Legibility of Building Facades and Imageability of Historical City Center, Case Study: Bukittinggi City Center

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Abstract. Urban design focuses more on organizing and structuring urban reality rather than the detailed design of the private domain. In this context, urban space legibility and imageability are the very important aspects in urban design. In fact, it is common for the development not to reflect the original characteristics of a region, so that the historical impression of the region fades. This study is aimed to describe the characteristics of "facades legibility" and "area imageability" along Minangkabau street as part of the historical city center of Bukittinggi. By structuring and organizing building facade elements, multi-themes of building facade legibility and region imageability could be extracted, they are development process image and development product image. Development process image presents the development urban space in colonial, post colonial, dan recent periods. Development product image presents a fundamental character change, from homogeneous-horizontal image to the dominant heterogeneous vertical impression. Horizontality reflects the existence of a communal or collective development. Heterogeneous verticality shows an individual or partial development, that presents conservative, moderate, and radical facade transformations of individual building. Therefore public process approach of designing cities based on the concept of urban heterogeneous self-image become the most important element in urban design management.

1. Introduction

Urban development is the result of various practical considerations such as function, use or utilization, costs, and availability of funds. In addition to solving practical problems, a criterion which is also very important in assessing the success of an incremental urban development is, whether the development of cities can "cure" or create a "unity" for the whole city. As Alexander once suggested, each stage of the development should be aimed at curing or creating unity of the whole city. Therefore, the design of the city, or the art of city building, is more focused on how to organize and structure the urban reality rather than focusing on the detail design of the private domain.[1]

The detail design of each building, if it functioned to cure the city, has three interrelated functions.[1] Those functions are above the interests of individual building, that is to enrich the design theme of the region; enhance the quality of physical, social and spiritual of a region or
strengthening the "genius loci", as well as develop urban space legibility and imageability, as the most basic function of building design. As one of the urban design principles, legibility means the possibility of structuring and organizing an environment within a coherent and imageable pattern. Reading an environment is a process obtaining spatial information from the environment. In this context, spatial characteristics influence the legibility. [2] These spatial characteristics are most easily perceived, because it concerns with the material side of an urban space that is visible to the eye. This material side of the city can be directly experienced or perceived by the senses of sight.

The complexity of architectural components in three dimensions determines the degree of urban space legibility. [2] The overall architectural components of the city is defined as the natural and artificial elements that make up the material side of the appearance of the city or urban space. Brendel stated that architecture of the city is made up of several components, namely: (a) natural conditions or situations; (b) silhouette of urban settlements; (c) the plan of urban settlements; (d) urban space; (e) building form; and (f) the furnitures of public space. [3] The basic unit forming the cities is the building design, includes building form and size, composition of buildings, and design of the parts of the building such as roof and facade. The complexity of the building components design determines the degree of its legibility and its associated urban space imageability, including in historical urban space.

Most cities have specific characters, built from multi-layer historical events and artifacts. It is clear that cultural built urban spaces of every city are the visual expression of their history matters, that represents their different historical layers or their sequential identities. Historic urban spaces or heritage related urban spaces are the cultural capital of urban places, which are important in shaping the future historical urban spaces. [4] The long period development in the historic city center district in West Sumatra, especially the city of Bukittinggi, cannot be separated from the problem of vanishing historical identity of the city, due to changes in individual buildings. To maintain and reinforce the historical identity of this central region, efforts are needed to control the development, by strengthening historical urban space imageability through increasing legibility degree of the associated architectural components.

Urban space image as an urban identity can be described as a place identity. Place identity is built from the merging of personal and social identities.[5] In this context, the interaction between individual and collective interests produces a complex entity of identities. The formation of such an identity has not been specified in advance, but has evolved through the interaction of individual or personal interest and collective or social interests through self-organization mechanism. The actions of many development actors to build their own identity, in individual or personal as well as in collective or communal way, which is not centrally controlled, gradually reach the limits of communication. In this situation, self-organization is inevitably needed. Self-organization mechanism appears if the evolving urban space identities are not forced into a predefined identity by anybody, but rather evolves by itself as a synthesis of personal and social identities. Self-organization or self-control, and self-regulation means a capacity of dynamism within a system that does not need external control to maintain order and stability, in case of occurring chaotic changes and challenges [6]

In order to maintain the specific character and identity of Bukittinggi historical city center, this study aimed to describes the characteristics of architectural components of the urban space in historical city center of Bukittinggi. Therefore, several research questions can be formulated, in relation to legibility, imageability, and identity of historic urban space, namely:

a) Which specific historical character of Bukittinggi city center can still be recognized or perceived (legible and imageable) ?

b) How self-organization mechanism build the legible urban space identity as a merging of personal and social indentity?

c) Which architectural elements or components are of important role in creating unity of the whole historical city center of Bukittinggi, which at the same time strengthen the "legibility" and "imageability" of Bukittinggi historical city center?
The legibility degree of a space will determine the level of sharpness space imageability. In context of the legibility degree of a space, visual communication is one of the important principles in designing the architecture of the city. Intact historical significance of a place will come to life if it can be read visually (legible). Without legibility, meaning of a place can be interpreted incorrectly or not at all. Regularity of the urban space is related to the way people perceive or read and understand the environment. Persepsual regularity becomes the basis for legibility or easier to identify and organize the parts into a coherent pattern.[1] Therefore, the challenge of creating urban space is to make the space becomes easy to read for the observer, by communication through sight and hearing, either overtly or subtly disguised. [7] This communication involves the use of proportional-scale, color, texture and detail so that the meaning or the image of the space presented itself. A space quality, that affect the ease of people to understand the possibilities offered, called the legibility. [7]

While the building is the basic unit forming the architecture of the city, architectural design of buildings is one of the city’s architectural elements that influence the formation of the image of a city or urban space. In the very dense urban areas, the parts of the building such as roof and facade, play important role in creating the legibility and imageability of the historical center of Bukittinggi. Legibility building facade character can be identified through the composition of the elements of building facade. There are many concepts that define legible building facades and its associated urban space, such as simple, coherent, perceivable, understandable, etc.[2] The other urban space legibility qualities, defined by Lynch consist of singularity, simplicity, continuity, dominance, clarity, clarity of intersections, directional differentiation, visual scope, motion awareness, time series, and name.[8] It seems that measuring legibility based on those concepts is not easy. On the other hand, according to DK Ching, visual component as the object of transformation and modification of building facade can be observed through the principles of formative idea, which is emphasis on geometry, symmetry, contrast, rhythm, proportion and scale. [9] Because persepsual regularity is concerned with legibility or easy identification and organization the parts into a coherent pattern, then to build the image sharp, unity of the relevant physical variables is the most important quality that can be achieved through harmony.[9] The most important quality of any work of art is the clarity of a single idea expression. Design of the city, therefore, aims to express the unity of its building design composition. [1] The composition of the urban design is the art of creating visual unity of elements that are very diverse. Visual unity suppose to created through harmony, which can be developed by simply using the repeat dimensions ratio or proportion, which is not influenced by personal feelings (subjective) but derived from objective reasons.[1] In general it can be said that the harmony in architecture can be derived from the shape of the building, windows, doors, and all the other elements in the building in accordance with certain ratios that are constantly connected to the other ratios.

From the above discussion on the building facade legibility and imagibility, it can be developed research conceptual framework as follows:

![Figure 1 Concept Framework of Research](image_url)

Variables or component of building facade design include: (a) The shape of the roof; (b) characteristic of horizontal elements; (c) characteristic of vertical element; (d) characteristic of solid-void; (e) characteristic of openings design; (f) characteristic of ground floor design; (g) the construction system; and (h) types of building materials, which are characterized by their properties, such as: (a) the style or typology; (b) geometry; (c) symmetry; (d) contrast; (e) rhythm; (f)
proportion, and (g) scale, that will influence the degree of legibility of the building facades. Legibility degree can be measured by the degree of unity and harmony, in which the unity degree will be measured by the level of continuity characteristics of each element of the building facade, and the harmony can be measured through the continuity of module or ratio order of each element of the building facade. In the end imageability urban space can be predicted based on the degree of legibility of building facade pattern.

2. Method
Based on the purposes of this research, this study is more analitical descriptive in nature, with a quantitative approach. This study did not arrive at the observer's perception to understand the image of the region, which should be explored with a qualitative approach. Imageability in this study is analyzed based on the quality of legibility as assessed by the objective conditions of the existing building facade design. Through the organizing and structuring of the elements of building facades based on the similarity in characteristics of building facades components and its physical changes, using information extracted from historical maps and documents as well as photographs and field survey, the study aimed to reveal various architectural categories and its development process which lead to the image formation of the historical city center of Bukittinggi (Minangkabau street).

Figure 2 Jalan Minangkabau or Minangkabau Street, as the study object, and Pasar Atas at present (source:https://www.google.com/search?q=jalan+minangkabau+bukittinggi&safe, accessed August 18, 2018)

Legibility degree can be measured by the degree of unity and harmony, in which the unity degree can be measured by the level of characteristics continuity of each element of the building facade, and the harmony can be measured through the continuity of module/ratio order of each element of the building facade. In this context, the degree of continuity can be determined by the percentage of buildings, as research samples, that have similar characteristics of its facade component. The higher the buildings percentage, the higher the degree of continuity and unity of the building facades characteristic, which in turn will determine the legibility degree of building facades pattern. In the end imageability urban space can be predicted based on the degree of legibility of building facade pattern.

This research is focused on the Minangkabau street as part of the historical urban space in city center of Bukittinggi. The location of this study was chosen based on consideration of the dynamic of the region development as a trade and tourism area. As an analysis unit or sample unit in this study is a building unit with one owner. The population in this study are all building units that line along Minangkabau street, which amount to 98 units. All these 98 units are analyzed (organized and structured) in this study to reveal their facades legibility degree and the imageability degree of their associated urban space.

3. Results and Discussions

3.1. Historical legibility and imageability of Minangkabau Street
The architecture of historical city usually formed through the accumulated changes in space over a period of time, within which there are many factors affecting each change until a city to be seen in its current form. [10] The present city form of Bukittinggi in West Sumatra Province can not be separated
from the historical background of city development, that has evolved from the time of pre-colonial era (the “nagari” era as the form of early cities in Minangkabau), the Dutch colonial era, the Japanese occupation era, the post-colonial era to the present. This city center has specific historical characters and hold specific physical evolution. The present urban space formation of Bukittinggi is influenced by the spatial form in every period of its development.[11],[12] Since the Dutch colonial period, the Japanese occupation, and the independence of Indonesia, Bukittinggi has always been the government center of Central Sumatra and Sumatra as a whole, with its various forms. [13] It shows the very strategically located Bukittinggi in the Bukit Barisan range. As the central government of Central Sumatra, Bukittinggi is equipped with various facilities and infrastructure, including civilian and military offices, markets, residential areas, garden, recreational facilities, schools, as well as the Clock Tower monument (Jam Gadang) which became a landmark of Bukittinggi.[14] Along with the city development, Bukittinggi was being crowded by migrants from various ethnic groups. Therefore Bukittinggi became a home of heterogeneous population. [14] Throughout its development, Bukittinggi experienced functional transformation from the symbol of colonial city the 1930s to the post colonial city the 1960s. [14]

In Bukittinggi, where heterogenous citizen live, the diversity of cultures has actually become an important part of the urban identity. In this context the present urban space formation of Bukittinggi, and also Minangkabau street region, is a result of the decisions and actions of many people which determine the future shape of cities. Therefore the public process of designing cities is of high importance since a city represents an urban social (cultural) diversity. [16] In this public process of designing cities plays the concept of urban self image the most important role. The concept of urban self image represents the very real but intangible perceptions of people about the essential qualities of their city. This urban self image becomes a reference for decision and action of many people to shape their urban space formation, through the mechanism of self-organization, self regulating, and self corecting. [15] The development of the trade center around the Jam Gadang monument, including the Minangkabau street, began when the Dutch East Indies government built the Pasar Atas in the 1900s. Along Minangkabau street there are shops that trades household needs such as electronic equipment, mobile shops, clothing, gold shops, pharmacies and other household equipment needs.[17] As part of the trading center of the city of Bukittinggi with a heterogeneous population, the building of shop houses or shops along the Minangkabau street undergoes rapid physical transformation and is very diverse, even tends to be chaotic in the first observation.

Figure 3. The various building facades design and transformation

By structuring and organizing building facades, based on the similarity of the building facade characteristic, the themes of building facade characteristics can be extracted and formulated as a tool to simplify and understand the character of building facades. Simplifying the building facade character in these themes will help strengthen the building facade legibility, which in turn will facilitate the introduction of regional image. The structuring and organizing of building facades in this study was carried out based on the classification of the age of the building units, the typology of building units,
the character of the transformation of building units from the original building, and the property similarity of building facades components design of all building units.

The result of building facades characteristic structuring and organizing reveals two main themes of building facades legibility and urban space image, namely the development or transformation process theme and the development or transformation product theme. The development process theme consists of two sub-themes, namely the time periods based transformation theme and self-organization based transformation theme. Meanwhile the sub-themes of the development product theme of building facade transformation includes the transformation degree theme and the unity degree theme that builds the image of the urban space or cityscape.

The time periods based transformation theme is represented by urban space image that are constructed from building facades as a reflection of the continuous stages of physical transformation of urban space in three periods, namely the colonial period (the 1920s – 1930s), post colonial period (the 1960s), and present. The colonial period is represented by the original two-story building with the jerkinhead roof, like a gable with a broken edge. This type of building with jerkinhead roofs was generally built in 1920-1930. [18] Shop buildings or shop houses at this time seemed to be built with the same concept as the Pasar Atas block design, with its horizontal characteristic. The buildings along the Minangkabau street were built by the Dutch government as a row of two-story houses with shops on the ground floor. The architecture of this two-story shop houses was a blend of Dutch architecture and tropical architecture. Buildings in the colonial period are only 13.3% of the whole building units.

(source:https://www.google.com/search?q=jalan+minangkabau+pasar+atas++bukittinggi accessed August 18th, 2018)

**Figure 4.** The row of shop houses from the colonial period and Pasar Atas buildings, which are dominantly horizontal

The post colonial period (the 1960’s) is represented by two-story buildings, with modern architectural styles that tend to be minimalist. This row of shop-houses buildings is still tied to the character of colonial buildings, especially in terms of the number of floors, openings design, roof type, and their other horizontal characteristics (see figure 5). This group of buildings dominates the row of shop houses with a total of 68.4%. While the group of shop houses built at present consists of buildings that are far from the characteristics of the original building, in terms of the number of floors (three-story buildings), openings design, roof type, and their other horizontal and vertical characteristics (see figure 6). Such building units are only amount to 18.3%. This physical developments phenomenon shows a tendency to leave and disregard the historical local values through numerous developmental changes which finally witnessed the gradual disappearance the local character and historical identity.
Figure 5 The row of shops houses of post-colonial period (1960s)

Figure 6 Row of shop houses representing the present period

The result of this study shows that the diverse building facade properties, that tend to be chaotic, are legible, which means that there is a possibility of structuring and organizing an environment within a coherent and imageable pattern in relation to the historical value as the "genius loci". The finding of this research confirms that historical urban space of Minangkabau street has specific characters, built from multi-layer historical events and artifacts. It is clear that cultural built urban spaces of Minangkabau street is the visual expression of their history matters, that represents their different historical layers or their sequential identities.

3.2. Urban space identity formation through self-organization mechanism

The second sub-theme of the development process themes is the self-organization based transformation theme, that consists of collective/communal transformation theme and partial / individual transformation theme. The collective/communal transformation theme indicated by groups of building units that have a unity or similarity in facade character, which is a reflection of the process of self-organization in groups, as shown in figures 4, 5, and 6. While the partial / individual transformation theme is characterized by individual building unit that has different facade character from the facades of other buildings, as shown in figure 3. These two sub-themes of self-organization based transformation theme are found in all three periods (colonial, post-colonial, and present period) of the buildings and urban space transformation or development.

3.3. The "legibility" and "imageability" of Bukittinggi historical city center based on unity of architectural components properties

As mentioned above the other legibility and imageability theme is development product theme, that represent the image that is built from the readability of building facades at the present time or one period of time. This development product theme of building facade transformation includes the transformation degree theme and the unity degree theme of building facades that builds the image of the urban space or cityscape.

By structuring and organizing the building facades based on their degree of change or transformation, there will be recognized three degrees of transformations, namely conservative, moderate and radical transformation. The conservative transformation of the building facade is indicated by changes that relatively do not cause changes to the original building as it was first built (13.3% of all building units). Buildings in this conservative transformation group are buildings...
representing the colonial period (figure 4). The moderate transformation of the building facades is indicated by changes in modern architectural styles that tend to be minimalist. This row of shopping buildings is still tied to the building character of the colonial era, especially in terms of the number of floors, openings design, and their horizontal characteristics. This group of moderate transformation buildings is the largest group (68.4% of all building units) representing the post colonial period (figure 5). Whereas radical transformation of building facades is indicated by a comprehensive change of the original building. This group of buildings with radical transformation is also a group of buildings (18.3% of all building units) that represent the period of present development period.

By combining the two themes of building facades legibility and urban space image, namely the development process theme and development product theme, as described above, can be recognized the existence of multi themes of building facades legibility and urban space images along Minangkabau street, within which all the sub themes and sub-sub themes are interrelated, as shown in table 1.

**Table 1.** Interrelationships among legible themes of building facade characteristics in the Minangkabau Street region.

| Development process theme: Time period based transformation theme | Development process theme: Self-organization based transformation theme |
|---|---|
| Colonial Period (13.3% of all building units) | Post Colonial Period (68.4% of all building units) | Present (18.3% of all building units) |
| Collective / communal development theme | conservative transformation* | Moderate Transformation* | Radical transformation* |
| 13.3 % | 53.1 % | 3.3 % |
| Partial / individual development theme | 0 | Moderate transformation * | Radical transformation* |
| 15.3 % | 15 % |

*: development product theme: transformation degree theme

The table above shows that the most of the building transformation as representations of the colonial period with conservative transformation and post-colonial period with moderate transformation are carried out through a collective or communal transformation or development and self-organization mechanism, which gives the impression of strong unity (high unity degree). On the contrary, building transformation carried out through partial/individual development is relative small in number compared to collective or communal development, and have no power to reduce the unity degree of building facades characteristic.

The result of this study reveals that the building facades properties in Minangkabau street area successfully enrich the design theme of the region, and therefore enrich the legibility and urban space image themes. Meanwhile, collective development through a self-organization mechanism can build the impression of strong unity on the characteristics of building facades throughout the region, and therefore improve the legibility degree of building facade characteristics and the imageability degree of associated urban space. This phenomenon shows the effectiveness of self-organization mechanisms in the development of urban space image.

Equally important are the unity degree themes, as part of the development product theme, which determines the physical image of urban space in a specific way. This unity degree theme is very important to be studied, since the physical characteristic of building facades is the first and easiest things to read by the observer in his efforts to understand the urban space. Unity and continuity together can achieve a harmonious facade design of buildings series through the regularity of the facade modules and the rhythm that is easy to read, which build a powerful image of the urban space. The roof style, horizontal pattern, vertical pattern, solid void pattern, openings pattern as well as ground floor design, system construction, and types of building materials, are the buildings elements,
that play the important role in achieving unity and continuity. Unity and continuity these facade elements are shown by uniformity in style, geometry, dimension, proportion, scale, symmetry properties, the nature of the contrast, the same rhythm.

Development product image presents a fundamental change in the character of the building facades along Minangkabau street from its original homogeneous-horizontal form to the dominant heterogeneous-vertical impression, due to domination of vertical facades components (see table 2), which build a firm boundary between one unit and another unit in a row of buildings. Horizontality reflects the existence of a collective/communal/integrated development, and verticality shows an individual or partial development. The heterogeneous vertical impression of facades is created by conservative, moderate, and radical facade transformation of individual building.

In the line of shop houses along the Minangkabau street, the characteristics of building facade elements, that play an important role in achieving unity and continuity, can be described and presented in the form of percentage of building units that have similar facades characteristics, as shown in table 2. The specific facades characteristics owned by most building units build the unity and continuity of facade elements as the main requirement of urban space image building.

### Table 2. Percentage of buildings with the same facades elements characteristics.

| No | Building Facade Elements | Percentage of buildings with the same characteristics of their facades elements |
|----|--------------------------|--------------------------------------------------------------------------------|
|    |                          | Style/Geom.-type DimENSION Propor-TION Scale SymmeTry contrast rhythm          |
| 1  | Roof                     | 59% 85%                                                             | 90% |
| 2  | Horizontal pattern       | 63,5% 85,7% 68,6% 85,7% 63,5% 14,3% 85,7%                       |
| 3  | Vertical pattern         | 100% 85,7%                                                         |     |
| 4  | Solid-void pattern       | 77% 63,5% 85,7% 68,6% 85,7% 63,5% 14,3% 85,7%                   |
| 5  | Openings pattern         | 68% 63,5% 85,7% 63,8% 85,7% 63,5% 14,3% 93%                      |
| 6  | Groundfloor design       | 85,7%                                                               |     |
| 7  | construction             | 70,5%                                                              |     |
| 8  | Material                 | 70,5%                                                              |     |

Table 2 shows that each facade component of the building along the Minangkabau street has an important role in building unity and continuity through the dominance of module or ratio regularities, as well as building facades similarity. Visual unity suppose to created through harmony, which can be developed by simply using the repeat dimensions ratio or proportion, which is not influenced by personal feelings (subjective) but derived from objective reasons. This is indicated by the high buildings percentage that have characteristic similarity in each building facade element or component. This means that, the line of buildings along the Minangkabau street that seem chaotic at first glance, actually have a relative high degree of building facade legibility and a strong physical image of the associated urban space.

The phenomenon of urban development and transformation along the Minangkabau street shows that urban design is a result of the decisions and actions of many people which determine the urban space formation or future shape of cities. Cultural diversity has become an important part of the urban identity. One major of urban design issue has always been how to synthesize these many interests into meaningful physical form. In this context, the public process of designing cities management, focusing on the efforts to incorporate cultural and social diversity into urban design strategies, is of high importance. [17] The concept of urban self-image becomes the most important element in this public process of designing cities. Urban self-image represents the real but intangible perceptions of people about the essential qualities of their urban space, that must be explored, articulated, and communicated.
to formulate themes and focuses for development or revitalization activity.[14] The business of the public process of designing cities management is to identify the various constructions of urban self-image that exist in people’s mind and bring them into as much consensus as possible, through hermeneutics and dialectics method. [19] The development of historical city center of Bukittinggi can not be seperated from the reality that the city is a place where heterogeneous people with different ideas participate in the struggle over what their city will look like. To be a friendly city, the physical space of historical city center of Bukittinggi should ensure both heterogeneity and difference or the right to be different.[20] Therefore the concept of urban self-image become the most important element in public process of designing cities management.

4. Conclusions
The historical city center of Bukittinggi has actually specific historical physical evolution and specific characters, that are multi-theme images. These multi-theme images consist of two basic themes of building facades legibility and and imageability, they are development process image dan development product image. On one hand, the development process image present the development urban space in colonial, post colonial, dan recent periods. On the other hand development product image present a fundamental change in the character of the building facades along Minangkabau street from its original homogeneous-horizontal form to the dominant heterogeneous vertical impression, represented by a firm boundary between one unit and another unit in a row of buildings. Horizontality reflects the existence of a collective/communal or integrated development, and verticality shows an individual or partial development. The heterogeneous vertical impression of facades is created by conservative, moderate, and radical facade transformation of individual building. The multi-theme or multi facet of building facades legibility and the associated urban space imageability of the historical city center of Bukittinggi represent the reality that this urban space is a place where heterogeneous people with different cultures and ideas participate in the struggle over what their city will look like. To be a friendly city, the physical space of historical city center of Bukittinggi should ensure both heterogeneity and difference or the right to be different.[18] Therefore the concept of urban self-image become the most important element in public process of designing cities management.

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