"REDESIGN OF ROTARY INTERSECTION AT CHAMBAGHAT (SOLAN, H.P) DUE TO 4 LANING OF NH22"

A PROJECT

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

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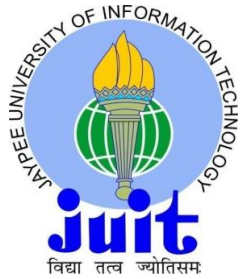
To



JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN -173234

HIMACHAL PRADESH, INDIA

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CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"REDESIGN OF ROTARY INTERSECTION AT CHAMBAGHAT (SOLAN, H.P) DUE TO 4 LANING OF NH22"** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering and submitted to the Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **SAHIL PANWAR (131657)** and **ABHISHEK SINGH (131645)** during a period from August 2016 to May 2017 under the supervision of **Mr. ABHILASH SHUKLA** and **Mr. AAKASH GUPTA** ,Assistant Professor, Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

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LIST OF ABBREVIATIONS

- **IRC- INDIAN ROAD CONGRESS**
- **NH- NATIONAL HIGHWAY**
- **SH- STATE HIGHWAY**
- **MDR- MAJOR DISTRICT ROAD**
- **ODR- OTHER DISTRICT ROAD**
- **hr.- HOUR**
- **km- KILOMETER**
- **m- METER**
- **no. – NUMBER**
- **ADT- AVERAGE DAILY TRAFFIC**
- **AADT- ANNUAL AVERAGE DAILY TRAFFIC**
- **PCU- PASSENGERS CAR PER UNIT**
- **Kmph- KILOMETER PER HOUR**

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Intersections are a crucial component of the roadway system and generally act as choke points on the transportation system. Intersection design is a balancing act of various elements and constraints to produce a solution that will address mobility, safety, environment, and financial aspects of the project. To achieve this balance, alternative strategies and options must be identified, developed, and evaluated in a systematic manner. Significant advances in transportation engineering have identified new traffic control measures and practices capable of further increasing the operational efficiency and safety of intersections. Understanding the effect and impacts of the various design factors and elements on the performance of each alternative is critical in the proper evaluation of alternatives and can have a significant influence on the final design of a project. As a crucial component of the transportation system, intersection design requires an objective methodology to identify the most appropriate solution that meets the purpose and need of the project as well as satisfies the site constraints. One such methodology is ROTARY Intersection.

1.2 TRAFFIC ROTARY

A traffic rotary is a specialized form of "At-Grade" intersection where vehicle from the converging arms are forced to move around an island in one direction in an orderly manner and "weave" out of the rotary movement into their desired direction.

1.3 GUIDELINES FOR SELECTING ROTARY TYPE OF INTERSECTION

- Circumstances where rotaries are an appropriate method of inter- section control are largely dependent on the layout of the site, proportion of right turning traffic and the traffic characteristics of the routes .

- Rotaries are not - generally warranted for intersection carrying very light traffic. This could be a good choice though for moderately busy intersections in urban and suburban areas, and also sometimes rural areas , where otherwise the alternative may be to go in for a complicated channelized layout or traffic signals .
- Normally the minimum traffic units for which rotary design should be considered is about 500 vehicles per hour, of course, there could be exceptions from this rule depending on factors peculiar to the individual sites and The upper limit of the traffic volume that a rotary can handle efficiently can be taken as about 3,000 vehicles per hour entering from all the intersection legs.
- Rotaries are most adaptable where the volumes entering the different intersection legs are approximately equal
- Rotaries are advantageous in locations where the proportion of right turning traffic at a junction is high. As a rough guide, it may be assumed that a four - legged junction, at rotary is more justified than traffic signal control if the right traffic exceeds about 30 percent of all approaching traffic
- A rotary is preferable if there are other junctions so near that there would be insufficient space for the formation of queues.

1.4 ADVANTAGES OF ROTARY

- An orderly and regimented traffic flow is provided. Individual traffic movements are subordinated in favor of traffic as whole .
- All traffic proceeds at a fairly uniform speed. Frequent stopping and starting are avoided
- weaving replaces the usual crossing movements at typical at - grade intersections, Direct conflict is eliminated, all traffic streams merging or diverging at small angles. Accidents occurring from such movements are usually of minor nature.
- Rotaries are especially suited for intersections with five or more intersection legs though these can also be adopted at intersections with 3 or 4 legs.
- They are self – governing for moderate traffic and need no control by police or traffic signals

1.5 DISADVANTAGES OF ROTARY

- As the flow increases and reaches the capacity, ' weaving’ generally gives way to a ' stop and go’ motion as vehicles force their way into the rotary, being followed by vehicle waiting in the queue behind them. Under such conditions, vehicles, once having got IRC: 65-1976 into the

rotary, may not be able to get out of it , because of vehicles across their path and the rotary may lock - up . " Once the rotary has " locked - up, the movement of vehicles completely stops and the traffic will have to be ultimately sorted out by the police.

- A rotary requires a comparatively larger area and nay not be feasible in many built-up locations.
- Where pedestrian traffic is large, a rotary by itself is not sufficient to control traffic and has to be supplemented by traffic police.
- Where the angle of intersection between two roads is too acute , it becomes difficult to provide adequate weaving length.
- The provision of rotaries at close intervals makes travel troublesome.
- .Traffic turning right has to travel a little extra distance.

1.6 TRAFFIC OPERATIONS IN A ROTARY

There are three traffic operations at a rotary - diverging, merging and weaving. All the other conflicts are converted into these three less severe conflicts.

- Diverging: These are the traffic operation wherein the vehicles moving in one direction is separated into different streams according to their destinations.
- Merging: It is the opposite of diverging. Merging is referred to as the process of joining the traffic coming from different approaches and going to a common destination into a single stream
- Weaving: It is the combined movement of both merging and diverging movements in the same direction.

1.7 DESIGN COMPONENTS OF ROTARY

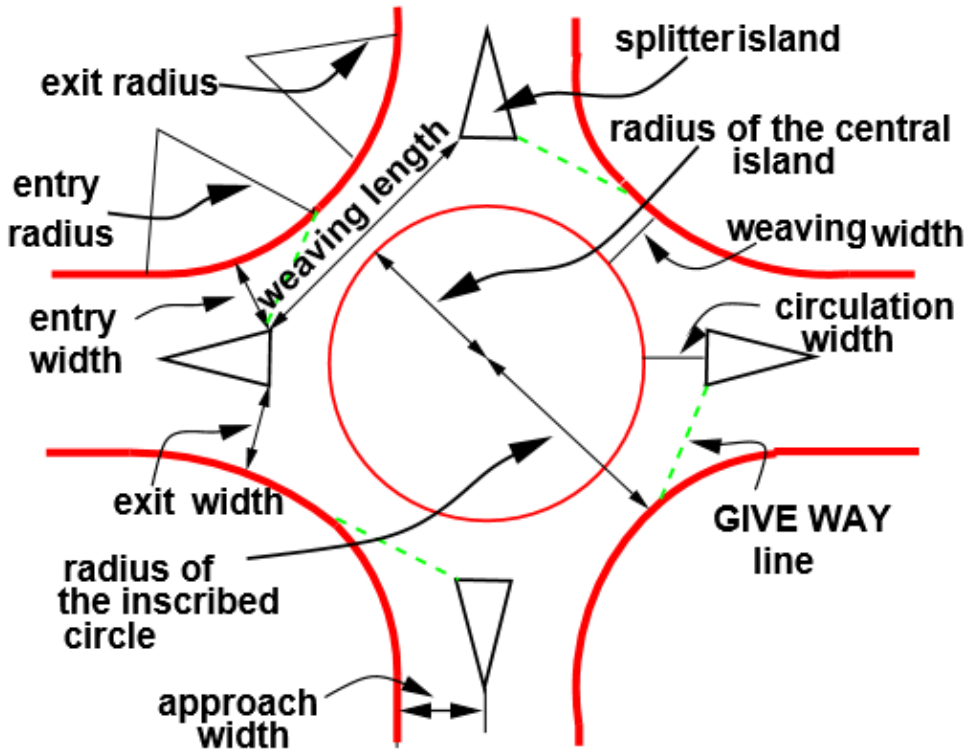


FIGURE 1 DESIGN ELEMENTS OF ROTARY

The design elements include :

- Design speed
- Radius at entry &exit
- Radius of central island
- Weaving length and width
- Width of carriageway at entry and exits.
- Capacity of the rotary
- Entry and Exit angles
- Shape of central island
- Channelizing islands
- Sight distances
- Grade
- Drainage
- Sign and marking

CHAPTER 2

PURPOSE AND NEED STATEMENT

2.1 NEED OF THE PROJECT

- The existing Rotary intersection at Chambaghat was designed in 1985 and the central Island was modified into a park to give an aesthetic appearance in 2006.
- Thus the existing rotary intersection has already exceeded the general design life of 15 years (as per IRC)
- Due to growth in the region and increase in the tourist activities over the year, this intersection no longer serves its original purpose effectively and a new design that integrates safe and efficient vehicle use must be considered.
- The traffic back-ups that occur during peak commuting hours due to increased local traffic and commuters from adjacent towns and states, difficulty faced by traffic police to mobilize the traffic especially during tourist seasons, poor visual quality of the landscape and improvements at the intersection.
- During peak hours, it is often observed that vehicles moving on national highway get stuck at the existing intersection leading to long jams and delays.

FIGURE2 EXISTING ROTARY INTERSECTION AT CHAMBAGHAT

FIGURE 3 TRAFFIC CONGESTION AT THE INTERSECTION

2.2 PURPOSE AND OBJECTIVE OF PROJECT

- The purpose of this project is to improve the junction of NH-22 i.e., Chandigarh -Shimla Road and Solan city road and Basal road at Chambaghat.
- The chambaghat rotary redesign project will –
  - Include geometric features of the rotary corresponding to the geometric parameters of the four lane national highway.
  - Improve roadway capacity and reduce traffic congestion in the Rotary area and side streets.
  - Improve safety for motorists by slowing traffic and thus reducing accidents at the intersection.
  - Minimal requirement of traffic police to physically mobilize the traffic at the intersection.
  - Heighten Level of Service by decreasing delays at the intersection.

CHAPTER 3

LITERATURE REVIEW

S.no	Application	Author	year	Work
1	Recommended practice for traffic rotaries	Indian Road Congress	1976	• This code provides general guidelines that must be followed during the design of traffic rotaries. • This code provides guidelines as to when a rotary type of intersection must be chosen from all available form of intersections by considering its various advantages and disadvantages. • It provides different shapes of rotary islands and channelizing islands depending upon different factors such as the number and disposition of the intersecting roads and the traffic flow pattern. • Minimum and desirable values of all the design parameters which are- Radius at entry, Radius at exit, weaving length, Width of Carriageway at entry and exit, Width of weaving and non-weaving section, entry and exit angles, sight distance, grades are provided corresponding to design speed, number of lanes, carriageway width of approach road. • Formulae to find practical capacity of rotary along with adjustments is also provided.
2.	Hill Road Manual	Indian Road Congress	1998	• The manual covers the various aspects of design, construction and maintenance of roads in hilly areas.

				• Geometric design standards considering importance of safety and free flow of traffic have been laid down. The design standards indicated however are absolute minimum. So the minimum values for Design speed , sight distance, width of road land (roadway, carriageway and shoulders), camber, etc. corresponding to Hilly areas are provided.
3	Recommendations about the alignment survey and geometric design of hill roads	Indian Road Congress	2001	• Survey procedure including guidelines for preliminary survey which consists of pegging the route previously selected on the basis of the reconnaissance survey, running transverse line along it for the purpose of taking longitudinal and cross-sections details and establishing benchmarks which will are used for the determination of final centerline of the road. Guidelines for map and/or plan preparation are also provided. • Revised Geometric design standards corresponding to hilly roads are provided.
4	Manual of specifications and standards for four laning of highways through public private partnership	Indian Road congress	2014	• Geometric design and general features of 4-lane highway • Guidelines, features and some standard designs of intersections and grade separators. This code provides several features which can come very handy in the design of the chambaghat project are – Layout of T-intersection, Layout of crossroad intersection and Layout for staggered intersection.

5	Design of rotary at Janglatmandi (Anantnag) to Reduce Traffic Congestion at The Intersection	Junaid Yaqoob and Er. Amir Lone	2016	• This paper presents the results of a literature review, data collection and analysis, and an expert review of Rotary design at Janglatmandi (Anantnag) according to IRC guidelines. • The capacity of weaving sections comes out to be 3821 PCU/hr. Total vehicles entering into each of weaving section are less than 3000 PCUs per hour and IRC suggests that the maximum volume of traffic that a rotary can efficiently is 3000 vehicles per hour entering from the all weaving section intersection. Hence rotary can accommodate the traffic safely
6	Analysis and design of Intersection on Approach Road of Birla Mandir, Bhopal	Rokade S, Jain M, Goyal P and Sharma V.	2014	• The peak hour traffic volume of the three legged Intersection was found out to be 2000 PCU per hour. This traffic intensity and other intersection characteristics in its present situation require traffic engineering measures for the safe operation of traffic at the intersection. • The maximum volume that a traffic rotary can handle efficiently can be taken as about 3000 vehicles per hour entering from all intersection legs. Rotaries are advantageous in locations where the proportion of right turning traffic at a junction is high. It is required to provide traffic rotaries at both Intersection 1 and 2. • The rotarised intersections in the urban area are designed for a design speed of 30 Km per hour.

				• As far as possible the intersections should be located on level ground. A rotarised intersection may be designed for a site/a plane which is inclined to the horizontal at not more than 1 in 50. • A flashing beacon is traffic signal head or similar type of device having a yellow or red lens in each face which is illuminated by rapid intermittent flashes. Flashing beacons should be provided (Red / Amber) to warn the vehicles entering the intersection area about the pedestrians and cyclist crossing at rotary legs • Bus stops must be provided at locations farther than 75 meter length from the intersection. The busses should not be allowed to stop within this 75 m length. Also the location of the bus stop should be kept the farther side of the junction.
7	Evaluation of Staggered and Cross intersections	David Mahalel, Joseph Craus and A. Polus	1986	• This paper has presented a comparative evaluation of two types of staggered intersections with a four-leg cross intersection, with the aim of analysing the safety and operational characteristics of the intersection layout. • The main advantage of the staggered intersection is in safety. The safety advantage manifests itself in the need of crossing major road traffic from the minor road to slow down, and in the lower number of conflict points and conflict streams.

				• This paper evaluates a certain low-cost improvement aimed at reducing vehicle delays and stops and decreasing accident risk. • Three major elements: a better understanding of the priority regime at the intersection area; a lower number of conflict points and their dispersion over space; and lower critical gaps.
8	The standard intersection drawings	Government of India (Ministry of surface transport, roads wing)		• Drawings of some standard intersection for different types of roads whether NH,SH,ODR,MDR,etc along with standard geometrics of the intersection elements.

CHAPTER 4

GEOMETRIC SURVEY OF THE EXISTING ROTARY

4.1 INTRODUCTION

In order to re-engineer the geometrics of the rotary at Chambaghat, it is important to know the values of the elements of existing rotary. So, survey techniques were employed to measure the values of the elements of existing rotary and then a plan was prepared of the existing rotary.

Initially ,the Sub-divisional office of Chambaghat was approached to get survey data related to Chambaghat. But the data obtained from the SDO office in the form of drawings contained the chainage ie., centerline of the road along the intersection was represented on the drawings with points at regular distances of 15 m. where as rest of features of chambaghat intersection like Curves were represented without their values.

But in order to design a new rotary it is must that a drawing of existing rotary with the values of all the design parameters like Entry & exit radius, dimensions of channelizing islands, weaving length and width, etc is available in hand so that the new design parameters can be compared with it.

To prepare this drawing, survey was conducted on the site by using measuring tape, theodolite and ranging rods. The data obtained is then used to prepare AUTOCAD drawings. The various steps are shown in the following figures.

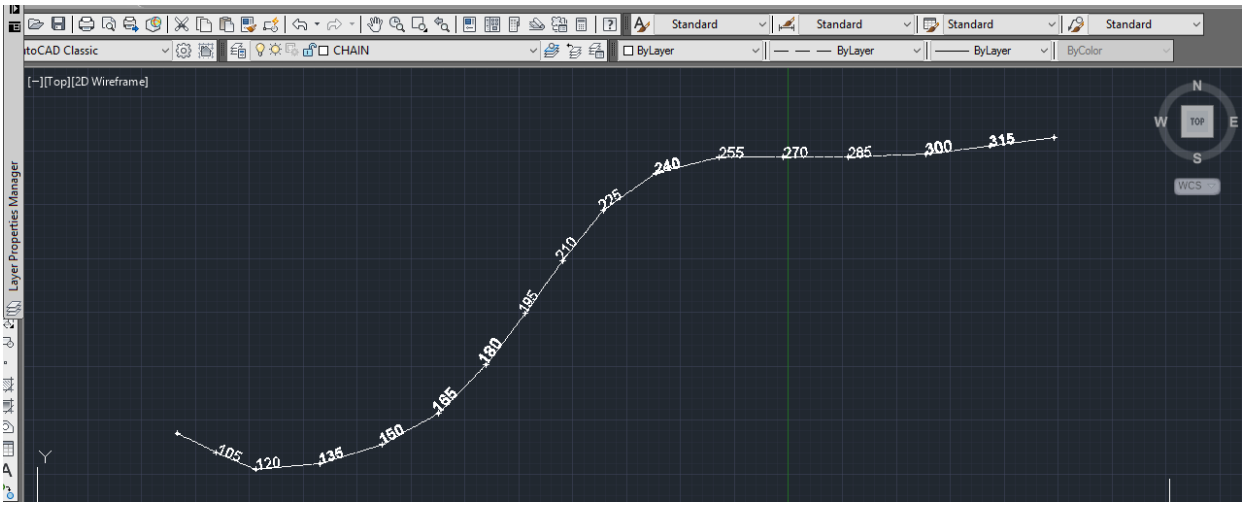


FIGURE 4 CHAINAGE DATA

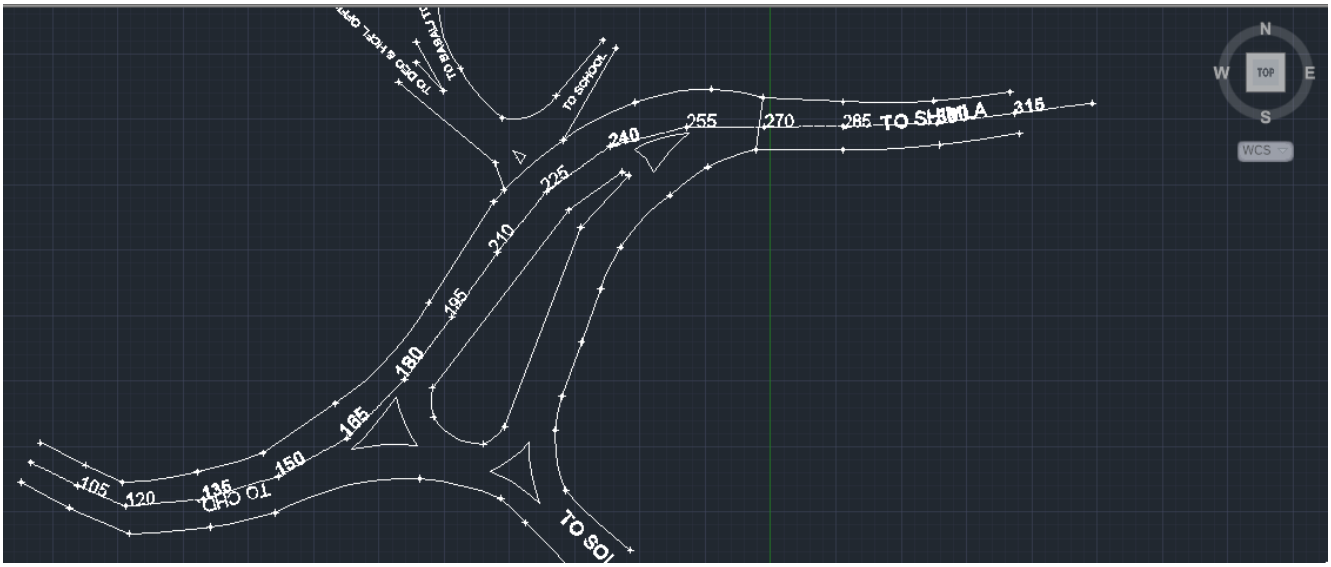


FIGURE 5 PREPARATION OF PLAN BY USING OFFSETS FROM THE CHAIN

4.2 ROTARY ELEMENTS DIMENSIONS OBTAINED FROM THE SURVEY

Table 1 VALUES OF ROTARY ELEMENTS OBTAINED FROM SURVEY

S.no	ELEMENT OF ROTARY	SYMBOL	VALUE IN metres
1	Weaving length	WL1	50.3
		WL2	20.8
		WL3	56.8
		WL4	14.6
2	Entry width	EW1	6.3
		EW2	4.1
		EW3	8.2
3	Exit Width	XW1	6.1
		XW2	5
		XW3	5.5
4	Centre island		
	Length	L1	42.7+12.6=55.3
		L2	40.8+13.5=55.3
	Width	CW1	15.6
		CW2	4
	Radius	R	10.3
5	Entry radius	ER1	60.7
		ER2	52.5
		ER3	35.3
6	Exit radius	EX1	42.8
		EX2	55.1
		EX3	25
7	Weaving Width	W1	5.7
		W2	13.1
		W3	4.8
		W4	5.3

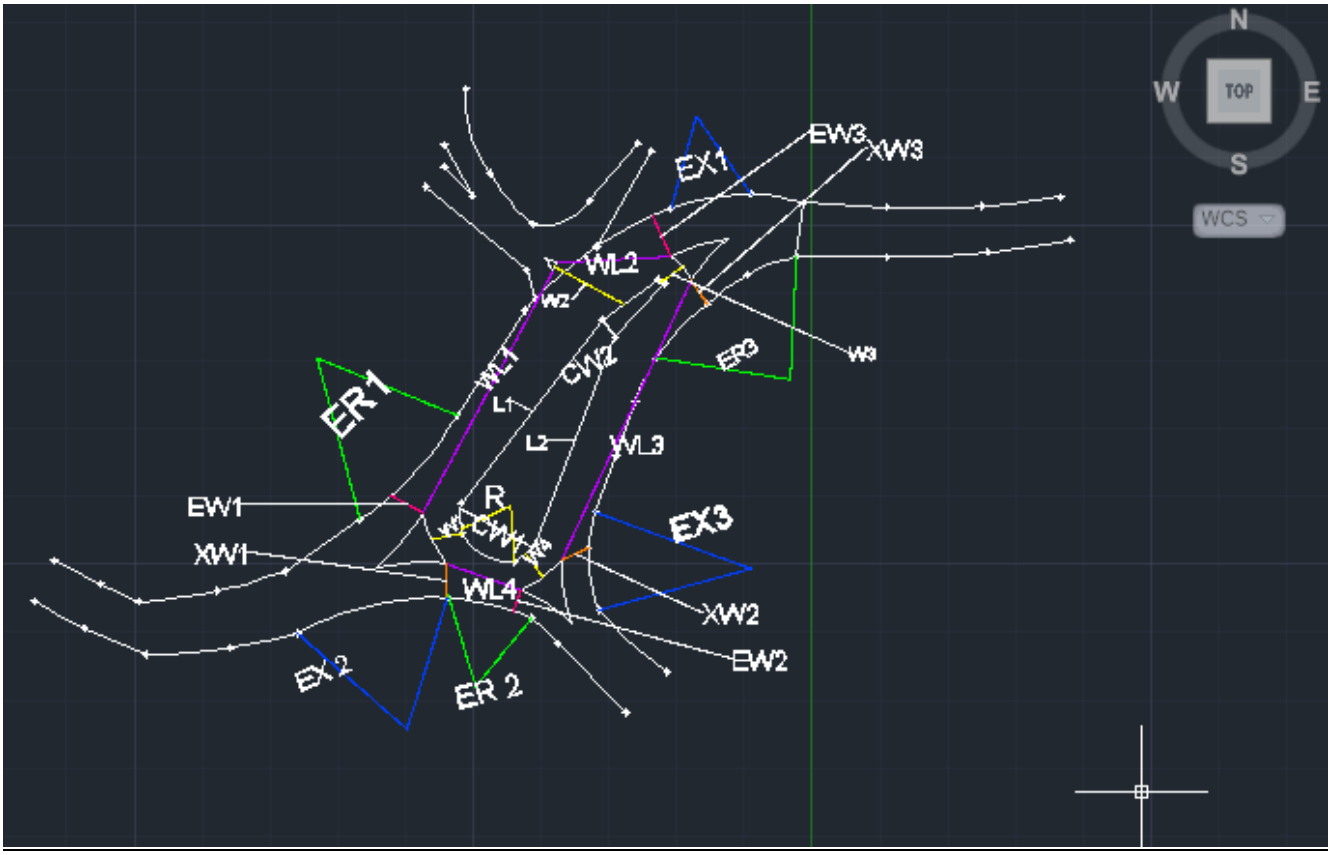


FIGURE 6 REPRESENTATION OF ROTARY ELEMENTS BY SYMOBLS

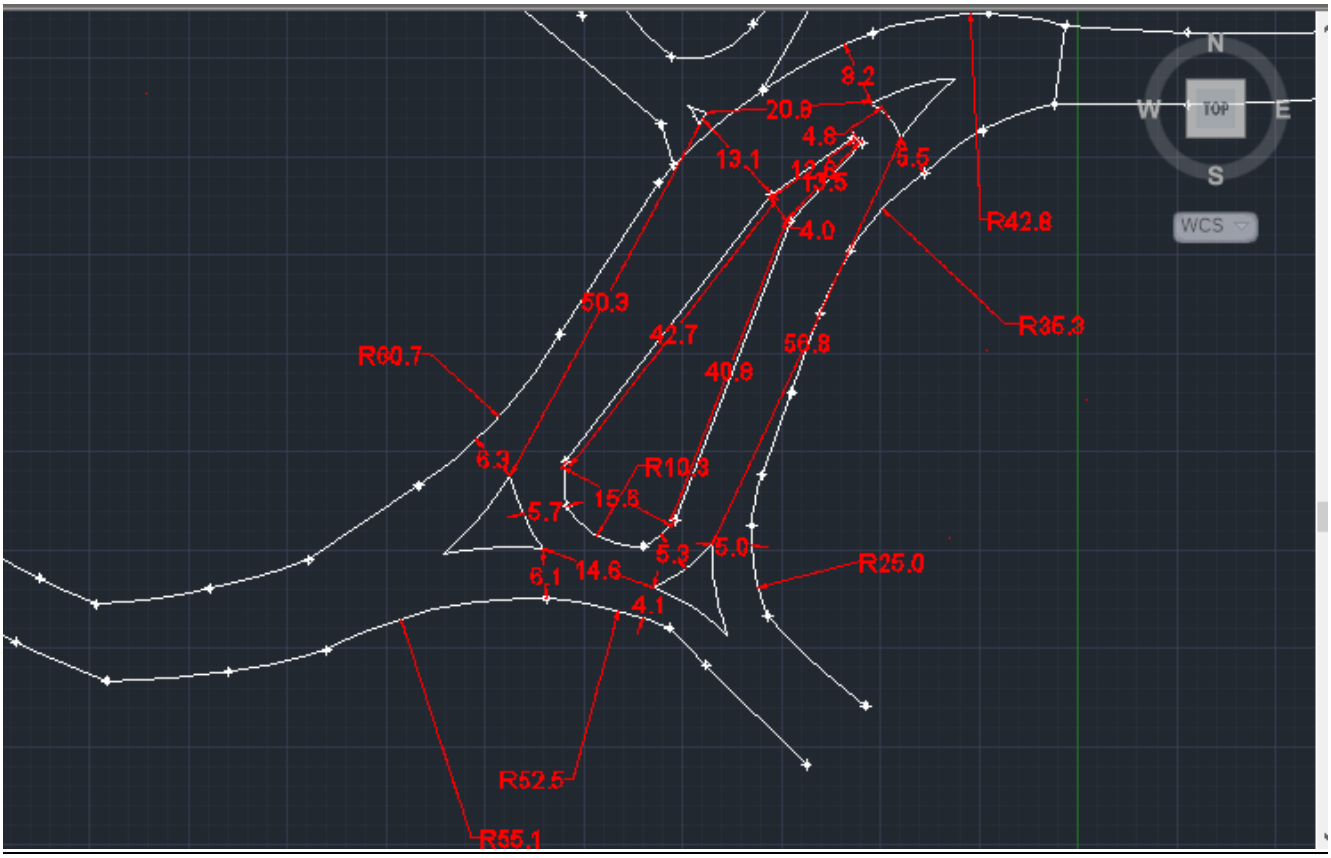


FIGURE 7 PLAN SHOWING ROTARY ELEMENTS WITH THEIR VALUES

FIGURE 8 CHANNELISING ISLANDS WITH THEIR DIMENSIONS

CHAPTER 5

TRAFFIC STUDY

5.1 INTRODUCTION

Traffic volume studies deals with the number, movements, and classifications of vehicle at specific roadway locations at specific time instants. These studies can help agencies make sound traffic safety-related decisions based on data about crucial times of traffic flow, the influence of large vehicles or pedestrians on traffic flow or trends in traffic volume at particular locations of the site.

5.2 SOME BASIC DEFINITIONS

- TRAFFIC VOLUME- No. of vehicles /travelers passing a highway spot per unit time.
- CRITICAL VOLUME- A volume for a given roadway that produces the greatest utilization of capacity for that street, given in terms of passenger's car or mixed vehicle per hour per lane.
- HOURLY VOLUME- The no. of mixed vehicles that passes a given section of a lane or roadway during a time period of an hour.
- TRAFFIC CAPACITY- The maximum no. of vehicles that has a reasonable expectations of passing over a given roadway or section of roadway in one direction during a given time period under prevailing roadway and traffic condition.
- AVERAGE ANNUAL DAILY TRAFFIC (AADT)- It is the 24 hour counts collected every day in the year.
- AVERAGE DAILY TRAFFIC (ADT)- It is the average of 24 hours count collected over a no. of days greater than one but less than a year.

5.3 METHOD OF TRAFFIC COUNT

Two basic methods of counting traffic are-

- Manual observation
- Automatic recording

5.3.1 MANUAL OBSERVATION

Most applications of manual counts require small samples of data at any given location. Manual counts are sometimes used when the effort and expense of automated equipment are not justified. Manual counts are necessary when automatic equipment is not available.

Manual counts are typically used for periods of less than a day. Normal intervals for a manual count are 5,10, or 15 minutes. Traffic counts during a Monday morning rush hour and a Friday evening rush hour may show exceptionally high volumes and are not normally used in analysis; therefore, counts are usually conducted on a Tuesday, Wednesday, or Thursday. Manual counts are recorded using one of three methods

a) Tally sheets
b) Mechanical count boards
c) Electronic count boards

5.3.2 AUTOMATIC OBSERVATION

The automatic count method provides a means for gathering large amounts of traffic data. Automatic counts are usually taken in 1-hour intervals for each 24-hour period. The counts may extend for a week, month, or year. When the counts are recorded for each 24-hour time period, the peak flow period can be identified. The following information can be determined using Automatic counts-hourly traffic patterns, daily or seasonal variations, growth trends, annual traffic estimates. Observers can use portable or permanent automatic counters.

5.4 DATA COLLECTED AT CHAMBAGHAT INTERSECTION

- Traffic studies were conducted to determine the maximum hourly traffic in a day continuously for a week in the month of October and November.
- Counting of vehicles by Manual recording by the use of tally sheets.
- Study were conducted from morning 9:00 am to 10:00 am and in the Evening from 4:00 pm to 5:00 pm
- Different type of vehicles entering in a particular maneuver was counted
- Later the no. of vehicles was changed to their corresponding PCU (Passenger Car per unit) values as per the regulations provided by the IRC.

TABLE 2 PCU VALUES FOR DIFFERNET CLASS OF VEHICLES

	VEHICLES	PCU
2	Cars and Light commercial vehicles(including 3 wheelers)	1
3	Trailers	4.5
4	Buses and medium and heavy commercial vehicles	3
5	Motorcycles and scooters(2 wheelers)	0.5
6	Pedal cycles	0.5
7	Animal drawn vehicles	4

DATA FOR OCTOBER 2016

TABLE 3 TRAFFIC DATA FOR 1/10/16 (SATURDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	35	72	51	143	19	24	7	12	1	0	159.75	305
2	CHD-SOLAN	34	18	35	39	5	6	7	11			96.5	103.5
3	CHD-BASAL	5	8	19	21	0	0	1	2			25.75	33
4	SOLAN-SHIMLA	55	71	134	118	6	4	3	1			202.25	186.25
5	SOLAN-CHD	32	40	56	42	8	5	4	2			116	93
6	SOLAN-BASAL	28	17	37	34	0	0	4	3			70	55.75
7	SHIMLA-BASAL	12	14	11	16	0	0	3	2			29	32.5
8	SHIMLA-SOLAN	78	71	108	160	6	11	6	4			202.5	258.25
9	SHIMLA-CHD	28	62	142	164	14	12	15	20			250	306.5
10	BASAL-CHD	8	4	11	19	0	0	3	2			26	28
11	BASAL-SOLAN	25	43	24	22	0	0	2	1			48.75	57.25
12	BASAL-SHIMLA	8	14	10	24	0	0	4	2			28	40.5
												1254.5	1499.5

TABLE 4 TRAFFIC DATA FOR 2/10/16 (SUNDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	35	56	72	160	21	24	8	14			185.25	316
2	CHD-SOLAN	47	24	26	51	3	4	7	6			91.25	99
3	CHD-BASAL	8	13	14	17	0	0	0	1			20	29.75
4	SOLAN-SHIMLA	64	52	134	144	5	6	2	3			203	210
5	SOLAN-CHD	29	36	45	58	9	5	2	3			99.75	109
6	SOLAN-BASAL	24	18	34	42	0	0	4	7			64	76.5
7	SHIMLA-BASAL	8	12	11	14	0	0	2	3			23	32
8	SHIMLA-SOLAN	62	94	124	144	7	10	7	6			212.5	262.5
9	SHIMLA-CHD	34	44	124	153	10	12	18	21			233.5	285
10	BASAL-CHD	4	6	8	14	0	0	3	2			20	24.5
11	BASAL-SOLAN	25	42	16	27	0	0	1	2			37.75	64.5
12	BASAL-SHIMLA	3	8	7	9	0	0	3	2			18.25	21
												1208.25	1529.75

TABLE 5 TRAFFIC DATA FOR 3/10/16 (MONDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	52	68	158	114	18	24	12	8			287	261
2	CHD-SOLAN	41	35	72	29	10	11	2	3			138.75	97.25
3	CHD-BASAL	26	22	21	14	0	0	2	0			46.5	30.5
4	SOLAN-SHIMLA	70	114	139	96	10	7	5	3			236.5	211.5
5	SOLAN-CHD	24	11	41	36	7	9	3	2			89	77.25
6	SOLAN-BASAL	42	34	27	21	0	0	4	2			70.5	52.5
7	SHIMLA-BASAL	10	7	14	23	0	0	3	1			30.5	31.25
8	SHIMLA-SOLAN	74	108	134	147	20	12	10	8			279.5	288
9	SHIMLA-CHD	46	74	152	139	23	21	14	21			297.5	320.5
10	BASAL-CHD	14	22	26	21	0	0	2	3			42.5	46.5
11	BASAL-SOLAN	32	35	48	42	0	0	4	3			84	77.25
12	BASAL-SHIMLA	25	19	18	22	0	0	4	5			48.75	51.25
												1651	1544.75

TABLE 6 TRAFFIC DATA FOR 4/10/16 (TUESDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	63	74	158	136	23	20	11	5			307.25	266.5
2	CHD-SOLAN	68	52	74	32	12	7	3	2			170	98
3	CHD-BASAL	42	38	48	34	0	2	1	1			82.5	71.5
4	SOLAN-SHIMLA	96	112	136	128	11	9	6	3			259	248
5	SOLAN-CHD	36	18	35	52	7	9	3	5			92	107.5
6	SOLAN-BASAL	35	32	38	42	0	0	4	3			76.25	75
7	SHIMLA-BASAL	8	7	13	18	0	0	2	2			25	29.25
8	SHIMLA-SOLAN	78	96	145	152	24	18	8	7			299.5	299
9	SHIMLA-CHD	45	82	172	198	20	17	13	18			304.75	364.5
10	BASAL-CHD	18	26	21	24	0	0	3	4			43.5	55.5
11	BASAL-SOLAN	34	28	38	35	0	0	2	1			69.5	59
12	BASAL-SHIMLA	17	11	12	23	0	0	3	1			33.75	34.25
												1763	1708

TABLE 7 TRAFFIC DATA FOR 5/10/16 (WEDNESDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	38	43	174	152	21	18	14	10			307.5	268.25
2	CHD-SOLAN	83	49	68	41	7	4	6	5			169.25	104.75
3	CHD-BASAL	48	43	24	30	0	0	1	2			63	68.25
4	SOLAN-SHIMLA	108	92	143	86	14	15	7	4			287	212
5	SOLAN-CHD	33	27	34	57	12	13	3	7			103.75	137.25
6	SOLAN-BASAL	22	29	34	26	0	0	2	3			56.5	56.75
7	SHIMLA-BASAL	11	7	17	15	0	0	1	0			28.25	20.25
8	SHIMLA-SOLAN	78	112	160	153	27	15	10	8			329.5	306
9	SHIMLA-CHD	56	82	146	204	24	19	16	19			308	379.5
10	BASAL-CHD	14	19	20	27	0	0	1	2			33.5	47.25
11	BASAL-SOLAN	28	23	43	31	0	0	2	1			70	51.25
12	BASAL-SHIMLA	17	12	12	18	0	0	2	3			30.75	36
												1787	1687.5

TABLE 8 TRAFFIC DATA FOR 6/10/16 (THURSDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	58	43	172	149	24	31	12	9	1		328	301.25
2	CHD-SOLAN	61	54	81	28	10	11	6	5			174.75	116.5
3	CHD-BASAL	34	42	30	41	0	0	2	3			61.5	81.5
4	SOLAN-SHIMLA	93	128	146	153	16	6	7	6			284.75	285
5	SOLAN-CHD	47	15	41	53	5	7	6	3			109.25	94.25
6	SOLAN-BASAL	58	46	39	27	0	0	2	1			88.5	64.5
7	SHIMLA-BASAL	14	8	14	23	0	0	5	6			39.5	47
8	SHIMLA-SOLAN	95	133	131	158	24	33	9	7			301.25	377.75
9	SHIMLA-CHD	48	92	134	125	22	27	10	12			266	311
10	BASAL-CHD	14	18	26	33	0	0	4	7			48.5	67.5
11	BASAL-SOLAN	28	33	41	47	0	0	4	2			74	77.75
12	BASAL-SHIMLA	15	12	19	13	0	0	2	3			36.25	31
												1812.25	1855

TABLE 9 TRAFFIC DATA FOR 7/10/16 (FRIDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	33	42	147	128	21	18	10	8			264.75	237.5
2	CHD-SOLAN	74	53	83	57	14	12	3	2			189.5	138.75
3	CHD-BASAL	38	23	45	32	0	1	2	0			79.5	52.25
4	SOLAN-SHIMLA	108	126	152	137	13	9	9	7			299	279.5
5	SOLAN-CHD	42	28	38	56	9	7	3	4			105.5	110
6	SOLAN-BASAL	28	26	35	41	0	0	3	2			65	66.5
7	SHIMLA-BASAL	14	9	18	25	0	0	8	7			52.5	52.75
8	SHIMLA-SOLAN	93	112	176	142	23	15	6	4			332.75	283
9	SHIMLA-CHD	53	74	178	213	25	17	10	8			322.75	343.5
10	BASAL-CHD	12	18	15	26	0	0	2	1			30	42.5
11	BASAL-SOLAN	41	43	34	19	0	0	3	4			73.75	63.25
12	BASAL-SHIMLA	21	18	14	12	0	0	3	2			38.75	31.5
												1853.75	1701

DATA FOR NOVEMBER 2016

TABLE 10 TRAFFIC DATA FOR 19/11/16 (SATURDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	27	58	65	154	21	26	8	15	0	0	172.25	320.5
2	CHD-SOLAN	30	14	37	45	4	7	9	12	0	0	98.5	112.5
3	CHD-BASAL	4	7	21	23	0	0	0	3	0	0	24	37.25
4	SOLAN-SHIMLA	50	62	132	134	7	5	4	2	0	0	202.5	201.5
5	SOLAN-CHD	27	35	51	53	10	7	5	4	0	0	116.25	112.25
6	SOLAN-BASAL	23	15	39	32	0	0	3	7	0	0	65.25	64.25
7	SHIMLA-BASAL	9	12	13	14	0	0	3	2	0	0	28.75	29
8	SHIMLA-SOLAN	60	78	118	153	5	13	6	5	0	0	196	265.5
9	SHIMLA-CHD	25	65	136	175	16	14	16	22	0	0	250.75	331.75
10	BASAL-CHD	9	9	14	16	0	0	2	2	0	0	26.75	28.75
11	BASAL-SOLAN	21	38	34	28	0	0	2	3	0	0	55.75	65.5
12	BASAL-SHIMLA	5	12	11	21	0	0	3	2	0	0	23.75	36
												1260.5	1604.75

TABLE 11 TRAFFIC DATA FOR 20/11/16 (SUNDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	31	63	76	178	24	25	9	13	1	0	202.75	339.25
2	CHD-SOLAN	28	19	32	40	2	5	8	9	0	0	83	96.25
3	CHD-BASAL	2	10	16	18	0	0	0	2	0	0	17.5	31.5
4	SOLAN-SHIMLA	52	68	130	146	6	6	3	2	0	0	196	221
5	SOLAN-CHD	26	38	48	62	9	4	3	4	0	0	103.5	114.5
6	SOLAN-BASAL	20	12	36	36	0	0	3	8	0	0	60	69
7	SHIMLA-BASAL	7	8	9	12	0	0	1	2	0	0	17.25	24
8	SHIMLA-SOLAN	57	87	108	160	8	9	8	8	0	0	198.75	276.25
9	SHIMLA-CHD	28	56	131	172	14	15	20	25	0	0	254	334
10	BASAL-CHD	5	7	9	13	0	0	2	1	0	0	18.75	21.25
11	BASAL-SOLAN	18	34	29	44	0	0	3	2		0	51.5	75.5
12	BASAL-SHIMLA	4	10	13	24	0	0	3	8	0	0	25	55.5
												1228	1658

TABLE 12 TRAFFIC DATA FOR 21/11/16 (MONDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	45	56	176	132	23	29	15	11	0	0	323.75	294
2	CHD-SOLAN	64	52	86	31	12	13	3	5	0	0	179	124
3	CHD-BASAL	37	34	37	26	0	0	2	1	0	0	70.75	54.5
4	SOLAN-SHIMLA	80	132	156	142	14	9	9	4	0	0	285	280
5	SOLAN-CHD	35	16	48	42	8	11	3	3	0	0	107.25	96
6	SOLAN-BASAL	40	46	37	38	0	0	6	3	0	0	85	81.5
7	SHIMLA-BASAL	12	8	18	27	0	0	4	2	0	0	39	39
8	SHIMLA-SOLAN	76	121	135	163	22	15	12	7	0	0	294	319.75
9	SHIMLA-CHD	45	80	156	132	24	21	15	23	0	0	306.75	324
10	BASAL-CHD	16	24	27	32	0	0	3	5	0	0	48	65
11	BASAL-SOLAN	38	34	46	41	0	0	3	2	0	0	83.5	72.5
12	BASAL-SHIMLA	20	17	17	23	0	0	5	3	0	0	47	44.75
												1869	1795

TABLE 13 TRAFFIC DATA FOR 22/11/16 (TUESDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	42	47	188	128	24	20	14	8	0	0	333.5	247.25
2	CHD-SOLAN	60	42	80	34	10	8	4	3	0	0	167	98.5
3	CHD-BASAL	32	30	42	28	0	2	1	2	0	0	69	62.5
4	SOLAN-SHIMLA	82	121	145	134	12	8	7	2	0	0	263.5	254.75
5	SOLAN-CHD	32	14	40	66	8	10	2	6	0	0	94	124.5
6	SOLAN-BASAL	38	41	42	46	0	0	5	4	0	0	85.5	88.75
7	SHIMLA-BASAL	10	6	14	23	0	0	2	3	0	0	27.5	36.5
8	SHIMLA-SOLAN	80	104	180	154	26	16	10	6	0	0	348	298
9	SHIMLA-CHD	40	74	160	201	22	18	14	20	1	0	302.5	370.5
10	BASAL-CHD	14	21	23	29	0	0	3	5	0	0	42.5	59.75
11	BASAL-SOLAN	36	30	42	38	0	0	2	2	0	0	75	66.5
12	BASAL-SHIMLA	18	12	14	26	0	0	4	2	0	0	39.5	41
												1847.5	1748.5

TABLE 14 TRAFFIC DATA FOR 23/11/16 (WEDNESDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	49	52	183	141	22	17	15	12	0	0	330.75	267
2	CHD-SOLAN	65	43	74	46	8	5	7	4	0	0	167.75	105.25
3	CHD-BASAL	34	32	27	31	0	1	2	1	0	0	58.5	61
4	SOLAN-SHIMLA	96	111	149	128	17	14	9	5	0	0	299	268.25
5	SOLAN-CHD	30	18	38	62	13	15	4	8	0	0	111.5	144.5
6	SOLAN-BASAL	31	43	38	29	0	0	3	4	0	0	70.25	73.25
7	SHIMLA-BASAL	12	5	18	19	0	0	1	3	0	0	30	31.75
8	SHIMLA-SOLAN	73	107	179	157	28	19	12	8	0	0	353.75	318.25
9	SHIMLA-CHD	43	76	157	224	25	21	17	23	0	0	315.25	413
10	BASAL-CHD	16	22	24	32	0	0	2	2	0	0	42	54.5
11	BASAL-SOLAN	32	28	49	34	0	0	3	2	0	0	82	61
12	BASAL-SHIMLA	15	11	13	21	0	0	1	4	0	0	27.25	41.25
												1888	1839

TABLE 15 TRAFFIC DATA FOR 24/11/16 (THURSDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	42	53	190	135	25	29	14	10	1	0	343	291.75
2	CHD-SOLAN	65	51	87	35	11	9	7	4	0	0	189.75	112.25
3	CHD-BASAL	39	32	34	38	0	0	1	5	0	0	66.25	77
4	SOLAN-SHIMLA	84	135	154	149	17	5	8	6	0	0	292	283.25
5	SOLAN-CHD	37	12	43	46	6	7	5	4	0	0	103.75	88
6	SOLAN-BASAL	48	38	42	37	0	0	3	2	0	0	87	71.5
7	SHIMLA-BASAL	16	13	21	32	0	0	6	7	0	0	51	62.75
8	SHIMLA-SOLAN	76	124	137	169	28	35	11	9	0	0	311	394
9	SHIMLA-CHD	42	86	148	131	23	29	12	14	0	1	284.5	329
10	BASAL-CHD	17	19	32	35	0	0	5	8	0	0	59.75	73.25
11	BASAL-SOLAN	32	37	45	46	0	0	4	3	0	0	81	82.75
12	BASAL-SHIMLA	18	15	13	27	0	0	2	4	0	0	32.5	50.25
												1901.5	1915.75

TABLE 16 TRAFFIC DATA FOR 25/11/16 (FRIDAY)

		2 WHEELER		CAR/JEEP		BUS		TRUCK		TRAILER		PCU Equivalent of traffic	
		Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
S.no	MANOUVERES												
1	CHD-SHIMLA	37	44	149	132	23	19	12	7	0	0	281.75	243
2	CHD-SOLAN	69	49	87	41	14	10	2	3	0	0	186.75	116.75
3	CHD-BASAL	36	25	43	28	0	1	2	1	0	0	76	52.75
4	SOLAN-SHIMLA	92	104	151	142	15	13	9	7	0	0	292	280
5	SOLAN-CHD	31	20	43	65	10	8	2	5	0	0	102.25	119
6	SOLAN-BASAL	38	46	46	45	0	0	5	4	0	0	89.5	91.5
7	SHIMLA-BASAL	15	6	23	32	0	0	7	6	0	0	55.25	54.5
8	SHIMLA-SOLAN	87	108	182	153	24	18	8	5	0	0	343.25	303
9	SHIMLA-CHD	46	79	169	222	27	15	11	7	0	0	317.5	347.25
10	BASAL-CHD	13	25	19	27	0	0	4	2	0	0	40.75	51.75
11	BASAL-SOLAN	34	36	33	22	0	0	3	5	0	0	67.5	64
12	BASAL-SHIMLA	23	20	17	9	0	0	4	3	0	0	46.25	33
												1898.75	1756.5

5.5 PRESENT AND FUTURE VALUE OF DESIGN TRAFFIC

The PCU values corresponding to 24/11/2016 comes out to be maximum i.e. **1915.75 PCU** so this value is taken as design traffic.

For calculating future value of this traffic value, assume a growth rate of 7.5 % and a design period of 15 years as per IRC recommendations. Therefore, Future value of this traffic is-

Future value = Present value*(1+Annual growth rate/100) ^Design period

FV =1915.75*(1+.075) ^15 =5668.47 PCU

Therefore, traffic value to be used for design and further calculations = 5668.47 PCU.

CHAPTER-6

REDESIGN OF ROAD INTERSECTION AT CHAMBAGHAT

To redesign the road intersection and to achieve the aim and purpose of the project as discussed earlier, different design alternatives will be considered with their geometrics, advantages and disadvantages and at the end the most suitable design alternative will be proposed along with the drawings prepared by Autocad.

6.1 CONVENTIONAL ROTARY BY USING IRC GUIDELINES

A conventional roundabout will be considered first and the traffic data collected will now be used to find parameters for re-designing the rotary intersection by following the guidelines of IRC

NOTE- The values of the design parameters that are calculated in the steps to follow are the minimum required values as recommended by the IRC 1965 and hill road manual 1998 for general conditions and the actual values to be provided may be different these values depending upon the terrain, location constraints and other special conditions.

6.1.1 RADIUS AT ENTRY

It depends on the design speed, amount of super elevation and the coefficient of friction. Since major intersections like rotaries are provided with advance information signs and drivers travel through them with anticipation of more critical conditions than on open highways, the values of coefficient of friction for purposes of design are regarded as higher than for other locations. Based on overall considerations. Table 17 below gives guidance for the selection of radii of curves at entry. In this table, range of values for the radius is given. The lower value is meant to ensure easy entrance of vehicles into the rotary, IRC: 65-1976 and the higher value to guard against any tendency for over- speeding.

TABLE 17 SUGGESTED VALUES OF RADIUS AT ENTRY FOR DIFFERENT DESIGN SPEEDS

Rotary Design Speed	Suggested Values of Radius at Entry
40	30-35
30	15-25

So for the Chambaghat intersection, the suggested minimum values of Radius at entry for design speed 30 kmph corresponding to urban areas is 15 meters.

6.1.2 RADIUS AT EXIT

The radii of the curves at exit should be larger than that of the central island and at entry so as to encourage the drivers to pick up speed and clear away from the rotary expeditiously. For this reason, the radius of the exit curves may be kept; about 1 to 2 times the radius of the entry curves, lf, however, there is large pedestrian traffic cross the exit road, radii similar to those at entrances should be provided to keep the exit speeds reasonably low.

The minimum value of Exit radius is 1.5 to 2 times the value of Entry radius i.e., 22.5 to 30 meters.

6.1.3 RADIUS OF CENTRAL ISLAND

Theoretically, the radius of the central island should be equal to the radius at entry. In practice, however, the radius of the central island is kept slightly larger than that of the curve at entry, this being an attempt to give slight preference to the traffic already on the rotary and to slow down the approaching traffic. A value of 1.33 times the radius of entry curve is suggested as general guide line for adoption.

So, the minimum value of Radius of central island is 1.33 times the value of Radius at entry i.e., 20 meters.

6.1.4 MINIMUM WEAVING LENGTH

It determines the ease with which the vehicles can maneuver through the weaving section and thus determines the capacity of the rotary. The weaving length is decided on the basis of factors such as the width of the weaving section, the average width of entry, total traffic and the proportion of weaving traffic in it. As a general rule, effort should be made to keep the weaving length at least 4 times the width of the weaving section. The following minimum values of weaving lengths for different design speeds should be observed.

TABLE 18 MINIMUM WEAVING LENGTH CORRESPONDING TO DIFFERENT DESIGN SPEEDS

Design Speed	Minimum weaving length
40 kmph	45 mt
30 kmph	30 mt

In order to discourage speeding in the weaving sections, the maximum weaving length should be restricted to twice the values given above. So the minimum weaving length for the chambaghat intersection is 30 m.

6.1.5 WIDTH OF CARRIAGE WAY AT ENTRY AND EXIT

The carriageway width at entrance and exit of a rotary is governed by the amount of traffic entering and leaving the rotary When deciding upon the width, the possible growth of traffic in the design period should be considered. It is recommended that the minimum width of carriageway be at least 5 meter with necessary widening to account for the curvature of the road. Following Table gives the value or the width of carriageway at entry inclusive of widening needed on account of curvature.

TABLE 19 WIDTH OF CARRIAGE WAY AT ENTRY AND EXIT

Carriageway width of the approach road (in m)	Radius at entry (in m)	width of carriageway at entry and exit (in m)
7 m (2 lanes)	25-35	6.5
10.5 m (3 lanes)	25-35	7.0
14 m (4 lanes)	25-35	8.0
21 m (6 lanes)	25-35	13.0
7 m (2 lanes)	15-25	7.0
10.5 m (3 lanes)	15-25	7.5
14 m (4 lanes)	15-25	10
21 m (6 lanes)	15-25	15.0

Thus the minimum width of carriageway at entry and exit required to be provided at Chambaghat is 10 m required for 4 lane NH with minimum 15 m entry radius.

6.1.6 WIDTH OF ROTARY CARRIAGE WAY

- The width of non - weaving section of the rotary should, be equal to the widest single entry into the rotary and should generally be less than the width of the weaving section.
- The width of the weaving section of the rotary should be one traffic lane (3.5 m) wider than the mean entry width

  i.e., **W = (e1+e2)/2 + 3.5**

  W = (10+10)/2 +3.5 = 13.5 m

6.1.7 CAPACITY OF THE ROTARY

It is important that the geometric design evolved for the rotary should be able to deal with the traffic flow at the end of the design period on the rotary. The practical capacity of a rotary is really synonymous with the capacity of the weaving section - which can accommodate the least traffic.

Capacity of the individual weaving sections depends on factors such as (i) width of the weaving section (ii) average width of entry into the rotary (iii) the weaving length and (iv) proportion of weaving traffic and could be calculated from the following formula

$$Q_p = \{ 280w(1+e/w)(1-p/3)\}/(1+w/l)$$

Where Q_p = practical capacity of the weaving section of the rotary in the passenger car units (PCU) per hour.

W = width of the weaving section in meters (i.e., average of 'e1' and 'e2', as in fig), e/w to be within the range 0.4 and 1.00

l = length in meters of the weaving section between the ends of channelizing islands (w/l to be within the range 0.12 and 0.4)

p = proportion of weaving traffic,i.e., ratio of sum of crossing streams to the total traffic on the weaving section (p =b+c/a+b+c+d),range of p being 0.4 to 1.0 .

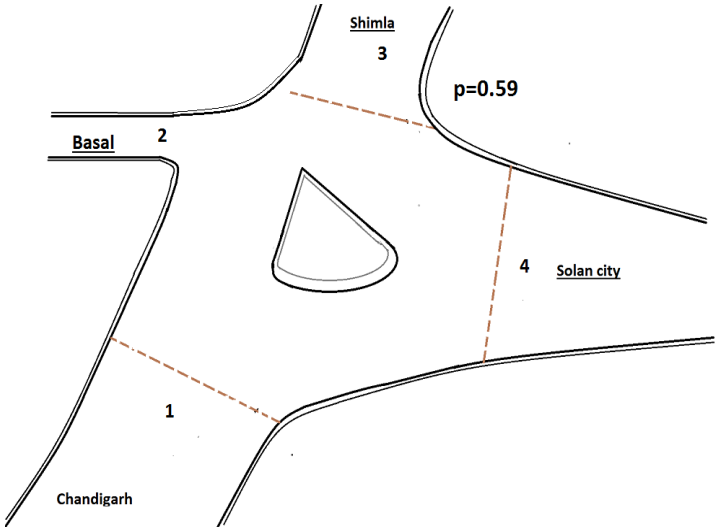
PROPORTION OF WEAVING TRAFFIC

Proportioning ratio =(b+c)/(a+b+c+d)

- **a-** Left turning traffic lane| moving along extreme left
- **b-** Crossing or weaving traffic turning towards right while entering to the rotary
- **c-** Crossing or weaving traffic turning towards left while leaving rotary
- **d-** Right turning traffic moving along right extreme lane

In order to find the value of proportioning ratio all the possible cases must be considered. These are as shown below-

CASE-1



Calculation

a- Chandigarh to Basal- 77

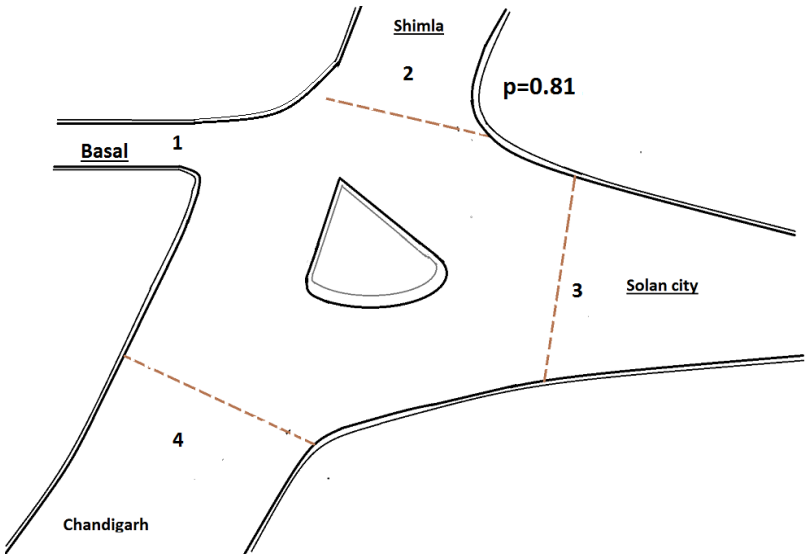
b-Chandigarh to Basal + Solan to Basal – 291+113=404

c-Shimla to Basal + Solan to Basal – 62.7+71.5=134.2

d-Solan to Shimla – 283.25

p=(b+c) \(a+b+c+d) =0.59

CASE-2



Calculation

a-Basal to Shimla -50.25

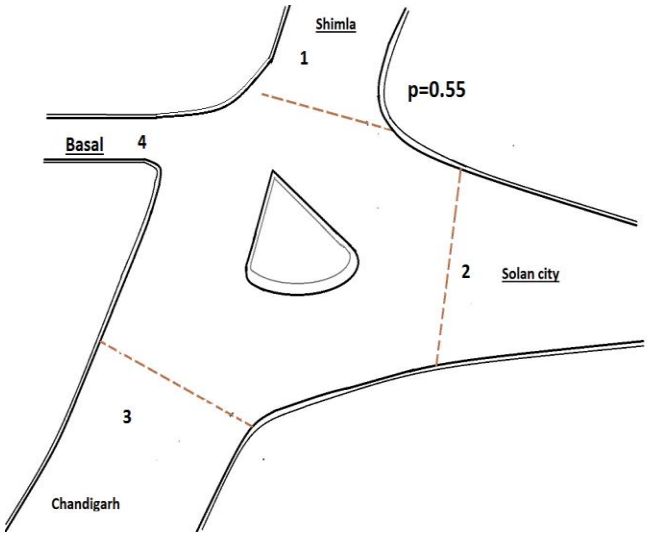
b-Basal to Solan+Basal to Chandigarh-82.7+73.25=156

c-Chandigarh to Shimla+Solan to Shimla-291+284=575

d-Chandigarh to Solan-112.75

p=(b+c) \(a+b+c+d) =0.81

CASE-3



Calculation

a-Shimla to Solan-394

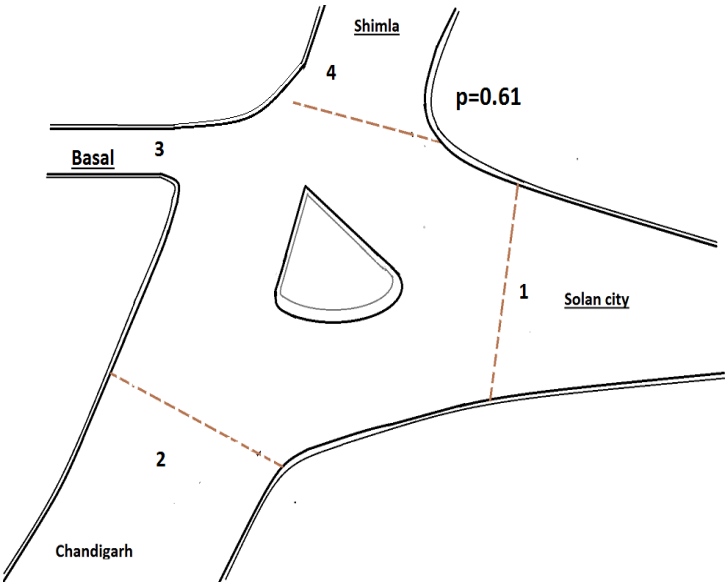
b-Shimla to Chandigarh + Shimla to Basal-329+62.75=392

c-Basal to Solan + Chandigarh to Solan-82.75+113=195

d-Basal to Chandigarh-73.25

p=(b+c)\(a+b+c+d)=0.55

CASE-4



Calculation

a-Solan to Chandigarh-88

b-Solan to Basal + Solan to Shimla-71.5+283.25=354.7

c-Basal to Chandigarh + Shimla to Chandigarh-73+329=402

d-Shimla to Basal-394

p=(b+c)\(a+b+c+d)=0.61

Note- The value of proportioning ratio is maximum of the above ie **P= 0.81**

Therefore, using this value to find out capacity of rotary

$$Q_p = \{ 280w(1+e/w)(1-p/3)\}/(1+w/l)$$

$$Q_p = \{280*13.5(1+10/13.5)(1-.81/3)\}/(1+13.5/30)$$

$$= 3312.68 \text{ pcu/hr}$$

6.1.8 FEASIBILITY

TABLE 20 VALUE OF ROTARY COMPONENTS OBTAINED BY FOLLOWING MINIMUM PARAMETERS LAID BY IRC

S.NO.	ROTARY COMPONENTS	MINIMUM VALUE AS PER IRC
1	DESIGN SPEED	30 KMPH
2	ENTRY RADIUS	15 meters
3	EXIT RADIUS	22.5 meters
4	WEAVING LENGTH	30 meters
5	RADIUS OF CENTRAL ISLAND	20 meters
6	WIDTH OF CARRIAGE WAY AT ENTRY	10 meters
7	WIDTH OF CARRIAGE WAY AT EXIT	10 meters
8	WIDTH OF WEAVING SECTION OF THE ROTARY	13.5 meters
9	CAPACITY OF ROTARY	3312.6 PCU/hr

- So , it is observed that the capacity of rotary calculated by following the minimum parameters laid by IRC =3312.68 PCU/hr .But the design traffic volume =5568.47 PCU exceeds this traffic capacity obtained.
- During the crossing of train over the track at the intersection, there will be long jams around the roundabout.
- Also a standard roundabout will delay and disturbance to the traffic moving over NH.
- Thus, a standard roundabout will not be a feasible design.

6.2 MODERN ROUNDABOUTS

Modern roundabout are used Where a conventional roundabout is not feasible due to space constraints or due to unsymmetrical intersections or multiple legged intersections or where further reduction in speed of vehicles traversing the intersection is required.

6.2.1 TYPES

Over the time many forms of Modern roundabouts have been developed in order to meet the custom demand of any specific intersection. Some of these are-

FIGURE 9 TURBO ROUNDABOUT

FIGURE 10 DOUBLE MINI ROUNDABOUT

FIGURE 11 SKYLINERS

Out of the above forms of mini roundabout, the sky liner and Turbo roundabout will not be feasible for the concerned situation so the feasibility of double mini roundabouts will be discussed hereafter.

6.2.2 DOUBLE MINI ROUNDABOUT

Mini-roundabouts are common in the UK, Ireland and Hong Kong. They are used in pair at staggered intersections. Mini-roundabouts can be a painted circle or a low dome but must be fully traversable by vehicles. They use the same right-of-way rules as standard roundabouts, but produce different driver behaviour. The idea is that Vehicles are required to treat the painted circle as if it were a solid island and drive around it but to allow motorists (especially large trucks) to drive over them in the absence of other traffic. In the UK and also in other jurisdictions that have adopted mini-roundabouts, to drive across the central disc or dome when it is practicable to avoid it is an offence.

FIGURE 12 TRAVERSABLE CENTRAL ISLAND USED IN DOUBLE MINI ROUNDABOUTS

FEASIBILITY –

Although the Double mini roundabout will solve the problem of the unsymmetrical or staggered intersection at chambaghat with very less space requirement but the administration of the vehicle traversing over the mini roundabout will be complex and will create confusion among the commuters. Also at the time of railway crossing, there will be long jams and the central island may not be accessible for traversing for such duration which may lead to accidents and delays. So , the modern roundabouts are not a feasible alternative for chambaghat intersection.

6.3 RIGHT/LEFT STAGGERED INTERSECTION WITH A FLYOVER

6.3.1 INTRODUCTION

The design is suitable for Right/left staggered intersection of a national highway having four-lane divided carriageway and two/single lane state highway/major district road. The 4 lane carriageway and the intersection geometrics will be designed by following the standards laid by –'Manual of specifications & standards for four laning of highways through public private partnership' by INDIAN ROADS CONGRESS 2014 and The standard intersection drawings by Government of India (Ministry of surface transport, Roads wing).

6.3.2 FEASIBILITY OF DESIGN

- The design will be provide no hindrance to the NH traffic as they will use the flyover whereas the local traffic will move below it.
- The design will counter the problem of obstruction due to railway track.
- The design will lessen the traffic burden on the intersection as majority of the traffic will move over the flyover. Thus, the intersection will serve efficiently for longer life.

6.3.3 DESIGN OF STAGGERED INTERSECTION

TABLE 21 DESIGN PARAMETERS FOR STAGGERED INTERSECTION

S.no.	PARAMETERS	RECOMMENDED VALUE (in m)
1	Width of carriageway	7.5+7.5 =15
2	Minimum Median width of mountainous terrain	2.5
3	Width of shoulders in mountainous terrain-1. Hilly side	1.5 (paved)
4	Width of shoulders in mountainous terrain-2.Valley side	1.5 (paved)+1.0 (earthen)=2.5

5	Right of way	21.5
6	Extra width of pavements & roadway at intersection	0.9
7	Right of way (at & in between intersection)	22.4
8	Total ht. of screen at the median	1.5
9	Absolute minimum radius at curves in the NH(mount.)	75
10	Radius of curve at the intersection with 2 lane SH/1 lane MDR	25-30
11	Minimum distance between the left & right staggered intersections	45

Using the above design parameters , drawing for the intersection are prepared by using AutoCAD.

6.3.4 DESIGN OF FLYOVER FOR THE STAGGERED INTERSECTION

A 4 lane flyover for the NH traffic is needed along with the staggered intersection. It is to be noted here that the actual flyover must be prepared after determining the dimensions of its elements (ie., Piles, Pile cap, Pier, Pier cap, Deck slab, Handrail) based on the Bending moment, shear force developed due to design load. But that is not required by the scope of this project and the CAD drawings of the flyover simply represent the concept that how the flyover will negotiate the track and how it will accommodate the NH traffic thus removing the present congestion in the area.

CHAPTER 7

CONCLUSION

Thus in order to improve the junction of NH-22 i.e., Chandigarh -Shimla Road , Solan city road and Basal road at Chambaghat and to redesign it as per the geometric parameters of the four lane national highway, the most practical and feasible solution will be to remove the existing rotary and provide in its place a right-left staggered intersection with a flyover for uninterrupted flow of the traffic.

CHAPTER 8

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