Architecture as Information Space

Peter Ferschin, Andreas Gramelhofer
Vienna University of Technology – Institute of Architectural Science and Theory
ferschin@iemar.tuwien.ac.at, angram@gmx.net

Abstract

This paper will discuss the relevance of architectural design towards the field of Information visualization by showing historical and contemporary examples of built structures with encoded information. This overview should demonstrate that information visualization in three dimensional physical environments was already created throughout the history of architecture, even within different cultures. From these examples some design principles for spatial coding of information will be extracted that can be transferred to the field of information visualization. Additionally architectural principles are related to metaphors from different fields of knowledge.

Keywords--- **Information Visualization, Information Design, Architecture**, **Information Architecture**

1. Introduction

The development of faster information processing tools have also created larger amounts of data to be processed. While the human being has amazing capabilities in visual information processing, large amounts of data in the abstract form of large tables of numbers and text cannot be analyzed and understood in short periods of time. Information Visualization as a scientific discipline tries to generate visual structures from abstract data types, to achieve a better insight into complex data structures and also to provide new methods of interacting with data. So it seems that the visual encoding of information will be necessary for an information society to understand the increasing amount of knowledge produced, and that this approach can be tracked down to its roots inside computer based information processing. But when we look back in history, we realize that visual communication techniques have a much older history than the history of computing [21]. Before developing abstract symbols to encode information, the human being used images to communicate. Some of these images were created on walls of caves or inside temples which brings another area into the discussion of communication media: the field of architecture. Architecture has also a long tradition as a cultural achievement, and this paper will discuss how information has been coded into physically built structures. The following chapters will introduce several examples of different fields of knowledge that have been coded in "books of stone".

Information	Metaphor	Example
Proportion	Human Body	Le Corbusier, Di Giorgio Martini, Schwaller de Lubicz
Proportion	Music	Stretto House
Sacred Knowledge	Path	Borobudur
Cosmological Order	Gods,Nature,Man	Balinese Architecture
Astronomy	Instrument	Observatory, Jaipur
General Knowledge	Theatre	Memory Theatre
Ethnology	Worldtrip	Museum of Ethnology, Leiden
Advertisement	Screen	Tokyo
Financial Data	Augmented Space	NYSE, Asymptote

Table 1: Overview of Built Information Architectures

This should emphasize that architecture has a rich tradition of creating information spaces, and the term "information architecture" has also a right to be used inside the area of architecture, although nowadays it is mainly used for describing structures of websites. At the end of the paper, several design principles will be derived from the introduced examples.

2. Architecture and Human Proportions

One of the most developed fields in architecture is the relationship of proportions in respect to the human body. Understanding architecture as a media for information, human proportions can be derived from various kinds of buildings. Examples can be found in the works of Le Corbusier [1], Di Giorgio Martini [2] and Schwaller de Lubicz [3], thus spanning the history of architecture from ancient egypt to contempary buildings.

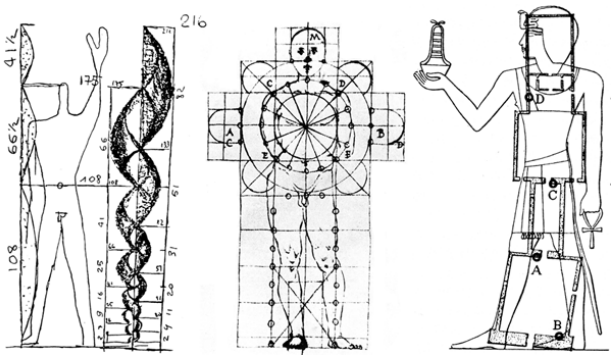

Figure 1 Modulor – Le Corbusier, Cathedrals and Human Proportions, Egyptian Temple and Human Proportions

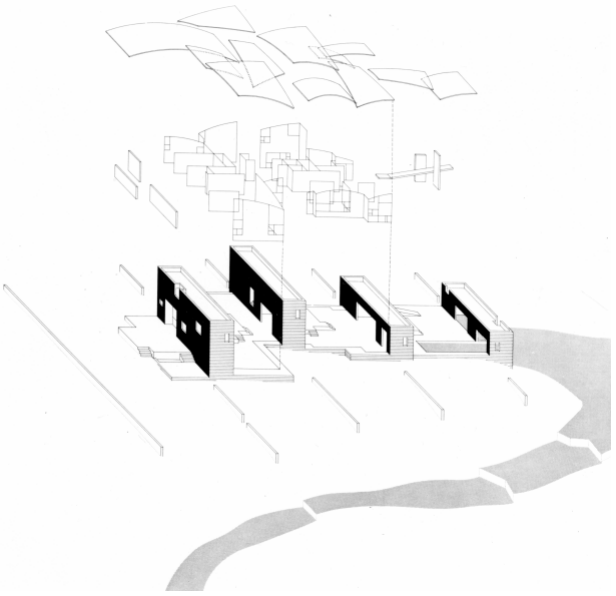

Figure 2 Stretto House by Steven Holl (Bartòk)

3. Architecture and Music

An example of the relationship between music and architecture is the Stretto House built by Steven Holl in 1991. This building is an architectonic representation of a piece by Béla Bartòk (*Music for Strings, Percussion, and Celeste*). As the four movements of the music elaborate on the contrast between light (strings) and heavy (percussion), the architecture consists of four massive parts connected with light framework.

"Bartòk's Music […] has a materiality in instrumentation which the architecture approaches in light and space. Formed in four sections, the building consists of two modes: heavy orthogonal masonry and light, curvilinear metal. The main house is aqueous space: floor planes pull one space to the next, roof planes pull space over walls and an arched wall pulls light from a skylight. Materials continue the concept in poured concrete, cast glass in fluid shapes, slumped glass and liquid terrazzo." [4] [5]

4. Symbolic Architecture

An interesting monument of symbolic architecture is Borobudur, a Buddhist stone-building in Java (Indonesia) dating back to 760 a.d. The monument consists of 10 concentric terraces (cf. Zikkurat) of diminishing size with 1460 reliefs and 504 Buddha-statues. Its purpose is a religious monument, where Buddhists can spiritually and physically experience the 10 stages of enlightenment (*Bodhisattva)*. This spiritual transformation is being translated into a spatial metaphor: Each terrace represents one of the stages of enlightenment, thus enabling the visitor to actually experience religious knowledge in a mnemonic manner. Another symbolic shape is encoded in the floorplan, that has been designed in correspondence of a buddhist mandala. The general shape of Borobudur reminds of a mountain, which is a major religious symbol in various cultures (cf. Bali, Ayres Rock). [6] [7]

Figure 3 Buddhistic Monument of Borobudur (Java)

5. Cosmological Architecture

The principles of architecture in Bali are derived from a social and cosmological system. While mountains and upper regions are dedicated to gods, lower regions are assigned to humans, the sea to demons and evil spirits. This trichotomy can be found in the topology of villages and cities, but it also reappears in the design of a single house or the composition of details. The hierarchy is reflected in the human body (head, body, leg) as a metaphor. A second principle of Balinese architecture is cosmological order. Two main axes are created through the orientation towards the holy mountain (Mount Agung) on one side and the path of the sun (East-West) on the other. Cities and villages as well as temples and houses are oriented along these cardinal-axes. Thus the holy part of a Balinese house is built towards Mount Agung, the dwelling part is in the middle and the profane parts (kitchen, hog house) are oriented in the direction of the sea.

The path through a house or temple is also very important. The chronology of construction (from the sacred parts towards the profane) and the process of entering a house (from the profane towards the sacred parts) or a religious ritual are related to each other. [8] [9]

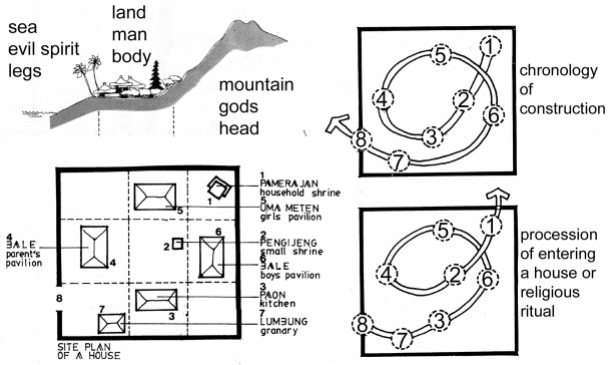

Figure 4 Architectural Principles in Bali

6. Architecture as Astronomical Device

Similar to Balinese architecture, historical buildings in India are also influenced by social or religious principles. Especially the observatory of Jai Singh II in Jaipur (1730 a.d.) is an example of architecture as an astronomical device.

All buildings were designed according to the astronomical and physical science of the time and were used for measuring and displaying astronomical facts like azimuth and zenith, rise and decline of stars. The buildings are instruments and scientific monuments at the same time, again information can be experienced in a spatial context, whereby light plays a special role in the architectural design. [10] [11] [12]

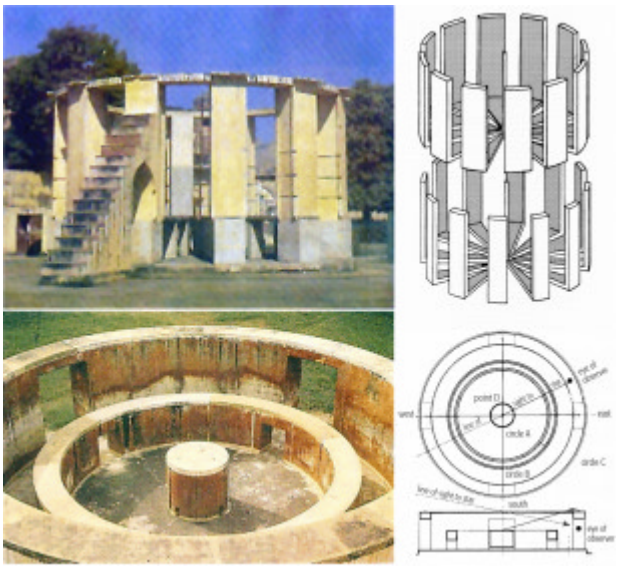

Figure 5 observatory of Jai Singh II in Jaipur

7. The Memory Theatre

Giulio Camillo Delmino's concept of a Memory Theatre (approx. 1550 a.d.) is an architectural representation of the knowledge of his time. Standing on a stage, the visitor could survey seven different categories of knowledge situated in the auditorium and badged with allegoric images. The concept is based on three principles:

Spatial experience is more comprehensive than abstract information. Explicit facts are easier to remember.

Spatial concepts possess immanent logic, which can be used to mnemonically link information.

The exploration of a building creates a linear sequence; many different paths through one space are possible, each time creating a different sequence from one source.

In this sense Camillo's design is a prototype of information architecture. [13] [14]

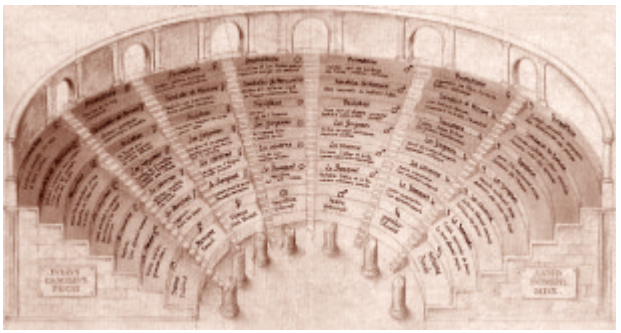

Figure 7 Memory Theatre – Giulio Camillo

8. Museums as Memory Theatre

The concept of memory theatre as a spatial mnemonic technique dates back to the Middle Ages, and was later pursued in the Renaissance by Giulio Camillo (1480-1544), Ramon Lull (1235-1316), Giordano Bruno (1548-1600), Peter Ramus (1515-1572) and Robert Fludd (1574-1637).

A modern example of memory theatre is the National Museum of Ethnology in Leiden, Netherlands. Originally designed as a hospital, the building has been adapted in 1996 to become a modern museum with a flexible topology of showrooms.

The basic idea is a thread around the globe, which links the different cultures and continents together. In this way a topology-concept is created as a representation of a historical excurse into human culture. The two stories of the building contain different exhibition-areas, which are laid out according to the imaginary thread around the globe in a graphic projection of continents on the floor plan. [15] [16]

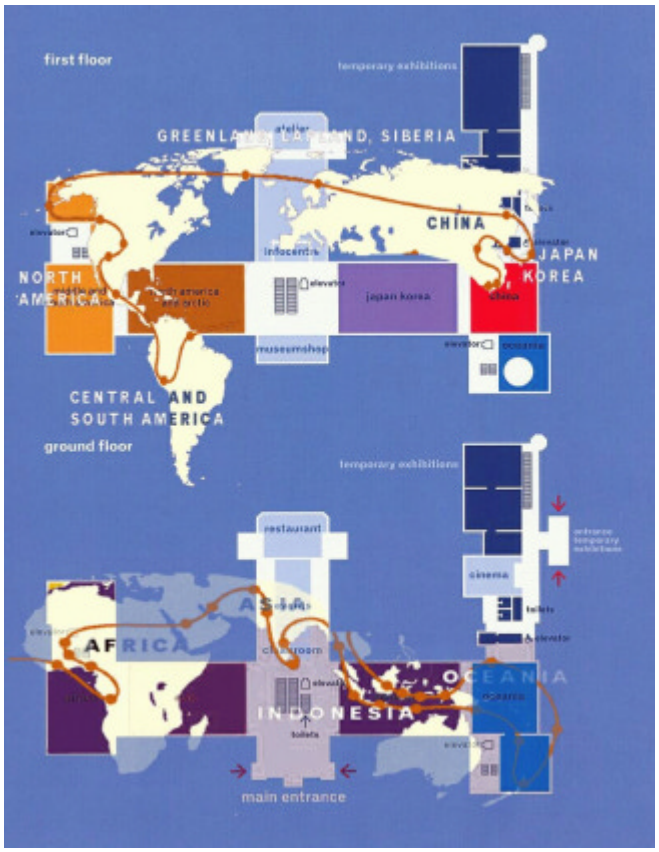

Figure 8 National Museum of Ethnology Leiden,NL

9. Architecture as Presentation Media

While information architecture frequently deals with the spatial representation of information, architecture as presentation media uses buildings as surfaces for displaying various information. Images or Videos are being projected on facades, texts are engraved in glass- or concrete, variable lighting is used to visualize current environment parameters like wind or temperature.

Examples of this technique can be found in advertisement tables or video screens, which dominate many urban spaces of modern cities (cf. Tokyo). [17]

Figure 9 Videoscreens in Tokyo

10. Augmented Architecture

An important part of information architecture is the combination of physical and virtual content. The aim is to design an architectural (physical) structure, which acts as a representation of virtual/abstract data in itself. Here architecture gains a transcendental quality, linking the physical world (e.g. of a room) to abstract information (e.g. the metaphysical).

An example of augmented architecture is Asymptote's design for the Advanced Command Center (ACC) of the New York Stock Exchange (NYSE). The ACC contains a great number of flatscreens and electronic tickers embedded in a curved structure of blue translucent glass, which forms the overall-frame and underlines the metaphor of floating information.

Additionally Asymptote designed a virtual representation of the NYSE, which acts as a real-time interactive 3D-model of the trading floor. The idealized simplification of the actual room enables brokers to visualize great amounts of real-time data: Virtual rooms can be used to create different scales or perspectives of trading information, market- or cash flows are presented spatially and linked to other recorded data, giving the user the opportunity to manipulate abstract data in an intuitive way according to his needs. [18] [19]

Figure 10 New York Stock Exchange – Asymptote

Conclusions

From the architectural examples, described in the article above, several design principles can be observed through these historic and contempory examples.

Information Architecture	Information Visualization	Examples
Metaphors from other disciplines	Transfer Metaphors to InfoVis	Human Body, Music, Theatre, Instrument, Cosmos, Symbol
Metaphors from other disciplines	Consult specialists	Anatomists, Musicians, Architects, Industrial Designers, Symbol. Experts
Path	Constrained Navigation	"Path to Enlighgtment", Procession, Worldtrip
Music	Use Sound	Harmony, Contrast ("Error" Sound, "Completion" Sound)
Natural Light (Sun, Stars)	Use Light	Observatory, Theatre
Time	Speed of Navigation, Change of Information, Transitions	Observatory, Procession, Paths
Mnemotechnic	Layout of Spaces, Characteristic Spaces, Identity	Memory Theatre, City with Monuments
Mnemotechnic	InfoVis as Learning Tool	Memory Theatre, Museum of Ethnology
Aesthetic Design	"Joy of Use", Encourage Exploration	Memory Theatre, Borobudur, Churches, Arch. Monuments, Museums, Exhibitions
Viewing Directions	Specific (predefined) Camera positions	Memory Theatre, Observatory
Symbols	Use Visual Language	Mandala (Meditation), Borobudur, Churches

Table 2: Design Principles

Architecture has been used to encode knowledge from various other fields with different metaphors as three-dimensional design. By transferring these metaphors (human body, music, symbols, path, instrument, etc.) to information visualization some new designs might be created in a similar way. The examples presented in this paper should be a motivation to investigate further inside the field of architecture, as many architectural designs have used metaphors from other disciplines. It should be mentioned that information visualization itself used architectural metaphors (perspective walls, information landscapes, etc.) which could be explored with a deeper meaning if architects are consulted in the design process.

Another important factor in built information architecture is time, which can be experienced as sequence of spaces, by a path through a building, or by observing special qualities at specific moments of time as in the astronomic example. This sequence of spaces includes another visualization goal, where visualized information can be used with mnemotechnic intentions, as it was done in the memory theatre and museum exhibitions. Additionally aesthetic qualities of spatial design can help to encourage the user to explore the data by increasing the "Joy Factor" for investigation. The example of symbolic architecture motivates to use design capabilities for encoding semantic information in specific shapes (as meditative symbols encourage contemplation), that are used inside a visualization. From a design point of view this results in seeing information as an additional dimension of design [20].

As a future extension of built architecture, interactive environments should be considered as part of an architectural design as it was done at the NYSE and other augmented spaces like CAVE environments.

Thus, information visualization should increasingly cooperate with other design disciplines, and as it was shown in this paper, especially the field of architecture might be a rich source for common future developments.

References

[1] Le Corbusier: Der Modulor. Band 1. Darstellung eines in Architektur und Technik allgemein anwendbaren harmonischen Maßes im menschlichen Maßstab. Stuttgart, 1998

[2] P. v. Naredi-Rainer: Architektur und Harmonie. Köln, 1982

[3] Schwaller de Lubicz, R. A.: The Temple of Man. Inner Traditions International, 1998

[4] Holl, Steven: Stretto House. New York, 1996

[5] Steven Holl url: http://www.stevenholl.com

[6] Miksic, John / Tranchini, Marcello: Borobudur. Golden Tales of the Buddhas. London, 1990

[7] Borobudur url: http://www.borobudur.tv/

[8] Oka Windhu, I. B.: Balinese Traditional Architecture. Department of Education and Culture. Republic of Indonesia, 1977

[9] Swellengrebel, Jan L.: Bali Studies, Life, Thoughts, and Rituals. The Hague - Bandung,1960

[10] Volwahsen, Andreas: Cosmic Architecture in India. The Astronomical Monuments of Maharaja Jai Singh II. München [u.a.], 2001

[11] Stierlin, Henri (HG.): Architektur der Welt: Indien. Köln, 1993

[12] Stierlin, Henri / Stierlin, Anne: Hinduistisches Indien. Tempel und Heiligtümer von Khajuraho bis Madurai. Köln [u.a.], 2002

[13] Camillo, Giulio: L'idea del theatro. Fiorenza, (Lorenzo Torrentino), 1550

[14] Memory Theatre url: http://www.ba.infn.it/~zito/camillo.html
[15] Staal, Gert / de Rijk, Martijn**:** Redesigning the National Museum of Ethnology Leiden, The Netherlands. Amsterdam, 2003
[16] National Museum of Ethnology url: http://www.rmv.nl/
[17] Meyhöfer, Dirk: Contemporary Japanese Architects. Köln [u.a.], 1994
[18] Asymptote Architecture url: http://www.asymptote-architecture.com/
[19] New York Stock Exchange url: http://www.nyse.com/
[20] Illera, Christa: Trilogie der Fünf. Fünf Dimensionen, fünf Prinzipien, fünf Phänomene. Wien, 2003
[21] E.R. Tufte. Envisioning Information. Cheshire, CT, Graphics Press. 1990.