Traffic volume and accident studies on NH-22 between Solan and Shimla

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ABSTRACT

This research is an attempt to study the basic differences between rigid and flexible pavements based on LCCA, durability, recycling, local preference, safety. We have also identified the difference in traffic volume at Tuttikandi in Shimla and Chambaghat in Solan on weekdays and weekends by making manual count of the vehicles passing by. The vehicles were classified into categories as cars, buses, trucks, motorcycles etc. The average of the number of vehicles on weekdays and weekends was calculated to estimate the mean traffic flow throughout the week.

We have also identified the black spots where the rate of occurrence of accidents has been quite high as a part of our accident studies on Shimla – Solan stretch of NH 22. We have visited the places and tried to list the various causes for these accidents. Apart from this we have also given measures to prevent such accidents in future by installing various road furniture like convex mirrors, fluorescent sign boards, light poles etc.

CERTIFICATE

This is to certify that the work titled "**Traffic volume and accident studies on NH-22 between Solan and Shimla"**" submitted by **Anish Mahajan and Jay Singh** in partial fulfilment for the award of degree of B.Tech Civil Engineering of Jaypee University of Information Technology, Waknaghat has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

Signature of Supervisor …….

Name of Supervisor ……..

Designation ……..

Date ……..

ACKNOWLEDEMENT:

We have taken sincere efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. We would like to extend our sincere thanks to all of them.

We are highly indebted to Mr Mudit Mishra for his guidance and constant supervision as well as for providing necessary information regarding the project & also for his support in completing the project.
We would like to express our gratitude towards our parents & the Department of Civil Engineering (JUIT) for their kind co-operation and encouragement which helped us in completion of this project.
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Introduction

There are two types of pavement surfaces:

- Flexible pavement
- Rigid pavement

A **flexible pavement** is made up of bituminous material and is based on the phenomenon of load transfer from one layer to the other.

A **rigid pavement** on other hand is made up of cement-concrete and transfers load by slab action.

NH-22 area between Solan and Shimla is a highly accident prone area with many black spots marked by the concerned authorities. It has a road length of about 50 kms between Solan and Shimla.

District Wise Length of Project Road:

S.No	Name of District	Length (km)
1	**Solan**	**23.007**
2	**Shimla**	**27.500**
3	**Total**	**50.507**

Motivation:

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 (NHAI) have demarked it as one of the most accident prone regions of Northern India.

Studying civil engineering for past 3 years has continuously made us curious as to why such accidents were occurring so frequently and further more if any measures could be taken to sabotage such mishappenings in the future. Having these questions in mind we decided to carry out detailed study on the topic "**Traffic volume and accident studies on NH-22 between Solan and Shimla"** which we felt had lots of insights and practical usage as well.

SCOPE :

- To study the areas on NH-22 where the rate of occurrence of accidents is high.
- Change in traffic flow between Solan and Shimla during weekends.
- Measurement and analysis of various geometrical design components i.e. SSD, Superelevation and Length of curve at the identified black spots.
- Measurement of the OSD and Length of the straight patches at Shalaghat and Kathleeghat stretches.
- Checking the sustainability of the aggregates used in the construction of NH 22 by performing Aggregate Impact Value, Los Angeles Abrasion Test and Flakiness and Elongation Indices test on the aggregates and comparing them with the values provided in MoRTHs.

ACCIDENT STUDIES

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.

The main objective here is to collect data regarding the accidents that have occurred on national highway 22 over the past 10 years, study the causes of accidents and suggest corrective measures at potential locations.

Collection of data:

For the collection of appropriate data we have visited the police stations at kandaghat, solan and shimla. We were provided information regarding the number of accidents that took place in distt. Solan and Distt. Shimla over the past 10 years. 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.

Accident Statistics of district Solan

YEAR	No. of Cases Registered	No. of 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 (upto 30-9-13)	199	267	51	389

Black Spots Identified

Kathleeghat:

- It is located 27kms from Solan towards Shimla.

CAUSES: Rash Driving

Problems: Narrow Curve

Measures: curve has been widened by HPPWD.

Place	No. of accidents in last 7 years	No. of casualities reported	No. of persons injured
Kathleeghat	8	4	9

picture of curve from Shimla side

Picture of curve from Solan side

Shalaghat (Aamod turn) :

- It is located at a distane of 30kms from Solan towards Shimla.

CAUSE: Rash Driving

Problems: Curve

Measures: Curve has been widened by HPPWD.

Place	No. of accidents in last 7 years	No. of casualities reported	No. of persons injured
Shalaghat	6	1	9

Picture of curve from Shimla side

Kiarighat:

- It is located at a distance of 21kms from Solan towards Shimla.

CAUSES: Rash Driving

Problems: Narrow Curve

Measures: curve has been widened by HPPWD.

Place	No. of accidents in last 7 years	No. of casualities reported	No. of persons injured
Kiarighat	10	0	9

Picture of curve from Solan side

Picture of the curve from Shimla side

Waknaghat :

- It is located at a distance of 24kms from Solan towards Shimla.

CAUSES: Rash Driving

Problems: Narrow Curve

Measures: curve has been widened by HPPWD.

The precautionary sign board needs to be Erected.

Place	**No. of accidents in last 7 years**	**No. of casualities reported**	**No. of persons injured**
Waknaghat	8	0	12

Pictures of the curve from Solan side

Pictures of the curve from Shimla side

Kandaghat :

- It is located at a distance of 15kms from Solan towards Shimla.

CAUSES: Rash Driving

Problems: Poor Visibility

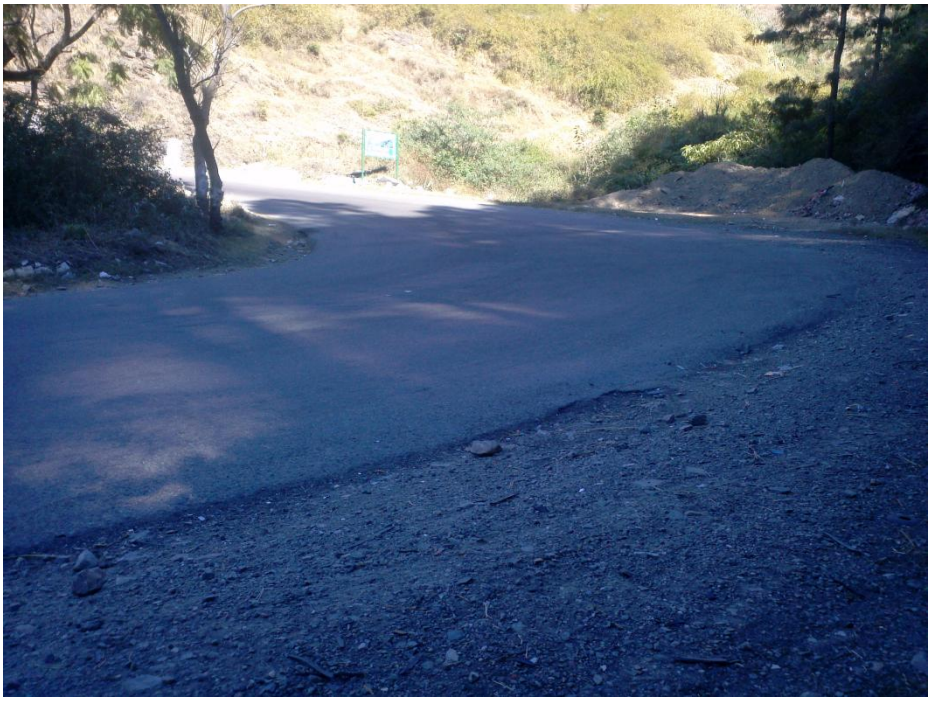
Measures: curve has been widened by HPPWD.

The precautionary sign board needs to be erected.

Place	**No. of accidents in last 7 years**	**No. of casualities reported**	**No. of persons injured**
Kandaghat	7	1	9

Picture of the curve from Shimla side

Picture of the curve from Solan side



Kiaribungalow :

Place	No. of accidents in last 7 years	No. of casualities reported	No. of persons injured
Kiyaribungalow	5	0	7

Causes : rash driving

Problems : curve

Measures : widening of the curve has been done .

Picture from Shimla side

Picture from Solan side

According to us the **major reasons** attributing to the **numerous accidents** occurring on **NH 22** are :

- **Rash driving:** Accidents are mainly caused when the drivers try to overtake on a blind curve as the overtaking sight distance(OSD) is almost negligible.

- **Narrow Curves:** Narrow curves are provided due to the topography of the area. A driver while driving on these curves must slow down his vehicle but in many cases inexperienced drivers do not do this and hence result in undesirable consequences as high speed on these curves may lead to overturning of the vehicle.

- **Poor visibility:** As the region is mountainous it experiences FOG during winters. As a result of fog the shortest sight distance is reduced to a great extent.
  Thus the reaction time for the drivers is reduced which may lead to collisions.

- **Rain:** the region also experiences excessive rainfall. During rainy season the roads become slippery as the coefficient of friction is reduced. This leads to slipping of vehicles especially two wheelers.

- **Snow**: 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.

- **Heavy Traffic at Night:** The region being a hilly area most drivers drive at night depending entirely on the light of the vehicle approaching from the other side. This is another cause for accidents as the drivers don't bother to negotiate the curve from the right driving side and lower the speed which may lead to collision with crash barriers even if there is some animal on the roads.

Our suggestions for safety measures :

- **Sign boards** : The signboards on many turns need to be erected. Also to guide the drivers during the night time and to make them aware of the curves ahead fluorescent signboards must be used.

- **Convex Mirrors:** The convex mirrors have not been provided on any of the curves.The convex mirrors must however be provided on all the blind curve to give visibility of the approaching vehicle from the other side.

- **Construction of retaining walls:** Lack of retaining walls along the carriageway leads to landslides from the hills especially during the rainy seasons.

- **Installation of light poles:** The 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.

Hearing what the locals had to say:

Although we had pondered and discussed the causes of such accidents amongst ourselves keeping in mind what the police constables had to say about the matter, we decided to further deepen our research, for which we went an interviewed a few local residents of shoghi to understand what they recognized to be the cause of such mishappenings**.**

<u>According to Mr Sharma, a local dhaba owner:</u>

“

The main reasons for the occurrence of accidents are:

Youngsters in the town these days are indulging excessively in drinking and driving resulting in rise of accidents.

Also there are a lot of under age drivers who drive rashly.

”

<u>According to Mr Thakur, a bank employee:</u>

“

The main reason for occurrence of accidents are:

The roads have many pebbles lying on the surface due to breakage of mountain rocks. The municipal corporation has failed to clean these roads and remove these pebbles from time to time. The result of such gravel is reduced friction and increase of slipping effect.

”

Traffic Volume Studies

Traffic volume is the number of vehicles crossing a section of road per unit time at any selected period. Traffic volume is used as a quantity measure of flow. The commonly used units are vehicles per day and vehicles per hour. A complete traffic volume study may include the classified volume study by recording the volume of various types and classes of traffic, the distribution by direction and turning moments and the distribution on different lanes per unti time. The objects and uses of traffic volume studies are given below:

- Traffic volume is generally accepted as a true measure of the relative importance of roads and in deciding the priority for improvement and expansion.
- Traffic volume study is used in planning,traffic operation and control of existing facilities and also for planning and designing the new facilities.
- This study is used in the analaysis of traffic pattern and trends.
- Classified volume study is useful in structure design of pavement in geometric design and in computing the roadway capacity.
- Volume distribution study is used in planning one way streets and other regular measures.
- Turning movement study is used in the design of intersections, in planning signal timings, channelization and other control devices.
- Pedestrian traffic volume study is used for planning sidewalks, crosswalks, subways and pedestrian signals.

There are variations in traffic flow from time to time. Daily traffic volume varies considerably during the week, **the peak weekend volume may be much higher than average weekday volume.** In classified traffic volume study, the traffic is classified and the volume of each class of traffic i.e. buses, truck, passenger cars, other light vehicles, rickshaws, bullock carts, cycles and pedestrians is found separately

Counting of traffic volume

Traffic volume counts maybe done by:

- Mechanical counters.
- Manually.

Due to unavailability of mechanical counters we carried out the traffic volume study manually.

Manual counts

This method employs a field team to record traffic volume on the prescribed record sheets. By this method it is possible to obtain data which cannot be corrected by mechanical counters, such as vehicle classification, turning moments and counts where the loading conditions or number of occupants are required. However it is not practically possible to have manual counts for all the 24hrs of the day and on all days around the year.

So we made manual counts on Wednesday(i.e. a week day) and on Sunday(i.e. weekend.)

We started the count at 11am at Chambaghat area of Solan. Where we counted the number of different types of vehicles passing by. We have divided the vehicles into different classes like cars, motor cycles, buses , trucks, tractors , cycle and others which include JCB and trailers.We continued the counting till 6pm in the evening.

The same procedure was carried out by us on Sunday as well. This helped us to get an idea about the change in traffic flow throughout the week.

Traffic in Solan on weekday:

Type of vehicle	Count	VDF	Traffic in MSA(10^{-6})
Cars	1273	1.0	1273
Motorcycles	366		
Buses	249	1.0	249
Trucks	213	4.0	852
Tractors	5	4.0	20
Cycles	7		
Others(JCB & Trailer)	3	3.0	9

Traffic in CVPD = Buses + trucks Traffic in MSA= 0.002403

Traffic in CVPD = 249 + 213

Traffic in CVPD = 462

Traffic in Solan on weekends:

Type of vehicle	Count	VDF	Traffic in MSA(10^{-6})
Cars	1817	1.0	1817
Motorcycles	424		
Buses	256	1.0	256
Trucks	143	4.0	572
Tractors	0	4.0	
Cycles	2		
Others(JCB & Trailer)	1	3.0	3

Traffic in CVPD = Buses + truck Traffic in MSA = 0.002648

Traffic in CVPD = 256 + 143

Traffic in CVPD = 399

Average of traffic on weekday and weekend:

Type of vehicle	Average count	VDF	Traffic in MSA(10^{-6})
Cars	1545	1.0	1545
Motorcycles	395		
Buses	252	1.0	252
Trucks	173	4.0	692
Tractors	3	4.0	12
Cycles	4		
Others(JCB & Trailer)	2	3.0	6

Avg. Total Traffic in MSA = 0.002507

What we observed:

- There is an increase in total number of vehicles traversing on weekends as compared to weekdays at Chambaghat junction.
- There is a considerable increase in number of cars and motor cycles. The main cause for this increase can be attributed to the number of tourists visiting Shimla during the weekends.
- However there is a decrease in the number of commercial vehicles i.e. trucks and buses. This may be due to holiday in schools and colleges on Sunday.

Traffic in Shimla on weekday:

Type of vehicle	Count	VDF	Traffic in MSA(10^{-6})
Cars	1112	1.0	1112
Motorcycles	179		
Buses	216	1.0	216
Trucks	356	4.0	1424
Tractors	1	4.0	4
Cycles	0		
Others(JCB & Trailer)	1	3.0	3

Traffic in CVPD : Traffic per day in MSA =0.002759

Traffic in CVPD = 216 + 356

Traffic in CVPD = 572

Traffic in Shimla on weekends:

Type of vehicle	Count	VDF	Traffic in MSA(10^{-6})
Cars	1317	1.0	1317
Motorcycles	237		
Buses	244	1.0	244
Trucks	193	4.0	772
Tractors	0	4.0	0
Cycles	0		
Others(JCB & Trailer)	0	3.0	0

Traffic in CVPD : Traffic per day in MSA= 0.0023

Traffic in CVPD = 244 + 193

Traffic in CVPD = 437

Average of traffic on weekday and weekend:

Type of vehicle	Average count	VDF	Traffic in MSA (10^{-6})
Cars	1215	1.0	1215
Motorcycles	208		
Buses	230	1.0	230
Trucks	275	4.0	1100
Tractors	1	4.0	4
Cycles	0		
Others(JCB & Trailer)	1	3.0	3

Avg traffic in MSA=0.002552

What we observed:

- There is an increase in total number of vehicles traversing on weekends as compared to weekdays at tutikandi bypass.
- There is a considerable increase in number of cars and motor cycles. The main cause for this increase can be attributed to the number of tourists visiting Shimla during the weekends.
- However there is a decrease in the number of commercial vehicles i.e. trucks and buses. This may be due to holiday in schools and colleges on Sunday.

Determination of **Length of curve, SSD and Superelevation** of the **Black Spots** identified **:**

Kathleeghat

Length of curve

As observed**,**

Length of Curve = 151m

As per formula for calculating **length of curve** recommended by **IRC**:

$$L = V^2/R$$

Taking the design speed for NH-22 to be approximately 40Kmph

$$L = 1600/60 = 26.67m$$

Hence provided curve length is well in permissible limit.

Kathleeghat

Stopping Sight Distance

As observed by us

SSD = 34.5m

As per Formula :

SSD = 0.278 V*t + (V^2)/254f

Speed(km/h)	20	30	40
SSD(m)	24.39	44.47	69.8

As per our observation, SSD = 34.5m

Hence the stopping sight distance is apt for a speed of 25kmph.

Kathleeghat

Superelevation

As per IRC,

Superelevation (e) = 0.1 (for hilly terrain)

As per Calculation:

$e = V^2/225R$

As per calculation,

Using **R = 20.56m**

Speed(km/h)	20	30	40
Superelevation (e)	0.029	0.067	0.119

As per our readings e = 0.016

Hence the superelevation is apt for a speed of 15kmph.

Waknaghat

Length of Curve

As observed,

Length of Curve = 139m

As per formula for calculating **length of curve** recommended by **IRC**:

$$L = V^2/R$$

Taking the **design speed** for NH-22 to be approximately **40Kmph**

$$L = 1600/43.75 = 36.57m$$

Hence provided curve length is well in permissible limit.

Stopping Sight Distance

As observed by us**,**

SSD = 34.0m

As per Formula :

$$SSD = 0.278\ V*t + (V^2)/254f$$

Speed(km/h)	20	30	40
SSD(m)	24.39	44.47	69.8

Hence the SSD is apt for a speed of 25kmph.

Waknaghat

Superelevation

As per IRC,

Superelevation (e) = 0.1 (for hilly terrain)

As per Calculation:

$e = V^2/225R$

As per calculation, **Using R = 20.56m**

Speed(km/h)	20	30	40
Superelevation (e)	0.04	0.09	0.16

As per our readings e = 0.034

Hence the superelevation is apt for a speed of about 18kmph.

Shalaghat

Length of Curve

As observed,

Length of Curve = 51.62m

As per formula for calculating **length of curve** recommended by **IRC:**

$L = V^2/R$

Taking the design speed for NH-22 to be approximately 40Kmph

$L = 1600/28.225 = 56.69m$

Hence provided curve length is well in permissible limit.

Stopping Sight Distance

As observed by us

SSD = 37.5m

As per Formula :

$SSD = 0.278\ V*t + (V^2)/254f$

Speed(km/h)	20	30	40
SSD(m)	24.39	44.47	69.8

Hence the SSD is apt for speed of about 25.

Shalaghat

Superelevation

As per IRC,

Superelevation (e) = 0.1 (for hilly terrain)

As per Calculation:

$e = V^2/225R$

As per calculation, Using **R = 20.56m**

As per our readings e = 0.088

Speed(km/h)	**20**	**30**	**40**
Superelevation (e)	0.063	0.14	0.25

Hence the superelevation is apt for a speed of about 23kmph.

Kiarighat

Length of Curve

As observed**,**

Length of Curve = 134.9m

As per formula for calculating **length of curve** recommended by **IRC**:

$L = V^2/R$

Taking the design speed for NH-22 to be approximately **40Kmph**

$L = 1600/31.25 = 51.2m$

Hence provided curve length is well in permissible limit.

Stopping Sight Distance

As observed by us

SSD = 34.55m

As per Formula :

$SSD = 0.278\ V*t + (V^2)/254f$

Speed(km/h)	**20**	**30**	**40**
SSD(m)	24.39	44.47	69.8

Hence the SSD is apt for a speed of 25kmph

Kiarighat

Superelevation

As per IRC,

Superelevation (e) = 0.1 (for hilly terrain)

As per Calculation:

$e = V^2/225R$

As per calculation, Using **R = 20.56m**

Speed(km/h)	20	30	40
Superelevation (e)	0.057	0.128	0.227

As per our readings e = 0.028

Hence the superelevation provided is only suitable for a speed of 10kmph.

Kiaribunglow

Length of Curve

As observed**,**

Length of Curve = 63.8m

As per formula for calculating **length of curve** recommended by **IRC**:

$L= V^2/R$

Taking the design speed for NH-22 to be approximately **40Kmph**

L= 1600/37.5 = 42.67m

Hence provided curve length is well in permissible limit.

Stopping Sight Distance

As observed by us,

SSD = 30.3m

As per Formula :

$SSD = 0.278 V*t + (V^2)/254f$

Speed(km/h)	20	30	40
SSD(m)	24.39	44.47	69.8

Hence the SSD is only suitable for a speed of 23kmph.

Kiaribunglow

Superelevation

As per IRC,

Superelevation (e) = 0.1 (for hilly terrain)

As per Calculation:

$e = V^2/225R$

As per calculation, **Using R = 20.56m**

As per our readings, e = 0.024

Speed(km/h)	20	30	40
Superelevation (e)	0.047	0.107	0.189

Hence the superelevation is only sufficient for a speed of 10kmph.

Kandaghat

Length of Curve

As observed,

Length of Curve = 65.0m

As per formula for calculating length of curve recommended by IRC:

$$L = V^2/R$$

Taking the design speed for NH-22 to be approximately 40Kmph

$$L = 1600/20.56 = 77.82m$$

Hence provided curve length is well in permissible limit.

Stopping Sight Distance

As observed by us,

SSD = 27.5m

As per Formula :

$$SSD = 0.278\ V*t + (V^2)/254f$$

Speed(km/h)	20	30	40
SSD(m)	24.39	44.47	69.8

Hence the SSD is apt for a speed of 21kmph.

Kandaghat

Superelevation

As per IRC,

Superelevation (e) = 0.1 (for hilly terrain)

As per Calculation:

$e = V^2/225R$

As per calculation, Using **R = 20.56m**

Speed(km/h)	20	30	40
Superelevation (e)	0.086	0.19	0.35

As per our readings e = 0.076

Hence superelevation is apt for a speed of 18kmph.

Overall Analysis of SSD, Length of Curve and Superelevation of all Black Spots :

Place	SSD (m)	Length of Curve (m)	Superelevation
Waknaghat	34.0	139	0.12
Shalaghat	37.5	51.62	0.31
Kathleeghat	34.5	151	0.06
Kiarighat	34.55	134.9	0.10
Kiaribunglow	30.3	63.8	0.085
Kandaghat	27.5	65	0.27

Lengths of Straight Patches

1. **Kathleeghat** = 135.6m
2. **Shalaghat** = 78.5m

According to **Khanna and Justo** :

Min. Reqd. OSD = $0.28*V_b*t + 0.28*V_bT + 2s + 0.28\ V_aT$

Where,

$T = \sqrt{14.4s/A}$, $s = 0.2\ V_b + 6$

t = 2sec.

V_b = speed of overtaking vehicle

V_a = speed of approaching vehicle

A = acceleration of overtaking vehicle (2.5 m/ s^2)

Assuming Speed of overtaking vehicle = 50kmph & Speed of approaching vehicle =20kmph

Place	Speed of overtaking vehicle (kmph)	Speed of approaching vehicle (Kmph)	OSD Available (m)	OSD REQD. (theoretically) (m)
Kathleeghat	**50**	**20**	**135.6**	**248.16**
Shalaghat	**50**	**20**	**78.5**	**248.16**

Testing of Aggregates used in NH-22 construction

Aggregate Impact Value Test:

Objective : To determine the toughness(impact value) of aggregates.

Apparatus:

- Impact testing machine
- Cylindrical vessel
- Tamping road
- Sieve 12.5, 10 and 2.36mm
- Balance
- Oven

Theory:

Toughness is the property of the material to resist impact due to traffic loads the road stones are subjected to the pounding action or impact and there is possibility of stones breaking into smaller pieces. The road stones should therefore be tough enough to resist fracture under impact.

Observation Table :

Sr. No.	Details	Weight (gm)
1.	Total weight of sample filling cylindrical measure. (W_1)	330
2.	Weight of crushed aggregate. (W_2)	84
3.	Weight of aggregates retained on 2.36mm sieve after the test.	244

Result:

Aggregate Impact Value = (W_2/W_1) * 100

Aggregate Impact Value = 25.45 %

LOS ANGELES ABRASION TEST

Objective:

To determine the hardness (Abrasion) of aggregates by the Los Angeles Abrasion test method.

Apparatus/Equipments Required:

- It consists of a hollow cylindrical machine closed at both ends having 70 cm internal diameter and 50 cm long, mounted on supports so that it may rotate about its horizontal axis.
- Steel spherical balls 4.5 cm diameter and weighing 390grams to 445 grams. The weight and number of balls per charge of aggregate depends upon the grading of aggregate sample.
- Sieve of size 1.7 and balance of capacity 10 kg.

Theory:

Due to the movements of traffic, the road stones used in the surfacing course are subjected to wearing action at the top. Resistance to wear or hardness is hence an essential property for road aggregates especially when used in wearing course. Thus road stones should be hard enough to resist the abrasion due to the traffic.

Observations:

Number of spheres used = **11**

Number of revolutions = **500**

Weight of specimen (W_1) = **5Kg**

Weight of aggregate retained on **1.7 mm** IS sieve after the test , W_2 g = **3.238 kg**

Percentage wear = $\frac{(W_1 - W_2)}{W_1} \times 100$

Percentage wear = 35.25 %

FLAKINESS AND ELONGATION INDICES TEST

Objective:

To determine the flakiness and elongation indices of the given aggregates sample

Introduction:

The particle shape of aggregates is determined by the percentages of flaky and elongated particle contained in it. In the case of gravel it is determined by its angularity number. For base course and construction of bituminous and cement concrete types, the presence of flaky and elongated particles are considered undesirable as they may cause inherent weakness with possibilities of breaking down under heavy loads. Rounded aggregates are preferred in cement concrete road construction as the work ability concrete improves. Angular shapes of particles are desirable for granular base course due to increase stability divided from the better interlocking. When the shape of aggregates deviates more from the spherical shape, as in the case of angular, flaky and elongated aggregate, the void content in aggregate of any specified size increases and hence the grain size distribution of a graded aggregate has to be suitable altered in order to obtain minimum voids in the dry mix of the highest dry density. The angularity number denotes the void content of single sized aggregates in excess of that obtained with spherical aggregates of the same size. Thus angularity number has considerable importance in the gradation requirements of various types of mixes such as bituminous concrete and soil-aggregate mixes.

The evaluation of shape of the particles, particularly with reference to flakiness, elongation an angularity is necessary.

Test for Determinations of Flakiness Index

Apparatus: -

The apparatus consists of :

- A standard thickness gauge,
- IS sieves of sizes 63, 50, 40, 31.5,25, 20, 16, 12.5, 10 and 6.3 mm and
- A balance to weigh the samples.

Theory: - The flakiness index of aggregates is the percentage by weight of particles whose least dimension (thickness) is less than three-fifths (0.6) of their mean dimension. The test is not applicable to sizes smaller than 6.3 mm.

Observations

Sieve size(mm)	Retained on IS sieve(mm)	Wt of fraction consisting of atleast 200 pieces(gm)	Thickness gauge size	Wt of aggregates	Length of gauge size	Wt of aggregates retained on length gauge
63	50	0	23.90	0	-	-
50	40	0	27	0	81	-
40	31.5	0	19.5	0	58	-
31.5	25	0	16.95	0	-	-
25	20	0	13.5	0	40.5	-
20	16	272.25	10.8	72.45	32.4	47.95
16	12.5	526.4	8.55	80.9	25.25	114.65
12.5	10	247.5	6.75	25.25	20.3	65.85
10	6.3	237.3	4.8	33.55	14.7	106.05

Flakiness index = Sum of weight of aggregates/ Sum of weight of fraction consisting of at least 200 pieces

= (212.15/1283.45)*100

Flakiness index = 16.5%

Elongation index = Sum of Wt. of aggregates retained on length gauge/ Sum of wt. of fraction consisting of at least 200 pieces

= (334.5/1283.45)*100

Elongation index = 26.06%

As per MORTH:

TABLE 400-6. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER B.OUND MACADAM FOR SUB-BASE/BASE COURSES

Test		Test Method	Requirements
1.	Los Angeles Abrasion value	IS: 2386 (Part-4)	40 per cent (Max)
	Or		
	Aggregate Impact Value	IS: 2386 (Part-4) or IS: 5640**	30 per cent (Max)
2.	Combined Flakiness and Elongation Indices (Total)	IS: 2386 (Part-I)	30 per cent (Max)

Hence, the results obtained are within the permissible limits stated in MORTH

Conclusions

by working on this project we have come across the main reasons for the occurrence of accidents on NH-22 stretch between Solan and Shimla. After visiting the black spots identified we came across various reasons that were leading to recurrent accidents.

As identified by us the main reasons are:-

- **Poor visibility**
- **Rain**
- **Snow**
- **Insufficient SSD and OSD**
- **Psychology**
- **Heavy traffic at night**
- **Distance between headlights**
- **Narrow curves**
- **Rash driving**

A shocking fact we came across was that there was no design of the highway available with any of the authorities. The reason they gave us for this was that the highway had been constructed during the British time. Another fact was that there had been no amendments made on this highway for the last 10 years according to the HPPWD engineers.

But keeping in mind the safety of the travelers time has come to take effective measures at various regions prone to accidents in order to make this highway safe for travelling. Installations of various road furniture's like convex mirrors fluorescent sign boards etc and construction of retaining walls on land slide prone areas can help serve the purpose.

Traffic Studies:

Avg. Total Traffic in Solan = **0.002507 Msa**

Avg. Total Traffic in Shimla = **0.002552 Msa**

Analysis of Geometric Design :

Kathleeghat:

Length of Curve = 151m, which is well within the permissible limits.

SSD = 34.5m, SSD is apt for speed of about 25KMPH**.**

Superelevation, e = 0.016, almost appropriate for speed of 20 kmph

Waknaghat :

Length of Curve = 139m, which is well in permissible limit.

SSD = 34.0m, SSD is apt for speed of about 25KMPH

Superelevation,e = 0.034, almost appropriate for speed of 20 kmph

Shalaghat:

Length of Curve = 51.62m, which is well within the permissible limits.

SSD = 37.5m, SSD is apt for speed of about 25KMPH.

Superelevation,e = 0.088, almost appropriate for speed of 20 kmph.

Kiarighat:

Length of Curve = 134.9m, which is well within the permissible limits.

SSD = 34.55m, SSD is apt for speed of about 25KMPH.

Superelevation,e = 0.028, almost appropriate for speed of 20 kmph.

Kiaribunglow

Length of Curve = 63.8m, which is well within the permissible limits.

SSD = 30.3m, SSD is apt for a speed of about 33kmph.

Superelevation,e = 0.024, almost appropriate for speed of 10 kmph.

Kandaghat

Length of Curve = 65m, which is well within the permissible limits.

SSD = 27.5m, SSD is apt for a speed of about 39kmph.

Superelevation,e = 0.076, almost appropriate for speed of 18 kmph.

Testing of Aggregates used in NH-22 construction:

AGGREGATE IMPACT VALUE TEST

Aggregate Impact Value = 25.45 %

LOS ANGELES ABRASION TEST

Percentage wear = 35.25 %

FLAKINESS AND ELONGATION INDICES TEST

Flakiness index = 16.5%

Elongation index = 26.06%

References

- Highway Engineering by Khanna and Justo
- Morths
- IRC: 37
- Himachal P.W.D. specifications 1990