

HYDERABAD TO YADAGIRI GUTTA ROAD SAFETY AUDIT AND ACCIDENT ANALYSIS

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ABSTRACT

In most regions of the world, the epidemic of road traffic fatalities is on the upsurge with over 1.2 million people die every year due to road crashes and about 50 million suffer nonfatal injuries. Motor vehicle population has grown at a compound annual growth rate (CAGR) of 10 per cent 2000-2013, fuelled by a rising tide of motorization. Concomitantly, traffic risk and exposure have grown. During the year 2014, there were around 5 lakh road accidents, which resulted in deaths of 134,513 people and injured more than 5 lakh persons in India. These numbers translate into 1 road accident every minute and 1 road accident death every four minutes. 1.5 the loss to the Indian economy due to fatalities and accident injuries estimated at 3% of GDP in 1999-2000 is particularly severe as 53.1% of road accident victims were in the age group of 25 to 65 year. Considering the above severity of the accidents recently National Highways Authority of India lunched massive Road Safety Audit Programmes to carry out the audit at Design stage, Construction stage as well as Pre-opening stage. The present study focuses on Road Safety Audit at construction stage conducted on NH-202 was discussed. The road safety audit at construction stage recommendations were given further improve the road safety at construction stage.

Keywords: Road Safety Audit, Construction stage, & National Highways Inframed.

1.Introduction

The National Highway No. 9(New NH No.65) starts from the intersection points of NH-9 & NH-7 at Hyderabad in the State of Andhra Pradesh and after traversing through Choutuppal, Chityala, Narketpally, Nakrekal, Suryapet, Sholapur, Vijayawada and terminates at Machhlipattanam (Seaport). The Project road starts from km 40.000 at Malkapuram from the outskirts of Hyderabad, the

capital city of Andhra Pradesh State and terminates at km 221.500 Totacherla. The project road (NH 9)(New NH No.65) “Starts” from Malkapuram Village at km 40.000 and “Ends” Totacherla village at km 221.500. Project includes developing the existing two lane carriageway to four lane dual carriageway configurations including strengthening of existing two lane between km 40.000 to km 221.500 on BOT basis and defined as “Project Highway”.



Index Map of the Project Highway



Index Map of the Project Highway Referencing System

The kilometer stones (km – stones) existing all along with entire length of the Project Highway is referred to as “Existing

Chainage” gives relationship between the “Existing Chainage” i.e. km – stone and the “Design Chainage” as per the field surveys using total station for the Project Highway.

Design Chainage Corresponding to Existing Kilometer Stone from Km 160.00 to km 221.50

Existing Chainage (i.e. Km stone)	Design Chainage (Km)	Existing Chainage (i.e. Km stone)	Design Chainage (Km)
Hyderabad – Vijayawada Section			
160+000	160+000	191+000	191+267
161+000	160+991	192+000	192+263
162+000	161+900	193+000	193+256
163+000	162+287	194+000	194+257
164+000	163+825	195+000	195+245
165+000	164+956	195+300	SHERMOHA MMAD PETA Bypass (km 195+075 to km 198+750)
166+000	165+940	196+000	
167+000	166+929	197+000	
168+000	167+928	198+000	
169+000	168+907	198+800	
170+000	169+904	199+000	199+333
171+000	170+897	200+000	200+328
171+800	AKUPAMU LA Bypass (km 171+725 to km 173+400)	201+000	201+324
172+000		202+000	202+313
173+000		203+000	203+288
173+400		204+000	204+284
174+000	173+920	205+000	205+270
175+000	174+910	206+000	206+341
175+700	KODADA Bypass (km 175+600 to km 183+525)	207+000	207+262
176+000		208+000	208+249
177+000		209+000	209+242
178+000		210+000	210+390
179+000		211+000	211+228
180+000		212+000	212+218
181+000		213+000	213+213
182+000		214+000	214+198
183+000		214+700	NAVABPET Bypass (km 214.700 to km 217+800)
183+600		215+000	
184+000	184+346	216+000	
185+000	185+340	217+000	
186+000	186+334	217+700	
187+000	187+325	218+000	217+776

Existing Chainage (i.e. Km stone)	Design Chainage (Km)	Existing Chainage (i.e. Km stone)	Design Chainage (Km)
188+000	188+314	219+000	218+776
189+000	189+295	220+000	219+776
190+000	190+285	221+000	220+776

1.2 Engineering surveys & investigations

The following engineering surveys & investigations shall be carried out for developing the project:

Data formats

The formats for carrying out various types of surveys have been derived from IRC: SP: 19 -2001 and as per the guidelines of MORTH (Ministry of Roads Transportation Highways).

Reconnaissance Survey

A detailed reconnaissance supplemented by thorough and in-depth visual investigations have already been carried out along the project road and completed which was aimed at a physical appreciation of the project road. The findings of the reconnaissance survey are presented in the form of linear plans.

Road Inventory

The condition of the project roads will be visually inspected with a view to broadly classifying the road conditions and preparing a suitable road inventory. Preliminary reconnaissance survey will be followed by road inventory surveys in order to capture the overall conditions of the roads.

Topographic Survey

A detailed topographic survey will be carried out along the proposed alignment using Differential Global Position System (DGPS), Total Station and Auto Level to collect sufficient topographic information to prepare a detailed digital terrain model – maps showing existing physical features and location reference along the alignment. A pair of inter-visible primary control stations will be installed at intervals not more than 5 km using DGPS.

- 1) Survey Corridor
- 2) Long Sections
- 3) Cross-Sections

Terrain

Most of the alignment passes through plain and rolling terrain from km 40.000 to km 160.000. The road from km 160.000 to km 221.500 traverses through plain terrain being on the plain of river Krishna.

As per IRC 73-1980 Code book

S.NO	Terrain Classification	Percent Cross slope of the Country
1	Plain	0-10
2	Rolling	10-25
3	Mountainous	25-60
4	Steep	Greater than 60

Rehabilitation, improvement and Upgradation

Since the existing carriageway is of flexible pavement, further improvement (including widening) on this will be considered with only flexible overlay treatment with the construction of shoulders as required. The additional two lanes flexible pavement is suggested. Similarly, for the bypass portions of Narketpally, Nakrekal, Akupamula, Kodada, SherMohammadPeta and Navabpet in Hyderabad – Vijayawada section flexible pavement option has been proposed for all the four lanes.

Requirement for additional right of way From km 40.000 to km 160.000

The average right-of-way (ROW) is about 30 m extending both sides of the existing road center line. This width is insufficient for accommodating the 4/6-lane highway. Thus, land acquisition is necessary. In villages and towns, the ROW is even smaller.

From km 160.000 to km 221.500

The average right-of-way (ROW) is about 30 m extending both sides of the existing road center line. This width is insufficient for accommodating the 4-lane highway. Thus, land acquisition is necessary. In villages and towns, the ROW is even smaller. The Right of Way varies from

17.85m to 60.0m (in proposed Akupamula bypass, where land Upto 60.0m is yet to be acquired). In most of the urban areas, properties exist adjacent to carriageway.

PAVEMENT DESIGN

Pavement design is a very critical component for the urban arterial highway and the requirements will be analyzed in depth taking into account relevant design parameters such as traffic projection, design cumulative ESA, materials characteristics and the climatic conditions. The cumulative ESA (Equivalent Standard Axle) will be made available from the traffic forecast model. An appropriate fixed value for the ultimate design life and the progression of ESA values for phased construction for different vehicle categories will be established for the project road. Vehicle damage factor will be available from the axle load survey. As strengthening course, flexible pavement will be provided designed based on IRC: 81-1997. Strategy for the materials to be used in profile corrective course will be decided after ascertaining the required thickness and the due consideration will be given to economize the item without compromising on the needed strength.

Both rigid and flexible pavement options will be exercised in case of additional two-lanes. Life cycle cost analysis will be carried out in order to decide the most viable option. Flexible pavement will be designed not merely on the method given in IRC: 37-2012 but the layer equivalency theory given in AASHTO will also be applied along with the serviceability factor in order to optimize the crust design. Rigid pavement will be designed as per the provisions contained in IRC: 58-2012. However, dowel and tie bars will be designed based on the AASHTO considerations.

Besides the above, designs for service roads, toll plaza, parking bays and cross roads will be carried out. Pavement management system will be evolved.

Maintenance needs (during construction and post- construction) and the future of abandoned road stretches.

Classified Traffic Volume Count From km 40.000 to km 160.000

Traffic Volume Count for 7 days conducted at 4 locations along the project highways in December 2015. Average Daily Traffic is presented in below table.

Average Daily Traffic

Volume Count Location	Km-50.00	Km-110.00	Km-130.00	Km-152.00
Two-Wheeler	2654	718	1237	582
Three-Wheeler	1095	609	1086	529
Car/Jeep	3407	1607	1797	908
Mini-Bus	50	38	71	30
Bus	1751	1075	1197	574
LCV	878	138	454	106
2-Axle	3306	2562	2548	1538
3-Axle	1979	1328	1545	978
MAV	198	123	199	92
Tractor With Trailer	58	51	194	52
Tractor Without Trailer	56	24	91	21
Cycle	178	151	314	164
Cycle Rickshaw	5	2	20	3
Animal drawn vehicles	1	1	16	4
Horse Cart	1	0	0	0
Others	0	2	2	2
Total Non-Motorised Vehicles	185	155	351	173
Total Motorised Vehicles	15434	8273	10420	5417
Total Vehicles	15618	8428	10772	5590
Total PCU	29845	18717	22677	12073

renewal courses will be defined. A strategy will be formulated to suggest utilization

From km 160.000 to km 221.500

Traffic Volume Count for 7 days conducted at 2 locations in each section along the project highways in November 2015. Average Daily Traffic is presented in below table.

Survey Location	Hyderabad – Vijayawada		
	At km 163	At km 216	
Car	1082	1512	
Auto Rick	840	1198	
Two wheelers	1070	1218	
Mini Bus	2	40	
Bus	786	1138	
LCV	308	126	
2-Axle Truck	823	1265	
3-Axle Truck	874	1133	
MAV	82	100	
Agr. Tractor	52	45	
Agr. tractor with trailer	91	35	
Total Toll able Vehicles	3990	5311	
Slow Moving and Toll Exempted Vehicles			
Cycle	648	543	
Cycle Rick	33	43	
Animal / Hand Cart	6	4	
Other Toll exempted vehicles	Car	9	10
	LCV	1	4
	Truck	1	1
	Bus	1	1
Total Motorised Vehicles	6065	7836	
Total Non motorised Vehicles	687	590	
Total Vehicles	6752	8426	
Total Motorised PCU	11301	14883	
Total Non Motorised PCU	426	382	
Total PCU	11727	15265	

Average Daily Traffic

Traffic surveys and Analysis

Traffic surveys will be carried out manually under normal conditions for durations as shown in the following table. Sufficient number of field staff under supervision of experienced traffic engineers will be engaged. The field staff will be properly trained about their work, responsibilities and safety in field before start of actual surveys. The field staff will be continuously monitored by the supervisors and the traffic engineers. The proposed traffic survey locations for each type of survey are shown in the following map.

Primary Surveys - Schedule

To capture traffic flow characteristics, travel pattern, speed characteristics, users' preference regarding toll imposition on traffic passing through the project road and other characteristics related to miscellaneous requirements on the Project Road, the following primary traffic surveys were conducted

- Classified Traffic Volume Count (TVC)
- Origin-Destination Survey (OD)
- Axle Load Survey
- Turning Movement Survey
- Speed and Delay Survey
- Truck Parking Survey
- Willingness to pay Survey
- Pedestrian/Cattle crossing Survey
- Wayside Amenities Survey

In addition, Consultants have also collected accident data along project road from secondary sources to identify the accident-prone sections on the project road, if any. Traffic survey stations for carrying out TVC and OD surveys were selected after a site reconnaissance and discussed with the NHAI officials considering the following parameters:

- The station should represent homogeneous traffic section
- The station should be outside urban and local influence

- The station should be located in a reasonably level terrain with good visibility
- The O-D stations should preferably be located near police stations for the convenience and safety of stopping vehicles for roadside interview survey.

➤ Axle Load survey

Axle Load Survey was carried out at one location (km 163) on Hyderabad - Vijayawada section. The main purpose for carrying out the survey was to assess the overloading pattern on the corridor and to estimate Vehicle Damage Factor. During the survey, Axle load of commercial vehicles, i.e. LCVs, 2-Axle, 3-Axle, Multi Axle Trucks and Buses, were weighed on random basis. The vehicles were stopped with the help of police and the drivers were directed to stop their vehicles in such a way that wheel of each axle can be weighed using portable Axle Load Weighing Pad. The readings were recorded by trained enumerators for each axle separately and the surveys were carried out for 48 Hours. A continuous traffic volume count survey will be carried out along with the axle load survey. The Axle load survey will be carried out on a random sampling basis for commercial vehicles (Freight Vehicles) along with few passenger buses to find out if they are overloaded

➤ Turning Movement survey

The turning movement survey was conducted at eight major intersections falling on the project corridor to obtain information on directional movement of traffic at all major intersections along the project road. The survey was conducted for twelve hours from 8.00 am to 8.00 pm with the help of trained enumerators. Each turning movement at the intersection was recorded by deploying enumerators in sufficient numbers at suitable locations. The data on peak hourly directional movement would be used to analysis and design the intersection.

Speed & Delay survey

Highway improvements result in increase in vehicle operating speed and reduction of congestion. Speed and delay studies on the existing facilities provide basis for estimating the causative problems and benefits of the improved facility. The study will be carried out using 'Moving Car Method' using new technology vehicles during the identified morning and evening peak periods. The test vehicle will run separately in both directions on each link (between major junctions) of each traffic homogeneous section of the project road. Three round trips will be carried out on each link section during morning and evening peak periods. The travel time, stopped delay and reasons for the stopped delay will be noted down in the prescribed survey format.

Pedestrian / Animal Cross Traffic Survey:

For carrying out these surveys, the Highway Engineer and the Traffic Engineer shall jointly identify the spots/locations popularly used by pedestrian and animals for crossing. For pedestrian crossings, such spots are generally at junctions/intersections, schools, hospitals, religious places and market/commercial areas. For animal crossings, the locations are close to village roads, paths, tracks leading to fields or where the village settlement is on both sides of the road. Such counts/surveys shall be carried out manually for head count, during peak hours in mornings and evenings on a working day. These survey locations will be decided once the alignment for bypasses or realignments are finalized for towns / villages.

Hyderabad – Vijayawada Section

The important dispersal/generation locations identified along the project road sections include:

- Munagala (km 160), starting point of project road.
- Kodad (km 178 to km 182), a major town
- Jaggayapet (km 202), connected to project road by SH 26

- Navabpet (km 216.00), end point of project road

Considering the above mentioned traffic generation / distribution points, total project road is divided into two homogeneous road sections for the purpose of analysis and presentation of traffic and travel characteristics. Gives the details of the homogeneous sections defined for the study.

Identification of Homogeneous Road Sections

The project road sections have been divided into homogeneous road sections on the basis of traffic generation and dispersal nodes located along the project road.

Flexible Pavement

The width of the road varies between 3.0m and 7.0 m and is hardly sufficient for passing of two vehicles simultaneously. However, in some of the stretches where crest curve exists on steep gradients the existing carriageway width ceases to intermediate lane width of 5.5 m.



Road Cross with section 3.3m Road Width



Road Cross section with 7.0m Road Width

From km 40.000 to km 160.000

The pavement design for new carriage way is done with an annual growth rate of



traffic of 5% as per NHAI's suggestion. The following design traffic in MSA has been arrived. MSA (Million Standard Axles) calculations

Year	5 Years	10 Years	15 Years
MSA at VC-1	41	93	160
MSA at VC-2	30	68	117
MSA at VC-3	32	73	126
MSA at VC-4	20	44	76

Hence for the stretch from km 40-100, the traffic taken for the pavement design was 150 MSA, since there are no bar charts more than 150 MSA in IRC 37-2001, whereas it is 120 MSA for the stretch of km100-160. Hence as per IRC 37-2001 the following thickness of layers is suggested.

Pavement Thickness for New Carriageway (Main Carriageway)

Layer Name	Thickness (mm) km 40-100	Thickness (mm) km 100-160
BC	50	50
DBM	160	150
WMM	250	250
GSB	200	200
Total	660	650

The flexible pavement thickness for service road is give below considering the 5msa as the loading effect.

Pavement Thickness for New Carriageway (Service Road)

Layer Name	Thickness (mm)
SDBC	25
BM	50
WMM	250
GSB	200
Total	525

From km 160.000 to km 221.500

A broad variation in pavement thickness along the project road has been observed. However, the pavement composition of the existing pavement is generally same consisting of bituminous wearing coat, base and sub-base courses. It is observed that the material composition of base and sub-base is same. The wearing coat (Bituminous) varies from 100 mm to 250 mm, base and sub-base course varies 120mm to 350mm. The bituminous course consists of 2 to 3 layers, the base material is generally loose and dry, and the subgrade below the base course consists of fine-grained clay and at some locations gravel.



Narketpally Bypass 6 lane VUP at Khamam-Suryapet Junction



No Road Markings Sharp curve



Sharp Curve & No road markings Accident Zone @Suryapet

Detail of Minor Junctions

Sl. No.	Design Chainage (km)	Existing Junction Type	Proposed Junction Type/Junction
1	41.265	Y-Junction	At Grade T-Minor At Malkapuram
2	44.422	Y-Junction	At Grade T-Minor At Burlagudam
3	45.710	T-Junction	At Grade T- Minor At Khaithapuram
4	47.060	T-Junction	At Grade T-minor At Pochampalli
5	49.660	Y-Junction	At Grade T-Minor At DharmajiGudem
6	53.155	T-Junction	At Grade T- Minor At Choutuppal Bus Station
7	54.630	T-Junction	At Grade T- Minor At Valigonda
8	57.710	T-Junction	At Grade T- Minor At AnkireddyGudem
9	59.660	Y-Junction	At Grade T-Minor At Panthangi
10	68.215	T-Junction	At Grade T- Minor At Pittampalli
11	80.260	T-Junction	At Grade T- Minor At Chityala Railway Station
12	82.412	T-Junction	At Grade T- Minor At Uttamarthi Village
13	93.870	Y-Junction	At Grade T-Minor At Nalgonda
14	101.400	Y-Junction	At Grade T-Minor At Kurumarthi
15	109.300	T-Junction	At Grade T- Minor At Adavibalaram
16	123.240	Y-Junction	At Grade T-Minor At Chikatigudem
17	125.556	4 Legged	4 Legged At Uppala Pahad

Sl. No.	Design Chainage (km)	Existing Junction Type	Proposed Junction Type/Junction
18	126.614	Nil	At Grade T- Minor At Tekumetla
19	127.845	Nil	At Grade T- Minor At Tekumetla
20	135.275	Y-Junction	At Grade T-Minor Anjanapuram
21	137.980	T-Junction	At Grade T- Minor
22	142.660	T-Junction	At Grade T- Minor
23	143.840	Y-Junction	At Grade T- Minor
24	158.845	T-Junction	At Grade T- Minor

From km 160.000 to 221.500

There are 4 numbers of major and 11 minor junctions in Hyderabad – Vijayawada section. For improvement of major intersections underpass has been proposed. Minor intersections are proposed to be developed as per IRC standards. The approach roads are basically SH, MDR & ODR along the project road.

4.1 Bridges & Culverts

An inventory of all the structures including culverts, bridges, flyovers, viaducts, etc., along the project road has since been commenced, as per clause the TOR. The inventory for the bridges, viaducts and ROB/RUB would include the parameters required as per the guidelines of IRC: SP: 35-1990. The findings of the bridge and structures inventory will be submitted in tabular format along with relevant physical and hydraulic parameters, in the Draft Feasibility Report.

Condition Survey for Bridges, Culverts and Structures: The Survey formats finalised in consultation with NHAI will be adopted for presentation of the data/details. Inventory survey will be carried out for each structure and summary will be set out in a Separate Report.

The Consultant will examine all existing bridges and cross-drainage structures on the project roads following the guidelines of IRC:SP:35-1990 "Guidelines for Inspection and Maintenance of Bridges" in order to determine their structural conditions, adequacy of waterway openings, load carrying capacity, anticipated future serviceability and the extent of repair/ strengthening and

rehabilitation measures needed.

The condition survey of the existing bridges will be carried out to assess:

- Structural condition
- Durability aspects
- Hydraulic efficiency

As a component of condition survey, visual observations will be made by senior bridge specialists keeping in view the requirement of IRC: SP: 35-1990 “Guidelines for Inspection and Maintenance of Bridges” and IRC: SP: 40-1993 “Guidelines on Techniques for Strengthening and Rehabilitation of Bridges”.

Visual observations to be carried out during the condition survey would be mainly to find out the distresses. In addition to the superstructures, the masonry substructures will be inspected to locate cracks and loose mortar in joints, especially for pier and abutments.

The wing walls and the return walls will be inspected to locate any separation of these from the abutment. Any unusual differential settlement which gives rise to cracks in the return or wing wall will be looked for.

For any distress observed, the extent or the magnitude plays a vital role and consequently the extent of the distress needs to be noticed. Thus evaluation of the distress is of paramount importance. In order to evaluate the distress in the form of a visible entity, it is necessary to know the reasons or causes of the identified distresses which would be briefly elucidated.

Load Carrying Capacity or Rating of Bridges - The assessment of the load carrying capacity or rating of existing retained bridges will be carried out in one or more of the following scenarios:

- when the design live load is less than that of the statutory commercial vehicle plying or likely to ply on bridge;

- if during the condition assessment survey and supplementary testing the bridge is found to indicate distress of serious nature leading to doubt about structural and / or functional adequacy; and

- Design live loads are not known nor are the records and drawings available.

The evaluation of load carrying capacity of the bridge will be carried out as per IRC: SP: 37-2010 “Guidelines for evaluation of Load Carrying Capacity of Bridges”. In line with the recommendations, as far as possible, the analytical and correlation method will be used for the evaluation of load carrying capacity of the bridges.

Culverts

The table given below indicates the existing CD works with widening/reconstruction requirement. The recommendations need to be verified at site and detail designs developed for each case in consultation with independent consultant. The details of each type of culvert, number of culverts require minor repair / widening and reconstruction indicates the existing CD works with widening/new construction requirement. The recommendations need to be verified at site and detail designs developed for each case in consultation with independent consultant.

The details of each type of culvert, number of culverts repair and widen and new construction are given in **table**

Details of improvement for Culverts

Type of Culvert	Number of Culverts and Condition		
	Existing	Repairs and Widen	New construction
Hume Pipe	43	30	13
Box	4	-	4
Slab	67	31	36
Total	114	61	53

➤ **Bridges**

Parallel bridges are proposed to be built either on upstream side or on downstream side as per site requirement wherever feasible as per site requirement span arrangement have been kept similar to the

existing bridges. In some cases, a combination of two/three spans only one span to cover the stream has been adopted. The longest bridge will be over river Musi. Their location, span arrangement and length and type of structure are listed below in

➤ **RUB (Road under bridge)**

In respect of RUB portion following points shall be taken care of:

- i) The RUB shall be designed, constructed & maintained as per the requirement of Railway Department
- ii) The Concessionaire shall enter into a tripartite agreement with Railways and Authority.
- iii) It is the responsibility of the concessionaire to obtain all necessary approvals / clearances from Railways in case of any deviations from the proposed design.
- iv) The concessionaire shall obtain approval of GAD and prepare detail design drawings of the RUB in consultation with Railways w.r.t. type of traction, future plans, vertical and horizontal clearance etc. and get it approved from Railways. The various departmental charges payable to Railways, except 2% for approval of GAD, shall be borne by the Concessionaire.
- v) The RUB structure shall be constructed and maintained by concessionaire under supervision of Railways.

➤ **Toll plazas**

Two toll plazas shall be provided by the concessionaire on the Project Highway from km 40.000 to km 160.000.

One toll plaza has been proposed at km 205+200 on Hyderabad – Vijayawada Section from km 160.000 to km 221.500.

➤ **Truck Layby** The provision of truck lay-byes shall be governed by site requirements and parking demand and as per the guidelines of MoRT&H Technical circular no. RW/34032/5/88 PO-II dated 22.8.88. Parking shall be designed in the form of rectangle/trapezoidal area parallel to and separated from the carriageway by a physical barrier. The parking lots shall

have necessary facilities like repairing, eating, resting, fuelling and shall be suitably landscaped. Location of Lay Bye is given in below tables.

Proposed Location of Truck Lay-Byes from Km 40.000 to km 160.000

Sl. No.	Chainage	Side
1	48.870	LHS
2	63.280	LHS
3	123.799	LHS
4	135.340	LHS
5	158.121	LHS

Proposed Location of Truck Lay-Byes

S.No.	Chainage	Side
1	189/4-6	RHS
2	201/6	LHS

Location of Bus Shelter on Service Road along Project Highway

Sl. No.	Chainage (km)	Side	Name / Location	Sl. No.	Chainage (km)	Side	Name / Location
1	163.00	Both	Munagala	9	194.00	Both	S.M. Peta
2	172.50	Both	Akumula (Realignment)	10	196.50	Both	S.M. Peta (Bypass)
3	175.00	Both	Komarambanda	11	202.00	Both	Chillakallu
4	184.00	Both	Kodada (Bypass)	12	208.00	Both	Gouravaram
5	186.00	Both	Dwarakunta	13	212.00	Both	Konakanchi
6	188.50	Both	Ramapuram	14	215.00	Both	Navabpet (Realignment)
7	191.00	Both	Garikapadu	15	216.00	Both	Navabpet (Realignment)
8	192.00	Both	Balusupadu	16	220.90	Both	Anasagaram

ROAD SAFETY AUDIT REPORT

Road Safety Audit (RSA) is a formal procedure for assessing collision potential and safety performance in the provision of new roads and schemes for the improvement and maintenance of existing roads. However, its systematic application can also ensure that a growing awareness

about good road safety principles is achieved throughout in highway planning, designing, construction and maintenance phases.

This Road Safety Audit aims to:

- Minimizing the likelihood of crashes.
- Ensuring that, if a crash occurs, the likelihood of the injury is minimized
- Ensuring that safety related design criteria have been met.

Alignment and Road Safety

The horizontal alignment of the project road is straight in majority of the project road section with occasional sharp curves. Traffic signs are missing at many locations on the project road. Very few/No warning signs exist before the junction and curves. At minor/major junction's km stone are observed showing where the cross road leads to. Horizontal alignment is very poor in most of the sections and where crest curves exist with steep gradient, horizontal curves overlap with vertical curves resulting in poor visibility and making it very unsafe for the road users. The embankment height varies from 2.0 m to 3.0 m and the soft shoulder is poor at many locations with erosion/breaching of side slopes.

Parking management on the project corridor

- It has been observed that vehicles are parked on the highway for varying lengths of time, which can be attributed to lack of understanding of highway etiquettes and sometimes out of necessity as there are no stopping lanes along the corridor in case of the need for a driver break or vehicle breakdown. Parking may also occur because of the lower parking capacity available at the ports. The presence of truck parking alongside the carriageway can result in an increased number of collisions, particularly at night.

Recommendation

Identify and provide adequate parking facilities which are signed and have

carriageway markings at appropriate locations for motor vehicles with signs in accordance with IRC: 67-2012. Working with the help of police, ensure that running junctions are kept clear from parked or waiting vehicles. It helps in preventing drivers from parking on the traffic lanes.

Unauthorized median openings

Reflectorized delineators at low embankments up to 3.0 meters height. Speed breakers / rumble strips not provided
Solar blinkers and solar lighting at junctions

Conclusion

It is safe to say that AASHTO's guidelines on geometric design are crucial to transportation engineering because they emphasize the safety of the driver, providing maximum efficiency of traffic operations and comfort to road users. Each of the design consideration above is promoting the safety of the driver but even so, more research should be conducted in the future so that these guidelines can be improved and so that good design can produce increased traffic safety as ever more users come to our streets and highways.

References:

1. *Geometric Design of Highways –American Association of state Highways and Transportation Officials.*
2. *Intersection informational Guide by Steyn, Hermanus*

Codes Referred:

1. IRC: SP: 73-1980
2. IRC 37-2012
3. IRC: 62-1976