Formal language of Lanna Shop House’s Façade in Lampang Old city, Thailand

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Abstract. This article aims to presents ‘the formal architectural language of Lanna Designs” that is a linguistic paradigm for decrypt the linguistic system which is hidden in the Lanna façade style. Lanna Designs present an identity of vital ordered and crucial articulated formal language which inherently set of mathematical rules for the arrangement of ornaments. The scope of this article is attempted to the morphology of façades of the ten shop houses which located in Lampang Old city and have familiar proportion and style. In this article, the sampling of façade buildings required proportion as three-stall and two-story with familiar style. The morphology is described based on terms of a symbolic encoding system that is represented as graphically building grammar. The system helps to emphasize commonalities in façade languages and propose a prototype of identified Lanna façade design. This methodology might be the option for decrypt or study in every facades style.

1. Introduction

This article attempts to decrypt the linguistic of façade which has style as Lanna design. It is suggested that the paradigm of computational representations in linguistic [1]. Furthermore, many of research attempt to expand their applicability to explain architectural language composition, Eilouti [2] is describes the FSA method which could define the style of Palladio’s design. The selected method has been represented by a string recognition device that is known as a finite state automaton. The concept underlying this automaton is borrowed from formal language studies. However, the advantages of formal language techniques to explain architectural language composition are still explored.

The Formal language is the regular language which represents the simplest form of language definition and process. The device is known as a finite state automaton (FSA). They consist of string (words) constructed from given alphabet of symbols (letters). It is a simple device to use defines to help classify strings into languages. A finite state automaton is an especially simple device to understand the language. Raksawin [5] is explains about Lanna shop house’s façade study which emphasizes only regionalism style. The method essential concerns about using a part of finite state automaton to decrypt the formal language of Lanna façade by the comparative relation with Eilouti method, [5]. Lanna shop house had classified by building physical in regionalism style, [6]. The building generally had two layers of the façade building; Inner façade and Outer façade. In this article will concern to study in two layers of façades.

Raksawin [5] ensured that this process could adapt to use to explain the formal language of Lanna Façade as the same of FSA. The essential of this method is classified alphabet of the symbol into language based on terms of symbolic encoding system to represent as graphically building grammar.
Moreover, this methodology could increase research boundary such as the meticulous elements of façade. By this newly methodology could be made a wider explore of façade study.

2. Context
Lanna Kingdom [8] (late 13th – 16th centuries) was situated in the north of Thailand with Chiang Mai as the center of the state. The northern area of Thailand used to be a majority part of Lanna and cover around 18 percent of the country’s land now is divided into nine provinces. Lampang Old City was one of the province which extremely important to the Lanna Kingdom before colonized by Siam or Kingdom of Thailand [1], [9]. By conservation of Natural and Cultural Environment centre was specified the conservation area for Lampang. The area is about 3.806 square kilometres which are located in Lampang three era areas. In the first era, it started on 13 B.E. the urban city was designed as a conch shell shape in the upper north of the land. The urban design was influenced by Hariphunchai (Former name of Lammun province) urban city. On 1845 B.E., the second era, the ruler of Lampang decided to expand the area to the south of the land where close to Wung River for start merchandising with other countries. The last era, began in 2325 B.E. the land expand to other side of river and prepare for train route which is appeared for connected Lanna with Siam (former name of Kingdom of Thailand). From the crucial history of this area, Conservation of Natural and Cultural Environment center is firstly chosen from its rich historical context as the Lanna building style and cultural diversity. Since 2420 B.E. [6] Lampang was the vital trade route along Wung River which was the most important river for forest concession process and trading with Burma Chan Yunan and Keng Tung.

3. The methodology
In this article examine the formal language of Lanna Shophouses Façade by encoding system which is a part of the idea of Finite state automata, it is a regular language. [5] The methodology to study Lanna Shop house facade has five stages of them.

3.1 Define style of sampling and Extrapolation and Digitizing sampling
Firstly, the definition the physical of Lanna Shop house building [5] and choose the sampling which has familiar proportion and style. Extrapolation and Digitizing are the methods to transfer the cross-referenced data by using a CAD program, [10]. The digitized drawings of individual shop houses within Lampang Old City area then form the empirical basis for the study.
3.2 Define L - line
This part aims to divide the façade area in horizon line for study. [5] Define L- line in four levels namely, L1 = Ground floor level, L2 = Entablature level, L3 = Second floor level, L4 = Roof level. However, in this article define five of L – line to divide in meticulous scale.

3.3 Define Q - line
This part aims to divide the façade area in vertical line. Define Q- line in four levels by considering from the edge of building and column [5]. The Q – line will start at Q1 – Q2 and will return to Q1 if the element which appears does not change. However, the system will continue to Q3 if the element has changed to other style or completely change the element.

3.4 Define symbol of each façade elements
This part aims to divide the façade elements in the symbol. The symbol consists of letter and number of each element. For example, W1 = wall with 1 window.

3.5 Translate symbol by string system
This part is considered to encode the façade elements to the symbol. For example;

\[
\begin{align*}
L1 &= C1 W34 V13 C1 W14 V13 C1 W34 V13 C1 \\
L2 &= C1 V13 C1 V13 C1 V13 C1 \\
L3 &= W51 W51 W51 \\
L4 &= W51 V42 V43 W51 V42 V43 W51 V42 V43 \\
L5 &= R3 R3 R3
\end{align*}
\]

4. The Lanna Design Study Sample
For the purpose of this study, the scope of analysis is limited to the design of Lanna Shop house’s façade which chosen from [4] The Preference studies of Lampang Shop house façades. In this Thesis, the criterion to chosen sampling was first chosen the similar proportion which was three-stall and two-story building. Definition about Lanna shop house style [7] that people realized the building as regionalism style with a height of the building that is not more than two-story. Many of the Lanna Shop houses have styles [8] of simple stores and Chinese commercial buildings were merged, becoming a single-or-two-storey terraced building of two-three units. The wooden floor was slightly raised. The wall was composed of wood planks. The gable roof or hip roof was covered with corrugated zinc steel sheets, baked clay tiles (Din khor) or kite-shaped tiles. Otherwise, there is a terraced house built with reinforced concrete and lime. Hip roofs can be found together with hip roofs can be found together with other forms. Stucco is mostly used to adorn the protruding balcony and other parts like vent, façade, beam, pole, and capital. It has the same style of Saranai building which was design mix between Chinese and early Victorian (Gingerbread House) architectural style with carved wood decorations.

![Figure 2. Lanna Shop house building](image-url)
In the following section, the methodology introduced in the previous section will be applied to selected Lanna facades to present their formal language. As such, façades of the ten buildings will be analysed according to their lexical structure and encoded in the form of formal language.

5. The Lanna Façade Language

The architecture elements appearing on the Lanna Shop house façade style display completely of all elements of a formal language that can be assembled into a finite alphabet and a finite set of composition rule. The major of this part will be to encode the elements of Lanna façade design. The main vocabulary elements shared by the facades of Lanna consist of wall units, columns, terrace, roofs and sculpture units. The Lanna vocabulary set consists of:

W: Wall unit
- W0 = space between wall and column.
- W1 = wall with 1 window. It has a variation W11, W12, W13 etc.
- W2 = wall with 2 windows. It has a variation W21, W22, W23 etc.
- W3 = wall with 1 door. It has a variation W31, W32, W33 etc.
- W4 = wall with 2 doors. It has a variation W41, W42, W43 etc.
- W5 = wall with door and window. It has a variation W51, W52, W53 etc.

C: Column unit
- C1 = Concrete Column in wall
- C2 = Concrete Column
- C3 = Wood Column

RA: Railing Unit
- RA1 = Concrete railing. It has a variation RA11, RA12, RA13 etc.
- RA2 = Wood railing. It has a variation RA21, RA22, RA23 etc.

V: Void Unit
- V1 = Wood void. It has a variation V11, V12, V13 etc.
- V2 = Concrete void. It has a variation V21, V22, V23 etc.
- V3 = Concrete and wood void. It has a variation V31, V32, V33 etc.
- V4 = Glass and aluminum void. It has a variation V41, V42, V43 etc.
- V5 = Glass and wood void. It has a variation V51, V52, V53 etc.

D: Decorate Unit
- D1 = Terrace concrete column. It has a variation D11, D12, D13 etc.
- D2 = Concrete brace. It has a variation D21, D22, D23 etc.
- D3 = Sculpture. It has a variation D31, D32, D33 etc.
- D4 = Tiny roof
- D5 = Frieze board
- D6 = Wood brace with decoration
- D7 = Wood panel decorate
- D8 = Strip wood panel

E: Eave Unit
- E1 = Wood eaves
- E2 = Concrete eaves

CA: Awning unit
- CA1 = Awning concrete
- CA2 = Wood Joist
- CA3 = Apron lining
6. Results and discussions

In this section, selected ten Lanna façade building will be represented by encoded symbols. For each Lanna façade, encoded diagram will be illustrated. This representation will describe the Lanna language of façade compositions.

Table 1. A formal language of Lanna Shop house’s Façade 01

| F0 | F1 |
|----|----|
| L1 0 | L1 C2 W3 C2 W3 C2 W3 C2 |
| L2 0 | L2 C2 V11 C2 V11 C2 V11 C2 |
| L3 D1 Ra1 Cal D1 Ra11 Ca1 D1 Ra11 Ca1 D1 | L3 C2 W41 C2 W41 C2 W41 C2 |
| L4 0 | L4 C2 W41 V11 D43 V11 D43 C1 W41 V11 D43 V11 D43 C1 W41 V11 D43 V11 C2 |
| L5 R2 E2 E2 E2 R2 | L5 R2 R11 R11 R11 R2 |
### Table 2. A formal language of Lanna Shop house’s Façade 02

| Fo | | F1 |
|----|---|---|
| L1 | 0 | L1 C2 W31 C1 W32 C1 W33 C2 |
| L2 | D2 C1 D2 C11 D2 C1 D2 | L2 C2 D2 V0 D0 D2 V0 D2 V0 C2 D2 |
| L3 | CA1 CA1 CA1 | L3 CA1 CA1 CA1 |
| L4 | 0 | L4 C2 W41 V2 D3 W41 V2 D3 W41 V2 D3 C2 |
| L5 | R2 E2 E2 R21 | L5 R2 R11 R11 R11 R2 |

![Figure 5 Lanna Shop house’s Façade 03](image)

### Table 3. A formal language of Lanna Shop house’s Façade 03

| Fo | | F1 |
|----|---|---|
| L1 | 0 | L1 C1 W34 V13 C1 W14 V13 C1 W34 V13 C1 |
| L2 | 0 | L2 C1 V13 C1 V13 C1 V13 C1 |
| L3 | CA3 RA2 CA3 RA2 CA3 RA2 | L3 W51 W51 W51 |
| L4 | C3 W0 C3 W0 C3 W0 C3 | L4 W51 V42 V43 W51 V42 V43 W51 V42 V43 |
| L5 | E1 E1 E1 | L5 R3 R3 R3 |

![Figure 6. Lanna Shop house’s Façade 04](image)
Table 4. A formal language of Lanna Shop house’s Façade 04

| Fo   | F1                        |
|------|---------------------------|
| L1   | 0                         | L1   | C2 W35 C1 W35 C1 W35 C2 |
| L2   | 0                         | L2   | V0 V0 V0                |
| L3   | CA1 CA1 CA1               | L3   | CA1 CA1 CA1             |
| L4   | W0 W0 W0                  | L4   | C2 W11 D31 D3 C2 W11 D31 D3 C2 W11 D31 D3 C2 |
| L5   | R21 E2 E2 E2 R21          | L5   | R2 R13 R13 R13 R2      |

Figure 7. Lanna Shop house’s Façade 05

Table 5. A formal language of Lanna Shop house’s Façade 05

| Fo   | F1                        |
|------|---------------------------|
| L1   | C31 W0 C31 W0 C31 W0 C31  | L1   | C2 W36 C2 W36 C2 W36 C2 |
| L2   | C3 E1 R2 C3 E1 R2 C3 E1 R2 C3 | L2   | C2 V14 C2 V14 C2 V14 C2 |
| L3   | 0                         | L3   | C2 D32 D3 C2 D32 D3 C2 D32 D3 C2 |
| L4   | 0                         | L4   | C2 D21 W13 D3 V46 C2 W13 D3 V46 C2 W13 D3 V46 C2 |
| L5   | E2 D21 E2 D21 E2          | L5   | E2 R11 E2 R11 E2 R11   |

Figure 8. Lanna Shop house’s Façade 06
Table 6. A formal language of Lanna Shop house’s Façade 06

| Fo  | F1          |
|-----|-------------|
| L1  | C1 W0 C11 W0 C1 | L1 | W39 W39 W39 |
| L2  | C1 W0 C11 W0 C1 | L2 | V15 V15 V15 |
| L3  | D33 D5 D5 D5 D33 | L3 | C2 CA1 W14 CA1 W14 CA1 W14 C2 |
| L4  | C2 R23 D6 D9 W0 D6 C32 R23 D6 D9 W0 D6 C32 D23 D6 W0 D9 D6 C2 | L4 | W14 V16 W14 V16 W14 V16 |
| L5  | R21 D51 R11 D51 R11 D51 R11 R21 | L5 | R21 R11 R11 R11 R21 |

Figure 9. Lanna Shop house’s Façade 07

Table 7. A formal language of Lanna Shop house’s Façade 07

| Fo  | F1          |
|-----|-------------|
| L1  | 0           | L1 | C2 W35 C2 W35 C2 W39 C2 |
| L2  | 0           | L2 | C2 V18 C2 V18 C2 V18 C2 |
| L3  | CA1 R13 CA1 R13 CA1 R13 | L3 | CA1 W52 CA1 W52 CA1 W52 |
| L4  | 0           | L4 | C2 D22 W52 V17 D41 C2 W52 V17 D41 C2 W52 V17 D41 D22 C2 |
| L5  | D22 E2 E2 E2 D22 | L5 | D22 E2 E2 E2 D22 |

Figure 10. Lanna Shop house’s Façade 08
### Table 8. A formal language of Lanna Shop house’s Façade 08

| Fo   | F1               |
|------|------------------|
| L1 0 | L1 C2 W31 C2 W36 C2 W36 C2 |
| L2 0 | L2 C2 V0 C2 V43 C2 V43C2 |
| L3 E1 R3 E1 R3 E1 R3 | L3 R3 R3 R3 |
| L4 0 | L4 C2 W27 D4 V46 C2 W28 D4 V46 C2 W37 D4 V46 C2 |
| L5 E1 E1 E1 | L5 R23 R11 R11 R11 R23 |

### Figure 11. Lanna Shop house’s Façade 09

### Table 9. A formal language of Lanna Shop house’s Façade 09

| Fo   | F1               |
|------|------------------|
| L1 0 | L1 C2 W36 C2 W36 C2 W36 C2 |
| L2 0 | L2 C2 D24 D25 D3 V19 C2 D24 D25 D34 V19 C2 D24 D25 D3 V19 C2 |
| L3 CA1 D1 RA12 CA1 D1 RA12 CA1 D1 RA12 D1 | L3 W35 W35 W35 |
| L4 C32 W0 E1 C32 W0 E1 C32 W0 E1 C32 | L4 W35 W35 W35 |
| L5 E1 E1 E1 | L5 R11 R11 R11 |

### Figure 12. Lanna Shop house’s Façade 10
Table 10. A formal language of Lanna Shop house’s Façade 10

| Fo  | F1             |
|-----|----------------|
| L1  | 0              |
| L2  | 0              |
| L3  | CA1 CA1 CA1    |
| L4  | D8 RA13 D8 RA13 D8 | L4 | C2 D8 W42 V18 D42 V18 D42 D8 W42 V18 D42 V18 D42 D8 W42 V18 D42 V18 D42 D8 C2 |
| L5  | D2 E2 E2 E2 D2 | L5 | R23 R11 R11 R11 R23 |

7. Conclusions

From the results, the ten of Lanna façades style which located in Lampang Old city are shown the familiar of elements. From the formal language of Lanna façade, it could conclude that the external façade had less ornament than internal façade. Some of elements appear as terrace (RA), eave (E) and awning (CA). It could summarize that Lanna façade always has terrace with concrete railing (RA1) on outer façade. In the inner façade, the walls with one door (W3) and void unit (V4) have many styles of doors more than other wall unit and void unit. It could discuss that door and void style are not significant for briefly as Lanna style. In both of façade layers, it could summarize that concrete column (C2) was the most popular element more than wood column (C3). Lanna façade was divided roof style (R) in two types otherwise, tile roof was preferable. Finally, A encoded system which comparative relation with FSA method can decrypt the formal language in clearly symbol and can representation and demonstrated to help add a different layer of façade to commonalities of system for classify elements language.

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