



## Planning a Resilient Road Network for Jalandhar and its Peripheral Areas

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(Received 06 January, 2017 Accepted 29 January, 2017)

(Published by Research Trend, Website: www.researchtrend.net)

**ABSTRACT:** All around the globe there is an urgent need to improve the urban road infrastructure. As the traffic on roads increases with each passing day the need to have a road which has both speed and safety is becoming a need of hour. In order to achieve our goal we must make sure that the highways and roads which we are planning are resilient and smart enough to cater the need of Indian road user.

Road infrastructure is the key pillar for road safety as in India there is a drastic increase in the road accidents due to rapidly increasing traffic volume. The Global Status Report 2013, published by the World Health Organization (WHO), reveals that 1.24 million people were killed worldwide each year in road accidents. India accounts for 0.39 million road fatalities per annum (in year 2012), which is about 30% of the world's total road fatalities.

Road accident cannot be prevented by just putting the “Accident prone area” sign board on roads. They are eliminated by having a detailed and systematic study of each of those vulnerable points. Road Safety Audit is one of those initiatives which our government has taken to make our road journey lot safer and faster.

The present road situation in Punjab is very alarming. Being the border and only state in India having Inland port at Amritsar for trade and commerce the road network is very much over burdened. As Jalandhar is situated in the heart of Punjab we have selected 20km of N.H-1 (Jalandhar-New Delhi) and 15km of N.H-44 (Jalandhar-Jammu) for doing the study and finding out the new ways of making this 35km stretch of road more safer.

### I. INTRODUCTION TO ROAD SAFETY AUDIT

We all have at some instance come across the shows on television where police officers visit a crime scene collecting the all the possible minute pieces of evidence to reveal what happened and why it happened. This is what exactly a Road Safety Audit does. A team of professionals visit a particular stretch of the road to figure out why a particular stretch of road is so prone to accidents. All the road users play a key role in building a RSA in right way

Initially started in 1990's in U.K., The Road safety audit may be defined as a formal inspection of an existing or a road being built or planned or any project that deal with road users, in which a qualified examiner reports on the safety performance of the road. The process is systematic and evidence based. It is typically commissioned by the project sponsor or client. It is performed by a team of auditors having sufficient knowledge regarding the stretch of the road.

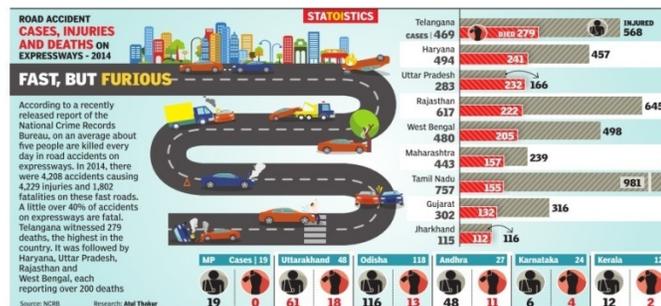


Fig. 1. Road Accident data.

**Road Safety Audits must not be misunderstood with**

- a project redesign
- informal checks or inspections
- a process of selection between alternative projects
- an assessment of the merits of the project
- Road Safety Audits are not only meant for high cost projects.

*A. What is Road Safety Audit?*

In RSA risks and hazards of the particular stretch or intersection are identified and assessed and detailed in a report along with the spotted flaws. This report also includes the countermeasures to attain the ultimate goal of the audit that is safety. In report we come across a number of alternate measures to ensure the same, rest is on the client what he prefers.

*B. Need of Road Safety Audit*

Road Safety Audit is embarked upon in order to apply safety principles, to an existing road or the design of a new road section to prevent future accidents occurring or to demote their severity. The main objective is ensuring safety of the road users. In addition, other specific objectives include: To gain advancement in the management of road design and construction to reduce cost of road schemes exclusively;

- To develop good safety engineering practice.
- To univocally acknowledge the safety needs of road users.
- To improve the design standards for safety

To achieve the above, the road safety audit takes place in the various stages of the project namely: workability, draft design, detailed design, before opening and a few months after opening. The break-through of road safety audit is that it is carried out independent of the design team.

**II. INTRODUCTION TO ROAD SAFETY MEASURES TAKEN IN PUNJAB**

In past 20-30 years, road accident fatalities and injuries are increasing at frightening rate in India including Punjab. The main reasons are booming increase in vehicle population along with lack of matching initiatives for improvements in road infrastructure/environment and application of modern traffic control and management tools to tackle such problems effectively and efficiently. Area of the state is about 50,362 square kilometers and is well connected with land transportation to fulfill state’s domestic demand. Transportation scenarios in state are divided into three parts, intercity connectivity, intra-city connectivity and rural connectivity. Lion’s share of the passenger trip begin and end within the state and only 3-4% of the total traffic is through traffic. Goal of the Punjab Government is to make an integrated and resilient transportation system encouraging Punjab’s social and economic development and enhancing Punjab’s competitiveness in Indian and global markets. All this cannot be achieved without improving the road safety conditions in the state.

**Table 1: Classification of Road Network**

Road Type	Length in State	Fatalities Percentage
National Highway(NH)	1,739 Kms	36%
State Highways (SH)	1,462Kms	46%
Major District Roads(MDRs)	1,670Kms	-----
Other District Roads (ODRs)	4,536Kms	-----
Link Roads (LR) (PWD-27,229 Kms, PMB-26,801 KMs)	42,740Kms	-----
Total	52147Kms	82%

(Source- PWD Punjab Section XVII)

*A. A Punjab State Road Safety Policy 2014 is proposed with its major focus areas on:*

- Horizontal coordination with different ministries and agencies
- Vertical coordination within ministries at national and regional levels.

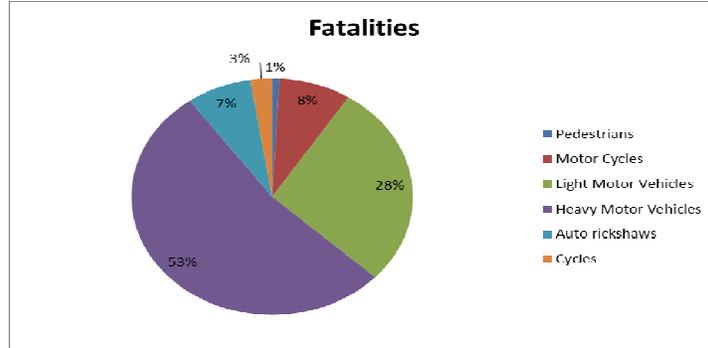
- Legislative framework
- Recognition of importance of Non-Motor Transport
- Resource mobilization and allocation
- Funding mechanisms
- Delivery of interventions
- Mechanisms for achieving results

- Systems for monitoring and evaluation
- Involvement of civil society and professionals
- Research and technical base and database management

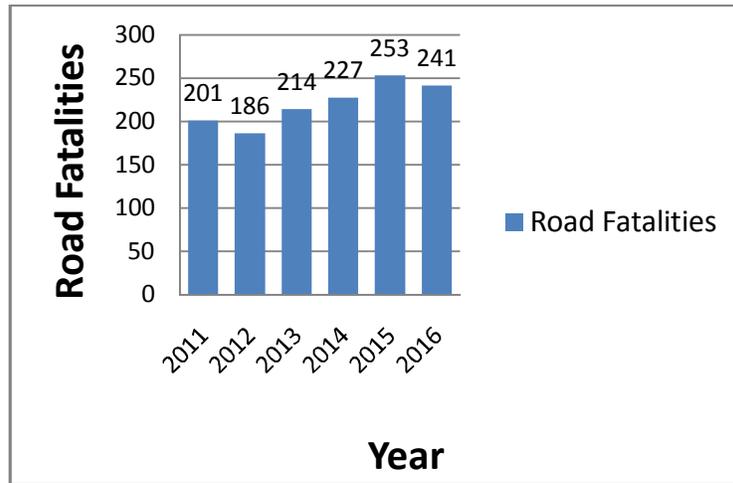
**B. The Impact of High Vehicular Speed on Safety**

An alarming number of people lose their lives in road accidents on this stretch every year. Between January and October 2016, there were a total of 241 road

fatalities. Of the 241 road fatalities reported till October 2016, the most vulnerable road user group was heavy motor vehicles at 128 (53%) fatalities, followed by light motor vehicles at 67 (28%). The remaining partake was made up by 20 (8%) casualties for motor cyclists, 18 (7%) for auto-rickshaw occupants, 6 (3%) for cyclists and 2 (1%) for pedestrians.



**Fig. 2.** Accident statistic.



**Fig. 3.** Accident Statistics (Year 2011-2016).

A significant contributory factor to the high accident rate on Phagwara - DAV University section is motor-vehicular speed, made possible by road infrastructure designed for automobiles to drive very fast. This is coupled with lack of adequate infrastructure for pedestrians and other vulnerable road users, such as crossings, footpaths, dedicated lanes, etc. There is very limited number of pedestrian crossings. Global research and best practices have demonstrated that high motor-vehicular speed is neither desirable nor viable in a modern, vibrant and people-oriented city.

High vehicle speed is only conducive on inter-city highways, where there is minimal cross movement and pedestrian activity. Within urban centers, a much lower design speed is desired, which allows for the safe co-existence of all modes of transport, including non-motorized transport (NMT) and pedestrians. Global research and best practices have demonstrated that high motor-vehicular speed is neither desirable nor viable in a modern, vibrant and people-oriented city. High vehicle speed is only conducive on inter-city highways, where there is minimal cross movement and pedestrian activity.

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For example, by designing for lower vehicular speed on urban roads, the Netherlands reduced road fatalities from a peak of close to 3500 fatalities per year in the 1970s, to about 500 fatalities per year today (Netherlands).

### III. INTRODUCTION TO NATIONAL HIGHWAY 44 AND NATIONAL HIGHWAY 1

#### A. Survey Locations

Three points along the corridor were identified to conduct the survey. These locations were identified after the initial reconnaissance survey. Following are the sections and its assumptions

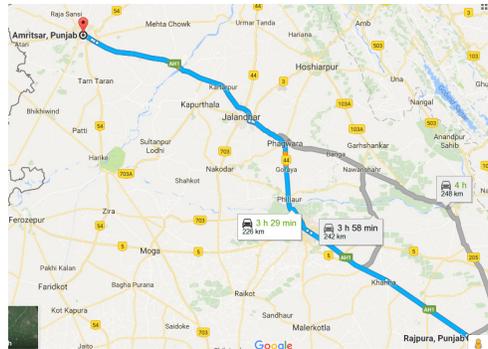


Fig. 4. Rajpura to Amritsar National Highway 1.

National highway 1 also known as the Grand Trunk road which connects Delhi with **Lahore (Pakistan)**. It enters Punjab from Rajpura and travels 250Km in Punjab before entering Pakistan from Atari, the last Indian town. At Jalandhar this bifurcates into National highway No 44 also known as N.H -1A, which connects National highway 1 with Jammu and Srinagar. The N.H-1 is being upgraded into a six lane expressway from past 7 years but due to government apathy and tardy process of the contractor this highway has become

a death trap for road users due to diversions, small bridge and incomplete under passes. To through a light to the accident prone nature of the highway we have under taken a road audit survey of small stretch which can very tell the story of the entire stretch.

**Section L1: D.A.V University (N.H-44) - Pathankot Chowk**

**Section L2: Pathankot Chowk - P.A.P Chowk (N.H-1 and N.H-44 Starting point)**

**Section L3: P.A.P Chowk - Phagwara (N.H-1)**



Fig. 5. Survey Locations.

### B. Data Analysis And Results

All vehicles are converted into a single unit – Passenger Car Unit (PCU), using PCU values mentioned in IRC 106 – 1990: Guidelines for capacity of urban roads in plain areas. Accordingly, peak hour was identified at each location and corresponding peak volume was calculated. An hourly chart showing volumes was also prepared to understand the traffic intensity at each location.

### C. IRC guidelines

The India Roads Congress (IRC) is the oldest and most significant technical body of highway engineers in India. It can be claimed that the development of roads in the country has been majorly influenced by the wise guidelines given by the IRC and has advanced according to the policies articulated by it. IRC came into existence from the Indian Road Development committee (the Jayakar Committee) appointed by the Government of India in November, 1927. This committee recommended the formulation of the road conferences that should be held periodically to discuss questions relating to road construction and maintenance.

IRC has provided guidelines ensuring the road safety in following codes

- IRC 002-1968 :Route Marker Signs for National Highways

- IRC 062-1976 :Guidelines for Control of Access on Highways
- IRC 067-2012 :Code of Practice for Road Signs
- IRC SP 044-1996 :Highway Safety Code
- IRC SP 055-2014 :Guidelines on Traffic Management in Work Zones
- IRC SP 088-2010 :Manual on Road Safety Audit

### C.1 Scenario of road infrastructure from Phagwara on National highway 1 to D.A.V University National highway 44

- Total Length-32.4 km
- Total Intersections- 4
- Total number of Major Road Intersections – 3
- Total Number of Minor Road Intersections - 1
- Total number of Flyovers- 14
- Total number of settlements in between-
- Total number of over and under bridges including rail over bridges- 1
- Total number of road fatalities occurring on the stretch- 241
- Major road accidents in recent year on this stretch- 62
- Number of education institutes on the stretch- 4

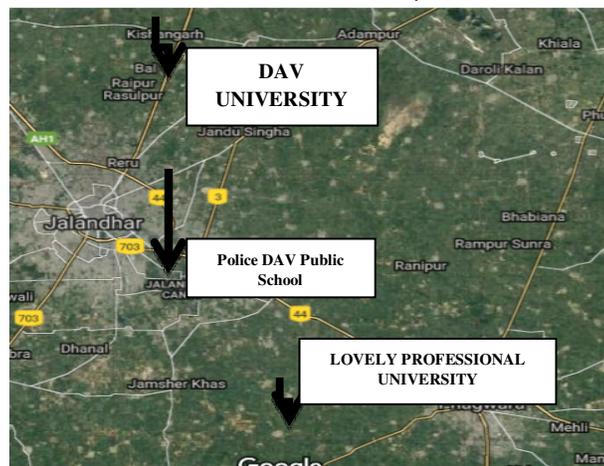


Fig. 6. Educational institutes.

## IV. GENERAL ISSUES AND RECOMMENDATIONS

### A. Major challenges

As the road is the main link between metropolitan cities of Punjab, there is huge rush of passengers car, trucks, buses and army convoys. Some of the main challenges which we have studied in our survey are the following.

### B. Incomplete structure resulting in accidents

Many bridges and under passes lies incomplete even after 7 years of commencement of the project. Due to incomplete structure the road stretch has been made vulnerable to various road accidents.



**Fig. 7.** Incomplete structures at P.A.P Chowk.



**Fig. 8.** Incomplete flyover.



**Fig. 9.** Some of the major road accidents on the road.

### *C. Junction Design*

**Problem:** It is observed that at every junction there is a slip lane for free left turns. There are no safe pedestrian crossings across these slip lanes and no holding area in the triangular islands. This leads to pedestrian vehicle conflicts and potentially unsafe situations. Also, on signalized junctions, no pedestrian phase is included in the signal cycle and there are no pedestrian signals. The junction area is large and medians do not run up-to the junction and this can lead to undefined moments.

**Recommendation:** Junction design needs to incorporate safe pedestrian crossing elements, including pedestrian crossing phase in the signal cycle. Also pedestrian signal should be installed at the junctions to better guide pedestrians. Junctions should be made tighter so that movements are clearly defined and at the approach road a channelizing island must be installed since the vehicles do not move on them as evident by the dust marks.



**Fig. 10.** Pathankot Bypass.

(i) *Fast Movement on Slip Lanes at P.A.P Chowk and Pathankot Chowk*

**Problem:** The slip lanes are generally very long, which allows vehicles to make left turns at high speeds. This is dangerous for pedestrians that need to cross the slip lanes in order to access the junction islands, where they have to wait, in order to cross the road.



**Fig. 11.** P.A.P Chowk.

**Recommendations:** Provide a speed hump just before the crossing for all long slip lanes. Alternatively, provide a raised pedestrian crossing, which also acts like a speed hump, and allows for pedestrians to cross without having to step down and up.



**Fig. 12.** Unplanned slip road.

(ii) *Missing Stretches of Footpath*

**Problem:** In some stretches along the corridor, there are no footpaths. The space designated for the footpath is covered by debris, forcing pedestrians onto the carriageway.

**Recommendation:** Provide a complete and continuous footpath along both sides of the corridor.

A footpath with frequent breaks will tend to not be used by pedestrians and are prone to encroachments. The minimum clear walking width of at least 1.5 meters, (excluding all obstacles such as vendors, street utilities, trees, etc.) must be maintained throughout



**Fig. 13.** Missing Stretches of Footpath.

(iii) Worn out road markings

**Problem:** In many places, road markings have worn out / completely disappeared.

**Recommendation:** Re-paint all road markings, including crossings, stop lines and lane markings.



**Fig. 14.** Unmarked roads.



**Fig. 15.** Unmarked junctions.

(iv) F.O.B at P.A.P Chownk

**Problem:** High number of vehicles at this junction due to major road intersection has resulted in many major

accidents including passengers waiting for buses at road sides.

**Recommendations:** Provide FOBs with direct connections with all major roads.



**Fig. 16.** Proposed FOB at P.A.P Chownk.



**Fig. 17.** Proposed FOB in front of LPU Gate 1.

(v) Broken iron grill on road dividers

**Problem:** Due broken railing on road divider it makes the already tough journey more difficult on this stretch. The railing which were broken due to vehicle collision are not repaired and are not removed from the site which further makes the road more prone to accidents.

**Recommendations:** The railing on the road must be changed with concrete crash barriers or with steel railings which can withstand a direct impact from a truck.



**Fig. 18.** Broken railing on road dividers.



**Fig. 19.** Use of Concrete Barrier.



**Fig. 20.** Use of Steel Barrier.

*(vi) Un-Organized Buses Queuing on the road itself*

**Problem:** Un-organized queuing of buses on the road obstructs the traffic on the stretch and at intersections queuing of buses lead to the traffic jam at slip ways. Due to fast traffic flow at the slip ways of intersections sudden stops of buses in such a traffic flow causes accidents.

**Recommendations:** Bus lay bays should be provided at regular intervals so that traffic is not obstructed by the buses.



**Fig. 21.** Unauthorized parking on National highway.

*(vii) Missing sign at the starting of flyover or under passes*

**Problem-**If vehicles stay on the right side of the road vehicles would have to take a U-turn from the other end of the flyover and this adds up in the distance and wastes

time ultimately. Vehicles may collide to the curbs due to non-availability of signboards.

**Recommendations:** Sign boards should be provided before the curbs between the flyover and service road begins as this will signify the beginning of curbs as well.



**Fig. 22.** Missing Sign Boards.



**Fig. 22.** Well planned road marking.

## V. CONCLUSION

Road Safety Audit (RSA) is the formal safety performance accessing of an existing or future road and it qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. RSA being a new but innovative concept for Indian Highways need to be emphasised to ensure safety of the users at state as well as national highways.

In our study we included Jalandhar and its peripheral areas of National Highway 44 from DAV University to the intersection point on National Highway 1 on Pathankot bypass and stretched till Phagwara city on National Highway 1.

After analysis it was observed that the highway was lacking some major aspects for safety such as missing signs, missing stretches of footpath, worn-out road marking, queuing up of buses, broken iron grills at medians etc. these enlisted were the main parameters for causing accidents. All unauthorized median openings should be closed and adequate provisions for crossing local people be made on priority. All undeveloped major and minor intersections must be developed with adequate lighting provisions as quickly as possible since maximum accidents were observed on these locations. Road markings should be maintained well for the guidance of the traffic. Footpaths and guard rails should be provided along the length. Manholes should be levelled up with the pavement. Foot over bridges

should be provided at areas with higher number of pedestrians. Bus lay byes need to be constructed at places where buses are queuing up on the road.

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