An-Najah National University

Faculty of Engineering and Information Technology

جامعة النجاح الوطنية

كلية الهندسة و تكنولوجيا المعلومات

Graduation Project Report II

Design of the First Bike Network in Nablus City

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Submitted in partial fulfillment of the requirements for Bachelor degree in Civil Engineering

2022 / 2023

إهداء

{يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ ۚ }

الحمد لله و الصلاة على سيدنا محمد عليه أفضل الصلوات , و أتم التسليم , أما بعد .

الحمد لله الذي وفقنا لإتمام هذه الخطوة في مسيرتنا الدراسية , ببحثنا هذا ثمرة جهدنا , و نجاحنا بمشيئة الله تعالى .

اهديه الى أعز الناس , أبائنا و أمهاتنا حفظهم الله و أدامهم نورا و سندا لنا.

لاخواننا و أخواتنا الذين ساندونا في وقت كنا بحاجتهم.

للأصدقاء و الصديقات و رفقاء الدرب الذين قاسمونا لحظات من الجهد , و التعب , و الفرح .

الى أستاذنا البروفيسور خالد الساحلي على ما ضحى به من وقته لأجلنا

الى جميع أساتذتنا و أهل الفضل الذين غمرونا بالحب و التقدير و النصيحة.

الى كل من لهم أثر في حياتنا , نهدي عملنا هذا

Acknowledgment

We would like to express a deep sense of gratitude to the Prof. Khaled Al- Sahili for his guidance and supervision as well as for providing necessary information for the project and also for the support in completing the project. Also we would like to thank the technician of the Transportation laboratory Eng. Taj Salahat, who has been always giving us advices and helping us and never hesitated to support us. Our grateful thanks are extend to the technician of the survey laboratory Eng. Mohanad Mayaleh, who gave us the permission to use all required equipment to complete the field work.

We would like also to extend our thanks to the students of the previous project Diala Juma and Batool Al-Tanbour for their outstanding work in the previous project.

We also extend our heartiest thanks to our parents for their support and encouragement throughout our study.

Finally, we wish to thank our friends and colleagues for their support, especially colleagues Hamdan Dababat and Rawan Rabaya for their assistance in conducting a traffic volume study, which is a part of this project.

Disclaimer

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AASHTO	American Association of State Highway and Transportation Official
BL	Bicycle Lane
LOS	Level of service
M	Median
MUTCD	Manual on Uniform Traffic Control Devices.
PL	Parking Lane
ROW	Right of Way
SW	Side Walk
TL	Travel Lane

Abbreviations for Traffic signs:

D3-1	Road name sign
R4- 11	Bicycles May Use Full Lane sign
R5-1b	Wrong Way sign
R9-3cP	Ride with Traffic plaque
W11-1	Bicycle Warning sign
W16-1P	Share the Road (plaque)
W16-8P	Path name sign

Abstract

Cycling is a sustainable and environmentally friendly transportation mode that can decrease greenhouse gas emissions and reduce traffic congestion in the city. However, a lack of bicycle infrastructure is a great barrier to the promotion of cycling. Internationally, the best and most livable cities demonstrate a direct link between the quality of life and urban forms that promote walking and cycling as means of getting around.

The main objective of the project is designing a bike network in Nablus city. This project is a simulation and continuation of a previous project, which was introduced by students of Civil Engineering at An-Najah National University.

In this project, a dedicated bike network was designed in the city of Nablus located between An-Najah National University campuses and Nablus downtown. Engineering software was used for designing the network based on the classifications and AASHTO standards, also based on the data available from the previous project, and by conducting a field work related to data collection.

Moreover, this study addressed the nature of the area in which the bike lanes was designed, in addition to the necessary maps, the topography of the city, and the nature of traffic congestion between the two university campuses. Most of this information was obtained from the municipality of Nablus.

Adding cycling lanes to the city of Nablus is a way of improving mobility, reducing the carbon dioxide emission, cost effective, reducing congestion and facilitate movement for university students, and promoting a healthier lifestyle as well as ensuring the safety of cyclists. In order to achieve this, cycling should be accessible, safe, convenient, and enjoyable for all as part of an integrated and sustainable transport system.

Chapter 1: Introduction

1.1. General Background

Bicycles around the world:

Cycling as a mode of transport is a low-cost, health-improving way to travel and offers environmental benefits for the cities that promote it. It is only recently, though, with concerns over climate change, pollution, congestion, and obesity among others, that have cities throughout the world have begun to implement policies to promote cycling.

Cycling is an inexpensive and sometimes fast means of transportation, so its use is popular all over the world. Statistics also show that it has become a popular means of mobility. Here are some stats about cycling.

- 2 billion or more bicycles are used worldwide, and the number is expected to rise to 5 billion by 2050, according to the World Economic Forum (WEF) (Sibilski,2015).
- According to a study conducted in 2015 in the Journal of Transport & Health, 42% of families around the world own at least a bicycle (Musselwhite, Holland, and Walker, 2015)
- According to the United Nations (UN) Environment Program (2015), urban trips in Chinese cities using bicycles reach 60 .

Bicycles in Palestine:

Although cycling has been increasing in developed regions, such as Europe and North America, some developing countries such as Palestine still have low-grade cycling activities due to lack of paths or connections, cultural and societal pressure especially for female, and driver behavior as important barriers to cycling.

At the local level, the percentage of bicycle use varies among Palestinian cities. For example, Jericho crosses one of the Palestinian cities that uses bikes the most, where a bicycle network was designed in 2013.

About the city of Nablus:

Nablus is one of the largest Palestinian cities in terms of population. It includes 56 villages, and population of the governorate is estimated at 423572 in year 2022, according to the (Palestinian Central Bureau of Statistic 2021)

The city of Nablus is distinguished by its important strategic location. It is located in the heart of Palestine, linking the north with the south and the east with the west. It forms a link between the mountain chain from north to south, and is considered the seat of the most important universities in the country. Figure 1-1 shows the location of Nablus city on the map of West Bank.

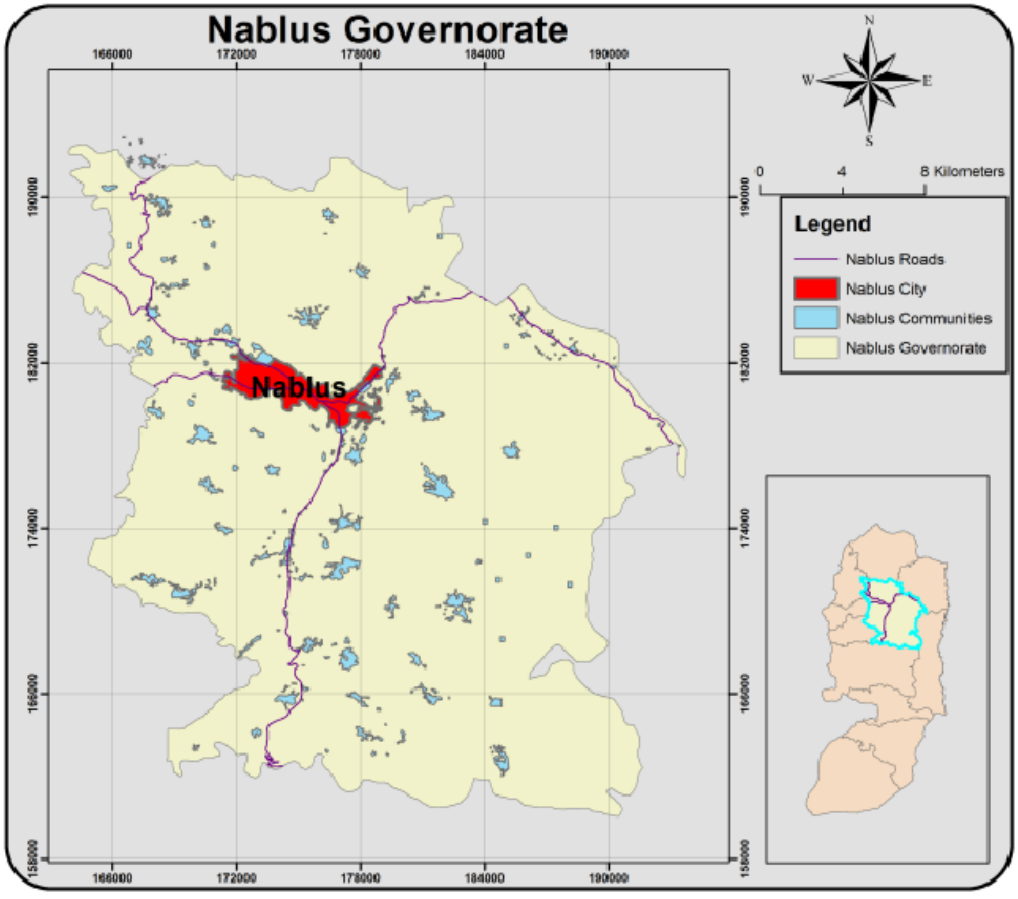

Figure 1-1: Location of Nablus City at the Map

About the Transportation in Nablus:

The limited capacity of the city's infrastructure and the rapidly increasing number of vehicles, in addition to the growing number of visitors arriving from both the occupied Palestinian territories and other countries' governorates, are all contributing factors to the traffic congestion that makes it difficult for residents of Nablus to move around.

Despite all of the traffic police's efforts to control traffic, drivers' disregard for traffic laws and regulations, as well as loading and unloading passengers in the middle of the road, lead to increased traffic congestion.

Bicycle usage in Nablus city is quite low, so it's important to promote it as a mode of transportation.

1.2. Objectives

The main objective of the project is to design a network of bicycles or electric bikes lanes between the two campuses of An-Najah National University (old and new campuses) to the eastern region through the city center.

To achieve this main objective, several particular objectives must be achieved in this project, as it follows:

- Assess the adequacy of the existing network to design a bicycle network and verify that it meets the design criteria.
- Select and locate the bicycle lanes in each direction of the street, based on the street conditions.
- Achieve the results by knowing how the design of the bicycle network effects on reducing vehicle traffic volume and reducing congestion.

1.3. Importance of the Project

The design of a bicycle network in Nabuls city is considered an effective solution for decreasing the number of problems that can be faced by the city. The most important one is the traffic congestion, especially because it includes one of the biggest universities in Palestine, An-Najah National University, which has more than 23,000 students. So, the problem of traffic congestion and the difficult transportation conditions, which can hardly accommodate this huge number of students, makes the students' movement more difficult. At this point, the importance of having this design of bicycle network decreases this traffic congestion and provides a high level of service for both the students and the public. So, they can move more easily and freely from and to the university.

This design is very important in the sense that it can reflect the sign of keeping up with international development at the university and in the city itself.

The use of environmentally friendly green transportation benefits the environment and protects against international concerns such as energy shortages and fuel emissions.

Chapter 2: Methodology

As part of this project, the methodology of work was in several stages, firstly; by defining the study area in terms of the areas most used by An-Najah National University students.

Therefore, the collection of data was computed based on available data and the field work. After that, the data was analyzed according to the design criteria and operational analysis. Finally, solutions were presented to design the bicycle network.

2.1 Specifying the Study Area

The area between the two campuses of An-Najah National University and the city center, up to the eastern public transportation complex, is one of the most frequently used by vehicles and pedestrians. Figure 2.1 shows the study area on the map.

To design a bicycle network, these areas have been selected as they have a high traffic volume and congestion, as this design aims to reduce congestion and facilitate students' access to the university.

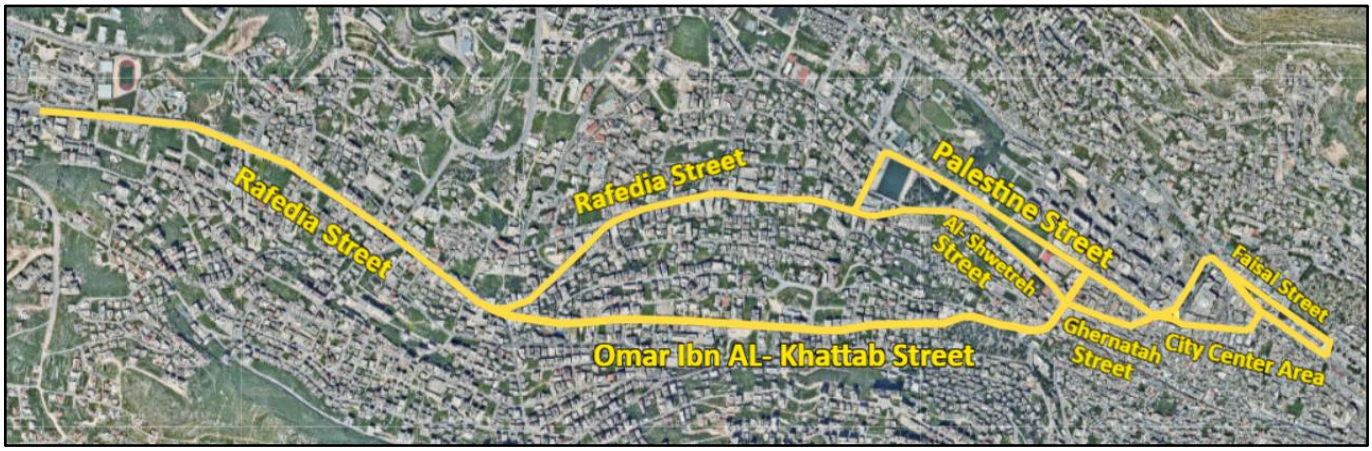

Figure 2- 1: Study Area

2.2. Collection of Data

To achieve the main goal of the design process, the necessary data should be collected and obtained based on using an available data, and the field work, in addition to using the Geomolg application - for geospatial information in Palestine - to identify the network and take the necessary maps.

2.2.1. Using Available Data

- **Potential demand studies:**

  The results of a questionnaire implemented by a group of students in the previous project, was used in this project to determine students' interest for using the bike network (Al-Tanbour and Juma, 2022).

2.2.2. Data Collection by Field Work

- **Roads inventory study:**

  A field work is done as an inventory study, to determine the existing elements of the street, check its conditions, and determine the dimensions for each.

- **Traffic volume studies:**

  A field work is done to determine the traffic volume at intersections, and conducting the peak hour volume for vehicles.

2.3. Data Analysis

After the collection of data needed for the design process is completed, it should be analyzed. A cross-section for each street was drawn at several stations. And the level of service was computed, according to the traffic volume at the peak hour to determine the number of vehicles that can be reduced when using the bike network.

2.4. Design Criteria

The American Association of State Highway and Highway Transportation Official (AASHTO) (2012), A Policy on Geometric Design of Highways and Streets (2018), the Manual on Uniform Traffic Control Devices (MUTCD) (2009), the Bike Lane Design Guidelines (2015), and the Urban Bikeway Design Guide (2013) were used as the basic engineering standards for the network design process.

2.5. Designing the Bicycle Network and Traffic Operations

According to the results of the data analysis, the geometric design for each element on the street, with bicycle lanes, was determined and drawn on the map using a Civil 3D software. The Synchro program was also used to determine the level of service according to the volume of traffic at peak hour, and to determine the number of vehicles that can be reduced when using the bike network.

2.6. Project Constrains

In our project, we faced some constraints in the design, including that the right of way for the street is limited, and we can't increase the street width because of the surrounding buildings as the area is an active area that is already built up.

Also, when it is to be constructed, it is expected to face objections by citizens to the prohibition of parking in some places to use is in designing the bike network. Furthermore, we cannot reduce the width of the sidewalks to gain additional width for vehicular traffic due to the large number of users/pedestrians within the study area.

Chapter 3: Data Collection

The design of any bicycle network on an existing road depends on component of the street, dimensions for each element, the right of way for the street, and the traffic volume of vehicles for each approach.

In this project, to determine the directions of the Bicycle network – one or two ways – and design of its own tracks, the existing street network should be studied as it achieved the required area for the design or not. Therefore, the inventory study of the existing network was carried out as detailed on the following sections.

3.1. Roads Inventory Study

The road inventory study is an important task to determine the roadway classification, road elements, and its conditions**.**

The number of lanes at each approach, existence of median, sidewalks, and its dimensions and conditions, was identified through field works and studied at all streets included in the network.

3.1.1. Yasser Arafat Street

Rafedia street is considered the longest street in the network, which extends from An-Najah National University to the city center area. Rafedia Street has been divided into five sections in places where the geometric properties of the street changes.

❖ Section 1: Al Junaid Street

Characteristics of the street:

- It is a four-lane street with a median.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- On street parking is allowed on one side of the street.
- It has a good pavement condition and good sidewalks condition.
- The median condition is not good in some parts.

Figure 3-1 represents section 1, at Al Junaid Street.

Figure 3-1: Section 1 (At Al Junaid Street)

Dimensions of the street elements in Table 3-1:

Table 3.1: Dimensions Of The Street Elements Of Section No.1 At Al Junaid Street

Section #	Length of Section (m)	Side walk (SW) m	Travel Lane (TL) m	Median (M) m	TL (m)	Parking Lane (PL) m	SW (m)	Right of way (ROW) m
1	1300	2.5	10.3	3	8.6	2.2	3.5	30.1

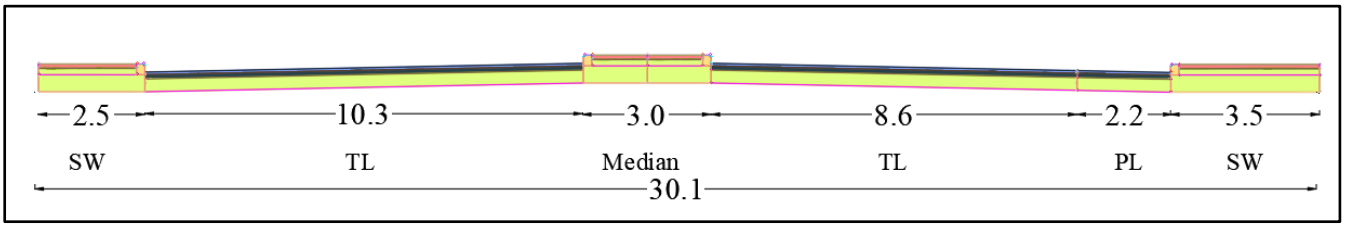

Figure 3-2: Section No.1- At Al Junaid Street Existing Cross Section

❖ Section 2: At Abu Asfoura Restaurant

Characteristics of the street:

- It is a two-lane street without a median.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- Pre-paid parking is permitted on both sides of the street.
- It has a good pavement condition and good sidewalks condition.

Figure 3-3 represents section 2, at Abu Asfoura Restaurant.

Figure 3-3: Section No. 2 - At Abu Asfoura Restaurant

Dimensions of the street elements in Table 3-2:

Table 3.2:Dimensions Of The Street Elements Of Section No.2 At Abu Asfoura Restaurant

Section#	L (m)	SW (m)	PL (m)	TL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
2	60	3.3	1.9	5.7	3.8	1.9	3.3	19.9

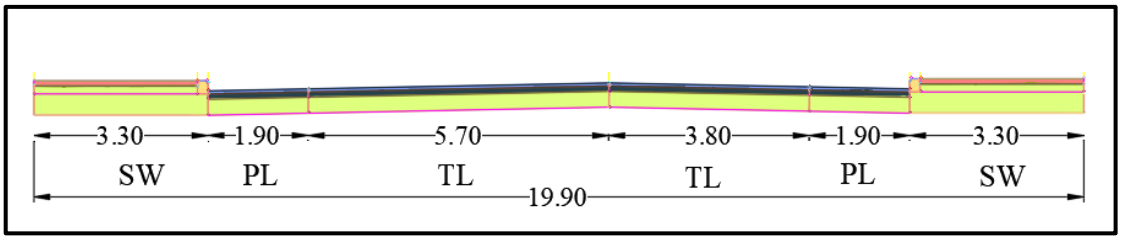

Figure 3-4:At Abu Asfoura Restaurants Section No.2 Existing Cross Section

❖ Section 3: Gift Corner

Characteristics of the street:

- It is a two-lane street without a median.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- Pre-paid parking is permitted on both sides of the street.
- The pavement and sidewalks condition are not good.

Figure 3-5 represents section 3, at Gift Corner.

Figure 3-5: Section 3 (At Gift Corner)

Dimensions of the street elements in Table 3-3:

Table 3.3: Section No.3 At Gift Corner - Dimensions Of The Street Elements

Section#	L (m)	SW (m)	PL (m)	TL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
3	370	2.25	1.9	3.5	4.6	1.9	2.25	16.4

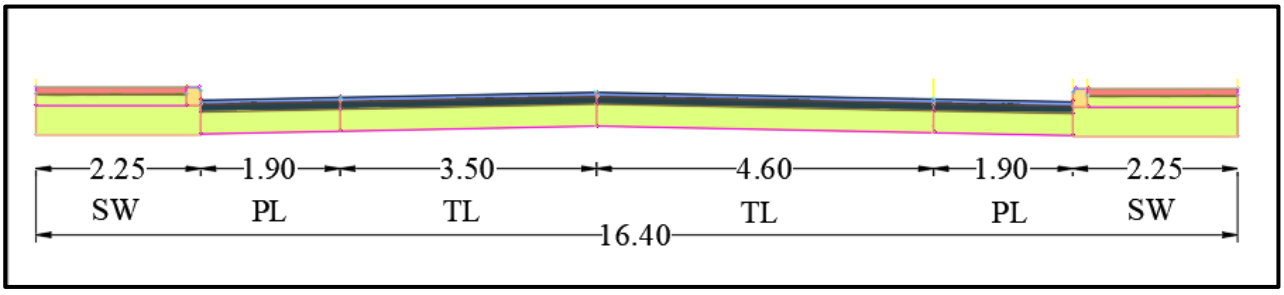

Figure 3-6:At Gift Corner Section No.3 Existing Cross Section

3.1.2. Rafedia Street

❖ Section 1: Shamia Ice cream

Characteristics of the street:

- It is a three-lane street without a median.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- Pre-paid parking is permitted on both sides of the street.
- It has a good pavement condition and good sidewalks condition.

Figure 3-7 represents section 1, at Shamia ice cream.

Figure 3-7:Section 1 (At Shamia Ice Cream)

Dimensions of the street elements in Table 3-4.

Table 3.4: Section No.1 At Shamia Ice Cream - Dimensions of the Street Elements

Section#	L (m)	SW (m)	PL (m)	TL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
4	970	3.5	1.7	6.8	4.4	1.7	1.5	19.5

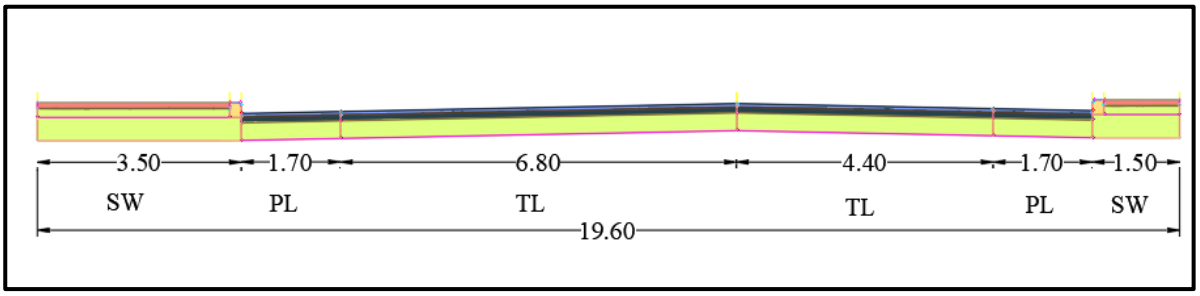

Figure 3-8: At Shamia Ice Cream Section No.1 Existing Cross Section

❖ Section 2: At Ibn Qutaiba School

Characteristics of the street:

- It is a three-lane street without a median.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- Parking is permitted on both sides of the street.
- The pavement condition is not good.
- It has a good sidewalks condition.

Figure 3-9 represents section 2, at Ibn Qutaiba School.

Figure 3-9:Section 2 (At Ibn Qutaiba School)

Dimensions of the street elements in Table 3-5.

Table 3. 5: Dimensions Of The Street Elements Of Section No.2 at Ibn Qutaiba School

Section#	L (m)	SW (m)	PL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
6	368	4.8	3.7	11.3	1.8	3	24.6

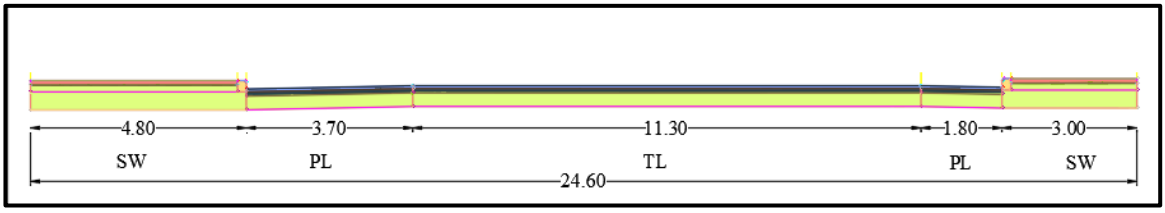

Figure 3-10: At Ibn Qutaiba School , Section No.2 Existing Cross Section

❖ Section 3: Nablus Municipality Sports Stadium

Characteristics of the street:

- It is a three-lane, one way.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- Parking is permitted on one side of the street.
- It has a good pavement condition and good sidewalks condition.

Figure 3-11 represents section 3, at Nablus Municipality Sports Stadium.

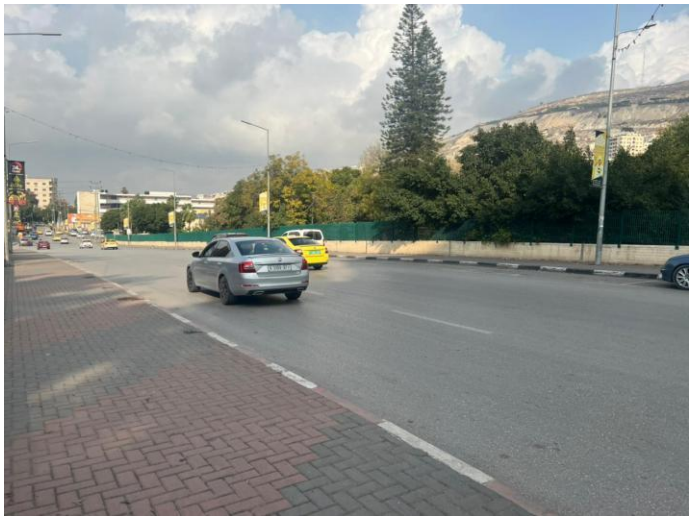

Figure 3-11: Section 3 -At Nablus Municipality Sports Stadium

Table 3.6 show the Dimensions of the street elements.

Table 3. 6: Dimensions Of The Street Elements of Section No.3.

Section#	L (m)	SW (m)	TL (m)	PL (m)	SW (m)	ROW (m)
6	255	2.5	11.6	2	2.9	19

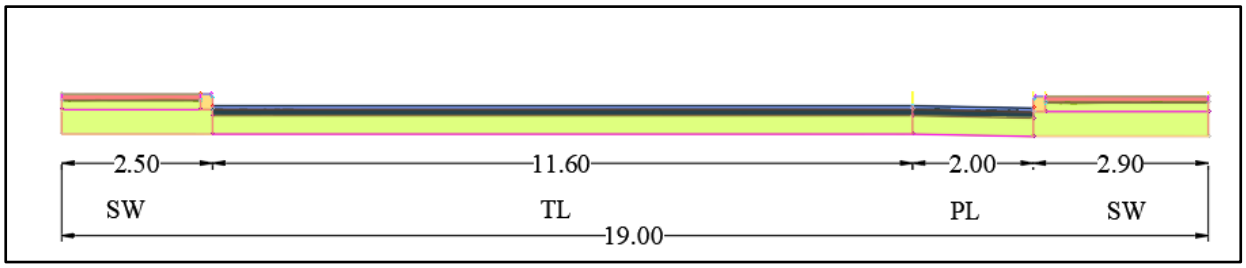

Figure 3-12: At Nablus Municipality Sports Stadium Section No.3 Existing Cross Section

3.1.3. Omar Ibn Al-Khattab Street

Omar Ibn Al-Khattab Street, which connects the city center to Rafidia Street and also has the An-Najah National University- old campus, is considered as one of the most critical streets in the network. The street was divided into three sections where the geometric characteristics change.

❖ Section 1: An-Najah National University (Old Campus)

Characteristics of the street:

- It is a two-lane street without a median.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- On street parking is allowed on one side only.
- The pavement condition is not good.
- The sidewalks condition is good.

Figure 3-13 represents section 1, An-Najah National University (Old Campus).

Figure 3-13:Section No.1- An-Najah National University (Old Campus)

Dimensions of the street elements in Table 3-7:

Table 3.7: Dimensions Of The Street Elements Of Section No.1 An-Najah (Old Campus)

Section#	L (m)	SW (m)	PL (m)	TL (m)	TL (m)	SW (m)	ROW (m)
1	375	2.8	2.2	3.6	3.6	2.8	15

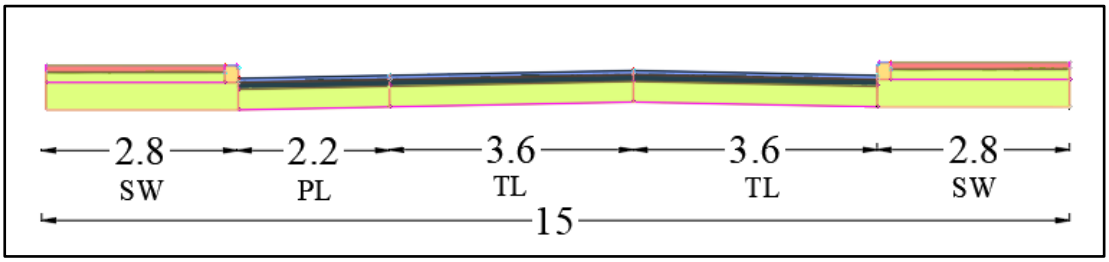

Figure 3-14:An-Najah University (Old Campus) Section No.1 Existing Cross Section

❖ Section 2: After An-Najah University (Old Campus)

Characteristics of the street:

- It is a two-lane street without a median.
- There are no speed limit signs on this section.

- There are sidewalks on both sides of the street.
- On street parking is allowed on one side of the street.
- It has a good pavement and sidewalks conditions.

Figure 3-15 represents section 2.

Figure 3-15:Section 2, After An-Najah University (Old Campus)

Dimensions of the street elements in Table 3-8.

Table 3.8: Dimensions Of Omar Ibn Al-Khattab Street Elements, Section No.2

Section#	L (m)	SW (m)	PL (m)	TL (m)	TL (m)	SW (m)	ROW (m)
2	1330	2.5	2.2	3.4	3.4	2.4	13.9

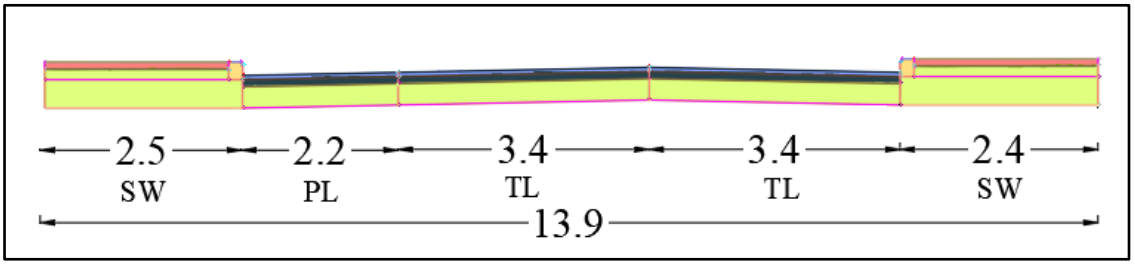

Figure 3-16: Omar Ibn Al-Khattab Street , Section No. 2 (Existing Cross Section).

❖ Section 3: At Al-Fatemiah School

Characteristics of the street:

- It is a two-lane street without a median.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- Parking is not permitted on both side of the street.
- It has a good pavement condition and good sidewalks condition.

Figure 3-17 represents section 3, At Al-Fatemiah School.

Figure 3- 17: Section No.3 - At Al-Fatemiah School

Dimensions of the street elements in Table 3-9.

Table 3.9: Al-Fatemiah Street - Dimensions Of The Street Elements

Section#	L (m)	SW (m)	TL (m)	TL (m)	SW (m)	ROW (m)
3	140	2.6	5.25	5.25	3	16.1

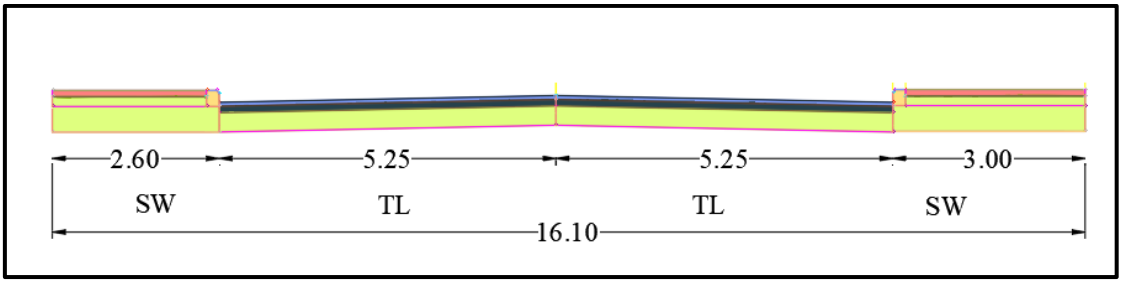

Figure 3-17: At Al-Fatemiah School Section No.3 Existing Cross Section

3.1.4. Ghernatah Street

Ghartana Street, which extends between Omar Ibn Al-Khattab Street and the city center and is recognized for its heavy traffic, and it's a one of the streets with high vehicles and pedestrians traffic.

One section of the street was taken because there were few geometric changes along it.

Characteristics of the street:

- It is a two-lane, one way.
- There are no speed limit signs on this section.
- There is a traffic light at intersection with Omar Bin Al Khattab Street.
- There are sidewalks on both sides of the street.
- On street parking is allowed on both side, but it's not allowed at intersection only.
- pavement and sidewalks conditions are not good.

Figure 3-19 represents, Ghernatah Street.

Figure 3-18: Ghernatah Street

Dimensions of the street elements in Table 3-10.

Table 3.10: Dimensions Of The Street Elements For Ghernatah Street

Section#	L (m)	SW (m)	PL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
1	288	2.8	2.2	6.2	2.2	2	15.4

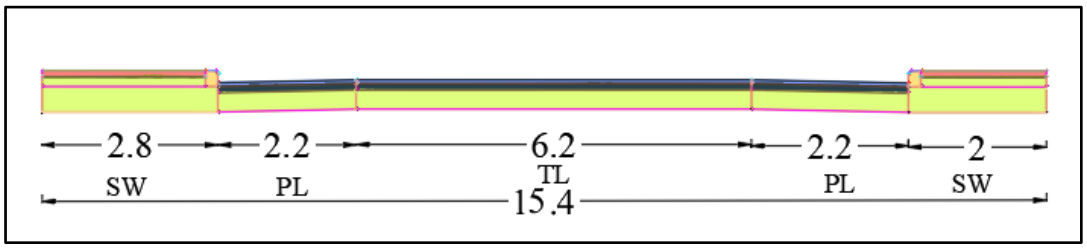

Figure 3-19: At Ghernatah Street Existing Cross Section

3.1.5. Palestine Street

Palestine Street is one of the important street as it connects Rafidia Street to the city center and it has a heavy traffic volume. One section was taken in accordance with the geometric changes.

Characteristics of the street:

- It is a one-lane, one way.
- There are no speed limit signs on this section.
- There are sidewalks on both sides of the street.
- Pre-paid parking is permitted on both sides of the street.
- It has a good pavement condition and good sidewalks condition.

Figure 3-20 represents Palestine Street section.

Figure 3-20: At Palestine Street

Table 3.11: Dimensions Of The Street Elements For Palestine Street

Section#	L (m)	SW (m)	PL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
1	537	2.4	2.2	4.8	2.5	1.7	13.6

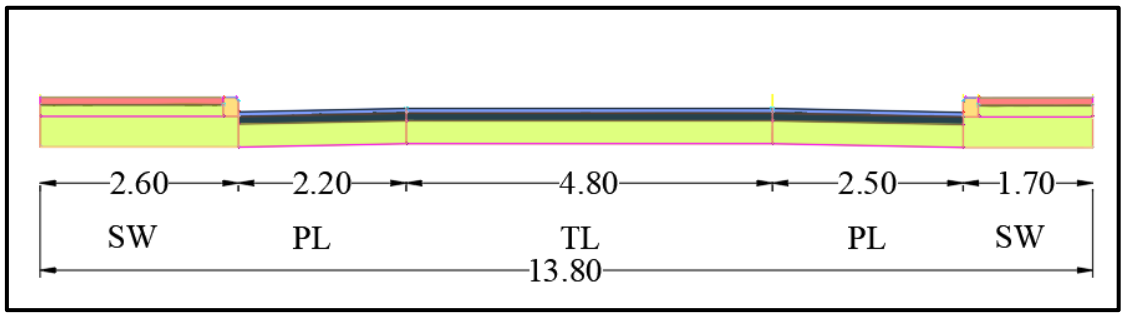

Figure 3-21: At Palestine Street Existing Cross Section

3.1.6. Al-Shwetreh Street

Characteristics of the street:

- It is a one-lane, one way.
- There are no speed limit signs on this section
- There is a traffic signal on the Fatimiah School intersection.
- There are sidewalks on both sides of the street.
- Parking is allowed on both side of the street.
- It has a good pavement condition and good sidewalks condition.

Figure 3-23 represents Al-Shwetreh Street.

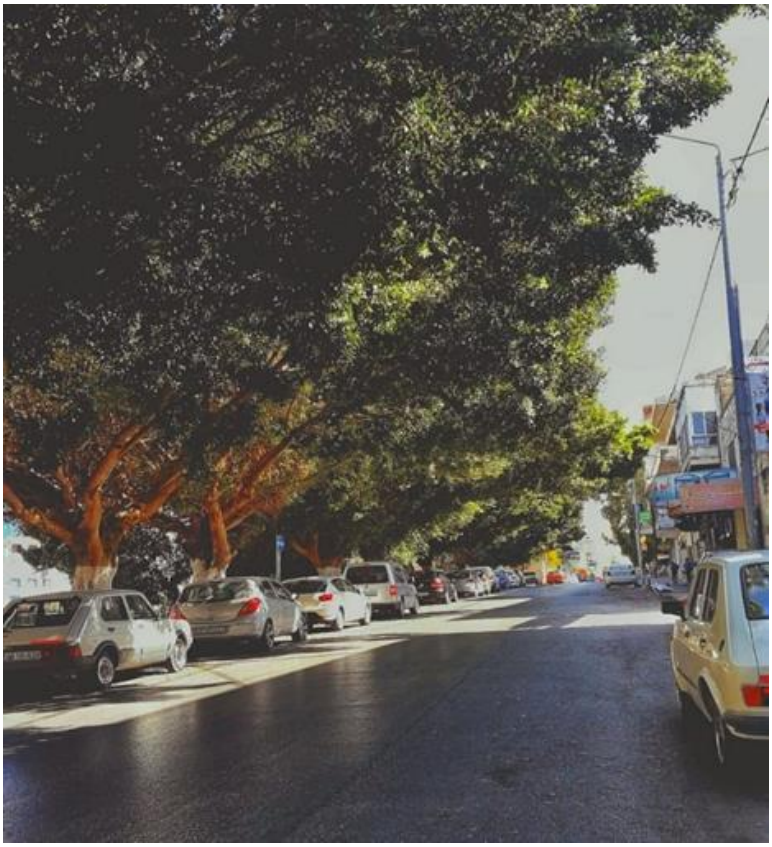

Figure 3-22: At Al-Shwetreh Street.

Dimensions of the street elements in Table 3-12.

Table 3.12: Dimensions Of The Street Elements For Al-Shwetreh Street

Section#	L (m)	SW (m)	PL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
1	500	2	2.25	7.8	2.25	2	16.3

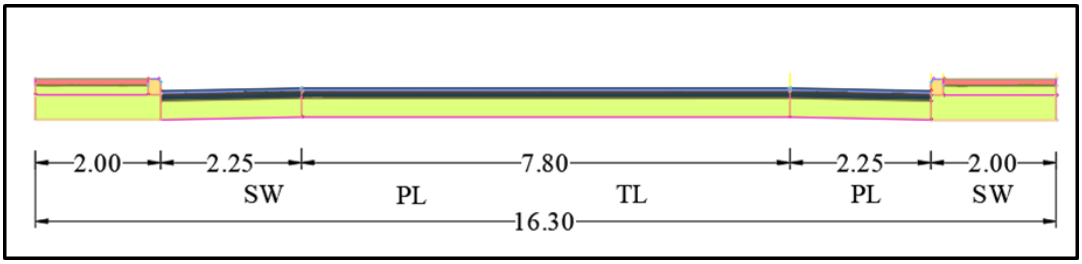

Figure 3-23: At Al-Shwetreh Street Existing Cross Section

3.1.7. The City Center Area

The center of city area is one of the important areas in the network, because of its privileged location, as it is located in the middle of the commercial area.

This area is also characterized by the large number of pedestrians, in addition to the high volume of traffic, and the issue increased because of the illegal and random parking lots, so it was necessary to pay attention to it. According to the observation of the geometric changes, 8 sections were taken. Distribution of sections along the streets is shown in Figure 3.24.

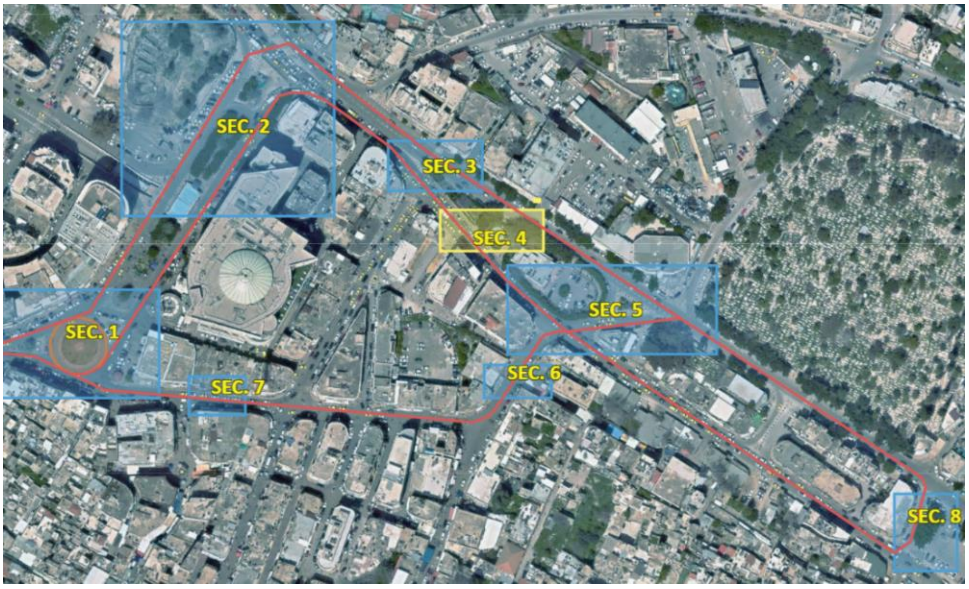

Figure 3-24: At The City Center Area

❖ Section 1: At The City Roundabout

Figure 3-25 represents the City Roundabout.

Figure 3-25: Section1 (At City Roundabout.)

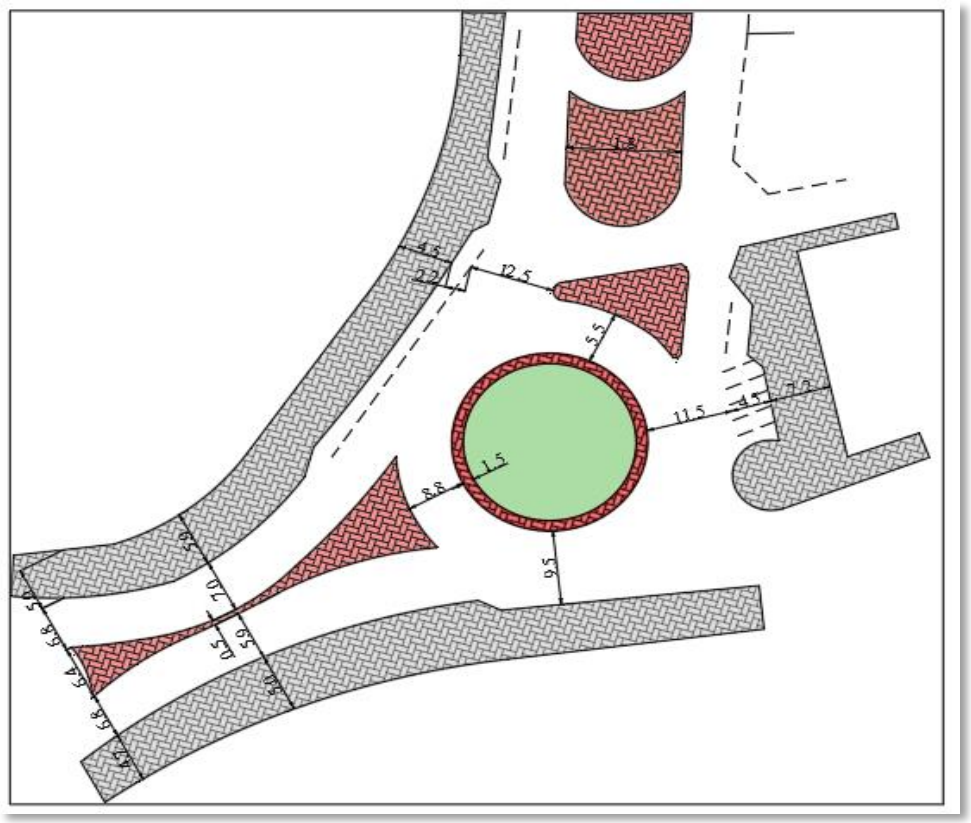

Figure 3-26: At City Roundabout Existing Cross Section

❖ Section 2.1: In Front of the Commercial Complex

Characteristics of the street:

- four lanes–two-way street with median.
- Parking is allowed on both side of the street.
- There is a sidewalk on both side.
- Sidewalk and pavement have a good condition .
- No speed limit.

Figure 3-27 represents the section in front of the Commercial Complex.

Figure 3-27: Section 1 (In Front of the Commercial Complex.)

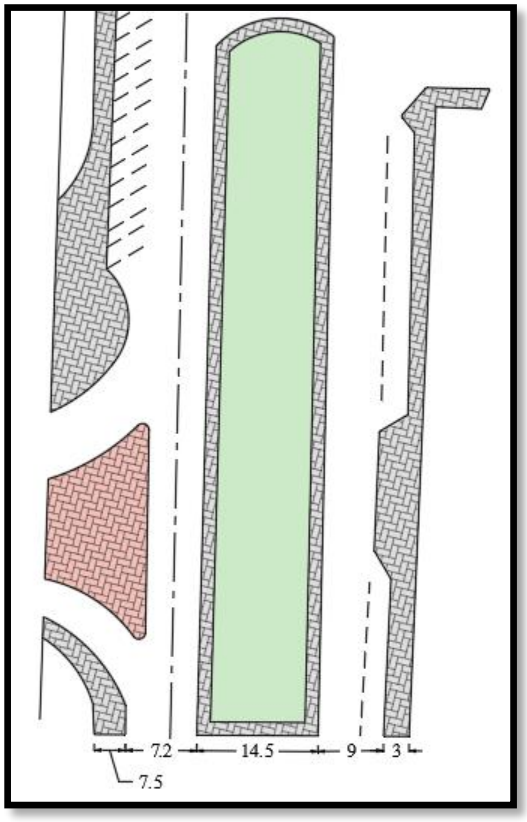

Figure 3-28: In Front of the Commercial Complex Existing Cross Section

❖ Section 2.2: In Front of Al-Watani Hospital

The street has the following characteristic:

- six lanes–two-way street with median.
- Parking is not allowed on both side of the street.
- There is a sidewalk on both side.
- Sidewalk and pavement have a good condition.
- No speed limit.

Figure 3-29 represents the section in front of Al-Watani Hospital

Figure 3-29: Section 2.2 (In Front Of The Watani Hospital.)

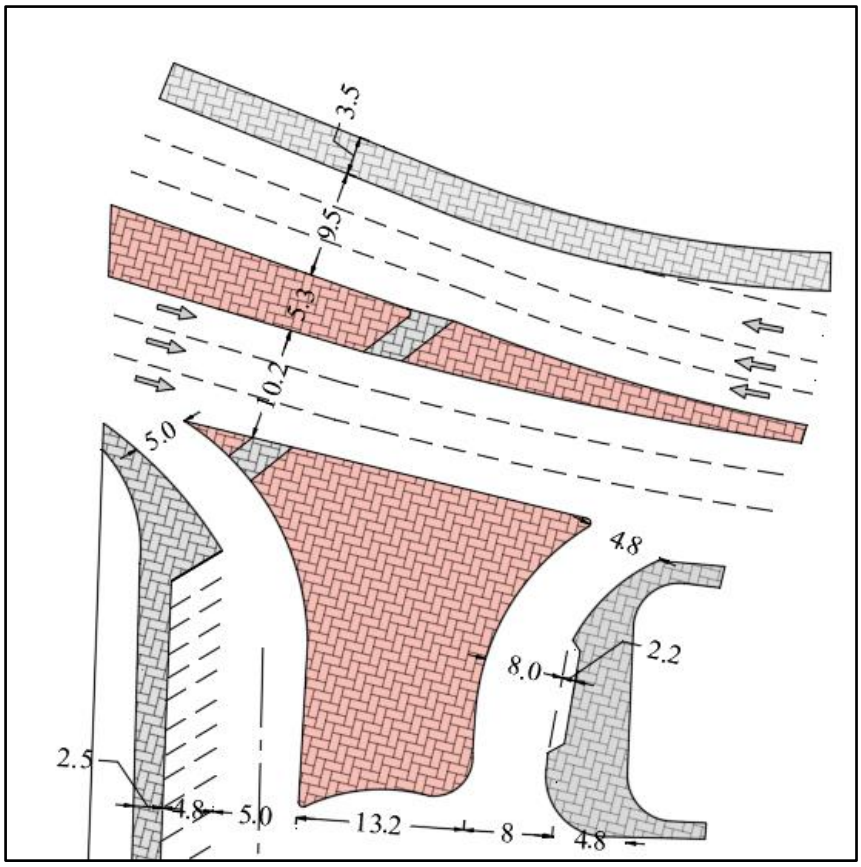

Figure 3-30: In Front Of The Watani Hospital Existing Cross Section

❖ Section 3: Faisal Street

The street has the following characteristic:

- Six lanes, two-way street with median.
- Parking is not allowed on both side of the street.
- There is a sidewalk on both side.
- Sidewalk and pavement have a good condition.
- No speed limit.

Figure 3-31 represents Faisal Street.

Figure 3-31: Section 3 (Faisal Street.)

Dimensions of the street elements in Table 3-13.

Table 3.13: Dimensions Of The Street Elements Of Section No.3 At Faisal Street

Section #	L (m)	SW (m)	TL (m)	M (m)	TL (m)	SW (m)	ROW (m)
3	140	3	13.3	4.8	12	3.0	36.1

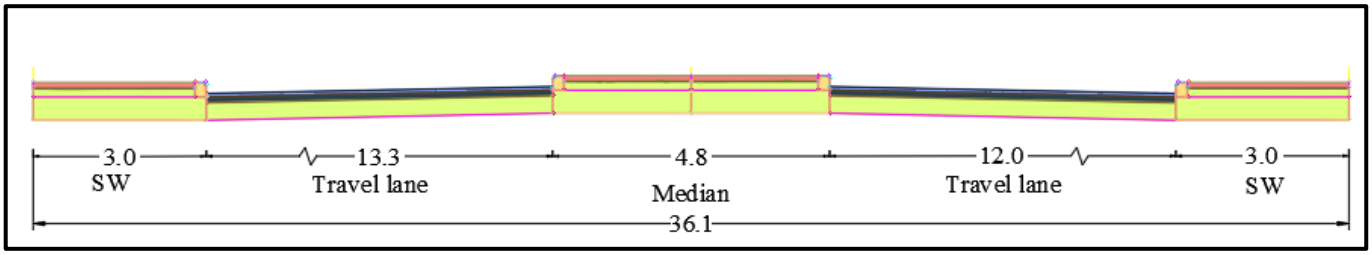

Figure 3-32: At Faisal Street Section No.3 Existing Cross Section

❖ Section 4: In Front of Nablus Municipality

The street has the following characteristic:

- Four lanes in one way and three lanes in another way with a median.
- Parking is not allowed on both side of the street.
- There is a sidewalk on both side.
- Sidewalk and pavement have a good condition.
- No speed limit.

Figure 3-33 represents the section in front of Nablus Municipality.

Figure 3-33: Section 4 (In Front Of Nablus Municipality).

Dimensions of the street elements is shown in Table 3-14.

Table 3.14: Nablus Municipality Street Elements

Section #	L (m)	SW (m)	TL (m)	M (m)	TL (m)	SW (m)	ROW (m)
4	74	3	16	16	12.7	1.8	49.5

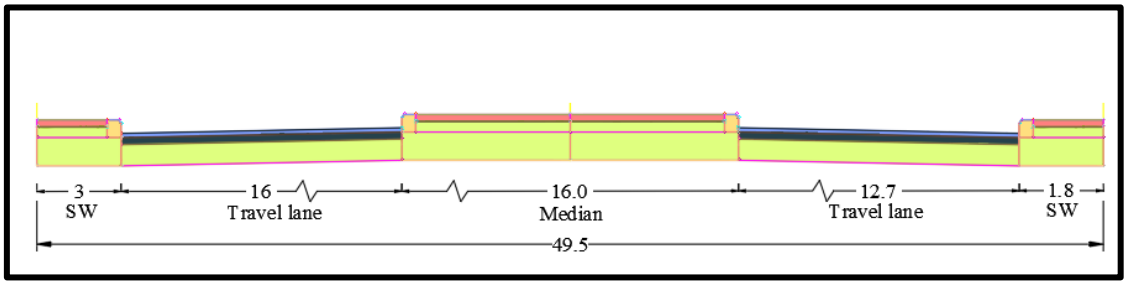

Figure 3-34: In Front Of Nablus Municipality Section No.4 Existing Cross Section.

❖ Section 5: Hettin – Al Masaqiah Intersection

Figure 3-35 represents Hettin – Al Masaqiah Intersection.

Figure 3-35: Section No.5- Hettin – Al Masaqiah Intersection

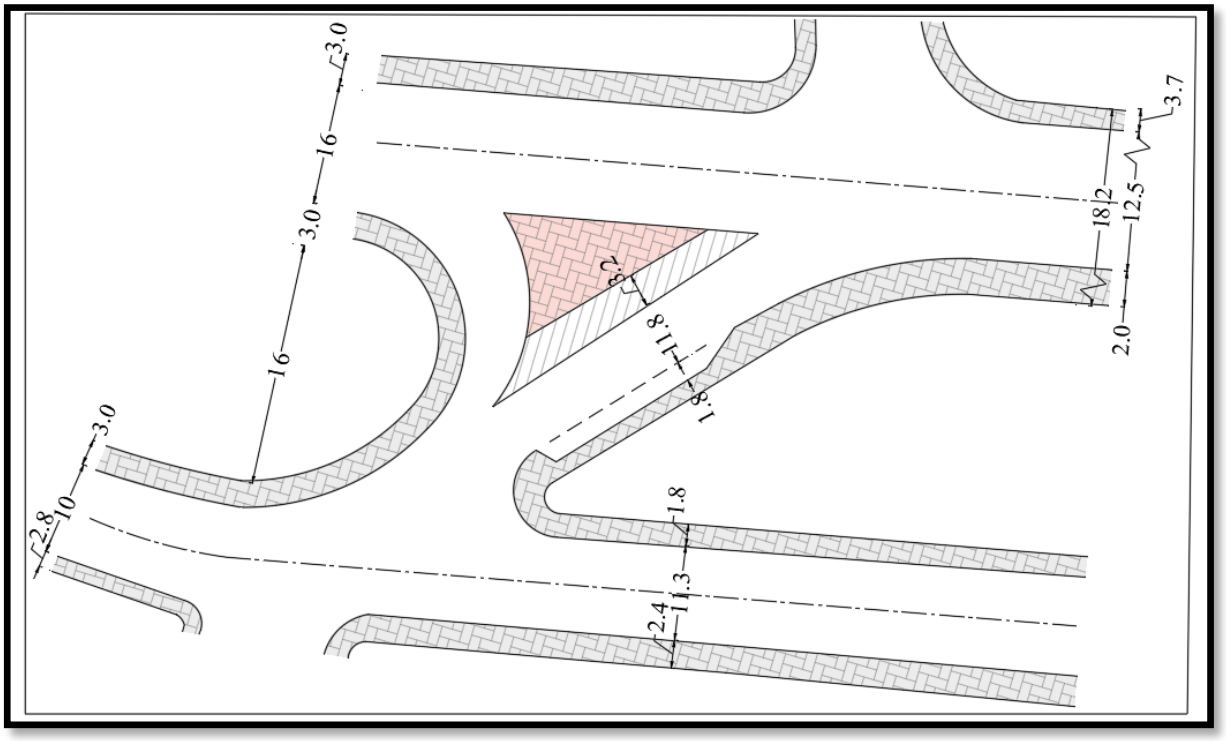

Figure 3-36: A Plan Of Section No.5 Existing Cross Section

❖ Section 6: Hettin Street

The street has the following characteristic:

- Two lanes – one-way street without a median.
- Parking is allowed on one side of the street.
- There is a sidewalk on both side.
- Sidewalk and pavement have a good condition.
- No speed limit.

Figure 3-37 represents Hettin Street.

Figure 3-37: Hettin Street

Dimensions of the street elements is shown in Table 3-15.

Table 3.15: Dimensions Of The Street Elements For Hettin Street

Section #	L (m)	(SW) (m)	TL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
6	68	2.4	3.9	3.9	2.2	2.4	14.8

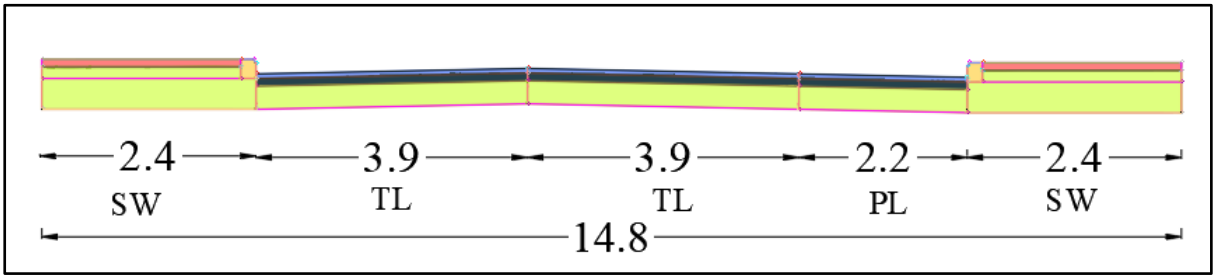

Figure 3-38: At Section No.6 Existing Cross Section – Hittin Street

❖ Section 7: Salah Al-Deen Street

The street has the following characteristic:

- Two lanes – one way without a median.
- Parking is not allowed on both side of the street.
- There is a sidewalk on both side.
- Sidewalk and pavement have a good condition.
- No speed limit.

Figure 3-39 represents a map for Salah Al-Deen Street.

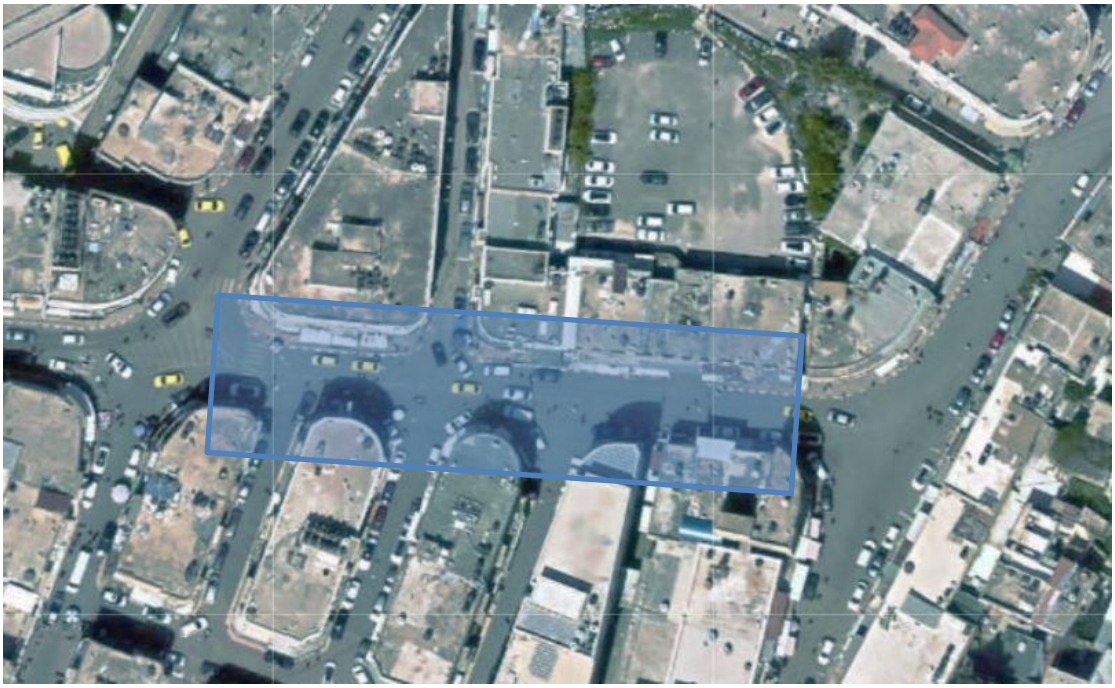

Figure 3-39: At section No.7, Salah Al-Deen Street.

Dimensions of the street elements is shown in Table 3-16.

Table 3.16: Dimensions Of The Street Elements For Salah Al-Deen Street.

Section #	L (m)	SW (m)	TL (m)	TL (m)	SW (m)	ROW (m)
7	156	3	4.5	4.5	3	15

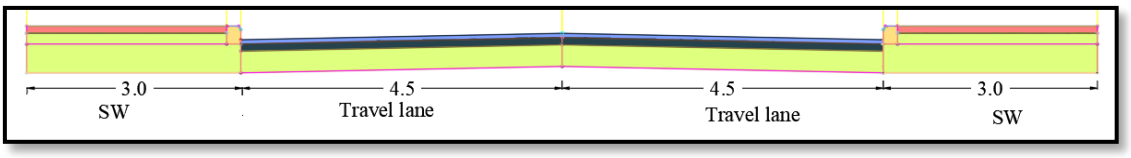

Figure 3-40: Section No.7 Existing Cross Section – Salah Al-Deen Street

❖ Section 8: Between Faisal and Al- Saqiah Street

The street has the following characteristic:

- Four lanes – two ways street with a median.
- Parking is not allowed on both side of the street.
- There is a sidewalk on both side.
- Sidewalk and pavement conditions are not good.
- No speed limit.

Figure 3-42 represents a map for section No.8.

Figure 3- 41: section No.8 Between Faisal and Al- Masaqiah Street.

Dimensions of the street elements is shown in Table 3-17.

Table 3.17: Dimensions Of Section No.8 , Between Faisal and Al- Masaqiah Street

Section #	L (m)	SW (m)	TL (m)	M (m)	TL (m)	SW (m)	ROW (m)
8	39	3.8	7	3.8	7	2.7	24.3

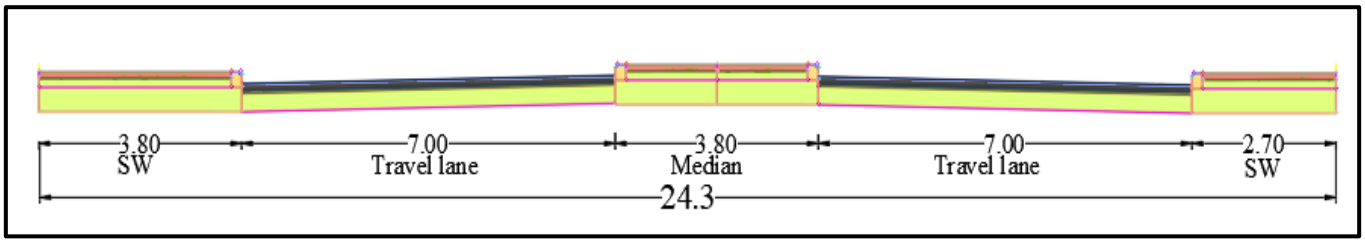

Figure 3-42: Existing Cross Section NO. 8 – Between Faisal and Al- Masakiya Street

3.2. Traffic Volume Study

The traffic volume of the group of intersections was studied in different areas of the network, to determine the peak hour, as Tables 3-18 to 3.23 show.

Table 3.18: Traffic Volume For The Rafrdia-Tunis Intersection

LOCATION: Rafidia - Tunis Intersection

TIME		NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND	Total Volume
FROM	TO	L	T	R	Total	L	T	R	Total	L	T	R	Total	L	T	R	Total	TOTAL	for each Hour
1:00	1:15	9	14	20	**43**	24	30	104	**158**	77	112	10	**199**	25	124	37	**186**	**586**	
1:15	1:30	12	17	35	**64**	30	34	123	**187**	120	162	10	**292**	16	114	45	**175**	**718**	
1:30	1:45	11	25	35	**71**	32	46	151	**229**	93	62	7	**162**	12	100	42	**154**	**616**	
1:45	2:00	13	19	29	**61**	27	34	155	**216**	116	126	5	**247**	15	136	49	**200**	**724**	**2644**
2:00	2:15	13	18	33	**64**	40	41	146	**227**	41	124	4	**169**	24	112	33	**169**	**629**	**2687**
2:15	2:30	15	14	25	**54**	37	43	110	**190**	115	88	8	**211**	18	148	42	**208**	**663**	**2632**
2:30	2:45	9	16	38	**63**	41	46	118	**205**	101	124	13	**238**	17	145	28	**190**	**696**	**2712**
2:45	3:00	21	19	44	**84**	47	48	94	**189**	101	94	6	**201**	19	130	46	**195**	**669**	**2657**
3:00	3:15	15	13	36	**64**	35	42	86	**163**	112	125	11	**248**	11	110	25	**146**	**621**	**2649**
3:15	3:30	10	22	28	**60**	32	51	114	**197**	95	112	13	**220**	18	145	34	**197**	**674**	**2660**
3:30	3:45	18	15	40	**73**	29	39	107	**175**	124	126	5	**255**	17	125	33	**175**	**678**	**2642**
3:45	4:00	12	13	34	**59**	39	40	129	**208**	87	118	7	**212**	25	126	40	**191**	**670**	**2643**
Max. Volume:																			**2712**

Peack Hour: 1:45 -2:45

Table 3.19: Traffic Volume For The Rafrdia-Omar Ibn Khattab Intersection

LOCATION: Rafidia - Omar Ibn Al Khattab Intersection

TIME		SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND	Total Volume
FROM	TO	L	T	R	Total	L	T	R	Total	L	T	R	Total	TOTAL	for each Hour
1:00	1:15	48	150	-	**198**	73	75	-	**148**	33	-	31	**64**	**410**	
1:15	1:30	62	175	-	**237**	68	57	-	**125**	46	-	51	**97**	**459**	
1:30	1:45	53	222	-	**275**	83	60	-	**143**	53	-	47	**100**	**518**	
1:45	2:00	42	169	-	**211**	74	88	-	**162**	45	-	58	**103**	**476**	**1863**
2:00	2:15	54	160	-	**214**	69	71	-	**140**	36	-	57	**93**	**447**	**1900**
2:15	2:30	46	203	-	**249**	83	78	-	**161**	36	-	42	**78**	**488**	**1929**
2:30	2:45	49	187	-	**236**	79	56	-	**135**	60	-	45	**105**	**476**	**1887**
2:45	3:00	65	168	-	**233**	72	74	-	**146**	32	-	36	**68**	**447**	**1858**
3:00	3:15	61	221	-	**282**	93	73	-	**166**	37	-	49	**86**	**534**	**1945**
3:15	3:30	56	254	-	**310**	69	74	-	**143**	101	-	55	**156**	**609**	**2066**
3:30	3:45	55	222	-	**277**	85	63	-	**148**	80	-	38	**118**	**543**	**2133**
3:45	4:00	70	223	-	**293**	90	54	-	**144**	61	-	71	**132**	**569**	**2255**
Max. Volume:															**2255**

Peack Hour: 3:00 - 4:00

Table 3.20: Traffic Volume For The Ghernatah - Omar Ibn Khattab Intersection

LOCATION: Ghernatah - Omar Ibn Al Khattab Intersection

TIME		NORTHBOUND				SOUTHBOUND				EASTBOUND				GRAND	Total Volume
FROM	TO	L	T	R	Total	L	T	R	Total	L	T	R	Total	TOTAL	for each Hour
1:00	1:15	-	-	**172**	**172**	17	253	-	**270**	-	87	65	**152**	**594**	
1:15	1:30	-	-	**156**	**156**	12	200	-	**212**	-	70	54	**124**	**492**	
1:30	1:45	-	-	**228**	**228**	15	310	-	**325**	-	78	48	**126**	**679**	
1:45	2:00	-	-	**284**	**284**	6	303	-	**309**	-	96	66	**162**	**755**	**2520**
2:00	2:15	-	-	**187**	**187**	15	295	-	**310**	-	113	43	**156**	**653**	**2579**
2:15	2:30	-	-	**248**	**248**	7	270	-	**277**	-	142	56	**198**	**723**	**2810**
2:30	2:45	-	-	**182**	**182**	14	267	-	**281**	-	127	68	**195**	**658**	**2789**
2:45	3:00	-	-	**213**	**213**	10	205	-	**215**	-	105	57	**162**	**590**	**2624**
3:00	3:15	-	-	**270**	**270**	12	200	-	**212**	-	97	63	**160**	**642**	**2613**
3:15	3:30	-	-	**245**	**245**	9	208	-	**217**	-	117	53	**170**	**632**	**2522**
3:30	3:45	-	-	**210**	**210**	9	185	-	**194**	-	94	46	**140**	**544**	**2408**
3:45	4:00	-	-	**187**	**187**	13	162	-	**175**	-	86	63	**149**	**511**	**2329**
Max. Volume:															**2810**

Peack Hour: 1:30 - 2:30

Table 3.21: Traffic Volume For The Al-Ameer Mohammed - Yaffa Intersection

LOCATION: Al- Ameer Mohammed - Yaffa intersection

TIME		NORTHBOUND				SOUTHBOUND				WESTBOUND				GRAND	Total Volume
FROM	TO	L	T	R	Total	L	T	R	Total	L	T	R	Total	TOTAL	for each Hour
1:00	1:15	10	209	-	**219**	-	-	251	**251**	-	181	16	**197**	**667**	
1:15	1:30	7	282	-	**289**	-	-	260	**260**	-	162	16	**178**	**727**	
1:30	1:45	6	251	-	**257**	-	-	185	**185**	-	156	15	**171**	**613**	
1:45	2:00	12	284	-	**296**	-	-	199	**199**	-	159	18	**177**	**672**	**2679**
2:00	2:15	3	291	-	**294**	-	-	197	**197**	-	178	16	**194**	**685**	**2697**
2:15	2:30	6	258	-	**264**	-	-	202	**202**	-	175	16	**191**	**657**	**2627**
2:30	2:45	5	323	-	**328**	-	-	195	**195**	-	178	18	**196**	**719**	**2733**
2:45	3:00	6	360	-	**366**	-	-	189	**189**	-	165	28	**193**	**748**	**2809**
3:00	3:15	5	300	-	**305**	-	-	194	**194**	-	175	22	**197**	**696**	**2820**
3:15	3:30	8	314	-	**322**	-	-	205	**205**	-	167	16	**183**	**710**	**2873**
3:30	3:45	9	392	-	**401**	-	-	202	**202**	-	158	19	**177**	**780**	**2934**
3:45	4:00	6	370	-	**376**	-	-	190	**190**	-	171	20	**191**	**757**	**2943**
Max. Volume:															**2943**

Peack Hour: 3:00 - 4:00

Table 3.22: Traffic Volume For The Al- Malek Faisal Street (Al-Watani Hospital)

LOCATION: Al- Malek Faisal Street (National Hospital)															
TIME		NORTHBOUND				EASTBOUND				WESTBOUND				GRAND	Total Volume
FROM	TO	L	T	R	Total	L	T	R	Total	L	T	R	Total	TOTAL	for each Hour
1:00	1:15	-	-	68	**68**	-	309	63	**372**	-	336	-	**336**	**776**	
1:15	1:30	-	-	72	**72**	-	365	72	**437**	-	460	-	**460**	**969**	
1:30	1:45	-	-	61	**61**	-	315	51	**366**	-	464	-	**464**	**891**	
1:45	2:00	-	-	129	**129**	-	243	61	**304**	-	495	-	**495**	**928**	**3564**
2:00	2:15	-	-	122	**122**	-	315	58	**373**	-	489	-	**489**	**984**	**3772**
2:15	2:30	-	-	83	**83**	-	253	58	**311**	-	450	-	**450**	**844**	**3647**
2:30	2:45	-	-	68	**68**	-	237	84	**321**	-	516	-	**516**	**905**	**3661**
2:45	3:00	-	-	88	**88**	-	248	62	**310**	-	405	-	**405**	**803**	**3536**
3:00	3:15	-	-	92	**92**	-	325	62	**387**	-	519	-	**519**	**998**	**3550**
3:15	3:30	-	-	104	**104**	-	279	81	**360**	-	496	-	**496**	**960**	**3666**
3:30	3:45	-	-	100	**100**	-	301	73	**374**	-	515	-	**515**	**989**	**3750**
3:45	4:00	-	-	96	**96**	-	300	80	**380**	-	473	-	**473**	**949**	**3896**
Max. Volume:															**3896**

Peack Hour: 3:00 - 4:00

Table 3.23: Peak Hour Summary For Each Intersection

Location	peak hour	NORTHBOUND	SOUTHBOUND	EASTBOUND	WESTBOUND	Total
Rafidia - Tunis Intersection	1:45 - 2:45	242	838	865	767	2712
Rafidia - Omar Ibn Al Khattab Intersection	3:00-4:00	1162	0	601	213	1976
Ghernatah - Omar Ibn Al Khattab Intersection	1:30 -2:30	947	1221	642	0	2810
Al- Ameer Mohammed - Yaffa intersection	3:00 -4:00	1404	791	0	748	2943
Al- Malek Faisal Street (National Hospital)	3:00 - 4:00	392	0	1501	2003	3896

The peak hour is deferent from one intersection to another, so the common peak hour was calculated for all intersections, which was from 3:00 – 4:00, as shown in Table 3-24.

Table 3.24: Common Peak Hour For All Intersections

TIME		Rafidia - Tunis Intersection	Rafidia - Omar Ibn Al Khattab Intersection	Ghernatah - Omar Ibn Al Khattab Intersection	Al- Ameer Mohammed - Yaffa intersection	Al- Malek Faisal Street (National Hospital)	Common Total	Total Volume for each Hour
FROM	TO	GRAND TOTAL	GRAND TOTAL	GRAND TOTAL	GRAND TOTAL	GRAND TOTAL		
1:00	1:15	**586**	**410**	**594**	**667**	**776**	**3033**	
1:15	1:30	**718**	**459**	**492**	**727**	**969**	**3365**	
1:30	1:45	**616**	**518**	**679**	**613**	**891**	**3317**	
1:45	2:00	**724**	**476**	**755**	**672**	**928**	**3555**	**13270**
2:00	2:15	**629**	**447**	**653**	**685**	**984**	**3398**	**13635**
2:15	2:30	**663**	**488**	**723**	**657**	**844**	**3375**	**13645**
2:30	2:45	**696**	**476**	**658**	**719**	**905**	**3454**	**13782**
2:45	3:00	**669**	**447**	**590**	**748**	**803**	**3257**	**13484**
3:00	3:15	**621**	**534**	**642**	**696**	**998**	**3491**	**13577**
3:15	3:30	**674**	**609**	**632**	**710**	**960**	**3585**	**13787**
3:30	3:45	**678**	**543**	**544**	**780**	**989**	**3534**	**13867**
3:45	4:00	**670**	**569**	**511**	**757**	**949**	**3456**	**14066**
Max. volume:								**14066**

Common Peak hour : 3:00 - 4:00

Table 3-25 to 3-28 shows the classifications of the traffic volume study for Tunis-Rafidia intersection. ***The classification tables of traffic volume for all intersections are located in appendix.***

Table 3.25: classifications of the Traffic Volume For The Rafidia-Tunis Intersection- Eastbound

LOCATION:		Rafidia - Tunis Intersection																						
TIME		EASTBOUND																						
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	58	0	18	0	1	0	0	86	0	24	0	2	0	0	6	0	4	0	0	0	0	199
01:15	01:30	74	0	46	0	0	0	0	118	0	40	0	0	4	0	3	0	7	0	0	0	0	292
01:30	01:45	52	0	39	0	2	0	0	20	0	36	0	4	2	0	5	0	2	0	0	0	0	162
01:45	02:00	81	0	33	0	0	2	0	102	0	19	1	2	2	0	3	0	1	0	1	0	0	247
02:00	02:15	12	0	28	0	1	0	0	105	0	15	0	3	1	0	3	0	0	0	1	0	0	169
02:15	02:30	61	0	51	0	2	1	0	55	1	26	1	5	0	0	4	0	4	0	0	0	0	211
02:30	02:45	60	0	39	0	1	1	0	92	1	25	1	4	1	0	10	0	3	0	0	0	0	238
02:45	03:00	60	0	41	0	0	0	0	64	0	21	1	7	1	0	5	0	1	0	0	0	0	201
03:00	03:15	61	0	47	0	1	3	0	88	0	33	2	0	2	0	7	0	3	0	0	1	0	248
03:15	03:30	53	0	39	0	1	2	0	89	0	20	1	2	0	0	12	0	1	0	0	0	0	220
03:30	03:45	73	0	50	0	0	1	0	95	0	18	2	11	0	0	3	0	2	0	0	0	0	255
03:45	04:00	50	0	34	0	3	0	0	77	0	30	1	7	3	0	4	0	2	0	1	0	0	212
Max. Volume:																								

Table 3.266: classifications of the Traffic Volume For The Rafidia-Tunis Intersection- Northbound

LOCATION:		Rafidia - Tunis Intersection																						
TIME		NORTHBOUND																						
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	3	0	1	0	0	1	0	20	0	8	0	0	0	0	9	0	1	0	0	0	0	43
01:15	01:30	5	0	1	0	0	2	0	30	0	10	0	1	1	0	9	0	4	0	1	0	0	64
01:30	01:45	8	0	2	0	0	0	0	30	0	13	0	1	1	0	11	0	5	0	0	0	0	71
01:45	02:00	6	0	1	0	0	0	0	27	0	7	0	2	0	0	14	0	1	0	3	0	0	61
02:00	02:15	9	0	2	0	1	0	0	30	0	9	0	1	0	0	8	0	3	0	0	1	0	64
02:15	02:30	7	0	3	0	0	0	0	25	0	5	0	1	1	0	9	0	3	0	0	0	0	54
02:30	02:45	8	0	3	0	0	0	0	28	0	8	0	1	0	0	13	0	2	0	0	0	0	63
02:45	03:00	10	0	4	0	2	0	0	35	0	9	0	2	0	0	12	0	8	0	2	0	0	84
03:00	03:15	8	0	2	0	0	0	0	28	0	6	0	0	2	0	15	0	1	0	2	0	0	64
03:15	03:30	8	0	0	0	0	0	0	32	0	4	0	0	0	0	12	0	4	0	0	0	0	60
03:30	03:45	5	0	0	0	0	0	0	35	0	11	0	0	0	0	17	0	5	0	0	0	0	73
03:45	04:00	7	0	2	0	2	0	0	27	0	7	0	0	0	0	10	0	4	0	0	0	0	59

Table 3.277: classifications of the Traffic Volume For The Rafidia-Tunis Intersection- Southbound

LOCATION:		Rafidia - Tunis Intersection																						
TIME		SOUTHSOUND																						
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	19	0	5	0	0	0	0	24	0	6	0	0	0	0	72	1	25	0	0	2	4	158
01:15	01:30	28	0	2	0	0	0	0	30	0	2	0	1	1	0	90	2	28	0	0	1	2	187
01:30	01:45	32	0	0	0	0	0	0	36	0	8	0	0	1	1	88	1	54	0	2	1	5	229
01:45	02:00	26	0	1	0	0	0	0	24	0	6	0	2	1	1	108	2	40	0	0	2	3	216
02:00	02:15	36	0	2	0	0	1	1	36	0	4	0	0	1	0	105	1	37	0	1	1	1	227
02:15	02:30	34	0	3	0	0	0	0	36	0	7	0	0	0	0	73	2	35	0	0	0	0	190
02:30	02:45	37	0	3	0	1	0	0	38	0	7	0	0	1	0	74	5	36	0	2	0	1	205
02:45	03:00	41	0	5	0	0	1	0	40	0	5	0	0	3	0	62	2	26	0	1	1	2	189
03:00	03:15	31	0	4	0	0	0	0	38	0	2	0	2	0	0	58	1	26	0	1	0	0	163
03:15	03:30	31	0	1	0	0	0	0	44	0	4	0	1	2	0	72	1	36	0	3	1	1	197
03:30	03:45	26	0	3	0	0	0	0	34	0	3	0	2	0	0	65	1	34	0	4	0	3	175
03:45	04:00	33	0	5	0	1	0	0	30	0	8	0	2	0	0	70	0	49	0	4	1	5	208
Max. Volume:																								

Table 3.288: classifications of the Traffic Volume For The Rafidia-Tunis Intersection- Westbound

LOCATION:		Rafidia - Tunis Intersection																						
TIME		WESRBOUND																						
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	20	0	5	0	0	0	0	86	0	33	1	2	2	0	27	0	9	0	1	0	0	186
01:15	01:30	14	0	2	0	0	0	0	82	0	26	1	2	1	2	30	0	14	0	0	1	0	175
01:30	01:45	6	0	6	0	0	0	0	76	0	19	0	1	1	3	39	0	3	0	0	0	0	154
01:45	02:00	11	0	4	0	0	0	0	105	3	23	0	3	2	0	29	0	17	0	0	2	1	200
02:00	02:15	21	0	3	0	0	0	0	76	0	27	2	3	2	2	26	0	6	1	0	0	0	169
02:15	02:30	14	0	3	0	0	1	0	115	2	27	1	2	1	0	29	0	12	0	0	1	0	208
02:30	02:45	11	0	6	0	0	0	0	103	0	33	3	3	2	1	18	0	7	0	1	2	0	190
02:45	03:00	14	0	4	0	0	1	0	94	0	33	1	0	1	1	35	0	9	0	1	1	0	195
03:00	03:15	9	0	2	0	0	0	0	80	0	21	4	4	1	0	23	0	2	0	0	0	0	146
03:15	03:30	13	0	5	0	0	0	0	104	1	35	1	3	0	1	27	1	5	0	0	0	1	197
03:30	03:45	16	0	1	0	0	0	0	83	0	37	0	3	2	0	29	0	3	0	0	1	0	175
03:45	04:00	23	0	2	0	0	0	0	81	0	37	3	3	2	0	35	0	5	0	0	0	0	191
Max. Volume:																								

3.3. Questionnaire

Based on the results of a questionnaire where a group of students from An-Najah National University (Al-Tanbour and Juma, 2022) conducted to estimate the percentage of bicycle users in the city of Nablus and to assess the level of their desire to use bicycles, the results are shown in Table 3-29.

Table 3.299: Questionnaire Main Results (Al-Tanbour and Juma, 2022)

1- Gender			
Male		**Female**	
685		1070	
2- Place of residence			
Nablus city		**outside Nablus city**	
860		895	
3- Your primary place of study at An-Najah National University			
The old campus		**The new campus**	
381		1374	
4- Faculty			
Faculty of Engineering and Information Technology	**Faculty of Medicine**	**Faculty of Science**	**Faculty of Human Sciences**
490	507	52	103
Faculty of Educational Sciences and Teacher Preparation	**Faculty of Sharia**	**Faculty of Agriculture and Veterinary Medicine**	**Faculty of Fine Arts**
68	51	46	119
Faculty of Economics and Social Sciences		**Faculty of Law**	
205		122	
5- academic year			
first year	**second year**	**third year**	**fourth year or more**

918	332	198	307
6- Do you own a car?			
Girls		**Boys**	
Yes	**No**	**Yes**	**No**
101	969	144	541
7- Do you own a bicycle or an electric bike?			
Girls		**Boys**	
Yes	**No**	**Yes**	**No**
29	1041	93	592

8- What kind of transportation do you use when you go to university?					
Private car	**Public transportation**	**Bicycle / Electric Bicycle**	**Motorcycle**	**Walking**	**Others**
335	1097	3	0	209	16

9-The extent of feeling safe and secure while using the bicycle / electric bike				
Very high	**high**	**average**	**Low**	**Very Low**
120	183	689	389	374

10- If there is a bicycle/electric bike network in the city of Nablus between the campus of An-Najah University and the city center, would you like to use the bicycle/electric bike instead of public transportation or a private vehicle?		
Yes	**No**	**Not sure**
663	597	497

11- If you use the bicycle between the university campuses and/or to the city center, do you prefer riding a bicycle or an electric bicycle?		
Bicycle	**Electric bike**	**Other than that**
265	906	584

12- If there is a network of bicycles / electric bikes in the city of Nablus and bicycle rental services, do you prefer owning or renting a bicycle?		
Owning	**Renting**	**Other than that**
599	586	570

- The Summary of questionnaire result is shown in Chapter 5.

❖ Statistical connotations (Kamel, 2020)

Until the results of the questionnaire are used, it must be ensured initially that number of students who responded to the questionnaire is sufficient to use its results in design bike network. To determine this, used this equation (Kamal, 2020).

$$n = \frac{N}{\left(\left(\frac{d}{z}\right)^2 * \frac{N-1}{pq}\right) + 1}$$

Where: *N= sample size*

z= standard grade = 1.96

d= Error percentage (level of significance) = 0.05

ρ=0.5

q=0.5

$$n = \frac{23000}{\left(\left(\frac{0.05}{1.96}\right)^2 * \frac{23000-1}{0.5 * 0.5}\right) + 1}$$

$= 377.8 = 378$

According to statistical equation, needed the questionnaire to be filled out by 378 students, but the number of students who answered the questionnaire is 1755. Accordingly, the sample is sufficient and statistically significant.

Chapter 4: Design Criteria

This chapter provides an overview of design criteria that facilitate safe and convenient travel for bicyclists on roadways. Bicyclists have similar access and mobility needs as other users of the transportation system and use the street system as their primary means of access to jobs, services, and recreational activities.

As per the AASHTO standard the design criteria of bike lanes are mainly focusing on the bike lane types, parking facilities, dimensions, signs, lighting and marking of different type bike lanes etc.

Moreover, in order to design a suitable bike lanes facility, the information about road function, traffic volume, traffic mix, expected users, speed, and road condition functional classifications shall be provided.

4.1 Bicycle Safety

Bicycles on the roadway are vehicles with the same rights and responsibilities as motorized vehicles. When a crash occurs between a vehicle and a bike it's the cyclist who is most likely to be injured. This section provides the safety tips and precautions in order to prevent bicycle incidents.

For Drivers (AASHTO, 2012):

- Reduce speed when traveling near cyclists.
- Check "blind" spots before crossing shared zones to make right turns.
- Look for cyclists before opening doors in parking spaces adjacent to bike lanes.
- No stopping, standing or parking in bike lanes.

For Cyclists (AASHTO, 2012):

- When bike lanes are adjacent to parked cars, ride in the left portion of the lane about 4-5 feet (1.2 – 1.5 m) from the cars.
- Obey all traffic control devices (signals and signs) and yield to pedestrians when turning across crosswalks

- Travel only in the same direction as traffic flow unless the bike lane is signed and marked for two-way travel. Pay extra attention to buses and trucks.
- When turning out of a bike lane, avoid making a left turn from a far-right lane or vice-versa.
- Wear a helmet and bright reflective vest or clothing at all times while riding.
- Only ride at night when equipped with front and rear working lights.

For Pedestrians:

- Before you step off the curb to cross the street, stop, look and listen for bicycles and other vehicles (bicycles can be very quiet).
- Do not stand or walk in a bike lane.
- Make eye contact with cyclists and drivers to be sure that they see you before you cross.

4.2 Functional Classification of Roads

Functional classification is the process of categorizing streets and highways into classes or systems based on the type of traffic service that they are intended to provide. Roads and highways are functionally classified to aid in the planning of appropriate design elements for each type of facility. A well-designed roadway system incorporates a variety of roadway types. The priority of access or mobility is assigned to each type of roadway. Roadways are classified into three types:

- Arterials, which have a high mobility and low accessibility for vehicles.
- Collectors, which have lower mobility than the arterials; the accessibility is higher than the arterials.
- Local roads, which have the lowest mobility and the highest accessibility.

Urban Arterial or Collector is the functional classification for the streets taken into consideration for this project.

4.3 Design Vehicle

The physical dimensions and operating characteristics of bicyclists vary considerably. Some of this variation is due to differences in types and quality of bicycles, whereas other variations are due to differing abilities of bicyclists. For bikeways that are shared with other users, such as shared use paths, the bicycle may not always be the critical design user for every element of design. For example, most intersections between roads and pathways should be designed for pedestrian crossing speeds as they are the slowest user.

As with motor vehicles, there are multiple types of design bicyclists. Many of the design dimensions for bikeways are based on critical dimensions or characteristics of different types of bicyclists. For example, recumbent and hand bicyclists are the critical user for eye height; however, a bicycle with a trailer might be the critical user when designing a median refuge island at a shared use path-roadway intersection (AASHTO, 2012)

Critical physical dimensions for upright adult bicyclists are shown in Figure 4-1. The minimum operating width of 4 feet (1.2 m) (AASHTO, 2012), sufficient to accommodate forward movement by most bicyclists, is greater than the physical width momentarily occupied by a rider because of natural side-to-side movement that varies with speed, wind, and bicyclist proficiency. Additional operating width may be required in some situations, such as on steep uphill grades, and the figure does not include shy distances from parallel objects such as railings, tunnel walls, curbs or parked cars. In some situations, where speed differentials between bicyclists and other vehicles are relatively small, cyclists may accept smaller shy distances. However, this should not be used to justify designs that are narrower than recommended minimums. The operating height of 8.3 feet (2.5 m) can accommodate an adult bicyclist standing upright on the pedals.

Other typical dimensions are shown in Figure 4-1 (AASHTO, 2012):

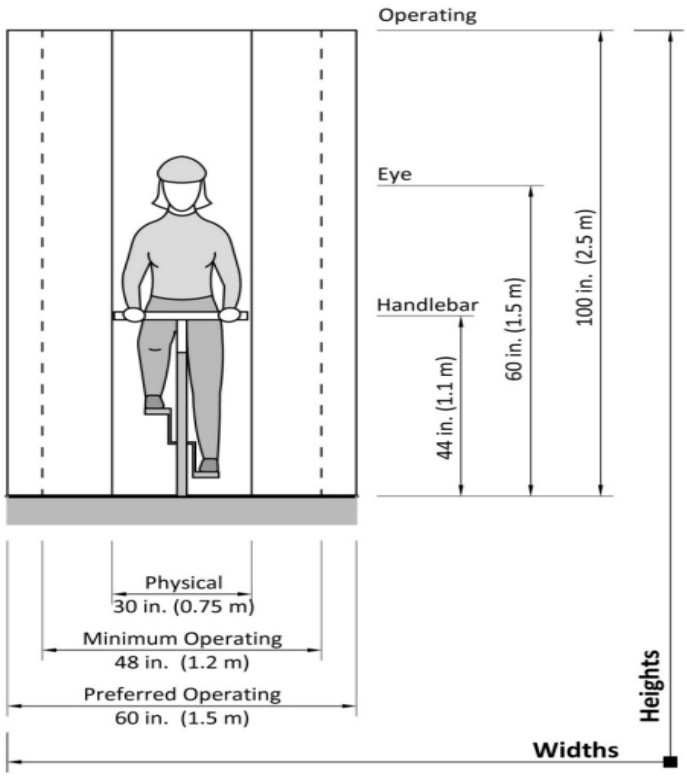

Figure 4-1 Critical Physical Dimensions for Upright Adult Bicyclists (AASHTO, 2012).

4.3.1 Typical Bicycle Dimensions

Figure 4-2 contains dimensions for several different types of bicycles including a typical bicycle, recumbent bicycle, tandem bicycle, and a bicycle with a child trailer (AASHTO, 2012).

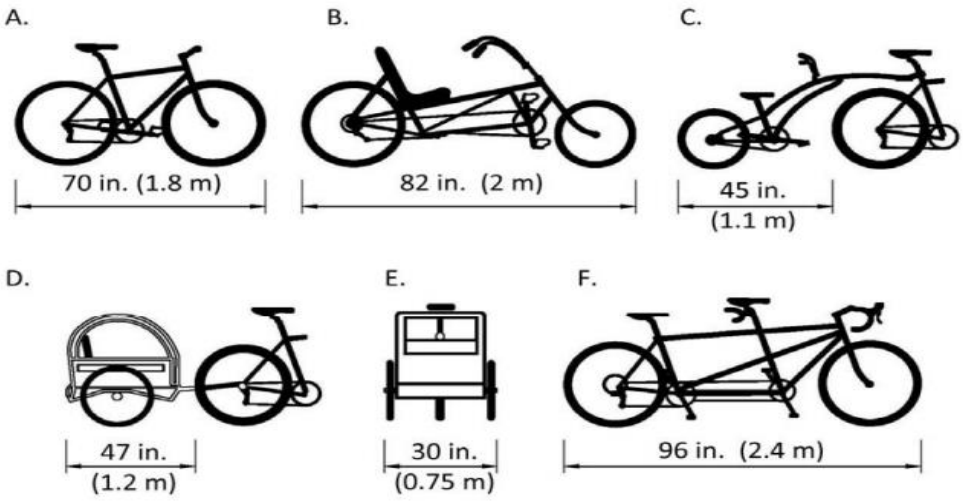

Figure 4-2: Dimensions for Several Different Types of Bicycles (AASHTO, 2010)

A. Adult typical bicycle.
B. Adult single recumbent bicycle.
C. Additional length for trailer bike.
D. Additional length for child trailer.
E. Width for child trailer.
F. Adult tandem bicycle.

Key dimensions:

Table 4.1 lists various key dimensions for typical upright adult bicyclists, as well as key dimensions for other types of users including recumbent bicyclists, tandem bicyclists, bicyclists pulling a child trailer and in-line skaters (AASHTO, 2012).

Table 4.1 Key Dimensions For Different Types Of Users (AASHTO, 2012).

User Type	Feature	Dimension	
		US Customary	Metric
Typical upright adult bicyclist	Physical Width (95th percentile)	30 in	0.75 m
	Physical length	70 in	1.8 m
	Physical height of handlebars (typical dimension)	44 in	1.1 m
	Eye height	60 in	1.5 m
	Center of Gravity (approximate)	33-40 in	0.8-1.0 m
	Operating width (minimum)	48 in	1.2 m
	Operating width (preferred)	60 in	1.5 m
	Operating height (minimum)	100 in	2.5 m
	Operating height (preferred)	120 in	3.0 m
Recumbent bicyclist	Physical length	82 in	2.2 m
	Eye height	46 in	1.2 m
Tandem bicyclists	Physical length (typical dimension)	96 in	2.4 m
Bicyclist with child trailer	Physical width	30 in	0.75 m
	Physical length	117 in	3.0 m
Hand bicyclist	Eye height	34 in	0.9 m
Inline skater	Sweep width	60 in	1.5 m

4.3.2 Key Performance Criteria

As with bicycle dimensions, bicyclist performance can vary considerably based upon operator ability and vehicle design. Table 4.2 lists various performance criteria for typical upright adult bicyclists as well as key performance criteria for other types of bicyclists.

Bicyclist speeds vary based on age and ability. Adults typically ride at 8-15 mph (15-25 km/h) on level terrain, while children ride more slowly. Experienced, physically fit riders can ride up to 30 mph (50 km/h); very fit riders can ride at speeds in excess of 30 mph (50 km/h) but will typically only ride at such speeds on roads.

Table 4.2: Key Performance Criteria For Different Types Of Bicyclists (AASHTO, 2012).

Bicyclist Type	Feature	Value	
		US Customary	Metric
Typical upright adult bicyclist	Speed, paved level terrain	8-15 mph	13-24 km/h
	Speed, downhill	20-30 plus mph	32-50 plus km/h
	Speed, uphill	5-12 mph	8-19 km/h
	Perception reaction time	1.0-2.5 s	1.0-2.5 s
	Acceleration rate	1.5-5.0 ft/s^2	0.5-1.5 m/s^2
	Coefficient of friction for braking, dry level pavement	0.32	0.32
	Coefficient of friction for braking, wet level pavement	0.16	0.16
	Deceleration rate (dry level pavement)	8.0-10.0 ft/s^2	2.4-3.0 m/s^2
	Deceleration rate for wet conditions (50-80% reduction in efficiency)	2.0-5.0 ft/s^2	0.6-1.5 m/s^2
Recumbent bicyclist	Speed, level terrain	11-18 mph	18-29 km/h
	Acceleration rate	3.0-6.0 ft/s^2	1.0-1.8 m/s^2
	Deceleration rate	10.0-13.0 ft/s^2	3.0-4.0 m/s^2

4.4 Elements of Design

The design of a bike lane must take into account existing traffic levels and behaviors, as well as adequate safety buffers to protect bicyclists from parked and moving vehicles, and enforcement to prevent motorized vehicle encroachment and double-parking. Color, lane markings, signage, and intersection treatments can all be used to distinguish bike lanes.

Surface condition significantly affects bicycle ride-ability. Pavement smoothness is important to bicyclist control and comfort. Gravel roads, loose material, cracks, bumps, and potholes on a paved roadway can pose severe steering and stopping limitations for bicyclists. Therefore, it is important to ensure that the roadway surface is in good repair.

4.4.1 Shared Lanes

Except where banned by law or regulation, bicycles are permitted to be used on any public roads. Most of the time, motor vehicles and cyclists use the same travel lanes. Shared lanes can be found everywhere, including on metropolitan roadways, suburban and rural highways, and tiny neighborhood streets.

Although shared lanes and roadways do not have bicycle-specific designs or dimensions, certain design elements can make shared lanes more bicycle-friendly. These include good pavement quality, sufficient sight distances and roadway designs that encourage slower speeds. Shared lanes are more bicycle-friendly when the signal timing is appropriate and there are detecting devices that react to cyclists. If such features are lacking, upgrades or retrofits should be carried out.

In general, roads with low traffic numbers and/or where traffic normally moves at low speeds may be acceptable for shared lanes in their current state. There is frequently no need for bike lanes or any other special modifications to make cycling more pleasurable and comfortable on these roads.

4.4.1.1 Shared lanes on major roadways

Lane widths of 13 feet (4.0 m) or less require most motor vehicles to be driven at least part way into the next lane to pass a bicyclist with an adequate and comfortable clearance (usually 3 ft [0.9 m] or more depending on the speed of the passing vehicle). Lane widths of 14 feet (4.3 m) or greater enable motorists to pass bicycles without encroaching into the adjacent lane. The usable lane width is normally measured from the center of the edge line to the center of the traffic lane line. Roadways with shared lanes narrower than 14 feet (4.3 m) may still be designated for bicycles with bicycle guide signs and/or shared lane markings (AASHTO, 2012).

4.4.1.2 Signs for shared roadways

A “Share the Road” sign assembly (W11-1 and W16-1P), shown in Figure 4-3, is intended to alert motorists that bicyclists may be encountered and that they should be mindful and respectful of them. However, the sign is not a substitute for appropriate geometric design measures that are needed to accommodate bicyclists. The sign may be useful under certain limited conditions, such as at the end of a bike lane, or where a shared use path ends and bicyclists must share a lane with traffic. A fluorescent yellow-green background can be used for this sign.

Figure 4-2: “Share The Road” Sign (W11-1 And W16-1p) (AASHTO, 2012)

Another sign that may be used in shared lane conditions is the "BICYCLES MAY USE FULL LANE" sign (R4-11) (shown in Figure 4-4). This sign may be used on roadways without bike lanes or usable shoulders where travel lanes are too narrow for cyclists and motorists to operate side by side within a lane.

Figure 4-3:“Bicycles May Use Full Lane” Sign (R4- 11)

Where wrong-way riding by cyclists is a frequent problem, a bicycle "WRONG WAY" sign and "RIDE WITH TRAFFIC" plaque (R5-1b and R9-3cP), that can be mounted back-to-back with other roadway signs (such as parking signs) to reduce sign clutter and minimize visibility to other traffic (shown in Figure 4-5). This sign assembly can be used in shared lane situations, as well as on streets with bike lanes and paved shoulders.

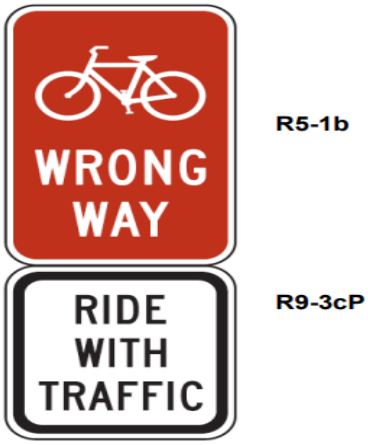

Figure 4-4: "Wrong way" And "Ride with traffic" Plaque

4.4.1.3 Marked shared lanes

In situations where it is desirable to provide a higher level of guidance to bicyclists and motorists, shared lanes may be marked with a pavement marking symbol. The symbol, known as the shared lane marking, is useful in locations where there is insufficient width to provide bike lanes. The marking also alerts road users to the lateral position bicyclists are likely to occupy within the traveled way, therefore encouraging safer passing practices. Shared lane markings may also be used to reduce the incidence of wrong-way bicycling.

4.4.2 Paved Shoulders

Adding or improving paved shoulders can greatly improve bicyclist accommodation on roadways with higher speeds or traffic volumes, as well as benefit motorists. Paved shoulders are most often used on rural roadways. Paved shoulders extend the service

life of the road by reducing edge deterioration, and provide space for temporary storage of disabled vehicles. Paved shoulders can benefit pedestrians as well by providing a place for

them to walk in locations where there is no sidewalk and the roadside is unsuitable for walking. Figure 4-6 shows paved shoulders dimensions.

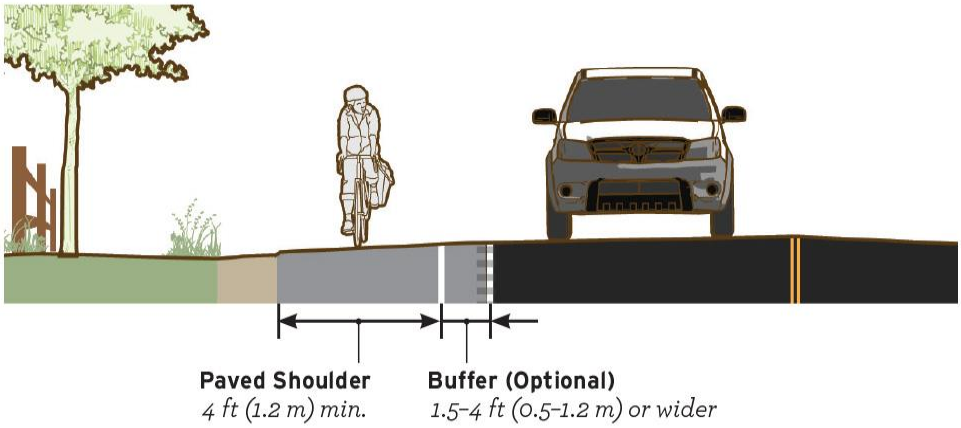

Figure 4-5: Paved Shoulders Dimensions (AASHTO, 2012).

- Paved shoulders should at least be 1.5 m from the face of guardrail, curb, or another roadside barrier.

- Where higher bicycle usage is expected it is desirable to increase the width of shoulders, or where vehicle speeds exceed 80 km/hr.

4.4.3 Bicycle lanes

Bicycle lanes are sections of the road that are designated for bicyclists to use first. They are typically one-way facilities that carry bicycle traffic in the same direction as adjacent motor vehicle traffic. Bike lanes are the most appropriate and preferred bicycle facility for urban and suburban thoroughfares. By installing bike lane symbol markings, paved shoulders can be designated as bike lanes.

Bike lanes enable bicyclists to ride at their preferred speed, even when adjacent traffic speeds up or slows down. Bike lanes also encourage bicyclists to ride on roadways in a position where they are more likely to be seen by motorists entering or exiting the roadway than they would be while riding on sidewalks.

4.4.3.1 Bicycle lane on two-way streets

Bike lanes should be provided on both sides of two-way streets as shown in Figure 4-7. A bicycle lane provided on only one side may invite wrong-way use.

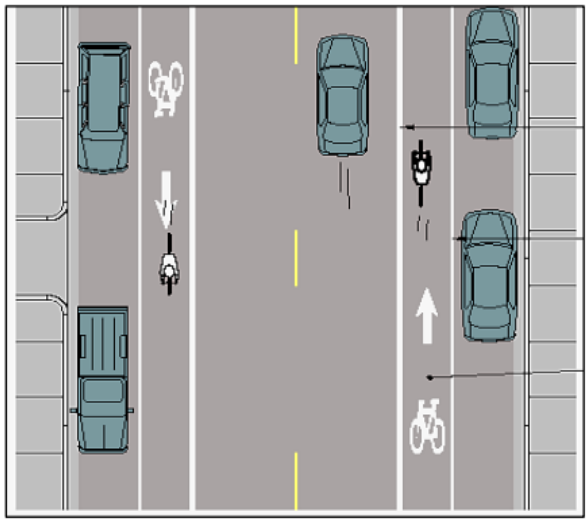

Figure 4-6: Bicycle Lanes On Two-Way Streets (AASHTO, 2012).

Exceptions can be made on streets with an appreciable grade. On streets where downhill grades are long enough to result in bicycle speeds similar to typical motor vehicle speeds, then a bicycle lane may be provided only in the uphill direction, with shared lane markings in the downhill direction (see Figure 4-8). This design can be especially advantageous on streets where fast downhill bicycle speeds have the potential to increase the likelihood of crashes with fixed objects, particularly in locations with on-street parking.

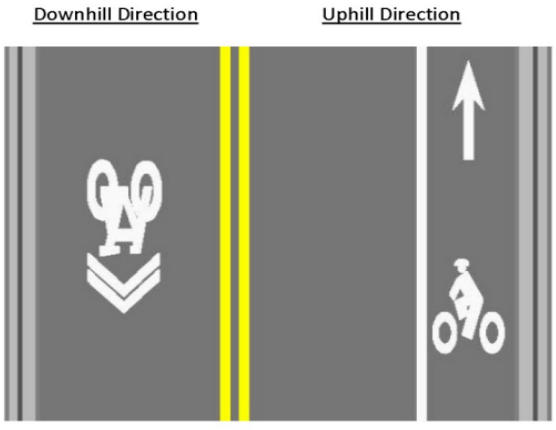

Figure 4-7: Bike Lanes In Downhill And Uphill Direction Streets (AASHTO, 2012).

4.4.3.2 Bicycle lanes on one-way streets

Bike lanes should normally be on the right-hand side of the roadway. However, a bicycle lane may be placed on the left if there are a significant number of lefts turning bicyclists or if it decreases conflicts.

On one-way streets, it is sometimes desirable to provide an exception for bicyclists by marking a contra-flow bicycle lane on the appropriate side, separated by a yellow centerline marking. This design is best used where there are few intersecting driveways and here bicyclist can safely and conveniently make transitions from the contra-flow lane as shown in Figure 4-9. Bicycle lane marking and directional arrows should be used on both the approach and departure of each intersection, to remind bicyclists to use the bike lane in the right direction and to remind motorists to expect two-way bicycle traffic.

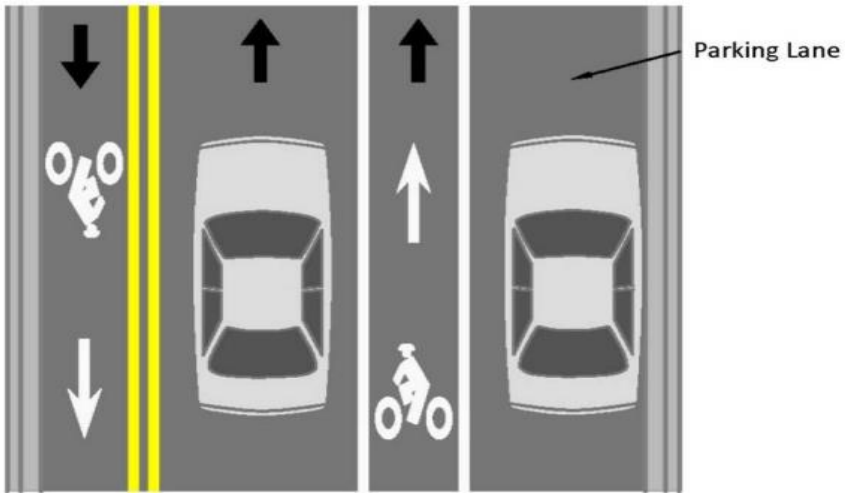

Figure 4-8: Typical Markings for One Way Street Designed for Two Way Bicycle Travel (AASHTO, 2012).

4.4.3.3 Bicycle lane widths

Bike lane widths should be determined by context and anticipated use. The speed, volume, and type of vehicles in adjacent lanes significantly affect bicyclists' comfort and desire for lateral separation from other vehicles. Bicycle lane widths should be measured from the center of the bicycle lane line. The appropriate width should take into account design features at the right edge of the bike lane, such as the curb, gutter, on-street parking lane, or guardrail.

Figures 4-10 and 4-11 show Typical Bike Lane Cross Sections when on-street parking is allowed and when its prohibited.

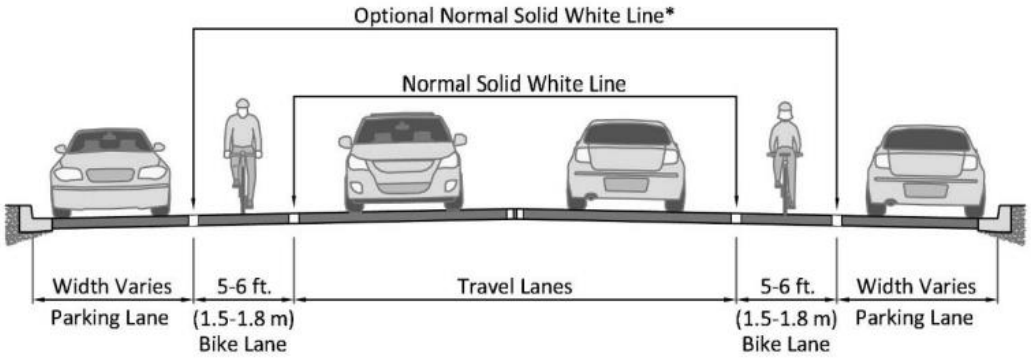

Figure 4-9: Typical Bike Lane Cross Sections When On-Street Parking Is Allowed (AASHTO, 2012).

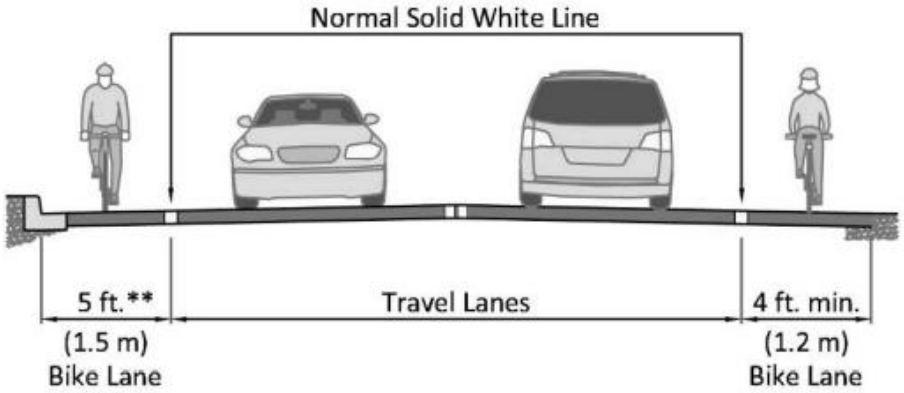

Figure 4-10: Typical Bike Lane Cross Sections When On Street Parking Is Prohibited (AASHTO, 2012).

* The optional normal (4 in-6 in/100-150 mm) solid white line may be helpful even when no stalls are marked (because parking is light), to make the presence of a bicycle lane more evident. Parking stall markings may also be used.

** On extremely constrained, low-speed roadways with curbs but no gutter (e.g. in locations with stone curbs), where the preferred bike lane width cannot be achieved despite narrowing all other travel lanes to their minimum widths, a 4-foot (1.2 m) wide bike lane can be used.

4.4.3.4 Bicycle lanes and on-street parking

When on-street parking is permitted, the bicycle lane should be placed between the parking lane and the travel lane. The recommended bicycle lane width in these locations is 6 feet (1.8 m) and the minimum bicycle lane width is 5 feet (1.5 m) (AASHTO, 2012). Care should be taken when providing wider bike lanes in areas where parking is scarce or otherwise in demand, as wider bicycle lanes may result in more double parking.

Bike lanes at the same level as the street and without physical separation should generally not be placed between the parking lane and the curb. Such placement reduces visibility at driveways and intersections, increases conflicts with opening car doors, complicates maintenance, and prevents bicycle lane users from making vehicular left turns.

4.4.4 Bicycle lane signs and markings

Bicycle lanes are designated for preferential use by bicyclists with a normal solid white line (4 to 6-inch or 100-150mm wide) and one of the (two) standard bike lane symbol markings, which may be supplemented with the directional arrow marking.

4.4.4.1 Bicycle lane lines

A bike lane should be delineated from the motor vehicle travel lanes with a normal solid white line. Bike lane lines can be dotted at locations where there will be frequent merging activity by bicyclists or motorists across the lane line. Bike lanes can also be dotted at bus stops or bus pullouts. Bicycle lane lines should remain solid and not dotted at signalized driveways and alleys.

Raised pavement markers, curbs, posts, or barriers should not be used to separate bicycle lanes from adjacent travel lanes. Raised devices are hazardous to bicyclists because they are fixed objects immediately adjacent to the travel path of the bicyclist. In addition, raised devices can discourage or prevent right-turning motorists from merging into the bicycle lane before turning. Raised devices can also make it more difficult to maintain the bicycle lane.

A normal solid line can be used to indicate the outside edge of the bike lane in locations with no curbs or where the edge of the roadway is poorly defined. Figure 4-12 shows the bicycle lane line types.

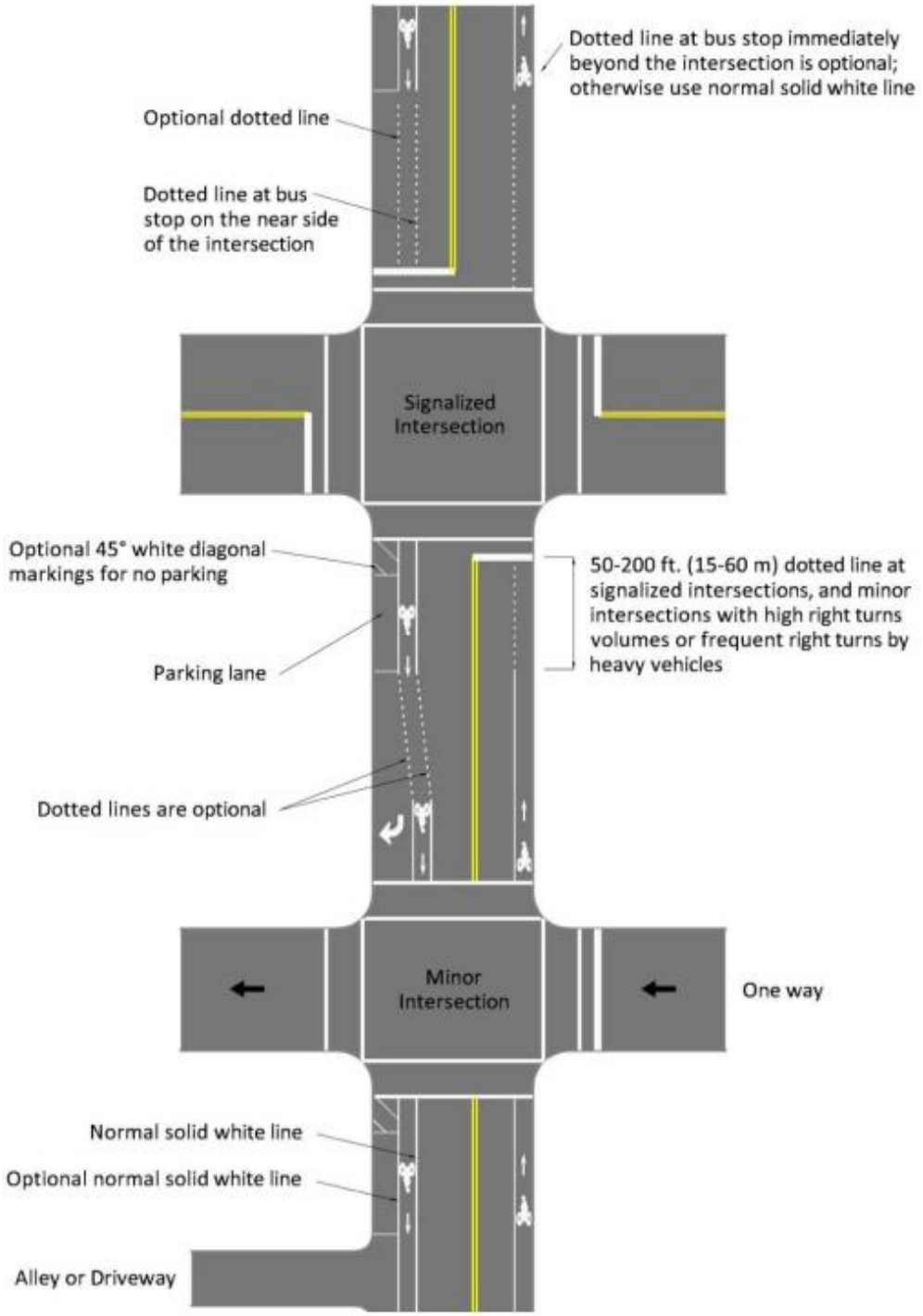

Figure 4-11: Typical Bike Lane Pavement Markings (AASHTO, 2012).

4.4.4.2 Bicycle lane markings

A bike lane should be marked with standard bike lane markings to inform bicyclists and motorists of the restricted nature of the bike lane. Markings should be placed after each intersection or signalized driveway. Supplementary markings may also be placed in a visible location on a bike lane that is entering the intersection (prior to the crosswalk), to remind bicyclists not to enter the bike lane on the wrong side of the road. However, in urban areas with short block lengths, this may result in an overabundance of bicycle lane markings. In general, due to the complexity of urban streets, flexibility is necessary in placing bicycle lane markings. Figure 4-13 shows bike lane symbol markings.

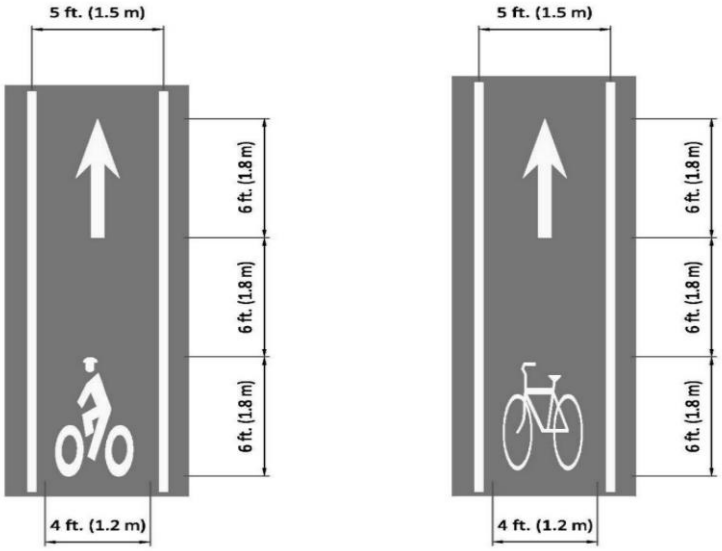

Figure 4-12: Bike Lane Symbol Markings (AASHTO, 2012).

Care should be taken to avoid placing symbols in areas where turning motor vehicles would damage or obliterate the markings, e.g. at driveways and the area immediately adjacent to an intersection. Figure 4-14 shows an example of symbol Placement to Avoid Premature Wear.

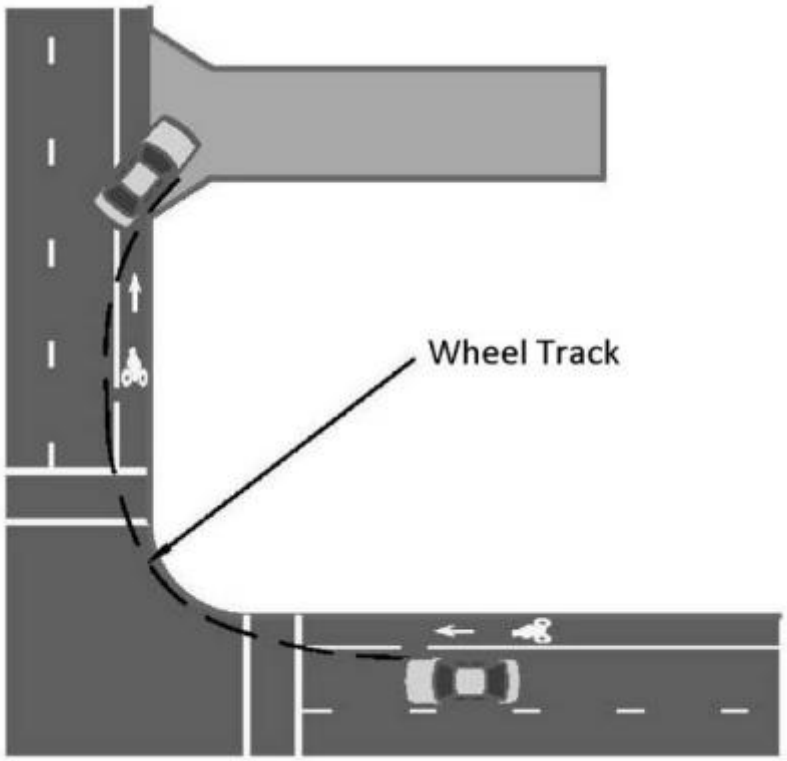

Figure 4-13: Symbol Placement To Avoid Premature Wear (AASHTO, 2012).

4.4.4.3 Bicycle lane signs

Bicycle lane markings are typically the primary indication to motorists and bicyclists of the restricted nature of bike lanes. Signs may be used to supplement bicycle lane lines and markings; however, they are less effective on streets with on-street parking.

Bike lane signs may also be placed as needed at periodic intervals along a bicycle lane. Spacing of the sign should be determined by engineering judgment based on prevailing speed of bicycle and other traffic, block length, distances from adjacent intersections, and other considerations. Bike lane markings are typically used more frequently than bike lane signs. Where the bike lane sign is used, however, it should generally be placed adjacent to a bike lane pavement marking. Figure 4-15 shows the bicycle sign symbol.

Figure 4-14: Bicycle Lane Sign (AASHTO, 2012).

4.4.5 Obstruction Marking

Barriers and obstructions, such as abutments, piers, rough grates, and other features constricting a bikeway should be clearly marked to gain the attention of approaching bicyclists. This treatment should be used only where the obstruction is unavoidable, and should not substitute for good bikeway design; removing the obstruction is preferred.

Signs, reflectors, diagonal yellow markings, or other treatments may also be appropriate to alert bicyclists to potential obstructions.

4.4.6 Traffic signs

This section gives an overview of requirements on signage and marking to support cycling, both for dedicated cycling infrastructure and for cyclists' general use of the highway. Traffic signs are classified into three general classifications:

- Regulatory signs.
- Warning sign.
- Guidance (way finding) signs.

The same sign may combine more than one function and some signs for cyclists fall into this category. It is important to understand these multiple roles, particularly where one is regulatory and requires enforcement.

4.4.6.1 Regulatory signs

Regulatory signs inform pathway (and roadway) users of local regulations. A sign of this type is placed at or near the location where the regulation applies. Regulatory signs are usually rectangular and have white backgrounds with black text and symbols.

Regulatory signs are essential for enforcing the provision of safer, more comfortable cycling infrastructure. Signs and markings for warning, information, and route guidance should be used sparingly to avoid adding to street clutter. It is almost always preferable to convey this information through environmental cues rather than formal signs; for example, cycling facilities that look like cycling facilities are preferable to shared infrastructure with pedestrians.

4.4.6.2 Warning signs

Warning signs are used to notify road and pathway users of unexpected conditions that might require a reduction of speed or other action necessary for safety. Use perceived as excessive or unnecessary can result in disrespect for other important signs. Warning signs should not be placed too far in advance, such that path users tend to forget the warning because of other distractions.

Warning signs are utilized to notify road and pathway users of unexpected conditions that might require a reduction of speed or other action necessary for safety. A warning sign should be used, for example, where pathway width must be reduced in a short section because of a constraint. However, warning signs should be used sparingly; use perceived as excessive or unnecessary can result in disrespect for other important signs.

For advance warning sign placements on shared use paths, the sign should be placed to allow adequate perception-response time. The location of the sign should be based on the stopping sight distance needed by the fastest expected path user; however, in no instance should the sign be located closer than 100 feet (30 m) from the location warranting the advance warning. Warning signs should not be placed too far in advance of the condition, such that path users tend to forget the warning because of other distractions. Figure 4-18 shows examples on Warning Signs considering bicycles.

Figure 4-15: Warning Signs Considering Bicycles (AASHTO, 2012).

4.4.6.3 Guide signs

Road name/path name signs (D3-1 and W16-8P) shown in Figure 4-20 and Figure 4-21 respectively, should be placed at all path-roadway crossings. This helps path users track their locations. At midblock crossings the D3-1 sign may be installed on the same post with a regulatory sign, above the stop or yield sign. Guide signs to indicate directions, destinations, distances, route numbers, and names of crossing streets should be used in the same manner as on roadways.

Figure 4-16: D3-1 Guide Sign (AASHTO, 2010).

Figure 4-17: W16-8P Guide Sign (AASHTO, 2012).

4.5 Grade

For pathways adjacent to roads (side paths), pathway grade should generally match the grade of the adjacent roadway. Grades on shared use paths in independent corridors should be kept to a minimum, especially on long inclines. Grades greater than 5 percent are undesirable because the ascents are difficult for many path users, and the descents cause some users to exceed the speeds at which they are competent or comfortable. In addition, because shared use paths are generally open to pedestrians, Grades on paths should be limited as follows:

- 5% maximum for any distance.
- 8.3% maximum for up to 200 feet (61 m).
- 10% maximum for up to 30 feet (9 m).
- 12.5% for up to 10 feet (3 m).

4.6 Bike Parking Lot Dimensions

When designing a layout that will create a bike parking lot, consisting of multiple columns of bike racks, one key is to ensure there is a usable aisle between the rows of racks. This will let cyclists easily flow into and out of the bike parking area and racks specifically. Figure 4-19 shows a Bike Parking Lot Layout with Minimum and Recommended dimensions.

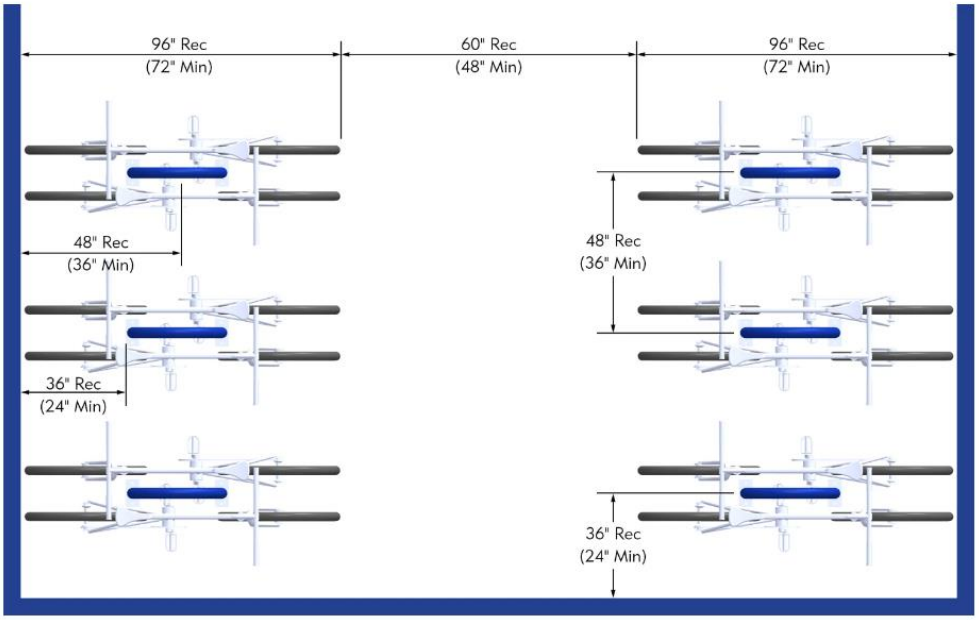

Figure 4-18: Bike Parking Lot Layout with Minimum and Recommended Dimensions (Bike Parking Guide).

- **Bike Parking Lot Layout with Rows & Columns**

Occasionally a bike parking design will need to have columns and rows of bike racks. Again, having appropriate space for aisles will be important for having a useful layout.

Use the same setbacks of 24" - 36" from perpendicular walls and 24" - 36" from parallel walls to begin placing the racks. Along with 36" - 48" between racks.

The measurement you'll want to focus on is between the racks with different orientations. There should be a recommend 108" (96" minimum) between the nearest leg of bike rack to the center of the other bike rack. The following figure shows a Bike Parking Lot Layout with Rows & Columns.

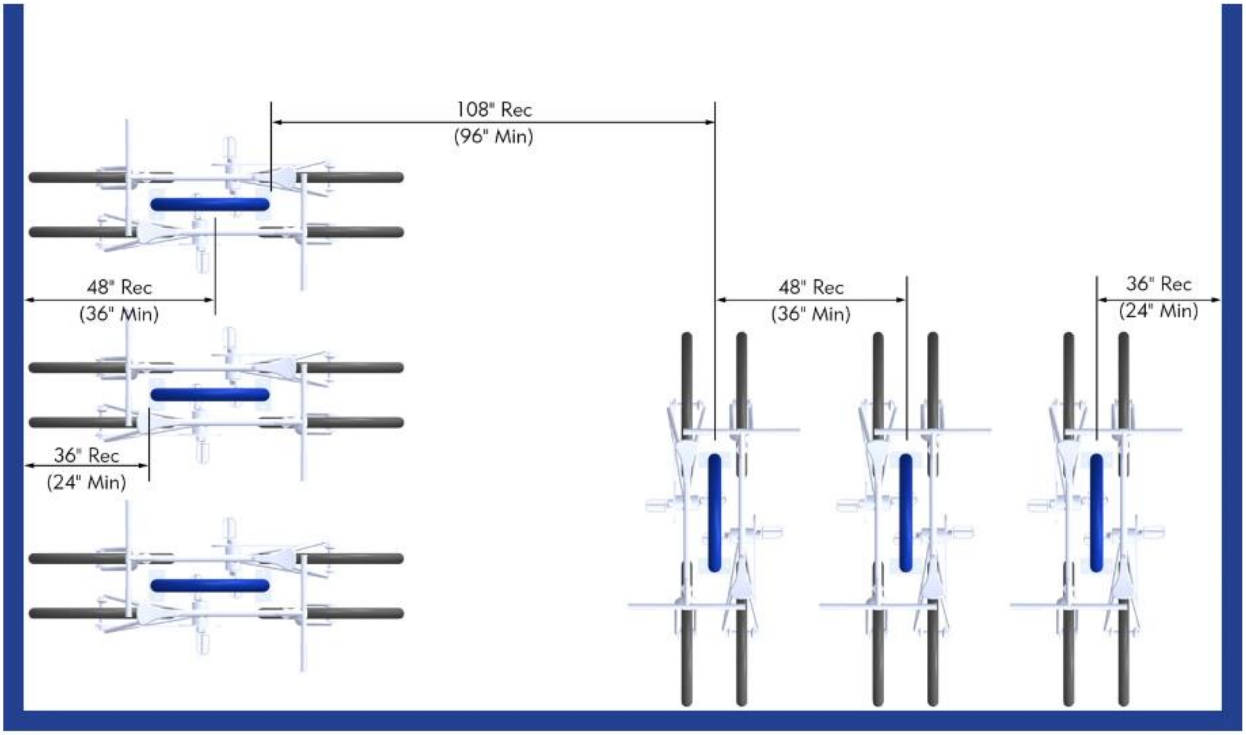

Figure 4-19: Bike Parking Lot Layout with Min. and Rec. dimensions (Bike Parking Guide).

Units' conversion:

Inch	96	72	60	48	36	24
Meter	2.4	1.8	1.5	1.2	0.9	0.6

CHAPTER 5: DATA ANALYSIS

In this chapter all data obtained, questionnaire, inventory study, and traffic volume was analyzed.

5.1. Questionnaire Analysis

When analyzing the results of the questionnaire, it was found that most students who are interested in bicycles, and considered as a transport method, study on the new campus, as shown in Figure 5-1.

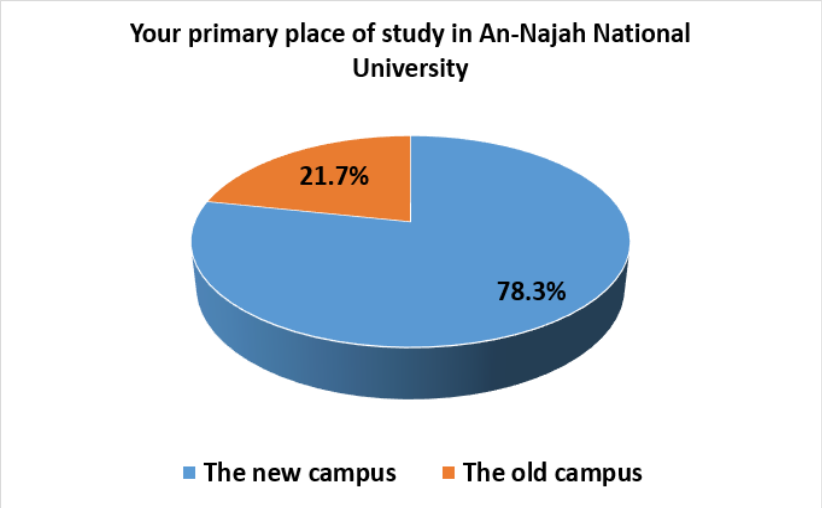

Figure 5-1: Percentage of Students Studying in The New and Old Campuses (Al-Tanbour and Juma, 2022)

As shown in Figure 5-2, a small percentage of students have a car, and this leads us to take great interest in designing a bike network according to safety standards, and to be considered the fastest and cheapest method compared to other methods.

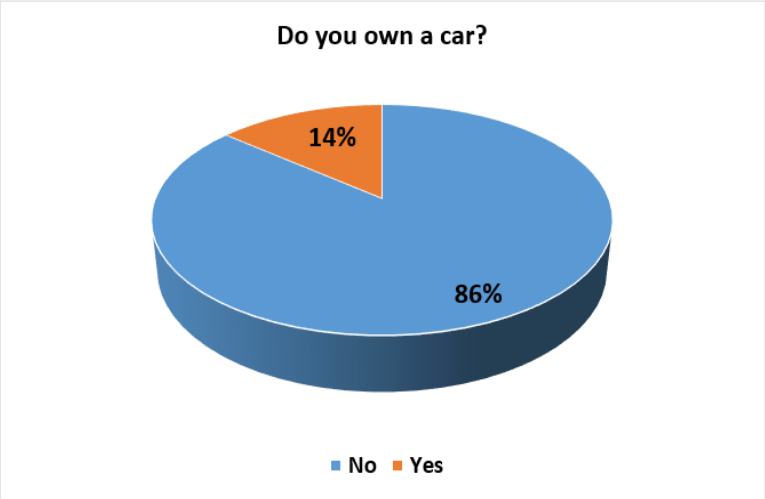

Figure 5-2: Percentage of Students Who Own Cars (Al-Tanbour and Juma, 2022).

Figure 5-3 shows, the percentage of students who have bikes is very low, but as Figure 5-4 shows, the percentage of students who use vehicles (private or public) is high, and this indicates the percentage of pollution in the air is high, so the design of the network will encourage students to use bike instead of other methods of transportation, in addition to improving air quality and reducing pollution.

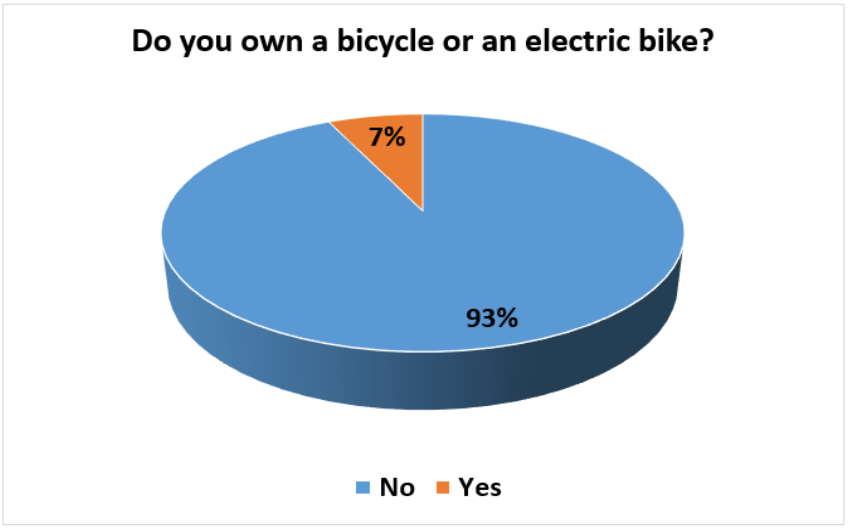

Figure 5-3: Percentage of Students Who Own Bicycles or Electric Bikes (Al-Tanbour and Juma, 2022).

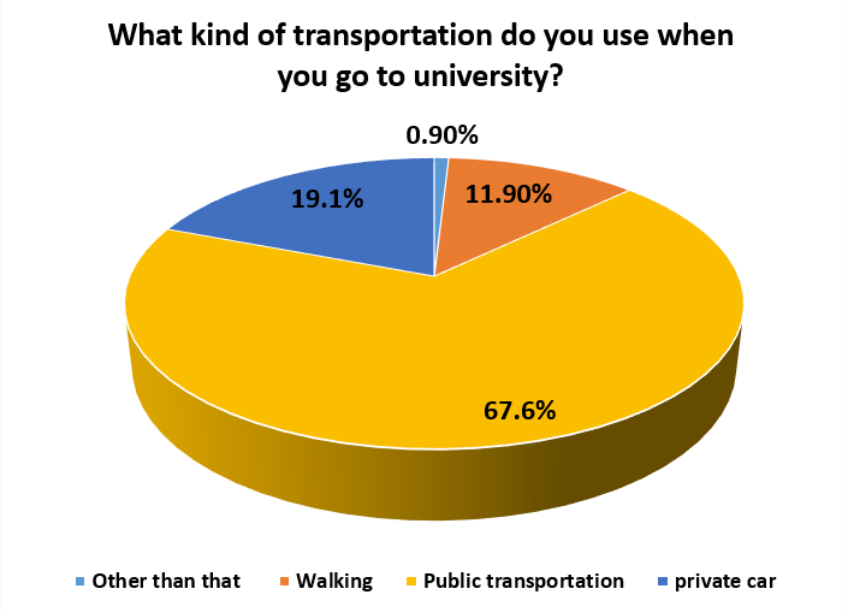

Figure 5-4: Percentage of Each Type of Transportation Students Use (Al-Tanbour and Juma, 2022).

Students' feelings of safety when riding bikes are shown in Figure 5-5. As a result, was design a network that satisfies with all security and safety requirements.

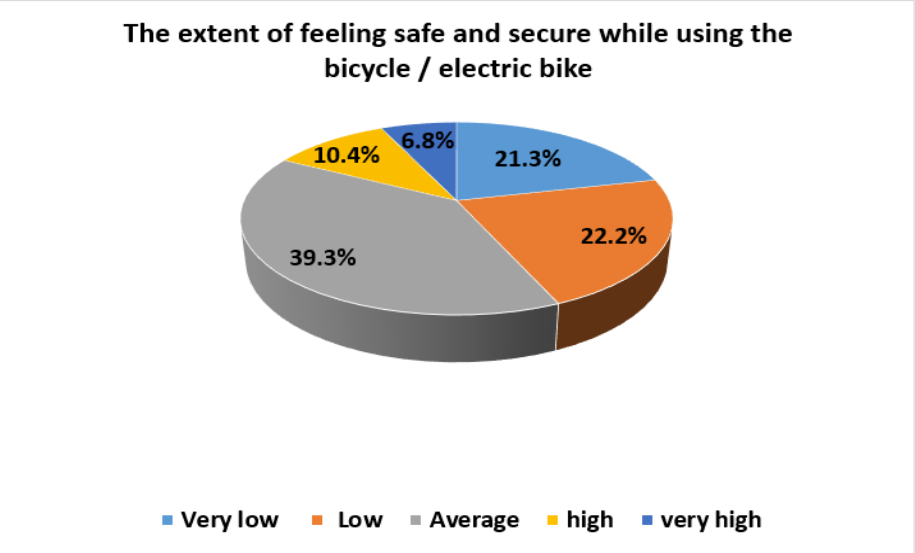

Figure 5-5: The Percentage of Students That Feel Safe While Using Bicycles (Al-Tanbour and Juma, 2022).

As Figure 6.6 shows, about the willingness of students to use bikes, after the execution of the network, that connects the campus, and the center of the city, down to the Eastern Public

Transport Complex. The ratio was 37.8% and it is a good indicator of the success of this project.

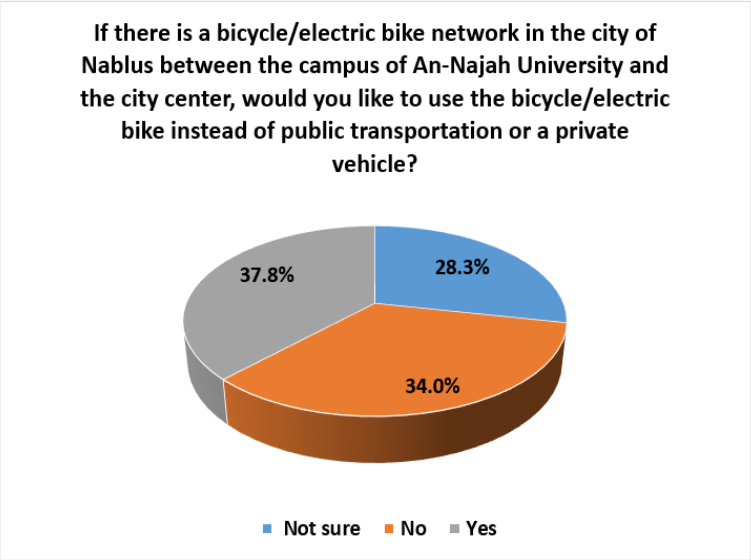

Figure 5-6: Percentage of Students That Are Willing to Use Bicycles (Al-Tanbour and Juma, 2022).

5.2. Traffic Volume Analysis

One of the objectives of the project is to investigate whether adding a bike network will reduce traffic volume and improve the level of service of the street or not. For this purpose, the reduction ratio has been calculated as will be shown in section 5.2.1, as well as the level of service for the street has been determined by using the Synchro software as shown in 5.2.2.

5.2.1. Effect of Using the Bike network in Reducing Traffic volume

To reach this objective and to calculate the amount of traffic reduction expected after the design of the bicycle network, the classification of vehicles was collected during the traffic count study, as well as the questionnaire showing the number of students wishing to use the bike network. Thereafter, the reduction rate per hour was calculated, and the following assumptions were used:

- The peak hour for traffic volume from 3:00-4:00 PM, was used to calculate the %reduction.
- Number of students who will use the bike network is 912 students.
- Each taxi car can accommodate 4 persons, and buses for 50 persons.

As a sample calculation for Rafidia - Tunis Intersection:

- Assume that an 84% of the students - 766 students - who used a taxi car, and a 16% of them -146 students - who used a bus.
- Number of taxi reduced = 766/4 =192 Taxi, and No. of buss = 146/50 = 3 buss.
- As shown in Table 5-1 on the peak hour, total no. of Taxis = 655, then, expected no. of taxis after adding a bike network = 655 -192 = 463 taxis,
  % of reduction = 192/655=29.3%, and for buss = 3/5= 60%
  Total % of reduction = (192+3)/ Grand total = 7.38%

Tables from 5-1 to 5-5 show the reduction ratios for each intersection that included in the traffic volume study.

Table 5. 1: Reduction Ratio For Rafidia - Tunis Intersection

Grand Total	Total No. of:		Expected No. After design for:		% of reduction for:		Total % of reduction
	Taxi	Bus	Taxi	Bus	Taxi	Bus	
2643	655	5	463	2	29.31	60.00	7.38

Table 5. 2: Reduction Ratio For Al- Malek Faisal Street (National Hospital)

Grand Total	**Total No. of:**		**Expected No. After design for:**		**% of reduction for:**		**Total % of reduction**
	Taxi	Bus	Taxi	Bus	Taxi	Bus	
3896	**861**	7	**669**	**4**	**22.30**	42.86	5.01

Table 5. 3: Reduction Ratio For Rafidia - Omar Ibn Al Khattab.

Grand Total	**Total No. of:**		**Expected No. After design for:**		**% of reduction for:**		**Total % of reduction**
	Taxi	Bus	Taxi	Bus	Taxi	Bus	
2255	**564**	5	**372**	**2**	**34.04**	60.00	8.65

Table 5. 4: Reduction Ratio For Al- Ameer Mohammed - Yaffa intersection.

Grand Total	**Total No. of:**		**Expected No. After design for:**		**% of reduction for:**		**Total % of reduction**
	Taxi	Bus	Taxi	Bus	Taxi	Bus	
2943	**1001**	2	**809**	**2**	**19.18**	150.00	6.63

Table 5. 5: Reduction Ratio For Ghernatah - Omar Ibn Al Khattab Intersection.

Grand Total	Total No. of:		Expected No. After design for:		% of reduction for:		Total % of reduction
	Taxi	Bus	Taxi	Bus	Taxi	Bus	8.34
2338	**914**	0	**722**	**2**	**21.01**	#DIV/0!	

In addition, a 5% reduction of the traffic volume was assumed from people who will be attracted to the bike network.

5.2.2. Effect of Using the Bike network in Improve the LOS, Using Synchro Software Analysis

Synchro software was used to represent the existing network before and after the addition of a bike network. Building on previous projects in 2011 that represented the network on Synchro, the geometry of the roads, number of lanes, and their dimensions were reviewed as well as the new roads constructed were drawn.

Subsequently, the traffic count data collected at 5 major intersections for 2023, was added.

About the minor intersections, for which data weren't collected for 2023, the traffic volume was predicted based on previous data, using a simple growth equation as the following:

Future Traffic = Present Traffic $(1 + \text{i})^n$

Where: *i= annual growth rate for a motor vehicle = 2.2%*

n=number of years =12 year

Therefore, the reduction ratio calculated after the design of the bike network at each intersection was multiplied to the traffic volume., and a growth factor = 0.95 was multiplied for all network, this represent the reduction of traffic volume from people who will be attracted to the system. Finally, LOS was collected then compared with LOS before adding a bike network. Tables 5.6 to 5.9 show the level of service and delays for intersections before and after adding a bike network.

NOTE: The symbol (-) means that the value is very large and the Synchro software can't analyze it.

Table 5.6: LOS And Delay For Rafedya Street Intersections, Before And After Adding A Bike Network.

Rafedya Street												
Intersection #		1	2	3	4	5	6	7	8	9	10	11
Before	LOS (ICU)	F	A	F	D	H	H	A	A	A	D	D
	Delay	-	4.2	75	-	-	-	8.9	2	10	-	35
After	LOS (ICU)	F	A	D	C	G	H	A	A	A	C	B
	Delay	-	3.5	42	-	-	-	3	0	8	-	13
Intersection #		12	13	14	15	16	17	18	19	20	21	22
Before	LOS (ICU)	F	F	H	B	H	A	F	F	F	F	F
	Delay	203	-	-	13	-	1.3	-	-	-	-	-
After	LOS (ICU)	F	E	H	A	H	A	F	F	F	B	F
	Delay	146	-	-	9.7	-	0.9	-	-	-	13	300

Table 5. 7: LOS And Delay For Yafa Street Intersections, Before And After Adding A Bike Network.

Yafa Street									
Intersection #		1	2	3	4	5	6	7	8
Before	LOS (ICU)	E	D	G	F	A	H	F	H
	Delay	58.1	-	-	117.5	-	-	-	-
After	LOS (ICU)	B	A	E	A	A	G	A	H
	Delay	15.4	-	-	8.4	-	-	-	-

Table 5. 8: LOS And Delay For CBD Area Intersections, Before And After Adding A Bike Network.

CBD Area												
Intersection #		1	2	3	4	5	6	7	8	9	10	11
Before	LOS (ICU)	C	H	H	E	E	F	C	B	A	A	A
	Delay	-	-	-	-	-	131	30.2	-	-	-	-
After	LOS (ICU)	B	G	G	D	D	E	C	A	A	A	A
	Delay	-	-	-	-	-	73.4	23.5	-	-	-	-
Intersection #		12	13	14								
Before	LOS (ICU)	A	D	H								
	Delay	-	43.1	-								
After	LOS (ICU)	A	C	G								
	Delay	-	21	-								

Table 5. 9: LOS And Delay For Faisal Street Intersections, Before And After Adding A Bike Network.

Faisal Street												
Intersection #		1	2	3	4	5	6	7	8	9	10	11
Before	LOS (ICU)	B	B	D	E	F	A	F	A	B	B	H
	Delay	11.8	-	-	-	93.4	0.2	214.6	-	-	12.1	-
After	LOS (ICU)	B	F	F	D	E	A	F	A	A	B	C
	Delay	11.8	-	-	-	71.8	0.2	155.5	-	-	11.2	-
Intersection #		12	13	14	15	16						
Before	LOS (ICU)	H	B	H	B	F						
	Delay	-	16.3	-								
After	LOS (ICU)	H	F	H	H	E						
	Delay	-	13	-								

In general, the level of serves is improved after adding a bike lane, this duo to reducing the number of vehicles, but at some intersection, LOS was decreased, this is duo to reducing the lane width at these intersections.

5.3. General Design Considerations.

After studying the network and collection of the necessary data, dimensions for each element of the street, and the traffic volume, the most suitable locations of the bike lanes was selected according to AASHTO Standards.

The bike lane was drawn on an aerial photography using Geomolg site. Several sections were taken where the geometry of the street elements is changing. The distributing and the type of bike lane was selected, depending on the travel and parking lane width.

An on street parking lane width (2.1 – 2.8) m for parallel parking is used, and the travel lane 3.6 m is preferable, and min. width is 3m. Otherwise, the shared lane was used.

5.4. Allocating Bicycle Lanes along the Streets

5.4.1. Bicycle Lanes along Yasser Arafat Street

Several sections were taken along the street where the geometry changes.

❖ Section 1: Al- Junaid Street

This section characterized by the high number of pedestrians, which is located in front of An-Najah National University, so the width of sidewalk must not be less than 2.5 meters.

Since the width of the road is sufficient to accommodate a Bike Lane (BL), a 1.5 m-wide lane is added on each direction with a 0.3 m separation line between the bike and the vehicle lanes. Table 5.10 shows the width of the street element with a BL. Figure 5-7 shows the distribution of the street elements with a BL.

Table 5. 10: Dimensions Of The Street Elements with a BL at Al-Junaid Street

Section#	SW (m)	BL (m)	TL (m)	M (m)	TL (m)	BL (m)	PL (m)	SW (m)	ROW (m)
1	2.5	1.5	8.8	3	7.1	1.5	2.2	3.5	30.1

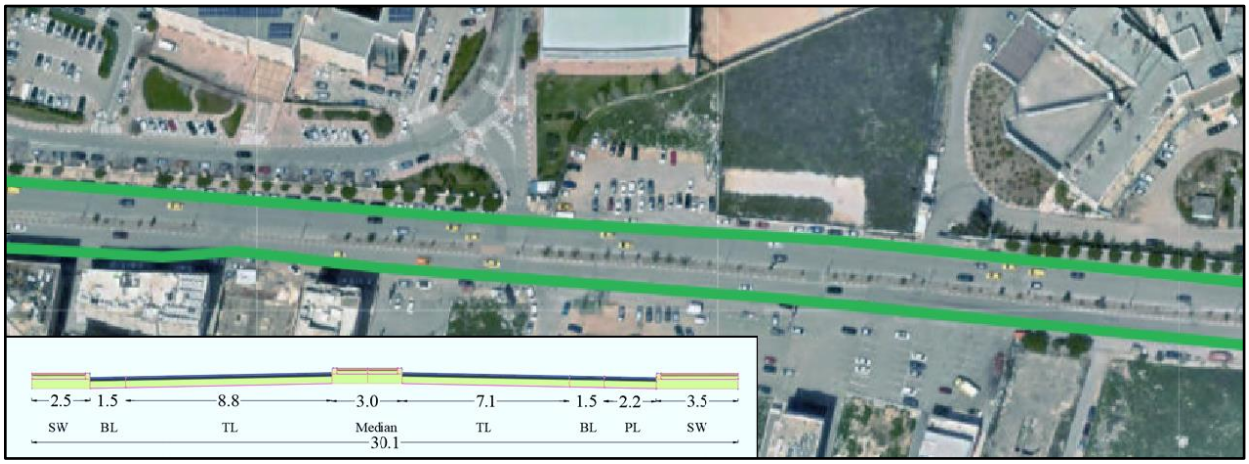

Figure 5-7: Distribution of Al Junaid Street Elements with a BL

❖ Section No. 2: Rafedia Street at Gift Corner Shop

This section also has a large number of pedestrians, so the width of sidewalk shouldn't be less than 2.25 meters.

The width of the north bound lane is 3.5, less than 4 meters. According to AASHTO, a bike lane couldn't be added. as a result, a share lane will be use for the vehicles and bicycles.

On the south bound lane, the width is 4.6 m, and it's justified to add a 1.5m wide bike lane with a 0.3m separation between the bike and the vehicle lanes. Table 5.11 show the width of the street element with a BL. Figure 5-8 show the distribution of the street elements with a BL.

Table 5. 11: Dimensions Of The Street Elements With a BL For Rafedia Street Section 2.

Section#	SW (m)	PL (m)	TL (m)	TL (m)	BL (m)	PL (m)	SW (m)	ROW (m)
3	2.25	1.9	3.5	3.1	1.5	1.9	2.25	16.4

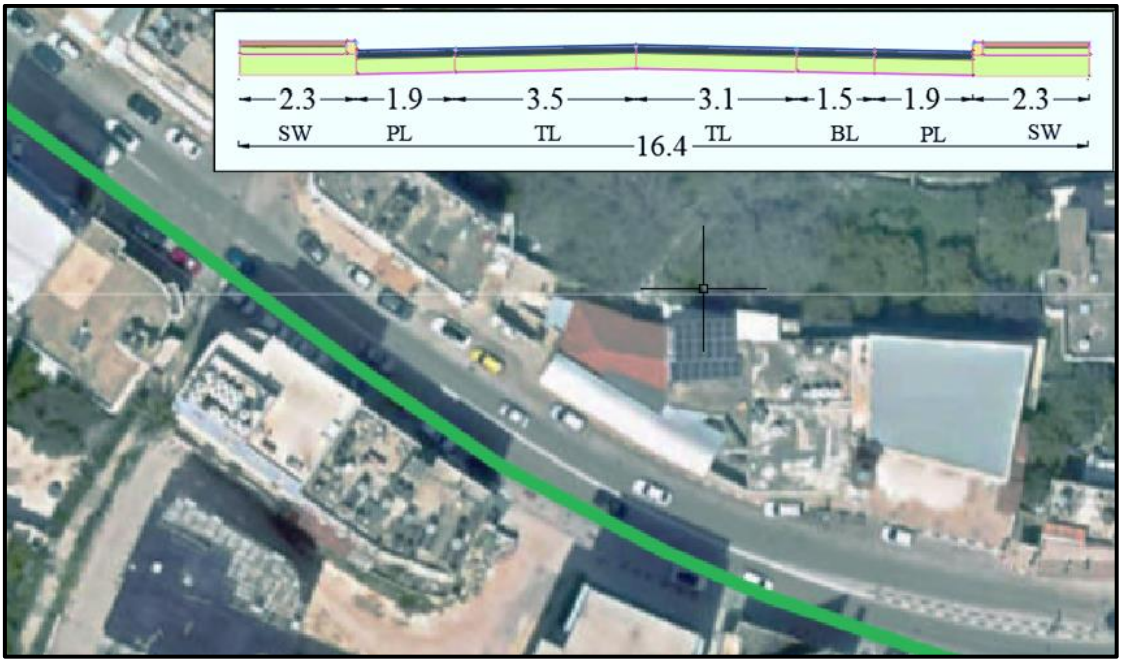

Figure 5-8: Distribution Of Rafedia Street Elements With a BL, Section No.2

5.4.2. Bicycle Lanes along Rafedia Street

❖ Section 1: Rafedia Street at Shamia Ice Cream Shop

The width of the road is greater than 4.5m on each direction, and this allows to added a bike lane in both side. Table 5-12 shows the width of the street element with a BL. Figure 5-9 shows the distribution of the street elements with a BL.

Table 5. 12: Dimensions Of The Street Elements With a BL for Rafedia Street Section No.1

Section#	SW (m)	PL (m)	BK (m)	TL (m)	TL (m)	BL (m)	PL (m)	SW (m)	ROW (m)
4	3.5	1.7	1.5	5.2	3	1.5	1.7	1.5	19.6

Figure 5-9: Distribution Of Rafedia Street Elements With a BL, Section No.1

❖ Section 2: Rafedia Street at Ibn Qutaiba School

In this section, the width of the road is 11.3 meters, sufficient to accommodate a BL in one direction, with a width of 1.5 m. Table 5.13 shows the width of the street element with a BL. Figure 5-10 shows the distribution of the street elements with a BL.

Table 5. 13: Dimensions Of Rafedia Street Elements With a BL - Section No.2

Section#	SW (m)	PL (m)	TL (m)	BL (m)	PL (m)	SW (m)	ROW (m)
5	**4.8**	**3.7**	**9.8**	**1.5**	**1.8**	**3**	**24.6**

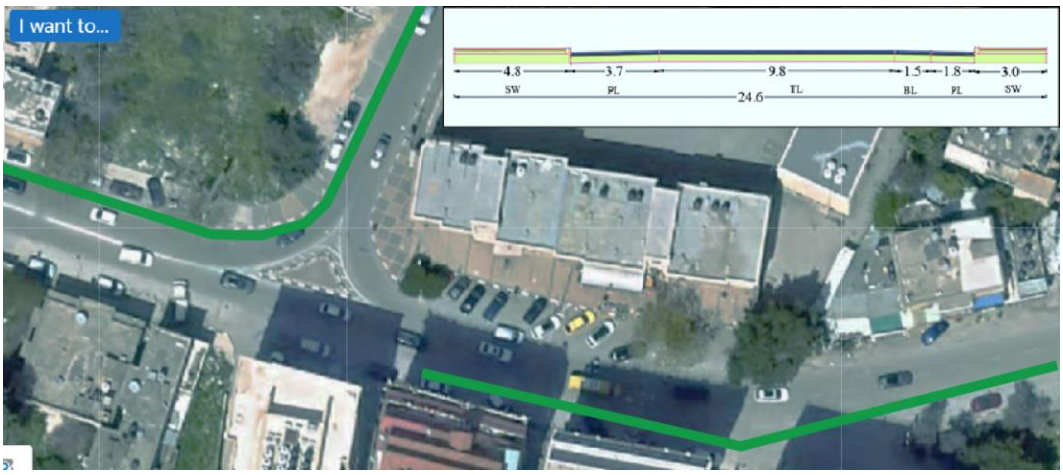

Figure 5-10: Distribution Of Rafedia Street Elements With a BL, Section No.2

❖ Section 3: Nablus Municipality Sports Stadium

The width of the road is 11.6 m, a bike lane is allocated in each direction with a width of 1.5 m. Table 5.14 and Figure 5-11 show the width and distribution of the street element with a BL.

Table 5. 14: Dimensions Of The Street Elements With a BL For Rafedia Street Section No.3

Section #	SW (m)	TL (m)	BL (m)	PL (m)	SW (m)	ROW (m)
6	2.5	10.1	1.5	2	2.9	19

Figure 5-11: Distribution Of Rafedia Street Elements With a BL, Section No.3

5.4.3. Allocating The Bicycle Lanes Along Omar Ibn Al-Khattab Street

Omar Ibn Al-Khattab Street has almost the same characteristics in section 1,2 and 3, consisting of a two lanes, each lane has a width of 3.3 to 3.6 m, with a sidewalk on both sides. As a result, the bike lane couldn't be added and the path is shared between vehicles and bicycles.

5.4.4. Allocating The Bicycle Lanes along Ghernatah Street

Ghernatah Street is characterized by high traffic and population regularity, being close to the city center. As a result, the bike lane couldn't be added and the path is shared between vehicles and bicycles. Figure 5-13 shows the width and distribution of the street element with a BL.

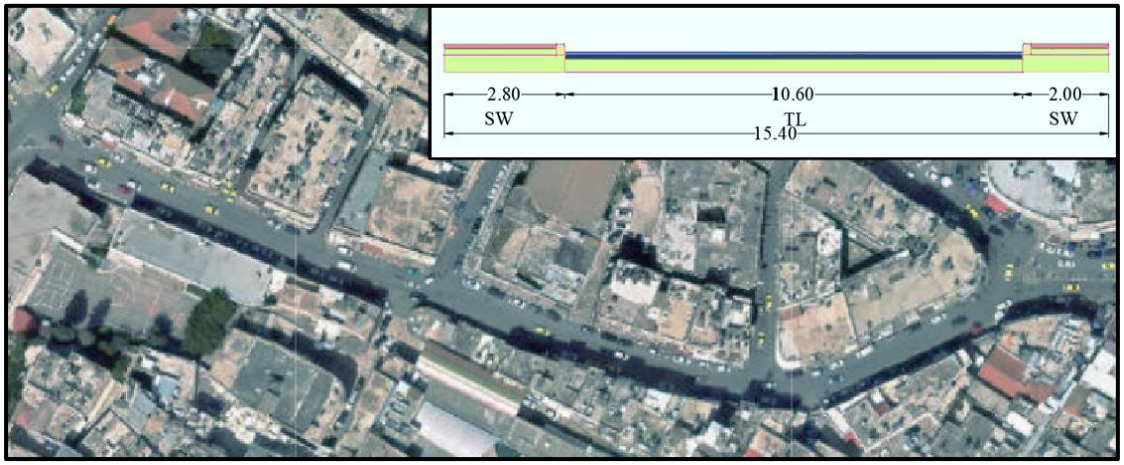

Figure 5-12: Ghernatah Street, Cross-Section Of The Street Elements.

5.4.5. Allocating The Bicycle Lanes along Palestine Street

Palestine street consists of one lane – one way, lane width is 4.8m, since a 1.5 m wide bike lane can be allocated. Table 5.15and figure 5- 14 shows the width of the street element with a BL.

Table 5. 15: Dimensions Of The Street Elements With a BL For Palestine Street

Section #	SW (m)	PL (m)	TL (m)	BL (m)	PL (m)	SW (m)	ROW (m)
1	2.4	2.2	3.3	1.5	2.5	1.7	13.6

Figure 5-13: Distribution Of Palestine Street Elements With a BL

5.4.6. Allocating The Bicycle Lanes along Al-Shwetreh Street

Al- Shwetreh Street is connecting the city center to Rafidia Street, it consists of two lanes – one way, the width of the two lane is 7.8 m. A 1.5 m wide bike lane can be allocated for one-way travel. Table 5.16 and Figure 5-15 show the width and distribution of the street element with a BL.

Table 5. 16: The Width Of Al-Shwetreh Street Elements with a BL.

Section#	SW (m)	PL (m)	BL (m)	TL (m)	PL (m)	SW (m)	ROW (m)
1	2	2.25	1.5	6.3	2.25	2	16.3

Figure 5-14: Distribution Of Al-Shwetreh Street Elements With a BL

5.4.7. The City Center Area

In city center area, it is considered one of the most crowded areas, so it was difficult to allocate special lane for bicycles, except in one section.

❖ Section 1- Faisal Street:

This street consists of 4 lanes on the westbound direction, and a 3 lanes in eastbound direction. A bike lane can be added in both directions; the dimensions of each element are shown in the following table.

Table 5. 17: Dimensions Of Faisal Street Elements With a BL.

Section#	SW (m)	BL (m)	TL (m)	Median (m)	TL (m)	BL (m)	SW (m)	ROW (m)
1	3	1.5	11.8	4.8	10.5	1.5	3	36.1

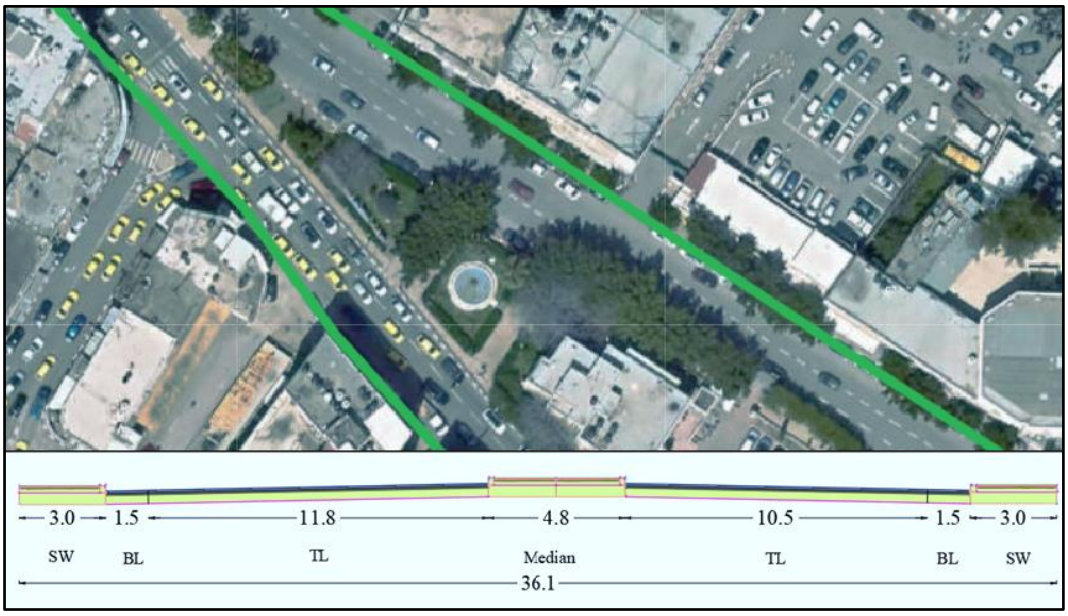

Figure 5-15: Faisal Street, Dimension Of The Street Elements With A Bike Lane

CHAPTER 6: DESIGN OF THE BIKE NETWORK

After allocating the bike lanes along the street according to the street capacity and its dimensions, the bike network was designed using a Civil 3D software.

This chapter will address the design of bike lanes along the street and at intersections, prepare a cross sections drawing that represent the elements of the street, prepare a Profiles for roads elevations at each station, also allocating and designing the Parking lots for bikes. Finally, estimate the cost of the project.

6.1. Bike Lane at Intersections

Intersection design should take into consideration bicyclist, pedestrian, and vehicle movements. In all cases, the degree of mixing or separation between bicyclists and other modes is intended to reduce the risk of crashes and increase bicyclist comfort. Many elements are designed to achieve safety for cyclists, including color, warning signs, pavement markings, bike box, and median Refuge Island.

6.1.1. Bike Box

A bike box is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase. That provides a group's bicyclists together to clear an intersection quickly. Also Facilitates the transition from a right-side bike lane to a left-side bike lane during red signal indication, this only applies to bike boxes that extend across the entire intersection. (Urban Bikeway Design Guide, 2011). Figure 6-1 shows an illustration of the bike box.

A Bike Box was designated at the intersection in this project with a width of 3.00 m at the head of the traffic lane in each direction, and the pavement marking and warning signs for bicyclists were added. Figure 6-2 shows the designated bike box at Rafedia - tunis intersection.

Figure 6- 1: Illustration Of The Bike Box (Urban Bikeway Design Guide, 2011)

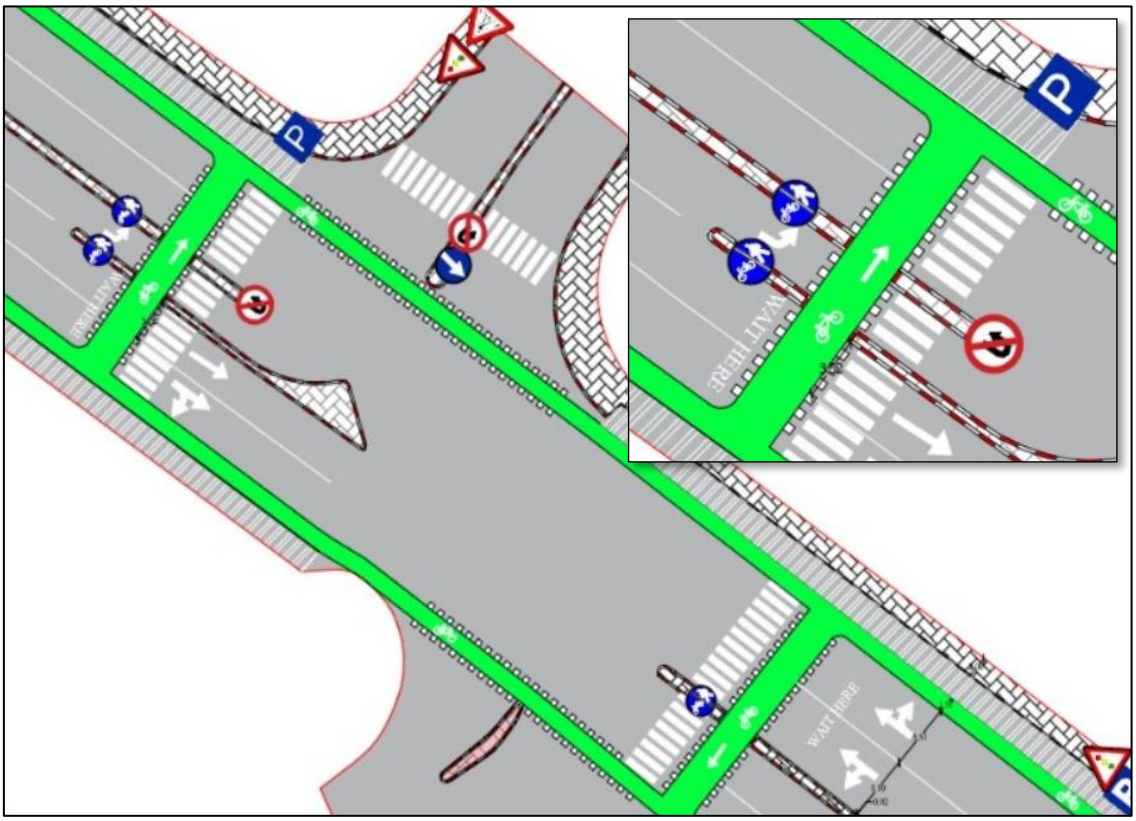

Figure 6- 2: The Designated Bike Box At Rafedia - Tunis Intersection.

6.1.2. Median Refuge Island

Median refuge islands are protected spaces placed in the center of the street to facilitate bicycle and pedestrian crossings. Figure 6-3 shows the Median Refuge Island (Urban Bikeway Design Guide, 2011).

Figure 6-4 shows the designated Median Refuge Island at Al-Watany Hospital.

Figure 6- 3: Median Refuge Island (Urban Bikeway Design Guide, 2011)

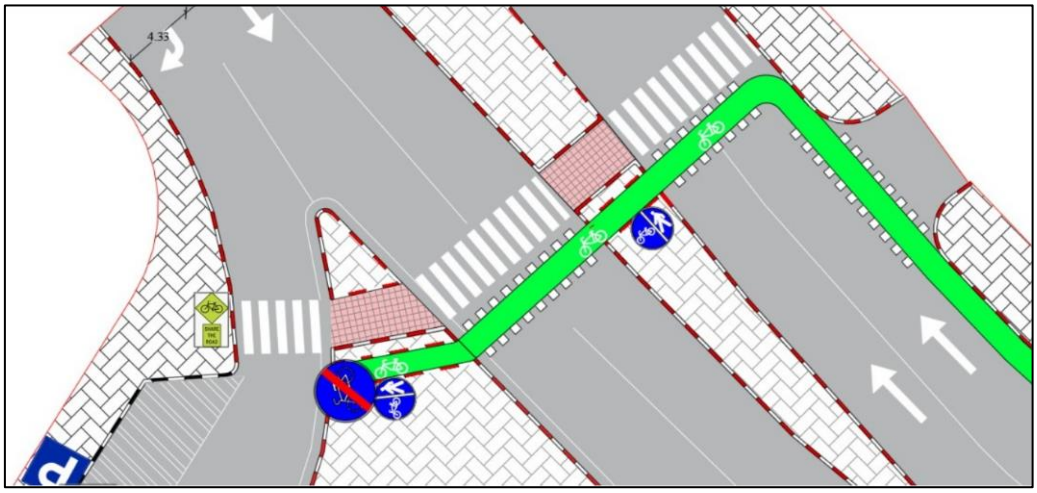

Figure 6- 4:The Designated Median Refuge Island At Al-Watany Hospital

6.1.3. Intersection crossing marking

Intersection crossing markings indicate the intended path of bicyclists. They guide bicyclists on a safe and direct path through intersections, including driveways and ramps. They provide a clear boundary between the paths of through bicyclists and either through or crossing motor vehicles in the adjacent lane.

In this project, the crossing lane was designed with a green calored and with the Elephant's feet Bicycle Crossing Markings, to icrease the visibilty of the Bicycle lane. the Elephant's feet Marking size was desgned to be 0.5 m wide squares with equal distance spacing.

Figure 6-5 shows the crossing Lane Marking with a Median Refuge Island at An-Najah new campus, station 0+300

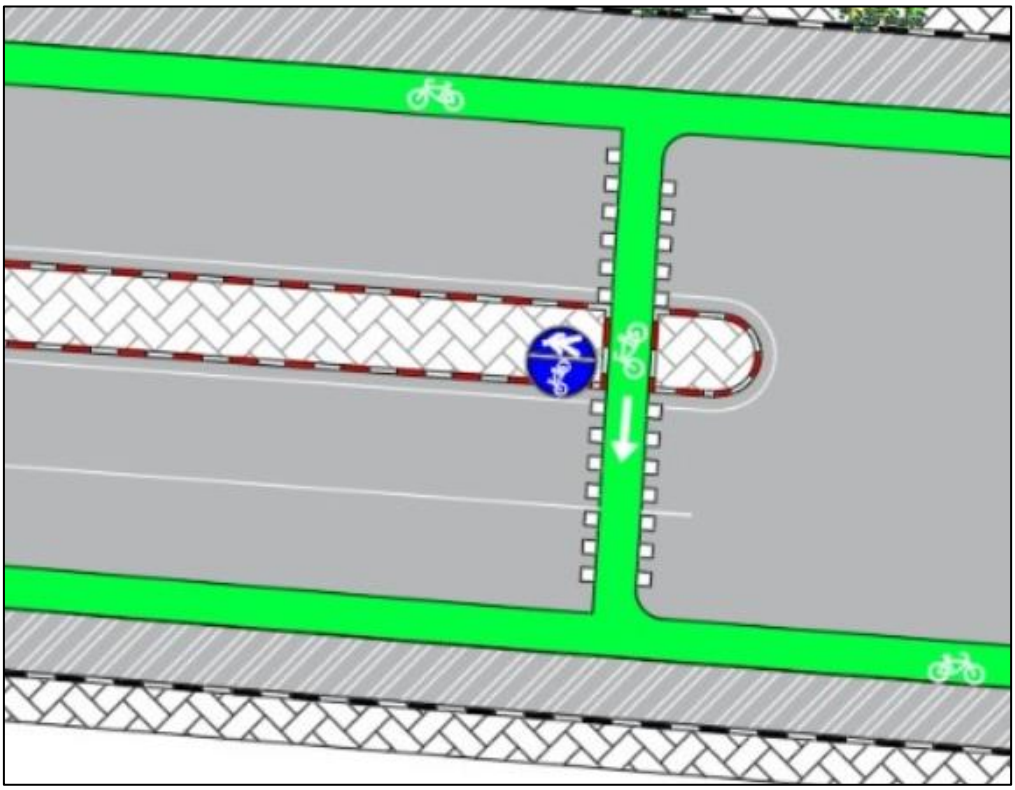

Figure 6- 5:The Crossing Lane Marking With A Median Refuge Island

6.2. Typical Cross Sections

A typical Cross Sections was drawn at several stations, to illustrate the street elements and its dimensions. Figure 6-6 to Figure 6-17 show plans and cross-sections for the designated network.

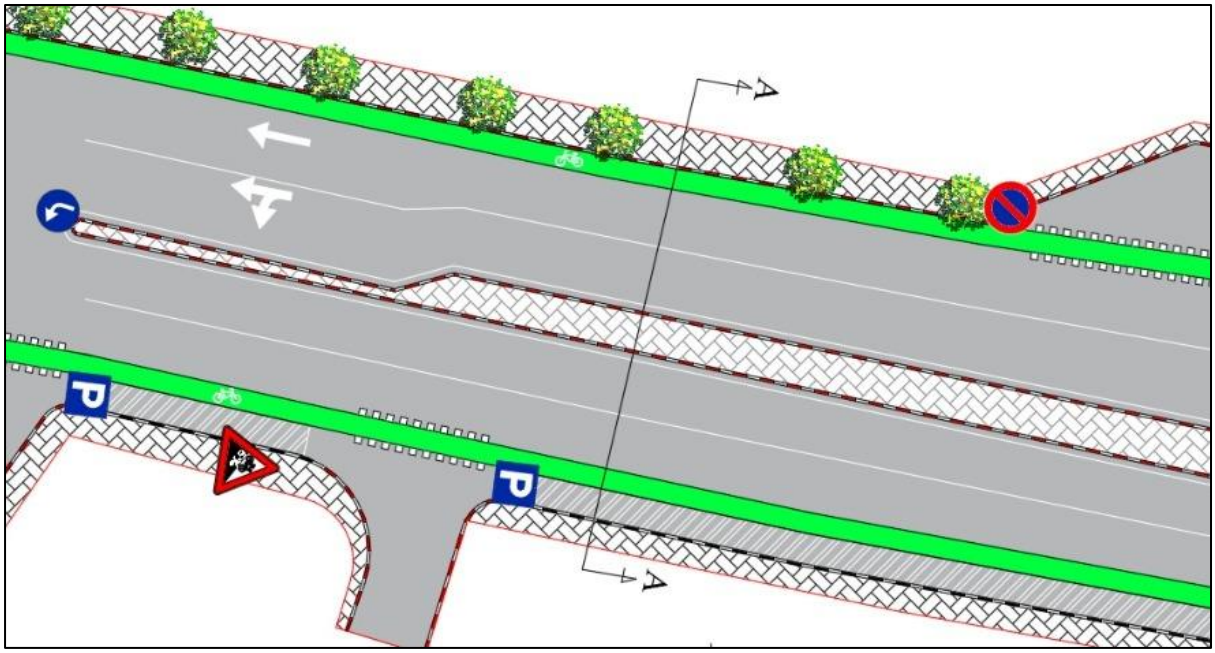

Figure 6- 6: Plan Drawing, Section A-A

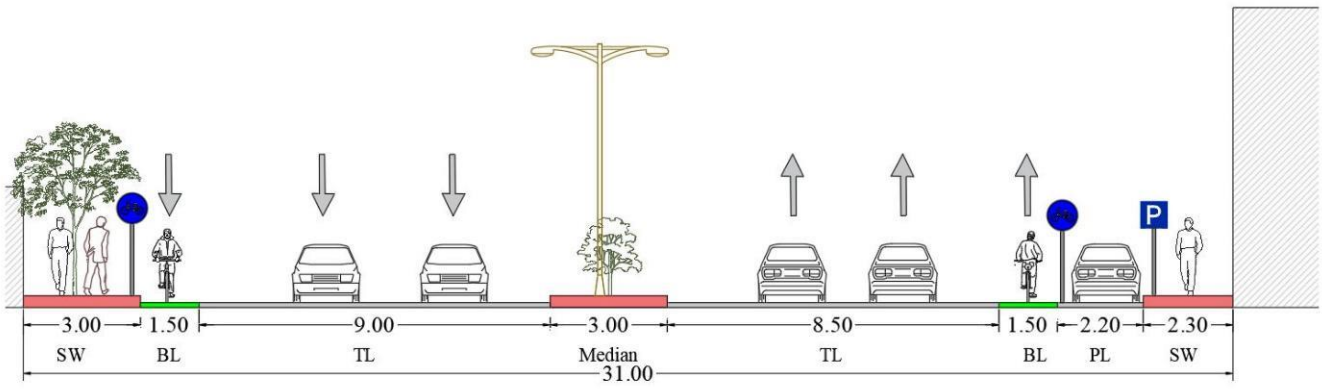

Figure 6- 7: Typical Cross Section A-A, At An- Najah New Campus

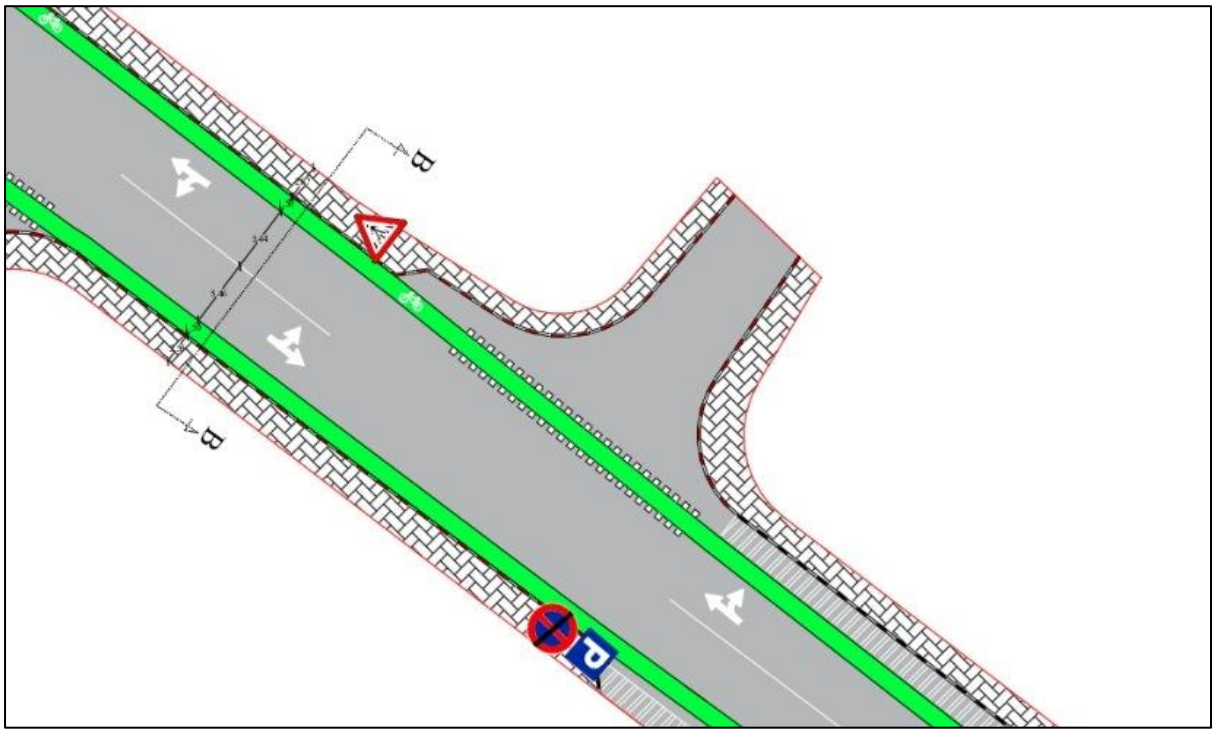

Figure 6- 8: Plan Drawing Section B-B, Rafidia Street

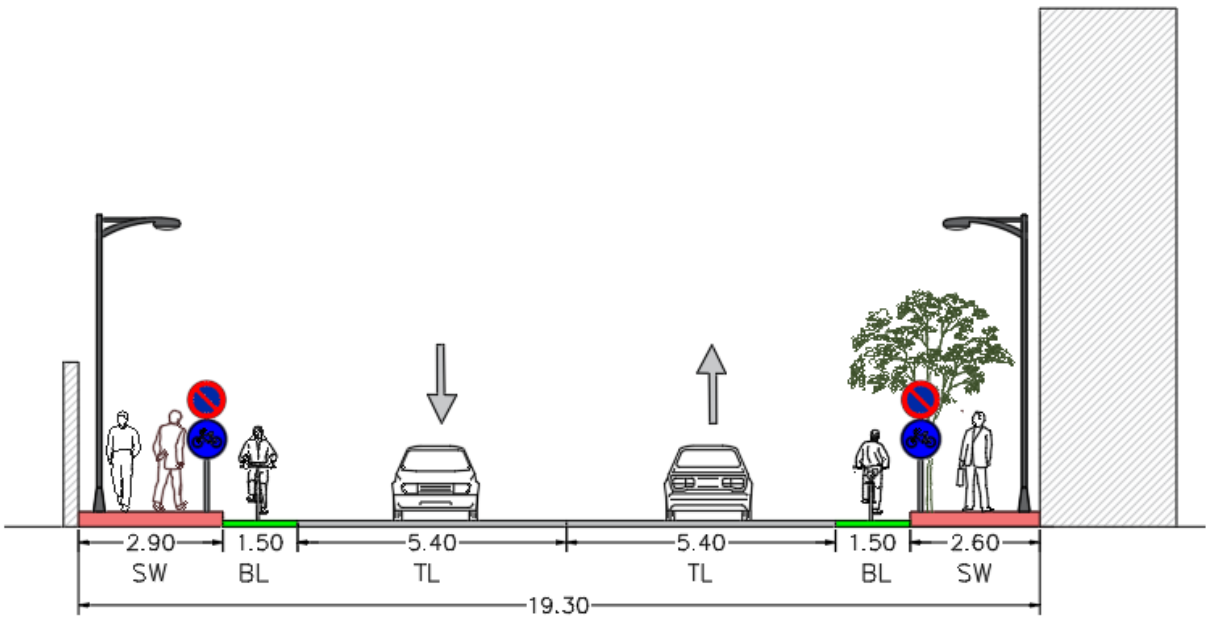

Figure 6- 9:Typical Cross Section B-B, Rafidia Street

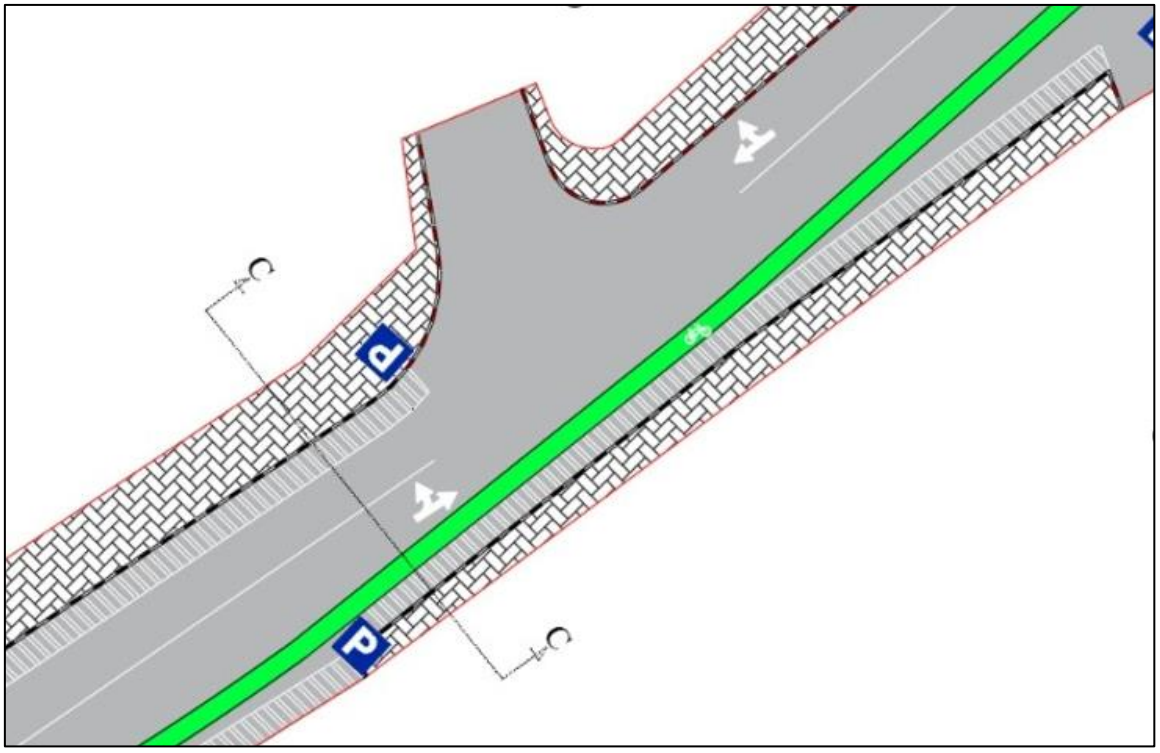

Figure 6- 10: Plan Drawing, Section C-C, Rafidia Street

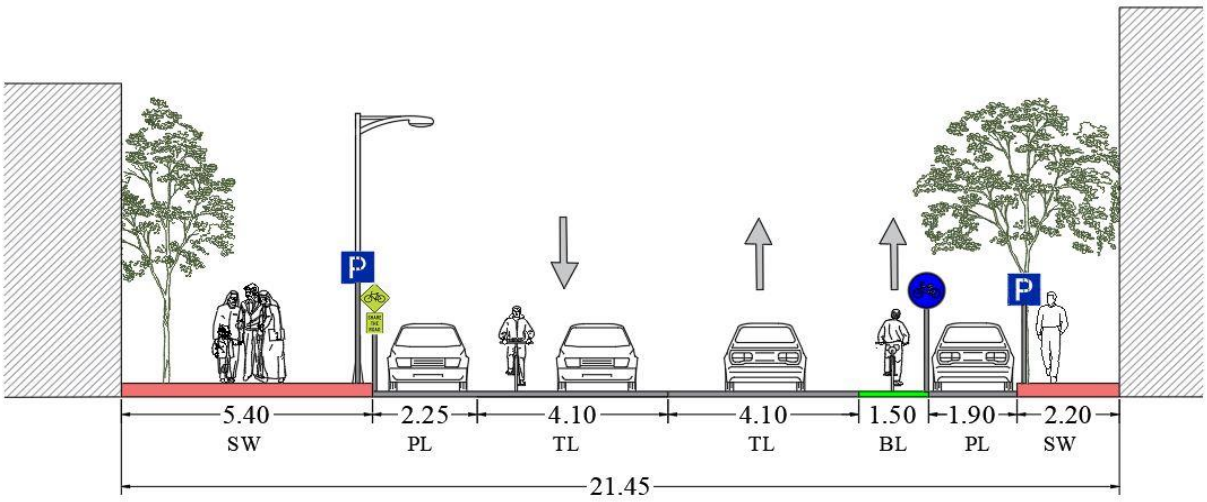

Figure 6- 11: Typical Cross Section C-C, Rafidia Street

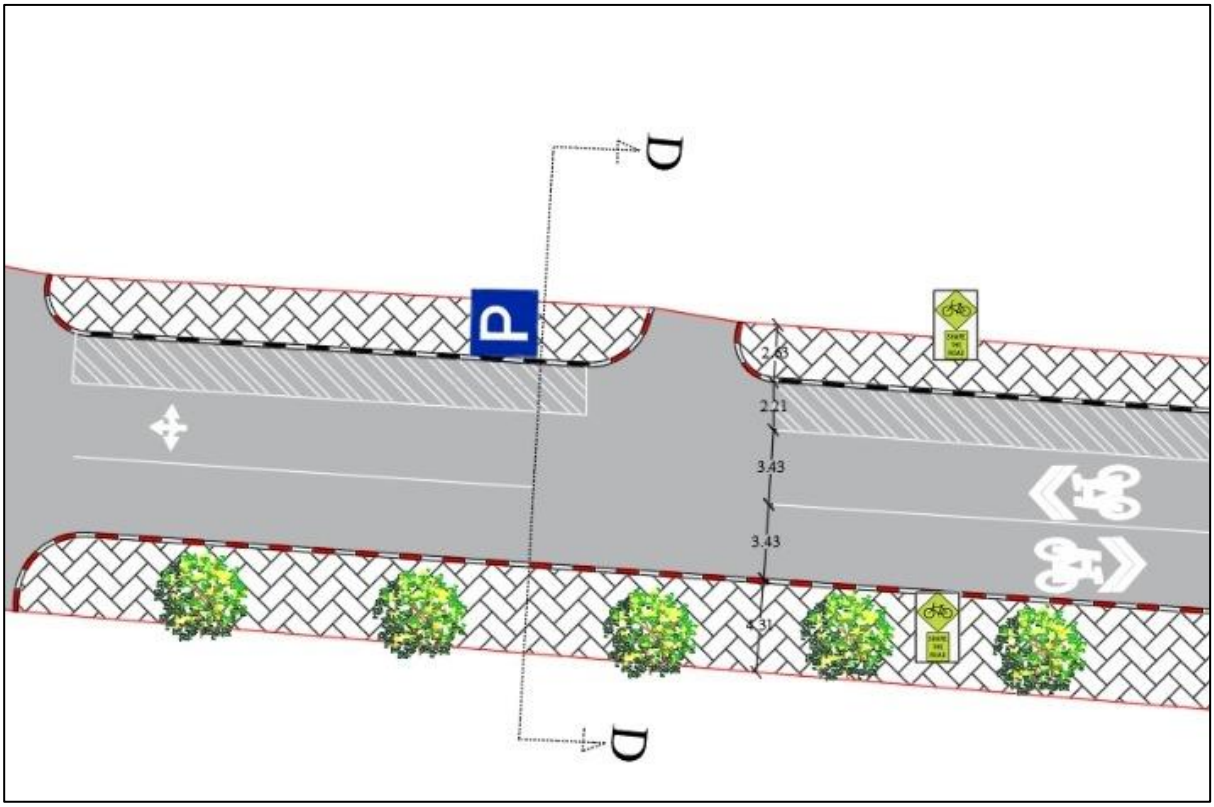

Figure 6- 12:Plan Drawing Section D-D, Omar Ibn Al-Khattab Street, An-Najah Old Campus

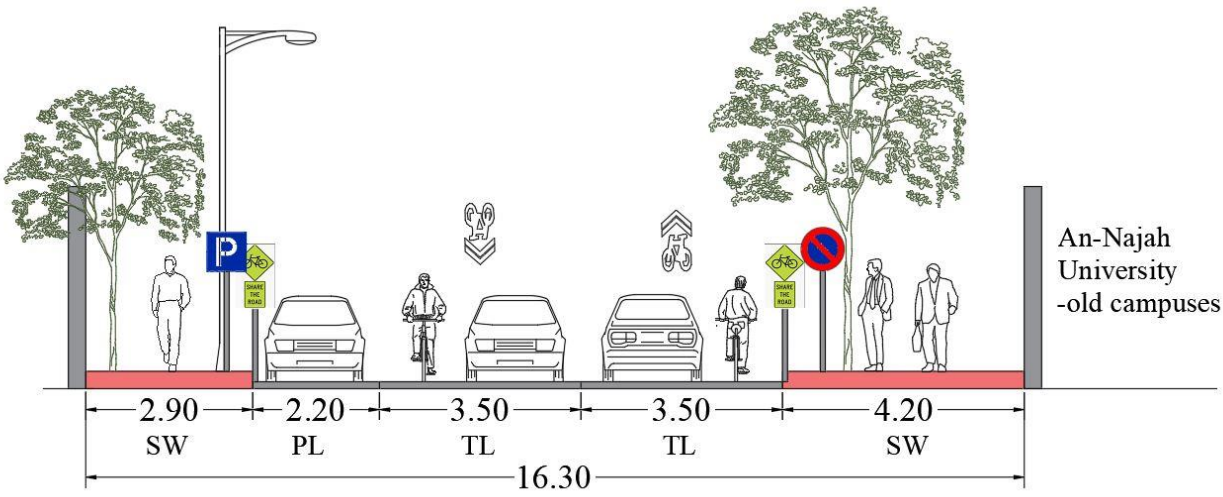

Figure 6- 13: Typical Cross Section D-D, Omar Ibn Al-Khattab Street, An-Najah Old Campus

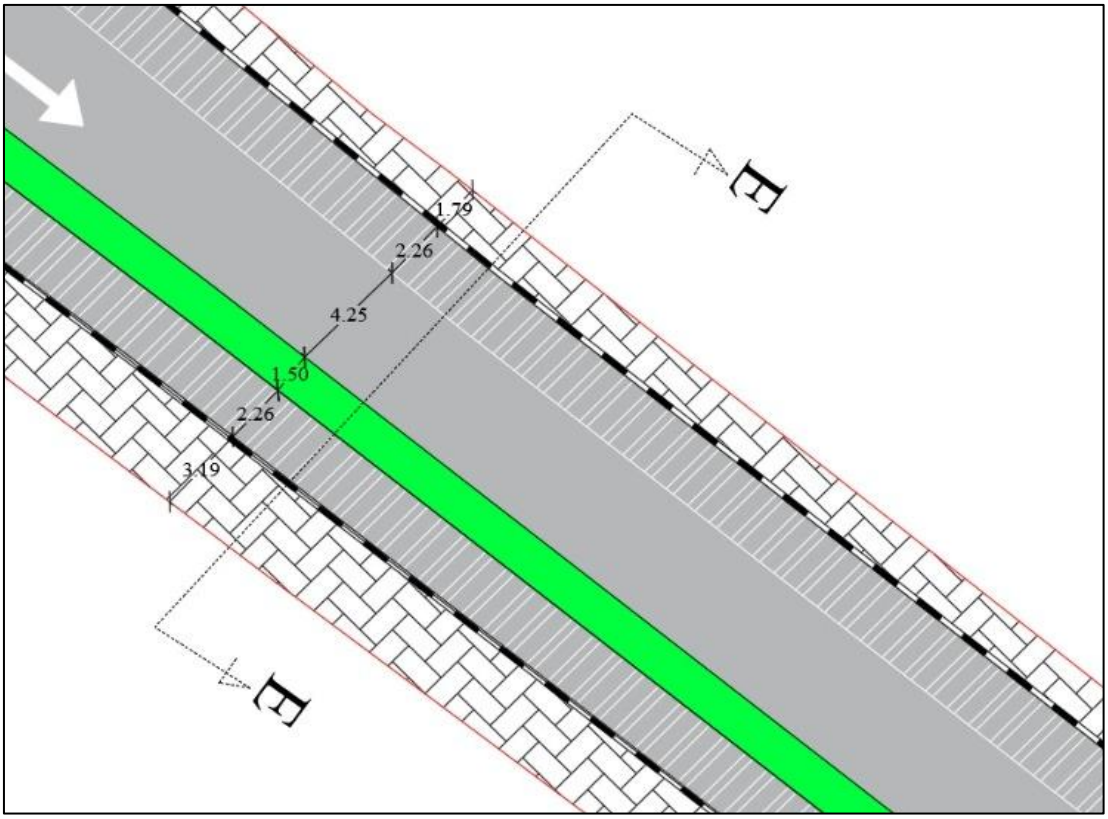

Figure 6- 14: Plan Drawing, Section E-E Al-Shwetreh Street

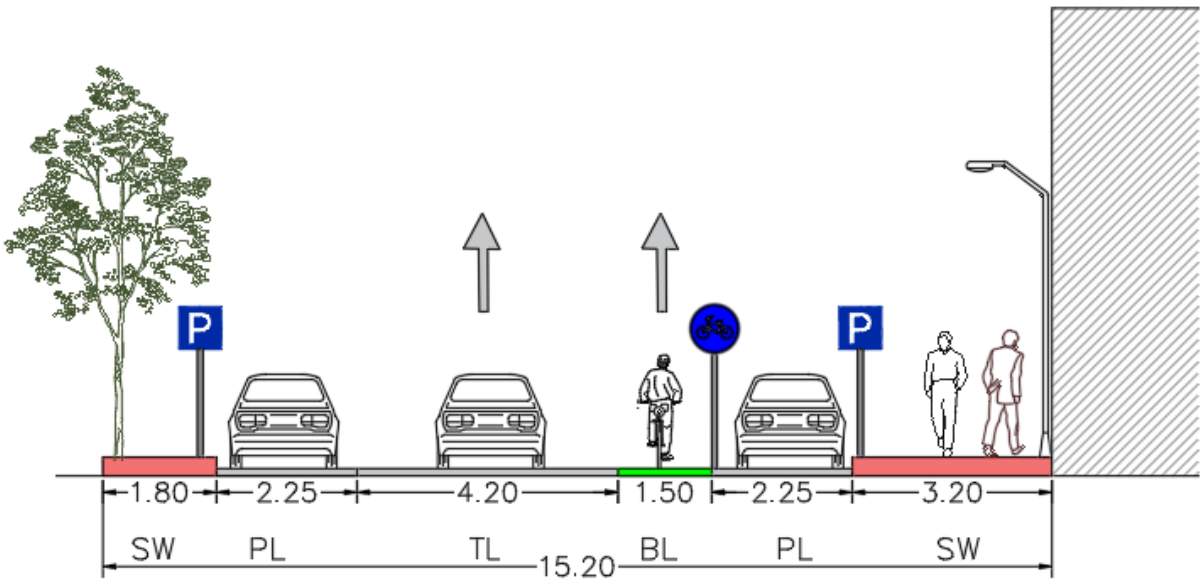

Figure 6- 15: Typical Cross Section, section E-E Al-Shwetreh Street

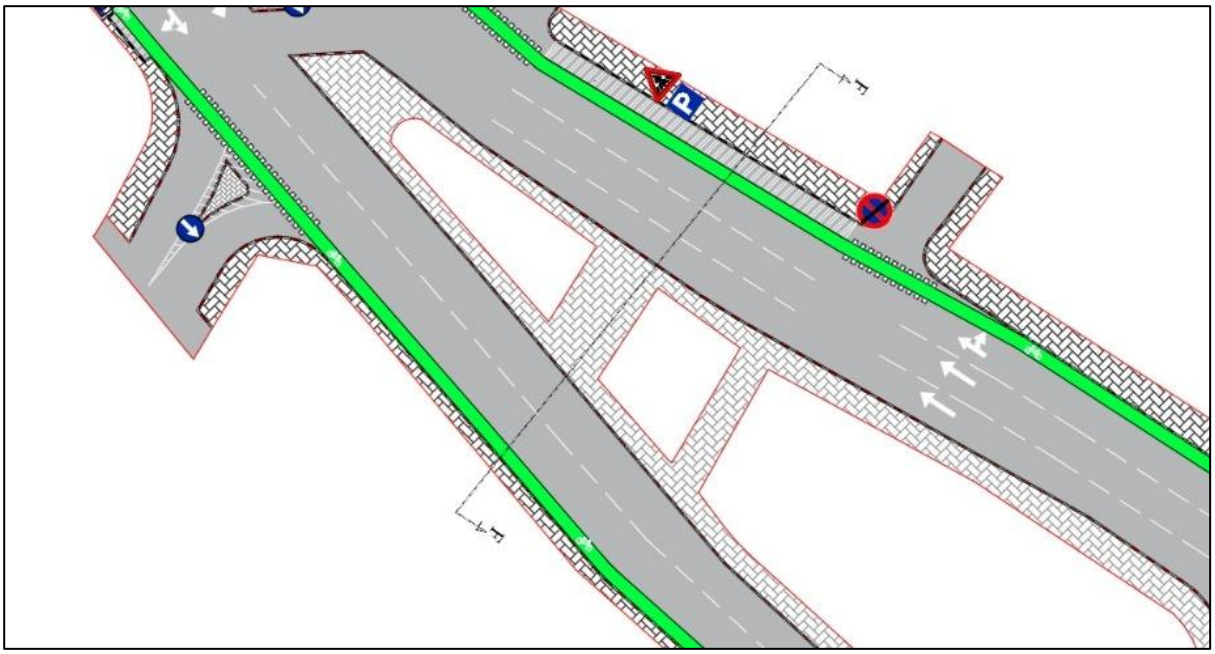

Figure 6- 16: Plan Drawing, Section F-F, Al-Malek Faisal Street

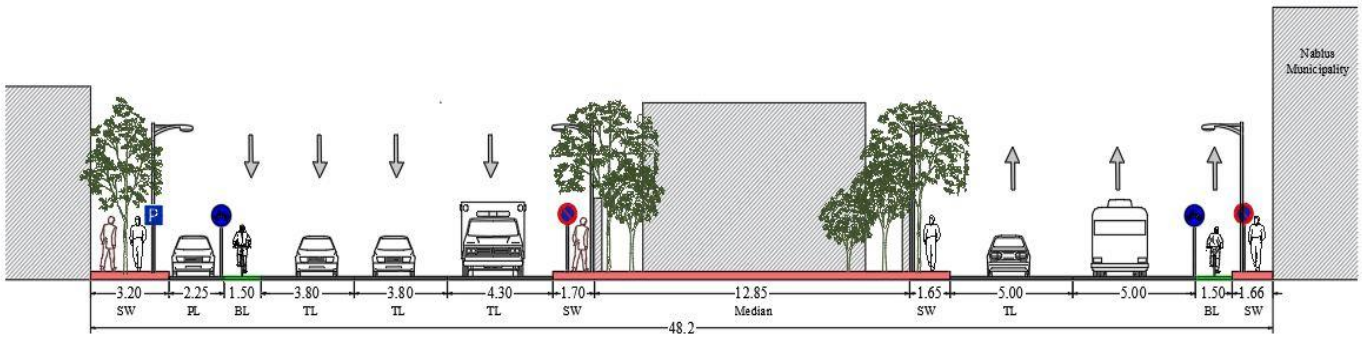

Figure 6- 17: Cross Section F-F, Al-Malek Faisal Street

6.3. Grade of the Street

Using surveying points, that represent the level of the street in the designed area. An indication profile was prepared for the street using Civil 3D software, to give an indication for bicyclists about the slope of the street. This may help them determine the type of bike they use (bicycle, electric). Figure 6-18 and 6-19 show the profiles for Salah Al-Deen street and the city center area. However, it should be mentioned that now with the wide spread of e-bikes, the grade issue is generally overcome by the electrical motors on bikes.

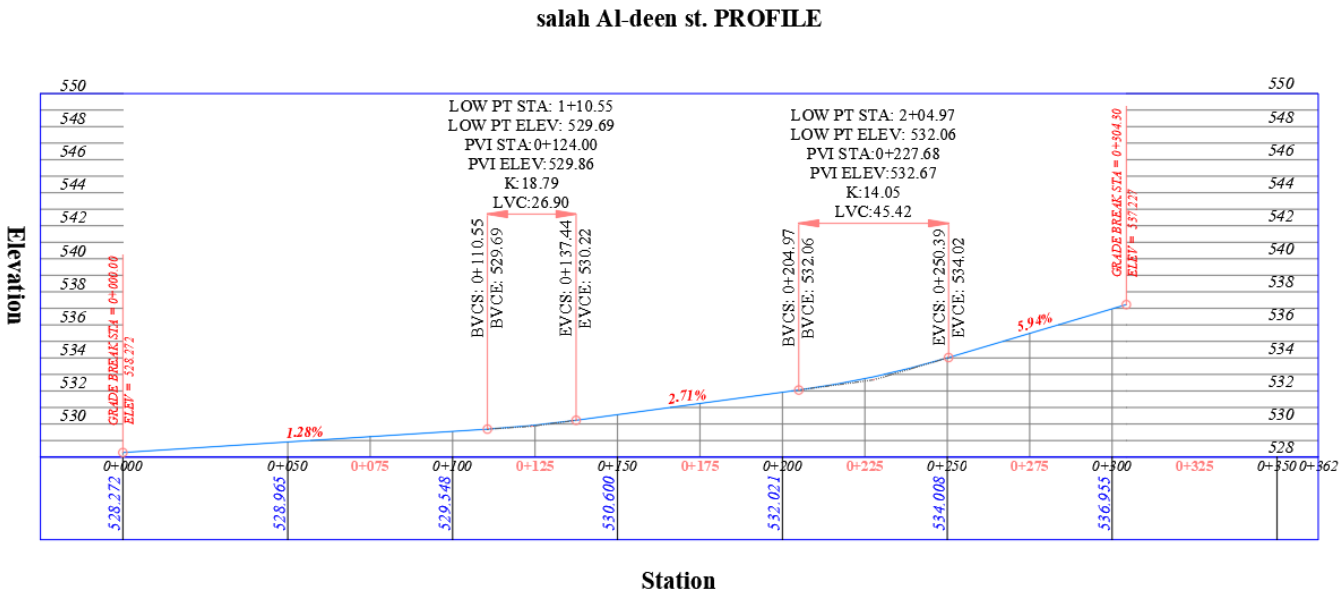

Figure 6- 18: Salah Al-Deen Street Profile

According to AASHTO, 2012, a 5% Maximum Grades for any distance, 8.3% Max. up to 61m distance, 10% Max. up to 9m distance, and 12.5% up to 3m distance. After drawing the profile, It was observed that the majority of streets have a steep slope, as the slope in them exceeds 5%. Warning signs representing a steep slope were posted on these streets.

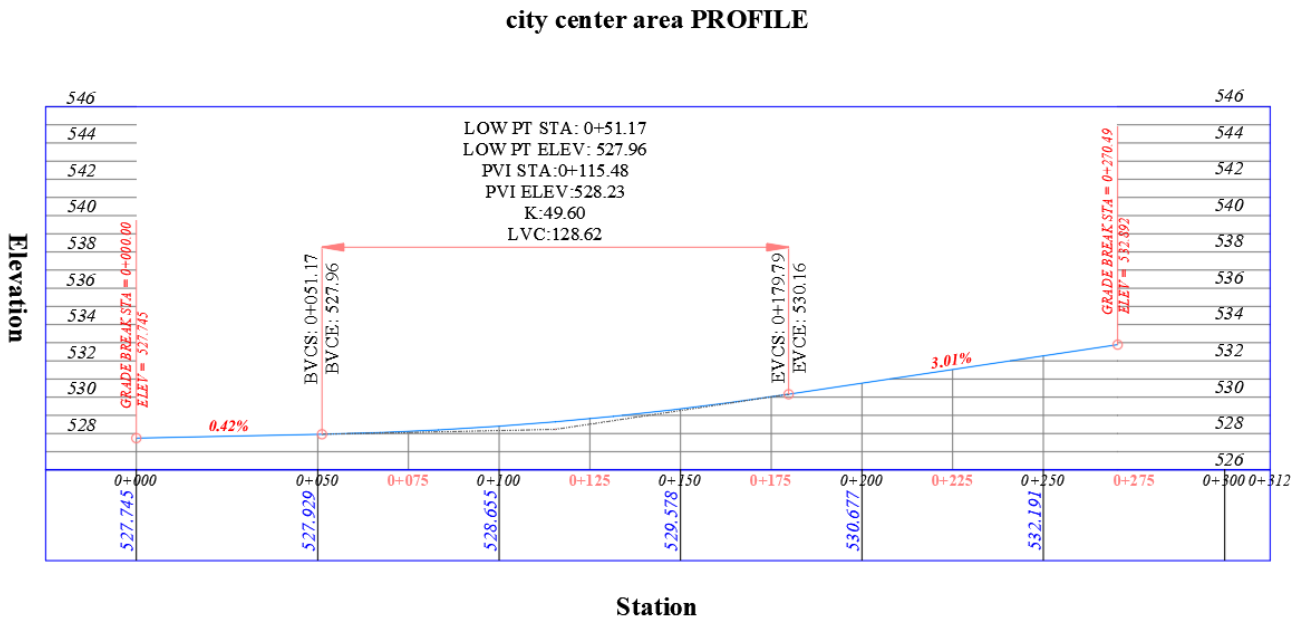

Figure 6- 19:City Center Area Profile

6.4. Bikes Parking Lots

For the design to be integrated, the bike parking lot was designed. 3 locations have been selected for the system, at An-Najah National University - new campus, An-Najah National University - old campus, and in the city center - Faisal Street. Figures 6-20 to 6-22 show the locations and dimensions of the proposed parking lots.

Figure 6- 20: Proposed Parking Lot, An- Najah New Campus

Figure 6- 21: Proposed Parking Lot, An- Najah Old Campus

Figure 6- 22: Proposed Parking Lot, City Center

- **Number of bikes needed in each parking**

To design the bike parking lot, the number of bikes needed was computed. According to the questionnaire sample, adding 15% as a percent of people how will be attracted to the system will use the parking in both the new and old campus, then, the 21.68% of the students how will use the bike in old campus will become 29.18%, and the 78.2% of the students in the new campus, will become 85.7%.

As previously explained, those wishing to use bicycles are 912 students, assuming that 80% of them will use the network at the peak hour in the same time. Then, the number of bikes needed on both campuses = 840 bikes, 626 bikes in the new campus and 214 bikes in the old campus.

- **Type of Rack**

According to Bike Parking Guide(2011), bike parking lot with rows and columns was used to design the bike parking, and a U- rack was used to carrying two bikes in both side, which is used in urban areas, and it secures the front and back wheels. Figure 6-23 show the U- rack.

- **Bikes Parking Lot (An-Najah University -New Campus)**

According to the Bike Parking Guide, bike parking was designed. The entrance and exit width of the parking is 1.8 m, distance between the edge and the first Rack =0.6 m, distance between the Rack Parallel to wall =0.9 m with length =2m, and the distance between the Rack perpendicular to wall = 1m with length = 1.8 m. The path between Rows of Parking has a width =1.4 m. As shown in figures 6-24 & 6-25.

Figure 6-23: U- rack (Bike Parking Guide)

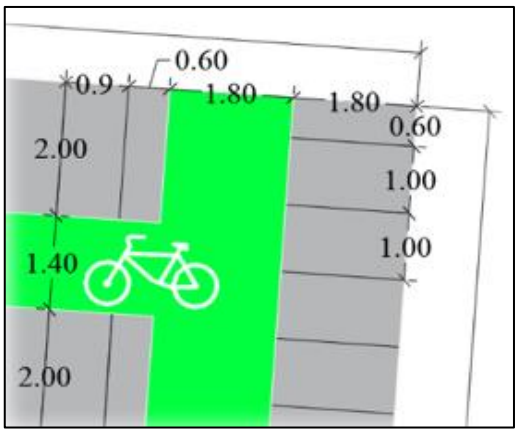

Figure 6-24: Details Of Bike Parking Dimensions.

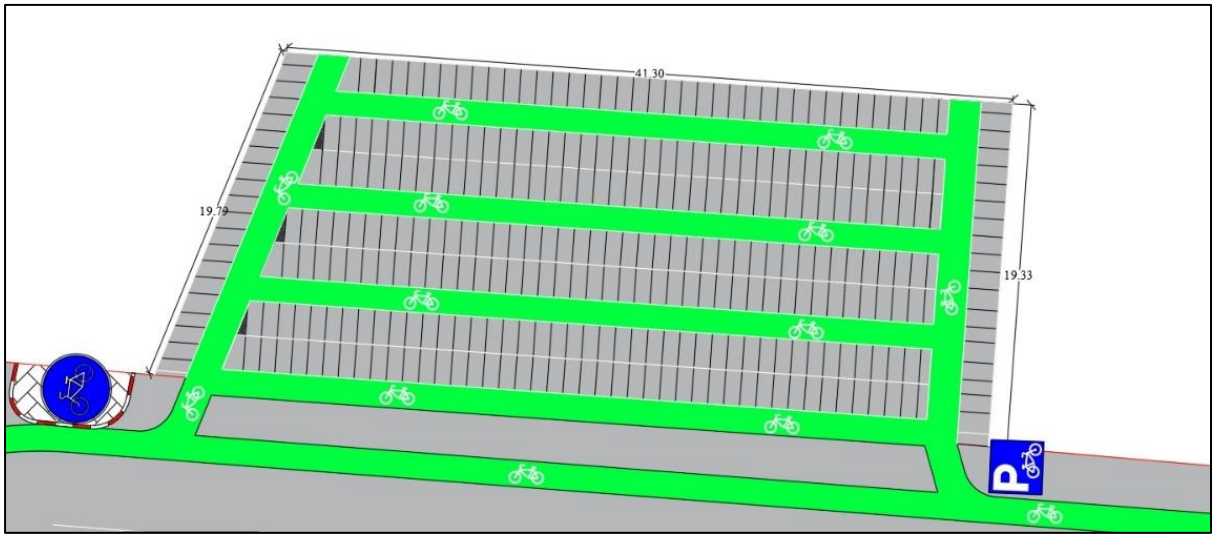

Figure 6- 25:Bikes Parking Lot, An- Najah New Campus

- **Bikes Parking Lot (An-Najah University - Old Campus)**

214 bikes are needed at the peak hour, the bike parking dimensions is as the following:

- The space between Racks = 0.9 m with a length = 2m for each parking.
- The width of path between bike parking = 1.5 m.

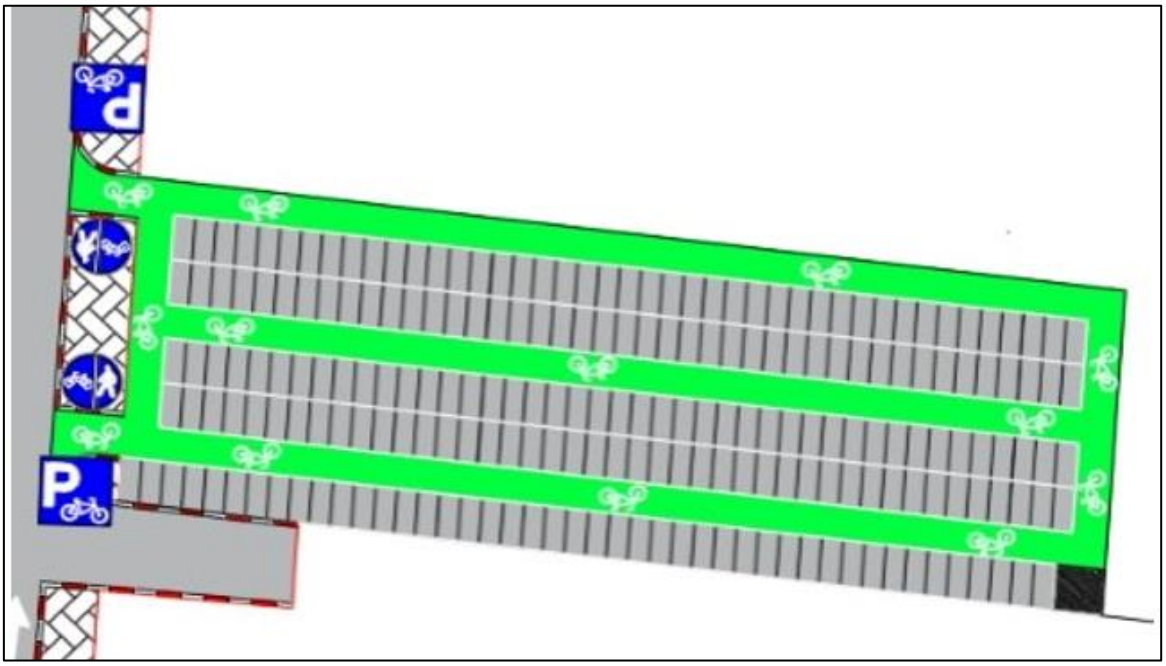

Figure 6- 26: Bikes Parking Lot, An- Najah Old Campus

- **Bikes Parking Lot at City Center Area – Faisal Street.**

An area =1512 square meter was used for the parking lot, as shown in Figure 6-27. The number of bike parking was computed to be the largest No. in the previse parking = 626 parking. The designated dimensions as the following:

- the space between Racks = 0.9 m with a length = 1.8 m for each parking.
- The width of path between bike parking = 1.2 m.

Figure 6-27 shows a plan of the Bike Parking Lots – City center area.

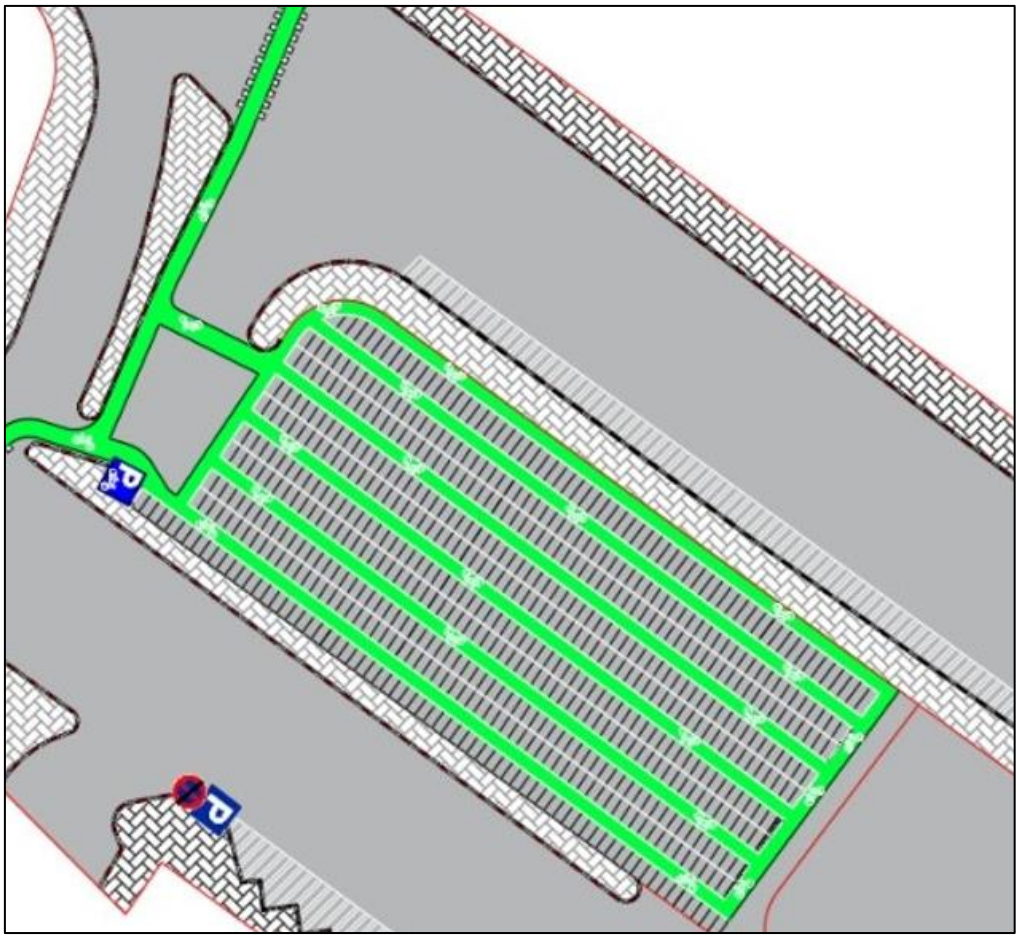

Figure 6- 27: Bike Parking Lot, City Center Area

Chapter 7: Cost Estimate

The Total cost of the project was estimated, and it is equal to $333,776.85, including the cost of traffic signs, U-Rack for parking, painting material, asphalt, and reconstruction cost. The following table summarizes the total cost of the project.

Table 7. 1: Cost Estimate for The Project

Term	Description	Unit	Quantity	Unit Cost ($)	Total Cost ($)
traffic Signs	-	No.	390	150	58500
U-Rack	Steel Rack	No.	733	129	94557
Painting of Bike Lanes	includes the Cost of painting materials and Labors	m^2	14480	8	115840
asphalt	include asphalt, base course, and excavation	m^2	2490	25	62250
Median Refuge Island	Excavation work, silt removal, reconstruction, and labor	m^2	53	50	2650
Painting of dividing lines	Labor and painting materials	m	15973	1	15973
Total Cost					**333776.85**

Reference: MADRAX- Bike Racks.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

The design of any bicycle network on an existing road depends on the street elements, and its dimensions, the right-of-way for street, and the traffic volume for vehicle at each approach.

An inventory study was made, to check the condition of the street element, and it's in general has a good condition. The Geomolg site and GIS software were used to draw the existing network, which is 8.6 Km in length. After that, a traffic volume study was computed to determine the peak hour at each intersection in the network; it was 3:00 – 4:00 pm.

To study the ability of people to use bicycles, the results of a questionnaire was used, which was prepared by a group of students in a previous graduation project. All results were analyzed and used to calculate the percent of traffic volume reduction after adding a bike network according to the traffic volume study, and it's found to be in average 7.2% for all network.

To check the effect of using a bike network in improving the level of service for the street, Synchro software was used to analyze the LOS before and after adding a bike network.

Finally, using a Civil 3d software, an integrated bike network was designed according to the AASHTO criteria, and the treatment method at intersection was used to minimize the conflict and risk for cyclists. Then the cost estimate was prepared for the project.

As a recommendation on this project:

- It is recommended that Nablus Municipality adopts the concept of providing bike network for the entire city, and as appropriate, considering the outputs of this project. This will have a positive impact on the overall traffic operating conditions in the network, in addition to the health benefits of the users and the city's residents and visitors as a whole.

- Cyclists must comply with the designated bike lanes and not exceed them to adjacent lanes for vehicles unless the bike lane becomes Mixed with traffic.

- Motorists must comply with signs and indicative regulations that prevent driving or parking on the bike lanes, as well as the marking at intersections that oblige vehicles to Wait behind them to give priority for cyclists to cross the road.

- Traffic signs that mean a steep slope for upgrade or downgrade direction were added on the side of the street to give an indication for cyclists about the street condition. It recommended to use an electric bike on steep slope roads such as Omar Ibn Al-Khattab Street, to reduce the effort on cyclists

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Appendix

The following tables show the classifications of traffic volume study

1. Al- Malek Faisal Street (National Hospital)

Details Of Traffic Volume For Al- Malek Faisal Street (National Hospital)- Eastbound

LOCATION:	Al- Malek Faisal Street (National																								
TIME		EASTBOUND																							
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	-	-	-	-	-	-	-	220	0	77	0	0	12	0	43	0	17	2	1	0	0	372
01:15	01:30	-	-	-	-	-	-	-	250	1	98	2	5	9	0	48	0	21	3	0	0	0	437
01:30	01:45	-	-	-	-	-	-	-	216	0	90	0	4	5	0	42	0	7	2	0	0	0	366
01:45	02:00	-	-	-	-	-	-	-	163	0	66	0	3	11	0	38	0	16	7	0	0	0	304
02:00	02:15	-	-	-	-	-	-	-	240	0	53	0	12	10	0	41	0	12	3	2	0	0	373
02:15	02:30	-	-	-	-	-	-	-	160	2	74	2	7	8	0	40	0	16	0	1	1	0	311
02:30	02:45	-	-	-	-	-	-	-	153	0	65	2	9	8	0	55	0	27	1	1	0	0	321
02:45	03:00	-	-	-	-	-	-	-	170	2	58	4	5	9	0	44	0	14	1	1	2	0	310
03:00	03:15	-	-	-	-	-	-	-	225	1	80	2	6	11	0	40	0	19	0	1	2	0	387
03:15	03:30	-	-	-	-	-	-	-	190	1	73	1	7	6	1	57	0	18	4	2	0	0	360
03:30	03:45	-	-	-	-	-	-	-	207	1	73	3	7	10	0	60	0	10	2	1	0	0	374
03:45	04:00	-	-	-	-	-	-	-	205	2	71	7	3	12	0	66	0	9	3	2	0	0	380
Max. Volume:																									

Details Of Traffic Volume For Al- Malek Faisal Street (National Hospital)- Northbound

LOCATION:	Al- Malek Faisal Street (National																								
TIME		NORTHBOUND																							
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	0	20	0	2	0	1	68
01:15	01:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	0	21	3	2	1	0	72
01:30	01:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	0	14	2	2	1	0	61
01:45	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	0	36	4	0	1	0	129
02:00	02:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	0	30	1	3	0	0	122
02:15	02:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	0	20	1	2	0	0	83
02:30	02:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	0	13	3	2	0	0	68
02:45	03:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	0	31	4	0	0	0	88
03:00	03:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	0	28	6	1	1	1	92
03:15	03:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77	0	21	4	0	2	0	104
03:30	03:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	0	25	5	1	2	0	100
03:45	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	0	20	3	0	0	0	96
Max. Volume:																									

Details Of Traffic Volume For Al- Malek Faisal Street (National Hospital)- Westbound

LOCATION:	Al- Malek Faisal Street (National																								
TIME		WESRBOUND																							
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	-	-	-	-	-	-	-	248	0	72	2	2	12	0	-	-	-	-	-	-	-	336
01:15	01:30	-	-	-	-	-	-	-	338	0	102	1	3	6	10	-	-	-	-	-	-	-	460
01:30	01:45	-	-	-	-	-	-	-	336	1	101	1	8	10	7	-	-	-	-	-	-	-	464
01:45	02:00	-	-	-	-	-	-	-	369	1	98	6	6	13	2	-	-	-	-	-	-	-	495
02:00	02:15	-	-	-	-	-	-	-	345	1	117	3	12	7	4	-	-	-	-	-	-	-	489
02:15	02:30	-	-	-	-	-	-	-	303	2	112	1	9	16	7	-	-	-	-	-	-	-	450
02:30	02:45	-	-	-	-	-	-	-	369	1	117	2	7	15	5	-	-	-	-	-	-	-	516
02:45	03:00	-	-	-	-	-	-	-	271	2	100	2	11	11	8	-	-	-	-	-	-	-	405
03:00	03:15	-	-	-	-	-	-	-	399	1	100	5	6	8	0	-	-	-	-	-	-	-	519
03:15	03:30	-	-	-	-	-	-	-	363	0	95	4	9	15	10	-	-	-	-	-	-	-	496
03:30	03:45	-	-	-	-	-	-	-	378	1	106	2	9	14	5	-	-	-	-	-	-	-	515
03:45	04:00	-	-	-	-	-	-	-	328	0	113	2	11	14	5	-	-	-	-	-	-	-	473
Max. Volume:																									

2. Rafidia – Omar Ibn Al Khattab Intersection

Details Of Traffic Volume For The Rafidia – Omar Ibn Al Khattab Intersection – Westbound

LOCATION:	Rafidia - Omar Ibn Al Khattab																						
TIME		WESRBOUND																					
FROM	TO	L							T							R							Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	22	0	11	0	0	0	0	-	-	-	-	-	-	-	19	0	11	0	1	0	0	64
01:15	01:30	37	0	7	0	2	0	0	-	-	-	-	-	-	-	40	0	10	0	1	0	0	97
01:30	01:45	31	1	18	0	3	0	0	-	-	-	-	-	-	-	30	0	11	2	1	2	1	100
01:45	02:00	33	0	12	0	0	0	0	-	-	-	-	-	-	-	37	0	15	2	4	0	0	103
02:00	02:15	32	0	4	0	0	0	0	-	-	-	-	-	-	-	35	0	17	2	3	0	0	93
02:15	02:30	17	0	19	0	0	0	0	-	-	-	-	-	-	-	38	0	4	0	0	0	0	78
02:30	02:45	45	0	15	0	0	0	0	-	-	-	-	-	-	-	40	0	3	0	2	0	0	105
02:45	03:00	20	0	10	0	2	0	0	-	-	-	-	-	-	-	25	0	10	0	1	0	0	68
03:00	03:15	35	0	2	0	0	0	0	-	-	-	-	-	-	-	36	0	9	2	2	0	0	86
03:15	03:30	68	0	23	0	10	0	0	-	-	-	-	-	-	-	35	0	15	3	2	0	0	156
03:30	03:45	50	0	25	0	5	0	0	-	-	-	-	-	-	-	22	0	14	0	2	0	0	118
03:45	04:00	41	0	15	0	5	0	0	-	-	-	-	-	-	-	45	0	20	1	5	0	0	132
Max. Volume:																							

Details Of Traffic Volume For The Rafidia – Omar Ibn Al Khattab Intersection – Eastbound

LOCATION:	Rafidia - Omar Ibn Al Khattab																						
TIME		EASTBOUND																					
FROM	TO	L							T							R							Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	62	0	9	0	1	1	0	60	0	11	0	1	3	0	-	-	-	-	-	-	-	148
01:15	01:30	50	0	14	1	2	0	1	41	0	9	0	5	2	0	-	-	-	-	-	-	-	125
01:30	01:45	65	0	12	2	1	1	2	42	0	14	0	2	1	1	-	-	-	-	-	-	-	143
01:45	02:00	52	0	18	0	3	1	0	73	0	9	0	3	3	0	-	-	-	-	-	-	-	162
02:00	02:15	50	0	13	1	5	0	0	55	0	12	0	2	2	0	-	-	-	-	-	-	-	140
02:15	02:30	65	0	14	0	3	1	0	55	0	18	0	4	1	0	-	-	-	-	-	-	-	161
02:30	02:45	58	0	15	2	3	1	0	45	1	7	0	3	0	0	-	-	-	-	-	-	-	135
02:45	03:00	58	0	13	0	1	0	0	57	0	9	1	5	2	0	-	-	-	-	-	-	-	146
03:00	03:15	68	0	17	3	4	0	1	58	0	12	2	1	0	0	-	-	-	-	-	-	-	166
03:15	03:30	46	0	18	2	3	0	0	58	0	12	0	2	2	0	-	-	-	-	-	-	-	143
03:30	03:45	64	0	16	3	1	1	0	55	0	5	0	2	1	0	-	-	-	-	-	-	-	148
03:45	04:00	73	0	11	1	4	0	1	43	0	9	0	1	1	0	-	-	-	-	-	-	-	144
Max. Volume:																							

Details Of Traffic Volume For The Rafidia – Omar Ibn Al Khattab Intersection – Southbound

LOCATION:	Rafidia - Omar Ibn Al Khattab																						
TIME		SOUTHBOUND																					
FROM	TO	L							T							R							Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	33	0	10	0	5	0	0	115	1	30	0	4	0	0	-	-	-	-	-	-	-	198
01:15	01:30	40	0	15	2	5	0	0	139	0	31	0	2	3	0	-	-	-	-	-	-	-	237
01:30	01:45	38	0	11	1	3	0	0	162	0	47	1	9	3	0	-	-	-	-	-	-	-	275
01:45	02:00	30	0	8	1	3	0	0	123	3	37	2	2	2	0	-	-	-	-	-	-	-	211
02:00	02:15	39	0	13	0	2	0	0	123	0	30	1	5	1	0	-	-	-	-	-	-	-	214
02:15	02:30	30	0	12	1	3	0	0	145	0	50	2	3	3	0	-	-	-	-	-	-	-	249
02:30	02:45	35	0	11	1	2	0	0	130	0	55	0	1	1	0	-	-	-	-	-	-	-	236
02:45	03:00	42	0	16	2	5	0	0	120	1	36	1	10	0	0	-	-	-	-	-	-	-	233
03:00	03:15	40	0	17	2	2	0	0	145	1	71	1	2	1	0	-	-	-	-	-	-	-	282
03:15	03:30	38	0	12	3	3	0	0	155	0	83	0	15	1	0	-	-	-	-	-	-	-	310
03:30	03:45	39	0	15	0	1	0	0	152	0	60	0	10	0	0	-	-	-	-	-	-	-	277
03:45	04:00	45	0	17	3	5	0	0	135	4	66	0	13	5	0	-	-	-	-	-	-	-	293
Max. Volume:																							

3. Al – Ameer Mohammed – Yaffa Intersection

Details Of Traffic Volume For The Al – Ameer Mohammed – Yaffa Intersection– Westbound

LOCATION: Al- Ameer Mohammed - Yaffa intersection																								
TIME		WESRBOUND																						
FROM	TO	L							T							R								
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Total
01:00	01:15	-	-	-	-	-	-	-	122	0	52	0	4	3	0	10	0	5	0	0	1	0	197
01:15	01:30	-	-	-	-	-	-	-	107	0	49	0	2	2	2	11	0	3	1	1	0	0	178
01:30	01:45	-	-	-	-	-	-	-	100	1	49	0	1	4	1	14	0	1	0	0	0	0	171
01:45	02:00	-	-	-	-	-	-	-	115	2	32	2	4	1	3	13		1	1	1	1	1	177
02:00	02:15	-	-	-	-	-	-	-	112	0	59	0	0	3	4	15	0	1	0	0	0	0	194
02:15	02:30	-	-	-	-	-	-	-	110	1	55	1	3	1	4	14	0	1	0	0	1	0	191
02:30	02:45	-	-	-	-	-	-	-	119	0	51	0	4	1	3	12	0	4	1	1	0	0	196
02:45	03:00	-	-	-	-	-	-	-	119	1	40	1	3	1	0	26	0	2	0	0	0	0	193
03:00	03:15	-	-	-	-	-	-	-	122	0	45	1	2	1	4	20	0	0	0	0	1	1	197
03:15	03:30	-	-	-	-	-	-	-	110	0	52	0	1	1	3	10	0	3	1	2	0	0	183
03:30	03:45	-	-	-	-	-	-	-	92	0	55	2	2	7	16	0	2	1	0	0	0	0	177
03:45	04:00	-	-	-	-	-	-	-	112	0	55	0	1	1	2	15	0	4	0	0	0	1	191
Max. Volume:																								

Details Of Traffic Volume For The Al – Ameer Mohammed – Yaffa Intersection–Southbound

LOCATION: Al- Ameer Mohammed - Yaffa intersection																								
TIME		SOUTHBOUND																						
FROM	TO	L							T							R								
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Total
01:00	01:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	0	88	2	1	3	7	251
01:15	01:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	0	96	0	3	1	10	260
01:30	01:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	113	1	62	0	3	3	3	185
01:45	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	0	67	1	2	0	4	199
02:00	02:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	2	63	0	3	0	4	197
02:15	02:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	2	65	0	4	2	4	202
02:30	02:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	1	47	0	1	2	4	195
02:45	03:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	0	55	1	3	1	4	189
03:00	03:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130	0	53	1	3	2	5	194
03:15	03:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	129	0	63	0	2	4	7	205
03:30	03:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	0	52	1	3	1	5	202
03:45	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	114	0	67	2	2	2	3	190
Max. Volume:																								

Details Of Traffic Volume For The Al – Ameer Mohammed – Yaffa Intersection–Northbound

LOCATION: Al- Ameer Mohammed - Yaffa intersection																								
TIME		NORTHBOUND																						
FROM	TO	L							T							R								
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Total
01:00	01:15	9	0	0	0	0	1	0	120	0	85	0	0	4	0	-	-	-	-	-	-	-	219
01:15	01:30	7	0	0	0	0	0	0	165	1	110	1	1	1	3	-	-	-	-	-	-	-	289
01:30	01:45	5	0	0	0	0	0	1	157	0	87	1	2	0	4	-	-	-	-	-	-	-	257
01:45	02:00	12	0	0	0	0	0	0	176	0	100	0	0	4	4	-	-	-	-	-	-	-	296
02:00	02:15	3	0	0	0	0	0	0	162	1	118	2	2	1	5	-	-	-	-	-	-	-	294
02:15	02:30	5	0	0	0	0	0	1	138	0	110	0	2	2	6	-	-	-	-	-	-	-	264
02:30	02:45	4	0	0	0	0	0	1	200	0	113	3	2	1	4	-	-	-	-	-	-	-	328
02:45	03:00	5	0	1	0	0	0	0	210	0	140	0	3	1	6	-	-	-	-	-	-	-	366
03:00	03:15	4	0	1	0	0	0	0	194	0	102	2	2	0	0	-	-	-	-	-	-	-	305
03:15	03:30	6	0	2	0	0	0	0	211	0	100	1	1	1	0	-	-	-	-	-	-	-	322
03:30	03:45	6	0	2	0	1	0	0	206	0	179	2	3	2	0	-	-	-	-	-	-	-	401
03:45	04:00	5	0	1	0	0	0	0	197	0	164	1	2	2	4	-	-	-	-	-	-	-	376
Max. Volume:																								

4. Ghernatah - Omar Ibn Al Khattab Intersection

Details Of Traffic Volume For The Ghernatah - Omar Ibn Al Khattab Intersection –Northbound

LOCATION:		Ghernatah - Omar Ibn Al Khattab Intersection																							
TIME		NORTHBOUND																							
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	71	5	83	7	6	0	0	172
01:15	01:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	3	80	4	13	0	0	156
01:30	01:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110	5	97	4	12	0	0	228
01:45	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	136	0	130	4	13	1	0	284
02:00	02:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	2	79	3	6	0	0	187
02:15	02:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130	0	103	5	10	0	0	248
02:30	02:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94	0	79	6	3	0	0	182
02:45	03:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103	0	90	10	10	0	0	213
03:00	03:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	190	0	73	4	3	0	0	270
03:15	03:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	0	100	10	10	0	0	245
03:30	03:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110	0	88	5	7	0	0	210
03:45	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90	0	86	7	4	0	0	187
Max. Volume:																									

Details Of Traffic Volume For The Ghernatah - Omar Ibn Al Khattab Intersection –Eastbound

LOCATION:		Ghernatah - Omar Ibn Al Khattab Intersection																							
TIME		EASTBOUND																							
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	-	-	-	-	-	-	-	40	0	33	5	9	0	0	41	2	16	3	3	0	0	152
01:15	01:30	-	-	-	-	-	-	-	48	3	13	0	6	0	0	25	0	24	4	1	0	0	124
01:30	01:45	-	-	-	-	-	-	-	47	2	26	0	3	0	0	30	0	12	0	6	0	0	126
01:45	02:00	-	-	-	-	-	-	-	61	1	32	0	2	0	0	55	0	13	0	6	0	0	170
02:00	02:15	-	-	-	-	-	-	-	73	0	30	0	10	0	0	26	0	7	3	7	0	0	156
02:15	02:30	-	-	-	-	-	-	-	80	0	53	3	6	0	0	41	0	10	2	3	0	0	198
02:30	02:45	-	-	-	-	-	-	-	81	0	31	7	8	0	0	37	0	21	6	4	0	0	195
02:45	03:00	-	-	-	-	-	-	-	62	0	34	6	3	0	0	25	0	30	0	2	0	0	162
03:00	03:15	-	-	-	-	-	-	-	66	0	25	2	4	0	0	27	0	30	3	3	0	0	160
03:15	03:30	-	-	-	-	-	-	-	80	0	25	8	4	0	0	20	0	31	4	6	0	0	178
03:30	03:45	-	-	-	-	-	-	-	66	0	15	10	3	0	0	23	0	23	0	0	0	0	140
03:45	04:00	-	-	-	-	-	-	-	65	0	16	3	2	0	0	38	0	19	3	4	0	0	150
Max. Volume:																									

Details Of Traffic Volume For The Ghernatah - Omar Ibn Al Khattab Intersection –Southbound

LOCATION:		Ghernatah - Omar Ibn Al Khattab Intersection																							
TIME		SOUTHBOUND																							
FROM	TO	L							T							R								Total
		Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	Car	Bus	Taxi	Bike	M.Cycle	Truck	Other	
01:00	01:15	12	0	2	0	2	0	1	97	0	149	0	5	0	2	-	-	-	-	-	-	-	270
01:15	01:30	8	0	3	0	0	0	1	61	0	134	0	1	1	3	-	-	-	-	-	-	-	212
01:30	01:45	10	0	4	0	0	0	1	90	1	212	1	2	2	2	-	-	-	-	-	-	-	325
01:45	02:00	3	0	1	0	2	0	0	101	1	194	0	1	5	1	-	-	-	-	-	-	-	309
02:00	02:15	10	0	5	0	0	0	0	110	0	181	1	2	0	1	-	-	-	-	-	-	-	310
02:15	02:30	5	0	0	0	1	0	1	126	1	139	0	1	1	2	-	-	-	-	-	-	-	277
02:30	02:45	8	0	3	0	2	0	1	117	0	146	0	2	1	1	-	-	-	-	-	-	-	281
02:45	03:00	5	0	4	0	1	0	0	98	0	103	1	2	0	1	-	-	-	-	-	-	-	215
03:00	03:15	8	0	2	0	1	0	1	88	0	109	0	3	0	0	-	-	-	-	-	-	-	212
03:15	03:30	5	0	3	0	0	0	1	106	0	97	1	2	0	2	-	-	-	-	-	-	-	217
03:30	03:45	3	0	5	0	1	0	0	87	0	93	0	4	0	1	-	-	-	-	-	-	-	194
03:45	04:00	8	0	4	0	1	0	0	90	0	70	0	1	0	1	-	-	-	-	-	-	-	175
Max. Volume:																									