

CHAPTER 2
HIGHWAY DESIGN

CHAPTER 2 HIGHWAY DESIGN

2.1. Geometric Design of Southern Section

2.1.1. Summary of Adopted Geometric Design Criteria

Summary of geometric design criteria for OCH main carriageway, interchange and local road which is adopted in the basic design is shown in **Table 2.1.1** to **Table 2.1.3**.

Table 2.1.1 Summary of the Adopted Geometric Design Criteria for OCH Main Carriageway

Item	Desirable Value	Criteria	Absolute Value	Adoption
Design Speed	80km/h			
Min. Radius to Horizontal Curve	400m	280m	230m	700m
Min. Horizontal Curve Length	480m	240m		246m
Min. Transition Curve Length		70m		229m
Min. Radius Without Transition Curve		2000m		2000m
Min. Radius Without Superelevation	5100m	3500m		3600m
Max. Grade		4%	5 – 7%*	2.850%
Min. Vertical Curve Length		70m		200m
Min. "K" value of Vertical Curves	Crest		45	70
	Sag		31	46
Crossfall of Carriageway	2.5%			
Crossfall of Outer Shoulder	4.0%			
Max. Superelevation		6%		6%
Max. Composite Gradient		10.5%		6.011%
Stopping Sight Distance		140m		142m**
Traffic Lane Width	3.5m			
Outer Shoulder Width	3.0m			
Marginal Strip Width (at Shoulder and Center Median)	0.75m			
Right (Inner) Shoulder	1.25m***			
Center Median Width	4.5m** / 3.0m** (without marginal strip)			

*: Limit Length is regulated **: Ultimate Stage: 6 lanes ***: Initial Stage: 4 lanes

Table 2.1.2 Summary of Adopted Geometric Design Criteria for Interchange

Interchange Standard			Type 2, Class 1			Remarks	
Design Speed of Ramp (Main Carriageway)			V = 40 km/ h (80km/h)				
Elements			Reference Value				
			Criteria	Absolute Value	Adoption		
Horizontal Alignment	Min. Radius of Curve		m	50	40	50	
	Min. Parameter of Spiral Curve		m	35*	-	45	*Min. length 35m
	Min. Radius of Curve Omitting Transition Curve		m	140	-	180	
	Min. Parameter at Exit Ramp Nose		m	60	50	60	
	Min. Radius of Curve at Exit Ramp Nose		m	160	-	300	
	Minimum Curve Radius without Superelevation		m	900	-	1000	Normal Crossfall 2.5%
Vertical Alignment	Max. Gradient	Expressway Side	%	6	Up Slope 6 Down Slope 7	5.918	
		National Highway Side	%	6	Up Slope 7 Down Slope 8	3.282	
	Min. K-Value of Vertical Curve	Crest	m	7	5	7.8	
		Sag	m	10	7	10	
	Min. Vertical Curve Length		m	40	35	40	
	Min. K-Value at Ramp Nose	Crest	m	15	10	15.1	
		Sag	m	17	12	-	
		Curve length	m	60	40	60	
Normal Crossfall		%	2.5				
Crossfall of Outer Shoulder		%	2.5				
Max. Superelevation		%	6.0		6		
Max. Composite Gradient		%	11.0		8.339		
Stopping Sight Distance		m	45		45		
Traffic Lane Width		m	3.5				
Outer Shoulder Width		m	2.5				
Marginal Strip Width (at Shoulder and Center Median)		m	0.5: Shoulder / 0.75: Median				
Right (Inner) Shoulder		m	1.0				
Center Median Width		m	2.5 / 1.0 (without marginal strip)				

Note: The setting of the maximum vertical gradient for ramps (including loop portions) must be less than the maximum composite gradient.

Table 2.1.3 Summary of Adopted Geometric Design Criteria for Local Road

Item	Unit	Design Standard for Design Speed 70km/h		Design Standard for Design Speed 70, 60km/h		Design Standard for Design Speed 50km/h	Design Standard for Design Speed 40km/h		Remarks (RDA Standards Reference)	
		A-1 (6-lane)	A-2 (4-lane)	B-2 (4-lane)	B-3 (2-lane)	C (2-lane)	D (S-lane)	E (S-lane)		
Road Class	-	A-1 (6-lane)	A-2 (4-lane)	B-2 (4-lane)	B-3 (2-lane)	C (2-lane)	D (S-lane)	E (S-lane)	-	
Type of Road	-	R0	R2	R2	R3	R4	R5	R5	Clause 3.1	
Terrain		Flat	Flat	Flat /Rolling	Flat /Rolling	Flat	Flat	Flat /Rolling	-	
Designed Traffic Volume	PCU /day	72,000-108,000	25,000-40,000	25,000-40,000	18,000-25,000	300-18,000	<300	<300	Table 2.6	
Design Speed	Rural	km/h	80	80	70	60	60	50	50	Cl. 2.5 / Table 2.6
	Urban	km/h	70	70	70	60	50	40	40	
Lane Width	m	10.5x2 3.5/lane	7.4x2 3.7/lane	7.0x2 3.5/lane	3.7x2 3.7/lane	3.5x2 3.5/lane	3.5x1 3.5/lane	3.5x1 3.5/lane	Table 3.3 -modified through discussion	
Cycle Lane	m	1.5x2	1.5x2	1.5x2	1.5x2	-	-	-	Included to outer shoulder width	
Outer Shoulder Width (Cycle lane included)	m	3.0x2	3.0x2	3.0x2	3.0x2	1.5x2 (2.4x2)	1.5x2 (1.8x2)	1.2x2 (1.8x2)	Primary width considering existing conditions for C,D,E class road	
Median Width Including Inner Shoulder Width	m	1.20	1.20	1.20	-	-	-	-	Table 3.3	
Drain (minimum)	m	0.90x2	0.90x2	0.90x2	0.90x2	0.90x2	0.90x2	0.90x2	Table 3.3	
R.O.W. (Drain Widths Excluded)	m	28.2 (30.0)	22.0 (23.8)	21.2 (23.0)	13.4 (15.2)	11.0 (12.8)	8.3 (10.1)	8.3 (10.1)	Future width for C,D,E class road	
Crossfall of Carriageway	%	2.5	2.5	2.5	2.5	3.0	3.0	3.0	Table 3.1	
Crossfall of Outer Shoulder	%	4.0	4.0	4.0	4.0	3.0	3.0	3.0	Table 3.2	
Minimum Radius	m	185	185	185	130	90	55	55	Cl.5.2.4/ Table 5.3	
Minimum Radii with Adverse Crossfall of 2.5%	Open	m	1105	1105	1105	810	565	360	360	Cl.5.2.5/ Table 5.4
	Built up	m	860	860	860	630	440	280	280	
Maximum Gradient	%	4	4	5 (7)	5 (7)	7	9	9 (10)	Cl.6.2.1/ Table 6.1	
Minimum Gradient	Rural	%	0.5	0.5	0.5	0.5	0.5	0.5	Clause 6.2.3	
	Urban	%	0.3	0.3	0.3	0.3	0.3	0.3		
Stopping Distance (SSD) Sight	m	115	115	115	85	65	45	45	Cl. 4.2/ Table 4.2	
Minimum Vertical Curve Length (for appearance criteria)	m	60	60	60	50	50	40	40	Cl.6.3.2.2/ Table 6.4	
Maximum Superelevation on Curvature	%	6	6	6	6	6	6	6	Cl.5.2.1/ Table 5.1	
Amount of Widening	m	Not required		Not required		0.90	Not required		Table 5.7	

List of control points (crossing road) for OCHSS is shown in **Table 2.1.4**.

Table 2.1.4 List of Control Points for OCH Southern Section

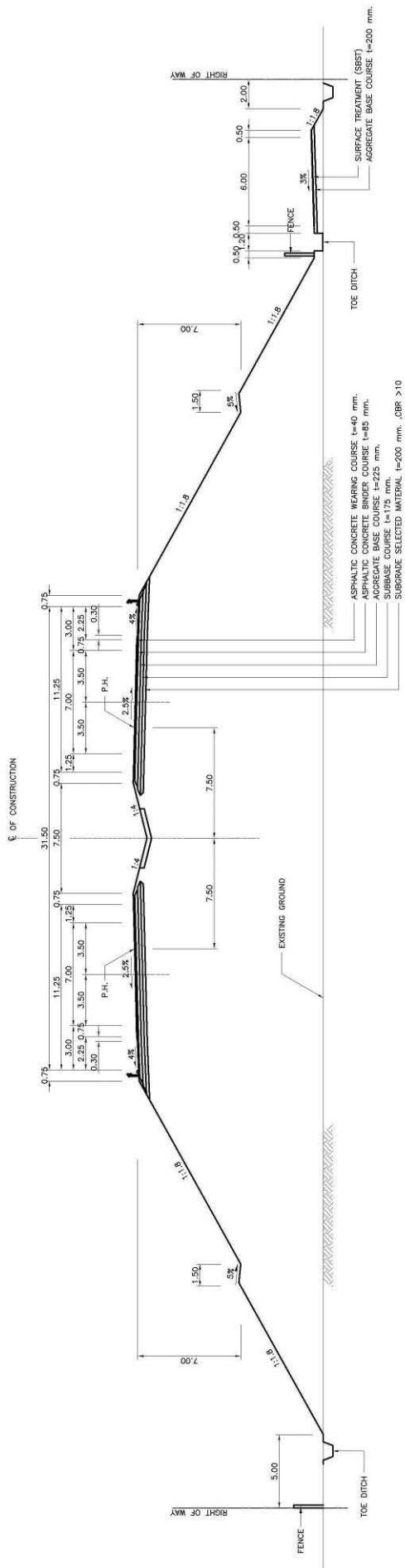
Serial No	Location	Description	Road Class	Existing Pavement		Future Widening Provision			UP / OP	Type of Structure	Width of OP	Span of UP	Existing Ground Level	New Proposed Level	HFL	Vertical Clearance	Deck Thickness	Min. Proposed Height	FRL (OCH) at Control Point	Difference	Remarks
				Pav. Width	Shoulder Width	Pav. Width	Shoulder Width	Drain, med													
1	16+990	Vihara Mawatha	D	3.0	-	3.5	1.5*2 (1.8*2)	0.9*2	UP	Box Culvert	-	40.0	3.5	5.83	8.20	4.80	0.70	12.230	12.231	0.001	
2	18+015	Malabe-Kaduvela Road (B263)	B-2	7.4	2.5*2	7.0*2	3.0*2	0.9*2+ m=1.2	OP	Bridge	22.1	-	14.5	15.65	8.20	5.10	1.55	8.850	8.831	0.019	
3	20+105	Thunkandahena Road	D			3.5	1.5*2 (1.8*2)	0.9*2	UP	Box Culvert	-	7.4	3.8	3.95	8.30	4.80	0.70	10.256	10.522	0.266	
4	21+640	Arangala-Pittugala Road	D	3.0	-	3.5	1.5*2 (1.8*2)	0.9*2	UP	Box Culvert	-	7.4	3.0	5.20	8.30	4.80	0.75	11.556	11.619	0.063	
5	23+940	Horahena- Suhada Mawatha	D	3.0		3.5	1.5*2 (1.8*2)	0.9*2	OP	Bridge	7.4	-	8.1	17.70	8.30	5.10	1.80	10.650	10.634	0.016	
6	25+014	Thaladiyawa Road	D			3.5	1.5*2 (1.8*2)	0.9*2	OP	Bridge	7.4	-	27.6	27.20	8.30	5.10	1.80	20.150	20.077	0.073	
7	25+650	Thalahena Road	E	3.0		3.5	1.2*2 (1.8*2)	0.9*2	OP	Bridge	6.8	-	15.8	25.20		5.10	1.80	18.150	18.144	0.006	
8	26+299	Balika Niwasa Road	C	4.0	0.3*2	3.5*2 (2.4*2)	1.5*2 (2.4*2)	0.9*2	OP	Bridge	10.9	-	13.7	23.50		5.10	1.90	16.350	16.179	0.171	
9	26+684	Kottawa-Athurugiriya Road	C	4.0	0.5*2	3.5*2 (2.4*2)	1.5*2 (2.4*2)	0.9*2	OP	Bridge	10.9	-	14.6	22.80		5.10	1.90	15.650	15.628	0.022	
10	27+061	Hospital Road	C			3.5*2	1.5*2 (2.4*2)	0.9*2	UP	Box Culvert	-	10.9	13.9	14.20	14.60	5.10	1.05	21.156	21.200	0.044	

2.1.2. Typical Cross Section

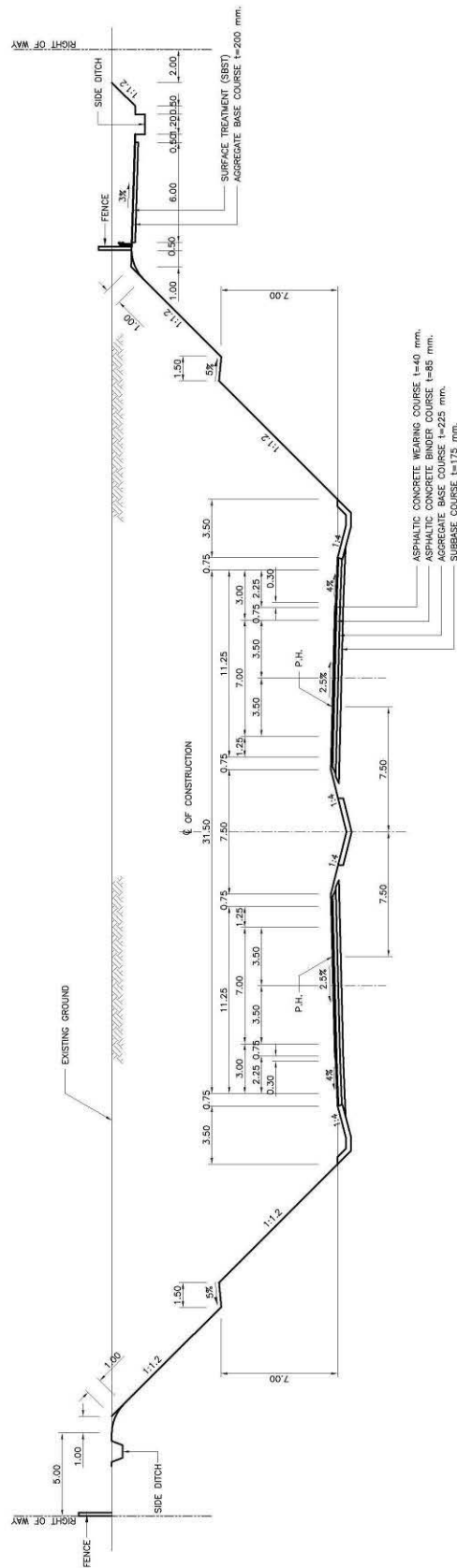
The cross-section of the OCH will ultimately have six lanes on both directions, while the initial OCH will have four lanes on both directions.

Detailed design for OCH Southern Section was carried out on four lane cross sections.

The typical cross-sections for OCH main carriageway, interchanges and local roads are shown as **Fig. 2.1.1 – Fig 2.1.3**.



TYPICAL CROSS SECTION (EMBANKMENT)



TYPICAL CROSS SECTION (CUT)
Typical Cross Section for OCH

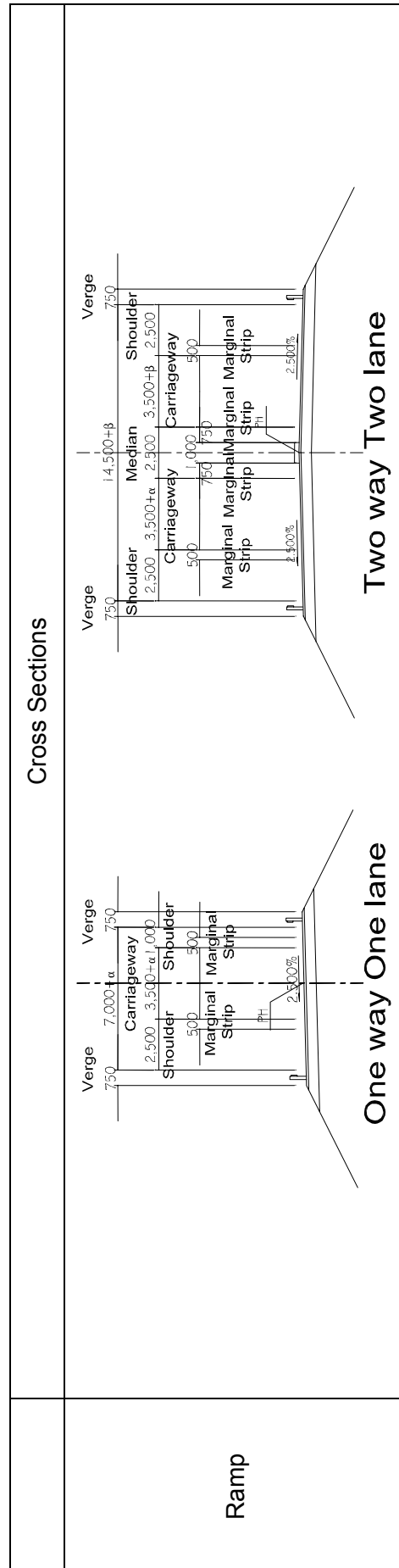


Fig. 2.1.2 (1) Typical Cross Sections for Interchanges (1)

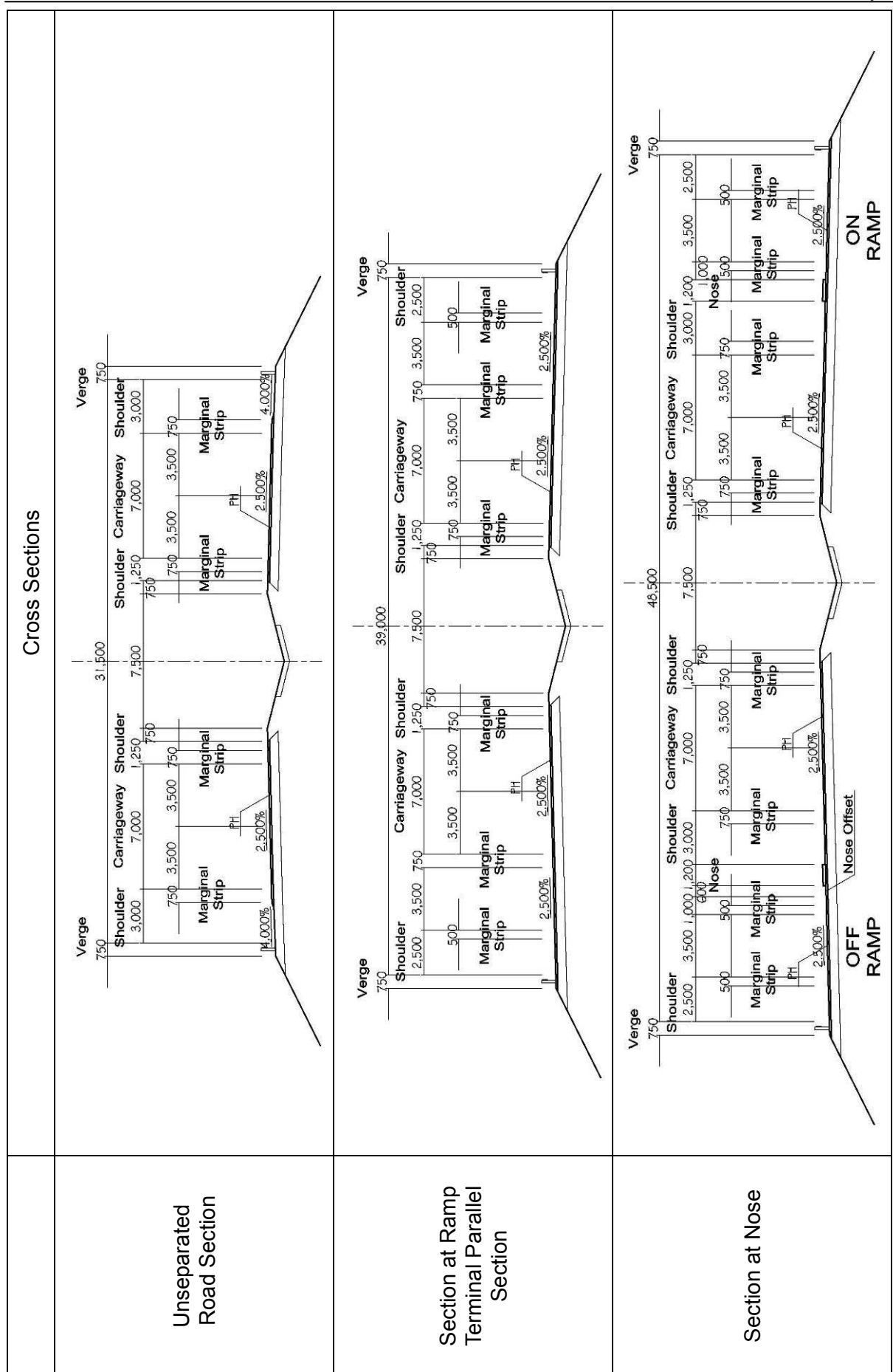
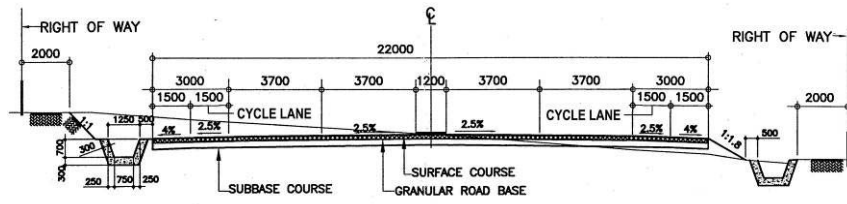
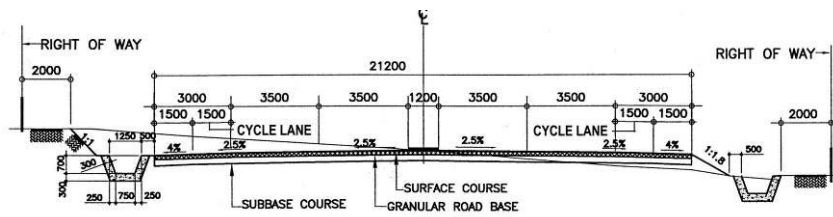


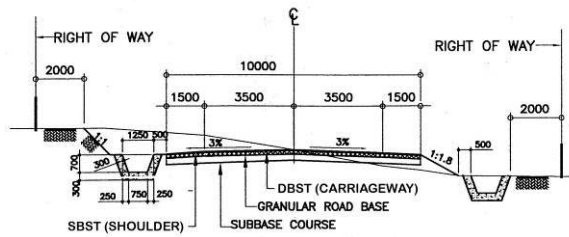
Fig. 2.1.2 (2) Typical Cross Sections for Interchanges (2)



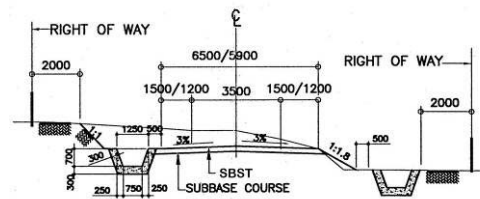
A Class Road



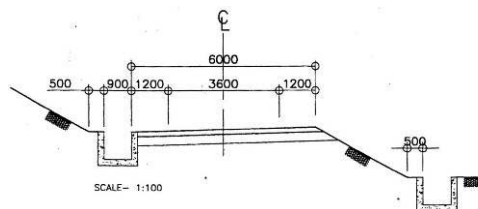
B Class Road



C Class Road



D & E Class Road



Frontage Road

Fig. 2.1.3 Typical Cross Sections for Local Roads

2.1.3. Vertical Alignment

(1) Selection of Vertical Alignment

The Vertical Alignment for OCH Southern Section was selected during the basic design period.

The concepts to fix the optimal vertical alignment was described in Chapter 3 and showed as follows:

- Embankment Height should be low to save construction cost.
 - To be free from High Flood Level (50 years return period).
 - Minimum vertical clearance for underpass.
 - A&B class Road: 5.1m
 - C&D class Road: Minimum 4.8m, Desirable 5.1m
 - Select the appropriate crossing points at some Overpass and Underpass locations to lower OCH Embankment Height. (Minor road would be able to detour up to 500m if necessary)
- Minimum vertical gradient of 0.3% is maintained for drainage on road surface.
- Minimize Land Acquisition.

Selected vertical alignment for OCH Southern Section is shown in **Fig. 2.1.4.**

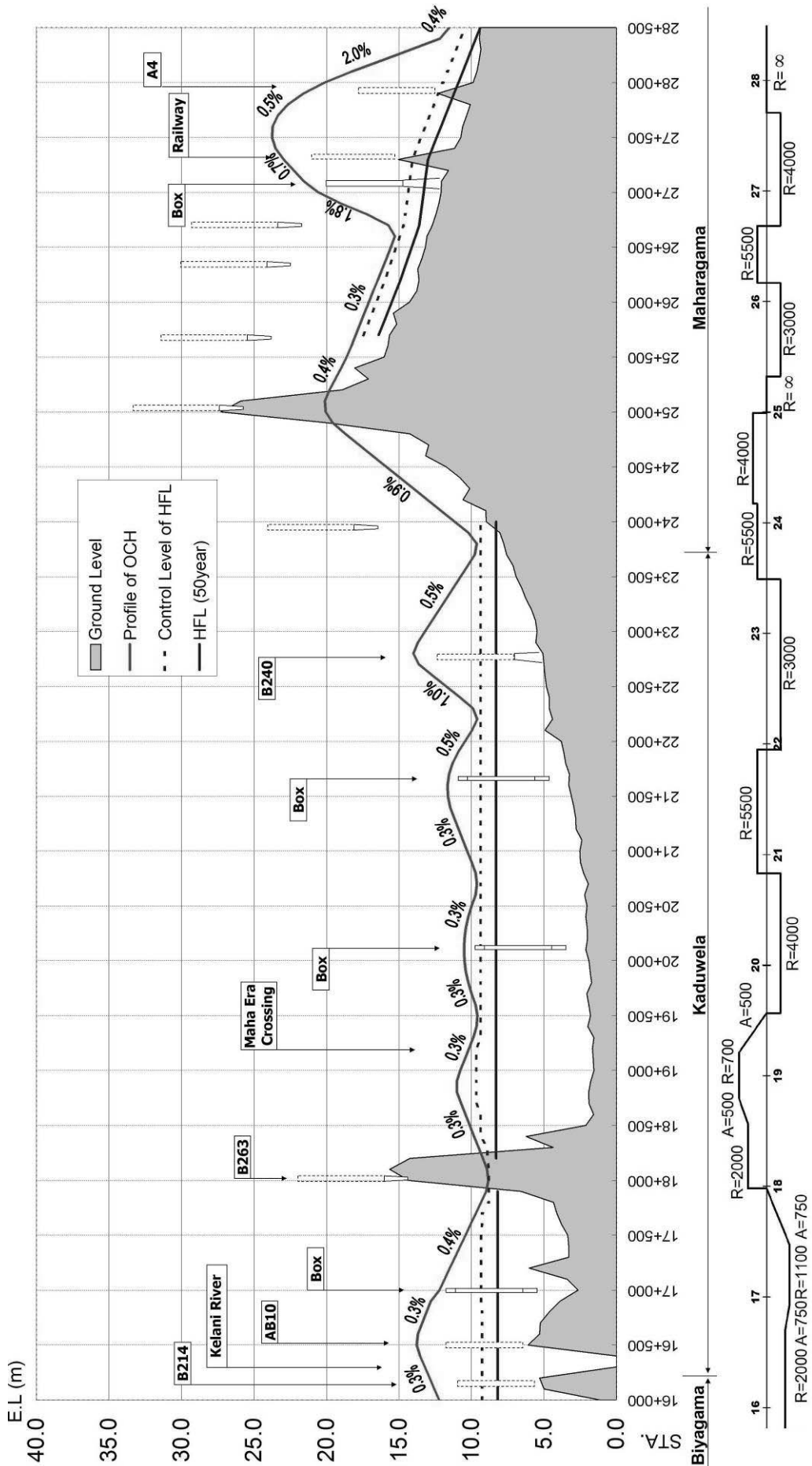


Fig. 2.1.4 Vertical Alignment for OCH Southern Section

(2) Vertical Alignment at the crossing with Malabe - Kaduwela Road

Exceptional value for control from high flood level was used at the crossing with Malabe – Kaduwela road. Details are shown as below.

In the Basic Design Study, carried out in 2001, the 50-year return period flood level has been taken as 7.5 m MSL and the 100-year return period flood level as 7.9 m MSL. The formation level of the embankment is taken as 300 mm from the 50-year flood level, which is the top of the sub grade at the shoulder.

After the basic design was suspended January 2002, the recent study was carried out by the LHI for NWS & DB has predicted that the 100-year return period flood level as 9.05 m MSL. Accordingly the SLLR&DC has requested to maintain the road embankment level at 8.0 m MSL by their letter ref.RD/PROJ/70 dated August 25, 2004 addressed to D/PMU [OCH].

In this respect, the JICA Study Team reviewed their model study and has established the 50-year return period flood level and the 100-year return period flood level as 8.3 m MSL and 8.6 m MSL respectively.

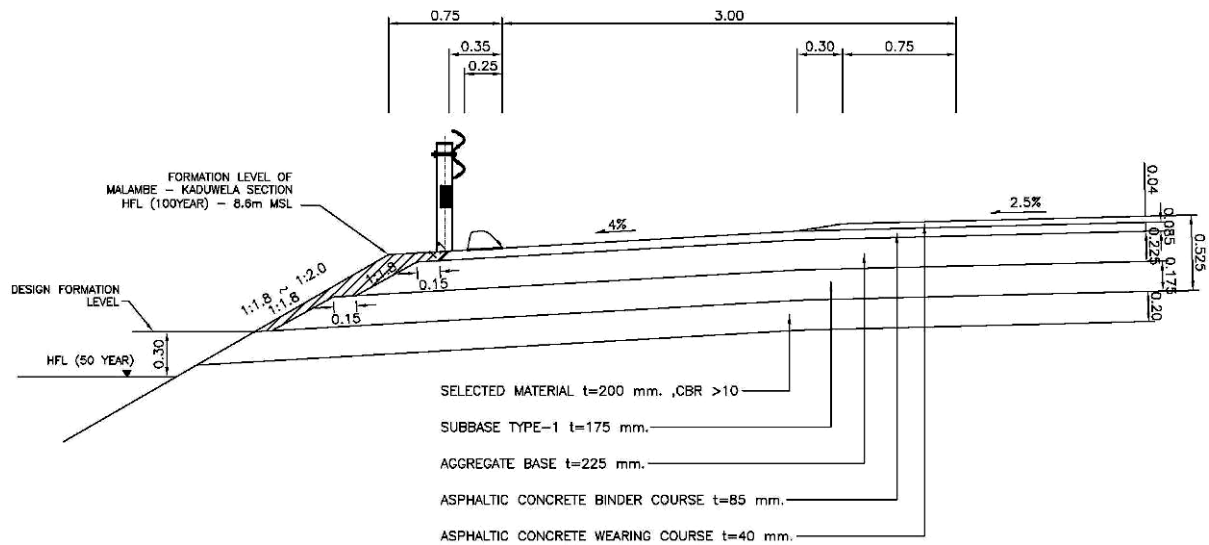
As such the RDA requirements, the formation level of the embankment is to be maintained at 300 mm above the present value of the 50-year return period flood level the Malabe – Kaduwela road has to be raised further by approximately 0.8 m. This will increase the construction cost and require additional land acquisition to accommodate the increase in height.

RDA by their e-mail dated December 02, 2003 has requested the JICA Study Team to reduce the formation level and hence the fill height and there by reduce the number of residents affected due to OCH main trace and the Malabe – Kaduwela Road.

To overcome the increase in the finished level of the Malabe – Kaduwela Road the JICA Study Team proposed to maintain the 50-year return period flood level at the edge of the shoulder and reduce the finished level of the Malabe – Kaduwela Road by the pavement structure height of OCH [0.792 m].

It has been conveyed to the JICA Study Team by D/PMU [OCH] that the 100-year return period flood level of 8.6 m MSL proposed by the JICA Study Team has been confirmed by the information obtained from long term inhabitants in the Kaduwela existing bridge location. It has also been conveyed that the increase in height has to be accommodated within the existing acquisition boundary and the edge of the shoulder to be maintained to the 100-year return period flood level of 8.6 m MSL for this section only.

Figure given below shows the formation level of OCH at other sections and OCH Sta.18 + 013.



Accordingly, the JICA Study Team has fixed the vertical alignment of the Malabe – Kaduwela Road with maximum possible reduction in OCH formation level for this section. With this alignment, it has proposed retaining walls on either side of the Malabe – Kaduwela Road to be within the available acquisition boundary as given in **Fig. 2.1.5**.

The JICA Study Team also proposes that if the alignment of Malabe – Kaduwela Road could be fixed as in **Fig. 2.1.6** and a pedestrian under – pass provided as shown will compensate the loss of access to the residents on the LHS of the OCH.

Proposal on **Fig 2.1.5** was selected through the Technical Committee Meeting.

2.1.4. Horizontal Alignment

The Horizontal Alignment for OCH Southern Section was selected taking into account the geometric design standards of OCH (refer to 2.1 and Basic Design Chapter 3) during the basic design period.

The alignment in OCH southern section is shown in **Fig. 2.1.7** to **Fig. 2.1.10**

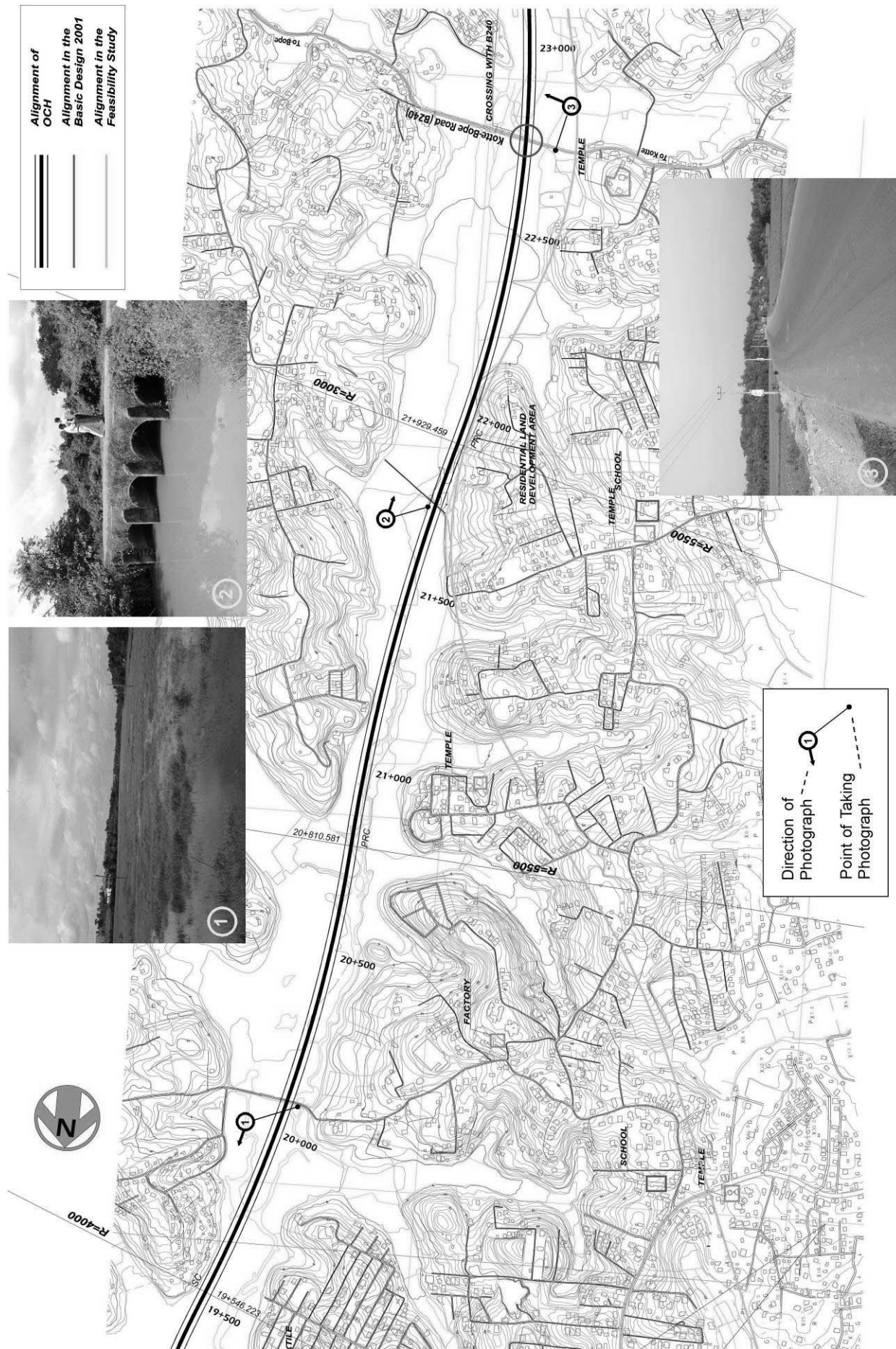


Fig. 2.1.8 Alignment for OCH Southern Section – Kaduwela Division (2) -