

## ***Shape Grammar for House Facade along the Alley in Urban Kampung, Tambora, Jakarta***

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### **ABSTRACT**

*The shape grammar can reveal the socio-spatial uniqueness that moulds the geometric shapes and elements of the house facade in a dense area of the urban kampung. The façade tends to not have the exact pattern due to adjustment of daily activities and needs in Tambora Jakarta. However, the grassroots have formed the pattern of events along the alley that represents contexts like milieu, economics, and social conditions. The alley has overlapping layers between private and public activities, which contribute to the geometric shapes and elements of the façade in Tambora. The house facade depicts activities and relationships inside and outside that manifest in geometric shapes and elements of the facade. Hereafter, this research combines the shape grammar for the geometric pattern of the facade and the pattern language for the qualitative contexts. The first step is categorising the geometric shapes and elements of the facade and the socio-spatial aspects into defined shape rules. Then, mapping the pattern language of activities and needs between inside-house program and outside-the use of space along the alley to delineate spatial relation. The result intends to comprehend the correlation between the logic of the geometric shape and facade elements concerning the qualitative context.*

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Tata bahasa bentuk mengungkap keunikan sosial keruangan yang membentuk geometri dan elemen fasad rumah di area padat kampung kota. Fasad cenderung tidak mempunyai pola tetap akibat penyesuaian aktivitas harian dan kebutuhan di Tambora, Jakarta. Namun, masyarakat membentuk pola peristiwa sepanjang gang yang merepresentasikan konteks seperti kondisi lingkungan, ekonomi, dan sosial. Gang memiliki lapisan bertumpuk antara aktivitas publik dan privat yang berkontribusi pada bentuk geometri dan elemen fasad di Tambora. Fasad rumah menggambarkan aktivitas dan hubungan antar ruang dalam dan luar yang termanifestasikan pada bentuk geometri dan elemen fasad. Selanjutnya, riset ini mengkombinasikan tata bahasa bentuk untuk pola geometri fasad dan pola bahasa untuk konteks kualitatif. Langkah pertama adalah mengkategorikan bentuk geometri dan elemen fasad dan aspek sosial keruangan sebagai aturan bentuk. Kemudian, pemetaan bahasa pola bahasa aktivitas dan kebutuhan antara bagian dalam – program ruang dan bagian luar – penggunaan ruang sepanjang gang guna mengilustrasikan hubungan antar ruang. Hasil riset bertujuan memahami korelasi antara logika bentuk geometri dan elemen fasad dengan konteks kualitatif.

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## 1. Introduction

Urban *kampung* (village), an informal settlement, has an adaptive process adjusting to daily activities and needs of grassroots that have translated into the house façade. The case study is along the alley in Kalianyar, Tambora, Jakarta, with distinctive milieu features, including a small river with three-meter width. The original alley on each side is only 50-60cm, and unique facades' response (see Fig. 1). An alley, a narrow street, becomes a centre of the crowd to socialise and work on ground level in the urban *kampung* (Desiyana, 2019). Meanwhile, the geometric shape of the façade is usually in disparate sizes, forms, and repetitions; nevertheless, the façade has similar types for architectural elements. Krier defines the facade as a show side facing the street that conducts the function and meaning of the building and conveys order and ordering between organisation room and cultural situation (Krier, 2010). Hence, the façade, located between the outside – public space along the alley and the inside – house program, plays a crucial role to disclose socio-spatial peculiarity.



**Figure 1.** Block plan, east alley elevation, and west alley elevation.  
(Source: Researcher, 2021)

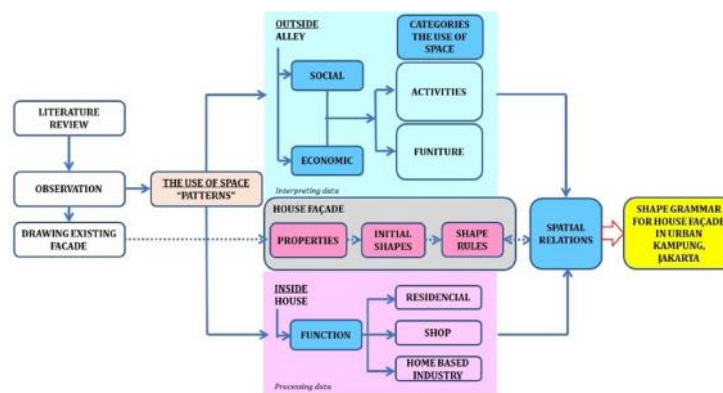
Furthermore, shape grammar has promised to reveal the form-making logic of the house façade in Tambora. In addition, shape grammar has laid a foundation for iterative computation thinking that proposes shape to compose form-making logic. The original works concentrate on calculating design by adopting mathematical logic and directly applying rules on shape, for example, painting and sculpture (Stiny & Gips, 1972), and Palladian plan (Stiny & Mitchell, *The Palladian Grammar*, 1978). Thus, the original works focus only on form-making logic without considering the context.

On the other hand, the further shape grammar works have begun to consider social and economic context mainly on an urban scale. Some works have tried to analyse existing design with different approaches, such as parameterization of urban spaces (Koltsova, Kunze, & Schmitt, 2012), urban grammar (Paio & Turkienicz, 2011), and flexible urban design (Duarte & Beirão, 2011). Then, the works have developed into design grammar (Lee & Gu, 2018), discursive grammar (Al-Jokhadar & Jabi, 2017), and descriptive grammar (Stouffs & Tuncer, 2015). However, there is a lack of elaboration with social and economic aspects or qualitative context for the form-making logic of the façade.

The resembling between pattern language and shape grammar has become a way to exert repetition and relationship, both the form-making logic and qualitative contexts. The pattern of architecture, events, and cities creates a set of parts and structures (Alexander, 1977). When a design comes from constructive thinking and shapes, it is reasonable to disassemble existing architectural forms into a set of parts, rules, and patterns. Shape grammar extracts the house façade, and pattern language digs socio-spatial events along the alley. The combination of those approaches assist in analysing the adaptive process of façade in Tambora, ultimately to answer, "How does shape grammar analyse the correlation between geometric and elements of the façade with the qualitative contexts in Tambora, Jakarta?"

## 2. Materials and Methods

### 2.1. Methods



**Figure 2.** Diagrammatic Thinking of Shape Grammar for House facade  
(Source: Researcher, 2021)

This research exerts shape grammar and pattern language approaches to decompose the basic shape of façade and correlate with qualitative factors. The first step is a literature review to comprehend those approaches in analysing existing design. Then, gathering data from the research area by observing and mapping. Processing data, the decomposition of house façade, employs grammatical rules, including façade properties, initial shapes, and shape rules. Interpreting data of social-economic context use the pattern language capturing daily activities related to spatial reasoning, including house function (inside), and categorise for the use of space (outside). Next, spatial relation correlates the house façade' components and qualitative contexts. The objective is to find spatial uniqueness with the logic of façade' form making. The final step is applying shape rules and spatial relations to the shape grammar of house façade.

### 2.2. Literature Review

#### 2.2.1 The Concept of Shape Grammar and Pattern Language

The research's framework examines a fundamental computation thinking of the existing architectural design to interpret and link geometric shapes with shape grammar and qualitative contexts with pattern language. First, shape grammar is a generative formalism that composed shapes and shape rules with repeated application rules on

digital computation (Jowers, Earl, & Stiny, 2019). Initially, the concept of shape grammar is the parametric design on the architectural plan (Stiny & Mitchell, *The Palladian Grammar*, 1978). Nowadays, shape grammar has become a guiding rule for science and theory of architectural design (Prakash, Shekhawat, & Goyal, 2017). In addition to that, the shape symbolically represents a set of parts and differs from symbols or words (Jowers, Earl, & Stiny, 2019). Second, the emergence of pattern language has substantially impacted the design process, ultimately related to computational thinking. Pattern Language defines the context, problem, design solution, and analysing patterns (Alexander, 1977). Thus, it is widely open to quantitative and qualitative contexts (Alexander, 1977). It develops into a context-knowledge model, which involves environmental, social, economic and normative entities (Gargaro & Fioravanti, 2013). Therefore, the concepts of these approaches in this research are:

1. Shape grammar defines initial shapes or properties of the facade and rules for shape composition.
2. Pattern language determines qualitative contexts or domains and patterns of activities and use of space.
3. Shape grammar and pattern language help to analyse spatial relations between the form-making logic of the facade and qualitative context.

### *2.2.2. Previous Shape Grammar and Pattern Language Works on Analysing Existing Design*

Most shape grammar analysis accentuates architectural and urban form when the analytical works are seldom related to form and context. Some examples focus merely on form analysis, such as Palladio's Villa (Stiny & Mitchell, *The Palladian Grammar*, 1978), Murcutt's house (Lee & Gu, 2018), Islamic pattern (Abdelsalam, 2012), Suakin House (AbdulRaheem & Rayis, 2016), historic building's facade (Dore & Murphy, 2013) and contemporary facade (Caetano, Santos, & Leitão, 2015). From those examples, there are some common analysing steps. First, it starts with sets of architectural properties to initiate form for a form making process. Second, the step determines patterns and rules as parameters to generate the design. In the end, the analysis stages of shape grammar need to categorise and relate the shape and vocabulary to determine the grammar of design.

The amalgamation between shape grammar and pattern language to analyse existing architectural and urban design helps to see design form responds to context or qualitative aspects. Some approaches have developed from both methods, such as urban grammar (Paio & Turkienicz, 2011), flexible urban pattern (Duarte & Beirão, 2011), the parameter of urban qualities (Koltsova, Kunze, & Schmitt, 2012), descriptive grammar (Montenegro, Beirão, & Duarte, 2011), and a rule-based design (Beirao, Duarte, & Stouffs, 2008). Those works have to define design parameters to analyse the pattern of public space with urban morphological elements.

The qualitative factors, including context, spatial reasoning, spatial qualities and function, assist the composition process of form using a ruled-based design. The former work on shape grammar includes the qualitative factors, such as combining spatial reasoning or social logic of space and discursive grammar or formal-topological relationships (Al-Jokhadar & Jabi, 2017) and façade typology of Malay Chinese Village Riau (Rangkuty & Widyastuti, 2019). Moreover, we need to define a set of rules of

geometry for the analysis and generation approach (Sönmez, 2018). Shape grammar utilises the typological and ontological approaches for context, domain and sets of relations (Stouffs & Tuncer, 2015). Hence, shape grammar and pattern language decompose and compose architectural or urban form correspond to qualitative factors.

Moreover, the predecessor works of shape grammar and pattern language on the existing design leaves some gaps:

1. The forms in previous works are in order, planned, and repetitive forms. However, it has not tried to analyse or compose adaptive, unplanned, and irregular forms. Therefore, the research of the house façade in Tambora is an initiation attempt to analyse the adaptive process of form-making logic.
2. The effort to combine pattern language with shape grammar is finite in an urban context; even it has investigated the correlation with the social logic of space. It creates a foundation to analyse public space along the alley with the house facades by adding the function of the building adjacent to the alley.
3. The stages of shape grammar are still suitable for interpreting data, where each stage of analysis must include qualitative factors.

### 2.2.3. The house façade in the Urban *Kampung*

The study of the house façade in the urban *kampung* is always in conjunction with public space on the alley. In this case, the boundary between public and private has blended along the alley in Tambora (Desiyana, 2019). Informal settlement exemplifies informal social and economic production by an incremental adaptive process (Dovey, 2016). Furthermore, it creates spatial negotiation by intervening in public space (Lirenza, Ellisa, & Paramitha, 2020). Moreover, it embodies the production and reproduction of social interaction space that influence the house façade (Pasaribu, Siahaan, & Tobing, 2020). Façade, as a part of architectural elements, represents socio-spatial distinctiveness, both shape composition and inside-outside activities. It conceives the initial shape and cultural identity. In a highly dense area, the alley has become a meeting area of the crowd, starting from domestic, social, and economic activities. The activities nodes and furniture along the alley have gradually affected the changing or incrementing house façade in an urban *kampung*. Based on previous works, there is a relation between form-making logic and the social logic of space. In this research, the social logic of space is for qualitative contexts, containing spatial use along the alley and building function inside the house.

## 3. Results and Discussion











### 3.1. Determining Domains, Pattern Language, and Sets of Relationships

The initiation of analysing house façade using an ontological approach determines domains and sets of relationships (Stouffs & Tuncer, 2015). This research uses an ontological approach, such as spatial utilisation, façade properties, house level, and façade position along the alley. Next, the typological approach or context (Stouffs & Tuncer, 2015) divides façade properties into walls, roof, stairs, terrace, balcony, railing, door, windows, ventilation, and canopy (Rangkuty & Widyastuti, 2019). Furthermore, the typological approach for spatial utilisation divides into inside and outside. Inside

contains a residential function (**R**) and residential mixed-function (**RS**). Meanwhile, outside is based on Domestic Activities (**Do**), Social Activities (**So**), and Economic Activities (**Wo**). Then, the house level divides into the ground (**GF**), first (**1F**), and second (**2F**) that represent the correlation inside and outside. Then, the house level divides into the ground (**GF**), first (**1F**), and second (**2F**) that represent the correlation inside and outside. The domain identification is a process to list the context and relate to organizational structure in pattern language (Alexander, 1977), sets of design (Koltsova, Kunze, & Schmitt, 2012) (Lee & Gu, 2018), and parameters for procedural facades (Dore & Murphy, 2013).

Furthermore, inside-outside utilisation made some patterns and sets of relations. The sets of relations have some categories that involve environmental, social, economic, and normative entities (Gargaro & Fioravanti, 2013). First, the inside has two conditions; (1) if the house is purely for residential (**R**), it has only **Do** for domestic activities and **So** for receiving guests; (2) if the house has a mixed-function, it has complete **Do**, **So**, and **Wo** for selling, buying, and working. The design requirements for **R** on **GF** are accessible and view to outside. The design requirements for **RS** on **GF** are similar, except for natural ventilation. Next, design requirements for **R** and **RS** on **1F/2F** are the view to outside, direct sunlight for drying clothes, access to a balcony, natural ventilation, access from the alley if the different user with the ground level. Second, outside along the alley has two conditions based on controlled domain or furniture in public space. First, the domestic activities as the extension of the house program have traced seating, cooking and washing tools only on **GF**, which need a shaded place, sufficient natural lighting, and near to house access. Second, overlapping functions both private – public activities such as motorcycle, seating, cooking tools, (un)movable trade furniture on **GF**. Seating has additional design requirements for community surveillance and sufficient natural lighting because grassroots can simultaneously supervise kids, chat, and plug grey hair. The additional requirements for motorcycles and (un)movable furniture are near road intersections or crowds because of economic activities. The patterns for using space uncover meaning and context (AbdulRaheem & Rayis, 2016), where different activities have differed architectural traces and requirements. Besides, the pattern of the façade has shown repeated fundamental relations and structured order (Paio & Turkienicz, 2011).

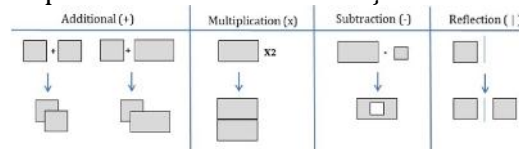
**Table 1.** Initial Shape and Parameter of The House façade's Properties

Properties	Initial Shape	Parameter Description
Walls		The wall follows the width (w) of the land border on ground level. On the first and next level, the width of the wall (w) adds one meter. The wall's average height (h) on each floor is 3 m.
Roof		The roof height is half of the wall height (h). The roof width is the same as the width of the wall (w) directly attached under it. The roof shape is a triangular prism; hence, there are two options.
Door		The door height (b) is two-third of wall height (h). The door width (a) is 0,9 m.
Windows		The window height is two-third of the door height (2/3b). The window width is (a) or (4/3a). The upper line of windows is always parallel to the upper line of the door.
Ventilation		The ventilation height is one-fifth of the door height (1/5b). The ventilation width is (a) or (4/3a). The underline of windows is attached or parallel to the upper line of the door.
Stairs		The stair height is as same as the floor height (h). The angle of the stair is 55°. The underline of windows is attached or parallel to the upper line of the door.
Terrace		The terrace height is as same as the wall height (h). The terrace width is as same as the wall width (w). The location is on the ground floor or first floor that has access from the alley.
Balcony		The balcony height is as same as the wall height (h). The balcony width is as same as the wall width (w). The location of the balcony is on the first floor or higher.
Railing		The railing height is one-third the wall height (h). The railing width is as same as the wall width (w). The location of the railing is attached with balcony.
Canopy		The canopy width is as same as the wall width (w) or activity space. The location of the canopy is attached with between each level of house



The façade's properties are the initial shapes, complete with the parameter depictions and description. In this case, the width of the wall maximises the land boundary on the ground floor when it mainly surpasses the boundary for one meter starting from the first floor and next floor. The height of the walls depends on the number of house levels. Like walls, the roof has the same width and two different shapes. The fenestration of windows, ventilation, and doors follows the needs of residents and the social-economic context. Stairs define the difference of house residents on the ground and first floor. The presence of railing is for safety and border starting from the first floor. Balcony only has access from inside house and terrace has direct access from outside to inside. Then, the canopy creates a shaded space, either attached or additional. Those façade properties are decomposition of house façade to define initial shape and parameter (see Table 1).

**Table 2.** Shape Rules for the House Façade in Tambora, Jakarta



The shape rules for this research are additional, multiplication, subtraction, and reflection (see Table 2). Additional can apply on similar or different initial shapes where each shape can pile up on top of the other. Different from additional, multiplication duplicates the shape to several shapes. For subtraction, it creates an opening on the plane. Meanwhile, reflection needs an axis to reflect the initial shape. The initial shapes and shape rules are stages on shape grammar that has the same meaning as a mathematical statement and architectural language component (AbdulRaheem & Rayis, 2016). The grammatical analysis extracts applied rules within the set of designs and reveal the spatial uniqueness of architecture building (Lee & Gu, 2018).

### 3.2. Shape grammars of the house façade in Tambora, Jakarta

After defining domains, spatial relations exhibit the cause-effect between the shape façade's properties and inside-outside utilities. It happens when shape grammars apply to the fixed part structure to accommodate the repeated application of the rule (Jowers, Earl, & Stiny, 2019). The facades trigger the use of public space along the alley, and social-economic activities mould the façade's form. The recomposition of the house façade follows the sequence of façade's properties on each floor. The result of analysing house façade using shape grammar, such as:

1. The domestic (**Do**), social (**So**), and economic (**Wo**) activities take place when the house has a shop or home-based industry (**RS**) on the ground level. It produces private-public space and furniture on the terrace and alley for those contexts. This type of house acts as a crowd attractor and meets with the public on **GF** (Desiyana, 2019); thus, the house has some openings, such as double windows and doors.
2. The domestic (**Do**) and social (**So**) activities occur on residential (**R**) as the result of the house next door with shop-residential function. Those activities bring public furniture and activities in front of the house. This type of house usually only has a





No	House Level	Façade Location	The Use of Space	Façade's Properties										
				Walls	Roof	Stairs	Terrace	Balcony	Railing	Door	Window	Ventilation	Canopy	
11	GF	Side	In RH	x3	+									+
			Out So, Wo											
	In RH													
	Out -													
	In R													
	Out -													
12	GF	Front	In R	+	+		+	+	+	+	+	+		
			Out So, Do											
	In R													
	Out Do													
13	GF	Side	In R	+	+	+	+		+	+	+	+		
			Out So, Do											
	In R													
	Out So, Do													
14	GF	Side	In R	+	+	+	+		+	+	+	+		
			Out So, Do											
	In R													
	Out So, Do													

Legends:

- GF Ground Floor
- 1F First Floor
- 2F Second Floor
- R Residential
- RS Residential-shop or home-based industry
- So - playing, chatting, supervising kids, plugging grey hair, looking for lice, storing)
- Do Domestic activities - cooking, washing clothes
- Wo Working - waiting for online orders, informal trading, storing

4. Conclusion

Shape grammar has an essential role in analysing existing design, not only its design, but it covers qualitative context. This paper is a start effort to comprehend phenomena in urban *kampung* using shape grammar for foundation computational thinking. The combination of shape grammar and pattern language approaches has helped to decompose and compose the logic of form and the social logic of space. Some keys to analysing the house façade in urban *kampung*; (1) Using the shape grammar stages, like initial shape, shape rules, spatial relations, and shape grammar; (2) The pattern language helps to identify the qualitative domain and the social logic of spaces, such as space utilisations, social-economic constraints, and spatial reasoning; (3) The pattern language in each stage of shape grammar has the purposes to eliminating, defining, interpreting, and analysing data.

The analysis of the façade has revealed the correlation between form-making logic and the social logic of space. Shape grammar helps to predict the form of the façade as part of the adaptive process in the urban *kampung*. The logic of the house façade includes (1) grassroots need crowds for informal social and economic production; (2) Their survival in the informal economy depends on the alley as the centre of public circulations and nodes; (3) The ground level, adjacent to the alley, is always converting and overlapping domestic, social, and economic activities; (4) The accessibility (door) and surveillance (windows) of the facade and types of public furniture in front of the house define the social logic of space; (5) The active frontage on the **GF** preserves social-economic activities and resilience. However, this research simplified the geometric shape of house façade due to a wide range of sizes and shapes. Therefore, this research needs further development about the logic of form and the qualitative context in the urban *kampung*.

## References

- Abdelsalam, M. (2012). The Use of Smart Geometry in Islamic Pattern: Case Study Mamluk Mosque. *6th ASCAAD Conference 2021: CAAD, Innovation, Practice* (pp. 49-68). Bahrain: The Kingdom University.
- AbdulRaheem, O. B., & Rayis, O. A. (2016). Design of Generative Model for the Language of Traditional Suakin Using Parametric Shape Grammar. *International Journal of Computer- Aided Technologies*, 3(2/3), 1-18.
- Alexander, C. (1977). *A Pattern Language: Towns, Buildings, Construction*. Berkeley: Oxford University Press.
- Al-Jokhadar, A., & Jabi, W. (2017). Qualitative Representation and Spatial Reasoning in a Rule-Based Computational Design Model. *The Virtual and The Physical: Between the Representation of Space and the Making of Space* (pp. 35-44). Wales: eCAADe.
- Beirao, J., Duarte, J., & Stouffs, R. (2008). Structuring a Generative Model for Urban Design: Linking GIS to Shape Grammars. *26th eCAADe conference proceedings* (pp. 929-938). Antwerpen: eCAADe.
- Caetano, I., Santos, L., & Leitão, A. (2015). From Idea to Shape, from Algorithm to Design: A Framework for the Generation of Contemporary Facades. In G. Celani, D. M. Sperling, & J. M. Franco (Eds.), *Computer-Aided Architectural Design Futures. The Next City - New Technologies and the Future of the Built Environment* (pp. 27-546). Sao Paulo: Springer.
- Desiyana, I. (2019). Interrogating Socio-Spatial Sustainability in Dense City: Case Studies in Kalianyar and Jembatan Besi. *SMART: Seminar on Architecture Research and Technology #3*, (pp. 119-136). Retrieved from <https://smartfad.ukdw.ac.id/index.php/smart/article/view/25>
- Dore, C., & Murphy, M. (2013). Semi-Automatic Modelling of the Building Facade with Shape Grammars Using Historic Building Information Modelling. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-5(W1)*, 57-64.
- Dovey, K. (2016). *Urban Design Thinking: A Conceptual Toolkit*. London: Bloomsbury.
- Duarte, J. P., & Beirão, J. (2011). Towards a Methodology for Flexible Urban Design: Designing with Urban Patterns and Shape Grammars. *Environment and Planning B: Planning and Design*, 38(5), 879-902.
- Gargaro, S., & Fioravanti, A. (2013). A Context-Knowledge Model for Architectural Design: A holistic approach by means of artificial intelligence techniques. *eCAADe 2013 Computation and Performance*, 1, 81-90.
- Jowers, L., Earl, C., & Stiny, G. (2019). Shapes, Structures and Shape Grammar Implementation. *Computer-Aided Design*, 111, 80-92.
- Koltsova, A., Kunze, A., & Schmitt, G. (2012). Design of Urban Space at Pedestrian Scale: A Method for Parameterization of Urban Qualities. *2012 16th International Conference on Information Visualisation*, 403-409.
- Krier, R. (2010). *Architectural Composition*. Hong Kong: Edition Axel Menges.
- Lee, J. H., & Gu, N. (2018). A Design Grammar for Identifying Spatial Uniqueness of Murcutt's Rural Houses. In *Computational Studies on Cultural Variation and Heredity, KAIST Research Series* (pp. 189-203). Singapore: Springer.
- Lirensa, F., Ellisa, E., & Paramitha, A. (2020). Spatial negotiations in domestic space of the home-based garment industry in Kampung Tambora, Jakarta. *IOP Conference Series: Earth and Environmental Science*, 1-11.

- Montenegro, N., Beirão, J., & Duarte, J. (2011). Public Space Patterns: Modelling the Language of Urban Space. *International Conference on Advances in Design Sciences and Technology, on Connecting Brains Shaping the World*. (pp. 1-13). Rome: EuropIA 13.
- Paio, A., & Turkienicz, B. (2011). An Urban Grammar Study: A Geometric Method for Generating Planimetric Proportional and Symmetrical Systems. *Nexus Network Journal*, 3, 151-169.
- Pasaribu, R. P., Siahaan, U., & Tobing, R. R. (2020). The Domination of Relationship Between “Function and Economy” in Production of “Public Visual View Space” on the “Open Façade” in Kampung Around Campus in Jakarta. *Advances In Natural And Applied Sciences*, 94-106. doi:10.22587/anas.2020.14.2.13
- Prakash, A., Shekhawat, H., & Goyal, G. (2017). Visual Calculation Through Shape Grammar In Architecture. *International Research Journal of Engineering and Technology (IRJET)*, 4(11), 293-301.
- Rangkuty, G. I., & Widyastuti, D. T. (2019). Architectural Typology of the Malay Chinatown Facade (Case: Perniagaan Street of Malay Chinese Village Bagansiapiapi, Rokan Hilir, Riau). *International Journal of Architecture and Urbanism*, 3(1), 95-110.
- Sönmez, N. O. (2018). A Review of the Use of Examples for Automating Architectural Design Tasks. *Computer-Aided Design*, 13-30.
- Stiny, G., & Gips, J. (1972). Shape Grammars and the Generative Specification of Painting and Sculpture. *C V Freiman (ed.) Information Processing 71*, (pp. 1460-1465). Amsterdam.
- Stiny, G., & Mitchell, W. J. (1978). The Palladian Grammar. *Environment and Planning B: Planning and Design*, 5(1), 5-18. doi:10.1068/b050005
- Stouffs, R., & Tuncer, B. (2015). Typological Descriptions as Generative Guides for Historical Architecture. *NEXUS Networks Journal: Architecture and Mathematic*, 785-805.