

# Typologies of Windows in Vernacular Buildings Based on Materials and Line Constructions: The Case of Kota Lama Semarang, Indonesia

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## Abstract

Typology studies in architecture are currently limited to the buildings as a whole, and not many have looked at architectural typologies that focus on architectural elements. Architectural elements are parts that contribute to the production of a building. This paper explores windows as an architectural element of buildings and their types. The research focuses on vernacular buildings in areas of urban heritage.

The study looks at a case study in the old city of Semarang “Kota Lama Semarang” a heritage area with vernacular buildings. The paper takes the position that architectural elements come in different types that contribute to architecture. For example, there are different types of doors and windows or columns. The study used a qualitative research method. Data was collected by direct observation of the elements, taking measurements and photos, and recording the data of windows in buildings in the old city of Semarang. The analysis involved cataloging the window characteristics based on material, understanding them and producing descriptions. The documentation provided supporting data for the research. Furthermore, a window classification catalog was carried out to identify the window types in vernacular buildings in the Kota Lama area of Semarang.

The findings show that there is a typology of material-based windows and line construction. The windows are made of wood, glass, steel and a mixture of various materials. This shows that the type of windows in this vernacular area has 4 types based on the material. Meanwhile, the form of lines resulting in the different types of windows in vernacular buildings in the heritage area. The type of windows based on line construction is thus composed of three types of repetitions: (1) vertical repetition; (2) horizontal repetitions; and (3) dimension repetition. This paper thus expands the discourse on typology, especially on architectural elements.

**Keywords:** Types, Typology, Vernacular architecture, Repetitions, Windows, Kota Lama Semarang, Indonesia.

## Introduction

Typology is understood as the study of the search for an original form or a particular type. The discussion of typology as a particular type shows that the most important thing is the essence, not the end result of architecture. According to Jean Nicholas Louis Durand in Vidler (1977), the essence can be obtained by a process of reduction, reducing the form of complex architectural objects to pure geometry or a solid basis. This essence can be redeveloped with certain parameters such as use, function, material, and form and thus become a new type. This cycle continues until a certain type is created over and over again. Currently, typology studies are still focused on discussing architecture as a whole, and not many see the elements as part of architecture.

Architectural elements are a part of the overall form of architecture, which consists of doors, windows, materials, and furniture, etc. Windows are elements that are widely discussed related to connectivity with the outside (Cetin, 2017; Wagenfeld, 2011). Similarly lighting (Wu, 2018; Zumthor, 2006), ventilation (Kartikasari et al., 2018; O' Donovan & O' Sullivan, 2023), and aesthetics have also been examined. This paper is based on the premise that windows are architectural elements that represent certain type. Thus, the study of the typology of architectural elements, especially windows, is important to broaden the discussion of typology in architecture. However, architectural elements such as windows are rarely discussed, especially to show the characteristics of a building. This is an important part of the architectural discourse.

There are many vernacular buildings in Indonesia. This paper looks at the architectural elements in the form of windows in vernacular buildings. In the old city area of Semarang, there are buildings with various types of windows. Certain buildings in the Old City of Semarang have more than one type of window in one building which has their own functions: one for circulation openings, one for lighting, and one for aesthetic functions. Seeing the essence of the windows in vernacular buildings in the old city of Semarang can show the existence of a typology that focuses on architectural elements.

This paper will be divided into several sections, the first section is related to exploring typology in architecture, classification of window types, then window typology in vernacular buildings in the urban heritage area. This paper aims to expand the typology discourse into a more detailed discussion, namely architectural elements.

## Theoretical basis

Typology is architectural knowledge related to type. According to Viddler (1997), in the 18th century, there has been a discussion on typology which divided types in architecture into three types. The first type describes that the architectural object must be returned to its origin. The second type explains that architectural objects are the result of the industrial revolution. The third type explains that architectural objects are part of urban space (Vidler, 1977). Meanwhile, Rafael Moneo (year) has talked about how architectural objects are linked to history along with existing realities so that they can maintain historical continuity. Moneo says that new types can be formed by modifying them through variations and deviations from an original type. The theory of Moneo provides architectural designs that objectively protect history and embrace the current culture and create complex urban spaces (He and Qi, 2019).

On the other hand, Durand (1809) has offered a conception of typology that reveals that typology requires architectural geometric reduction (Vidler, 1977). Durand's statement further explains that new types can be formed by reducing complex forms to a solid base (Vidler, 1977). This method not only generates large-scale typologies but also realizes urban relevance (Oechslin, 1986). However, from the typological discourse, not much has been discussed related to the typology of architectural elements, not as a whole, but as parts of architectural constituents.

Meanwhile, type studies began to develop into an approach to the development of architectural methods (Colquhoun, 1969; Vidler, 2013). Typological discourse has begun to develop when there were various debates related to the existence of a fourth or fifth typology (Jefferson, 2018). On the other hand, Vidler (1997) reveals that modern architecture can

identify the same basis, relying on the need to legitimize architecture as a "natural" phenomenon and the development of natural analogies which are very directly related to the development of production itself. Thus, the search for architectural types prioritizes the originality of an architectural form (Syoufa et al., 2022).

From the various discourses on architectural typology that have existed so far, this paper sees the potential to discuss the typology of the elements that are part of architecture, not looking at the whole building. This paper attempts to see in more detail how the essence of architectural elements can also be the basis for architectural design.

### Review of Literature

Tracing architectural elements in vernacular buildings is an effort to preserve architectural knowledge, one of which is by looking at doors and windows as was done by Hakim (2017) who explored the typology of doors and windows of Dutch colonial dwellings in Ciburuy Pasantren Tasikmalaya. This paper looks at the potential for tracing architectural elements, especially windows in conservation areas in the city of Semarang. This aims to see the existence of a typology of windows in conservation areas that can be developed as the development of today's architectural elements. Doors and windows are a threshold that can connect or separate the two areas (Simmel, 1994). The existence of windows is an important architectural element, apart from being an element that can enter light and air (Vatin and Gamayunova, 2014), windows are a link between indoor and outdoor spaces as revealed by Wagenfeld (2011).

The existence of windows reflects the architecture of a building, this is evidenced by the existence of various discourses related to the shape of windows which can indicate architectural style. Hakim (2017) said that the types, ornaments, and sizes of the doors and windows of each room have a character. Geometric shapes are widely used in the form of buildings and residential windows with the material used being teak wood. This shows that the material is one of the elements that make up the window typology. In addition, the discourse on windows in architecture cannot be separated from energy efficiency (Vatin and Gamayunova, 2014; Tikhomirov *et al.*, 2019). The selection of window types and their constituent elements is an interesting discussion for the development of architectural designs based on building elements. Tracing how the existing window types and reading them becomes a typology and can be developed into a new typology that has potential in architectural design.

Improving technology and materials is the basis of a design that focuses on energy efficiency, particularly in the making of architectural design decisions. Windows are one of the architectural design issues which are key factors in energy efficiency and functionality (Kaasalainen *et al.*, 2020). On the other hand, the importance of window elements as a constituent of the overall architectural design of the building has become the main discussion regarding the current design. This shows the possibility of uncovering different types of windows in buildings of different types. This is also one of the bases for the search conducted by Hakim (2017) when looking for window typologies in colonial buildings. Meanwhile, traditional houses in Ardabil have windows by considering the response to the regional climates in their designs (Feridonzadeh and Sabri, 2014). This study sees the potential to explore window typologies in vernacular buildings in conservation areas. This can be used as enrichment related to window typology as an architectural element.

### Research Method

This research uses a qualitative research method. It employs case study as a method focusing on vernacular buildings in an urban heritage area. Data is obtained by observation and is then analyzed and explained descriptively (Creswell, 2009). Data collection involves directly coming to the location, measuring, and taking photos of the windows. Collecting data directly helps traceability, especially those related to the micro aspects (Harani, Atmodiwirjo and Yatmo, 2021). Data is then categorized based on the function of the building and its location. To assist analysis, the data is cataloged into a search-based data. Catalogs are a method that can

help the analysis process (Harani, 2023). To help read the data, all windows are re-drawn with the appropriate size and shape that follows the original shape using AutoCAD.

The study focuses on the old city area of Semarang as the case study. The research was conducted in the Old City of Semarang, with a focus on the main streets of the Old City, Jalan Letjend Suprpto, Letjend Suprpto, Garuda, Cendrawasih I, Merak, Meliwis. This is an area that has a number of vernacular buildings in the city of Semarang. The area is quite specific because it is a conservation area being developed into a tourism area. Changes in the functions of the buildings are quite high (Harani, Werdiningsih and Riskiyanto, 2017). Thus, it is interesting to explore the typology of windows in this area. Even though the functions have changed, the positions of the windows in the buildings are still unchanged. To find the type of window that has been cataloged, a search is needed in the form of reading the data again and then looking at the building as a whole including the orientation of the building. This paper looks at shapes as a basic search method.

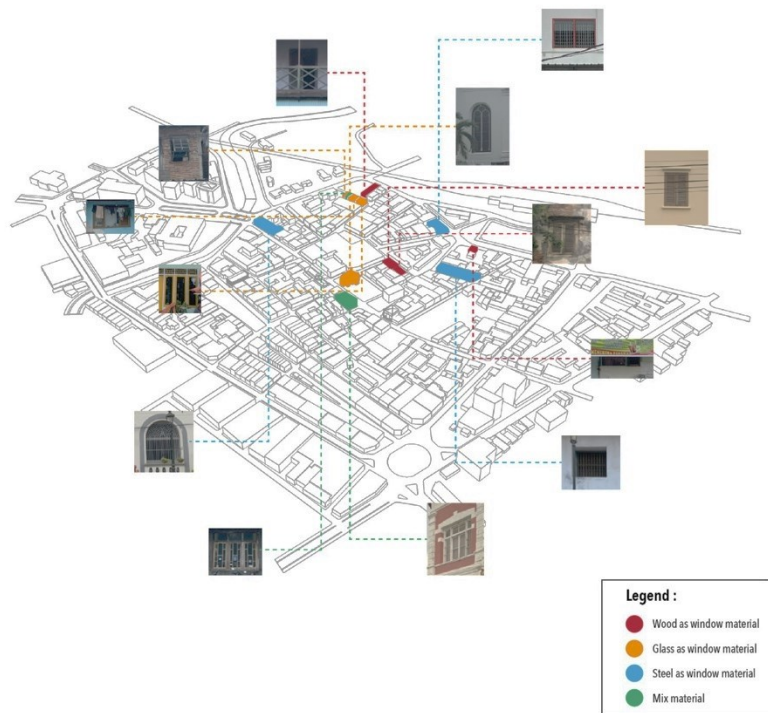
### **Findings and the Discussion**

Kota Lama Semarang established in the land of 31 ha in Semarang, has many heritage buildings that have been built since the colonial era (Harani et al., 2017). Most of the buildings have been influenced by colonial architecture, especially the Dutch style. Long ago, the function of the buildings was for offices and industrial buildings. However, nowadays the function of the building is going through transgressions due to the evolution of the area. The buildings now function as commercial buildings and housing, and some of them have just been abandoned (Harani, Werdiningsih and Riskiyanto, 2017; Sari, Harani and Wibowo, 2018).

Looking at the building façades, it is clear that there are more than one type of window (Said et al., 2020; Küçük, S,2014). The forms of the windows vary: there are rectangular-shaped, arc-shaped and also circular-shaped windows. Each window has its own function: there's a window that adds some sort of aesthetic function to the building, and the other window is for admitting and controlling light and air.

The digital drawings of the 117 windows in the heritage buildings in Kota Lama Semarang are presented below. There are 30 windows that were classified as preservation windows because they were in the preservation building. Rest of the 87 windows were non-preservation windows. The number of windows presented is just a sample of the buildings that exist in Kota Lama Semarang.

Window's Mapping



**Fig. 1:** Windows Mapping in vernacular building in Kota Lama Semarang  
Source: Authors


























Figure 1 shows window mapping on vernacular buildings in the old city of Semarang. There are various types of windows grouped based on material and shape. However, this paper focuses on discussing vernacular buildings. The data obtained shows that there are 117 types of windows. They are analyzed based on their shapes focusing on the composing lines of the shapes. The window type catalog is produced as shown in the Table. 1.

**Table 1.** Table of Windows Digital Redrawing  
Source: Author

 Foto 2706	 Foto 2706	 Foto 2711	 Foto 2719	 Foto 2727
 Foto 2575	 Foto 2576	 Foto 2576	 Foto 2578	 Foto 2579

 <b>Foto 2592</b>	 <b>Foto 2584</b>	 <b>Foto 2599</b>	 <b>Foto3991</b>	 <b>Foto 2584</b>
 <b>Foto 3869</b>	 <b>Foto 3838</b>	 <b>Foto 3863</b>	 <b>Foto 3863</b>	 <b>Foto 3869</b>
 <b>Foto 3043</b>	 <b>Foto 3043</b>	 <b>Foto 3023</b>	 <b>Foto 3011</b>	 <b>Foto 2996</b>
 <b>Foto 2970</b>	 <b>Foto 2970</b>	 <b>Foto 2595</b>	 <b>Foto 2959</b>	 <b>Foto 2021</b>
 <b>Foto 2015</b>	 <b>Foto 2015</b>	 <b>Foto 2015</b>	 <b>Foto 1933</b>	 <b>Foto 1933</b>
 <b>Foto 1988</b>	 <b>Foto 1988</b>	 <b>Foto 3462</b>	 <b>Foto 3465</b>	 <b>Foto 2336</b>
 <b>Foto 2348</b>	 <b>Foto 2314</b>	 <b>Foto 2340</b>	 <b>Foto 1988</b>	 <b>Foto 1980</b>
 <b>Foto 3581</b>	 <b>Foto 3579</b>	 <b>Foto 3550</b>	 <b>Foto 3556</b>	 <b>Foto 3559</b>




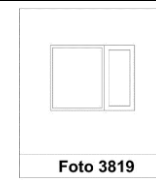

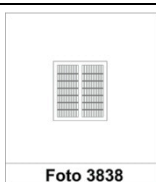


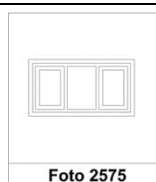



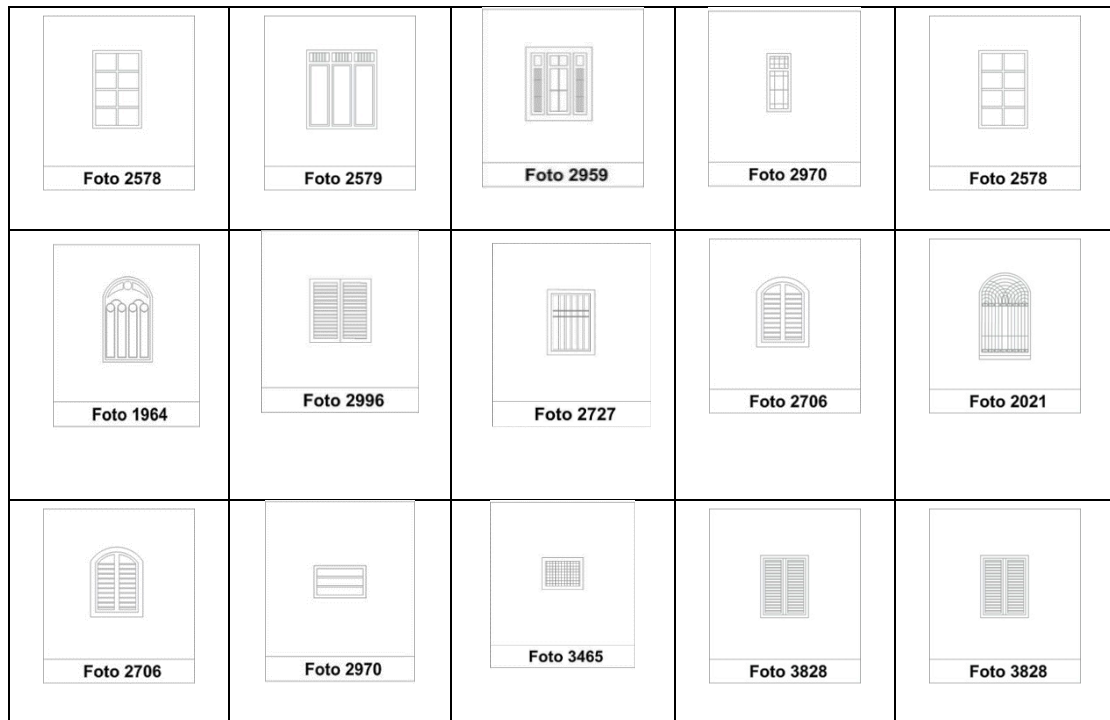
 Foto 3550	 Foto 3576	 Foto 3579	 Foto 3537	 Foto 3539
 Foto 1968	 Foto 2326	 Foto 2539	 Foto 2366	 Foto 3566
 Foto 1964	 Foto 1980	 Foto 3570	 Foto 3570	 Foto 3535
 Foto 1969	 Foto 3852	 Foto 3535	 Foto 3535	 Foto 3556
 Foto 3524	 Foto 3527	 Foto 3507	 Foto 2310	 Foto 3524

The window catalog shows the typology of the architectural elements. It comprises 25 window types as shown in the table 2. Among these 25 windows, the types based on 'line' as the basic shape constituent have been identified. Size is also considered in the search performed.

**Table 2:** Table of Windows Digital Drawing with Code Explanation

Source: Author

 Foto 2706	 Foto 2711	 Foto 2719	 Foto 3819	 Foto 3863
 Foto 3838	 Foto 3879	 Foto 3991	 Foto 2575	 Foto 2576



From the two catalogs above, following results show the type of window. The classification based on origins form are:

- (1) Rectangular; code 2719, 3819, 3863, 3838, 3879, 3991, 2575, 2576, 2578, 2579, 2959, 2970, 2578, 2579, 2959, 2970, 2996, 2727, 3465, 3828.
- (2) Combination; 2706, 2711, 1964, 2706, 2021.

The window classification based on the number of window leaves are:

- (1) one leaf windows; 2711, 3863, 3879, 2578, 2970, 2727, 2970, 3465.
- (2) two leaf windows; 2706, 2719, 3819, 3838, 3991, 2996, 3828.
- (3) three leaf windows; 2575, 2576, 2579, 2959.

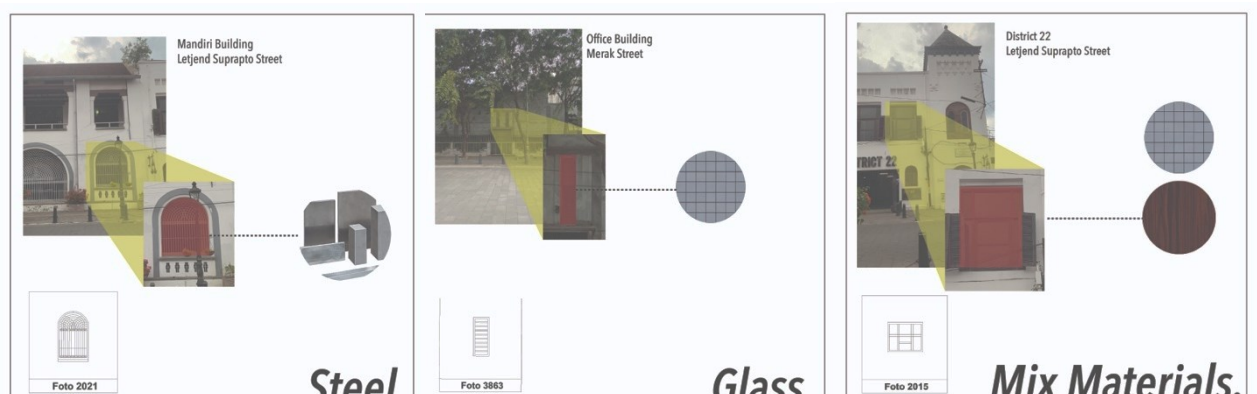
Window's Classification based on materials are:

- (1) wood; 2706, 2719, 3819, 3863, 3879, 3991, 2575, 2576, 2578, 2579, 2959, 2970, 1964, 2996, 3828.
- (2) steel; 2711, 3838, 2727, 2021, 3465.

Window's classification based on its function:

- (1) Air controller; 2706, 2719, 3838, 3991, 2996, 3828.
- (2) Light controller; 2711, 3863, 2578, 2970, 1964, 2021, 2970, 3465, 2579.
- (3) Both air and light controllers; 3819, 3879, 2959.

Based on the materiality, I tried to trace the window designs in vernacular buildings in the old city area of Semarang, and found that there are four types of materials that make up the windows. The four materials include: (1) wood; (2) Steel; (3) Glass; and (4) Mixed materials. The examples of window designs with these materials are as follows:





**Fig. 2:** Windows Mapping Material

Source: Authors

According to the building function, it can be concluded that for housing type of buildings use windows with 2 or 3 leaves and they function as air and light admitters/ controller. Housing types tend to use wood frame windows and can be opened and closed as the active window type. They use a rectangular form of windows. Banking type building use 2 window leaves that function just for the aesthetic value of the building. The material tends to be steel or wooden frame. The window of a banking-type building can't be opened, because it's just an aesthetic element for the building. For the commercial buildings, a window with 2 or 3 window leaves is chosen among other types. The window is an active window and thus it can be opened and closed. The material tends to be wood, steel, and also glass. The original form is more various in the commercial buildings; they use both rectangular and arc-forms of windows. The main function of a window in a commercial building is to control the air and light inside the building but also to compliment the esthetics of the building.

From the data that has been obtained, it can be found that various types of windows are arranged based on the line as the basic part. Arranged lines can be seen as being repeated based on a horizontal arrangement or a repetition based on a vertical arrangement. Since the window arrangement and dimensions are the underlying parts of searching for the window types, the result is that the repetition of size is also the essence of the window typology in the old city area of Semarang.

## Conclusions

This study concludes that there are two window typologies in vernacular buildings in the old town of Semarang, namely material-based and line geometry. Material typology can be shown by the presence of full material, mixed material and pure material. Meanwhile, for the lines that make up the shape, there is a repeating line typology.

This paper thus expands the discourse on typology, especially on architectural elements. The typologies that have so far been focused on the architectural discussion as a whole can be expanded to determine the type of elements that are part of the architecture. This shows that a part of a building can provides a more micro essence. A building can be presented from the architectural parts that compose it into a unified whole. The findings from this study can be developed as a basis for designing architectural elements which have only served as a complement to architecture so far. Architectural elements can show the essence and type of architecture through window typology.

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