PAPER NAME

Measuring the Accessibility to Transit Station_.Proceeding-Geomate-2020-(647-652).pdf

AUTHOR

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WORD COUNT

3261 Words

CHARACTER COUNT

17060 Characters

PAGE COUNT

6 Pages

FILE SIZE

732.9KB

SUBMISSION DATE

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10th Int. Conf. on Geotechnique, Construction Materials and Environment, Melbourne, Australia, 11-13 November 2020, ISBN: 978-4-909106049 C3051

MEASURING THE ACCESSIBILITY TO TRANSIT STATION: A CASE STUDY OF TANJUNG KARANG, LAMPUNG INDONESIA

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ABSTRACT

Tanjung Karang station in the center of the capital city of Lampung province is the largest transit station within the city and has been in operation for decades. In addition to serving long-distance passengers between Lampung and South Sumatera provinces, the transit station is also connected to a number of districts in the northern part of the province where most of the users are commuter passengers. Analysis is conducted by using the scoring method against a number of variables that are considered the most decisive to indicate the level of accessibility. They are travel distance, travel time, travel cost, road network conditions, and public transport, respectively. The score of each variable is 2.55; 2.63; 2.74; 1.53; and 0.96, respectively, and the final score results is 2.08 meaning that the accessibility level of the study area to Tanjung Karang station is categorized as moderate. The lowest score regarding public transport indicates more effort is needed to make the city bus more attractive to citizens to use the bus to reach railway transit station.

Keywords: accessibility, transit station, public transport, Tanjung Karang, Indonesia

INTRODUCTION

Accessibility refers to people's ability to reach goods, services and activities, which is the ultimate goal of most transport activity. Many factors affect accessibility, including mobility (physical movement), the quality and affordability of transport options, transport system connectivity, mobility substitutes, and land use patterns. More comprehensive analysis of accessibility in planning expands the scope of potential solutions to transport problems [1]. Other researcher defining accessibility is the measure of the capacity of a location to be reached by, or to reach different locations. Therefore, the capacity and the arrangement of transport infrastructure are key elements in the determination of accessibility [2]. In other words, people who are in locations that are more accessible will be able to reach activities and destinations faster than those in inaccessible locations. The latter will be unable to reach the same amount of locations in a certain period of time. Accessibility determines equal access and opportunity. The public transport accessibility level (PTAL) in the United Kingdom, for example, is a method of transport planning that determines the access level of geographical locations in regards to public transportation [3]. In other European part, in order to rank certain place is conducted by measuring the levels of sustainable accessibility by travel mode at each geographical location in the study area as illustrated for the city of Galway, Ireland [4]. Otherwise, it is often claimed that a modal shift from private to public transport (particularly rail) would generate positive feedback effects, including reductions in car travel and CO_2 emissions, as well as increases in walking and cycling. It would also create opportunities for urban development, especially near railway stations. Conversely, mixed land-use developments near railway stations would improve accessibility for people to live, work and play close to home with access to transit station. Analysis is conducted by using the scoring method against a number of variables that are considered the most decisive to indicate the level of accessibility.

CASE STUDY AND DATA

Bandar Lampung is the capital city of Lampung province in the south of Sumatra island, Indonesia. This city is the main gate to enter Sumatra, which becomes the main route for land transportation and logistics distribution activities from Java to Sumatra, and vice versa. Bandar Lampung has a strong role in the growing economy of Sumatra, also become the center of economy activities in Lampung region. The city's area is about 169.21 km², with an estimated population of 1,015,910 as of 2017. Tanjung Karang Station in Bandar Lampung is the terminus of the railway service from Palembang, Baturaja, Blambangan Umpu and Kotabumi. Figure 1 shows the transit station and surrounding areas.

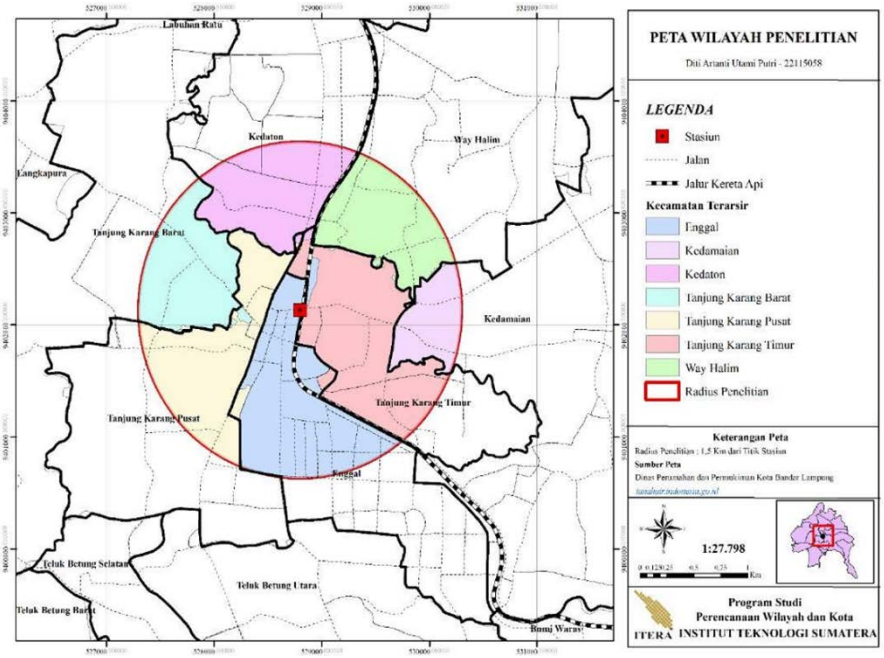


Fig. 1 Bandar Lampung city map

Passenger Statistics

The passenger traffic departing from Tanjung Karang railway station during fiscal year 2017-2018 presents in following Fig. 2. Number of the highest departure passenger in 2017 was recorded as 71,074 in October and as many as 92,820 in 2018 occurred on December.

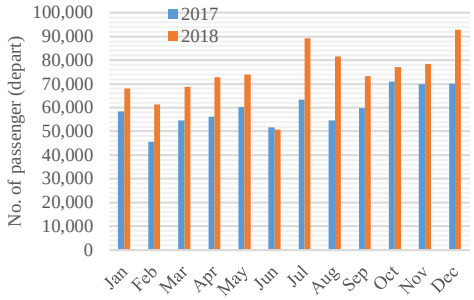


Fig. 2 Monthly depart passenger, 2017-2018

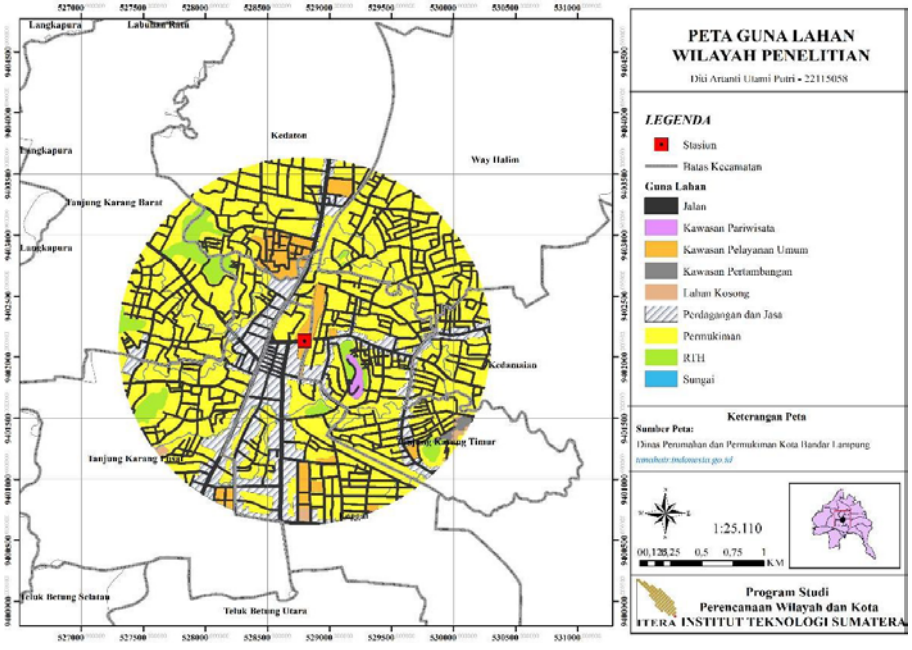


Fig. 3 Land use within study area

The average number of passengers per month during 2017 is 59,610 and an average of 72,281 people

during 2018 or there was a 21% increase in the number of departing passenger.

Characteristics of the Study Area

According to such literatures the most frequently used buffer sizes in the literature (700 and 800 m) were adopted, together with a larger buffer of 3000 m in line with the increasing body of TOD literature focusing on (electric) bicycles as feeder modes to railway stations.) [6], while other researchers emphasize the classification of railway stations. The structures of a station influence the functions it can fulfil – a common topic in e.g. ecology, where stability and reactions to disturbances are dealt with. Spatial planning and transport policy then discuss where which functions should be fulfilled, and railway stations generally form part of the context of other systems. The systematic description of these interrelations also illustrates why the interests of so many actors must be integrated in railway station operation and development [7]. The scope of this study is a residential area within ± 1.5 m radius of the station with a wide coverage of ± 7 km² and covers seven administrative districts as shown in Fig.3. According to Fig 3, most of the land are designated for residential (yellow), commercial (white), support facilities (orange) and open space (green).

RESULT AND DISCUSSION

A 160 respondents in the study area were surveyed and their responses related to the variable of travel distance, travel time, and travel cost are described below.

Travel Distance

The distance from the residence to railway station varies between 0.5 km to 4 km, with an average distance of 1.64 km. The graph related to travel distance based on grade level is shown in Fig. 4 below.

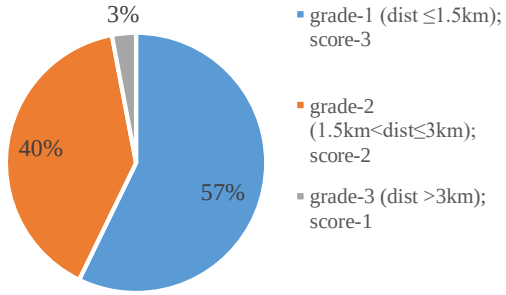


Fig. 4 Travel distance heading railway station

As many as 57% of 160 respondents reside less than 1.5 km from the station and 40% of them live between 1.5 km and 3 km. Referring to these finding, the result of the travel distance variable score is 2.55 of 3.0.

Travel Time

Almost the same as the travel distance variable, the travel time records the time taken by the respondent from the residence to the railway station. The fastest time is recorded in 2 minutes and the longest time is 30 minutes. Graphically, the travel time required towards railway station based on three grades is presented in Fig. 5.

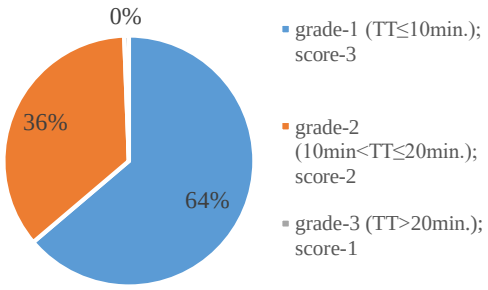
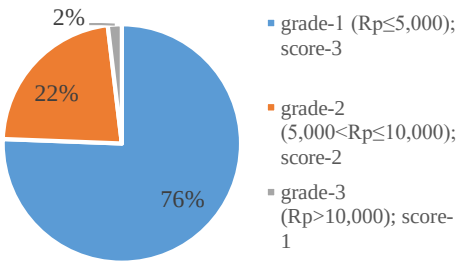


Fig. 5 Travel time heading to railway station

Nearly 64% of respondents take time about 10 minutes to reach railway station from home and the rest are needed the time between 10 minutes to 20 minutes. Since most of the respondents take time nearly to 10 minutes to reach railway station, a final score of 2.63 of 3.0 is obtained in terms of travel time variable.

Travel Cost

Travel costs vary from Rp0 to Rp15,000, indicating there are a number of respondents on foot or non-motorized transportation to reach the railway station and some of them have changed modes several times. Figure 6 shows the travel cost of respondents according to each grade.



Fig, 6 Travel cost needed to reach station

As shown in Fig. 6, as many as 76% of 160 respondents paid Rp5,000 from the house to the railway station indicating the group used only one trip

and one mode of transportation since Rp5,000 was the average fare for a single trip by bus or para-transit mode. Based on the overall calculation result, the final score of travel cost variable is 2.74 of 3.0.

Road network Conditions

Scores related to road network conditions are calculated after field observations are made. Some decisive assessment components are the road surface, road markings, availability of sidewalks, and side friction.

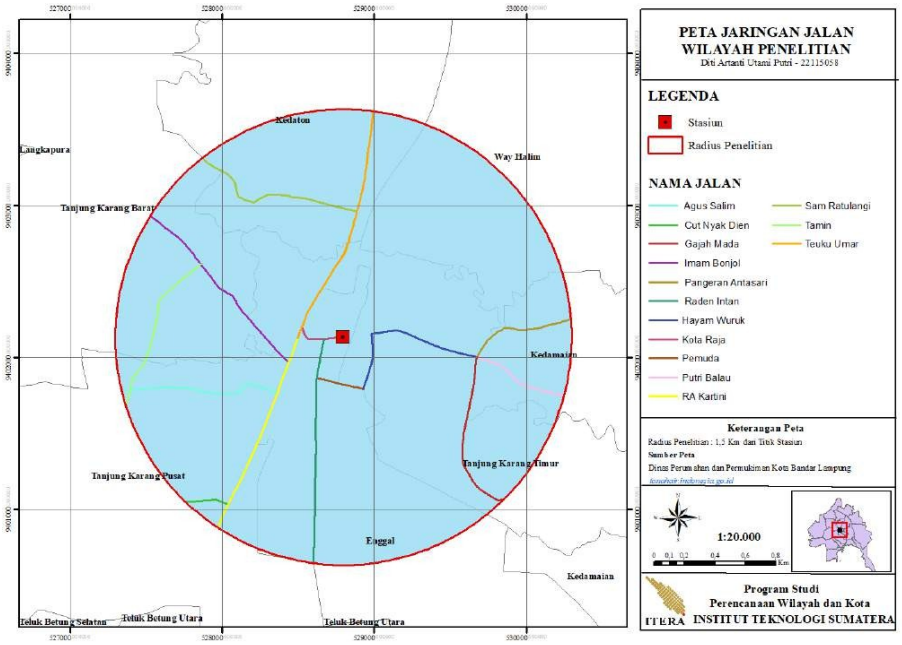


Fig. 7 Road network within study area

In this case, there are 14 road sections that were observed with several levels of function hierarchy, namely secondary arterials, primary collectors and secondary collectors referring to Indonesian urban road classification. Road network within study area and its surrounding presents in Fig. 7 and Table 1.

Table 1 Road network assessment score

Road section	Assessment score					Ave. score
	Surface	Shoulder	Marking	Side walk	Side friction	
Raden Intan	3	2	1	2	1	1.80
RA Kartini	3	1	3	2	1	2.00
Teuku Umar	3	1	3	3	1	2.20
Kota Raja	3	2	1	3	0	1.80
Imam Bonjol	3	1	2	1	0	1.40
Gajah Mada	3	1	1	3	0	1.60
Pemuda	2	0	0	0	0	0.40
Hayam Wuruk	3	2	2	1	0	1.60
Antasari	3	1	1	1	1	1.40
Putri Balau	3	1	2	0	2	1.60
Agus Salim	3	1	2	0	1	1.40
Tamin	3	1	2	0	3	1.80
Cut Nyak Din	3	0	1	0	2	1.20
Sam Ratulangi	3	1	1	0	1	1.20
	Final score					1.53

Note: 3: excellent; 2: good; 1: moderate; 0: poor

Table 1 shows the variables that contributed the highest score to the assessment were road surfaces. This indicates that almost all of the 14 road sections observed were in excellent condition. Whereas the side friction variable contributes to the lowest value expressed by on street parking, entry-exit vehicles to land-use and street vendor activities within surrounding areas.

Public Transport Availability

In this section, the assessment is carried out related to the availability of public transport services (city buses and para-transit) on the fourteen road networks within the study area and the availability of bus stops along the network. Detailed assessment results are shown in Table 2. Based on observations, most of the road networks within the study area are serviced by para-transit, and only the main roads with the function of secondary arterial are served by city buses. City bus and para-transit services are fully carried out by private companies and almost without control by the city government regarding service quality. Resolving this issue has been stated as for the vast majority of station areas, the transportation supply is not enough to match the potential demand created by the existent land uses around the stations [8].

Table 2 PT and bus stop assessment score

Road section	Function	Assessment score		Ave. score
		PT availability	Bus stop	
Raden Intan	Secondary arterial	3	3	3.0
RA Kartini	Secondary arterial	2	1	1.5
Teuku Umar	Secondary arterial	2	0	1.0
Kota Raja	Secondary arterial	3	0	1.5
Imam Bonjol	Primary collector	1	0	0.5
Gajah Mada	Secondary collector	1	0	0.5
Pemuda	Secondary collector	3	0	1.5
Hayam Wuruk	Secondary collector	1	0	0.5
Antasari	Secondary collector	1	0	0.5
Putri Balau	Secondary collector	9	0	0.0
Agus Salim	Secondary collector	1	0	0.5
Tamin	Secondary collector	2	0	1.0
Cut Nyak Din	Secondary collector	2	0	1.0
Sam Ratulangi	Secondary collector	1	0	0.5
Final score				0.96

Note: 3: service & bus stops available; 2: unregularly service & rare bus stops; 1: sometimes service & no bus stops available; 0: both no available

Based on Japan experiences, typically, two actors are involved in the development of railway corridors in Tokyo. They are the local governments and the private railway operators. Local governments in Japan are two-tiered consisting of prefectures serving wider areas and municipalities serving local areas. In particular, the prefecture, in Tokyo called the Tokyo Metropolitan Government (TMG), plays an important role in the development of railway corridors. The role of the TMG mainly concerns conditioning and facilitating land use developments [9]. Station area projects in Europe suggested Both technological change (development of high-speed and urban-regional railway networks, transfer of distribution and manufacturing activities away from station areas) and institutional change (privatization of railway companies) play a role, and are compounded by two diff erent strands of public policies: promoting the attractiveness of urban neighbourhoods and cities and promoting sustainable development [10].

Final Results of Accessibility Level

The classification for determining the level of accessibility of the study area is determined qualitatively as follows: poor accessibility (score: 0.00~1.20), moderate accessibility (score: 1.20~2.40), and good accessibility (score: 2.41~3.00). Hence, the final results of the assessment of accessibility level within the study area can be seen in Table 3.

Table 3 Final score of assessment

No	Variable	Score	Accessibility level
1	Travel distance	2.55	good
2	Travel time	2.63	good
3	Travel cost	2.74	good
4	Road network	1.53	moderate
5	Public transport	0.96	poor
	Final score	2.08	moderate

Variables related to travel cost seem to give the highest value to the final score, while the public transport availability variable contributes to the smallest score. The final results of 2.08 meaning that the accessibility level of the study area to Tanjung Karang station is categorized as moderate

CONCLUSION

This paper develops a relatively simple way to determine the level of accessibility to reach a railway station and the end result is not so surprising since the best practices in developing cities within developing countries are still very limited in the practical order. The involvement of the main actors in the context of land-use transport interaction still requires more efforts, especially from the central and local government, railway companies, land developers and transport operators in order to create sustainable development. Experience clearly demonstrated that knowledge sharing is an essential element for integrated land use and transport planning to take place, but just bringing together under the same roof practitioners from the two fields of expertise will not make this form of integrated planning to occur (on the contrary, it might aggravate personal differences) [11]. In a dense urbanized area, where the dwelling market is saturated, it is necessary to take explicitly into consideration the interactions among the different urban agents, and the effects of such interactions on the dwelling price, in order to correctly forecast the evolution of the land use pattern, as stated by Coppola and Nuzzolo [12]. More advanced, a resilient city can generally be summarized as the dimensions of economic resilience, social resilience, ecological resilience, and infrastructure resilience. The results demonstrate the

cross-linkage between development and urban resilience, which is in nature a resilience in development. However, improving urban resilience to climate change requires a systematic, long-term, and local based approach. Urban development cannot autonomously lead to a more resilient city, it's often on the opposite [13]. Variables related to public transport availability which have the lowest score on the assessment of accessibility level is one of the most difficult big challenges since the city mayor of Bandar Lampung more pay attention to build flyovers and widening roads to overcome increasing travel demand. The steps to deal with rapid motorization through transport demand management manners and strategies to develop the non-motorized transport have not been seen at all. Several cities have jumped several steps ahead related to the issue of sustainable transport, and this issue is closely related to path walkability. As stated by Park et. al. [14], the path walkability is defined as the quality of physical walking environment that can be measured objectively based on the micro-level physical characteristics of a street and its adjacent intermediary space between the outer edge of the sidewalk and the façade of nearby buildings. Based on finding results the score of each variable i.e. travel distance, travel time, travel cost, road network conditions, and public transport is 2.55; 2.63; 2.74; 1.53; and 0.96, respectively, and the final score results is 2.08 meaning that the accessibility level is categorized as moderate. More efforts are needed to make Bandar Lampung to become more accessible for their citizens particularly the public transport performances.

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