

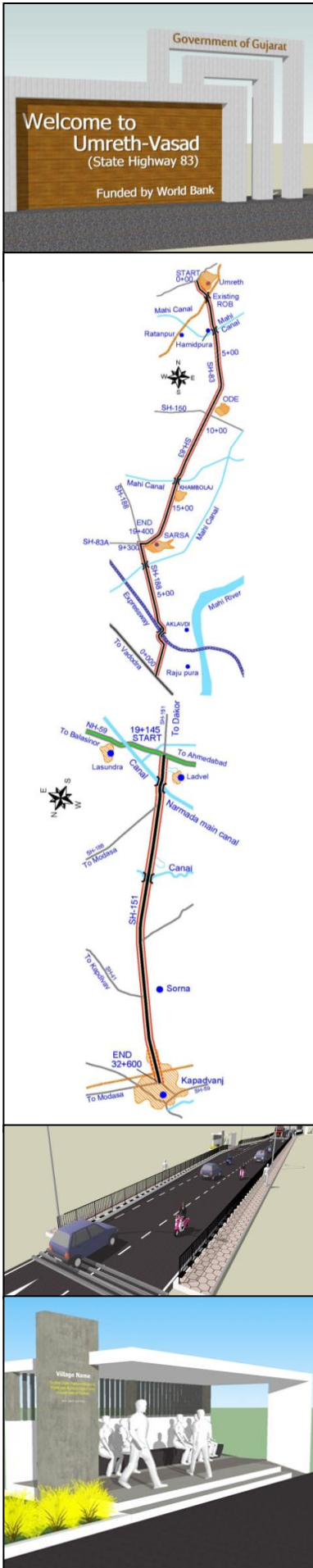
**ROADS AND BUILDINGS DEPARTMENT
GOVERNMENT OF GUJARAT**

**Project Preparatory Works Consultancy Services for
Gujarat State Highway Project - II**

Detailed Project Report

Executive Summary

(UMRETH – VASAD, LADVEL – KAPADVANJ)



January 2013



EXECUTIVE SUMMARY

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

1. Gujarat is one of the versatile and dynamic states in India. The state has established itself on stronger economic foundation. Over the last decade the name of “Gujarat” has emerged synonymous with progress and vibrancy. Government of Gujarat (GoG) through Roads and Buildings Department (R&BD) is thriving to deliver better than the best road infrastructure for the communities.

2. Gujarat roads, managed by R&BD, are known as one of the best in the country. R&BD is successfully managing its road assets through various flagship programs of GoG, besides multilateral funding and Public Private Participation. The Gujarat State Highway Project – I (GSHP-I) successfully implemented by R&BD, GoG through 2001 to 2007 with the World Bank assistance, has set many bench marks for other states to follow. The state appreciating need of sustenance of its economic growth, endorses that the infrastructure is one of the key and further its enhanced quality is a great value addition.

3. GSHP-I project umbrella before its closure itself rooted efforts towards second highway project for the state. The Updated Strategic Options Study (USOS) for the Core Road Network of the Gujarat State was carried out in 2005-06 to this respect and the same was duly revalidated in 2010. This study has prioritised road sections on strategic parameters to arrive at about 1,600 km road length. R&BD, GoG with in-principal agreement with the World Bank (WB) has finalised project budget as Rs. 2,100 crore. As a pre-requisite for loan appraisal process with the WB, R&BD, GoG selected about 397.9/460 km of road length for project preparatory works.

4. R&BD, GOG has taken a step forward by selecting LEA Associates South Asia Pvt. Ltd. (LASA) as Project Preparatory Works Consultant. Project Preparatory Works Consultancy Services (PPWCS) mandates the consultant for detailed engineering project report preparation along with procurement documents for selected 397.9 km road length.

1.1.1 Project Corridors

5. The corridors are selected by R&BD across the state to have representation of various project interventions like four laning, wide two laning and maintenance. The list of project corridors at a glance is furnished through Table 1.1. The map showing project corridor is provided as Map 1.2.

Table 1.1: List of Project Corridors

Work Type	Sr. No.	Link Name	SH No.	Length (km)
Two Laning / Wide Two Laning	1	Lunawada – Khedapa (Border)	SH-02, SH-152	56.70
	2	Bayad – Lunawada	SH-69,SH-63, VR/MDR	44.56
	3	Dhansura – Meghraj	SH-145	46.65
	4	Gondal – Atkot	SH-01	35.40
	5	Dhandhuka – Dholera	SH-20	27.00
	6	Umreth- Vasad (including Kapadvanj-Ladvel)	SH-83,SH-188, SH-151	35.45
	7	Dabhoi – Bodeli	SH-11	38.60

Work Type	Sr. No.	Link Name	SH No.	Length (km)
Four laning	8	Mehsana-Himmatnagar	SH-55	66.15
Rehabilitation	9	Paliyad-Dhandhuka	SH-001	46.00

Source: As provided in Terms of Reference (ToR)¹

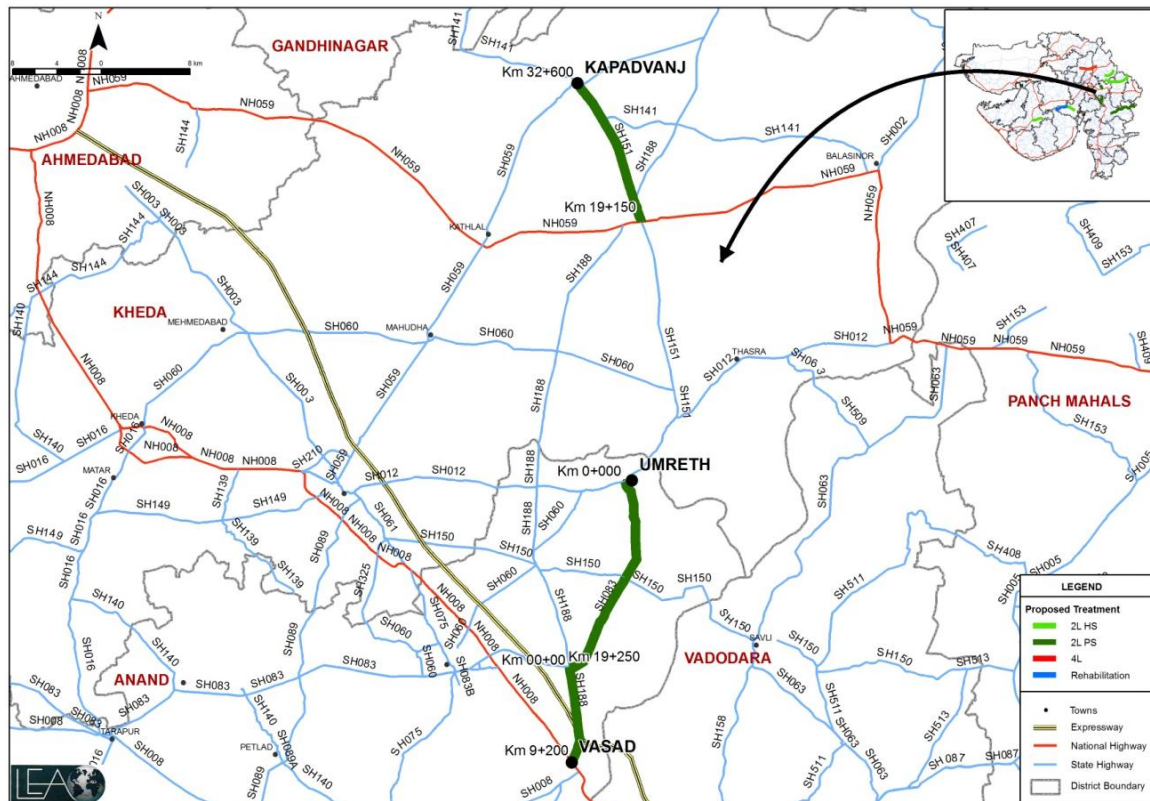
1.2 BROAD OBJECTIVES AND SCOPE

6. The broad objective of the assignment is to have detailed engineering project ready for bidding. It includes economic analysis for each section, integration of road safety audit in final design, implementation and O&M along with Environmental Impact Assessment, Environmental Management Action Plan and Rehabilitation and Resettlement Studies as per World Bank Guidelines.

Project Intervention	Total Length (Km)
Widening to tWide 2L	286.9 km
Widening to 4L	66 km
Maintenance/Rehabilitation	45 km
Total length	397.9 km

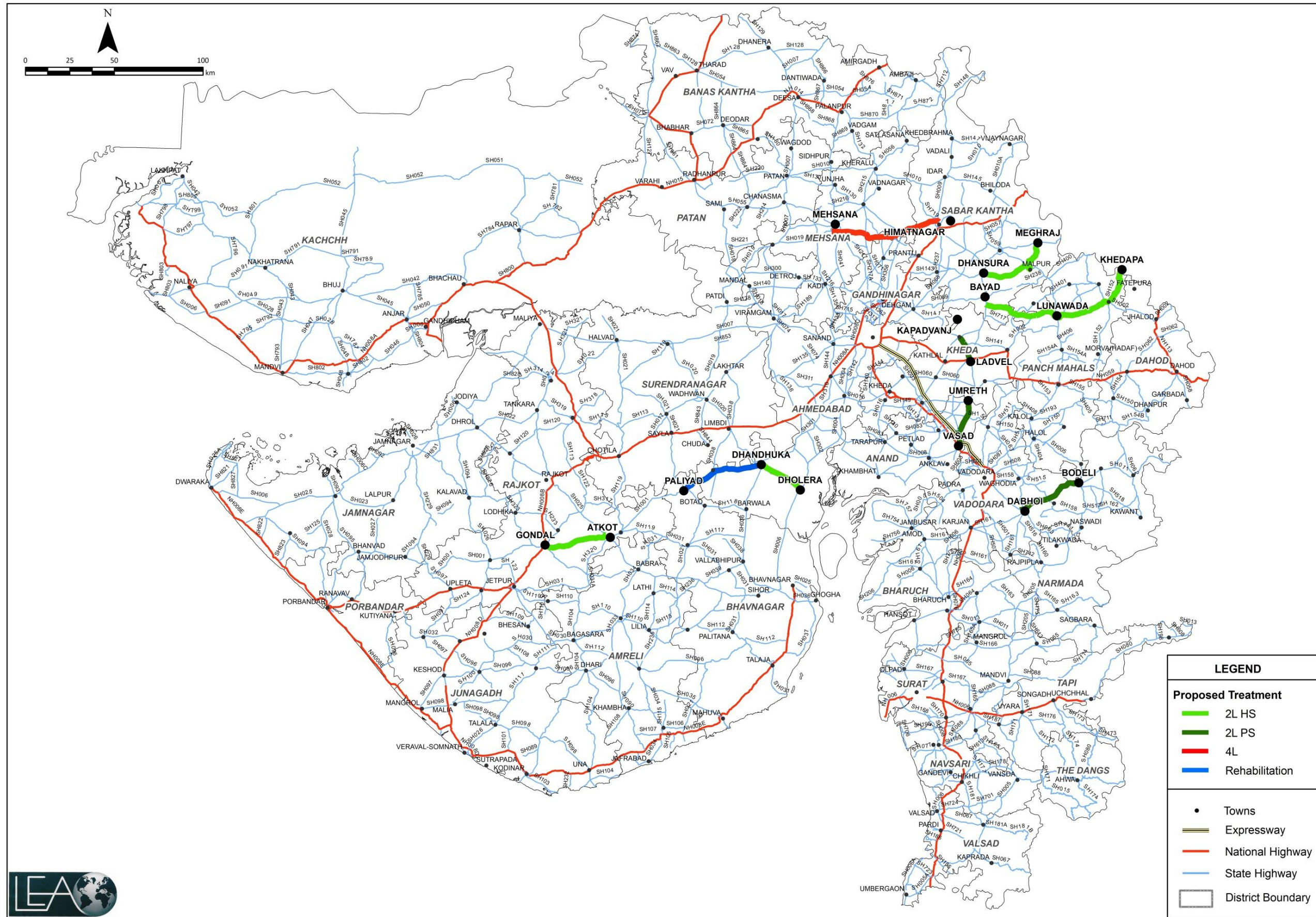
1.3 DETAILED PROJECT REPORT

7. This Executive Summary of DPR pertains to two laning with paved shoulder of the project corridor Umreth-Vasad (SH-083&SH-188) and Ladvel-Kapadvanj (SH-151). The key map showing project corridor is presented in Map 1.1.



Map 1.1: Map Showing Project Corridor

¹ Bodeli-Alirajpur Corridor left out as part of GSHP-II as it is being declared as National Highway



Map 1.2: Project Corridors

2 SOCIO-ECONOMIC PROFILE OF THE CORRIDOR

8. **Population Distribution:** The project corridor passes through 3 talukas covering a total population of 9.06 lakh in 2001 which increased to 10.6 lakh during 2011. Population of project corridor talukas grew at an Average Annual Growth Rate (AAGR) of 1.7 percent during the year 2001 to 2011.

9. Total 13 census villages and 3 towns (Umreth, Ode and Kapadvanj) abut the project corridor. Population of these villages/settlements as per 2001 census is 162,882, which is almost 18 percent to the project corridor talukas population. Settlements seen along the corridor are Umreth, Ode, Khambholaj, Sarsa and Kapadvanj. The total number of HH along project corridor is 31,480 constituting an Average Household (HH) size of 5.2.

10. **Age and Sex Ratio:** The overall population below 6 years age in project corridor taluka is 13 percent. Average sex ratio for project corridor talukas during 2001 was 912 which increased to 928 during 2011. For the project corridor villages, the analysis for sex ratio reveals 920 females per thousand males.

1. **Juvenile Sex ratio:** Similarly, looking into the Juvenile sex ratio it was analysed that as against the juvenile sex ratio of 847 for project corridor talukas, the project corridor villages had the sex ratio of 849.

11. **Literacy Rate:** As per the Provisional Census 2011, project corridor talukas possess literacy rate of 66 percent which was nearly 53 percent during 2001. Average literacy rate in project corridor villages is 55 percent; this constitutes 63 percent male literates and 46 percent females.

12. **Urban Rural Population:** Urban population in project corridor talukas during 2001 was 3.30 lakhs which has increased to 4.49 lakhs as per census 2011. Amongst all the project corridor talukas, the share of urban population is higher in Anand taluka. As per census 2001, settlements abutting project corridor comprises 3 towns (Umreth, Ode and Kapadvanj) for the length of 41km.

13. **Occupational Structure:** Total workers according to census 2001 in project corridor taluka are 3.67 lakhs which comprises 81 percent workers classified as main workers and rest 19 percent as marginal workers. The total workers in project corridor settlements are 63,110. Workers composition along the corridor shows high share of workers engaged in others sector followed by agricultural sector.

14. **Workforce Participation Ratio:** The Workforce Participation Ratio (WPR) for project corridor taluka in 2001 was 41 percent. Comparing and analysis the male WPR and Female WPR, it was recorded that the female WPR is merely 26 percent as against the male WPR of 54 percent. The average WPR for Project corridor settlements is lower than the Talks WPR.

15. **Schedule Caste and Schedule Tribe Population:** As per Census 2001, total SC and ST population along the corridor accounts for the figure of 12,342 which is nearly 8 percent to total population for settlements along the project corridor. Primarily, the predominant group amongst the social groups is that of SC community. Largest share of SC community is concentrated along Kapadvanj, Umreth and Vasad village/settlements.

3 CORRIDOR CHARACTERISTICS

3.1 PROJECT CORRIDOR

16. The project corridor Umreth-Vasad attracts number of tourists to nearby pilgrimage centre Dakor. The corridor in both the stretches provides connectivity to NH-59 and NH-8 as an intermediate link to other state highways. The Kapadvanj-Ladvel section provides connectivity to NH-59 to northern part of Gujarat from Kapadvanj while bridging this gap Umreth-Vasad section provides good and short, toll free alternative to either NH-8 or NE-1 at present. Normally interstate traffic is normally using these connectors. The project corridor falls in central region of Gujarat State. The project corridor comprises three sections with different state highways. First section is from Umreth-Sarsa (SH-83), second section joining Vasad from Sarsa (SH-188), and a third distant section Kapadvanj to Ladvel (SH-151) connecting NH-59 at Ladvel. The existing corridor characteristics are presented in Table 3.1.

Table 3.1: Existing Corridor Characteristics

Sr. No.	Components	Details		
1	Corridor Name and SH No.	Umreth-Vasad and Kapadvanj-Ladvel (SH-83, SH-188, SH-151)		
2	Sections	Umreth-Sarsa (SH-83)	Sarsa-Vasad (SH-188)	Ladvel-Kapadvanj (SH-151)
3	Districts	Anand		Kheda
4	Chainage (km)	Start	End	Total
	Umreth-Sarsa (SH-83)	0+000	19+250	28.4
	Sarsa-Vasad (SH-188)	0+000	9+200	
	Ladvel-Kapadvanj (SH-151)	19+145	32+600	
5	Total Length of Corridor (km)	41.85		
6	RoW (m)	24		
7	Carriageway width (m)	7	7	7
8	Intersection/Junction	4		3
9	Traffic	7,837 vehicle (11,135 PCU)		3,106 vehicle (3,985 PCU)
10	Terrain type	Plain		
11	Soil Classification	Black Cotton, Clayey		
12	Pavement Condition	Fair, Poor		
13	CD Structures			
	Major Bridge	1		
	Minor Bridge	16		
	Pipe	41		
	Slab	9		
	Total Number of Structures	67		
14	Riding Quality- IRI (m/km)	3.00 to 7.40		3.00 to 3.97
15	Existing Crust Thickness	210 mm to 600 mm		
16	Soaked CBR	4.8% to 14.3%		
17	Vehicle Damage Factor			
	Vehicle Type			VDF
	Mini Bus			0.61
	LCV			0.37
	BUS			0.42
	2-Axle Truck			4.99
	3-Axle Truck			5.64
	M-Axle Truck			4.6

4 TRAFFIC ANALYSIS AND FORECAST

4.1 INTRODUCTION

17. Road development projects are meant for achieving multi-objectives while meeting the basic needs of the road user - Mobility and Accessibility. Key functionalities and upcoming utilization of the project corridor in years to come is the essential task for which the highway facility needs to be upgraded or improved. All proposed solutions from traffic point of view are judiciously incorporated in issues related to geometry, environmental and social.

4.2 EXISTING TRAFFIC CHARACTERISTICS

18. The AADT of about 7,837 vehicles (11,135 PCU) on Umreth-Vasad, 6,300 vehicles (12,871 PCU) at km 20+100 and 3,106 vehicles (3,985 PCU) at km 23+600 on Kapadvanj-Ladvel are plying on the corridor with 73%, 51% and 79% of passenger traffic respectively. Travel desire pattern on the corridor indicates most of the traffic travelling is within state. The average speed on the Umreth-Vasad is 42.0 kmph and on Kapadvanj-Ladvel it is 50.0 kmph.

19. The traffic analysis for the corridor and influence area is taken as deep as to study and analyse traffic levels for each homogeneous section of the corridor for present and future conditions. Traffic sections with present and proposed lane configuration as well as traffic levels are tabulated in Table 4.1.

Table 4.1: Homogenous Sections with Details

Sections	Chainage		Length	Section	Present Configuration	Total	PCU
	Start	End					
Homogeneous Sections (Kapadvanj – Ladvel)							
1	19.1	20.5	1.4	Rural	2L	6,300	12,871
2	20.5	32.6	12.1	Rural	2L	3,106	3,985
Homogeneous Sections (Umreth - Vasad)							
1	0	19.25	19.25	Rural	2L	7,837	11,135
2	0	9.2	9.2	Rural	2L	7,837	11,135

4.3 TRAFFIC FORECAST

20. The traffic is forecasted using the trend based and econometric method for each homogeneous section. Further the forecasted traffic by trend based method is used for the estimation of the future capacities and arrive at the improvement option for entire project corridor. Projected total traffic in vehicles and PCU till the year 2045 is as below.

Table 4.2: Total Forecasted Traffic

Modes	2011	2015	2020	2025	2030	2035	2040	2045
SH:83-km 14+200, Khambholaj								
Total Vehicles	7,837	9,848	12,861	16,310	20,499	24,416	27,486	30,971
PCU	11,135	13,900	18,083	23,221	29,841	36,204	41,298	47,180
SH:151-km 20+100, Sikandar Porana								
Modes	2012	2015	2020	2025	2030	2035	2040	2045
Total Vehicles	6,300	7,560	10,035	13,066	17,001	20,809	23,872	25,593
PCU	12,871	15,516	20,784	27,736	37,311	46,851	54,685	59,146
SH:151-km 23+600, Savli								
Modes	2012	2015	2020	2025	2030	2035	2040	2045
Total Vehicles	3,106	3,687	4,812	6,082	7,604	9,013	10,110	10,713
PCU	3,985	4,679	6,025	7,631	9,638	11,531	13,025	13,855

5 ROAD SAFETY AUDIT

5.1 PROJECT BRIEF

21. Umreth-Vasad and Ladvel Kapadvanj is proposed to be improved with better riding quality and enhanced safety. Road Safety Audit addresses identification of safety related deficiencies as well as behavioural safety issues while subsequently recommending countermeasures in approaching towards sustainable design solution. All sections of the project corridor are visited and studied. Review and audit of safety measures of the corridor are followed with the prevailing best practices. With proposed improvement option of two lane with paved shoulders, the objective of the exercise focuses on abating road accidents and their severity while improving riding quality.

5.2 ACCIDENTS STATISTICS

22. First Information Report (FIR) details relating to the accidents, fatalities and injuries in the project corridor and its immediate influence area are collected and studied. Though such information is recorded by police stations, there is a potential scope of other minor injury and property damage accidents to not have reported. However, efforts are extended in preparing safety improvement options beyond available accident data and the same is incorporated in final improvement proposals. 12 injuries are reported, in a span of 2 years (2010 to 2011) for Umreth and Sarsa and 6 years (2006-2011) for Vasad. The data indicates most accidents concentrated within the jurisdiction of Rajpura junction. The record indicates no fatality on Umreth – Vasad corridor.

23. In contrast, there are 9 fatalities and 60 injuries reported on Ladvel – Kapadvanj corridor in a span of 6 years (2006 – 2011). This is a substantial figure of more than 1 death in a year. Motor cycles are involved in 7 accidents. Most significantly, 17 pedestrians are reported in fatalities or injuries. The analysis indicates concentration of accidents in three locations namely, Ladvel junction, Kapadvanj and near km 022+000.

5.3 SAFETY ISSUES FOR PROJECT CORRIDOR

5.3.1 Carriageway

24. It is observed that shoulders are inadequate in width being in a poor condition. There is an immediate need to provide a minimum of 1.5 m shoulders along the project corridor.

5.3.2 Geometric design

25. During the audit, it is identified that sight distance at sharp curves lack in standards and needs to be improved with geometric design. Curve passing through villages needs proper signage. Appropriate control measures are essential.

5.3.3 Intersections/Junctions

26. There are seven major junctions observed on the project corridor. It is observed that considerable habitants gather near these junctions; thereby generating local trips. It is audited that the existing junction design lacks in incorporating local travel behaviour and influence of

habitations in proximity, which makes them potential accident prone spots. It is identified that careful attention needs to be given in developing appropriate designs for these junctions. In addition, provision of suitable location of bus stops near junction needs to be considered.

5.3.4 CD Structures

27. The cross drainage works, especially culverts/Canals, are narrow in width and the parapets of the culverts are potential hazards.

5.3.5 Wayside amenities

28. It is observed that Intermediate Public Transport (IPT) modes operating on this corridor are popular as well as in demand due to their services in providing local accessibility and mobility at affordable price to the habitants. They usually travel with over occupancy and their stoppages and parking are uncertain, creating chaotic and unsafe conditions to the other traffic utilizing corridor.

5.3.6 Traffic Management and Control Issues

29. It is identified that traffic signs needs to be provided at many places The existing signages are in a poor condition. It is identified that provision of pavement markings lack at many places on the project corridor.

5.4 IDENTIFIED ISSUES AND SUGGESTIONS

30. Suggestions, recommendation as well as issues identified from safety audit are incorporated into final improvement options which include, but not limited to,

- a. Deficient 18 horizontal curves;
- b. Identified 91 major/minor intersections (including access roads);
- c. Identified 6 highway sections near habitations and;
- d. Identified deficient 67 structures.

31. The details of the recommended interventions are presented in Volume-III Road Safety Audit.

6 DESIGN OF CORRIDOR

6.1 IMPROVEMENT OPTION

32. The existing carriageway width of the project corridor is 7.0m, i.e. Two Lane (2L) configuration for both Umreth-Vasad and Ladvel-Kapadvanj road. Project scope is for widening of existing road from 2L to 2L+PS+HS configuration.

33. The project corridor has right of way of 24m. The improvement option for project corridor is seen with respect to traffic, safety, speed and mobility. World Bank advises and shared iRAP² reports are also taken into consideration.

34. The project section, Umreth-Vasad is carrying 7,837 vehicles on the project road in 2011-2012 projecting to 23,221 PCUs in 2025 and 41,298 PCUs in 2040. Looking the traffic figures project road needs to be planned at least in a phased manner for higher order up gradation. This section from Umreth to Vasad calls for four laning by 2026. The emerging traffic scenario and feasibility of improvement option can be simulated through Table 6.1.

Table 6.1: Emerging Traffic Scenario and Improvement Needs

	Traffic/Year	2011	2015	2020	2025	2030	2035	2040
Umreth-Vasad	Vehicle	7,837	9,848	12,861	16,310	20,499	24,416	27,486
	PCU	11,135	13,900	18,083	23,221	29,841	36,204	41,298
	Configuration	2L	2LPSHS			4L		
	V/C	0.37	0.37	0.48	0.62	0.50	0.60	0.69
Ladvel-Kapadvanj	Vehicle	3,106	3,797	5,316	7,120	9,304	11,996	15,580
	PCU	3,985	4,830	6,725	9,214	12,476	16,833	23,001
	Configuration	2L	2LPSHS					
	V/C	0.13	0.13	0.18	0.25	0.33	0.45	0.61

35. The project section Ladvel-Kapadvanj is carrying 3106 vehicles on the project road, in 2011-2012 projecting to 9214 PCUs in 2025 and 23,001 PCUs in 2040. Not the traffic numbers but importantly bridging the missing link between Kapadvanj to Vasad through Ladvel-Dakor-Umreth supports up gradation to wide two lanes with paved shoulders. Any further higher order upgradation is not envisaged till 2040. Also this project section (Ladvel-Kapadvanj) is recommended for wider two lanes, i.e. addition of paved shoulders based on World Bank's advice of provisioning of paved shoulders irrespective of the capacity needs but on the pretext of the safety aspects.

36. The project corridor is proposed to be widened and strengthened to two lanes with paved shoulder and hard shoulder (2L+PS+HS), except the settlements along the project road Umreth and Ode. Where existing four lanes are present and the same are continued as

² iRAP: International Road Assessment Programme, Gujarat is also covered under the programme with selected corridors. Findings of IRAP and recommendations at particular stage are shared.

standard four lane configuration. For the Sarsa development, wider four lane sections are proposed for about two kilometre length. The cross-section depicting placement of existing carriageway and proposed improvement is presented through Figure 6.1.

37. Cross sectional elements are based on the adopted design standards. The adopted lane width is 3.5 m; paved shoulder is 1.5 m wide in general, and hard shoulders of 1 m width for the project road section.

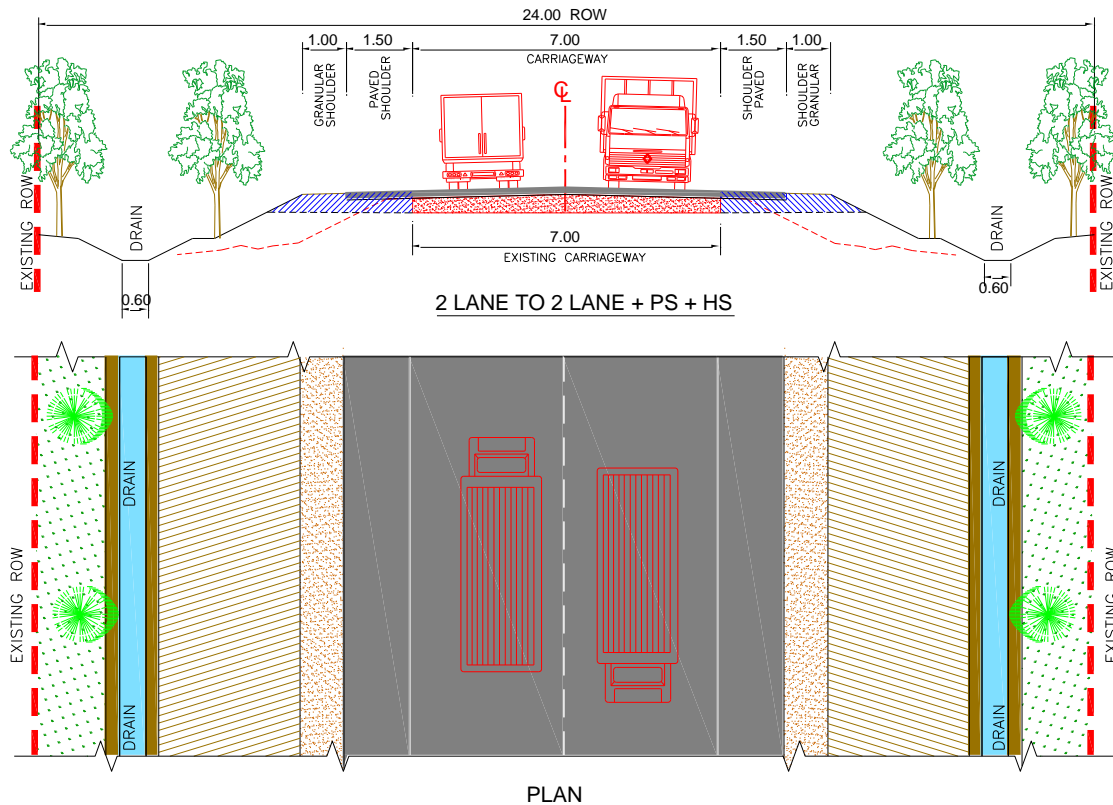


Figure 6.1: Proposed Improvement Option (2L to 2L+PS+HS)

38. The project corridor predominantly traverses through agriculture land. Existing environmental and social aspects are duly integrated in improvement scheme within available right of way width.

6.1.1 Widening Scheme

39. Existing road is placed concentrically within available ROW of 24 m, in general. The condition of the existing pavement is poor in Umreth-Vasad Section and poor to fair in Kapadvanj-Ladvel section.

40. The project section from Umreth to Vasad is proposed for reconstruction along with improvement in geometry. The Kapadvanj-Ladvel section is also proposed for reconstruction. The concentric option is worked out with consideration of available RoW, least disturbance to long standing trees and other utilities along the project section including social impacts on the project corridor.

41. The factors considered for widening preferences are:

- Availability of land;
- Geometric improvement;
- Utility Lines;
- Ribbon developments and settlements; and
- Environmental and Social concerns.

42. The proposed widening scheme is presented in Table 6.2.

Table 6.2: Proposed Widening Scheme

From (km)	To (km)	Length (km)	Existing Width	Proposed Carriageway Width	Proposed Paved Shoulder Width	Proposed hard Shoulder Width	Remarks
Ladvel-Kapadvanj							
19.125	20.5	1.375	7	7	1.5	1	
20.5	25	4.5	7	7	1.5	1	
25	31.425	6.425	7	7	1.5	1	
31.425	31.700	0.275	10	10	0	0	
31.7	32.066	0.367	10	10	0	0	Retain Existing Closed Drain of 1.0m width 31+700 to 32
Umreth-Vasad							
0.000	0.650	0.650	7+1+7	7.5+1.5+7.5	0	1	
0.650	0.806	0.156	7	7.5+1.5+7.5	0	1	
0.806	0.871	0.065	7				Taper
0.806	1.686	0.880	10				Existing New RoB
1.686	1.751	0.065	7				Taper
1.751	2.5	0.749	7	7	1.5	1	
2.500	3	0.500	10	7	1.5	1	
3.000	3.325	0.325	10	7	1.5	1	
3.325	3.425	0.100	10	7	1.5	1	
3.425	3.725	0.300	7	7	1.5	1	
3.725	4.025	0.300	10	7	1.5	1	
4.025	7.175	3.593	7	7	1.5	1	
7.175	7.400	0.508	10	7	1.5	1	
7.400	7.618	1.894	7	7	1.5	1	
7.618	7.683	0.065	7				Taper
7.683	9.294	1.611	7+0.8+7	7.5+1.5+7.5			from 8+990 to 9+200 Footpath exists on both sides 1.5m with
9.294	9.359	0.065	7				Taper
9.359	17.335	7.976	7	7	1.5	1	
17.335	17.400	0.065	7				Taper
17.400	18.225	0.825	10	7.5+1.5+7.5			Footpath exists on both sides 1.5m with
18.225	19.138	0.913	7	7.5+1.5+7.5			Footpath exists on both sides 1.5m
Vasad-Sarsa							
0.000	0.088	0.088	7	7.5+1.5+7.5		1	
0.088	2.600	2.512	7	7	1.5	1	
2.600	3.700	1.100	7	7	0	0	Expressway Approach No shoulders
3.700	8.100	4.400	7	7	1.5	1	
8.100	8.900	0.800	7	7	1.5	0.5	
8.900	9.119	0.219	7	7	1.5	1	
9.119	9.184	0.065	7	7.5+1.5+7.5		1	

6.1.2 DESIGN INTERVENTIONS

43. The process involved in design intervention is depicted in Figure 6.2.

Speed

44. The horizontal geometry with speeds less than 65 kmph in rural sections is improved. Largely following the mandate improvements are proposed within available RoW and in exceptional cases land acquisition is also proposed. Efforts are also made to provide safe designs in settlements considering speeds 40-65kmph.

Trees

45. Special efforts have been made to minimize the impact on trees, saving them to the extent possible.

Social Impact

46. For the sections through settlements specific care has been taken to safe guard cultural properties, existing permanent structures towards reducing the social impacts

Safety

47. The safety is very much incorporated in the design process; interventions include provision of speed humps at exit and entry of settlements, Raised pedestrian crossings, foot paths, improved junction layouts, advanced warning signs, Rumble strips, Provision of Guard rails etc.

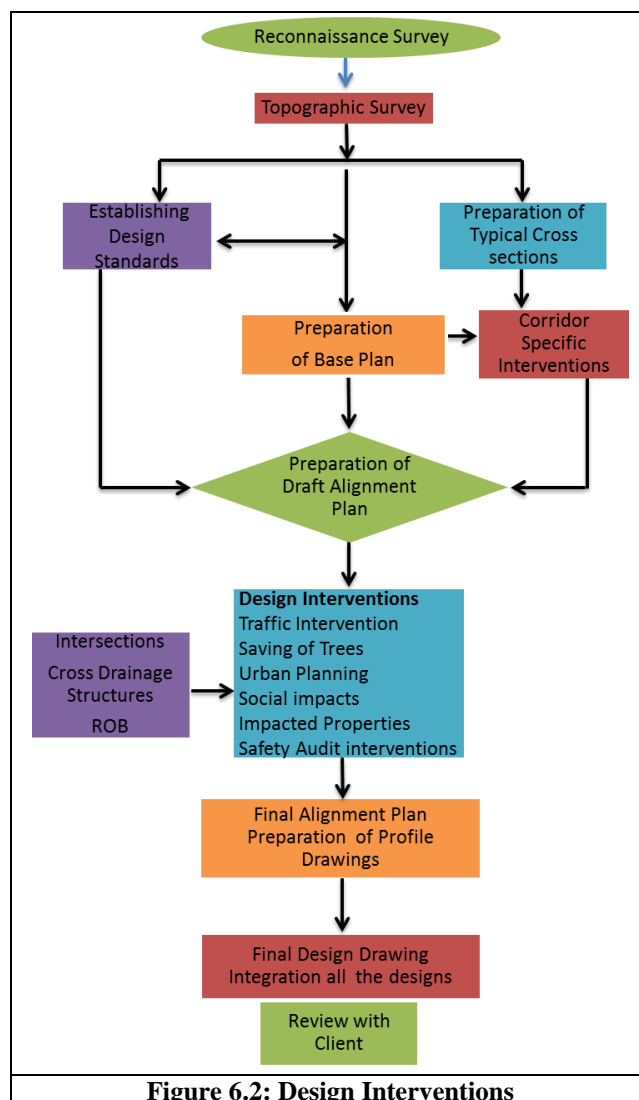


Figure 6.2: Design Interventions

6.2 INTERSECTION/JUNCTION DESIGN

48. At-grade intersections, unless properly designed can be accident-prone and can reduce the overall capacity of the road. The basic requirements for the design of intersections are not only to cater safe movements of road users, but also to provide them full traffic information by way of signs and pavement markings. Simplicity and uniformity is the guiding principles for intersection design. Based upon these principles the at-grade intersections have been categorized as:

1. Major Intersections
2. Minor Intersections
3. Access roads and Cart Tracks

49. The project corridor is having six major junctions, 12 minor junctions/intersections and 27 access roads and cart tracks. The location of intersections along the project corridor with various categories of roads, improvements proposed is detailed in this section.

6.2.1 Major Intersections

50. Intersections with category of roads like NH/SH/MDR and having black top surface are presented in Table 6.3.

Table 6.3: Major Intersections/Junctions

Sr. No.	Intersection/ Junction	Type	Chainage (km)	Existing Width (m)	Improvement
SH-83 (Umreth-Sarsa)					
1	Umreth	3-Arm	0+000	16.00	As per MOST standards
2	Umreth-Ratanpura-Bhatpur	4-Arm	2+500	7+00	As per MOST standards
3	Ode Municipal & Railway Station	4-Arm	8+143	16.00	As per IRC
4	Ode Municipal & Village	4-Arm	8+960	16.00	As per IRC
5	Bhalej and Ahima (SHDP Connectivity)	4-Arm	9+230	7.00	As per IRC
6	Anand-Bhalej-Sarsa-Vasad	4-Arm	19+138	7.00	As per MOST standards
SH-188 (Sarsa-Vasad)					
7	Vasad-Vadodara-Anand	3-Arm	0+000	7.00	As per MOST standards
SH-151 (Kapadvanj-Ladvel)					
8	Pakhiya, to SHDP road	3-Arm	20+535	7.00	As per IRC
9	Bayad-Dehgam	3-Arm	32+067	7.00	As per MOST standards

51. The start of the project corridor forms a junction with SH-12 near Umreth, providing connectivity to Nadiad and Dakor. The junction design is based on type designs for T junction on NH/SH as per MOST specifications. Another intersection is at Sarsa, provides intersection point for traffic moving to Anand and SHDP corridor. The Vasad end forms T-intersection joining the NH-8, part of golden quadrilateral of NHAI. The detailed junction design is provided through Volume VIII

6.2.2 Minor Junctions

52. The project section Umreth-Vasad is having 23 the junctions with category of roads like MDR ODR and VR. Two typical designs (Type-I, Type-II) have been developed for these junctions types. Type-1 is for approach road having carriageway width greater than 5 m. Type-2 is for approach road having carriageway width less than 5m. Six out of the 23 are Type-1 and Seventeen are Type-2. Design details of these intersections are provided at Volume VIII- Drawings.

6.2.3 Access Road and Cart tracks

53. The access road leading to commercial establishments, public amenities and cart tracks leading to agricultural fields are 44 in number along the Umreth-Vasad section. For access road/carts tracks two types of typical designs are developed. i.e. Type-I and Type-II. Type-1 is for access road having carriageway width greater than 5m. Type-2 is for access road having carriageway width less than 5m. Design details of these intersections are provided at Volume VIII- Drawings.

6.3 WAYSIDE AMENITIES AND SAFETY ASPECTS

6.3.1 Pedestrian Safety

54. Pedestrian crossing across the roads is normally major cause for the accidents. iRAP study findings for Gujarat have highlighted such and other issues. To reduce the speed and subsequently to increase the pedestrian safety rumble strips are proposed at major intersections/ junctions and at entry and exit of settlements.

55. **Speed humps** are provided at the 3 locations. The speed humps are also provided on all the access roads leading to project highway and minor intersections.

56. **Rumble strips** are provided at 20 locations on Umreth-Sarsa section, 8 locations on Sarsa-Vasad section and 10 locations on Ladvel-Kapadvanj section.

57. **Pedestrian Crossings:** The zebra crossings are provided at 6 locations on Umreth-Sarsa section and raised pedestrian crossings are provided at 7 locations on Umreth-Sarsa section, 2 locations on Sarsa-Vasad section and 4 locations on Ladvel-Kapadvanj section.

6.3.2 Cattle Crossing

58. Cattle's crossing zone is identified between km 14+650 and km 15+000 on SH-083, signs are provided to indicate the zone.

6.3.3 Crash Barrier

59. The guard rails are provided at sharp curves, approaches to canals and green tunnels along with signage's to provide safety for vehicles at such locations. The locations of Guard rails are given Table 6.4. The guard rails are provided with W-metal beam type barrier, the details of the same are provided in design drawings.

Table 6.4: Location of Crash Barrier

Sr. No.	Start Chainage	End Chainage	Side
	SH-83 (Umreth -Sarsa)		
1	03+3000	3+8000	On Both side
2	7+100	7+400	On Both sides
3	13+600	14+100	On Both side
	SH-188 (Sarsa-Vasad)		
4	2+000	2+300	On Both sides
5	4+000	5+700	On Both sides
6	6+250	6+850	On Both sides
7	7+600	7+900	On Both sides
8	8+100	8+700	On Both sides
	SH-151 (Kapadvanj-Ladvel)		
9	19+300	20+000	On Both side
10	23+400	23+700	On Both side
11	28+700	28+900	On Both sides
12	31+400	31+800	On Both sides

6.3.4 Signage

60. The detailed signage plan is provided in Volume VIII of this report. The same is checked for compliance to the safety audit report.

6.3.5 Median Openings

2. The project road is provided the four lane sections along village settlements as discussed above, at same time median openings are also provide to facilitate for easy access to nearest development at 7 locatations.

6.3.6 Bus Shelter Design

61. The existing bus shelters along the project corridor are generally associated with settlement area or at an intersection. It is proposed to provide bus stops and bus bays in both directions at these locations. The details of bus shelters and bus bay locations along the project corridor are given in Table 6.5 the typical design of Bus Stop is given in Figure 6.3.

Table 6.5: Proposed Bus Shelter and Bus bays

Sr. No.	Chainage (km)	Village Name	Bus Stop (L/R)
Section: Umreth-Sarsa			
1	3+300	Hamidpura	R/l
2	8+100	Ode	L
3	8+115	Ode	R
4	14+440	Khambholaj	R
5	14.423	Khambholaj	L
6	16+658	Khanpur	R
7	16+719	Khanpur	L
7	18+748	Sarsa	R/L
Section: Sarsa-Vasad			
1	00+750	Rajupura	L
2	00+880	Laxmipura	R
3	04+655	Vaherkheda	L
4	04+750	Vaherkheda	R
Section: Kapadvanj-Ladvel			
1	22+695	Savali	R/L
2	26+216	Dahiyap	L
3	26+250	Dahiyap	R
4	32+030	Kapadvanj	R

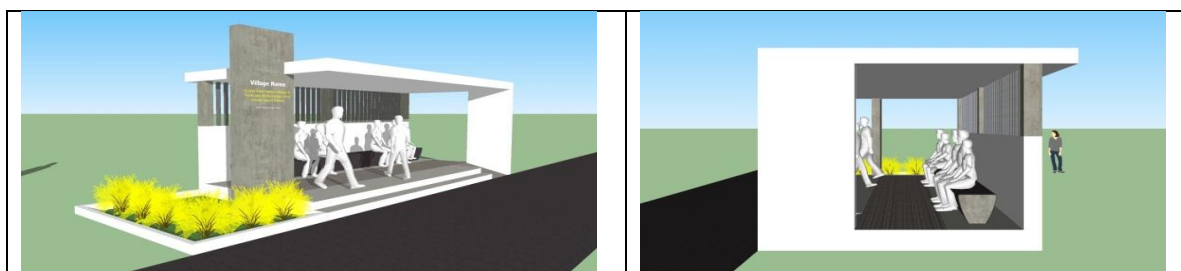


Figure 6.3: Typical Design of Bus-Shelter

6.3.7 Integration of Way Side Facilities

62. The integration of bus shelter, foot path and pedestrian crossing is done and the typical plan is depicted in Figure 6.4.

6.3.8 Information on Infrastructure Development

63. The entry and exit point is treated with welcome signage's with due information regarding the project corridors. The same is shown in Figure 6.5. The detailing is provided in Volume VIII of this report. These signs are provided at four locations near exit and entry of project sections.

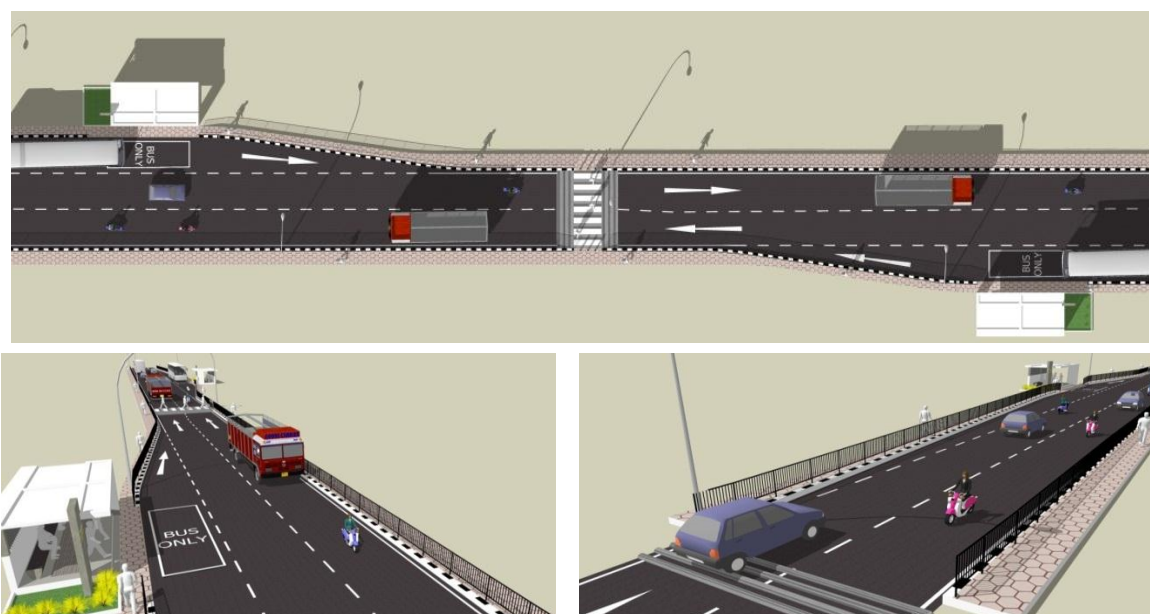


Figure 6.4: Integration of Wayside Facilities

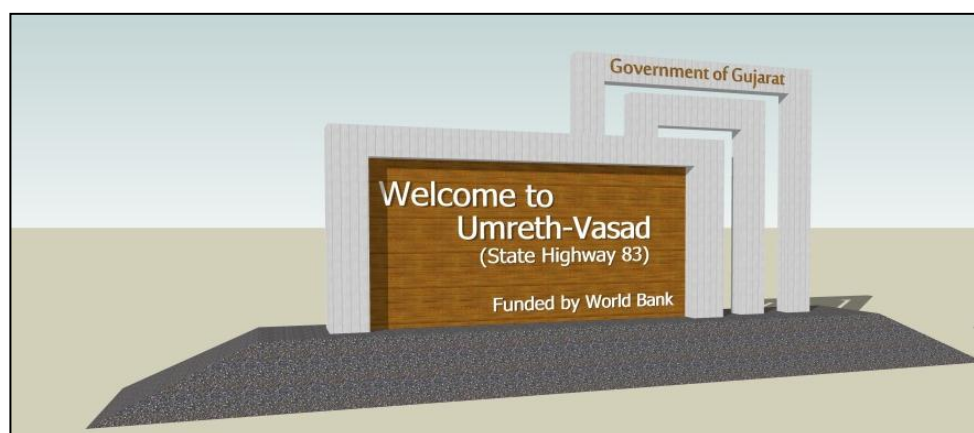


Figure 6.5: Typical View of Welcome Sign

6.4 PAVEMENT DESIGN

64. Pavement design forms an integral part of highway design. Pavement performance under prevailing and projected traffic and environmental conditions is considered to be crucial as it has an implication on the economic returns from the project. Present sub section deals with pavement design and strengthening of the existing pavement crust

65. Following criteria has been adopted for identification of failed section of bituminous surfacing for this project.

- Cracking – sections with cracking exceeding 20% of the area, and/or
- Rutting greater than 20mm and/or
- Settlements of deformations in pavement section in area exceeding 10%
- Extensive ravelling

66. The failed sections as identified above will be considered as candidate sections for reconstruction/rehabilitation of the pavement. The pavements of road sections other than failed sections will be considered for strengthening of pavement by providing overlay.

A. UMRETH-SARSA-VASAD**6.5 PROPOSED PAVEMENT COMPOSITION**

67. As discussed this section from Umreth-Sarsa-Vasad is conceived as staged four laning. Even traffic mix, mostly commercial vehicles which are through are expected to continue to ply till Vasad after entry from Umreth for various obvious reasons. Shortest route being non tolled one will continue to attract traffic from NH-59, SH-5 to establish good linkage with north-south running NH8 across the state. Though based on traffic projections four laning requirement falls in the year 2025-26. Till then with full MSA pavement is designed as 2LPSHS till 2025. Beyond which depending upon land availability and subsequent decisions either concentric or eccentric upgradation to 4L by addition of new two lanes shall be effected. Proposed composition of for reconstruction of existing pavement and new construction is provided here under:

2015 – 2025 (2L to 2LPSHS)	2015-2025 (2L to 4L)
MSA 2025 (Bituminous) :33.5 2030 (Granular) : 58.3	MSA 2025 (Bituminous) : 16.7 2030 (Granular) : 29.1
BC – 40 mm DBM ³ – 120mm WMM – 250 mm GSB –230 mm Subgrade from borrow areas-500 mm CBR 7%	BC – 40 mm DBM – 100 mm WMM – 250 mm GSB –230 mm Subgrade from borrow areas-500 mm CBR 7%

68. Paved shoulders are proposed on both sides of main carriageway for this corridor. Pavement for the paved shoulders shall be considered as new pavement. The design of new and reconstruction pavement has been done in accordance with IRC Publication No. IRC; 37-2001 for flexible pavement.

69. Pavement sections are prepared with respect to type of treatment, varying widths, improvement options and road furniture in line with existing site condition on situation to situation. The pavement treatment scheme is presented in Table 6.6.

Sarsa-Vasad

- Type B: New construction with 12.0m formation width
- Type B1: Overlay with 8.0 formation width on Expressway approach; Existing Section is retained
- Type B2: New construction with restriction on formation width i.e. 11.0m
- Type D: New Construction with four lane carriageway configuration, formation width of 18.5m

Umreth-Vasad

- Type C: New Construction with four lane carriageway configuration, formation width of 18.5m
- Type C1: New Construction with four lane carriageway configuration, formation width of 19.5m with closed drain and foot paths
- Type E: New construction with 12.0m formation width
- Type E1: New construction with 12.0m formation width, at the locations where formation also 12m wide.

³ As per IRC 37: 2001 DBM requirement works out as 120 mm for 10 years design life. Considering heavy commercial movements, it is thought appropriate to have lesser bituminous course thicknesses. Accordingly 120mm DBM is considered as single layer of 100mm compacted DBM and left over 20mm is replaced with WMM. The same shall ensure single layer of DBM and optimization of bituminous layers.

Table 6.6: Pavement Treatment Scheme

From (km)	To (km)	Length (km)	Treatment Option	Type
Umreth Vasad				
0.000	0.650	0.650	Reconstruction	C
0.650	0.806	0.156		C
0.806	0.871	0.065		E
0.806	1.686	0.880		No Treatment, Recently opened RoB
1.686	1.751	0.065		E
1.751	2.500	0.749		E
2.500	3.000	0.500		E1
3.000	3.325	0.325		E1
3.325	3.425	0.100		E1
3.425	3.725	0.300		E
3.725	4.025	0.300		E1
4.025	7.175	3.593		E
7.175	7.400	0.508		E1
7.400	7.618	1.894		E
7.618	7.683	0.065		E
7.683	9.294	1.611		C1
9.294	9.359	0.065		E
9.359	17.335	7.976		E
17.335	17.400	0.065	E	
17.400	18.225	0.825	C1	
18.225	19.138	0.913	C1	
Vasad-Sarsa				
0.000	0.088	0.088	Reconstruction	D
0.088	2.600	2.512	Reconstruction	B
2.600	3.700	1.100	Overlay	B1
3.700	8.100	4.400	Reconstruction	B
8.100	8.900	0.800		B2
8.900	9.119	0.219		B
9.119	9.184	0.065		D

B. Ladvel-Kapadvanj

70. Pavement composition for new and reconstruction of pavement and strengthening of existing pavement for mesa relevant to 7 years for bituminous courses and 15 years for granular base and sub base courses is presented in Table 6.7.

Table 6.7: Proposed Pavement Composition

Pavement Treatment	Type A	Type A1	Type A2	Type A3
Reconstruction/Widening	BC	40	40	40
	DBM	120	60	60
	WMM	250	250	250
	GSBC	230	230	230
	Subgrade	500	500	500

71. Pavement sections are prepared with respect to type of treatment, varying widths, improvement options and road furniture in line with existing site condition on situation to situation. The pavement treatment scheme is presented in Table 6.8.

Table 6.8: Type of Treatment Option by Section

From (km)	To (km)	Length (km)	Type
19.125	20.500	1.375	A
20.500	25.000	4.5	A1
25.000	31.425	6.425	A1
31.425	31.700	0.275	A2
31.700	32.066	0.367	A3

Ladvel-Kapadvanj

- Type A: New construction with 12.0m formation width from km 19.125 to 20.5 ;
 Type A1: New construction with 12.0m formation width from km 20.5 to 31.425;
 Type A2: New construction with existing in closed drain in the same place;
 Type A3: New construction with proposed closed drain and footpath;

6.6 IMPROVEMENT PROPOSAL FOR STRUCTURES

A. Umreth-Vasad Corridor

72. **Major and Minor Bridges:** Out of 7 minor bridges one minor bridge at km 0+275 across SH-83 is proposed to be replaced by new structure, 4 are retained as they are and among rest of two minor bridges needs repair and widening & repair respectively. The details of proposed treatments for bridges are provided in Table 6.9.

Table 6.9: Proposed Treatment: Umreth-Vasad

Umreth-Vasad (SH-083 & SH-188)									
Sr. No.	Design Chainage (km)	Type of Bridge	Nos. of Span	Span length (m).	Total Length of Bridge	Total Width of Bridge	Carriageway Width (m)	Overall Structure Condition	Proposal
1	SH-083 0+275	Minor	1	7.00	7.00	17.50	6.50 x 2	Condition: 3 1. Minor spall & Repaired bridge	Replace by new structure (B.C. 2/3x3/0) 4-Lane
2	1+336	ROB Umreth	2	1 x 37.70 + 1 x 21.50	59.20	12.00	7.50	Condition: 5	Retain
3	3+600	Mahi Canal Minor	4	7.30	29.20	7.50	6.00	Condition: 3 1. Cracks in Slab 2. Lining damaged	Retain
4	7+875	Minor	1	6.30	6.30	13.70	5 x 2	Condition: 3 1. Both Side fully Blocked	Repair
5	10+850	Minor	3	5.50	16.50	8.00	6.00	Condition: 3 1. Spalling in slab 2. Loose joints and vegetation in substructure	Repair and widening
6	14+025	Mahi Canal Minor	2	10.20	20.40	7.70	6.00	Condition: 4 1. Railing needs plaster	Retain
7	SH-188 4+700	Minor	2	5.50	11.00	12.00	7.00	Condition: 5	Repair
8	7+750	Mahi Canal Minor	3	8.50	25.50	7.70	6.00	Condition: 4 1. Vegetation 2. Cracks due to Vegetation	Retain

73. **Culverts:** The condition of some culverts along this corridor are bad, more over these are very old structures with loose joints, blockage of pipes, scour and growth of vegetation. Head walls of some culverts are damaged. Accordingly reconstruction is suggested of such highly damaged culverts.

74. The summary of proposed treatment for culverts is presented in Table 6.10.

Table 6.10: Summary of Proposed Treatment

Treatment	Numbers
Repair	15
Repair and Widen	2
Replace with new	14
Head wall reconstruction	3
Retain	1
Total	35

B. Ladvel-Kapadvanj

75. Major Bridge: The major bridge (on Narmada Main Canal) at SH-151 km 19+700 is in good condition, hence this bridge is retained. Out of 8 minor bridges 5 needs repair, 2 bridges are retained as they are and one at km 29+461 is replaced with new structure. The details of proposed treatment for major and minor bridges are presented in Table 6.11.

Table 6.11: Proposed Treatment: Ladvel-Kapadvanj (SH-151)

Sr. No.	Design Chainage (km)	Type of Bridge	Nos. of Span	Span length (m).	Total Length of Bridge	Total Width of Bridge	Carriageway Width (m)	Overall Structure Condition	Proposal
1	18+715	Minor	1	7.00	7.00	8.80	7.00	Condition: 5 1. LHS railing damaged 2. Vegetation	Repair
2	19+455	Minor	3	9.80	29.40	8.50	7.00	Condition: 4 1. Both Side railing is damaged 2. Vegetation	Repair
3	19+700	Major (Narmada Main Canal)	5	25.40	127.00	8.60	7.00	Condition: 4 1. Vegetation	Retain existing structure.
4	23+575	Minor	3	7.30	21.60	8.20	6.50	Condition: 5	Repair
5	24+420	Minor	1	10.00	10.00	9.50	6.50	Condition: 5 1. Railing pipe missing 2. Vegetation	Repair
6	28+827	Minor	3	7.30	21.60	8.20	6.50	Condition: 4 1. Crack in Return 2. Vegetation	Repair
7	29+218	Box Minor	2	3.50	7.00	12.00	7.00	Condition: 5	Retain structure
8	29+355	Box Minor	2	3.50	7.00	12.00	7.00	Condition: 5	Retain structure
9	29+461	Minor	2	5.10	10.20	10.00	7.00	Condition: 3 1. Crack in Pier due to vegetation 2. Widened structure, Abutment and Pier jacketed, Top slab supported by steel girder	Replace by new structure (B.C. 3/3x3/0)

76. **Culverts:** The condition of some culverts along this corridor are not good, more over these are very old structures with loose joints, blockage of pipes, scour and growth of vegetation. Head walls of some culverts are damaged. Accordingly reconstruction is suggested of such highly damaged culverts.

77. Out of 15 pipe culverts 8 are proposed to be replaced and others to be retained and repair.

7 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

7.1 ENVIRONMENTAL IMPACT ASSESSMENT

78. The proposed upgradation (strengthening and widening) of Umreth – Vasad (including Ladvel – Kapadvanj) Corridor are designed within the available RoW. The environmental and social screening and the subsequent consultations with the stakeholders confirmed that there are no sensitive environmental features that are present along the corridor. In addition to the construction related impacts, the key issues raised were (i) safety issues with respect to geometric / curve improvement and provision of road safety furniture's at settlement / urban areas and temples, schools and cultural properties and (ii) provision for sufficient drain facility including upgrading the bridges and culverts and provision of additional culverts at water logging areas.

79. As per the Government of Gujarat Gazette dated 5th July, 1973, the project corridor from Umreth to Sarsa (SH-83) and Ladvel to Kapadvanj (SH-151) is notified as Protected Forest and warrants forest clearance for diversion of 21.8ha of forest land for non-forest purpose (strengthening and widening). Proposals have been submitted to the forest department for necessary action for the purpose of obtaining forest clearance and for seeking permission for tree felling.

80. The environmental impacts associated with the proposed widening and upgradation activities are construction related impacts pertaining to the road widening projects. These are proposed to be addressed through good engineering practices and adoption of environmental management measures proposed in the Environmental Management Plan (EMP) for the corridor. The EMP budget of INR 3.76 million comprises of the funds necessary for the implementation of management measures as well as includes the provision for environmental monitoring, HIV/ AIDS prevention measures and for the cultural / community enhancements.

7.2 LAND ACQUISITION AND RESETTLEMENT IMPACTS

81. A total of 0.20 ha of private agricultural land belonging to 8 households will be acquired for the proposed improvement. The additional land will be required for the geometric improvement of curves at 2 locations – km 3+052 to km 3+232 (RHS) and km 3+331 to km 3+490 (LHS) at Hamidpura village. Other than these two locations, the proposed improvement will be carried out within the existing RoW of 24 m throughout the corridor.

82. According to the census survey the proposed road improvement will affect agriculture land of 6 households, 32 commercial structures (of which 29 are kiosks which belong to non-titleholders) and barbed wire fencing of 2 properties (1 farm house, and 1 poultry farm). The project will also affect the built up structure of a shrine (at km 1+825) and a temple (at km 9+130) which is located along Vasad-Sarsa section of the proposed corridor.

83. Five public consultation meetings were held along the project corridor with road side communities to obtain their views and suggestions regarding the proposed project interventions. The consultations have provided inputs towards mitigation of impacts, improvement in designs, and preparation of resettlement plan and its implementation. Based on the suggestions design modifications including curve improvement, shifting of alignment to protect mainly structures of religious importance, provision of road safety measures such as pedestrian crossings, warning signs, markings, etc has been carried out.

84. A resettlement budget of INR 2.64 million including compensation for the affected land & structures, assets within the affected properties and rehabilitation and resettlement assistance has been estimated. Any unforeseen impacts on resettlement during implementation will be taken up in accordance with the Resettlement Policy Framework (RPF) of the project.

8 ACCESSIBILITY AND MOBILITY TO TRANSPORT FACILITIES IN VILLAGES: SUMMARY

8.1 INTRODUCTION

85. Baseline socio-economic information related to accessibility and mobility to transport facilities in the villages along the proposed corridor has been collected and analyzed. The study intended to assess the travel pattern of villagers, which includes, travel time to major markets, educational and health institutions, frequency of trips to nearby places, perception of villagers on travel situation, etc. The findings of the present study shall form basis for measuring impacts after the proposed roads are improved. There are 40 villages located within 2 km bandwidth of the proposed corridor, of which 20 villages are chosen for the survey. Altogether 100 households are surveyed.

86. **Gender and Age Distribution:** Age distribution shows that 50 percent of the population belongs to the age group of 26-60 and 14 percent of the population is in the age group of 6-14.

87. **Education profile:** Female population has a lower level of education compared to male population.

88. **Income Profile and Dependency Ratio:** 52 percent of the sample households have a monthly income of less than Rs.3000, of which 27 percent have a monthly income less than Rs.2000. The dependency ratio is 1.8:1.

89. **Occupation Profile:** major percentage of sample population is engaged in business and trade.

8.2 MAJOR FINDINGS

90. **Trip Information:** Analysis of trip information of villagers is based on 175 cases of usual trip information of 100 surveyed households. Analysis based on chi-square test shows that trip information does not vary significantly between income-groups.

91. **Mode of Travel:** Amongst the 175 usual trip information, 91 (52 percent) travel on foot and 71 trips (41 percent) are by bicycle, auto-rickshaw, bus or *chakda*.

92. **Frequency of Travel:** 41 percent of the 175 usual trips are on daily basis, 18 percent of the trips are for 3-4 times in a week and 19 percent trips are on monthly basis. Among all vehicles auto-rickshaw and bus are the most used modes for usual trip. Bus is used for 30 percent of usual trips. Of the total trips using vehicles, 17 percent trips are on daily basis.

93. **Perception about Present Transport Situation:** Villagers opined about the requirement of good quality roads, more number of buses, improved access to health centres, etc.

9 PROJECT COSTING

9.1.1 PROJECT COST

94. The project corridor is divided in two sections as Umreth to Vasad and Ladvel to Kapadvanj. Separate estimation and rate analysis has been done for the same. The project corridor is designed involving widening, reconstruction and maintenance of both pavement and cross-drainage structures. Based on the estimated quantities and extensive rate analysis, combined project cost including environmental and social cost is Rs 102.30 crore. The total cost is presented in two subheads as Construction Cost and Social Cost. Environmental Management Plan (EMP) related cost is factored in construction cost itself. The total cost under two sub heads is given in Table 9.1.

Table 9.1: Project Cost

Sr. No.	Description	Amount (INR)
1	Civil Construction Cost	1,02,03,80,108
2	Social Cost	26,49,958
Grand Total		1,02,30,30,066

10 ECONOMIC ANALYSIS

10.1 RESULTS OF ECONOMIC ANALYSIS

10.1.1 Base analysis

95. The economic analysis has been undertaken for the project road by using RUCS equations. The results obtained are in terms of Economic Internal Rate of Return (EIRR), Net Present Value (NPV), as presented in Table 10.1 for project corridors individually and as a one complete package.

Table 10.1: Result of Economic Analysis – Base Case

Corridor	Indicator	EIRR					
		Without Time		With Time		With Accidents	
		20 years	30 years	20 years	30 years	20 years	30 years
Umreth Vasad	EIRR	32.43%	32.81%	47.31%	47.39%	47.57%	47.65%
	NPV (in Million Rupees)	1,266	1,693	2,308	2,869	2,326	2,890
Kapadvanj Ladvel	EIRR	6.43%	10.00%	19.65%	20.80%	26.41%	27.02%
	NPV (in Million Rupees)	-61	-33	106	167	216	299
Total corridor	EIRR	26.53%	27.19%	38.32%	38.51%	40.00%	40.16%
	NPV (in Million Rupees)	1,153	1,609	2,318	2,939	2,495	3,152

96. The project is economically viable. Umreth Vasad, however, shows higher attractiveness as compared to Kapadvanj Ladvel corridor. The two corridors, if seen together, become viable even with only VOCs as benefit from the project.

10.1.2 Sensitivity analysis

97. Any investment is subject to risks and uncertainties. All risks culminate into either increase in project cost, reduction in benefits or both put together. In order to cover the above stated risks, a detailed sensitivity analysis, with respect to the sensitive parameters, has been undertaken. The various sensitivity scenarios considered are as follows:

- Sensitivity 1: Base Costs plus 15% and Base Benefits (15% Increase in cost);
- Sensitivity 2: Base Costs and Base Benefits minus 15% (15% reduction in benefits); and
- Sensitivity 3: Base Costs plus 15% and Base Benefits minus 15% (15% Increase in costs and 15% reduction in benefits).

98. The results of the sensitivity analysis have been presented in Table 10.2, Table 10.3 and Table 10.4.

Table 10.2: Results of Sensitivity Analysis for Umreth Vasad Corridor

Scenarios	Description	EIRR					
		Without Time		With Time		With Accidents	
		20 years	30 years	20 years	30 years	20 years	30 years
I	Base Costs + 15 % and Base Benefits	29.03%	29.55%	42.27%	42.39%	42.50%	42.62%
II	Base Costs and Base Benefits minus 15%	28.73%	29.26%	41.80%	41.93%	42.03%	42.15%
III	Base Costs + 15 % and Base Benefits minus 15 %	25.66%	26.37%	37.34%	37.54%	37.54%	37.74%
		NPV (in million Rupees)					
I	Base Costs + 15 % and Base Benefits	1,176	1,604	2,219	2,779	2,236	2,800
II	Base Costs and Base Benefits minus 15%	991	1,355	1,878	2,354	1,893	2,372
III	Base Costs + 15 % and Base Benefits minus 15 %	902	1,266	1,788	2,265	1,803	2,283

Table 10.3: Results of Sensitivity Analysis for Kapadvanj Ladvel Corridor

Scenarios	Description	EIRR					
		Without Time		With Time		With Accidents	
		20 years	30 years	20 years	30 years	20 years	30 years
I	Base Costs + 15 % and Base Benefits	4.71%	8.68%	16.99%	18.44%	23.10%	23.94%
II	Base Costs and Base Benefits minus 15%	4.51%	8.59%	16.81%	18.29%	22.89%	23.75%
III	Base Costs + 15 % and Base Benefits minus 15 %	2.87%	7.36%	14.39%	16.20%	19.93%	21.05%
		NPV (in million Rupees)					
I	Base Costs + 15 % and Base Benefits	-89	-61	78	139	187	271
II	Base Costs and Base Benefits minus 15%	-78	-54	64	116	157	228
III	Base Costs + 15 % and Base Benefits minus 15 %	-106	-82	36	88	129	200

Table 10.4: Results of Sensitivity Analysis for Total Corridor

Scenarios	Description	EIRR					
		Without Time		With Time		With Accidents	
		20 years	30 years	20 years	30 years	20 years	30 years
I	Base Costs + 15 % and Base Benefits	23.77%	24.61%	34.51%	34.77%	36.02%	36.25%
II	Base Costs and Base Benefits minus 15%	23.55%	24.41%	34.19%	34.47%	35.69%	35.93%
III	Base Costs + 15 % and Base Benefits minus 15 %	21.01%	22.07%	30.72%	31.10%	32.08%	32.42%
		NPV (in million Rupees)					
I	Base Costs + 15 % and Base Benefits	1,035	1,491	2,200	2,821	2,377	3,034
II	Base Costs and Base Benefits minus 15%	870	1,258	1,860	2,388	2,010	2,569
III	Base Costs + 15 % and Base Benefits minus 15 %	752	1,140	1,742	2,270	1,892	2,451

99. The sensitivity analysis reflects project's viability even in the worst scenario, for both the corridors individually as well as one complete package. However, the project is a safe project from the perspective of the users, with reduced incidence of accidents. If the project is seen in case of no traffic calming measures, the returns for 20 years of project period are observed to be higher at 53.7% as against 47.57% in the base case for Umreth vasad , 30.01% as against 26.41% in the base case for Kapadvanj Ladvel and 43.81% as against 40.00% in the base case for one complete package.

10.2 IMPACT OF PROJECT DELAY ON ECONOMY

100. The project needs to be planned and implemented soon. The savings in travel time is precious for the economy. In case, the project implementation is delayed, the cumulative loss in value of travel time is likely to go up from Rs 98 million in 2015 to about Rs 5122 million in the year 2040 for Umreth Vasad, and from Rs 8.7 million in 2015 to about Rs 689 million in the year 2040 for Kapadvanj Ladvel. Therefore, the state should get the project initiated soon. (Refer Figure 10.1 and Figure 10.2).

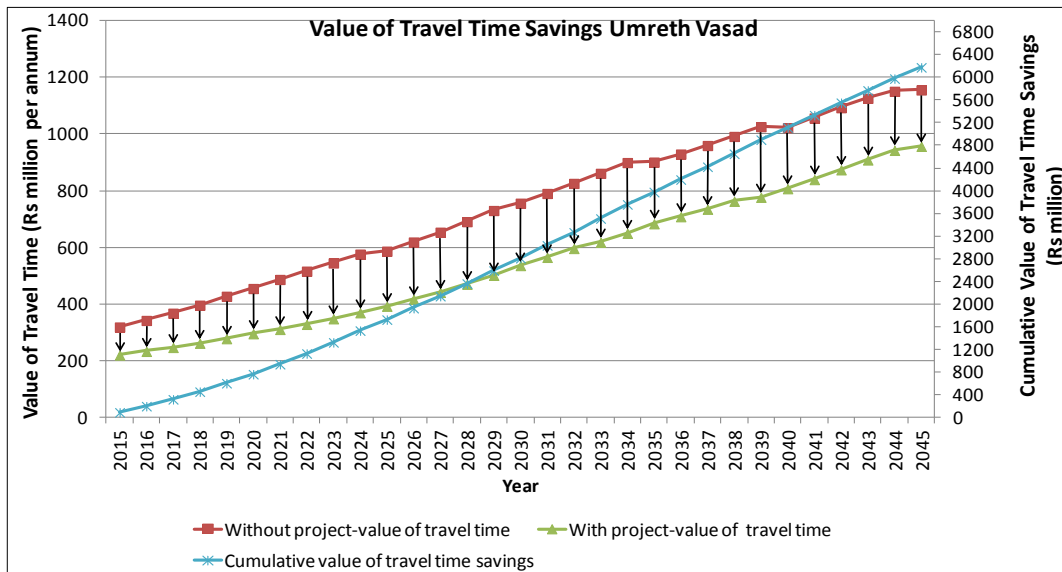


Figure 10.1: Value of Travel Time Savings - Umreth Vasad

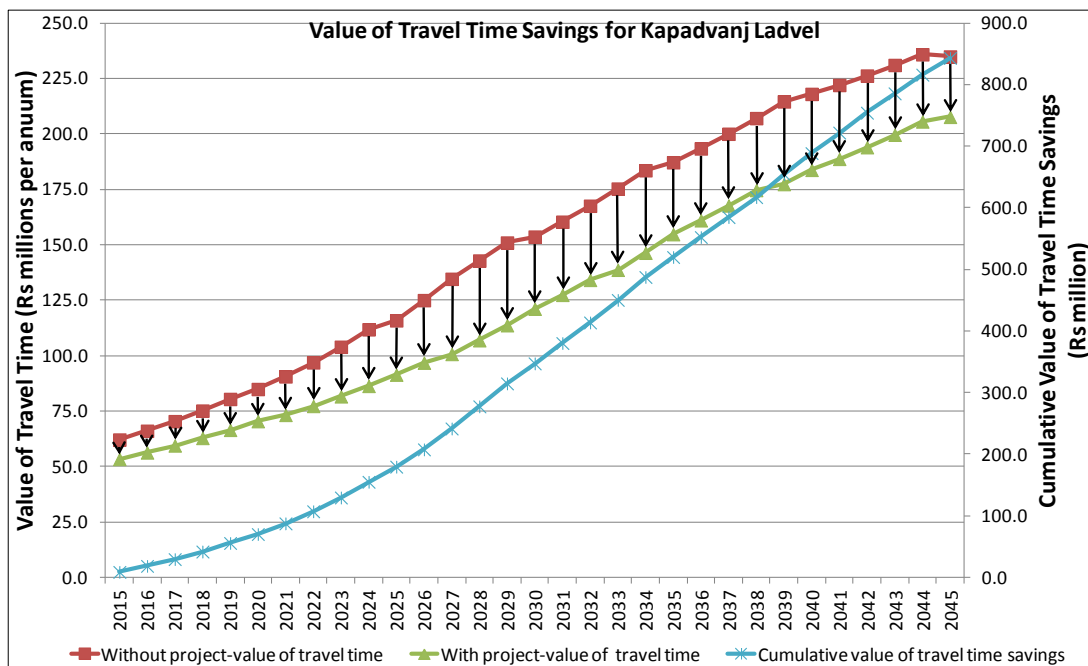


Figure 10.2: Value of Travel Time Savings – Kapadvanj Ladvel

10.3 CONCLUSION

101. The proposed road project/s is/are *desirable from the society's point of view*. The project corridors individually as well as one complete package is found to be economically viable with positive net present values and EIRR greater than 12%, even in the worst scenario of drop in benefits coupled with increase in cost. Hence, based on the above results, the project is recommended