Assessment of Road Safety Audit of NH-69, Karnataka State, India

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Abstract—Road Safety Audit (RSA) is a formal procedure for assessing accident potential and safety performance of new and existing roads. RSA is an efficient, cost effective and proactive approach to improve safety of the road users with leading to any trend of accidents and their impacts. RSA appears to be an ideal tool for improving road safety in India, as basic and accurate data on accidents have yet to be collected in a scientific way as well as in a systematic method. It is evident from the traffic composition for the countries like India, where heterogeneous traffic with varying vehicle types differing in their vehicle static and dynamic characteristics.

The project stretch considered is NH-69 (Bhadhravathi to Shivamogga – Karnataka State) ranging 22.1 Kms. The present study deals with road inventory, signage inventory, traffic volume count survey, spot speed study, Speed and delay study and other surveys such as topographic survey and Accident data has been collected for the stretch for a period of 2012-16 is collected and analysis is carried out. The study aims to evaluate Road Safety Audit of a section of four-lane National Highway (NH)-69 and will focus on evaluating the benefits of the proposed actions that have emanated from deficiencies identified through the audit process. Missing road and median markings to be done and speed signs should match with speed. Access and service lanes are also deficient which requires immediate improvement.

Keywords (Index Terms):— Road Safety Audit (RSA), NH-69, road safety in India and speed signs.

I. INTRODUCTION

In 1980's the Road Safety Audit (RSA) process was started in the United Kingdom. On 11 May 2011, the plan of action for Road Safety 2011-2020 was launched around 100 countries including India. The main goal of the plan is to prevent five million road traffic deaths globally by 2020 (Arun S Bagi et al.). Road safety audit has the greatest ability when it is considered for traffic design before and after the construction stage. Main purpose of RSA is to focus on the accident influential and safety condition of the highways. RSA is a formal procedure having definite aim with standard procedure. For the effective outcome, its need to be conducted by appropriate experienced and trained persons and they should be of independent of design team. An audit procedure initiates from beginning of design and at construction stage.RSA can also conducted on the existing road, so it can help to identify the deficiencies and formopportunity becomes to identify the highway engineering measures to improve safety.

The start of this century, the rate generation of mechanized vehicle has been expanding constantly. The awesome incrementinnumberofenginevehiclesoutandabouthasnot similarly coordinating with relating increment in complete length of highway arrange *(S. S. Jain et al.,).* The highway length has not possessed the capacity to take care of the demand made by the gigantic development of vehicle populace. The blended movement condition winning on our street organize has additionally exasperated the activity circumstance. Along these lines the vehicles populace increments in step by step *(Atul Kumar)*. Because of this advancement with changing condition situation, the rates of mishaps are expanding radically. RSA is the principle worry tolessenmischance.MischancefatalitiesrateinIndiaishigh inthecorrelationwiththatinthecreatednations.

Fundamental methodologies of road safety are counteractive action and diminishment of accidents. In accident decrease, consciousness of accidents that happened on existing highway to enhance the outline of highway or to impact the conduct of road user is utilized *(S. S. Jain et al.,)*.

In accident prevention, learning of aptitude in safe street outline – street geometry, and in addition the materials utilized. Accident reducing action ought to be the fundamentaltargetofthehighwayspecialisttoguaranteethat theroadsaresafe*(PavanDeshpande).*Atthepointwhenthe accident rate is least on roadway extend then the highway is to be considered as more secure for road user. In the event that accident rate is more than the street is not protected, paying little respect whether all principles were seen amid arranging andplan

A. Road Accident Scenario inIndia

The Road safety is more important in India because close to 5, 00,000 road accidents and nearly 1, 46,000 deaths caused in 2015.Non highway roads witnessed 47.6% of total accidents. This is followed by NH with a rate of 28.4% and SH with 24%. The 2% length on National Highway carry 40%ofgoodtraffic,while7%ofStateHighwaycarry30%of good traffic. The road safety on Indian roads has slowly worsened over the past years. As seen from the below table andgraph,numberofdeathsisincreasedyearbyyear*(PavanDesh pande).*

B. Projectlocation

NH-69 is a major National Highway in India that runs alongthestatesof Andhra Pradesh and Karnataka. The western terminal is at the junctionofNH-66nearHonnavaraandterminatesattheeast end at Chittoor. It passes through Honnavar, Sagara, Shivamogga, Banavara, Sira, Madhugiri, Chinthamani, and Mulabagilu in Karnataka and in Andhra Pradesh it passes throughPalamaner,Chittoor.NH-69is625kminlength.

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C. StudyArea

A portion of NH-69 was selected for project.The selected stretchhasabypassportionofBhadravathi.Thestretchstarts fromKm183.100(atjoiningofbypassandNH-69)andends at Km 205.2 (at MRS circle). The length of study section is approximately22.1Kms.

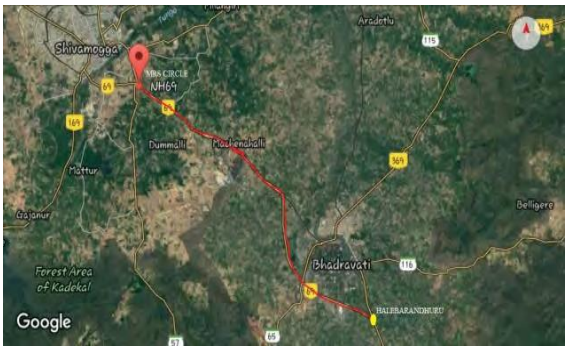


Fig. 1:Spatial view of study area

II. OBJECTIVES

- To examine safety features and find out deficiencies and conflict point in the road network which lead to accident and safety hazards to roadusers.
- ToconductaRSAaccordingtospecificationgiveninthe IRC:SP:88:2010

III. METHODOLOGY

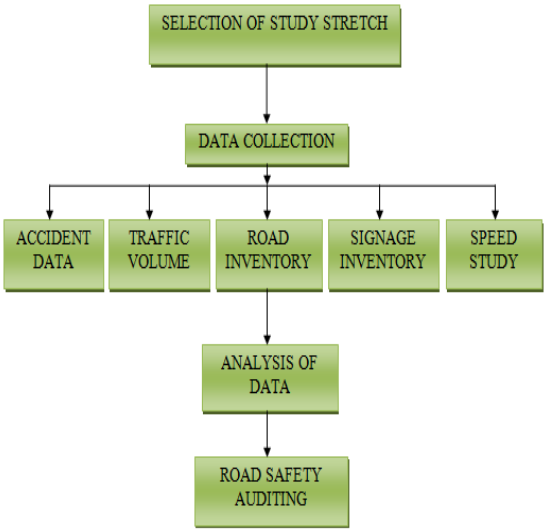


Fig. 2: Flow chart of methodology

IV. RESULTS ANDDISCUSSIONS

ThemainaimoftheRSAistoensuretheentirenewroadand existing road network operate safely. Road safety audits evaluatetheoperationofaroadbyfocusingonroadsafetyas pedestrians, cyclists, motorcyclists, truck/bus drivers, on-roadpublictransportusers,etc.Soforthatdifferentdata's are collected like accident data, traffic data and road inventorydata.

A. Accidentstatistics

The road accident data was collected from Tunganagara Police Station, Vidyanagara Police Station, and Bhadravathi TrafficPoliceStationlimitsoffiveyearsdatafrom2012-16.

Accident data from Bhadravathi Police Station (ch.183.100– ch.192.500)

Table 1: *Year Wise Road Accident Statistics of Selected Stretch*

Year	No of accidents	Total no. of deaths	Total no. of injuries
2012	43	4	51
2013	41	7	57
2014	51	15	50
2015	28	6	28
2016	35	9	32

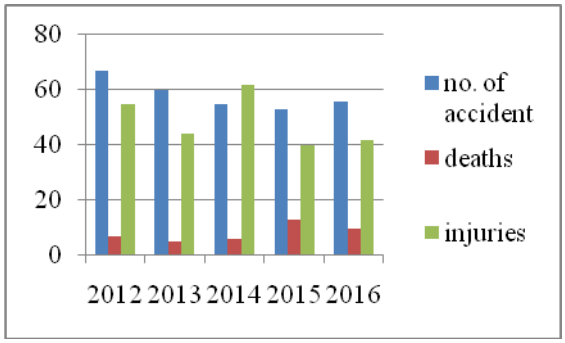


Fig. 3: Accident Statistics of Selected Stretch (ch.183.100 – ch.192.500)

Accident data from Vidyanagara and Tunganagara Police Station (ch. 192.500– ch.205.200)

Table 2: Year Wise Road Accident Statistics of Selected Stretch

Year	No. of accidents	Total no. of deaths	Total no. of injuries
2012	67	7	55
2013	60	5	44
2014	55	6	60
2015	53	13	38
2016	56	10	39

B. Spot SpeedStudy

Spot speed is the instantaneous speed at a particular section or a point. There are different methods are used. In the first method, the time taken by the vehicle to travel a short distance is determined. Then the instantaneous speed is determined. Then the instantaneous speed is measured by pre calibrated radar equipment which displays or records the speed in desired units such as kmph. In this project, Radar Gun is used.

Results of spot speed study (**ch.183.100– ch.192.500)**
Modal speed= **49** Kmph.

Design speed (98thpercentile) = **80**Kmph.
Maximum speed (85thpercentile) =**70**Kmph.
Minimum speed (15thpercentile) =**39**Kmph.

Fig. 4: Spot speed study using RADAR

At section from ch.183.100 – ch.192.500 (undivided 2 lane highway) spot speeds are summarized in table below.

Table 3: Frequency Distribution of Spot Speed Data

Frequency distribution of spot speed data				
Speed range Kmph	Mean speed Kmph	Frequency	Percentage frequency	Cumulative frequency
0-10	5	0	0	0
10 20	15	0	0	0
20-30	25	4	3.2	3.2
30-40	35	12	9.6	12.1
40-50	45	28	22.4	35.2
50-60	55	28	22.4	57.6
60-70	65	24	19.2	76.8
70-80	75	21	16.8	93.6
80-90	85	5	4	97.6
90-100	95	3	2.4	100
Total		125	100	

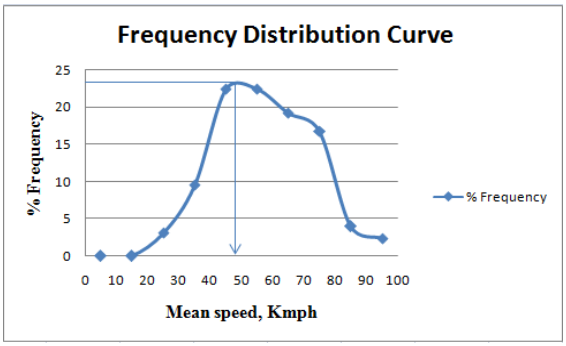


Fig. 5: Frequency Distribution Curve

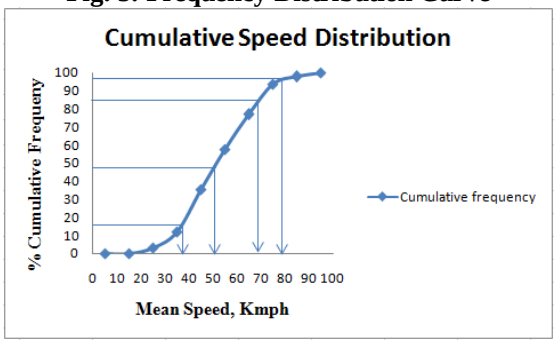


Fig. 6: Cumulative Speed Distribution Curve

At section from ch.192.500 – ch.205.200 (divided 4 lane highway) spot speeds are summarized in table below.

Table 4: Frequency Distribution of Spot Speed Data

Frequency distribution of spot speed data				
Speed range Kmph	Mean speed Kmph	Frequency	Percentage frequen	Cumulative frequenc
0-10	5	0	0	0
10 20	15	0	0	0
20-30	25	11	3.14	3.14
30-40	35	69	19.7	22.84
40-50	45	87	24.85	47.69
50-60	55	106	30.28	77.97
60-70	65	61	17.42	95.39
70-80	75	16	4.57	100
80-90	85	0	0	100
90-100	95	0	0	100
Total		350	100	

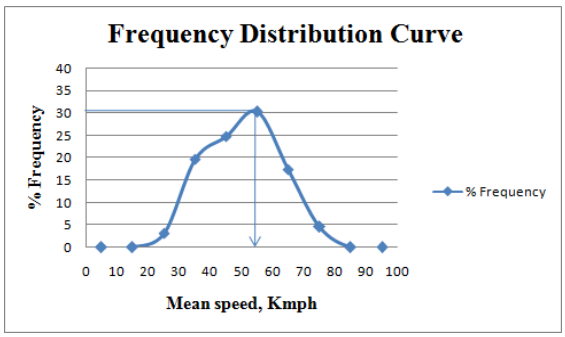
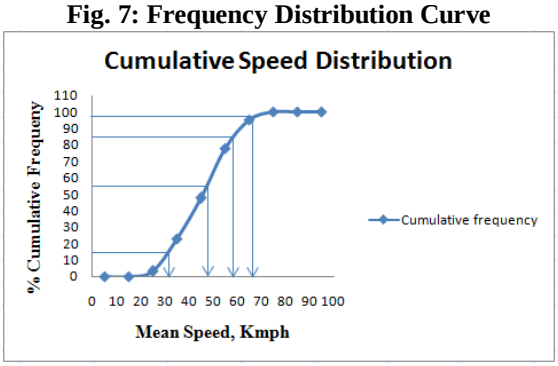


Fig. 7: Frequency Distribution Curve



Results of spot speed study (**ch.192.500– ch.205.200)**
Modal speed= **55**Kmph.

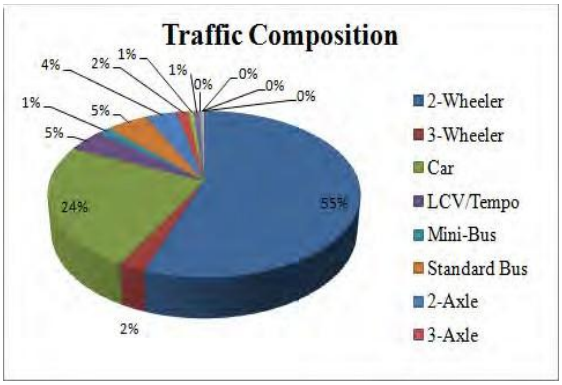
Design speed (98thpercentile) = **68**Kmph. Maximum speed (85thpercentile) = **60**Kmph. Minimum speed (15thpercentile) = **31**Kmph.

C. Traffic VolumeCount

A traffic count is a count of vehicular or pedestrian traffic, which is conducted along a stretch.Trafficvolumestudyis conductedtofindthenumber,movements,andclassification of vehicles at thegiven stretch. In this project, volume count isconductedfor3daysi.e.,weekendandoneworkingdayfor 12 hours from 6.00am to6.00pm.

Table 5: Traffic composition (ch.205.200 to ch. 192.500)

Types of Vehicles		AVERAGE DAILY TRAFFIC					
		Total Vehicles			% Composition		
		Bhadravathi to Shivamogga	Shivamogga to Bhadravathi	Both Direction	Bhadravathi to Shivamogga	Shivamogga to Bhadravathi	Both Direction
FAST MOVING VEHICLES	2-Wheeler	4364	3624	7988	56.11	54.42	55.33
	3-Wheeler	180	164	344	2.31	2.46	2.38
	Car	1740	1748	3488	22.37	26.25	24.16
	LCV/Tempo	392	275	667	5.04	4.13	4.62
	Mini-Bus	97	103	200	1.25	1.55	1.39
	Standard Bus	415	310	725	5.34	4.66	5.02
	2-Axle	318	223	541	4.09	3.35	3.75
	3-Axle	115	89	204	1.48	1.34	1.41
	Multi Axle	56	42	98	0.72	0.63	0.68
	Tractor	51	33	84	0.66	0.50	0.58
SLOW MOVING VEHICLES	Cycle	20	18	38	0.26	0.27	0.26
	Hand-Cart	8	10	18	0.10	0.15	0.12
	Animal Drawn	10	8	18	0.13	0.12	0.12
	Other (Specify)	11	12	23	0.14	0.18	0.16
Total Vehicles		**7777**	**6659**	**14436**	**100**	**100**	**100**



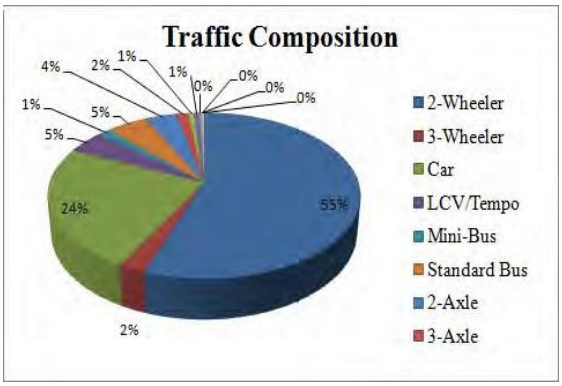


Fig. 9: Traffic Composition

Inthisstretchi.e.,fromch.205.200toch.192.500whichis4 lanehighwaysobservedlargeproportionoftwowheelersand cars. Vehicles like bicycles, tractors and animal drawn are very less in the entire study stretch. And also heavyvehicles like trucks are in considerableproportion.

D. RoadInventory

Road inventory survey was conducted in the selected stretch to know the existing conditions like the roadway width and footpath width, shoulder width, type of pavement, condition of pavement, shoulder, footpath, and details of cross road. Cross section includes width of carriageway, width of shoulders, median, drains etc. Road inventory survey is conducted to know the existing condition of the highway. In RSA, cross section are checked regarding their dimensions are accordance with IRC standards and their performances.

E. Traffic SignageInventory

Road signs are basically of three types namely, mandatory, cautionary,informatorysigns.Thereforetrafficsignage inventory is necessary to know present condition of traffic signs in the selected stretch

Fig. 10: Road inventory at 194.300 Km

F. Black spots on NationalHighway

Road accident black spot is a stretch of national highway of about 500m in length in which either 5 road accidents took placeduringlast3yearsor10fatalitiestookplaceduringlast 3years.WiththehelpofFIRcopiesaround8blackspotsare identified.

Fig. 11: Lack of sight distance

F. Road SafetyAuditing

Checklist 8- Alignment

Checklist 9- Cross Section

Checklist 10- Junctions

Checklist 11- Road Signs

Checklist 12- Road Markings

Checklist 13- Lighting

Checklist 14- Roadside Hazards

Checklist 15- Roadside Facilities

IRC: SP:88-2010provided the checklist for auditing. These checklists help toguide the road safety audit team. These checklists depict the performance and condition that affects the road network in safety point ofview.

IRC:SP:88-2010has provided 18 checklists for auditing.Fortheexisting highway and for this project checklist are listed as below.

From the road inventory survey, width of shoulder at the selected stretch is not as per IRC standards. The width is varyingfrom0.3mto3.0m.Duetothepoormaintenanceof shoulder vegetation covers the width of shoulder (earthen shoulder) and the strength of shoulder is poor. The fig.15 and fig.16 showing poorly maintained shoulder of inadequate width and strength. During rainy season condition of shoulders would worsen, results in the drainage problem and condition of the pavement may effected.

ROAD INVENTORY DATA

Road Name: Hirebrandur to Old Bellapura Cross — Road No: NH60 — Section: Km 183.100 to Km 186.900

From (Km)	To (Km)	Terrain	Land Use	Location	CARRIAGE WAY			SHOULDER						DETAILS OF CROSS ROADS					
					2 Lane			LEFT			RIGHT			LEFT			RIGHT		
					Type (BT/C C/OR /ER)	Width (m)	Condition (GT/GE /VG)	Type (BT/C C/Ob/ ER)	Width (m)	Condition (G/F/G /VG)	Type (BT/C C/OR/ ER)	Width (m)	Condition (G/F/G /VG)	Location (Km)	Type (BT/C C/GR/ ER)	Cross Width (m)	Location (Km)	Type (BT/C C/CR/ ER)	Cross Width (m)
183.600	183.700	Plain	Dry Agri.	Hirebrandur	BT	7.2	G	ER	1.8	F	ER	1.8	F	-	-	-	-	-	-
183.700	183.800	Plain	Dry Agri.	Paper Town	BT	7.2	F	ER	1.8	P	ER	2.0	P	-	-	-	-	-	-
183.800	184.300	Plain	Dry Agri./Pdct.	Paper Town	BT	7.2	F	ER	0.7	F	ER	1.2	F	-	-	-	-	-	-
184.500	184.600	Plain	Forest	Paper Town	BT	7.5	F	ER	0.5	F	ER	1.1	F	-	-	-	184.565	CR	4.20
184.600	184.700	Plain	Forest	Paper Town	BT	7.2	F	ER	0.6	F	ER	1.2	F	-	-	-	-	-	-
184.700	184.800	Plain	Forest	Paper Town	BT	7.5	F	ER	0.2	F	ER	0.9	F	-	-	-	184.760	CR	5.00
184.800	185.000	Plain	Forest	Paper Town	BT	7.1	F	ER	1.2	F	ER	1.3	F	-	-	-	-	-	-
185.000	185.300	Plain	Forest	Paper Town	BT	7.2	F	ER	1.4	F	ER	1.5	F	-	-	-	185.060	CR	3.50
185.300	185.400	Plain	BUBR	Ujampalli	BT	7.1	F	ER	1.3	F	ER	1.1	F	-	-	-	-	-	-
185.400	185.500	Plain	BR	Ujampalli	BT	7.2	F	ER	1.4	F	ER	1.2	F	-	-	-	185.470	BT	5.50
185.500	185.600	Plain	BR	Ujampalli	BT	7.1	F	ER	1.2	F	ER	1.4	F	185.550	BT	3.05	-	-	-
185.600	185.700	Plain	BU	Ujampalli	BT	7.0	F	ER	1.5	F	ER	1.5	F	-	-	-	-	-	-
185.700	185.800	Plain	BU	Ujampalli	BT	7.1	F	ER	2.2	F	ER	2.4	F	185.736	BT	3.50	185.736	BT	6.55
185.800	185.900	Plain	BU	Ujampalli	BT	7.1	F	ER	0.6	F	ER	2.0	F	-	-	-	-	-	-
185.900	186.600	Plain	BU	Ujampalli	BT	7.2	F	ER	1.0	F	ER	1.8	F	-	-	-	185.980	CC	3.60
186.000	186.400	Plain	BUBR	Old Bellapura	BT	7.0	F	ER	1.2	F	ER	1.4	F	186.060	BT	3.50	186.060	BT	5.50

Fig. 12: Inadequate width of shoulder

G. Median

In selected stretch more number of T- Junction are present.

Mostofthesejunctionhavepoorsightdistanceforthe minor roads due to the presence of vegetations, buildings etc. and alsosignboardsarenotinstalled;speedbreakersarenotused in minorroads.

Fig. 13: Damaged median at ch.202.300 Km

I. Visibility ofSigns

Fig. 14: Sign board covered with vegetation at ch.188.100 Km

Fig. 15: Poor condition of sign Board at ch.190.100 Km

Fig. 16: Poor visibility of Bus stop at ch.197.300 Km

Fig. 17: Vegetation covering over barrier

Fig. 18: Damaged parapet

V. CONCLUSION

Thepresentworkismadetoconductroadsafetyauditforthe existinghighwayi.e.,fromch.183.100–ch.192.500whichis bypasssectionandch.192.500-ch.205.200whichisfourlane highway. Accident data is collected from 3 police stations and it is observed that from 2012-16 accident rates is less varied. Because of recently upgraded four lanes national Highway-69fromkm192.200tokm205.200,thosehighway guidelines have been brought up abruptly. Be that as other relatedfactorswouldnotbringshouldthislevelforexample, roaduserbehavior,encompassingprevailingstatesandsoon.

Manyvillagescomealongtheprojectstretch,sointersections aremoreandalsopedestriantrafficandtwowheelertrafficis more. But safety measures such as sight distance, placement and maintenance of sign boards, marking at these junctions are not good. Throughout the stretch shoulder width is varyinganditiscoveredbyvegetation,soitcausesdrainage problem and bus bays are occupied for parking and some agricultural activities. Crash barriers are not maintained properly, markings on road, divider are averagely maintained.Reflectingpropertiesofsignboardsaredamaged due to irregularmaintenance.

Hence, there is needed to develop the knowledge about the trafficconditions,signboards,roadmarkingsamongtheroad users and regular auditing to improve the road safety is necessarybyhighwayauthorities.

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