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Technical Analysis of Accidents on NH-22 in HILLY Terrain: Causes & Remedies

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Abstract: **Almost 50.507 Kilometers of stretch comes under completely hilly terrain on NH-22 starting from Solan to Shimla. The aforesaid stretch consists of sharp curves, bends and steep slopes. These features have resulted in more than 3000 cases of accidents getting registered involving more than 4100 vehicles and causing more than 780 deaths with more than 5500 serious injuries in the 10 year span of 2003-2013. There are seven major spots on this stretch where occurrence is more frequent than other places namely kiareeghat, waknaghat, kaithleeghat and more. The main reasons were found to be rash driving, narrow curves, poor visibility, rain and snow and heavier traffic at night time than the rest of the day. Now these reasons cover more than 87% of the total cases registered.**

The highway was constructed at the time of British rule even before independence and no step has been taken by the Government of India in this aspect to improve alignment or trajectory of this road. The main reasons were found to be lack of signboards, convex mirrors, retaining walls and light poles at critical spots. This want is resulting in recurrence of accidents. Technically speaking on the whole stretch there are only two short stretches where overtaking sight distance is proper otherwise it is lower than desired value. The safe stopping sight distance is also not enough at seven critical points on the permissible limit of speed. Though the studies clearly show that if this value is reduced by 10 kms per hour the safe stopping sight distance increases by 83.3% which can reduce the number of casualties to a great extent. The length of curvature has been found to be sufficient under permissible limit but super elevation shows huge difference compared to desired values. Apart from technical reasons the provision necessary can make the travel extremely safe which should be implemented as the earliest.

Keywords: **Accidents, Sight Distance, Curvature, Major Spots.**

1. INTRODUCTION

Pavements are generally classified as flexible or rigid pavements [1, 2]. While flexible pavements are made of bituminous layers and transfer the load from one layer to the other, rigid pavements are generally made of cement concrete and load transfer occurs through slab action [3].

NH-22 area between Solan and Shimla is a highly accident prone area with many black spots and this has been marked and noted by the concerned authorities. The total road length between Solan and Shimla is 50.507 Km with about 23.007 km (46%) of the total stretch in Solan district and the remaining 27.50 km (54%) in Shimla district. The NH-22 stretch between Solan and Shimla witnesses a large number of accidents every year. The local police and National Highway Authority of India have demarked it as one of the most accident prone regions of Northern India.

The paper attempts to identify the locations on the NH-22 between Shimla and Solan which are most accident prone, tries to evaluate the causes of such accidents and suggest remedial measures.

2. RESEARCH METHODOLOGY

The research methodology involved field visit and taking various readings with the help of Auto-level, Total-Station, Tachometer . We identified 'black spots' on the NH 22 on the Solan and Shimla stretch from the data collected from various responsible authorities. Variation of traffic pattern was also observed on the weekdays and weekends to check the propensity for accidents on weekdays and weekends. Analysis of geometrical design components of roadways including SSD, superelevation and length of curve were calculated. Existing straight stretches of the road were evaluated for OSD and the length of these stretches.

3. ACCIDENT STUDIES ON NH-22:

The problem of accident is a very acute in highway transportation due to complex flow pattern of vehicular traffic, presence of mixed traffic along with pedestrians. Traffic accident leads to loss of life and property. Thus the traffic engineers have to undertake a big responsibility of providing safe traffic movements to the road users and ensure their safety.

Road accidents cannot be totally prevented but by suitable traffic engineering and management the accident rate can be reduced to a certain extent. For this reason systematic study of traffic accidents are required to be carried out. Proper investigation of the cause of accident will help to propose preventive measures in terms of design and control. Table 1 shown below gives complete data regarding cases registered in the police stations in area in the past 10 years (2003-2013).

Data was collected from the police stations at Kandaghat, Solan and Shimla. The information collected included the number of accidents that took place in District Solan and Shimla over the past 10 years. Based on the data the police authorities have also marked a number of black spots on the highway where the rate of occurrence of accidents has been quite high. We cross-checked the analysis and found that the black spots marked by the police exactly matched our analysis. The details of these black spots have been summarized in Table 2. Table 3 shows the number of accidents on these black spots with number of casualties reported and number of persons injured. The exact locations of these places on NH-22 have been shown in Figure 1.

Table 1: Accidents Statistics of District Solan

Year	No. of Cases Registered	No. Vehicles Involved	No. of People Killed	No. of People Injured
2003	330	381	54	527
2004	357	528	68	601
2005	340	369	106	577
2006	320	474	102	575
2007	366	637	110	630
2008	359	464	90	459
2009	242	304	76	410
2010	266	350	62	441
2011	275	361	59	579
2012	223	304	52	341
2013 (up to 30/09/13)	199	267	51	389

Table 2: Summary of accident details at black spots

Serial No	Name of locality	Distance	Cause of Accident	Problems	Measures adopted
1	Kathleeghat	27 Km from Solan towards Shimla	Rash Driving	Narrow Curve	Curve has been widened by HPPWD
2	Shalaghat	30 Km from Solan towards Shimla	Rash Driving	Narrow Curve	Curve has been widened by HPPWD
3	Kiarighat	21 Km from Solan towards Shimla	Rash Driving	Narrow Curve	Curve has been widened by HPPWD
4	Waknaghat	24 Km from Solan towards Shimla	Rash Driving	Narrow Curve	Curve has been widened by HPPWD
5	Kandaghat	15 Km from Solan towards Shimla	Rash Driving	Poor Visibility	Curve has been widened by HPPWD
6	Kiari bungalow	21 Km from Solan towards Shimla	Rash Driving	Narrow curve	Curve has been widened by HPPWD

Table 3: Summary of casualty details at black spots

Place	No. of accidents in last 7 years	No. of casualties reported	No. of persons injured
Kathleeghat	**8**	**4**	**9**
Shalaghat	**6**	**1**	**9**
Kiarighat	**10**	**0**	**9**
Waknaghat	**8**	**0**	**12**
Kandaghat	**7**	**1**	**9**
Kiari bungalow	**5**	**0**	**7**

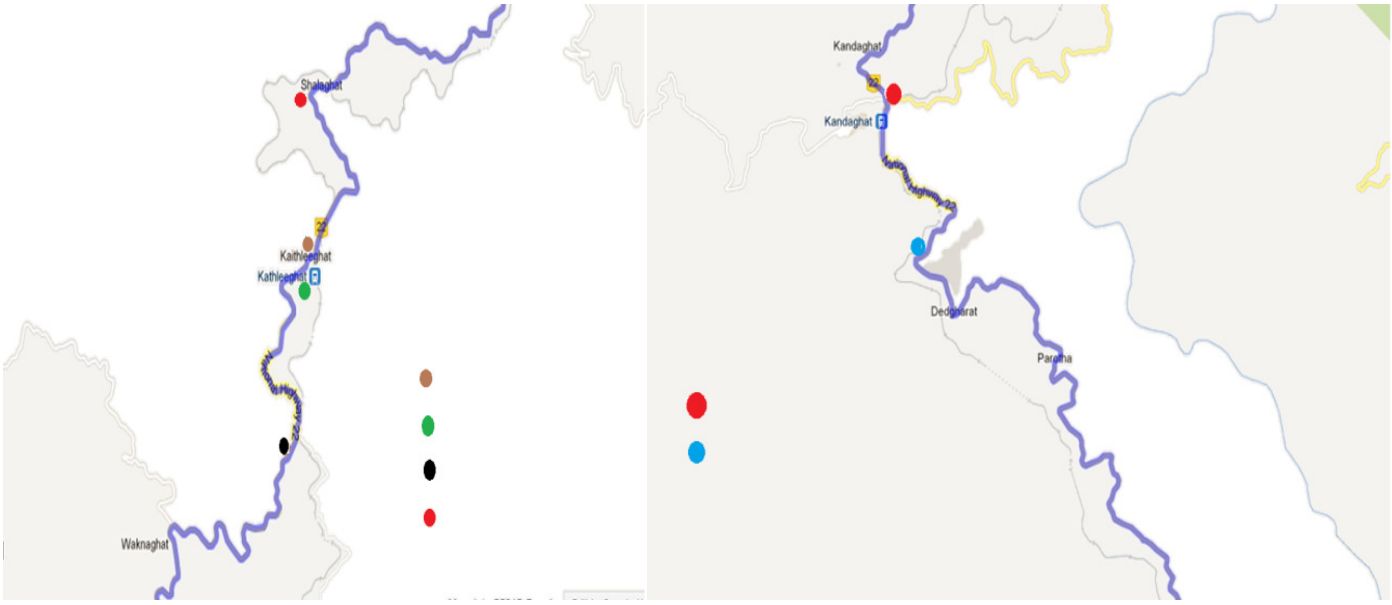

Figure 1: Location of black spots on NH-22 highway between Solan and Shimla

From the data analysis and physical verification of these 'black spots' the major reasons for such high probability for accidents are mainly due to the following reasons:

Majority of the drivers have a tendency to overtake on curves which leads to accidents since when the drivers try to overtake on a blind curve the overtaking sight distance (OSD) is almost negligible.

Narrow curves are provided due to the topography of the area. A driver while driving on these curves must slow down the vehicle but in many cases due to inexperience of drivers or any other causes, results in accidents as high speed on these narrow curves often lead to overturning of the vehicle.

The region is in a hilly terrain and experiences heavy fog during winters. Due to fog the shortest sight distance (SSD) is greatly reduced. This causes the reaction time for the drivers to be reduced which lead to collisions.

The region also experiences excessive rainfall. During rainy season the roads become slippery and the coefficient of friction between the tyres and the road surface is greatly reduced. This leads to slipping of vehicles especially two wheelers.

The regions close to Shimla experience lots of snowfall in the months of December and January. The presence of snow on carriageway also poses significant threat to the vehicles. Most of the cases of overturning and slipping of vehicles into gorges are reported during this period of the year.

The region being a hilly area driving in night time depends entirely on the headlight of the vehicle approaching from the opposite direction. This is also another important reason for accidents as the drivers often do not safely negotiate the curve from the correct driving side by lowering the speed which may lead to collision with crash barriers or other vehicles.

4. GEOMETRIC DESIGN PARAMETERS FOR BLACK SPOTS ON NH-22:

We have already determined the six black spots on the NH-22 stretch of road lying between Solan and Shimla. In this section, we evaluate the different road geometric parameters at these black spots. The road geometric design parameters evaluated were length of curve, SSD and superelevation. Standard formula prescribed by IRC (IRC:37 -2001) were used to evaluate the data.

At Kathleeghat, the length of curve was measured to be about 151m. Using the provisions of the IRC code the length of the curve was calculated to be 27 m assuming a speed of 40 km/hr which is well within the permissible limits. Similarly, the SSD was measured to be 34.5 m. The SSD value calculated for different speeds of 20, 30 and 40 km/hr and was computed to be 24.39 m, 34.37 m and 69.8 m respectively. Hence, it was observed that the SSD was apt for speed of about 25km/hr which is less than the design speed (40 km/hr) at Kathleeghat. IRC: 37-2001 suggests that the superelevation values for hilly regions should be 0.1. The superelevation calculated was found to be 0.016 which was appropriate for speed of 20 km/hr

At Waknaghat, the length of curve was measured to 139 m. Using the same assumptions as above, the length of the curve was computed to be 37 m and was well within the permissible limits. Similarly, the SSD was measured to be 34 m. The SSD values remain the same as the previous case because we assume similar velocity conditions. Hence, SSD values were apt for speed of about 25km/hr which is less than the design speed (40 km/hr) at Kathleeghat. The superelevation calculated was found to be 0.034 which was appropriate for speed of 18 km/hr. Similar evaluation of geometric design parameters were carried out and have been presented in table 4

Table 4: Summary of geometric design parameters for black spots location on NH-22

Place	SSD (m)	Length of curve (m)	Superelevation
Waknaghat	34	139	0.12
Shalaghat	37.5	51.62	0.31
Kathleeghat	34.5	151	0.06
Kiarighat	34.6	134.9	0.10
Kiaribungalow	30.3	63.8	0.085
Kandaghat	27.5	65	0.27

Similarly length of straight stretches was determined at Kathleeghat and Shalaghat. It was assumed that the speed of overtaking vehicle was 50 km/hr and speed of approaching vehicle was 20 km/hr. The requirements of OSD at these two locations have been shown Table 6.

Table 5: Summary of OSD for straight stretches on NH-22 between Solan and Shimla

Place	Speed of overtaking vehicle (km/hr)	Speed of approaching vehicle	OSD available (m)	OSD required (m)(As per IRC:37-2001)
Shalaghat	50	20	135.6	248.16
Kathleeghat	50	20	78.5	248.16

5. REMEDIAL MEASURES

The following remedial measures are suggested to reduce the number of accidents on NH-22 between Solan and Shimla. These include erection of signboards on turns and at blind spots.

Further, to ease the drive conditions during night time and to make them aware of the curves ahead fluorescent signboards must be used. The authors suggest provisions of installing convex mirrors on the curves. The convex mirrors installed on all the blind sports or sharp curves will give visibility of the approaching vehicle from the other side.

Partial presence of retaining walls along the carriageway leads to landslides, especially in rainy season which is a big cause of accidents. As such, retaining walls should be provided at all such blind spots and sharp curves. Finally, the authors suggest that light poles of suitable height must be installed to enhance the visibility of drivers at night. Care must be taken that there is sufficient light on the carriageway so that visibility is increased.

6. CONCLUSION

The paper attempts to analyze the main reasons for the occurrence of accidents on NH-22 stretch between Solan and Shimla. Identification of black spots was done using the information collected from various police stations in Kandaghat, Solan and Shimla. Data analysis of these black spots revealed the main reasons for accidents on the black spots on NH-22 were poor visibility, rain and snow, insufficient SSD and OSD on curves, late reaction time of drivers, heavy traffic at night, and distance between

headlights, narrow curves and inexperience of driving on hilly terrains. Interestingly, no design details exist for this highway as it was constructed in the pre-independence era of India. Further, there have been no changes that have been done on this stretch of the highway (from Solan to Shimla) in the last decade. However, keeping in mind the safety of the travellers serious thoughts need to be given to driver safety to prevent accidents. The authors on their part suggest installation of various road furnitures like convex mirrors, fluorescent sign boards, light poles and where possible provisions of retaining walls to reduce the risk of accidents.

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