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Evaluation of the Suitability of Spatial Structure in Tegal City, Central Java Province

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ABSTRACT: As regulated in Law No. 26 of 2007 concerning Spatial Planning, the urban spatial structure is an arrangement of settlement centres and infrastructure networks that support socio-economic activities through hierarchical functional relationships. In Tegal City, one of the crucial infrastructure elements is the road network, especially the North Coast national route, commonly called the Pantura Route. The Pantura Route strategically affects urban mobility and connectivity between regions. Its location in the city centre makes this route an important arterial corridor connecting major cities on Java Island, such as the Jakarta-Tegal-Purwokerto-Yogyakarta-Surabaya route. However, the high intensity of land use for economic, social, and educational activities has caused various problems, such as traffic accidents. In 2018, 59% of accidents occurred along this route, although this route only covers 13% of the total length of roads in Tegal City. Other problems include limited road infrastructure, physical damage to roads, and low road accessibility, which are also supporting factors. Important local-scale activities along the Pantura route, such as schools, health centres, and trade activities, raise concerns regarding the suitability of spatial structures and safety, especially when compared to national Standards (SNI 03-1733-2004). The method used in this study uses primary and secondary surveys and qualitative descriptive analysis, namely content analysis. The results of this study indicate that the deviation of spatial structures that occur in Tegal City is more than 50% seen from the existence of educational facilities (elementary and junior high schools), health facilities (health centres), and markets with a local scale that are not appropriate along the Pantura route. With regional authority within the framework of Law No. 23 of 2014 concerning Regional Autonomy, the city government is expected to be more active in managing spatial planning, especially spatial structures, so that deviations do not occur. This study aims to evaluate the suitability of the spatial structure of Tegal City by evaluating the function of the road network and the scale of service facilities based on urban environmental planning Standards. The findings of this study are expected to support effective and sustainable spatial planning of Tegal City.

Keyword: *Deviation; Spatial Structure; Tegal City*

I. INTRODUCTION

The spatial structure defined by Law No. 26 of 2007 on Spatial Planning involves the organization of settlement centers along with the network of infrastructure and facilities that support the community's socio-economic activities, all of which have hierarchical and functional relationships. Among the various infrastructure networks, the road network is particularly significant. The road network in Tegal City features the Pantura route, which plays a crucial role in facilitating various urban activities. The effectiveness of this dense road network is heavily dependent on the arterial road system and the Pantura route. The Pantura road traversing Tegal City holds a strategically advantageous position as it links economic corridors between cities and regions on a national scale. Centrally located within Tegal City and boasting high capacity, the Pantura route serves as a vital transportation artery. It connects the western and eastern parts of Tegal City, establishing links between Jakarta, Tegal, Semarang, and Surabaya, and vice versa. Additionally, it connects the central region to the south of Tegal City, linking Jakarta, Tegal, Purwokerto, Yogyakarta, and Surabaya. The role of the Pantura Road as a connecting route is essential for facilitating interactions between regional activity centers.

The relationship between transportation and land use is both complex and dynamic, as it encompasses a variety of interests and activities. The presence of a transportation route significantly influences land use development, and conversely, land use can impact transportation systems. Every land use necessitates enhancements to the transportation infrastructure in the corresponding area [2]. Tegal

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City's strategic location as a transit hub has led to a predominance of trade and service activities in its land use. However, this potential also gives rise to several issues, particularly concerning road safety. In 2018, there were a total of 203 traffic accidents on the Pantura route in Tegal City, with approximately 59% of these incidents occurring on this route, despite it comprising only 13% of all roads in the city [18]. Furthermore, challenges such as inadequate road infrastructure, damage to the road network, and limited accessibility persist within Tegal City's road system. Along the north coast route of Tegal City, various land uses can be observed, including schools, government offices, places of worship, health centers, kiosks, stalls, and other service-oriented businesses. According to Indonesia's National Standard (SNI) No 03-1733-2004 regarding Procedures for Urban Environmental Planning, local service facilities, such as educational institutions (elementary and junior high schools), should be centrally located within residential communities and must not be situated across highways. This guideline similarly applies to health facilities, including health centers and integrated health posts. Additionally, with the implementation of Law Number 23 of 2014 on Regional Autonomy, districts and cities have gained increased autonomy to regulate permits or allocate budgets in alignment with regional priorities.

This policy can significantly influence the organization of urban spatial structures if executed effectively. Conversely, if the arrangement of urban spatial structures does not adhere to existing regulations, it may negatively affect the surrounding community in Tegal City as well as road users. Given the urgency of current issues, spatial planning policies are vital and serve as a key tool for steering urban development towards greater focus and sustainability. However, the implementation of these policies often encounters challenges, including sectoral conflicts of interest, inadequate coordination among government agencies, and a general lack of compliance with relevant regulations [3]. Therefore, this study aims to assess the alignment of Tegal City's spatial structure by examining the functionality of the road network in relation to service facility Standards based on Indonesia's National Standard (SNI) No 03-1733-2004 concerning Procedures for Urban Environmental Planning.

II. THEORETICAL FRAMEWORK

Relationship between Spatial Structure and Infrastructure

The dynamics of urban development are evolving in response to the rapid population growth and urbanization trends. As urban populations increase, the demand for space and infrastructure becomes more pronounced [13]. Spatial planning reflects both the spatial structure and spatial patterns of an area. According to Law Number 26 of 2007, spatial structure refers to the arrangement of settlement centres along with the networks of infrastructure and facilities that support the community's social and economic activities, which operate within functional hierarchical relationships. Generally speaking, spatial planning serves as a regulatory framework that governs procedures, essential considerations, spatial planning processes, land use, and the management of spatial utilization [16]. In Indonesia, spatial planning is categorized into tiered and complementary areas, including national, provincial, and district/city levels. Each central or regional government tier possesses distinct authorities, particularly concerning infrastructure.

Infrastructure can be defined as a form of public capital derived from government investment [11], which significantly influences the effectiveness of community economic and social development. As Presidential Regulation Number 38 of 2015 outlined regarding Government Cooperation with Business Entities in Infrastructure Provision, infrastructure is divided into economic and social categories. This study focuses specifically on economic infrastructure, which is crucial for facilitating the provision of goods and services, particularly in road infrastructure.

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Road Infrastructure

Based on Government Regulation of the Republic of Indonesia No: 34 of 2006, Regulation of the Minister of Public Works No. 03 / PRT / M / 2012 concerning roads and their functions, roads are grouped into arterial roads, collector roads, local roads, and environmental roads: a) Arterial roads are public roads that serve as the main transportation method, with characteristics of long trips, high average speeds, and a limited number of efficient entrances (access). b) Collector roads are public roads that serve as collectors or dividing transportation with characteristics of medium-distance trips, medium-average speeds, and a limited number of entrances. c) Local roads are public roads that serve local transportation with characteristics of short-distance trips, low average speeds, and the number of entrances is not limited. d) Environmental roads are public roads that serve as environmental transportation with characteristics of short-distance travel and low average speed. The road infrastructure development on Pantura is useful for supporting national economic development and growth because of its strategic role. The Pantura route itself is a route that functions as a primary arterial route, where the management and development process is the responsibility of the central government. A map of the existing condition of the road network in Tegal City can be seen in Figure 1.

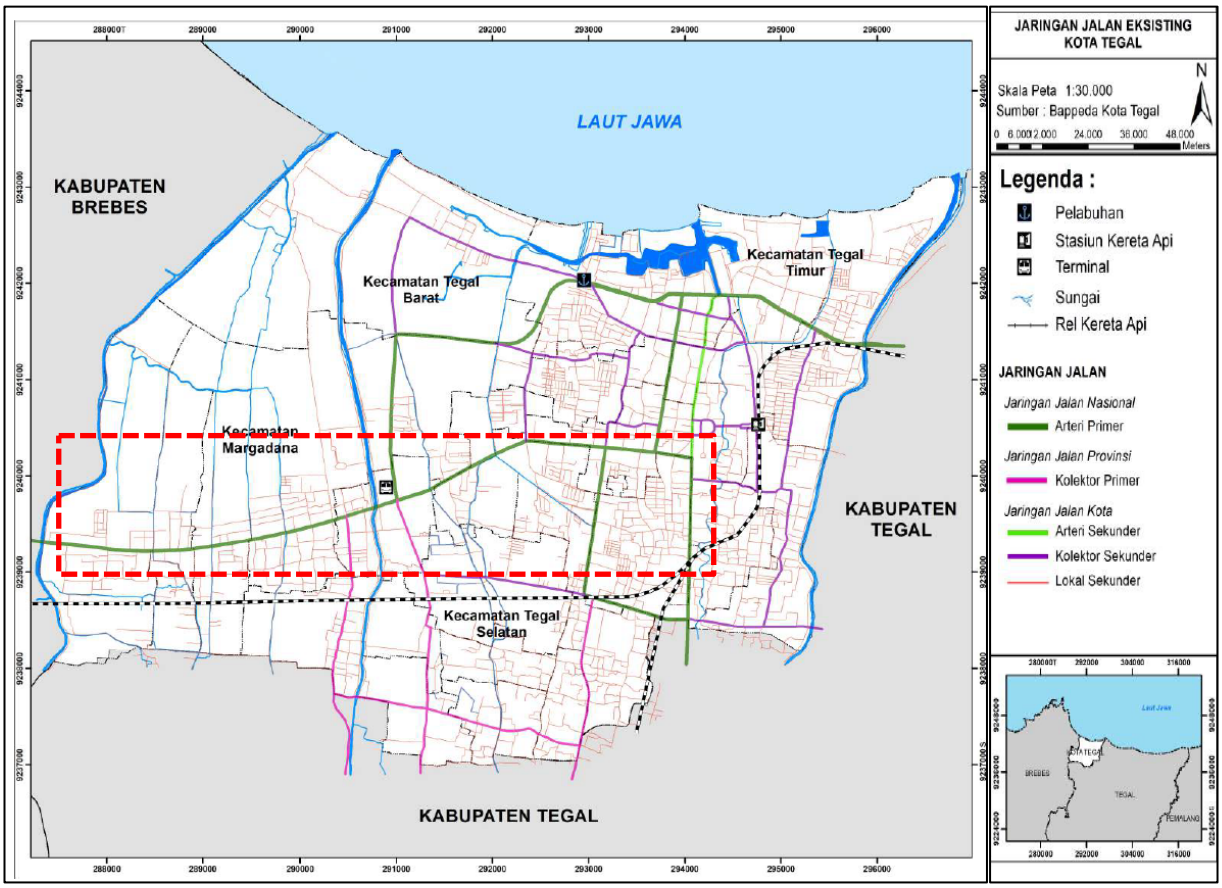

Figure 1. Existing Road Network Map of Tegal City

III. METHOD

This research was conducted in Tegal City, Central Java Province, over six months from January to June 2024. A qualitative descriptive approach was employed to carry out the study. Descriptive research details natural and man-made phenomena, encompassing activities, characteristics, relationships, changes, differences, and similarities [15]. The qualitative descriptive analysis specifically focuses on outlining the existing conditions of spatial structures in Tegal City. Data collection was performed using two methods: primary surveys and secondary surveys. The primary survey involved direct observation, while the secondary survey was conducted by gathering data and information from planning documents,

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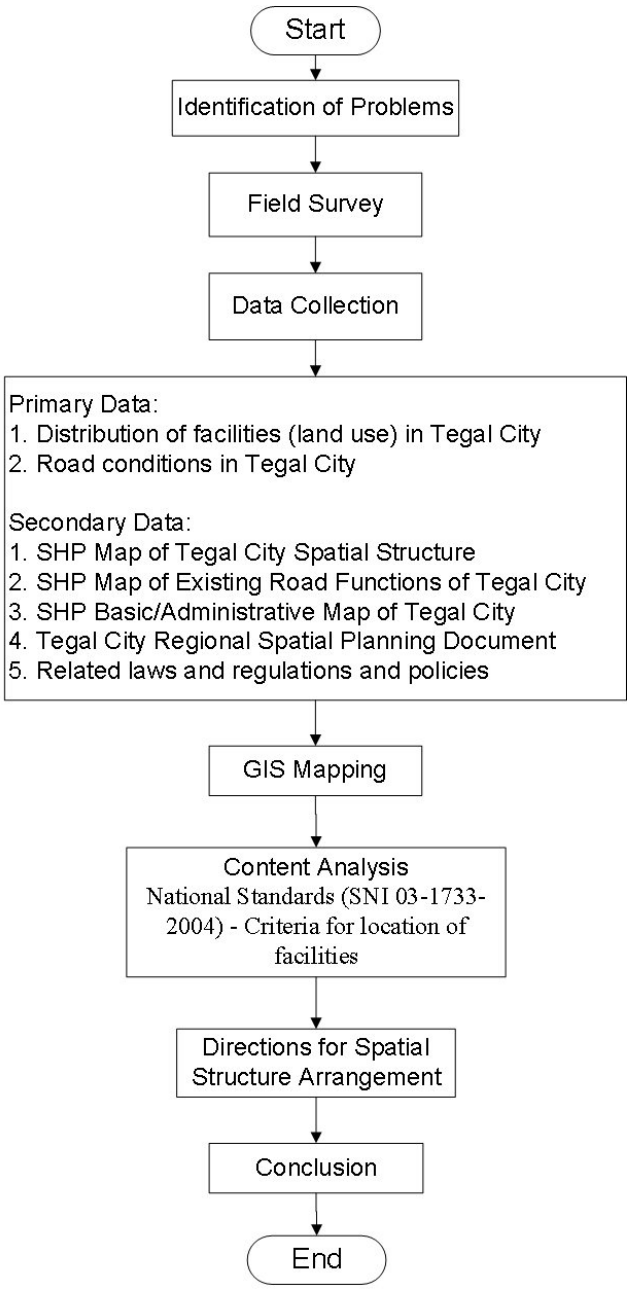
specifically the Tegal City RTRW. This study utilized content analysis, a method that encompasses the analysis of text content and serves as a specific analytical approach. Content analysis techniques systematically examine the content of texts or documents, aiming to identify particular patterns, themes, or characteristics within the text being studied. This technique is predominantly used in qualitative research to analyze collected text data [14]. This research used content analysis to evaluate and compare the Standards outlined according to Indonesia's National Standard (SNI) No 03-1733-2004 03-1733-2004 with the existing condition data. The flow diagram illustrating this research process can be found in Figure 2.

Figure 2. Research Flow Diagram



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IV. DISCUSSION

According to the Tegal City Regional Spatial Planning Document (RTRW), the spatial structure of Tegal City is categorized into a City Service Center, City Service Sub-Center, and Environmental Service. This classification appears to be inadequate. The spatial structure's hierarchy for urban service levels should be delineated into two categories: Regional Service Scale and Local Service Scale. The Tegal City RTRW for 2017-2032 includes a map illustrating the existing spatial structure, as shown in Figure 3. This map indicates that the Pantura route is classified as a City Service Sub-Center, which serves the sub-city areas by providing services to residents and facilitating activities in various parts of the city. Its hierarchy, function, scale, and service area are greater than the Environmental Centre's but lesser than the City Centre's[2].

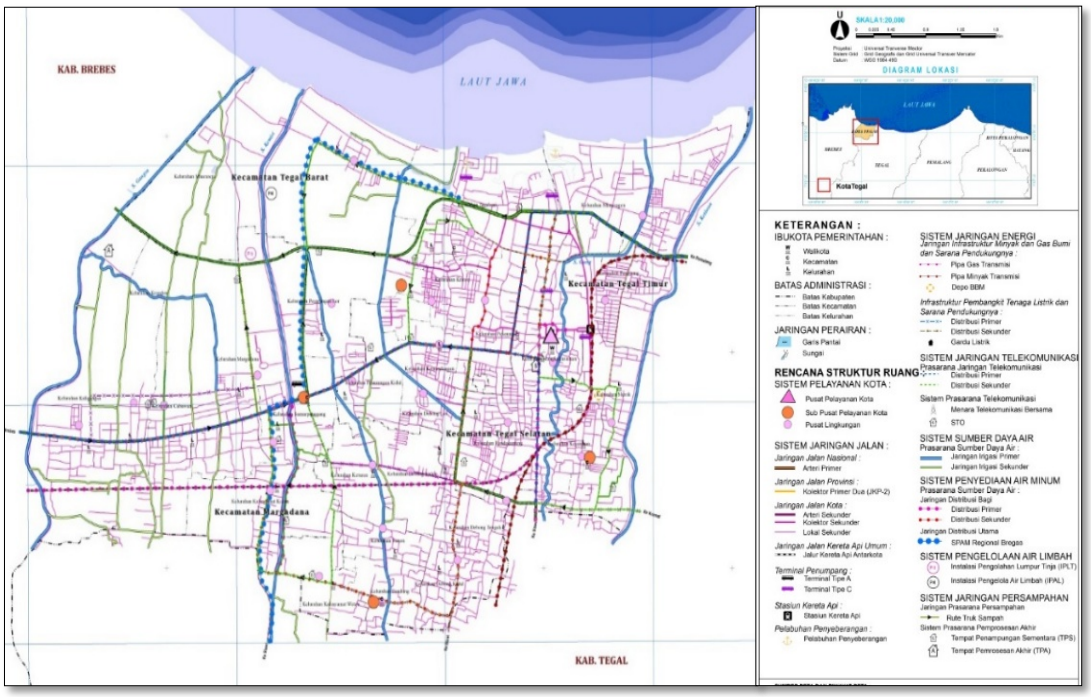

Figure 3. Existing Map of Tegal City Spatial Structure

After conducting field observations, the Tegal City spatial structure distribution was obtained, which was described according to the service scale on the map in Figure 4.

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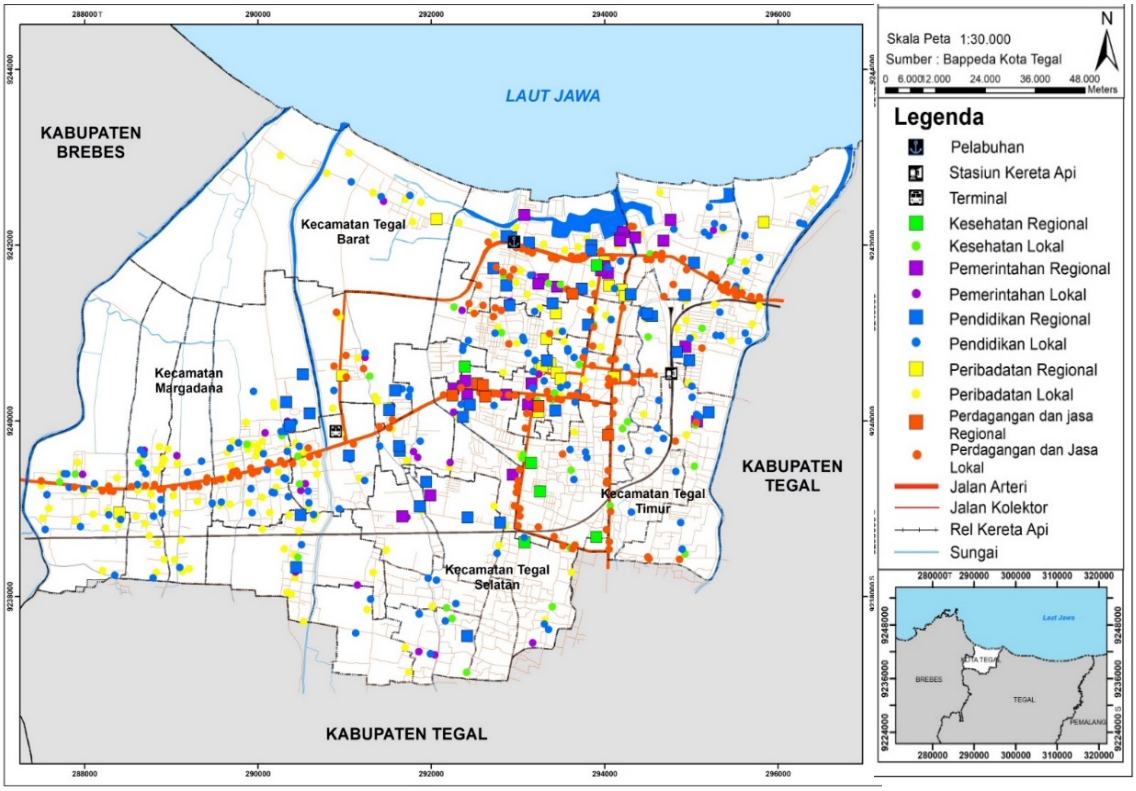

Figure 4. Tegal City Spatial Structure Distribution Map

Arterial roads, as outlined in Law No. 2 of 2022 concerning Roads, serve several essential functions: they connect (1) various national activity centres; (2) national activity centres to regional activity centres; and/or (3) national and regional activity centres to primary airports and main or collector ports. According to Government Regulation No. 34 of 2006, arterial roads must maintain an average speed of at least 60 km/hour, have a capacity that exceeds average traffic volume, and facilitate long-distance travel without interference from local traffic and activities. However, as illustrated in Figure 4, the Pantura route exhibits numerous local-scale activities, indicating that the presence of these facilities does not comply with regulatory provisions and poses risks to road users. The existence of local service scale facilities generates back-and-forth traffic, leading to infrastructure management challenges, including traffic accidents attributable to inadequate road safety measures resulting from improper land use [10]. In 2022, Tegal City reported 379 traffic accidents, up from 272 cases in 2021, marking a 29% increase. The primary contributors to these accidents are human factors (92%), vehicle issues (5%), and road infrastructure/environmental conditions (3%) [1]. These data underscore how local-scale land use activities along the Pantura route diminish traffic comfort and safety, ultimately increasing the likelihood of accidents.

Analysis of Spatial Structure Deviation

Several deviations occur in the spatial structure of Tegal City when viewed from the existence of local scale supporting facilities as previously discussed. These deviations are not by the Indonesian National Standard (SNI) No 03-1733-2004 concerning Procedures for Urban Environmental Planning and the function of the Pantura route as an arterial road. The description of the deviations in the spatial structure can be seen in Table 1.

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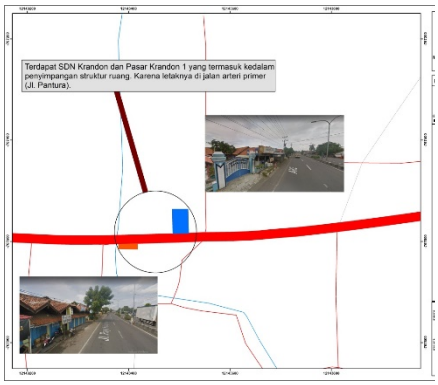
Table 1. Evaluation of the Tegal City Spatial Structure

Analysis	Photo Mapping
Standard: The elementary school's (SD) location should not cross the highway and be in the middle of a group of residents. **Analysis:** A deviation in the spatial structure occurs, namely in the elementary school building located on the edge of Jalan Pantura with the status of a primary arterial road class and a minimum speed limit of 80 km/hour. The elementary schools are SDN Margadana 1, SDN Krandon 1, and SD Al-Irsyad..	
Standard: The junior high school (SMP) is in a location that can be reached by public transportation but is not always in the centre of the environment. **Analysis:** A deviation in the spatial structure occurs, namely in the junior high school building located on the edge of Jalan Pantura with the status of a primary arterial road class and a minimum speed limit of 80 km/hour. Meanwhile, the junior high school should be on a collector road with a maximum vehicle speed limit of 30-50 km/hour. The deviation in the spatial structure is located at SMPN 3, SMPN 7, and SMPN 9.	
Standard: The location of the high school/vocational school (SMA/SMK) should be accessible by public transportation, but it should not always be in the centre of the neighbourhood. **Analysis:** A deviation occurs, namely, there is an SMP building located on the edge of Jalan Pantura, which has the status of a primary arterial road class and a minimum speed limit of 80 km/hour. Ideally, the location of the SMP is on a collector road with a vehicle speed limit of 30-50 km/hour. The location included in the deviation of the spatial structure is SMKN 3.	

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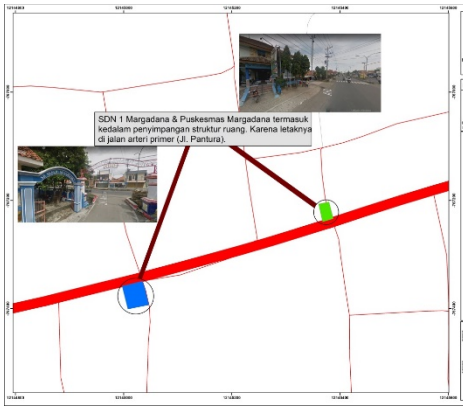
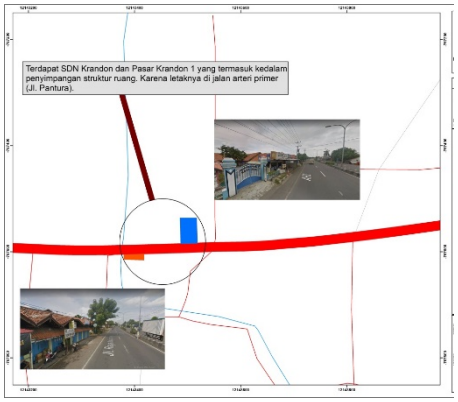
Analysis	Photo Mapping
Standard: The location of the Community health centre (Puskesmas or Puskeswan) should be accessible by public transportation or can be integrated with the village office. **Analysis:** In the existing condition, a deviation in the spatial structure occurs. Namely, there is a Puskesmas or Puskeswan building located on the edge of Jalan Pantura with the status of a primary arterial road class and a minimum speed limit of 60 km/hour. Ideally, the location of the Margadana Health Center in Margadana District and the Animal Health Center in Tegal Timur District are on collector roads that have a vehicle speed limit of 30-50 km/hour.	
Standard: The location of the neighbourhood market should be accessible by public transportation. **Analysis:** A deviation in the spatial structure occurs. Namely, there is a market located on the edge of Jalan Pantura with the status of a primary arterial road class and a minimum speed limit of 60 km/hour. Ideally, the location of the neighbourhood market is on a collector road with a vehicle speed limit of 30-50 km/hour.	
Standard: The location of small-scale service trade places such as stalls, small shops, and grocery stores should be in the middle of a group of neighbours. It can be part of other facilities or inaccessible by public transportation. **Analysis:** A deviation in the spatial structure occurs, namely stalls and grocery stores located on the edge of Jalan Pantura with the status of a primary arterial road class and a minimum speed limit of 60 km/hour. Ideally, stalls, small shops, and grocery stores are located on a collector or local road with a vehicle speed limit of 20-50 km/hour.	

Based on Table 1. it can be seen that in Tegal City, there are deviations in the spatial structure of educational land use (elementary, junior high, senior high/vocational high schools), deviations in the use

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of health land (health centres), and deviations in the use of trade and service land (grocery stores/small-scale shops).

Directions for Spatial Structure Arrangement

After an evaluation of buildings that violate the spatial structure, several things can be done to improve the spatial structure, namely:

1. Lowering the class of the Pantura road, which was originally a primary artery, to a secondary collector
2. Moving the location of the building to a more suitable place by the Standard so that it does not endanger road users if they want to carry out their activities.
3. Arranging clear zoning for various land use functions so that uncontrolled growth does not occur
4. Adding a primary arterial road located in South Tegal District, which is integrated directly with Tegal Regency from Jalan Banjaranyar in Tegal Regency to Jalan Dr. Cipto Mangunkusumo in Tegal City via the left side through Debong Tengah - Debong Kidul - Debong Kulon - Keturen - Pesurungan Kidul - Sumurpanggang Villages. The addition of new arterial roads is expected to support the development of several areas in Tegal City so that there is an even distribution of settlement and trade and service centres. It can reduce delays and obstacles in city service centres due to continuous flow.

The following are directions for the spatial structure plan of Tegal City based on the analysis results, which can be seen in Figure 5.

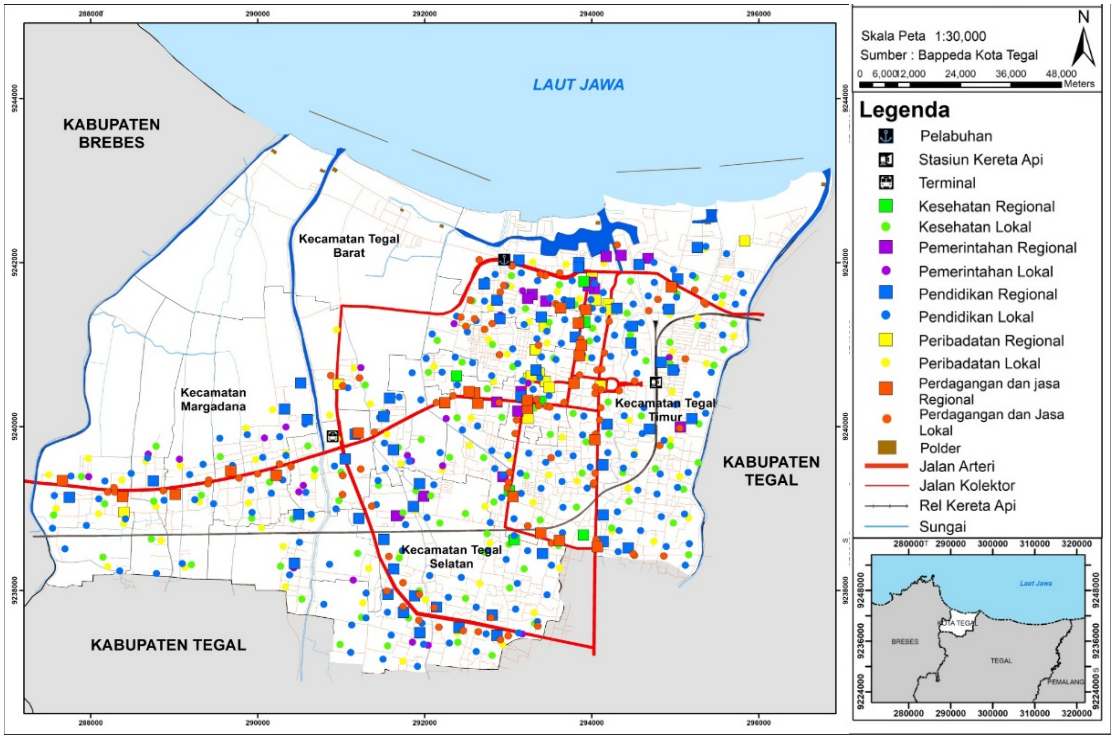

Figure 5. Tegal City Spatial Structure Plan Direction Map

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V. CONCLUSION

This study examines the spatial suitability of public facilities in Tegal City with national planning standards. Several inconsistencies were found in this study when viewed from the function of the road network and the condition of supporting facilities around the Pantura route network, which has the status of an arterial road. The analysis results show that the deviation of the spatial structure occurs in more than 50% of the existing land use activities. This means that the condition of the Pantura route is not ideal for local-scale activities because it endangers road users and land use activities.

Reducing the function of arterial roads to collector roads is the direction of the plan proposed by the author, considering that there are facilities on the Pantura route that do not comply with SNI, such as educational facilities (elementary and junior high schools), health facilities (health centres), and markets. The improvement of the spatial structure can support the economic growth of Tegal City, maintain the safety of drivers in using the road, reduce the safety of users of facilities along Pantura Road, reduce the risk of traffic accidents, and increase pedestrian accessibility.

These findings are expected to be the basis for compiling the revised Tegal City Regional Spatial Plan and the integration of land use adjustments with road functions to be more adaptive to development dynamics not only on arterial roads but also on roads with other functions to realize land use integration with infrastructure that is effective, comfortable, safe, and efficient. Recommendations for further research are expected to show the suitability of spatial structure and the spatial pattern of an area with security and safety for road users and its influence on local economic growth.

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