Objective Embodied Mapping

Embodied Perception for Museum of Cartography

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BENVGA05 MARCH THESIS

CONTENT PAGE

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Introduction

Chapter 0A

A.1

Strøget – The People's Place

Walking down the sideway pavements of Strøget street in Copenhagen had always been an unpleasant experience during the 1960s. One will bump into each other or blocking the way on the narrow pavement, and walking with the fumes from vehicles. This is because automobiles had taken over the street, turning streets to roads, and pushing the pedestrian on narrow sidewalks.

All of these began to change when Jan Gehl pushed forward the proposal of turning Strøget into a auto-free zone in 1962, stretching from the Town Hall Square at the west, to the Kongens Nytorv at the east. It brought back cleaner and friendlier footpath for happy pedestrians. And restaurants, outdoor sidewalk cafes, shops, galleries, gift stores, street performances began to pour the street with excitement, succeeding Strøget street into a great tourist attraction. People began to explore the street and places around it. Strøget was not just as a space to move but a place of activities, a place of experiences. It was a place for "public life".[01]

Figure 01. Stroget in 1935 with vehicular roads.

Figure 02. Stroget since vehicular free zone proposal 1962.

01 Jan Gehl, *Public Spaces, Public Life: Copenhagen / Jan Gehl & Lars Gemzøe* (København: Danish Architecture Press,2003) p.04.

A.2

Pedestrian Navigation

People move around the city with or without purpose(s). One could be walking to meet a friend, or simply pacing to the warmth from the sun and the smell of trees. However, one might still be necessary to know where one is, how one has been there, or how one goes somewhere else. And these queries can be answered and performed through navigation, or in more precisely pedestrian navigation since walking is the mode of movement.

Navigation is an action of location searching and way-finding to determine one's current position and the accurate course to move from one place to another.[02] It requires the application of a map, which is a visual representation of a geographical area, to navigate the pedestrian of the urban environment. When navigating, the 'navigation memory' constructed from the map will be constantly revisited corresponding to the context of reality, to reassure the

02 Bernhard Rell-Pros Wellenhof, *Navigation: Principles of Positioning and Guidances* (New York: Springer, 2007) p.05-06.

course of navigation. This is the process of identifying what has been learned from the map and overlay this information with reality to make accurate way-finding decisions.

Thus, pedestrian navigation can be described as a process of interaction between the navigator (a person) and the map, being the 'information medium' and the urban environment, being the 'physical medium'. It is a 'triangular relationship' or triangular interaction, which one depend on the others, and complete the others to perform navigation; to allow the movement through space.

My project initiates by exploring the impact of the pedestrian navigation system in the urban context and to understand the 'triangular relationship' between the person (navigator) and the information medium (map) and the physical medium (urban context). A mapping exercise is initially executed to investigate the spatial and perceptual experience constructed from the 'navigator-map-urban triangular relationship' during pedestrian navigation, which then lead to further realisation of the architecture proposal.

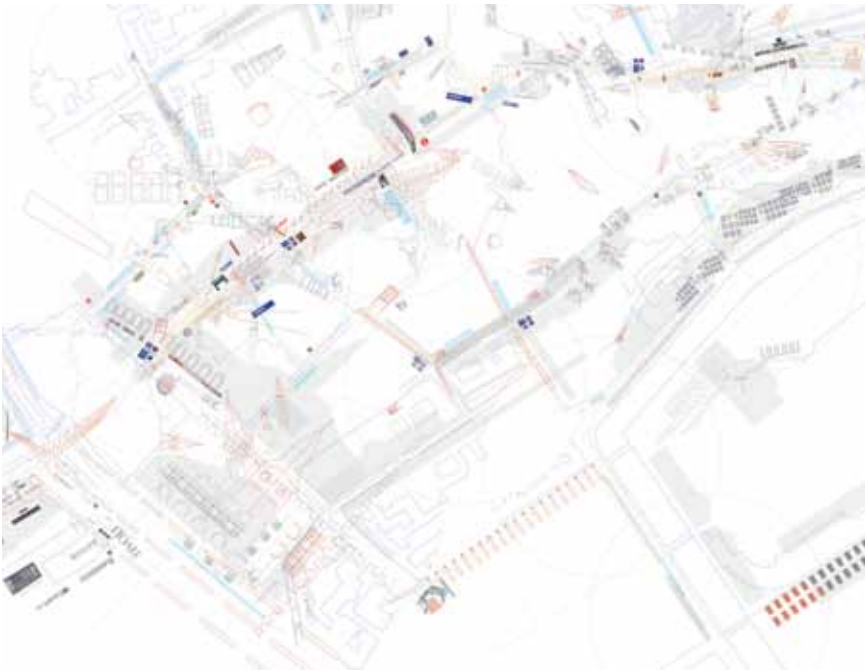

Figure 03. Mapping of Spatial and Perceptual Experience In Copenhagen via Google Street View.

A.3

Research Problems

In the 15th century, the Age of Discovery, paper maps are drawn to assist explorers to navigate to discover new trade routes and new places.[03] Their travel accounts are then collected to improve the maps. This shows cartography is important for both navigation and discovering the environment.

Then today in the 21st century, the advancement in science and technology, especially digitization has brought changes to cartography and navigation. Handheld maps (traditional maps) have been progressively replaced by digital maps, such as Google Maps and Global Positioning System(GPS). The reliability and usability of digital maps has earned the trust of some many people. One can just key in the name or coordinate of the current location and destination, and the most suitable course, sometimes with more choices will

03 J. J. O'Connor and E. F. Robertson, *'The History of Cartography'*, The History of Cartography, < http://www-gap.dcs.st-and.ac.uk/history/HistTopics/Cartography.html> (accessed 21 March 2014).

be determined. There is only a need to follow the set course, or so called the 'dot' on the navigation device that represent oneself, and even if moving away from designated course, new course will be automatically set to follow. This has given people a more passive role in navigation, which slowly takes away people's ability and knowledge to navigate. 'Exploration' is not part of navigation anymore, neither in the urban environment nor maps, because people doesn't need to, as technology has effortlessly done it and is continuously doing it for them.

Cartography is understand by most people as to assist navigation in today's society, and is mostly constituted with modern technology. Its main purpose for communicating spatial information regarding the environment is slowly being forgotten by people. Many also see cartography as to make maps, more precisely digital maps, and for navigation in the complicated urban environment.

However, maps are not used properly, which is read and recognise the spatial surroudings, but only as reliable and dependable technology that accurately lead people from 'point to point, to point, to point, and to point'. In a way, it is questionable that; 'how many people explore the map in his/her navigation device? How many actually only look at the 'search bar', 'the current location pointer', 'the projected route line', 'the choices of route' and most importantly the 'travel time'?

Cartography is more known as to create maps for navigation. Less people realises about the purpose of cartography to give spatial understanding

of the environment, in which environment is the wider context, not just our immediate surroundings.

The thesis intents to address a few key questions such as; how can architecture inform people about the purpose of cartography to provide spatial understanding of the environment? What architecture can bring to this realisation that the potential of cartography has been less concerned, and also that navigation has been incorrectly practiced?

Figure 04. Navigation on mobile device.

A.4

Thesis Aims and Objectives

Rather than directly stating to people that cartography gives people spatial understanding of the environment, the thesis aims to find an expression of embodied perception to provoke people to realise spatial information is embedded in maps, which is the main product of cartography. As a result, the hypothesis of the thesis is ***'an architecture that encourages objective embodied sensory interactions can demonstrate that cartography gives people spatial understanding of the environment.'***

The architecture aims to motivate people to be attentive and responsive in engaging the architecture as a unified whole. It will act as an active driver to encourage people to rethink the importance of spatial interaction and spatial knowledge in both cartography and navigation, as well as for their overall understanding of the living environment. In short, the architecture will improve people understanding of cartography to be more then a technological tool for navigation, as well as navigation is more than reaching a destination.

Furthermore, the thesis will also aim to explore the capability of museum, as 'institute for education' to appropriately communicate the understanding of cartography. However, rather than delivering users with the understanding of cartography through viewing the exhibition, the architecture wish to allow users to understand cartography by experiencing cartography.

Key qualities of embodied perception, such as attention, expectation, movement, depth, three-dimensional structure and memory will be discussed.

A.5

The Methodology

The thesis will rely on theoretical and interdisciplinary approach by reviewing studies on embodied perception in relation to architecture and psychology. Empirical research on architecture case studies will be conducted to examine the bodily and perceptual interaction expressed by the 'triangular relationship' between users and 'museum curating' and 'exhibition space'. Concepts on philosophy, sociology and cartography will also be explored to outline the notion of embodied perception, drawing its relationship with architecture, cartography and museology. Finally, the proposition of the thesis will be demonstrated through design developments of the studio project to generate further discussion.

A.6

The Structure

Chapter one will begin by introducing the problem of misinterpretation of cartography and its potential focus of study, which is the embodied perception in cartography. This chapter will then explore the notion of embodied perception in architecture and psychology. Drawing its relationship with spatial memory, the method '*Objective Embodied Mapping*' will be proposed.

Based on the definition of '*Objective Embodied Mapping*', chapter two will observe and compare spatial layout (organisation) of architecture case studies to examine the possibilities of the 'triangular relationship' between visitors and 'exhibition space' and 'museum curating' in controlling movement and exploration. Spatial organisation conditions and possibilities that will contribute to the thesis's proposition will be determined.

Chapter three will study the 'context' and 'content' relationship by comparing case studies of art museum and science museum to unveil the

perceptual experience delivered by the exhibition. The concept of 'classification' and 'framing' in education, by B. Bernstein will be examined to seek for ways to implement the concepts in thesis.

Chapter four will first outline the proposal and background of the Museum of Cartography. It will then use the rules determined from the comparative analysis of spatial layout (organisation) in chapter two to demonstrate a proposal that will enhance users' embodied perception of the architecture. Exhibition spaces that incorporate the ideas from the 'context' and 'content' analysis will also be tested.

Definition of Embodied Perception

Chapter 01

1.1

Cartography

'Cartography is the art, science and technology of making maps, together with their study as scientific documents and work of art. In this context, maps are regarded as including all types of maps, charts and sections, three-dimensional models and globes, representing the earth and any heavenly body at any scale.' [04]

by J. B. Harley and David Woodward.

Cartography is described as the study and practice of map-making that combines the science, aesthetics and technique to represent the reality and to communicate spatial information, which in any case the reality can be material or immaterial, and related to earth or nature, presented with any

04 J. B. Harley and David Woodward, *History of Cartography: Volume 1 - Cartography in Prehistoric, Ancient and Medieval Europe and The Mediterranean* (Chicago: The University of Chicago Press, 1987) p.xv.

appropriate proportion and measuring system. It includes all 'stages of evaluation, compilation, design and drafting required to produce a new or revised map document from all forms of basic data. It also includes all stages in the reproduction of maps and encompasses the study of maps, their historical evolution, method of cartographic presentation and map use.' [05]

However, many do not conceive cartography as defined above. Cartography is uncritically considered by the society as maps making, and is usually defined according to its perceived functions, areas or periods of map production, such as to map the world, to create road maps and to create navigation maps.[06] The word 'cartography' first entered the Oxford English Dictionary in 1859 and was previously 'coined as a Portuguese neologism ('cartographia') by the Viscount de Santarem in 1839', according to Dennis Wood.[07]

At present, the advancement in the Information Age, have seen some institutes and departments in higher education have avoid using the traditional term 'cartography' and prefer more modern terms such as geomatics, geoinformatics and GI science.[08] Not just the term 'cartography', but its scope and content constituted with it does not has clarification in our society. This shows that cartography is in need of recognition.

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05 J. B. Harley and David Woodward, *History of Cartography: Volume 1 - Cartography in Prehistoric, Ancient and Medieval Europe and The Mediterranean* (Chicago: The University of Chicago Press, 1987) p.xv-xvi.

06 J. B. Harley and David Woodward, *History of Cartography: Volume 1 - Cartography in Prehistoric, Ancient and Medieval Europe and The Mediterranean* (Chicago: The University of Chicago Press, 1987) p.xv.

07 Dennis Wood, *'Cartography is Dead (Thank God!)'*, Making Maps, < http://makingmaps.owu.edu/mm/cartographydead.pdf> (accessed 17 April 2014).

08 Laszlo Zentai, *'Changing of The Meaning of Term "Cartographer" in the Last Decades"*, < http://lazarus.elte.hu/cet/academic/icc2009/zentai.pdf> (accessed 17 April 2014).

1.2

Embodied Perception

Definition

'Perception is the organisation, identification, and interpretation of a sensation in order to form a mental representation', according to Daniel L. Schacter, Daniel T. Gilbert and Daniel M. Wegner.[09] The sense organs will react to physical or chemical stimulation to produce sensations to be registered and processed in the nervous system, forming thinking or imagination in the brain, which is what is known as perception.[10]

In cognitive science, perception has always been studied separately, divided according to the categories of senses for information processing. This 'disembodied' notion of perceptions has been criticised, leading to the

09 Daniel L. Schacter, Daniel T. Gilbert and Daniel M. Wegner, *Psychology* (New Yory: Worth Publisher, 2009) p.123.
10 Daniel L. Schacter, Daniel T. Gilbert and Daniel M. Wegner, *Psychology* (New Yory: Worth Publisher, 2009) p.123.

proposal of embodied perception by psychologist, which perception is studied by including all the senses as a whole. There have been a few approaches of embodied perception, but the thesis will only examine the *'Focus on Interaction With The Environment'* approach by J. J. and Eleanor Gibson, which is based on ecological psychology study, concentrating on the interaction between the observer and the environment.[11]

According to Natalie Sebanz and Guenther Knoblich, 'embodied perception referred to a conglomerate of theoretical claims postulating that the body, its movement, and the interaction with the environment fundamentally shape people's perception of the world'.[12] The body experiences itself, its movement and interaction with the surrounding to understand the surrounding. Embodied perception is able to reveal the way our body affects our interpretation of the environment.

For example, the observer can immediately perceive how large an object is from the dynamic pattern of information generated when the observer is moving towards the object.[13] Embodied perception is a visual perception that embodies the body, and postulating the body as the nucleus to interact and to understand the environment. This is also related to Merleau-Ponty's argument with his philosophy stating:

'Our own body is in the world as the heart is in the organism: it keeps the visible spectacle constantly alive, it breathes life into it and sustains it inwardly,

11 E. Bruce Goldstein, *Encyclopedia of Perception* (USA: SAGE Publication, Inc, 2010) p.387.
12 E. Bruce Goldstein, *Encyclopedia of Perception* (USA: SAGE Publication, Inc, 2010) p.387.
13 E. Bruce Goldstein, *Encyclopedia of Perception* (USA: SAGE Publication, Inc, 2010) p.387.

and with it forms a system.' [14]

In his opinion, the body is located as the centre of the experiential world, allowing our perceptual experiences to be integrated through our body. Our body and its movement constantly interact with the environment, which the body and the environment will rely on one another to continuously inform and redefine the other.

Three-dimensional Structure, Depth and Movement

'Vision reveals what the touch already know. We could think of the sense of touch as the unconscious of vision. Our eyes stroke distant surfaces, contour and edges, and the unconscious tactile sensation determines the agreeableness or unpleasantness of the experience.' [15]

by Juhani Pallasmaa.

The three-dimensional structure of the environment reveals how the body perceive the environment. The plasticity and tactility of our environment, giving clue to how it's shaped and how we understand it through our perception. It varying sizes and distances of its elements produced depth, which when we move we can understand better our environment. Embodied perception relies on the three dimensional structure and depth of the environment, and movement

14 Maurice Merleau-Ponty, *Phenomenology of Perception* (London: Routledge, 1992) p.203.
15 Juhanni Pallasmaa, *The Eyes of The Skin* (England: John Wiley & Sons Ltd, 2005) p.42.

of the body to be initiated. This is also strengthen by Juhani Pallasmaa when he further mentioned, 'As we open a door, the body weight meets the weight of the door; the legs measure the steps as we ascend a stairway,…' [16]

Effects of Attention, Expectation and Experience

'In short, attention is what turns looking into seeing. It allows us to be selective towards the setting and feature of the visual scene and to prioritise its processing.[17] Selection of attention can be depended on both the observer and source. The observer can perform voluntary (endogenous attention) and involuntary (exogenous attention) attentions.[18] Voluntary attention will improve perception, while involuntary attention might result in rejection. The similarities of the appearance and crowding of the sources will also affect the attention of the observer.[19]

Expectation has an effect on embodied perception, by allowing you to perceive in a certain way. People that are particularly sensitive to certain setting or aspect, will detect them from weaker stimuli.[20] Perception motivation can be understand by observing the tests in the following page:

17 E. Bruce Goldstein, *Encyclopedia of Perception* (USA: SAGE Publication, Inc, 2010) p.74.
18 E. Bruce Goldstein, *Encyclopedia of Perception* (USA: SAGE Publication, Inc, 2010) p.91.
19 E. Bruce Goldstein, *Encyclopedia of Perception* (USA: SAGE Publication, Inc, 2010) p.103.
20 Dennis Coon and John O. Mitterer, *Introduction to Psychology: Gateway to Mind and Behaviour* (USA: Wadsworth, Cengage Learning, 2010) p.171.

Figure 05. Expectation Model.

What is in the middle? Some people perceive it as 'B', while others will perceive it as '13'. This shows how expectation affects perception. Now, if 'A' and 'C' is blocked, the middle will be perceived as '13'. If '12' and '14' is blocked, the middle will be perceived as 'B'. This shows how context affects perception.

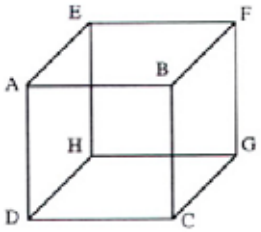

Figure 06. Neckar Tube.

The Necker Tube by L. A. Necker in 1832. The cube can be seen in more than one ways. Some see it as a cube with face ABCD, and some see it with face EFGH. This shows people expectation to perceive accordingly.

Attention and expectation can affects embodied perception. By projecting attention, embodied perception can be achieved, and experience

can be felt. By having different expectation, different embodied perception is achieved, so providing different experiences. For example, a continuous flat wall that seems distancing will lose the attention of the observer, creating lesser embodied experience.

Embodied Perception and Spatial Memory

Perception and memory are closely interlinked. Without memory, which is 'the ability to store and retrieve information over time', perception of objects will be meaningless.[21] Perception allowed experience to be achieved (considered as 'learned' in cognitive science) and repeated experiences will be encoded into memory. Memory is then also triggered during the perception process to achieve an experience. For example, our experience of riding a bicycle incorporates our previous cycling memories.

According to E. Bruce Goldstein, the most important type of memory that is related to navigation and how we experience our surrounding is spatial memory. Spatial memory is important in planning and executing navigational task for travelling (long-term) and control of actions in immediate surroundings (sensorimotor).[22] It addresses the role of embodied perception by providing clues from past memories about its immediate interactions with the environment. Additionally, embodied perception also plays an important role as primary input

21 Daniel L. Schacter, Daniel T. Gilbert and Daniel M. Wegner, *Psychology* (New Yory: Worth Publisher, 2009) p.168.

22 E. Bruce Goldstein, *Encyclopedia of Perception* (USA: SAGE Publication, Inc, 2010) p.915.

of spatial memory and important in informing body-to-object relations.[23]

Juhani Pallasmaa stated that the body is not simply a physical entity, that it contains both memory and dream, past and future. He continued by saying that 'we remember through our bodies as much as through our nervous system and brain.'[24] This describes spatial memory is retrieved to allow embodied perception of the environment, and the body engage with the environment, forming embodied perception which create memory.

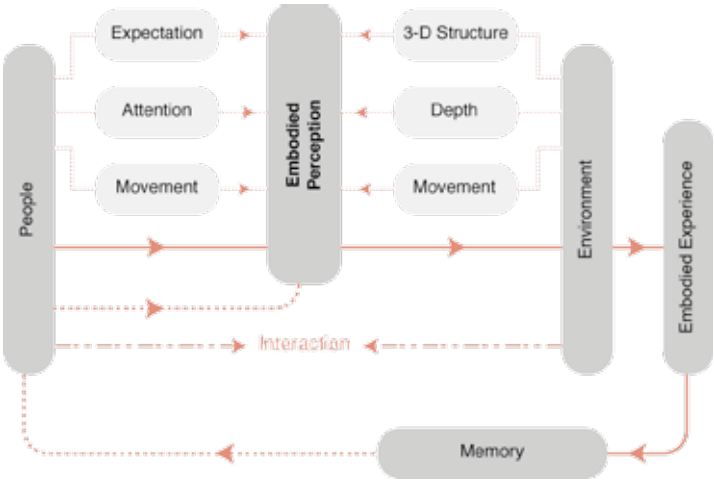

Figure 07. Embodied Perception Relationship Diagram.

23 E. Bruce Goldstein, *Encyclopedia of Perception* (USA: SAGE Publication, Inc, 2010) p.915.

24 Juhanni Pallasmaa, *The Eyes of The Skin* (England: John Wiley & Sons Ltd, 2005) p.45.

1.3

The Museum

Preservation, Research and Communication

What is a museum? What are museum for? These are some questions about museums that are often being asked. According to Andre Desvallees and Francois Mairesse, 'museum is either the institution or the establishment or the place generally designed to select, study and display the material and intangible evidence of man and his environment.'[25] By holding the identity of institution, museum became the solution(s) that satisfied society needs.[26] Museums are empowered with the trust to provide reliable education and accurate source of information. To do this, museums work with their three main functions: *preservation* (which includes the acquisition, conservation and management of collections), *research* and *communication*, which include education and

25 Andres Desvalles and Francois Mairesse, *Key Concept of Museology* (Paris: Armand Colin, 2010) p.56.
26 B. Malinowski, *A Scientific Theory of Culture* (Chapel Hill: University of North Carolina Press, 1994).

exhibition.[27]

Museums work with *objects* which form their *collections*.[28] According to Burcaw, '*objects* are acquired and preserved due to their potential value as examples, as reference material, or as *objects* of aesthetic or educational importance.' [29] These *objects* are then being studied and managed. The *objects* and the results of *research* undertaken on the *objects* will be presented to the public in exhibition. This is the process of *communication*.

'Museum Curating'

'Museum curating' is the practice of managing *communication*, being the art and techniques of exhibitions, or exhibition design. It is a part of *museography* (museum practice) in *museology* (museum studies), which *museography* is defined as the practical or applied aspect of *museology*, that is to say the techniques which have been developed to fulfil museal operations, in particular with regard to the planning and fitting out of the museum premises, conservation, restoration, security and exhibition, and the art of exhibitions.[30]

Since the thesis will be examining the art and techniques of exhibitions, the term 'museum curating' will be used. Throughout the thesis, terms such

27 Andres Desvalles and Francois Mairesse, *Key Concept of Museology* (Paris: Armand Colin, 2010) p.20.
28 Andres Desvalles and Francois Mairesse, *Key Concept of Museology* (Paris: Armand Colin, 2010) p.20.
29 E. G. Burcaw , *Introduction to Museum Work* (London: Altamarina Press, 1997).
30 Andres Desvalles and Francois Mairesse, *Key Concept of Museology* (Paris: Armand Colin, 2010) p.52-53.

as ‘exhibition space’ will be used to define the space for presentation of the *collections* and *research*, and ‘exhibition’ as the interaction between ‘museum curating’ and ‘exhibition space’. The word ‘displays’ will be used to represent exhibiting *collections*.

The above research has explained museum architecture and ‘museum curating’, both hold responsibilities in *communication* of the exhibition, and should integrate as a whole to perform as a museum. However, according to André Desvallées and François Mairesse, most architecture isn’t successful in integrating the entire museum mechanism because the architecture programme does not cover all museographical issues. Moreover, architects favor the appearance rather than the functionality of the architecture.[31]

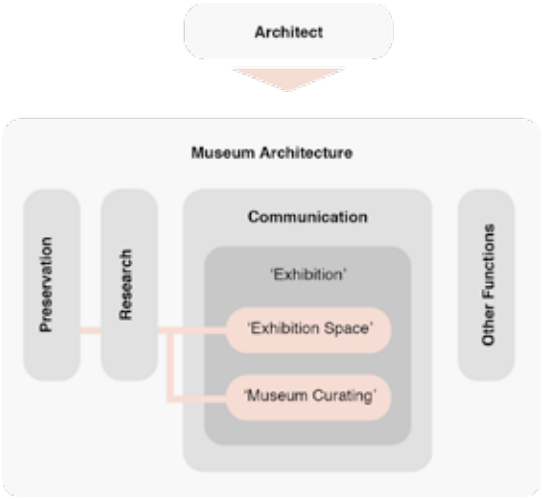

Figure 08. Museum Architecture incorporating ‘Museum Curationg’.

31 Andres Desvalles and Francois Mairesse, *Key Concept of Museology* (Paris: Armand Colin, 2010) p.24-25.

1.4

'Objective Embodied Mapping'

Embodied perception is the transition to creating spatial memory. Our body constitute movements to interact with the architecture spaces in which we obtain embodied experiences. These experiences, rather in the way we see the ceiling, sense the floor or touch the handrail can be converted into memories. Our attention and motivation towards the space, and including our memories, related or unrelated, will affect our embodied perception in the architecture space. And the architecture can be designed to provide such perceptions and experiences, even carving memories.

With this, an architecture that intensify the users' attention and expectation to interact with the architecture spaces will increase the potential of the users' embodied perception to create spatial memories. This means that architecture can be shaped through its layout and appearance to articulate the users attention and expectation to interact with the spaces, which directly affect the users' embodied perception of the spaces. And if the users are attentively

engaged with the spaces, the users' embodied experiences of the architecture will potentially be converted into memories.

According to Juhani Pallasma, *'An embodied memory has an essential role as the basis of remembering a space or a place.'* [32]

This method, as termed as *'Objective Embodied Mapping'*, when integrated in the Museum of Cartography proposal, can allow the users to directively engage the series of exhibition spaces and to map their memory of experiences.

32 Juhanni Pallasmaa, *The Eyes of The Skin* (England: John Wiley & Sons Ltd, 2005) p.72.

Spatial Structure and Order

Chapter 02

'The experiential narrative that a museum embodies is inseparable from its physical condition – its architecture.'

by Susanna Sirefman. [33]

33 Susanna Sirefman, *Formed and Forming: Contemporary Museum Architecture* (Cambridge, Massachusetts: The MIT Press, 1999) p.297.

When users explore the museum space, or more precisely the 'exhibition space', the architectural design of the 'exhibition space' will facilitate the displays. Users will be brought together with the *objects* on display to allow them to engage with the information that these *objects* convey.[34] 'Exhibition space' becomes a container that hold the users and the *objects* on display, together with the information constructed as a whole. This draws an understanding that the spatial layout (organisation) of the 'exhibition space' and the *objects* on display contribute to the fabrication of museum experience.

The previous chapter has shown the importance of attention and motivation in providing embodied experience. The users' attention will decrease when requested to focus on one of the few similar sources, or when requested to focus on a source among a crowd of different sources. This shows that hierarchy among sources can create attention. On the other hand, when users with a specific expectation encounter an unexpected source, users may feel disinterested in the source. This chapter will also observe how control of the users' movement will affect the potential of exploration (users exploring the space).

Selected case studies; Louisiana Museum of Modern Art (Denmark), Sainsbury Centre of Visual Arts (Norwich), Staatsgalerie Stuttgart (Germany), Tate Modern (London), Jewish Museum (Berlin) and Ashmolean Museum – renovated (Oxford), will be observed and compared to outline the analytical research on spatial *structure* and *order* to identify their effects on attention, expectation and exploration.

34 Ipek Kaynar, *Visibility, movement paths and preferences in open plan museums: Anobservational and descriptive study of the Ann Arbor Hands-on Museum* (United States: Purdue University Press, 2005).

Fig. 09. Ashmolean Museum Upper Ground

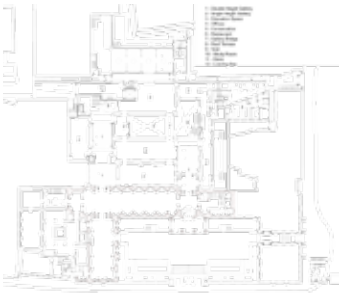

Fig. 10. Ashmolean Museum Ground

Fig. 13. Sainsbury Visual Arts Centre Ground

Fig. 16. Louisiana Museum Ground

Fig. 11. Berlin Jewish Museum Ground

Fig. 12. Berlin Jewish Museum Basement

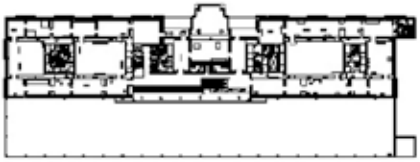

Fig. 14. Tate Modern 5th Floor

Fig. 15. Tate Modern 3rd Floor

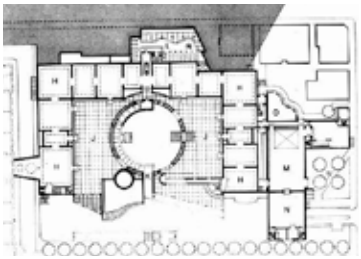

Fig. 17. Staatsgalerie Stuttgart Ground

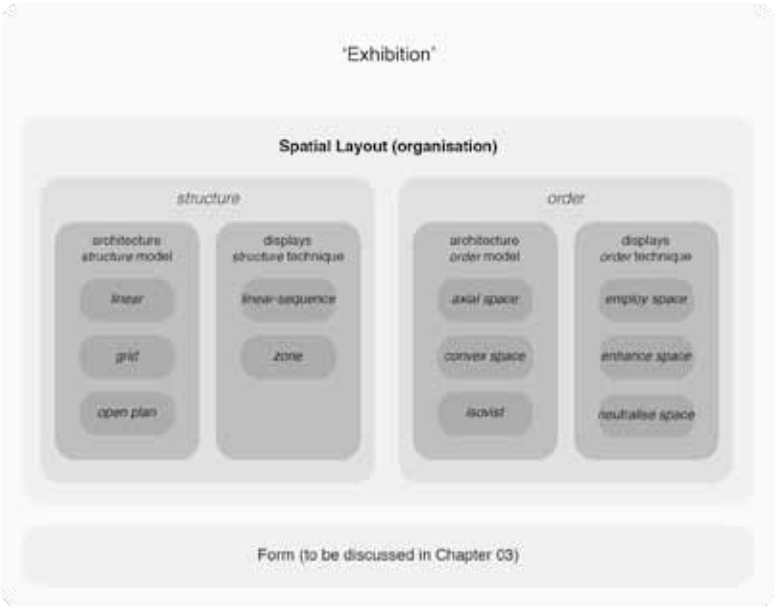

Figure 18. Spatial Layout Relationship.

2.1

Structuring Space - Architecture *Structure* Model

The structure of space is defined by Bill Hiller as 'artefacts we move about in, and learn to understand by living in'.[35] It is the organisation of space in which we comprehend as we utilise the space over time. Thus, structure cannot be seen all at once, nor are they imposed all at once by minds.[36] In the context of the 'exhibition', structure of space will articulate the users' path in the 'exhibition', which is how users will journey through the 'exhibition'. Accordingly, it can also be suggested that *structure* of space encompasses the users' continuous movement through space for embodied perception encounters.

The research on the case studies managed to reveal three architecture *structure* models. The first is the *linear structure* that organises spaces in a continuous behaviour and so imposes governance on the pattern of movement. This can be exemplified in the layout of Staatsgalerie Stuttgart and the Louisiana

35 Bill Hillier, *Space is the machine* (United Kingdom: Press Syndicate of University of Combridge, 2007) p.186.
36 Bill Hillier, *Space is the machine* (United Kingdom: Press Syndicate of University of Combridge, 2007) p.186.

Museum. However, both the case studies demonstrate relative different type of *linear structure*. The Staatsgalerie Stuttgart follows the traditional *U-shaped* solution that structured the 'exhibition space' in a more controlled and predictable layout.[37] It also has repetitive spaces that do not amplify users' attention at any specific spatial encounter.

On the other hand, the Louisiana Museum has an *irregular linear structure* that connects to form a ring. Its irregularity contains control over the users' movement, but promotes exploration more than the Staatsgalerie Stuttgart's model. This layout manipulates users' attention with its non-repetitive spaces, but the less of spatial hierarchy creates no distinctive attention.

Figure 19. Louisiana Museum Irregular Linear Structure

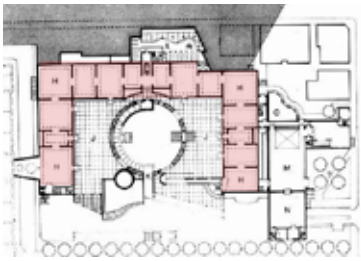

Figure 20. Staatsgalerie Stuttgart U-shaped Linear Structure

37 Josep Montaner and Jordi Oliveras, *The Museums of The Last Generation* (London: ACADEMY EDITION, 1986) p.107.

The second model is the *grid structure* that the spaces are subdivided from the overall 'exhibition space'. This *structure* such as illustrated in the layout of Tate Modern and Ashmolean Museum, prevent users from exploring the 'exhibition' in an orderly sequence, and 'maximises the randomness in the pattern of movement and exploration'.[38] However when comparing the layout of Ashmolean Museum with Tate Modern, it adopted a more directive *grid structure*, with connection points from one space to its adjacent spaces, giving more control over users' movement. Both the layouts are able to capture users' attention with its hierarchical spaces, but Ashmolean Musuem's randomness might wear off users' attention.

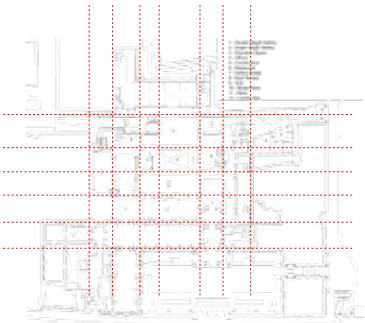

Figure 21. Ashmolean Museum Grid Structure

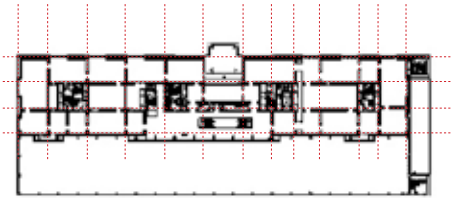

Figure 22. Tate Modern Grid Structure (directive)

There is also a *structure* model exist as a *sub-linear* and *sub-grid structure* that the control of movement and exploration is determined by its weighting on its *subs- structure*. This is shown in the layout of the Berlin Jewish Museum by having a continuous spatial structure and sub-gridded

38 Kali Tzortzi, 'Museum Building Design and Exhibition Layout: patterns of Interaction', Proceeding to the 6th International Space Syntax Symposium (2007) p.04.

rooms adjacent to linear 'exhibition space'. This layout is able to entitle users with consistent expectation that the rooms will provide them with experience encounters.

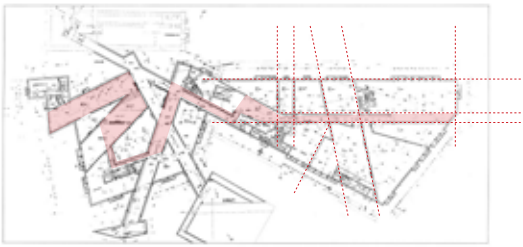

Figure 23. Berlin Jewish Museum sub-linear sub-grid structure

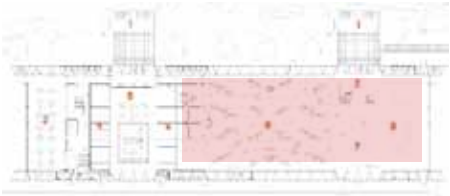

Figure 24. Sainsbury Visual Arts Centre open plan structure

The third model is the *open plan structure* as portrayed by the Sainsbury Centre. Unlike the previous discussed models, the *open plan structure* consists of a large, open space that eliminates the usage of permanent dividing walls. This model places the structuring of the space layout in the responsibilities of the museum curator, maximising the potential of 'museum curating'.

However, as observed from the current curated design of the 'exhibition' in Sainsbury Centre, the users are provided with much freedom to move, but with lesser to explore as the overall space is constantly perceived as a whole. This layout does not engage users with focused attention, but offer the users with a matching expectation of spatial encounters.

2.2

Structuring Space - Displays *Structure* Model

Having looked at the *structure* model of 'exhibition space', the thesis will now examine the displays *structure* technique. Instead of carrying the status of a model such of the architecture *structure* model, the displays *structure* is considered as technique. This definition corresponds with the definition of 'museum curating' in Chapter One. Based on the observation from case studies, two displays structure techniques are concluded.

The first and being a traditional technique is the *linear-sequence structure*. Linear sequence 'exhibition' is most appropriate when a story is to be narrated, particularly in chronological order.[39] This *structure* technique will control the movement and exploration of the users. However, the control over exploration is dependent on the architecture *structure* that will contain

39 Barry Lord and Gail Dexter Lord, *The Manual of Museum Exhibition* (Oxford: AltaMira Press, 2001) p.25.

the displays *structure*. For example, Louisiana Museum still contribute to users' exploration with its *linear-sequence structure* technique of displays, in an *irregular linear* structured 'exhibition space'. In contrast, the Staatsgalerie Stuttgart with its *U-shaped linear structure*, provides lesser potential for users' exploration. Although both museums adopted different *linear structure* model, they still manage to hint the users about the chronological narrative of the 'exhibition', revealing users with what to expect.

Figure 25. Louisiana Museum linear-sequence structure technique with irregular linear structure model - promote exploration.

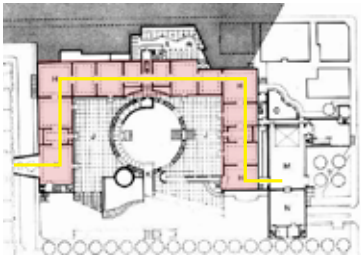

Figure 26. Staatsgalerie Stuttgart linear-sequence structure technique with U-shaped linear structure model - control movement.

The next is the *zone structure*. This technique categorises the objects on display into categories, which dissect the overall narrative of the 'exhibition', creating individual narratives that can or cannot be explored in a chronological order. For instance, the *zone structure* adopted by Ashmolean Museum allows users to differentiate between the partial-narratives of the 'exhibition'. Then, moving from one zone to the other, dictated by the *grid structure* model, gives

less control of users' movement, allowing chances to explore. When exploring the 'exhibition', users might have unexpected encounters that the users might or might not favour.

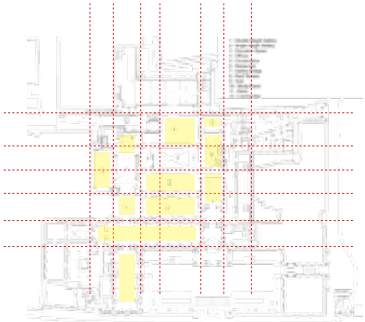

Figure 27. Asmolean Museum zone sructure technique with grid structure model - promote exploration, unexpected encounters, non-focused attention.

On the other hand, the Berlin Jewish Museum incorporates a combined *zone structure* and *linear-sequence* structure technique. It has an overall chronological narrative separated partially by different levels in the museum to realise the theme 'Two Millennia of German Jewish History'.[40] Then, in the condition of Louisiana Museum, the partial-narrative of are zoned more subtly from one another as it adopted the linear structure model that allow continuous movement through space.

40 *'A Jounrney Through Two Millennia of German Jewish History', Jewish Museum Berlin, < http://www.jmberlin.de/main/EN/01-Exhibitions/01-Permanent-Exhibition/01-overview.php?slide=2> (accessed 14 April 2014).*

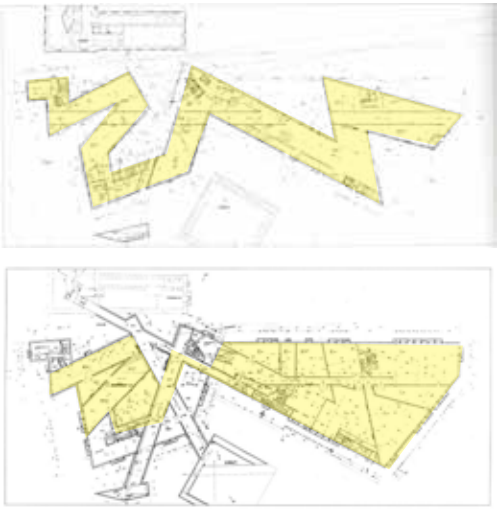

Figure 28. Berlin Jewish Museum with linear-sequence structure separated to different zones through different leveling.

Last but not least, Tate Modern is applied with various *linear-sequence structures* within *zone structures*, providing a sense of chronology within the zones, but freedom to choose the order to explore the zones, provide a non-chronology overall narrative of the 'exhibition'. Users engaging the 'exhibition' will also be able to focus their attention on different narrated zones.

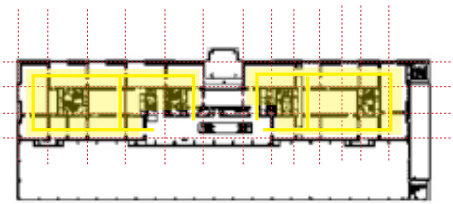

Figure 29. Tate Modern linear-sequence structures within zone structure.

2.3

Ordering Space - Architecture *Order* Model

The *order* of space is the 'overall rational concepts, which can be grasped all at once, and which often have a geometrical or simple relational nature'.[41] It is the organisation of space in which we comprehend in a specific point of time and space. Thus, *order* can be perceived immediately all at once, and interpreted all at once by minds.[42] In the context of the 'exhibition', order of space will articulate the orientation of visitors in the 'exhibition', which is how visitors will position himself/herself reacting to the 'exhibition'. Accordingly, it can also be suggested that *order* of space encompasses the visitors' perception that generate movement in space.

To investigate the *order* of space, the thesis will employ the theories of space syntax. Space syntax, as introduced by Bill Hillier, is the morphology

41 Bill Hillier, *Space is the machine* (United Kingdom: Press Syndicate of University of Combridge, 2007) p.186.
42 Bill Hillier, *Space is the machine* (United Kingdom: Press Syndicate of University of Combridge, 2007) p.187.

of space, including the methods, techniques and theories used to analyse and communicate the relationship of spaces.[43] Space syntax realises three basic conceptions of space; *axial space*, *convex space* and *isovist*.[44] These three concepts will be discussed below to draw distinction to the *order* of space.

According to Bill Hillier, '*axial space* or axis line is a straight sight-line and possible path'.[45] It is an overall concept of space that can be identified at once, which ascertain it as an order of architecture space. *Axial space* can be differentiated according to the length of its straight sight-line. 'A long model axial space will traverse the building in its length and width, constantly giving clues about the global structure of the gallery, and responding to the key concern for lucid organisation of spatial elements, while axially synchronised views, revealing vistas, and relatively uniform isovists, enhanced information stability,' described Kali Tzortzi.[46]

The possible path to be taken is straightforward and easily recognised, and users will familiarise the pattern of the path when moving through the *axial space*. The *axial space* will more intensively attracts users' attention when compared with other spaces in the museum. Tate Modern and Staatsgalerie Stuttgart are examples that demonstrate the application of long *axial space order*. They encompass more control over the movement of users but reduce users' exploration potential.

43 Bill Hillierand Julienne Hanson, *The Social Logic of Space* (Cambridge: Cambridge University Press, 1984)
44 Björn Klarqvist, *A Space Syntax Glossary* , Nordisk Arkitekturforskning (1993) p.02.
45 Bill Hillierand Julienne Hanson, *The Social Logic of Space* (Cambridge: Cambridge University Press, 1984)
46 Kali Tzortzi, 'Museum Building Design and Exhibition Layout: patterns of Interaction', Proceeding to the 6th International Space Syntax Symposium (2007) p.10.

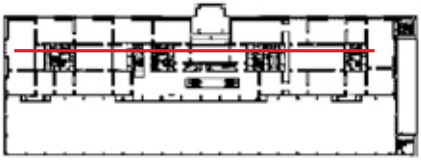

Figure 30. Tate Modern long axial space.

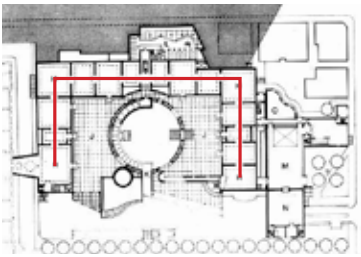

Figure 31. Staatsgalerie Stuttgart long axial space.

Then, in the short *axial space order*, the overall spatial structure became invisible. Each space within the overall spatial structure is different from the others, providing an unclear organisation of spatial elements, and inconsistent *isovists*, diminishing information stability. As a result, the users will be subjected to explore the 'exhibition'. Short *axial space order* usually only suggest movement from one space to any adjacent spaces, such as exemplified in the Louisiana Museum, Berlin Jewish Museum and Ashmolean Museum. In this order, users walking from space to space might have contradicting expectations, but provides possibilities to gain improved attention.

The second architecture order model is *convex space* that is an occupiable space 'where no line between any two of its points crosses the

perimeter.[47] It's opposite is the concave space that prevent the whole perimeter of the space to be seen when one is at a static point. The study of this *order* model will lead to understanding of how spatial design can articulate spatial perception to encourage movement. Firstly, in a *convex space*, users have a complete field of vision of the size and shape of the space, including the orientation of the objects in space. This order model can be illustrated in the layout of Tate Modern, Ashmolean Museum and Staatsgalerie Stuttgart.

Figure 32. Tate Museum convex space exhibition space.

In the condition of a concave space or non-convex space, the users do not contain the complete field of vision of the entire space from a static point. Users will proceed to explore the 'blind-spot(s)' hidden away from their field of vision, or these 'blind-spot(s)' might be unintentionally disregarded and unexplored, such as demonstrated in the layout of Louisiana Museum, Sainsbury Centre and Berlin Jewish Museum. Convex space provides users with a uniform

47 Björn Klarqvist, *A Space Syntax Glossary* , Nordisk Arkitekturforskning (1993) p.02.

attention, but concave space with its 'blind-spot(s)' divided users attention.

The third architecture *order* model is isovist, defined as the total area visible from a particular point.[48] This order is a consequence of the *axial space* and *convex space*, which the users' position at different space will produce different *isovist*. For instance, Staatsgalerie Stuttgart with long *axial space* and *convex space* has consistent *isovists*. Louisiana Museum and Berlin Jewish Museum that are with short *axial space* and non-convex space have smaller and inconsistent isovists.

Figure 33. Staatsgalerie Stuttgart consistent isovist.

Figure 34. Louisiana Museum smaller inconsistent isovist.

The articulation of isovist can control the amount of spatial information delivered to the users at a time. This proves, by manipulating the axial space and convex space in relation to the isovist projection, the control of movement and exploration in space can be determined. Isovist reveals the changing of depth in space that inaugurates users embodied perception of the 'exhibition space'.

48 A. Turner, M. Doxa, D. O'Sullivan and A. Penn, *'From isovists to visibility graphs: a methodology for the analysis of architectural space'*, Environment and Planning B 28 (2001) p.1.

2.4

Ordering Space - Displays *Order* Technique

Displays *order* techniques are spatial concepts regarding the placement of displays and their engagement with the 'exhibition space'. Displays *order* techniques are spatial strategies that can be comprehend at once, relative to the nature of seeing. They trigger the progressive encounter of the users with the displays in 'exhibition space'. Displays *order* can be divided into three different ways of engaging with the 'exhibition space'; *employ space*, *enhance space* and *neutralise space*. These displays order techniques have been studied by Tzortzi Kali and will be further enhanced through this thesis to examine their effects on embodied perception.[49]

The *employ space* order technique exploits the layout of the 'exhibition space' to amplify the displays qualities. In other words, 'exhibition space' is used as a supporting character to give added dimension to the displays as the main

49 Kali Tzortzi, 'Museum Building Design and Exhibition Layout: patterns of Interaction', Proceeding to the 6th International Space Syntax Symposium (2007) p.07-09.

Figure 35. Sculptures in the Ashmolean Museum are arranged to enhance the vistas between zones of the exhibition.

character. The Ashmolean Museum has sculptures in some space arranged in relation to other displays in other spaces, suggesting the interconnection of their narratives. The vistas intensify the impact of these displays, accounting them with greater importance over the other displays. This *order* technique is also illustrated in the Staatsgalerie Stuttgart which the *isovist* of its long *axial space structure* is utilised to frame superiority of the displays. This *order* technique utilises the potential of the architecture spatial layout to focus users' attention on the displays.

Figure 36. Sculpture in Louisiana Museum located to enhance the spatial experience.

Figure 37. Sculptures in Sainsbury Centre are arranged to reorganise space.

The other polar situation is the *enhance space* order technique which displays are arranged to improve the qualities of the 'exhibition space'. This is illustrated in the Louisiana Museum which displays are placed in long narrow spaces and sculptures are orientated in relation to users' approach to promote exploration of the architecture space, by investing more time to move and perceive the displays in the 'exhibition space'.

Displays are integrated with the architecture layout to draw the potential of the architecture layout for spatial enhancement, rather than relying on the architecture layout for its own priority. The Sainsbury Centre *open plan* structure has also been improved with sculptures in display cases distantly arranged and following the folding of the secondary structure, creating new spatial experience. This *order* technique combines the arrangement of the displays with the architecture spatial layout to enhance the overall attention on the space.

The third *order* technique, *neutralise space order* incorporates a neutral bond which the displays arrangement is independent from the 'exhibition space' layout, and the 'exhibition space' layout performs as an invisible backdrop to the exhibition. Both appear to serve the functionality of themselves; the 'exhibition space' that discloses its spatial layout, and the displays that unfolds its own narrative, such as embodied in the Tate Modern 'exhibition'. Both the architecture and displays spatial layout do not affects the users' attention on the space.

Figure 38. The displays and exhibition space create a neutralised interaction.

x	Staatsgalerie Stuttgart	Tate Modern	Sainsbury Centre	Louisiana Museum	Jewish Museum	Ashmolean Museum	Best Combination
architecture *structure* model	u-shape linear	grid	open-plan	irregular linear	hybrid - linear and grid	grid	hybrid - linear and grid
displays *structure* technique	linear-sequence	linear-sequence within zone	linear-sequence	linear-sequence	sub-linear sub-zone	zone	sub-linear sub-zone
axial space	long	long	long	short	short	short	short
convex - concave space	convex space	convex space	concave space	concave space	convex and concave space	convex space	convex space / convex and concave space
isovist	axial isovist	axial isovist	axial isovist	short isovist	convex isovist	isovist connect space	isovist connect space
displays *order* technique (overall)	employ space	neutralise space	enhance space		employ space	enhance space	employ space / enhance space
movement	controlled	controlled	less uncontrolled	less controlled	less controlled	uncontrolled	less controlled
exploration	least exploration	exploration	less exploration	more exploration	most exploration	exploration (disorientation)	more exploration
expectation	more expected	expected	most expected	expected	more expected	least expected	expected / more expected

less attention — more attention

Figure 39. Table showing the analysis of spatial structure and order to achieve the best options that elevate users' attention level, which will allow users to interact with the architecture for embodied perception.

Goal-Oriented Attention Approach

According to the table, a hybrid between linear and grid architecture structure model can most efficiently focus users attention. This is supported by a sub-linear sub-zone displays structure technique, which users are guided through the chronological narrative of the exhibition, with the partial-narrative zoned clearly to give users expectation or motivation.

Convex spaces are also observed to give more focus of attention from blind-spots. Both employ space and enhance space are more suitable than neutralise space to create a more attentive spatial experience. Then, the use of isovist to connect spaces, such as used in Ashmolean Museum, is able to give clues (expectation) as well as to attract users interest (attention) to journey through the 'exhibition'. Last but not least, an 'exhibition' experience that is between expected and more-expected, can allow people to pay more attention and engage with the 'exhibition'.

From the above analysis, a goal-oriented attention approach spatial layout is proposed. This is by combining both elements that affects embodied perception; expectation and attention, to create a spatial layout that users are given expectation to attend to, which the architecture will realise for the users. The experience of navigating in the architecture space will incorporate the users engagement to explore and progressively encounters clues that leads to 'exhibition' spaces, such as building up the attention to experience the upcoming encounters.

Context & Content Relationship

Chapter 03

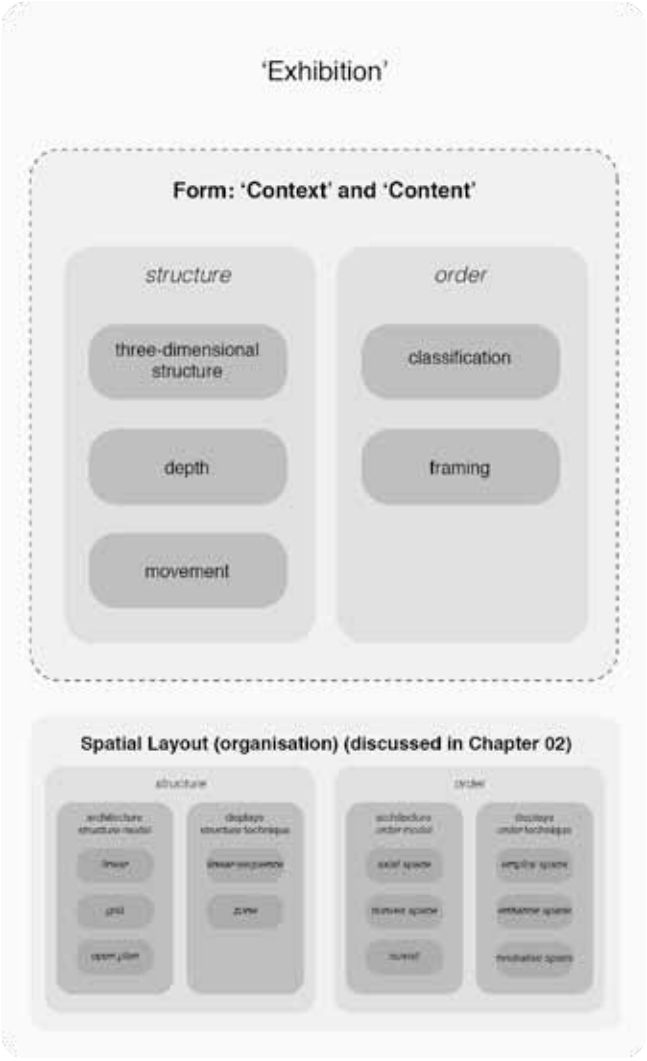

Figure 40. 'Context' and 'Content' Relationship.

Cognitive scientists have stated that the process of encoding a memory begins with attention, where by paying more attention, perceptual experience became more intense and will allow memory to be encoded.[50] Thus, by designing the architecture to focus the users' attention to interact with the architecture for embodied perception, spatial memories can be created.

The comparative analysis on the spatial layout (organisation) in the previous chapter has concluded by proposing a spatial layout that creates goal-oriented attention. This shows that the aim of the spatial layout is to direct users movement to nodes of attention. Thus, this chapter will observe the form of 'exhibition space' and displays in separated spaces of the entire 'exhibition' to examine how users' attention can be regulated for embodied perception and creating memories in nodes of attention formed from the spatial layout.

According to Francis D. K. Ching, 'form may refer to an external appearance that can be recognised, as that of a chair or the human body that sits on it. …form suggest reference to both internal structure and external outline and the principle that gives unity to the whole.'[51] Thus, it is evident that form is the appearance and the configuration of its appearance. In this thesis, the form of 'exhibition space' will be derived as the 'context', being the architecture appearance that will accommodate the displays. And the displays' form will be derived as the 'content', being the objects appearance that will occupy the 'exhibition space'. Both the 'context' and 'content' will be observed together. Then, similar to spatial layout, form also contains *structure* and *order*.

50 Luke Mastin, *'Memory Encoding', The Human Memory,* <http://www.human-memory.net/processes_encoding.html> (accessed 22 April 2014)

51 Francis D. K. Ching, *Architecture: Form, Space and Order* (Hoboken, New Jersey: John Wiley & Sons, Inc, 2007)) p.34.

3.1

'Context' and 'Content' - Structuring Form

The form's structure is recognised as the users utilise the space, and cannot be seen nor understand all at once. Chapter one has briefly describe the relationship of three-dimensional structure, depth and movement with embodied perception. These features affect the plasticity, tactility, size and distance of the environment. Then, as described by Francis D. K. Ching in his book, *'Architecture: Form, Space and Order'* that these features are properties of form, it can be proposed that *three-dimensional structure*, *depth* and *movement* are the *structure* of form.[52]

Three-dimensional structure is the shape of the form, together with its characteristic outline and surface configuration.[53] It is the point of interaction between our body and the 'exhibition', which embodied perception is achieved.

52 Francis D. K. Ching, *Architecture: Form, Space and Order* (Hoboken, New Jersey: John Wiley & Sons, Inc, 2007)) p.34-35.
53 Francis D. K. Ching, *Architecture: Form, Space and Order* (Hoboken, New Jersey: John Wiley & Sons, Inc, 2007)) p.34-35.

Figure 41. The brick wall in Louisiana Museum breaks down the entire volume of room, bringing it closer to human scale.

Thus, the articulation of the *three-dimensional structure* will regulate the users embodied perception of the 'context' and 'content'. For instance, in this exhibition space of Louisiana Museum, the brick walls and floor break down the entire volume of the room, bringing the scale closer to human. The unevenness of the brick texture if felt when the users is walking in the space. Most sculptures are not in cases, inviting the users to interact. All of these contribute to embodied perception that will lead to creating memories.

Figure 42. Depth application in Louisiana Museum that leads users' attention.

Figure 43. Depth application in Ashmolean Museum that distract users attention in the current exhibition space.

Depth is a dimension of the volume.[54] It is the deepness or shallowness between surfaces of shapes within space. *Depth* stimulates embodied perception by allowing the *three-dimensional structure*, size and distance to be perceived. The *depth* of the linear space in this part of Louisiana Museum focuses the users' attention and encourages the users to engage the space with their body. The depths between the linear columns and the glass provide changing of depth that our body perceives. However, depth may also disorientate the users' attention, such as in the Ashmolean Museum.

In this part of the thesis, we will only discuss the form's *movement*, not including the users' movement. *Movement* is an act of motion of the 'context' and/or 'content'. It is able to change the *three-dimensional structure* and *depth* of the form. Movement might also instantly capture the users attention and change the users embodied perception of the space. For example, the Atmosphere Exhibition in Science Museum London has a floor projected with changing imagery to explain climate change.[55] The floor has turned the space into a centre of attention, allowing users to interact by visualising the floor and navigating the screen. This embodied experience might become memories of many users of the museum.

Three of the *structure* models may simultaneously be adopted by the 'context' and 'content' of the 'exhibition'. They may also appear in material or immaterial forms.

54 Francis D. K. Ching, *Architecture: Form, Space and Order* (Hoboken, New Jersey: John Wiley & Sons, Inc, 2007)) p.28.

55 Leonora Oppenheim, *'Atmosphere: The Science Museum Opens Amazing Interactive Gallery to Explain Climate Change',* treehugger, <http://www.treehugger.com/sustainable-product-design/atmosphere-the-science-museum-opens-amazing-interactive-gallery-to-explain-climate-change-photos.html> (accessed 22 April 2014).

Figure 44. The 'Atmosphere Exhibition in Science Museum London to explain climate change.

3.2

'Context' and 'Content' - Ordering Form

The form's *order* is the overall concept of the organisation of form that can be understand all at once. There are two form's *order*; *classification* and *framing*. Classification and framing are theories in sociology of education introduced by sociologist Basil Bernstein.

According to B. Bernstein,

Classification is *'the degree of boundary maintenance between contents'* and is related to the boundary or separation between categories of knowledge.[56] Strong *classification* means knowledge are rigidly separated into subjects, and weak *classification* means the boundary between education and subjects are blurred.

56 B. Bernstein, *Class, Codes and Control: Vol. 2* (London: Routledge & Kegan Paul, 1973) p.88.

Framing refers to the control on the communication methods of knowledge.[57] Strong *framing* refers to limited options to communicate knowledge, and weak *framing* indicates more freedom.

His ideas on *classification* and *framing* have been extensively explored, even in the field of museology, due to the importance of knowledge communication in museum. Pradinuk has proposed a spatial interpretation of both ideas, and Stavroulaki and Peponis used both ideas to look at teaching ideas in museum.[58] The thesis will attempt to incorporate B. Bernstein ideas into ordering the 'context' and 'content' for embodied perception. Understanding his ideas, the thesis proposes:

Classification is the degree of boundary maintenance between 'context' and 'content'. Strong classification means 'content' coordinate with the 'context', and weak classification means 'content' does not coordinate with the 'context'.

Framing refers to the control of attention points on 'content'. Strong framing refers to focused attention point on 'content', and weak framing indicates more points of attention.

The Louisiana Museum exhibition space in Figure 45 has a strong *classification*, which the 'content' coordinate with the 'context', and strong framing with one focused attention on the combined 'context' and 'content'. This allows users to be more engaged with the space for embodied perception.

57 B. Bernstein, *Class, Codes and Control: Vol. 2* (London: Routledge & Kegan Paul, 1973) p.88.
58 Kali Tzortzi, *Space: Interconnectiong Museology and Architecture* (2011) p.25.

Figure 45. Classification and Framing for focused attention.

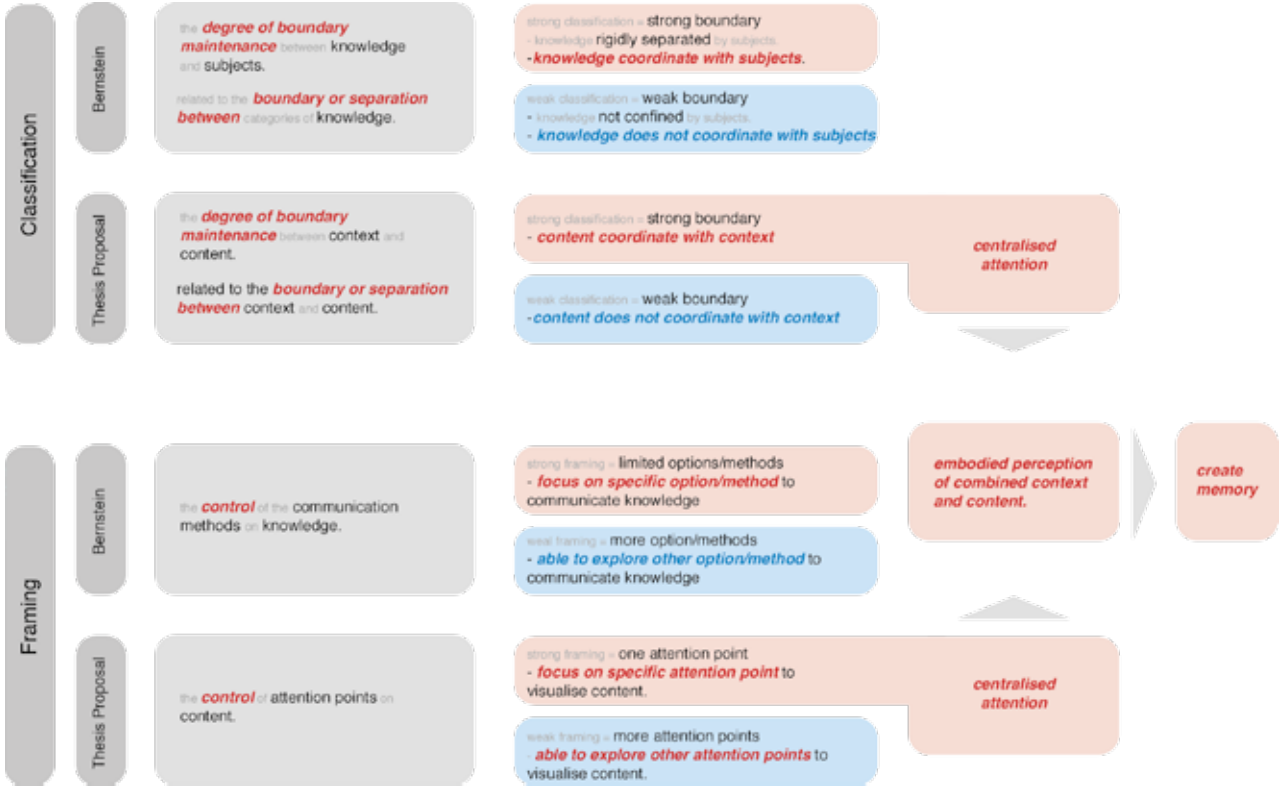

Figure 46 shows another exhibition space in Louisiana Museum that has a weak *classification*, which the 'content' and 'context' do not follows the same rhythm, and weak *framing*, which the differences between the 'contents' does not allow focus of attention on the space as a whole.

Figure 46. Strong classification, with content coordinate to the context and strong framing, with one focused attention on the combined context and content.

Figure 47. Weak classification, with context and content do not follow the same spatial rhythm and weak framing, which the variety of content does not centralise the attention of this exhibition space.

The Proposal: Museum of Cartography

Chapter 04

4.1

Proposal and Context

The Museum of Cartography will be built on an empty site on Axeltorv Square, in the central Copenhagen, Denmark, slightly further west of the Town Hall Square, which is the west end of the Strøget street.

The first Copenhagen Central Station was built in 1847, north-west of the Axeltorv Square, and was replaced by a larger second Central Station on the opposite side in 1864. Axeltorv Square was becoming a main traffic centre, and among the busiest spots and walking streets area in Copenhagen.[59] In 1911, the second Central Station proved too small and was replaced by the third Central Station on the same location. Its current expansion will be completed in 2018 to accommodate more users of the station. The Central Station is a major

59 *'Axeltorv - Copenhagen'*, Copenhagen-Portal Dk, < http://www.copenhagenet.dk/cph-map/CPH-Axeltorv.asp> (accessed 10 April 2014).

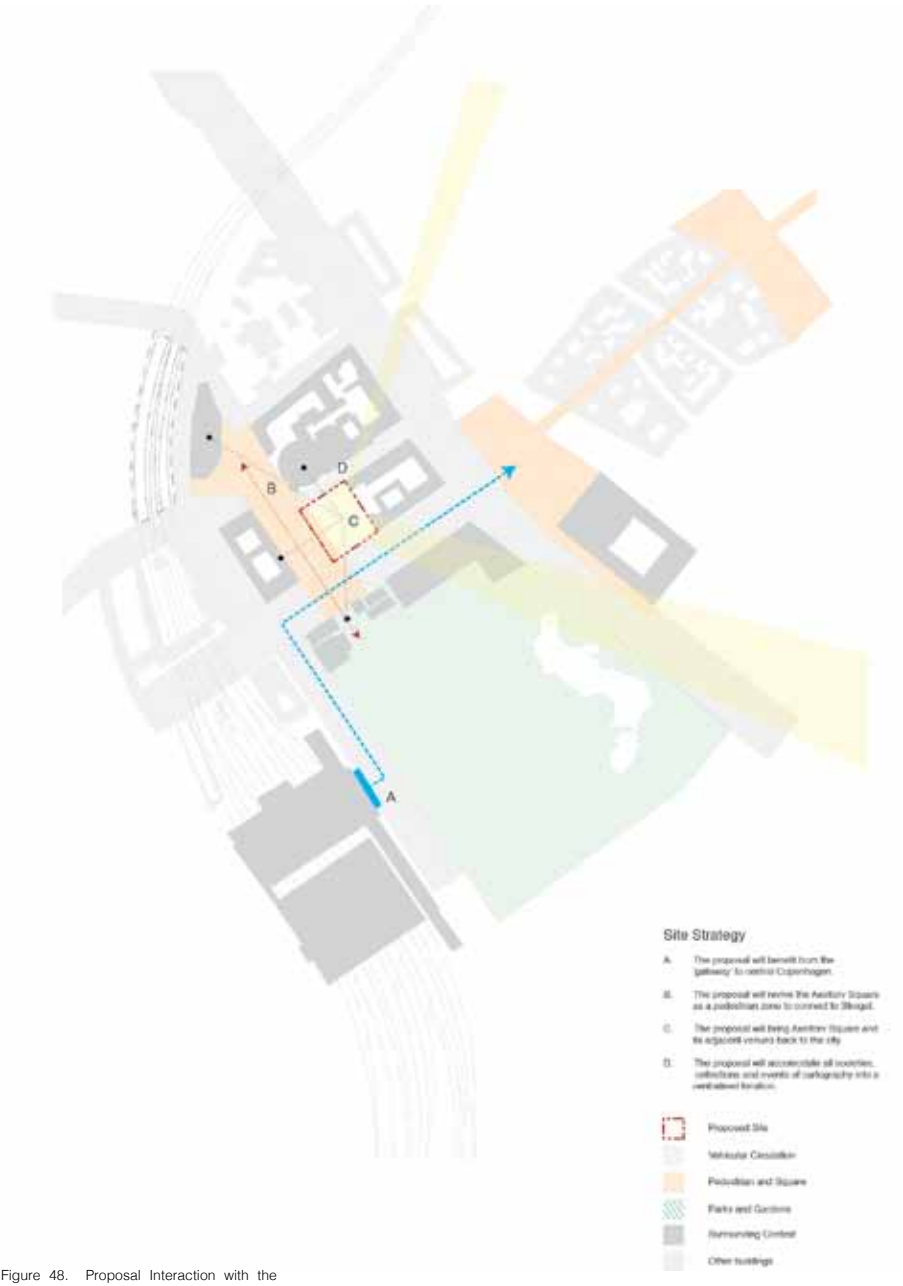

Figure 48. Proposal Interaction with the context of Copenhagen.

transportation 'gateway' in and out and around Copenhagen.[60] Some even considered Copenhagen as the 'gateway' to Scandinavia.[61]

The Museum of Cartography as located on Axeltorv Square will benefit from this 'gateway' to establish as an information centre to provide people with travel guidance. Simultaneously, the museum will introduce people to cartography and improve the way people engage and experience the city. The museum becomes a connection point between people and the urban.

Besides functioning as a museum for exhibition, it will also accommodate the current Cartography Society, Dept. of Maps, Prints and Photography, and the large collections of cartographic references, source materials, older maps and atlases that are currently in The Royal Library.[62] The proposal will also incorporate an auditorium hall for cartography conferences and events, as well as an observatory to allow users to relate cartography to the perceived reality.

Meanwhile, it will attempt to integrate the Axeltorv Square and other historical buildings adjacent to it; the Axelborg complex, the Cirkus Building, the Palads Theatre and the Tivoli Gardens, as a whole, to reconnect back to the central Copenhagen.

Then, at a wider context, the proposal aims to promote the world's understanding and appreciation of cartography.

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60 *'Copenhagen Central Station'*, Visit Denmark, < http://www.visitdenmark.co.uk/en-gb/denmark/copenhagen-central-station-gdk497959> (accessed 10 April 2014).

61 *'Copenhagen - The Gateway to Scandinavia'*, Daily Scandinavia, < http://dailyscandinavian.com/copenhagen-gateway-scandinavia/> (accessed 10 April 2014).

62 *'History of Cartography'*, The Royal Library, <http://www.kb.dk/en/nb/fag/bibfag/kartografihistorie.html> (accessed 04 April 2014).

University of Copenhagen

The Department of Geography and Geology in the University of Copenhagen has courses that constantly researching on the GIS and cartography. The Dark Cosmology Centre in the university then focus on the "Dark Universe". The centre aim to gain the astrophysical insight into the nature of mysterious dark energy and dark matter.

Post and Tele Museum

The museum consists of collections of the history, systems and facilities of communication. The exhibition marks the importance of postal service and communication to contribute to the exploration of new places, as well as the recording of their explorations.

Tycho Brahe Planetarium

The facility is Denmark's most advanced centre in popularising astronomy and space research and promoting knowledge on natural science. It als has its permanent exhibition of The Active Universe as well as a large screen to showcase various kind of experiences.

Royal Library of Copenhagen

The library contains the Department of Maps and Geography. It is also the headquarter of the Danish Cartographic Society. The Royal Library has a collection of reference works, source materials and older maps and atlasses regarding the History of Cartography and has carry out numerous projects related to cartography. Numerous events such as the International Cartography Exhibition in 2003 and the International Cartography Conference: Maps, Myths and Narrative: Cartography of The Far North has also been held in the library.

Figure 49. Four locations related to the development of Cartography and the city of Copenhagen are selected to create a navigation map to shape the architecture spaces of the museum.

4.2

Contextualising Design

The design initiates by performing a spatial mapping of pedestrian routes passing through city landmarks and places to four chosen locations (Fig.49) that are related to the development of cartography and the city of Copenhagen. The navigation experience to these four places; the University of Copenhagen, Post and Tele Museum, Tycho Brahe Planetarium and The Royal Library will be mapped, concerning the interactions with the urban environment that one incorporates while navigating the city (Fig. 50). These navigation experiences will then be developed into architecture spaces in the museum, which users will engage in an active interaction with the architecture spaces by using their body to gain embodied experiences.

At the same time, users will be given a museum map (Fig. 52) that utilise the names of the landmarks and places on the navigation map to represent the museum spaces. Thus, when exploring the museum with the map, the users'

Figure 50. Navigation map revealing the perceptual encounters and spatial interactions between body and the city during the act of navigation of a cartographer.

embodied perception will stimulate past memories of those places, especially for the locals. However, people unfamiliar with the city, will create new memories through embodied perception of the museum, and a link between oneself with the environment will be created when exploring the city thereafter.

In short, the architecture actuates the users to actively navigate and interact with the museum to map embodied perceptions constructed from previous memories, or to create new memories. It simulates the users as a *'cartographer'* of the museum experience, and finally as a *'map'* that represent the spatial experiences of the museum architecture (Fig. 51). As a result, the architecture performs as an active driver that trigger users to understand the important of cartography for giving spatial understanding of the environment, as well as to indulge people to further explore their environment.

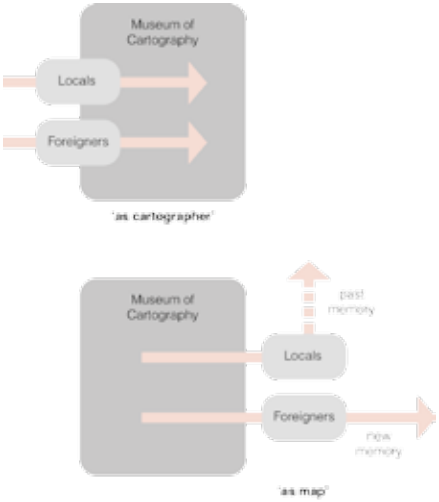
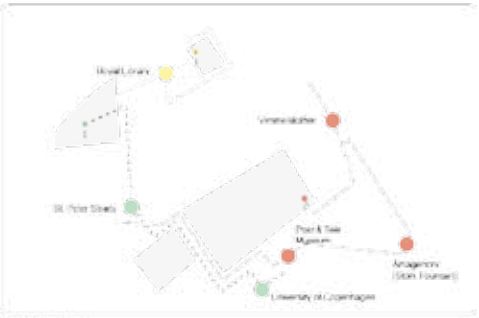
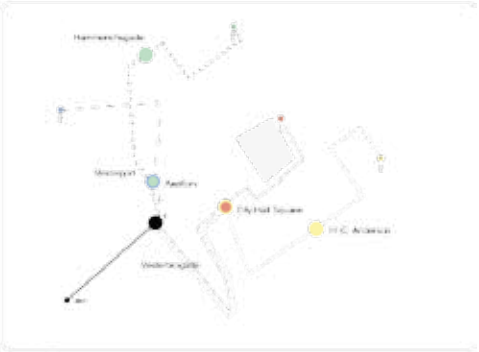


Figure 51. Users embodied perception of museum spaces, 'as a cartographer', 'as a map'.

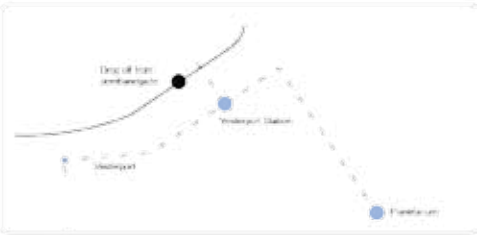


Second Floor

First Floor



Ground Floor



Basement Floor

Museum of Cartography Visitor Route Plan

Figure 52. Museum maps named after Copenhagen landmarks and places to initiate a sense of connectivity between museum of cartography, people and urban environment.

4.3

Design Realisation - Goal-oriented Attention Layout

The previous comparative observations managed to demonstrate that different museum spatial layout can creates different effects on exploration, expectation and attention, which are the concerns of embodied perception. Firstly, the museum architecture will employ the *'goal-oriented attention'* spatial layout conceptualised in Chapter Two. It will combine the linear and grid structure architecture model, having 'exhibition spaces' that are distant and dissimilar between one another. This is true with the ideas of attention outlined in chapter one, in which crowding of sources and concentrating attention on one of other similar sources will reduce the observers' attention.

Thus, by designing 'exhibition spaces' further from one another, and with different characteristics, users can have more concentrated attention, so to gain more intense embodied experiences for encoding memories. The 'exhibition spaces' will also make use of convex space design, by providing unobstructed view with no 'blind-spot' in 'exhibition spaces' to concentrate users' attention.

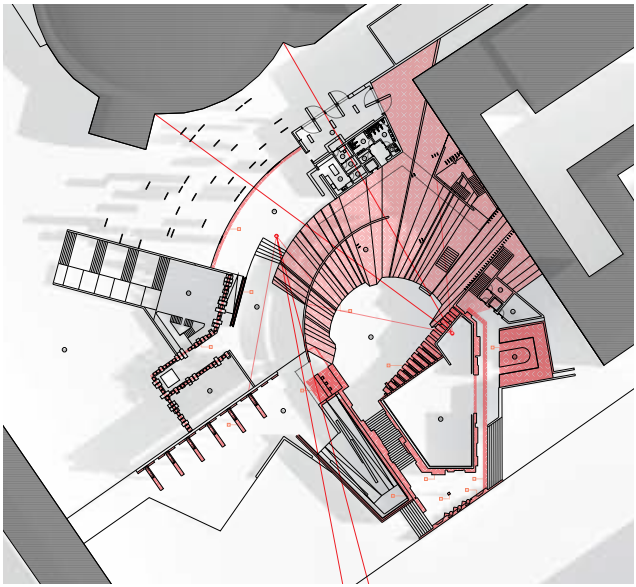


Figure 53. Ground Floor Plan

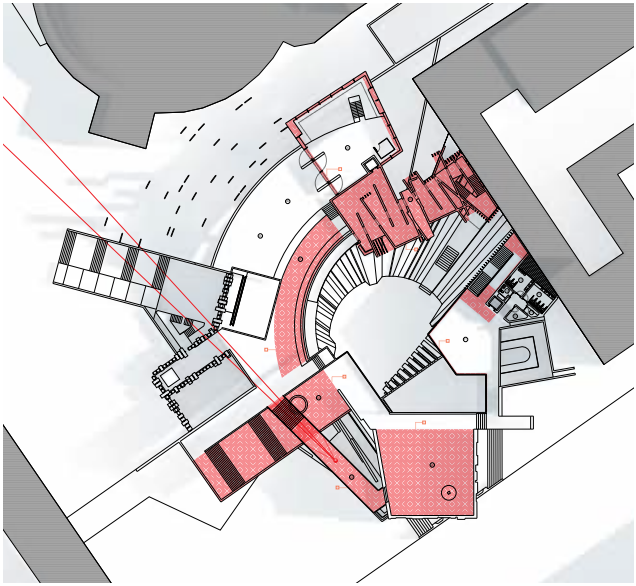


Figure 54. First Floor Plan

Next, the museum architecture will utilise the linear structure displays technique divided into four zones to allow the overall narrative of Cartography to be experienced in a chronological order, however with distinctive zoning between partial narratives to allow focus of users' attention. Zoning will also create users' expectation that he/she will yet to encounter upcoming experiences.

These distancing 'exhibition spaces' will then be connected with circulation spaces to create hierarchy of spaces, which also allow users' attention to build up while approaching the 'exhibition spaces'. The circulation spaces leading to a particular 'exhibition space' are also designed to have isovist into other 'exhibition spaces' to create expectation of upcoming encounters.

The overall spatial layout means to create distancing 'exhibition spaces', such as attention points, connected with circulation spaces to allow users' attention and expectation to be built as approaching, and most important of all to engage users into active interaction with the architecture for embodied perception, and especially amplified in 'exhibition spaces'.

4.4

Design Realisation - Embodied Perception Creates Memory

The previous discussion has explored the spatial layout (organisation) to achieved a 'goal-oriented attention' layout. This section will outline a proposal for the museum architecture in order to exploit the 'context' and 'content' relationship, in relation to the structure and order rules developed in Chapter Three. The proposal of these spaces will engage the users into embodied perception and to allow memories to be created or recalled.

Vesterbrogade is an 'introductory exhibition' space that is important to give the users a sense of introduction to the museum experience. The space is designed with strong-framing that uses the lattice structure to frame the space as unified embodied experience. The lacttice structure which is the focus of attention, can be easily recognised as it is an adoption from the street immediately outside the museum, giving users a clue of mapping spaces. This space uses short axial isovist to begin incorporating the users with the need for orientation in the building.

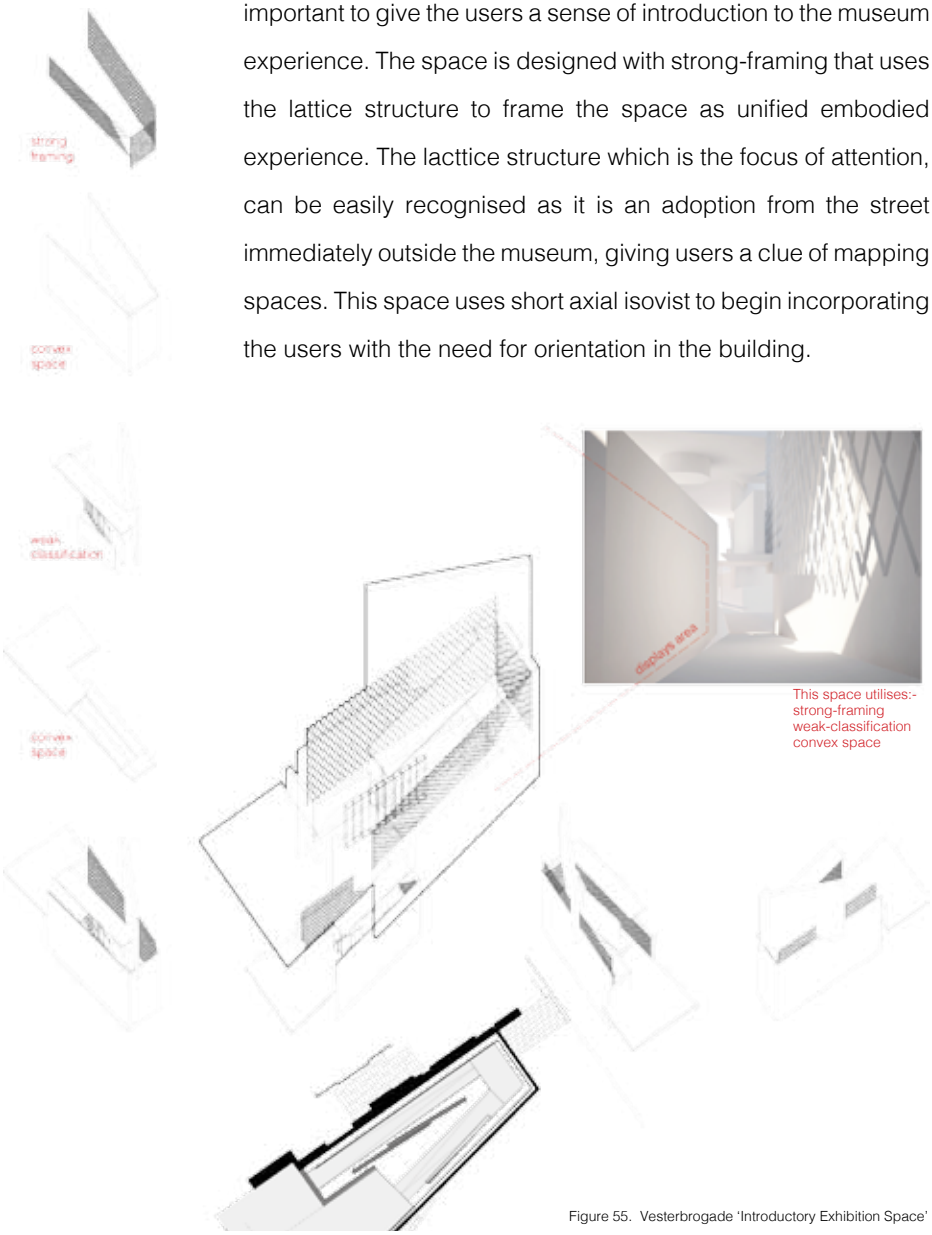


Figure 55. Vesterbrogade 'Introductory Exhibition Space'

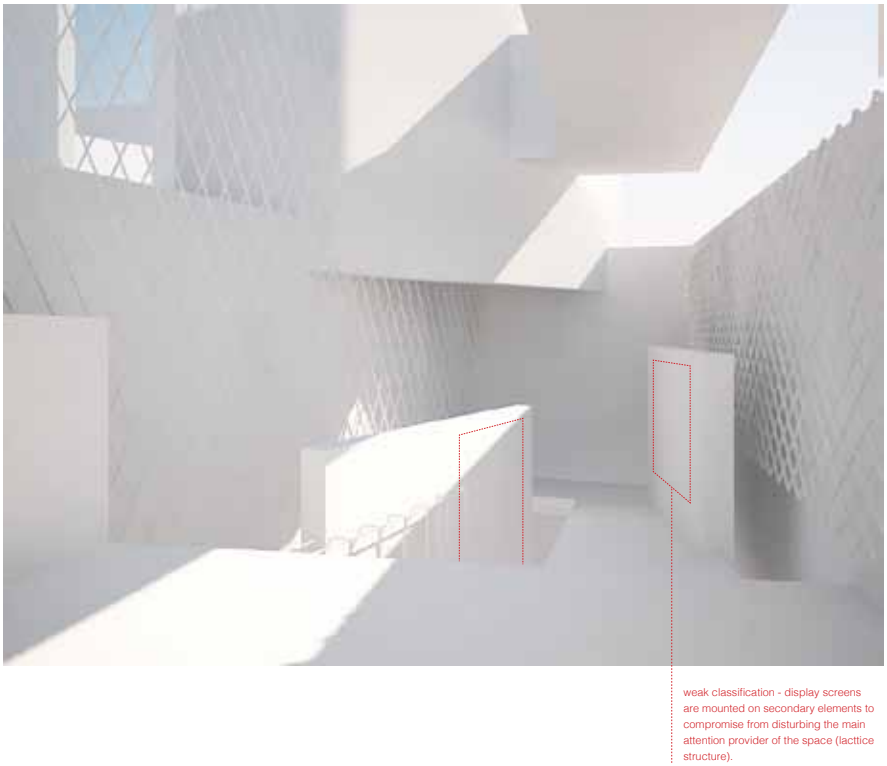


Figure 56. The Vesterbrogade 'Introductory exhibition space' frames the spatial experience with the perimeter lattice structure.

City Hall Square - Interactive World Map

The City Hall Square is a centralised exhibition area is connected from the 'introductory exhibition space' and then branching out into the four separated zones of linear-sequence exhibitions. The space is designed with strong-framing and strong-classification, where the large circular floor surface with the overhanging 'zig-zag skyline' platform of ground floor wrap the panoramic experience of the museum interiors into the perceiver in the city hall square. And with the world map projected onto the surface, the space connects the floor through the users' body and connects with the museum interior.

On the other hand, a person walking along the circulation space on upper floor will be constantly connected to the slow-changing projecting that suggest for to see if one revisit his/her perception on the ground again.

This space utilises:-
convex space
strong-framing
strong classification
isovist
employ space

Figure 57. The exhibition space is designed to visualised the entire panorama of the museum from within the building.

Stroget Street - Window Shopping

The most interesting experience of the real Stroget street is its long pedestrians with shopping places on both sides of its street. In the museum, the Stroget street is designed with a long axial space straight from the beginning to the ending of this exhibition space to reveal the then expected entry into the segments of this space. The axial space constantly frame the entire experience and allow users to refer to it as a reference of the space. Thus, building up attention and interaction with the axial space.

It is a window shopping experience. Users walking down the axial space will be fed with windows cut-out in walls to engage the users through the thick walls which are arranged in almost arm reach length. It creates an entire new experience for tall and tight spaces, which the users will feel engaged with the large maps displays and the architecture as a whole.

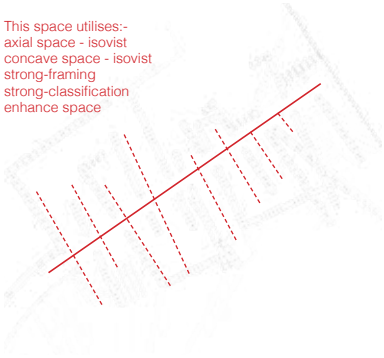


Figure 58. Plan drawing showing axial space

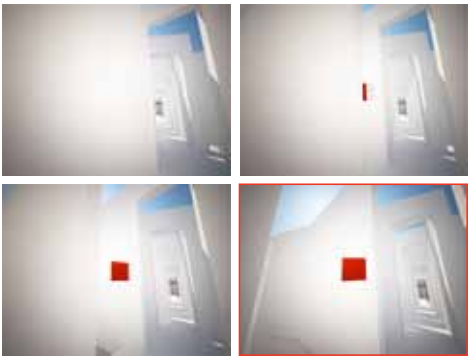


Figure 59. The experience of viewing through the cut-out holes when walking.

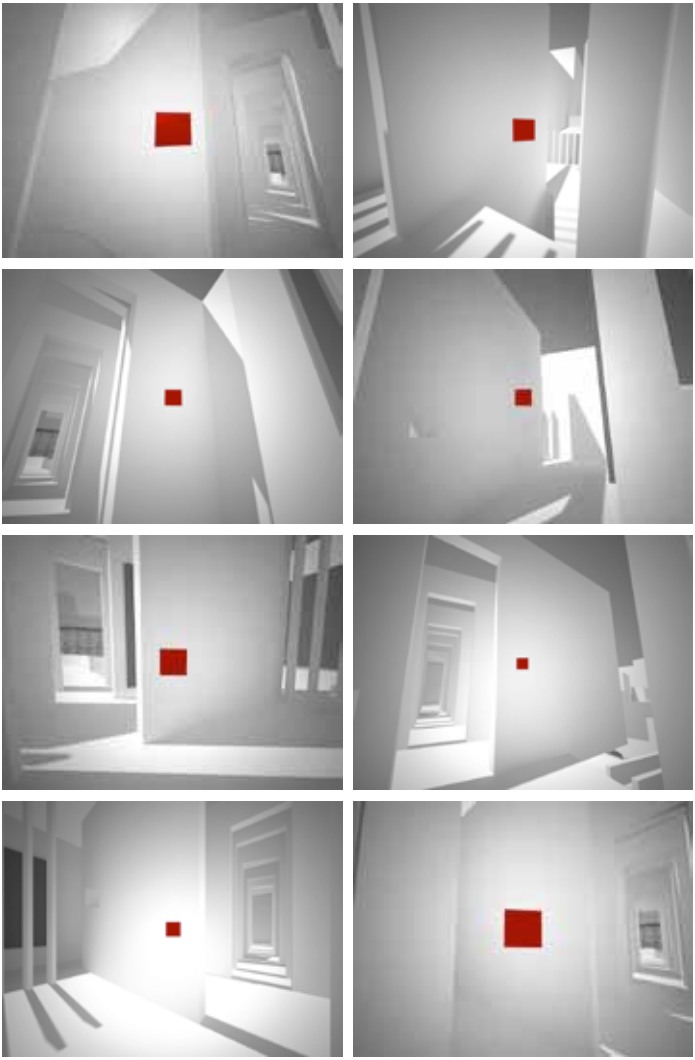


Figure 60. The images above demonstrates the cut-out hole that create window experience to view the displays, engaging the users with the walls, and even through the walls.

Vesterport

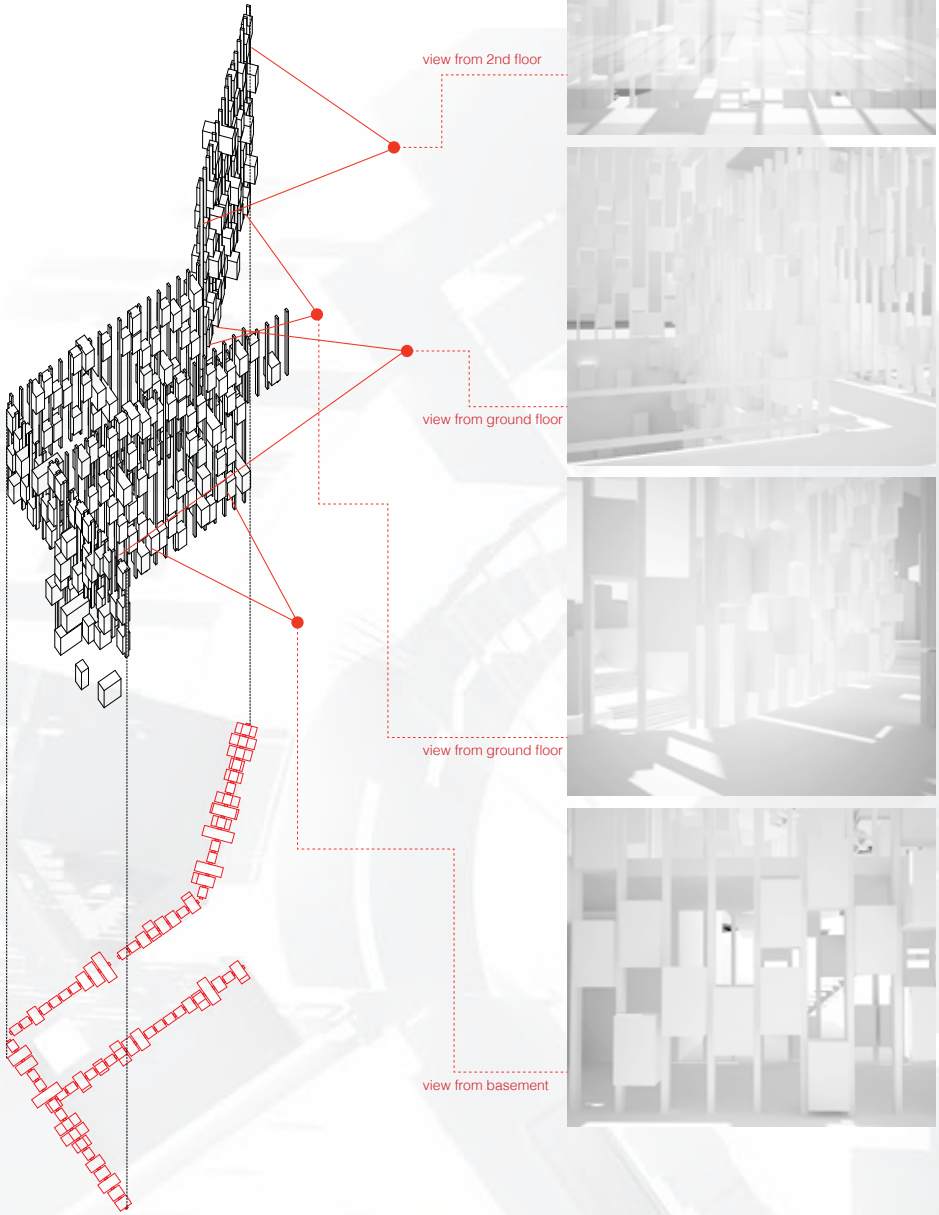
The Vesterport exhibition space is part of the 'future potential of cartography' partial-narrative of the overall exhibition. It is designed to bring the users closer to the growing importance of technology in cartography. However, placed technology as a tool to help understand cartography, rather than being dominated by technology. The space contains cubes with sculptured surface, arranged consistenly across three levels of the museum to extend this exhibition into circulation spaces. Its role as an exhibition is only exposed when the users uses a digital device to scan the cubes to reveal a collection of online maps uploaded by cartographers, designers or even beginners.

The space constantly ask for interactions, for every cube reveal different maps, and with some maps accessible from certain levels of the museum. This space uses strong framing, but weak-classification that relies on users possibilities to interact. It is also designed withthe technique of enhance space, which when the users interact with the cubes, it allows user to explore the space.

Figure 61. Engaging the spaces with technological device.

This space utilises:-
strong-framing
weak-classification
enhance space

Figure 62. The Vesterport exhibition with cubes of sculptured surface that link users with online maps collection through electronic devices.


view from 2nd floor
view from ground floor
view from ground floor
view from basement

Ny Kongensgade

The Ny Kongensgade exhibition is presented with a collection of white window frames reconstructed to imitate the white frames of openings on the building facades along the real Ny Kongensgade. In the exhibition, the window frames melted the boundary the building and display. Whether the window frames are part of the building? or is it additions to allow artworks to be projected is quietionable. The frames are installed with see-through displays with artworks of maps appearing and dissapearing alternatively. This requires the users to engage with the space to navigate around the frames to capture the best view of the artwork.

The space incorporated strong-framing and strong classification to frame the users' attention onto the windows that populated the entire space with a single unified language.

This space utilises:-
onvex space
strong-framing
strong-classification
enhance space

Figure 65. See-through screens for displays inNy Kongensgade exhibition.

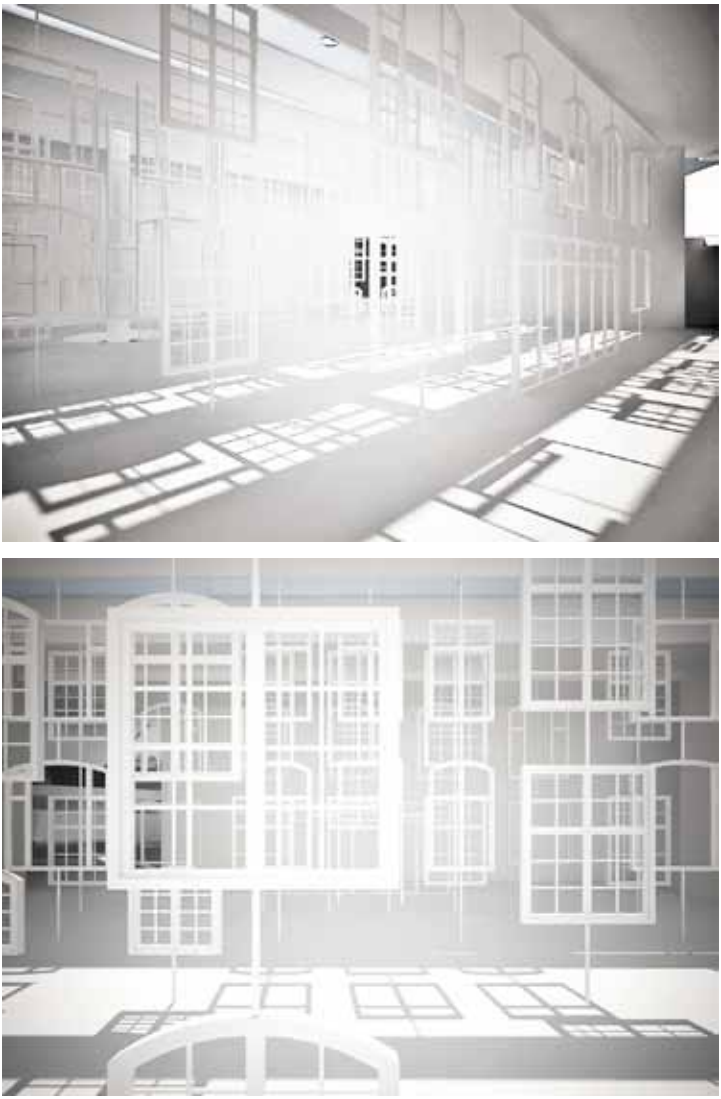


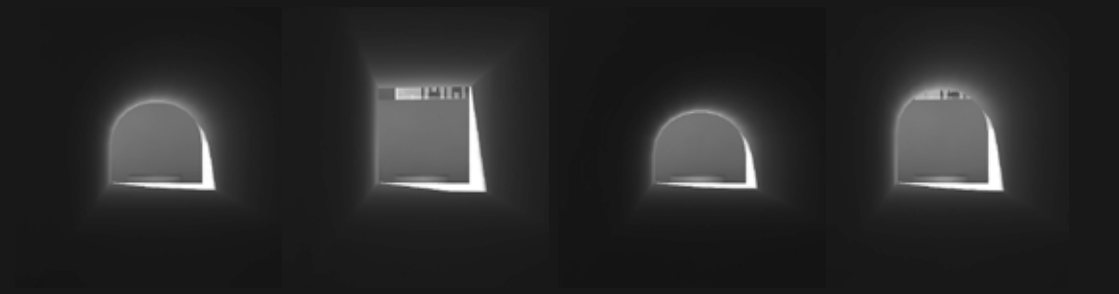
Figure 66. The frames in Ny Kongensgade that melted the boundary between building and displays.

Sans Pedar Street

This exhibition space explore the quality of a horizontal tight space by using bricks to relate to the human scale. Cuts on the ceiling and floors reveals further engagement with the space that allow people to explore its corners and surfaces. Then in order to view the displays, one will need to distance himself/herself away from the displays, maybe leaning on the bricks wall, staring down the displays and experiencing the sun at the same time. It allow users to engage more than a tunnel in this exhibition space.

The exhibition uses a strong-framing strategy by combining the displays and architecture as a single point of attention. It also uses strong classification strategy, which the content is always within the boundary of the context.

The Theatre Museum is a dark tunnel exhibition, which will incorporates projections onto its surface to complete change the atmosphere, simulating a world mapped with the users. its ceiling will also move and allow users to experience the movement with their body. The theatre museum is designed with strong-framing and strong classification, framing the attention and embodied perception of the combined museum experience on the walls. Its not just a wall, but also a floor, ceiling, and screen.



Circulation Space - Giving Expectations

The museum architecture spatial layout is proposed with two main important components, the exhibition space and the circulation space. The circulation space as seen in the page beside, acts as important connective space that allow users' attention to build up as they approach the exhibition. The architecture users a aluminium to capture attention and designing them to posturise a sense of direction to the further encounters.

They are also important in meeting the users expectation so that the users will less likely to react in disinterested with the exhibition. This is done by employing the ideas of isovist that encourage users to overlook into other adjacent exhibition spaces to have a hint of what to be experienced.

Figure 70. Circulation to build-up users attention.

Images of the Spaces Extracted from Google Street View

Figure 71. Google Street View Image of Vesterbrogade.

Figure 72. Google Street View Image of City Hall Square.

Figure 73. Google Street View Image of Stroget Street.

Figure 74. Google Street View Image of Vesterport.

Figure 75. Google Street View Image of Ny Kongensgade.

Figure 76. Google Street View Image of Theatre Museum.

5.0

Conclusion

The purpose of this thesis is to prove that an architecture that encourages objective embodied mapping can demonstrate that cartography gives people understanding of the spatial environment.

The study into cartography illustrates cartography to be conceived by its function, such as for the purpose of navigation, rather than its rightful definition of cartography. It shows cartography need for recognition to allow its potential growth in the future.

By understanding the definition and characteristics of embodied perception, the thesis is able to inform that attention, expectation and experience are key aspects that will affect how the body will interpret the environment through embodied perception. Further investigation also shows that when greater attention is given into having more intense embodied perception, the possibilities of encoding memory is much higher. Then understanding that the allocation of a person attention is deal to its interaction with the spatial environment, proves

that by articulating our spatial environment, attention can be amplify to benefit the process of encoding memory through embodied perception.

The observation into the spatial layouts of selected case studies have reveal the capability of the spatial structure and order of both the architecture and displays in manipulating the control of movements to regulate exploration of the exhibition in the museum. The later comparative analysis of the observation is able to propose a 'goal-oriented attention' spatial layout, suitable for controlling the expectation and attention levels of the users for embodied perception.

By investigating the 'context' and 'content' relationship, it is achieved that the three-dimensional structure, depth and movement of architecture or displays can inaugurate embodied perception. The further observation into museum case studies also proved ideas of 'classification' and 'framing' as suitable order technique for ordering the 'context' and 'content' relationship for embodied perception.

The integration of the idea of 'goal-oriented attention' layout, and ideas to manipulate the 'context' and 'content' relationship in an exhibition has established the museum of cartography as an architecture that encourage active interaction of the users with the architecture for mapping embodied perception to demonstrate cartography gives spatial understanding of the environment.

06

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07

List of Figures

Figure 09 Obtained from http://www.dezeen.com/2009/11/26/ashmolean-museum-by-rick-mather-architects/ [accessed 13 April 2014]

Figure 10 Obtained from http://www.dezeen.com/2009/11/26/ashmolean-museum-by-rick-mather-architects/ [accessed 13 April 2014]

Figure 11 Obtained from http://kberry.wordpress.ncsu.edu/2012/11/13/4/ [accessed 13 April 2014]

Figure 12 Obtained from http://kberry.wordpress.ncsu.edu/2012/11/13/4/ [accessed 13 April 2014]

Figure 13 Obtained from http://www.bdonline.co.uk/stephen-hodder's-inspiration-sainsbury-centre-norwich/5029920.article [accessed 14 April 2014]

Figure 14 Extracted from Tzorti, K. (2007) 'Museum Building Design and Exhibition Layout: patterns of interaction'

Figure 15 Extracted from Tzorti, K. (2007) 'Museum Building Design and Exhibition Layout: patterns of interaction'

Figure 16 Extracted from Tzorti, K. (2007) 'Museum Building Design and Exhibition Layout: patterns of interaction'

Figure 17 Obtained from http://www.archdaily.com/124725/ad-classics-neue-staatsgalerie-james-stirling/ [accessed 14 April 2014]

Figure 18 Created by W. H. Hew

Figure 19 Edited by W. H. Hew

Figure 20 Edited by W. H. Hew

Figure 21 Edited by W. H. Hew

Figure 22 Edited by W. H. Hew

Figure 23 Edited by W. H. Hew

Figure 24 Edited by W. H. Hew

Figure 25 Edited by W. H. Hew

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Figure 27 Edited by W. H. Hew

Figure 28 Edited by W. H. Hew

Figure 29 Edited by W. H. Hew

Figure 30 Photo obtained and edited from http://www.naturalwoodfloor.co.uk/wp-content/gallery/projects-museum-1/tate-modern-gallery.jpg [accessed 13 April 2014]

Figure 31 Photo obtainned from Montaner, J. and Oliveras, J. (1986) *The Museums of The Last Generation*, London: ACADEMY EDITION.

Figure 32 Obtained from http://www.galleriesnow.net/wp-content/uploads/2013/09/Tate-Modern-The-EY-Exhibition-Paul-Klee-3.jpg [accessed 11 April 2014]

Figure 33 Photo obtainned from Montaner, J. and Oliveras, J. (1986) *The Museums of The Last Generation*, London: ACADEMY EDITION.

Figure 34 Obtained and edited from http://media-cdn.tripadvisor.com/media/photo-s/05/66/1a/c3/utstallningslokal.jpg [accessed 13 April 2014]

Figure 35 Obtained from http://www.rickmather.com/project/category/ashmolean_museum [accessed 17 March 2014]

Figure 36 Obtained from http://www.xamou-art.co.uk/wp-content/uploads/2012/04/louisiana-gallery-04.jpg [accessed 13 April 2014]

Figure 37 Obtained from http://fabrica.org.uk/partners/european-partners/sainsbury-centre-for-visual-arts/ [accessed 13 April 2014]

Figure 38 Obtained from http://chloenelkin.files.wordpress.com/2011/08/a-living-man-declared-dead-and-other-chapters-tate-modern-london-ts-own-site-4.jpg [accessed 11 April 2014]

Figure 39 Created by W. H. Hew

Figure 40 Created by W. H. Hew

Figure 41 Obtained from http://www.visitcopenhagen.com/copenhagen/louisiana-museum-of-modern-art-gdk414157 [accessed 9 April 2014]

Figure 42 Obtained from http://www.xamou-art.co.uk/wp-content/uploads/2012/04/louisiana-gallery-04.jpg [accessed 13 April 2014]

Figure 43 Obtained from http://www.rickmather.com/project/category/ashmolean_museum [accessed 17 March 2014]

Figure 44 Obtained from http://www.outputmagazine.com/digital-signage/applications/display/adder-connectors-help-light-up-science-museum/ [accessed 21 April 2014]

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Figure 46 Obtained from http://www.manss.com/files/media-image//foster-partners-louisiana-exhibition-1-2117.jpg [accessed 17 April 2014]

Figure 47 Obtained from http://www.visitnorthsealand.com/ln-int/north-sealand/culture/shakespeare-modern-art [accessed 17 April 2014]

Figure 48 to 70 All Drawings Created by W. H. Hew

Figure 71 to 76 Obtained from https://www.google.com/maps/place/Copenhagen/@55.6712673,12.5608388,12z/data=!3m1!4b1!4m2!3m1!1s0x4652533c5c803d23:0x4dd7edde69467b8 [accessed 27 April 2014]