Agra Smart City Mission

JUNCTION IMPROVEMENT (PAN CITY), AGRA

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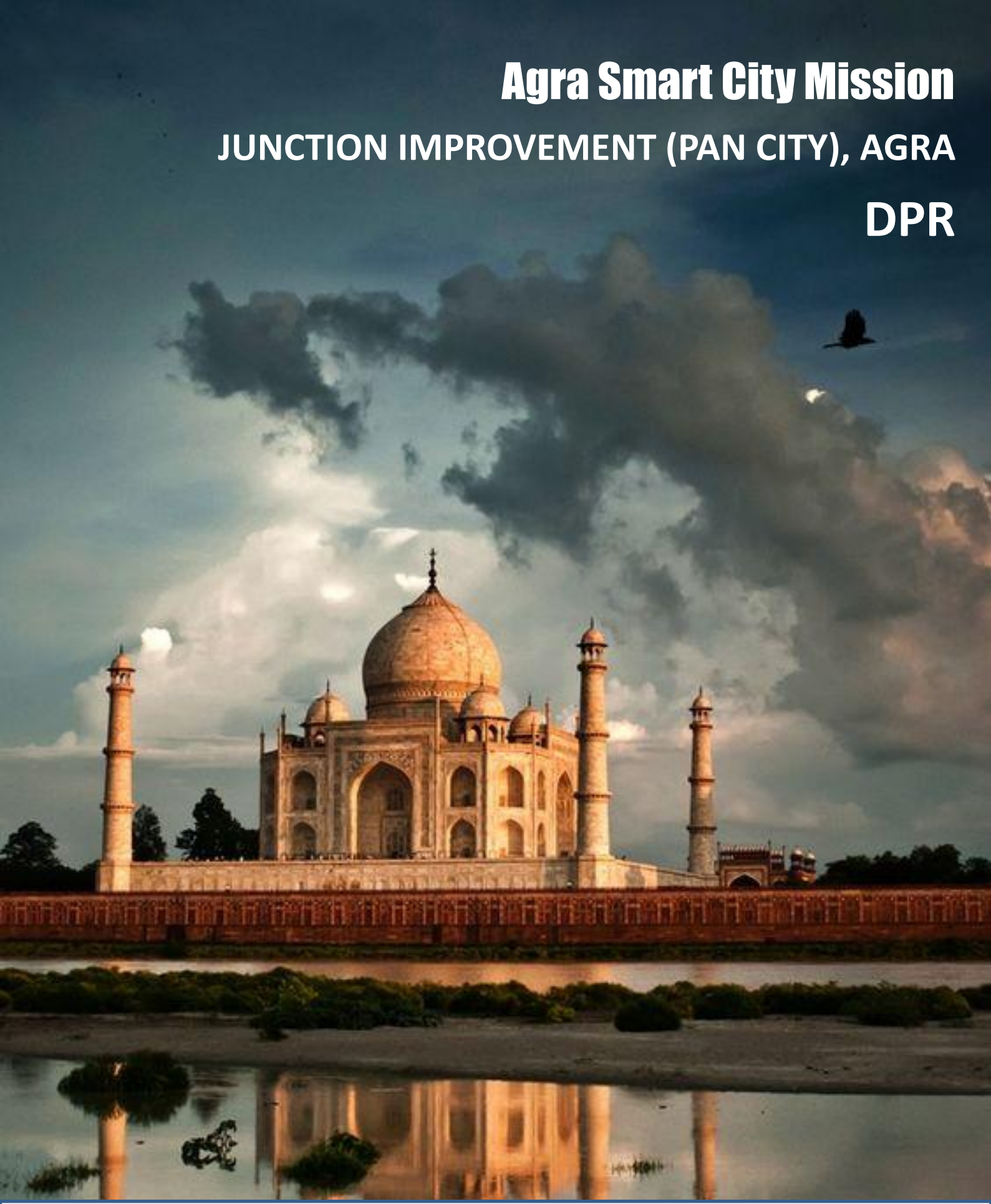

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CHAPTER 1. EXECUTIVE SUMMARY

Agra is the third largest city of Uttar Pradesh and is a commercial city, having small-scale and household industries. Agra is known for handicraft work majorly marble, leather, carpet, brassware, artistic daring and jewelry craft which attracts a large number of domestic tourist and from all over the world.

Agra is located at the junction of four national highways namely Delhi Kolkata(NH-2), Agra Mumbai(NH-3), Agra Jaipur(NH-11) and Agra Aligarh(NH-93). It has two state highways namely Agra Fatehabad(SH-62) AND Agra Gajnair(SH-39). Agra Fatehabad (SH-62) lead to inner ring road which connects NH-2 and Yamuna Expressway forming not only spine of the city but provide improved access to Taj Mahal for the tourist.

Agra is one of the most populous cities in Uttar Pradesh, and the 24th most populous in India. High vehicle density added with lack of pedestrian safety measures have led to an increasing congestion due to the increasing and alarming population and accident rates particularly at the intersection in the city, and thus has been an area of major concerns. To address this issue Smart City Agra has identified 28 junctions in the city which need improvement to ensure safe and smooth flow of traffic in the city. Accordingly, Smart City Agra has entrusted Darashaw and Company Pvt Ltd with the work to improve and upgrade 7 intersections in the PAN city area for easy and smooth movement of traffic. The intersections identified are as follows:

1. Hari Parvat Crossing
2. Babu Jagjivanram Crossing
3. Sai Ka Takiya Junction
4. Shastri chowk
5. Bodala Choraha
6. Hotel Amar T-Point
7. St. Johns Crossing

CHAPTER 2. INTRODUCTION TO AGRA- SCOPE & METHODOLOGY

2.1 Introduction to Agra

Agra city is governed by Municipal Corporation which comes under Agra Metropolitan Region. The Agra city is located in the Uttar Pradesh state of India. As per provisional reports of Census India, the population of Agra in 2011 is 1,585,704; of which male and female are 845,902 and 739,802 respectively. Although Agra city has population of 1,585,704; its urban / metropolitan population is 1,760,285 of which 939,875 are males and 820,410 are females.

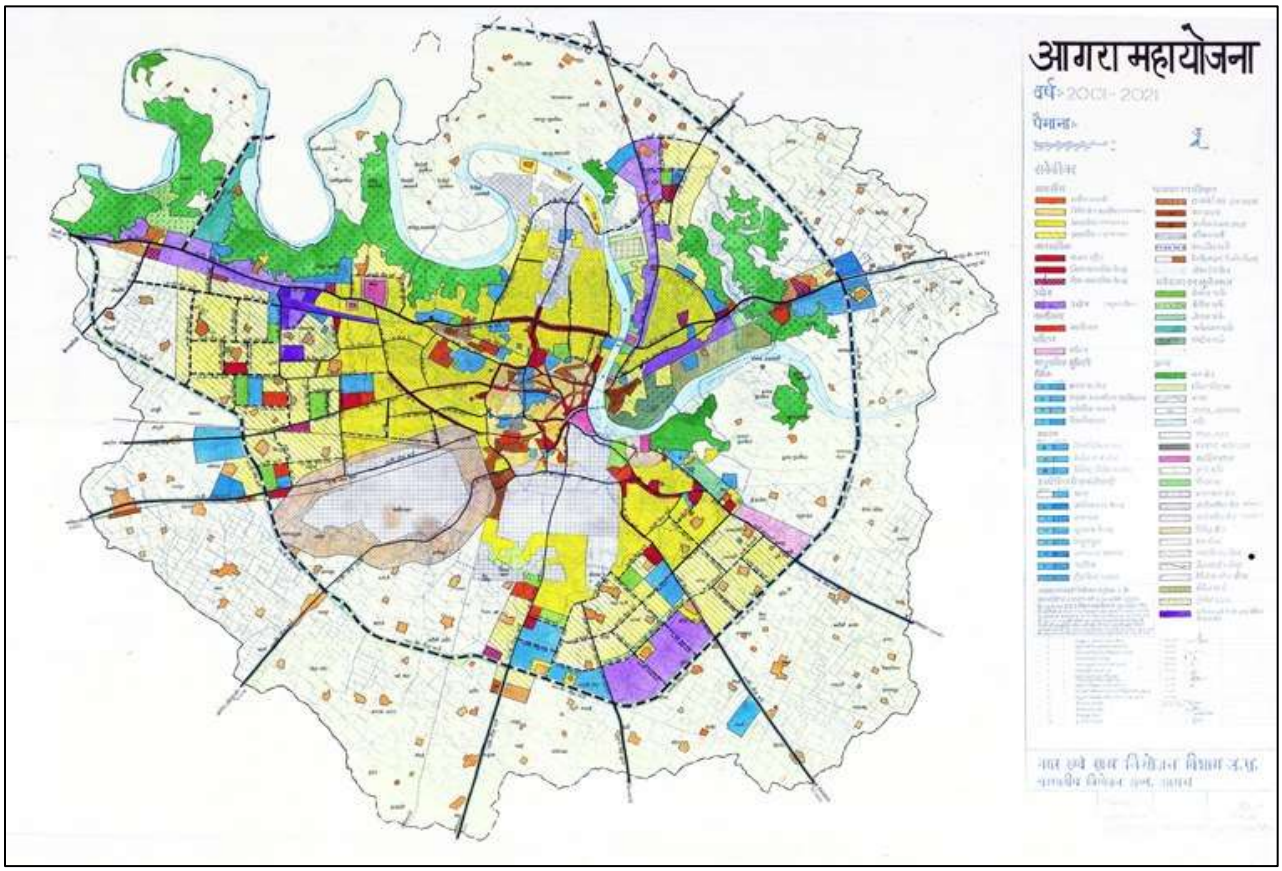

Figure 1: Agra Master Plan 2021

Agra Master Plan 2021 envisages an urban area of the order of 20,000 ha which has been subdivided into various land uses as given in the table above. It is also estimated that the housing shortage for the plan period of the order of 2.5 lakh.

S.No.	Land use	Area (in ha)	Percentage (%)
1	Residential	9923.80	49.53
2	Commercial	544.17	2.72
3	Industrial	1606.31	8.01
4	Office	508.40	2.54
5	Tourism	178.18	0.89
6	Public & Semi Public	1763.40	8.80
7	Traffic & Transportation	2161.60	10.79
8	Recreation & Open spaces	875.40	4.37
9	Other Open Spaces	421.58	2.10
10	Other	2054.13	10.25
Total		**20036.97**	**100**

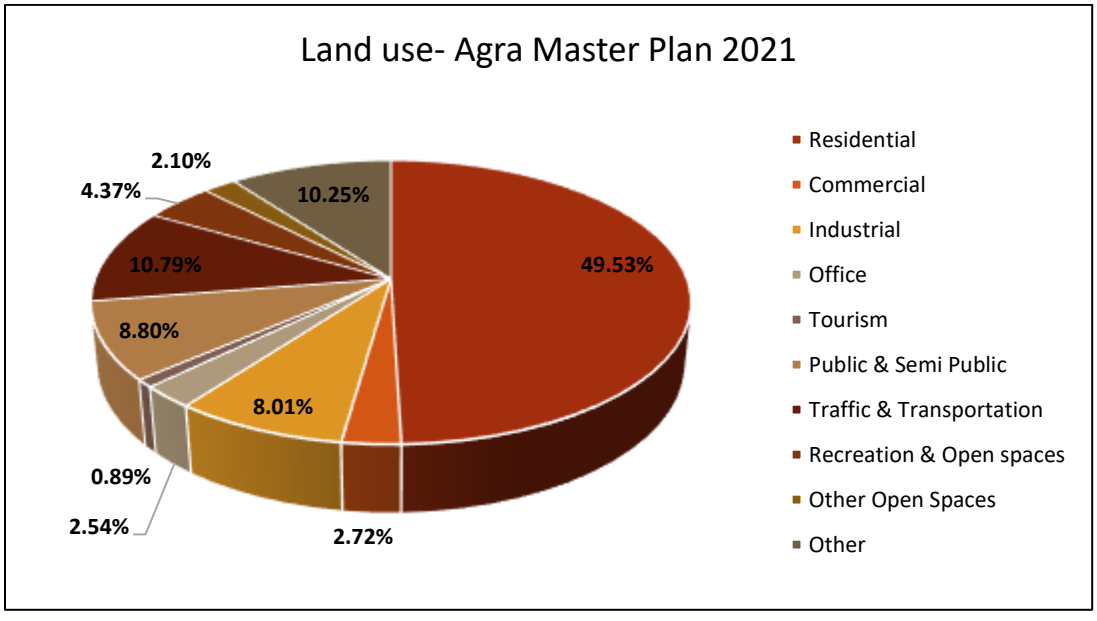

Figure 2: Land use as per Master Plan 2021

2.2 History

Agra is the city of the inimitable Taj Mahal. The story of Agra begins much earlier than the Taj, however it finds mention in the epic Mahabharata when it was called Agra Bana are Paradise. Ptolemy, the famous second century A.D. geographer, marked it on his map of the world as Agra. Tradition and legend ascribe the present city of Raja Badal Singh (around 1475 A.D.) whose Fort, Badalgarh, Stood on or near the site of the present Fort. However, the 12th century A.D. Persian poet Salman, too, speaks of a desperate assault on the fortress of Agra, then held by one King Jaipal, by sultan Mahmud of Ghazni. It was Mughals who finally nurtured Agra with the finest monuments architects could design: The Taj Mahal of Shah Jhan, Agra Fort of Akbar, Itmad-Ud-Daulah and neighboring Sikandra are but few of the many that spangle the city, each of which stands in mute testimony to the city's grandeur over the ages.

2.3 Regional Setting

Being centrally located on the national map, Agra forms an important regional urban center. All traffic weather by rail or road going south invariably passes through Agra thus making it a major transport node at the regional level as well as at the national level. This has also led to an extremely rapid and haphazard growth pattern. The city of Agra is situated on the Western Bank of river Yamuna on National Highway (N.H2) at about 200 Kms from Delhi in the state of Uttar Pradesh.

Agra is geographically located at 27°12' North latitudes and 78°12' East longitudes. It has an extremely strategic location on the confluence of three distinct geo-physical regions namely the plain of Uttar Pradesh, the plateau of Madhya Pradesh and the desert of Rajasthan.

The city also falls in the center of the four-culture areas- Braj, Bundelkhand, Rajputana and western U.P. Both these factors have played significant roles in shaping the life and history of the city.

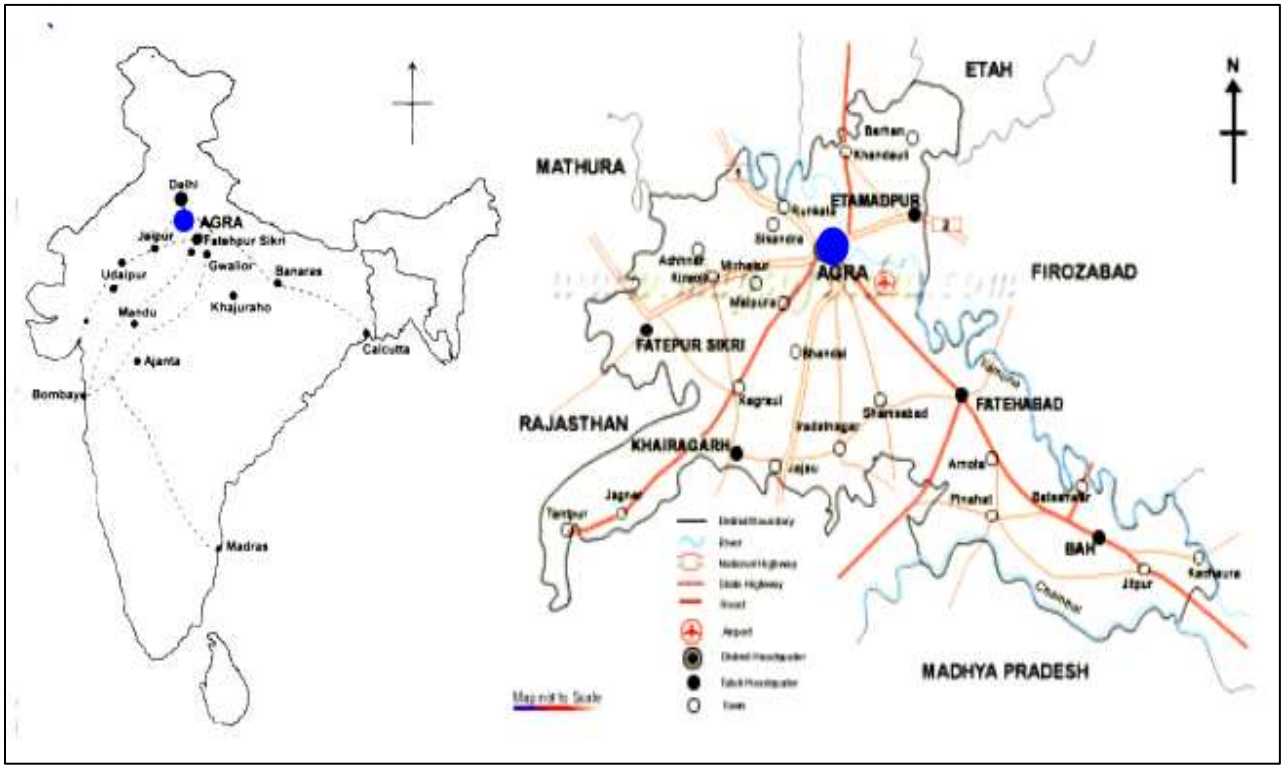

Figure 3: Agra city-Regional Setting

Figure 4: Agra District Map

2.4 Physical Characteristics

The river Yamuna enters the city from the north-east corner, flows towards south for some distance and then turns towards east. The general slope is from west to east in CIS-Yamuna area on the right bank of the river Yamuna. The climate of Agra city is extreme and tropical. During summer season the maximum temperature of the city rises to 47^0C and drops down to minimum of 3^0C during winter season. The city receives moderate to high rainfall with an average yearly rainfall of about 686mm. The ground levels at Agra vary from RL 150 m to 170m. The strata consist of mainly sandy soil. The sub-soil water level is generally 6 to 8m below ground level. The HFL of Agra City is 154.76m at Jawahar Bridge. The city stretches for about 9.0 kms along the Yamuna river. The major part of the city is on the Western side of Yamuna and has grown beyond the river on the eastern side and is called the Trans Yamuna area while the original part is called as CIS Yamuna.

2.5 Demographic Characteristics

According to the census 2011, the Agra Urban Agglomeration has a population of 17.65 lakhs. It comprises of the Agra Municipal Corporation area (Pop. 15.85 lakhs), Agra cantonment (Pop. 0.5 Lakhs) and adjacent rural areas. Compared to a population of 12.75 lakhs in 2001, the decadal growth rate of pollution has been 38.03 which is highest in the last five decades. During the post-independence period, commerce showed a phenomenal increase with the associated industrial development and establishment of the industrial estates, which resulted in attracting people to the city.

Table 1: Population Growth Agra

Census of India 2011 Year	Population (lakhs)	Growth Rate (%)
1961	4.62	-
1971	5.91	27.92
1981	7.81	32.15

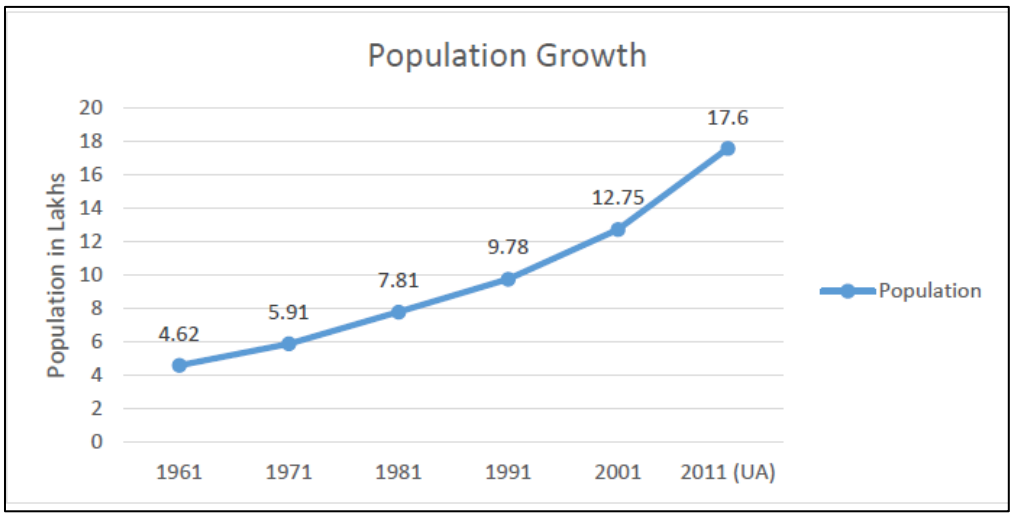

Figure 5: Decadal Population Growth Agra City

Some of the key demographic characteristic of Agra Urban Agglomeration are as follows.

- **Total Population:** 1,760,285
- **Sex Ratio**: 873
- **Average Literacy Rate**: 73.13 %
- **Population Density (District):** 1,093 persons/ sq.km

In the city of Agra, the core city area holds up a major share of the city population and has a very high population density. The area under the jurisdiction of the Agra Cantonment also has relatively lesser population density due to its land use character. However, the outward growth pockets are sparsely populated. It is important to note that, as per the city growth trends, some pockets along the proximity to main roads has been witnessing an increase in the number of settlements.

2.6 Administrative Set up

The Agra Nagar Nigam is among the largest municipal bodies in the state of Uttar Pradesh providing civic services to the estimated population of 1,686,976 (as per 2010 est.) Within its jurisdiction are some of the most attractive tourist spots of the world including Taj mahal and Sikandra.

The Municipal Body has always been alive in its constitution and functioning to the growing needs of citizens. Agra Nagar Nigam (ANN) is a local government committed to provide basic infrastructure facilities including entertainment facilities to the people of the city. ANN is very well known for the managing the

city by using private sector participation as well as introduction of innovative mechanism in management to serve people efficiently.

2.7 Infrastructure

Road: Regarding the physical infrastructure of the city, the total road length is 142 km. Out of which only 75% is two lanes. Near about all the streets and roads are narrow, and it hinder the smooth flow of traffic, creating more health hazard due to vehicular pollution. The existing road network is inadequate for both intercity as well as intracity traffic movement. The vehicles are highly varied in character. At the same time at least 10 types of vehicles run on the road. The nation traffics area also passing in the across the city, it increases the traffic volume and traffic gum as a resultant of the increase the air pollution.

Electricity: Per day electricity deficiency is about 250MVA and the inadequate transmission infrastructure is leading to power breakdown. Agra faces regular severe power breakdown ranging from 4 to 6 hours per day. This has resulted in a large number of Diesel Generators sets coming up in the city creates a considerable amount of air pollution.

Water Supply: The source of water supply is Yamuna River. It is said that 40% of total water supply losses during transmission. The everyday shortage of water supply is 50mld. The water supply is for only 1-2 hours in morning. The water quality is low for most of the part it is having high coliform count due to breakage in the pipes. Iron content in water is exceptionally high & residual Chlorine and TDS are considerably high in some localities.

Sewerage: About 30% of the city area is covered by sewerage network but due to enormous increase in population most of the area are not served by sewerage system. The total sewerage generation of the city is 128.6 MLD. There is no sewerage treatment plant. The sewerage is found flowing along the roads into open drain.

2.8 Economic Base

Economic Activities:

- Tourism
- Small-scale and household industries
- Trade In addition to being a tourism destination

Agra is basically a commercial city. The major part of its industrial activity is in the form of small-scale and house- hold industries. These are mainly located in the old Mughal city particularly Lohamandi, Rakabganj, Kotwali, Taj Ganj areas. The largescale units are located in Chatta and Hariparvat areas. The important

industries are textile, leather, foundries, diesel engines, generator sets, electrical goods, fans, pipes, C.I, casting, leather goods including shoes, steel rolling, packaging materials, etc. The major handicrafts are marble, leather, carpet, brassware, artistic Dari and jewellery crafts.

The city being an infertile land and prone to floods so agriculture was practiced only as a subsidiary activity in limited areas. Therefore, industries received an impetus and the proximity to river Yamuna was also an added advantage. The traditional handicrafts flourished, patronized by the Mughal court. Agra has been a center of traditional handicraft industries from the Mughal times. A number of factors contributed in building this image like the availability of raw materials: leather, stone, cotton threads within the city or the region, marble from Makrana, red sandstone from Bharatpur. Also, there was less extent of fertile land, this also facilitated the growth and development of industries. Hence employment in agriculture shifted to allied sectors. Besides a massive amount of building activity was going on during the Mughal period and a number of craftsmen were hired to develop local skills. All these factors attributed towards Agra becoming the stronghold of traditional handicraft industries. The history of growth of traditional handicrafts begins with the Mughals.

One of the key factors that draw a major number of tourist to the city is the connectivity it enjoys with the Delhi. Agra is well connected with the National capital via road and rail. The following section elaborates the regional setting of the city.

2.9 Significance of Tourism in Agra

Agra's importance on tourist map cannot be underestimated; it is one of the key tourist destinations attracting tourists from all over the world. The city forms one edge of the prime tourist circuit in India- the so-called Golden Triangle, the other two cities being Delhi and Jaipur. The city is rich in its art, heritage and culture, which are also reflected in its historical monuments. This makes the city as one of the most attractive tourist places of the country.

The Agra city currently has three world heritage sites: the Taj Mahal, Agra Fort and Fatehpur Sikri. This entire area is called Taj Trapezium (TTZ), a 10,400 sq. km area around the monument where industrial business is limited.

Other than these there are Akbar Tomb at Sikandara (in proximity to Agra) and Imtab – Ud- Dauld's Tomb in Agra are proposed to be world heritage site. On an average per day Taj Mahal attracts 8,000 to 10,000 tourists, among this 54% are international and 46% are national tourists.

The tourists' seasons are mainly from October to March. The international tourists are mainly from the countries like USA, UK, Germany, France, Italy and Japan. Duration of stay is crucial for middle income of tourists.

From the point of publicity and the tourist awareness most of the common tourists visit Taj mahal Only 50 % of the tourists visit Fatehpur Sikri.

Other monuments like Akbar Tomb, Imtab – Ud- Dauld's receives few visitors. Due to the lack of accommodation facilities most of the tourists go back the same day. No organize tourists circuit has developed to increase the no of day stay of the tourists. As per the department of tourism of Agra in 1998city had 3500 rooms in different hotels.

Only 12% international tourists and 6% of the national tourists can effort these luxury hotels for overnight accommodation. It is recognized that the hotel industry is not doing as well as it should because the average tourist does not stay for long enough in Agra. For making the stay of the visitors longer other spots should be promoted to the tourists to increase the attraction besides Taj mahal.

In 1998 2.1 million people visited Taj Mahal Where as Imtab – UdDauld's and Akbar tomb received only 39,000 visitors. There is no \pedestrian circuit to take tourist along the riverfront. Directional sign is few and refer to Taj Mahal, Sikandra, Fatehpur Sikri. It is estimated that visiting Taj Mahal alone can take maximum 2 hours and four hours combined Akbar Tomb.

The visitation can be increased to twelve hours if other riverfront monuments are visited. In additional a visit to Fatehpur Sikri takes four hours and Sikandra three hours. The total duration of visitation has stretched to two – three days.

Table 2: Number of Tourist visit to Agra

	2012	2013	2014	2015	2016
Number	9158976	9114221	9601728	10812435	10332917
Change in tourist numbers	-	-0.49%	5.35%	12.61%	-4.43%
% of Foreign Tourists	14.7%	13.6%	12.3%	12.4%	13.2%

Figure 6 Tourist Map of Agra

2.10 Review of Existing Transport System

The city of Agra has a radial pattern of the road network. The city was formed on the banks of river Yamuna, which also makes it a natural barrier within the city. The railway lines stretching along North-South Direction and East-West direction also act as a barrier cutting the city into different parts. Railway over bridges is one of the major components that act as a connector. However, ROB experience heavy traffic now a day, leading to congestion in the city. Due to heavy traffic demand, some of the ROBs have been widened. The old part of Agra, being a historical city has a network of narrow roads.

Some of the major roads of the city are appended below:

- Mall Road
- M.G. Road
- Taj road

- Idgah Road
- NH 19 towards Delhi and Kanpur
- NH 44 towards Dholpur
- NH 509 towards Aligarh
- NH 21 towards Fatehpur Sikri, Bharatpur, and Jaipur
- Dayal Bagh Road
- Mughal Road
- Fatehabad Road
- Inner Ring Road
- Yamuna Expressway
- Agra Lucknow Expressway

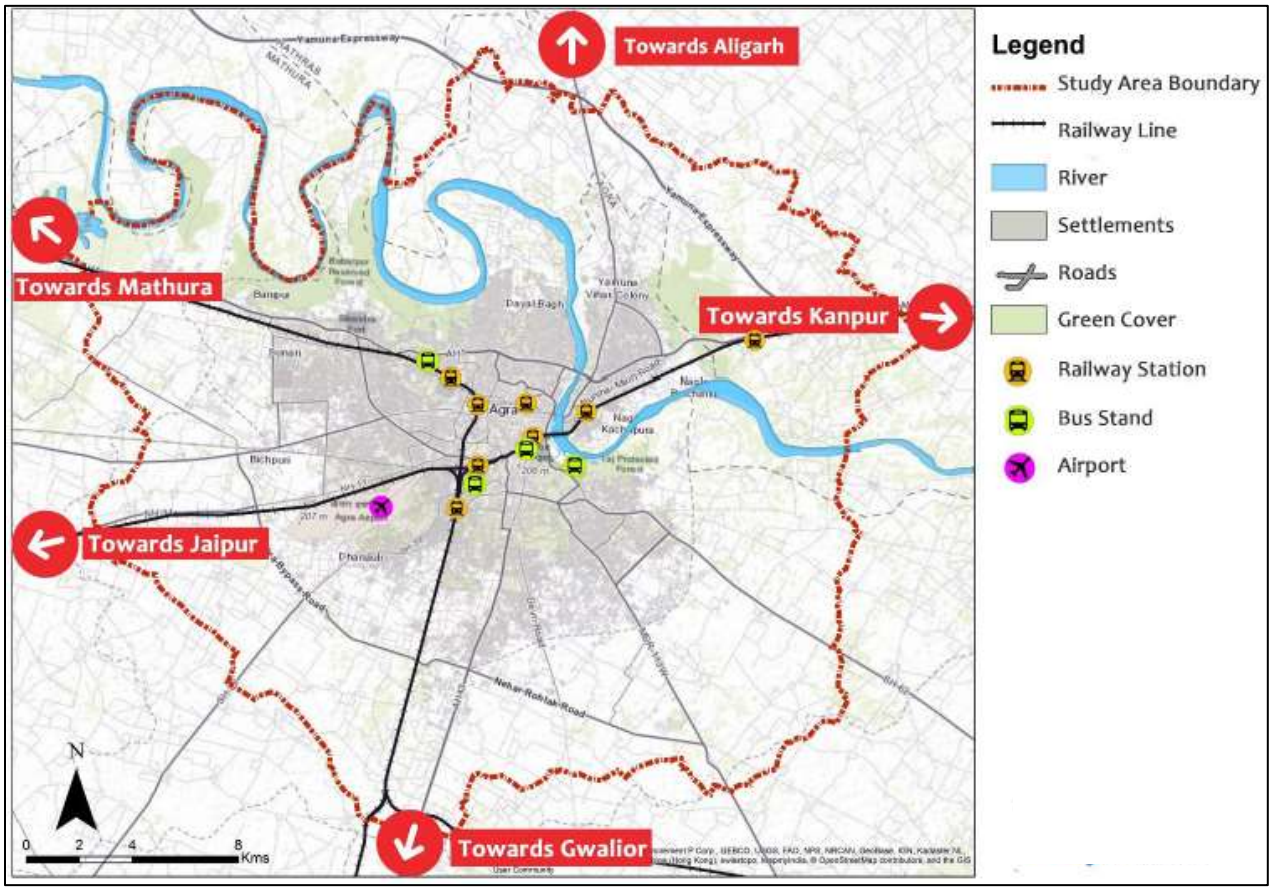

Figure 7: Existing Connectivity and Transport Setting Area

Connectivity aspects of the Agra city area described in the following subheadings.

2.10.1 Rail Connectivity

Location of Agra falls on the important railway corridors of the country such as Delhi - Mumbai, Delhi - Chennai. Some trains also connect the city to eastern areas of India via direct trains to the city like Kolkata. The high frequency of trains through these routes makes Agra well connected by rail with other major cities. Apart from the regular trains, Agra city is also connected through tourist circuit trains such as - the Palace on Wheels, the Royal Rajasthan on Wheels, the Buddhist Special Train etc. Agra has following Railway Stations of Indian Railways:

- Agra Cantonment Railway Station, Agra
- Agra Fort Railway Station, Agra
- Agra City Railway Station, Agra
- Raja Ki Mandi Railway Station, Agra
- Idgah Railway Station, Agra
- Yamuna Bridge Railway Station, Agra
- Billochpura Railway Station, Agra
- Fatehpur Sikri Railway Station, Agra
- Etmadpur Railway Station, Agra
- Keetham Railway Station

Figure 8: Agra Cantt Railway Station

2.10.2 Road Connectivity

The city of Agra is well connected by the road. The following points elaborate the regional road connectivity with Agra.

1. Northside connectivity: NH2 highway and recently built Yamuna Express Highway are the two parallel roads that connect Agra to the north. The drive to Delhi is about 4 to 5 hours.
2. Eastside connectivity: Both the NH-2 and Yamuna Express highway continues to the East till Kanpur and Lucknow.
3. Westside connectivity: From Jaipur - NH11, a four-lane highway, connects Agra with Jaipur via the bird sanctuary town of Bharatpur.
4. Southside connectivity: From Gwalior, a distance of around 120 km, takes around 1.5 hours on the National Highway 3, also known as the Agra - Mumbai Highway.

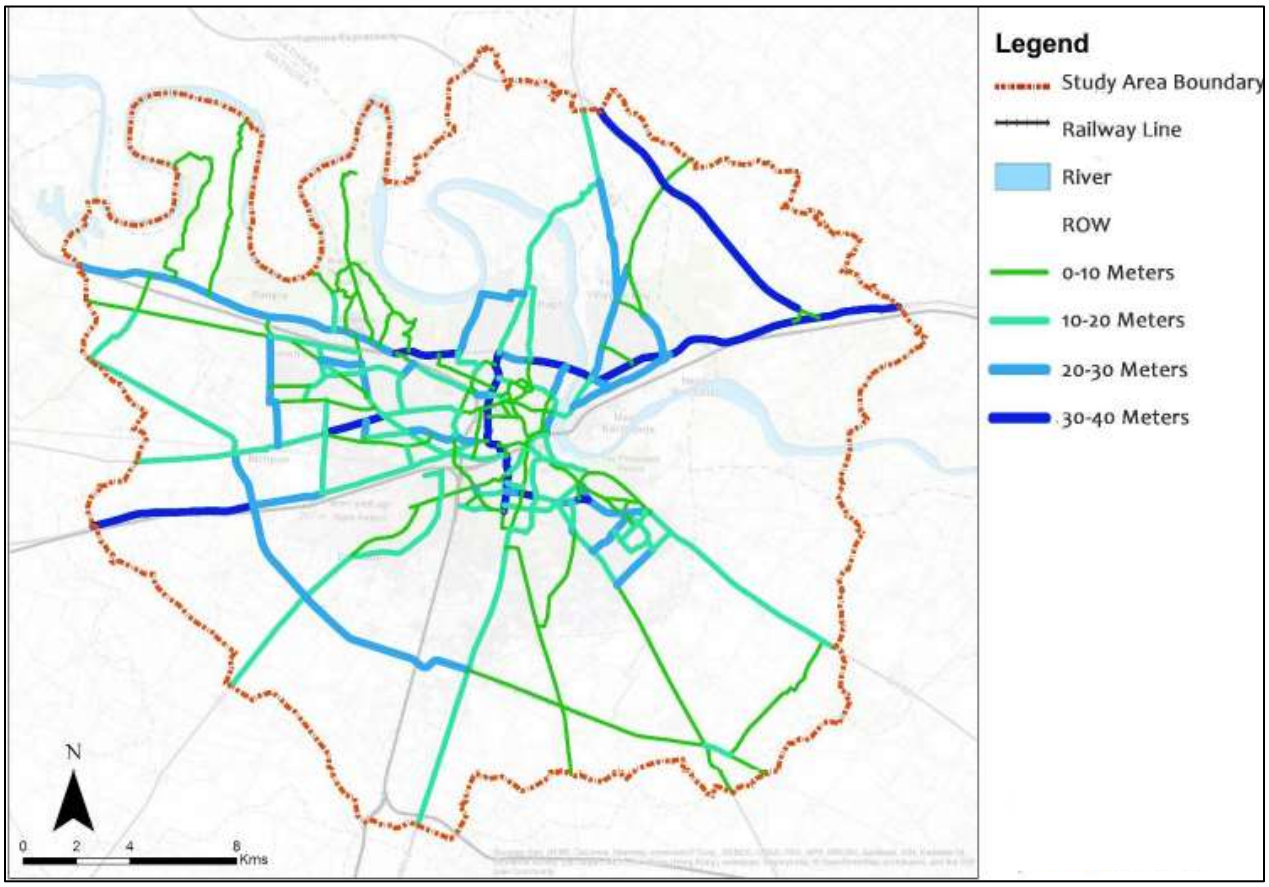

Figure 9: Road Network Inventory

2.10.3 Air Connectivity

Agra is also connected via air through Kheria Airport, Agra. Presently it has direct flight services to Delhi, Khajuraho, and Varanasi. However, Agra currently has only 0.2% share of the passenger air traffic demand of the state. Agra is also supposed to get its direct air connectivity to Jaipur shortly.

2.11 Project Brief

Agra is the city of the inimitable Taj Mahal. It is as loved by Indians as it is by foreigners who throng here in large numbers to admire its beauty. Along with Delhi and Jaipur, Agra forms the Golden Triangle of tourism in India. Situated in Uttar Pradesh, Agra is synonymous with the Taj Mahal, however, there's a lot more to the city than this world-famous monument. Right from the epic Mahabharata to the Mughal Dynasty, Agra has been monumental and has played a significant role in shaping India's history. Agra has two UNESCO World Heritage sites which are Agra Fort and Taj Mahal, however, Taj Mahal features in the 50 most popular tourist destinations in the world.

Near the gardens of the Taj Mahal stands the important 16th-century Mughal monument known as the Red Fort of Agra. This powerful fortress of red sandstone encompasses, within its 2.5-km-long enclosure walls, the imperial city of the Mughal rulers. It comprises many fairy-tale palaces, such as the Jahangir Palace and the Khas Mahal, built by Shah Jahan; audience halls, such as the Diwan-i-Khas; and two very beautiful mosques.

The report focuses on the issues faced by commuters at the intersection in terms of traffic congestion, vehicular conflicts and safety and accordingly it proposes to improve the junction design and pedestrian infrastructure for smoother flow of traffic and safe movement of pedestrians.

The main objective of the study is to:

1. Remove obstacles for ease movement of traffic
2. Prepare an Intersection Improvement Plan with improved design, pedestrian facilities, vendor zones etc.

Figure 10 Identified Junctions in the PAN City Area, Agra

2.12 Scope of Project

The scope of work of the study is as under:

2.12.1 Data Collection

2.12.1.1 Primary Survey:

To identify the issues at the intersection following surveys have been carried out.

2.12.1.2 Reconnaissance Survey:

Reconnaissance surveys have been carried out at each intersection for identification of existing situation and capture the problems. These then form the basis for conceptualizing the improvement schemes.

2.12.1.3 Topographical survey:

Survey has been conducted up to 100 meters on all the arms of the intersections to identify and map the contours of the ground and existing features on the surface of the earth or slightly above (i.e. trees, buildings, streets, walkways, manholes, utility poles, retaining walls, etc.). The base drawings prepared from the survey are used for detailed designing of the intersection.

2.12.1.4 Traffic survey:

Traffic Intersection Volume Counts on the identified intersection and other relevant information such as previous studies, reports etc. has been collected for Agra pan city area.

2.12.2 Secondary data:

Comprehensive Mobility Plan, Transport-related Detailed Project Reports, Master Plan, Development Plan, or other land use planning documents, Plans for bus priority/bus rapid transit (BRT) networks, cycling networks, pedestrian networks etc., Latest street design guidelines for prepared by IRC, UTTIPEC and other relevant agencies Any other document related to transport planning/ designing, Details/ drawings/ documents related to upcoming infrastructure projects such as flyovers etc. to be studied and reviewed for any further clarification for the improvement of junctions.

2.12.3 Data Analysis

The observations from the reconnaissance survey, topography surveys, secondary data and the intersection traffic volume count collected were analyzed and inferences are drawn, which helped to identify problems, types and their relative intensity.

From the above analysis Intersection/Junction Improvement Plan have been prepared with the following components:

Existing plan and Pattern: Based on the topography survey a detailed drawing of the existing scenario has been prepared.

2.12.4 Proposed Plan

Based on the topography survey and the traffic volume analysis various options are prepared with respect to the change in geometrical design, traffic flow and integrations of pedestrians, hawkers etc. The drawings also show the circulation plan as well as locations of Signals wherever required, signage's & markings which facilitates directing road users at intersection to produce an increased and more orderly flow of pedestrians & vehicles. The drawing so made have considered the following points:

- Plan within the land available
- Minimal or No damage to green belt
- Improvisation of all the medians/openings for smooth traffic flow
- Improvisation of existing Non-Motorized facilities
- Smoothening of all entry exit curves

Micro Simulation: For the alternatives developed for the intersections, a micro simulation is carried out in VISSIM to assess the impact of the proposed changes on traffic flow. The output so generated is analyzed and help in proposing the best alternative for any intersection.

Selection of Best Suited Alternative: After carrying out the micro simulation, the best alternative shall be put up to the stakeholders.
The alternative proposed would be discussed with the stakeholders and the most preferred alternative would be selected.
For the selected alternative an elaborate Bill of Quantity (BOQ) shall be developed, which would then have incorporated in RFP to call for bids.

2.13 Methodology

The project preparation has been broadly classified into 5 stages: -

2.13.1 Project Preparation

- Identifying the Objectives
- Scope of work for study
- Identification of issues and gaps

2.13.2 Site Visits and Data Collection

- Identification of Data Required for Data
- Assessment of existing circulation plan
- Secondary Data- Collect necessary secondary data like earlier studies, maps, etc.
- Primary Survey
- Reconnaissance survey
- Topographic Survey

2.13.3 Data Analysis

- Existing buildings/structures (indication only)
- Main roads, sub roads including diversions/de-tours Signals
- Junctions
- Roundabouts
- Medians / bollards /permanent barricades, compound walls
- All utility (electricity, telephone etc.) poles/boxes
- Overhead high-tension lines
- Trees: To be indicated in second categories, above and below 30 cm of main trunk circumference
- Footpaths/pathways/platforms/sidewalks etc. with all the features

- Kerb
- Manholes
- Drains (covered and uncovered), Sign boards/markings
- Service lines/cable ducts
- Difference in levels wherever occurs

2.13.4 Traffic Survey

- Analyzing the traffic volume count
- Peak Hour Traffic analysis
- Traffic flow in peak hour
- Hourly variation of Traffic
- Traffic composition for Peak Hour

2.13.5 Agra Smart City Recommendations

- Preparation possible design options.
- Suggesting the best possible design option along with the detailed design and circulation plan, signage and road markings.

CHAPTER 3. LITERATURE STUDIES

3.1 Design Principles and Methodology

The Road Intersections are the critical elements of the Road sections and the function of a designed intersection is to control conflicting and merging streams of traffic, to minimize the delay including pedestrian and bicycle traffic.

Intersection design influences the capacity of the corridor and the safe movement of conflicting directions. The pattern of the traffic movements at the intersection and the volume of traffic on each approach, during one peak period of the day determine the lane widths required including the auxiliary lanes, traffic control devices and channelization, wherever necessary. The arrangement of the islands and shape, length of the auxiliary lanes also differs based upon the type of intersection.

The general design principles of intersection design are the approach speeds, restriction on available land, sight distance available and the presence of the larger volume of all the road users in urban areas, although it is necessary for the users of these guidelines that there should be an application of the knowledge about the local conditions while interpreting and arriving at the solution in terms of design.

3.2 Function

The function of an intersection is to enable safe interchange between two directions or two modes.

The design of an intersection must be comprehensible to road users. This aim is best achieved with a well-organized situation with a minimum number of conflict points. The basic principle to limit the number of conflict points as much as possible can be at odds with other requirements; for example, in relation to traffic flow.

If additional lanes are built for this reason, the result can be that the traffic situation is no longer sufficiently comprehensible and 'aids' (such as traffic lights) are needed.

It is important that the speed of the various road users is minimized during interchanging. In collision with a car at low speed, the chance of survival is significantly greater than when the car is traveling at a higher speed.

3.3 Requirements of A Designed Intersection

Intersections should have uniform design standards so that even a new comer in the area anticipates what to expect at the intersections. Some of the major design elements in which uniformity is required are design speeds, intersection curves, vehicle turning paths, super elevations, level shoulder width, speed change lane lengths, channelization types of curves and types of signs and markings.

Intersections must be designed to maintain the consistency and the continuity of the infrastructure dedicated to each road user and the cohesion should be maintained for which the design elements such as raised crossings, path markings and segregation by posts. All the intersection movements should be obvious to all road users.

The main objective of intersection design is to facilitate the safe and efficient movements of all vehicles including heavy vehicles (buses, trucks etc.) and NMT (bicycles, pedestrians etc.). Intersection design should be fitted closely to the operating characteristics of its users.

3.4 Safety

The main objective of the intersection design is to reduce the number and severity of potential conflicts between cars, buses, trucks, bicycles and the pedestrians.

3.5 Classification of Intersection

Intersection functions to control conflicting and merging traffic (and to achieve this, intersections are designed on certain geometric parameters and are broadly classified into three main heads. Designers are often faced with tough choices of prioritizing the conflicting requirements of one mode over another. Here the key is to apply the most appropriate solution based on the type of junction as well site conditions/constraints. The three main types of junction solutions are:

1. Un signalized intersection,
2. Signalized Junctions
3. Roundabouts

Basic Design Principles

The ultimate aim is to provide all the road users with a road layout which minimizes confusion at the conflict points. The need for flexibility dictates the choice of the most suitable junction type. The selection process requires the economic, environmental and operational effects of each proposed option.

Different combinations of the intersection type are determined primarily by the number of intersecting legs, the topography, the character of the intersecting roads, the traffic volumes, patterns, and speeds, and the desired type of operation.

Types of intersection depending on the geometric forms are as follows

1. 3 leg Junctions
2. 4- leg Junctions
3. Multi leg Junction

3.5.1 Un signalized intersection

Locations, where secondary (access or distributor) or low volume roads intersect with primary or a higher volume corridor (arterial or distributor), may be treated as un-controlled or un-signalized junctions. These junctions may be three or four armed. Uncontrolled intersections can create dangerous situations for NMVs conflicting with crossing or turning motorized traffic. These conflicts can be classified as conflicts at primary or secondary roads.

3.5.1.1 Primary Road Conflicts

At uncontrolled junctions with distributor roads all turns may be permitted, where vehicular traffic volume is considered low and enough safe gaps are available. At higher volume distributor roads, and on arterial roads where high volumes are combined with high speeds of motorized vehicles, restrictions on right turns for motorized vehicles should be enforced through a continuous median on the primary road. This discontinues or terminates the secondary streets at primary roads allowing only left turning movements at the resultant junction. However, any restrictions on crossing NMV and pedestrian traffic across the primary roads would increase their journey time as well distances and adversely affect the directness of the route. At such locations where, alternative safe crossings are more than 200m away 'NMV and pedestrian only (no motorized vehicles allowed) crossings should be considered either as 'grade separated' or 'signalized at-grade', especially at locations where high crossing demand exists. On low volume distributor roads where all turns are permitted, NMVs may turn as vehicles by gap acceptance. Here speeds of 30km/hr. or less should be achieved at the junction by introducing traffic calming devices on all conflicting streets, including the primary road.

3.5.1.2 Secondary Road Conflicts

NMVs moving along primary roads conflict with vehicular traffic while crossing secondary streets at uncontrolled junctions. Similar conflicts are also created at property entrances requiring vehicular access (such as residence and petrol stations). Adequate treatment along NMV path at junctions is required to resolve these conflicts and ensure safety and coherence for crossing bicyclists. Design requirements for such treatment include speed reduction for vehicles on secondary roads, design ensured continuation of NMV path/track and warning NMVs about expected vehicular conflicts. All of these requirements can be

bundles in a single junction design known as the raised crossing design. Raising the motor vehicle lane or crossing by a set height achieves raised crossings. This is typically equivalent to the height of the footpath so that the design benefits pedestrians and others with special mobility needs (such as wheelchairs) to move across unhindered while crossing vehicles slow down (due to the steepness of the ramp access to the crossing as on a speed breaker) and are forced to yield to them. In this arrangement however, cyclists need to be accommodated to ensure a similar quality and level of service as the pedestrian.

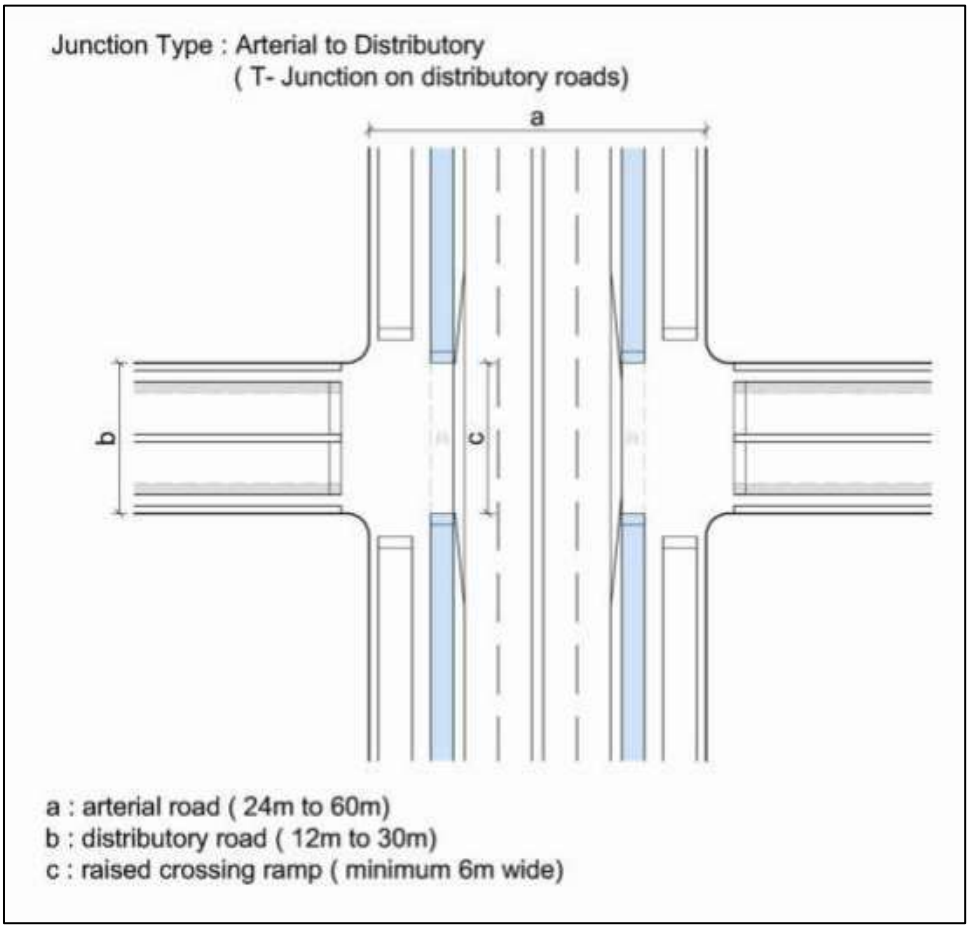

Figure 11 Arterial to Access – raised crossing on access roads

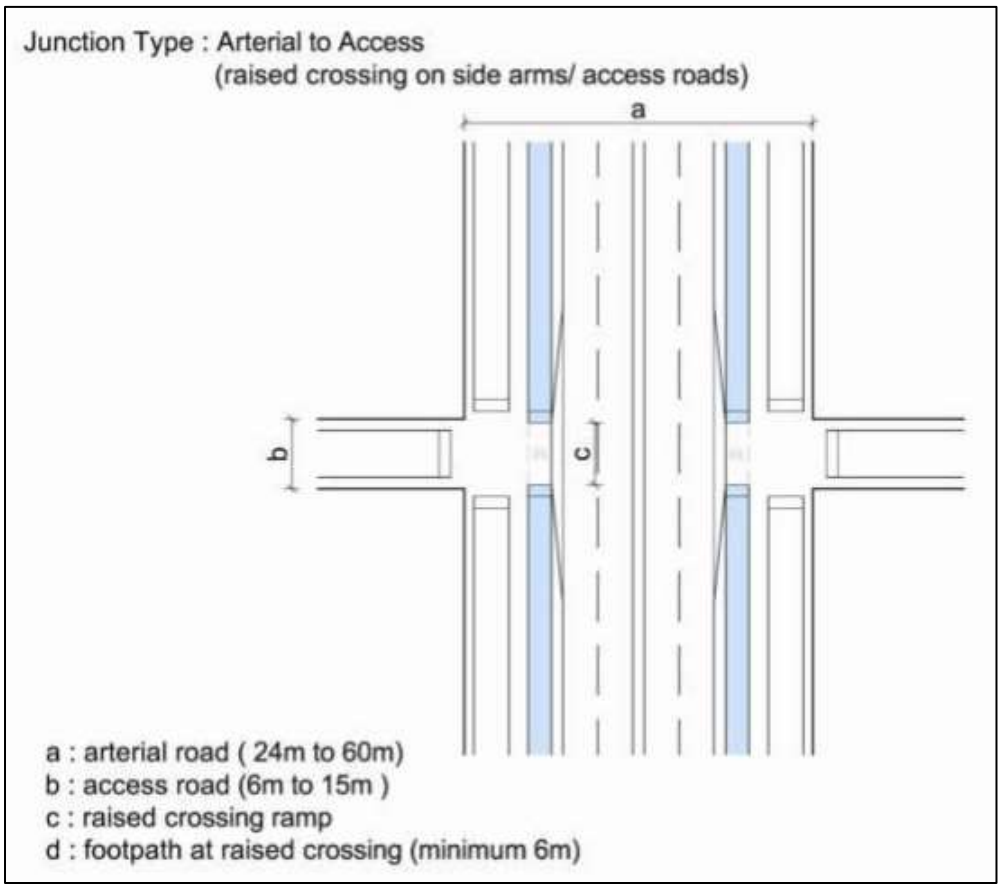

Figure 12 Arterial to Access – raised crossing on side arms

3.5.2 Signalized Intersections

Signalized intersections are a less (sustainably) safe solution than roundabouts or grade separated intersections and must therefore be regarded as second best in terms of safety. Since signalization is applied at junctions where higher motorized vehicle volumes require control by traffic lights, it is more likely that signal engineers will prioritize motorized traffic over bicyclists in the phasing plan. Here, selected geometric and signal phase design elements can be used to result in a signalized intersection, which significantly improves the crossing conditions for cyclists and pedestrians. The list of these elements available at a designer's disposal and the design process leading to their selection and use has been described in the following section.

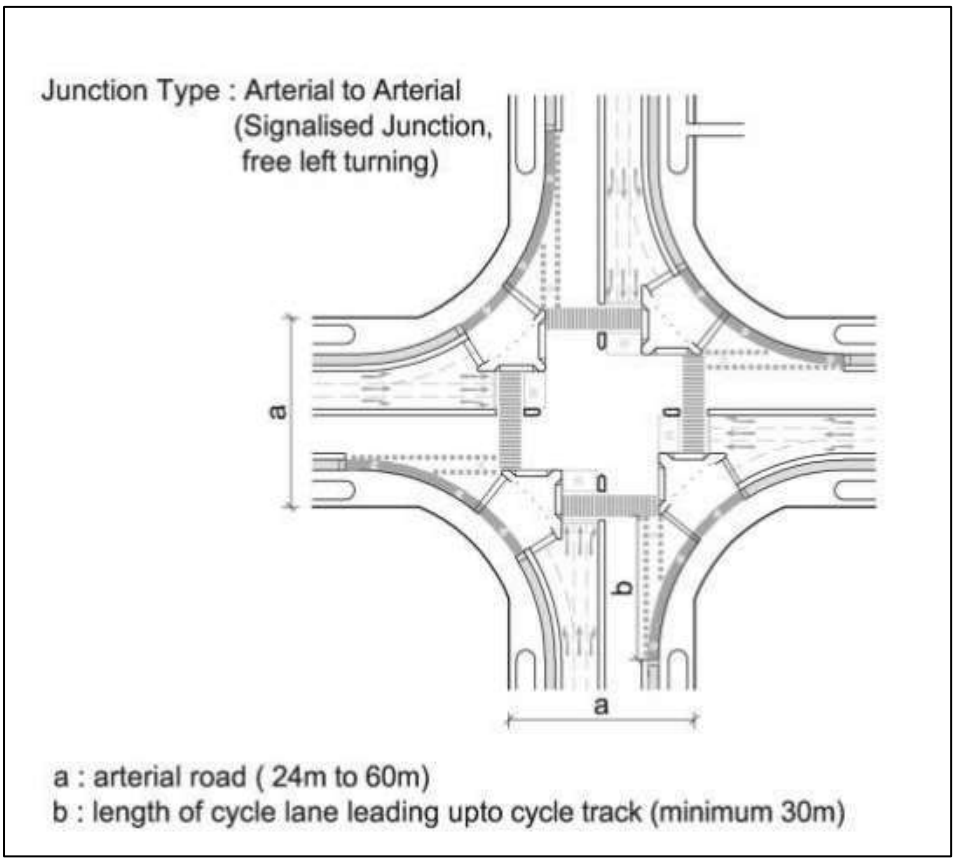

Figure 13 Arterial to Arterial –Signalized intersection (with pedestrians and cyclist facility)

3.5.3 Roundabouts

A Roundabout is a type of circular intersection with a specific design and traffic control features. Roundabouts can be designed to suit most site conditions, traffic volumes, speeds, and all road user requirements. This is one versatile solution, which combines the benefits of safety and efficiency in an attractive package. Safety is achieved by reduced speed (less than 40 km/hr) within the roundabout and efficiency by high directness in time and distance or minimal delays for all users. Roundabouts, on higher traffic intensity junctions, requiring complex crossing decisions by cyclists would require segregated bicycle infrastructure along with safer crossing provisions for pedestrians, whereas lower intensity junctions may rely more on mixed conditions and traffic calming techniques. Roundabouts are used to control merging and conflicting traffic flows at an intersection, by performing two main functions:

1. It defines the priority of the traffic streams entering the junction, so as to ensure that the traffic entering should not be a hindrance to the already existing traffic circulating in the roundabout.

2. It causes the diversion of traffic flow from its straight path, ensuring slow speeds of vehicles as they enter the junction.

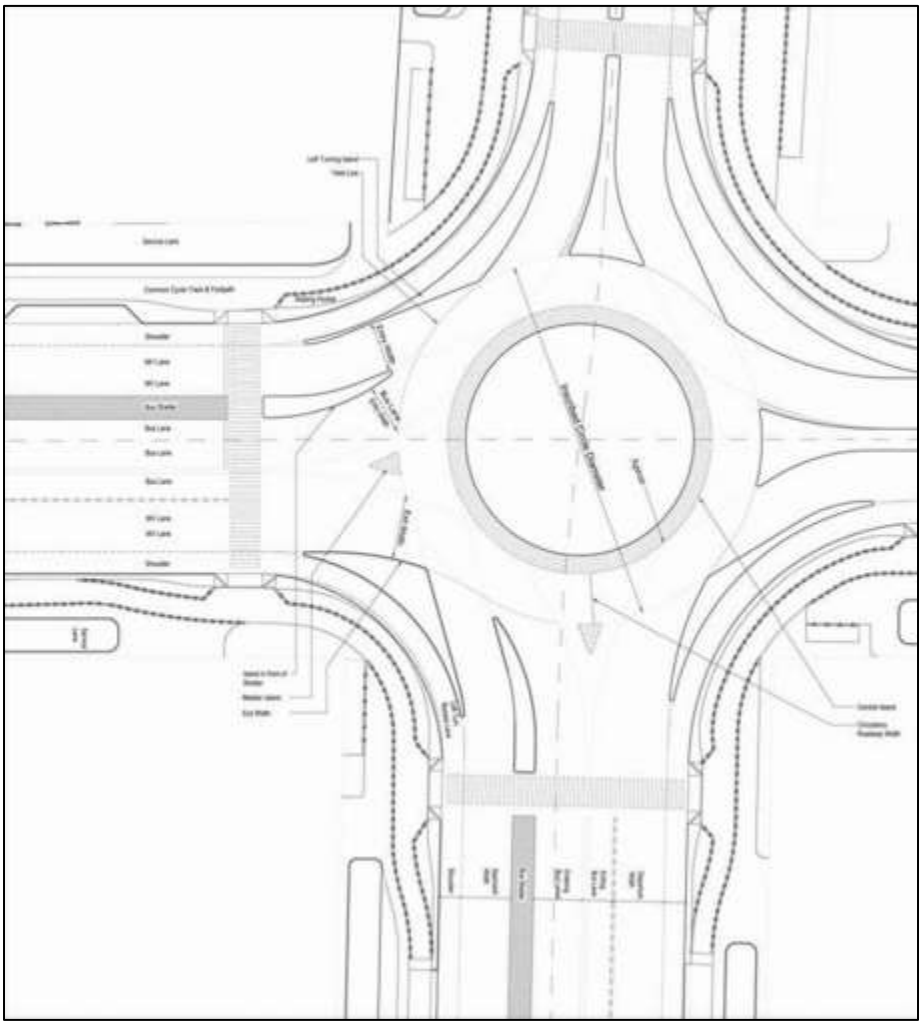

Figure 14 Terminology of Roundabout

Central Island

The central island is the raised area in the centre of a Roundabout, around which traffic circulates.

Splitter Island

A Splitter Island is the raised area or a painted area on an approach used to separate entering from exit traffic, deflect and slow entering traffic and provide storage space for pedestrians.

Apron

To accommodate the wheel tracking of large vehicles, on small size Roundabouts: an apron is the mountable portion of the central island adjacent to the circulatory Roadway.

Circulatory Roadway

A curved path used by vehicles to travel around the central island.

Yield line

A yield line is a pavement marking used to mark the point of entry from an approach into the circulatory roadway.

Inscribed circle diameter

The inscribed circle diameter is the basic parameter used to define the size of the Roundabout. It is measured between the outer edges of the circulatory roadway.

Approach width

The width of the roadway used by approaching traffic upstream of any changes in width associated with roundabout. The approach width is typically no more than half of the total width opf roadway.

Departure width

The width of the road way used by departing traffic downstream of any changes in width associated with the roundabout. It is typically less than or equal to half of the total width of the roadway.

Exit width

The width of the exit where it meets the inscribed circle' It is measured perpendicular to the right edge of the exit to the intersection point of the left edge line and the inscribed circle.

Entry radius

Minimum Radius of curvature of the outside curve

Entry Width

It defines the width of the entry where it meets the inscribed circle. It is recommended that at least one lane in addition to the approach lane should be added.

3.5.3.1 Design Process

There are two methods with which the geometric alignment of a roundabout can be designed: Each method has been explained in detail in the Annexure after this section. The methods are:

- **METHOD 1** – Tangential Method.
- **METHOD 2** – Lane widening at Splitter Island at circulatory roadway side.

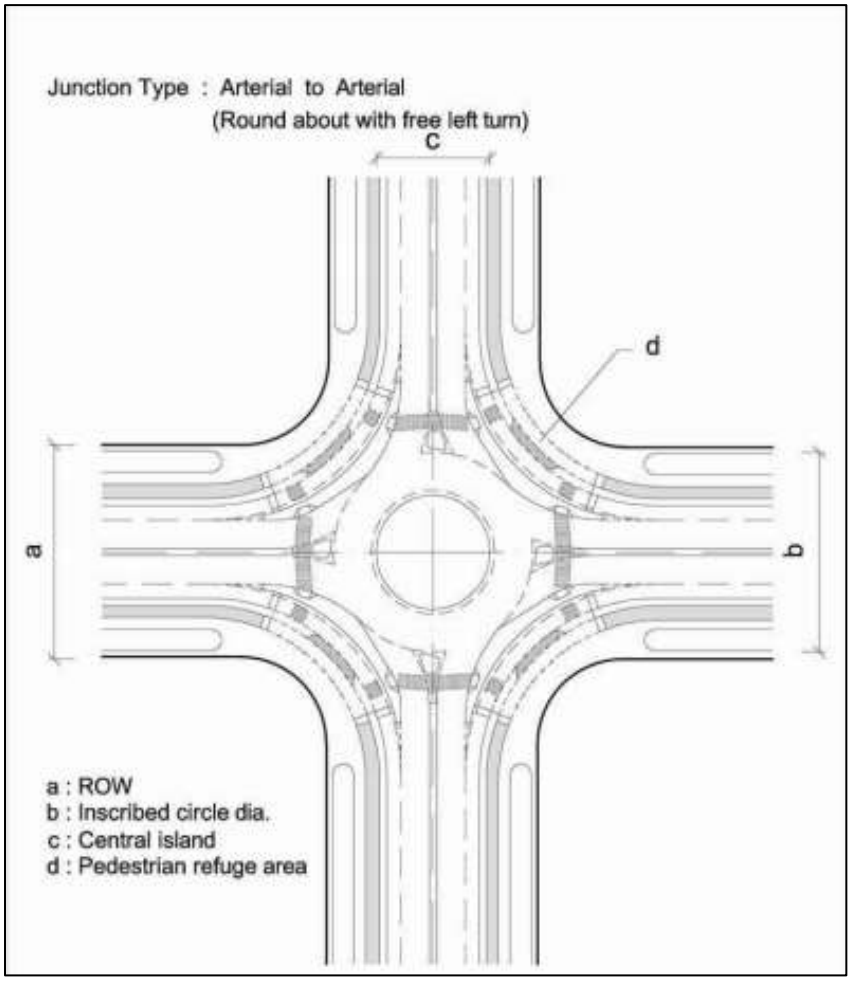

Figure 15 Roundabout with free left turn– Arterial to Arterial – METHOD 1

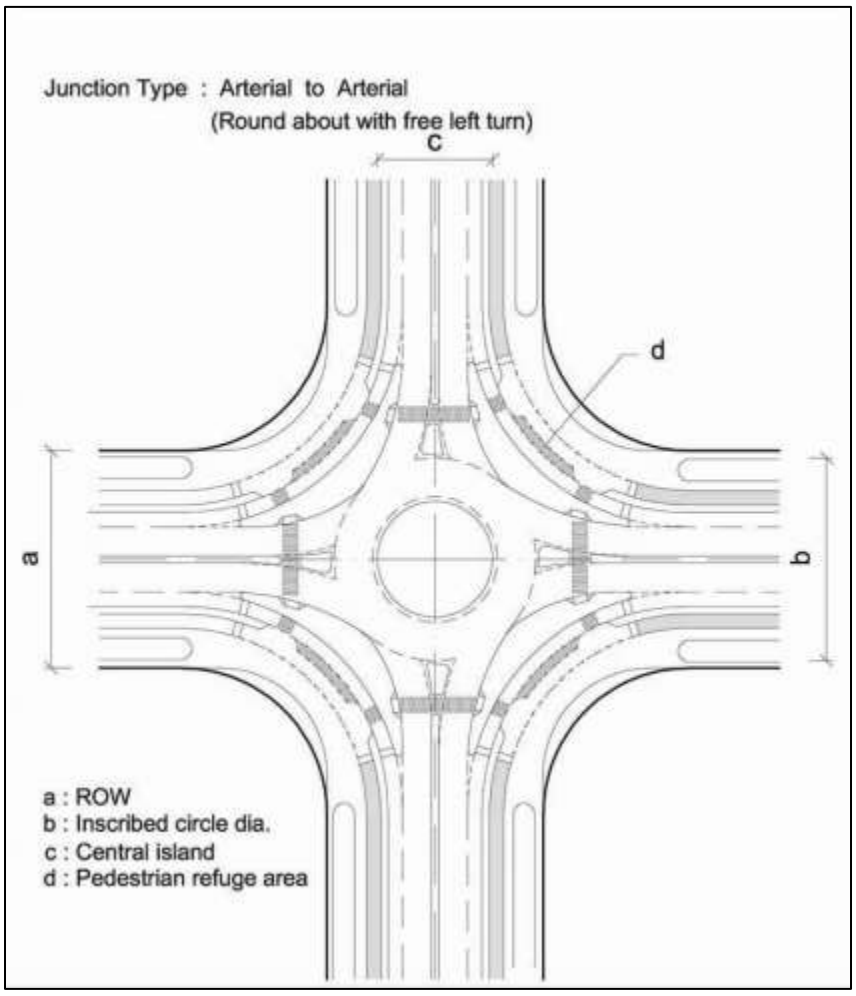

Figure 16 Roundabout with free left turn– Arterial to Arterial – METHOD 2

3.6 Parameters of Intersection Design

Intersection are designed having regard to flow speed, composition, distribution and future growth of traffic. Designed has to be specified for each site with due regard to physical conditions of the site, the amount and cost of land, cost of construction and the effect of proposal on the neighbourhood. Allowance have to be made for traffic signs, lightning columns, drainage, public utilities etc. The preparation of alternative designs and comparison of their cost and benefits is desirable for all major intersections.

3.6.1 Design Speed

Three types of design speeds are relevant for intersection element design:

i. Open highway or “approach” speeds

ii. Design speed for various intersection elements. This is generally 40 percent of approach speed in built up areas and 60 percent in open area.

iii. Transition speeds for design of speed change elements i.e. changing from entry/exit speed at the intersection to merging/ diverging speed.

3.6.2 Design Traffic Volumes

Intersections are normally designed for peak hour flows. Estimation of future traffic and its distribution at peak hours is done on the basis of past trends and by accounting for factors like new development of land, socio-economic changes etc. Where it is not possible to predict traffic for longer period, intersection should be designed for stage development for design period in steps of 10 years. Where peak hour flows are not available they may be assumed to be 8 to 10 percent of the daily flow allocated in the ratio of 60:40 directionally.

3.6.3 Radius of Curves at Intersection

The radii of intersection curves depend on the turning characteristics of design vehicles their numbers and the speed at which vehicles enter or exit the intersection area. The design curves are developed by plotting the path of the design vehicles on the sharpest turn and fitting curves or combination of curves to the path of inner rear wheels. Generally, four types of curves are possible to fit in with the wheel paths of a turning vehicle. Simple Circular Curve (Simple in layout but does not follow actual wheel path),3-centered compound (Closest to the actual wheel path and all transition curve but paved area is 20 percent more, where the numbers of semi-trailers combination vehicles are substantial a symmetrical curve is closer to the wheel path), Simple curve with offset and taper. (This closest to 3 compound curve and keeps the paved area at the intersection a minimum), Transitional curves (Difficult to layout and compute but closest to actual path). Selection of appropriate curve radii, influences the vehicle speed at various points. The speed should be such that the vehicle should either be able to stop before the conflict point or accelerate to suitable speed to merge with traffic flow. The speed with which drivers can follow a curve can be taken to be 6√R Km/h for up to speed 55km/h, Where R is the radius of the curve in meters.

S.No.	Vehicle type	Overall Width	Overall Length (m)	Overhang Front (m)	Minimum Turning	
1	Passenger Car (P)	1.4-2.1	3-5.74	0.9	1.5	7.3
2	Single Unit Truck (S.U)	2.58	9	1.2	1.8	12.8
3	Semi-Trailer and Single Unit Bus (WB- 12m)	2.58	15	1.2	1.8	12.2
4	Large Semi-Trailer (WB-15m)	2.58	16.7	0.9	0.6	13.71
5	Large Semi-Truck Trailer (WB18)	2.58	19.7	0.6	0.9	18.2

3.6.4 Visibility at Intersections

The sight distance is one of the major factors in safety at intersections. There are two considerations which are important to the driver as he approaches an intersection:

i. Overall visibility at intersection layout so that it can be comprehended properly at first glance by the approaching driver, for visualising the prospective worthiness of the layout, a simple method for this is to hold the junction drawing horizontally at eye level and observe the proposed layout from the direction of each approach, simulating the drivers view of the junctions. This squinting procedure can remarkably bring out many defects in the design.

ii. Sight triangle visibility to negotiate an intersection is another important requirement on becoming aware of approaching intersection, the driver must be able to observe and comprehend the speed and direction of approaching traffic from all other legs of the intersection. If a vehicle is approaching he should be able to safely stop prior to reaching the intersection. The approaching driver must be able to see sufficient distance along the cross road so as to judge if he can cross by suitably adjusting the speed and direction. Special care to ensure visibility should be taken if intersection is located on high land in a cutting at or near a summit or near a bridge. Telephone poles, kiosks, signs, light posts etc. should not be placed where they restrict visibility.

3.7 Survey And Investigation

In order to appreciate an in-depth assessment, various types of data have been collected which includes traffic characteristics, topography of the intersections etc. within the study area. It is an essential pre-requisite to appreciate the problems with respect to traffic movement, available infrastructure and to understand the need for organizing the same in an efficient manner. This appreciation and understanding is essential for identifying the present conditions and constraints for designing the intersections.

Accordingly, compilation of relevant secondary data and primary survey such as topographical survey were conducted within the ABD area. The details are given in the section below.

3.7.1 Primary Data Collection

For understanding the current situation of the intersections with respect to the modes plying on the roads and the physical features on the site, following surveys were conducted:

Reconnaissance Survey: Reconnaissance survey was carried out at each junction for identification of existing condition for the improvement measures to be carried out and for working out the detailed cost estimates.

Topographical Survey: The survey was conducted to demarcate and replicate the physical features such as the roads, footpaths, medians, trees, fences, electric poles, lamp posts, signage boards, etc. Based on the survey a base drawing of the intersections was prepared, which were then used for preparing the alternatives.

Intersection Volume Count: The survey was conducted to alalyse the tarffic pattern of the junction during the peak hours of day. The data was interpreted for design of the junction.

3.7.2 Secondary Data Collection

The secondary data collection included Comprehensive Mobility Plan, Transport-related Detailed Project Reports, Master Plan, Development Plan, or other land use planning documents, Plans for bus priority/bus rapid transit (BRT) networks, cycling networks, pedestrian networks etc., Latest street design guidelines for prepared by IRC, UTTIPEC and other relevant agencies Any other document related to transport planning/ designing, Details/ drawings/ documents related to upcoming infrastructure projects such as flyovers etc. to be studied and reviewed for any further clarification for the improvement of junctions.

CHAPTER 4. TRAFFIC SURVEY AND PROPOSALS OF THE IDENTIFIED JUNCTIONS

4.1 Introduction

Based on the reconnaissance survey, data analysis, stakeholder consultations and expert analysis all the seven intersections have been redesigned, keeping in view the site conditions are as follows:

1. Up gradation of existing intersection to best suitable option with the existing land availability.
2. Minimum or no damage to the trees and green planter.
3. Improvisation of existing islands with a smooth entry and exit.
4. Smoothening of turning radius wherever necessary.
5. Provision of signals and signage's wherever required.
6. Improvisation of existing pedestrian crossing.
7. Providing free left turns based on space availability and traffic flow.

Considering all the above observations, Darashaw has designed improvement plan for each junction and the detailed drawings of each option is given in the subsequent section.

The identified 7 intersections in the PAN city area are as follows:

1. Hari Parvat Crossing
2. Babu Jagjivanram Crossing
3. Sai Ka Takiya Junction
4. Shastri chowk
5. Bodala Choraha
6. Hotel Amar T-Point
7. St. Johns Crossing

4.2 Hari Parvat Crossing

Figure 17 Google image of Hari Parvat crossing Junction

* Hariparvat Crossing Junction is located between Hariparvat Road and Mahatma Gandhi Road Junction point.
* Nearby this Junction, are located two Major Institutions- IGVI College and MD Jain Inter College. Both Hariparvat Road and Mahatma Gandhi Roads are six lane roads.
* The North road of this Junction leads to Kandari. The West road leads to Lohamandi, and the East road and South road leads to Gadhapura and Rui ki Mandi.

4.2.1 Traffic Survey

The analysis of the survey data undertaken reveals that a total of 117655 numbers of vehicles and 98,649 PCUs are observed on a single day (24 Hrs. Intersection Count). The morning peak hour is 8:00 AM – 9:00 AM.

Name of Road: - **Station No.: -** **From: 08:00 AM** **To: 08:00 AM**

Road Classification: - **Direction: - Peak Hour Traffic in each Direction** **Tuesday** **Weather: - Clear**

Survey Location: - Hari Parbat **Date of Survey: - 14-06-2016 To**

Time	Direction from (A)					Direction from (B)					Direction from (C)					Direction from (D)					Total Outflow	Total Inflow
	Outflow	B	C	D	Inflow	Outflow	A	C	D	Inflow	Outflow	A	B	D	Inflow	Outflow	A	B	C	Inflow		
Total Vehicles																						
Slow	**1373**	438	477	458	**1,579**	**1351**	500	599	252	**1,252**	**1,696**	575	456	665	**1,527**	**1313**	504	358	451	**1,375**	**5733**	**5733**
Fast	**29074**	9,722	12,297	7,055	**31180**	**28787**	10,498	6,647	11,642	**27952**	**28207**	13,982	6,733	7,492	**26601**	**25854**	6,700	11,497	7,657	**26189**	**111922**	**111922**
Total	**30447**	10160	12774	7513	**32759**	**30138**	10998	7246	11894	**29204**	**29903**	14557	7189	8157	**28128**	**27167**	7204	11855	8108	**27564**	**117655**	**117655**
Total PCU																						
Slow	**1248**	486	387	375	**1,774**	**1,665**	702	678	285	**1,330**	**1950**	496	503	951	**1,558**	**1410**	576	341	493	**1,611**	**6273**	**6273**
Fast	**24345**	7,966	10,594	5,785	**26093**	**23914**	9,013	5,334	9,567	**22981**	**23424**	11,784	5,568	6,072	**21878**	**20693**	5,296	9,447	5,950	**21424**	**92376**	**92376**
Total	**25593**	8452	10981	6160	**27867**	**25579**	9715	6012	9852	**24311**	**25374**	12280	6071	7023	**23436**	**22103**	5872	9788	6443	**23035**	**98649**	**98649**

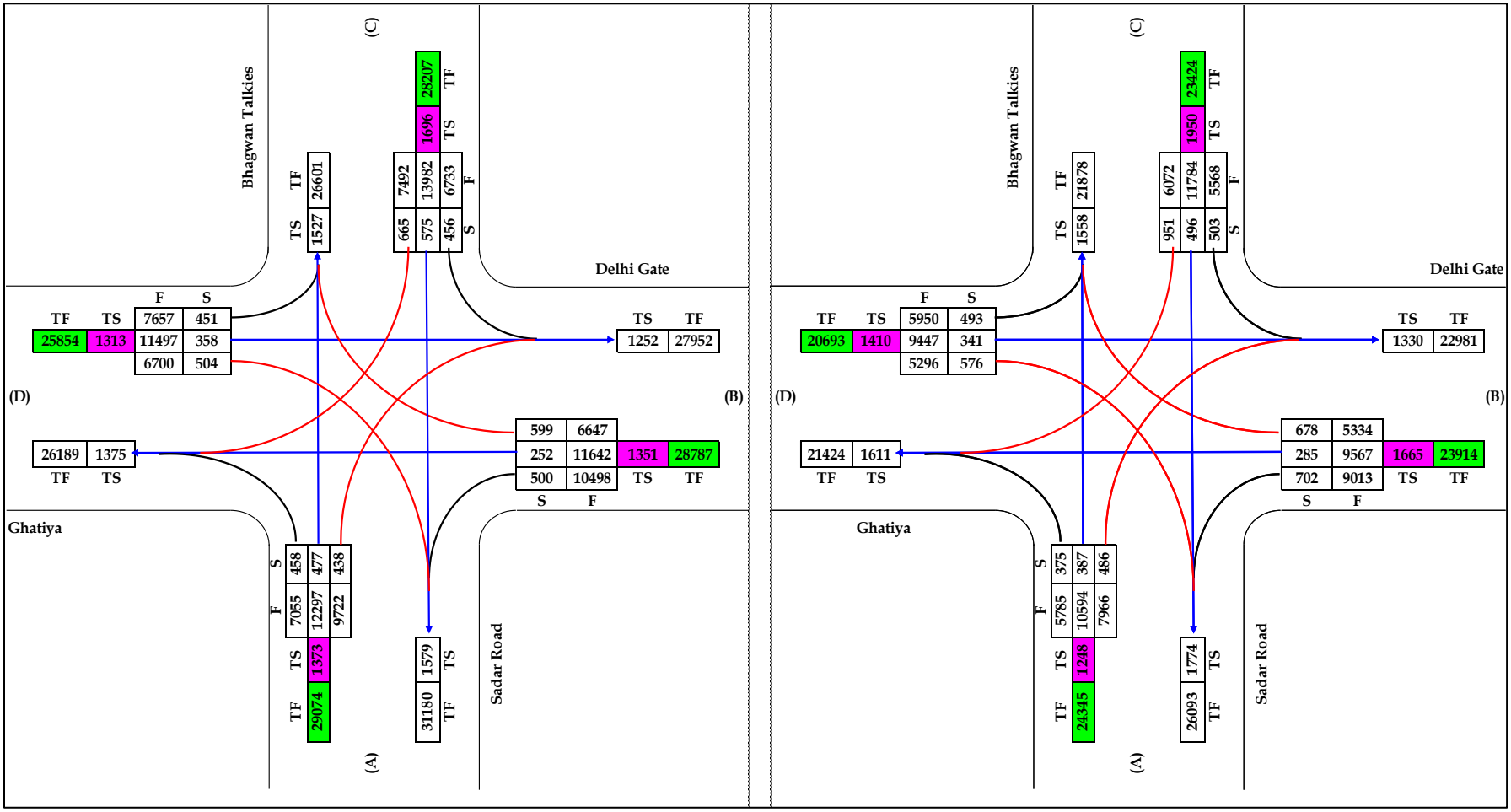

Figure 18 Peak hour Vehicle & PCU count in each direction at Hari Parvat crossing

4.2.2 Proposal for Hari Parvat Crossing

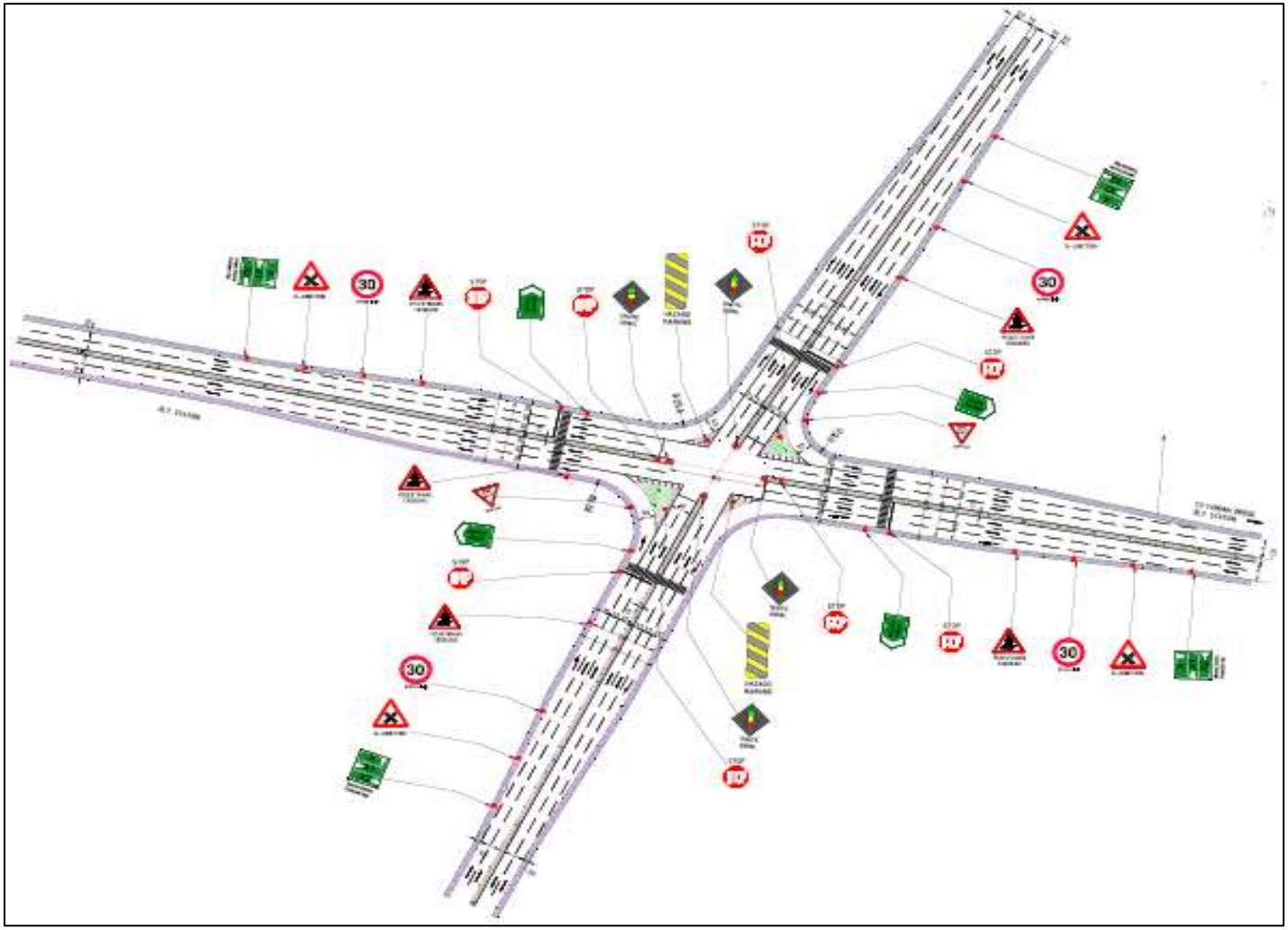

Figure 19 Proposal for Hari Parvat Crossing

4.3 Babu Jagjivanram Crossing

Figure 20 Google image of Babu Jagjivanram Crossing

* Babu Jagjivanram Crossing is located between the Mall road and the Purani Mandi road Junction point.
* This Junction lies between major commercial zones.
* The North road of this junction leads to Purani mandi Chouraha, the South East road leads to Fatehabad and the South West road leads to Shastri Chowk.

4.3.1 Traffic Survey

The analysis of the survey data undertaken reveals that a total of 22471 numbers of vehicles and 22259 PCUs are observed on a single day (24 Hrs. Intersection Count). The morning peak hour is 8:00 AM – 9:00 AM.

Name of Road: -

Road Classification: -

Survey Location: - Jagjeevan ram crossing

Station No.: -

Direction Towards: - Total Traffic

Date of Survey: - 13-12-2017 To 14-12-2017

Time	Direction from (A)				Direction from (C)				Direction from (C)				Total Outflow	Total Inflow
	Outflow	B	C	Inflow	Outflow	A	B	Inflow	Outflow	A	B	Inflow		
Total Vehicles														
Slow	**646**	453	193	**540**	**509**	300	209	**799**	**586**	240	346	**402**	**1741**	**1741**
Fast	**10004**	8571	1433	**7683**	**8047**	6649	1398	**10216**	**2679**	1034	1645	**2831**	**20730**	**20730**
Total	**10650**	9024	1626	**8223**	**8556**	6949	1607	**11015**	**3265**	1274	1991	**3233**	**22471**	**22471**
Total PCU														
Slow	**1699**	1137	562	**786**	**600**	14	586	**2141**	**1776**	772	1004	**1148**	**4075**	**4075**
Fast	**9104**	7645	1459	**6478**	**6808**	5619	1189	**9058**	**2272**	859	1413	**2648**	**18184**	**18184**
Total	**10803**	8782	2021	**7264**	**7408**	5633	1775	**11199**	**4048**	1631	2417	**3796**	**22259**	**22259**

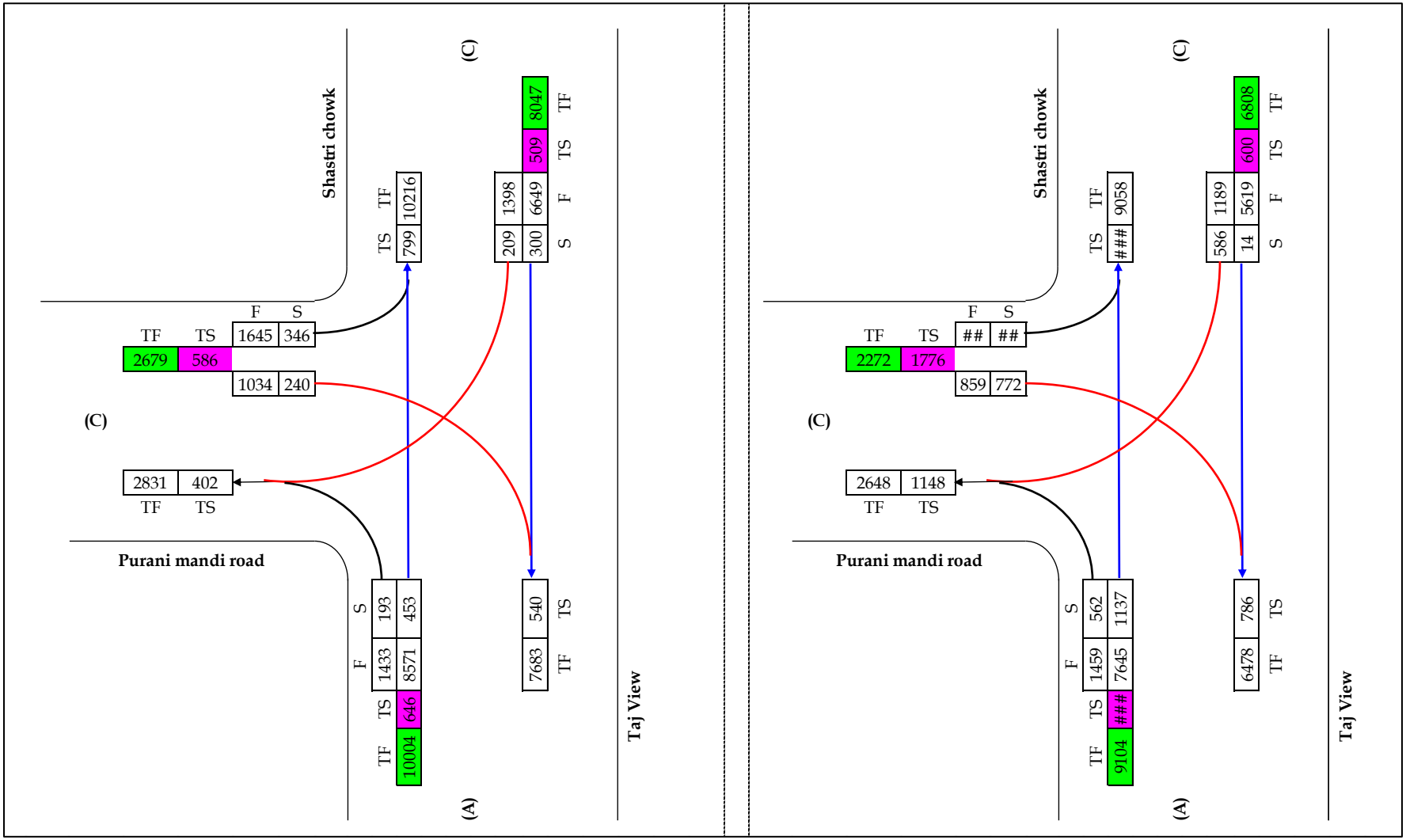

Figure 21 Peak hour Vehicle & PCU count in each direction at Babu Jagjivanram Crossing

4.3.2 Proposal for Babu Jagjivanram Crossing

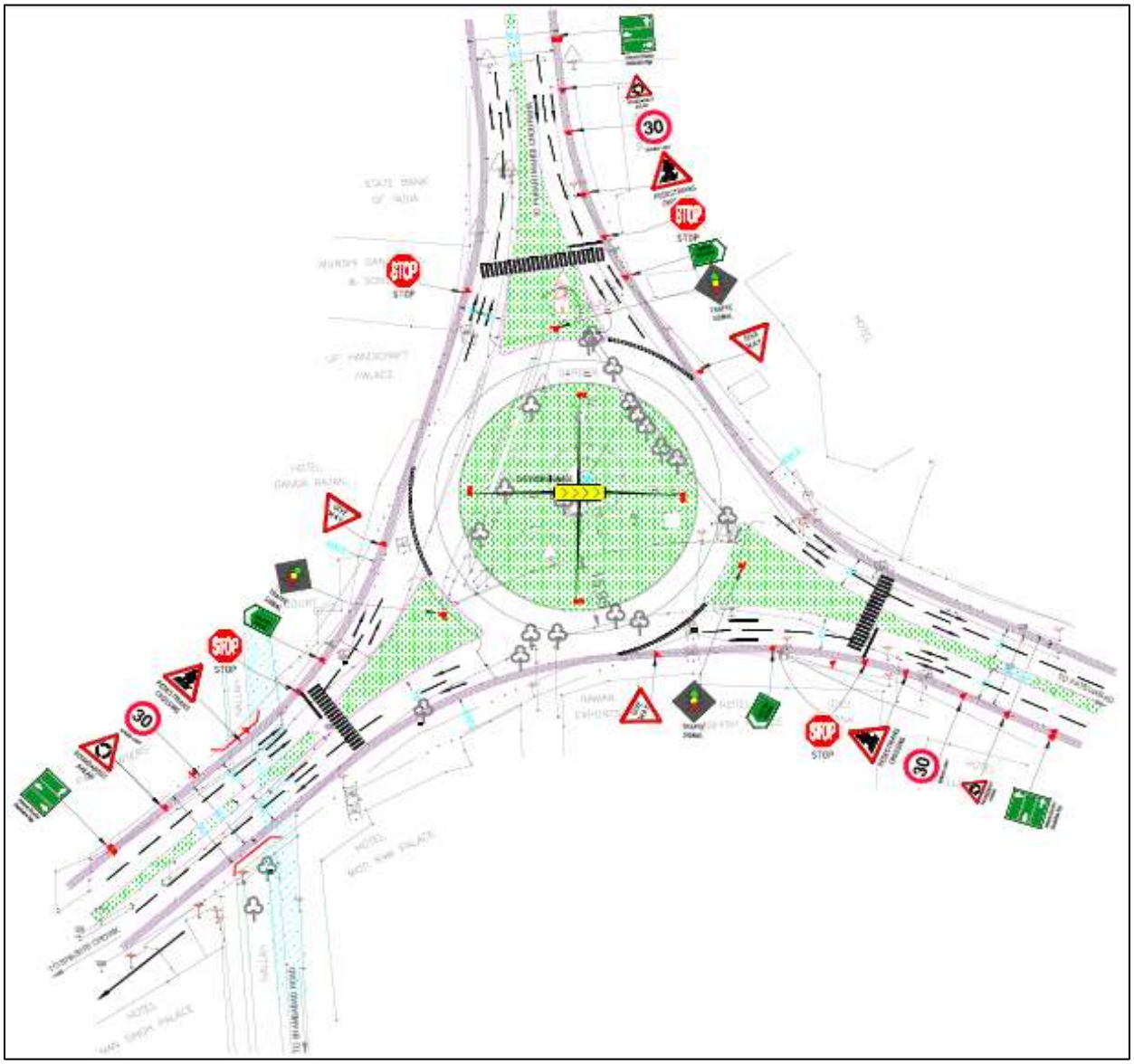

Figure 22 Proposal for Babu Jagjivanram Crossing

4.4 Sai Ka Takiya Junction

Figure 23 Google image of Sai ka Takiya Junction

* Sai ka Takiya Junction is located between Mahatma Gandhi Road and Namner Road Junction Point. It is located near Sai ka Takiya Masjid.
* Both Namner road and M.G. Road are four lane roads.
* The North road of this junction leads to Soorsadan. The South –West road leads to Pratapura and East road and West road leads to Bijli ghar and Namner Choraha.

4.4.1 Traffic Survey

The analysis of the survey data undertaken reveals that a total of 48438 numbers of vehicles and 31836 PCUs are observed on a single day (24 Hrs. Intersection Count). The morning peak hour is 8:00 AM – 9:00 AM.

Name of Road: -
Road Classification: -
Survey Location: - Sai Ka Tila Crossing

Station No.: -

Direction: - Peak Hour Traffic in each Direction

Date of Survey: - 11-12-2017 To

From: 08:00 AM Monday
Weather: - Clear

To: 08:00 AM

Time	Direction from (A)					Direction from (B)					Direction from (C)					Direction from (D)					Total Outflow	Total Inflow
	Outflow	B	C	D	Inflow	Outflow	A	C	D	Inflow	Outflow	A	B	D	Inflow	Outflow	A	B	C	Inflow		
Total Vehicles																						
Slow	**1018**	666	5	347	**1,101**	**1098**	222	486	390	**823**	**972**	499	114	359	**938**	**870**	380	43	447	**1,096**	**3958**	**3958**
Fast	**11120**	9,222	0	1,898	**10771**	**15884**	3,997	4,046	7,841	**15351**	**4730**	1,694	1,379	1,657	**6962**	**12746**	5,080	4,750	2,916	**11396**	**44480**	**44480**
Total	**12138**	9888	5	2245	**11872**	**16982**	4219	4532	8231	**16174**	**5702**	2193	1493	2016	**7900**	**13616**	5460	4793	3363	**12492**	**48438**	**48438**
Total PCU																						
Slow	**919**	518	0	401	**1,280**	**1,175**	167	627	381	**518**	**526**	526	0	0	**1,043**	**1003**	587	0	416	**782**	**3623**	**3623**
Fast	**8649**	7,200	2	1,447	**8194**	**11921**	2,984	3,073	5,864	**7200**	**1229**	1,229	0	0	**5508**	**6414**	3,981	0	2,433	**7311**	**28213**	**28213**
Total	**9568**	7718	2	1848	**9474**	**13096**	3151	3700	6245	**7718**	**1755**	1755	0	0	**6551**	**7417**	4568	0	2849	**8093**	**31836**	**31836**

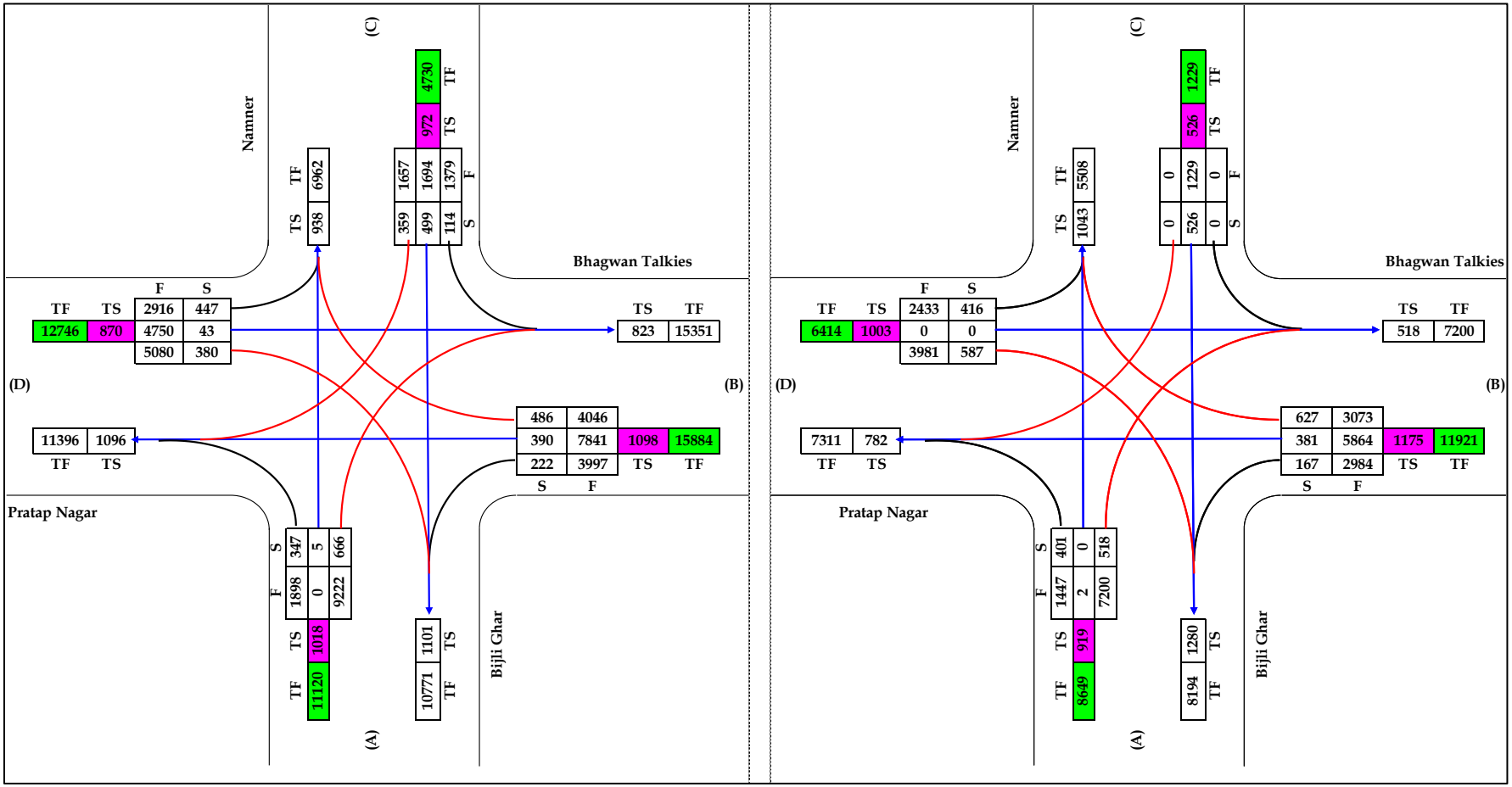

Figure 24 Peak hour Vehicle & PCU count in each direction at Sai Ka Takiya Junction

4.4.2 Proposal for Sai Ka Takiya Junction

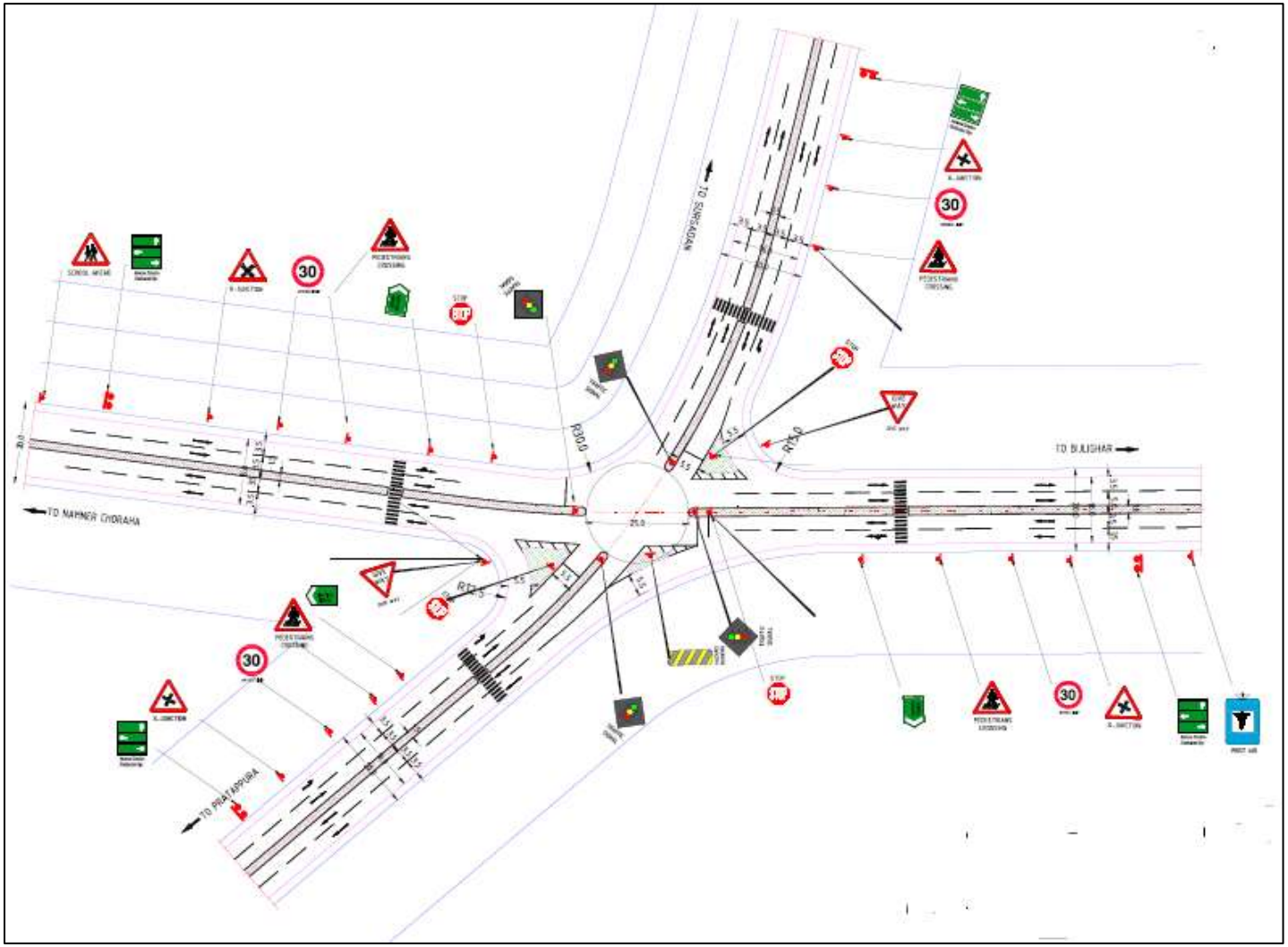

Figure 25 Proposal for Sai Ka Takiya Junction

4.5 Shastri chowk Junction

Figure 26 Google image of Shastri chowk Junction

* Shastri chowk Junction is located between Taj Road and the Mall road Junction point.
* The landmarks nearby this junction are JK Cottage Industries and Commissioner Office.
* Mall road is a major road in Shastri Chowk Junction and is a four-lane road. The North East road of this junction leads to Circuit House, the South East road leads to Bateshwar and the South-West road and North west road leads to V.P. Tourism Office and Avanthi Bai Circle.

4.5.1 Traffic Survey

The analysis of the survey data undertaken reveals that a total of 102341 numbers of vehicles and 90853 PCUs are observed on a single day (24 Hrs. Intersection Count). The morning peak hour is 8:00 AM – 9:00 AM.

Name of Road: -

Station No.: -

From: 08:00 AM To: 08:00 AM
Tuesday

Road Classification: -

Direction: - Peak Hour Traffic in each Direction

Weather: - Clear

Survey Location: - Shastri Chowk Crossing

Date of Survey: - 12-12-2017 To

Time	Direction from (A)					Direction from (B)					Direction from (C)					Direction from (D)					Total Outflow	Total Inflow
	Outflow	**B**	**C**	**D**	**Inflow**	**Outflow**	**A**	**C**	**D**	**Inflow**	**Outflow**	**A**	**B**	**D**	**Inflow**	**Outflow**	**A**	**B**	**C**	**Inflow**		
Total Vehicles																						
Slow	**4230**	2,216	1,034	980	**2,235**	**1572**	665	451	456	**4,844**	**5,175**	1,176	2,263	1,736	**1,868**	**1142**	394	365	383	**3,172**	**12119**	**12119**
Fast	**25982**	10,109	8,962	6,911	**24942**	**21882**	7,492	7,657	6,733	**21557**	**26363**	8,677	9,843	7,843	**22236**	**15995**	8,773	1,605	5,617	**21487**	**90222**	**90222**
Total	**30212**	12325	9996	7891	**27177**	**23454**	8157	8108	7189	**26401**	**31538**	9853	12106	9579	**24104**	**17137**	9167	1970	6000	**24659**	**102341**	**102341**
Total PCU																						
Slow	**5509**	3,004	1,177	1,328	**2,663**	**1,947**	951	493	503	**6,382**	**6057**	1,236	2,955	1,866	**2,181**	**1410**	476	423	511	**3,697**	**14923**	**14923**
Fast	**22372**	8,713	7,388	6,271	**20854**	**17590**	6,072	5,950	5,568	**18503**	**22441**	7,174	8,496	6,771	**17963**	**13527**	7,608	1,294	4,625	**18610**	**75930**	**75930**
Total	**27881**	11717	8565	7599	**23517**	**19537**	7023	6443	6071	**24885**	**28498**	8410	11451	8637	**20144**	**14937**	8084	1717	5136	**22307**	**90853**	**90853**

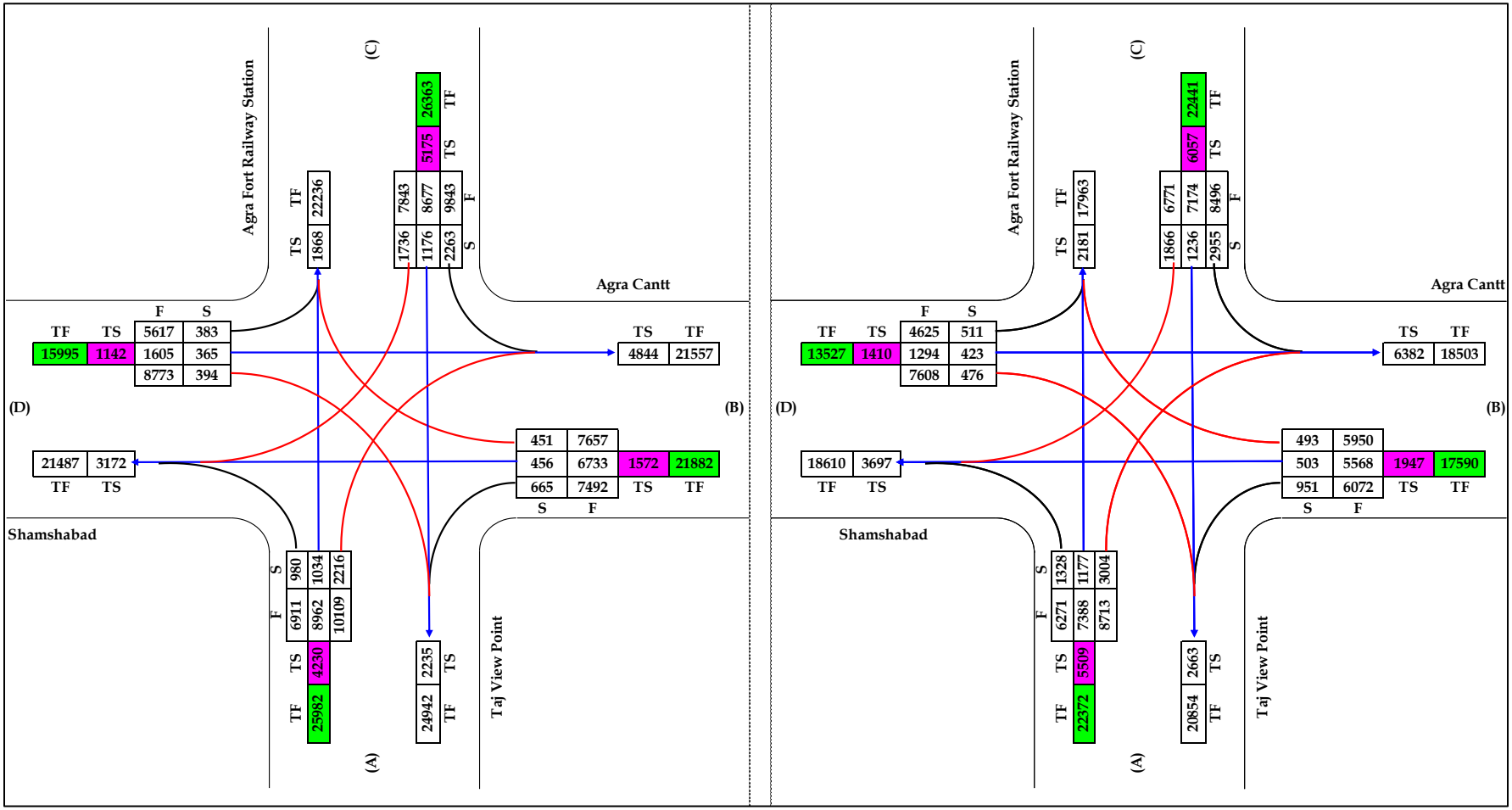

Figure 27 Peak hour Vehicle & PCU count in each direction at Shastri chowk

4.5.2 Proposal for Shastri chowk

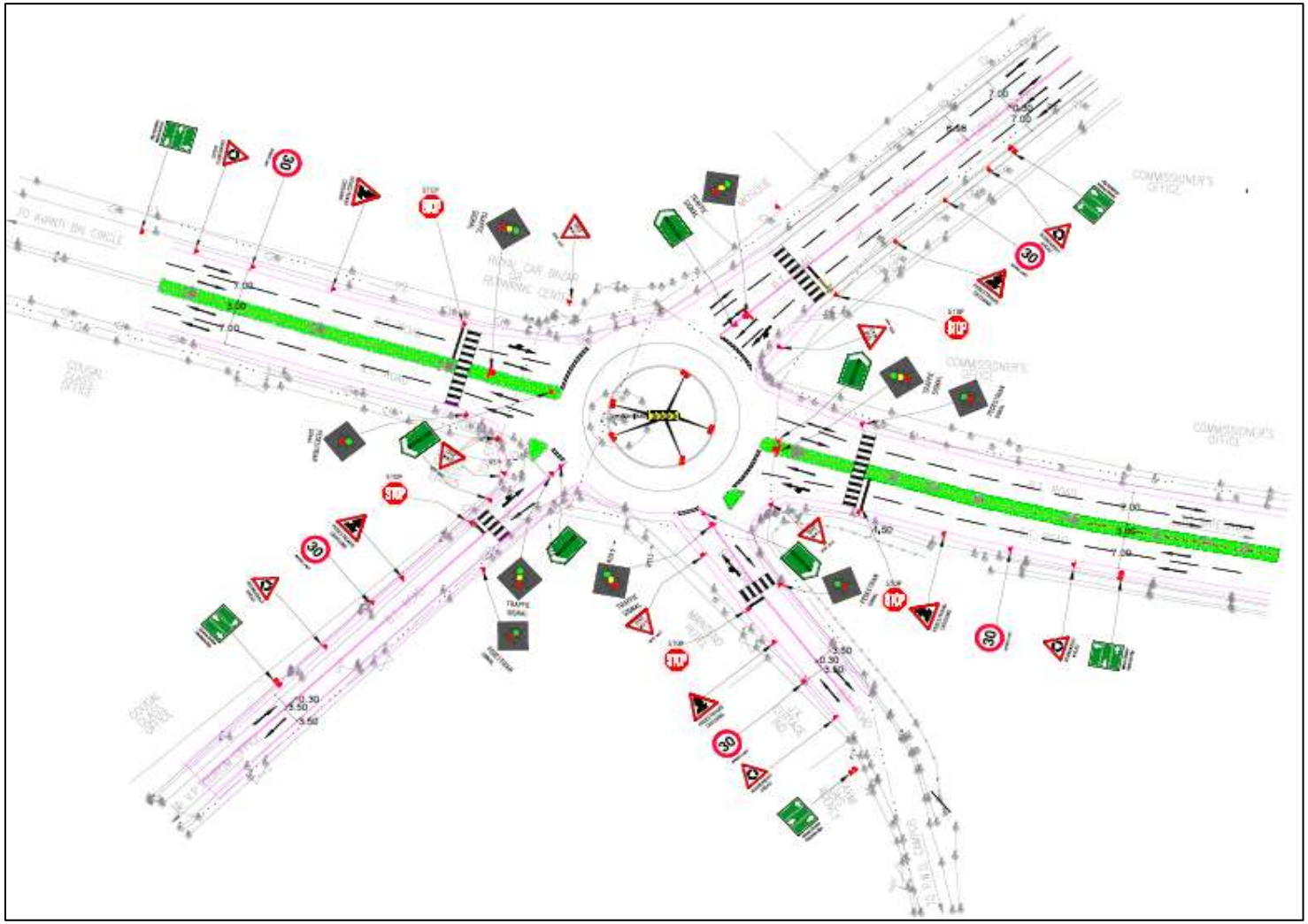

Figure 28 Proposal for Shastri chowk

4.6 Bodla Choraha

Figure 29 Google image of Bodla Choraha

- Bodla Choraha is located between the Sikandra Bodla road and Mahatma Gandhi Road Junction point.
- This Junction lies near the Maruti Estate. The East road of this junction leads to Loha Mandi Chouraha, the South East road leads to Mahatma Gandhi Road and the West road and North – West road leads to Bichpari and Parytak Garh.

4.6.1 Traffic Survey

The analysis of the survey data undertaken reveals that a total of 63955 numbers of vehicles and 54774 PCUs are observed on a single day (24 Hrs. Intersection Count). The morning peak hour is 8:00 AM – 9:00 AM.

Name of Road: -
Road Classification: -
Survey Location: - Bodla Crossing

Station No.: -

Direction: - Peak Hour Traffic in each Direction
Date of Survey: - 14-06-2016 To

From: 08:00 AM To: 08:00 AM
Tuesday
Weather: - Clear

Time	Direction from (A)					Direction from (B)					Direction from (C)					Direction from (D)					Total Outflow	Total Inflow
	Outflow	B	C	D	Inflow	Outflow	A	C	D	Inflow	Outflow	A	B	D	Inflow	Outflow	A	B	C	Inflow		
Total Vehicles																						
Slow	**1214**	421	394	399	**1,140**	**944**	448	316	180	**1,014**	**1,119**	383	371	365	**891**	**712**	309	222	181	**944**	**3989**	**3989**
Fast	**22558**	10,995	8,773	2,790	**18306**	**18485**	10,648	5,676	2,161	**19164**	**13783**	5,617	6,561	1,605	**15940**	**5140**	2,041	1,608	1,491	**6556**	**59966**	**59966**
Total	**23772**	11416	9167	3189	**19446**	**19429**	11096	5992	2341	**20178**	**14902**	6000	6932	1970	**16831**	**5852**	2350	1830	1672	**7500**	**63955**	**63955**
Total PCU																						
Slow	**1663**	576	476	611	**1,214**	**1,312**	485	500	327	**1,377**	**1483**	511	549	423	**1,149**	**643**	218	252	173	**1,361**	**5101**	**5101**
Fast	**19217**	9,295	7,608	2,314	**14934**	**15026**	8,711	4,544	1,771	**16015**	**11306**	4,625	5,387	1,294	**13345**	**4124**	1,598	1,333	1,193	**5379**	**49673**	**49673**
Total	**20880**	9871	8084	2925	**16148**	**16338**	9196	5044	2098	**17392**	**12789**	5136	5936	1717	**14494**	**4767**	1816	1585	1366	**6740**	**54774**	**54774**

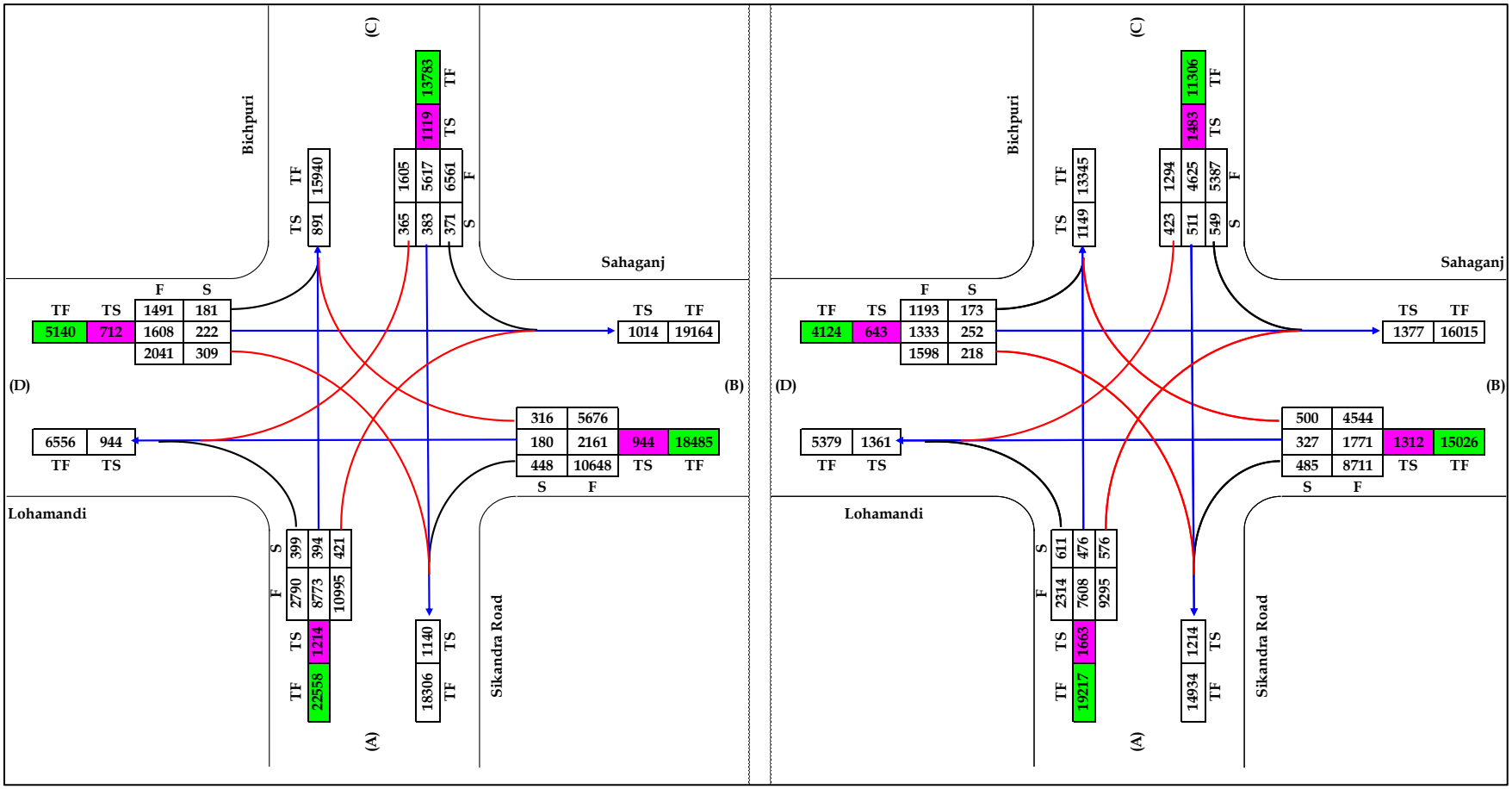

Figure 30 Peak hour Vehicle & PCU count in each direction at Bodla Choraha

4.6.2 Proposal for Bodla Choraha

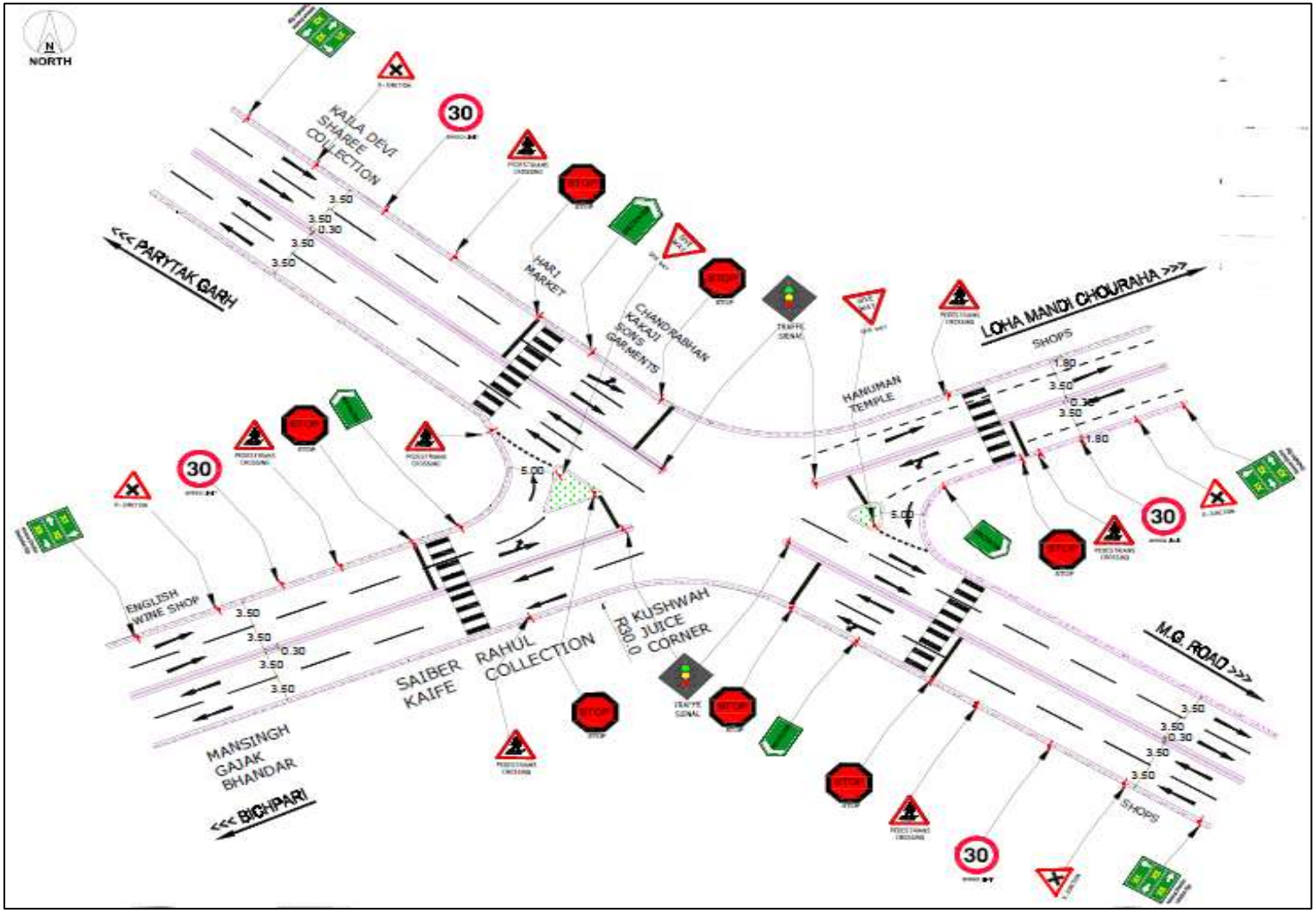

Figure 31 Proposal for Bodla Choraha

4.7 Hotel Amar T-Point Junction

Figure 32 Google image of Amar T-Point Junction

- Amar T-Point Junction located between Mall road and Minto Road junction point. This Junction is T shaped Junction.
- Both Mall road and Minto road are four lane roads. This Junction is located near the Hotel Amar.
- The East road of this junction leads to Fatehabad, the South road leads to Digner and the West road leads to Shastri Chowk.

4.7.1 Traffic Survey

The analysis of the survey data undertaken reveals that a total of 36462 numbers of vehicles and 30133 PCUs are observed on a single day (24 Hrs. Intersection Count). The morning peak hour is 8:00 AM – 9:00 AM.

Name of Road: -

Station No.: -

Road Classification: -

Direction Towards: - Total Traffic

Survey Location: - Amar Hotel Crossing

Date of Survey: - 12-12-2017 To 13-12-2017

Time	Direction from (A)				Direction from (C)				Direction from (C)				Total Outflow	Total Inflow
	Outflow	B	C	Inflow	Outflow	A	B	Inflow	Outflow	A	B	Inflow		
Total Vehicles														
Slow	**1386**	606	780	**1760**	**1741**	860	881	**1555**	**1849**	900	949	**1661**	**4976**	**4976**
Fast	**12163**	9233	2930	**12579**	**12658**	9581	3077	**12900**	**6665**	2998	3667	**6007**	**31486**	**31486**
Total	**13549**	9839	3710	**14339**	**14399**	10441	3958	**14455**	**8514**	3898	4616	**7668**	**36462**	**36462**
Total PCU														
Slow	**1494**	753	741	**1731**	**1677**	863	814	**1619**	**1734**	868	866	**1555**	**4905**	**4905**
Fast	**9543**	7236	2307	**10063**	**10172**	7645	2527	**10331**	**5513**	2418	3095	**4834**	**25228**	**25228**
Total	**11037**	7989	3048	**11794**	**11849**	8508	3341	**11950**	**7247**	3286	3961	**6389**	**30133**	**30133**

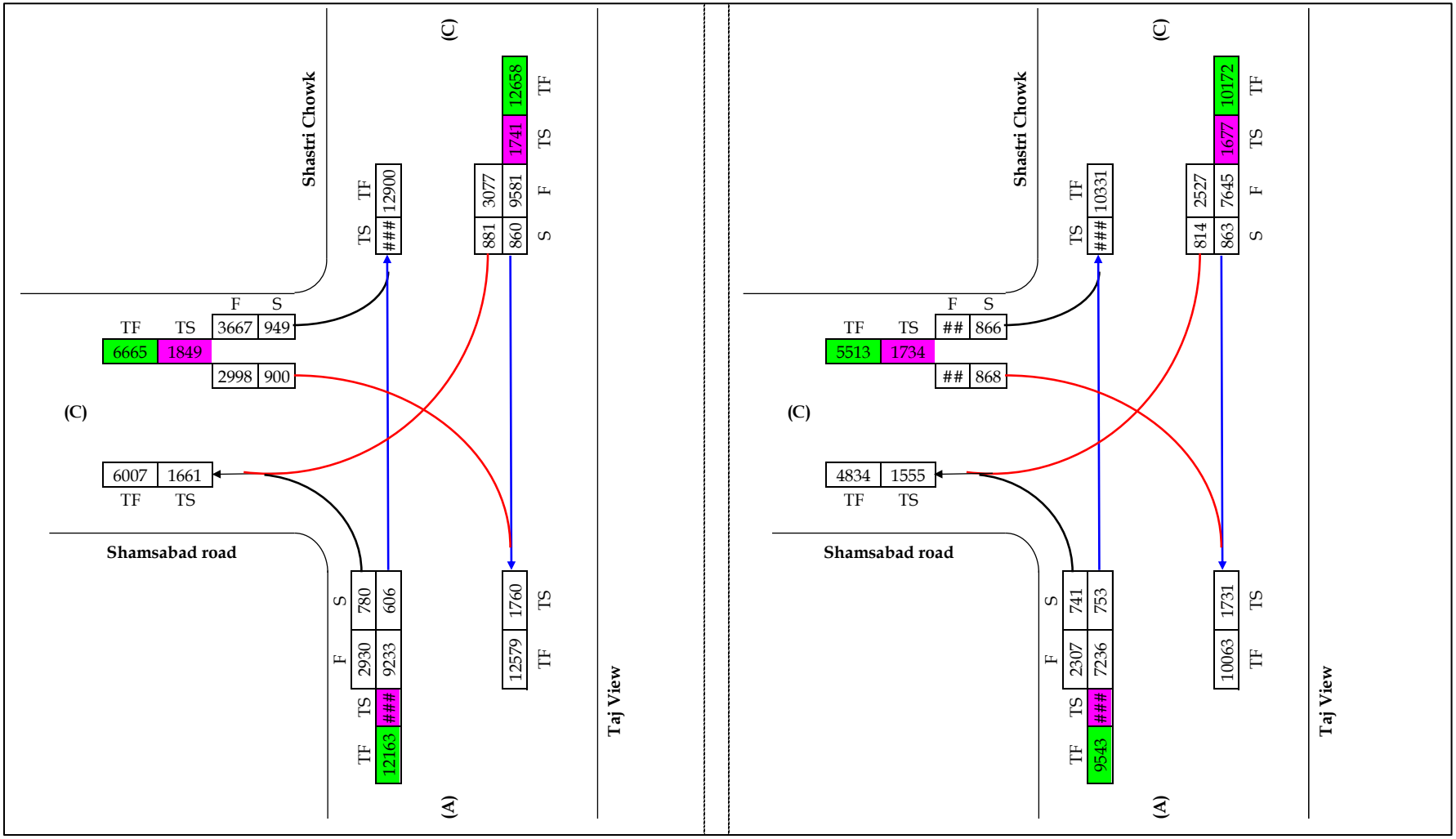

Figure 33 Peak hour Vehicle & PCU count in each direction at Hotel Amar T-Point Junction

4.7.2 Proposal for Hotel Amar T-Point Junction

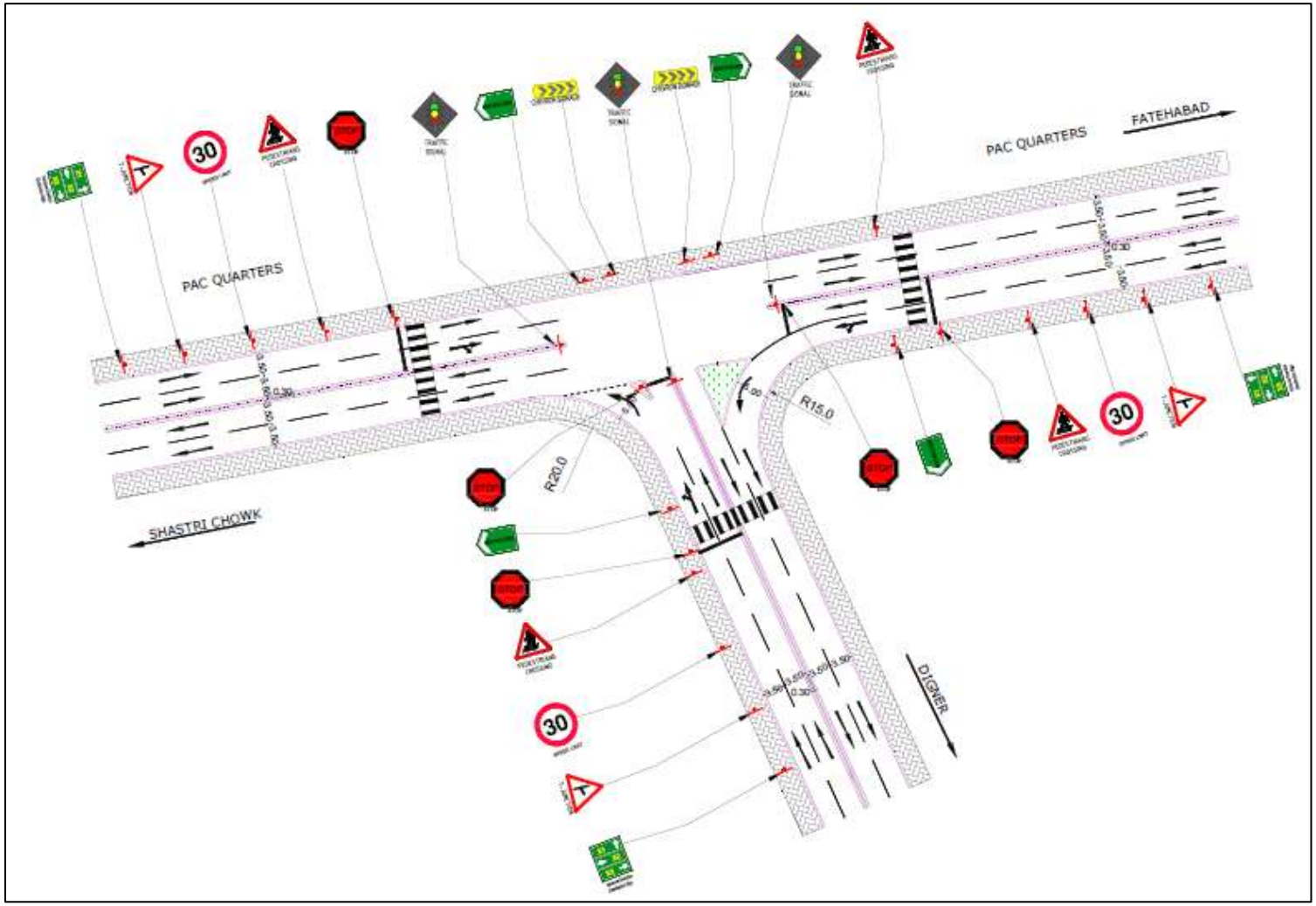

Figure 34 Proposal for Hotel Amar T-Point Junction

4.8 St. Johns Crossing

Figure 35 Google image of St. Johns Crossing

* St. Johns Crossing is located between Bagh Muzaffar Road and Mahatma Gandhi Road Junction point.
* This Junction is located nearby St. Johns College. The North road of this junction leads to Sanjay Palace, the South road leads to Raja Mandi and the West road and East road leads to Sirki Mandi and Gadhapura.

4.8.1 Traffic Survey

The analysis of the survey data undertaken reveals that a total of 113296 numbers of vehicles and 89536 PCUs are observed on a single day (24 Hrs. Intersection Count). The morning peak hour is 8:00 AM – 9:00 AM.

Name of Road: -
Road Classification: -
Survey Location: - St. John's Crossing

Station No.

Direction: - Peak Hour Traffic in each Direction

Date of Survey: - 10-12-2017 To

From: 08:00 AM To: 08:00 AM
Sunday
Weather: - Clear

Time	Direction from (A)					Direction from (B)					Direction from (C)					Direction from (D)					Total Outflow	Total Inflow
	Outflow	B	C	D	Inflow	Outflow	A	C	D	Inflow	Outflow	A	B	D	Inflow	Outflow	A	B	C	Inflow		
Total Vehicles																						
Slow	**1463**	490	544	429	**1,396**	**1419**	488	479	452	**1,420**	**1,623**	548	443	632	**1,489**	**1313**	360	487	466	**1,513**	**5818**	**5818**
Fast	**34620**	6,921	18,269	9,430	**35570**	**11812**	4,437	3,702	3,673	**17541**	**36355**	19,784	6,699	9,872	**31392**	**24691**	#####	3,921	9,421	**22975**	**107478**	**107478**
Total	**36083**	7411	18813	9859	**36966**	**13231**	4925	4181	4125	**18961**	**37978**	20332	7142	10504	**32881**	**26004**	11709	4408	9887	**24488**	**113296**	**113296**
Total PCU																						
Slow	**1996**	743	695	558	**1,719**	**1,813**	627	567	619	**1,869**	**2125**	630	579	916	**1,821**	**1568**	462	547	559	**2,093**	**7502**	**7502**
Fast	**27780**	4,890	16,471	6,419	**28519**	**7706**	2,952	2,346	2,408	**12113**	**28922**	17,111	4,665	7,146	**25429**	**17626**	8,456	2,558	6,612	**15973**	**82034**	**82034**
Total	**29776**	5633	17166	6977	**30238**	**9519**	3579	2913	3027	**13982**	**31047**	17741	5244	8062	**27250**	**19194**	8918	3105	7171	**18066**	**89536**	**89536**

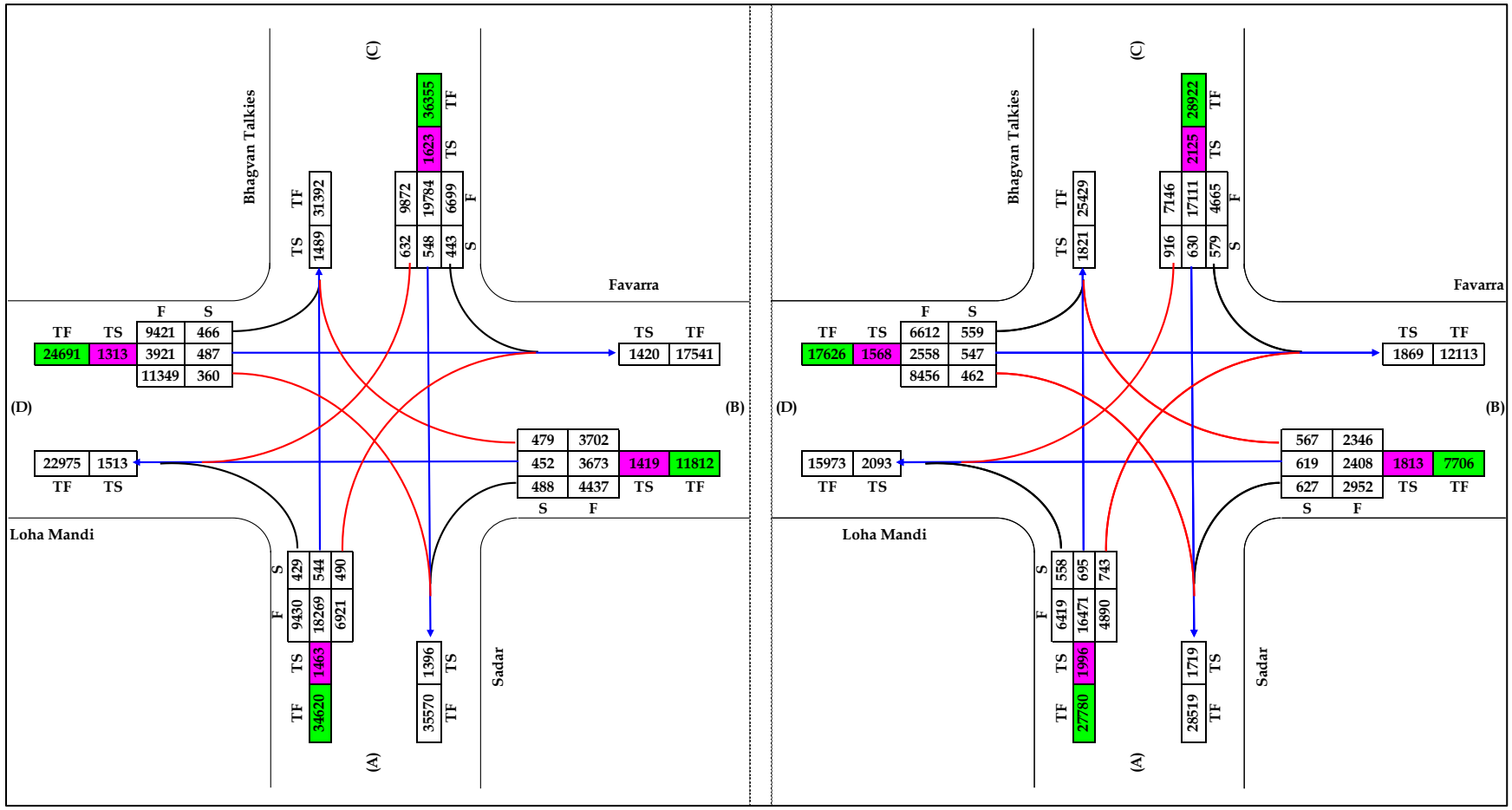

Figure 36 Peak hour Vehicle & PCU count in each direction at St. Johns Crossing

4.8.2 Proposal for St. Johns Crossing

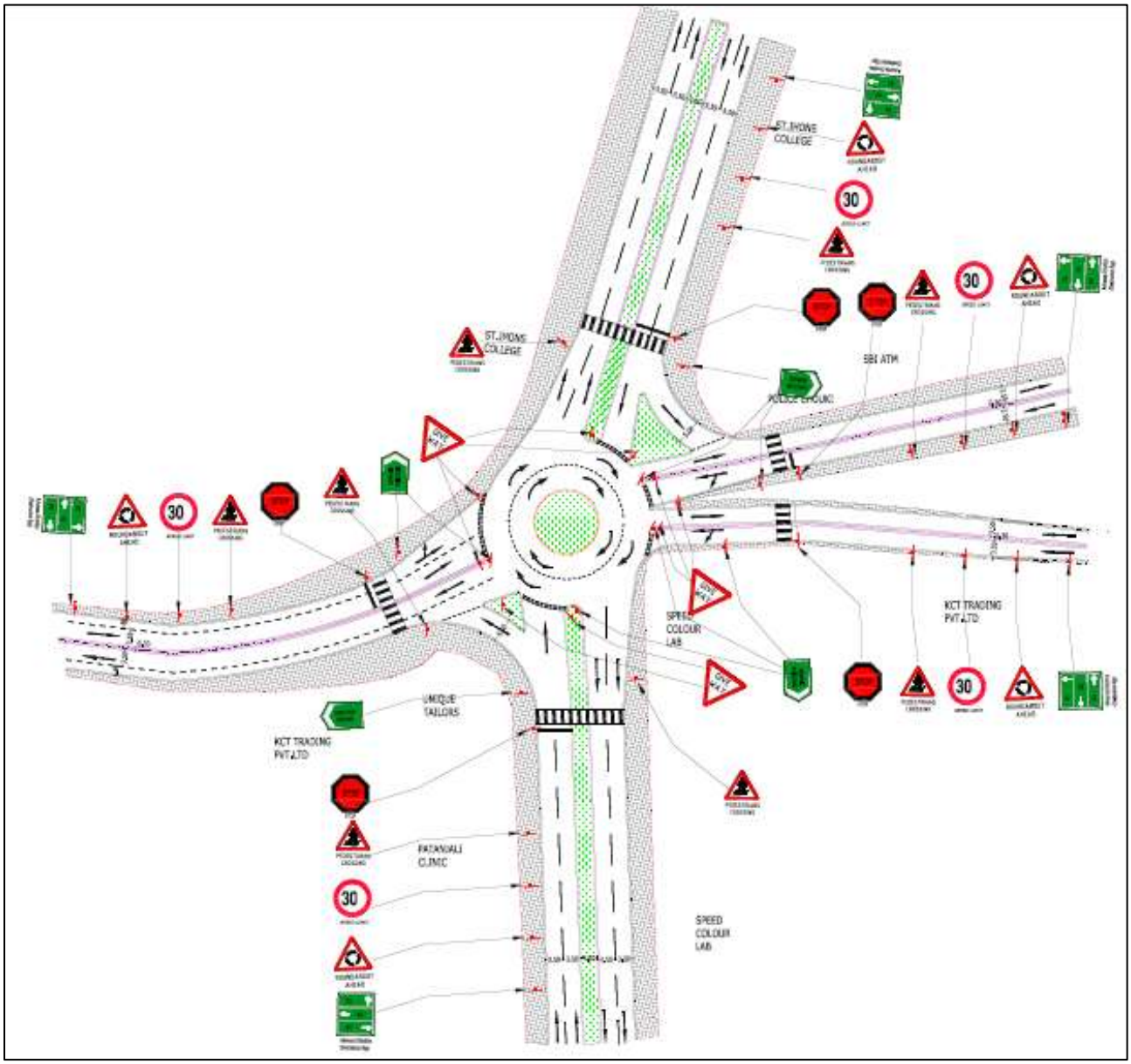

Figure 37 Proposal for St. Johns Crossing

CHAPTER 5. BOQS AND COST ESTIMATES

DARASHAW

1926

ALL ABOUT TRUST

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