GEOMETRIC DESIGN OF T-INTERSECTION IN AN URBAN AREA

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ABSTRACT
Geometric design of T-intersection is one of the essential parts for the development of city to reduce traffic congestion. Safe, efficient and economic operation of a highway relies on how assiduously geometric design of intersection has been worked out. That is possible only if the design elements have been meticulously considered. Chittagong city, the commercial capital of Bangladesh is considered as the heart of national economy. An efficient road network is badly needed here to boost up the economy of the country. There are many T-intersections in this city which are the cardinal points influencing the city roads and traffic conditions. Using the selected data and prescribed formula, the practical capacity have been evaluated and compared with the total traffic for the particular T-intersection. It has been found that the practical capacities are larger than the existing traffic volume. So geometric elements of the intersections can be treated as quite satisfactorily. But due to illegal parking and traffic mismanagements, traffic congestion is frequently observed at the T-intersection. For solving it, some suggestions are enclosed regarding traffic congestion and given remedial measures for T-intersection.
Keywords: geometric elements, T-intersection, practical capacities & traffic congestion.

INTRODUCTION
Transportation system is one of the infrastructures of a city. Most of the economic status depends upon the transportation systems. The efficiency, safety, speed, cost of operation and capacity of road systems very much depend on the intersection design. Some of the factors to be considered in intersection design. In roadway, intersection is the most critical part. Intersection is defined as the area where three or more roads intersect with is other. At the intersection turning and crossing depends on the types of intersection. The growth of traffic in road network of large cities is serious concern from traffic Engineers point of view. Improper intersection creates traffic congestion which affects the performance of intersection and overall road network. Intersection directly influences socio-economic development of the city as well as the country. So the intersection should be properly designed and managed. Chittagong City, the commercial capital of Bangladesh and the area experiencing rapid population growth and boom in vehicle number with traffic congestion has been examined in this thesis work.. The development of commercial area, residential area and industrial area are depends on intersection. Proper intersection design reduces jamming concentration which save the time and attract the foreigners for investment. Intersection is a compulsory part of traffic management system in the city area, must function properly to be success in achieving goals of regional development. From the above discussion the following objectives have been selected for the present study.

1. Investigation of some T-intersection at present condition and its problem identification.
2. To study the traffic volume of the present condition at the selected intersection.
3. To compare obtained result with standard values.
4. To propose a new channelization as a remedy for traffic congestion.

METHODOLOGY (SECTIONS)

The entire procedure is composed of some continuous functions following reaching point of finishing threshold. The work done under this project is shown with a flow diagram in Fig. 4.1.

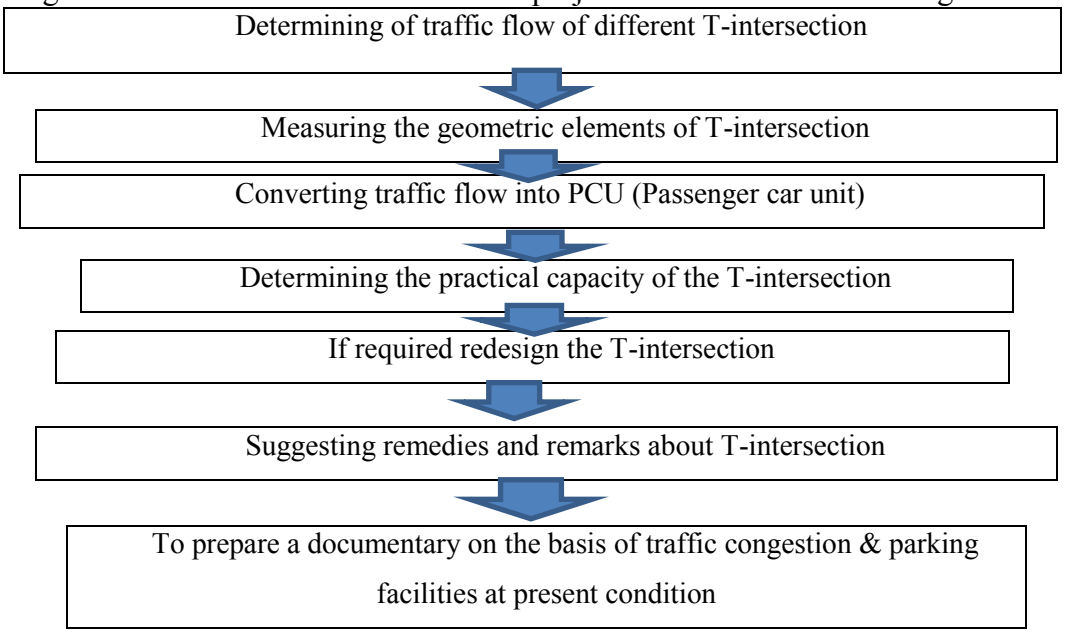


Fig 1: Work flow diagram showing the performed steps

Among many other intersection in Chittagong City two T-intersection sites(Kaptai Raster Matha and CNB intersection) under inspection and study have been selected as vulnerable ones those remaining in need of proper treatment. The performance of observing as well as auditing, the existing geometries at the selected intersection are successfully done. Tapes have been used to measure the present geometries. The weaving length, weaving width, entry width, radius and diameter of central island have been measured. The other geometries such as entry angle, exit angle, internal angle to weaving section are calculated. The traffic flow is counted manually at the selected intersection per hourly with left turning, right turning, straight and u-turning with carefully. The traffic survey is done at peak period. 7 hours traffic volume data were recorded for getting peak hour and also the maximum number of vehicles. The different types of vehicles are counted separately and converted into passenger car units [4] to get the generalized idea about the traffic flow. The geometric elements which govern practical capacity are measured and calculated. A generalised formula [5] recommended by The Transport and Road Research Laboratory (U.K) used to determine the practical capacity is mentioned in equation (1)

$$Qp = \frac{[280w(1+e/w)(1-p/3)]}{(1+w/l)} \quad (1)$$

A channelization in existing T-intersection with defined parking facilities is proposed for minimizing confliction between right turning and u-turning traffic. A channelization intersection is one in which traffic is directional into definite paths by islands and markings.

INVESTIGATION

Causes of traffic jam

Chittagong city is the busiest city in Bangladesh due to port of Karnophuli. Most of the goods transfer from this city to another city. So intersection is to be designed very carefully. Otherwise due to improper designed jamming concentration increases are various causes of traffic jam at the intersection. Some of the causes investigated at the T intersection. This types of congestion occurred due to traffic mismanagement, illegal parking and improper design of the intersection. Some of the causes of traffic jam at the intersection have been shown below:

1. Mismanagement of the traffic rules at the intersection.
2. Illegal CNG, Rickshaw parking.
3. Illegal loading and unloading buses at intersection.
4. Composition of traffic at the same road.

Determination of existing geometric dimension:

The existing geometric dimension of Kaptai rastar matha and CNB have been shown in Fig.2 and Fig. 3.

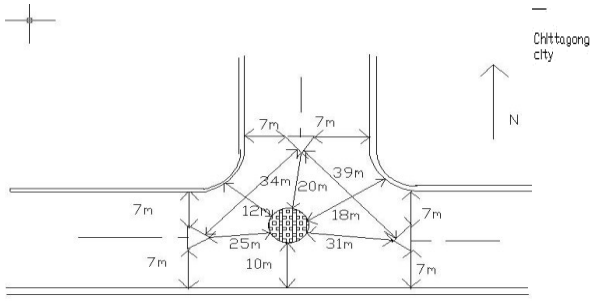


Fig. 2: Existing Geometric dimension at Kaptai rastar matha CNB

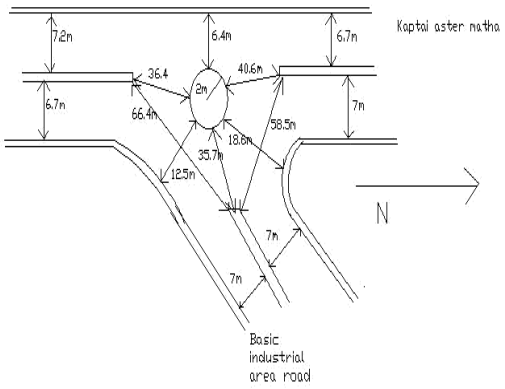


Fig. 3: Existing dimension at T-intersection

The existing geometric dimension is measured at Kaptai rastar matha and at CNB and compared with standard values. The standard dimension of geometric elements according to AASHTO are shown in Table 1.

Table 1: The standard dimension of geometric elements according to AASHTO

Name of the geometric element	1.Entry width (e_1)	2.Non-weaving width (e_2)	3.Weaving width (w)	4. Weaving length (L)
Standard value (m) (AASHTO)	7 (For 2 way road)	7 (For 2 way road)	10.5	30 (For urban area)

Traffic volume study

In the intersection at every legs, traffic volume have been collected. There are various types of traffic on the intersection so traffic flow counted separately. At the leg of the intersection all of the straight, left turning, right turning traffic have been collected separately. Generally tally methods are used for

determining traffic flow. Various types of traffic converted in a single unit in PCU (passenger car unit). The collecting traffic volume converted into PCU , sample calculation of which have been shown in Table 2.

Table 2: Daily Traffic flow Chart for the face Kaptai to Chittagong City at
Kaptai Rasta Matha (Date: 25/3/2015)

Time limit (HR)	CNG/ Car (1.0)	Ricksha w/two Wheels (2.0)	Mini Bus/ Mini Truck (1.75)	Bus/ Truck (2.8)	Heavy Truck (3.50)	Tempo /Micro (1.50)	Hand Drawn Vehicle (5.0)	Total (PCU)
7.40-8.40 AM	210	69	15	11	3	34	1	472
8.40-9:40 AM	212	62	15	8	2	24	0	490
9.40-10.40 AM	275	77	12	7	1	29	1	522
10.40-11:40 AM	245	70	9	9	2	19	1	467
4.30- 5:30 AM	267	72	21	16	6	41	0	575
5.30-6:30 AM	245	82	17	21	6	48	0	684
6.30-7:30 AM	238	75	14	19	11	42	0	568

Geometric design of Kaptai raster matha

Kaptai raster matha is one of the most important intersection in Chittagong city. Most important tourist area Kaptai lake is connected by Kaptai raster matha intersection. CUET is also connected by this intersection. Some of heavy vehicle is gone Kalurghat industrial area by using this intersection. More flow than Kaptai road is generated in here every day. Tourist vehicles are found at the vacation. This intersection influences the traffic volume at a great extent. The peak hour value has been shown in Table 3.

Table 3:Traffiic flow data in PCU at Kaptai raster maatha(peak hour)

Approach	Left turning	Right turning	Straight ahead	U-turning
Chitagong City to Kaptai rastar matha intersection	587	0	970	74
Kaptai to Kaptai rastar matha intersection	311	684	0	146
Karnopuli to kaptai rastar matha intersection	0	331	1037	68

The collected traffic flow data have been shown in Fig 4.

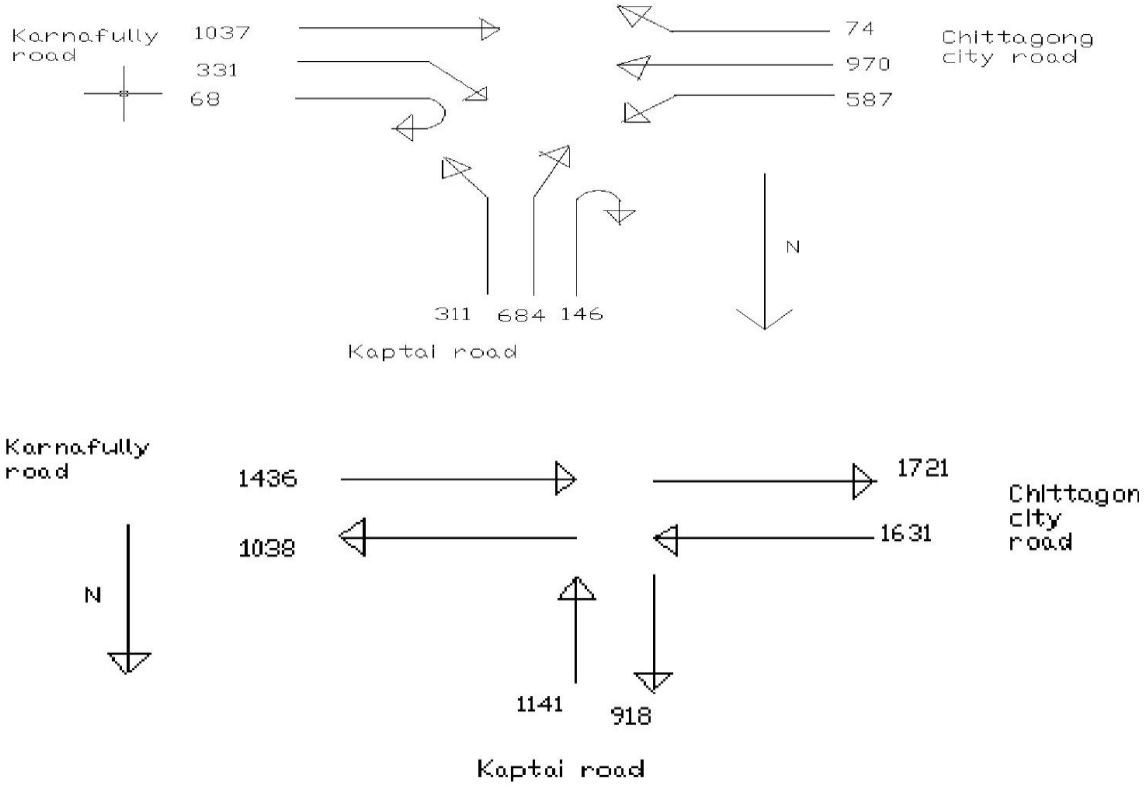


Fig 4:Traffic flow diagram at Kaptai raster matha (peak hour)

T-intersection design for Kaptai rastar matha from Chittagong city to Kaptai:

Width of entry, e_1= 7m Width at exit e_2 = 24 m

Non weaving width, e= $(e_1+e_2)/2$ = 15.5m Weaving width,w= 11.9m
a=587pcu,b=74+970pcu,c=331pcu
Weaving length, L= 34m, The maximum weaving occurs in the junction,
From the above data practical capacity found Q=4352 >1962 pcu/hour. So the T-intersection is satisfied. Similarly in other three direction, it was found that T-intersection is satisfied.

Geometric design of T-intersection at C&B

Most of the heavy vehicles in Chittagong city used this intersection for going to Kalurghat heavy industrial area. The peak hour value at CNB have been shown in Table 4.

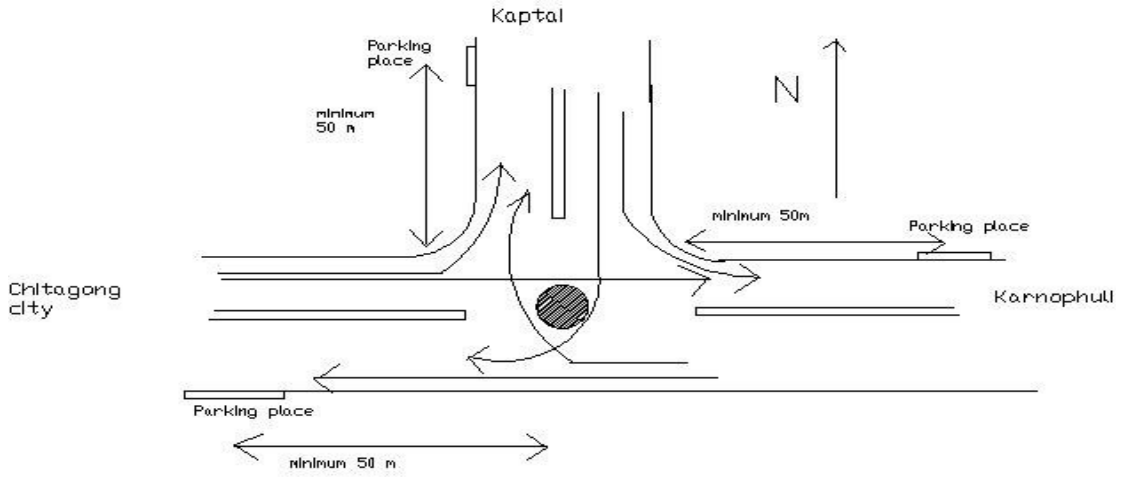
From similar calculation it was found that this T intersection satisfies the practical capacity in all four directions.

Remedial measure

It has been found that the geometric dimension of the intersection are ok. But in T-intersection at the peak period traffic congestion are created. It is normally occurred due to lackage of parking facilities, illegal loading and unloading of vehicles and mismanagement of traffic rules. For this flowing measures can be taken.

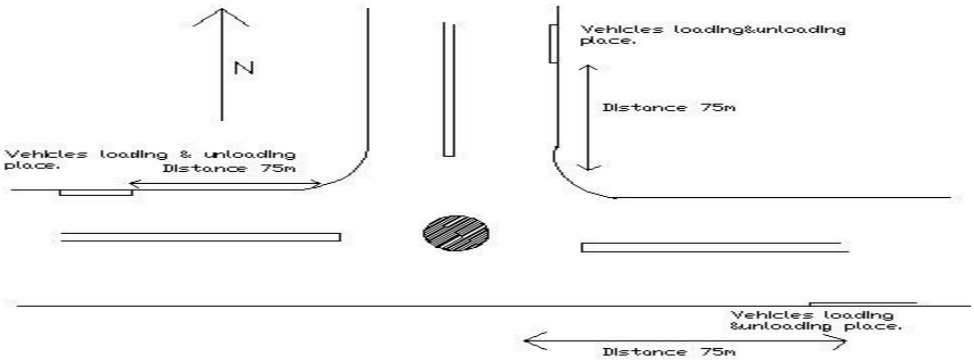
Parking facilities

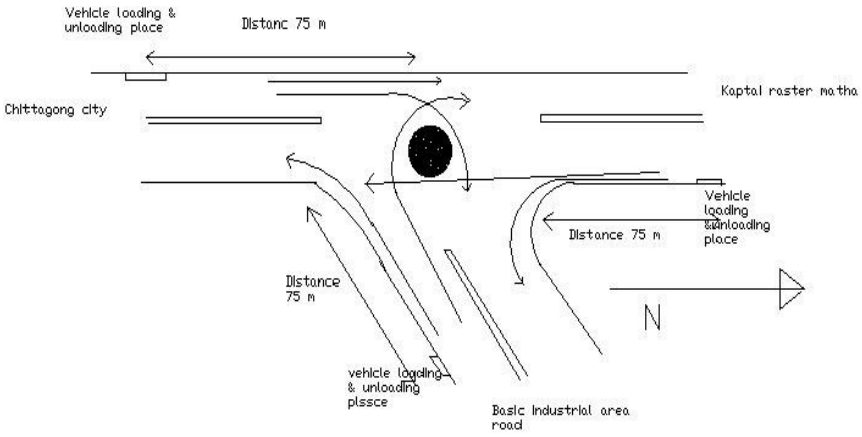
Due to illegal CNG and Rickshaw parking in T-intersection traffic congestion occurred. For removing traffic congestion in T-intersection can be reduced by providing parking facilities. Parking facility should be provided certain distance from the intersection. Illegal bus stoppage should be also removed from intersection. So bus stoppage may be identified certain distance from the intersection. The parking facilities have been shown in Fig 6.



Defining loading and unloading place

Normally the vehicles loading and unloading have done in T-intersection at peak period and passing long time. For this reason, the effective width are reduced and practical capacity reduced. As a result, traffic congestion occurred in T-intersection. For reducing traffic congestion the loading and unloading should be done before intersection. The loading and unloading place have been shown in Fig 7. and Fig 8 below:





Channelization

The direction of traffic flow at intersections to definite paths, by means of traffic markings, islands or other means is known as channelization. A channelization intersection is one in which traffic is directional into definite paths by islands and markings. An unchannelised intersection, on the other hand, is one without islands for directing traffic into definite paths. An unchannelised intersection is the most simple type but is the most dangerous and inefficient. All important junction should, therefore, provide for channelization. The proposed channelization have been shown in Fig. 9. at Kaptai Rastar Matha and Fig. 10. at C&B

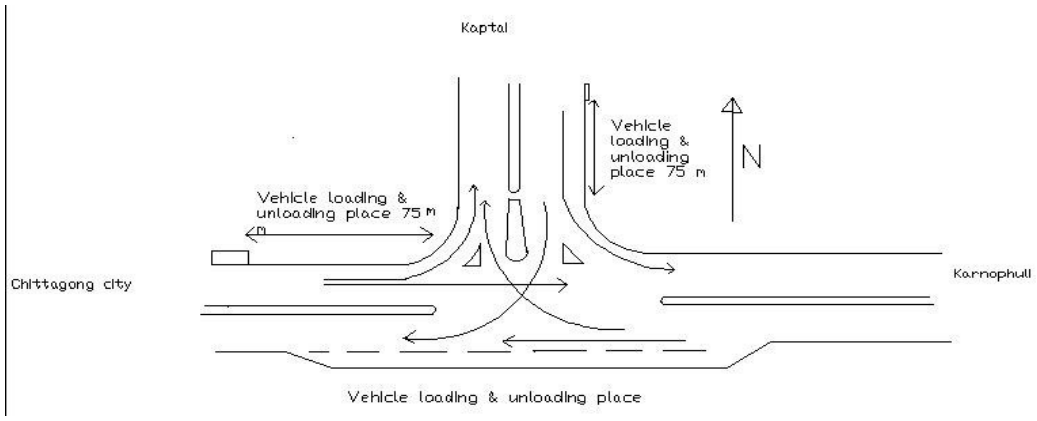


Fig. 9: Channelized T-intersection with a divisional island & two turning roadways (Kaptai Raster Matha)

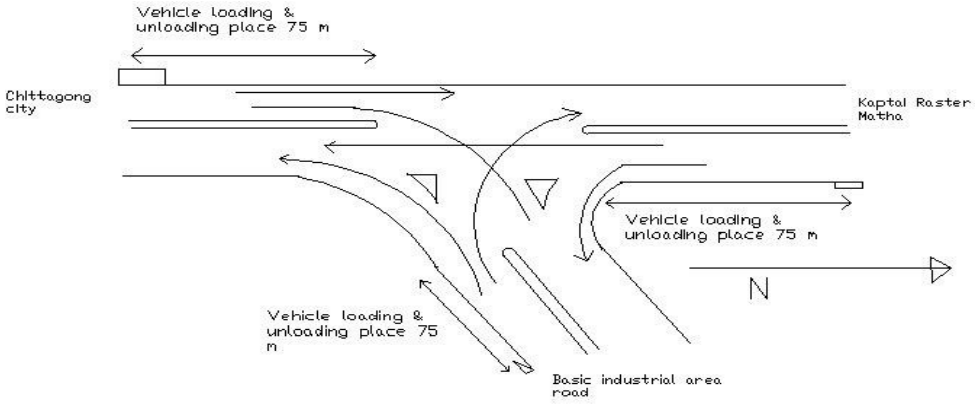


Fig. 10: Channelized T-intersection with a divisional islands & two turning roadways (C&B)

RESULTS AND CONCLUSION

The existing dimension were checked at present condition and compared with standard values and determination of practical capacity of the intersection and compared with survey value. From the investigation, it has been found that the geometric dimension of the intersections is ok. It is normally occurred due to lackage of parking facilities, illegal loading and unloading of vehicles and mismanagement of traffic rules. By providing parking facilities at certain distance from the intersection, traffic congestion can be minimized. Illegal bus stoppage should be also removed from intersection. Traffic loading and unloading have done in T-intersection at peak period which reduces the practical capacity of intersection by reducing the effective width of the roads. So loading and unloading facilities are proposed in two study area Kaptai Raster Matha and CNB intersection.

CONCLUSIONS

Cities are the heart of economic growth for any country. According to Burtone Et.al.(1994), around eighty percent of GDP (Gross Domestic Product) growth in developing countries is expected to come from cities. For the purpose of economic activities to provide movement facilities. Transportation system is the best way for movement and medium for reaching destination. In proper transportation system hamper economic activities and overall development of any country. In most of the developing countries which are overburden with extreme and huge population, increasing economic activities and opportunities in the cities in rapid increase in urban population and consequent need for transportation facilities. Authorities in this country often fail due to pressure of increasing population growth and economic activities in the cities, due to unplanned expansion of the cities traffic congestion. The urban transportation network is the backbone of the urban cities. So the transportation network should be design with carefully with growing population and diversified land activities. Some land should be kept around transportation network system for future readjusted of updated of the intersection. Any lacking between growing transportation demand and network capacities result in traffic congestion at the intersection. If any traffic congestion there occurred there by economic loss from above the investigation in T-intersection some conclusion have drawn which following below:

1. Every intersection for rural, urban and suburban contains individual capacities for traffic content. The practical capacity of the T-intersection depends on the effective width of the network system. Prescribed capacities are available in various international text books. Determining traffic capacities compared with prescribed capacities and then decision specified.
2. If the practical capacity is more than the total traffic at the max weaving section at the intersection then geometric dimension is not treated. But if the practical capacity is less than the total traffic then the geometric dimension of the intersection should be revised.
3. The suggestion attached with this thesis paper contain the solution to the present traffic congestion and other existing road user problem. It may be stated here that the disbenefits of poor traffic management system prevailing in the Chittagong came badly during inspection performance.
4. If the geometric dimension is ok but for mismanagement traffic congestion is created at peak hour time then some recommendation should be implemented for traffic movement at the T-intersection.

Whatever this points summarize, it may be exclaimed with bold voice that the thesis contains solution to the question following listening the intersection related problems and parking facilities provided and traffic flow pattern to be set up roles.

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