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Pavement Marking as a Means of Traffic Control Device for an Urban Intersection as per Indian Practice

Faheem Ahmed Malik
School of Civil Engineering and Geoscience
Newcastle University
Newcastle-upon-Tyne, England

Riyaz Ahmed Qasab, Aaqib Ali, Saqib Ali,
Uzair Zahid Zahoor, Umer Jan
Department of Civil Engineering
Islamic University of Science & Technology
Awantipura, Jammu & Kashmir, India.

Abstract— Road markings are an integral part of our road geometrics but are unfortunately being considered as passive traffic control devices. These can actually be used as a means of Intersection control. Polo-View intersection lies in the heart of Srinagar city which is the summer capital of the state of Jammu & Kashmir in India. This intersection is a place of main commercial activity of the state (Central Business District) and has a historic, cultural and tourism importance. A detailed investigation of the said intersection is done and all the parameters are calculated and evaluated. Based upon the traffic flow there are many possible solutions to the Intersection Control. As all the software's which are used to evaluate different options of Intersection design like PTV Vissim are not applicable in India, therefore traditional Traffic flow curves between major and minor roads are used for evaluations. Based upon these curves there are many solutions and each one is weighted. Traffic markings are an integral part of every road, therefore there respect and compliance are the pre-requisites for harmonious flow conditions, when these things are integrated with effective markings these form an important form of intersection design. We have aimed at designing these different possible Intersection types and then suggesting the best out of them as well as their long term implications. We have also taken into account how the Autonomous Vehicles may change the type of Intersection control.

Keywords— *Component; Road Markings; Traffic Control Devices; Central Business District; Intersection Design; Minor And Major Flow.*

I. INTRODUCTION

Pavement/Road Markings are mainly considered passive Traffic Control Devices. Traffic Control Devices (TCD's) are the various aids and devices used to control, guide and regulate Traffic. These are the means of communication between the Transportation Engineer and the Road User. Road users include motorist, cyclist and pedestrians. Harmonious and smooth flow conditions are achieved in traffic flow only when the Road Users are well educated about the TCD's and are properly enforced in practicality. In Transportation Management except for the road drivers, there is direct control on the actions and activities of the drivers in all the other modes of transportation e.g. Air, Water, Rail etc. In order to achieve relative control on the Behavior of the driver and

A. Pre Requisites of a Traffic Control Device.

- It should fulfill its intended purpose.
- It should command the Attention of the Road User.
- The message should be conveyed clearly, with a simplified approach
 - The whole system of Transportation should be such that Road users Respect a TCD.
 - Positioning of TCD should be such that it conveys the message in advance, so that road user can easily make decisions in advance with respect to the requisite message conveyed.
 - TCD should make driving easy rather than complicating it.

B. Functions of Pavement Markings

- Pavement Markings control and guide the Traffic (Motorist, Cyclist and Pedestrian). By doing so they promote Road Safety.
 - These act as a Psychological Barrier and warn drivers about the Hazardous Locations as well as serve other purposes such as delineating the conflicts e.g Diverging by guiding the Traffic in separate lanes, Merging traffic at a requisite speed by providing the Tapper between two Traffic lanes. They also help in increasing the Capacity (as per HCM [1] Capacity is directly proportional to speed up to a certain speed) as well as increase the Level of Service (L.O.S) without any new investment in the Infrastructure.
 - Pavement Markings when used for Channelizing the Intersection rather than construction of Solid Blocks for Islands, make further Improvements easy as no Dismantling of the Islands have to done at the time of improvement.
 - All the Other Traffic Control Devices like Traffic Signs, Signals, and Parking Controls require Pavement Markings.
 - Cross Walks that are provided at the same grade with the Pavement essentially require these markings. In fact these are an essential part in the design of the same.
 - When limited Carriageway width is available, then medians are replaced by the Centre Line which if enforced properly provide an additional Overtaking Maneuver easily during low flow conditions. The response of the Authorities

This project was funded and facilitated by Design Innovation IUST under Ministry of Human Resource Development Scheme guiding them on the predefined path TCD's are the most important tool of a Traffic Engineer.

becomes much more effective in case of an incident like Emergency or increase in Congestion if it is used with Active Traffic Management (A.T.M) scheme e.g changing the number of lanes in a particular direction to account for variation in Peak, or closing of a Particular Lane due to emergency breakdown .

- In the changing Transportation Scenario where the Right of way is confined as in the case of Bus Rapid Transit System (BRT) and also with the advent of green technology Bicycle lanes are becoming essential, it is imperative that the Authorities as well as Road user understand the Importance and respect these Markings and make the maneuvers accordingly.

- Chicanes can be provided easily with the help of markings instead of a physical obstruction to reduce the speed without changing the alignment. This helps in reducing the speed when approaching a hazardous location or an Intersection. It also promotes safety on Long Straight Roads.

- Bus stops are provided effectively only with the markings only.

- Markings are the best means for assigning right of way, especially when there is a significant difference between the major and minor road traffic as is evident from the Road Research Lab curve [10].

- Lane markings are essential and help in cutting out unnecessary weaving when enforced properly.

- These are essential in controlling the vehicles approaching an Intersection and assigning them right of way.

- Traffic Signs and Pavement Markings complement each other.

- It is Essential that the markings are conceptualized in the planning stage only so as to achieve a better output.

- They give a sense of security to the pedestrians as well as Vehicle drivers and help in reducing the passenger-vehicle conflict.

C. Types of Pavement Markings.



Although some include Word Marking as a separate sub type but it has not been taken as a separate entity here because these form an integral part of all the markings wherever they are used and the function as well as purpose of providing these marking without the word message gets lost then.

II. PRINCIPAL OF THE PAVEMENT MARKINGS

- Double Lines represent maximum restriction.
- Solid Lines are restrictive in nature and it's an offence to cross or even straddle them.
- Broken Lines are restrictive in nature and can be crossed with adequate safety in mind.
- When a combination of a Solid and a Broken Line is used, for left hand drive countries Vehicle should not cross the Continuous line that will provided on the left hand side whereas it should not cross the broken line that will be provided on the right hand side

These Principles are used worldwide in U.K [2], U.S.A [3] and in India [4] also. These are also recommended by the United Nations [5].

III. INTERSECTION MARKINGS.

Intersection Markings are divided into:-

Longitudinal Markings:- These markings are placed along the direction of Traffic on the pavement. Their purpose is to indicate the driver, his proper position on the Pavement being used.

Transverse Markings:- Transverse Markings are placed across the direction of Traffic . It is not essential that they are placed at Right angles to the Flow , they may or may not be placed Perpendicular to the Road Surface.

Object Marking :- Physical obstructions in the carriageway have to be properly marked. e.g.. Traffic Islands in the Intersection have to properly marked. Sometimes the Island may not necessarily be of different material than that of the pavement, they may be of the same material with markings.

Stop Line: - Stop lines are used to indicate the point beyond which vehicles are required to stop in compliance with a stop sign, traffic signal or a traffic police. These are placed either parallel to the intersecting roadway or perpendicular to the direction of approaching Vehicles. There are two types of Stop Lines:-

a) Single Stop Line is a Continuous solid line

b) Double Stop Line are two Continuous Solid Lines spaced at a very small distance from each other which are necessarily supplemented by a stop Sign and a Word Message of "STOP" marked on the carriageway.

For a double Stop Line it is imperative that a vehicle before entering the major road stops at the transverse Line and no vehicle should pass these transverse lines in such a manner or at such a time so that the vehicle on the other road has to change its course or speed in order to avoid a collision.

Give Way Line: - These are broken lines placed either parallel to the intersecting roadway or perpendicular to the direction of approaching Vehicles. These are used for assigning Right of Way. Roads having Give Way sign have to give way to the Traffic on the other Road. These are supplemented by a Warning Line longitudinally and also generally with a Give Way Sign.

Pedestrian Crossings [6]:- Pedestrian Crossings are very important for the safety of the Pedestrians as they guide the Pedestrian in the proper pre-defined paths. These are the places specifically marked for the Pedestrians to cross the Carriageway. These reduce the Pedestrians -Vehicular Conflicts. The requisite opening on the Footpaths (for Footpaths at different Grades) should be provided with a Ramp so that the facility can be easily used by the specially abled persons, old aged and other people.

Cyclist Crossings: - For the Cyclist to cross the carriageway, sometimes a crossing is provided. For this the percentage of the cyclist has to be significant. In the present scenario of Transportation System of South Asia, although the percentage of cyclist is very less at almost all places, but with the advent of green technology it is likely to increase and should be encouraged.

Directional Arrows: - These inform the driver in advance about their maneuvers especially when they have to choose a Traffic Lane for their specified destination. These guide the traffic effectively in correct direction and proper lane. The help in decreasing the effect of conflict points and thus bring smoothness in the flow. These are very important for the Road user unfamiliar to the place or road Facility. Their most important advantage is that they convey their message without distracting the attention of the driver from the carriageway. Since they are viewed at a low angle therefore they are elongated in the direction of traffic.

Box Markings: - These are markings in the form of a Box having Crosse Diagonal lines where vehicles must not become stationary even for a short duration of time. Even in case of Signalized Intersection having a green phase, Drivers are still prohibited from entering such an area if it cannot be crossed. This ensures that the junction is not chocked. Sometimes the flow takes in such a manner that a wedlock is created and the traffic can only be normalized by policing or by changing the signals in the control Office if the area is provided with an Area Traffic Control which is a rear phenomenon here. If such a situation is quite common then Box Markings are a proper solution.

Channelizing Lines are used to demarcate the neutral area at the nose of a Channelizing island to reduce the probability of collision with kerb nose.

Speed Change Lane Markings:- These markings provide for proper and safe use of acceleration and deceleration lane. Main function is that it should help the driver in making the decision in advance about the path of Travel he should follow.

Protected Right Turn Line:- For an Intersection having high percentage of Right Turn Maneuver , it sometimes becomes necessary to provide a separate Right Lane as there is always a chance that the following vehicle may hit the vehicle waiting in line and it may lead to unnecessary conflicts.

Rotary Marking: - The kerbs of the central Island and that of the Diverging Islands are painted and exits are indicated by appropriate signs and Directional Arrows.

Continuity Lines:-

he Centre Line, Stop Line, Give Way Line and Turn Markings may or may not be continued as per the site Conditions and the local Practices

DESIGN OF MARKINGS AS PER INDIAN PRACTICE.

S. No.	Type of Marking		
1.	Single Stop Line	200 mm white line	Should be placed between 1.25 – 9 m from the nearest carriageway edge of Intersecting Road with 150mm thick Longitudinal Warning Line extending up to 30m.
2.	Double Stop Line	Two 200mm white line spaced 300mm	-----do----- and necessarily supplemented by a stop Sign and Stop word Message
3.	Give Way Line	Two Broken lines 200 mm wide, 300 mm apart with 600mm Segment and a Gap of 300mm	2 – 2.5 m from the Transverse Marking supplemented by a Give Way Sign and a hollow Triangular Sign on the pavement along with Longitudinal Warning Line
4.	Pedestrian Crossings [6]	2 – 4 m wide with 500mm equally spaced White Strips	Distance Between the Intersections should be minimum 150m and for Mid-Block Elements 300, supplemented by a STOP Line
5.	Cyclist Crossings	Two 100mm wide White line spaced equal to the width of cycle Track i.e. 1-3m	These are generally provided after Pedestrian Crossings if provided in the direction of flow.
6.	Direction Arrows	Length 5m for Design Speed of 50 K.M.P.H or more otherwise 3.5m and a Base width of 0.3m of the Arrow	
7.	Box Marking	Equally spaced yellow 20mm wide crossed Diagonal lines in the form of a Box with Perpendicular distance of 2 m between them and inclined at 45o in the direction of Intersecting Road	
8.	Rotary Marking	Kerbs of Central Island are painted with alternate Strips of 500mm width with White and Yellow, that of Road Side Kerbs with Black and White	Lane Markings within the Rotary are provided for 3 or more traffic Lanes and at the Entrance Solid lines of 30m are provided for each Lane.

IV. DESIGN OF INTERSECTION

For Design of an Intersection Detailed Traffic Survey of the Intersection is a Pre-Requisite. Polo-View Intersection is located in the Central Business District of the State of Jammu & Kashmir . It is at a Distance of 780 meters from the Tourist Reception Centre (T.R.C). It is the main Tourists Market of the state Tourism is the backbone of the economy of the state. Intersection houses the Historic Bund Market where shops/firms were established in the early 1800's. Intersection also has the oldest Bank of the state , which was established by the British known as Grindlay's Bank. It also houses the Majestic Chinars in the Vicinity as well as the Polo Ground. The famous Polo-View Market is a major source of Attraction for the Tourists especially foreign tourist. In the vicinity are the major Educational Institutes of the state, Office of Chambers of Commerce, hotels, restaurants, corporate offices, bank headquarters , state as well as Central Treasury. From Polo-View Intersection Commercial Establishments start state right up to Old Court Road (I.e around 1200 meters) on both side of the road as well as all the sub lanes meeting this main road. It is the main Road of the City Centre.

A. Present Scenario

At present the Intersection is at Grade which is having a non-functional Traffic Beat of Radius 1m at a distance of 18.8m from the Right Edge of the roadway , which is almost at the edge of the Roadway (The direction is taken from T.R.C towards Lal Chowk). The Intersection at present is not properly designed. There are no proper markings and even no pre-defined Bus Stop, so Buses stop at the Intersection, to allow passengers to alight and board the bus. Often cars are also parked at the Intersection for a long duration of time which adds fuel to the fire. Sometimes a Grid Lock is created at the Intersection which needs to be rectified immediately. The present route of Public Transportation is Unidirectional from T.R.C to Lal Chowk only.

B. Basic Map of the Intersection

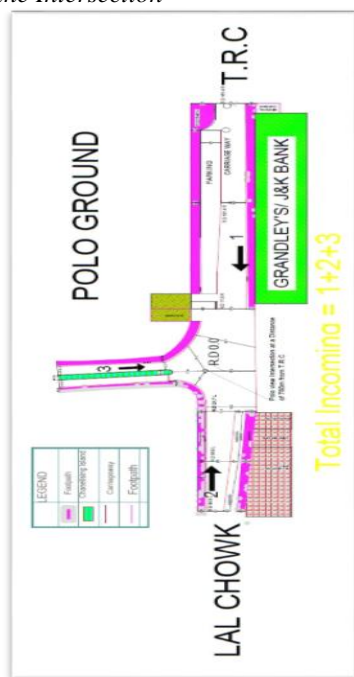


Figure 1: Basic Map of Polo view Intersection showing Traffic Census procedure

C. Traffic Survey [7]

Traffic volume Study was done on all directions of Traffic movement 2 times for consecutive 7 days in Accordance with IRC [7]. The Traffic plying is of Heterogeneous in nature, therefore the equivalency factors as recommended by IRC are to be used for obtaining the desired PCU's.

Duration of Traffic Census: - The Traffic Census is to be carried out for 3 hours continuously twice a day at a stretch though with adequate time given to each Surveyor in rotation to have proper rest and food. The objective is to find the design Hourly Volume (DHV) which is the combination of two distinctly different sets of circumstances, i.e. Morning and Afternoon Peak Hour. Schedule [9]

For Traffic Survey Schedule recommended by IUT [8] is from 7 a.m. to 10 a.m. in the Morning and between 6 p.m. to 9 p.m. in the Evening. Due to climatic Conditions (Pre Dominant Winter Climate) as well as Social Set up in the Valley of Kashmir Traffic plying at 7.00 a.m.- 8.00 a.m. in the morning is very less but however from 10.00 a.m. -11.00 a.m. is significant , so duration of schedule was changed from 8.00 a.m. -11.00 a.m. . Similarly between 7.00 p.m. -9.00 p.m. traffic in the whole valley in not of any significant counts, although there are significant number of Trucks only , carrying mostly Construction Material and goods to warehouses from different parts of Country and Horticultural Commodities to various parts of the country . Land use Pattern of CBD doesn't include any of them, so Traffic Survey from 7.00 -9.00 p.m. would have been futile so Evening Survey was scheduled from 4.00 – 7.00 p.m.

Abnormal Condition: - Abnormal Traffic condition if encountered, then the survey is to be immediately called off. Abnormal Conditions include Strike, Diversion, Maintenance, etc. There were around 5-6 instances were survey was immediately called off due to strike and Bad Weather.

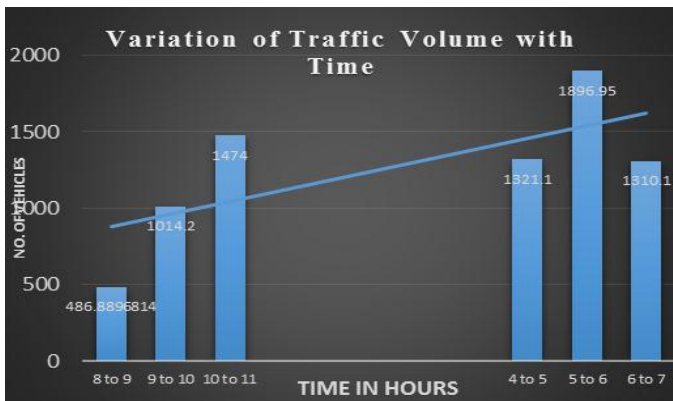
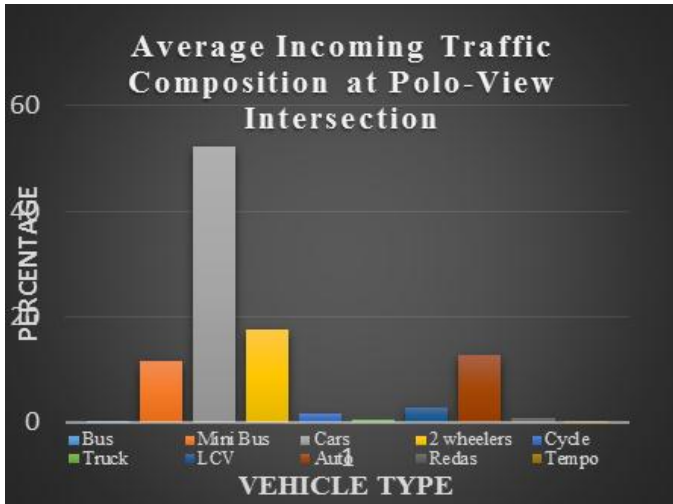
Recording of Data: - A field data Sheet was prepared for recording of data in Hourly manner. Traffic was recorded in the five-dash system for Manual Method of Census which includes Vertical Strokes for the first four vehicles which was followed by an Oblique Stroke for the Fifth Vehicle so as to depict a total of five.

Compiling of Data: - Data was compiled immediately after the Survey and all Surveyors had proficiency in Microsoft Office which made compiling of data convenient and hassle free. Special Care was taken that a particular Surveyor will compile data taken by him only so as to minimize errors and Omissions.

The average Incoming Traffic on the polo View Intersection (which is the average is of 7 continuous days twice a year one in the Harvesting and other in the Lean season) is tabulated below.

Design	Average Incoming	Bus	Mini Bus	Cars	2 wheeler	Cycle	Truck	LCV	Auto	Redas	Tempo	Total Vehicles	PCU'S
8 to 9	0.275	84.08832	164.5162	116.394536	11.4	4.242857	18.71209	67.47065	19.8	0	0	496.2896214	778.1689
9 to 10	1.65	157.85	455.4	171.05	20.9	6.05	70.95	108.9	19.8	1.65	1.65	1014.2	1551.413
10 to 11	2.2	171.6	726	293.7	22.55	6.6	28.05	209.55	7.15	6.6	6.6	1474	2088.845

4 to 5	0	99.55	738.65	218.9	22	0.55	18.7	217.25	2.2	3.3	1321.1	1749.55
5 to 6	0.55	266.75	1060.4	283.25	36.85	3.3	24.2	216.7	2.2	2.75	1896.95	2757.453
6 to 7	3.3	90.75	780.45	228.8	12.1	1.65	46.75	129.8	13.2	3.3	1310.1	1658.305
Total	7.975	870.5383	3925.416	1312.084536	125.8	22.39286	207.3621	949.6707	64.35	17.6	7503.239681	10583.73
Percentage	0.106287	11.60283	52.31628	17.40650688	1.676609	0.298443	2.763634	12.65681	0.85763	0.234565		100



D. Evaluation of Traffic Census.

For Intersection Control type, Plot Recommended by Road Research Lab (U.K) [10], which is also recommended by IRC-SP41-1994 "Guidelines for Design of At-Grade Intersections" is used

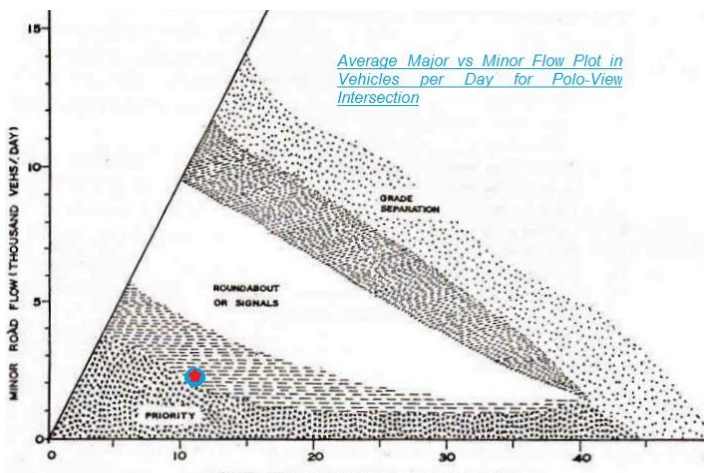


Figure 2: Road Research Lab U.K plot for Major Flow vs Minor Flow

The Plot clearly arrives as three possible Solutions

1. Control Based on assigning Priority.
2. Roundabout.
3. Traffic Signal.

For Intersection Control with respect to minimum Delay in negotiating the Intersection, SWEROAD Plot is used.

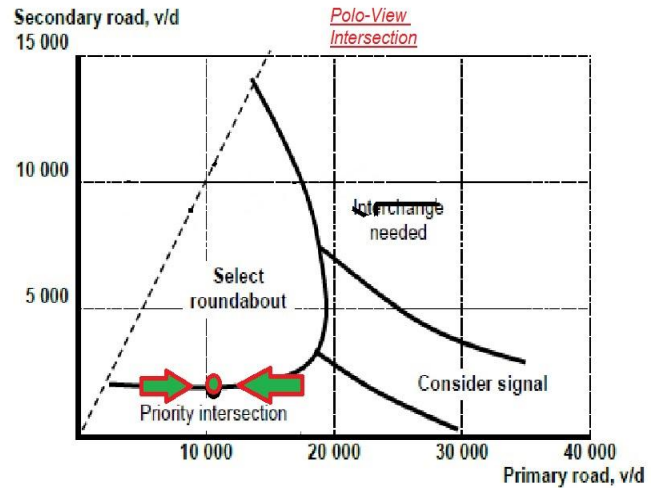


Figure 3: SWEROAD plot for Major Flow vs Minor Flow

The Plot clearly arrives at two possible types of Intersections.

1. Control Based on assigning Priority.
2. Roundabout.

V. CONTROL BASED ON PRIORITY

Intersection Control on the basis of Markings. For Traffic originating from the direction of T.R.C two lanes of Traffic one going straight towards Lal Chowk (since the Bus has to follow the Straight Path as per the Route), therefore it is given Priority. For the Traffic Intending to go in the Direction of M.A. Road it is provided with a Give way Sign. For the Traffic originating in the direction of M.A.Road again two lane of traffic one intending to go in the direction of T.R.C and other in the direction of Residency Road, both are provided with a Give Way Sign and Markings. For the Traffic Originating in the Direction of Residency Road there are again two separate lane one for the Traffic Intending to go straight and other towards left. Left one has no conflict whereas the Straight on is given Priority over other.

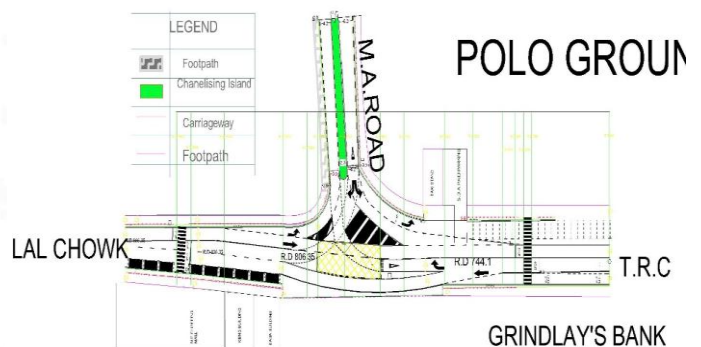


Figure 4 : Recommended Design layout as per Intersection Markings

.	Origin	Destination	Maneuver	No. of Conflicts	Priority given w.r.t
1	T.R.C	M.A.Road	Right Turn	2	Yes on 3 & No on 5
2	T.R.C	Residency Road	Straight	0	-
3	M.A.Road	Residency Road	Left	1	No
4	M.A.Road	T.R.C	Straight	1	No
5	Residency Road	T.R.C	Straight	2	Yes w.r.t to 3,4 &1
6	Residency Road	M.A.Road	Straight	0	-

A. From T.R.C

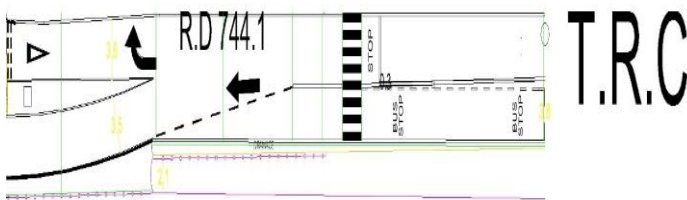


Figure 5: Recommended Design Layout from T.R.C Leg

It is desirable that Bus Stop is located at a Distance of 75m [8] from the Intersection. The Centre of the Bus is located at a distance of 79m from the Intersection Center. Bus Stop starts from R.D 0.00 which has been taken as reference point. Length of the stop has been designed as 30m to accommodate two large busses with easy maneuvers with an overtaking possibility within the stop for the buses. Pedestrian Crossing has been given immediately after the Bus Stop so that the Bus needs not to stop at any other location while negotiating the Intersection. It is also desired for Bus Passengers to choose their path immediately after they get off the Bus so as to achieve effective Time Management of the Passengers. The basic Principle of the Design is to give the Bus Passengers the priority. Twice the word message of “BUS STOP” is marked on the carriageway of the Bus Stop. A white Solid Line is provided between the Bus Stop and the rest of the carriageway so that the Bus Stop is not encroached by other Vehicles. Edge line on the left hand side of Bus Stop is provided 200mm wide White Line at a distance of 150mm from Edge.

Also the edge as well as Top of the Kerb should be painted with a yellow continuous line of 100mm width so as to mark No-Parking zone to ensure busses only use the designated area for boarding and disembarking only. Cross Sectional view has two lanes of Traffic of 3.5m width in the opposite Direction with proper Markings consisting of the Centre Line of width of 150mm. A 3m wide Pedestrian Crossing has been provided at R.D 30.00 up to R.D.33.00 with White Strips each of width 500mm are provided for a Comfortable walk to Road Users as well as for Wheelchairs. A Stop Marking is provided with Length of Warning Line as 30m Solid Line. On Extreme Right Hand side Perpendicular Parking is provided with adequate Makings After the Pedestrian Crossing a Solid Line is provided for a Distance of 8 meters so that the Bus is able to accelerate in the distance to ensure that its Mergence with the rest of the traffic occurs hassle free. After that Bus Bay is tapered in lin 7.5 (Recommended is lin 6 to lin 8) [8].

From R.D 41.00 Two lanes of Traffic of Traffic originate in the direction of travel, one for the Straight moving another for Right turn, both are provided with Directional Arrows marked on the Carriageway. The Straight one is provided with White solid line on both the sides with width of Left side 150mm and for the Right Hand side equal to 100mm (width of Traffic Lane markings). At R.D 88.00 Give Way Marking is provided for the Lane on the Right Hand Side. From R.D 88.00-1112.00 Box Markings are provided so that no Vehicle Stops there and prevents the chocking of the Intersection. On-Street Parallel Marking is provided from R.D.125.30 onwards.

B. From Lal Chowk

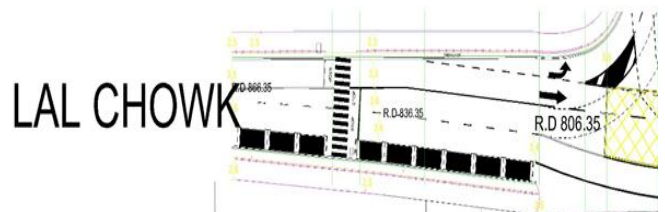


Figure 6: Recommended Design Layout from Lal Chowk Leg

Pedestrian Crossing is provided from R.D.166.1 to 163.1 with proper Stop Line and Warning Line . From R.D 147.5 two lane of Traffic start with one going Through and the other one towards left. Left one is provided with edge marking on one end whereas on the right hand side is provided with Continuity Line 100mm wide with Length of Segment and Gap of 500mm. For the Traffic going through left lane it is provided with a solid Edge Line whereas other side is provided with a Lane Marking of 100mm wide with length of Segment 1.5m and Gap of 3m up to R.D. 125.00 after then solid white Line of 150mm up to R.D. 79.70. By this way the Diverging Conflict is minimized due to providing of separate lane with proper taper so as the diverge in their own lanes and are provided with requisite Directional Arrows.

The portion of the Roadway in between the Different Roadways between R.D.79.20-R.D 116.30 is marked with Diagonal Markings so as to prevent chocking of Intersection at any interval of time.

C. From M.A.Road

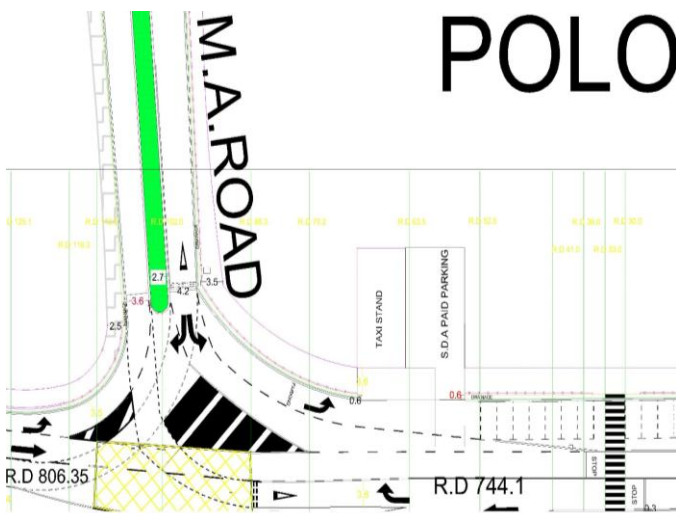


Figure 7: Recommended Design Layout from M.A.Road Leg

The Traffic Coming from M.A.Road is at provided with a Give Way Sign. Then the Two lanes of Traffic diverge from it with proper Directional Arrow. One Towards T.R.C and the other one towards Lal Chowk (Red. Square of Kashmir). For the Traffic towards Lal Chowk it is provided with Continuity Line (Right Turn Marking) 100mm wide with Gap and Length of Segment equal to 500mm and sufficient Length is provided (from R.D 125.00-R.D160.6) for the Traffic to Integrate with the through traffic moving from T.R.C to Lal Chowk. For the Traffic moving towards T.R.C it is gets further diverted into two one for Traffic moving towards T.R.C another towards the S.D.A Parking.

Sufficient Integration Length is provided for traffic to merge into the through Traffic moving from Lal Chowk to T.R.C (from R.D 35.6-R.D. 80.00). Traffic Lane marking of 100mm wide with Length of Segment 1.5m and Gap of 3m are provided for the Integration whereas for the Traffic moving from M.A.Road to T.R.C is provided with solid White Line of 200mm width from the left hand side whereas 100mm wide Lane Marking with Length of Segment and Gap of 1.5m is provided on Right Hand Side with the Parking Lane for S.D.A Perpendicular On-Street Parking is provided on left hand side from R.D.0.00-R.D 52.50.

VI. DESIGN OF ROUNDABOUT

Description	Data Recommended by IRC:-65-1976	Dimensions in Meters
Radius at Entry	15-20	15
Radius at Exit	1.5-2 times	30
Radius of Central Island	1.33 times	20
Width at Entry(e_1)	For Radius of 15-25 m for 4 Lanes =10m	10
Width of Non Weaving Section(e_2)	Width of Widest Entry =For Radius of entry = 15-25 m	10
Average Entry Width(e)	$\frac{e_1 + e_2}{2}$	10
Width of Weaving Section(W)	$\frac{e_1 + e_2}{2} + 3.5$ in the range 6-18	13.5
$\frac{e}{W}$	0.4 - 1	0.74
Length of Weaving Section(L)	$45 - 2 \times 45 = 45 - 90$	65
W/L	0.12 - 0.40	0.208
P		0.7
Q_p		4177 PCU's
Minimum Sight Distance	30	30
Grade with respect to Horizontal(u)	1 in 50	1 in 50
Channelizing Islands		Funnel Channel Entrance & Wider Exit Throat.

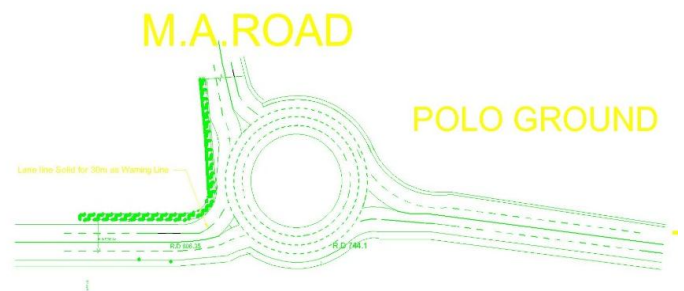


Figure 8: Recommended Design Layout of Roundabout

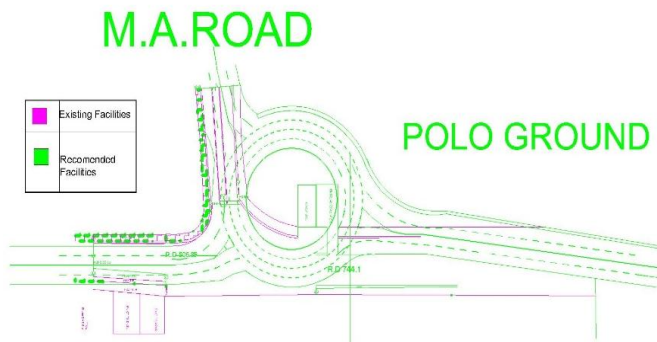


Figure 9: Recommended Design Layout of Roundabout overlaying the present right of way.

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

VII. DISCUSSION

Earlier the Civilization used to develop around the Rivers for better avenues and ease in the Lifestyle and Working because of availability of Water in Plenty in the nearby. Now in Today's World New Residential Colonies as well as Industrial Estates are being developed along Major Roads/Motorways because of which Ribbon Development is going at a very fast space especially in the Developing Countries, due to which different new Conflict Points, and Bottlenecks are being created. With the spurt of these new Intersections it is becoming difficult day by day to address the problem of congestion everywhere because of Economic and various other Constraints including the views of stakeholders. There has been a lot of work going on the Intersection Design. World wide different Intersection Designs are being put forward which effectively solve the problem of Congestion. In all these Design Control on the bases of Markings is taking a Back Seat with very little case studies or Research being done on them. They solve the problem economically with no addition investment in the Infrastructure as well as maintaining the Sanctity of the Place without disturbing its aesthetics. For Road Markings to be used successfully as a Design Control it is essential they Road Users respect them and Strict Enforcement is done. It is high time that they are being used effectively as more number of Intersections with Congestion problem are expected to swell up.

It is high time that we start working on 2E's of Traffic Engineering i.e Education and Enforcement in addition to our Engineering E, so that we are able to achieve better flow conditions as well as better driving Standards, before it's too late.

In the present scenario there are clearly three possible solutions of the Intersection Design. All of them require the Markings to be designed properly. Signal Design is successful if the Signals are respected and adhered to as per the Markings. The stopping of a vehicle at the Stop Line is essential, which otherwise reduce the Effective Dimensions and results in the reduction of Capacity of Intersections. Signal will cause unnecessary Delay to the Traffic moving from T.R.C to Lal Chowk and also to the Traffic moving from Lal Chowk to T.R.C which is a matter of concern. It is also essential that all the stake holders of the Intersection accept the solution whole heartedly , for signalized Intersection removal of the Parking immediately after the Interstation is essential which will not be acceptable to the nearby Establishments.

Roundabout is a good option as it can suffice its design for a good number of years, it can be used to improve the aesthetics of the area by proper landscaping and other measures. There will still be some delay caused but it will not have that much impact as the vehicles will be continuously moving. The effectiveness of design is still dependent upon the effectiveness of the Markings and Giving Way to Traffic plying in the Rotary. The major Disadvantage is the Land Acquisition that is to be done, as Rotary demands much more area than that is available at the site at present. Land Acquisition in such a place is a very difficult which involves huge sum of money and also Rehabilitation of the Displaced Commercial Establishments. The place is of Historic Importance and middling with it may result in many serious consequences and may even make the place to loose its charm.

As per Sweroad Plot for achieving minimum Intersection Delay either Priority or Roundabout is to be considered, Roundabout requires Land Acquisition which is to be avoided as far as possible. Signals to function properly and give the desired output it is essential that People adhere to the Guidelines set up by the designer as is required for the Priority based on Markings. Usually for such type of Intersection in the beginning it is essential that Strong Enforcement and education of the Design Controls are done, but once people start adhering to these norms then they momentarily follow them and use of these Design Controls at other places becomes much easier. If the whole Central Business District (CBD) is controlled on the bases of the Design Controls then within a short duration of time people will adhere to these guidelines as the "System of Transport of the CBD" by virtue of which these Design Controls will get branded and will eventually lead to the Sustainable Urban Transport of this Summer Capital of the state of Jammu & Kashmir , which is essential for a developing country like India also with respect to the Driver Behavior.

VIII. SUMMARY AND CONCLUSION

"Road Markings can be effectively used as a Design Control Measure provided proper Education and Enforcement is done". It is high time that the Road Markings be considered as a measure of negotiating the Intersection for At-Grade Intersections. In Practical in the field there are many Constraints which sometimes make the use of Other Type of Intersections difficult e.g. Land Acquisition or other Intersections in the vicinity which will make Signal Installations difficult. In these Circumstances Road Markings come to the aid of Traffic Engineer. The beauty of

Engineering lies in simplifying things rather than Complicating. A solution which is difficult to design might always be not be the Best Option.

IX. FUTURE

We all know Autonomous Cars/ Driverless car are the future of Transportation. Although the idea of Autonomous Cars has been around for a very long time , but in the recent years it has suddenly seen a spurt . The big firms like Google, Audi, Ford, etc have invested a lot in this technology and they are expected to start mass productions of these cars in coming years. Driverless cars will have the ability to communicate with three things. The first one is with the infrastructure, second one with the other cars, third one with the other things which may be anything. So the car will automatically respond to the markings and make the move accordingly being in contact with the conflicting car. When driverless cars take over our transportation system, Intersection Control on the bases of road markings will naturally be the best option in At grade Intersection control and even in some cases may be the optimum control for the flow which at present is demanding Grade separators. In future roundabouts and traffic signals will naturally become obsolete and will have to be replaced obviously by the road markings. So, the present way of designing in which we are looking for a futuristic view of 10-20 years we should keep these things in mind and take decisions accordingly.

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