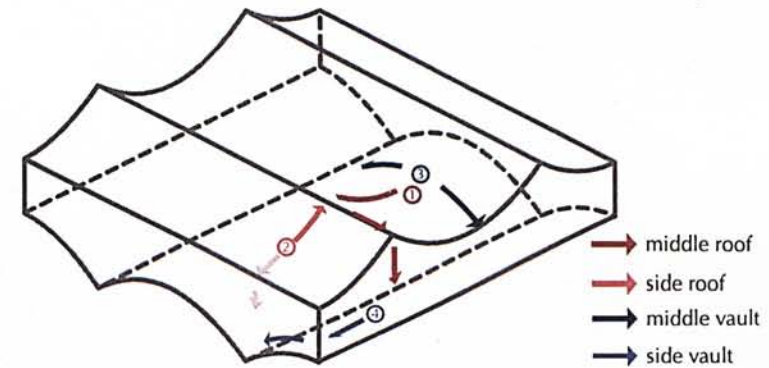
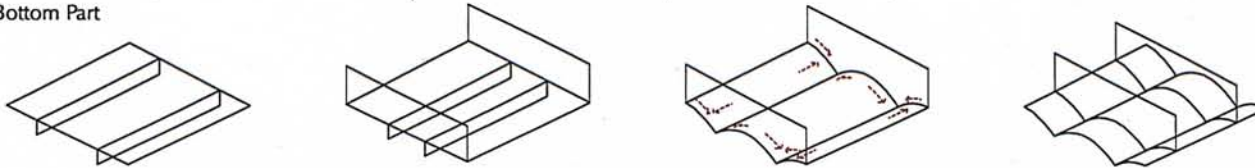


Structural Understanding

Top Part



Bottom Part



The structural idea was explored in multi-layers:

| | |
|-------------|---|
| Vault | |
| Single Unit | Exterior Treatment Direction of Ribs, Extension of Exterior Wall, Reshape of Profile, Interior Treatment Vaults, Walls, Floors, |
| Multi-Units | Horizontal Vertical |

The exploration is independent from the museum design, but shows the potential in the structural idea.

Vaults

Adjacent of Vaults

Rounded ends
Lifted-up ends

2 arc VS 1 arc
2 arc VS 2 arc
2 arc VS 3 arc
2 arc VS 4 arc

Basic Units

EXTERIOR TREATMENTS

Direction of Ribs
Rotation of ribs; cropping of exterior profile.

Top Views
15°
30°
45°

Extension of Exterior Walls
Separated wall facing the vaults
Light fit
Hanged wall

Reshape of Profile
Direction of vaults PERPENDICULAR to the edges.
Direction of vaults PARALLEL to the edges.

INTERIOR TREATMENT

Vaults

Separated (Basic Unit)
Touching at EDGES
Touching at MIDDLE
Overlapping of Vaults (Partly)
Overlapping (Fully)

Walls

Basic Unit
Shifting Elements of Walls

Floors

Multi-Units

Horizontal
Vertical (1)
Vertical (2)
Vertical (3)

Museum Design

Putting the basic unit in the site, the walls at east and south were shifted inward to create "light" zones open to the street. To avoid the redundancy of the southern wall, the lower rib at the south was lifted up by two supports, allowing connection between the southern ground and the middle ground.

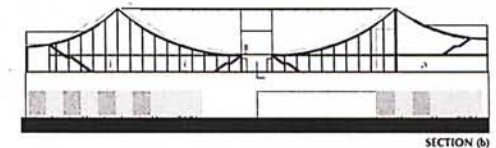
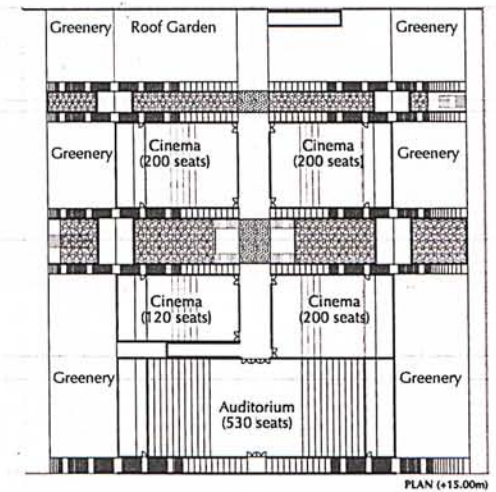
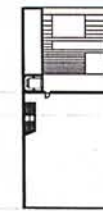
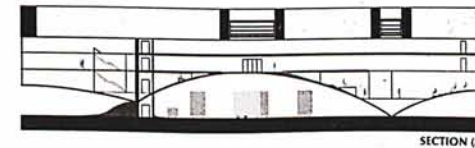
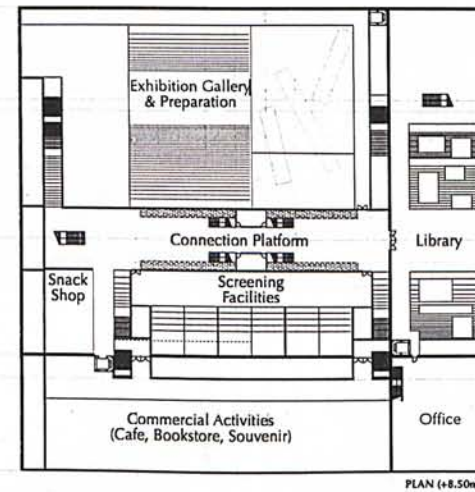
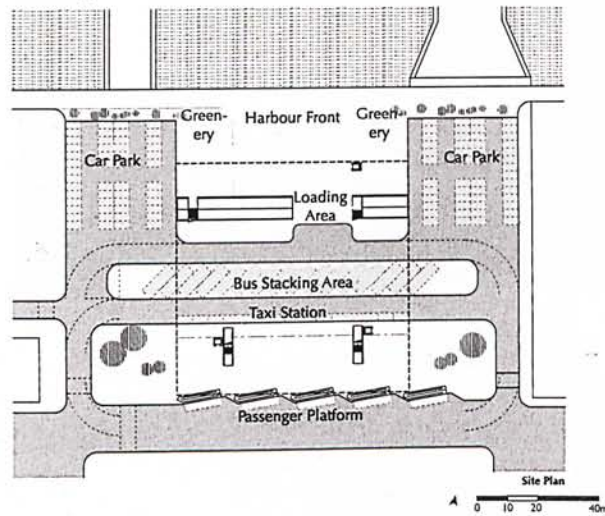
The southern ground incorporated the passenger platform, while the middle ground contains the bus stacking area and taxi station. The loading area will be at the northern ground.

The "light zone" as the east is the stepped library; the one as the south facing the main street contains commercial program like cafe and bookstore. The area at the angle is the administration area, including film laboratories and cataloguing office. The "dark" zone is divided by the connection platform: the southern area contains screening facilities of smaller scale (30 seats per room), and the northern area is exhibition gallery. When walking on the connection platform people can look at those activi-

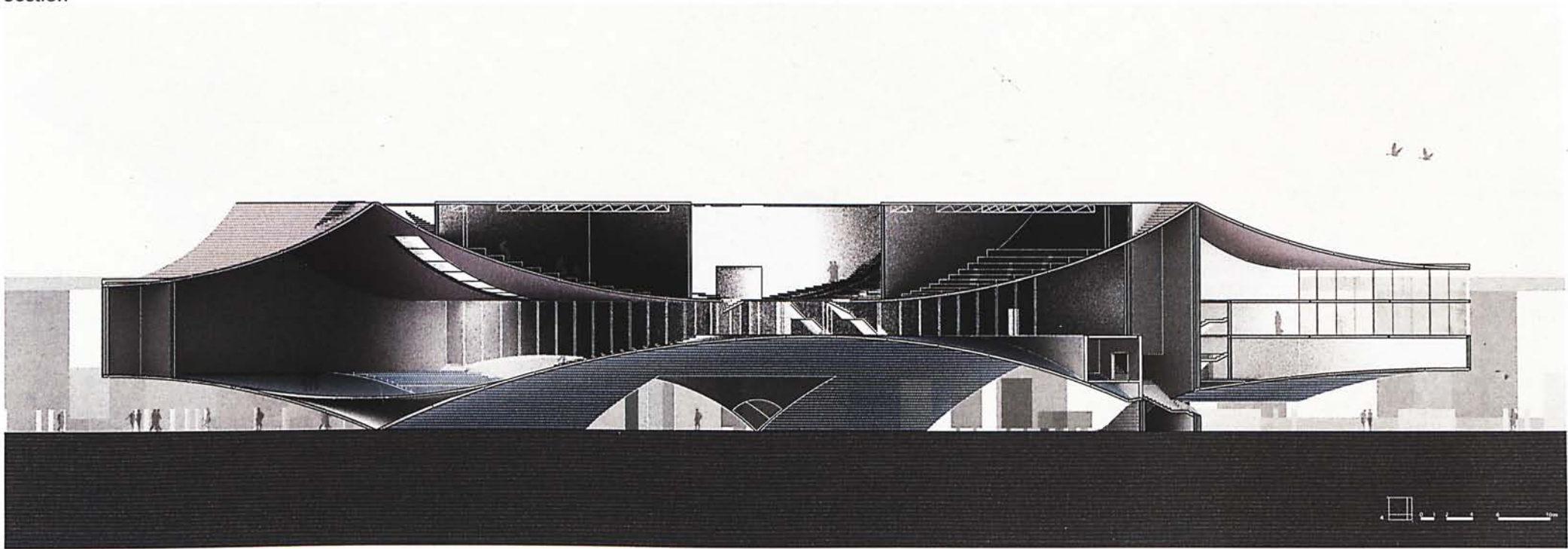
ties without interrupting the users, as the activity area is sunken.

Cinemas are put at the rooftop, using the curved surface by the structural idea. There are 4 cinemas (200 seats x 3 and 120 seats x 1) and 1 auditorium of 530 seats. The partition walls are acting as resisting walls to prevent vaults corrupt. Rooftop at the northern part is left as a public space, viewing over the East Island Corridor to the sea.

Drawings

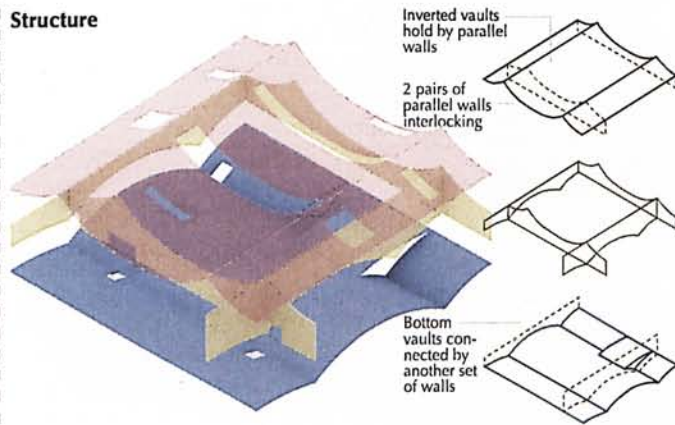


Section

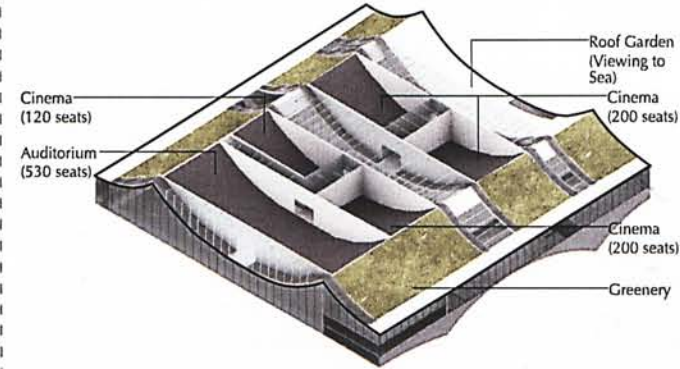


Diagrams

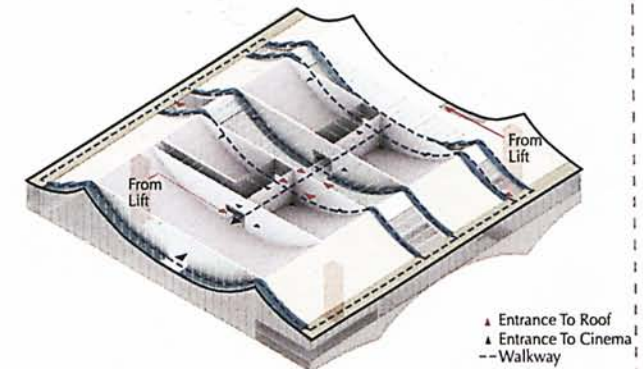
Structure



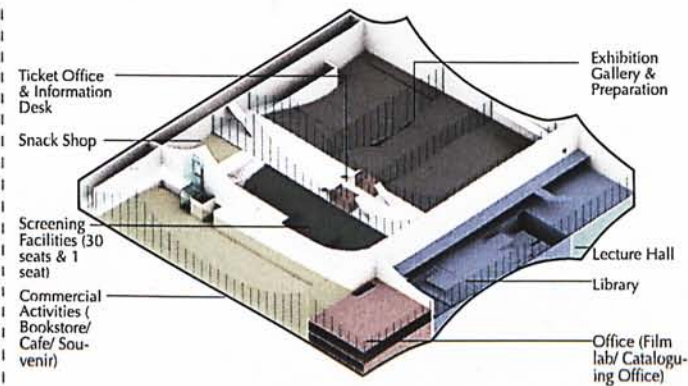
Program - Roof



Circulation - Roof



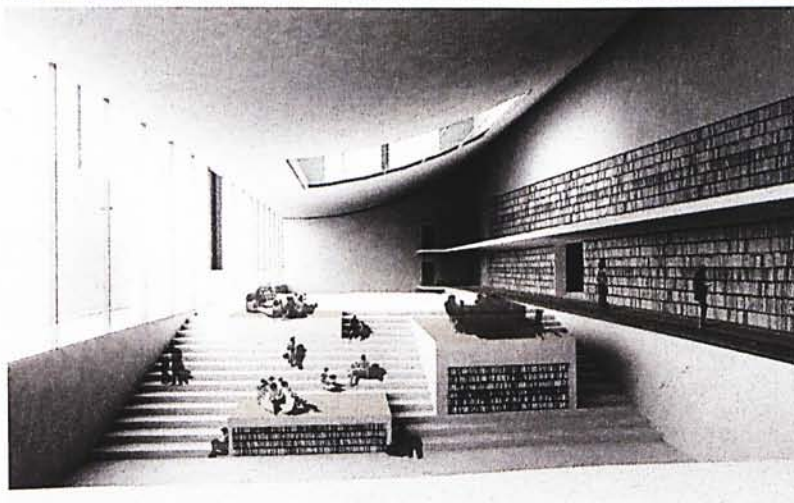
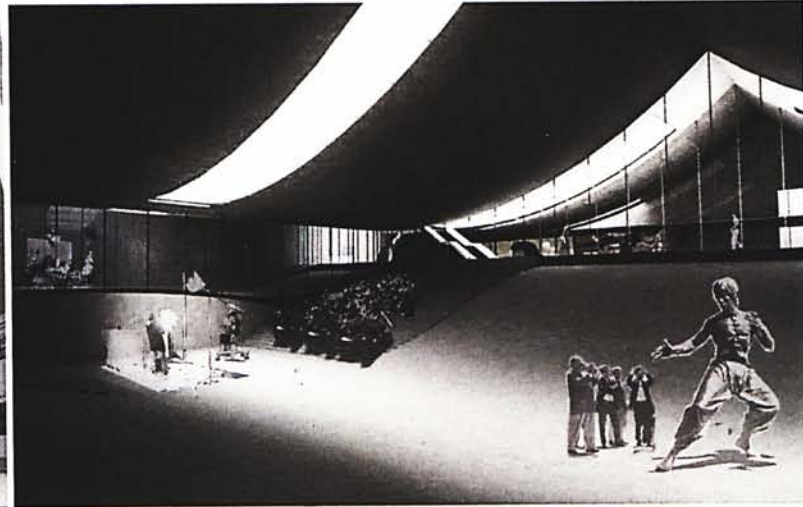
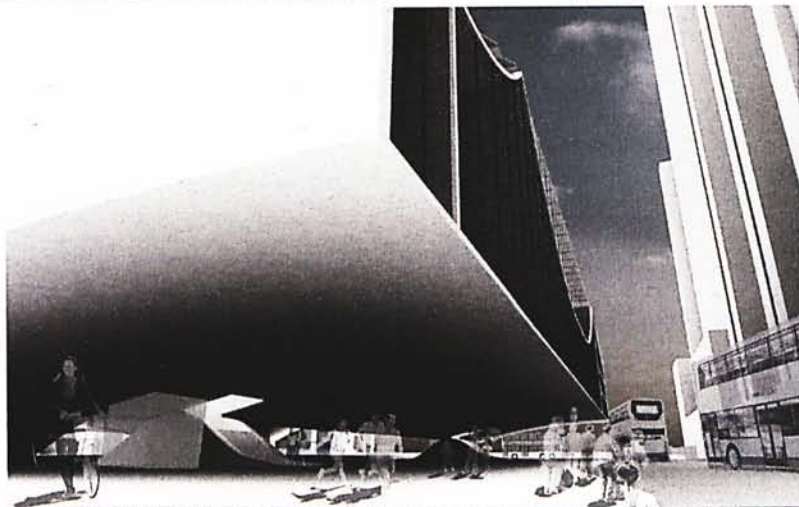
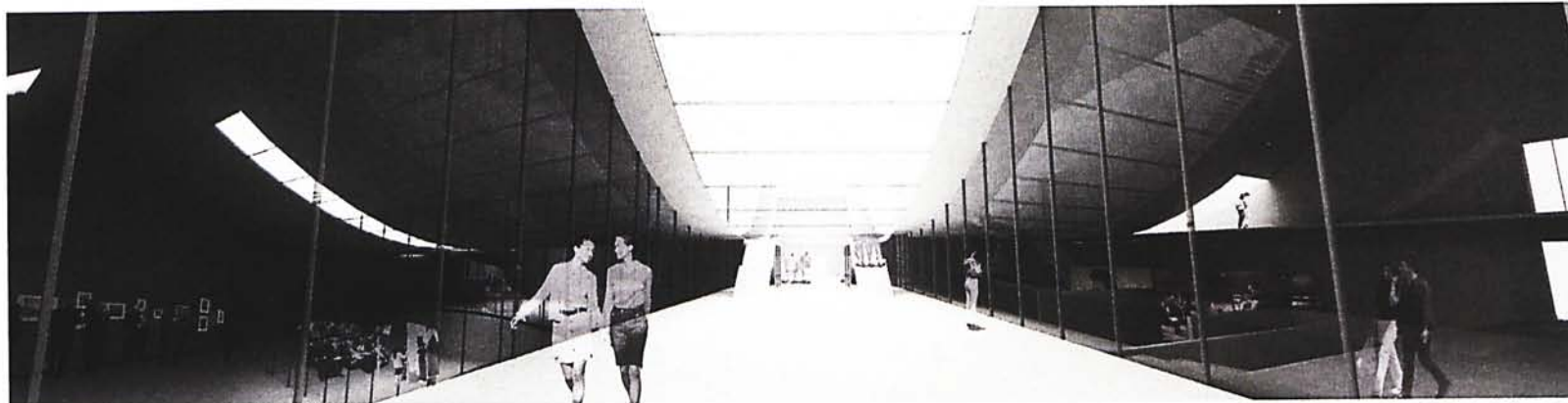
Program - Interior



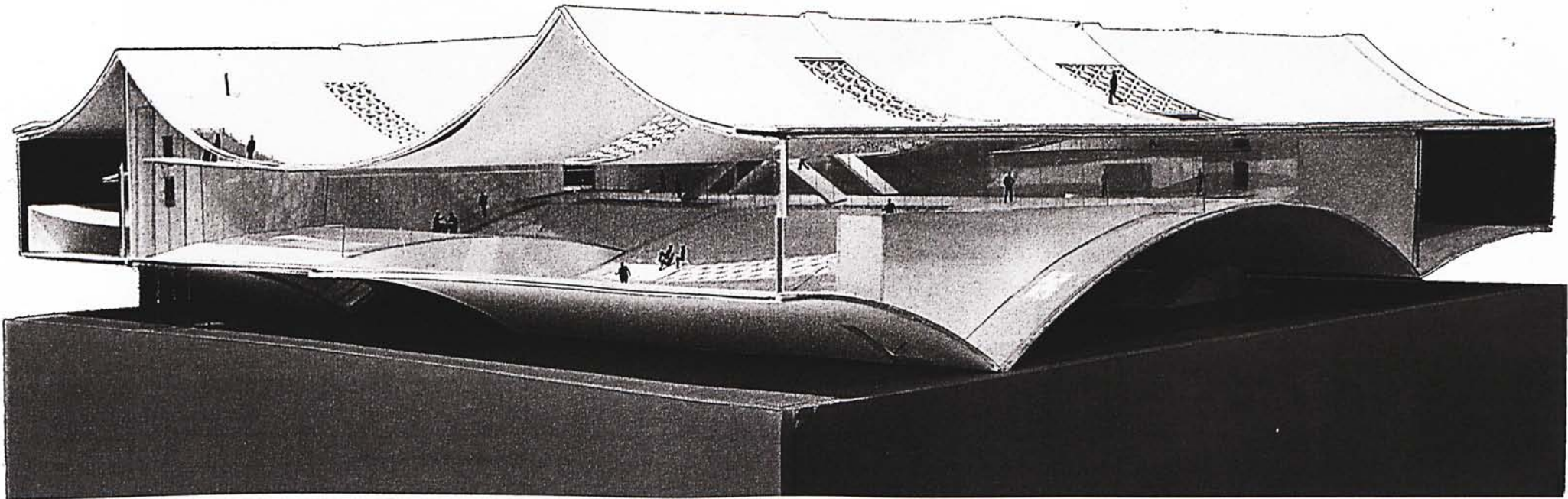
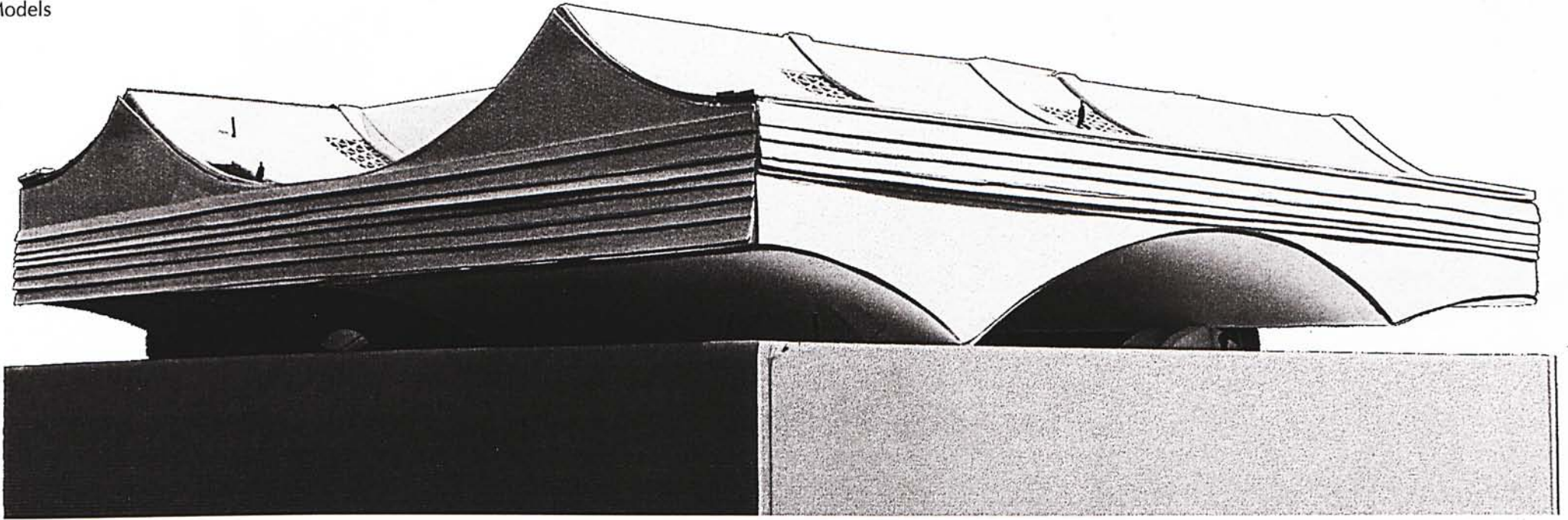
Circulation - Interior



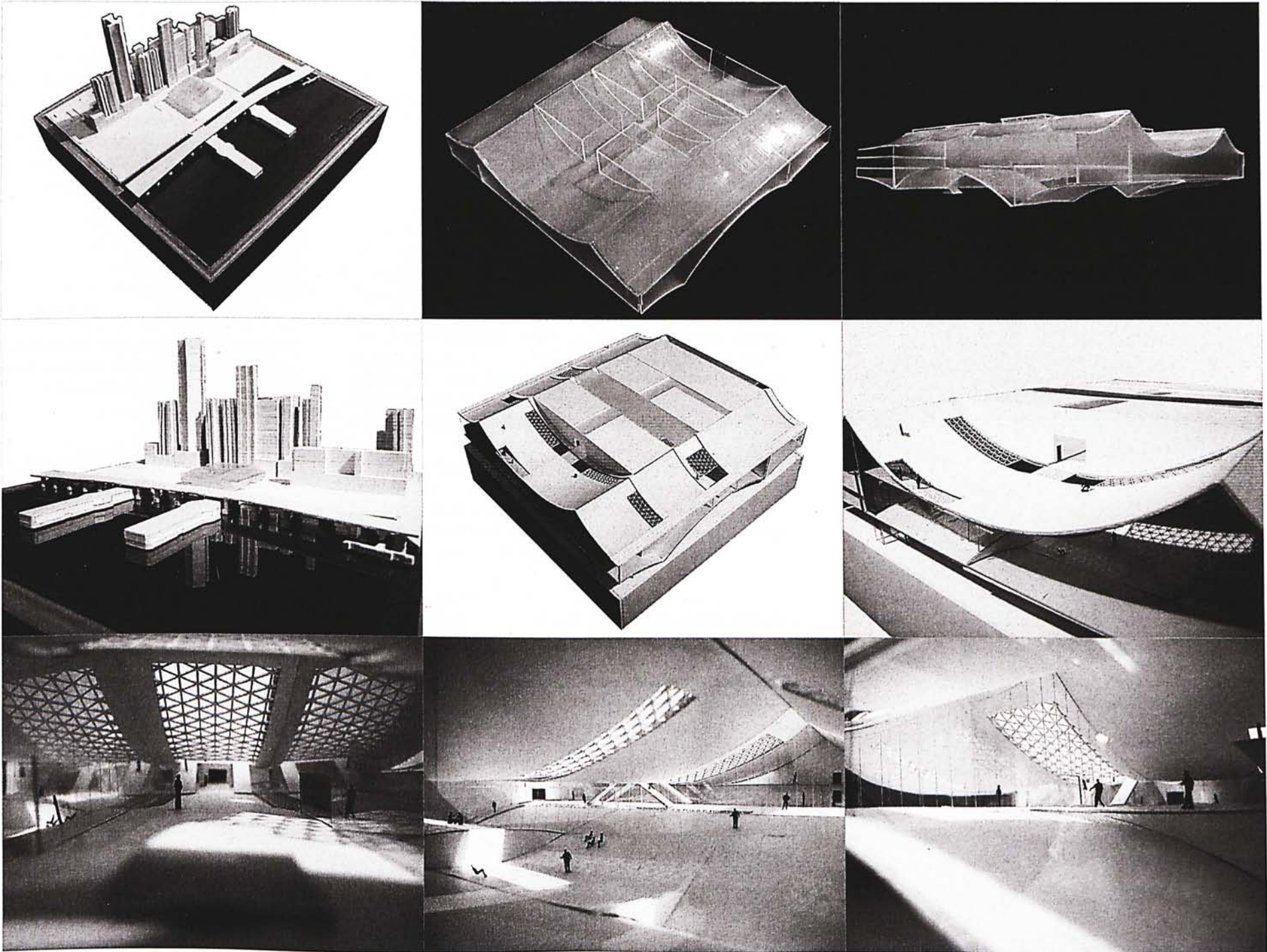
Renders



Models



Models



Epilogue

During the final review the reviewers are more interested in the structural idea rather than the program arrangement or site improvement. But all of us cannot ensure if the structural idea can overcome the span of more than 35m. If the project have consult the professional engineers will be much more convincing and completed. This is also the point I mentioned initially that architect can not completed a building by himself, we should be keen on cooperation of other building professionals.

When thinking about the thesis I mentioned that I want to reduce the arbitrariness of architects but the creation of the structural idea actually is very accidental. Architects do need a strong observation ability to discover the potential of the phenomenon.

In the project the structural idea dominants the architecture, the site and program arrangement follow the structural idea. This is possible in thesis, but may not be practical in real. The investigation on design process will be continue.

I have no idea who will read this book, may be a few architectural students sharing the similar topics. And the book will probably stored in the library until one day to be demolished. Many other thesis projects are already being forgotten in the library. So, what is the value of thesis project?

This is also the first question when I consider my thesis topic. Someone treats this as a conclusion of the past years' studying; someone thought this as the chance to design whatever you interested before. For me, the project contributes to nothing except myself. I use the thesis to complete my design ability, which is the structural issue, supposed my weakest design ability.

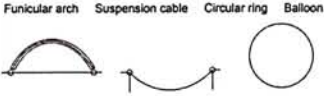
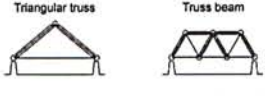
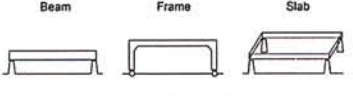
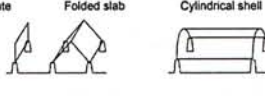
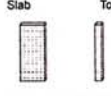
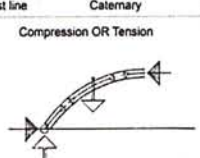
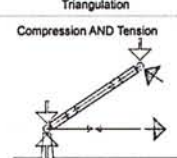
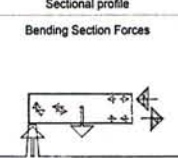
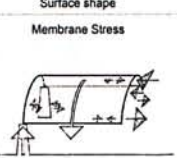
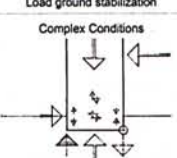






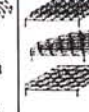


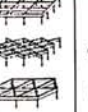









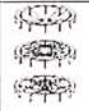








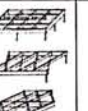

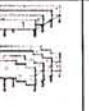









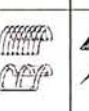

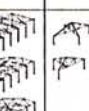
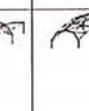



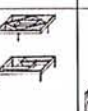





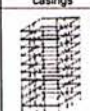

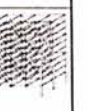

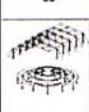



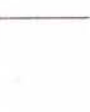
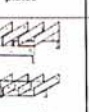



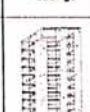
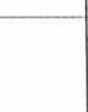
My initial thesis topic is about "Structural System Resists Earthquake Force", a very different topic from the result project. But after discussing with the tutors, and consider the supporting resource, I gave up the topic. Until the semester began I still had no idea what I would do.

So at the beginning I had some research on plant and animal. In fact I had no direction at that time. But later the topic had been reduced to a very basis question: How to design architecture? Then pieces of thing started to merge to be one, and finally resulted this thesis project.

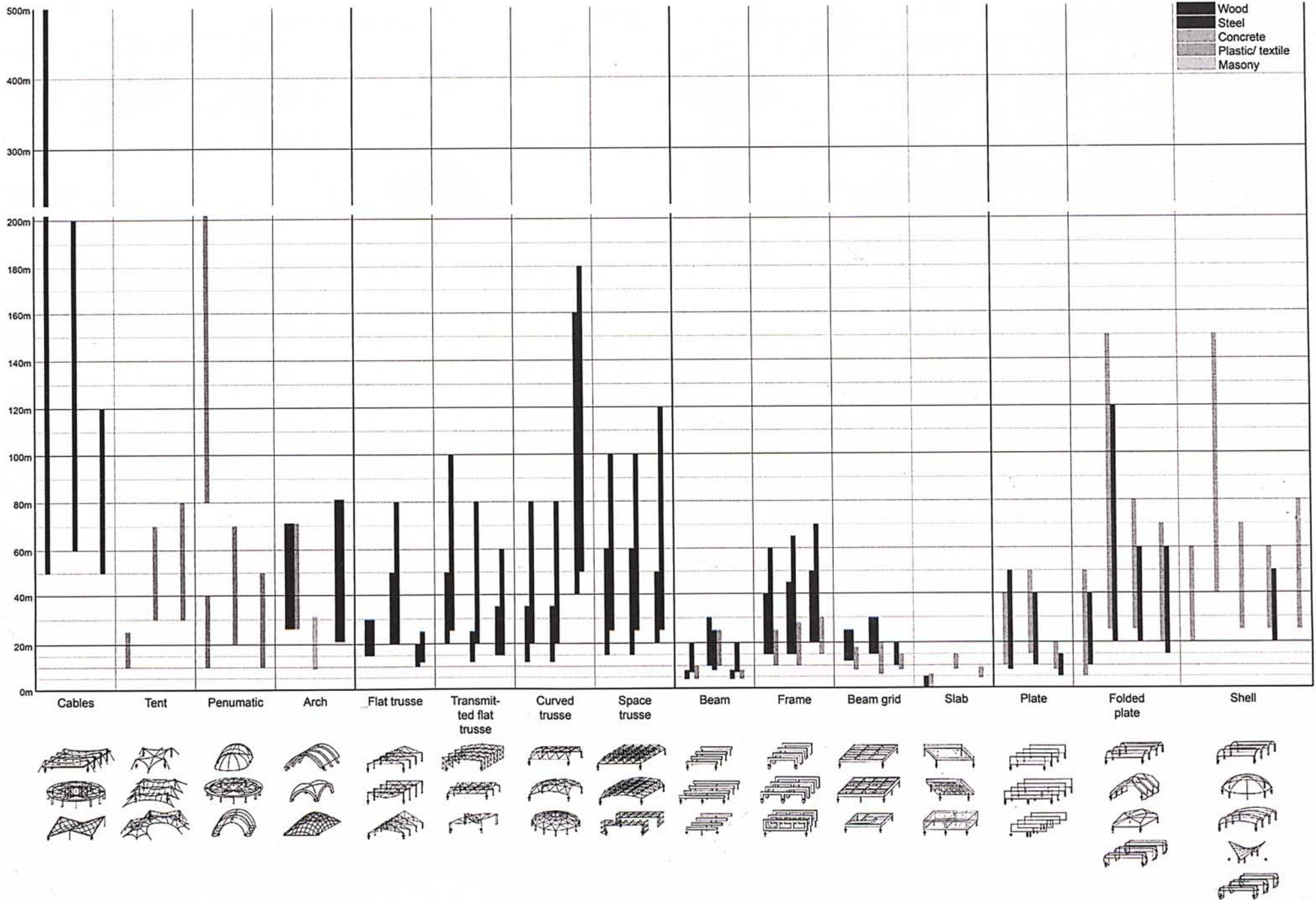
This is not a new project. In face this is very similar to the structural studio in master one year. But as I said before, the thesis valued as it contributed to my self's growing.

Just want to share some of my thoughts, as the only reader will be my fellow junior. Design is using our creativity to confront pressure (from Shin Mnatsunaga), so act well under pressure.

Structure System Classification

| FORM-active structure systems | | | | VECTOR-active structure systems | | | | SECTION-active structure systems | | | | SURFACE-active structure systems | | | HEIGHT-active structure systems | | | |
|---|---|---|---|---|---|---|--|---|---|---|---|--|---|---|---|---|---|---|
| Non-rigid, flexible matter shaped in a certain way and secured by fixed ends, can support itself and span space. | | | | Compressive and tensile members, arranged in a certain pattern and put together in a system with hinged joints, form mechanisms that can redirect forces and can transmit loads over long distances without intermediate support. | | | | By means of rigid connections, separate beams and columns can be combined to form one coactive multi-component system in which each member through deflection of its axis is participating in the mechanism of resisting deformation. | | | | Surface elements which can perform load-bearing functions can be composed to form mechanisms that redirect forces. | | | Structure systems, of which the main tasks is to collect loads from horizontal planes stacked upon one another and to vertically transmit them to the base. | | | |
| Funicular arch Suspension cable Circular ring Balloon  | | | | Triangular truss Truss beam  | | | | Beam Frame Slab  | | | | Plate Folded slab Cylindrical shell  | | | Slab Tower  | | | |
| Thrust line Catenary Circle Compression OR Tension  | | | | Triangulation Compression AND Tension  | | | | Sectional profile Bending Section Forces  | | | | Surface shape Membrane Stress  | | | Load ground stabilization Complex Conditions  | | | |
| Cable structure | Tent structure | Pneumatic structure | Arch structure | Flat trusses | Transmitted flat trusses | Curved flat trusses | Space trusses | Beam structures | Frame structures | Beam grid structures | Slab structures | Plate structures | Folded plate structures | Shell structures | Bay-type high-rises | Casing high-rises | Core high-rises | Bridge high-rises |
| Parallel cable systems | Peak tents | Air-controlled indoor systems | Linear arches | Top chord trusses | Linear trusses | Cylindrical trusses | Flat space trusses | One-bay beam | One-bay frame | Homogeneous grids | Uniform slabs | One-bay plates | Prismatic folded plates | Cylindrical shells | Framed bays | Frames casings | Cantilever cores | Girder bridges |
| Radial cable systems | Undulating tents | Air cushion systems | Vaults | Bottom chord trusses | Folded trusses | Saddle-shape trusses | Folded space trusses | Continuous beam | Multipanel frames | Graded grids | Ribbed slabs | Continuous plates | Intersecting folded plates | Dome shells | Trussed bays | Trussed casings | Indirect load cores | Storey bridges |
| Biaxial systems | Indirect peak tents | Air tube systems | Thrust lattices | Two chord trusses | Intersecting trusses | Dome-shape trusses | Curved space trusses | Pin-jointed beam | Storey frames | Concentric grids | Box frames | Cantilever plates | Pyramidal folded plates | Saddle shells | Stabilized post-beam bays | Stabilized post-beam casings | Core combinations | Multistorey bridges |
| Cable trusses | | | | Cambered trusses | | Spherical trusses | Linear space trusses | Cantilever beam | | | Cantilever slabs | Intersecting plates | Linear folded plates | Linear shells | Shear wall bays | Shear wall casings | | |
| | | | | | | | | | | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | | | |  | |  |  |  | | |  |  |  |  |  |  | | |

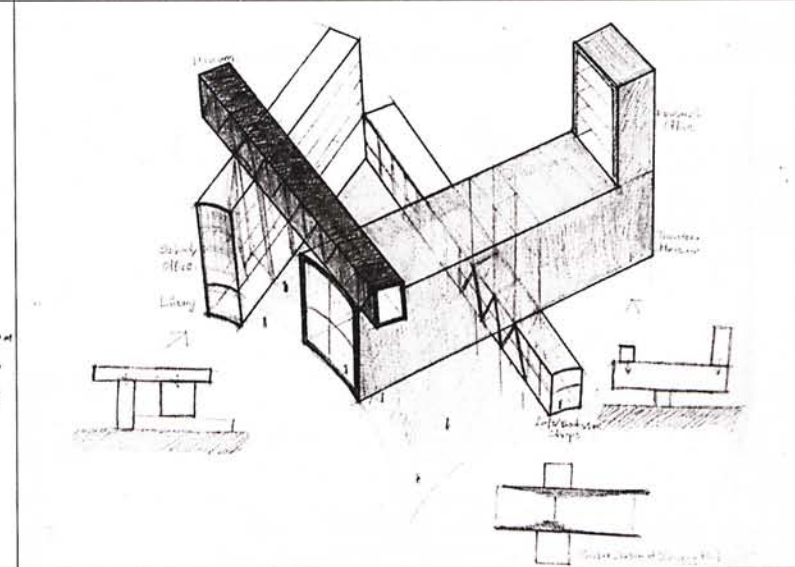
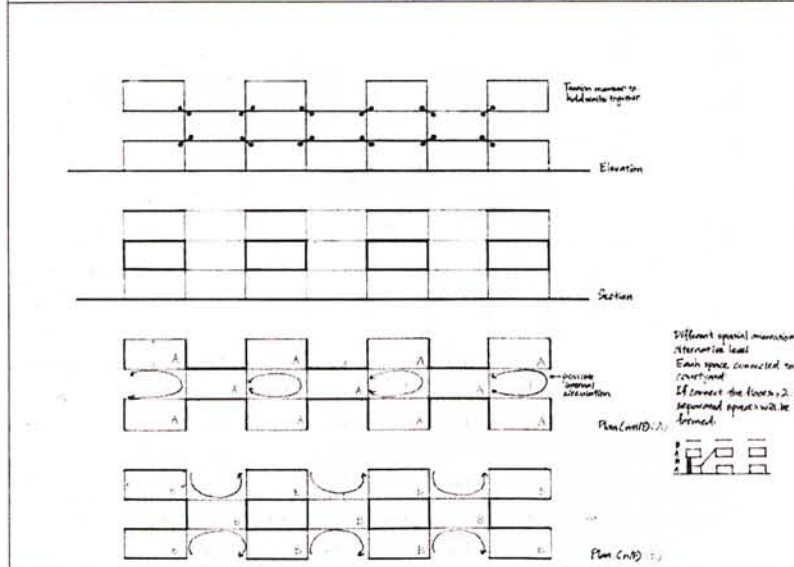
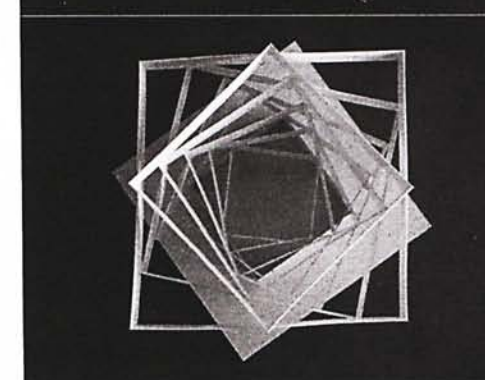
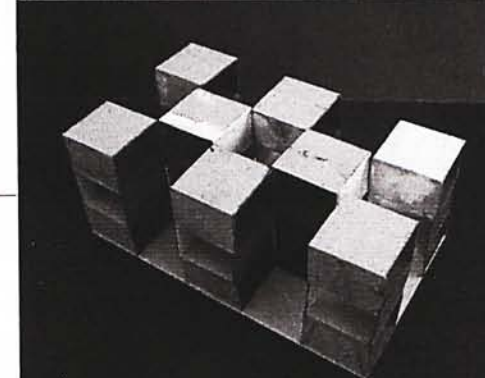
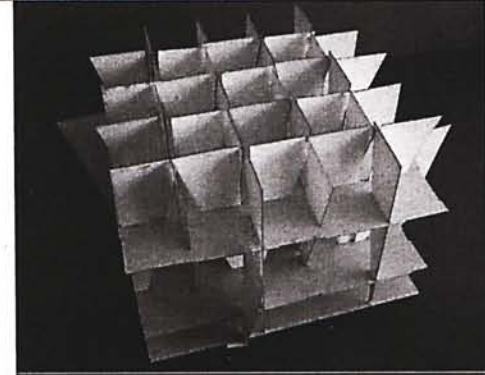
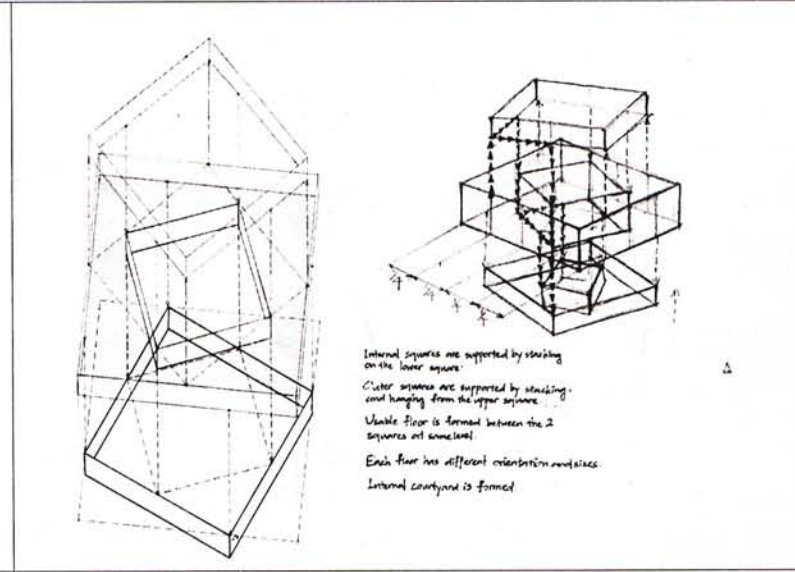
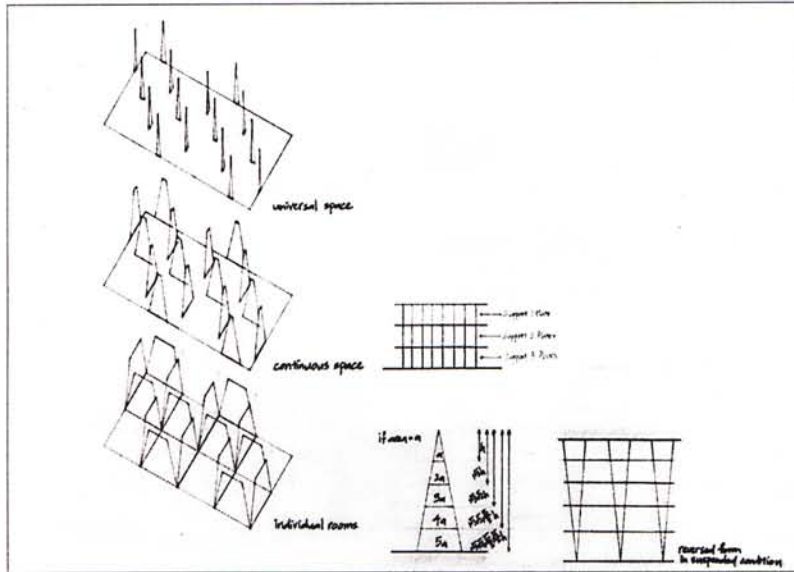
Span



Function of Form

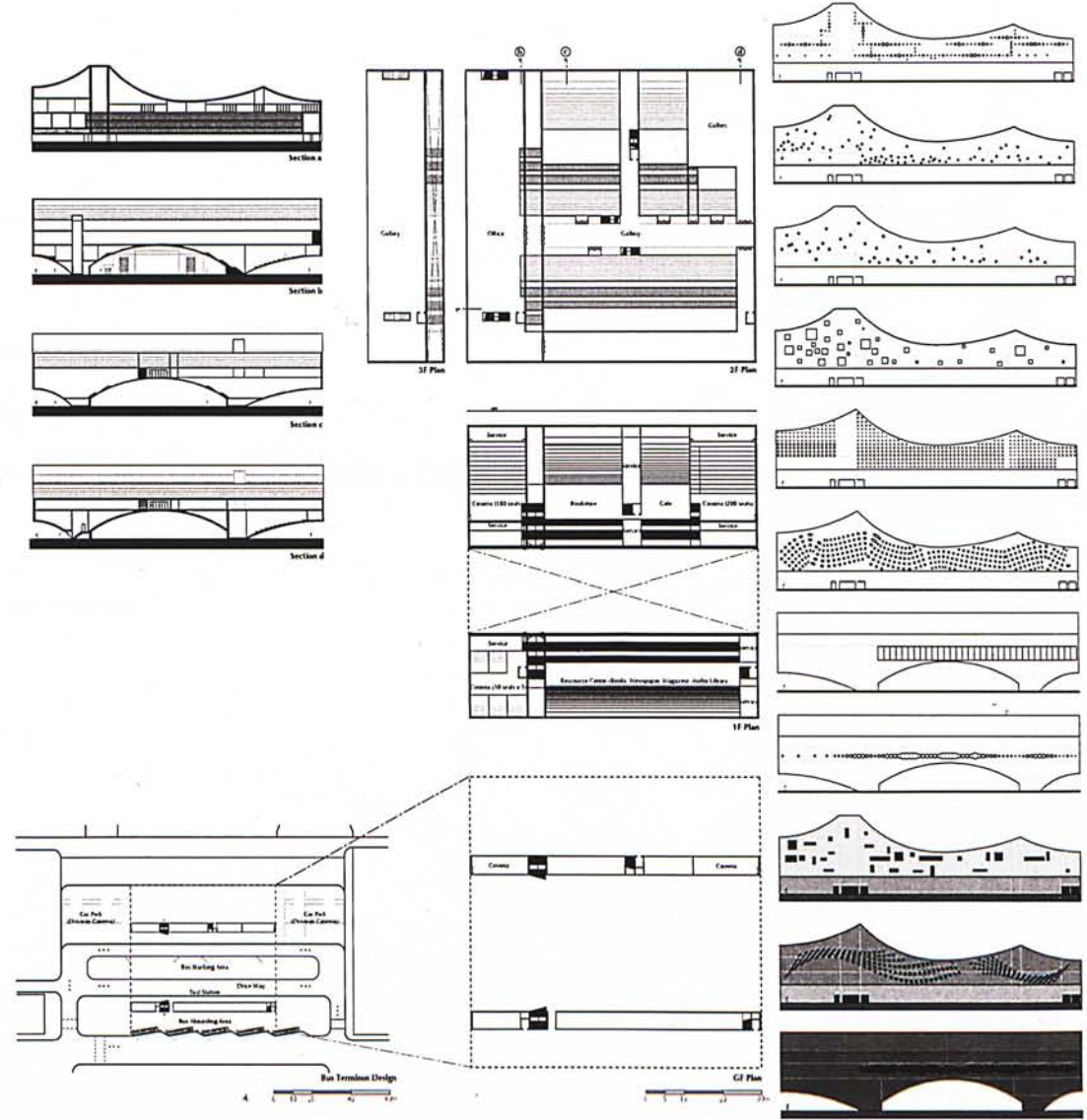
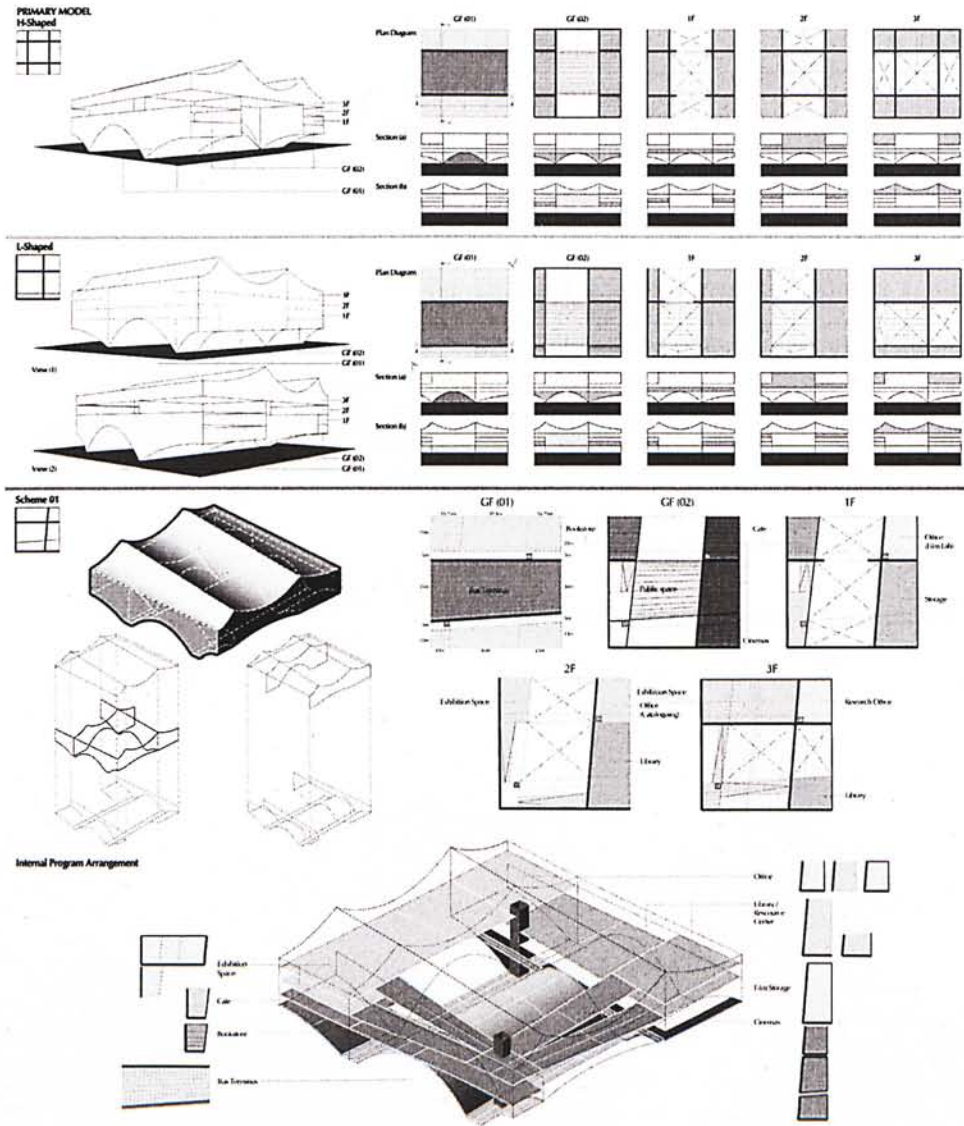
| | FORM-active structure systems | | | VECTOR-active structure systems | SECTION-active structure systems | | SURFACE-active structure systems | | | | |
|--|---|---|---|--|---|---|---|--|---|---|--|
| | Cable/ Tent | Pneumatic | Arch | Diagrid | Frame | Grid Slab | Folded Plate | Shell | Domes | | |
| Horizontal Tessellation | | | | | | | | | | | |
| Vertical Tessellation (tower) | | | | | | | | | | | |
| Curved Tessellation (spherical frames) | | | | | | | | | | | |
| Base Units & Spatial Qualities | Parallel Cable Tensile Membrane Lightness, Stretching, smoothness, vaulting, asymmetry, orientedness | Air Supported Pneumatic Membrane Quilting, Undulation, roundity, lightness, amorphousness, centeredness, stacking, bubbling, inflatedness, vaulting | Barrel Vault Massiveness, Solidity, Orientedness, non-orientedness, vaulting, extrusion, ribbing | Curved Rib Vault Hyper-curving, Ribbing, closure, axially, vertically, pointedness | Diagrid Lightness, Crystallinity, repetition, latticing, verticality, gradation, differentiation, conicality, diagonality, amorphousness, twistedness | One Way Frame Lightness, Griddedness, openness, freedom, segmentation, bending, porosity, orthogonality, diagonality, enclosure, ripping | Grid Slab Griddedness, Striation, boundlessness, waffing, hierarchy, porosity, lacing, vaulting, differentiation, segmentation, continuity, uniformity, aggregation | Folded Plate Pleating, Arching, flatness, slanting, wapping, vaulting, corrugation, tubularity, asymmetry, pinching | Conical Shell Arching, Directionality, quilting, piercing, linearity, orientedness, bracing, hyper-curving | Surface Dome Enclosure, Non-orientedness, axially, cruciformity, scalloping, faceting, multi-scaling | Yazdi-Bandi Dome Diamonding, Gradation, conicality, roundity, orthogonality, asymmetry, cruciformity, orientedness |
| | Radial Cable Tensile Membrane Tenting, Tapering, orientedness, arching, vaulting, floating, lightness, verticality, cellularity, non-orientedness, enclosure, rotundity | Inflated Beam Pneumatic Membrane Striatedness, Scalloping, centeredness, rotundity, lightness, bubbling, quilting | Cross Vault Verticality, Cruciformity, structuredness, horizontality, openness, axially closure, roundness, rectangularity, asymmetry | Cellular Vault Cellularity, Pointedness, symmetry, cruciformity, centeredness, rectilinearity | | Two Way Frame Lightness, Striation, boundlessness, repetition, differentiation, enclosure, centeredness, weightness, extrusion, stacking, hinging, continuity | | Hyper-Curved Umbrella Column Shell Slanting, Linearity, folding, tenting, axially, hyper-curving, focusing, specularity | Ribbed Dome Pleating, Scalloping, verticality, rotundity, pleating, faceting, squareness, triangularity | Kar-Bandi Dome Crystallinity, Stalactiformity, ribbing, stellatedness, symmetry, faceting, diagonality, pleating, asymmetry, rectangularity, orientedness, rotundity, non-orientedness, cellularity, non-repetition | |
| | | | | Compress Rib Vault Verticality, Stellatedness, rectangularity, symmetry, diamonding, vaulting, horizontality, openness, cruciformity | | Space Frame (Double-Layer-Grid) Lightness, Continuity, repetition, openness, unstructuredness, aggregation, boundlessness, enclosure | | Three-Pointed Hyper-Curved Shell Lightness, Radiating, rotundity, attenuation, thinness, pleating, enclosure, triangularity, slitting, tapering, scalloping, flaring, pleating, torquing | Ribbed Dome Asymmetry, Twisting, enclosure, stacking, arching, rotundity, faceting, stellatedness, conicality | Muqarnas Dome Granularity, Stepping, faceting, rotundity, symmetry, enclosure | |

Design Exercise



Review - February, 2011

Review - March, 2011



Advanced-level Biology of Hong Kong | Manhattan

Elcroqius 145 Christian Kerez - basic on architecture

Elcroqius 139 SANNA - architectural topology

Elcroqius 129 129 Herzog & de Meuron - the monumental and the intimate

Structure Systems | Heino Engel |

The Function of Form | Farshid Moussavi | Harvard University GSD

Consultative Committee on the Core Arts and Cultural Facilities of the West Kowloon Cultural District

Museums Advisory Group

The Report to the Consultative Committee

Transport Department - Transport Planning & Design Manual

ARCHITECTURE LIBRARY

建築學圖書館

THESIS 畢業論文

Overdue Fines on Thesis

HK\$1.00 per hour

4 hrs.

| Time Due 還書時間 | | |
|------------------|--|--|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

CUHK Libraries



004782979