

Mapping of Cultural Heritage Buildings in Padang City based on Geographic Information Systems

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ABSTRACT

This research aims to analyze heritage buildings in Padang City, focusing on their distribution, condition, ownership status, and identification of buildings that may qualify as cultural heritage sites. The research method employed is quantitative descriptive with a spatial approach, utilizing map analysis and Nearest Neighbor Analysis, leveraging both secondary data and field surveys. The research findings indicate a pattern in the distribution of heritage buildings based on their functions in Padang City. Religious functions are evenly distributed, while social and cultural functions tend to cluster together. Special functions are evenly dispersed, whereas commercial functions are randomly distributed, and residential functions are also evenly distributed. There are three types of damage observed in heritage buildings, ranging from mild to severe, with some already destroyed. The number of heritage buildings and their levels of damage are as follows: 47 buildings with mild damage, 15 with moderate damage, and 9 with severe damage, including 2 that have been destroyed. Additionally, there are 6 buildings suspected to be cultural heritage sites, such as the Mercusuar Sungai Beremas and the Japanese Tunnel on Bukit Lampu, Batu Busuk Kuranji Rotten Rock Hydroelectric Power Plant, Bagindo Aziz Chan Birthplace Museum, Tarok Mosque, Syekh Surau Baru Tomb, and Siti Nurbaya Big House. As a recommendation, the Padang City Government is advised to conduct a comprehensive identification and inventory of all cultural heritage buildings. The distribution data of cultural heritage buildings is available in the form of a Web GIS accessible via the link: <https://azizkurniawan-bangunan-cagar-budaya-kota-padang.gis.co.id/>.

KeyWords: *Distribution Pattern, Ownership Status, Geographic Information System, Padang City.*



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INTRODUCTION

Cultural Heritage is a tangible cultural heritage in the form of cultural heritage objects, cultural heritage buildings, cultural heritage structures, cultural heritage sites, and cultural heritage areas on land and/or water that need to be preserved because they have important value for history, science, education, religion, and culture through a determination process (Law No. 11/2010). Cultural heritage objects are human-made objects, movable or immovable, which consist of units or groups, or parts or remnants thereof, which are at least 50 years old, or represent a distinctive style period and represent at least 50 years, and are considered to have significant value for history, science, and culture, and objects important for history, science, and culture (Law No. 5/1992 Article 1).

Orr et al (2021) stated that cultural heritage is a broad term encompassing tangible and intangible aspects of society and culture that are valued. This includes monuments, groups of buildings, and archaeological sites, as well as objects (and collections) and intangible

cultural practices such as dance and storytelling. These forms of heritage shape individual and community identities, provide evidence for past events and contribute to well-being through engagement with them. Understanding the current challenges facing cultural heritage is crucial if it is to be preserved and passed on to future generations.

Our cultural heritage is threatened by gradual changes in weather patterns and extreme events. Rising temperatures, along with changes in rainfall, relative humidity, and wind, for example, can hurt materials comprising cultural heritage assets (Ridwan et al., 2014^a). This is because changes in average climate conditions as well as changes in the frequency and intensity of extreme weather events can affect biological, chemical, and physical mechanisms leading to asset degradation. This includes increased freeze-thaw cycles in northern Europe, extreme heat and drought in the Mediterranean region, overall decreases in summer rainfall in Europe, and increased winter storms and heavy rainfall in the Atlantic region (Ridwan et al., 2014^b). Additionally, cultural heritage sites in coastal areas are highly vulnerable to sea level rise and storm surges, while natural disasters such as floods, landslides, earthquakes, volcanoes, and wildfires can also have adverse effects on cultural heritage (Sesana et al., 2018).

Padang City has an interesting cultural heritage that is worth exploring, with traces still visible today. Many historical remnants remain, such as old buildings, places of worship, offices, official residences, schools, halls, warehouses, and hilly areas, among others. However, many cultural heritage buildings are untraceable, and some have been demolished and replaced with new structures. The replacement of these buildings can cause the old ones to lose their authenticity and, in some cases, vanish without a trace. This is largely due to the lack of knowledge and attention from the public regarding the cultural heritage buildings in Padang City. Based on the background described above, the researcher proposes the title of the study: "Mapping Cultural Heritage Buildings in Padang City Based on Geographic Information Systems (GIS)".

METHODS

Sugiyono (2017) states that research methods are essentially scientific characteristics for obtaining data with specific purposes and uses. The method used in this research is the quantitative descriptive method. In this, description is carried out with a spatial approach using map analysis and Nearest Neighbor Analysis that utilizes secondary data and field survey data. This research was conducted in Padang City, the capital of West Sumatra Province. According to Government Regulation No. 17/1980, the area of Padang City is 694.93 km², equivalent to 1.65 % of the total area of West Sumatra Province. Padang City consists of 11 Sub-districts, with the largest Sub-district being Koto Tangah, covering an area of 232.25 km².

RESULTS

Cultural Heritage is tangible cultural heritage, which includes Cultural Heritage Objects, Cultural Heritage Buildings, Cultural Heritage Structures, Cultural Heritage Sites, and Cultural Heritage Areas, both on land and in water. All of these components have significant value in the contexts of history, science, education, religion, and culture, thus requiring preservation. Specifically, Cultural Heritage Buildings are constructed arrangements that may consist of natural or human-made objects, designed to fulfill spatial needs that may have walls or not, and are equipped with a roof. According to Government Regulation of the Republic of Indonesia No. 1/2022, the criteria for Cultural Heritage are as follows 1) Aged 50 years or older; 2) Represents the shortest style period aged 50 years; 3) Has special significance for history, and science, education, religion, and culture; and 4) Has cultural value for strengthening the nation's identity. Below are the research findings on Cultural Heritage Buildings in Padang City.

3.1 The distribution of cultural heritage buildings in Padang City

The research findings reveal the presence of 71 cultural heritage buildings scattered across 8 Sub-districts within Padang City. Specifically, these buildings are distributed in 5 in Koto Tengah, 2 in Kuranji, 1 in Lubuk Begalung, 9 in Lubuk Kilangan, 7 in Nanggalo, 28 in Padang Barat, 11 in Padang Selatan, and 8 in Padang Timur. It is noted that the Padang Barat has the highest number of cultural heritage buildings. This suggests the possibility that the Padang Barat district served as the primary entry point for foreign colonial civilization into Padang City. Another piece of evidence is the abundance of Dutch remnants found in this Sub-district.

3.2 The distribution of cultural heritage buildings can also be observed based on their functions

Religious function

Based on the research findings, here is a list of cultural heritage buildings that serve as residential dwellings located in three districts in Padang City: 1) Padang Barat (Rumah Gadang Datuk Rajo Ibrahim, and Rumah Gadang Sini Kayo); 2) Padang Selatan (DPRD Official Residence, and Rumah Gadang Ang Sia, Rumah Gadang Ema Idham, and Rumah Gadang St. Zainun Family, and Rumah Gadang Sidi Family); 2) Kuranji (Hotel Padang, Kuwera Mess, Puri Wedari Governor's Residence).

Religious function

Based on the research findings of cultural heritage buildings in Padang City that serve religious purposes, several buildings are located in the Padang Barat. Here is a list of cultural heritage religious buildings in Padang City namely GPIB Church (Protestant Church in Western Indonesia), Padang Bishopric Building, Saint Leo Church Complex, Padang Cathedral Complex, Tri Dharma Temple, Ganting Grand Mosque, and Muhammadiyah Mosque.

Special function

Based on the research findings, several cultural heritage buildings with specialized functions in Padang City are generally military complex buildings. This is because military complexes have interests that require confidentiality, and these buildings are predominantly located in the Padang Barat. Here is a list of military complex buildings in Padang City namely General Adjutant Office of Regional Military Command 032 Wirabraja, Equipment Detachment Office "A" 01-12-03 Padang, West Sumatra Province Military Audit and Financial Office, Supply and Transportation Detachment Complex 1-44-05 Padang, and Military Auditorium Complex Padang.

Business function

Based on the research findings, several cultural heritage buildings have been repurposed for commercial namely PT Amindo Corp. Office (formerly PT Pataka K.S. Office/Warehouse), PT Hiswana/Pertamina Office, which was previously established, Spaar Bank (formerly Beautik Hotel), Japanese Defense Area in Muara Padang, Pulau Air Railway Station, Simpang Haru Railway Station, and Former Geo Wehry & Co, now transformed into PT. Indonesian Trading Company.

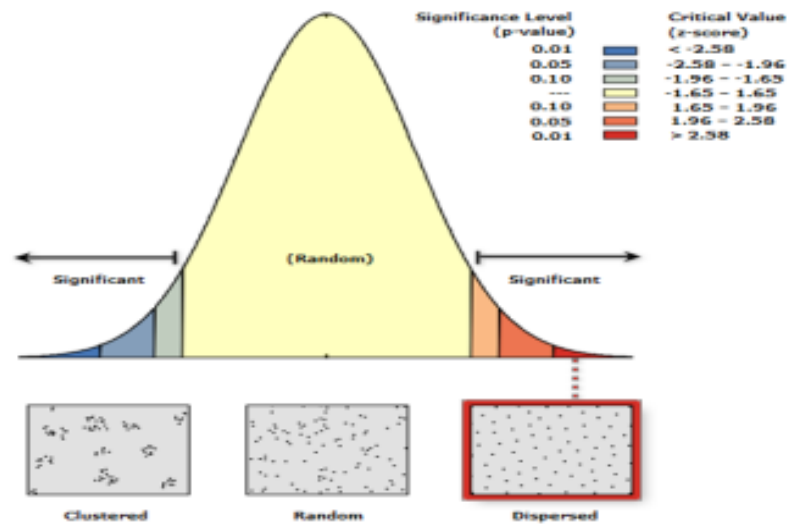
Social and cultural function

Based on the research findings, several cultural heritage buildings in Padang City have been repurposed for social and cultural functions. These include iconic landmarks such as the Pemoeda Monument and the Joang 45 BPPI Building, which serve as reminders of historical events (Yefterson et al., 2023). Additionally, former governmental buildings like the Padang City Hall (Gemente) and educational institutions such as the former Europeesche Lagere School Padang (SMA 1 Padang) and Meer Uitgebreid Lager Onderwijs (Mulo) Padang (SMP 1 Padang) have been transformed into venues for cultural activities and social gatherings. Furthermore, military complexes like the Padang Military Auditorium Complex and former detention houses have also been adapted for cultural events and exhibitions. Moreover, various Japanese defense complexes scattered across the city, including Rimbo Kaluang, Tabing, Lubuk Minturun, Gunung Pangilun, Indaruang, and Padang Besi, along with the tunnels within the Padang Besi complex, contribute to the cultural heritage of Padang by showcasing remnants of wartime history. These repurposed cultural heritage buildings play a vital role in preserving the city's history and enriching its social and cultural fabric.

3.3 Pattern of distribution of cultural heritage buildings based on their function

Based on the analysis results using ArcGIS software, the pattern of distribution of cultural heritage buildings with religious functions in Padang City is presented in Fig 1 below.

Nearest Neighbor Ratio: 1.790642
 z-score: 4.001839
 p-value: 0.000063



Sumber: Output ArcGIS 10.3.1

Given the z-score of 4.00183892459, there is a less than 1% likelihood that this dispersed pattern could be the result of random chance.

| | |
|-------------------------|-----------------|
| Observed Mean Distance: | 379.6890 Meters |
| Expected Mean Distance: | 212.0407 Meters |
| Nearest Neighbor Ratio: | 1.790642 |
| z-score: | 4.001839 |
| p-value: | 0.000063 |

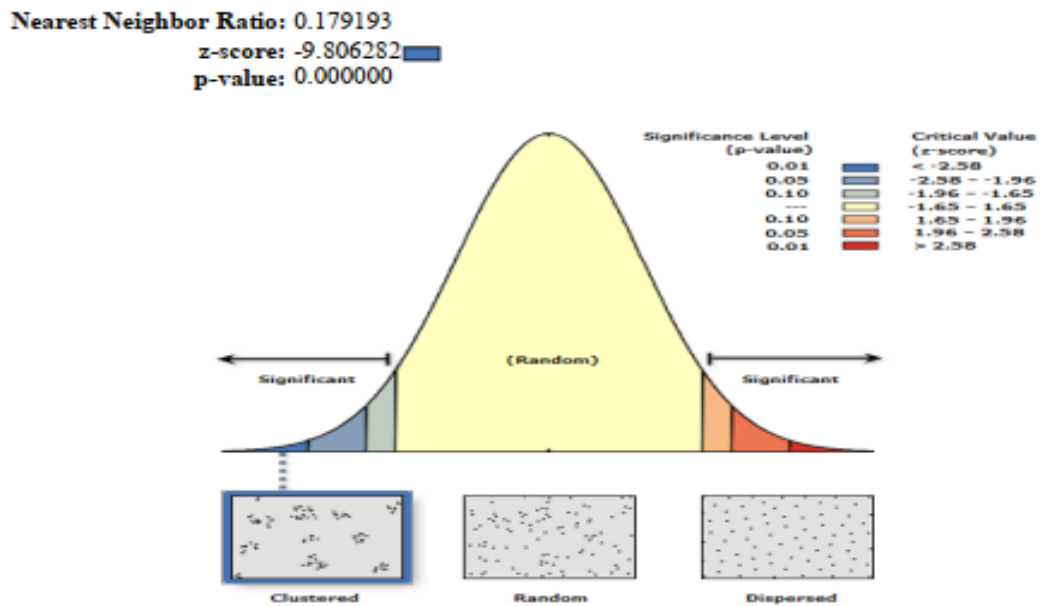
Figure 1. Cultural heritage buildings with religious functions in Padang City

Based on the calculation results using the Average Nearest Neighbor analysis using ArcGIS application, the distribution of cultural heritage buildings with religious functions produces a Nearest Neighbor Ratio value of 1.790642 with an Expected Mean Distance of 212.0407 m and a z-score of 4.001839. This result indicates that the distribution of cultural heritage buildings with religious functions is dispersed. These results refer to the theory of Bintarto & Hadisumarno (1978), which states that a dispersed distribution pattern occurs when the distance between one location and another is relatively similar, with an index value approaching 2.15. A dispersed distribution pattern can also occur if the value of $T = 2.5$ or approaches 2.5. This means that based on the analysis results using the Average Nearest Neighbor method, it can be concluded that cultural heritage buildings with religious functions are distributed with a relatively uniform pattern or evenly dispersed.

Distribution of cultural heritage buildings based on social and cultural function

Based on the calculation results using the Average Nearest Neighbor analysis using ArcGIS application, the distribution of cultural heritage buildings in Padang City based on their function for social and cultural purposes produces a Nearest Neighbor Ratio value of 0.179193 with an Expected Mean Distance of 1066.3740 m and a z-score of -9.806282.

This result indicates that the distribution of cultural heritage buildings with social and cultural functions tends to be clustered. The calculation results refer to the Theory of Bintarto & Hadisumarno (1978), which states that the clustered distribution pattern occurs when the distance between one location and another is close and tends to cluster in specific places, with an index value of 0 (zero). The clustered distribution pattern occurs if the value of $T = 0$ or approaches zero. So, based on the analysis results using the Average Nearest Neighbor method, it can be concluded that cultural heritage buildings with social and cultural functions tend to be distributed in groups, indicating a tendency to gather in specific areas.



Sumber: Output ArcGIS 10.3.1

Given the z-score of -9.80628214857, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

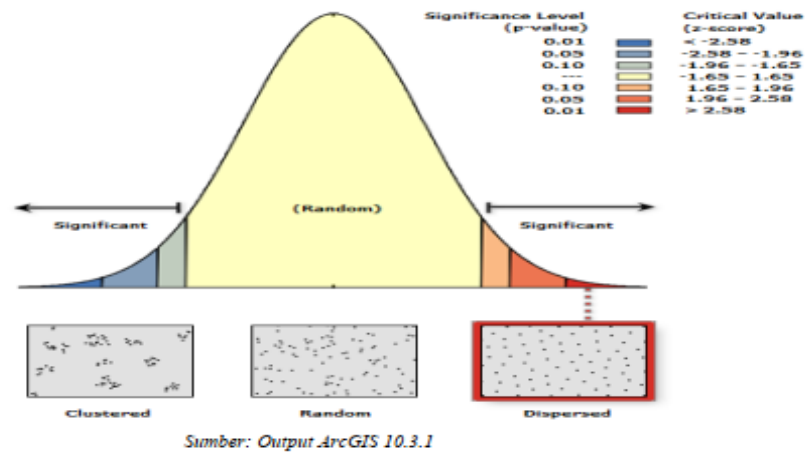
| | |
|--------------------------------|------------------|
| Observed Mean Distance: | 191.0865 Meters |
| Expected Mean Distance: | 1066.3740 Meters |
| Nearest Neighbor Ratio: | 0.179193 |
| z-score: | -9.806282 |
| p-value: | 0.000000 |

Figure 2. Cultural heritage buildings based on social and cultural function

Distribution pattern of cultural heritage buildings with a specific function

Based on the analysis results using ArcGIS software, the distribution pattern of cultural heritage buildings in Padang City is presented. In the Fig 3 below.

Nearest Neighbor Ratio: 2.231408
 z-score: 4.711539
 p-value: 0.000002



Given the z-score of 4.71153873257, there is a less than 1% likelihood that this dispersed pattern could be the result of random chance.

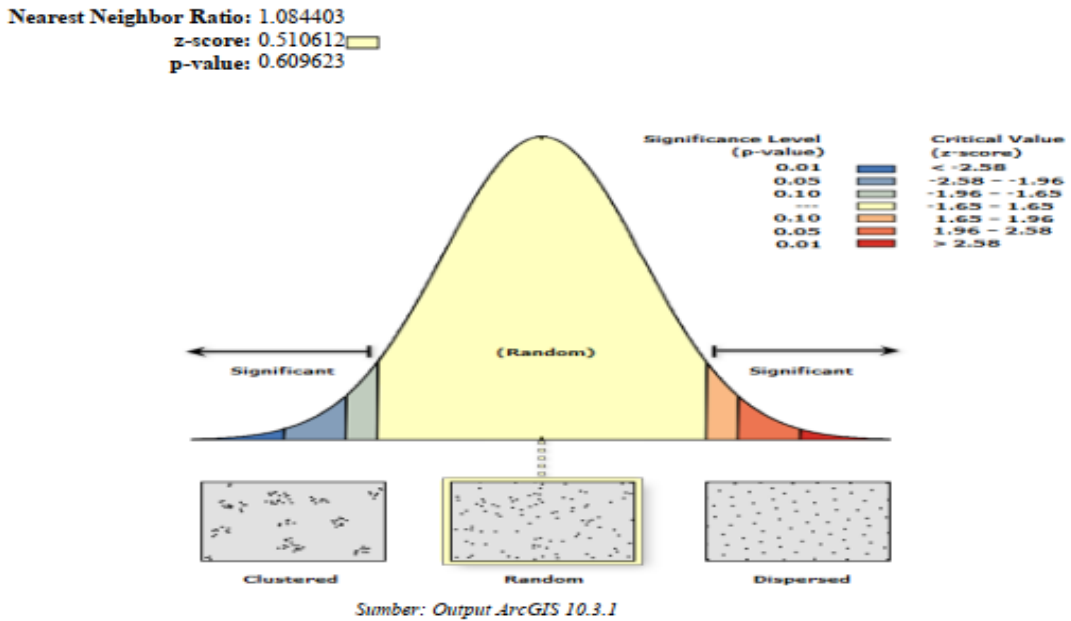
| | |
|--------------------------------|-----------------|
| Observed Mean Distance: | 288.5438 Meters |
| Expected Mean Distance: | 129.3102 Meters |
| Nearest Neighbor Ratio: | 2.231408 |
| z-score: | 4.711539 |
| p-value: | 0.000002 |

Figure 3. Cultural heritage buildings with a specific function

Based on the calculation results using the Average Nearest Neighbor analysis with ArcGIS software, the distribution of cultural heritage buildings with specific functions yields a Nearest Neighbor Ratio value of 2.231408, with an Expected Mean Distance of 129.3102 m and a z-score of 4.711539. This result indicates that the distribution of cultural heritage buildings with specific functions is dispersed. These calculations align with the theory of Bintarto & Hadisumarno (1978), which states that a dispersed distribution pattern occurs when the distance between one location and another is relatively similar, with an index value approaching 2.15. A dispersed distribution pattern can also occur if the value of $T = 2.5$ or approaches 2.5. Therefore, based on the analysis results using the Average Nearest Neighbor method, it can be concluded that cultural heritage buildings with specific functions are evenly dispersed or uniform, with relatively similar distances between one location and another.

Distribution of cultural heritage buildings serving as business premises buildings serving as business premises

Based on the analysis results using ArcGIS software, the distribution pattern of cultural heritage buildings in Padang City is presented in the Fig 3 below.



Given the z-score of 0.510611707343, the pattern does not appear to be significantly different than random.

| | |
|--------------------------------|-----------------|
| Observed Mean Distance: | 502.2137 Meters |
| Expected Mean Distance: | 463.1244 Meters |
| Nearest Neighbor Ratio: | 1.084403 |
| z-score: | 0.510612 |
| p-value: | 0.609623 |

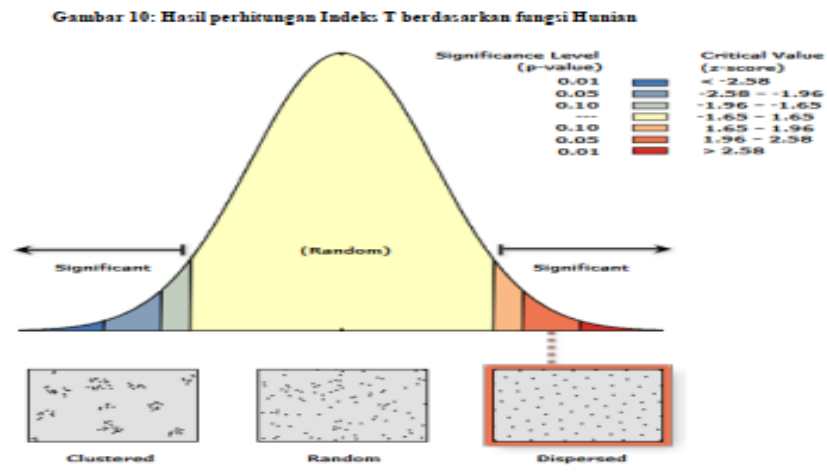
Figure 4. Cultural heritage buildings serving as business premises buildings serving as business premises

Based on the calculation results using the Average Nearest Neighbor analysis with ArcGIS software, the distribution of cultural heritage buildings serving as business premises yields a Nearest Neighbor Ratio value of 1.084403, with an Expected Mean Distance of 463.1244 m and a z-score of 0.510612. This result indicates that the distribution of cultural heritage buildings serving as business premises is random. These calculations are consistent with the theory of Bintarto & Hadisumarno (1978), which states that a random distribution pattern occurs when the distance between one location and another is irregular, with an index value of 1 (one). A random distribution pattern can also occur if the value of $T = 1$ or approaches 1. Therefore, based on the analysis results using the Average Nearest Neighbor method, it can be concluded that cultural heritage buildings serving as business premises are randomly distributed or do not follow a specific pattern in their distribution in Padang City. The distance between locations does not exhibit a particular pattern or tendency to cluster or disperse evenly.

Distribution of cultural heritage buildings serving as residences

Based on the analysis results using ArcGIS software, the distribution pattern of cultural heritage buildings in Padang City is presented in the Fig 5 below.

Nearest Neighbor Ratio: 1.372509
 z-score: 2.363547
 p-value: 0.018101



Given the z-score of 2.36354737392, there is a less than 5% likelihood that this dispersed pattern could be the result of random chance.

| | |
|--------------------------------|------------------|
| Observed Mean Distance: | 1235.2024 Meters |
| Expected Mean Distance: | 899.9592 Meters |
| Nearest Neighbor Ratio: | 1.372509 |
| z-score: | 2.363547 |
| p-value: | 0.018101 |

Figure 5. Cultural heritage buildings serving as residences

Based on the calculation results using the Average Nearest Neighbor analysis with ArcGIS software, the distribution of cultural heritage buildings serving as business premises in Padang City yields a Nearest Neighbor Ratio value of 1.372509, with an Expected Mean Distance of 899.9592 m and a z-score of 2.363547. This result indicates that the distribution of cultural heritage buildings serving as business premises is uniform (dispersed). These calculations align with the theory of Bintarto and Surastopo Hadisumarno (1978), which states that a dispersed distribution pattern occurs when the distance between one location and another is relatively similar, with an index value approaching 2.15. A dispersed distribution pattern can also occur if the value of $T = 2.5$ or approaches 2.5. Therefore, based on the analysis results using the Average Nearest Neighbor method, it can be concluded that cultural heritage buildings serving as business premises are evenly dispersed or uniform. The distance between one location and another tends to be relatively similar or alike, indicating that cultural heritage buildings serving as business premises have a uniform distribution pattern in Padang City.

Condition of cultural heritage buildings in Padang City

To assess the condition of cultural heritage buildings, researchers conducted field surveys. Based on the research findings, the level of damage to cultural heritage buildings ranges from low to severe. 1) Cultural heritage buildings with minor damage: Based on the

research findings, there are 47 buildings with minor damage, 13 of which are remnants of Japanese defenses such as Japanese holes and tunnels scattered across various areas. 4 of them are located in Mount Pangiliun, 3 are in Indaruang/PT Semen Padang Factory, and 6 are in the Police School Complex of Padang Besi; 2) Buildings with moderate damage: According to the research, there are 15 cultural heritage buildings with moderate damage, 8 of which are Japanese relics in the form of Japanese holes for defense fortifications. Among these, 3 are located in Muara Padang, specifically in Mount Padang, 3 are in the Parupuk Tabing, and 2 are in the Lubuk Minturun; and 3) Buildings with severe damage: Based on the research, there are 9 buildings with severe damage, and among these, 2 buildings have been demolished, namely the Rumah Gadang Ema Idham and the Rumah Gadang H. St. Zainun Family.

Ownership status of cultural heritage building

Based on the research findings, the ownership status of cultural heritage buildings varies greatly. Among these buildings, 15 are owned by the Padang City government, 1 building is owned by the West Sumatra Provincial Office, 3 buildings are owned by the community, and 8 buildings are privately owned.

Management of cultural heritage buildings

Angel's Wing Padang manages 1 building. Bank Indonesia is responsible for 1 building. Bank Mandiri manages 2 buildings. Dewan Harian Angkatan 45 and BPCB Sumbar are responsible for 1 building. The Congregation of GPIB Church controls 1 building. The Ang Sia Family owns and manages 1 building. The Diocese of Padang manages 2 buildings. The Supreme Court is responsible for 1 building. The community is involved in the management of 11 buildings. The Padang City Government manages 4 buildings. The Provincial Government is responsible for 2 buildings. The Central Government is involved in 2 buildings. The Padang City Government and BPCB Sumbar manage 1 building. The Warehouse Contractor is responsible for 1 building. The Managers of Klenteng See Hin Kiong control 1 building. The Mosque Management manages 1 building. The Management of SMP 1 Padang controls 1 building. The Indian Season Association owns and manages 1 building. Pertamina manages 1 building. PLN is responsible for 1 building. Pokdarwis Gunung Padang manages 3 buildings. Private individuals control 8 buildings. PT KAI Regional 2 Sumbar is responsible for 2 buildings. PT Kurnia Jagad Abadi manages 1 building. PT Perusahaan Perdagangan Indonesia is involved in the management of 2 buildings. PT Semen Padang manages 3 buildings. SPN Padang Besi controls 4 buildings. The Indonesian National Armed Forces (TNI) is responsible for 1 building. TNI AD Kodam 1 Bukit Barisan manages 6 buildings. Lastly, the Santa Leo Church Foundation is responsible for 1 building. Suspected Cultural Heritage Buildings: Gold River Lighthouse and Japanese holes on Bukit Lampu; Bagindo Aziz Chan Birth House Museum; Tarok Surau; Sheikh Surau Baru's Tomb; Siti Nurbaya's Rumah Gadang; and Batu Busuk Kuranji Hydroelectric Power Plant.

CONCLUSIONS

The management of cultural heritage buildings involves various parties, including the city, provincial and central governments, as well as communities and private entities. These buildings play a vital role in preserving the city's history and enriching the social and cultural fabric of Padang City. The distribution of cultural heritage buildings based on their functions is diverse, with some functions showing a scattered pattern and others tending to be clustered.

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