

**IDENTIFICATION AND ANALYSIS OF PAVEMENT FAILURES
AND ACCIDENTS ON ROAD STRETCH (PHAGWARA, NH1)**

**Submitted in partial fulfillment of the requirements of the degree of
MASTER OF TECHNOLOGY**

in

CIVIL ENGINEERING

by

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2017

DECLARATION

I, **ROGAM DOMING** (11202174), hereby declare that this submission is my own work and that to the best of my insight and conviction, it contains no material beforehand distributed or composed by other individual or office. No material which has been acknowledged for reward of some other degree or certificate of the college or other organization of higher learning with the exception of where due affirmations have been made in the content. It was arranged and displayed under the direction and supervision of **Mr. AMIT KUMAR YADAV** (Assistant Professor).

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CERTIFICATE

This is to certify that **ROGAM DOMING** under Registration No. **11202174** has prepared the dissertation-2 report titled “**IDENTIFICATION AND EVALUTION OF PAVEMENT FAILURES AND ACCIDENTS ON ROAD STRETCH (PHAGWARA,NH1)**” under my direction. This is a bonafide work of the above competitor and has been submitted to me in fractional satisfaction of the prerequisite for the honor of Masters of Technology in Civil Engineering.

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ACKNOWLEDGEMENT

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I am also thankful to our teaching staff, non-teaching staff and all others involved in this Project.

Signature of student

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ABSTRACT

Pavement design, development process of the most economical combination of pavement layers, mainly deals with the design of material mixtures and the thickness of different pavement layers. Even if the Highways are well designed and constructed, they may require proper maintenance. If not, different misfortunes such as cracking fatigue, bleeding, potholes, rutting, etc. occur in the pavement which is a complex phenomenon due to many factors involved such as precipitation, traffic, etc.

In this paper pavement failure is defined in terms of reduced serviceability caused by development of cracks and ruts. Before entering into maintenance strategies, we must look at the reasons of Failures in Bituminous pavements. The reason for the failure is due to many reasons or combination of reasons. Applying a correction in the current surface will enhance maintenance life and also works to enhance the layers. The three parameters that are evenness index, pavement cracking and rutting are considered while other failures have been omitted while going for maintenance operations.

Along with maintenance techniques there are different methods for pavement preservation which will help to improve pavement life and delay its failure. The purpose of this study was to evaluate and recommend remedies to minimize the possible causes of pavement distresses. The paper describes the pavement's failures and problems during the last few years on a number of projects in Punjab, Phagwara. Based on the various past experiences pavement preservation techniques and measures are also discussed that will be useful in increasing the serviceable life of pavement.

The length of 18 km of the NH-1 was chosen, starting from Kajurla to Chachoki, to conduct a survey of the pavement distress. 50 important locations in the highway were chosen for study. In this study, The observation showed that the most common found pavement failures in the highway were potholes, alligator cracks followed by raveling and edge failures. The most required possible incurable treatments is an overlay, patching and improving shoulder. It was also noted that lateral drainage is not maintained, cleaned up and even absent in some places of NH- 1.

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CHAPTER-1

INTRODUCTION

1.1 GENERAL

The pavements are mainly consisting of shoulder and carriageway.

Pavements are classified as: -

- Flexible Pavement.
- Rigid Pavement.
- Semi Rigid Pavement.

A highway is constructed to support the wheel loads that may roll on it in future.

Pavement should possess strength to bear the stress imposed on it by moving traffic.

Its thickness should be such that it can easily distribute the stresses to subsequent layers. Pavement should have the following characteristics: -

- It should be structurally sound to withstand the load imposed on it.
- It should be dust proof for traffic safety.
- Should have smooth riding surface so that it provides comfort to the road users travelling at high speeds.
- Wearing surface should hard.
- The pavement should develop minimum friction with tyres.
- The surface texture should be adequate for avoiding skid.
- The geometric design should be appropriate for avoiding slip.
- Life cycle cost of pavement should be as low as possible.
- The Pavement surface should be impervious that water cannot penetrate into lower layers of the pavement.

The pavement design is the most development process in an economical mix of pavement layers (in the relation for thickness and types of pavement materials) to fit the soil foundation and cumulative movement to be undertaken during the design life. The Pavement structure design is different from design of buildings and bridges. The pavement design till today is based on empirical and semi empirical approach and there is no rotational method of design. Pavement design mainly consist of two parts :- (1) design of the material mixture. (2) Design of pavement structure (design of thickness and of different component layers). The main factors that are

considered in pavement design are traffic, road geometry, and position, climate, soil and drainage. Road maintenance is one of the important component of the whole road design. Even if the highways are well designed and built, may require maintenance, the extent of which will depend on several factors including the pavement types..

The failure of flexible pavement is defined by the formation of pot holes, ruts, cracks, settlements, local depressions, etc. depression is usually followed with localized and shelves in the vicinity. The failure of any pavement structure can develops waves and corrugations in the pavement surface and longitudinal ruts and shoving. When it is excessive the pavement unevenness may itself be considered as a failure. The subject of pavement distress or failure is considered to be the complexity of several factors contributing to their degradation and failure. Aging and oxidation of bitumen films leads to the deterioration of the flexible pavement. The harmful actions at the pavement are rapidly increasing when excess water is retained on vacuum spaces of the pavement.

Brand new pavement at the beginning of it's design life is expected to be one without any undesirable features or distresses. The more distress the shorter will be the life of pavement. At some point suffering is so large in intensity (eg, 75% of the steering wheel path area in the project area has cracks) that the pavement are conserved "failed" or at the end of their design life.

90% of Indian states (including Punjab) are constructed with flexible pavement (blacktopping).

1.2 STUDY AREA

1.2.1 Location:

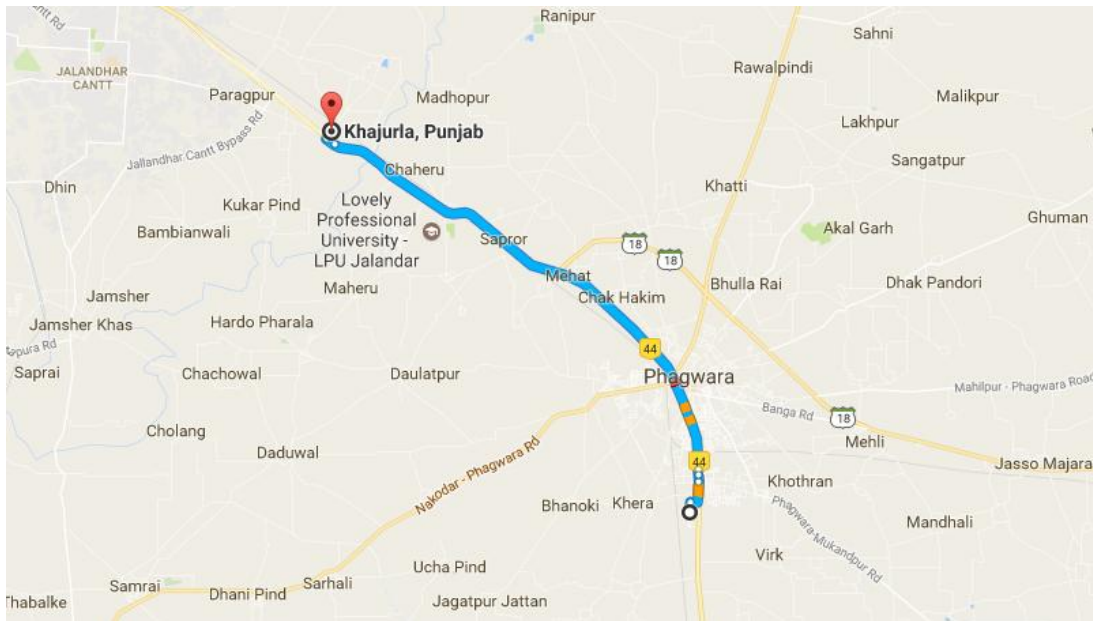


Fig.1: Map of stretch road, NH-1, Phagwara.

1.3 Types of failures in Flexible pavement:

There are mainly four major categories of distresses in flexible pavement they are:

1. Cracking.
2. Surface Deformation.
3. Disintegration (potholes, etc.).
4. Surface Defects (bleeding, etc.).

A. Cracking: The types of cracking are:

1. Fatigue cracking
2. Longitudinal cracking
3. Transverse cracking
4. Block cracking
5. Slippage cracking
6. Edge cracking

1. Fatigue cracking:

Fatigue cracking is also called Alligator cracking. These are the series of interconnected cracks creating small, irregular shaped pieces of pavement. It is caused due to repeated traffic load (fatigue). The cracks leads to disintegration of the surface and results is the potholes. Fatigue cracking is usually associated with base or drainage problems.

2. Longitudinal cracking:

Longitudinal cracking are long cracks that run parallel to the roadway. These are caused by frost heaving or joint failures or may be load induced. Multiple parallel cracks may eventually form from the initial cracks known as deterioration that is usually a sign that crack repairs are not the problems.

3. Transverse cracking:

Tranverse cracking are the cracks perpendicular to the pavement centerline or layout. They usually begin as hair cracks lines or very narrow and widen with age. If the asphalt cement is too hard thermal issues can lead to low temperature cracking.

4. Block cracking:

Block cracking are the inter connected series of of cracks that divide the pavement up into rectangular blocks. Sometimes this is the results of longitudinal cracks and transverse cracks intersecting. The may also happen due to lack of compaction during construction.

5. Slippage cracking:

Slippage is half-moon shaped cracks generally having two ends pointing into the oncoming vehicles. These are the result of poor bonding between the required removal of the slipped area and repaving and are created by the horizontal forces from traffic.

6. Edge cracking:

Edge cracking starts as crescent shapes at the edges of the pavement. They expand from the edge until they begin to resemble fatigue cracking and also results from lack of support of the shoulder. When subsurface water causes a weakness in the pavement, they occur in a curbed section.

B. Surface Deformation:

The types of surface deformation are:

1. Rutting
2. Corrugations
3. Shoving
4. Depressions

1. Rutting:

Rutting is the surface depression in the wheel path. Severe rutting will hold water in the rut and width of the rut is a sign of which layer has failed. A narrow rut is a surface failure but wide ones are the sub grade failure. The cause for rutting is inadequate compaction.

2. Corrugation:

Corrugation is a form of plastic movement typically ripples or shoving across the pavement surface. Corrugation occur usually at the places where vehicles accelerate or decelerate.

3. Shoving:

Shoving is the longitudinal displacement of the localized area of the pavement surface. It is located at hill or curved or at intersections.

4. Depression:

Depression are the small, bowl shaped localized pavement surfaces area with slightly lower elevations than the surrounding pavement. They are caused by localized consolidation of the supporting layers and causes hazard to motorist, roughness of the road and allow water to collect.

C. Disintegration:

The types of disintegration are:

1. Potholes
2. Reveling
3. Stripping

1. Potholes:

Potholes are the small, bowl shaped depressions in the pavement surface that penetrate all the way through the HMA layer down to the base course.

2. Reveling:

Reveling is the progressive disintegration of an HMA layer from the surface downward resulting to the dislodgement of aggregate particles.

3. Stripping:

Stripping are the loss of bond between the aggregates and asphalt binder that begins at the bottom of the HMA layer and progress upward.

D. Surface Defects:

1. Bleeding
2. pumping

1. Bleeding:

Bleeding are the water bleeding occurs when water seep out of joints or cracks or through an excessively porous HMA layers.

2. Pumping:

Pumping are the cause of water and fine materials when ejected from under laying layer through cracks in the HMA layer in the moving loads. It may occur due to poor drainage.

India is the second largest network in the world as it has a road network of over 4,689,842 km. Density of India's road network is similar to that of the United States (0.65) and higher than that of China (0.16) or Brazil (0.20) ie. 0.66 km of roads per square kilometer of land. By road department 2015, India had completed and placed in use over 21,300 kms of recently built 4-lane or 6-lane highways connecting many commercial, cultural centers and major manufacturing centers. As per 2009 estimation, India need to invest US \$1.7 trillion on infrastructure projects before 2020 to meet its economic needs.

Expressways make up of India's road network is approximately 1,208 km (751 mi). like Yamuna Expressway 165 kilometer is the India's longest 6-laned controlled access opened reduce the time travel between Greater Noida and Agra from 4 hours to just 100 minutes.

National highways and state high ways plays the major role as it connect the state capital, tourist center, two cities in a state, main ports, etc.

March 2014, India had completed placed in following new built highways:-

- 5,839 km of its 4-lane Golden Quadrilateral highways.
- 6,011 km of its 4-lane north-south and east-west corridor highways.
- 353 km of 4-lane port connecting highways.
- 4533 km of 4-lane inter capital highways.
- 961 km of 4-lane bypass and other national highways.

1.4 ROAD NETWORK OF PUNJAB

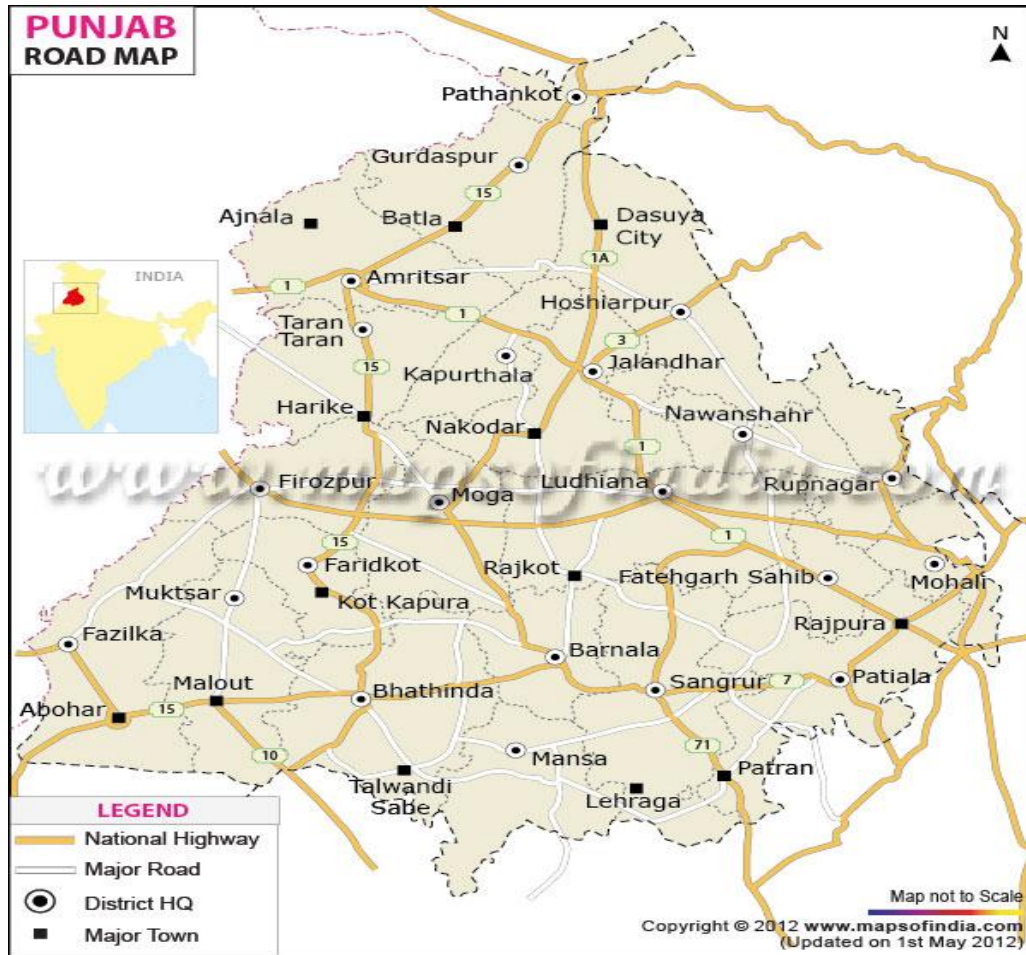


Fig.2: Punjab Road Map

1.5 NATIONAL HIGHWAYS:

Almost 1739 kilometers of National highway is passing from the state of Punjab and 405 kilometers of National highway have been upgraded to 4-lane under National Highway Development Program (NHDP).

1.6 STATE HIGHWAYS:

There is 1462 kilometers of state highways in the extensive network of 7373 kilometers of plan roads in the state of Punjab.

1.7 Road Accidents In Punjab

Punjab has one of the most accident rate and has the most fatal rate in India. The severity o accident deaths per 100 mishaps in the state increasing in past four years ie. From 2009 to 2012 was 65% to 76%.

The total number of road accidents in India was 1,38,258 in the year 2012, out of which 9.1% occurred on Punjab roads.

1.8 OBJECTIVES OF THE STUDY

The main objectives of the present study was to carry out a survey on pavement distresses and accident analysis on the stretch road of NH-1, Phagwara city, Punjab, India.

The objectives of the present study are listed below:

- To identify the different locations of pavement failures in the highway.
- To study the frequency of pavement distresses in the highway.
- To study the various possible causes of distresses and suggesting remedies and solutions for these distresses.
- To assess the performance of the Highway.
- To identify the accident prone locations and the causes of accident.
- To study the accident analysis by collecting data from police stations.

1.9 SCOPE OF THE STUDY

The site observation of flexible pavement failure indicates frequent occurrence of longitudinal cracking from the top surface layer. The study of Flexible pavement distresses and accident analysis is very advantageous for the engineers because of the following reasons:

1. It gives us the most accurate reason for the pavement failure making the repairing work easier.
2. It gives the knowledge about the pavement distress making us able to make more efficient and high performance pavement.
3. High performance of pavement ensures efficient traffic flow and safety to the road users and public.
4. The study of pavement failures in the area helps in improving in design of the pavement.
5. From accident data we get information of the detail of accident the date, time and person involved in accident, location, detail of vehicle involved, nature of accident, causes of accident, accident cost ,and road and traffic condition.
6. The study of road accident data we can improve design of road which is lacking and we can improve the traffic and other conditions of the road.

CHAPTER- 2

LITERATURE REVIEW

2.1 PAST STUDIES

Markwick and Starks (1941) measure the pressure between tires of lightweight truck and pavement. Inflation pressure was 0.28-0.35 mba (40 to 50) Jesse). The researchers concluded that normal local contact normal pressure caused by air tires was almost 1.5 times higher than inflation pressure. The pressure seems to be independent of the speed of the truck. The shear stress was directed to the inside. Under solid tire, the Shear stresses were directed to the outside .

Seitz and Housman (1971) experimented Studies on passenger car frame radial ply without profile. The authors noted the internal shear stresses along the contact. The authors concluded that these pressures are due to wall bending (antenna effect), that Rubber pressure tread (poison's effect) only reduces the size of contact shear stress due to bending but not their direction.

Lippmann (1985) measured the distribution of pressure between the tread of the passenger radial-ply tire and pavement. The author noted that tire bulging results in inward shear stress at the edge of the tire.

Gerritsen et al. (1987) Field study in The Netherlands is on the verge of cracking in Asphalt pavement, and potential surface causes Cracking. Static indirect tensile tests were performed on basic samples collection. They showed that asphalt concrete outside the wheel paths tend to be low Characteristics of the force at low temperatures.

Dauzats and Rampal (1987) surveyed on several pavement sections in the south of France. In this area, the pavements are subjected to severe thermal pressure. After construction of the road containing a slow lane and a fast lane the longitudinal surface cracks were observed after 3 or 5 yrs in these sections. Longitudinal sections are located in the midline side of the slow lane and it was also observed that the appearance of cracks fluctuated with the seasons.

Sebaaly and Tabatabaie (1989): they tested radial-ply, bias-ply and wide base radial-ply single tires by using different levels of inflation pressure of 0.52 to 0.76 MPa. The researcher observed that the contact pressure distributions were non-uniform, with maximum contact pressure of 1.75 times the inflation pressure. The minimum contact pressures were obtained along the tread and maximum contact pressures were obtained along the center tread for all three tires.

Huhtala et al. (1989): Measured contact pressure for two twin tires and three twin tires. The varied tire pressure was from 0.48 MPa to 1.08 MPa. For the passenger car tires the contact pressures reached maximum at the edge, for truck tires the contact pressures attained a maximum at the tire's center.

Matsuno and Nishizawa (1992) : they examined longitudinal surface cracking in asphalt road pavement in Japan. The manual observation is that the cracking appeared 1 to 5 years after the road's construction typically occurred in the passing lane. It was also recorded that the cracking was within the wheel paths and the cracks did not appear in shadowed areas such as near an overpass bridge.

Matsuno and Nishizawa (1992): examined the axisymmetric elastic finite element analysis with uniform normal contact stress which represent the entire tire contact pressure. From the analysis by keeping the Poisson's ratio of 0.35 at constant, the authors found that the strains under the tire are mainly compressive in the vertical direction and high lateral strains at the tire edge were sufficient to cause cracking.

Perdomo and Nokes (1993): they examine the response of a flexible pavement system due to different loading by using the computer program CIRCLY. The loading considered are of two types that are non-uniform normal tractions only and non-uniform normal tractions accompanied by non-uniform inward shear tractions. The researchers concluded that the maximum tensile strains occur on the surface of the pavement at the edges of the tires when inward shear tractions were considered in the analysis.

Jacobs (1995) : the author analyzed the stresses in a pavement structure that have three layers with constant thickness for each layer , same elastic modulus for base and subgrade layers, one Poisson's ratio for all layers, and three different elastic moduli for the AC layer.the author concluded that by the tangential stress on the surface the normal stresses at the bottom of the asphalt concrete layer were not affected.at the edge of the loaded area the tensile stresses can be much higher than the tensile stresses at the bottom of the asphalt concrete layer.

Collop And Cebon (1995): by using different analytical and numerical solution they examined the potential of longitudinal surface fatigue cracking in asphalt pavements. The authors concluded from 2D plane strains elastic half space solution that there is a singularity in surface stresses at both the ends of the contact when assumed a discontinuity in shear tractions and that shear tractions between the pavement and the tires induce high local tension to the surface longitudinal Cracks that is propagate by transverse cracking.

Kjersti Granas Bardal and Finn Jorgensen (2017): they researched on the valuing the risk and social cost of road traffic accidents, seasonal variation and the significance of delay costs. They used convenient risk model and a time loss model for delay the risk, severity and social costs of traffic accident in a rural, arctic context. They compares summer and winter accidents for private and heavy vehicles and risk of minor accidents was highest in winter in particular for the heavy vehicles. Delay cost were higher than materials cost and constituted 10% of total social costs. They suggested extensions of the current cost benefits analysis to include delay costs.

Athanasios Theofilatos (2017): performed on incorporating real time traffic and weather data to explore road accident likelihood and severity in urban arterials. The study investigates regarding accident likelihood, the Bayesian logistic regression shows that variations in traffic significantly influence accident occurrence. Real time traffic and weather data are utilized and no significance effect of weather parameters was found to exist. ES

Viktor Korchagin, Sergej Ljapin (2017): they discovered that efficiency of socio-natural economy system (SNES) depends on number of road accidents, road accident features, duration and quality of rehabilitation of SNES component affected by the road accident. They give the need to unite services and entities taking part in road accident consequences eliminating into Road Accident Consequences Elimination Subsystem (RACE) which give the opportunities to decrease number of accidents associated with road transport, minimize damage inflicted by road accident, decrease risk of any kind for the entire SNES.

CHAPTER 3

METHODOLOGY AND INVESTIGATION

National Highway one (NH-1) is one of the oldest highway and the most prominent National Highway of India. It links New Delhi and ends in the town of Atari in Punjab, Pakistan. It was the part of famous Grand Trunk Road in the Medieval times built by Sher Shah Suri.

The highway passes through Amritsar , jalandhar, Phagwara, Ludhiana, Rajpura, Ambaa, Kurukshetra, Karnal, Panipat, Sonipat, kundli, finally reaches Delhi. The highway is 456 km long, and it is the shortest route between Delhi and Lahore via Wagah Border. The route from Amritsar to Jalandhar is 4-lane and the route from Jalandhar to Delhi is 6-lane. In Delhi it is 8-lane road and it is called The Ring Road.

Visual investigation of various pavement distresses found in NH-1 in Phagwara was carried out. Length, size and the depth of pavement distresses found in the highway were measured. The Total study of the road was also carried out on the road accidents in Phagwara. The survey was also done on transportation system, the traffic system, finding the black spot in Phagwara city. Some Previous years Accident Data were also collected from police station because all cases regarding road accidents are tackled by the police and the records are maintained.



Fig. 2: Slippage cracks near Royal Pesort.



Fig. 3: Water on the existing road.



Fig.4: pothole with cracks on road near Chaheru.



Fig.5: No drainage system.

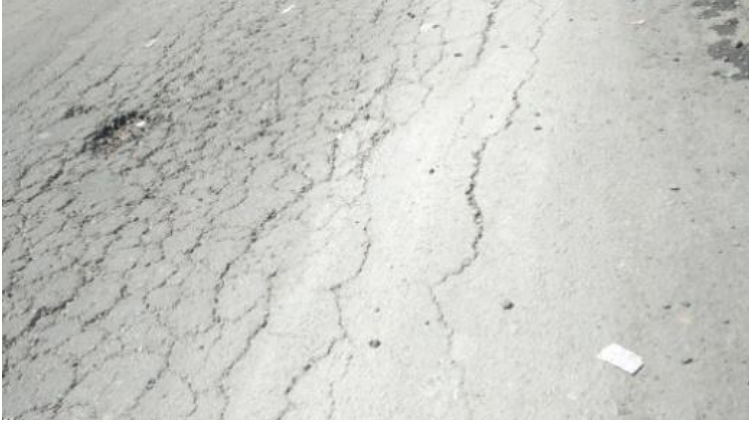


Fig.6 :Cracks and bleeding on the road near GTC Meal area. Fig.7: Edge cracking near bus stand



Fig.8: Patches and Alligator cracks near Hanuman Mandir Fig.9: Edge cracks on light wala chowk.



Fig.10: Pumping and cracks near Mouli



Fig.11: appearing edge cracking



Fig.12: Patch near rail bypass



Fig.13: Patches near Chachoki.



Fig.14: Patches and revealing near LPU.



Fig.15: longitudinal cracking at chaheru.



Fig.16: Rutting and cracks at Kajurla (near Havelli).



Fig.17: Edge cracking at Phagwara (near sugar mill)



Fig.18: Patching of road near civil hospital. pavement.



Fig.19: Polished Aggregate of Existing



Fig.20: Failures on the over bridge at kashi Nagar chandighar bypass.



Fig.21: Alligator Cracking near DAV College



Fig.22: Existing pavement of Alligator and Depression near Cabana resort



Fig.23:Patches near Cabana.

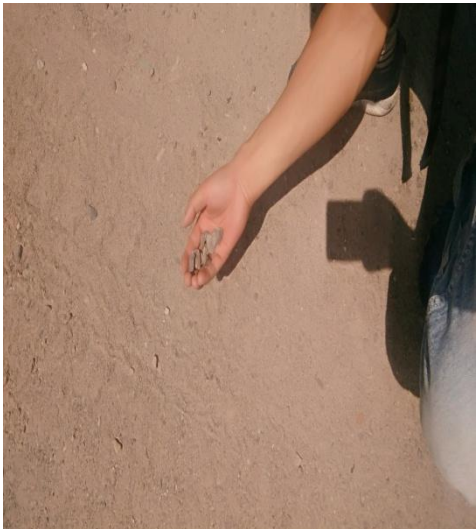


Fig.24: reveling



Fig.25: Potholes and alligator cracks near Haddi meal. Fig.26: a big patch near Saprur.



Fig.27: Alligator cracking at KASHI Nagar

Fig.28: Alligator cracks at the existing pavement at Khashi Nagar



Fig.29: Potholes near Chak Hakim



Fig.30: Block Cracking near Chak Hakim



Fig.31: Slippage Cracking Civil Hospital stand



Fig.32: Block Cracking near Phagwara bus



Fig.33: Alligator cracking near Virk Village



Fig.34: Alligator Crracking near Mouli Village.



Fig.35: Alligator cracking and Depression at near Chachoki. Fig.36: Depression at Chauckoki Village.

3.1 TRANSPORT SYSTEMS IN PHAGWARA

3.1.1 Growth of Vehicles

The vehicular population growth in Phagwara is very large, with just 4384 registered motor vehicles in 1981 to 2,94,164 in 2010, an increase of 67 fold in a time of just two decades. But it is interesting to know that growth of vehicles had slowed down substantially during the 1900's to 2000's. In Phagwara Vehicular population grew at an average annual rate of around 6% but if we calculate it from 1982 to 2001, annual growth rate goes to 23%. The personalized vehicular population has increased by more than 75 fold from 1981 to 2010. The trend in passengers vehicles ownership shows a gradual shift from slow mode to fast modes. The growth of two wheelers and cars has been much higher than the growth of population as well as vehicles. It is worth noting that rickshaw cycle and bicycle still remain an important mode of transportation which shows dominance of low capacity operating in the city.

3.1.2 Types of Accidents:

From the year 2009 to 2013 total number of accident has decreased from 281 to 241 because of non-fatal accidents. During 2009 there were 202 non fatal accidents that went down to 133 during the year 2013, a reduction of around 34%. Although there is reduction in non fatal accidents and in total number of accidents, fatal accidents have been unchecked so far. In Quantitative terms total number of accidents have increased by 37% in a time span of just 5 years.

Table no. 1: The table shows the accident scenario of Phagwara.

Year	Fatal	Serious	Minor	Total accidents
2009	79	92	110	281
2010	97	84	117	298
2011	88	83	58	229
2012	107	81	86	274
2013	108	59	74	241

3.2 TIME OF ACCIDENTS

The percentage of accident occurred are identified during day time and night time. It is found that the average accident during day time is around 70% as comparison to 30% during night time.

3.3 ACCIDENT SPOTS IN PHAGWARA CITY

On the basis of the intensity and frequency of accident Phagwara traffic police have identified a few accidents prone locations in the city and found that Traffic Light Chowk near Wahid sugar mill was the most accident prone location. Most of the goods vehicles operate new bypass road on NH-1 and there is enrichment on both sides of the road. As a result most accident occurred on the road is crossing path of the road. The other reason for accident is the sugar mill where heavy vehicles that are used for transporting materials.

3.3.1 Accidental black spot:

By doing manual survey and collecting data from police station black spot is got where maximum numbers of accidents occurred. My black spot on NH-1 in Phagwara city is “Traffic Light Chowk” near wahid sugar mill. The Location of spot is one kilometer east from Phagwara bus station.

3.4 SEVERNITY OF ACCIDENT AT BLACK SPOT :

Got Accident data carried out from Phagwara police station of yaer 2009 to 2013 there are 52 numbers of fatal accidents, 69 numbers of major accidents and 53 numbers of minor accident as shown in the table.

Table no. 2: Accident data of Phagwara from year 2009 to 2013.

Year	Fatal	Major	Minor	Total
2009	9	22	9	40
2010	12	12	11	35
2011	9	14	12	35
2012	10	12	9	31
2013	9	11	12	32
Total	49	71	53	173

3.5 SPOT SPEED SURVEY

Spot speed survey was carried out from LPU to Light wala chowk in five different location :

1. Chaheru bridge.
2. Haddi over bridge.
3. Khashinagar.
4. Civil Hospital.
5. Traffic light chowk.



Fig.37: Chandigarh bypass



Fig.37: Light Wala Chowk



Fig.38: Haddi over bridge



Fig.39: Chaheru bridge

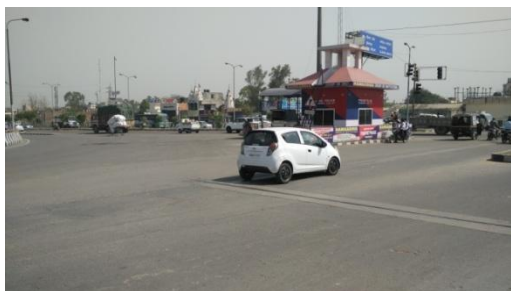


Fig. 40: Traffic light chowk.

Table no. 3: Spot speed survey.

Sr. No.	Location	2w	3w/auto rickshaw	4w(kmph)	Bus/truck	LCV(kmph)
1	Chaheru pull	42	38	52	41	37
2	Haddi meal	41	37	49	32	38
3	Kashinagar	47	38	60	56	37
4	Civil Hospital	45	42	50	37	40
5	Traffic Light Chowk	59	47	62	46	58

3.6 ANALYSIS OF COLLECTED DATA (CASE STUDY):-

3.6.1 ACCIDENT DATA COLLECTION:

In accident study the accident data collection is the first step. The data collection of the accident are primarily done by the police. Secondary data are the motorist accident record which are done by the motorist themselves. The data to be collected should have all the parameters –

- A. General :- date, time, classification of accidents like fatal, major, minor. Person involved in accident, etc.
- B. Location :- detail and description of location of accident.
- C. Vehicle details :- registration number, description of vehicle, loading detail, vehicular defects, etc.
- D. Nature of Accident :- details of collision, damages, injuries and casualty.
- E. Road and condition of traffic :- details of road geometry, surface characteristics, types of traffic, traffic density, etc.
- F. Accident cost :- financial losses incurred due to personal injuries, property damages and casualty.

CASE 1:

1. General:

- a) Date of accident: 26/01/2014
- b) Time of accident: 02:15 pm
- c) Person involved in accident: Ashok Kumar Arora s/o Kisan Lal
- d) Classification of accidents : Minor

2. Location: Detail of location of accident: Traffic light chowk (Near Wahid sugar mill), Phagwara.

3. Detail of vehicle involved:

- a) Car (reg no: HR-71A-3622), PRTC Bus (reg no: PB-11AN-9195).
- b) Condition of vehicle was normal.

4. Nature of accident:

- a) Details of collision : Head to back collision, Bus and collide to car, in overtaking.
- b) Casualty of both vehicles were normal.

5. Primary causes of accident: Speed of bus is beyond limit (>60 kmph on NH to overtake the car).

6. Accident cost:

- a) Losses of car: Bursting of tire, car engine came out due to impact transferred by bus after collision, rim break, cracking of front glasses.
- b) Losses of Bus: Bonnet of bus came out of its position.

7. Road and Traffic condition: Geometric condition of road is good, surface characteristics of road surface are in proper condition, adequate. We can observe the road surface condition by following picture of the site.

FIRST INFORMATION REPORT
(Under Section 154 Cr.P.C.)

CIPA-R1.11 00

1. District: KAPURTHALA P.S: BHAGWARA CITY Year: 2014 FIR No.: 8 Date: 26-01-2014

2. Act(s): Section(s):
(i) IPC 1860 279/427
(ii)
(iii)
(iv)

3. Occurrence of Offence:
(a) Day: Sunday Date From: 26-01-2014 Date To: 26-01-2014
Time Period: Time From: 14:15 hrs Time To: 14:15 hrs
(b) Information received at P.S: Date: 26-01-2014 Time: 15:45 hrs
(c) General Diary Reference: Entry No.: 20 Time: 15:45 hrs

4. Type of Information: WRITTEN

5. Place of Occurrence:

(a) Direction and Distance from P.S: North/1.5 Km
(b) Address: ਨੇੜੇ ਮੁਹਾਰ ਮਿਲ ਚੌਕ, ਖਜ਼ਾਰਾ / Neoh Sugar chowk (Red light) Beat No.: 07
(c) In case, Outside the limit of the Police Station:
Name of P.S: District:

6. Complainant/Informant:

(a) Name: ਸਰਿੰਦਰ ਸਿੰਘ (S/O) ਸਿਧਨ ਝਰਾ Nationality: INDIA
(b) Birth Year: 1961 Date of issue: Place of issue:
(c) Passport No.
(d) Occupation:

(e) P R/o ਵਾਸੀ ਮਕਾਨ ਨੰਬਰ 1654 ਨਜ਼ਦੀਕ ਸਿਵ ਚੌਕ ਡਾਕਮਸ ਵਾਲੀ ਗਲੀ ਖਲਾਸਪੁਰ ਜਿਲਾ ਜਗੜਾ, BILASPUR, YAMUNA NAGAR, HARYANA
C R/o ਵਾਸੀ ਮਕਾਨ ਨੰਬਰ 1654 ਨਜ਼ਦੀਕ ਸਿਵ ਚੌਕ ਡਾਕਮਸ ਵਾਲੀ ਗਲੀ ਖਲਾਸਪੁਰ ਜਿਲਾ ਜਗੜਾ, BILASPUR, YAMUNA NAGAR, HARYANA

7. Details of Known/Suspect/Unknown accused with full particulars(attach separate sheet if necessary):

(i) ਚਰਿੰਦਰ ਸਿੰਘ (S/O) ਸ਼ੇਕਾਰ: ਸਿੰਘ
P R/o ਵਾਸੀ ਮਿਲੋਰਾ ਬਾਟਾ ਸਮਾਣਾ ਜਿਲਾ ਪਟਿਆਲਾ, SAMANA, PATIALA, PUNJAB
C R/o ਵਾਸੀ ਮਿਲੋਰਾ ਬਾਟਾ ਸਮਾਣਾ ਜਿਲਾ ਪਟਿਆਲਾ, SAMANA, PATIALA, PUNJAB

(ii)

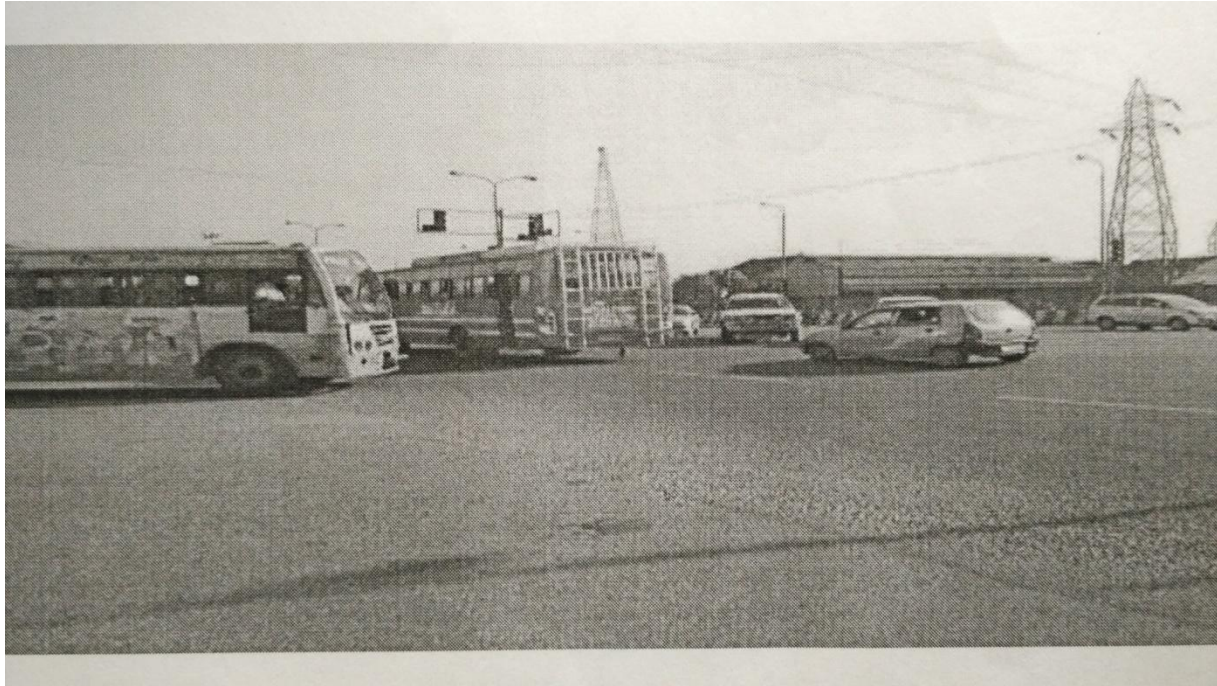
8. Reason for delay in reporting by the complainant/informant: NO DELAY

9. Particulars of the properties stolen/involved(attach separate sheet if necessary):

Sl.No.	Property Type(Description)	Est. Value(₹.)	Status
(i)			
(ii)			
(iii)			

*Attended
Order by S*





CASE 2:

1. General:

- a. Date of Accident : 01/09/2012
- b. Time of Accident : 09:00 am
- c. Person involved in accident : Paramjeet Singh, s/o- Major Singh
- d. Classification of accident : Fatal

2. Location :

- a) Detail of location of accident : Traffic light Chowk 1km north, Phagwara
- b) Detail of vehicle involved :**
 - a) TVS Scooty (reg no : PB-36D-3726), Bus (reg no: PB-08-BC-9729).
 - b) Condition of both the vehicles were normal.

4. Nature of accident :

- a) Detail of collision : Head to back collision
- b) Casualty : Fatal (Death on the spot)

5. Primary cause of accident :

Speed of bus is beyond limit (>70 kmph on NH)

6. Accidental Cost :

Loses of scooty.

7. Road and Traffic condition : Geometric condition of road surface is good, surface characteristics of road surfaces are not in proper condition, inadequate. We can observe the road surface condition by following picture of the site.

FIRST INFORMATION REPORT

(Under Section 154 Cr.P.C.)

CIPA-RL11 B2

1. District: KAPURTHALA P.S.: PHAGWARA CITY Year: 2012 FIR No.: 120 Date: 01-09-2012

2. Ad(x): Section(x):
(i) IPC 1860 304A/337/279/427
(ii)
(iii)
(iv)

3. Occurrence of Offence:
(i) Day: Saturday Date From: 01-09-2012 Date To: 01-09-2012
Time Period: Time From: 09:00 hrs Time To:
(ii) Information received at P.S.: Date: 01-09-2012 Time: 13:05 hrs
(iii) General Diary Reference: Entry No.: 22 Time: 13:05 hrs

4. Type of Information: WRITTEN

5. Place of Occurrence:

(i) Direction and Distance from P.S.: North/1.0 Km. Dist No.: 07
(ii) Address: ਮੁਹਾਰ ਮਿਲ ਵੀਕ ਡੇ ਮੈਡੀ ਮਿਲ, ਚੌਕ/NEAR Traffic light chawk (Wahid sugar mill), Phagwara.
(iii) In case, Outside the limit of the Police Station:
Name of P.S.: District:

6. Complainant/Informant:

(i) Name: ਅਮਰਿੰਦ ਸਿੰਘ (S/O) ਮੇਹਰ ਸਿੰਘ
(ii) Birth Year: Nationality: INDIA
(iii) Passport No.: Date of issue: Place of issue:
(iv) Occupation:
(v) P. No. DO:



C No. ਵਾਹੀ ਮੇਹਰ ਸਿੰਘ ਆਰ ਵਾਹੀ ਮੇਹਰ ਸਿੰਘ, Rawalpindi, KAPURTHALA, PUNJAB

7. Details of Known-Suspect/Unknown accused with full particulars(attach separate sheet if necessary):

(i) ਅਮਰਿੰਦ ਸਿੰਘ Alias ਮੇਹਰ (S/O) ਅਮਰਿੰਦ ਸਿੰਘ
P No. -
C No. ਵਾਹੀ ਮੇਹਰ ਸਿੰਘ ਆਰ ਵਾਹੀ ਮੇਹਰ ਸਿੰਘ, Bhogpur, Jalandhar Rural, PUNJAB
(ii)

8. Reason for delay in reporting by the complainant/informant: NO DELAY

9. Particulars of the properties stolen/involved(attach separate sheet if necessary):

S.No.	Property Type(Description)	Est. Value(Rs.)	Status
(i)			
(ii)			
(iii)			

Signature



Traffic Light Chowk near Wahid Sugar Mill

Case 3:

1. General :

- a) Date of accident : 17/02/2014
- b) Time of Accident : 01 : 15 pm
- c) Person Involved in Accident : Pawan Kumar, s/o- Naresh Sharma
- d) Classification of accident : Fatal (Death)

2. Location : Hargovind nagar, Phagwara

3. Details of vehicle involved :

- a) Car Volkswagen polo, (reg no :PB-36C-2417), TVS Scooty (reg no PB-36-D-3669)
- b) Condition of both the vehicles were normal.

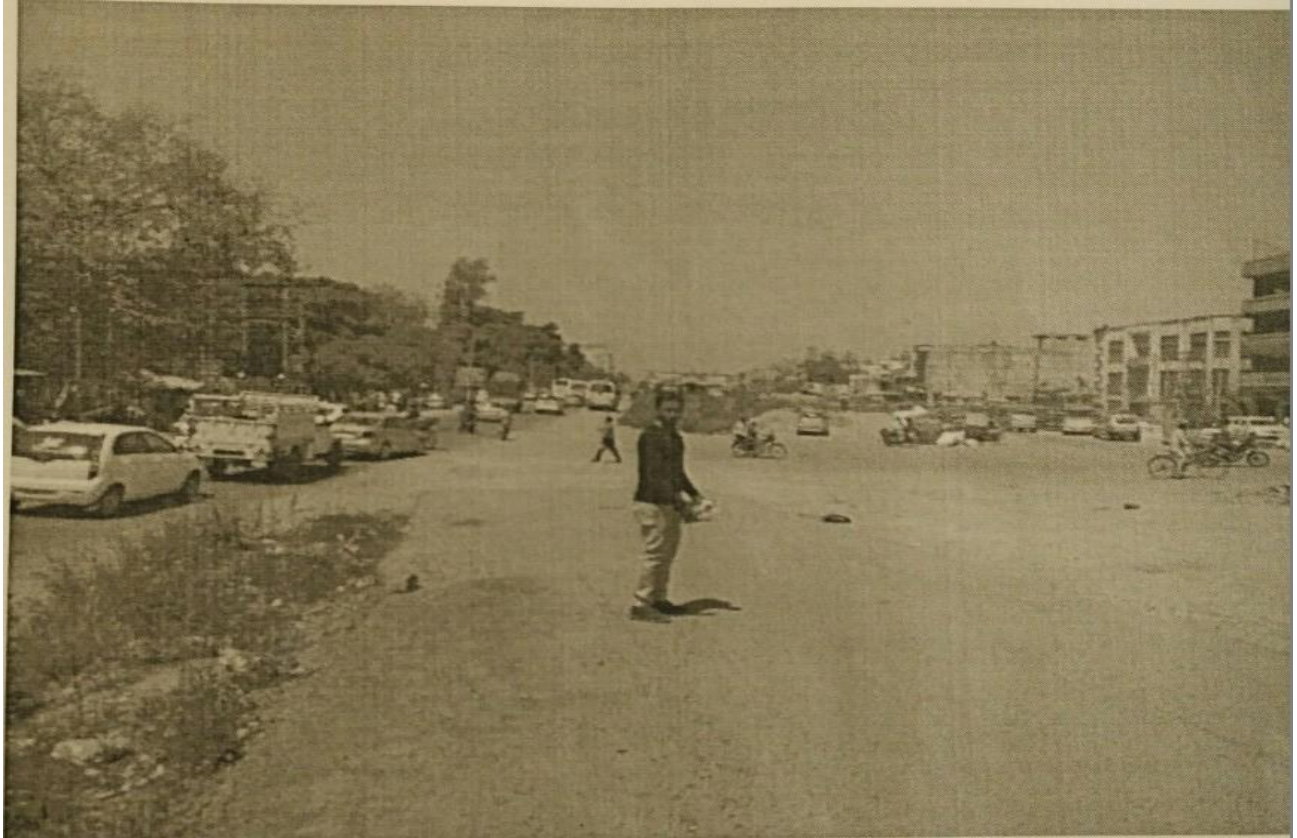
4. Nature of accident :

- a) Detail of collision :Head on Back collision
- b) Casualty : Fatal (Death)

5. Primary Causes of accident : Careless driving, without giving horn,trying to overtake.

6. Accidental cost : Loses of TVS Scooty, head light of car.

7. Road and Traffic condition : Geometric condition of road surface is good, surface characteristics of road surface are not in proper condition, inadequate . We can observe the road surface condition.



This road surfaces has very bad condition so that why there are number of chances of more accidents due to irregularities in road surfaces. This type of irrerugarities can be arising due to heavy rainfall or if chamber is not provided properly for the drainage of water the road surface, Second reason may be that if poor quality material is used during road construction. So these are some reason for destruction of road surfaces.

CPA-R1.11.09

(Under Section 154 Cr.P.C.)

1. District: KAPURTHALA P.S.: PHAGWARA CITY Year: 2014 FIR No.: 17 Date: 17-02-2014

2. Author: Section(s):
To: 279/104A/137
By:
On:

3. Occurrence of Offence:
(A) Day: Monday Date From: 17-02-2014 Date To: 17-02-2014
Time Period: Time From: Time To:
(B) Information received at P.S.: Date: 17-02-2014 Time: 13:15 hrs
(C) General Diary Reference: Entry No.: 16 Time: 13:15 hrs

4. Type of Information: WRITTEN

5. Place of Occurrence:
(A) Direction and Distance from P.S.: North/1.0 Km.
(B) Address: *ਭਗਤਿੰਦਰ ਨਗਰ ਲਾਈਟ ਚੌਕ, ਫਗਵਾਰਾ / Traffic light chowk, Hargobind nagar.* Beat No.: 02
(C) In case, Outside the limit of the Police Station: District:

6. Complainant/Informant:
(A) Name: *ਮੁਕੇਸ਼ ਕੁਮਾਰ ਸਿੰਘ* Nationality: INDIA
(B) Birth Year: Date of issue: Place of issue:
(C) Passport No.:
(D) Occupation:
(E) P. No.:

7. Details of Known Suspect/Unknown accused with full particulars(attach separate sheet if necessary):
(A) UNKNOWN
P. No. :
C. No. :
(B)
(C)

8. Reason for delay in reporting by the complainant/informant: NO DELAY
9. Particulars of the properties stolen/involved(attach separate sheet if necessary):
- No. Property Type(Description) Est. Value(Rs.) Status
(A)
(B)
(C)

CASE 4:

1. General :

- a) Date of accident : 04/01/2014
- b) Time of accident : 09:30 PM
- c) Person involved in accident : Ashok Kumar, s/o –Davinder Kumar
- d) Classification of accident : Minor

2. Location :

Detail of location of accident : Santokpura side G.T road, Phagwara (1.5 km west).

3. Detail of vehicle involved :

- a) TATA ACE (Reg no : PB-08-BP-8492)
- b) Condition of vehicle was normal.

4. Nature of accident :

Detail of collision : Person was crossing the road and the vehicle was fast and gets collided

5. Primary Causes of accident :

Driving over speed

6. Accidental Cost :

No loses of vehicular parts

- 7. Road and Traffic condition :** Geometric condition of road surface is good,surface characteristics of rad surface are not in proper condition, inadequate.

FIRST INFORMATION REPORT
(Under Section 154 Cr.P.C.)

CPA-B1-11 90

1. District: KAPURTHALA P.S.: PHAGWARA CITY Year: 2014 FIR No.: 3 Date: 04-01-2014

2. Act(s):
(a) IPC 148-1 Section(s):
(b) 279/304A
(c)
(d)

3. Occurrence of Offence:
(a) Day: Saturday Date From: 04-01-2014 Date To: 04-01-2014
Time Period: Time From: 09:30 hrs Time To: 09:30 hrs
(b) Information received at P.S.: Date: 04-01-2014 Time: 12:30 hrs
(c) General Diary Reference: Entry No.: 16 Time: 12:30 hrs

4. Type of Information: WRITTEN

5. Place of Occurrence:
(a) Direction and Distance from P.S.: West/1.5 Km. Beat No.: 03
(b) Address: ਸੰਤੋਖਪੁਰਾ ਗੇਟ G.T ROAD, PHAGWARA / *santokhpura, side G.T Road, Phagwara*
(c) In case, Outside the limit of the Police Station: District:

6. Complainant/Informant:
(a) Name: AMBOK KUMAR (S/O) DAVINDER KUMAR
(b) Birth Year: 1984 Nationality: INDIA
(c) Passport No. Date of Issue: Place of Issue:

(d) Occupation:
(e) P No: ਗੁਰੀ ਨੰਬਰ 2, ਚੰਦਰੀ ਨਗਰ PHAGWARA, PHAGWARA CITY, KAPURTHALA, PUNJAB
C No: ਗੁਰੀ ਨੰਬਰ 2, ਚੰਦਰੀ ਨਗਰ PHAGWARA, PHAGWARA CITY, KAPURTHALA, PUNJAB

7. Details of Known/Suspect/Unknown accused with full particulars (attach separate sheet if necessary):
(a) ਮਹਿੰਦਰਾ (S/O) ਸਰਜੀਤ ਸਿੰਘ
P No 4-A - ਮਹਿੰਦਰਾ ਚੰਦਰੀ ਨਗਰ, Jalandhar City, PUNJAB
C No 4-A - ਮਹਿੰਦਰਾ ਚੰਦਰੀ ਨਗਰ, Jalandhar City, PUNJAB
(b)

8. Reason for delay in reporting by the complainant/informant: NO DELAY

9. Particulars of the properties stolen/involved (attach separate sheet if necessary):
Sl.No. Property Type (Description) Est. Value (Rs.) Status
(a)
(b)
(c)



Attested
B. Singh Phagwara

CASE 5:

1. General:

- a) Date of accident : 21/09/2012
- b) Time of accident : 09:30 am
- c) Person involved in accident: Sukhdev Singh, s/o Resham Singh
- d) Classification of accident: Minor

2. Location:

Detail of location of accident : Below the bridge, paper chowk, Banga road, Phagwara.

3. Detail of Vehicle involved:

- a) SUV – (reg no –PB-28-BP-9287).
- b) Condition of vehicle was normal

4. Nature of accident :

- a) Details of collision : Person was crossing the road and gets collided with the vehicle
- b) Casualty : Minor head injury and backbone injury.

5. Primary causes of accident : Driving over speed.

6. Accidental cost: No loses of vehicular part.

7. Road and Traffic Condition: Geometric condition of road surfaces is good, surface characteristics of road surface are in proper condition, adequate. We can observe the road surface condition.

CASE 6:

1. General :

- a) Date of accident :02/06/2012
- b) Time of accident :02:30 pm
- c) Person involved in accident : Vicky Duggal,s/o – Satish Duggal
- d) Classification of accident : minor

2. Location :

Detail of location of accident : paper chowk, G.T Road, Phagwara.

3. Detail of Vehicle involved :

- a) Sedan car (registration no. – PB-36-G-2312), Heavy loaded tanker (registration no. – HR-55K-1456)
- b) Condition of vehicle was normal

4. Nature of accident :

Detail of collision : Back to Back collision Heavy loaded tanker was overtaking the car,back portion of tanker collide with back side of car.

Casualty : No injury.

5. Primary Causes of accident : Driving over speed.

6. Accidental cost : Back portion of car was scratched and back light of car was broken.

7. Road and Traffic Condition: Geometric condition of road surface is good, the road is part of NH1.

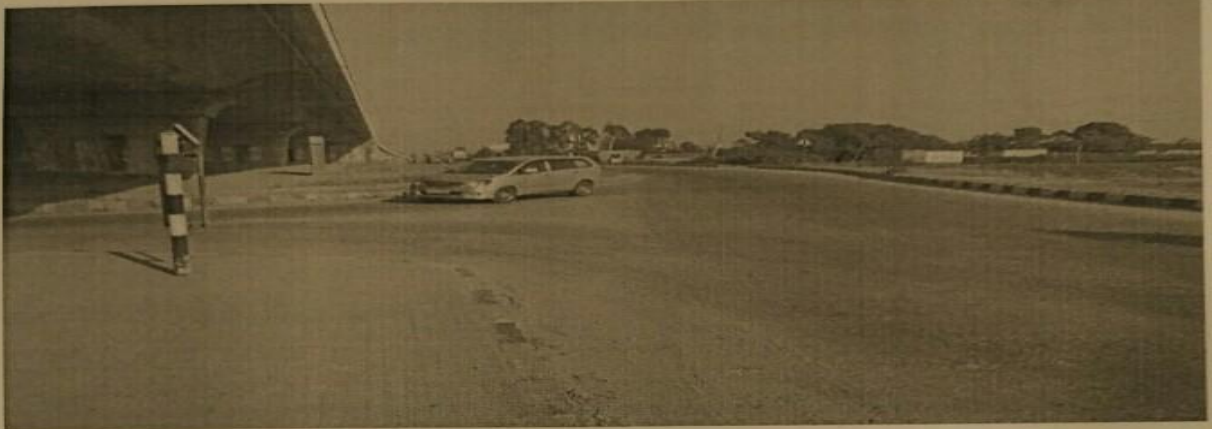


Fig no: 14 below the bridge, Paper chowk, Banga road, G.T.Road, Phagwara.

FIRST INFORMATION REPORT
(Under Section 154 Cr.P.C.)

1. NAME OF POLICE STATION: PHAGWARA CITY
 2. DISTRICT: PHAGWARA
 3. DATE: 27-09-2012
 4. TIME: 12:00 hrs
 5. PLACE OF OCCURRENCE: PHAGWARA CITY, PAPER CHOWK, BANGA ROAD, G.T. ROAD

6. NAME OF REPORTER: [Name illegible]
 7. ADDRESS OF REPORTER: [Address illegible]
 8. OCCASION: [Occasion illegible]
 9. STATE OF OCCURRENCE: [State illegible]
 10. NAME OF OFFENDER: [Name illegible]
 11. ADDRESS OF OFFENDER: [Address illegible]
 12. STATE OF OFFENDER: [State illegible]

13. NAME OF VEHICLE: [Name illegible]
 14. REGISTRATION NO: [No. illegible]
 15. MAKE OF VEHICLE: [Make illegible]

16. NAME OF DRIVER: [Name illegible]
 17. ADDRESS OF DRIVER: [Address illegible]
 18. STATE OF DRIVER: [State illegible]

19. NAME OF WITNESSES: [Name illegible]
 20. ADDRESS OF WITNESSES: [Address illegible]
 21. STATE OF WITNESSES: [State illegible]

22. NAME OF INVESTIGATING OFFICER: [Name illegible]
 23. RANK: [Rank illegible]
 24. SIGNATURE: [Signature illegible]

CASE 7:

1. General :

- a) Date of accident: 27/07/2012
- b) Time of accident: 10:00 am
- c) Person Involved in accident: dev Raj, s/o Buddh Raj
- d) Classification of accident: Major..

2. Location :

Detail of location of accident : Near auto rickshaw stand, G.T Road ,Phagwara.

3. Details of Vehicle involved :

- a) Motorcycle (reg no: PB-36-F-4270), Bus (reg no : PB-10-CZ-5757)
- b) Condition of Vehicle was normal

4. Nature of accident :

- a) Details of collision : Head on Collision
- b) Casualty : Injury in head and leg.

5. Primary Causes of accident : Driving over speed.

6. Accidental cost : Loses of bike.

7. Road and Traffic condition : Geometric condition of road surface is good, surface characteristics of road surface are in proper condition.

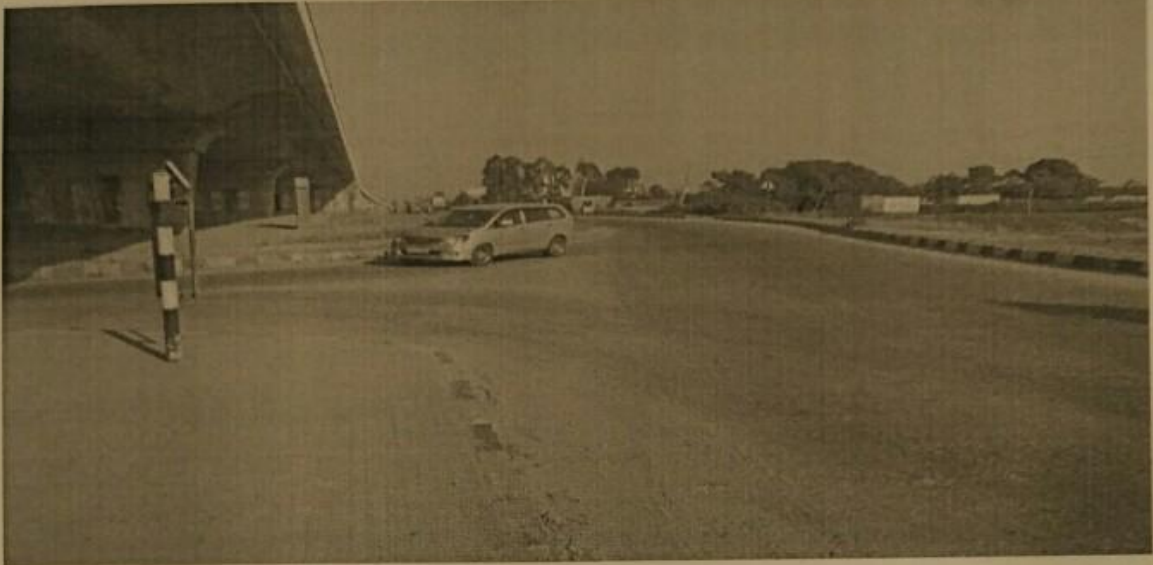


Fig no: 14 below the bridge, Paper chowk, Banga road, G.T.Road, Phagwara.

FIRST INFORMATION REPORT
(Under Section 154 Cr.P.C.)

SI No. 123456 PHAGWARA CITY Year 2012 FORM No. 130 Date 23-09-2012

1. Name of Station: PHAGWARA CITY Station No. 123456

2. Name of Officer: Date Recd. 23-09-2012 Date For 23-09-2012

3. Name of Informant: Time Recd. 09:30 hrs Time For 10:45 hrs

4. Name of Station: Time Recd. 10:45 hrs Time For 10:45 hrs

5. Name of Informant: Name of Station: Station No.:

6. Name of Informant: Name of Station: Station No.:

7. Name of Informant: Name of Station: Station No.:

8. Name of Informant: Name of Station: Station No.:

9. Name of Informant: Name of Station: Station No.:

10. Name of Informant: Name of Station: Station No.:

11. Name of Informant: Name of Station: Station No.:

12. Name of Informant: Name of Station: Station No.:

13. Name of Informant: Name of Station: Station No.:

14. Name of Informant: Name of Station: Station No.:

15. Name of Informant: Name of Station: Station No.:

16. Name of Informant: Name of Station: Station No.:

17. Name of Informant: Name of Station: Station No.:

18. Name of Informant: Name of Station: Station No.:

19. Name of Informant: Name of Station: Station No.:

20. Name of Informant: Name of Station: Station No.:

CHAPTER 4

RESULTS AND DISCUSIONS

Details of distresses found in NH-1, Phagwara starting from Kajurla to Chachoki are tabulated in Table.

Table no. 4: Distresses found in Nh1, Phagwara.

No.	Locations	Found Distresses on the Highway
1.	Kajurla	Rutting and cracks
2.	Royal resort	Slippage cracking, water on the existing road
3.	Chaheru bridge	Longitudinal cracking
4.	Chaheru	Potholes and alligator cracks, Reveling , patch, longitudinal cracking
5.	LPU	Polished aggregates, patch
6.	Haddi meal	Alligator cracking
7.	Sapror	A big patch
8.	Cabana resort	Alligator cracking, patch and depression
9.	CAV College	Alligator cracking
10.	Chandigarh bypass over bridge	Potholes, longitudinal cracks
11.	KashiNagar	Longitudinal cracking, Alligator cracking
12.	Civil hospital	Slippage cracking, patching
13.	Chak Hkim	Potholes
14.	Sugar meal	Edge cracking
15.	Bus stand	Alligator cracking, edge cracking
16.	Hanuman mandir	Patch and alligator cracking
17.	Light wala chowk	Edge cracking, alligator cracking
18.	Virk	Alligator cracking
19.	Mouli	Alligator cracking, pumping, edge cracks
20.	GTC area	Alligator craks and bleeding
21.	Chachoki	Alligator cracking, depression, patch

The most commonly found distresses are Alligator cracking, longitudinal cracking, along with releveling, rutting and edge failures. Poor/absent drainage also caused stripping in some spots causing potholes and edge cracks.

The possible treatment of the surveyed distresses are discussed below:

Table no. 5: possible treatment of the surveyed distresses.

No.	DISTRESSES FOUND	PROBABLE TREATMENTS
1	Fatigue (alligator) cracking	Strengthen the pavement, strengthen the base, base recycling, improve the drainage and reconstruction.
2	Longitudinal cracking	Cut and patch, replace bituminous surfacing, reconstruction of joints.
3	Potholes	Cut and patching, base reconstruction.
4	Edge cracking	Widen the pavement, realignment, shoulder strengthening, proper and efficient drainage.
5	Reveling	Thin bituminous overlay.
6	Block cracking	Crush aggregate overlay, cut and patch, seal cracks.
7	Rutting	Strengthening overlay, replace or recycle bituminous surface, shoulder improvement, reconstruction.
8	Polished aggregate	Thin bituminous overlay.
9	Patching	Mill off and relay upper layers, replace wearing course or thin bituminous overlay, reconstruction of weak layers.
10	Transverse (thermal) cracking	Cut and patching, crack sealing, reconstruction of base, crushed aggregate overlay, reconstruction of joints.

4.1 ANALYSIS OF ACCIDENTS:

Road accident is the most unwanted thing to happen to the road user, though happen quite often.

The main causes of accidents are:

1. Road Users:

Excessive speed driving and rash driving, violation of the traffic rules and regulations, failure to perceive traffic situation or signal or sign in adequate time, carelessness, fatigue, alcohol, sleep, etc.

2. Vehicles:

Defects in vehicles such as failure of brakes, steering system, tire burst, lighting system.

3. Road Condition:

Pavements failures like potholes, rutting, slippages, reviling, stripping, skidding road surface.

4. Road Design:

Defects in geometric design of road such as inadequate sight distance, inadequate width of shoulders, improper traffic light, improper curve design and improper traffic control devices.

5. Environmental Factors:

Unfavorable weather conditions like smoke, mist, snow and heavy rainfall.

6. Other Causes:

Other causes for accident may be improper location of advertisement boards, gate of level crossing not closed when needed etc.

4.2 REMEDIES:

There are some major remedies which should be adopted to control the accidents up to some extent.

4.2.1 Accident Reconstruction:

Accident reconstruction represents the accidents occurred in schematic diagram where the pre-collision speed which helps in enforcing rules to control or check movement of vehicles on road at high speed is determined. Data required to determine pre-collision are:

1. Mass of the vehicles.
2. Velocities after collision.
3. Path of each vehicle as it approaches the collision point.

The Figure below shows the schematic diagram of collision of two vehicles that occur during turning movements. The diagram is known as Collision Diagram. It provides a powerful visual record of accident occurrence over significant period of time.

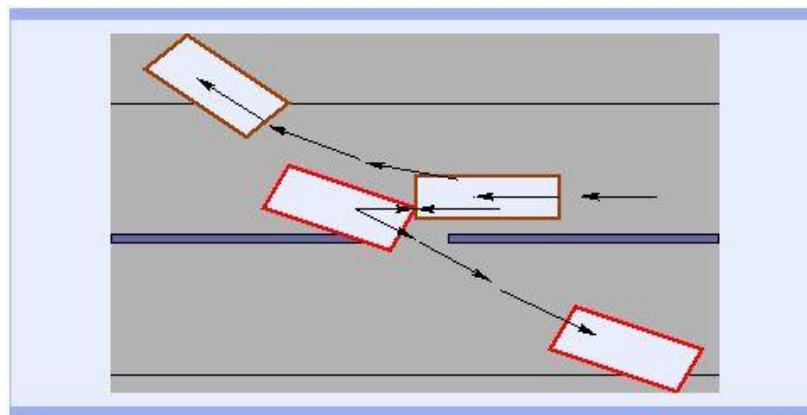


Fig. 41: Schematic diagram of collision.

The Collision may be of two types:

1. Collinear impact.
2. Angular collision.

1. Collinear impact:

It may again divided into two parts:

1. Rear end collision.
2. Head on collision.

2. Angular collision:

Angular collision occurs when two vehicles coming at right angles and they collide with each other. The direction of the vehicles after collision depends on the initial speeds of the two vehicles and their weights.

4.3 SAFETY MEASURES:

Some safety measures are described below:-

1. Safety measures related to Engineering:

There are various safety engineering measures that may prevent accidents are enumerated below:

a. Visual Guidance to driver:

The number of factors that the driver can distinguish and clear fix in his mind is limited and there is consecutive change of picture in driver's mind when he is in motion.

Factors affecting driver's attention can be divided into three groups:

- i. Factors related to the road: traffic signs, change in direction of road, three legged intersection.
- ii. Factor connected with traffic: other vehicles pedestrians, cycles.
- iii. Factors related indirectly to the vehicles motion: vegetations and landscapes, buildings and structures that strikes the eyes.

2. Road Reconstruction:

On road the number of vehicles increases from year to year, which introduces complications in organization of traffic, sharply reduces the operation and transportation characteristic of roads and lead to the growth of accidents rate on the road. So for this reason reconstruction is needed and reconstruction is needed for the places of accidents which is needed to be marked properly to be planned accordingly.

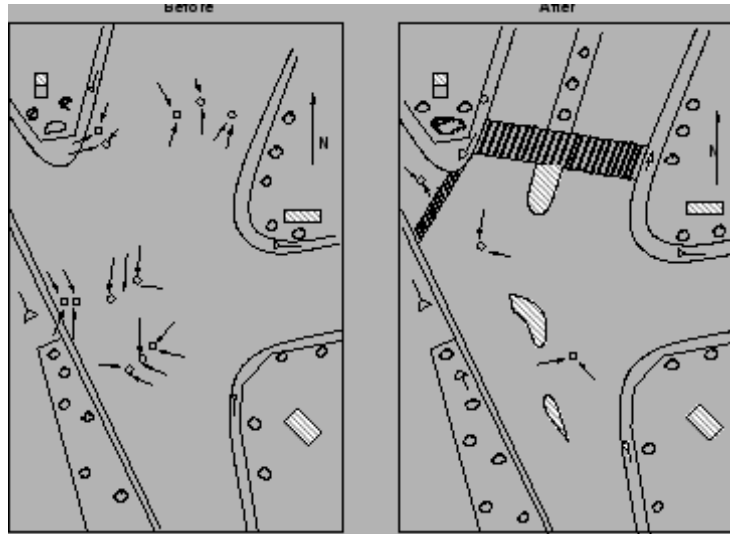


Fig.42: Diagram of road before and after reconstruction.

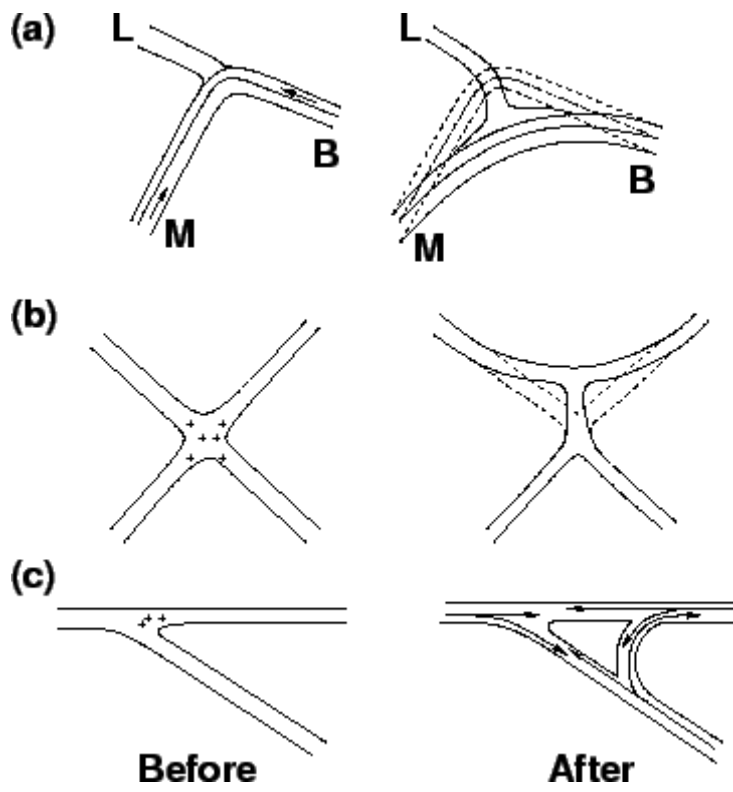


Fig.43: Road reconstruction techniques.

3. Channelization:

The channelization at the intersection separates the traffic stream travelling in different directions. It provides them a separate lane that corresponds to their convenient path and spreading as far as possible the point of conflict between crossing traffic streams. The traffic lanes are separated by marking relevant lines or constructing slightly elevated islands as shown the fig below. Proper channelization reduces confusion allowing driver time to make next decision.

The principles of proper channelization are:

1. They should ensure superiority to the vehicles using road of higher class.
2. The layout of the intersection should clearly visible, simple and understandable by the driver.
3. By visual guidance, islands and markings the layout of intersection makes it necessary for a driver running through it to choose at each moment of the time one not more than two possible direction of travel.
4. The island provided should separate high speed and turning traffic flows.
5. Pedestrian crossing should be provided.
6. The width of the traffic lane should be ensured unhampered turning to the big vehicles. The traffic lane near island is 4.5 to 5 m at entry and exit and the width of straight section without kerb should be 3.5m.

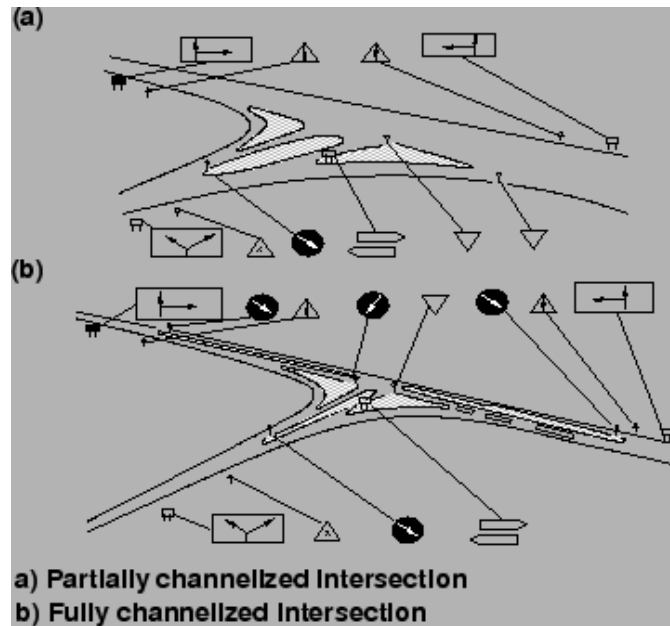


Fig.44: Showing Channelization.

4.4 OTHER METHOD:

The various other methods of traffic accident mitigation are described below:-

1. Street Lightning:

Street lightning of appropriate standard contributes to safety during night time. Installation of good lightning results in 21% of reduction in all accidents, 29% reduction in all casualty accidents, 21% reduction in non pedestrian casualty accidents and 57% reduction in pedestrian casualty accidents.

2. Improvement in Skid Resistance:

If pavement is wet or very smooth the skidding of the vehicles may occur or wet weather crashes may occur. It is important to improve the skid resistance of the road.

3. Constructing Flyovers and Bypass:

In local traffic places where traffic is high bypass are required to separate through traffic from local traffic to decrease the accident rate and to minimize the conflicts at major intersections flyover are required for better safety and less accident rate.

4. Road Markings:

They ensure proper guidance and control to the traffic on a highway and serve as supplementary function of road sign.

5. Regular Accident Studies:

In regular studies of accidents, preventive measures are taken and after that the accident data are again collected to check the efficiency of the measures and for future implementation of further preventive measures.

Safety Measures Related to Enforcement:

The various safety measures of enforcement that prevents accidents spots prone to accidents described below:

1. Speed Control:

Check on spot speed of all vehicles should be done at different locations. Timing and legal action on those who violate the speed limit should be taken.

2. Training and Supervision:

The transport authorizes should be strict while issuing licence to the public service vehicles and the taxis drivers. Only after conducting some driving tests to check whether the driver is fit, the driving licence should issue and driving licence of the driver should be renewed after specified period.

3. Medical Check:

The driver should be tested for vision and reaction time at prescribed interval of time.

4.5 Safety Measures Related to Education:

The various measures of education that can prevent accident are enumerated below:

Education of road users:

The public should be taught the rules of the road, correct manner of crossing etc. by introducing necessary instruction in the schools for the children's, and by exhibiting posters of serious results due to carelessness of road users.

Safety Drive:

Training courses and workshops should be organized for drivers, imposing traffic safety week when the road users are properly directed by the help of traffic police as a means of training the public.

Safety Audit:

It is the procedure of assessment for the safety of the road. It ensures minimization of future accidents. By Wrisberg and Nilsson, 1996 suggested Safety Audit in five stages and they are:

1. Feasibility Stage:

The starting point for the design is determined such as number and types of intersections, relationship of the new scheme to the existing road and relevant design standard.

2. Draft Stage:

The horizontal and vertical alignment and junction layout are determined in this stage. After this decision about the land acquisition is taken.

3. Detailed Design Stage:

In this marking, signs, lightning, and other roadside equipments and landscaping are determined.

4. Pre-opening Stage:

Before opening a new or modified road, road should be driven walked or cycled and should be done at different condition like darkness, bad weather, etc.

5. Monitoring of the Road in use:

At the final stage after the road has been operation for few months assessment is done to determine whether the utilization is obtained as intended or any adjustment to the design are required in the light of the actual behavior of road users.

CHAPTER-5

CONCLUSION

- The side drainage are not maintained, cleaned and even absent in some place of NH-1.
- Longitudinal cracking, potholes, block cracking, are the most failures found on the road.
- All distresses found are not exceeding their limits.
- The most probable required treatment for survey distress are patching, overlay and shoulder improvement.
- Lacking in geometric design like non availability of speed breaker, footpaths, advertisement boards at intersection, no improvements in zebra crossing, non availability of zebra crossing or other parameter like absence of traffic police.
- It is seen by the accident data majority of accident occurred between two wheeler, four wheeler and pedestrian while crossing the road.
- Pedestrian volume are very at light wala chowk cross road and there is no facilities for pedestrians to cross the road so it creates the black spot.
- At light wala chowk there are no footpath so it increases the pedestrians accident.

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