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Interpretation Method for Cultural and Climatic Expression Performance Acceptance for Envelope Building in Phinisi Tower, Makassar, Indonesia

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ABSTRACT

Natural and cultural aspects significantly affect architectural form development. High-rise building contributes to produce a high expression in the public space vision since it is gigantic. As an architectural aspect, a high-rise building has 2 main aspects, including Cultural Expression (Culex) and Climatic Expression (Climex) on its envelopes. This study aimed to design an interpretation method for Culex and Climex performance acceptance in high-rise building envelopes in Phinisi Tower, Makassar, Indonesia. Three theories, including gestalt perception, triadic semiotics, and tropical design or Critical Tropicalism were applied. Moreover, categorization, interpretation, and TRNSYS software simulation were used to process and analyze data from respondents and observations. This study led to the formation of an expression interpretation called Identification, Contextualization, and Implementation, abbreviated as "ICI." Culex was categorized into 2, including historical and traditional contexts. Climex also were categorized into 2, including historical and traditional contexts, and envelope configuration and geometry inter floors changes. There were 5 steps for interpreting the high-rise building envelope expression, including 1) Observational perspectives determination, 2) Organizing Gestalt principal basic expressions, 3) Culex and Climex contextualization, 4) Classification of the expression-creating element categories, and 5) Performance acceptance, inclusive or exclusive categorization. Generally, this method can contribute to designing high-rise buildings related to cultural and climatic elements.

Key words : *Method, Interpretation, Expression, Envelope, Climatic, Cultural, Building, High-rise*

Introduction

Architecture is part of the built environment consisting of form, function, and meaning aspects (Capon, 1999; Salura, 2015). Through its expression, its identity is easily seen since it is real, tactile, and perceivable. High-rise buildings have seized a large public space vision and physically affected the urban areas' environmental quality. (Jahnkassim *et al.*, 2016). Moreover, their figures have a more gigantic appearance than the low-rise buildings on a human scale, implying the potential to deliver messages by expressing building envelope from several perspectives (Sugiman, 2017).

Globalization and urbanization positively influence architectural development globally but still become a single dogma, causing uniformity in the architectural forms. Therefore, a sustainable local identity is needed to synergize technological, cultural, social, and historical aspects (Al-Jokhadar *et*

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al., 2016). A cubist shape envelope with glass material has become phenomenal in high-rise buildings in tropical areas like Indonesia. However, the envelope expression for such buildings negates the cultural and climatic aspects because it ignores the performance of its architectural acceptance in the surroundings. Therefore, it was important to conduct this study in high-rise constructions to measure cultural and climatic performance acceptance in humid and multi-cultural tropical areas.

Based on the context of place, the term climatic denotes anything related to climate, including temperature, humidity, and solar radiation, and its concept is behind forming an architectural design that represents a response to everything about climate. Generally, such an expression is described as the inherent architectural characteristics embodying a climatic response to achieve good performance through envelope building.

The building envelope has functioned as a character and place identity (regionalism). Cultural expression is anything related to traditional and historical elements in the physical and non-physical forms that develop and is embedded in people's lives represented through symbols, signs, and activities. Moreover, this definition estimates the value of a place to help understand the past and enrich the present while still being valuable for future generations (Antariksa, 2009).

This study aimed to produce a Culex and Climex interpretation method in a high-rise building envelope with the Phinisi Tower in Makassar, Indonesia, which represents the maritime culture of the local community, as the case study.

Culex and Climax are two mutually corroborated aspects embodied in the high-rise building envelope. To establish the measurements, the data was obtained using questionnaires from occupants and observers around the case study building, totaling 30 respondents, including observers and residents. These two parameters in the high-rise building envelope of Phinisi Tower were categorized and classified into their constituent elements and were measured with each element's values through interpretive methods and software simulations.

The tropical design theory, Critical Tropicalism, has 3 different emphases on architectural language, the tropical buildings' appearance, and the envelope function-fulfilling assumptions for climate comfort in the building, including The "Line, Edge and Shade," The "Tradition-based," The "New Screen and Louver Kitsch" (BAY, 2001).

In tropical design comprehension, buildings can influence, change, and execute them through their performance since understanding their progress is harder than generating an aesthetic message (Albayrak, 2011).

Materials and Methods

The Phinisi tower comprises a podium and a tower with a high building envelope character among the constructions in the surrounding. The podium and the tower consist of 4 and 16 floors, respectively. Moreover, the podium is 15.50 m high, representing 15% of its total height, 97.5m.

The building expression from the perspective position has a ratio of ±0.4, as shown in Figure 1.

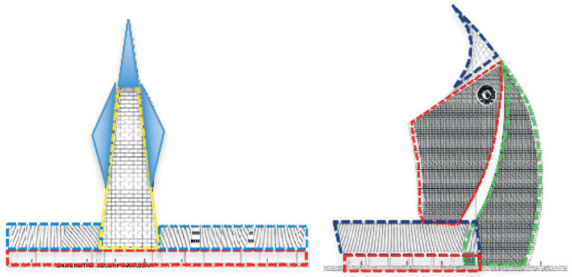
Fig. 1. Building Perspective Ratio

According to the architect, the design concept emphasizes the local culture in-depth. Furthermore, the configuration of form and the detail of the building envelope was designed as an icon of the Phinisi boat with which the South Sulawesi people are familiar and is associated with maritime culture, hence the building's name.

The building envelope performance is possibly recognized by their expressions. Further, the Gestalt organizing principles are used to construct perceptions from their visual observations (Elshater *et al.*, 2011). A building's perceived envelope's visuals are understood as a basic expression.

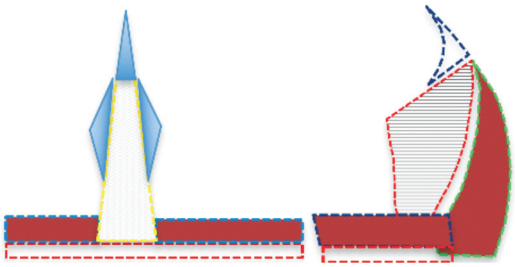
The basic expression of how the building envelope elements in the Phinisi Tower are arranged was defined with the Gestalt Organizing Principle, while the composition identification was conducted through 2D and 3D drawings and the visual observation of the existing building. Furthermore, the analysis was conducted by observing the configuration arrangement based on the building envelope form.

Proximity as the element's adjacency, creates a layer of mass arrangement lined up horizontally on the podium, while the vertical mass of the tower forms a hyperbolic shape with a pointed top, as shown in Figure 2.



(a) (b)

Fig. 2. Proximity (a) Front Elevation, (b) Side Elevation



(a) (b)

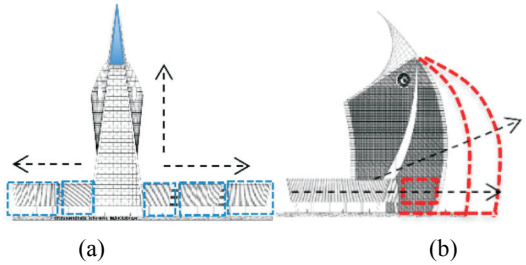
Fig. 3. Similarity(a) Front Elevation, (b) Side Elevation

Similarity as the basic expression, is formed by comparing the envelope surface texture and color to clarify the podium shape that clamps the tower, while the difference clarifies the hyperbolic shapes, as shown in Figure 3.

Continuity asthe basic expression, implies horizontal and vertical flows of the podium and the tower, respectively, due to the repetitive shape elements directing it, as shown in figure 4.

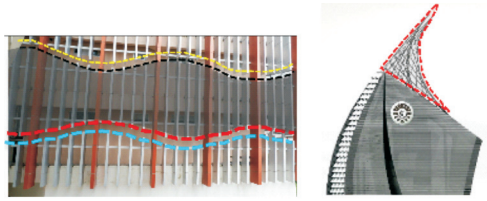
Good Form, the expressions of imperfect or empty shapes, are completed into solid shapes, such as in the vertical grill of the envelope, forming a wave formation and the empty roof truss in the tower (pointed top) to imply a solid triangle, as shown in Figure 5.

Figure and Ground, the basic expressions of shapes using contrasting backgrounds, portray two forms, a row of masses that float at the bottom and a single hyperbolic towering with sharp edges, as shown in Figure 6



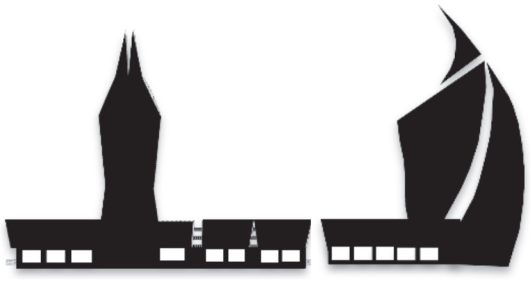
(a) (b)

Fig. 4. Continuity (a) Front Elevation, (b) Side Elevation



(a) (b)

Fig. 5. Good Form Figure(a) Front Elevation, (b) Side Elevation



(a) (b)

Fig. 6. Good Form Figure(a) Front Elevation, (b) Side Elevation

Considering the organizing principles of Proximity, Similarity, Continuity, Good Form, Figure, and Ground of the Phinisi Tower, there is an adjacency of elements to form a horizontal mass arrangement layer at the lower part (podium) and a vertical mass to form a hyperbolic (tower).

The basic expression is formed from the similarity of the envelope surface texture and color to clarify the podium mass's shape that clamps the tower, while the difference in the two parameters clears the hyperbolic shape. Furthermore, the same expression implies that there are horizontal and vertical flows of the podium and the tower, respectively, due to the repetitive shape elements directing it.

Culex Interpretation

Architectural expression was defined by observers through the appearance of the building envelope and the way of viewing (perception) and defining (interpretation) which indicates observers' reality of truth.

Observers stated that the Phinisi Tower had become iconic or a landmark in the area and an orientation point for the public movements in Makassar city.

Their interpretation of the envelope shape expression was that the Phinisi boat sail, with which the people of South Sulawesi or Makassar city are very familiar, is associated with maritime culture. Furthermore, the building name represents the traditional fishing boats of the Bugis community.

The second interpretation of the envelope expression in Phinisi Tower was "*Pasapu*," or the headgear of the well-known hero from South Sulawesi, Sultan Hasanuddin, who was also a representative and a proud figure of the South Sulawesi people.

A Phinisi ship with an opened sail highly identified the Bugis-South Sulawesi community with maritime or fishing culture (Figure 7a), and it was the same for Pasapu or headgear of national hero Sultan Hasanuddin (16th King of Gowa South Sulawesi) (Figure 7b).

(a) (b)

Fig. 7. Interpretation of the envelope form

Climex Interpretation

The comprehension of Climex was obtained from respondents initially directed to observe the case study building. They understood that the Phinisi Tower is located in a humid tropical climate, with solar radiation all year round and high humidity. Moreover, as a microclimate, the tower is in a coastal lowland with an average temperature of 28.4° C and humidity (Figure 6.a).

Climex was interpreted from the high thermal performance results, and the envelope's climatic performance was measured using the Trnsys software. The input data for the simulation included the number of floors and the climatic data for a certain period obtained from the Meteorological, Climatological, and Geophysical Agency (BMKG) (Table 1).

Table 1. Data required for Trnsys simulation

Uraian	Keterangan
Location	Makassar
Number of floors	16
Number of zones	16
Period	20 – 26 September 2020
Software	TRNSYS
Climate Data	• Air temperature • Air humidity • *Dew Point Temperature* • Solar radiation • Air pressure • Wind speed and direction
Output	Air Temperature

Source: Observation and BMKG

The building configuration used in the Trnsys software simulation consisted of geometry and building material, boundary conditions, orientation, and other components. As a simulation tool, TRNSYS has been validated through the actual performance process by comparing the room temperature from simulation with field measurements on a building model. The simulation showed that the room temperature correlation value between the output and field measurements was >0,8. Generally, if R2 >0,7, the model is highly accurate and is valid, and therefore, in this case, the geometry of the building is the appropriate actual building model drawn in 3D using software.

Boundary conditions and configuration of materials and thermal properties used for each element are shown in Figure 6a and 6b. The conditions include 1) the upper outer zone (external roof), 2) a total of 2 zones of the upper and lower floors (adjacent ceiling), 3) the outer zone (external wall), and 4) the lower zone (ground floor) boundaries.

The Phinisi Tower Climex was visible from the envelope elements' configuration to protect against climatic factors such as solar radiation and wind. There are 2 types of envelope configurations functioning as shading devices with horizontal (Figure 8) and vertical types (Figure 9).

The simulations with and without building enve-

Fig. 8. Horizontal shading device

Fig. 9. Vertical shading device

lopes produced the temperature of each floor zone. Furthermore, the pattern of room temperatures in Phinisi Tower from the simulation results showed a steady increase and decrease from the bottom floor to the top and from the 6th to the 12th floor, respectively. The decrease ranged from 0,01°C – 0,34°C (Figures 10 and 11).

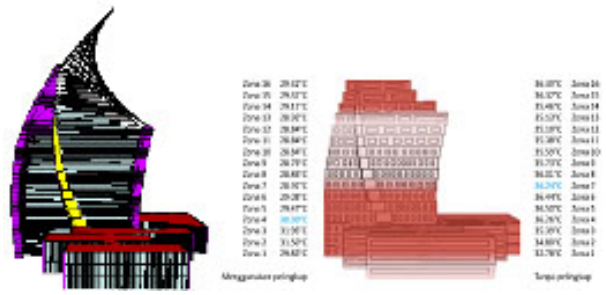
The temperature decrease was caused by climatic factors, although the building's geometry could be influential, especially for the 6th-12thfloors, since they had narrower floor area geometries than zone. Therefore, the six floors received the shading effect from the 13th zone and had a narrow opening glass area than other floors.

The rising temperatures were also observed on the floors above (13th -16th), caused by the floor area's geometry which gets narrower by each floor up to the top. Consequently, the bottom floors do not receive shading effect from the ones above, while those below, being wider, can absorb heat due to reflectance.

Figure 10 shows that the Phinisi Tower with and without an envelope has a maximum temperature of 32.8°C and 38.6°C, respectively, implying that the envelope function reduced the readings by 5.8°C. Furthermore, the simulation results show that the envelope effect can significantly reduce the room temperature in the range of 2,67°C – 8,18°C.

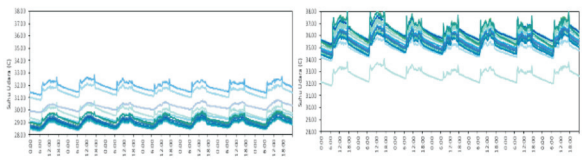
The shading effect of the envelopes in buildings with different types is indicated by the temperature performance in the 1st – 3rd floor spaces, which recorded decreasing temperatures, despite not being optimum like 4th – 16th floors, ranging from 2,67°C – 3,85°C. The 4th-16th floors experienced a temperature decrease because of the building envelope ranging from 5,31°C – 8,18°C.

This phenomenon showed that the horizontal shading device of the building envelope performed better in reducing the indoor temperature than the vertical.



(a) (b)

Fig. 10. Simulation results for each floor zone (a) with envelope (b) without the envelope



(a) (b)

Fig. 11. Temperature difference graph (a) with envelope (b) without the envelope

Results and Discussion

The understanding of Climex and Culex in the Phinisi Tower case study was attained through the stages of analyses of the building envelope, including basic expression, and Culex and Climex analyses. The last two analyses consisted of identification, contextualization, and simulation.

Culex building envelopes can be categorized into 2, those Emphasizing historical context and traditional context.

As well, Climex building envelopes can be categorized into 2, that are envelope configuration and geometrical changes between floors.

Some elements form the Culex categorization of Phinisi Tower, including; The "Tradition-based" paradigm, Extending, Iconic, reproducing the expression of local architecture by using it as a vocabulary to generate new building types and functions.

Meanwhile, those creating the Climex configuration include cantilevered eaves, balcony, and Louvres (horizontal and vertical), while the geometrical changes of inter-floor are influenced by the category area, orientation change direction, and floor pattern and orientation.

The parameters that create Culmex are iconic design strategies, which by using traditional architectural vocabulary in its design (stilt houses), can stir the revival of the practices that implemented high-rise buildings and the use of modern materials. Contrastingly, Climex parameters are the temperature differences between the simulation results with and without the building envelopes and the temperature variations between the floor zones.

ICI method is an abbreviation for Identification, Contextualization, and Implementation method used to interpret Culex and Climax on the high-rise building envelope, as shown in Figure 12.

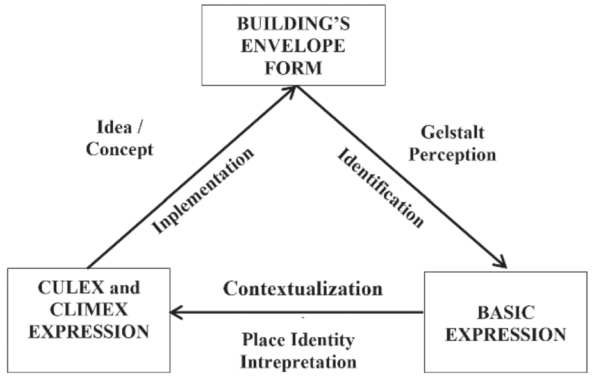


Fig. 12. ICI Interpretation Method

Acceptance of Expressions building's envelope use the terms inclusive and exclusive, to categories of acceptance of building envelop expression. Inclusion in this case is defined as the participation of elements that make up cultural and climatic expressions, while exclusiveness is defined as the neglect or limitation of elements forming climatic and cultural expressions.

There are 5 (five) steps in interpreting Culex and Climex expression of high-rise building envelopes, including

- Determining the ratio of distance perspective of the observer to the expression of the building, whereby a value between 0.4 and 1 denotes a position that allows a clear sight of the building and the complete configuration of the building envelope form.
- Using the Gestalt Organizing Principle identification to establish the basic expressions of the high-rise building envelope, including the Principle of Proximity, Similarity, Continuity, Closure/Good Form, Figure, and Ground.
- Contextualizing basic expression through Culex and Climex-based interpretation categorization. Culex categories are historical and traditional contexts and Climex categories are building envelope configuration and the geometrical inter floors changes. The basic expressions are then placed on Culex and Climex categories through interpretation generated through the perception, which is built from qualitative or quantitative observer references (cognitive memories).
- Classification of the categorization elements based on interpretation results. Culex elements are used here, and they include design paradigms and the revival of traditions and design strategies, each of which can be classified based on data, information, or reference parameters.
- Classification of the Culex and Climex categories on high-rise building envelopes based on the society's social structure and the natural context, including acceptance of inclusive or exclusive expressions.

Conclusion

There is an issue in the expression of high-rise buildings, specifically the cultural and climatic expressions, which can be interpreted through the Identification, Contextualization, and Implementation method.

Expression is a message conveyed through form, which, when done collectively, leads to the clear communication of the idea or design idea presented on a building envelope.

This study resulted in a method of interpreting high-rise building envelope expressions with 5 steps, including determining observational perspectives, organizing basic gestalt expressions, contextualizing Culex and Climex expressions, classifying elements forming their categories, and classifying performance acceptance.

The results of this method contributes to designing a high-rise building envelope that incorporates cultural and climatic elements.

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