Visual quality evaluation of urban commercial streetscape for the development of landscape visual planning system in provincial street corridors in Malang, Indonesia

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Abstract. The visual aesthetic experience in urban spaces is important in establishing a comfortable and satisfying experience for the community. The embodiment of a good visual image of urban space will encourage the emergence of positive perceptions and meanings stimulating the community to produce a good reaction to its urban space. Moreover, to establish a Good Governance in urban planning and design, it is necessary to boost and promote a community participation in the process of controlling the visual quality of urban space through the visual quality evaluation on urban street corridors. This study is an early stage as part of the development of 'Landscape Visual Planning System' on the commercial street corridor in Malang. Accordingly, the research aims to evaluate the physical characteristics and the public preferences of the spatial and visual aspects in five provincial road corridors in Malang. This study employs a field survey methods, and an environmental aesthetics approach through semantic differential method. The result of the identification of physical characteristics and the assessment of public preferences on the spatial and visual aspects of the five provincial streets serve as the basis for constructing the 3d interactive simulation scenarios in the Landscape Visual Planning System.

1. Introduction
Indonesia is well known as a developed country with a high density of citizens, including Malang. Malang is a historical city designed by Dutch at the first era of its development, and later on becomes a dense city with a rapid growth of vehicles, building developments, and city dwellers. Thus, this condition leads to lack of control of the proper governance of the city. Moreover, Malang also is the second biggest town in East Java, has played a prominent role as an educational city in Indonesia, inviting a large number of students from many regions to live and study in this town. As a result, Malang has grown significantly in economic since there are plenty activities related to an economical aspect. On the other hand, five provincial streets crossed the city functioning as the intercity track between cities, which has become the mode of inter-city transport movement. Many universities and schools surrounded four of the five roads accommodating high intensity of youthful activities from
day to night as well as commercial live also. Thus, this path becomes an essential and strategic route, which has led and accelerated to the uncontrolled rapid growth of trade and services sector along this streetscapes. Furthermore, the fast and uncontrolled growth of commercial function in those streetscape has led to the lack of comfortable space for pedestrians, availability of street amenity, completeness of street furniture, and less but not least, the lack of visual and spatial comfort. New commercial buildings with a different style of façade, color, material and various commercial signage have led to chaos in visual order. As a result, this affects the visual comfort in pedestrian space, as seen by city dwellers walking alongside the street. In the study and planning of urban streetscape, it is essential to observe the growth and the development of its architectural embodiment. Street corridor reflects the quality of urban space and represents the character of the city at once. According to Jackson (as cited in Porteous [6]), the city should provide its citizens with a continuously satisfying aesthetic and sensory experience. It means that the aesthetic experience is significant for making cityscape. City planners must be able to accommodate the creation of urban space that can ensure the production a comfortable and satisfying experience for the community.

The establishment of high visual quality of urban spaces is aimed to raise up a good urban image. According to Nasar [5], every person possesses own perception and association, either in the positive or negative, to the surrounding environment as well as to every element that shaped image in the neighborhood. The creation of good urban visual will encourage the emergence of proper perception and meaning, thus invites the public to produce a good reaction on its urban spaces. An excellent visual quality of city streetscape will give a good visual aesthetic experience for the community and psychologically create a positive thought and action. Moreover, forms of urban environment both physical and non-physical form an interwoven perception and appreciation closely with humans. Preferences of urban streetscape depend on how the public perceive the values embodied in the formation of the city. Similarly, the human preference greatly influenced by the values generated by the creation of the city. Urban space becomes a space medium that is responsive to the values that exist in human beings with the perceptions values that generated by the formation of urban space. Further, an excellent visual quality for the pedestrians is a fundamental issue needed to be paid attention to city government, community and professionals including architects and city planners for the sake of increasing a pedestrian comfort and creating a better urban living by reducing private vehicle usage by the citizens.

The linkage between visual qualities studies of pedestrian space with the prominent features in the built environment has been found in the literature. According to Rapoport as cited in Nasar [5], places have many features and consist of fixed features, semi fixed features, and non-fixed features. Consequently, it needs to conduct a study involving a group of people in a particular area to determine a prominent feature in the built environment. Moreover, assessment of visual qualities in pedestrian space should include an emphasis on space form as an object of art evaluated by people experiencing the pedestrian space. There fore, this study uses two approaches namely perceptual-cognitive judgment, and evaluative responses. The former refers primarily to the characteristic of the environment, relate to the performing direct physical measurement as well as visual observation along sidewalks. Meanwhile, evaluative responses relate mainly to the observer's emotional response to the environment by conducting people preferences method about the spatial and visual quality of pedestrian comfort.

Several studies proved that public participatory combined with virtual environments and web technology method had been used to perform a spatial and visual quality assessments of pedestrian comfort. Santosa et al. [10] carried out the development of 3D Interactive Simulation System (3DISS) as a medium to enhance visual comfort in pedestrian space through public participation. The communities will feel appreciated by having opportunities to actively participate in decision-making process in creating and ensuring a more comfortable and satisfying pedestrian space. Moreover, several researchers have developed VE systems and user (web) interfaces for building consensus. Santosa et al. [3] developed a spatial decision support system using web-based 3D visualization. Koga et al. [6] developed a landscape planning support system for public participation that also used models
as an analog tool. Shen and Kawakami [11] developed a visualization tool on a multi-user platform to represent design alternatives and supplement traditional presentation material for reaching a consensus on townscape designs. A new approach system of public participatory through online public participation utilizing virtual environments and web technology is highly appealing since the use of virtual environments media is beneficial in understanding the spatial pattern planned. Furthermore, the advanced of virtual environments in planning support systems also require an active user interaction for interaction to 3D objects in the world of 3D models. Through an active interaction and navigation, the user is expected freely explore the space as well as assess it. Another researcher also has been focused on user interaction studies. Conniff et al. [1] performed the development of virtual environment system to compare an active navigation and a passive observation of user interaction. Santosa et al. [9] developed a user interface design that combines three models of 3D simulation: passive observation, active navigation, and dynamic interaction.

Several studies also have shown that the combination method of the Semantic Differential (SD) and Virtual Environment (VE) has been widely used to assist research associated with the streetscape analysis. Several researchers have shown that the combination of VE and SD method was adequate capable performing the streetscape's evaluation (Koba & Kishimoto [2]; Koizumi et al. [4]). Other researchers conducted typology method and image analysis methods, using pictures, maps and even computer graphic images (Yoshimura & Tsukamoto [12]).

The above references show the importance of public preferences and the decision-making system through Virtual Environment simulation as a coupling method for the evaluation of visual quality in urban space. Hence, this study performs a people preference through semantic differential method (in the first stage) that combined with the development of Virtual Environment (VE) system (in the second stage). The study results of the first stage will be used as the baseline data to develop a VE system for the public participation activities in the following research for the sake of preparing a Decision Design Support System (DDSS) for assessing and enhancing a spatial and visual comfort in pedestrian space.

2. Objectives and methodology
This study aims to evaluate the visual quality of the evolving a commercial streetscape of provincial street corridors in Malang based on the physical characteristic and the public preferences of spatial and visual comfort. According to Kaplan as cited in Santosa [10], preference judgment is a powerful tool for understanding the patterns underlying what we consider aesthetically pleasing.

2.1. Research location
The case study area is located in Malang, Indonesia. The research focuses on five commercial provincial street corridors, which are Tlogomas Street, MT Haryono Street, Soekarno-Hatta Street (which is a new commercial development area in the north-western part of Malang), Borobudur Street, and Ahmad Yani Street, as presented in Figure 1. These streetscapes lie on the strategic sectors playing a prominent role in commerce and service, surrounded by high dense settlements and educational facilities.

2.2. Research framework
As illustrated in Figure 2, this research is on the first stage of multiple staged-projects which are intended to develop a Landscape Visual Planning System to support the implementation of city improvement involving stake holders (government, community, experts). The first phase of the research is the fundamental step of the research focusing on two principal activities. Firstly, the identification of physical characteristics of the commercial street corridor on the five provincial street in Malang. Secondly, the assessment of public preference on the visual and spatial quality of the commercial street corridor in the five provincial street in Malang. The results of both research activities will be an important step for the next stage to construct and develop the Landscape Visual Planning System. The development of this system is part of the development a prototype of Decision
Design Support System for landscape improvement of a street corridor. This system performed three-dimensional interactive modeling simulation application in the virtual environment. The decision-making system on interactive modeling system utilized parameters of interactive modeling based on the visual and spatial characteristic preference parameters generated in the first stage of the research.

**Figure 1.** Map of the research location.

**Figure 2.** Research framework.
2.3. Research method

The first year of the study performed a field survey method and a people preferences. Field survey methods applied field observation activities through documentation and measurement of visual and spatial elements in commercial provincial street corridors. Meanwhile, the method of public preference, one of the research approaches in the field of environmental aesthetics, applied a semantic differential scales through the use of bipolar scales of the different attributes measuring the public's assessment of the visual and spatial qualities of the commercial provincial street corridors.

2.3.1. Data gathering of the physical characteristic. Data collecting indicating the physical existence of street corridors consists of three steps. Firstly, taking sequence photos using a pocket camera on 20 points of each street, which 2 sided direction of each spot. These pictures are used to investigate the type of street profiles on each corridor which later can contribute in creating 3D modeling of spatial and visual comfort improvement in study areas. Secondly, taking a continuous photo of every building facade alongside the corridors to create a photo montage of each street which plays an important role to classify building functions and build a general picture of street corridors. Thirdly, identification of physical characteristics on five commercial provincial street corridors by structured field survey divided into six categories, i.e., building use, setback and building profile, building façade, sidewalk, tree canopy, street furniture.

2.3.2. Questionnaires. Spreading questionnaires consisting of two groups of global independent variables, i.e., spatial comfort and visual comfort, which consist several sub variables. Sampling methods used non-probability sampling with purposive sampling technique. This technique does not provide the same possibilities for each element of the population to be selected into the sample. Sampling was performed by taking into account the factors of knowledge, confidence, and experience of researchers and used as consideration for determining the members of the population to be selected for a sampling. Research sampling consists 90 pedestrians who walk in the study areas on each street corridor between 9 AM to 5 PM. Age of respondents was required aged 18 years and over so that they capable of understanding the questions and providing an assessment of the visual quality of the commercial streetscape objectively. The total number of respondents is 450 respondents. Variables used in this research are intended to concentrate the respondents' assessment against the visual and spatial comfort of the five provincial street corridors. The questionnaire uses research variables which refer to the 12 variables of spatial comfort and nine variables of visual comfort, as shown in Table 1.

| Dependent Variable | Variable | Independent Variable |
|--------------------|----------|----------------------|
| Spatial and visual comfort for pedestrians | Spatial comfort | Sidewalk function, sidewalk position, sidewalk dimension, sidewalk material, walking continuity, building border width, building setback, street furniture position, street furniture type, vegetation type, vegetation function, vegetation position. |
| | Visual comfort | Visual appearance variety, region dominant colour, street corridor transparency, building appearance uniqueness, building height proportion, visibility proportion, human height & building height proportion, human height and street furniture proportion, signage visibility. |

Semantic scale measurement refers to the method of Thurstone scale. The measurement is intended to analyze the public preferences on the visual and spatial comfort of the five provincial street corridors. The semantic scale contains items organized by level of intensity, from high to low. Respondents will be asked to put each item statement, in one of the seven category scales. The neutral point is in grades 4, while the average value of > 4 has indications tend to be positive and for the mean value which <4 have indications tend to be negative.
2.3.3. **Data analysis.** The method used to analyze questionnaire results is multiple linear regression. This method attempts to model the relationship between all explanatory variables and a response variable by fitting a linear equation to observed data. Moreover, this analysis can be used to determine the most influential variable affecting spatial and visual comfort in study areas.

3. **Development of commercial streetscapes in provincial street corridors**

As designed by Dutch architect in the early era of development of Malang, this city is well-planned based on city planning rules which focussing on region aesthetic, related to a geographical condition which is surrounded by mountains with fascinating panorama and clear fresh weather. In the present, as the city develops, there are some changes made by city government and citizens causing the city to slowly leave its characteristics which are intimately related to the history of city planning and development. The interests of various parties on behalf of the commercial aspect and the optimization of urban land have changed the face of the town to be less aesthetic. The city's aesthetic climate response architectural which is prioritizing visual comfort has long been forgotten.

The important role of provincial streets is to function as the intercity track between cities, which has become the mode of inter-city transport movement. Thus, this road becomes a critical and strategic route, which has led to the rapid growth of trade and services sector along this streetscapes. The five commercial streets studied in this research are the provincial street that plays important roles in business and commerce centers in Malang. The streets are located in strategic areas adjacent to several famous university campuses, including the University of Brawijaya Malang. These streets have become Central Business District (CBD) areas formed in the post-colonial era, replacing the Kayutangan Street which is the Central Business District during the Dutch colonial period. Along with the development of Malang as the second largest student city in East Java after Surabaya, these 5 street corridors have grown into streetscapes with many commercial buildings in the form of shops. The store has various architectural styles and characteristics that play a role in forming visual aesthetics on the corridors.

4. **Features of the five provincial street corridors**

Physical characteristics of five commercial streetscapes are identified by structured field survey, which is divided into six categories, i.e., building use, setback, and building profile, building façade, sidewalk, tree canopy, street furniture.

4.1. **Commerce streetscape profile**

As illustrated in Figure 3, the building use of each street corridor is dominated by commerce and service, which is around 80% up to 85% of total building use in Tlogomas, MT. Haryono, Sukarno Hatta, and Borobudur, while that in Ahmad Yani is close to 70% of total building use. The second highest rank of building use in Tlogomas, MT. Haryono and Ahmad Yani is housing, while that in Sukarno Hatta and Borobudur is an office. This condition shows how much important these study areas are in controlling trade and service growth.

![Figure 3. A compilation graph of building functions on each street corridor](image-url)
4.2. Physical characteristics of commerce streetscape

4.2.1. Building setback. The building setback in Tlogomas and MT. Haryono is dominated by 3-5 meters of setback. Meanwhile, the dominant building setback in Sukarno Hatta is around 10-20 meters, while Borobudur shows the worse condition compared by that in Sukarno Hatta, by the dominance of building setback around 5-10 meters. The condition of building setback dominance in Ahmad Yani is quite similar with that in Tlogomas and MT. Haryono which is 3-5 meters of building setback.

4.2.2. Building façade. As the result of a field survey, most of the building facade styles in alongside the five commercial streetscapes was modern architecture style. This style indicated by square form, the dominance of horizontal and vertical lines, and the use of modern fabricated materials (such as concrete, glasses, aluminum, steel), with various type of façade colors. Most of those buildings represent an attractive and exciting image as they are functioning as commerce and service facilities.

4.2.3. Sidewalk. The existence of sidewalks alongside these 5 street corridors are in unacceptable: they are not well-designed with ideal width and continuous path to accommodate comfort and safety for pedestrians. Moreover, there are some points of the sidewalks which are used by some street-sellers to place their stands or kiosks. It resulted in the un-comforting feeling of pedestrians related to the needs of appropriate space to walk comfortably on the sidewalks.

4.2.4. Tree canopy
As shown in Figure 4, there are four types of tree canopy on study areas, which are columnar, round, vase, and fountain. Each canopy type has its function such as direction guide, shelter, pollution absorber, heat reducer, aesthetic function. The most type dominated five street corridors is round tree canopy. The dominance is more than 80% in Tlogomas, around 71% in MT. Haryono, almost 43% in Sukarno Hatta, more than 45% in Borobudur, and around 37% in Ahmad Yani, with the total number of this type of tree canopy, is 632 (about 50% of total trees in study areas). Meanwhile, Ahmad Yani has the highest number of a tree (398 trees), followed by Sukarno Hatta (290 trees), Tlogomas (209 trees), and both MT. Haryono and Borobudur with the same number of trees (160 trees).

Table 2. A compilation of tree canopy types on each street corridor

| Tree canopy | STREET CORRIDORS | Total |
|-------------|-----------------|-------|
| Type 1: Columnar | Tlogomas | MT Haryono | Soekarno-Hatta | Borobudur | Ahmad Yani | |
| 1 (0.48%) | 19 (6.21%) | 0 (0.00%) | 80 (20.2%) |
| 170 (81.34%) | 114 (71.25%) | 124 (42.76%) | 74 (46.25%) | 150 (37.6%) |
| 34 (16.27%) | 42 (26.25%) | 94 (32.41%) | 68 (42.50%) | 123 (30.9%) |
| Type 4: Fountain | Tlogomas | MT Haryono | Soekarno-Hatta | Borobudur | Ahmad Yani | |
| 4 (1.91%) | 4 (0.25%) | 54 (18.62%) | 18 (11.25%) | 45 (11.3%) |
| Total | 209 | 160 | 290 | 160 | 398 | 1217 |

*Data tables contains the number and percentage of trees in each street corridor.
4.2.5. Street furniture. The recent conditions of five streetscapes indicate the lack of street furniture, both the number of availability and also the quality. Almost all pedestrian ways in those streetscape required a proper street furniture such as trash can, outdoor sitting, shelter.

5. Public preferences
Based on the first stage of questionnaire spreading, there are five chosen photos represented the best condition of visual and spatial comfort, and the worst condition of visual and spatial comfort in each street corridor, as presented in Figure 5. This phase aims to investigate the first judgment of spatial and visual comfort of each street.

![Figure 4. The best and the worst spatial and visual comfort quality based on people judgment](image)

5.1. Characteristics of respondents
The most respondents on each street are in the range of age between 18-25 years old, male, living in Malang, have the Senior High School background of education, and have a different occupation which is not stated on the lists.

5.2. Public preferences of spatial comfort
Based on the data presented in Table 3, there is only one fourth of total spatial comfort variables in Tlogomas and MT. Haryono which are scored above 4: vegetation type, vegetation function, and vegetation position. Otherwise, 75% of spatial comfort variables are located in the negative zone with scores are below 4. It explains how the un-comforting pedestrians are while walking alongside the streets. Meanwhile, as seen in the Table, a public judgment in Sukarno Hatta represents a better condition compared to the two previous streets. It can be stated that besides three variables which scored above 4 in Tlogomas and MT. Haryono, there are two more additional variables which are also located in “comfort zone” in Sukarno Hatta, which are building border width and street furniture type, while more than 50% of total variables are in the un-comforting zone. On the other hand, despite the better evaluation in Sukarno Hatta, the result of spatial comfort judgment in Borobudur is very unsatisfactory with almost 100% of variables are located below 4. People feel very un-comforting while walking in this street, and the only variable making it better is vegetation function which is scored 4.62. In the meantime, community judgment of spatial comfort in Ahmad Yani Street is not far different from that in Borobudur. There are only two variables located in the comfort zone, which are vegetation type and vegetation function, while more than 80% of total variables are scored below 4. Therefore, it can be concluded that related to spatial comfort in general; people feel very uncomfortable while walking on the five streetscapes.
5.3. Public preferences of visual comfort

Unlike the result of spatial comfort judgment, the Table 4 shows that public evaluates visual comfort in Tlogomas in a positive way with almost 100% of variables are scored above 4. There is only visibility proportion which is judged below 4. Otherwise, there is only one-third of visual comfort variables in MT. Haryono that are located in the comfort zone, while two third of them are scored below 4. Meanwhile, there is a contrary result between public judgment in Sukarno Hatta and Borobudur. The chart illustrates that 100% of respondents give positive judgment in Sukarno Hatta related to visual comfort, while they feel unsatisfied with 100% variables in Borobudur with none of the variables are scored above 4. In the meantime, there is two third of visual comfort variables in Ahmad Yani which are scored above 4, while the rest 33% of them are below 4. Therefore, it can be summarized that people feel 100% visually comfortable while walking in Sukarno Hatta, and close to 100% comfortable while walking in Tlogomas and Ahmad Yani. In the opposite, they feel 100% visually uncomfortable while walking in Borobudur. Meanwhile, people feel slightly comfortable while walking in MT. Haryono related to visual comfort quality.

Table 4. The result of visual comfort
Meanwhile, as stated in Table 5, it can be summarized that people feel visually uncomfortable while walking in Tlogomas, MT. Haryono, Sukarno Hatta, and Borobudur. In the opposite, they feel visually comfortable while walking in Ahmad Yani (indicated by score >4).

5.4. Public recommendation of additional street furniture
Table 6 illustrates some additional facilities recommended by community-based on the impact in creating safety and comfort for pedestrians, which different urgency rank of each type. Vegetation reaches the highest rank in 3 streets (Tlogomas, Borobudur, Ahmad Yani), while outdoor sitting is the most recommended facility in M.T. Haryono, and that in Sukarno Hatta is a trash can. This fact represents the needs of improvement to create a better quality of urban environment supporting walkability in study areas. Otherwise, related to the unideal width of current sidewalks which cannot accommodate ideal comfort for pedestrians, the least recommended facilities are a ramp (in Tlogomas, M.T. Haryono, Sukarno Hatta, Ahmad Yani) and health track (in Tlogomas and Borobudur).

Table 6. Recommendation of additional facilities by community

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| STREET CORRIDORS | Tlogomas | MT Haryono | Sukarno-Hatta | Borobudur | Ahmad Yani |
|------------------|----------|------------|---------------|-----------|------------|
| Shelter          | 9.59     | 5.89       | 9.82          | 8.80      | 10.24      |
| Ramp             | 3.84     | 4.08       | 3.21          | 4.89      | 4.29       |
| Railing          | 4.8      | 3.40       | 5.41          | 4.55      | 5.00       |
| Bollard          | 5.04     | 8.84       | 5.21          | 6.50      | 5.95       |
| Outdoor Sitting  | 7.67     | 12.24      | 10.02         | 10.27     | 8.10       |
| Zebra Cross      | 9.59     | 7.26       | 10.42         | 12.22     | 10.00      |
| Diffable Facility| 10.55    | **12.02**  | 9.82          | 7.82      | 8.10       |
| Trash Can        | 11.99    | 4.31       | **12.22**     | 10.27     | 11.67      |
| Signage          | 6.85     | 9.98       | 8.42          | 5.52      | 6.43       |
| Bus Stop         | 6.85     | 8.39       | 7.01          | 5.13      | 7.38       |
| Vegetation       | **12.23**| 5.67       | 8.02          | **15.16** | **13.10** |
| Health Track     | 3.84     | 10.20      | 4.41          | 4.16      | 4.52       |
| Tourist Signboard| 6.95     | 7.71       | 6.01          | 4.40      | 5.24       |
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*The percentage value of additional facilities recommended by community

5.5. The dominant variables affecting spatial and visual comfort
Regression parametric partial test as shown in Table 7 shows some variables partially affecting spatial and visual comfort for pedestrians in Tlogomas, which are: sidewalk position and street corridor transparency, whereas the most dominant variable affecting dependent variable, is sidewalk position. Meanwhile, simultaneous regression shows significance value which is less than 0.05 meaning that all independent variables simultaneously affect spatial and visual comfort for pedestrians. In the meantime, adjusted R square value shows 45.4% of independent variable variety explaining the spatial and visual comfort for pedestrians, while the rest 54.6% is explained by other variables which are not included in this research.
The most influential variable is indicated by a significancy p-value which is less than 0.05 and unstandardized coefficient which is furthest from 0. Partially influential variable (Significancy p-value less than 0.05) included in this research.

Meanwhile, as shown in Coefficients table, some variables partially affecting spatial and visual comfort for pedestrians in M.T. Haryono are building setback and signage visibility, whereas the most dominant one is signage visibility. Meanwhile, simultaneous regression analysis shows that all independent variables simultaneously affect spatial and visual comfort for pedestrians. In the meantime, adjusted R square value shows 48.1% of explanatory variable variety explaining the spatial and visual comfort for pedestrians, while the rest 51.9% is explained by other variables which are not included in this research.

Furthermore, the only variable partially affecting spatial and visual comfort for pedestrians in Sukarno Hatta Street is vegetation position. Meanwhile, simultaneous regression shows significance value which is less than 0.05 meaning that all independent variables simultaneously affect spatial and visual comfort for pedestrians. In the meantime, adjusted R square value shows 57.2% of independent variance explained.

### Table 7. A regression model of Spatial and Visual Comfort of Pedestrians.

| STREET CORRIDORS | Tlogomas | MT Haryono | Soekarno-Hatta | Borobudur | Ahmad Yani |
|------------------|----------|------------|----------------|-----------|------------|
| (Constant)       | 0.70     | 1.23       | 0.22           | 0.35      | 0.01       |
| sidewalk_function| -0.05    | -0.06      | -0.16          | 0.72      | 0.01       |
| sidewalk_position| 0.35     | 0.40       | 2.29           | 0.03*     |            |
| sidewalk_dimension| 0.09     | 0.10       | 0.60           | 0.55      | -0.06      |
| sidewalk_material| 0.18     | 0.18       | 1.17           | 0.24      |            |
| walking_continuity| 0.08     | 0.09       | 0.71           | 0.48      |            |
| building_border-width| 0.24    | 0.24       | 1.48           | 0.14      |            |
| building_setback| -0.02    | -0.02      | -0.12          | 0.91      |            |
| street_furniture_position| -0.11| -0.11     | -0.85          | 0.40      |            |
| street_furniture_type| -0.09    | -0.10      | -0.67          | 0.50      |            |
| vegetation_type| -0.26    | -0.28      | -1.55          | 0.13      |            |
| vegetation_function| 0.27    | 0.30       | 1.74           | 0.09      |            |
| vegetation_position| -0.04    | -0.05      | -0.29          | 0.77      |            |
| Visual_appearance_variety| -0.10 | -0.10     | -0.67          | 0.51      |            |
| region_dominant_color| 0.13    | 0.12       | 0.88           | 0.38      |            |
| street_corridor_transparency| -0.29 | -0.25      | -2.01          | 0.04*     |            |
| building_appearance_uniqueness| 0.15   | 0.13       | 0.97           | 0.34      |            |
| building_height_proportion| -0.09  | -0.07      | -0.48          | 0.63      |            |
| visibility_proportion| 0.21    | 0.18       | 1.28           | 0.20      |            |
| human_height_and_building_height_proportion| -0.02 | -0.02      | -0.14          | 0.89      |            |
| human_height_and_street_furniture_proportion| 0.21   | 0.19       | 1.57           | 0.12      |            |
| signage_visibility| 0.01     | 0.01       | 0.01           | 0.37      |            |

* Partially influential variable (Significance p-value less than 0.05)
* The most influential variable is indicated by significance p-value which is less than 0.05 and unstandardized coefficient which is furthest from 0
variable variety explaining the spatial and visual comfort for pedestrians, while the rest 42.8% is explained by other variables which are not included in this research.

Meantime, the regression parametric partial test indicates a variable affecting spatial and visual comfort for pedestrians in Borobudur Street: visual appearance variety. Meanwhile, simultaneous regression $p$ significance value which is less than 0.05 meaning that all explanatory variables simultaneously affects dependent variable, spatial and visual comfort for pedestrians. In the meantime, adjusted $R$ square value shows 62.4% of independent variable variety explaining the spatial and visual comfort for pedestrians, while the rest 37.6% is explained by other variables which are not included in this research.

On the other hand, as stated in the Coefficient table, the only variable affecting spatial and visual comfort for pedestrians in Ahmad Yani is vegetation function. Meanwhile, all independent variables simultaneously affect spatial and visual comfort for pedestrians, as indicated by simultaneous regression shows significance value which is less than 0.05. In the meantime, adjusted $R$ square value shows 66.1% of independent variable variety explaining the spatial and visual comfort for pedestrians, while the rest 33.9% is explained by other variables which are not included in this study.

6. Conclusion and future work
In summary, it can be concluded that related to spatial comfort in general; people feel very uncomfortable while walking on the five streetscapes. Meanwhile, people feel 100% visually comfortable while walking in Sukarno Hatta, and close to 100% comfortable while walking in Tlogomas and Ahmad Yani. In the opposite, they feel 100% visually uncomfortable while walking in Borobudur. Meanwhile, people feel slightly comfortable while walking in MT. Haryono related to visual comfort quality. On the other hand, people feel uncomfortable while walking in Tlogomas, MT. Haryono, Sukarno Hatta, and Borobudur, related to spatial and visual comfort. In the opposite, they feel comfortable in general while walking in Ahmad Yani. Thus, it can be concluded that spatial and visual comfort are two aspects contributing impacts to one another which can be investigated any further in future work.

Meanwhile, there are recommended facilities based on the impact in creating safety and comfort for pedestrians, which different urgency rank of each type. Vegetation reaches the highest rank in 3 streets (Tlogomas, Borobudur, Ahmad Yani), while outdoor sitting is the most recommended facility in M.T. Haryono, and that in Sukarno Hatta is a trash can. This fact represents the needs of improvement to create a better quality of urban environment supporting walkability in study areas. Otherwise, related to the unideal width of current sidewalks which cannot accommodate ideal comfort for pedestrians, the least recommended facilities are a ramp (in Tlogomas, M.T. Haryono, Sukarno Hatta, Ahmad Yani) and health track (in Tlogomas and Borobudur).

Finally, the result of public preferences shows that the most influential variable in Tlogomas is sidewalk position, followed by street corridor transparency in the second rank, while that in M.T. Haryono is signage visibility, followed by building setback in the second rank. Meanwhile, the most influential variables in Sukarno Hatta, Borobudur, and Ahmad Yani are vegetation position, visual appearance variety, and vegetation function, respectively. Independent variable variety used in this study explains around 45.4% up to 62.4% of spatial and visual comfort for pedestrians, while the rest is explained by other variables which are not included in this research and can be investigated in the future study.

The results of this study are used to conduct the next stage of the projects to develop a Landscape Visual Planning System as the Decision Design Support System (DDSS) for assessing and enhancing a spatial and visual comfort in pedestrian space.

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