



## **“TRAFFIC STUDY AND DESIGN OF TRAFFIC SIGNAL AT IDENTIFIED INTERSECTIONS IN MANSAROVAR, JAIPUR”**

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**Abstract-**Transport facility is an important part of growing economy of a country. A good road network is desired for trade and commerce & the system increases development of socioeconomy.

An efficient road network is the requirement and needs of commuters by constructing and improvement of road infrastructure. To manage travel demand, the intersection should give least resistance to traffic flow so that the travel time can be minimized. The vehicles are growing at a high rate on roads of Indian cities, so because of that we are facing problems of traffic. As vehicular traffic began to increase, the congestion on the streets began to hamper the safe and efficient movement of traffic.

The roads in the Mansarovar of Jaipur has been taken for improvement for delay in the journey time due to congestion at crossings. This is due to conflict, confusion and irritation caused by mixed traffic, which leads to accidents. These can be reduced by introduction of traffic management techniques.

In Present Study, four intersections are identified on primary road of Mansarover Jaipur, Mainly Shiprapath, Veer Tejaji Road & Madhyam Marg and its adjoining Cross roads. Remedial measures such as geometric improvement & providing traffic signals are proposed, so that road capacity be utilized with minimum accidents.

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### **I. INTRODUCTION**

#### **1.1 General**

From origin to destination of people and material transportation is used. Transportation ensure supply of goods is good quality & right time at least cost & time. Due to turning movement of vehicle and mixed traffic creates congestion. With help of traffic signal in present condition, congestion can be reduced. Accidents may be reduced at safe speed and less delay occurs.

Traffic signal controls, conflicting streams of vehicular and pedestrian traffic. These signals shall benefitted a large area and can be linked with computer network.

### **II. TRAFFIC CONGESTION**

A traffic system is said to be congested when the demand exceeds the capacity of the section. Traffic congestion is the travel time or delay in excess of that normally incurred under free flow traffic condition.

#### **Need of Study**

Jaipur city witnessed a fast growth in population and purchase of vehicles. Population was 23.23 lacs in 2001 and 30.73 lakh in year 2011, with annual population growth as 5.53% annually.

The growth of the vehicles as shown below in the Table is far more than the increase in population of the city.

**Table: Vehicle growth in Jaipur**

Year	Vehicles	Percentage of vehicle increase in comparison of 2009
2011-2012	18,70,976	Base Year
2012-2013	20,38,565	8.95%
2013-2014	22,22,060	18.76%
2014-2015	23,89,124	27.69%
2015-2016	24,23,648	29.56%

Source: Jaipur Traffic Police,

### **Objective**

Present study objectives are to improve junctions & flow of traffic & minimize accidents.

The main objectives area:-

- Accessibility to mix traffic flow traffic.
- Selected intersections are taken for traffic study & intersection improvement.
- Accident possibility reduction at crossing.
- Flow pattern of traffic & remedial measures for improvement

### **III. METHODS FOR SIGNAL DESIGNING**

There are four methods for signal design,

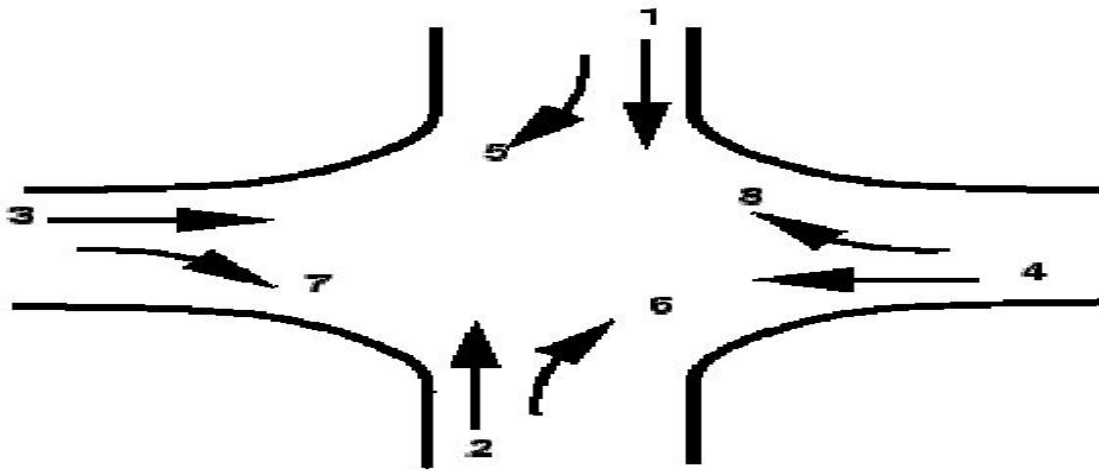
1. Trial cycle method
2. Approximate method
3. Webster's Method
4. IRC Method

### **PHASE DESIGN**

The objective of phase design is to separate the conflicting movements in an intersection into various phases, so that movements in a phase should have no conflicts.

Phasing is often guided by

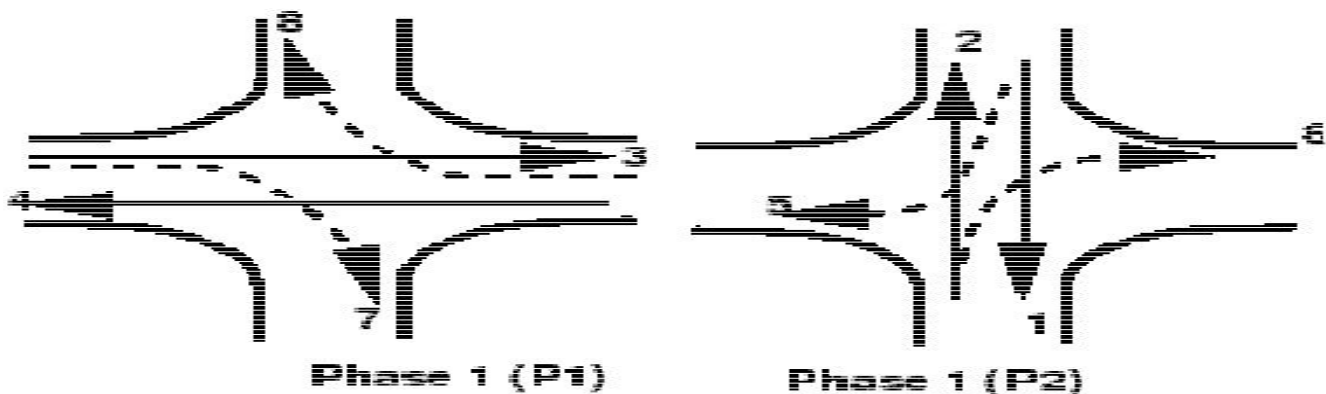
- The Geometry of the intersection,
- Flow patterns especially the turning movements,
- The relative magnitudes of flow.



Four legged intersection

#### A) TWO PHASE SIGNAL

Two phase system is usually adopted if through traffic is significant compared to the turning movements. For example in figure 3.2, non-conflicting through traffic 3 and 4 are grouped in a single phase and non-conflicting through traffic 1 and 2 are grouped in the second phase.



Two phase signal

**Present study aims** to suggest improvement in the flow of traffic by removing congestion and time delays due to it on the selected intersections on Mansarovar roads by suggesting traffic control signals. **Study has carried out in following steps:**

- Identification and selection of Intersections
- Collection of Accident Data
- Total Station Survey
- Traffic Survey
- Analysis of Traffic Data
- Design of Traffic Signals

#### IV. IDENTIFICATION OF INTERSECTIONS

There are a large number of signalized intersections in Jaipur city, which vary with respect to geometric design, phasing pattern, operating conditions and degree of enforcement.. The following major intersection in Mansarovar were selected for study as at these junctions facing queuing of vehicles and delays, conjunction of traffic due to new development & recent commercial activities and difficulty in pedestrian crossing. On the basis of this following 4 intersection were selected for study:-

- V.T. Road – Madhyam Marg Crossing
- Maharani farm – Shiprapath T-Junction
- Gujar Ki thadi Road (Shanti Nagar) – Shiprapath T-Junction
- Bhragu Path – Shiprapath T-Junction

#### V. COLLECTION OF ACCIDENT DATA

Accident data of the past years were collected from the Police Department to identify the black spot locations and to check the requirement of traffic signals as per warrants given in the guidelines. Data collected as shown in the Table.

**Table :Accident Data**

YEAR	FIR	DEATHS	INJURED
2014	1148	249	1007
2015	1123	269	974
2016	1101	258	1028
2017	1075	227	976
2018 (up to July 2018)	1108	194	907

Source: Jaipur Traffic Police,

Accidents observed at intersection locations selected in the study are also collected for past Three year period as shown in Table

**Table :Accident Data at Intersection Locations**

Intersection Name	Year	FIR	Death	Injured
1. V T Road-Madhyam Marg Crossing	2015	3	-	3
	2016	5	-	7
	2017	8	2	10
2. Maharani farm – Shiprapath T-Junction	2015	4	-	5
	2016	5	4	5
	2017	2	-	1
3. Gujar Ki Thadi – Shiprapath T-Junction	2015	11	-	10
	2016	5	-	5
	2017	3	-	3
4. Bhragupath – Shiprapath T-Junction	2015	4	-	6
	2016	1	-	1
	2017	4	-	4

Source: Jaipur Traffic Police,

## VI. TRAFFIC SURVEY

Traffic Survey was carried out at the selected intersections locations to determine:

- The characteristics of traffic presently plying on the roads envisaged in the project junctions and the trend of traffic growth on these roads in the past.
- Turning movement of traffic at junctions as per IRC.
- Capacity analysis of Junctions.
- Assessment of traffic flow problems over the design period and the improvement required.
- The impact of diverted and generated traffic.

Keeping in view the above objectives following traffic surveys were carried out:

- Turning Movement Count Survey

### Analysis of Traffic Data

Turning Movement Counts collected were converted in equivalent PCU terms and Peak hour counts were identified to determine the time cycle length of the traffic signals. PCU factors adopted for conversion are as shown in Table

**Table :PCU Factors as per IRC 64-1990**

SI No.	Vehicle Type	Equivalency Factor
<b>Fast Vehicles</b>		
1	Motor Cycle or Scooter	0.50
2	Passenger car, Pick-up Van or Auto-rickshaw	1.00
3	Agricultural Tractor, Light Commercial Vehicle	1.50
4	Truck or Bus	3.00
5	Truck-trailer, Agricultural Tractor-trailer	4.50
<b>Slow Vehicle</b>		
6	Cycle	0.50
7	Cycle-rickshaw	2.00
8	Hand Cart	3.00
9	Hors-drawn vehicle	4.00
10	Bullock Cart*	8.00

\* for smaller bullock carts, a value of six will be appropriate

### Design of Traffic Signals

Design of Traffic Signals was carried out using the method and Warrants as given in IRC: 93-1985 are used to determine the requirement of the traffic signals and are described in the paragraphs below:

**Warrant 1 - Minimum Vehicular Volume:** The traffic volume on the major street and the higher volume minor street for each of any 8 hours of an average day should be equal to the values indicated below:

**Table :Minimum Vehicular Volume Warrant**

No. of lanes on each approach		Veh. Per hour on major street (both approaches)	Veh. Per hour on minor street (one direction only)
Major street	Minor street		
1	1	650	200
2 or more	1	800	200

2 or more	2 or more	800	250
1	2 or more	650	250

(Source:- IRC: 93-1985)

**Warrant 2 - Interruption of Continuous Traffic:** The traffic volume on the major street and the higher volume minor street for each of any 8 hours of an average day should be equal to the values as indicated in Table

**Table :Interruption of Continuous Flow Warrant**

No. of lanes on each approach		Veh. Per hour on major street (both approaches)	Veh. Per hour on minor street (one direction only)
Major street	Minor street		
1	1	1000	100
2 or more	1	1200	100
2 or more	2 or more	1200	150
1	2 or more	1000	150

(Source:- IRC: 93-1985)

**Warrant 3 - Minimum Pedestrian Volume:** For each of any 8 hours of an average day the following traffic volume must exist:

- On the major street, 600 or more vehicles per hour enter the intersection (both approaches); or where there is a raised median island 1.2 m or more in width, 1000 or more vehicles per hour (both directions) enter the intersection.
- During the same 8 hours as in (i) above, there are 150 or more pedestrians per hour on the highest volume cross-walk crossing the major street.

**Warrant 4 - Accident Experience:** The accident experience warrant is satisfied when:

- Adequate trials of less restrictive remedies with satisfactory observance and enforcement have failed to reduce the accident frequency;
- Five or more reported accidents, of types susceptible of correction by traffic signal control have occurred within a period of 12 months, each accident involving personal injury or property damage to an apparent extent of Rs. 2000 or more.
- The signal installation will not seriously disrupt traffic flow.

**The signal design procedure involves six major steps as described below:**

- Phase design
- Determination of amber time and clearance time
- Determination of cycle length
- Pedestrian crossing requirements,
- The performance evaluation of the above design.

The objective of phase design is to separate the conflicting movements in an intersection into various phases, so that movements in a phase should have no conflicts

## VII. STUDY AND RESULTS

### Advance traffic & Engineering Study (IRC 93-1985)

- i. Traffic volume survey for the number of motorized and non-motorized vehicles entering the section in each hour from each approach, during 16 hour study (6AM to 10 PM) of a representative day, was conducted. The 12 consecutive hours selected (8 AM to 8 PM) contains the greatest percentage of 24 hours.
- ii. Peak hours study for 2 hours in morning (9AM to 11AM) and 2 hours in evening (6PM to 8PM) for vehicles volume for each traffic moments from each approach was also observed.
- iii. Pedestrian volume count was conducted intersection and found that only 1 intersection (VT Road Madhyam Marg) does have more than 150 parsons per hour in peak point is each approach.

### Warrant study

As per IRC-93-1985, Traffic Control signals should not be installed, unless one or more of the signal warrants specified are met-

### V.T. Road – Madhyam Marg Crossing.

#### (a) Warrant 1 – Minimum Vehicular Volume.

**Table :Minimum Vehicular Volume**

SI No.	Street Name	Motor Vehicle per Hour (PCU)			Requirement as per IRC
		In Coming	Out Going	Total	
<b>Major Street</b>					
1	To B2 Bypass	777	782	1559	> 800
2	To Gopalpura Bypass	778	474	1252	> 800
<b>Minor Street</b>					
1	To Shiprapath	385	374	759	> 250
2	TO New Sanganer Road	335	644	979	> 250

As in both major street total Motor Vehicle (PCU) are more than 800 and in both minor street total Vehicle Traffic (PCU) are more than 250, hence, there is necessity to install Traffic Signals.

#### Warrants 2 – Interruption of continuous traffic

**Table :Interruption of continuous traffic**

SI No.	Street Name	Motor Vehicle per Hour (PCU)			Requirement as per IRC
		In Coming	Out Going	Total	
<b>Major Street</b>					
1	To B2 Bypass	777	782	1559	> 1200
2	To Gopalpura Bypass	778	474	1252	> 1200
<b>Minor Street</b>					
1	To Shiprapath	385	374	759	> 150
2	TO New Sanganer Road	335	644	979	> 150



As in both major street total Motor Vehicle per hour (PCU) is more than 1200 & in both minor street is more than 150, hence there is necessity to install Traffic Signals.

**Warrants 3 – Minimum Pedestrian Volume**

**Table :Minimum Pedestrian Volume**

Sl No.	Street Name	Pedestrian Volume in Peak Hour	Requirement as per IRC
<b>Major Street</b>			
1	B2 Bypass to Gopalpura Bypass	174	> 150
2	Shiprapath to New Sanganer Road	161	> 150

Pedestrian Volume in peak hour in Major Street is more than 150, hence there is necessity to install Traffic Signals.

**Warrants 4 – Accident Experience**

IRC Warrant satisfied when 5 or more reported accidents occurred in last 12 month with each accident involving personal injury or property damage to on appsrent extend of Rs. 2000 or more.

At this junction 8 accident in last one year, Hence as per the warrant, traffic signals should be installed.

**Recommendation** - Hence, it is very clear from above warrant study of junction that traffic control signals are very necessary. The present installed signals should be made operative. (Design of Traffic signal enclosed in Chapter – 05)

**VIII. DESIGN OF TRAFFIC SIGNALS**

Intersections selected for the study are analyzed for the provision of traffic signals to channelize the traffic flow across the junction on the basis of traffic data collected as per the guidelines/ warrants given in IRC: 93-1985 "Guidelines on Design and Installations of Road Traffic Signals". As per study & result in only 3 intersections needs Traffic Control by Traffic signals.

**Detailed design of traffic signal at one intersection is as follows.**

**VT ROAD – MADHYAM MARG CROSSING**





Based on the traffic data collected at this intersection, Total PCU comes out as. 18543, and peak hour traffic is 2274 PCU turning movement count across intersection, saturation flow and design volumes are given in the Table below.

**Table : Turning Movement Counts VT Road – Madhyam Marg crossing**

S. No.	Directions				As per Template	Total PCU (8AM to 8PM)	Peak Hour PCU (7PM to 8PM)	Width of Road >(5.5m)	Saturation Flow	Design Volume
1	N	-	S	N-S	SHPIRA PATH TO N.S. ROAD	2138	191	10.5	5,513	215
2	N	-	E	N-E	SHPIRA PATH TO B2BYPASS	671	110	10.5	5,513	124
3	N	-	W	N-W	SHPIRA PATH TO GOPALPURA	637	84	10.5	5,513	95
4	S	-	N	S-N	N.S. ROAD TO SHIPRAPATH	2118	223	10.4	5,460	251
5	S	-	E	S-E	N.S. ROAD TO B2BYPASS	661	51	10.4	5,460	57
6	S	-	W	S-W	N.S. ROAD TO GOPALPURA	560	61	10.4	5,460	69
7	E	-	W	E-W	B2BYPASS TO GOPALPURA	3502	329	7.2	3,780	370
8	E	-	N	E-N	B2BYPASS TO SHIPRAPATH	622	74	7.2	3,780	83
9	E	-	S	E-S	B2BYPASS TO N.S. ROAD	2656	375	7.2	3,780	421
10	W	-	E	W-E	GOPAPLURA TO B2BYPASS	3634	622	6.0	3,150	699
11	W	-	S	W-S	GOPAPLURA TO N.S.ROAD	504	78	6.0	3,150	88
12	W	-	N	W-N	GOPAPLURA TO SHIPRAPATH	840	77	6.0	3,150	87
					<b>TOTAL</b>	<b>18543</b>	<b>2274</b>			

$$PHF=2274/18543=0.12$$

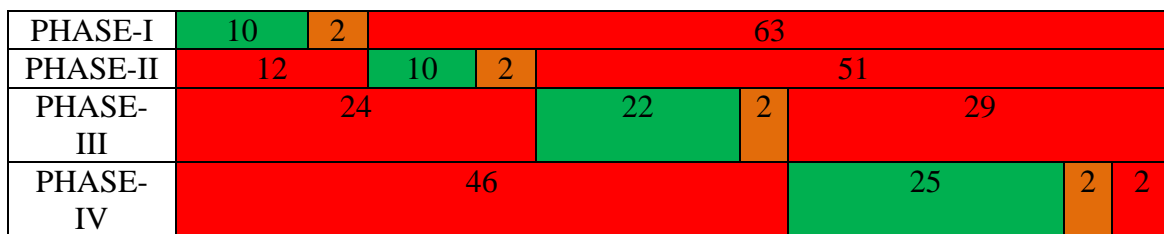
Assumptions made to calculate the signal cycle timing parameters and total loss time, saturation flow and optimum cycle length computed are given in Table below. Three Phase Signal design for the selected time cycle is presented in Table below and band diagram for the same has been shown in Figure below.

**Table :Four Phase Signal Design for V.T. Road – Madhyam Marg Crossing**

S. No.	PARTICULAR	Time
1	INERA GREEN PERIOD	4 Second
2	AMBER TIME	2 Second
3	STARTING DELAY for each lane	2 Second
4	Pedestrian crossing speed	1.2 m/Second
5	Total Loss time	16 Second
6	$Y=y1+y2+y3$	0.58
7	Optimum cycle time $C_o$	70 sec
8	Effective Green $g$	70 sec (70-16)=54sec
9	Total Cycle time	75 sec

**Table :Four Phase Time Cycle Lengths for V.T. Road – Madhyam Marg Crossing**

PHASE	GREEN	AMBER	RED	TOTAL
PHASE-1 (NS, NE, NW)	10	2	63	75
PHASE-2 (SN, SE, SW)	10	2	63	75
PHASE-3 (EW, EN, ES)	22	2	51	75
PHASE-4 (WE, WS, WN)	25	2	48	75



**Figure : Signal Cycle Diagram (V.T. Road – Madhyam Marg Crossing)**

**IX. CONCLUSION AND RECOMMANDATIONS**

On the basis of our traffic signal studies of the 4 intersections of Mansarovar Jaipur ,we have conclude that presently only one junction not required traffic signal.Following is our recommendatios for each intersection:

**1.V.T. Road – Madhyam Marg Crossing.**

It is recommended that already installed traffic signals (which are not functioning at present) at this junction **must be made operative** with design cycle of 75 sec

**2.Maharanifarm – ShiprapathT-Junction**

It is recommended that already installed traffic signals (which are not functioning at present) at this junction **must be made operative** with design cycle of 46 sec.

**3.Gujar Ki Thadi Road (Shanti Nagar) – Shiprapath T-Junction**

That It is recommended traffic signals should be installed at this junction with design cycle of 36sec.

#### **4.Bhragu Marg – ShiprapathT-Junction**

The filed data of traffic movements are medium and as per IRC warrant study ,traffic signals are not required.

Also traffic on all above intersections should be controlled by providing slip lanes for left turning vehicles, by providing Island & by increasing carriageway width with proper guiding kerb stones.

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