



Discovering the Axial Lines of Bunus River as a Social Network in Kampong Bharu using Space Syntax Analysis

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Abstract: The global trend in modern development often fails to appreciate and damages the natural beauty of old rivers in central city districts. This issue is observed in the case of the Bunus River, which once served as the main transportation route for early settlements in Kampong Bharu – a traditional village located in the heart of Kuala Lumpur city center. Despite its 9.2-kilometer length, the Bunus River is currently underutilized, unexploited, and lacks a sense of place. It has been covered with a pathway and used as a cycling track for city residents due to heavy pollution and significant floods in 2007 and 2011. However, the inefficient design of the pathway has left the river buried and unnoticed by most residents in the area. Therefore, this study aims to investigate the Axial Lines of the Bunus River as a social network in Kampong Bharu, utilizing Space Syntax analysis. The research method for this study employed mixed methods, focusing on the Bunus River in Kampong Bharu as the case study. Observational research was carried out along the Bunus Pathway. The data was analyzed through Space Syntax Axial Line analysis to test the axis of the river. The findings of this study revealed that optimizing the axis of the river could direct much more active movement into the area. Consequently, it is concluded that the Bunus River should be integrated into the design of the cycling tracks and pedestrian paths that span over it, thus improving the connectivity of the pedestrian and social network in Kampong Bharu as a whole.

Keywords: Bunus river, Bunus pathway, social network, Kampong Bharu, space syntax

1. Introduction

1.1 Background of Research

Rivers are rich ecosystems and sources of life that provide benefits to natural and human systems. Historically, many early settlements have developed along the riverbanks, which also support a diverse range of life forms and contribute to rich biodiversity. However, the rapid growth of urban populations worldwide has led to significant transformations in river landscapes, affecting their morphologies, processes, and forms (Li et al., 2022).

The degradation of urban rivers in Malaysia, caused by rapid urbanization, has become a significant concern. In the past, rivers played a vital role as a source of life, providing food, water, irrigation, and transportation. Unfortunately, many rivers in Malaysia, particularly in urban areas of West Malaysia, are now considered “dead” due to pollution (Povera, 2017). These rivers have become dumping grounds for human waste and various types of waste generated by industrial, agricultural, commercial, and transportation activities. The cumulative effect of these developments has placed excessive stress on and polluted the river systems. Although the government has initiated numerous efforts to minimize pollution during the country’s development, the rivers remain severely degraded due to poor management and a lack of public interest (Ibrahim & Mat Noordin, 2020; Povera, 2017).

The case study focuses on the Bunus River, which has been buried and covered underground as a response to pollution issues. However, this approach has resulted in underutilized, lack of exploitation, and monotonous appearance of the river. Moreover, the inefficient design of the Bunus Pathway, which spans over the river, has created divisions within Kampong Bharu, isolating certain areas from the rest. Consequently, the objective of this study is to identify the axial lines of the Bunus River as a social network in Kampong Bharu, emphasizing that where covering the river should not be considered as a viable option. In this context, axial lines refer to the longest lines of visibility that represent linear spaces in urban settings (Vaughan & Geddes, 2009).

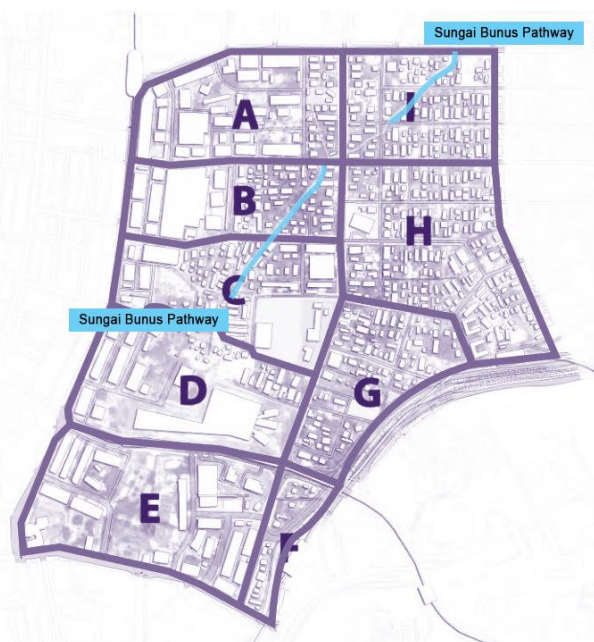
1.2 Objective of Study

The primary aims of this study encompass identifying the social network in Kampong Bharu, examining pedestrian movement within and departing from the area, and analyzing the connectivity and usability of the Bunus Pathway.

2. Methodology

2.1 Data Collection Method

The research method employed for this study is mixed methods. The Bunus River, also known as *Sungai Bunus*, which has been transformed into the Bunus Pathway in Kampong Bharu, was selected as the case study. The analysis focused on the river morphologies and accessibility, as they constitute significant contributions to this research. Structured observation and participant observation were utilized as part of this research. During participant observation, the researchers actively participated and personally experienced the walking distance along the pathway. Structured observation, on the other hand, took place over a two-week period to gain a better understanding of the surrounding context. The structured observation followed the Gate Observation method, derived from the Space Syntax Observation Manual, to identify movement patterns based on land use and pedestrian categories, including locals, teenagers, commuters, tourists, and immigrants (Vaughan & Grajewski, 2001). The key variable in categorizing the pedestrian group is the travel time, travel distance, departure time, and movement pattern (Jang et al., 2023). The observations were conducted on both weekdays and weekends, taking into account different zonings (see Appendix A for the Gate Observation sheet).



**Fig. 1 - The Zonings in Kampong Bharu. Content source: Mahdzar, 2017.
Graphic source: Jimi Sham & Mahdzar, 2019**

During the observation, nine zoning classifications were identified, that is zone A) business zone, B) commercial zone, C) educational zone, D) commercial zone, E) corporate zone, F) transit zone, and G, H, I) residential zone. These zones were used to determine the number of users, the type of users, accessibility, and movement patterns within each specific area (see Figure 1). The gate observation method was chosen as the primary technique for spatial observation, focussing on observing as many gates as possible. This method enables the identification of the flow of people, particularly in and around the Bunus Pathway (Mahdzar, 2008; Mansouri & Ujang, 2017; Vaughan & Grajewski, 2001). Each zone consists of 7 to 8 observation gates, with a 5-minutes timeframe assigned to each gate. The observation periods were divided into specific time slots: 8 am to 9 am for the morning rush hour, 1 pm to 2 pm for the lunchtime peak, 3 pm to 4 pm for the mid-afternoon period, and 7 pm to 8 pm for the evening rush hour.

2.2 Data Analysis Method

The Space Syntax Axial Lines analysis was chosen to examine the pedestrian movement counts obtained from the Gate Observation method. This analysis involves integrating spatial configurations and connectivity analysis. Space Syntax Axial Lines refer to networks of streets and squares that facilitate the measurement of the relationship between connectivity and integration in different locations (Dursun, 2007). The analysis encompasses both global and local integration, connectivity, and correlation values. The connectivity analysis is significantly correlated with pedestrian and vehicular movement patterns to, from, and along the river. It helps to understand the level of connection between different areas. The integration analysis assesses the global and local integration within the specific context. Axial global integration represents the integration values of axial lines, in this case, with a radius set at 3 km, providing a representation of the integration pattern on a larger scale (Hillier, 2007). Axial local integration, on the other hand, focuses on integration values within a smaller radius of 500 m from the study area (Hillier, 2007). The layout analysis of the Bunus Pathway is achieved through the comparison of graphs. These graphs illustrate a range of results, indicated by colors from red to blue, representing the highest to lowest levels of integration or connectivity. Additionally, the correlation value ranges from low (below 0.5) to high (above 0.5), providing insights into the relationships observed.

3. Case Study

3.1 Bunus River

Bunus River, measuring approximately 9.2 kilometers in length, is a significant tributary of the Klang River (*Sungai Klang*). It was specifically chosen among other rivers in Malaysia due to its central location within the city, making it the only river that both starts and ends within the city (Universiti Putra Malaysia, 2018). The river flows from Wangsa Maju through Setapak and Titiwangsa before reaching Kampong Bharu and ultimately joining the Klang River. Its urban location presents opportunities for the incorporation of cycling and jogging tracks along its course. The development of these tracks began in 2015 at the Bunus River Recreational Park in Wangsa Maju, followed by the Bunus River Retention Pond at Kampung Boyan, and the Bunus Pathway in Kampong Bharu in 2017 (Chen, 2022). However, these tracks are currently not connected, highlighting the need for further study on enhancing connectivity (PressReader, 2017).

Over the years, the Bunus River has undergone hydrological changes, becoming smaller and narrower. It has gained notoriety as one of the most polluted rivers, contributing to severe flooding in the city in 2007 (Rahim & Kasmuri, 2020). Another major flash flood occurred in 2011, resulting in significant disruptions to major roads surrounding Jalan Tun Razak and Kampong Bharu, primarily caused by overflow from the Bunus River (Abu Bakar, n.d.).



Fig. 2 - Massive flooding (a) Kampong Bharu, 2007; (b) Kampong Bharu, 2011. Source: Abu Bakar, n.d.

3.2 Bunus River Morphologies in Kampong Bharu

Over time, the Bunus River has suffered severe degradation, resulting in significant changes to its physical appearance (Rahim & Kasmuri, 2020). Out of its original length of 9.2 kilometers, only 5.5 kilometers of the river remains visible, while the remaining section, extending towards Kampong Bharu, is concealed and flows underground (Daily Express, 2015). This is an unfortunate event, considering that the Bunus River holds a significant historical value for Kampong Bharu. It served as the primary axis for early settlements, providing essential resources such as food, water, and transportation (Ahmad Syah, Perbadanan Kampong Bharu, personal communication, January 14, 2019). In the 1900s, Jalan Raja Abdullah, the main road in Kampong Bharu, was established, connecting the Bunus River and the Klang River. However, rapid urbanization in Kampong Bharu has placed excessive stress on the river systems, resulting in pollution caused by waste disposal from local communities, street vendors, construction sites, and factory workers (Jabatan Pengairan dan Saliran Malaysia, n.d.). As a consequence, the Bunus River has gradually become narrower and eventually started disappearing in the 1960s, eventually ceasing at Jalan Dewan Sultan Sulaiman in the early 2000s, as depicted in Figure 3. Subsequently, this section was paved in 2017 (Ahmad Syah, Perbadanan Kampong Bharu, personal communication, January 14, 2019).



Fig. 3 - Bunus River Morphologies in Kampong Bharu.

Content source: Ahmad Syah, Perbadanan Kampong Bharu, personal communication, January 14, 2019

Graphic source: Mahdzar, 2017

3.3 Bonus Pathway

The remaining 3.7 kilometers of the Bonus River in Kampong Bharu is concealed, with only a 600-meter section paved over to create the pathway. However, the pathway appears disjointed and disconnected at various points, dividing it into two separate parts: the residential zone on the Northeast side and the educational zone on the Southwest side as shown in Figure 4. The Northeast Pathway begins at Jalan Raja Muda Musa and ends at Jalan Hamzah, while the Southwest Pathway extends from Jalan Raja Bot to Jalan Dewan Sultan Sulaiman, as illustrated in Figure 4. Currently, the Northeast Pathway is underutilized due to its lack of connectivity, which will be further explored in this study.

The walking distance for Northeast and Southwest Pathways ranges from 3 to 4 minutes, covering 250 meters and 350 meters, respectively. These two disjointed pathways are separated by a junction that requires individuals to cross the busy main road, Jalan Raja Abdullah, and traverse an informal 250-meter route to continue their journey, as indicated in Figure 4. Consequently, the total travel distance for the entire pathway is 850 meters, which corresponds to approximately 10 minutes of walking.

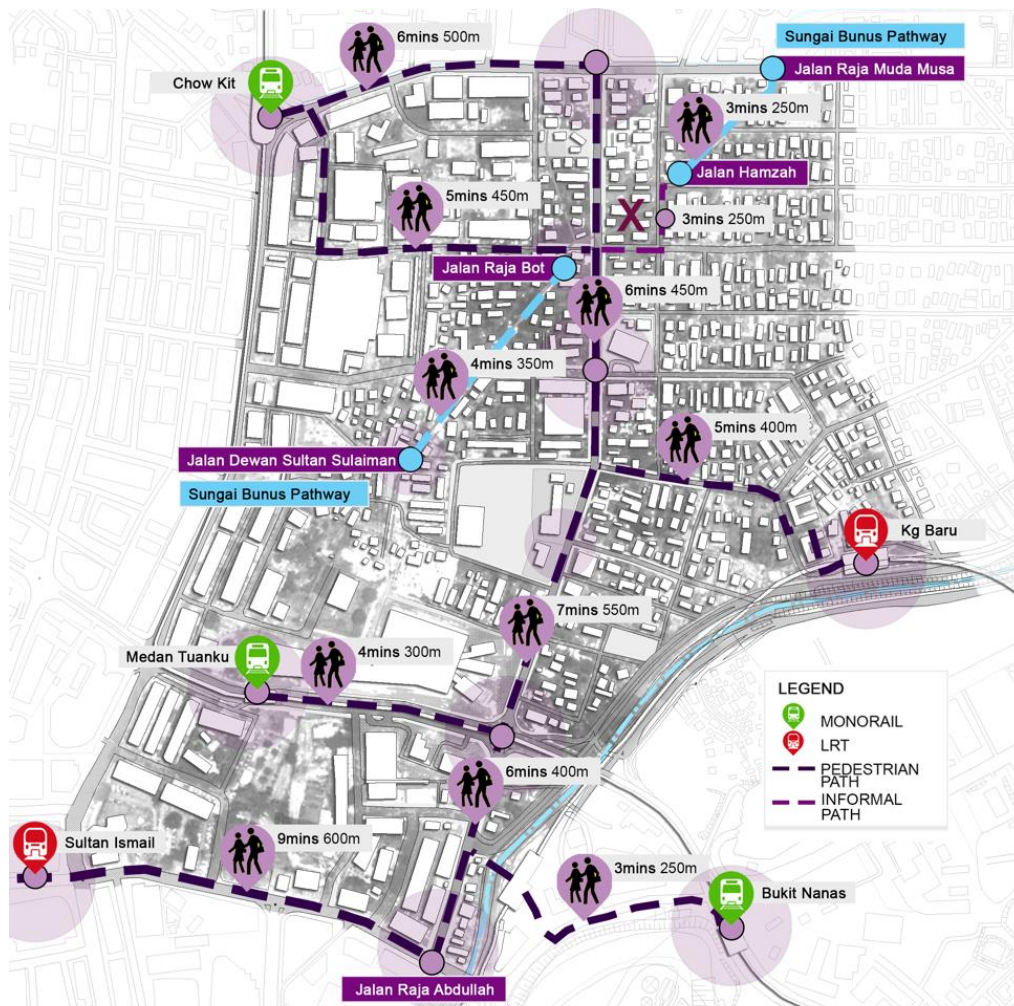


Fig. 4 - Walking Distance to and from Bonus Pathway and within Kampong Bharu.
Content & graphic source: Jimi Sham & Mahdzar, 2019

4. Findings

4.1 Gate Observation

The strategic location of Kampong Bharu attracts diverse individuals and activities, resulting in high pedestrian and vehicle traffic throughout weekdays and weekends. According to the observation study, Zone H and B exhibited the highest pedestrian count to the substantial activities occurring within these zones, as presented in Table 1. The breakdown and analysis of each zone is outlined below.

Table 1 - Weekday Pedestrian Count by Zone

Zone	Local	Tourist	Teen	Commuter	Immigrant	Total	%
A	233	25	6	35	35	334	9
B	501	52	12	12	81	658	18
C	313	3	72	9	18	415	11
D	39	33	43	155	45	315	8
E	16	30	81	140	33	300	7
F	37	66	36	171	44	354	10
G	169	9	13	14	19	224	6
H	599	33	27	23	26	708	19
I	385	10	19	14	29	457	12
Total	2292	261	309	573	330	3765	100

Table 2 - Weekend Pedestrian Count by Zone

Zone	Local	Tourist	Teen	Commuter	Immigrant	Total	%
A	217	17	10	28	45	317	9
B	428	30	12	9	90	569	16
C	269	5	61	3	15	353	10
D	35	26	56	192	49	358	10
E	13	44	72	82	35	246	7
F	45	107	110	197	57	516	13
G	213	10	17	11	19	270	8
H	444	23	30	18	19	534	15
I	350	10	24	12	21	417	12
Total	2014	272	392	552	350	3580	100

Tables 1 and 2 display the pedestrian count for each zone. There are five distinct categories of pedestrians: locals, tourists, teens, commuters, and immigrants, who exhibit significant movement patterns within Kampong Bharu. Zone A encompasses Jalan Raja Muda Abdul Aziz, Jalan Raja Abdullah, Jalan Raja Bot, and Jalan Tuanku Abdul Rahman. It serves as a local business zone, housing shophouses that sell groceries, office buildings, and boutique hotels. This zone primarily attracts locals, commuters, tourists, and immigrants. Locals constitute the largest percentage in this zone, as most of the shophouses are owned by them. Some shops and restaurants employ foreign workers, who can be seen loitering around the Chow Kit area on weekends. Tourists also frequently travel between the Chow Kit Monorail and this zone for accommodation. The majority of visitors arrive from Bonus Southwest Pathway in Zone B, with only a few coming from the Northeast Pathway. There is not a significant difference between weekday and weekend activities in this zone.

Zone B is identified as a commercial zone, comprising Jalan Raja Bot, Jalan Raja Abdullah, Jalan Raja Alang, and Jalan Tuanku Abdul Rahman. With Chow Kit Market situated in the center and surrounded by traditional village houses that stretch between Jalan Raja Bot and Jalan Raja Alang, this zone experiences heavy pedestrian and vehicle traffic most of the time. Table 1 indicates that pedestrian flow accounts for 18% on weekdays and 16% on weekends. It is a multicultural zone, attracting locals, immigrants, and tourists. Chow Kit Market holds significant cultural value and has become a popular tourist spot. Local vendors, street hawkers, eating corridors, food stalls, night markets, and wet markets are abundant in this area. Immigrants and tourists can often be seen traveling from Zone A to Chow Kit Market. The majority of Bonus Southwest Pathway users utilize this route to reach Zone B. Among all nine zones, immigrants are predominantly found working at Chow Kit Market, while some enjoy the street ambiance.

Zone C, encompassing Jalan Raja Alang, Jalan Raja Abdullah, Jalan Dewan Sultan Sulaiman, and Jalan Tuanku Abdul Rahman, serves as an educational zone for the local community. It houses Sultan Sulaiman Club, Sekolah Menengah Kebangsaan Puteri Wilayah, Sekolah Rendah Agama Tengku Ampuan Jemaah, Islam Tengku Ampuan Jemaah Kindergarten, and Sekolah Kebangsaan Kampong Bharu. During school mornings and afternoons on weekdays, as well as weekends, this zone experiences heavy traffic with a large population of teenagers. Bonus Southwest Pathway connects Zone B to Zone C and is primarily used by locals as a street that links the residential area, Chow Kit Market, and education institutions. Observation revealed children playing football and elders engaged in conversations along this pathway. Teenagers appeared to use the pathway as a shortcut to the school.

Zone D is a commercial zone housing Quill City Mall, Kuala Lumpur City Hall, and University of Kuala Lumpur. It is located within Jalan Dewan Sultan Sulaiman, Jalan Raja Abdullah, Jalan Sultan Ismail, and Jalan Tuanku Abdul Rahman, in close proximity to Medan Tuanku Monorail Station. During the observation study, many teenagers and commuters were observed traveling to and from the zone via Medan Tuanku Monorail Station, while immigrants and tourists were seen lingering in front of the mall, arriving from Jalan Tuanku Abdul Rahman. The usage of the pathway to reach Zone D was relatively low.

Zone E is a corporate zone characterized by numerous high-rise office buildings, including Jalan Sultan Ismail, Jalan Raja Abdullah, Jalan Dang Wangi, and Jalan Tuanku Abdul Rahman. This zone primarily attracts commuters, who make up the largest percentage, along with teenagers and immigrants. Commuters predominantly travel from Dang Wangi Station, walking along Jalan Dang Wangi to reach Sogo Shopping Mall and the interchange station at Sultan Ismail Station. Some locals also use the Bunus Pathway to access this area for work.

Zone F serves as a transit zone where commuters interchange between Dang Wangi Station and Bukit Nanas Monorail Station, and vehicles enter the AKLEH highway (Ampang–Kuala Lumpur Elevated Highway). It encompasses Jalan Sultan Ismail, Jalan Ampang, Jalan Dang Wangi and Jalan Raja Abdullah. Many tourists, commuters, and teenagers can be seen walking along Jalan Ampang, traveling to and from Bukit Nanas Monorail Station and Dang Wangi Station.

Zone G is a residential zone characterized by traditional houses that stretch from Jalan Raja Muda Musa, the Klang River, and AKLEH to Jalan Sultan Ismail, and Jalan Raja Abdullah. This area predominantly consists of traditional village houses enclosed by perimeter fences. There are not many activities happening within this zone. During the observation period, the area appeared quiet and secluded from the rest of Kampong Bharu, despite Kampong Bharu Station being located nearby. Bunus Pathway is also inaccessible from this zone.

Zone H is predominantly inhabited by residents and includes Jalan Raja Uda, Jalan Mahmud, Jalan Raja Muda Musa, and Jalan Raja Abdullah. It stands out as the busiest area in Kampong Bharu, accounting for 19% of pedestrians on weekdays and 15% on weekends, as shown in Table 1. This zone is renowned for its culinary offerings, with street-side eating corridors where many houses convert their frontage to stalls and restaurants selling local food. People flock here for lunch every day, and it has even gained popularity among tourists and visitors due to its famous local cuisine. The area is usually crowded, and traffic congestion is a common occurrence, particularly during peak hours. Although the Bunus Northeast Pathway is relatively close, not many individuals seem to utilize the pathway to access the well-known in-house restaurants.

Zone I is also a residential area that spans between Jalan Raja Muda Abdul Aziz, Jalan Mahmud, Jalan Raja Uda, and Jalan Raja Abdullah. This zone primarily comprises traditional houses, where children can often be seen playing outside within the neighborhood. There are also some house restaurants scattered throughout this area. The Bunus Northeast Pathway runs through the local communities in this zone. However, due to severe traffic congestion and the disconnected nature of the Bunus Pathway, the locals in this area are somewhat isolated from the rest of Kampong Bharu. The streets are packed with vehicles during peak hours, as people utilize them as shortcuts to the city. Only a few individuals use the pathway, as it does not connect to other zones in the same way that the Southwest Pathway does.

4.2 Pedestrian Flow Analysis

Figure 5 illustrates that on weekdays, Kampong Bharu is primarily dominated by locals, followed by commuters, immigrants, teens, and tourists. The same pattern applies on weekends, with a slight shift between immigrants and teens, as indicated in Figure 5. Consequently, the main target group for this study is the local communities in Kampong Bharu. Based on Figure 5, the distribution of locals is noticeably uneven. On weekdays, locals are mostly concentrated in Zone H, engaging in house restaurants, and Zone B, where they sell goods at Chow Kit Wet Market. The majority of residents residing along the Bunus Pathway in Zone B, C, and I are locals as well. However, the number of locals using the pathway from Northeast to Southwest is insignificant. They are observed in the southern part of Kampong Bharu, which includes Zone D, E, and F. This significant disparity can be attributed to rapid urbanization and severe traffic congestion, resulting in a disconnection of locals from the surrounding areas. This phenomenon becomes apparent while walking along Jalan Raja Abdullah, where the context transitions from traditional village houses to condominiums and large office towers.

Tourists, on the other hand, are more commonly found in the transit area, specifically Zone F, as they interchange between stations and enter or exit the city center. Within Kampong Bharu, tourists are predominantly seen in the Chow Kit area and the renowned food haven in Zone B and H, respectively, due to the area's significant cultural identity. Figure 5 also indicates that the highest pedestrian flow for teens occurs in Zone E, where they are frequently found around the transit area, traveling to and from schools located outside Kampong Bharu. However, within Kampong Bharu, most teens are concentrated in Zone C, which serves as an educational zone hosting four school buildings. Commuters are primarily concentrated in commercial, corporate, and transit zones, namely Zone D, E, and F, while immigrants are commonly spotted at Chow Kit Market and around the transit area for work and leisure activities. Zone C, being primarily a school zone, attracts the least number of tourists, commuters, and immigrants, as it offers limited attractions beyond the school compound.

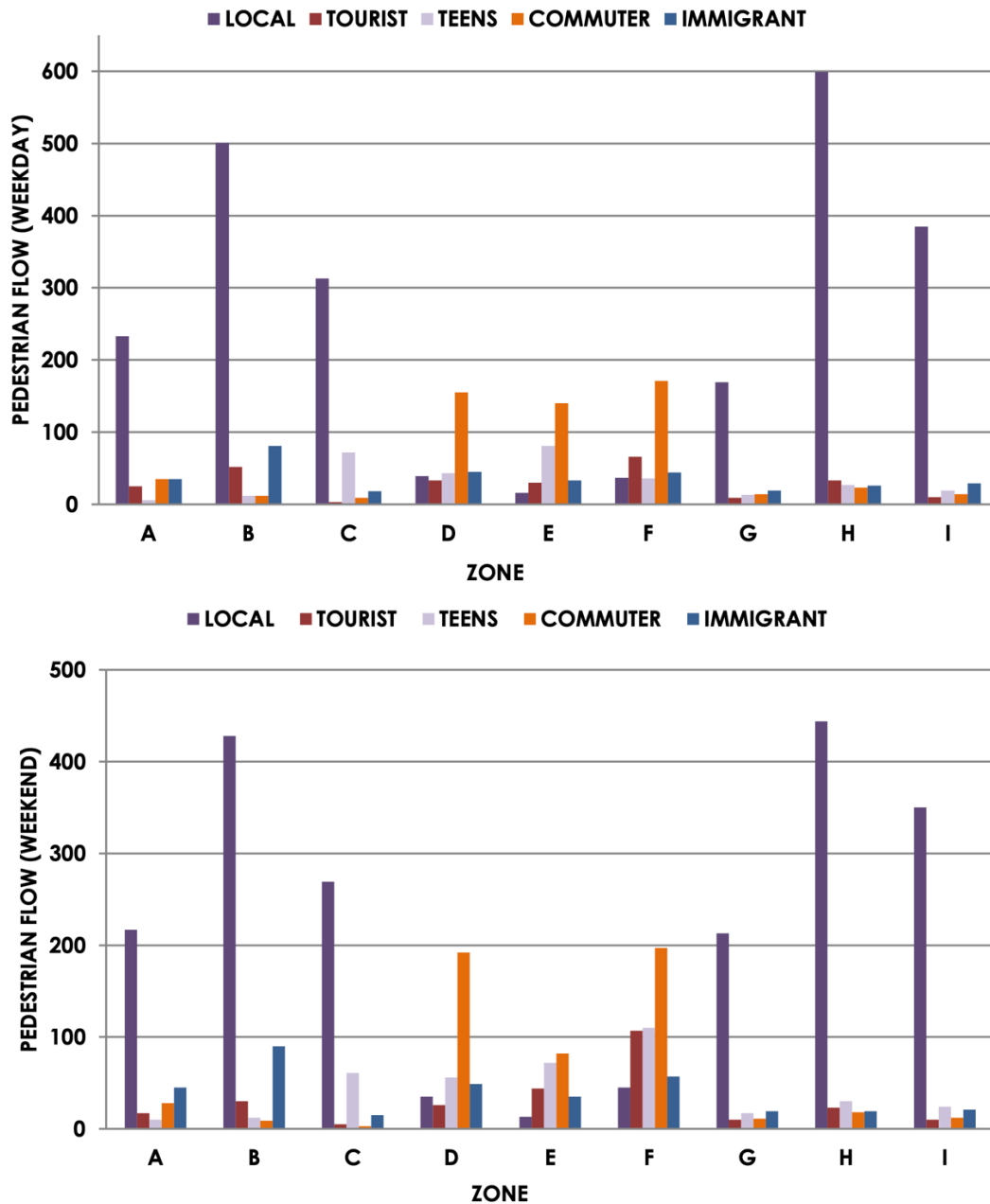


Fig. 5 - Weekday and Weekend Pedestrian Flow by Zone Analysis. Source: Jimi Sham & Mahdzar, 2019

On weekends, the busiest areas remain Zone H and B, where locals are actively engaged in selling goods. They can also be seen lingering around the local roads within these areas, although they appear somewhat isolated from the neighborhood context. According to Figure 5, locals still dominate the pedestrian count, but there is a noticeable decrease compared to weekdays. This decline can be attributed to the gridlocked and congested vehicular movements resulting from heavy traffic coming in and out of Kampong Bharu as a shortcut to the city. Tables 1 and 2 indicate a significant increase in the number of pedestrians in Zone F, from 354 on weekdays to 516 on the weekends. This zone attracts a high concentration of tourists, teens, and commuters who utilize public transportation to travel to the city center for work and leisure activities. On weekends, the Bunus Pathway experiences lower pedestrian traffic compared to weekdays. During the observation, only a few teens were observed using the pathway to reach Zone C for sports events at school. Most of the time, the pathway remains unoccupied due to its fragmented path, which is separated by traffic.

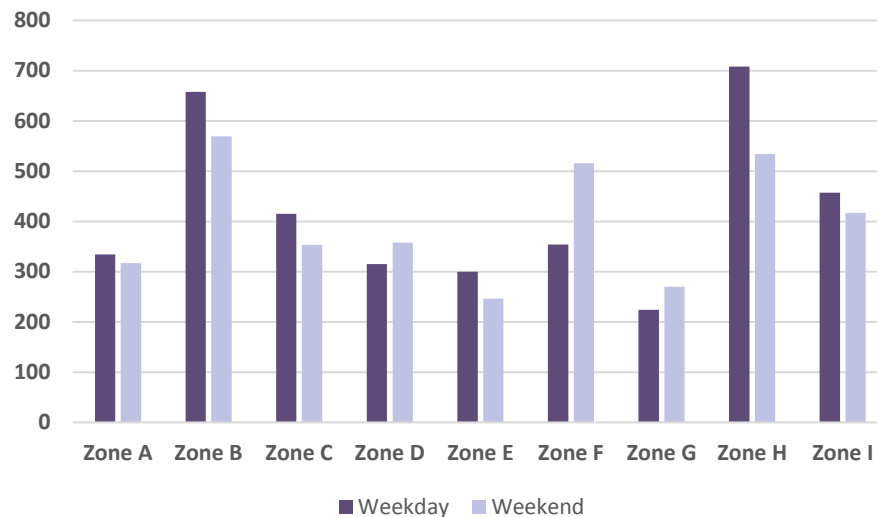


Fig. 6 - Pedestrian Flow Statistics for Weekday and Weekend. Source: Jimi Sham & Mahdzar, 2019

During the one-hour observation for each gate, it is evident that Kampong Bharu experiences high pedestrian movements on both weekdays and weekends. Zone B and H, which encompass Chow Kit Market and the street-side eating corridor, consistently exhibit the highest pedestrian flows in Kampong, regardless of the day. However, Kampong Bharu often serves as a passageway for people to reach their main destination, explaining the significant pedestrian flow at the transit zones on both weekdays and weekends. Due to its location within the city, the area attracts vehicular traffic seeking a shortcut to the city center through Jalan Raja Abdullah and Jalan Ampang. Despite the advantage of public transportation, Kampong Bharu remains congested with people and traffic throughout the week, resulting in the isolation of local communities residing in the area. The locals are mostly concentrated in the northern part of Kampong Bharu, specifically in Zone A, B, C, G, H, and I, which are bounded by their perimeter fence. Despite the high pedestrian traffic observed in Zone B, H, and I, the usability of Bunus Pathway falls short in meeting the demands of the bustling movement patterns in the area. Although children can be seen playing along the Bunus Southwest Pathway, the Northeast Pathway is underutilized, with only a few individuals using it as a shortcut. People are primarily observed using the main roads and streets around Kampong Bharu. Most zones experience higher pedestrian traffic on weekdays compared to weekends, except for Zone D, F, and G, which are the commercial, transit, and residential zones, respectively. This discrepancy is due to the presence of public transportation facilities in these zones, such as Medan Tuanku Monorail in Zone D, Dang Wangi, Bukit Nanas Station and also entering AKLEH in Zone F, and Kampong Bharu Station accessed through Zone G. It is evident that Kampong Bharu experiences a vibrant movement, but the pedestrian network within the area is inadequate.

4.3 Space Syntax Axial Line Analysis

Figure 7 illustrates the connectivity value in Kampong Bharu, with colors ranging from red to blue indicating varying levels of integration or connectivity. The highest connectivity is observed along Jalan Raja Abdullah, particularly in the southern part with values 16 and 6, indicating its significance as a primary road that connects all the local roads and provides a strong link to the city. The Bunus Pathway exhibits moderate connectivity, with the Southwest pathway showing higher connectivity compared to the Northeast pathway. The disjointed nature of the pathway contributes to this disparity, impacting the overall connectivity within Kampong Bharu.

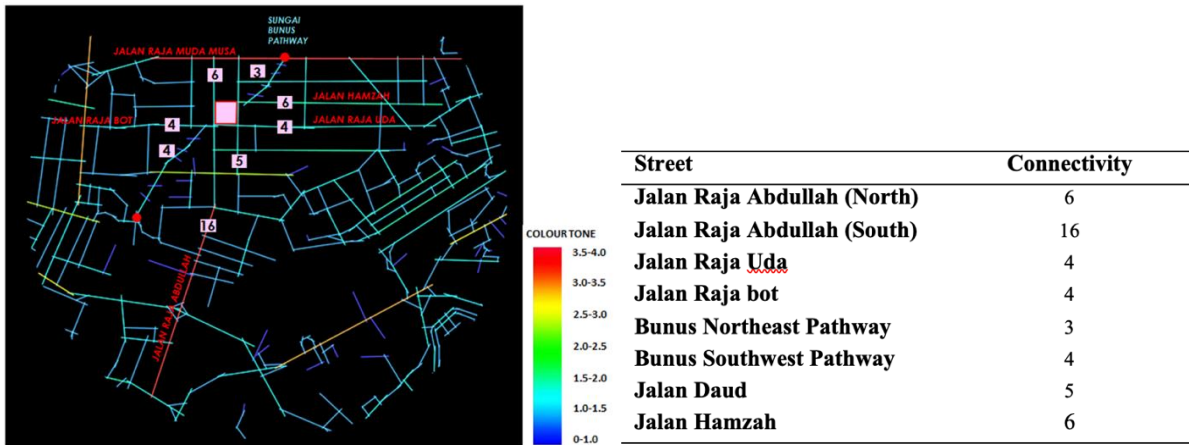


Fig. 7 - Space Syntax Axial Line Analysis on Connectivity. Source: Mahdzar & Jimi Sham, 2019

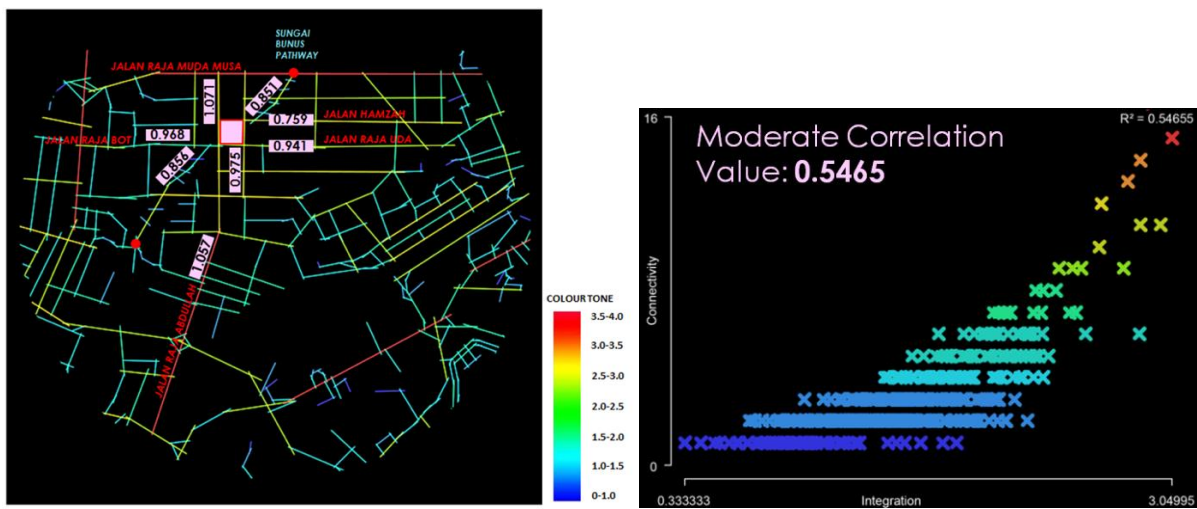


Fig. 8 - (a) Global Integration Analysis within 3km Radius; (b) Correlation Value between Connectivity and Global Integration. Source: Mahdzar & Jimi Sham, 2019

Figure 8(a) presents the global integration analysis, highlighting the most integrated street in red, which is Jalan Raja Abdullah with integration values of 1.057 for the south part and 1.071 for the north, part. The Bunus Pathway demonstrates high integration values, with the Northeast Pathway scoring 0.851 and the Southwest Pathway scoring 0.856. However, the correlation value between connectivity and global integration is 0.5465, indicating a moderate relationship (as depicted in Figure 16(b)). This could be attributed to the dense urban nature of Kampong Bharu, where there are no distinct nodes and numerous fragmented connections. Zone I, comprising Jalan Raja Uda, Jalan Daud, and Jalan Hamzah, exhibits relatively high integration values, comparable to Zone B (Jalan Raja Bot), in terms of effectively integrating with the primary road. However, as a whole, Zone I lacks overall connectivity, as indicated in Table 3.

Table 3 - Global Integration Analysis within 3km Radius

Street	Connectivity	Integration Value
Jalan Raja Abdullah (North)	6	1.071
Jalan Raja Abdullah (South)	16	1.057
Jalan Raja Uda	4	0.941
Jalan Raja bot	4	0.968
Bunus Northeast Pathway	3	0.851
Bunus Southwest Pathway	4	0.856
Jalan Daud	5	0.975
Jalan Hamzah	6	0.759

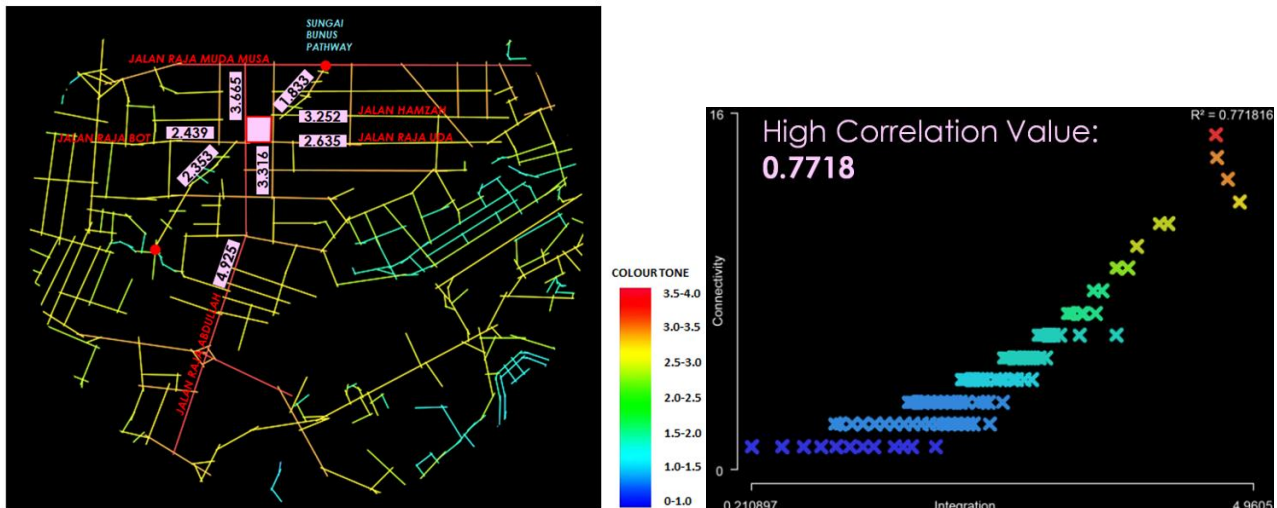


Fig. 9 - (a) Local Integration Analysis within 500m Radius; (b) Correlation Value between Connectivity and Local Integration. Source: Mahdzar & Jimi Sham, 2019

According to Figure 9(a), the local integration values in Kampong Bahru are higher than the global integration values. Jalan Raja Abdullah continues to have the highest local integration value, indicated by the red color, as it is both the highest globally and locally integrated road. On the other hand, Bunus Northeast Pathway has the lowest integration value. Within Kampong Bharu itself, Zone I exhibits strong integration with other local roads, which accounts for its high local integration value (as shown in Table 4). Figure 9(b) depicts a scatter plot of the local integration correlated with connectivity, showing an r-value of 0.7718, which is relatively high. This suggests a strong relationship between local integration and connectivity. The smooth connectivity within small areas and the proper grouping of zones contribute to this high correlation value.

Table 4 - Local Integration Analysis within 500m Radius & Pedestrian Count by Street

Street	Connectivity	Integration Value	Pedestrian Count (Weekday)	Pedestrian Count (Weekend)
Jalan Raja Abdullah (North)	6	3.665	337	326
Jalan Raja Abdullah (South)	16	4.925	673	652
Jalan Raja Uda	4	2.635	212	111
Jalan Raja bot	4	2.439	350	386
Bunus Northeast Pathway	3	1.833	78	83
Bunus Southwest Pathway	4	2.353	216	223
Jalan Daud	5	3.316	110	105
Jalan Hamzah	6	3.252	118	101
Total	-	-	2094	1987

Based on Table 4, it is evident that pedestrian flow in Kampong Bharu is influenced by the integration of streets, as well as the accessibility, connectivity, and visibility of the networks. Jalan Raja Abdullah, with its high integration value, also experiences the highest pedestrian count, thanks to its accessibility, connectivity, and visibility within the local area. On the other hand, Jalan Raja Bot has a lower integration value compared to Jalan Daud and Jalan Hamzah. It attracts a denser flow of people. This is likely due to the presence of the popular Chow Kit Wet Market on Jalan Raja Bot, which acts as a crowd-puller and enhances the accessibility and connectivity of the Bunus Southwest Pathway, making it more attractive compared to the Northeast Pathway.

Figure 10 illustrates the correlation values between pedestrian count and local integration for weekdays and weekends, showing different patterns. On weekdays, the correlation value (r-value) is 0.5458, indicating a moderate relationship between pedestrian count and local integration. However, on weekends, the correlation value drops to 0.4775, which is relatively low. This suggests that the pedestrian flow in Kampong Bharu is influenced by the connection of networks both on weekdays and weekends, although to a lesser extent on weekends. In conclusion, the pedestrian flow in Kampong Bharu is influenced by the integration, accessibility, connectivity, and visibility of the street networks within the area, with Jalan Raja Abdullah and Jalan Raja Bot standing out as key contributors to pedestrian movement. The

correlation between pedestrian count and local integration is moderate on weekdays and lower on weekends, indicating the varying impact of network connectivity on pedestrian flow during different days of the week.

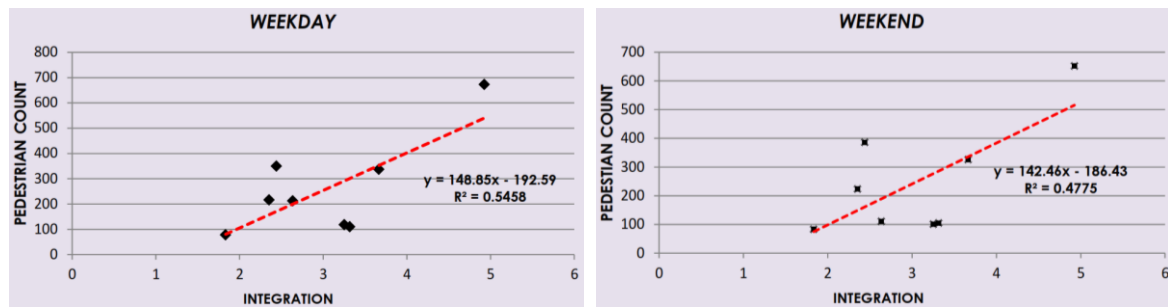


Fig. 10 - Correlation Value between Pedestrian Count and Local Integration.
 Source: Jimi Sham & Mahdzar, 2019

5. Conclusion and Discussion

The strategic location of Kampong Bharu, near the city center and with convenient access to public transportation, presents opportunities for enhancing its connectivity and walkability. The existing zoning in Kampong Bharu is well-defined, but the connectivity, particularly to and from the Bunus Pathway, is currently weak. This results in isolation movement patterns within each zone, with limited connections between them. The north side of Kampong Bharu, in particular, shows signs of being disconnected from the rest of the area, hindering social interaction among the local residents.

The study highlights that pedestrian movement in Kampong Bharu is more influenced by the surrounding land uses and attractions rather than the connectivity of pathways. To optimize the usage of the Bunus Pathway, it is important to create a pedestrian-oriented environment that integrates diverse place uses and street activities (Mahdzar, 2008; Mansouri & Ujang, 2017). This can be achieved by improving the connectivity and accessibility of the pathway through efficient design and careful consideration of the surrounding elements. Jalan Raja Abdullah, as the main street in Kampong Bharu, exhibits high connectivity, particularly towards the south leading to the city center. However, the lack of connectivity to other parts of Kampong Bharu results in heavy vehicular traffic along this road, isolating the local communities within the area. To address this issue, the study suggests incorporating the axis of the Bunus River as a connector. The Bunus River, once a main spine connecting the Bunus River and Klang River neighborhoods, should be embraced as a pathway that sprawls across Kampong Bharu, integrating with the riverine landscape. This approach would not only improve connectivity but also enhance the social network within Kampong Bharu.

By utilizing the Bunus River as a landmark and integrating it with the Bunus Pathway, the walkability and overall experience of the neighborhood can be enhanced. The presence of the river would contribute to the aesthetics and allow people to engage with and appreciate the natural environment more meaningfully (Mansouri & Ujang, 2017). Figure 11 proposes a pathway that connects multiple zones, acting as a "community axis", a central line where locals and children can gather and interact. This pathway should be supported by accessible transit routes, enabling easier movement within and around Kampong Bharu and fostering a stronger social network within the area. The findings of this study can serve as a valuable reference for future initiatives aimed at improving the connectivity, walkability, and overall quality of the Bunus River and Bunus Pathway in Kampong Bharu. By implementing these recommendations, Kampong Bharu can transform into a more connected, vibrant, and people-friendly neighborhood.

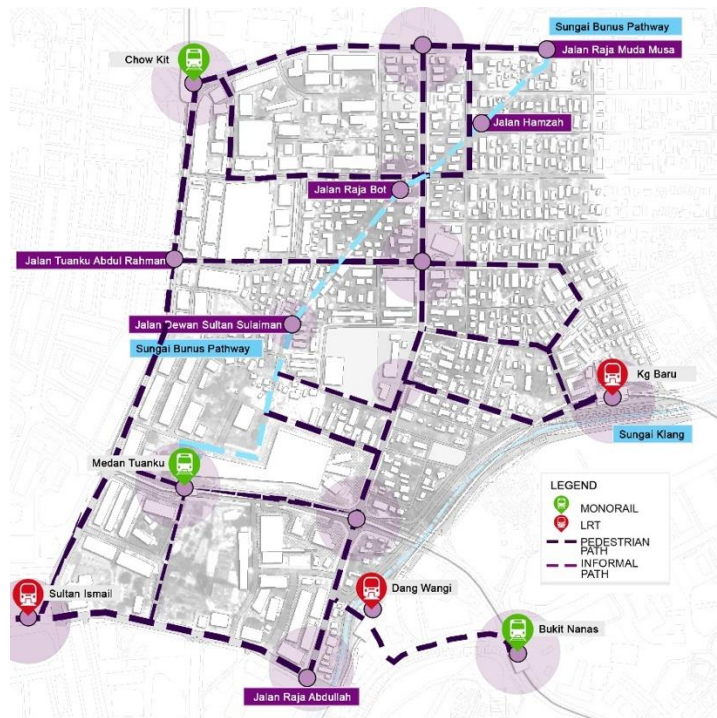


Fig. 11 - Suggested Network Pattern. Source: Jimi Sham & Mahdzar, 2019

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Appendix A: Gate Observation Sheet

GATE OBSERVATION SHEET

TIME: 8AM 1PM 3PM 7PM WEEKEND / WEEKDAY
 ZONE: A B C D E F G H I
 WEATHER: SUNNY / CLOUDY / RAINING / WINDY

GATE 1:

LOCAL	COMMUTER	TEENAGER	TOURIST	IMMIGRANT
TOTAL				

GATE 2:

LOCAL	COMMUTER	TEENAGER	TOURIST	IMMIGRANT
TOTAL				

GATE 3:

LOCAL	COMMUTER	TEENAGER	TOURIST	IMMIGRANT
TOTAL				

GATE 4:

LOCAL	COMMUTER	TEENAGER	TOURIST	IMMIGRANT
TOTAL				

GATE 5:

LOCAL	COMMUTER	TEENAGER	TOURIST	IMMIGRANT
TOTAL				

GATE 6:

LOCAL	COMMUTER	TEENAGER	TOURIST	IMMIGRANT
TOTAL				

GATE 7:

LOCAL	COMMUTER	TEENAGER	TOURIST	IMMIGRANT
TOTAL				

GATE 8:

LOCAL	COMMUTER	TEENAGER	TOURIST	IMMIGRANT
TOTAL				

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