Building Facade Transformation of Shophouses Viewed From Sustainability Principles
Case Study: Shophouses in Bandung City

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Abstract. This study is based on phenomenon of shophouse’s facade transformation in cities which is made after shophouses are built for business identity. Viewed from sustainability perspective where ‘sustainability’ is defined as able to maintain continuation with minimal long-term effect on the environment—the changes on shophouses building façade materials is indicated as energy wasting problems.

The study was conducted in Bandung, Indonesia. The first part of this study is intended to draw typology out of the quantity changes of building facade and to trace the driving factors for its typology. The Conclusion of this study shows a high requirement for facade transformation which is categorized as Minor, Medium and Major changes that forced by inadequacy of the original design in representing the accommodated function, activities or products. The next part of the study aims to provide several recommendations and innovative solution to prevent excessive use of building materials as well as energy waste that goes against sustainability principles.

Keywords: bandung, building facade, shophouse, sustainability principles, transformation

1. Introduction

Shop-house is designed to accommodate both dwelling and business unit needs [1]. This type of architecture could be found almost at every emerging city in Indonesia. These buildings are typically characterized with rectangular form with its narrow front size and has two or three floor levels. In Bandung, shop-house buildings are commonly found in districts along the city’s main downtown roads.

Shop-houses’ facade transformation could be viewed as a response to specific needs related to the shop’s functions and formed a “new quality” of urban streetscape [2]. Viewed from sustainability perspective, the transformation of building facade can potentially contribute to building materials wastage as well as specific energy wastage in term of quantity and quality [3].

The first stage of this study is concentrated on the amount/quantity of material being used in each type of changes that range from minor to major changes which is indicated as total dismantling and replacing old facade. Another form of transformation is related to blocking or allowing natural light into the building which is increasing energy consumption either for cooling system or lighting.
This study attempts to analyze the transformation of shop-houses’ facade in Bandung City through the perspective of sustainability principles which specifically first based on wasted materials quantity. The result of this study would serve as a foundation for the formulation of concept and recommendation that can contributes to more efficient and sustainable design for shop-houses building facade. Literature Study

2. Literature Study

2.1. Facade Review
According to Taywade [4] the word “facade” originates from French façade, which means “front” or “face”. Thus, building facade can be simply defined as the front part of a building. Facade is the visual element an observer would first notice of a building. Through facade, one can form a general idea of the building’s interior function [5]. As well meaning and interior space organization [6].

The appearance and image of a building are strongly influenced by various elements that form the building’s character [7]. The facade configuration elements that make up a building’s image are:
1. Openings elements such as doors, windows and aesthetical openings.
2. Geometries/ shapes which can either be solid (massive) or transparent (void).
3. Dominant materials such as glass, timber, etc.
4. Finishing type and method i.e., exposed concrete or natural stone that creates different impression compare with painting method.
5. Color combination.

The facade of shophouse in this case—is usually constructed by several single elements that together form a particular unity to express a particular characteristic. These single elements, among others, are material, color, texture, door, window, wall, roof and ornament. These elements are arranged in such a way to create an image or dramatic effect according to the function of the building.

2.2. Transformation Review
Widyastomo in Antoniades [8] said architectural transformation is a change process that occurs gradually until an ultimate phase is reached whereby the change is conducted as response to external and internal influence. Transformation of form in architecture can be subtractive, additive or substitutive to a building form or volume. Debaigts [9] identifies five main reasons of shophouse’s facade transformation as follow: (1) The type of business conducted and product sold; (2) Commercial policy; (3) The nature, appearance, and quality of the product sold; (4) The competition; and (5) Architectural constraints.

2.3. Sustainability Principle
Architecture sustainability of building encompasses all of the building’s cycle; from construction to operation, conservation and demolition phase. In this context, facade as a part of a building possesses an important role in ensuring sustainability and energy-efficiency.

Building and sustainability are inseparable in the context of management of materials and energy efficiency [10]. Building material changes in finish-constructed architecture product is generally could be counted in two categories such as materials inefficiency and energy inefficiency [11]. The amount of materials inefficiency is not always parallel with high energy inefficiency. Dependent to each material used the energy inefficiency is counted from its exploration at the environment until seen as part of constructed architecture elements. This includes the energy used for transportation from (mining) site to production, production process, transportation to construction site, site preparation, its construction and maintenance. Both of those basic thinking also direct or indirectly have an impact to environmental condition.
In this research, general variables related to the studied sustainability principles are generated from greenship rating tools assessment criteria (Verse 1.2) which was formulated by Green Building Council Indonesia (GBCI) in 2013 [12]. With regard to the topic of shophouse’s facade transformation, this study gives emphasis on this following GBCI criteria: (1) Energy efficiency and conservation that includes natural lighting and ventilation; (2) Indoor health and comfort that deals also with view to the outside of the building, visual comfort and thermal comfort; (3) Air quality and comfort.

The assessment of the aforementioned criteria is then identified with the transformation that affects shophouse’s facade elements such as exterior color, signage/banner installation, door modification, wall demolition, etc

3. Research Methodology

This research applies qualitative method and employs direct observation technique to study the physical condition of the objects also equipped by interview with several informants with relevant knowledge on the studied issues.

Based on the result of the observation and interview could be identified type of transformation. Which is then classified into several categories based on the significance of the changes. Impacts on sustainability are further studied through each type of transformation.

3.1. Sample Location and Determination

One-hundred shophouse’s samples and their owners/tenants are chosen as the subject of this research’s observation and which are located in 3 sub-regions (SWK): Cibeunying, Gedebage, and Bojonagara. Geographically. These three Sub-Regions are situated on the eastern, central and western part of Bandung City.

The three Sub Regions are valued as good representations of the city’s general characteristic, as:

a) Cibeunying is characterized through its higher education institution, culinary and trade services as well as heritage area (including chinatown shophouses).
b) Gedebage could be identified form its industrial and residential area and is prepared as primary service area of Bandung.
c) Bojonagara which is located in the western part of Bandung serves as one of the city’s main gates. It is also characterized through its major transportation hubs such as airport and train station besides its commercial functions.

Shophouses taken as samples are of row type—each row consists of several shophouses with at least one shophouse has undergone facade transformation.

3.2. Data Analysis Technique

Data from observation and interview are used to determine the changes on the facade elements of the shop-house buildings from their original form. A scoring method is then applied to classify those changes into three categories: Minor, Medium and Major changes. Those changes could fundamentally be an addition or subtraction to the facade elements. Addition of facade element that includes installation of signage, addition of ornament, installation of secondary skin and other exterior structures such as canopy and stairs. Meanwhile, subtraction of facade element could be manifested in changes from opening to massive wall or demolition of facade wall, etc.

Result of the transformation—which takes into account business type, road classification and other influenced factors on the building’s facade—is subsequently reviewed in accordance to sustainability principles, with emphasis on material usage and energy wastage aspects

4. Analysis And Result

Based on the data gathered from 100 shophouse samples in three Urban Sub-Regions (SWK)—Cibeunying, Bojonagara and Gedebage—researchers assess each type of facade modification using a scoring method. For the purpose of this assessment, the types of modification are distinguished as
follow: (1) addition of building floors, (2) modification of building roof, (3) modification of doors, (4) modification of windows, (5) installation of signage components on the facade wall displaying business brand, advertisement, etc. (6) addition of secondary skin/wall panel/sunshading /double skin, (7) addition of building material; and (8) addition of exterior elements (such as stair and terrace canopy).

4.1. Analysis of Facade Transformation Typology

Based on the assessment and the total score accumulated the transformation is determined in three classifications as follow:

1. Minor Facade Transformation Typology
   This typology encompasses changes mostly in the form of ornament addition that does not require deconstruction of existing facade elements. Common practices are addition of name board, terrace canopy etc. In this scene replacement of the building’s second skin material that does not cover the whole facade.

2. Medium Facade Transformation Typology
   Observation shows several cases where changes are made through the addition of giant signboard that blocks the building openings, the addition of secondary skin, the installation of stairs/steps, as well as the modification of doors, windows and even roofs. These changes has visually transformed part of the facade into a completely different form.

3. Major Facade Transformation Typology
   Several shophouse buildings exhibit transformation on almost all facade elements, including wall, openings, roof, and the number of the building’s floor. These changes often trigger the dismantling of existing walls as well as openings, which in turn transforms the building facade into a completely different form. This type of transformation is classified as major facade transformation.

4.2. Analysis of Shophouse’s Facade Transformation in Three Urban Sub-Regions (SWKs) of Bandung

From a total of 100 shophouse samples made up by:

- 40 samples from Bojonagara Urban Sub-Region,
- 30 samples from Cibeunying Urban Sub-Region, and
- 30 samples from Gedebage Urban Sub-Regions;
As many as 37% have undergone medium transformation, 34% minor transformation, and the rest 29% total transformation. The cases of shophouse’s facade transformation can be found almost evenly on all types of road, from arterial to collector and local road but are more prominent on secondary collector road. The majority of the cases also occurred to shophouses with two floors or more. In general, the most common types of business accommodated by shophouses with minor, partial or major facade transformation are retail, service and culinary.

Table 1. Sample of Transformation Classification Based On Material Components

| Building Facade Components | Minor Typology | Typologi Medium | Typologi Mayor |
|----------------------------|----------------|-----------------|---------------|
|                           | Exterior Repainted | Signage component | Building skin material |
|                           | Terrace canopy | Another Elements Addition | Advertisement board |
|                           | Secondary Skin | Stairs | Doors |
|                           | Roof | Railing/ Fence | The Walls and Its Components |
|                           | Floors | Addition |

Figure 2. Transformation Classification Result Based On Material Component
4.2.1. Minor Facade Transformation. Cases of minor facade transformation are most prevalent on collector roads and found in almost equal number in all three Urban Sub-Regions. In Bojonagara Urban Sub-Region, minor facade transformation amounts to 35% from a total of 40 samples; in Cibeunying it makes up 29% of total 30 samples; while in Gedebage, 38% of total 30 samples (Figure 3a and Figure 4a).

The most frequent change found in this typology includes the installation of name board (72%, and more prevalent in shophouses with service business); the addition of terrace canopy (36%, typically in shophouses with culinary business); and the modification of exterior paint (31%, in shophouses with culinary and retail business).

The most common types of business catered by shophouses within this minor category are service (26.47%) and retail (38.23%). The service businesses are generally locally-scoped; such as beauty shop, bank, travel agent and printing service. Similarly, the retail businesses within this classification are primarily shops that aim to cater to the daily needs of local residents, with their scope of service limited to the surrounding neighborhood. These locally-scoped shops include, among other, clothing store, stationary store and food store.

4.2.2. Medium Facade Transformation. Cases of medium facade transformation are also commonly found in the area alongside collector roads.

Transformations within this category include modification/replacement of doors (40%), modification of windows (36%), installation of advertisement board (34%), installation of secondary skin (33%), modification of roofs (18%) and addition of stairs/steps (1%). In 29% of the total samples, the additions of secondary skin and advertisement board have put a stop to the function of existing windows (Figure 3b and Figure 4b).

The most prevalent types of business within this category are service (24.33%) and retail (35.14%).

4.2.3. Major Facade Transformation. In the case of major facade transformation, 45% of samples are located in Bojonegara Urban Sub-Region and 52% are on collector roads.

About 27% of the total shophouses sample has dismantled their original facade walls and openings, replacing them with a completely new facade design. Adding new floors onto existing building structure is also another common practice that prompts major facade transformation, as found in 17%
of total sample. Lastly, the addition of railing, which requires dismantling of some of facade elements, amounts to 12% (Figure 3c and Figure 4c).

The types of business catered by shophouses in this category are culinary (34.5%), retail (17.23%), service (20.69%) and others (27.58%).

The percentages of minor, medium and major facade transformation by elements are shown in Figure 4. Minor transformation involves repainted signage, exterior and interior building skin, and terrace canopy, each comprising 25%, 15% and 10% respectively. Medium transformation includes advertisement board, secondary skin, stairs, doors, and windows, each comprising 10%, 15%, 5%, 20%, and 25% respectively. Major transformation is represented by railing/fence, the walls and its components, floors addition, and exterior repainted signage, each comprising 10%, 5%, 5%, and 50% respectively.

Figure 4. Percentages of Minor, Medium and Major Facade Transformation by Elements

Another Elements

Figure 5. Shophouses with Minor, Medium and Major Facade Transformation

4.3. Analysis of Shophouses Facade Transformation Based On Sustainability Principles

Viewed from sustainability principle, the medium and major typology are two classifications of facade transformation that encourage most significant material wastage. In medium transformation, change on doors and windows causes wastage of existing material, while simultaneously encourages considerable energy consumption through the use of substitute material such as aluminum. Other changes such as the installation of secondary skin also potentially increase energy consumption rate by way of the materials used; especially when the secondary skin is constructed from metals such as iron, aluminum, etc.

In major transformation, material wastage becomes a byproduct of changes on almost every aspect of facade element; considering that almost all existing material are discarded and replaced by the new ones. Old materials—which supposedly could be used for longer period—are dismantled and replaced by newer ones which could probably be produced through a process that requires higher energy consumption.
4.4. Factors Causing Shophouses Facade Transformation

Through observation and interview, researchers are able to identify several factors causing shophouses facade transformation as follow:

- The needs of signage to represent the products, brand and business; and the lack of space on the original facade that could cater to such needs. Owners/tenants often do not have other options but to install signage in front of the existing facade, although this practice would subsequently obstruct several original elements such as walls and window openings from view.
- The change of the building’s function; where the 2nd and 3rd floor are transformed from living space into business/commercial space such as cafe, restaurant and shop. This prompts owners/tenants to dismantle parts or the whole outer walls on the upper floors to accommodate the new function.
- Shophouse’s design as a whole cannot represent the building’s function as well as the products and brand, which prompts owners/tenants to modify the facade according to their needs and preferences.
- Some tenants already had a certain standard operational procedure (SOP) for their business design, especially in types of business such as bank, health clinic and fastfood restaurant.
- The needs to provide additional protection shield to the building (i.e. secondary skin and canopy) with various purposes such as reducing heat intensity from direct exposure to sunlight and preventing rainwater from entering the building.
- The absence of regulation concerning the function, business type and building facade of shophouses means that owners/tenants have a complete freedom to make change as well as exploration on the facade.
- The needs to replace poor quality construction material and facade structure used by developer with better ones.

Table 2. Tabulation of Analysis on Shophouse’s Transformation in Each Business Type

| The Typology of Transformation | Leased (unfunction yet) | Hotel | Education | Services | Office | Culinary | Shops | Mix-used |
|--------------------------------|------------------------|-------|-----------|----------|--------|----------|-------|----------|
| Minor                          |                        |       |           |          |        |          |       |          |
|                                | 0                      | 0     | 3         | 9        | 2      | 5        | 13    | 2        |
|                                | 0%                     | 0%    | 8.82%     | 26.47%   | 5.89%  | 14.70%   | 38.23%| 5.89%    |
| Medium                         |                        |       |           |          |        |          |       |          |
|                                | 0                      | 0     | 1         | 9        | 7      | 5        | 13    | 2        |
|                                | 0%                     | 0%    | 2.70%     | 24.33%   | 18.92% | 13.51%   | 38.14%| 5.40%    |
| Major                          |                        |       |           |          |        |          |       |          |
|                                | 1                      | 2     | 6         | 6        | 0      | 10       | 5     | 4        |
|                                | 3.45%                  | 6.59% | 3.45%     | 20.69%   | 0%     | 34.5%    | 17.23%| 13.79%   |
| TOTAL                          |                        |       |           |          |        |          |       |          |
|                                | 1                      | 2     | 5         | 24       | 9      | 20       | 31    | 8        |
|                                | 1%                     | 2%    | 5%        | 24%      | 9%     | 20%      | 31%   | 8%       |

5. Conclusions

The result of this study shows a high requirement for facade transformation in shophouses as a result of the inadequacy of the original design in representing the shophouses business’ function, activity and product. The transformation contributes to energy wastage especially through the use of construction material against sustainability principles.

In conclusion, the above phenomenon should be treated as an evaluation whereby an all-inclusive synergy is needed, encompassing all parties from developer, consumer (owner and tenant), designer and builder, to government, to ensure that facade be designed according to the shophouses function so as to minimize changes and energy wastage.
6. Recommendation
This research will be conducted through several stages. This paper represents the first stage, where analysis on facade transformation with regard to sustainability principles is only based on preliminary observation and literature study.

The next stage will deal with further study, where the transformation will be researched more specifically by using GBCI criteria with emphasis on source and cycle of material being used in the transformation.

Recommendations drawn through this study are elaborated as follow:

- In the area of spatial planning, a categorization system of shophouses needs to be provided; developed based on the identity of each activity to ensure a more distinguishable facade design.
- In the aspect of architectural design, shophouses facade should be able to address the need for signage elements such as name board, advertisement board and so on.
- The use of recyclable materials should be encouraged in shophouses with high risk of transformation in order to reduce environmental load.
- The prospect of developers selling shouphouses with just in-construction-frame facade should be taken into consideration to allow would-be owners to design their own facade.

![Figure 6. Example of design recommendation for shophouse’s facade with space for advertisement](source)

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