Exploring syntax and semantics of spatial structure

A study on Traditional Taiwanese City form in Chi'i'ng Dynasty

YU-LI CHANG

Graduate Institute of Architecture, National Chiao Tung University, Hsinchu 30050, Taiwan
http://www.arch.nctu.edu.tw   jecho@arch.nctu.edu.tw

Abstract. In this paper, we want to figure out the relations of complex semantics and syntax on five traditional Taiwanese cities in Chi'i'ng Dynasty by using a language approach. The issues of traditional Taiwanese central city in Chi'ing Dynasty had been interpreting by historical, social, and cultural research but had lacked the explicit construction of spatial structure on semantics-syntax. Therefore, we use a data modeling on knowledge level to describe the relationship between syntax and semantics. Through the research of Chi'ing Dynasty's history, we find out the spatial relations of Taiwanese traditional city to establish the functional categories of spatial structures. Then the language of semantics components and the meaning's attributes are coded as logical statements to map the elements of syntax on architectural form, political vocabularies, spatial layout, and spatial myth. We argue that using this approach several social and spatial structures of cities can be clearly defined and understood.

Keywords. Spatial structure; syntax; semantics; power structure; traditional Taiwanese cities.

Introduction

This paper presents a language approach to capture the relation of complex semantics and syntax on five traditional Taiwanese cities (Taipei, Hsin-Chu, Taichung, Tainan and Kaoshing) in Chi'i'ng Dynasty. Several researches (Han, 1993; Chiou, 1997; Shiau, 1999; Su, 2001; Chi, 2001) contributed different views towards understanding the traditional Taiwanese central cities in Chi'ing Dynasty from historical, social, and cultural points of views. While providing broader range of interpretation of such complex subject, their spatial structures remain unknown. Using semantics/syntactic approach, such as architectural language, this paper describes a model over the power hierarchy of traditional Taiwanese cities based on their spatial relations.

Most of studies on architectural language over traditional Taiwanese architecture focus on describing the building itself (Andrew, 1999; Chiou, 1995a, 1995b, 1995c, 1996); city-related domain have less researches conducted using this approach. In addition, by viewing buildings as elements, the spatial relations of these buildings are similar to the synthesis of building elements. Thus, the language model of design (such as Coyne and Gero, 1986; Wang, 1993; Lin and Chen, 1997) can be easy mapped to the descriptive model of city form. In other words, a design is described as a sentence with vocabularies and grammatical structure, so does a group of building in a city can be described as sentences with higher hierarchical structure (Alexander, 1977). Similarly, using data modeling approach

(Eastman, 1991); we use attributive relation of semantics and syntax to describe the spatial relation of city form.

Problems and objectives

Therefore, design problem is that reorganize the complex data on knowledge level (Smithers, 1996). So we argue that reorganize the complex semantics and syntax of city by computational mechanism to provide a new interpretative model describing and structuring the behavior of city on the form level. When design is described as the relation of language on knowledge level, then design can be dealing with the hierarchical language on logical attributive relation of semantics and syntax, through a set of constraint and analysis of semantics structures on knowledge level (Eastman, 1996). In this method, Representing design by defining the knowledge structure of design problems. And the spatial structures of Chi'ing regime had conducted an explicit analysis of semantics (Chen, 1988; Wong, 1993; Chiou, 1997). So, we can find the logical and hierarchical language of spatial structures by a set of syntax and the attributive relation of semantics. Therefore, we can map the components of syntax elements to semantics from the analysis of spatial structures to interpret the representation of city spatial structures by logical reasoning.

The analysis of spatial structures of political power in Chi'ing Dynasty

In the history of China, Chi'ing Dynasty (1700-1910) was a feudal empire. We compared with five traditional Taiwanese cities (Taipei, Hsin-Chu, Taichung, Tainan and Kaoshing) in Chi'i'ng Dynasty to study the city space in order to analyze the spatial structure of political power. In our research, we found that the political power is based on three functional space; there are military control center, educational center and administrative center, which is also geographically traffic center. (Table 1)

The political power of this ancient empire merely presented on the location of administrative center, because she took a negative attitude to govern Taiwan. Therefore, the city walls have be metaphor as the political power, such as a symbol and sign of administration. In China, constructing the city just as building a room must depend on Feng-Shui in order to conduct the spatial myth of the feudal empire. Then according to Capital system in the book of Kao Gong Ji, the layout of political space has been planning in the city. The next step is to depend on 'Zuo Zun You Bei' of Li-Zhi to set up the hierarchical buildings of political power in the city and to establish the whole spatial structure of feudal empire by the influence of educational center.

The language of formal components and the meaning's attributes

We use attributive relation of semantics and syntax to describe the spatial relation of city form as following. The vocabularies of political buildings can be described into four sentences of seman-

SP	Spatial structure of function					
Function Categories	**Administration**	**Economy**	**Justice**	**Traffic**	**Educational center**	**Military control Center**
Map Elements	Fu shu Xian shu Ting shu Dian shi shu				Xue gong Yi xue , Shi yuan Wen wu miao Memorial temple	Can jiang shu Shou bei shu Jun zhuang ju City walls, gates

Table 1: the relationship between the spatial structure of function and elements of buildings

Figure1: the style of city gates of the five traditional Taiwanese cities

tics. St1: The city walls are a district and boundary of feudal empire. St2: The towers of city gates are a landmark and path of feudal empire. (Figure1) St3: County buildings of Ming-Tang style are the center of nodes of feudal empire. St4: Educational buildings of Ming-Tang style are the center of teaching of feudal empire.

The spatial layout of political power based on the city walls can be described into six sentences of semantics. St1: The administrative building is the center of traffics and nodes in order to manifest the political center on administration, economy and justice. St2: The layout of buildings have arranged by 'Zuo Zun You Bei'. St3: the city gate is the landmark of paths in order to manifest a symbol of political district. St4: Educational buildings are public architecture in order to manifest the mechanism of political reproduction by teaching. St5: The city walls, gates and military camp manifest the military control space of feudal empire. St6: The traffic of main street connect to the city gates form the geographical center and division

The spatial layout of political power based on the city walls can be described into six sentences of semantics. St1: The administrative building is

the center of traffics and nodes in order to manifest the political center on administration, economy and justice. St2: The layout of buildings have arranged by 'Zuo Zun You Bei'. St3: the city gate is the landmark of paths in order to manifest a symbol of political district. St4: Educational buildings are public architecture in order to manifest the mechanism of political reproduction by teaching. St5: The city walls, gates and military camp manifest the military control space of feudal empire. St6: The traffic of main street connect to the city gates form the geographical center and division.

The spatial myth, Feng-Shui, symbol the nature and legitimization of political power in constructing city. This contains four sentences of semantics. St1: On geographically, the city wall and her power manifest controlling overall situation, because landscape and mountains have occurred relationships with her. St2?The city wall and her power manifest the God's will. St3: The city wall locates the context of empire Feng-Shui extends the legitimating of political power. St4: The city wall and her political power present the nature and holy power.

The hierarchical relation of political power can

City	Taipei	Taichung	Tainan	Hsin-Chu	Kaoshing
Numbers of city gate	5	8	8	4	4
Numbers of administrative building	6	6	8	4	5
The circumference of city wall	1506	650	2520	840	810
Administrative hierarchy	Fu	Fu	Fu	TingXian	TingXian

Table2: The hierarchical relation of political power

be deal with the numbers of city gate and administrative building, the circumference of city wall, administrative hierarchy. (See Table.2.) This is the sentence of semantics.

A data modeling on syntax-semantics

In this work, we conduct the relations of syntax-semantics by using a data modeling on knowledge level. Through the analysis of Chi'ing Dynasty's historical city development, we discover the spatial structure of Taiwanese traditional central city layout to establish the functional categories of spatial structures following the political power structure strongly. Therefore, the semantic of spatial structure of central cities reflect what Chi'ing sees Taiwanese. By coding the social concepts into the semantic and syntax of our spatial structure description, the power structure will be unleashed and analyzed. The mapping between spatial structure syntax and its semantics is derived from the hierarchical attribute of rules. One example of symbols and their relations are shown in the following Table3. The semantic components and the meaning's attributes are coded as logical statements to map the elements of syntax on architectural form, political vocabularies, spatial layout, and spatial myth. The mapping strategy between syntax (the structure) and the social semantic concept (the rules) are shown in Figure 2.

Conclusion

With this approach, we evaluate the syntactic descriptions of five traditional Taiwanese cities in Chi'ing Dynasty. And to deal with the both relation of semantics and syntax, involving in the language of spatial structure. Not merely, establishing the rules of shape grammar. At the same time, emphasis was addressed an analytic framework providing a computational mechanism for the research of traditional Taiwanese city in Chi'ing Dynasty to interpret explicit behavior of social semantics and structure the ill-problem of city. We also argue that using this approach several social and spatial structures of cities can be clearly defined and understood.

Acknowledgements

References

Su Shiow-Mei: 2001, Representation of Historical District – A Study of the Sue-Hiro Tyo of Tainan City in the Japanese Colonial Period, Taiwan.

Chi, Heng-chang: 2001, From Colonial City to "Hari City": Landscapes of Consumption in Hsimenting, Taipei, Taiwan.

Shiau, Tao-ming: 1999, The walled-city of Feng-shan in Taiwan during the Ch'ing, Taiwan.

Han, Dong-Soo1993 A Study on the Castle

Table3. One example of symbols and their relations.

Sp={spatial structures, values (X)}, X∈ the categories of function elements.
Fc={category of function, values (Y)}, Y∈ the sentences of Map (Eij).
∀ Map (Eij)∈ the architectural elements of syntax.
IF Symbol {Sp (Style (x), Mass (x), Hierarchy (x), Symmetry (x), Circulation (x), Whole (x))
Q Regime} =df (a set
component of syntax elements, X), X∈ Ma (Eij)
THEN → Mapping semantics description {semantics, a set component
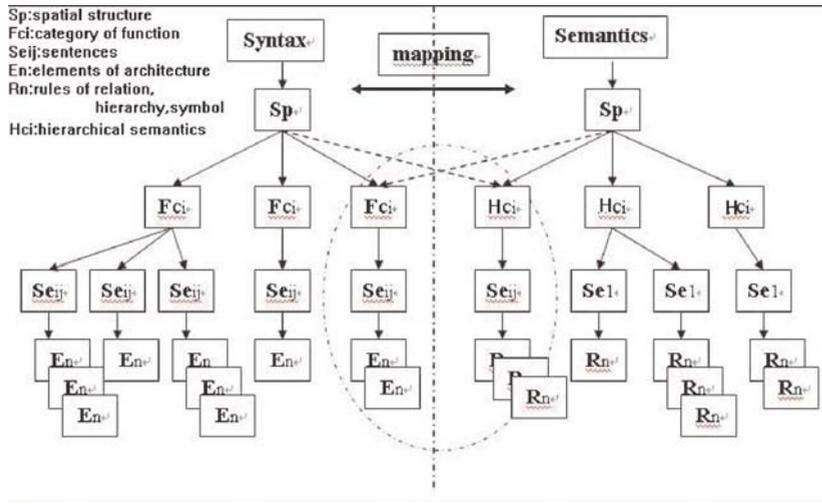of syntax elements syntax, values (X)}

Figure 2. The mapping strategy between syntax (the structures) and the social semantic concept (the rules).

System and its Construction of Prefecture Cities in Ch'ing Dynasty?Provincial Capitals as Major Study, Taiwan.

WANG MING HUNG: 1993, FORM AND RULE, THE HD PRESS, TAIWAN.

Chiou, Shang Chia and Krishnamurti, Ramesh: 1997, A Grammar of Taiwanese Temples, CAADRIA '97 [Proceedings of the Second Conference on Computer Aided Architectural Design Research in Asia / ISBN 957-575-057-8] Taiwan 17-19 April 1997, pp. 297-311.

Kang Li, Andrew: 1999, Expressing Parametric Dependence in Shape Grammars, with an Example from Traditional Chinese Architecture, CAADRIA '99, Shanghai (China) 5-7 May 1999, pp. 265-274.

Sanly, Suzan and Saglamer, Gulsun: 1995, An Architect/An Architectural Language and A Shape Grammar, Sixth International Conference on Computer-Aided Architectural Design Futures, Singapore, 24-26 September 1995, pp. 453-467.

Eastman, Charles M: 1991, A Data Model Analysis of Modularity and Extensibility in Building Databases, February 1991. Report No. 16.