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Solving Congestion Problem at 3 Legged Junction-Case Study of Pantha Chowk Intersection in Kashmir

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Abstract

Pantha Chowk, a crucial road link to South Kashmir and to Jammu or in other words the throat of Srinagar City is undoubtedly the busiest intersection of the valley considering its strategic position and the importance of roads which it forms link to. It has been witnessing harrowing traffic jams for years while state government despite embarrassments at the highest levels has done nothing. At peak hours-the mornings and afternoons, the traffic on the busy road remains badly affected as vehicles are seen stranded. The queues at times last for hours & extend up to distances in kilometers resulting in serious worry for commuters.

The primary objective of this study is to identify the problem, understand it & provide a solution to the traffic wedlock which exists at the Pantha Chowk junction. The basic methodology which we are intending to follow is to concentrate only on the junction itself where the six directional components of traffic meet instead of making plans to upgrade & widen the connecting roads. This way the solution offered will be less time consuming, highly economical & will avoid rehabilitation of residences and shops which have come up along the road.

Based on traffic studies an analysis is carried out to see whether an At-Grade intersection is acceptable or not, for current traffic loads at the junction since the 3 legged Y intersection at the Pantha Chowk had been designed more than 8 years back. The main portion of this study will be to upgrade the existing 3 legged Y intersections into a rotary/roundabout or well placed installations of traffic signals and designing their signal cycle time, interval with the sequence and duration of individual phases to serve all approaching traffic at a desired level of service. The detailed results and conclusions are documented in this report.

1. Introduction

Pantha Chowk intersection is the most problematic junction in the whole valley & its current scenario makes no stone unturned in questioning the credibility of our engineers. With growing number of tourists & devotees of Amarnath pilgrimage, the already congested wedlock becomes more worse and not only does it portray wrong impression in the minds of travellers and foreigners as soon as they enter the valley, but it also hinders the economic progress & traffic prosperity in the valley.

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Pantha Chowk is undoubtedly the busiest intersection of the valley considering its strategic position and the importance of roads which it forms link to. It forms a crucial road link to South Kashmir and to Jammu and is rightly referred as the throat of Srinagar City. It has

been witnessing harrowing traffic jams for years while state government despite embarrassments at the highest levels has done little except for holding meetings after meetings for solution to the problem, which is swelling with the growing number of vehicles. At peak hours- the mornings and afternoons, the traffic on the busy road remains badly affected as vehicles are seen stranded. The queues at times last for hours & extend up to distances in kilometres resulting in serious worry for commuters. It also forms an important link to other world known famous tourist spots like Gulmarg, Yusmarg etc and thus the junction is also subjected to heavy tourist flow. The jams at times have proved deadly for those who cannot reach the hospital in time because even ambulances are unable to find way out of these gridlocks. Similar are the complaints of school children, government and other employees saying that they never reach to their destinations in proper time. The tremendous traffic load at the junction seems never ending with the rapid development and progress of motor transport in the valley.

1.1. Research Approach

The project's research approach is based on a week of field study, evaluation and development. This approach will ultimately yield a guideline document to assist in the design of an effective solution to reduce the severity of all the traffic problems which are existing at the Pantha Chowk Intersection. The basic methodology which we are intending to follow is to concentrate only on the junction itself where the six directional components of traffic meet instead of making plans to upgrade & widen the connecting roads. This way the solution offered will be less time consuming, highly economical compared to other plans & will avoid rehabilitation of constructions, residences and shops which have come up along the road sides. Moreover from our analysis of traffic studies the problem lies at the junction only which requires an intelligent solution at the same place instead of widening the interconnecting roads. The Pantha Chowk junction is a 3 legged Y intersection where the problem of traffic congestion is actually caused by 3 major conflict points due to coinciding of two through movements and two turning movements of traffic, plying on the primary & secondary roads. Despite channelization done at the junction there is no effect in reducing the severity of these conflict points which basically cause delay in traffic movements ultimately leading to tremendous traffic jam extending to distance in kilometers. The results & analysis of field study will be evaluated, and the findings will be incorporated into recommended design procedures in the solution part of the document.

1.2. Understanding the Problem

Pantha Chowk is a 3 way road junction, one of which goes towards National Highway and forms a vital link to South Kashmir, the other towards main city Lal Chowk which is the commercial and business hub of the valley and the third one towards villages like Sempora, Zewan, Pattan etc. It also forms an important link to other world known famous tourist spots like Gulmarg, Yusmarg, Tangmarg etc and thus the junction is also subjected to heavy tourist flow. Sonwar-Pantha Chowk highway stretch snakes through the cantonment area as a result of which a large number of non civilian vehicles, Army convoys ply on this vital intersection putting tremendous pressure on roads. Also there is a stone quarry in the vicinity which contributes to a tremendous number of carriage trucks along this junction. Delhi Public School, a reputed one in the category of its type is also situated exactly at the Pantha Chowk with its main gate coinciding with the heart of the junction which contributes to a movement of about over 110 busses four times a day and six days a week. All this adds to the tremendous traffic load at the junction. The problem of traffic congestion is actually caused by 3 major conflict points due to coinciding of two through movements and two turning movements of traffic, plying on the primary & secondary roads.

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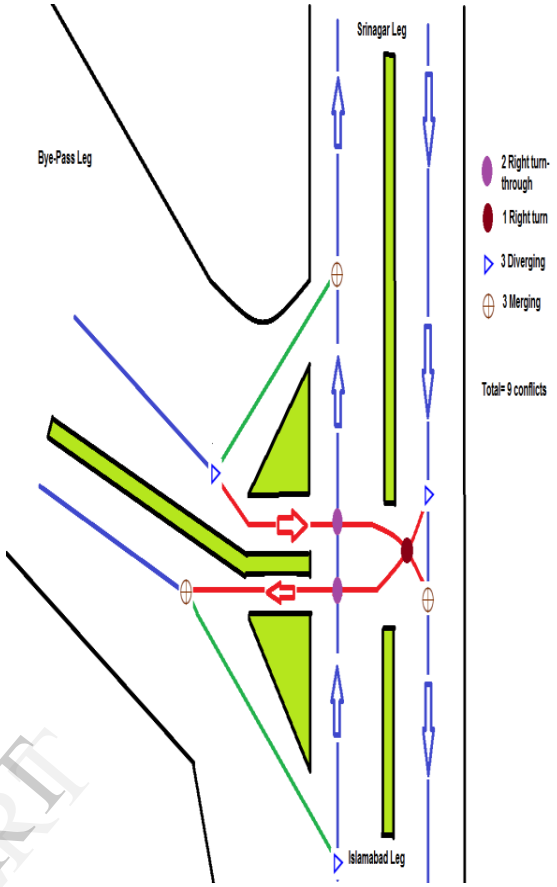
Despite channelization done at the junction there is no effect in reducing the severity of these conflict points. During the peak hour 1261 out of the total 2738 vehicles (46%) entering the junction participate in the major conflict area which leads to the delay in traffic movements. The primary road between South & North Kashmir passing through the intersection is the busiest with 20852 out of the total 28181 (73%) vehicles passing through it. Also during the peak hours the 110 busses of DPS undertake the left and right turning movements at the junction which intercepts the traffic plying on the other interconnected roads. All this causes a tremendous delay in the free movement of traffic at the junction which leads to harrowing jams & queues of vehicles can be seen stranded up to kilometres.

1.3. Conflicts at Pantha Chowk Intersection

Any location having merging, diverging or crossing manoeuvres of two vehicles is a potential conflict point. These are undesirable for any intersection as they are responsible for the delay in traffic & the possible accidental potentials at a site. The main purpose of any intersection design is to reduce the number and the severity of these conflict points. The figure below shows us the existing conflict points at the Pantha Chowk intersection despite channelization having been done at the site. The number of conflicts for competing right turn and through movements is 2. The conflict between right turn traffics is 1, and between merging traffic and diverging traffic are 3 each. The conflicts created by pedestrians are not taken into account as they are negligible as compared to the vehicular traffic. Therefore, the Pantha Chowk intersection has about 9 different types of conflicts. The essence of the intersection control is to resolve these conflicts at the intersection for the safe and efficient movement of vehicular traffic on all the interconnecting legs. The major problem of the traffic wedlock at the junction is basically created due to the 3 conflict points at the heart of the junction which lead to coinciding of two thorough and two right turning movements. As a result one of the components of traffic plying on either road is allowed to move alternatively keeping the other traffic at stand still. Due to high traffic volumes at the link roads, the time delay is sufficient to form long queues of vehicles on these link roads extending up to distances in kilometers & the wedlock which comes into existence after such a traffic mess ultimately makes the vehicles to strand in queues up to hours, unable to move out of it.



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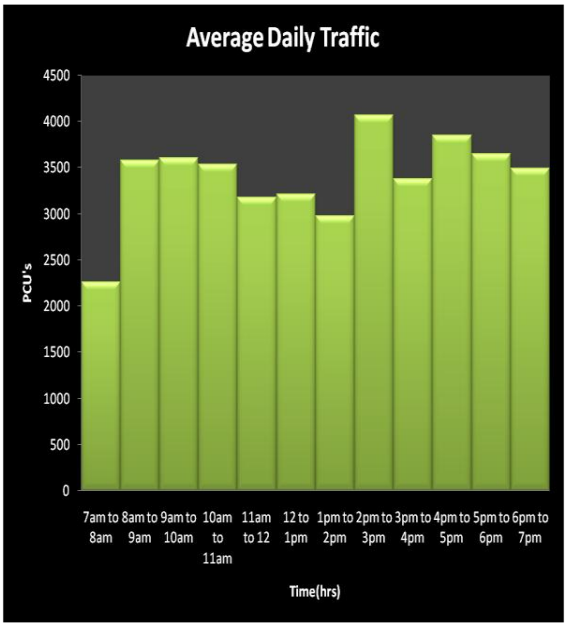
2. Traffic Volume Study

Traffic Volume study was done on all the six directional components of traffic movements at the intersection for a period of seven consecutive days. The traffic data thus obtained is consolidated to present the data in a compacted manner. The consolidated data sheets used also incorporated the compositional and directional break up of traffic in PCU's (Passenger Car units) for peak hours of traffic taken as the average of one week. Also they show the proportion of turning movements for traffic entering from each lane which is later required in the design of Traffic signal system. The peak hours are determined on the basis of maximum PCU's in that hour.[1]

2.1. Consolidated Traffic Data Analysis



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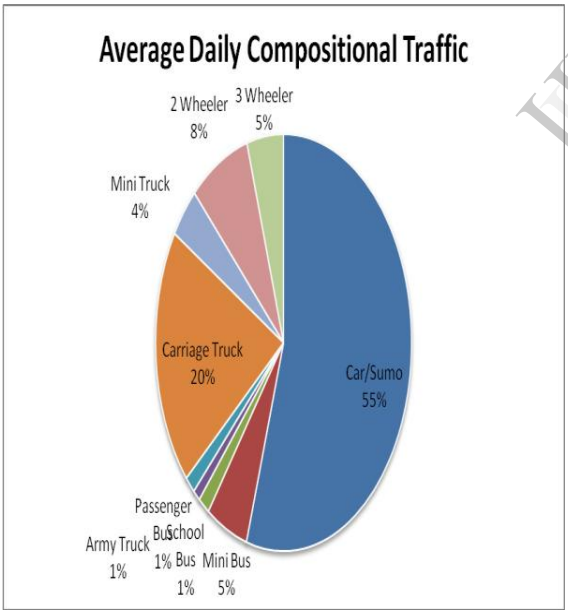

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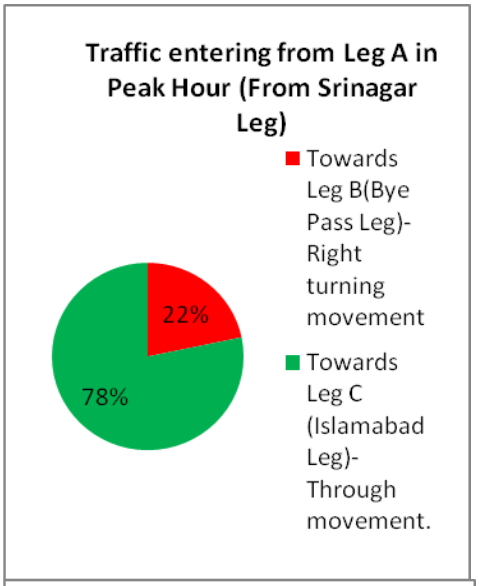

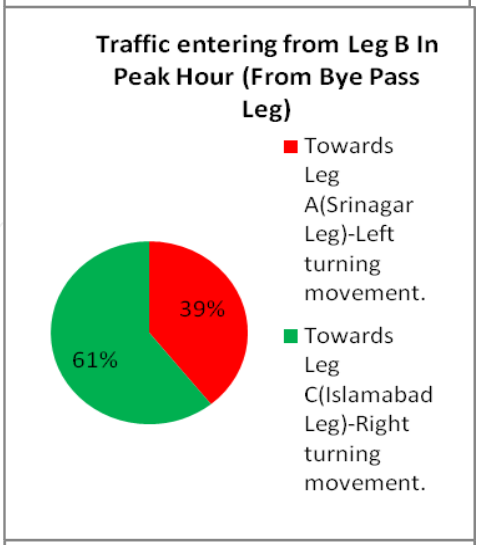

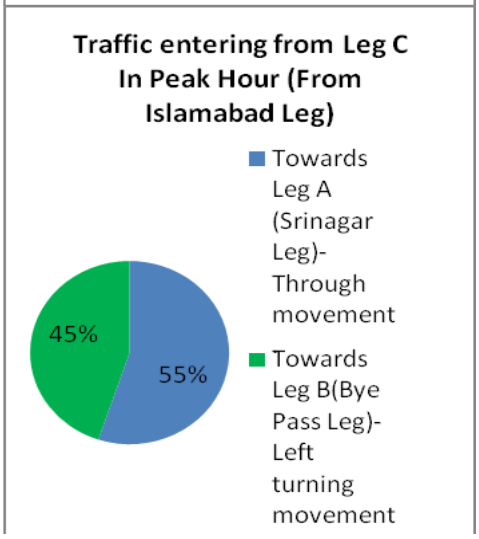

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3. Intersection Delay Study

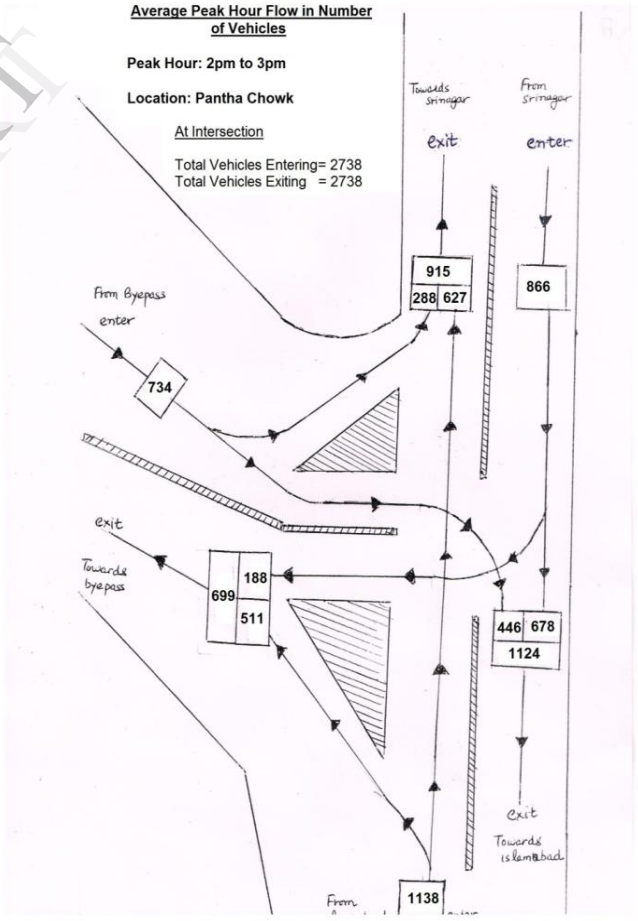
Intersection delay study was carried out on all the approaches from which the traffic enters the intersection. The type being addressed in this section is stopped-time delay, also known as stopped delay, which is the time that vehicles are waiting in line on the approach to an intersection. Uses for the data include capacity analysis, signal warrant analysis and multi-way stop consideration. The criteria used for multi-way stop consideration is an average delay to minor-street traffic of at least 15 seconds per vehicle during the highest hour. The peak hour signal warrant requires that the total stopped time delay experienced by the traffic on one minor street approach (one direction only) controlled by a stop sign equals or exceeds: 4 vehicle-hours for a one-lane approach; or 5 vehicle-hours for a two-lane approach[2]. This study also provides the Percent of Vehicles Stopped, which is a useful indicator of signalized intersection performance.

Term	Result
Total Delay	50670 Vehicle-seconds
Average Delay per stopped Vehicle	15 seconds
Average Delay per approach Vehicle	13.16 seconds
Percent of Vehicles stopped	87.7%

Term	Result
Total Delay	181005 Vehicle-seconds
Average Delay per stopped Vehicle	15 seconds
Average Delay per approach Vehicle	14.98 seconds
Percent of Vehicles stopped	99.9%

Term	Result
Total Delay	21975 Vehicle-seconds
Average Delay per stopped Vehicle	15 seconds
Average Delay per approach Vehicle	11.09 seconds
Percent of Vehicles stopped	73.9%

4. Traffic flow diagram

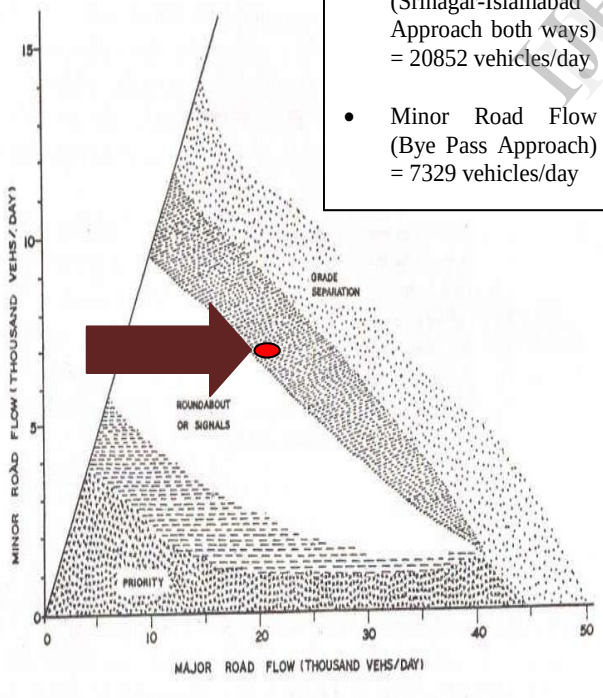


4. Design of Various Solution Options

4.1. Warrant for Intersection type

A UK based relationship provided in the Indian standard code [IRC-SP 41-1994] between the volume of traffic plying on the primary & secondary roads is being used all over the world in deciding the type of intersection at any junction[3]. The results from that plot clearly indicate the need of a roundabout intersection or an effective 3 phased signal system at the junction with a possibility of even upgrading it into a grade separated type which involves a central ramp to be provided along with an effective at grade 2 phased signal system as the regions with dotted lines between priority, roundabout and grade separation are the areas where the selection between the two shall be governed by other considerations, such as the availability of space & costs etc [IRC-SP 41-1994]. The plot thus clearly indicates that the existing intersection at the Chowk which is basically a priority intersection fails at the junction considering current traffic loads. The junction was re modified in 2005 by providing channelizing islands but based on current traffic there is no justification for it to exist there & this study questions about its existence.

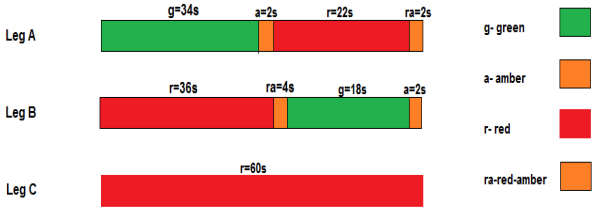
- Major Road Flow (Srinagar-Islamabad Approach both ways) = 20852 vehicles/day
- Minor Road Flow (Bye Pass Approach) = 7329 vehicles/day



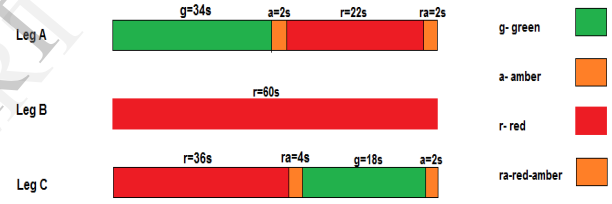
4.2. Design of a 3 phase signal system

The immediate priority is given to the design of a 3 phase signal system in accordance with IRC-93-1985[4]. The results of the design are expressed in terms of phase diagrams of the signal system

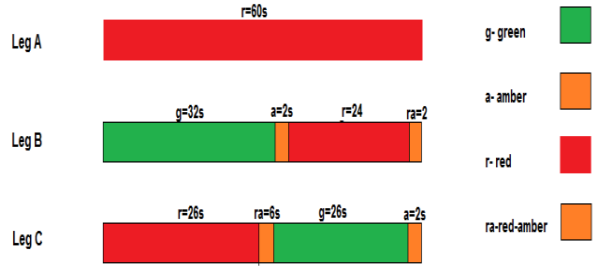
Phase 1



Phase 2



Phase 3



5.2. Design of a Rotary Intersection

The next priority which will serve as an effective solution for current traffic loads is the rotary intersection. The round about in this study has been designed by IRC method in accordance with IRC-65-1976[5]. The results of the design are expressed in the tabular form as:

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Design Parameters	Value
Radios of Entry	20 m
Radios of Exit	40 m
Radios of Central Island	27 m
Weaving Length	45 m
Carriage way width	7 m
Entry Angle	60 degree
Exit Angle	30 degree
Minimum Sight distance	26 m
Restricted Entry Speed	27 kmph
Grade	1 in 50 with horizontal
Capacity (Qp)	5000 pcu's

5.3.1. Applicability of Round About at Pantha Chowk

Based on Traffic data at Pantha Chowk

T_1= Weekly Average traffic = 4068.5 (PCU) per hour

T_2= Peak Day Peak Hour Traffic = 4943 (PCU) per hour

$Q_p > T_1$ (OK)

$Q_p > T_2$ (OK)

Thus the roundabout of the above design at the Junction is applicable.

5.3.2. Overall Acceptability of Roundabout

1. IRC recommends that the maximum volume of traffic that a rotary can efficiently handle is 3000 vehicles per hour entering from all the legs of intersection.[5]

At Pantha Chowk

7 Day average peak hour traffic entering from all legs = 2738 vehicles per hour. [OKAY] -----(Fig. 7)

2. Rotary is justified where intersecting motor traffic is 50% or more of the total traffic on all intersecting roads[5]

At Pantha Chowk

Intersecting motor traffic
(2227+4391+7296) x 100/(28181) = 13914 x 100/28181= 50% [OKAY] -----(Fig. 7)

6. Conclusion

The existing 3 legged Y intersection at the junction comes under the lowest class of intersection design from traffic engineering considerations. The 3 legged intersections is provided when there is a meager traffic flow while here in Kashmir it is still there even when the volume of traffic flow is significantly large. The highest class of at grade intersection that is the Rotary intersection has the highest capacity compared to all other at grade intersections but it has not yet been considered at the junction which is a big engineering failure. From our studies, the average peak hour traffic entering from all legs is 2738 vehicles per hour (4900 PCUs) which is well above the capacity of the existing 3 legged Y Intersection & well within that of a rotary. More ever the intersecting motor traffic is 50% (13914/28181 vehicles on an average day) of the total traffic on all intersecting roads which necessitates a rotary intersection and the existing 3 legged Y intersection is in adequate considering such parameters. A UK based relationship provided in the Indian standard code [IRC-SP 41-1994] is being used all over the world in deciding the type of intersection at any junction. The results from that plot clearly indicate the need of a round about intersection or an effective 3 phased signal system at the junction with a possibility of even upgrading it into a grade separated type. The plot thus clearly indicates that the existing intersection at the Chowk which is basically a priority intersection fails at the junction considering current traffic loads. The junction was re modified in 2005 by providing channelizing islands but based on current traffic there is no justification for it to exist there & this study questions about its existence.
While the immediate priority is given to the 3 phased signal system which has been designed in this study. This is because till further action is taken regarding the construction of the Rotary intersection, it will serve as

an effective control for the movements of traffic at the intersection. However for long term effective solution a rotary is more justified. The designed radius of central island as obtained R=27m along with a carriage way width of 7m at the entrance & exit of the rotary, makes an occupancy of area equal to 3632 metre square. The area can be made available at the Pantha Chowk Junction for the provision of such a rotary by utilizing some part of the bus yard on one side & the rehabilitation of the shops on the other side to clear the area for its efficient use. The hindrances in providing area for the rotary at the junction are insignificant compared to the havoc, and problems the busiest intersection of the valley poses to the people of the state. More ever it will be economical with lesser utilization of space as compared to the existing project of the State Government which involves widening of a stretch of 0.75 km of road from Zewan Chowk to Pantha Chowk & its up gradation into 4 lane roads, requiring extensive rehabilitation on both sides of the whole stretch which will only result in the dilution of traffic density on this stretch with regards to the extra widened space on the roads. It will not contribute in any way in reducing the critical conflict points at the main junction which is the main factor causing havoc traffic jams & resulting in stranded vehicles queuing up to kilometers on all the approaches of the interconnected legs at the junction.

The total delay to traffic movements during the peak hour is 88%, 74%, 99% on Srinagar leg, Islamabad leg & Bye pass leg respectively which is a very alarming figure. With the rapid development of motor transport in the valley, this figure will always rise with the potential of causing more worries for the commuters. It is high time now that we consider the up gradation of the existing lowest class of an Intersection design at the junction into a higher class.

7. Refrences

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[2] Traffic & safety Manual on "Intersection Delay Study", lowa Department of Transportation, Office of traffic & Safety ,issued on 19-02-07

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