

## Foundation Of Pedestrian Environment: Analysing Active Mobility Towards Walking And Cycling

### Case Study: Orchard Road, Singapore

Muhammad Naufal Rizqita<sup>1</sup>, Revianto Budi Santosa<sup>2</sup>

<sup>1</sup>Architecture Undergraduate, Universitas Islam Indonesia

<sup>2</sup>Architecture Professor, Universitas Islam Indonesia

<sup>1</sup>Email: 17512036@students.uui.ac.id

**ABSTRACT:** *In a number of countries, active mobility mode of transport such as walking and cycling has achieved more encouragement and Singapore has already embraced that concept. Although it must always go hand in hand with designing a safe pedestrian environment and their own aspects and criteria. Using the data from visual surveys and analytical reviews, this research focuses on visual analysis according to pedestrian index value criteria at Orchard Road that is associated with large commercial areas as a case study for demonstrating how pedestrian-friendly and safe they are and the effect on the surrounding environment. This paper concludes that Orchard Road has proven able to demonstrate how pedestrian-friendly and safe they are for active mobility users with all aspects fulfilled at high result. The findings expand our understanding of the safe pedestrian environment aspects to promote the active mobility concept.*

**Keywords:** pedestrian aspects, active mobility, Orchard Road

### BACKGROUND

During the course of research observation, walking is the most efficient way of transportation to conduct a visual analysis of the object. Being a pedestrian while interacting simultaneously with others as well their surrounding environment, they shift their walking behaviors and direction constantly; it is a multi-sensory experience. In recent years, walking and cycling as a course of active transport modes have achieved more popularity and are being encouraged in many countries. With these trends, it started awareness of communities and governments for its natural, social, and even economic advantages of active mobility while starting to demand more walkable and bike-able areas. We acknowledge that large cities and other metropolitan areas are trying to deal with a variety of significant trends. Increasing levels of traffic congestion, the cost of building and maintaining the infrastructure required to support our road-transport system, and the degradation of public open areas that inhibit walking are by any means should be concerning for a sustainable future and for livable cities and towns for future generations (ITF, 2012). Walking and cycling, though, is more than simply riding around the city, walking and cycling cities can also be considered livable cities. Traffic-free communities, car-free streets, and public squares created by active mobility programs play a vital role in improving the quality of life (CLC and The Seoul Institute, 2016).

“Discussing livable cities and pedestrian-friendly environments cannot be separated from a safe system approach for the design of the walking environment so that it is organized in such a way that specific risk groups are not exposed to avoidable risks” (ITF, 2012). Accompanied by people with restricted mobility due to physical disabilities, it is

important to provide people with mobility disabilities with a safe place to walk. According to Carlson et al. (2006), most of the evidence on the fatal and negative impact is highly not relevant to walking. The report shows the serious risks associated with walking are traffic injuries involving cars and falling. In order to enhance this situation, there is a need for awareness-raising within society to continue to change this trend and the associated consequences. Plans to create pedestrian-friendly environments and to encourage public transport and sustainable transportation, such as walking and cycling as part of daily life, are crucial in gaining this goal.

In November 2014, Singapore itself has already embraced active mobility design with different types of infrastructures and facilities are provided for pedestrians and cyclists, while their guidelines for walking and cycling are most often focused on raising safety and convenience for users. "Singapore's main campaign to promote walking and cycling is it's the "walk cycle ride"; this program promotes walking and cycling along with the first/last mile (FLM) travel modes as well as mainly promotes the use of public transport" (LTA, 2017b). This research focuses on Orchard Road that is associated with large commercial areas as a case study for demonstrating how pedestrian-friendly and safe they are and the effect on the surrounding environment.



**Figure 1** Orchard Road Case Study Area (Marked in Yellow)

Source: Google Earth (accessed November 7, 2020)

Orchard Road is Singapore's famous shopping belt with a vibrant and entertaining street crowded with hotels and shopping malls. Originally located in the area of what was once used to be fruit orchards and spice plantations, the 2,4-kilometer long boulevard was reconstructed into a vibrant shopping destination. With a grand boulevard that passes Orchard Road is Singapore's famous shopping belt with a vibrant and entertaining street crowded with hotels and shopping malls. "Originally located in the area of what was once used to be fruit orchards and spice plantations, the 2,4-kilometer long boulevard was reconstructed into a vibrant shopping destination" (CLC and The Seoul Institute, 2016). With a grand boulevard that passes through the area, has long been a people's attraction and still buzzing with a lively urban culture. One of the challenges that will be analyzed in this research is how Orchard Road creates a safe-haven for the pedestrian environment while putting pedestrians first by accommodating their comfort, safety, and accessibility at all levels.

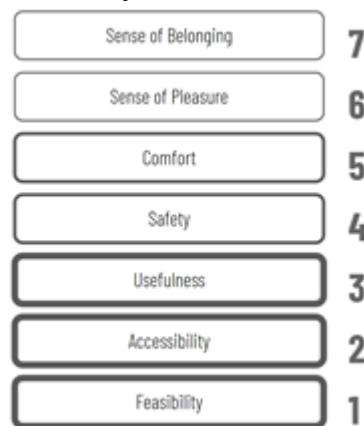
### Research Question

1. What are the pedestrian-friendly aspects that are available to support active mobility (walking, cycling) on Orchard Road?
2. How do pedestrian-friendly aspects affect the surrounding environment towards comfort, safety, and accessibility?

### LITERATURE REVIEW

#### Hierarchy of Pedestrian Needs

The intention to make the city walkable was an essential objective of urban planning even earlier than the current focus on selling walkability as a health-related activity. Vikas (2006) suggests seven criteria for the design of a successful walking environment: feasibility and accessibility, usefulness, safety, comfort, sensory pleasure, and a sense of belonging. For the research on the safe pedestrian environment, this research took three variables that will be conducted for analysis.



**Figure 2** Hierarchy of Walking and Cycling Needs on Pedestrian  
Source: Vikas (2006)

#### 1. Feasibility and Accessibility

Vikas (2006) explains that feasibility and accessibility are the foundation of walking. Once active mobility (walking, cycling) is interpreted to be feasible, accessibility is the next key aspect that influences active mobility. "Accessibility includes the ability of a person to access a location; measures the distance to a destination; physical and perceived barriers to walking and cycling to a location; and interconnection between land uses" (Vikas, 2006).

#### 2. Safety

"Earlier studies have shown that the perception of perceived safety from crime and violence is influenced by environmental features such as the physical condition and maintenance of the environment, the configuration of streets, the types of land use, the shifts and modifications made to the environment, and the presence or lack of people" (Vikas, 2006, Zegeer, 1998).

### 3. Comfort: Physical and Physiological

“Existing case studies involving impact of environmental factors on human activity indicate that pleasant microclimate conditions, including wind, sunlight and shade, and temperature, are critical for encouraging outdoor activities” (Vikas, 2006). Some of the physical features defined as contributing to active mobility in public spaces include broad sidewalk width, vegetation shade and cover, a barrier-free route, and traffic-calming approaches.

**Table 1.** Review of Variables and Related Results

Variable	Case Study	Results	Ref.
Feasibility and Accessibility	Measuring the qualities of urban design related to walkability.	The urban design may describe patterns in walking activity with observational studies used to verify digital measures that make it easier to research the interaction between urban design and physical activity.	
Safety	Analyzing walkability index for elderly people by developing WIEH	Generally, planners should pay attention to the several factors that influences degree of walkability especially for elderly health.	
Comfortability	Creation of the Walkability Friendly Cities to allow effective urban decisions concerning pedestrian accessibility. Case study: Rijeka, Croatia	Walkability Friendly Cities discusses the influences examined across five themes: characteristics of the sidewalks, situation of surrounding us as we walk, perception of safety when walking; and the environment-factors that affect pedestrians.	

Source: Author's Collection

### Active Mobility

“Pedestrians refer to a very wide range of people who use sidewalks as a way of commuting either for recreation or transporting them to and from facilities. Key groups of users include infants and children, expectant mothers, older persons, wheelchair users, the ambulant disabled, persons with visual impairment, and persons with hearing impairment” (URA, 2018). Whilst cyclists in Singapore are the most versatile, they could ride at the footpath, cycling path, and road. Providing cyclists a dedicated path where there is little variation in pace among users will be the optimum condition for them. However, due to some reasons such as space limitations, cyclists may have to share the space and interact with other users.

### RESEARCH METHODS

This paper study consists of qualitative and quantitative research methods, where it focuses on the perception of people through observing, recognizing, and realizing how

physical environments affect behaviors in Orchard Road, Singapore. This study begins with field observations and studies from secondary data (Google Earth) of the Orchard Road sidewalk based on parameters and variables in the literature review. The method of evaluating the findings of this research uses an inductive approach, where the results of the research in the research matrix are linked to the conclusion of the paper.

**Table 2.** Corresponding Variables and Parameters to Classify Pedestrian

Variable	Indicator	Parameter	Criteria to Classify the Pedestrian
Accessibility	Pedestrian Path	Pedestrian surface quality	1 = bad 2 = acceptable 3 = good
		Sidewalk existence and width	1 = none 2 = one or both side partial 2.5 = one side continuous 3 = both side continuous
		Availability of obstacle	1 = severely affects walking 2 = occasionally affect walking 3 = none of obstacle
		Traffic street intersections	1 = >3 2 = 1 or 2 3 = no intersection
Safety	Traffic Conflict	Street lighting quality	1 = bad 2 = acceptable 3 = good
		Diversity of information sign	1 = none 2 = medium 3 = high
Comfortability	Pedestrian Path	Availability of urban furniture	1 = no urban furniture 2 = moderate availability of urban furniture 3 = high availability of urban furniture
		Availability of vegetation	1 = no vegetation 2 = moderate availability of vegetation 3 = high availability of vegetation

Source: Author's Collection

**Table 3.** Criteria Determination to Classify the Pedestrian

Indicator	Parameter	Criteria	Explanation
Accessibility	Pedestrian Path Road Users	1 = Low Accessibility	There is no availability of pedestrian path and or building setback
		2 = Medium Accessibility	There is facilitated with a pedestrian path but with no regulated or proportioned setback (min. 1-1.50 m)
		3 = High Accessibility	There is a pedestrian and or cycling path with extensive setback ( $\geq 1.50$ m)
Safety	Traffic Conflict	1 = Low Safety	There is a high traffic conflict that occurs continuously and disturbs the road users
		2 = Medium Safety	There is a traffic conflict that occurs on several occasion (1-3 incident)
		3 = High Safety	There is no traffic conflict that occurs (no incident)
Comfortability		1 = Low Comfortability	There is no urban furniture and or vegetation and not maintained
		2 = Medium Comfortability	There is a moderate availability of urban furniture and or vegetation and maintained (dist. $\geq 200$ m)
		3 = High Comfortability	There is a high availability of urban furniture and vegetation and maintained (dist. $\leq 200$ m)

Source: Author's Collection

**Table 4.** Index Results of Walking and Cycling (Active Mobility) Availability

Index Value Criteria	Result
1-1.5	Not suitable
1.5-2	less suitable
2-2.5	suitable

2.5-3	most suitable
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Source: Author's Collection

Equipped with relevant theory, subject knowledge and area conditions related to the predetermined variables of pedestrians, all of them contribute to the revelation of factors that affect pedestrian conditions of Orchard Road, Singapore.

## RESULTS AND DISCUSSIONS

In analyzing the Orchard Road, the qualified indicators mentioned in the previous research methods were used in this step for further analysis. From those indicators above, the analysis can be continued and further detailed into several parameters. Further observation allows focusing on certain parts of Orchard Road that have quite different characteristics and conditions.



**Figure 3** Part of Observed Orchard Road Section  
Source: Google Earth (accessed December 13, 2020)

### 1. Part 1 (Pedestrian at ION Sky and Tang Plaza)

Pedestrian of Orchard Road at this part has a large intersection along Paterson Road and Scotts Road that has partial level crossings (one side) with the rest at underground crossings. This particular section features a distinctive characteristic in terms of pavement width and arrangement.

## 2. Part 2 (Pedestrian at Ngee Ann City and Paragon)

Sandwiched between Ngee Ann City and Paragon at both sides making this particular pedestrian section crowded from all other parts. Ngee Ann City's plaza in particular has free spaces for events that can be held and act as pockets of spaces along Orchard Road. This section features level crossing from Orchard Road and Cairnhill Road intersection.

## 3. Part 3 (Pedestrian at Istana Park)

Located near Istana Park which is a public green space that brings the serene ambiance with numbers of large Angsana as canopy trees on both sides.

### Accessibility

#### 1. Pedestrian Surface Condition

Designing a public sidewalk should get down into every detail that matters, including the walking surface. Walkable pedestrian also means roll able pedestrian; it works well for everyone that has disabilities (wheelchair users, rolling walkers, etc.) All of the observed area already has adequate integrated curb-and-gutter along with hard granite paving material. Pedestrian at Part 1 features playing with distinctive paving patterns that break the repetition along Orchard Road.



**Figure 4** Pedestrian Surface Condition at Observed Part  
Source: Google Earth (accessed December 13, 2020)

**Table 5.** Pedestrian Surface Quality Result

Observed Part	Index Value Criteria	Result
Part 1	3	Most Suitable
Part 2	2.5	Most Suitable
Part 3	2.5	Most Suitable

#### 2. Sidewalk Existence and Width

Based on visual observation and secondary data (Google Street View), the pedestrian path between Orchard Road, Singapore has already been in maintained condition with the regulated and proportioned setbacks along with 7.6-11.6 meters of setback line along the sidewalk and all of the observed area has both side continuous sidewalks. According to URA, "Up to 50% of podium façade area can be transformed into building setback in the shape of urban verandahs to create unique articulation and varied



building frontages". Separated bike lane is not too necessary as the sidewalks are wide enough to share between all active mobility users.



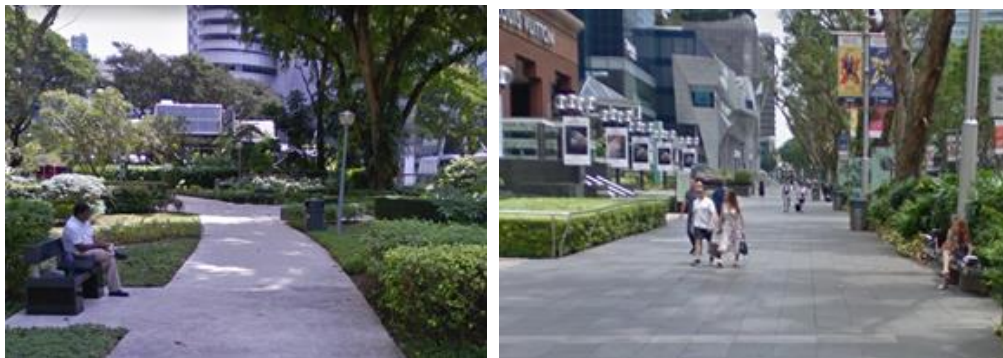
**Figure 5** Pedestrian Path around Orchard Road, Singapore  
Source: Google Earth (accessed December 13, 2020)

**Table 6.** Pedestrian Surface Quality Result

Observed Part	Index Value Criteria	Result
Part 1	3	Most Suitable
Part 2	3	Most Suitable
Part 3	3	Most Suitable

### 3. Availability of Obstacle

With high pedestrian intensity Orchard Road is able to control and manage unwanted obstacles that can disrupt the flow of pedestrians and cyclists. At-grade pedestrian networks have strict building setback regulations that require unobstructed paths along the sidewalk, and also features covered walkways between 3-5 meter as public amenities. Both parts did not have obstacles (illegal street vendors, illegal parking, illegal advertising signs, and damaged sidewalk) with ease access at all parts.



**Figure 6** Clear Sidewalk with No Obstacle Around Observed Part  
Source: Google Earth (accessed December 13, 2020)

**Table 7.** Availability of Obstacle Result

Observed Part	Index Value Criteria	Result
Part 1	3	Most Suitable
Part 2	3	Most Suitable
Part 3	3	Most Suitable

#### 4. Traffic Street Intersection

Since 1977, within the huge developments and traffic increase, the URA has proposed plans of an underground pedestrian network to create connected facilities between underground and at-level pedestrian malls. From visual surveys, both of the observed parts have a broad range of traffic intersections starting from small one-lane into four-lane vehicle roadway. At Part 2 and 3 features adjacent level crossings that are easier for active mobility users to cross on both sides, while as the result of having larger street intersections, Part 1 only has underground crossing and partial level crossing only on one side. Although it completed with pedestrian walkway components and its vertical circulation (staircases, escalator, and lift); still sometimes difficult for people with disabilities and cyclists to use and tricky for tourists to find the underground crossing.



**Figure 7.1** Underground Pedestrian Network Plan

Source: CLC and The Seoul Institute, 2016



**Figure 7.2** Traffic Street Intersection at Observed Part

Source: Google Earth (accessed December 13, 2020)

**Table 8.** Traffic Street Intersection Result

Observed Part	Index Value Criteria	Result
Part 1	2	Less Suitable
Part 2	3	Most Suitable
Part 3	3	Most Suitable

## Safety

### 1. Street Lighting Quality

At night the sidewalk is made by the light, and sometimes more people spend their time in public space after dark. Using lighting to support public space urbanism means providing a range of solutions based on place. Various kinds of events and programs have been held by the Singapore government to promote vibrant night street life. Besides for events, basic lighting standards from light location and frequency are within acceptable distance of 10 meters, accompanied with alternative lightings such as spotlights and wall-washers that make the street light glow.



**Figure 8** Street Lighting Condition During Night at Orchard Road, Singapore.

Source: CLC and The Seoul Institute, 2016, Google Earth (accessed December 13, 2020)

**Table 9.** Traffic Street Intersection Result

Observed Part	Index Value Criteria	Result
Part 1	3	Most Suitable
Part 2	3	Most Suitable
Part 3	3	Most Suitable

## Comfortability

### 1. Availability of Urban Furniture

Orchard sidewalk as busy places demand high intensity of urban furniture for active mobility users to use (bench, bike racks, trash cans). In 1997, the URA introduced guidelines for refreshment zones in order to develop more vibrant areas. At sidewalk zones there is differentiate between 'walk and talk zone' or outdoor refreshment area (ORA) where people had area for stopping without obstructing others that strolling and rolling. The ORA zone itself provide adequate urban furniture that can enjoy space fully. Several cases notably from the development of Discovery Walk near Part 2 that built over Stamford Canal and changed into mixed-use spaces. All of observed area has this kind of concept and pass the accepted minimum distance (200 meters).



**Figure 9.1** Discovery Walk that built over Stamford Canal.

Source: CLC and The Seoul Institute, 2016, Google Earth (accessed December 13, 2020)

**Table 10.** Availability of Urban Furniture Result

Observed Part	Index Value Criteria	Result
Part 1	3	Most Suitable
Part 2	3	Most Suitable
Part 3	3	Most Suitable

### 2. Availability of Vegetation

Street trees shape spaces as it plays a vital role in spatial definition of a public space, providing shading while absorbing UV and pollutant, and it protects sidewalk with being a sturdy barrier between vehicles and pedestrians. Since the 1970s from the plan of Garden City Movement, Orchard Road has planted a linear alley of Angsana trees creating lush natural canopy that can protect the sidewalk while still having proper spacing to create adequate shading. Both Part 1 and 2 already have these aspects, however at the down side vegetation at Part 2 especially near Ngee Ann City still not



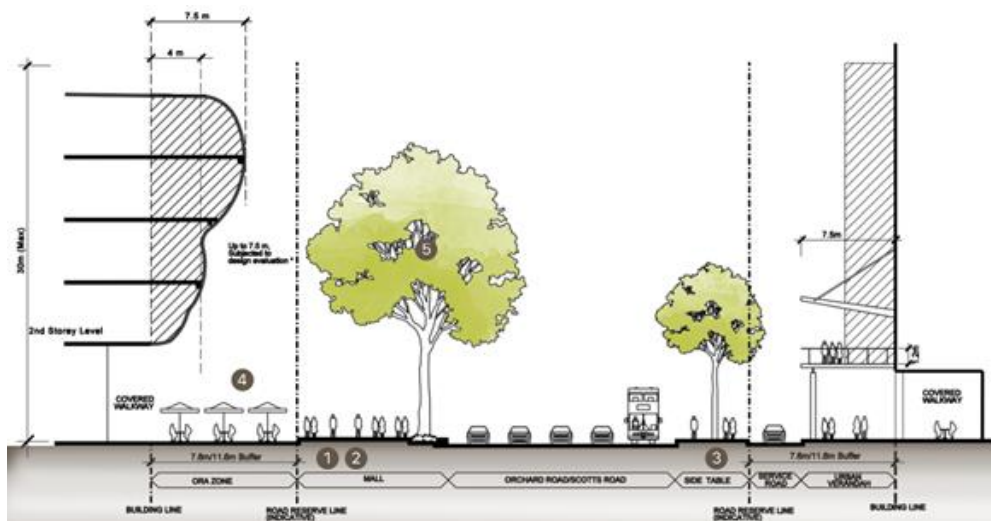
grown fully yet leaving a lot of unshaded area as the results of fallen tree caused by storm in 2018.



**Figure 10** Angsana and Yellow Flame Tree at Orchard Road  
Source: Google Earth (accessed December 13, 2020)

**Table 11.** Availability of Vegetation Result

Observed Part	Index Value Criteria	Result
Part 1	3	Most Suitable
Part 2	2	Less Suitable
Part 3	3	Most Suitable



**Figure 11** Street Section Visualization on Orchard Road.

Source: URA, 2018

Legend:

1. Pedestrian Surface Condition
2. Sidewalk Existence and Width
3. Availability of Obstacle and Street Lighting Quality
4. Availability of Urban Furniture
5. Availability of Vegetation

### Street Section

From the discussed aspects above, the bigger picture of the combination between those aspects could be seen through and visualized through the street section of Orchard Road. All of those aspects are determining the livability for the overall index of Orchard Road.

### LIMITATIONS

With Orchard Road in Singapore as a case study, this research was conducted in a prominent commercial area with high levels of accessibility that supports active mobility as a primary mode of transport. Therefore, the results from this research tend to be more applicable with similar urban situations or neighborhoods with similar development conditions. Additionally, the shortcoming attributed to limited time of visual surveys require this research other secondary data mainly images from Google Earth.

More thorough analysis could not be conducted that distinguish between walking and cycling as mode of transport, exercise, or leisure as the results of the visual survey were affected by limited time and sample. Finally, in the future conducting more studies relating to deep research of mixed methods properly need to expand our understanding of pedestrian aspects influencing active mobility concepts.

### CONCLUSIONS

As a conclusion, with all respect Orchard Road has proven able to demonstrate how pedestrian-friendly and safe they are for active mobility users with all aspects fulfilled at high result. Some observed parts are better than others but it is still at slight margin with none of fatal mistakes in the design.

**Table 12.** Accessibility Result

Observed Part	Index Value Criteria	Result
Part 1	3	Most Suitable
Part 2	2.8	Most Suitable
Part 3	2.8	Most Suitable

**Table 13.** Safety Result

Observed Part	Index Value Criteria	Result
Part 1	2.5	Suitable
Part 2	3	Most Suitable
Part 3	3	Most Suitable

**Table 14.** Comfortability Result

Observed Part	Index Value Criteria	Result
Part 1	3	Most Suitable
Part 2	2.5	Suitable
Part 3	3	Most Suitable

## REFERENCES

- Ewing, R.; Handy, S. 2009. Measuring the unmeasurable: Urban design qualities related to walkability. *J. Urban Des.*
- Centre for Liveable Cities (CLC) and The Seoul Institute. 2016. *Walkable and Bikeable Cities. Lessons from Seoul and Singapore*. CLC: Singapore.
- ITF. 2012. *Pedestrian Safety, Urban Space and Health*. OECD Publishing.
- Campisi, T. 2020. How to Create Walking Friendly Cities. A Multi-Criteria Analysis of the Central Open Market Area of Rijeka. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*. doi: 10.3390/su12229470
- Zegeer, C.V. 1998. *Design and Safety of Pedestrian Facility*. Institutes of Transportation Engineer.
- Alves,F. 2020. Walkability Index for Elderly Health: A Proposal. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*.
- Carlson SA, Hootman JM, Powell KE, Macera CA, Heath GW, Gilchrist J, Kimsey CD Jr, Kohl HW. 2006. *3rd. Self-reported injury and physical activity levels: United States 2000 to 2002*. *Ann Epidemiol*.
- Vikas, M. 2008. Walkable streets: pedestrian behavior, perceptions and attitudes, *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*. 1:3, 217-245.
- LTA, 2017b. Walk Cycle Ride. Land Transport Authority, Singapore. <https://www.lta.gov.sg>. (accessed November 7, 2020).
- URA, 2018. Walking and Cycling Guide. Urban Redevelopment Authority, Singapore. <https://www.ura.gov.sg>. (accessed November 7, 2020).