Daffodil International University

Inspection of Inherent Weakness of Road Intersection at Dhanmondi Area

Submitted by

Md. Mahfuzul Haque	163-47-227
Al Montasir Mahmud	163-47-264
Md. Al-Amin	161-47-104
Mohaimenul Islam	163-47-277

Department of Civil Engineering

102, Shukrabad, Dhanmondi, Dhaka-1207

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Inspection of Inherent Weakness of Road Intersection at Dhanmondi Area.

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Submitted By

Md. Mahfuzul Haque

Al Montasir Mahmud

Md. Al-Amin

Mohaimenul Islam

Supervised By

Khondhaker Al Momin

Lecturer

Department Of Civil Engineering
Daffodil International University

Declaration

This thesis titled "Inspection of Inherent Weakness of Road Intersection at Dhanmondi Area" was performed for the course completion CE 400, Titled - Project & Thesis.

The whole work is carried out by the authors under the strict and friendly supervision of Khondhaker Al Momin, Lecturer, Department of civil engineering, Daffodil International University (DIU), Dhaka, Bangladesh. Neither thesis nor any part of this has been submitted or is being concurrently submitted elsewhere for any other purpose.

Supervised by:

Khondhaker Al Momin
Lecturer
Department of Civil Engineering
Daffodil International University

Submitted by:

Md. Mahfuzul Haque ID#163-47-227 Department of Civil Engineering Daffodil International University	**Al Montasir Mahmud** ID#163-47-264 Department of Civil Engineering Daffodil International University	**Md. Al – Amin** ID#161-47-104 Department of Civil Engineering Daffodil International University	**Mohaimenul Islam** ID#163-47-277 Department of Civil Engineering Daffodil International University

APPROVAL

The thesis titled "Inspection of Inherent Weakness of Road Intersection at Dhanmondi Area" Submitted by Md. Mahfuzul Haque, 163-47-227, Al Montasir Mahmud, 163-47-264, Md. Al-Amin, 161-47-104, Mohaimenul Islam, 163-47-277 in Department of civil engineering, Daffodil International University (DIU) has been accepted as satisfactory for the partial fulfillment of the requirement of the degree of B.Sc in Civil Engineering on 8th October, 2020.

Khondhaker Al Momin (Supervisor)
Lecturer
Department of Civil Engineering
Daffodil International University

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Dedications

This thesis dedicated to all of our parents and teachers who inspired us for made this effort possible.

Abstract

Intersection is one of the most important components of road communication. Just as a proper intersection can make a road successful, on the other hand, it can also act as one of the obstacles to a road system if the intersection can't cooperate with the demands of road traffic.

In general, this project and thesis inquire into the weaknesses of some major road intersections which are congenital, and how this condition currently affects the overall performance of the traffic system.

Eventually, this evaluation will be helpful to develop an ideal model of an intersection, and based on the ultimate result and the model it will play an adjuvant role in transitioning from its current circumstance. This inquisition will subsequently not only help to build an ideal road intersection system which is ultimately essential for a successful traffic system but also eventually signed for a progressive road structure.

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Chapter One
Introduction

1.1 Background

Due to traffic jams, plenty of working hours have to be left on streets which indirectly put a massive impact on the economy. Imperfect traffic signaling systems, insufficient manpower, slender road spaces, and overtaking tendency of drivers create pro-longed traffic congestions. One of the main reasons of traffic congestion is the design flaws in the road and other issues. These errors are innate, but over time these defects have become apparent. This thesis is mainly based on finding out the essential characteristics of an effective intersection and comparing the pieces of information with some of the busiest and major intersection in Dhaka City and also by finding out their deficiencies. To solve this issue afterward a model has been established on the basis of the overall situation.

1.2 Project Significance

There are several reasons behind the traffic jam. One of which is "inherent weakness" of the intersection. This is one of the major reasons for the decline in the efficiency of traffic signals. This project focuses on this topic and analyzes it. By analyzing these errors or weaknesses, one can get a sense of how much these errors are currently reducing the effectiveness of these traffic routes. And based on these patterns, a model can be developed to solve these problems, which provides a practical idea of current and future actions to solve the problem.

1.3 Objective, scope, and possible outcomes

- Investigating the present situation of intersections
- Design faults
- Current efficiency of the intersections
- Weaknesses of intersections
- Applicability of intersections based on present and future
- Possible process to solve the current problem
- Significance of proposed model

1.4 Methodology

To achieve the above objectives, the research work is initiated by:

- To be aware of the required components of an intersection
- By collecting information about current traffic conditions
- Efficacy of the intersections
- Physical observation of components of intersections
- Observing which essential components are absent in the current condition
- Comparing all intersection data to get an average view of the present situation
- Create an appropriate model based on the collected information and overall situation
-

1.5 Project Organization and Outline

This thesis consists of five chapters. These describe all the respective steps and the plans according to the following outline:

- **Chapter 1 – Introductio**n: This chapter, we described a brief introduction of the thesis, its objectives goals, and a basic outline of the thesis.
- **Chapter 2 – Literature Review:** This chapter presents a literature review for the intersection of its classification and strengthening technique of other tasks related to this research.
- **Chapter 3 – Modeling and Assessment:** In this chapter the current notable features of surveyed intersections. The analysis of this data will extremely helpful in establishing a functional model in the latter.
- **Chapter 4 – Parameter study:** This chapter presents the analytical study which is done by comparing the current system and a new proposed system. The proposed system is the outcome of the analysis from the previous phase.
- **Chapter 5 - Conclusions and Recommendations:** This chapter summarizes the findings of this research, presents its conclusions and makes recommendations for overall safety, several common weaknesses, the effectiveness of the proposed model and for further academic research.

Chapter Two
Literature Review

2.1 Introduction

There are several factors behind the inefficiency of a method or system. In other words, the method will be effective as long as it can keep the balance between the supply and demand. If the demand exceeds the supply, the method loses much of its effectiveness. Therefore, before implementing a method, it is essential to analyze the effectiveness of the method considering the current situation and as well as the future. A city's roadway transportation system is no exception. Intersection design is one of the essential elements of the roadway transportation system. If intersection design is applied without considering current and future needs and problems, then what has been created today to solve the problem may cause the opposite problem in the future. If an intersection is congenitally defective, it will continue to reduce the normal functioning and efficiency of a roadway system until the problem is resolved.

2.2 Definition

Intersection is the place where the joining or crossing of two or more roads happen. The main function of an intersection is to enable the road user to make a route choice (Jakob, 2020).

Intersection Classification(Miah, 2011)**:**

- **Basic form-wise**
  - **At-grade**
    - Tee
    - Wye
    - Cross
    - Skewed
    - Staggered
    - Roundabout
  - **Operation-wise**
    - Uncontrolled
    - Controlled
      - Priority Controlled
      - Signalized

- **Grade Separated interchange**
  - Trumpet
  - Diamond
  - Cloverleaf
  - Roundabout/rotary

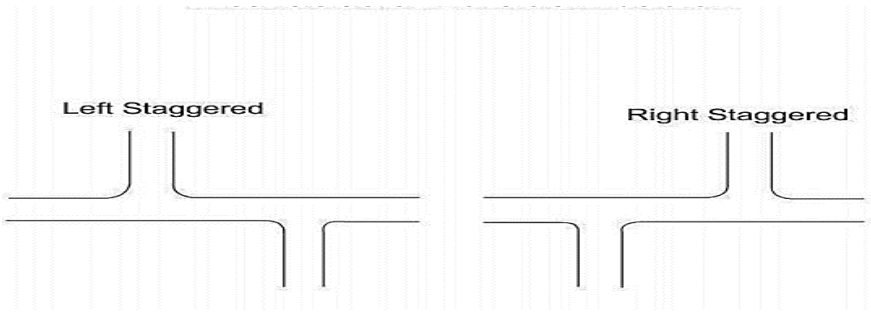
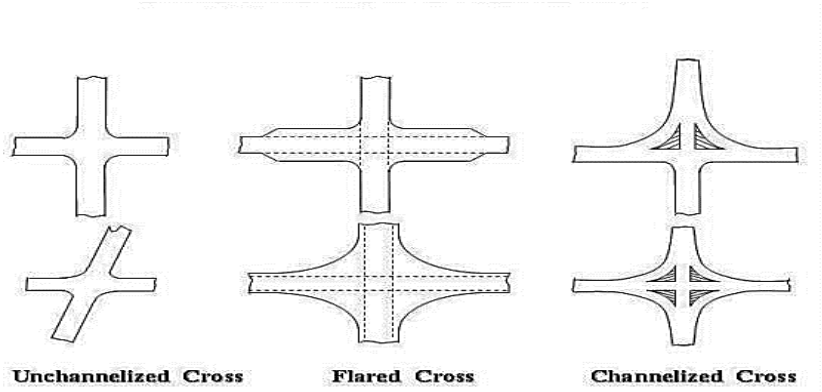


Figure 2. 1: Staggered Intersection.



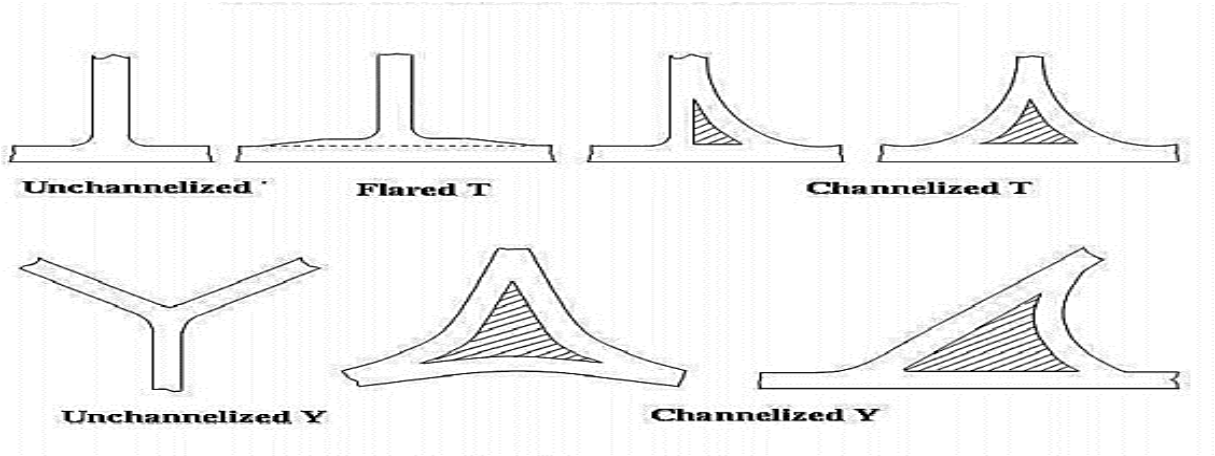


Figure 2. 2: Leg Intersections.

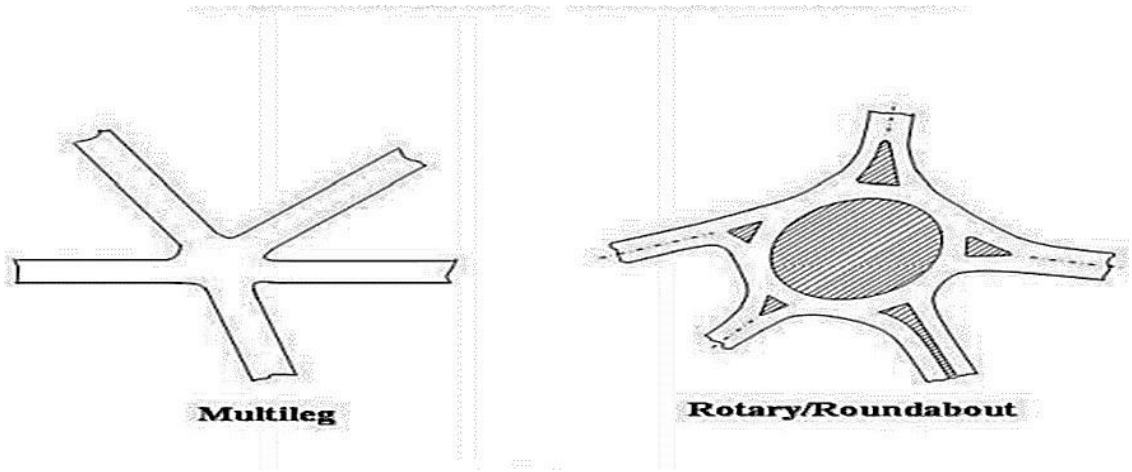


Figure 2. 3: Multi Leg Intersection.

❖ Road Intersection Geometric Layout Configuration Consideration :

1. Untreated/ Non-Engineered Cross Junction

Deficiency – There are no lane markings. Vehicles can easily change lanes, resulting in congestion and accidents.

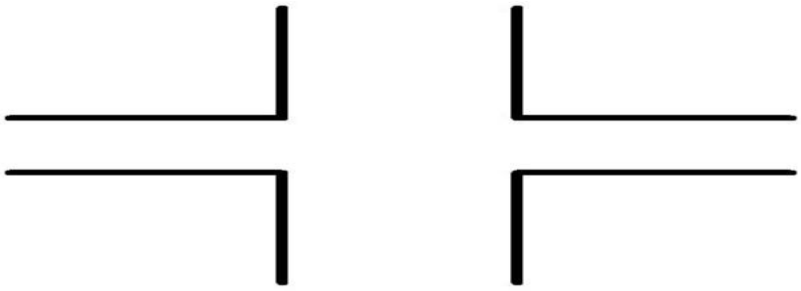


Figure 2. 4: Untreated/ Non-Engineered Cross Junction.

Solution – Lanes are marked. In the context of traffic control, a lane is part of a roadway that is designated for vehicles, to control and guide drivers and reduce traffic conflicts. Most public roads have at least two lanes, one for traffic in each direction, separated by lane markings.

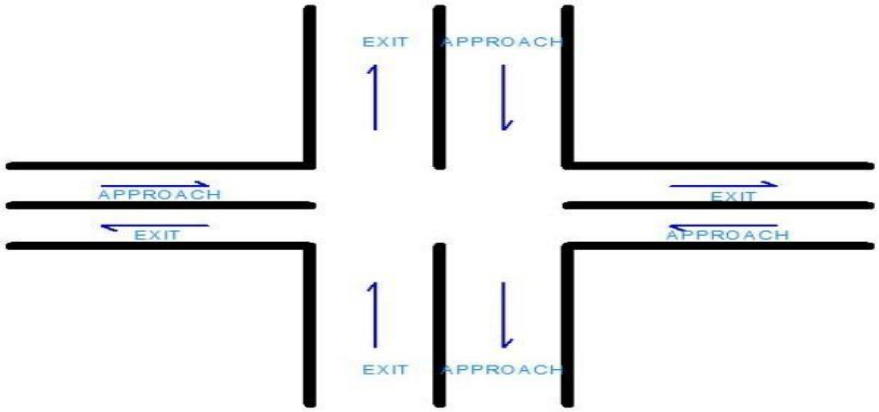


Figure 2. 5: Lane markings.

2. Lane markings dividing the pavement equally

Deficiency – This is non-engineered. By default, the road width is divided in a 50-50 ratio although the demand for traffic flow in one direction may be greater than in other directions.

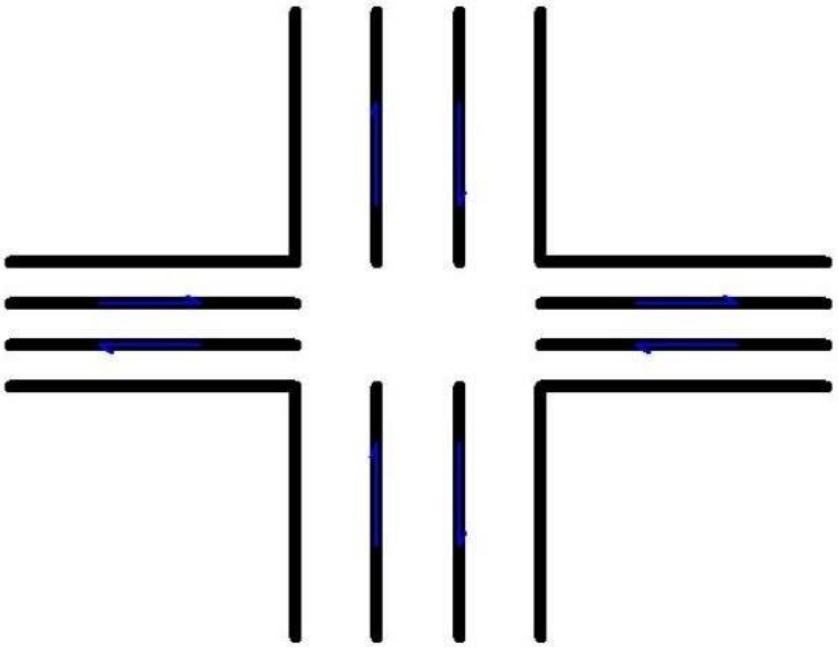


Figure 2. 6: Disproportionate Extrinsic demand.

Solution – Pavement should be divided based on demand. If there are 3 lanes in the road, 2 lanes can be allocated to the direction in which demand is greater and 1 lane in the other direction. This is called disproportionate extrinsic demand.

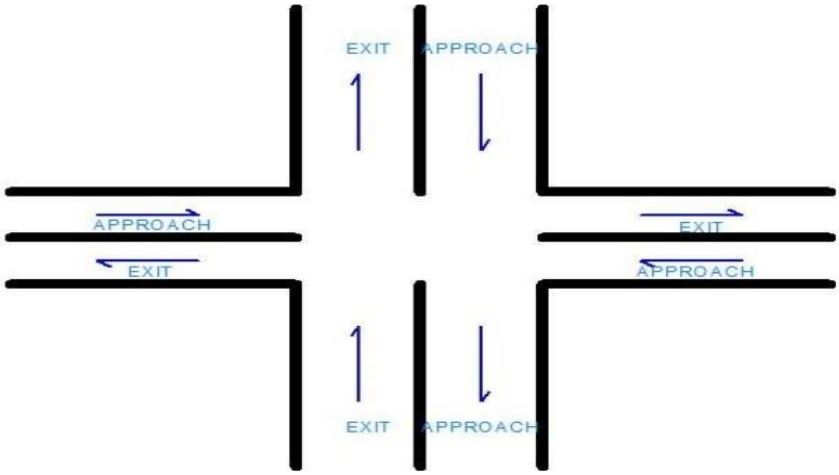


Figure 2. 7: Lane markings dividing the pavement equally.

3. Absence of Stopline

Deficiency – If there are no stop lines, cars won't stop at intersections and proceed ahead. There will be no discipline.

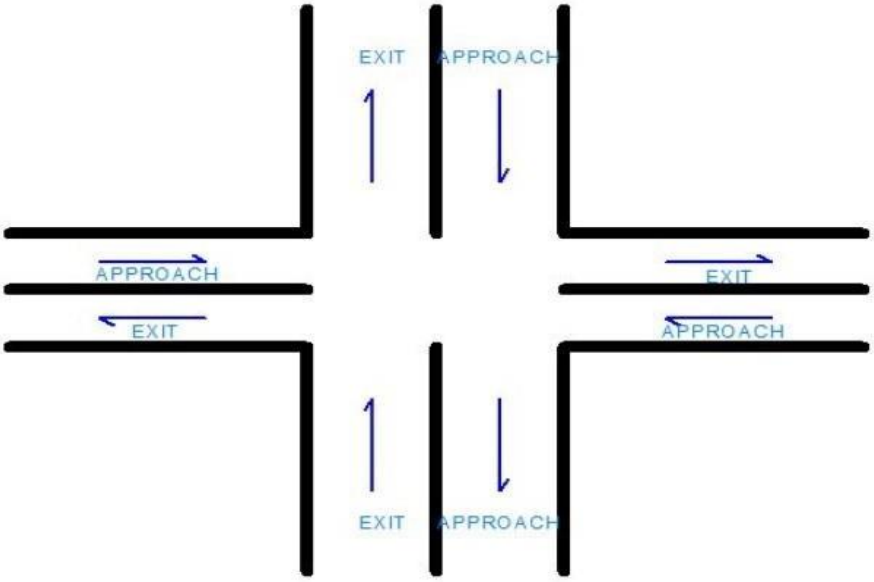


Figure 2. 8: Absence of Stop line.

Solution – A stop line means to give way to all vehicles traveling in, entering or approaching the intersection, whether vehicles are turning left or right, or going straight ahead. Giving way at a stop line means the driver must remain stationary until it is safe for the driver to proceed.

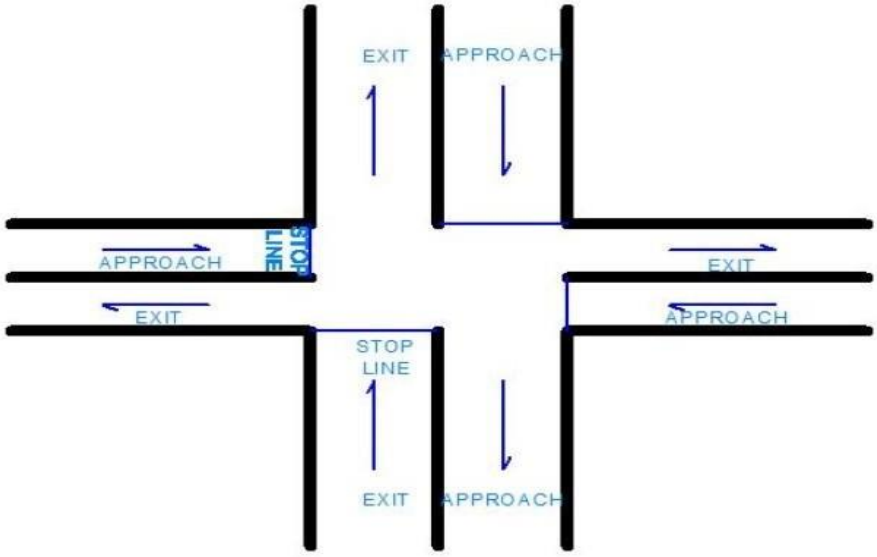


Figure 2. 9: Introducing Stop Lines.

4. Tight Radius/Orthogonal Corners

Deficiency – The more tight the turn is, the lower the speed. If the turn is an orthogonal corner, it is non- engineered and is not possible.

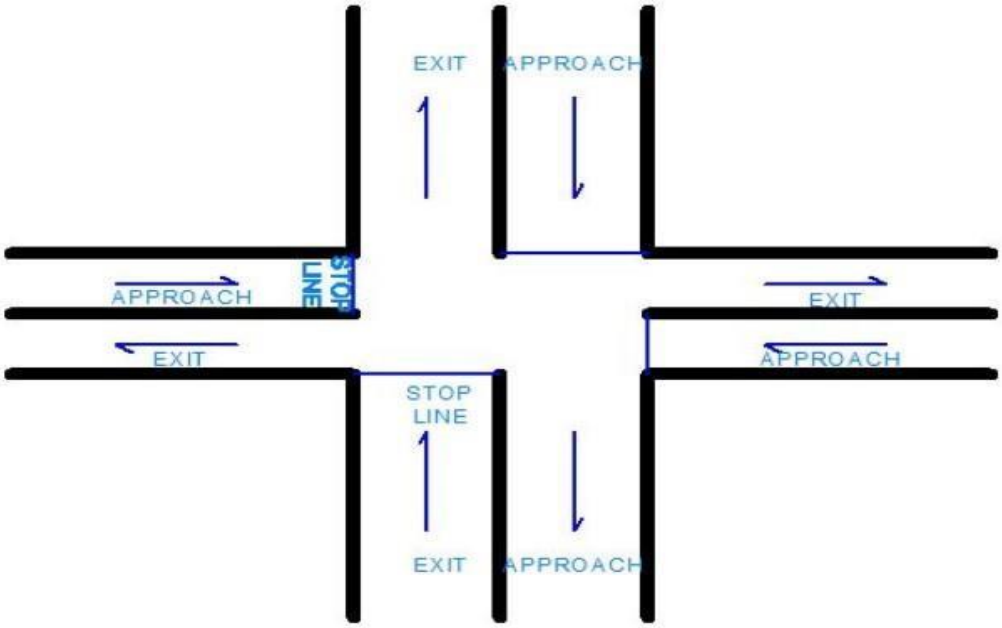


Figure 2. 10: Tight Radius/Orthogonal Corners.

Solution- If the vehicles want to maintain speed at a turn, the road corners must be curved. This is called corner widening. The larger the radius of the turn provided, the greater the speed it can attain.

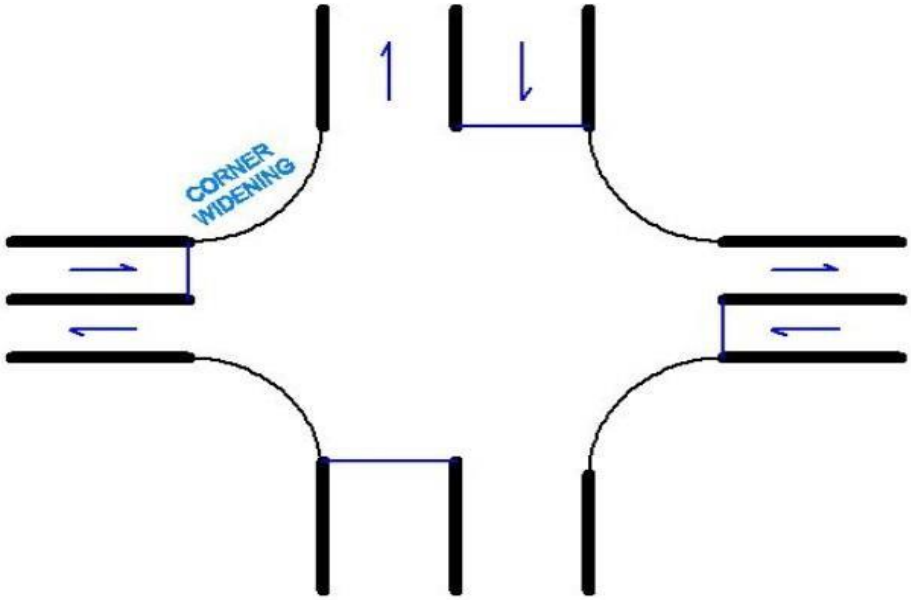


Figure 2. 11: Corner Widening.

5. No Channels

Deficiency – If the cars line up on the right side of the lane to make a right turn, the one in the back want to use the left lane to move ahead, the through traffic can't pass through.

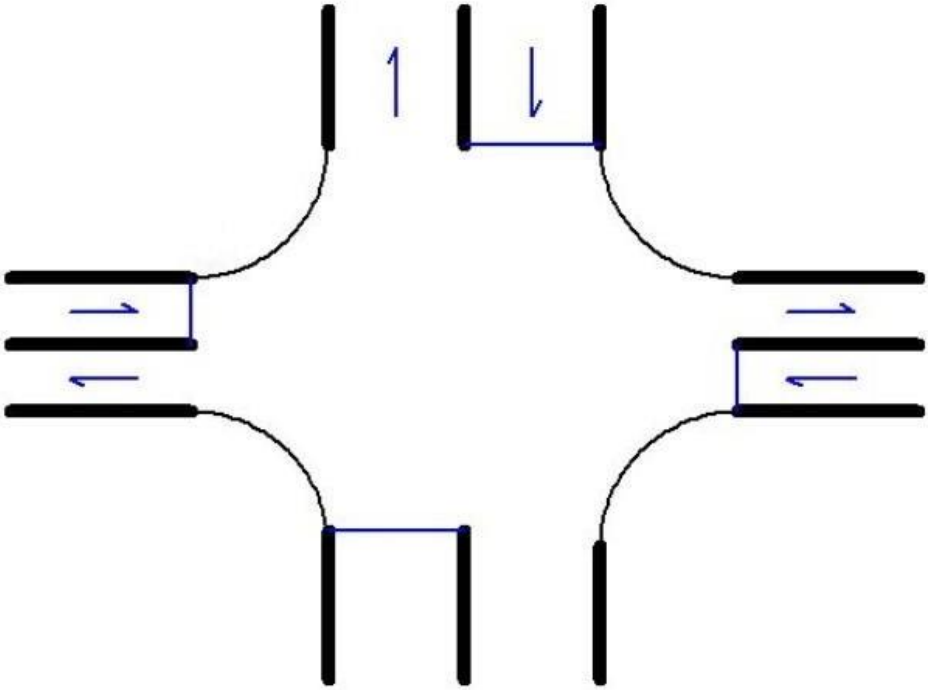


Figure 2. 12: No channels.

Solution – The solution to this is channelization.

- Control of speed: Channelization is also used for supporting stop or speed regulations.
- Channelization moves the stop line forward. So, the added advantage is less travel time.
- Channelization results in small junctions and increase discharge. It makes the actual footprint small.
- Proper Channelization increases junction handling capacity, improves safety, provides maximum convenience, and instills driver confidence.

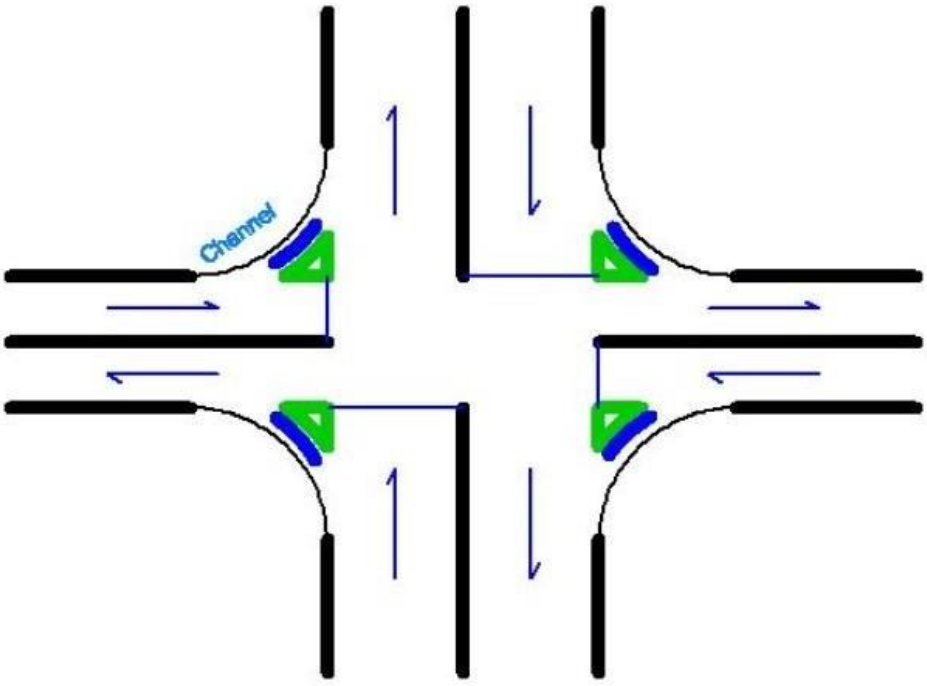


Figure 2. 13: Channelization.

6. Bottleneck

Deficiency – If the approach at an intersection has a greater width than the exit, it results in a bottleneck. Bottleneck intersections cause queue spillover and network gridlock. The problem is inconsistent width.

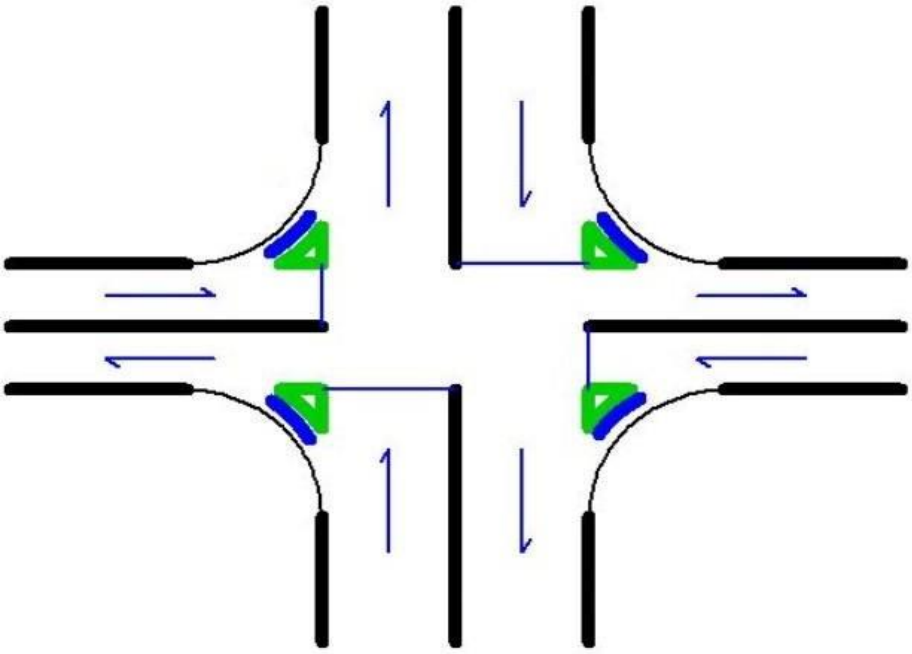


Figure 2. 14: Bottleneck.

Solution – Geometric Proportioning – Approach and exit must be inconsistent width. If there are 3 lanes in approach and 2 lanes in exit, one lane must be blocked for the through traffic. Consistent width eliminates bottleneck.

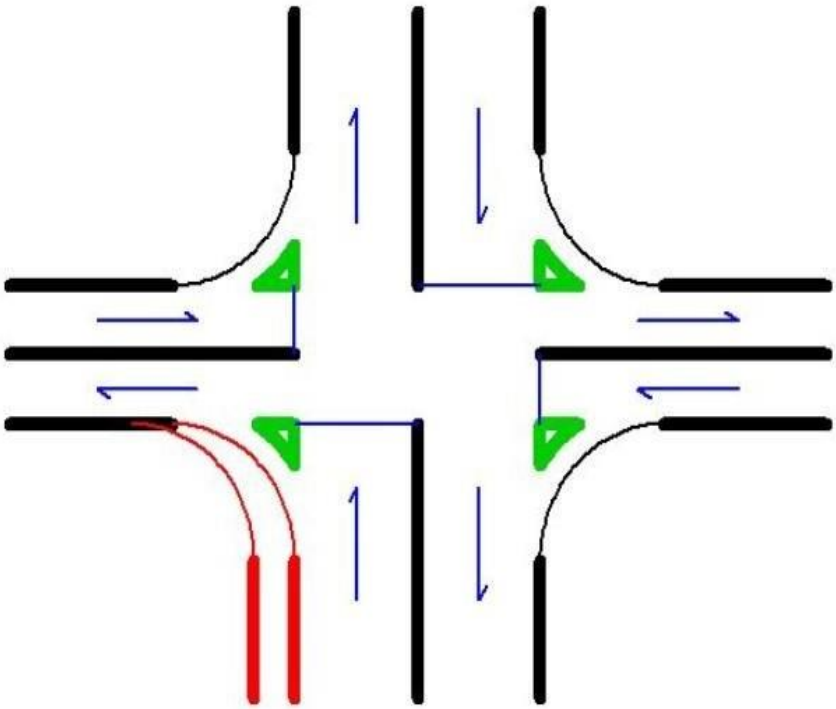


Figure 2. 15: Geometric Proportioning.

7. No smooth curve to help make turns

Deficiency – In a straight road, the radius of curvature is infinity. While making a turn, the car must slow down and the radius must be decreased. If we provide orthogonal corners, the car has to stop which results in congestion.

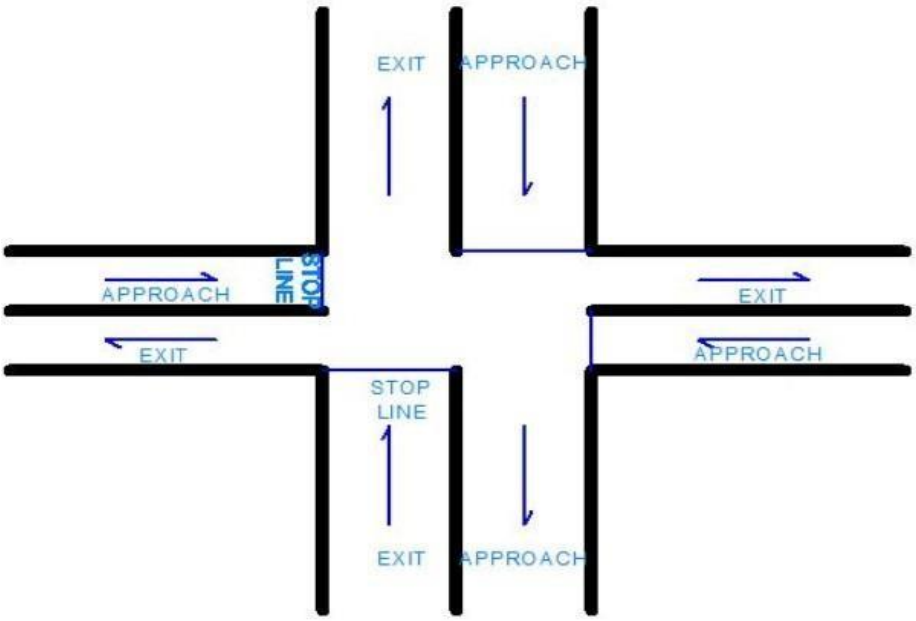


Figure 2. 16: No smooth curve to help make turns.

Solution-The solution is to provide a compound curve which is actually a comfort/smoothing curve consisting of three curves in total with different radius. The approach curve has the greatest radius (R1) since the speed is high. At the turn, the radius (R2) is the smallest and finally, the radius(R3) is increased to accommodate higher speed. This results in free flow.

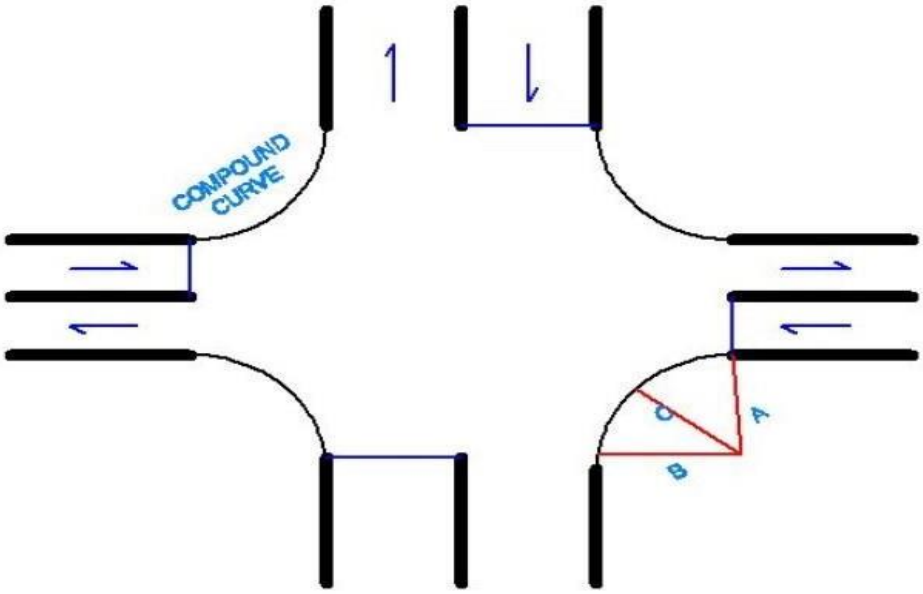


Figure 2. 17: Compound Curve.

8. Right- turnover

Deficiency – Lane waste. If there is one car each making a right turn and a left turn, two lanes are wasted.

Solution – Exclusive right turn or lane is provided. 50% of one lane is taken from opposite sides with respect to centerline which makes one common lane and gives way for through traffic.

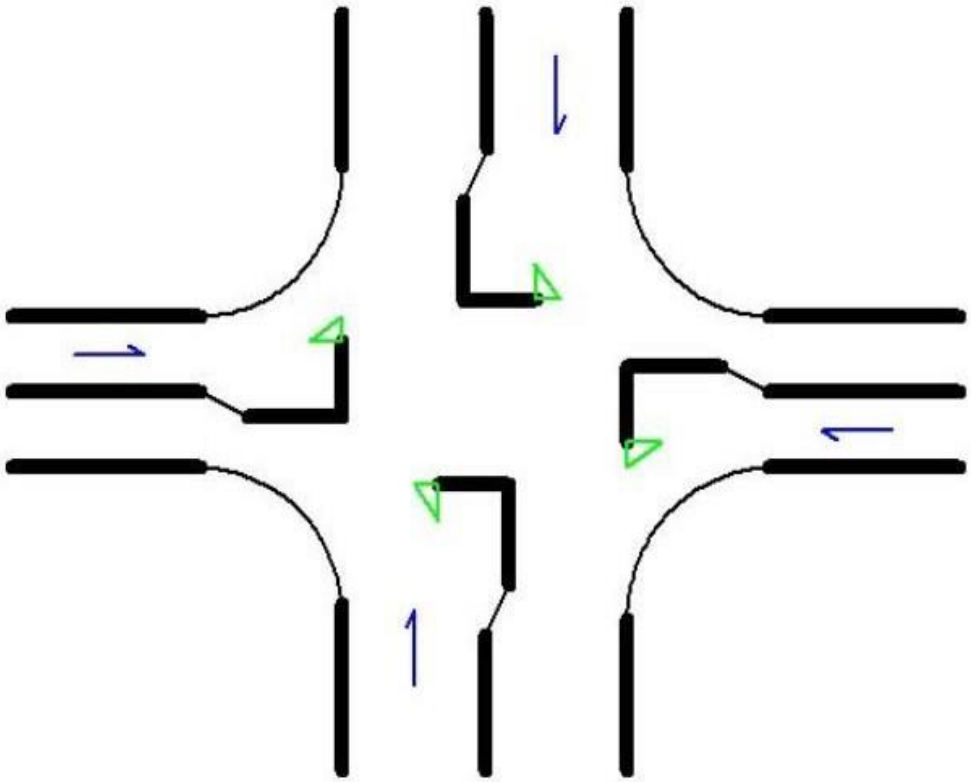


Figure 2. 18: Right- turnover.

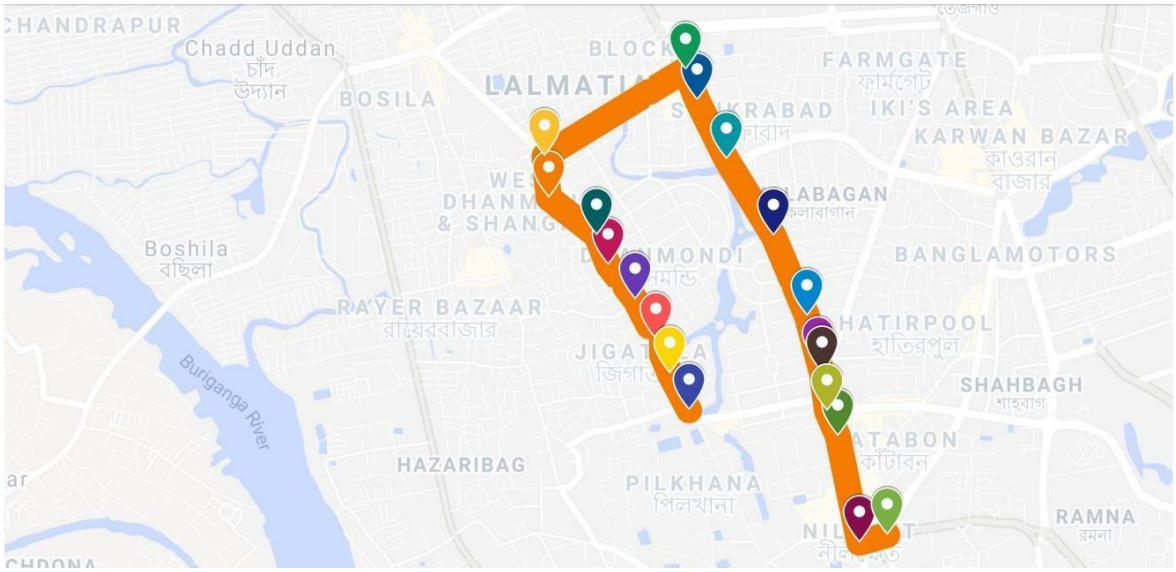
2.2 Summary

According to the considerations and reviews, it is quite clear that there is an essential need to contemplate all these considerations to dispel the common weaknesses of an intersection. The maximum portion of the road of the Dhaka city is extremely affected by huge traffic jam. A greater portion of the traffic jam of this city happens due to the lack of the efficacy of intersections. Considering the current situation of the traffic jam of Dhaka city it is really important to conduct these alluded considerations and effective planning to lessen the rate of traffic jams.

Chapter Three
Modelling & Assessment

3.1 Introduction

This chapter mainly deals with the current crucial features of the intersections of an exiguous part of Dhaka city, which will help to give a proper picture of the overall situation of those places and its appropriate analysis. And this analysis will play a crucial role in creating a suitable model for the salvation from this situation through subsequent comparative research.



Source: Google Map Location of Surveyed Intersections

3.2 Modelling & Assessment

❖ **Overall Observational Data of Intersections:**

Table 1**. Manik Mia Avenue:**

	Features of Intersection	Statement
1	Untreated / Non-Engineered cross-section	Absent
2	Lane marking dividing the pavement equally	Ok
3	Stop line	Ok
4	Tight radius / Orthogonal corners	Not Present
5	Channels	Absent
6	Bottleneck	Present (Vehicles approaches from Asad gate to Dhanmondi 27 & vehicles approaches from farmgate to Dhanmondi 27)
7	Smooth curve to help make turns	Not ok. 90^0 turn
8	Right-turnover	Absent

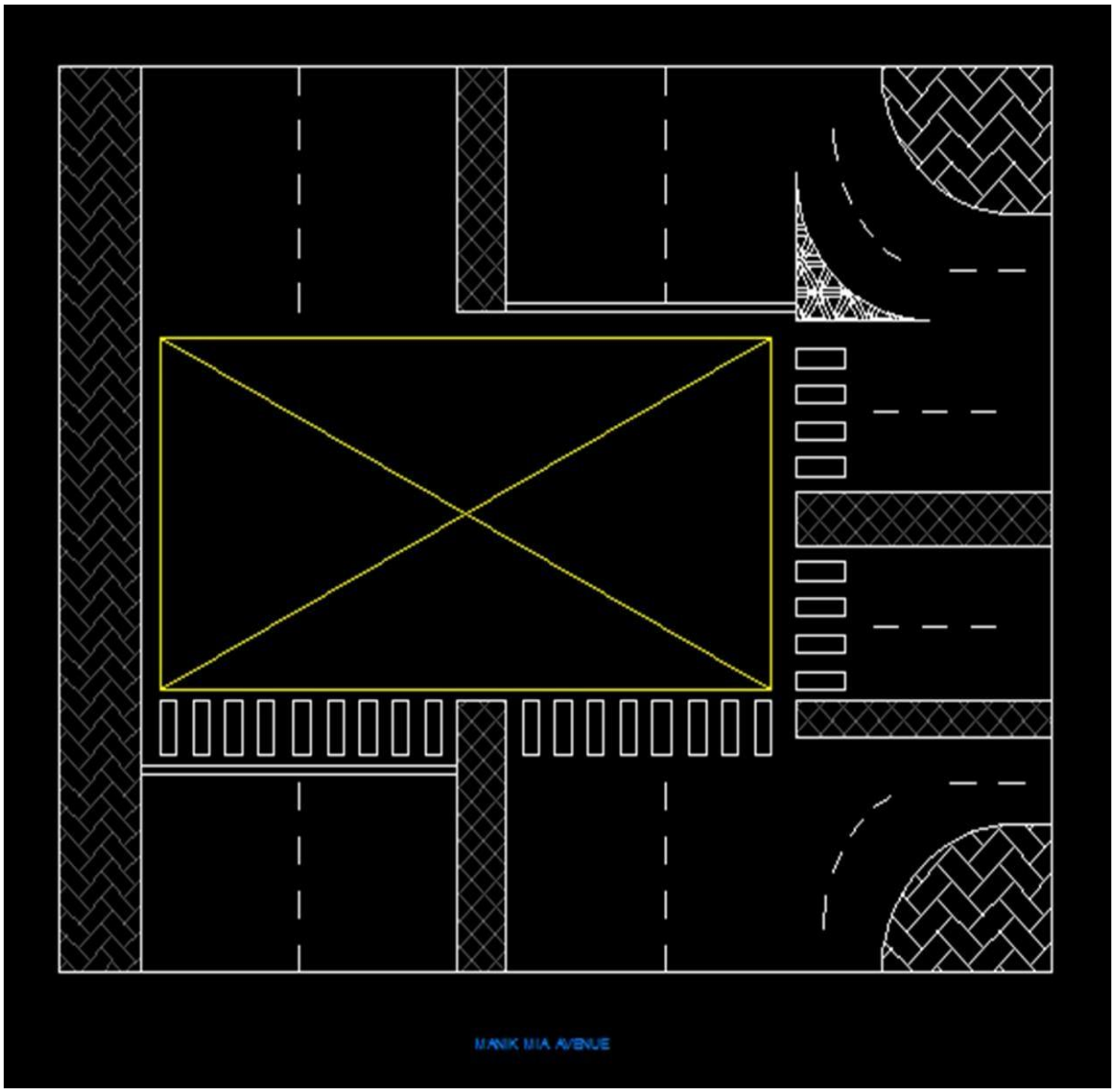


Figure 3. 1: Computer-aided design of Manik Mia Avenue.

Table 2. **Dhanmondi 27:**

Serial	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Present only in front of Rapa Plaza side road**
4.	**Tight radius / Orthogonal corners**	**Present (When vehicles making the turn from Shukrabad to eye hospital road)**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (When vehicles making the turn from Shukrabad to eye hospital road & vehicles moving from the left side to Manik mia avenue)**
7.	**Smooth curve to help make turns**	**Not ok. 90^{0} turn**
8.	**Right-turnover**	**Absent**

Table 3. **Shukrabad:**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Ok**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (When cars move from Dhanmondi 32 to road 12 & the cars from road 12 moving through Shukrabad to Dhanmondi 32)**
7.	**Smooth curve to help make turns**	**OK**
8.	**Right-turnover**	**Absent**

Table 4. **Dhanmondi 32 :**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Ok**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Two channels Present (On Bir Uttam Kazi Nuruzzaman road side)**
6.	**Bottleneck**	**Semi Present (In U-turn)**
7.	**Smooth curve to help make turns**	**OK**
8.	**Right-turnover**	**Absent**

Table 5. **Dhanmondi 29 :**

	Features of Intersection	**Statement**
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Ok**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (When cars passes both 29 road 10 to 67 Kalabagan 2nd Ln and also in U-turn)**
7.	**Smooth curve to help make turns**	**OK**
8.	**Right-turnover**	**Absent**

Table 6. **Dhanmondi 7 :**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Ok**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present when cars pass both (15 Rd No. 7 and 20 Rd No.7) of the road**
7.	**Smooth curve to help make turns**	**Absent (90-degree angle)**
8.	**Right-turnover**	**Absent**

Table 7. **Dhanmondi 6 :**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Ok**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present when cars passes both (14 Rd No. 6and 18 Rd No. 6) of the road**
7.	**Smooth curve to help make turns**	**Ok**
8.	**Right-turnover**	**Absent**

Table 8**. Concord arcadia / Road - 3 (Green road):**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Ok**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Present (1 on Green roadside)**
6.	**Bottleneck**	**Present in U-turn**
7.	**Smooth curve to help make turns**	**Ok**
8.	**Right-turnover**	**Absent**

Table 9. **Science lab signal:**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Semi ok (More lanes will be adequate)**
2.	**Lane marking dividing the pavement equally**	**Absent in branch roads**
3.	**Stop line**	**Absent**
4.	**Tight radius / Orthogonal corners**	**Not Present**
5.	**Channels**	**One channel present in elephant road to new market turn**
6.	**Bottleneck**	**Semi present in Science lab to Dhanmondi turn**
7.	**Smooth curve to help make turns**	**Ok**
8.	**Right-turnover**	**Absent**

Table 10. **Nilkhet :**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Ok**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Present on New Market turn & petrol pump to Palashi turn**
6.	**Bottleneck**	**Present (Due to slow-moving vehicles)**
7.	**Smooth curve to help make turns**	**Present when vehicles move from Newmarket Pilkhana road to Mirpur road & vehicles approaching from Nilkhet road and making the turn in front of the patrol pump through Palashi.**
8.	**Right-turnover**	**Absent**

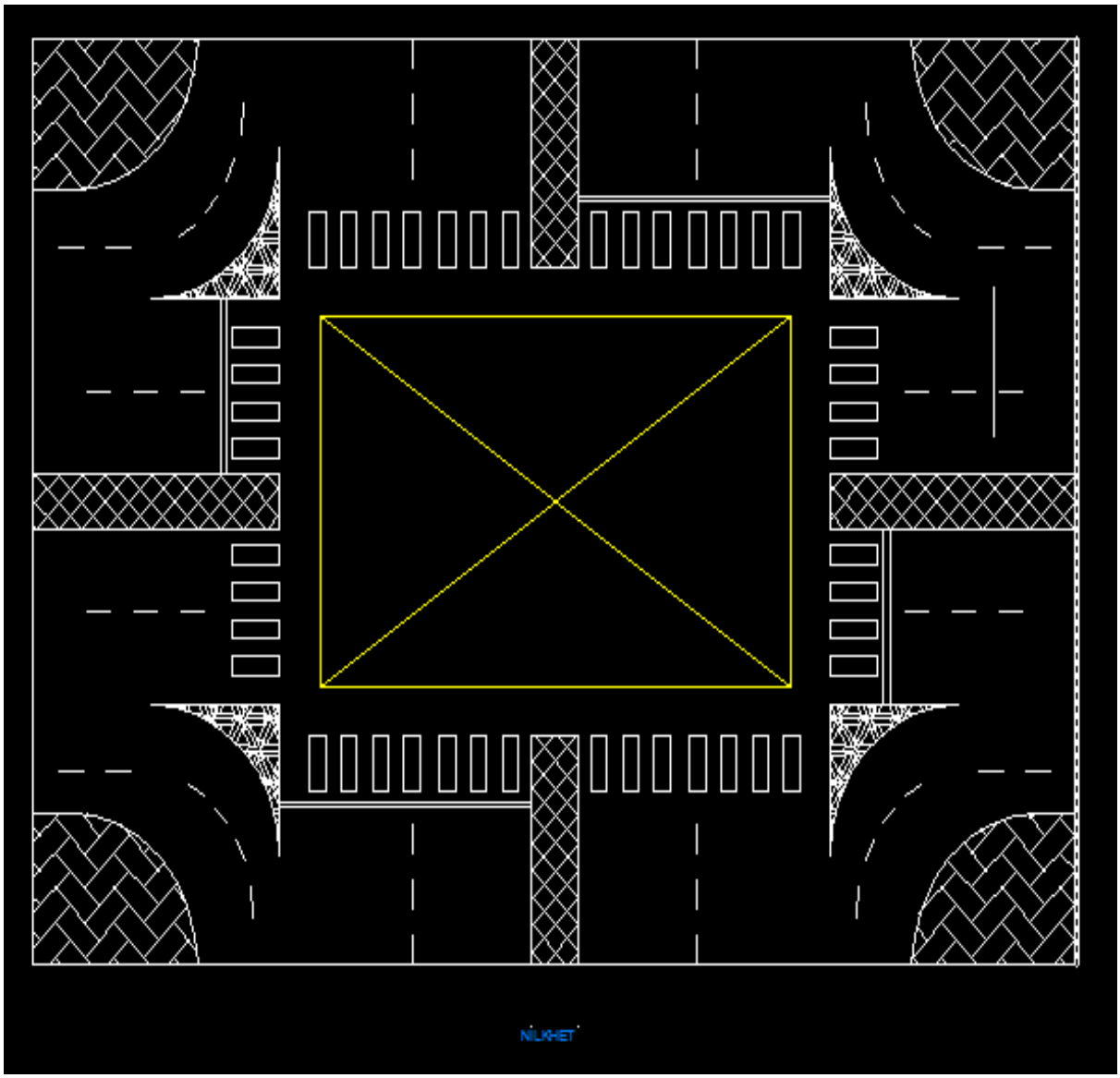


Figure 3. 2: Computer-aided design of Nilkhet.

Table 11. **City corporation market (Nilkhet) :**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Ok**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (When vehicles moves through Zahir Raihan road to Kataban road and east and west side of Nilkhet road)**
7.	**Smooth curve to help make turns**	**Ok**
8.	**Right-turnover**	**Absent**

Table 12. **14 Bir Uttam M A Rab Road/Star Kabab:**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Absent**
4.	**Tight radius / Orthogonal corners**	**Absent**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (U-turn)**
7.	**Smooth curve to help make turns**	**Absent (90-degree angle)**
8.	**Right-turnover**	**Absent**

Table 13. **Fortune Square:**

	Features of Intersection	**Statement**
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Absent**
4.	**Tight radius / Orthogonal corners**	**Present**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (U-turn)**
7.	**Smooth curve to help make turns**	**Absent (90-degree angle)**
8.	**Right-turnover**	**Absent**

Table 14. **Jigatola Bus stand:**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Present**
4.	**Tight radius / Orthogonal corners**	**Present**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (U-turn and when vehicles move from the east and west side of the 50 Rd No. 3A)**
7.	**Smooth curve to help make turns**	**Absent (Almost 90-degree angle)**
8.	**Right-turnover**	**Absent**

Table 15. **Medinova/ULAB:**

	Features of Intersection	**Statement**
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Absent**
4.	**Tight radius / Orthogonal corners**	**Present**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (U-turn)**
7.	**Smooth curve to help make turns**	**Absent (90-degree angle)**
8.	**Right-turnover**	**Absent**

Table 16. **Ibn Sina hospital/Mega builders:**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Present**
4.	**Tight radius / Orthogonal corners**	**Present**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (U-turn and east and west side of 53 Rd No 9A)**
7.	**Smooth curve to help make turns**	**Ok**
8.	**Right-turnover**	**Absent**

Table 17. **ADC empire plaza:**

	Features of Intersection	**Statement**
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Absent**
4.	**Tight radius / Orthogonal corners**	**Present(U-turn)**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (U-turn and north and south side of Rd No. 12A)**
7.	**Smooth curve to help make turns**	**Almost 90-degree angle**
8.	**Right-turnover**	**Absent**

Table 18. **Abahani Playground:**

	Features of Intersection	Statement
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Absent**
4.	**Tight radius / Orthogonal corners**	**Present(U-turn)**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (U-turn)**
7.	**Smooth curve to help make turns**	**Almost 90-degree angle**
8.	**Right-turnover**	**Absent**

Table 19. **Bangladesh eye hospital:**

	Features of Intersection	**Statement**
1.	**Untreated / Non-Engineered cross-section**	**Absent**
2.	**Lane marking dividing the pavement equally**	**Ok**
3.	**Stop line**	**Present**
4.	**Tight radius / Orthogonal corners**	**Present**
5.	**Channels**	**Absent**
6.	**Bottleneck**	**Present (In U-turn and when vehicles move either Satmasjid road to Dhanmondi 27 or Dhanmondi 27 to Satmasjid road)**
7.	**Smooth curve to help make turns**	**90-degree angle**
8.	**Right-turnover**	**Absent**

3.3 Summary

From This chapter, the following points can be concluded:

- The effectiveness of these intersections is inefficient compared to the current condition.
- Absence of uniform and natural flow of traffic.
- The possibility of Common accidents are strong.
- Less safety for pedestrians.
- Traffic congesting is a common scenario.
- Insufficient road markings.

Chapter Four
Parametric Study

4.1 Introduction

In this chapter, a parametric study is done by comparing the current system and a new proposed system. The proposed system is the outcome of the previous analysis. There are multiple ways to gain the desired outcome. It is not possible to investigate each and every parameter. So, a feasible model is selected as a competent one. The parameters that will be discussed in this chapter are:

- Explored observation and analysis of several considerable intersections.
- Proposed Intersection model and review of it.

4.2 Case Study:
Overall analysis of deficiencies and features of surveyed intersections :

Serial	Features of Intersection	Abahani Playground	ADC empire plaza	Japan Bangladesh frienship Hospital	Bangladesh eye hospital (Sankar)	City corporation market (Nilkhet)	Concord Arcadia / Road - 3	Dhanmondi 6	Dhanmondi 7	Dhanmondi 27	Shukrabad
1	Proper Sign and Lane Marking	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok
2	Stop line	Absent	Absent	Present	Present	Present	Present	Present	Present	Semi Present	Absent
3	Corner Widening	Present	Present	Present	Present	Present	Present	Absent	Present	Present	Absent
4	Proper Channelization	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
5	Bottleneck	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present
6	Smooth curve to make right turn	Absent	Absent	Absent	Absent	Present	Present	Present	Absent	Absent	Present
7	Right- turnover	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
8	Zebra Crossing	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
9	Exclusive Left turn	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Serial	Features of Intersection	Dhanmondi 32	Fortune Square	Ibn Sina Hospital	Jigatola Bus stand	Kalabagan	Manik Mia Avenue	ULAB	Nilkhet	Science Lab	Star Kabab
1	Proper Sign and Lane Marking	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok
2	Stop line	Present	Absent	Present	Present	Present	Ok	Absent	Present	Absent	Absent
3	Corner Widening	Absent	Present	Present	Present	Absent	Absent	Present	Absent	Absent	Absent
4	Proper Channelization	Two channels Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent
5	Bottleneck	Semi Present	Present	Present	Present	Present	Present	Present	Present	Present	Present
6	Smooth curve to make right turn	Present	Absent	Present	Absent	Present	Absent	Absent	Semi Present	Present	Absent
7	Right- turnover	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
8	Zebra Crossing	Present	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent
9	Exclusive Left turn	Present	Absent	Absent	Absent	Absent	Present	Absent	Present	Present	Absent

Table 20. **Combined numeral configuration consideration among surveyed intersections.**

From the surveyed data it appears that almost 63% of intersections doesn't contain any stop line but without stop line, there will be no discipline because vehicles won't stop at intersections and proceed ahead. There is around 58% of intersections also have tight radius or orthogonal corners. The tighter the turn is, the lower the speed. Whether the turn is an orthogonal corner or right angle then vehicles will be forced to lose its speed in that turn. If the vehicles want to maintain speed at a turn, the road corners must be curved. This is called corner widening. The larger the radius of the turn provided, the greater the speed it can attain. It would have been more appropriate if there were more channels in some major and busy intersections because channelization provides maximum convenience and instills driver confidence, increases junction handling capacity & improves safety. The overall observations have shown that In 18 out of 19 intersection bottleneck occurs, which is really pessimistic. This complication happens because the approach of those intersections contains greater width to exit ratio. To get retrieve from this approach and exit must be inconsistent width. If there are 3 lanes in approach and 2 lanes in exit, one lane must be blocked for the through traffic. Consistent width eliminates bottleneck. There is almost 53% of the intersections that don't contain a smooth curve. In a straight road, the radius of curvature is infinity. While making a turn, vehicles must slow down and the radius must be decreased. It also occurs due to orthogonal corners and as a result, vehicles have to stop which results in congestion. The solution is to provide a compound curve that is helpful to make turns without losing vehicle speed. It is worth noting that there is no Right- turnover in any surveyed intersections but it will really utile as purpose to turn a vehicle without the wasting lane. This results in a free flow.

Significant features and affirmations of the proposed model:

1) Median strip: The median strip is the reserved area that separates opposing lanes of traffic on divided roadways. It is suitable for divided roadways other than highways, such as some major streets in urban or suburban areas(Country lane, 2019). The reserved area may simply be paved, but commonly it is adapted to other functions; for example, it may accommodate decorative landscaping, trees, a median barrier or railway(Proz, 2015), rapid transit, light rail or streetcar lines(WikiMili, 2019).

Purpose of Medians:

- Provide separation between traffic traveling in opposite directions.
- Provide a refuge zone for pedestrians crossing heavily-trafficked areas.
- Provide an area for landscape plantings and bio-retention systems.
- Access control of vehicles.
- Addresses differences in grade between opposite travel lanes within the ROW.
- Location for the placement of transit stations.

2) Box junction: A box junction is a road traffic control measure designed to prevent congestion and gridlock at junctions. The surface of the junction is typically marked with a yellow crisscross grid of diagonal painted lines (or only two lines crossing each other in the box), and vehicles may not enter the area so marked unless their exit from the junction is clear, or they are intending to turn right and are prevented from doing so by oncoming traffic(Wikizero - Box junction, 2016), or other vehicles on the box waiting to turn right. Box junctions may be painted on other areas of roadway which must be kept free of queuing traffic, such as exits from emergency vehicle depots, level crossings, and car parks(AUTOJOSH, 2018).

3) Speed Breaker: A speed breaker is a hump surface across the roadway having a rounded shape with a width greater than the wheelbase of most of the vehicles using the road. When there is decrease variation in sensory stimuli and at locations where speed controls are desired, a speed breaker acts as a strong stimulus to arouse a reaction in the brain. Since the driver reaction times are faster in response to audible and tactile stimuli than to visual stimuli, a driver subconsciously reduces the speed(Lawgic, 2015). It is suitable for the intersections of minor roads with major roads, and mid-block sections in urban areas where it is desirable to bring down the speeds and selected local streets in residential areas(RDSO, 2016), school, college or university, campuses, hospitals, etc. Also, in areas where traffic is observed to travel faster than the regulated or safe speed in the area.

4) Pedestrian crossing: Pedestrian crossing or crosswalk is a painted road surface where pedestrians may cross a road. It is part of a safety system that allows people to crossroads when it is safe to do so. In town and cities, traffic and pedestrians are both users of roads. There must be rules which keep pedestrians safe, but allow traffic to flow as smoothly as possible(Wikipedia, 2019). In this intersection model marked pedestrian crossings is used because it indicates optimal and preferred locations for pedestrians to cross and help designate right-of-way for motorists to yield to pedestrians.

5) Road Marking: Road Markings are the colored paintings on the road that provide guidance for disciplined and safe driving. It is suggested to mark all the major roads with lanes, edge, and median markings together with delineators(Ctp, 2019).

Types of intersectional markings included:

- Stop Lines
- Give way Lines
- Pedestrian Crossings
- Marking on approach to Intersection
- Marking on Speed Change Lane
- Directional arrows
- Protected Right Turn lanes
- Box Markings

Functions of lane marking :

- Perform an important function of guiding and controlling traffic.
- Serve as a psychological barrier and signify the delineation of the traffic path.
- Channelize the movement of the pedestrians and cyclists into the safe zones((r2), 2015).
- Conveys information to road users without distracting the attention from the carriageway(CHANDNA, 2019).
- It is indispensable to ensure a smooth & orderly flow of traffic and for promoting road safety.

6) Footpath: Footpath or pedestrian way is a type of thoroughfare that is intended for use only by pedestrians. The pedestrian gets a lot of benefits and safety while walking on the road due to the footpaths(hena5858, 2019). It also helps pedestrian to stand and wait at someplace without any tension of vehicle hitting. The use of railings in footpaths are an effective measure to protect pedestrians from the dangers of traffic(Curran, 2015).

7) Corner Widening: The narrow angled or orthogonal corner is one of the main reasons behind lowering the speed of a vehicle. In the orthogonal corner of an intersection, vehicles are to be forced to lose their speed in that turn. The larger the radius of the turn provided, the greater the speed vehicles can attain. The provided corner in the model is curved (< 90° angle) to resolve this deficiency.

4.3 Summary

From this chapter, it can be concluded that, without termination of the weaknesses of the current intersection the desired goal of a dynamic intersection could not be achieved. Apart from some inessential intersections, the proposed model could be efficient to apply the in major intersections. And it is quite clear that the current system will fail in the near future. On the contrary, it could lead to more serious problems If the current situation is not resolved forthwith and effectively.

Chapter Five
Conclusion & Recommendations

5.1 General

Intersections are a critical element of a roadway or road section. They are normally applied as a major bottleneck to the smooth flow of traffic in major accident spots. That doesn't mean that it always will be able to coup with any circumstances. A plan should be formulated only after considering the present and future overall situation. Otherwise, it will not be effective. The performance of a signalized intersection is judged based on its signal timings. The efficiency of an intersection is determined on the basis of how well it accommodates the demands of all road users (Imran, 2016) The dangers to pedestrians and road users have to be considered before implementing an intersections. The main goal of this research work was to study the real situation of some important intersections. And based on the study generating a model that will be able to eliminate the laxness of ongoing circumstances. To resolve the major issues in intersections this will be helpful for further study.

5.2 Findings of the study

- The present performance condition existent intersection is certainly inadequate.
- Deficiency of evenly and natural circulation of traffic.
- The potential chance of common accidents is high.
- The limitations of the current intersection have been overcome through the proposed model.
- The proposed model is more efficient than present intersections and it is designed. regarding the aspects to overcome the current and oncoming complexity.

5.3 Limitation

- Couldn’t be able to capture the top (360º) view of intersections.
- Data from different periods could not be collected.
- More intersections data could be more helpful to display the overall condition of the intersections.
- It would have been more effective if (NEXUS® Intersections, SIDRA) these types of software were used for evaluation, planning, and design.

5.4 Recommendation for Future

- The analysis will be more efficient and effective if data are procured from more and more intersections in different places.
- The intersection analysis and design software could be used to get more precise resolution.
- Data can be taken from various periods of time to obtain an elaborate view.
- In addition to the vulnerabilities mentioned here, each intersection may have other vulnerabilities that can be worked out in the next analysis.

5.5 Concluding Remarks

Excepting a competent intersection, it is inconceivable to maintain a several busy roadways successfully. Since it is one of the most essential elements to maintain uninterrupted traffic operation. So, in this thesis work, it has been tried to formulate an adequate model which is based on the overall analysis involved in it. This model is accomplished to take into consideration of safety, effectiveness, and common weaknesses related to intersection. A susceptible intersection will certainly be able to offer a disturbance-free system for vehicles and pedestrians. Thinking a little deeper it becomes clear that it is ultimately essential for improving the economy of a country and the quality of life of its people.

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