

E. AHMEDABAD – VIRAMGAM CORRIDOR**E.9 REVIEW OF PRE-FEASIBILITY STUDY****E.9.1 Submittal Referred to**

1. The document made available for review was the Draft Final Report¹ by GSRDC. The document was submitted to GSRDC in 2003 by the consultants. The field works seem to have been undertaken in second half of the year 2001.

E.9.2 Traffic Studies and Forecast**E.9.2.1 Base Year Traffic Volumes**

2. The classified traffic volume survey was conducted at three (3) location viz. km 16.800; km 23.300 and km 47.700. The Origin Destination Survey was conducted at km 22.500 and km 47.700. These surveys were conducted in the month of September 2001. The corridor was split into three locations viz. Ahmedabad – Sanand Town; Sanand Town to Sachana village and Sachana village to Viramgam.

3. The average traffic volumes levels reported on corridor by location are as given under:

Location	ADT		Commercial Traffic	
	Vehicles	PCU	Vehicles	PCU
Talav	8812	13009	3215	8676
Sanand	19133	21487	4059	11149
Sachana	4626	8847	2448	7042

E.9.2.2 Traffic Forecast

4. The alternate traffic forecast techniques were described. They include State Domestic Products method; Time Series method; Vehicle Registration method and IRC method. The report also suggests growth rates arrived by alternate methods. The report noted that "... .. final selection of the appreciable growth rate is done after compression and taking into accounts of circumstantial parameters". The main section of the report does not present any forecasted figures. However, towards MSA calculation, the Registration method was adopted and forecasted figures were reported. The figures as reported are refer to forecasted volumes (of fast vehicles only) by locations. They are as given under:

Year	Talav	Sanand	Sachana
2001	8459	15134	4563
2010	13234	24652	6909
2015	16462	31175	8451

¹ The Preparation of Pre-feasibility Report and Bid Documents for capacity Augmentation of Ahmedabad – Viramgam Road was undertaken by Dorsch Consult (India) Private Limited.

Year	Talav	Sanand	Sachana
2020	20054	38621	10114
2025	23923	46867	11846
2030	27947	55701	13579

E.9.2.3 Tollable Traffic

5. The assessed tollable traffic (Ref. Section 13.7.4) is of the base year only. For the future growth rates by modes are being suggested. They are as given under:

Year	Cars	Mini Bus	Bus	LCV	Track	MAV
2001	2188	120	981	983	1887	177
2005	4.5%	5.5%	4.5%	5.5%	4.5%	4.75%
2010	4.0%	5.0%	4.0%	5.0%	4.0%	4.25%
2015	3.5%	4.5%	3.5%	4.5%	3.5%	3.75%
2020	3.0%	4.0%	3.0%	4.0%	3.0%	3.25%
2025	2.5%	3.5%	2.5%	3.5%	2.5%	2.75%
2030	2.0%	3.0%	2.0%	3.0%	2.0%	2.25%

E.9.3 Project Cost

6. In order to arrive at preliminary project cost, necessary engineering investigations, analysis, etc. have reportedly been undertaken. The project cost arrived at is given under:

Cost Components	Cost in Crores (Rs.)
Existing Road	58.28
Bypass (@ Rs. 3.1 cr/km)	15.50
Addl. Concrete work	33.20
Drainage	5.35
Toll Plaza	3.20
Shifting of Services	5.35
Road Appurtenances and Way side amenities	2.14
Miscellaneous Work	2.14
Total	125.17

E.9.4 Environmental and Social Assessment

7. Initial environmental and social impact assessment has been undertaken. The EMAP has been prepared. The report does not report whether land acquisition is required. It estimates cost towards environmental protection measures at Rs. 41.90 lakhs during construction phase. Further, during operational phase the report estimates Rs. 75,000 are needed.

E.9.5 Economic Analysis

8. The economic analysis was undertaken to assess economic viability proposed four laning. It included assessment of benefits both that of VOC and time costs. Analysis period considered was 30 years. The resulting the analysis are given under:

Sr. No.	Option	EIRR (%)	NPV (Rs. in million)
1.	Base case	26.8	857.23
2.	Cost increased by 10%	23.7	848.91
3.	Traffic decreased by 10%	23.3	725.28
4.	Cost increased by 10% and Traffic decreased by 10%	20.6	616.96

9. It is based on above analysis, the consultants have reported that project road section is economically viable.

E.9.6 Financial Analysis

10. For financial analysis, the landed project cost is taken as Rs. 154.89 crores. The debt equity ratio considered is 60:40. The results of financial analysis are given under:

Description	Results
Project IRR	13.21%
Equity IRR	12.12%
Addition Equity required (in lakhs)	2505
DSCR (Average)	1.28
DSCR (Minimum)	1.00
Concession Period	30 Years

11. Additional equity is reportedly required to meet shortfall in cash in first 10 years by the project developer. Based on the above findings consultants report the project is not viable. However, further consultants record “to spruce up” the project IRR to an acceptable IRR of 15%, the following is assumed towards the means of financing the project.

Description	Rs. in Lakhs	%
Equity	5212	34.0
Government Capital Grant	2280	15.0
Debt	7818	51.0
Total	15310	100.0

12. The above considerations lead to the following, results:

Description	Results
Project IRR	15.19%
Equity IRR	14.79%
Addl. Equity required	Rs. 1169 Lakhs
DSCR (Average)	1.43
DSCR (Minimum)	1.00
Concession Period	30 Years

13. Based on the above, the consultants reported that project is viable under condition that government gives a grant of Rs. 2280 lakhs.

E.10 OUR EFFORTS AND FINDINGS

E.10.1 Salient Corridor Characteristics

14. The section of corridor between Ahmedabad and Viramgam is a part of the longer corridor between Ahmedabad to Maliya, SH-17, which connects Kandla Port and Kuttch region with other parts of Gujarat state. The other road which provides connectivity to the two extreme parts of Gujarat is the NH-8A and NH-15 (Figure E.10-1). Due to the poor condition of the corridor along SH-17, most of the port and Kuttch bound traffic use NH-8A and NH-15 route, even though the travel distance is longer.

15. The project road starts from km 12, after Sarkhej rotary. It is 48 km in length, passing through settlements of Sanand, Sachana and Viramgam. A number of chemical and pharmaceutical factories fall along the corridor.

E.10.2 Traffic Studies and Forecast

E.10.2.1 Traffic Survey Locations

16. The classified traffic volume survey, origin-destination survey and axle load survey were conducted at one location as per the details given below (Map given as Annexure E-1) to establish base year traffic volume and desire levels and axle load spectrum.

Table E.10-1: Traffic Survey Locations

Location	Chainage	Survey Detail	Survey Duration
CORRIDOR: Km 11.5 to Km 59.0, Ahmedabad-Viramgam			
After Sanand near vadnagar Bus Stop	at 26/000 km	Traffic Volume	7 Days
		Origin Destination	1 Day
		Axle Load	1 Day

E.10.2.2 Traffic Volume Levels-2006

17. The average daily traffic volume levels recorded by sections on project corridor (Table E.10-3-(1)) were converted to annual average traffic volume levels, by applying seasonal correction factor (Table E10-3 (2)). The details on traffic volume characteristics are given under:

Table E.10-2: Traffic Volume-Salient Aspects

S.No	Section	Traffic Volume			PCU Factor
		ADT(Veh)	AADT(Veh)	AADT(PCU)	
1	Ahmedabad -Viramgam	20823	18741	34421	1.84

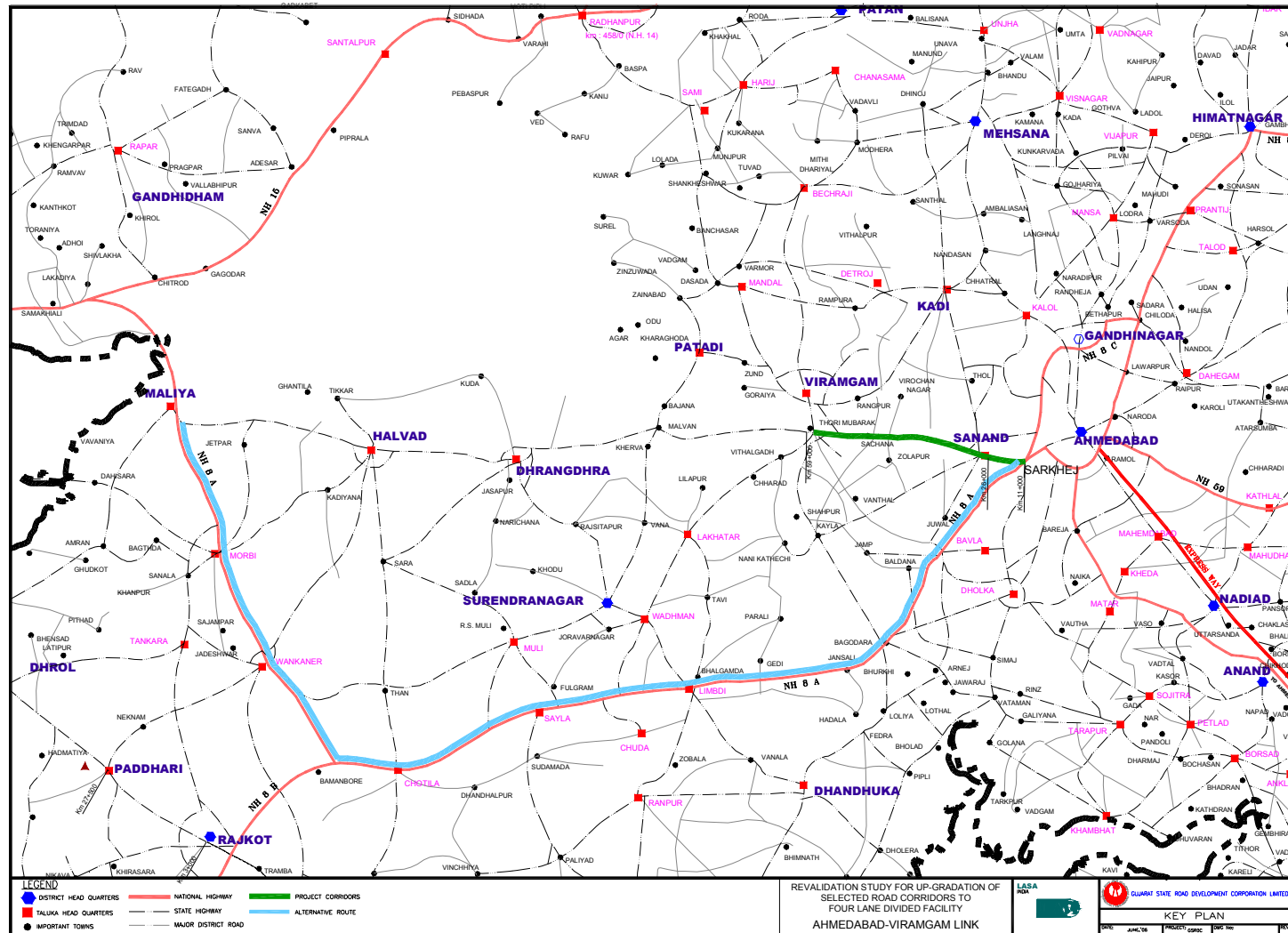


Figure E.10-1: Project Key Plan

Table E.10-3: Ahmedabad –Viramgam: Traffic Volume Levels

Table E10-3-(1): Average Daily Traffic Volume (ADT in VEHs)

Corridor Name	Sc/Mc	Auto Rickshaw/Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rikshaw	Animal Drawn Vehicles	Others	ADT (VEH)
Ahmedabad-Viramgam	3911	2137	512	2680	561	929	2022	3650	2174	595	399	296	706	109	103	39	20823

Table E10-3 (1): Annual Average Traffic Volume (AADT in VEHs and PCU)

Corridor Name	Sc/Mc	Auto Rickshaw/Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rikshaw	Animal Drawn Vehicles	Others	ADT (VEH)	AADT (PCU)
Ahmedabad-Viramgam	3520	1924	460	2412	505	836	1820	3285	1956	535	359	267	635	98	93	35	18741	34421

Table E10-3-(3) Traffic Composition

Corridor Name	Sc/Mc	Auto Rickshaw/Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rikshaw	Animal Drawn Vehicles	Others	AADT (VEH)
Ahmedabad-Viramgam	18.8%	10.3%	2.5%	12.9%	2.7%	4.5%	9.7%	17.5%	10.4%	2.9%	1.9%	1.4%	3.4%	0.5%	0.5%	0.2%	100%

Table E10-3-(4) Peak Hour Share of Traffic by Mode Types

Corridor Name	Peak hour	Sc/Mc	Auto Rickshaw/Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rikshaw	Animal Drawn Vehicles	Others	AADT (VEH)	AADT (PCU)
Ahmedabad-Viramgam	19:00-20:00	259	174	37	181	41	68	135	228	125	35	31	30	45	12	11	5	1417	2576

18. Traffic composition (Table E10-3 (3)) reveals that goods traffic is about 45%. It is evident from PCU factor derived above. The peak traffic share was observed to be about 7.5% (Table E10-3 (4)). The details on traffic volume data collected are given at Annexure E-2.

19. The pre feasibility study traffic levels were revisited. Comparison² was not made, as locations for conduct of surveys were different. It is important to note in this context that there has been growth in traffic levels. Compared Updated SOS³ traffic volume levels of 2005, traffic volume levels recorded high growth. From this what one can infer is that the project corridor is important, recording high volume levels. Further it is important to note that moderate to high growth in traffic levels are reported on this corridor and has high component of commercial traffic.

E.10.2.3 Traffic Desire Pattern

20. The Origin-Destination data by mode was analyzed. The trip ends by mode type were seen with respect to immediate influence area zones, traffic originating and terminating within Gujarat state and traffic which has one of the trip ends (either origin or destination) outside Gujarat.

21. The traffic zoning scheme and maps are placed at Annexure B-3.

22. The Cars and Goods Traffic desire is given at Table E10-4. The desire lines are shown in Maps E.1& E.2 suggest high proportion of tollable traffic amongst the modes that are tollable.

Table E.10-4: Traffic Desire Pattern on Break of Trips Internal and External to Gujarat

Section		Cars			Goods Traffic		
		Both Trip ends on Corridor	With one Trip end on corridor-Generated in Gujarat	With one of Trip ends out side Gujarat	Both Trip ends on Corridor	With one Trip end on corridor-Generated in Gujarat	With one of Trip ends out side Gujarat
Ahmedabad - Viramgam	Veh	500	2669	23	688	6897	856
	%	15.7%	83.6%	0.7%	8.2%	81.7%	10.1%

² The value reported was ADT not AADT. Further locations were different

³ Updated SOS was done in 2005 under GSHP

Draft Final Report

*Revalidation Study and Overall Appraisal of the Project for
Four-Laning of Selected Road Corridors in the State of Gujarat*

E. AHMEDABAD – VIRAMGAM
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E.10.2.4 Traffic Forecast

23. The traffic volume on the project corridor is forecasted under various considerations. The updated SOS method was based on the assumption that the state shall implement the development of roads there shall be and no imposition of road user charges. In these conditions the normal traffic shall grow at fairly high growth rates. Further, to this the latent demand for travel will be realised leading to induced and generated traffic levels. If projects are implemented under commercial format, their perceived to be disutility by the road users, as they need to pay user fee. This phenomenon is observed across several road projects in India, if an alternate route is available. The project roads are state roads. It is important to implicitly consider alternative routes for road users' are available. Hence, in this revalidation study, the traffic volume levels forecasted explicitly consider likely diversions and suppression of demand, as road users shall try maximising benefits by performing less trips. With these considerations alternative traffic forecasts were made. The adopted forecast for financial analysis is suppressed demand alternative (Table E.10-5).

Table E.10-5: Projected Traffic Volume by Alternate Considerations

Link Name	Study	Year	Sc/Mc	Auto Rickshaw/ Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/ LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Tractor	Tractor without Tractor	Cycle	Cycle-Rikshaw	Animal Drawn Vehicles	Others	AADT (VEH)	AADT PCUs
Ahmedabad-Viramgam	SOS-II	2006	2063	1017	837	2440	683	1152	1276	3578	1837	527	166	112	455	19	10	30	16200	32113
		2010	2771	1195	983	3058	761	1343	1554	4564	2397	703	193	130	500	20	10	34	20214	40184
		2015	3887	1468	1207	4092	859	1595	2002	6253	3385	1024	233	157	563	20	11	39	26795	53663
		2020	5201	1804	1483	5476	953	1849	2531	8368	4660	1449	278	187	634	21	11	45	34950	70468
		2025	6638	2142	1761	6989	1058	2144	3200	11198	6415	2052	332	223	700	21	11	51	44935	92245
	Revalidation Study - Trend based	2006	3520	1924	460	2412	505	836	1820	3285	1956	535	359	267	635	98	93	35	18741	34421
		2010	4789	2268	543	3045	564	978	2229	4226	2583	723	419	311	699	101	95	40	23611	43236
		2015	6717	2786	667	4075	638	1162	2872	5790	3657	1052	507	376	787	104	98	46	31333	57538
		2020	8989	3422	819	5454	708	1347	3631	7748	5034	1490	605	449	886	107	101	53	40841	75322
		2025	11472	4064	973	6964	785	1561	4590	10369	6930	2109	722	536	978	110	104	60	52325	98212
	Revalidation Study - Supressed Demand	2006	3520	1924	353	1793	391	634	1370	2367	1383	384	359	267	635	98	93	35	15605	27029
		2010	4377	2160	403	2114	427	719	1580	2758	1638	461	400	297	686	100	95	38	18253	31283
		2015	5560	2497	475	2596	472	825	1889	3339	2024	579	458	340	754	103	97	42	22051	37477
		2020	6830	2886	585	3305	527	959	2322	4058	2476	728	519	385	829	105	99	47	26660	45092
		2025	8112	3257	644	3789	557	1046	2629	4756	2985	884	587	436	898	107	100	51	30839	52213

24. As noted the traffic volume is forecasted by growth rate approach⁴. The growth rates considered are moderate⁵. They are considered based on findings of Updates SOS of GSHP⁶. The traffic volume is categorized to forecast as growth rates are expected to vary by type of interaction and mode types therein. The growth rates adopted are given under :

Table E.10-6 Adopted Traffic Growth Rates

Mode	Region	Central Gujarat				India			
		2006-10	2010-15	2015-20	2020-25	2006-10	2010-15	2015-20	2020-25
Scooter/Motor Cycle		5.6	4.9	4.2	3.5	4.2	4.2	4.2	4.2
Auto Rickshaw/ Chakda		2.9	2.9	2.9	2.5	2.9	2.9	2.9	2.9
Car/ Jeep (OT)		3.4	3.4	3.4	2.8	3.4	3.4	3.4	3.4
Car/ Jeep (NT)		4.2	4.2	4.2	3.5	4.2	4.2	4.2	4.2
Mini Bus		2.2	2.0	1.7	1.7	2.2	2.2	2.2	2.2
Standard Bus		3.2	2.8	2.4	2.4	3.2	3.2	3.2	3.2
Tempo/ LCV		3.6	3.6	3.4	3.4	3.6	3.6	3.4	3.4
2-Axle Truck		3.9	3.9	3.6	3.6	3.9	3.9	3.6	3.6
3-Axle Truck		4.3	4.3	4.0	4.0	4.3	4.3	4.0	4.0
MAV		4.7	4.7	4.3	4.3	4.7	4.7	4.3	4.3
Tractor with Trailer		2.7	2.7	2.5	2.5	2.7	2.7	2.5	2.5
Tractor without Trailer		2.7	2.7	2.5	2.5	2.7	2.7	2.5	2.5
Cycle		1.9	1.9	1.9	1.6	1.9	1.9	1.9	1.9
Cycle Rickshaw		0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5
Animal Drawn		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Others		2.1	2.1	2.1	1.8	2.1	2.1	2.1	2.1

25. The traffic volume levels thus derived are (Table E10-7) given under:

Table E.10-7: Projected Traffic Volume Levels

Section		2006	2010	2020	2030
Ahmedabad – Viramgam	Veh	15605	18253	26660	36227
	PCU	27029	13283	45092	61537
	GR(%)		4.0%	3.9%	3.1%

26. The detailed statements on mode wise traffic levels by locations and their forecast are given at Annexure E-3.

E.10.3 Engineering Studies and Investigations

E.10.3.1 Alignment Verification

27. As per the stipulated scope of this revalidation study we have carried out alignment verification for Ahmedabad – Viramgam road corridor. For this purpose all the available

⁴ Alternative approaches need exhaustive time series data specific to corridor on socio-economic and traffic related aspects and their forecasts.

⁵ Moderate growth rates are adopted to overcome any likely diversions and suppression of demand on imposition of tolls as users' will try to maximise the benefits.

⁶ Updated SOS Report undertaken included exhaustive analysis of regional level traffic growth analysis and econometric variables. It established region specific growth rates for projects to be implemented through state funding.

alignment details from earlier studies along with Gujarat State Highway Project (GSHP) were studied.

28. GSHP designs are taken as base because of non-availability of other details.

29. GSHP design drawings were collected as the corridor was inspected. Considering ground condition improvement scheme was finalised.

E.10.3.2 Strip Mapping

30. Providing linear diagrams in the form of strip map has been an important mandate of this study. Using GSHP design drawings the field work was carried out to prepare the updated strip maps⁷ showing the existing and proposed scenario.

E.10.3.3 Highway Geometrics

31. On review of the earlier study details, the geometrics as provided in GSHP, where applicable are adopted for new proposed four-lane facility.

E.10.3.4 Pavement Design

32. Taking pre-feasibility study and GSHP pavement design details as the base new pavement design is carried out. Towards this latest traffic volumes and computed VDF values for this corridor were adopted.

E.10.4 Design and Project Cost

E.10.4.1 Geometric Design

33. Geometric design standards are adopted as per GSHP and IRC standards.

34. The adopted typical cross sections are placed at Annexure B-5.

E.10.4.2 Pavement Design

35. **VDF:** The VDF got computed after fresh Axle Load survey near Sanand. The adopted VDF values for computation of MSA are:

LCV	–	0.54
Bus	–	1.13
2-Axle Truck	–	9.78
3-Axle Truck	–	9.6
Multi Axle Truck	–	5.6

⁷ The Strip Maps prepared were submitted to GSRDC for needful action.

36. **CBR:** Design CBR values are adopted from GSHP pavement design:

Section Name	Design CBR
Ahmedabad – Viramgam	12%

37. **New Pavement Design:** For design of new pavement IRC-37:2001 was followed. The design life is taken as 20 years. Average growth of commercial vehicles is considered as 5.2%⁸. For two different sections respective maximum, directional, traffic is considered for calculation of design lane MSA. Lane distribution factor as stipulated was considered. New pavement design crust for Ahmedabad – Viramgam road corridor is tabulated as under:

Ahmedabad-Viramgam		
CBR – 5%		
MSA – 376		
Adopted Design for CBR 5%, MSA – 150 ⁹		
	Required	Recommended
BC	50	50
DBM	170	100
WMM	250	400 ¹⁰
GSB	300	300
Total	770 mm	850 mm

E.10.4.3 Overlay and Profile Correction

38. GSHP improved facility is in place. It is felt appropriate to have only profile corrective course to get unidirectional camber on this corridor. But looking to some of the specific minor/major distresses it was decided to conduct BBD survey¹¹ for ensuring adequacy of structural strength and accordingly design of overlays as required.

39. At this stage BBD survey is in progress. The analysis and findings of the same shall be incorporated in the final report of this study.

40. The following scheme has been adopted for the corridor :

- Profile correction with BM – Average 50mm thick
- Overlay – DBM – 80mm, BC – 40mm

⁸ .This figure is higher than projected volumes. But to be on the safe side higher value of traffic growth rate is adopted for developing the pavement design.

⁹ . As stipulated by IRC:37 – 2001, “For traffic exceeding 150 msa, the pavement design appropriate to 150 msa may be chosen and further strengthening carried out to extend the life at the appropriate time based on pavement deflection measurements as per IRC:81.

¹⁰ . Substitution of pavement layers as per IRC:37-2001 and IRC:81-1997.

¹¹ .During the discussions with the Secretary, R&BD it was decided to additionally conduct BBD Survey as it was not part of original scope of services. It is felt important from design and cost estimation point of view.

E.10.4.4 Structures Design

41. Generally the new structures are proposed similar to that of GSHP. Details pertaining to existing structures and proposed scheme for four laning is placed at Annexure E-4. Based on these rates adopted for various structure items are:

Sl. No.	Description	Unit	Rate (Rs.)
1	Major Bridges	Sqm	26,000/-
2	ROB	Sqm	26,000/-
3	Minor Bridges	Sqm	24,000/-
4	Slab Culverts	Sqm	18,000/-
5	Box Culverts	Sqm	18,000/-
6	Pipe Culverts (Single Row)		
a	Diameter \geq 0.90m	Rm	7,500/-
b	Diameter $>$ 0.75m & $<$ 0.60m	Rm	6,500/-
c	Diameter \leq 0.60m	Rm	5,500/-

42. **Rates Adopted:** The National Highway – Ahmedabad Division (NH- Ahmedabad) schedule of rates¹² were adopted for cost estimates.

43. Based on the judgements where required, escalation was applied. Further for some of the items realistic rates were evaluated and used.

E.10.4.5 Project Cost

44. Base year assessed project construction cost worked is given under :

Sl. No.	Description of Item	Total Amount (in million Rs.)
1	Highway Cost	982.43
2	Intersections, Toll Plaza, Bus Bay/Bus Shelters	121.51
3	Structure Cost	84.22
4	Existing Road Maintenance	11.99
Total Construction Cost		1200.15

45. Details pertaining to quantity and cost calculation are placed at Annexure E-5.

E.10.5 Environmental and Social Impact Assessment

46. Project Corridor¹³ traverses through three talukas in Ahmedabad district with a total length of 47.8 km. Sanand and Viramgam are the talukas which are likely to be affected the most and Ahmedabad (6 km of the Project corridor passes through this taluka) - the least (Table E.10-8)

Table E.10-8: Propensity of Impacts (By Taluka)

¹² . Based on the discussions held with officers of GSRDC and R&BD it was decided to adopt largely the schedule of rates of R&BD for estimation of the project cost.

¹³ . The Project Corridor Ahmedabad-Viramgam runs east to west and is an alternate route to the port of Kandla (majority of the traffic uses the NH 8 at present) from Ahmedabad. This corridor is spread out in three talukas of Ahmedabad district with a total population of 4.58 million and area of 1973 km² as per 2001 Census.

District	Taluka	Area (km ²)	Length of Corridor (km)	Population
Ahmedabad	Ahmedabad	304.1	6.0	4220048
	Sanand	784.5	32.0	193335
	Viramgam	885.2	9.8	172400
Total		1973.9	47.8	4585783

47. Viramgam is the largest with an area of 885.2 km² (44.84 % of total area of Talukas being traversed) and Ahmedabad is the smallest, with only 304 km² (15.4 % of total area of Talukas being traversed). Population distribution Ranges between 172 thousand in Viramgam to 4220 thousand in Ahmedabad which shows a wide variation. Ahmedabad has the highest share of population (92 % of all Talukas being traversed) covering three Talukas.

48. **Impacts on Flora**¹⁴: There is no rare or endangered species among these plantations. Some Eucalyptus plantations are found within industrial parks. Other than that, the main concentration of trees, which are generally not of good timber value, are found in the strip plantations.

49. To prevent vehicle collisions with the roadside trees, they cannot be close to the pavement, particularly trees with strong and rigid stems. Some trees are safety hazards because they preclude adequate sight distance. Many of these roadside plantations will be impacted by the widening of the road from two lane to four lane (Table E.10-9)

Table E.10-9: Tree Plantation along The corridor

Name	No. of Trees	No. of Trees to be impacted
Ahmedabad-Viramgam	2750	1800
Total	2750	1800

50. **Reserve Forest within the Study Area**: Except for the roadside plantation, no reserve forest flora will be impacted by this project.

51. **Bio-diversity and endangered species**: There are no rare and endangered species that occur in any of or are close to the corridor. Therefore, it is unlikely that the widening of the road to four lane is going to have any negative impact whatsoever on any endangered species of flora.

52. **Impacts on Fauna**: Some of the fauna of Gujarat has received world wide attention and concern. Two species in particular are famous and endangered as they exist in the only known habitat in the world. Asiatic Lion (*Panthera leo persica*) and; second, the Indian Wild Ass (*Equus onager khur*) which are unique and confined to the narrow forest patches in Gir and the arid-zones of Kachchh respectively. Wild ass sanctuary is near vicinity of the project corridor. Nal Sarovar Sanctuary is a place visited by many water bird species during winter. This sanctuary is

¹⁴. Negative impacts on flora will involve the removal of trees, shrubs and ground cover during pre-construction from within the Corridor of Impact. There may also be possible damage to remaining vegetation during the construction phase of the project. Strip plantations of trees within the RoW of State Highways have been declared as Protected Forests on all the project roads.

at a distance of 38 km from this corridor. Therefore, it is unlikely that the widening of the road to four lane is going to have any negative impact on this sanctuary.

53. **Impacts on Cultural Environment:** Strip mapping carried out on the project corridor was the main source of identification of the affected cultural properties falling within and just outside the RoW of the project corridor. All the Archaeological Monuments are beyond 2 km from the corridor. Therefore, it is unlikely that the widening of the road to four lane is going to have any negative impact on any Monuments (Table E.10-10)

Table E.10-10: Archaeological Monuments/Sites within 10 km of Project Corridor

Name	Location	Distance from corridor (in kms.)	Description
Roza of Baba Alisaq, mosque, tank, tomb	Sarkhej	Within 2.0 Km.	
Gayatri Siddhanath temple	Sanand	Within 1 Km.	Belonging to the royal family of Sanand, houses apart from the temple, 5 cenotaphs, of the royal family, believed to be more than 100 years old, one of which might be more than 500 years old.
Mansar Talav and shrines	Viramgam	Within 2.0 Km.	
Munar Lake	Viramgam	Within 2.0 Km.	Built in about AD 1100. In shape it is irregular, and is supposed to resemble a conch (shanka). It is enclosed by a ghats or flight of steps, which lead down to the water.

54. Cultural properties lying along the highways are most susceptible to impacts due to construction activities depending upon the access to the property, distance between the road pavement and the cultural property, the condition and scale of the built structure (Figure E.10-2). Road construction machinery operating during the construction phase is likely to require a belt of about 4-5m from the edge of the carriageway. In such instances cultural properties located within a distance of 5m from the edge of the carriageway, risk being damaged by the heavy machinery (Table E.10-11).



Figure E.10-2: Shrine Liable to be Relocated

Table E.10-11: Cultural Properties along Project Corridor

Place	Name	Condition	Location (Ch.)	Distance from Edge of Pavement (m)	Direction and Siting w.r.t. RoW	Environment, Annual Gathering and Other Details	Impacts During Construction
Shantipura	Shrine	Average	14.5	5	L	Rural	A,B,C
Telav	Temple	Average	17.7	1	R	Rural	A,B,C
Telav	Temple	Good	17.75	12	R	Rural	C,D
Sanand	Temple	Good	21.8	2	R	Semi Urban	C,d
Sanand	Shrine	Average	23.92	12	R	Urban	B,C
Sanand	Temple	Average	24.27	10	R	Urban	B,C

Place	Name	Condition	Location (Ch.)	Distance from Edge of Pavement (m)	Direction and Siting w.r.t. RoW	Environment, Annual Gathering and Other Details	Impacts During Construction
Sanand	Shrine	Average	24.45	3.5	R	Urban	A,B,C
Sachana	Shrine	Average	47.12	7.2	L	Semi Urban	A,B
Sachana	Shrine	Good	47.3	2	L	Semi Urban	A,B,C
Impacts during Construction include (A)→ Damage to structure due to operation vehicles, (B)→Contamination of site, (C)→Pollution and (D)→Interrupted Access to Site.							

55. **Land Acquisition:** Widening from two lane to four lane of the roads might require acquisition and clearing of various types of properties. Land acquisition involves land take of legal lands for the larger interests of the society, like the creation of road infrastructure, as is the case in the four laning project. Sachana, at km 47, is a small village with a very constrained RoW. The road passes close to a temple at the north end of the village but there is no scope for widening at that point because the railway line is directly adjacent to the road in the north side. In order to overcome this developing a bypass to avoid resettlement and shifting of temple felt needed if design solutions do not permit scheme within ROW (Figure E.10-3)



Figure E.10-3 Near Sachana Village at 47.9 Chainage

56. However, due to the design considerations of limiting the proposed road widening not beyond the existing RoW, substantial land acquisition needs are reduced. The assessed land requirements by use type are given in Table E.10-12.

Table E.10-12: Extent of Properties Likely to be impacted

Type of Land Acquisition	Area in Hectare
Agricultural Land	33.96
Residential Area	0.35
Commercial Area	0.76
Open Land	10.57
Scrub Land	2.20
Industrial Area	0.51
Plantation	0.24

Type of Land Acquisition	Area in Hectare
Community	0.02
Total area in Ha	48.59

57. **Impacts on Water Resources:** A road project can significantly alter the hydrological setting of an area and add to the siltation and pollution level in water sources. The identification and mitigation of such adverse impacts assume greater significance in water scarce regions such as Gujarat.

58. **Water resources along the project corridor:** Widening of a road entails the removal of open wells, tube or borewells within the RoW resulting in a permanent loss of water supply. Wells, which are non-perennial, or not in use, may be easily removed or filled in. A pond, in village Telav, located at km 17.6 may lose some storage volume to filling during construction. The other concern is contamination of water in the pond by sediment-laden water during this phase. Refer Figure E.10-4.



Figure E.10-4: Pond near Telav Village



Figure E.10-5 Well near Sachana

59. This corridor has wells interspersed within the RoW along the corridor. The nearest well is at 4 m from existing edge of carriageway at km 46.85. (Figure E.10-5) The common concern for all wells is contamination due to road run-off and collision during construction. During the operation, lubricants and exhaust emissions, which may be mixed with road run-off, may pollute the water. Table E.10-13..

Table E.10-13: Water bodies likely to be impacted by Project

Link Name	Sensitive Environment	Chainage	Direction	Distance from CL (m)	Phase	Impact
Ahmedabad-Viramgam	Pond	17.6	North	12	Construction	▪ Sedimentation from construction run-off
		46.9	South	15		▪ Collision potential from vehicles
	Well	51.6	North		Operational	▪ Contamination due to run-off of lubricants and exhaust emission.
		46.85	South	4		

E.10.6 Tollable Traffic

60. The vehicles which are tollable¹⁵ as per the Concession agreements are considered for assessment of tollable traffic in the base year. From the road side interview conducted, the desire of traffic recorded was used to assess the tollable traffic. In this project towards assessment of tollable traffic all the intra zonal and inter-zonal trips of the zones lying on the corridor are excluded. This exclusion may lead to slightly under estimation of tollable traffic. Further assuming there is going to be diversion from the corridor on imposition of tolls the assessed tollable traffic is dropped by 30% to establish conservative tollable traffic under a suppressed traffic growth scenario, as compared to trend based forecast.

61. The assessed tollable traffic by mode in the base year is given in Table E-10.14. Annexure E-6 provides link wise tollable traffic projections.

Table E10.14: Assessed Tollable Traffic

Corridor Name	Toll Plaza Location	Traffic Category	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Total (AADT in Veh Nos)
Ahmedabad - Viramgam	km 27/00	Total Traffic	353	1793	391	634	1370	2367	1383	384	8674
		Non Tollable Traffic	103	347	126	162	319	224	47	30	1357
		Tollable Traffic	250	1445	265	472	1051	2143	1337	354	7317

62. The forecasted tollable traffic, by mode at 10 year interval is given at Table E10-7. This forecast is based on suppressed demand growth rate approach.

Table E.10-15: Tollable Traffic Projection

Link Name	Toll Plaza Location Chainage	Year	Cars (OT)	Cars (NT)	Mini Bus	Std. Bus	Lcv/ Tempo	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	TOTAL AADT (VEH)	TOTAL AADT (PCU)
Ahmedabad-Viramgam	km 27/000	2006	250	1445	265	472	1051	2143	1337	354	7317	17248
Ahmedabad-Viramgam	km 27/000	2010	286	1704	290	535	1213	2497	1583	425	8532	20145
Ahmedabad-Viramgam	km 27/000	2020	398	2571	348	692	1710	3608	2375	660	12361	29223
Ahmedabad-Viramgam	km 27/000	2030	524	3629	411	877	2380	5139	3502	1007	17469	41631
Ahmedabad-Viramgam	km 27/000	2040	691	5124	485	1112	3312	7319	5164	1538	24744	59456

63. In addition to above, estimated tollable traffic is forecasted at 2% p.a. up to “COD” and 5% thereafter¹⁶ the forecasted traffic by mode is given as Annexure E-7.

E.10.7 Financial Analysis

64. The financial analysis of the project has been undertaken to assess the viability of the projects under a commercial format. A number of options/scenarios of project have been worked

¹⁵ Only Cars and commercial vehicles which include buses are tollable

¹⁶ This is based on new model concession agreement of Gol.

out to aid in decision-making process. The following scenarios have been considered for undertaking the financial analysis:

- a) Scenario 1: Ahmedabad Viramgam corridor (47.5 km);
- b) Scenario 2: Ahmedabad Viramgam Maliya Corridor as one (179.9km);

E.10.7.1 Inputs and Assumption

Revenue Model

- (b) **Tollable Traffic:** The tollable traffic, by each toll plaza, has been estimated and presented in Sub-Section 10.6. This traffic forms an input to the financial analysis.
- (c) **Toll Rates:** The toll rates are those which have been recommended by the Ministry, vide a notification in the year 1997. These have been escalated to prices as on 31st March 2006. The per km toll rates as well as the toll rate for the project corridor, at 2006 prices, have been given in Table E.10-16.

Table E.10-16: Toll Structure (at 2006 prices)

Mode	Toll Rate (Rs./km at 2006 price)	Toll Rates (Rs./Trip at 2006 price)	
		Ahmedabad Viramgam	Ahmedabad Viramgam Maliya
Car/Jeep	0.61	30	110
Mini Bus	1.07	50	190
Bus	2.13	100	385
LCV	1.07	50	190
2-Axle Truck	2.13	100	385
MAV	3.43	165	615

For future, the toll rates have been assumed to increase at an inflation rate of 5% p.a. For estimation of corridor level toll rate, this has been rounded to nearest five rupee.

65. Annual Toll Collection: The annual toll revenue realisation, over the project period, at current prices, has been given in Table E.10-17.

Table E.10-17: Annual Toll Revenue

Year	Annual Toll Collection (Mill Rs at current Prices)	
	Ahmedabad Viramgam	Ahmedabad Viramgam Maliya
2010	343.2	804.6
2015	529.1	1248.3
2020	808.6	1911.2
2025	1236.6	2930.4
2030	1889.8	4488.1
2035	2887.4	6894.9

Cost of Project

66. The initial civil cost of project has been estimated for the two scenarios of part and full development of the corridor. The construction activities have been assumed to be undertaken in the years 2008 and 2009. The total cost of project is as follows:

Type of Cost	Ahmedabad Viramgam	Ahmedabad Viramgam Maliya
Civil Construction Cost	1200.15	6028.98
Contingency (10%)	120.02	602.90
Construction Supervision (3%)	39.60	198.96
Inflation During Construction	180.60	907.26
Total Cost of Project	1540.37	7738.10

67. Routine and periodic maintenance have been taken as follows:

Routine Maintenance – Rs. 40,000/km

Periodic Maintenance – Rs. 3 mill/km

Assumptions for Analysis

68. A number of assumptions have been considered for the analysis. They have been listed below:

- (a) The base debt-equity ratio has been taken as 7:3.
- (b) The analysis period has been taken as 30 years.
- (c) The rate of interest considered for the analysis has been assumed as 12% p.a. This is looking at the present increase in interest rates.
- (d) With respect to the increased interest rates, the expected post-tax return on investment has also been taken at a value of 15 – 17%.
- (e) The subsidy/grant component has been limited to 40% of the total project cost. Under the VGF scheme, a maximum of 20% of the total project cost is expected to come from the central government and the balance, if any, needs to be given by the state government.
- (f) The disbursement of VGF has been taken during the construction period. It is to be disbursed after the equity draw-down by the concessionaire in over. The phasing of VGF/capital grant has been linked to the debt draw-down.
- (g) The Corporate Tax is taken at 33.66%¹⁷. In the event of the tax rebate, a Minimum Alternative Tax of 11.22 %¹⁸ has been included in the analysis.
- (h) The depreciation schedule has been taken as per the IT and Companies Act.
- (i) Insurance premium has been assumed at 0.7% of the assets/investment.

¹⁷ The breakup is 30% Corporate Tax, with 10% surcharge and 2% education cess.

¹⁸ The MAT is 10% with 10% surcharge and 2% education cess.

- (j) The tax concession on road projects has been taken for the analysis. There is a 10 year, full tax rebate on road infrastructure projects, starting from the first year of operation of the same.
- (k) The loan repayment period has been assumed as seven years after two years of moratorium.

E.10.7.2 Results of Financial Analysis- Base Case: Realistic Traffic

69. The financial analysis for the base case has been presented in the Table E.10-18. The details of financial analysis are presented through Annexure E-8.

Table E.10-18: Results of the Analysis in Base Case

Indicators	Ahmedabad Viramgam		Ahmedabad Viramgam Maliya	
	20 Yrs	30 Yrs	20 Yrs	30 Yrs
Viability Gap Funding				
mill Rs	-	-	3095.2	2321.4
% of Project Cost	-	-	40%	30%
Pre-Tax IRR (%)	22.87	24.25	17.93	18.24
Post-Tax IRR (%)	19.73	21.23	16.96	17.03
Return on Equity (%)	25.84	27.16	21.33	19.63
Minimum DSCR	0.17	0.17	0.41	0.35
Average DSCR	1.67	1.67	1.44	1.23
Payback Period	9yrs 0.5 mths	9yrs 0.5 mths	11 yrs 5 mths	12yrs 5 mths

70. Ahmedabad Viramgam is a very attractive project. It can be taken under pure BOT arrangement without any VGF. For the expected rate of return, the concession period comes to about 13 years. But the viability of the full corridor is seen to be marginal if concession period is taken as 20 years. At this point it is to be noted that if the full corridor does not come up together, then the possibility of traffic using this route will be low.

E.10.7.3 Sensitivity Analysis: Variation in Revenue and Cost Levels

71. In order to understand the sensitivity of variation in revenue and cost levels on the project viability, a case of increased and reduced cost and toll revenue realisation, respectively, has been worked out and the results are presented in Table E.10-19.

Table E.10-19: Sensitivity Analysis: Case of Revenue and Cost Variation (30 Year Period)

Indicators	Ahmedabad Viramgam			Ahmedabad Viramgam Maliya		
	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost
Viability Gap Funding						
mill Rs	-	-	-	3559.5	3327.4	4627.4
% of Project Cost	-	-	-	40%	43%	52%
Pre-Tax IRR (%)	22.11	21.43	19.55	18.20	18.16	18.26
Post-Tax IRR (%)	20.20	19.66	18.10	17.02	17.05	17.19
Return on Equity (%)	25.71	24.65	21.78	19.70	19.66	20.07
Minimum DSCR	0.88	0.71	0.62	0.35	0.17	0.16
Average DSCR	1.63	1.55	1.36	1.23	1.23	1.25
Payback Period	9 yrs	9 yrs 4 mths	10 yrs 7mths	12 yrs 9 mths	13 yrs	13 yrs 3 mths

72. The section between Ahmedabad Viramgam is a robust project from commercial perspective. Even in the worst of scenarios, 15% rise in project cost along with 15% reduction in revenue, the project does not require any grant component to make the project viable. On the other hand, the full corridor if taken together becomes marginally viable with 40% of VGF in case of cost increase.

E.10.7.4 New Model Concession Agreement as Base

73. The Committee on Infrastructure has recently prepared a New Model Concession Agreement, for the upcoming BOT projects. Anticipating the implementation of the same, a set of analysis has been undertaken with the new MCA as the base as well. The major assumptions, beyond the ones already stated, which have been incorporated in this analysis as per the new MCA are:

- The traffic growth has been considered at 5% per annum over the concession period, starting from the COD. However, from the base year to the year when the construction is completed, the traffic growth has been taken as 2% per annum.
- In case the project corridor qualifies for a six-lane, within the project period, the concession period has been limited to a maximum of that many years.

74. The analysis does not include the scenario of full corridor as one package. This is because as per the new MCA, the year of requirement of six laning varied for the two individual sections, which meant two different concession periods.

75. The results of the analysis have been presented in Table E.10-20.

Table E.10-20: Results under New MCA Assumptions

Indicators	Ahmedabad Viramgam
Requirement of Six Lane	2018
Maximum Concession Period	11 Yrs
Viability Gap Funding	
mill Rs	154.04
% of Total Project Cost	10%
Pre-Tax IRR (%)	19.26
Post-Tax IRR (%)	17.5
Return on Equity (%)	25.81
Minimum DSCR	1.06
Average DSCR	1.68
Payback Period	7 yrs 2 mths

E.10.7.5 Conclusions

76. The project under study is a robust project if seen for the section between Ahmedabad and Viramgam. The full corridor is viable with 30% of project cost as VGF, over a period of 30 years. The corridor is a strategic one hence needs to be taken up for implementation. Due to the narrow lane configuration and poor road condition, most of the port and Kutchh bound traffic takes the route via NH-8A, which is about 65 kms longer. If this corridor is widened, there will be a substantial saving to the vehicle owners as well as the society. It is therefore recommended that the full corridor be taken up for implementation.

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