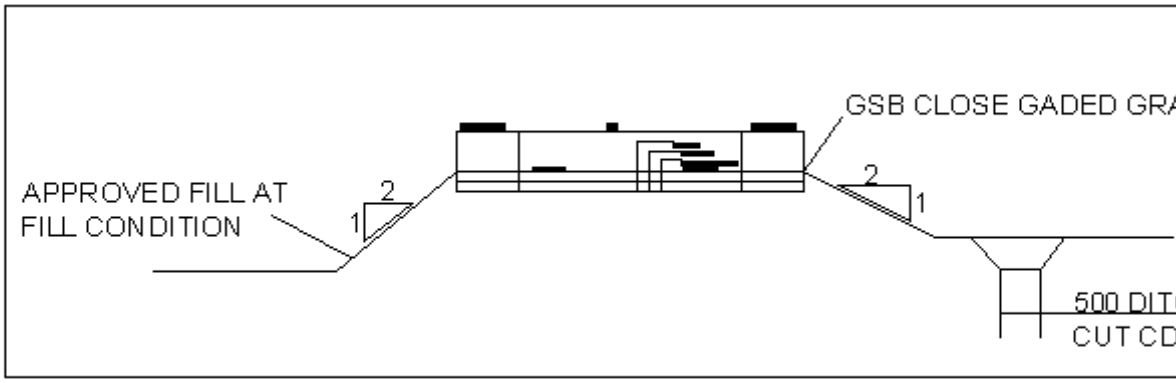

PIU & SRP Dn. R &BD., GoG

RENGINEERING CHARACTERISTICS

1.1 ROADWAY CHARACTERISTICS

1. The project corridor is a Maintenance / Rehabilitation corridor, part of SH-160 and SH-06 and SH-05 and covers a distance of 55.910 km. The corridor passes through four talukas namely Karjan, Padra of Vadodara District and Bhadaran, Borsad of Kheda District in Gandhinagar region. The corridor provides major linkage between Western Gujarat and Central region.

Photo 1.: Karjan-Borsad road Two Lane, km 43+800

2. Road Inventory

3. The carriageway measured is 5.50m, 7.00m, and 10.0m wide, two lane throughout the length. Agriculture is the predominant land use on both sides of the corridor in most of the length. The corridor runs through mostly plain terrain and has CH type soil in most of the length and in some length it is of CH type soil. Error! Unknown switch argument. provides details of the project corridor.

Table 1.1: Details of Project Corridor

Details	Karjan-Padra Road Start from Padra, Km 000+000 to Km 023+200	Padra- Mahuvad chokadi. Km 016+000 to Km 023+500	Mahuvad chokadi to Gambhira Bridge (Mujpur) Road. Km-0+000 to 4+240	Gambhira (Mahi bridge), Kinkhlod – Bhadaran – Borsad. Km 035+585 to Km 056+555
SH Number	SH-160	SH-05	SH-06	SH-06
Districts	Vadodara	Vadodara.	Kheda	Kheda
Start Chainage (km)	000+010	016+000	00+000	035+585
End Chainage (km)	023+200	023+500	04+240	056+555
Total Length (km)	23.200	07.500	4.240	20.970

Terrain	Plain	Plain	Plain	Plain
Carriageway (m)	5.50m and 7.00 mt & 10mt	10.00m and (at Padra & Mahuvad chokadi Two lane with divider)	7.00 mtr	(10.00m at Bhadaran & Kinkhlod chokadi Two lane with divider)

4. The present lane configuration is as above corridor lengrth taken two lane in proposed corridor of Karjan-Padra-Mahuvad-Gambhira-Borsad Road (Start from Padra to Karjan, Km-0+00 to 23+200 i.e. 23+200 of karjan and ends at Borsad, Km-35+585 for the length of 55+910 Km.) with about 0.00 m to 1.50 m earthen shoulders on either side. The road formation height varies from 0.0 m to 4.0 m.

1.1.1 En-route Settlements and Intersections

5. The project corridor, **(1) Karjan – Padra (SH – 160 start from Padra to Karjan upto Amod Junction**) **en-routes 15 villages** viz., Padra, Dhayaj, Narsipura, Goriyad, Sarsavani, Virpue, Medhad, Musepur, Manpur, Pingalvi, Kherda, Ansura, Karjan, Umaj Road, Karmadi Road, and on **(2) Padra – Mahuvad chokadi , ((SH – 05**) **en-routs 3 villages** viz., Padra, Dabhasa, Mahuvad. **(3) Mahuvad chokadi to Gmbhira Bridge (Mujapur**), **en-routs 2 villages** viz.,Mahuvad and Ekalbara And **(4) Borsad- Bhadaran-Kinkhlod – Gambhira upto Mahi river bridge (SH – 06**) **en-routs 14** villages viz., Part of Borsad town, Bhadaran, Rampura, Ingal vadi, Khedasa, Pipali, Moti Seradi, Kinkhlod, Mahadev Pura, Bilpada, Devpura, HimatPura, Gambira, and Bamangam.

6. Table 1.2 provides details of entoute villages and talukas.

Table 1.2: En-route Settlements

Settlement Name	Type	Start Chainage (km)	End Chainage (km)
SH – 160, PADRA-KARJAN ROAD			
Padra	Village	00+000	00+200
Dhayaj	Village	01+750	02+250
Narsipura	Village	02+450	02+600
Goriyad	Village	03+750	04+325
Sarsavani	Village	06+325	07+220
Virpur	Village	09+950	09+990
Medhad	Village	10+400	10+700
Musepur	Village	12+350	12+480
Manpur	Village	14+850	14+950
Pangalvi	Village	15+600	15+640
Kherda	Village	18+400	18+500
Ansura	Village	18+530	18+900
Karjan	Village	22+200	23+250
Umaj Road	Village	22+300	22+320
Karamadi Road	Village	22+740	22+750
SH – 05, PADRA-MAHUVAD CHOKADI ROAD			
Padra	Village	16+000	16+500
Dabhasa	Village	20+400	20+650
Mahuvad	Village	22+650	23+000
SH – 06, MAHUVAD CHOKADI TO GAMBHIRA BRIDGE (MUJAPUR) ROAD			
Mahuvad	Village	22+650	23+000
SH – 06, BORSAD-GAMBHIRA ROAD			

Settlement Name	Type	Start Chainage (km)	End Chainage (km)
Part of Borsad town Khambhat Road	Village	35+000	35+600
Bhadaran	Village	38+900	39+300
Rampura	Village	43+150	43+250
Ingalvadi	Village	43+350	43+430
Khedasa	Village	43+470	44+250
Pipali	Village	44+800	44+825
Moti Seradi	Village	44+825	45+450
Kinkhlod	Village	46+850	47+900
Mahadev pura Road	Village	50+870	50+880
Bilpada	Village	51+100	51+475
Devpura	Village	52+550	52+560
Himat pura	Village	52+850	52+980
Gambira	Village	54+800	54+900
Bamangam	Village	54+800	54+900

7. There are total 15 Intersections/junctions across the project corridor, out of which 12 intersections / junctions are on Sh-236 and all are three armed intersections, while there are 3 intersections / junctions on SH-021 out of which one is four armed intersection and 2 are three armed junctions. Details of all Intersections / Junctions are tabulated in Table 1.3 below.

Table 1.3 Details of Major/Minor Junctions

Sr. No.	Intersection/Junction Name	Type	Chainage (km)	Side	Width (m)		Surface Type
					LHS	RHS	
SH – 160, PADRA-KARJAN ROAD							
1	Karjan	3-Arm	20+800	LHS	7.0	--	BT
2	Karjan & Umaj	4-Arm	22+310	LHS & RHS	7.0	5.0	BT
3	Amod & NH-08	4-Arm	23+200	LHS & RHS	7.0	7.0	BT
SH – 05, PADRA-MAHUVAD CHOKADI ROAD							
4	Padra	3-Arm	16+000	LHS	5.5	--	BT
5	Dabhasa	3-Arm	20+450	RHS	--	3.6	BT
6	Mahuvad	3-Arm	23+400	RHS	--	7.0	BT
SH – 06, MAHUVAD CHOKADI TO GAMBHIRA BRIDGE (MUJAPUR) ROAD							
SH – 06, BORSAD-GAMBHIRA ROAD							
7	Khambhat	3-Arm	35+785	RHS	--	7.0	BT
8	Bhadran	3-Arm	39+025	RHS	--	7.0	BT
9	Aklave & Kinkhlode	4-Arm	46+850	LHS & RHS	5.5	3.6	BT
10	Kinkhlode	3-Arm	47+825	LHS	7.0	--	BT
11	Gambhira & Bamangaon	4-Arm	54+850	LHS & RHS	5.5	5.5	BT

1.1.2 Railway Crossing

8. There is one narrow gauge railway level crossing at Km 0+000 on SH-160. of padra karjan road

1.1.3 Pavement Condition

9. The functional evaluation of existing pavement has been carried out by visual inspection. Judicious traveling and recording of the major distress types like cracking, potholes, raveling and rutting has been taken into account. Table 1.4 provides the pavement distress in terms of cracking, potholing and raveling against the percentage length of the corridor.

Table 1.4: Pavement Condition of the Corridor

Severity	Percentage Area of the Corridor		
	Cracking	Potholing	Ravelling
Nil	60 %	83.28 %	28.48 %
Low	0.52 %	2.19 %	9.46 %
Medium	1.83%	1.95 %	47.13 %
High	1.31 %	12.58 %	14.93 %
Salient Observations • 96.34 % area is without cracking; • Low to medium severe cracks has been observed in 2.35 % of area.	**Salient Observations** • Low to medium severe pot holes has been observed for 4.14 % of area; • High severity potholes are in 12.58 % of project length.	**Salient Observations** • Low to medium severe ravelling in 56.59 % of project length;	

Cracks & Settlements Km 47+150 (SH-06) Borsad-Gamdhira Bridge roda

Block cracking Km 14+775 to14+875 (SH-160) Padra-Karjan roda

1.1.4 Structural Strength

10. Structural strength of the existing pavement has been evaluated by Benkelman Beam deflection measurements. The details of investigation are discussed in the ensuing sub-sections.

1.1.5 Pavement Deflection Survey (BBD)

11. Pavement deflection surveys have been carried out in the month of December-2012 for Km 00+000 to Km 23+200 (SH-160), Padra-karjan road, and for Km 16+000 to Km 23+500 (SH-05), Padra-Mahuvad chokadi, Mahuvad chokdi to Gamdhira bridge 0 to 4.240

12. and for km-35+585 to 56+555 (SH-06), Borsad-Gambhira Road on Karjan-Borsad project corridor using a Benkelman Beam in accordance with testing approach of IRC-81-1997. The deflection measurements are made in the outer wheel path in a staggered manner. 3 sets of measurements are taken at each point, namely D_0, D_{2700}, D_{9000}. Pavement temperature and sub grade moisture data has also been collected during the course of the survey for applying temperature and seasonal corrections.

1.1.6 Temperature Correction

13. Pavement temperatures at the time of BBD measurements varied between 25^0C and 36^0C. The temperature correction is made as per clause 4.4.1 of IRC: 81-1997.

1.1.7 Correction for Seasonal Variation

14. Characteristics of existing sub-grade have been collected during BBD survey. Rainfall characteristics of the project area were collected from local meteorological department. The correction for the seasonal variation is done in accordance with provisions of IRC: 81-1997 by using respective charts for rainfall and soil type.

15. The pavement condition is poor in most of the kilometers of the corridor. Characteristic deflection for the respective homogeneous sections (Table 1.5), are calculated as the mean plus 2 times the standard deviations.

Table 1.5: Homogeneous Sections Based on Deflection Values & Overlay required

Chainage (km)		Characteristic deflection in mm	O L (MM)	Thickness proposed	MSA Xx10^6	PCC Thic.
From	To					
SH – 160, PADRA-KARJAN ROAD , Km 0.00 to 23+200						
0+0	0+500	2.11	173	115	6.05	25
0+500	1+000	1.47	119	115	6.05	25
1+000	1+500	1.18	78	115	6.05	25
1+500	2+000	1.47	119	115	6.05	25
2+000	2+500	0.90	NIL	115	6.05	25
2+500	3+000	1.20	83	115	6.05	25
3+000	3+500	1.09	58	115	6.05	25
3+500	4+000	1.43	114	115	6.05	25
4+000	4+500	1.44	115	115	6.05	25
4+500	5+000	1.08	55	115	6.05	25
5+000	5+500	1.01	20	115	6.05	25
5+500	6+000	1.20	83	115	6.05	25
6+000	6+500	1.30	97	115	6.05	25

Chainage (km)		Characteristic deflection in mm	O L (MM)	Thickness proposed	MSA Xx10^6	PCC Thic.
From	To					
6+500	7+000	1.70	142	115	6.05	25
7+000	7+500	1.16	73	115	6.05	25
7+500	8+000	1.16	73	115	6.05	25
8+000	8+500	1.02	27	115	6.05	25
8+500	9+000	1.00	NIL	115	6.05	25
9+000	9+500	0.93	NIL	115	6.05	25
9+500	10+000	1.07	51	115	6.05	25
10.000	10+400	Dropped Lengt h as taken up by R & B Division , Vadodara Being New Major Bridge under const. with Approaches				
10+400	10+500	1.08	55	115	6.05	25
10+500	11+000	1.01	20	115	6.05	25
11+000	11+500	1.15	71	115	6.05	25
11+500	12+000	1.34	103	115	6.05	25
12+000	12+500	1.01	20	115	6.05	25
12+500	13+000	0.90	NIL	115	6.05	25
13+000	13+500	1.19	81	115	6.05	25
13+500	14+000	1.30	97	115	6.05	25
14+000	14+500	1.51	97	115	6.05	25
14+500	15+000	1.76	121	115	6.05	25
15+000	15+500	1.26	59	115	6.05	25
15.500	16+000	1.25	57	115	6.05	25
16+000	16.500	1.07	NIL	115	6.05	25
16+500	17+000	1.06	NIL	115	6.05	25
17+000	17+500	1.41	85	115	6.05	25
17+500	18+000	1.23	53	115	6.05	25
18+000	18+500	1.56	102	115	6.05	25
18+500	19+000	1.90	133	115	6.05	25
19+000	19+500	1.26	59	115	6.05	25
19+500	20+000	1.27	61	115	6.05	25
20+000	20+500	1.36	78	115	6.05	25
20+500	21+000	1.22	51	115	6.05	25
21+000	21+500	1.10	NIL	115	6.05	25
21+500	22+000	1.22	51	115	6.05	25
22+000	22+500	1.02	NIL	115	6.05	25
22+500	23+000	1.08	NIL	115	6.05	25
23+000	23+200	0.91	NIL	115	6.05	25
	SH – 05,	**PADRA-MAHUVAD CHOKADI ROAD , km-16+00 to 23+500**				
16+0	16+500	0.93	75	115	10.97	25
16+500	17+00	1.03	95	115	10.97	
17+000	17+500	1.64	172	115	10.97	25
17+500	18+000	1.16	120	115	10.97	
18+000	18+500	1.36	146	115	10.97	25
18+500	19+000	1.08	107	115	10.97	
19+000	19+500	1.28	137	115	10.97	25

Chainage (km)		Characteristic deflection in mm	O L (MM)	Thickness proposed	MSA Xx10^6	PCC Thic.
From	To					
19+500	20+000	0.98	85	115	10.97	
20+000	20+500	1.33	142	115	10.97	25
20+500	21+000	1.18	123	115	10.97	
21+000	21+500	0.62	--	115	10.97	25
21+500	22+000	0.59	--	115	10.97	
22+000	22+500	1.13	116	115	10.97	25
22+500	23+000	1.78	181	115	10.97	
23+000	23+500	1.11	113	115	10.97	25
SH – 06, MAHUVAD CHOKADI TO GAMBHIRA BRIDGE (MUJAPUR) ROAD, Km 00+00 to 4+240						
SH – 06, BORSAD-GAMBHIRA ROAD, Km-35+585 to 56+555						
35+585	36+0	1.68		115	23.09	25
36+0	37+0	1.00		115	23.09	25
37+0	38+0	1.12		115	23.09	25
38+0	39+0	1.12		115	23.09	25
39+0	40+0	1.12		115	23.09	25
40+0	41+0	1.12		115	23.09	25
41+0	42+0	1.12		115	23.09	25
42+0	43+0	1.12		115	23.09	25
43+0	44+0	1.12		115	23.09	25
44+0	45+0	1.12		115	23.09	25
45+0	46+0	1.12		115	23.09	25
46+0	47+0	1.12		115	23.09	25
47+0	48+0	1.12		115	23.09	25
48+0	49+0	1.12		115	23.09	25
49+0	50+0	1.12		115	23.09	25
50+0	51+0	1.12		115	23.09	25
51+0	52+0	1.12		115	23.09	25
52+0	53+0	1.12		115	23.09	25
53+0	54+0	1.12		115	23.09	25
54+0	55+0	1.12		115	23.09	25
55+0	56+0	1.12		115	23.09	25
56+0	56+555	1.12		115	23.09	25

1.2 BRIDGE/CD STRUCTURES

1.2.3 Introduction

16. A detailed condition survey by visual inspection of the existing structures has been carried out to assess and appreciate the number, type and condition / characteristics of the bridges and cross drainage (CD) structures. The bridge inventory and condition consists recording of administrative and technical data for each bridge such as name, location, construction data, length, type of material, carriageway width, type of structure.

1.2.4 Field Investigation

17. For the purpose of maintenance inspection, the bridges and CD works are classified in three categories:

i) Major bridges with length 60 meters or more;
ii) Minor bridges with length between 6-60 meters and
iii) Culvert with length up to 6 meters.

18. Data is collected with suitable format and photographs are taken for reference. The inspection is carried out as per guidelines of IRC (SP-35:1990) and the following aspects are documented:

Concrete Elements

- Measurement of external dimensions, preparation of sketches, and taking photographs of critical components;
- Cracking;
- Honeycombing;
- Scaling/spalling of concrete cover;
- Leaching;
- Holes in the deck slab;
- Corrosion in reinforcement.

Masonry Elements

- Measurement of external dimensions, preparation of sketches and taking of photographs of critical components;
- Longitudinal cracks;
- Lateral and diagonal cracks;
- Cracks between the arch ring, spandrel or parapet wall;
- Loosening of mortar.

Other Elements

19. The condition of the following components is also assessed:

- Expansion joints, if provided;
- Back wall and bearing shelf of piers of abutments;
- Drainage system, choking of Hume pipes, silting, etc;
- Railings/parapet;
- Footpaths and kerb, if any;
- Drip course, if provided;
- Wearing coat;
- Furniture items of bridge;
- Abnormal scouring, local scouring, etc.;
- Apron flooring, cut-off walls, wing walls, etc.

20. The structures have already been in existence for 50% to 75% of their design lives, assuming a 50 years life. They exhibit distresses of various kinds. Broadly the defects identified are:

- Honeycombing, exposure of reinforcement and cracks in RCC components;

- Highly corroded reinforcement;
- RCC railings either broken or cracked in most cases;
- Wearing coat on bridges generally severely cracked;
- Cracks in back wall and wing wall of abutment in major and minor bridges;
- Longitudinal joints between concrete and masonry where widening has already been done are not water proofed;

1.2.5 Inventory and Condition

21. Total number of structures present along Savarkundla – Dhasa project corridor is 49, out of which 40 are on SH-236 (3 are Major Bridges, 16 are Minor Bridges, 4 are Slab Culverts, 15 are H P Drains and 2 are Causeways) and 9 are on SH-021 (5 are minor bridges, and 4 are Slab Culverts). A summary of the same is presented in Table 1.9.

Table 1.6: Number and Type of Structures

Type of Structures		Number of Structures
SH – 160 Karjan-Padra Road, Km 0.00 to 23+200		
Bridges	Major	02
	Minor	01
Culverts	H.P.Drain	24
	Slab	9
	Canal Structures	2
	Total	**38**
SH – 05 Padra Mahuvad chokadi Road		
Bridges	Box Culverts	07
Culverts	H.P.Drain	18
	Canal Structures	00
	Total	**25**
SH – 06, MAHUVAD CHOKADI TO GAMBHIRA BRIDGE (MUJAPUR) ROAD, Km 00+00 to 4+240		
	Major	01
	Box Culverts	01
	H.P.Drain	06
	Total	8
SH – 06 Borsad-Gamhira Bridge Road Km-35+585 to 56+555		
Bridges	Major	01
	Minor	--
Culverts	H.P.Drain	19
	Slab Drain	08
	Canal Structures	05
	Total	33
Total Number of Structures		**104**

1.2.5.1 Major Bridges

21. There are total 03 major bridges. Overall width of major bridges 7.5 m. to 10.00 m. The details of existing carriageway width and number of major bridges falling under each category are given in Table 1.7

Table 1.7: Details of Major Bridges

Sr. No	Chainage (km)	Structure Number/ River Name	Type of Bridge	Nos. of span	Span length (m)	Total Length of Bridge (m)	Total Width of bridge (m)	Carriageway Width (m)	Structure Condition
SH – 160 Karjan-Padra Road, Km 0.00 to 23+200									

Sr. No	Chainage (km)	Structure Number/ River Name	Type of Bridge	Nos. of span	Span length (m)	Total Length of Bridge (m)	Total Width of bridge (m)	Carriageway Width (m)	Structure Condition
1	14+200	-- 'KOTHWADA'/ dhadhar	Solid Slab	3	15.30	50	7.50	6.90	1. VEGETATION 2.LHS & RHS BED APPRON DAMAGED
2	10+350	-- 'ON VISHVAMITRI RIVER'	Solid Slab	2	10.0	45	7.50	6.85	1. UNDER CONSTRUCTION (Before this was as a Minor bridge)
	SH – 06, MAHUVAD CHOKADI TO GAMBHIRA BRIDGE (MUJAPUR) ROAD, Km 00+00 to 4+240								
1	3+200	'ON MAHISAGAR RIVER'	Solid Slab	21 2	37.75 33.00	832	7.50	6.90	1. VEGETATION 2.Top wearing coat need
	SH – 06 Borsad-Gamhira Bridge Road Km-35+585 to 56+555								
3	51+965	-- 'LOCAL NALLA'	Solid Slab	2	20.00	46.00	9.70	6.85	1. VEGETATION 2. PARAPET OF BRIDGE DAMGED 3.THREE JOINTS ARE OPENED 4.LHS & RHS PIPE RAILING TOTALLY DAMAGED

MJBR on river Dhaddar Km ch 14+200

MJBR on river Dhaddar Km 14+200

MJBR on river Dhaddar km- 14+200

1.2.5.2Minor Bridges

22 There are total 01 minor bridges. Overall width of minor bridges 7.5 m. The details of existing carriageway width and number of minor bridges falling under each category are given in Table 1.8.

Table 1.8: Details of Minor Bridges

Sr. No	Chainage (km)	Structure Number/ River Name	Type of Bridge	Nos. of span	Span length (m)	Total Length of Bridge (m)	Total Width of bridge (m)	Carriageway Width (m)	Structure Condition
SH – 160 Padra Karjan Road									
1	11+900	--	Slab type	2	15.00	32.00	11.7	7.50	1. Maso. Parapet Damaged 2. Railing on both ends damaged 3. Protection work of guide bund required to repaired. 5.Vegetation.

1.2.5.2 Canal Crossing

23 The Details of Canal crossing are given below in Table.

Sr. No	Chainage (km)	Structure Number/ River Name	Type of Bridge	Nos. of span	Span length (m)	Total Length of Bridge (m)	Total Width of bridge (m)	Carriageway Width (m)	Structure Condition
SH – 160 Padra Karjan Road									
1	0+575	--	Canal Structure with slab	1	6.00	LHS-6.30 RHS-12.45	7.00	7.00	1.RHS-Headwall collapsed for 4.50 2. Vegetation
2	19+200	--	Canal Crossing	1	0.350	4.60	15.70	5.50	1. Vegetation
SH – 06 Borsad Gambhira Bridge Road. Km-35+585 to 56+555d									
1	36+010	--	Canal Structure with slab	1	6.00	LHS-6.30 RHS-12.45	7.00	7.00	1.RHS-Headwall collapsed for 9.45 m 2. Vegetation
2	37+500	--	Canal Syphon	1	0.600	8.30	7.50	7.00	1. Vegetation
3	42+900	--	Canal Syphon (Skew)	1	0.600	20.00	12.50	7.00	1. vegetation
4	45+200	--	Canal Syphon (Skew)	1	0.600	20.00	12.50	7.00	1. vegetation

Sr. No	Chainage (km)	Structure Number/ River Name	Type of Bridge	Nos. of span	Span length (m)	Total Length of Bridge (m)	Total Width of bridge (m)	Carriageway Width (m)	Structure Condition
5	48+800	--	Canal Syphon (Skew)	1	0.600	20.00	12.50	7.00	1. vegetation

1.2.5.3 Culverts

24 Total of 107 number culverts exists on this corridor out of which 72 are pipe culverts and 22 are slab culverts and 7 Nos are Canal crossing structures. Width of all culverts is 6.50m to 12.5m.. The summarized condition by number and type of structures are presented in Table 1.9.

Table 1.9: Details of Culverts

Sr. No	Chainage (km)	Structure Number/ river Name	Type of Structure	Span Arrangement		Total Length	Total Width (m)	Carriage way Width (m)	Structure Condition
				No.	Pipe Dia.\ Span Length (m)				
SH-160 Padra Karjan Road Km- 0.00 to 23+200									
1	0+295	--	Slab Drain	1	3.00	6.50	11.50	5.50	1. Vegetation Good Condition
2	0+500	--	H.P.Drain	1	0.600	12.5	8.90	7.00	1. Vegetation 2. Head wall out of plumb & Broken.
3	0+715	--	Slab Drain	1	3.00	17.20	11.50	5.50	1. Vegetation 2. H.Wall damaged
4	2+.070	--	Slab Drain	1	3.00	11.50	12.10	5.50	1. Vegetation 2.Plaster need to Head wall
5	3+245	--	H.P.Drain (Skew)	1	0.900	5.00	7.50	5.50	1. Vegetation 2.C.C. Block need on bothside
6	3+875	--	Slab Drain	1	3.10	9.60	8.25	5.50	1. Vegetation 2. Both Head wall damaged 2.Plaster need to Head wall
7	4+025	--	H.P.Drain (Skew)	1	0.600	5.60	8.00	5.50	1. Vegetation 2. Head wall damaged 3. blockage
8	4+275	--	H.P.Drain	1	0.900	5.00	8.50	5.50	1. Vegetation 2. Head wall damaged 3. blockage
9	4+320	--	H.P.Drain	2	0.900	7.50	7.50	5.50	1. vegetation 2. Both Headwall damaged
10	4+994	--		1	0.900	5.00	7.50	5.50	1. vegetation

Sr. No	Chainage (km)	Structure Number/ river Name	Type of Structure	Span Arrangement		Total Length	Total Width (m)	Carriage way Width (m)	Structure Condition
				No.	Pipe Dia.\ Span Length (m)				
			H.P.Drain (Skew)						2.LHS H.Wall need Damaged 3. Pipe blocked partly
11	6+238	--	H.P.Drain	1	0.750	4.25	7.50	5.50	1. vegetation 2. Partly Damaged Headwall
12	6+500	--	H.P.Drain	2	0.900	6.00	11.20	5.50	1. vegetation 2. Partly Damaged Headwall
13	6+615	--	Slab Drain	1	4.00	11.60	10.70	5.50	1. Vegetation 2. Both Head wall need Plaster.
14	7+017	--	H.P.Drain (Skew)	2	0.900	6.00	9.80	5.50	1. vegetation 2. Plaster need to Head wall 3. Pipe blocked fully
15	7+183	--	H.P.Drain	1	0.900	6.15	10.00	5.50	1. vegetation 2. Partly blocked 3. H.Wall need Plaster.
16	8+180	--	H.P.Drain	1	0.900	6.00	12.50	5.50	1. vegetation 2. Partly blocked 3. New Head wall required to be construct at both end of pipe.
17	8+750	--	H.P.Drain	1	0.900	6.00	12.50	5.50	1. vegetation 2. Pipe blocked
18	9+500	--	H.P.Drain	1	1.200	6.35	13.15	6.50	1. vegetation 2. Partly blocked pipe 3. Coping need on both Headwall
19	10+690	--	H.P.Drain (Skew)	1	0.900	6.40	15.00	6.50	1. vegetation 2. Pipe blocked.
20	11+350	--	Slab Drain	2	10.00	30.00	9.70	7.00	1. vegetation 2. Some part of Abutment & Pier required plaster. 3. On Bothside of Nalla portion required to be protected with C.C. Aprons
21	11+595	--	H.P.Drain	2	0.900	5.80	10.90	5.50	1. vegetation 2. Partly blocked 3. Head wall out of plumb & Broken.
22	11+850	--	H.P.Drain	2	0.900	5.80	25.00	6.50	1. vegetation
23	11+930	--	H.P.Drain	1	0.900	6.50	25.00	6.50	1. vegetation
24	12+600	--	H.P.Drain	1	0.900	6.50	10.20	5.50	1. vegetation 2. Head wall out of plumb & Broken.

Sr. No	Chainage (km)	Structure Number/ river Name	Type of Structure	Span Arrangement		Total Length	Total Width (m)	Carriage way Width (m)	Structure Condition
				No.	Pipe Dia.\ Span Length (m)				
25	12+925	--	H.P.Drain (Skew)	1	0.900	6.50	10.20	5.50	1. vegetation
26	14+700	--	Slab Drain (Skew)	2	10.00	25.00	12.00	7.00	1. bottom slab required plaster 2. Vegetation
27	15+050	--	Slab Drain (Skew)	1	3.00	19.50	9.00	5.50	1. bottom slab required plaster 2. Vegetation
28	17+680	--	H.P.Drain	1	0.900	4.60	15.70	5.50	1. vegetation 2. Pipe blocked.
29	19+225	--	H.P.Drain	1	0.900	4.60	15.70	5.50	1. vegetation 2. Pipe blocked. 3.0 RHS & LHS H.Wall Damaged
30	19+725	--	Slab Drain	1	3.00	5.85	10.20	5.50	1.. Vegetation 2. RHS H.Wall Damaged
31	20+225	--	H.P.Drain	1	0.900	4.60	12.60	5.50	1. vegetation 2. Pipe blocked.
32	20+800	--	H.P.Drain	2	1.200	8.05	10.30	7.00	1. vegetation 2. Head wall Damaged 3. Pipe blocked.
33	21+175	--	H.P.Drain	2	0.900	7.70	10.40	7.00	1. vegetation 2. Head wall Damaged 3. Pipe blocked.
34	21+393	--	H.P.Drain	1	0.450	4.80	15.50	7.00	1. vegetation 2. Head wall Damaged 3. Pipe blocked.
35	22+280	--	H.P.Drain	1	0.900	5.20	15.50	7.00	1. vegetation 2. Head wall Damaged 3. Pipe blocked.
	SH – 05 Padra Mahuvad chokadi Road								
1	16+070	17/1	Box Culverts	2	3.000	```5.20	15.50	7.00	1. vegetation
2	16+180	17-1A	Box Culverts	2	3.000	15.0	12.5	10	1. vegetation
3	16+290	17/2	H.P.Drain	2	1.200	10.5	12.5	10	1. vegetation
4	16+590	17/3	H.P.Drain	2	1.200	10	12.5	10	1. vegetation
5	16+846	17/4	H.P.Drain	2	0.900	10	12.5	10	1. vegetation
6	17+318	18/1	H.P.Drain	3	0.900	10	12.5	10	1. vegetation
7	17+465	18/2	H.P.Drain	2	0.900	10	12.5	10	1. vegetation
8	17+652	18/3	H.P.Drain	3	1.200	10	12.5	10	1. vegetation
9	17+945	18/4	H.P.Drain	2	0.900	10	12.5	10	1. vegetation

Sr. No	Chainage (km)	Structure Number/ river Name	Type of Structure	Span Arrangement		Total Length	Total Width (m)	Carriage way Width (m)	Structure Condition
				No.	Pipe Dia.\ Span Length (m)				
10	18+740	19/1	Box Culverts	2	3.00	10	12.5	10	1. vegetation
11	19+325	20/1	Box Culverts	1	5.00	10	12.5	10	1. vegetation
12	19+460	20/2	H.P.Drain	2	0.750	10	12.5	10	1. vegetation
13	20+275	21/1	Box Culverts	1	4.00	10	12.5	10	1. vegetation
14	20+700	21/2	Box Culverts	2	3.00	10	12.5	10	1. vegetation
15	20+925	21/3	H.P.Drain	2	0.900	10	12.5	10	1. vegetation
16	21+320	22/1	H.P.Drain	2	0.900	10	12.5	10	1. vegetation
17	21+540	22/2	H.P.Drain	1	1.200	10	12.5	10	1. vegetation
18	21+656	22/3	H.P.Drain	1	0.900	10	12.5	10	1. vegetation
19	21+860	22/4	H.P.Drain	1	0.900	10	12.5	10	1. vegetation
20	22+363	23/1	H.P.Drain	2	0.900	10	12.5	10	1. vegetation
21	22+784	23/2	H.P.Drain	1	0.900	10	12.5	10	1. vegetation
22	22+800	23/3	Box Culverts	1	4.00	10	12.5	10	1. vegetation
23	22+900	23/4	H.P.Drain	1	0.900	10	12.5	10	1. vegetation
24	23+070	24/1	H.P.Drain	2	1.200	10	12.5	10	1. vegetation
25	23+563	24/2	H.P.Drain	2	0.900	10	12.5	10	1. vegetation
	SH – 06, MAHUVAD CHOKADI TO GAMBHIRA BRIDGE (MUJAPUR) ROAD, Km 00+00 to 4+240								
1	0+	--	H.P.Drain	2	0.900	10	12.5	10	1. vegetation
2	0+	--	H.P.Drain	1	0.900	10	12.5	10	1. vegetation
3	1+	--	H.P.Drain	1	0.900	10	12.5	10	1. vegetation
4	1+	--	H.P.Drain	4	0.900	10	12.5	10	1. vegetation
5	1+	--	H.P.Drain	1	0.900	10	12.5	10	1. vegetation
6	2+	--	Box Culverts	2	3.00	10	12.5	10	1. vegetation
7	2+	--	H.P.Drain	2	0.900	10	12.5	10	1. vegetation

Sr. No	Chainage (km)	Structure Number/ river Name	Type of Structure	Span Arrangement		Total Length	Total Width (m)	Carriage way Width (m)	Structure Condition
				No.	Pipe Dia.\ Span Length (m)				
SH – 06 Borsad Gambhira Bridge Road. Km-35+585 to 56+555									
1	35+775	--	H.P.Drain (Skew)	1	1.200	20.00	6.60	7.00	1. Vegetation 2. Partly blocked
2	36+825	--	H.P.Drain	1	0.600	10.00	8.90	7.00	1. Vegetation 2. Head wall out of plumb & Broken. 3. Partly blockage.
3	38+286	--	Slab Drain	1	3.00	10.20	4.40	7.00	1. Vegetation 2. LHS H.Wall Collapsed 3. Returns block damaged
4	38+771	--	H.P.Drain	1	1.200	3.05	11.30	7.00	1. Vegetation 2. Head wall damaged partly 3. Partly blockage
5	39+800	--	H.P.Drain	2	1.200	25.00	12.70	7.00	1. Vegetation 2. Head wall damaged partly LHS 3. Partly blockage
6	40+300	--	H.P.Drain	3	1.200	22.5 x 3	22.50	7.00	1. vegetation 2. Some Masonary on LHS H.Wll collapsed 3.Both side Apron Need for flow.
7	40+650	--	H.P.Drain (Skew)	3	1.200	25.0 x 3	13.10	7.00	1. vegetation 2. Pointing needs to both H.Wall
8	41+645	--	H.P.Drain	1	0.900	5.20	9.90	7.00	1. vegetation 2. RHS H.Wall need to rise 3. Parapet broken.
9	42+575	--	H.P.Drain	2	0.600	12.50	13.00	7.00	1. vegetation 2. Partly blocked
10	42+940	--	H.P.Drain	1	0.600	5.60	10.40	7.00	1. vegetation 2. .Head wall on RHS Collapsed damaged 3.0 Partly blocked.
11	43+390	--	H.P.Drain (Skew)	1	0.900	14.0	6.20	5.50	1. vegetation 2. HP is of NP-2 edge is damaged. 3.Head wall fully damaged. 4. Parapet broken.
12	43+500	--	H.P.Drain	3	1.200	8.90	14.60	7.00	1. vegetation 2. Partly blocked 3. H.Wall need to rise
13	44+275	--	H.P.Drain	2	1.200	7.00	12.70	7.00	1. vegetation 2. Partly blocked 3. H.Wall need to rise
14	46+390	--	H.P.Drain	1	0.900	6.00	12.70	7.00	1. vegetation 2. Partly blocked pipe
15	46+500	--	H.P.Drain	1	0.900	5.60	10.00	7.00	1. vegetation 2.RHS H.Wall Need to rise 3. Pipe blocked.

Sr. No	Chainage (km)	Structure Number/ river Name	Type of Structure	Span Arrangement		Total Length	Total Width (m)	Carriage way Width (m)	Structure Condition
				No.	Pipe Dia.\ Span Length (m)				
16	46+700	--	Slab Drain	2	6.00	12.40	10.50	7.00	1. vegetation 2.One span of slab drain blocked 3.Crash Barrier need on both side
17	47+.080	--	Slab Drain	1	3.000	4.20	10.00	7.00	1. bottom slab required plaster 2. Some part of Abutment Brickwall on LHS damaged 3. Returns damaged 4. Vegetation
18	47+250	--	Slab Drain	1	6.00	5.50	10.00	7.00	1. bottom slab required plaster 2. LHS & RHS Appron need for smooth flow in RCC 3. Returns damaged 4. Vegetation
19	47+600	--	Slab Drain	2	2.75	11.40	10.00	7.00	1. bottom slab required plaster 2. Onespan blocked 3. Vegetation
20	47+700	--	Slab Drain	2	7.00	14.50	17.50	7.00	1. bottom slab required plaster 2. Vegetation
21	49+225	--	Slab Drain (Skew)	1	3.00	4.30	17.50	7.00	1. bottom slab required plaster 2. Vegetation
22	50+200	--	H.P.Drain	2	1.200	7.50	12.50	7.00	1. vegetation 2.No Head wall Constructed 3. Pipe blocked.
23	50+640	--	H.P.Drain	3	0.900	7.50	12.50	7.00	1. vegetation 2.No Head wall Constructed 3. Pipe blocked.
24	50+975	--	Slab Drain	2	6.00	12.40	11.20	7.00	1. bottom slab required plaster 2. Vegetation
25	52+170	--	Slab Drain	1	4.00	5.50	10.40	7.00	1. bottom slab required plaster 2. Vegetation
26	52+500	--	H.P.Drain	3	1.200	7.50	12.50	7.00	1. vegetation 2.No Head wall Constructed 3. Pipe blocked.
27	54+100	--	H.P.Drain	2	0.900	25.00	25.00	7.00	1. vegetation 2. Pipe blocked.
28	55+875	--	H.P.Drain	3	1.200	25.00	25.00	7.00	1. vegetation 2. Head wall Constructed 3. Pipe blocked.

Out of 107 culverts 02 H P drains Head wall tobe reconstruct being damaged with width of 12.50 mtr.

MATERIAL AND GEOTECHNICAL INVESTIGATIONS

Introduction

Soil and material investigations are the foundation of successful highway projects. An effort spent on investigations pays many folds in terms of appropriate, economic and adequate design and also benefits in smooth and faster project implementation. The information collected, samples submitted to the GERI and test results have the direct bearing on the design of pavement structure as well as cost of the project. Investigations for soil and other materials have been carried out to establish the following requirements.
Selection and location of suitable materials for sub grade, embankments, pavement layers, structures;
Pavement sub-grade characteristics and strength;
Assessment of properties of the existing pavement layers for its rehabilitation option;
Investigation of required sub-grade and sub-soil characteristics and strength for road and embankment design and sub soil investigation;
Identification of sources of construction materials;
To provide the most reliable material characteristics input to design the new pavement;
Assessment of properties of the existing pavement layers for its rehabilitation option.
To provide the most reliable material characteristics input to design the new pavement; the soil and material investigation has been divided into the following components to satisfy all the above mentioned objectives:
Trial pits followed by sampling at various levels;
Field density and field moisture tests on existing sub-grade followed by laboratory tests;
Identification of sources of construction materials on the basis of local inquiries;
Identification of new borrow area for material suitable for use in embankment, sub grade and granular sub-base;
Investigating materials available at identified sources for stone aggregate and sand;
Identifying sources for other construction material like cement, bitumen, steel etc.
Testing procedures followed for soil investigations as per codes listed in Table 1.13 and for other construction materials test procedures followed are as per national and international codes like BIS, ASTM, BS as applicability to determine their suitability in accordance with MORT&H specifications. All laboratory tests conducted at National Accreditation Board for Testing and Calibration of Laboratories (NABL) certified highway engineering laboratory.

Table 1.7: Testing Codes Adopted

Type of Test	Method
Field dry density using sand replacement method	IS 2720 Part 28
Field dry density using core cutter method	IS 2720 Part 29
Moisture content determination	IS 2720 Part 2 (section I)
Atterberg's limits	IS 2720 Part 5
Sieve analysis - natural soils - rock aggregate	 IS 2720 Part 4 IS 2386 Part 1
Compaction test (Heavy Compaction)	IS 2720 Part 8
CBR and Swell (Soaked and unsoaked at three energy levels for sub-grade)	IS 2720 Part 16

Soil classification has been done according to the Indian Soil Classification System (ISC) as detailed in IS 1498.
The detailed programme for soil and material investigation has been prepared. Table 0.8 summaries the tasks accomplished to achieve the desired objectives.

Table 0.8: Stage Specific Investigations

Sr. No.	Task Description
1	Pavement composition by test pit excavation penetrating pavement structure down to sub-grade to record pavement composition, perform field density test of sub grade, collection of sub grade

	samples
2	Investigation of existing pavement by Benkelman Beam Test

Existing Sub–Grade Soil and Pavement Material Investigations

The sub grade conditions and existing pavement structure characteristics, such as thickness and material properties for the pavement layers, has been investigated by means of test pits. Test pits have been excavated at every 3 km intervals along the road to perform field density and collect sub grade soil and base course samples for laboratory tests. They have been carefully dug from the pavement surface up to sub-grade level where these have been manually leveled and prepared for field density tests. Field density tests on the sub-grade soils have been conducted at each test pit location and a small quantity of sample has also been collected in airtight containers for determining the field moisture content. Pavement structural composition of existing pavement at different chainage of every test pit is also noted. The average thickness of crust observed is 0.35 m.

Sub Grade Soil Samples

Representative samples of soils and materials collected from the test pits are subjected to various laboratory tests listed as below:

Grain size distribution test for each sample;

Atterberg's limits for each sample;

Four days soaked CBR at two energy levels as well as static CBR at FDD on each homogenous group of soils;

Four day's soaked CBR at MDD is determined. Based on test readings CBR graph is plotted and from the graphs plotted for CBR corrected value is taken into account.

Test Results

Existing Sub Grade Soil

Total thirteen samples have been collected and tested for grain size analysis and Atterberg's limit. Out of thirteen samples received from trial pits, three samples belong to Clayey Sand Classification (SC) and ten sample belongs to Clayey Soil Classification (CH) type. Percentage distribution of each type of existing sub grade soil along the project corridor is shown in Figure 1.1.

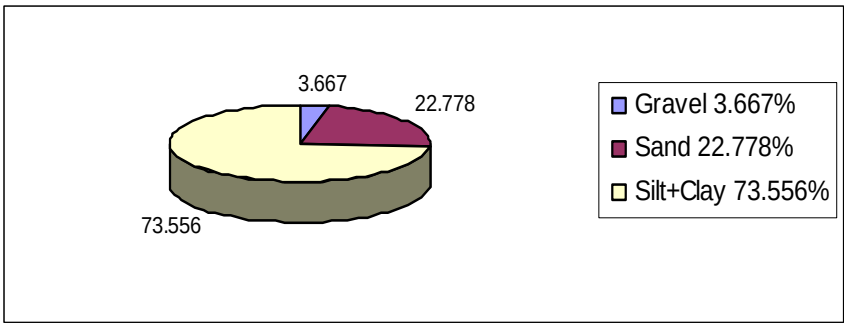

Figure 1.1: Distribution of Sub grade Soil (Major Pits) type along the Project Corridor

Table 1.9Table 1.11 provides the variation of liquid limit, plasticity index and free swelling index for each type of soil received from existing sub grade (major pits).

Table 1.9: Results of Existing Sub grade

Soil Type	Liquid Limit (%)		Plasticity index (%)	
	Minimum	Maximum	Minimum	Maximum
SC	30	32	9	11
CH	51	75	30	54

One of the most important components that influence the structural strengths of a pavement is the sub-grade strength, which in turn is influenced by moisture content and degree of compaction. The test results are appended as attached annexure..

The limiting values of LL and PI for subgrade soil are 50% and 25% respectively as per IRC 36:2010. All the samples satisfy the stipulations.

As per MoRT&H specification free swelling index of sub grade material should not be greater than 50%.
The field dry density (FDD) of the existing sub-grade varies from 1.30 gm/cc to 1.647 gm/cc.
The field moisture content (FMC) is found to vary from 12.2 % to 20.8 %.
Maximum Dry Density (MDD) is varying from 1.50 gm/cc to 1.81 gm/cc and OMC is varying from 12.7 % to 21.2%.
The test results signify that samples of the project road has sub-grade compaction in between 86.0% to 91.01%,
.

Homogeneous soil groups are selected on the basis of different soil properties and tested for CBR with heavy compaction for soaked condition. CBR value at 97% of MDD has been determined from the graphs plotted for CBR for this corridor.
The 4-day soaked CBR value at 97% of MDD of sub-grade samples varies from 1.1% to 3.71 %.
Figure 1.6Figure 1.2 shows variation of CBR value along the project corridor.

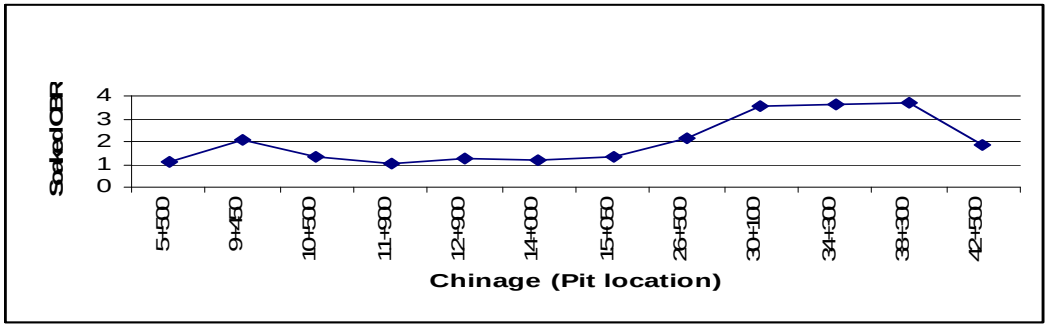

Figure 1.2: Value of CBR % along the Project Corridor

Crackes and pot holes seen on road of Padra Karjan		**Crackes and pot holes seen on road of Padra Karjan**

View of Padfra-Karjan road		View of Padfra-Karjan road