Colonial City Pattern in Indonesia Using Depth Calculation: Introduction To Study Ratio On Master Plans Using DepthMapX

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Colonial City Pattern in Indonesia Using Depth Calculation: *Introduction To Study Ratio On Master Plans Using DepthMapX*

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Abstract. Most cities in the world try to apply the concept of sustainable in every development. Improper city planning is usually caused by not paying attention to the early pattern of the city. In the context of Indonesia, consideration is not given to the original planning of cities, as they had existed from the time of its initial colonization. This provokes the question of what a sustainable urban form may be. Disruptive innovations have historically offered significant promise in the speeding up of development for the sake of increasing urban activity. In this study, such disruptive innovations in urban patterns were investigated using the Space Syntax approach. The object of the study was cities that had undergone planning during the Dutch colonial era. This study used Depth Calculation (DC) methods to get the ratio of similarity between cities involved. The master plans involved in the study were those of two cities in the Netherlands (Amsterdam and Delft) and three cities in Indonesia (Bandung, Semarang, and Malang). The maps calculated the depth of cities and then performed ratio analysis using DepthMapX. The results showed that there is a similarity of DC in the master plans between cities in Indonesia planned by Herman Thomas Karsten. The resulting ratios were hoped to indicate how much difference there is between colonial city pattern in Indonesia (CCPI) and city pattern in the Netherlands. This study will hopefully contribute to a better understanding of Indonesian city planning in line with Sustainable Urban Forms.

Key words: Colonial City Pattern in Indonesia (CCPI); Connectivity; Depth Calculation (DC); DepthMapX; Space Syntax; Sustainable Urban Form

1. Introduction

Indonesia is a country whose development is inextricably connected with that of the colonial state, in this case the Netherlands. The Dutch had colonized Indonesia for 350+ years. Over such a long

period of colonialism, there were changes in various areas of life, one of which was the introduction of a particular master plan scheme in the construction of cities. There was a desire on the part of the Dutch people to build on city models similar to those in the Netherlands. The architecture in the colonial city was to resemble closely buildings in the Netherlands. However, in the course of their development cities on the colonial model in Indonesia experienced change wherein all things that had led to the original colonial city planning were lost. To now approach a notion of sustainability in Indonesian cities on the colonial model (CCPI), it is necessary to study the ratio of similarity between cities in Indonesia and those in the Netherlands. Master planning in the Netherlands is considered to follow the same hierarchy of design as the colonial cities in Indonesia. This hierarchy can be measured from its depth. Therefore it is necessary to calculate the depth of the cities in the Netherlands and Indonesia.

Discuss about disruptive innovations in the city, it usually contribute significantly to the speeding up the activity in a city. The goal is to create high quality space that is easy for the public to access [1]. In the development of a city, radical developments are sometimes needed to address urban issues, such as low-carbon innovations [2]. To achieve such ends an understanding of the development of the original pattern of a city is considered necessary to take into account. In this study, the extreme alterations of urban patterns are examined by using the Space Syntax approach to determine the similarity ratio between city patterns. In response to the global issue of sustainable development, CCPI needs to be studied for the purpose of achieving Sustainable Urban Form. Some studies of colonial cities have been done, such as participatory approaches [3], political and economic studies [4,5] and sustainable development in urban cities due to the effects of urbanization [6,7]. To enrich the study of colonial city development in particular, the research approach that will be done here is a study of urban patterns using the ratio of the comparison between the master plans of different cities. This approach uses the depth calculation (DC) of the usual Justified Graph to determine the hierarchy of relationships in space syntax.

Other studies using DC have been conducted by [8] on Javanese homes. This study resulted the depth ratio of certain rooms measured by comparing the basic depth of the Javanese house. This study developed from [9] on Home-based Home Enterprises (HBEs) in determining the development patterns of a home. To further sharpen understanding, the Space Syntax approach using Justified Graphs expanded the studies down to the city scale. Space Syntax studies on DC have also been performed by [10] in calculating the spatial configuration of residential and public buildings. DC was performed using the Justified Graphs that were omitted in [11] in determining spatial configurations. The study of similarities through DC by [12] on the determination of "Oku" (depth) uses boundaries in space based on the pattern of occupancy and a territory in Japan. By using the Space Syntax approach it can be found that important space has a similar pattern in arrangement of functions. Determination of hierarchy of space is conditioned by the culture exist in the area. Demands of the culture put the function or space directly where it should be.

The study of space syntax on a city scale was conducted by [13]. The study focused on the city development by combining geometric analysis and geographic accessibility analysis. The development of a city can be seen from the mobility that occurs by accessibility of existing transportation modes in the city. As a network, it can be approached on the geometric patterns and geographical conditions of a city.

The use of the Space Syntax approach is usually done with reference to the layout of buildings and cities. In the urban context, this is influenced by the environment of human movement and social interaction [10]. Space syntax method can be used in reading city space [14] and is useful to read objective space, also stating that there is a relationship between physical structure and social structure. In the study of urban space readings, the operation of urban systems can be read in conjunction with building structures [15].

The main objective of this study is to determine the depth ratio of the master plan on colonial cities in Indonesia compared to the master plan of cities in the Netherlands. The result of this research is in the form of DC, which is expected to assist in solving problems arising from city development. So the

other objectives are expected (1) To establish the quantity of various patterns of colonial cities in Indonesia and cities in the Netherlands and (2) Conducting comparison between total depth (TD) and depth of the colonial city in Indonesia. This research will enrich the study of the development of colonial cities in Indonesia and enrich the study related to Justified Graph application on space syntax. Due to Indonesian cities intrinsically colonial characteristics, it is expected that the results will help address development problems in urban areas using the Sustainable Urban Form approach.

2. Method

According to [11], Space Syntax is the theory and technique associated with the relationship between the complex spatial structure and the human being in it. This approach can be applied to large-scale urban areas and complex settlements and buildings. The essence of all space syntax analysis is the concept of network graphs (figure 1).

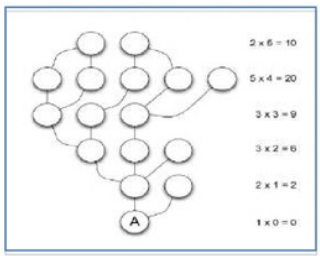

Figure 1. Justified Graphs [11].

The approach taken was to calculate the TD in the master plan of Amsterdam and Delft (figure 2 and Figure 3). After that was conducted a calculation of depth on the master plans in Bandung, Semarang, and Malang (figure 4, figure 5, and figure 6). The three cities in Indonesia are known to have been planned by Herman Thomas Karsten (1885-1945). The selection of Amsterdam and Delft are made given consideration that Herman Thomas Karsten's hometown was Amsterdam and that he studied construction engineering at Delft in 1920. In addition, the two cities are known to have led to the development of Architecture technology and education in the Netherlands.

Figure 2. Old Map of Amsterdam, 1904

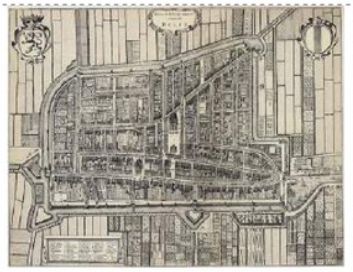

Figure 3. Old Map of Delft, 1649

Figure 4. Old Map of Bandung, 1921

Figure 5. Old Map of Semarang, 1906

Figure 6. Old Map of Malang, 1914

2.1. Research Plan

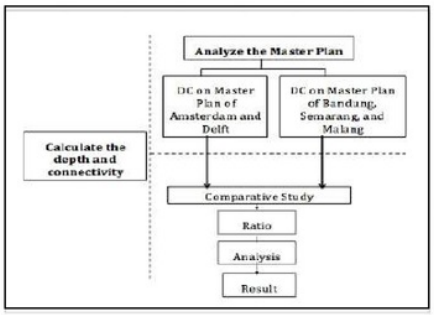

Figure 7. Research plan of CCPI

This research is divided into 2 stages, namely determining DC in Dutch cities and colonial cities in Indonesia and conducting the comparative study of DC in both countries to get the ratio of similarity (figure 7). The next stage is calculating the ratio of the Station, City Hall, and City Square.

2.2. The Steps of DC

The steps that need to be done in doing DC are as follows:

1. Digitizing of old maps of Amsterdam, Delft, Bandung, Semarang, Malang. It is necessary to insert the map image into the DepthMapX program. The DepthMapX program can only import maps from DXF files only [16].
2. Converting process from raster image to vector in order to be processed in AutoCAD. Improve the map from line to polyline to ease the running time calculation of the DepthMapX program.
3. Determine the depth of the master plan in the Netherlands and Indonesia.
4. The statistical calculation of the data generated from the DepthMapX program

3. Result

In conducting DC, starting point calculation was required. The predefined maps had to be converted into Visibility Graphs (VGA). Next, on the VGA map was conducted Visual Step Depth calculation (VSD) to find the depth of the map. The starting point was determined to be the main station of the

city, the station being chosen with the consideration that in the Netherlands the term "Centraal Station" is identified as the center of mobility of arrival and departure in a city. Simultaneously, from that result can also be known connectivity that occurs in the VGA map (Figure 8-12).

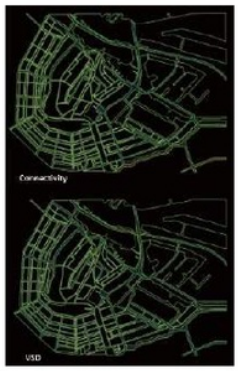

Figure 8. Connectivity and VSD of Amsterdam Calculated by DepthMapX

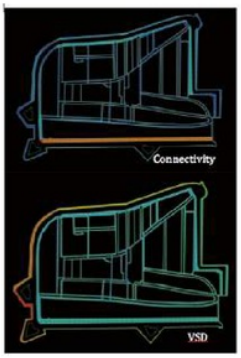

Figure 9. Connectivity and VSD of Delft Calculated by DepthMapX

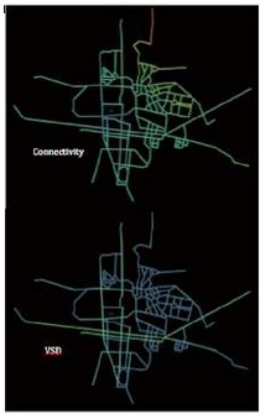

Figure 10. Connectivity and VSD of Bandung Calculated by DepthMapX

Figure 11. Connectivity and VSD of Semarang Calculated by DepthMap X

Figure 12. Connectivity and VSD of Malang Calculated by DepthMapX

After determining the Connectivity and Visual Step Depth (VSD), then was performed statistical analysis on Visibility Graphs (VGA) that had been made (Table 1 and Table 2).

Table 1. Visual Step Depth and Connectivity Statistical Data of Amsterdam and Delft.

Value	Average	*Minimum*	Maximum	*Std Dev*	Count
Visual Step Depth					
Amsterdam	5.37	0	12	1.96	298138
Delft	6.50	0	20	4.28	82336
Connectivity					
Amsterdam	3508.64	46	19554	2858.45	298138

Delft	3377.73	20	15929	4246.41	82336

Table 2. Visual Step Depth and Connectivity Statistical Data of Bandung, Semarang, and Malang

Value	Average	*Minimum*	Maximum	*Std Dev*	Count
Visual Step Depth					
Bandung	4.32	0	13	1.84	20079
Semarang	4.03	0	13	2.15	40918
Malang	5.70	0	12	2.70	94903
Connectivity					
Bandung	370.33	30	2563	311.22	20079
Semarang	1112.66	22	5480	1238.39	40918
Malang	1251.02	9	6028	988.15	94903

4. Discussion

In accordance with the purpose of this research, it is necessary to conduct a comparative study of Visual Step Depth (VSD) and Connectivity. The ratio of similarity can be realized firstly by comparing the Total Depth (TD) ratio in the Netherlands. The next step is to do the DC comparison in Bandung, Semarang, and Malang. To obtain the ratio of depth of particular areas the Basic Depth Ratio (DR) and Depth Deviation (DD) are determined. This is a deviation between the depth of a specific areas and the Total Depth (TD) of Amsterdam and Delft. The DR of the City Square (DRCS), DR of the City Hall (DRCH), DD of the City Square (DDCS), and DD of the City Hall (DDCH) are:

$$DRCS = \frac{DCS}{\overline{TD}} \qquad DDCS_x = \sqrt{\frac{\sum\left(x_i - \bar{x}\right)^2}{n-1}} \tag{1}$$

$$DRCH = \frac{DCH}{\overline{TD}} \qquad DDCH_x = \sqrt{\frac{\sum\left(x_i - \bar{x}\right)^2}{n-1}} \tag{2}$$

Table 3. Total Depth and Ratio on City Square and City Hall.

Cities	Total Depth	Depth on City Square	Depth ratio on City Square	Depth on City Hall	Depth Ratio on City Hall
Amsterdam	12	6	0,5	2	0,17
Delft	20	4	0,2	1	0,05
Bandung	13	3	0,23	3	0,23
Semarang	13	3	0,23	3	0,23
Malang	12	6	0,5	3	0,25

Table 4. Total Connectivity and ratio on Station.

Cities	Total Connectivity	Connectivity on Station	Connectivity Ratio on Station
Amsterdam	19554	3575	0,18
Delft	15929	1546	0,10
Bandung	2563	329	0,13
Semarang	5480	1008	0,18
Malang	6028	1096	0,18

Table 5. Depth Deviation among cities

Cities	Depth Deviation with Amsterdam	Deviation on City Square	Deviation on City Hall
Bandung	0,71	0,19	0,05
Semarang	0,71	0,19	0,05
Malang	0	0	0,06
Cities	**Depth Deviation with Delft**	**Deviation on City Square**	**Deviation on City Hall**
Bandung	4,95	1,18	0,13
Semarang	4,95	1,18	0,13
Malang	5,66	3,91	0,14

Table 6. Connectivity Deviation among cities

Connectivity Deviation on Station with Amsterdam	
Bandung	0,04
Semarang	0,00
Malang	0,00
Connectivity Deviation on Station with Delft	
Bandung	0,02
Semarang	0,06
Malang	0,06

Based on table 3 it can be seen that Total Depth in each city in Indonesia is similar to Amsterdam, especially the city of Malang. However, the connectivity ratio that is taken in the area of the station is relatively low in each city (table 4). Based on table 5 it is revealed that the depth of the city square in Malang city is similar to that in Amsterdam (deviation 0). Based on the station connectivity deviation (table 6), the results of calculations in Semarang and Malang are very similar to those of Amsterdam and Delft.

5. Conclusion

Based on the results and discussions, it can be regarded that there are significant similarities in the master plans of cities in both countries. It is seen that the planning of Herman Thomas Karsten tended to follow that of Amsterdam rather than Delft. If seen from point of view of the similarity ratio, then Depth and Connectivity is the basic thing that caused the pattern of colonial cities in Indonesia to be similar to the pattern of cities in the Netherlands (although physically they tend to look different) because this study focused specifically on the Justified Graphs.

For future research, designing a simulation to facilitate depth analysis seems useful. It is necessary to test other colonial cities in Indonesia, as well as those in other countries. Planners and the city government can determine the deviation in the development of a city from its original model, so as to provide a basis for sustainable planning directives in line with Sustainable Urban Form.

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