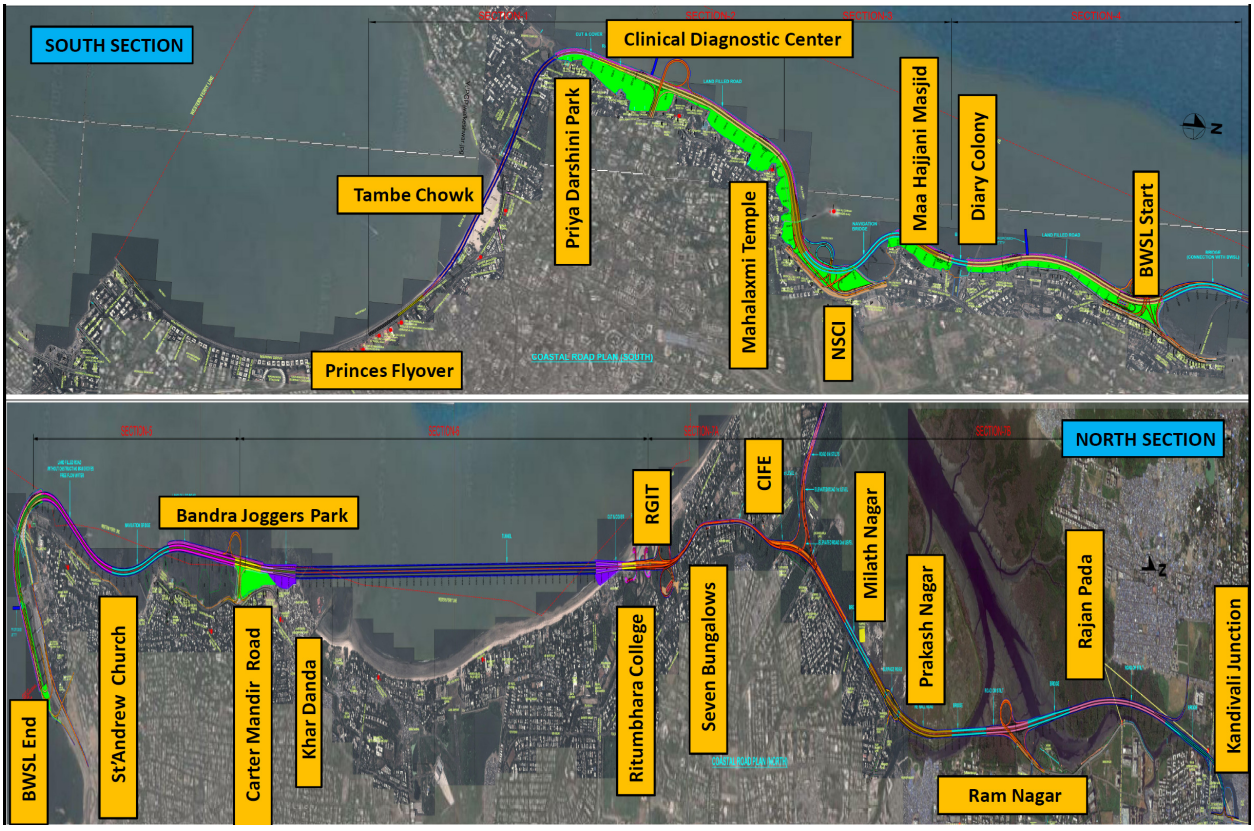
Municipal Corporation of Greater Mumbai

CONSULTANCY SERVICES FOR PREPARATION OF FEASIBILITY REPORT, DPR PREPARATION, REPORT ON ENVIRONMENTAL STUDIES AND OBTAINING MOEF CLEARANCE AND BID PROCESS MANAGMENT FOR MUMBAI COASTAL ROAD PROJECT



Alignment Design Report

April 2016

STUP Consultants Pvt. Ltd.
Plot 22-A, Sector 19C,
Palm Beach Marg, Vashi,
Navi Mumbai 400 705 ,

Ernst& Young Pvt Ltd
8th floor, Golf View Corporate Tower
B, Sector 42, Sector Road
Gurgaon - 122002, Haryana

STUP Consultants P. Ltd

Plot No.22A, Sector 19C, Palm Beach Road
Vashi, Navi Mumbai 400 705
Phone: 2789 62 41 - 45. Fax: [91-22] 2789 62 40
e-mail : navimumbai@stupmail.com

OFFICE OF ORIGIN **STUP, VASHI**

OWNER CLIENT **MUNICIPAL CORPORATION OF GREATER MUMBAI**

CONTRACTOR

PROJECT **CONSULTANCY SERVICES FOR PREPARATION OF FEASIBILITY REPORT, DPR PREPARATION, REPORT ON ENVIRONMENTAL STUDIES AND OBTAINING MOEF CLEARANCE AND BID PROCESS MANAGMENT FOR MUMBAI COASTAL ROAD PROJECT**

TITLE **ALIGNMENT DESIGN REPORT**

DATE	Rev. No.	MODIFICATIONS/ PURPOSE OF ISSUE	PREPARED		CHECKED		APPROVED	
			Name	Signature	Name	Signature	Name	Signature
13.04.16	R0	For Approval	MK		NKJ		AGA	

DATE 13.04.16

PAGES 8+262= 270

NOTE No. 8098/E/DN-22A

(R0) REV.No.

Contents

List of Table

List of Figure

1. Introduction

1.1 General

Mumbai is reckoned as the financial capital of India. It houses a population of 12.4million besides a large floating population in a small area of 437sqkm. As surrounded by sea and has nowhere to expand. The constraints of the geography and the inability of the city to expand have already made it the densest metropolis of the world. High growth in the number of vehicles in the last 20 years has resulted in extreme traffic congestion. This has lead to long commute times and a serious impact on the productivity in the city as well as defining quality of life of its citizens. The extreme traffic congestion has also resulted in Mumbai witnessing the worst kind of transport related pollution.

Comprehensive Traffic Studies (CTS) were carried out for the island city along with its suburbs to identify transportation requirements to eliminate existing problems and plan for future growth. CTS identified requirement of new arterial road along the Western Coast as part of transportation networks as shown in Figure 1.1. Therefore, Municipal Corporation of Greater Mumbai (MCGM) has proposed to construct a Coastal Road on Western side of the city. The report concentrates on feasibility of the proposed Coastal road.

History of Reclamation of Mumbai

It took over 150 years to join the original seven islands of Mumbai. These seven islands were lush green thickly wooded, and dotted with 22 hills, with the Arabian Sea washing through them at high tide. The original island of Mumbai was only 24 km long and 4 km wide from Dongri to Malabar Hill (at its broadest point) and the other six were Colaba, Old Woman's island, Mahim, Parel, Worli, Mazgaon as presented in Figure 1.2.

After the British arrival, the demand for land steadily increased, and by 1730; it was becoming impossible to accommodate the entire population of Mumbai inside the Fort. The sea was making inroads at Worli, Mahim and Mahalaxmi, which turned the ground between the islands into a swamp, making travel between Mumbai islands hazardous.

The first major reclamation took place in 1708, to construct the causeway between Mahim and Sion.

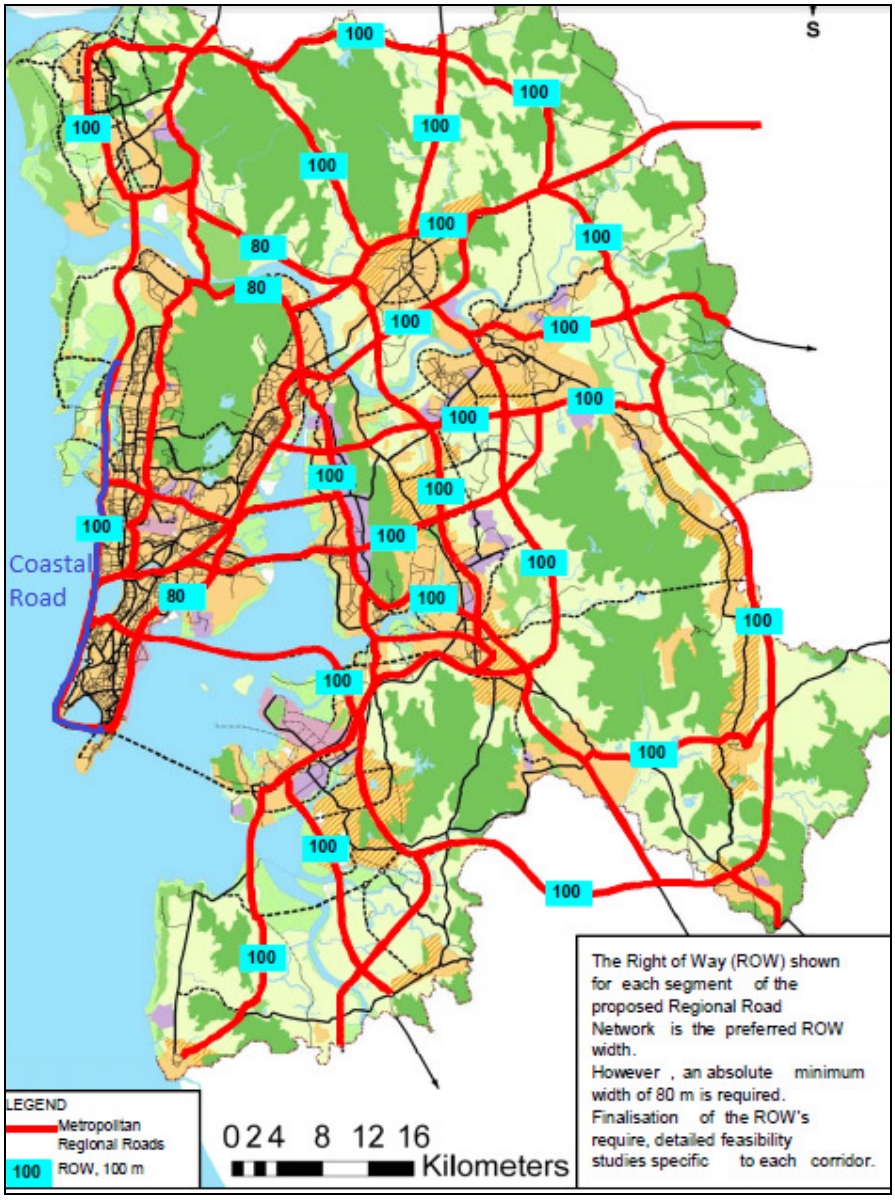


Figure 1.1: Highway Network Proposed by CTS

The second major reclamation took place in 1772, to stop the ingress of water and the consequent flooding of central Mumbai, and to connect Mahalaxmi and Worli. This causeway was named Hornby Vellard, sealing the Great Breach (Breach Candy) between Dongri, Malabar hill and Worli.

At the fortified Dongri hill, an esplanade and parade ground was cleared, from the walls of the Fort to the present day Crawford market. The flat lands from Mahalakshmi to Kamathipura were reclaimed only after the completion of construction at Breach Candy by Hornby in 1784. In 1803, Mumbai was connected to Salsette by a causeway from Sion.

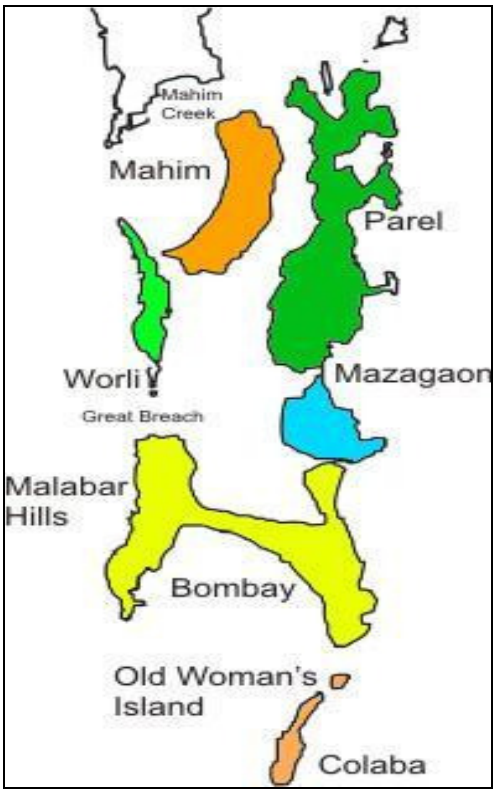


Figure 1.2: Seven Islands of Mumbai

1.2 Colaba Causeway

The Thane and Colaba causeway were built during the tenure of Sir Robert Grant, the Governor of Mumbai. He was also responsible for the construction of a number of roads between Mumbai and the hinterland. The Colaba Causeway was completed in 1838 joining Colaba, Old Woman's island and the H-shaped island of Mumbai together. Land prices shot up and Colaba became the centre of commerce. The Causeway was widened and strengthened from 1861 to1863 (Cusrow Baug is built on the causeway).

The horse drawn tramcars revolutionised transport in Colaba. The Prongs Lighthouse was constructed off the island in 1875 and in the same year the

Sassoon Docks were built by David Sassoon on reclaimed land. The BB & CI (Bombay and Central India) Railways established a terminus at Colaba. 90,000 sq. yards of land was reclaimed on the western shore of Colaba by the City Improvement Trust, the work was completed in 1905. A seaside promenade (Cuffe Parade) was completed the next year.

The next reclamation came in 1836, when the development of the Mumbai port had already begun. Major quarrying had already begun in 1870. The hills of Chinchpokli and Byculla were quarried and dumped into the sea, to fill the land near the railway line, the swamps and also the port to prevent the accumulation of stagnant water. The first railway line was laid down in 1855 from Bori Bunder to Thane.

By 1862 the town became widespread and the constructions that took place began to give rise to the modern city of Mumbai. This became a regular feature in the succeeding years. The Fort walls were demolished and the tanks up to Parel were filled. From 1870 to 1970, industrial and commercial development prospered, which increased the spate of reclamation that ended with the famous Backbay reclamation.

The first Backbay Reclamation Company (BRC) was formed in the 1860s with the express purpose to reclaim the whole of Backbay. With the end of the American Civil War in 1865, land prices fell. The government took over the narrow strip of land created by the BRC and gave it to the BB & CI Railways (Bombay Baroda and Central India) to construct a new line between Churchgate and Colaba.

A proposal was made in 1917 to reclaim 607 hectares of land between Colaba and Backbay. The project was taken over by the Development Directorate who planned to reclaim 463 hectares and would have to relocate the Colaba terminus, which was moved to Bombay Central. The work continued till 1945. Eventually 177 hectares was developed by 1929 of which 94 hectares was sold to the military and 6 hectares was incorporated into the Marine Drive and its sea wall. Figure 1.3 presents the map of Mumbai in 1945.

Independence did not end the reclamation work but a third Backbay Reclamation was put into effect and yielded the acreage on which stand the high rise buildings of Nariman Point and Cuffe Parade. East of the Naval Dockyards some land was reclaimed and work was done to the north too. Coastal Regulation Zone (CRZ) was introduced in 1990 banning reclamation for commercial activities.

1.3 Report Structure

Chapter 1: Provides Introduction and history of Mumbai.
Chapter 2: Provides information about project.
Chapter 3: Provides design standards and specifications
Chapter 4: Project Alignment Description
Chapter 4: Explains Horizontal and Vertical design detail of coastal Road Alignment.
Chapter 5: Explains Horizontal and Vertical design detail of all Interchanges alignment of Costal Road.

2. Project Information

Mumbai being island city, surrounded on three sides by Arabian Sea, sea links were planned on the western flank and the trans-harbour link on the east to connect the island city to the main land. One of the prime reason sea links were planned as bridges was the restriction placed by the earlier Coastal Regulatory Zones (CRZ) regulations preventing reclamation or stilt roads in the CRZ areas. The CRZ notification dated 6 January 2011 issued by the Ministry of Environment and Forests, Govt. of India (MOEF, GOI) now makes it possible to envisage coastal roads on stilts. During the meeting held in Mumbai on 15 April 2011, the proposal of a reclamation based coastal road encircling Mumbai was presented to the Hon'ble Minister MoEF, GoI. Hon'ble Minister suggested the proposal needed a closer examination through a committee. Accordingly, Govt. of Maharashtra constituted a Joint Technical Committee under the Chairmanship of Municipal Commissioner, MCGM on 30 June 2011 to study and make recommendations on the subject of coastal roads in Mumbai. The Committee held various meetings and deliberated on the issues which were presented through its report to Govt. of Maharashtra on 29 December 2011. The Committee recommended about 35.6 km. coastal road comprising a combination of road based on reclamation, bridges, elevated roads and tunnels on western side of Mumbai. The Committee recommended this coastal road with two options of alignments, both with a view to resolve the traffic congestion in Mumbai and to enable creation of the much needed recreational open spaces.

2.1 Objectives

This report presents studies carried out to verify feasibility of the proposed coastal road and recommendations for detailed design stage of the project. Therefore, this report contains Alignment Design Report studies including detailed survey.

2.2 Scope of Work

- Horizontal design detail of coastal Road Alignment.
- Vertical design detail of coastal Road Alignment.
- Horizontal design detail of all Interchange Alignments of coastal Road.
- Vertical design detail of all Interchange Alignments of coastal Road.

3. Design Standards and Specifications

3.1 General

This section describes the design standards and principles based on which the various designs will be carried out. These proposed standards are consistent with the parameters recommended in the relevant standards of the Indian Roads Congress (IRC). The aim of this chapter is to evolve Design Standards and Material Specifications for the study primarily based on IRC publications and MoRTH circulars and relevant recommendations from the international standards and to recommend the same for concurrence/approval of MoRTH.

3.2 Design Speed

Design speed is the basic parameter, which governs the geometric characteristics of the road. As the project road is an access controlled urban arterial, the design speed is proposed 100 Km/hr. However, in exceptional circumstances minimum design speed 80 km/hr shall be adopted where site conditions are extremely restrictive i.e Tunnel, Bridges etc. For interchanges design speed is proposed 40-60 Km/hr depends on availability of land.

3.3 Terrain Classification

Terrain is classified by the general slope of the ground across the arterial alignment. The following terrain classification recommended by IRC:SP:99-2013 is proposed to be adopted:

Table 3-1**Percentage Cross Slope of the Country**

Terrain Type	Percentage Cross Slope of the Country
Plain	Less than 10 percent
Rolling	Between 10 and 25 percent

The proposed alignment predominantly follows the plain/rolling terrain as per above classification. However, short stretches (say less than 3 km) of hilly terrain shall not be taken into consideration while deciding the terrain classification for the project road. The geometric designs will be prepared based on IRC:SP:99-2013 for plain terrain except for few sections where design would be based on specifications for rolling terrain.

3.4 Carriageway Width

The proposed width of a traffic lane is taken as 3.5 m corresponding to 100 Kmph design speed. It is proposed to have four lane carriageway for each traffic direction. Outer lane of the four lane carriageway is dedicated for BRTS services. Merging and demerging will provide at intersection location to outer lane of carriageway. Two lane carriageway provide for all interchange arms.

3.5 Median

Depressed median is proposed. The width of median is the distance between inside edges of carriageways. The recommended width of median is 11m for the proposed coastal road alignment.

3.6 Paved Shoulders

Paved shoulder on outer sides of the both carriageway/pavement. Paved shoulder will have same specification and strength as main carriageway. The paved shoulder will be of 2.25 m wide. This will provide better and safer traffic operation conditions, lower maintenance and facility of directly using these as part of carriageway when the road is widened. Shoulder will work as emergency lane. The Paved shoulder will be 1.5m both sides of carriageway arms of all intersections. This shoulder will act as extra widening for sharp horizontal curve at Arms of intersection.

3.7 Crossfall

Mumbai having average annual rainfall more than 1000mm. So crossfall of 2.5% is proposed . The cross fall for earthen/granular shoulders on straight portions shall be at least 1.0 percent steeper than the given crossfall to carriageway. On super elevated sections, the earthen portion of the shoulder on the outer side of the curve would be provided with reverse cross fall so that the earth does not drain on the carriageway and the storm water drain out with minimum travel path.

3.8 Side Slopes

To attain a natural appearance along the roadside, the side slopes should be as flat as possible and rounded. The slopes should be designed from stability considerations and to provide a reasonable opportunity for a driver to recover control of an errant vehicle. If the right of way or other constraints make it impractical to provide recoverable slopes, it would be necessary to provide a safety barrier.

Embankment slopes 1V:4H or flatter are recoverable slopes.

Fixed obstacles such as culvert headwalls shall not extend above the fill slope within the clear zone distance.

Embankment slopes between 1V: 3H and 1V: 4H are traversable but non-recoverable and a clear run out area at the base is desirable.

Embankment with height 6.0 m or above shall be designed in accordance with IRC: 75 taking into account slope stability, bearing capacity, consolidation, settlement and safety considerations based on geotechnical and investigation data.

Roadway in Cutting: The road level shall be fixed, keeping in view the provisions of relevant IRC Codes, and the side slopes of the cut section shall be governed by the type of soil met with. Generally the side slopes shall be as per IRC:SP:99-2013 as given below.

Table 3-2 **Slopes and Cut Sections**

Type of Soil	Slope (H:V)
Ordinary Soil	3:1 to 2:1
Rock	½: 1 to 1/8: 1(Depending upon quality of rock)

3.9 Horizontal Alignment

Alignment shall be fluent and blend with the topography. The horizontal curves shall be designed to have largest practical radius and shall consist of circular portion flanked by spiral transitions at both ends. At intersections arms designed for minimum 75m radius of horizontal curve.

3.9.1 Super elevation

Super elevation shall be limited to 5 percent. Considering urban arterial will be used by mixed traffic.

3.9.2 Radii of horizontal Curve

The desirable minimum and absolute minimum radii of horizontal curves are provided in table 3-3

Table 3-3 **Minimum Radii of horizontal curves**

Design Speed (Km/h)	100	80
Absolute Minimum Radius (m)	440	260
Desirable Minimum Radius (m)	700	400

The radius of horizontal curves for various terrain conditions shall not be less than the desirable minimum values except for location of site constraints.

3.9.3 Transition Curves

The transition curves shall be provided at both ends of the circular curve. The recommended minimum length of transition curves is provided to the proposed alignment based on design speed as per IRC.

3.9.4 Sight Distance

The safe stopping and Intermediate sight distance for both horizontal and vertical directions will apply in design. The sight distance values as per IRC recommendations are provided in table 3-6:

The desirable values of sight distance shall be adopted unless there are site constraints. A minimum of safe stopping sight distance shall be available throughout.

Table 3-4 **Safe Sight Distance**

Design Speed (Km/hr)	Safe Stopping Sight Distance (m)	Desirable minimum Sight Distance (m) (Intermediate Sight Distance)
100	180	360
80	120	240

3.10 Vertical Alignment

The vertical alignment should provide for a smooth longitudinal profile. Grade changes shall not be too frequent as to cause kinks and visual discontinuities in the profile. Desirably there should be no change in grade within a distance of 150m. The directions given in IRC:73 and IRC:SP:23 should be complied.

Decks of small cross drainage structure (i.e culverts or minor bridges) shall follow the same profile as the flanking road section, without any break in the grade line.

The aspect of efficient drainage shall be kept into consideration while designing vertical profile and cross-sections of the Project Road as stipulated in IRC:SP:42 and IRC:SP:50.

3.10.1 Gradients

The ruling and limiting gradients are given in Table 3-5.

Table 3-5 **Gradients**

Terrain	Ruling Gradient	Limiting Gradient
Plain	2.5 percent	3 percent
Rolling	3 percent	4 percent

Ruling gradient shall be adopted as far as possible. Limiting gradients shall be adopted only in very difficult situations and for short lengths. In cut-sections, minimum gradient for drainage considerations is 0.5 percent (1 in 200) if the side drains are lined: and 1.0 percent (1 in 100) if these are unlined

3.10.2 Vertical Curves

Long sweeping vertical curves shall be provided at all grade changes. Summit curves and valley curves shall be designed as square parabola and cubic parabolas respectively. The length of the

vertical curves is controlled by sight distance requirements. The minimum grade change requiring vertical curve and the minimum length of vertical curve shall be as per table 3-6.

Table 3-6 **Minimum Length of Vertical Curve**

Design Speed (Km/h)	Minimum Grade Change Requiring Vertical Curve	Minimum Length of Vertical Curve (m)
100	0.5 percent	85
80	0.6 percent	70

3.11 Lateral and Vertical Clearance at Underpass

Wherever a cross road is proposed to be taken below the Project Road, minimum clearances at underpasses shall be as follows:

3.11.1 Lateral clearance

I. Full roadway width of the cross road shall be carried through the underpass. For Vehicular Underpass, the lateral clearance shall not be less than 12 m (7m carriageway+2x2.5 m shoulder width on either side) or as indicated in Concession Agreement.

II. For Light Vehicular Underpass, the lateral clearance shall not be less than 10.5 including 1.5m wide raised footpaths on either side.

III. Crash barriers shall be provided for protection of vehicles form colliding with the abutments and piers and the deck of the structures.

3.11.2 Vertical Clearance

Vertical clearance at underpasses shall not be less than the values given in Table below as per table 3-7

Table 3-7 Vertical Clearance

i) Vehicular Underpass	5.5
ii) Light Vehicular Underpass	3.5
iii) Pedestrian , Cattle underpass	2.4 m

3.12 Lateral and Vertical Clearance at Overpasses

Where any structure is provided over the Project Road; the minimum clearances shall be as follows

3.12.1 Lateral clearance

Full roadway width for 8 lane carriageway shall be carried through the overpass structure. The abutments and piers shall be provided with suitable protection against collision of vehicles. Crash barriers shall be provided on abutment side and on sides of piers for this purpose. The ends of crash barriers shall be turned away from the line of approaching traffic. The span arrangement for the overpass structure shall be as specified Concession Agreement.

3.12.2 Vertical Clearance

A minimum 5.5 m vertical clearance shall be provided from all points of the carriageway of the project Road.

3.13 Access Control

Project Road shall be designed for fast motorised traffic with full control of access. Access to the arterial road shall be provided with grade separators at location of intersections. Parking/Standing, loading/unloading of goods and passengers and pedestrians/animals shall not be permitted on the expressway.

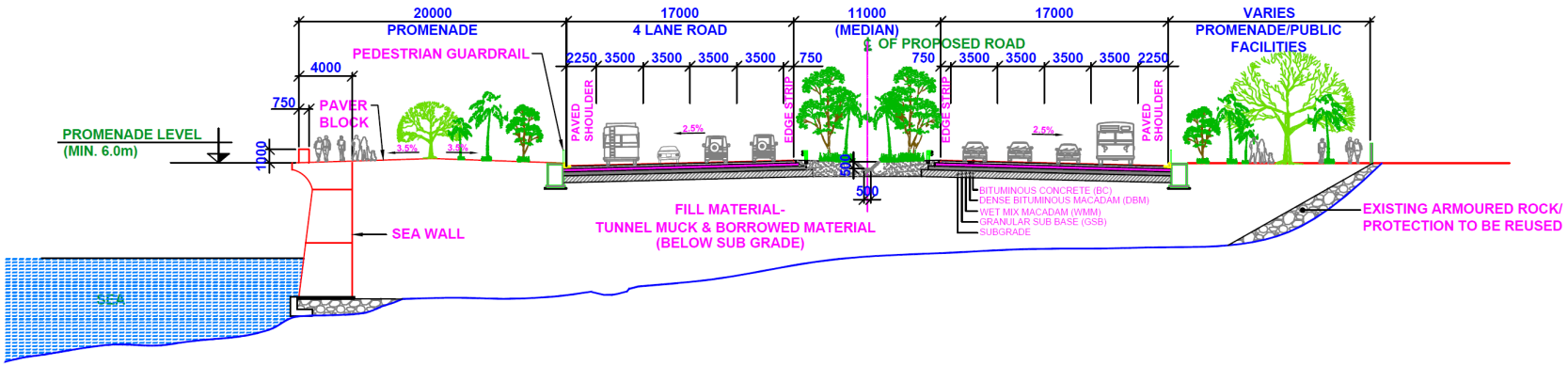
3.13.1 Location of interchange

The locations of individual interchanges are determined primarily to reduce detour considering regional network and nearness to places of importance. Location of interchange is guided by the following situations:

At crossing or nearest points of major roads to important ports, airports, material transport facilities, commercial and industrial areas, and places of tourist interest.

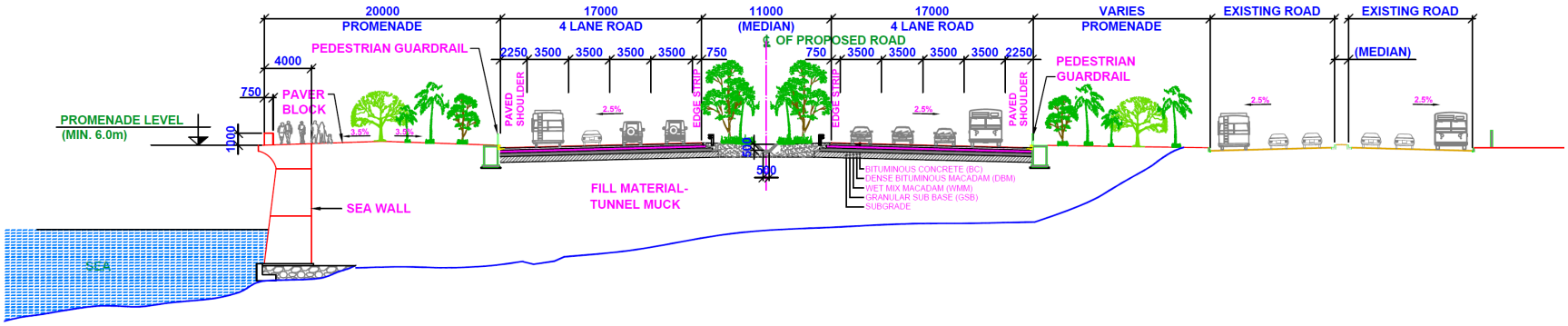
3.14 Typical cross Section Detail

Figure 3-1 **TCS-01 Typical Land Filled Road**



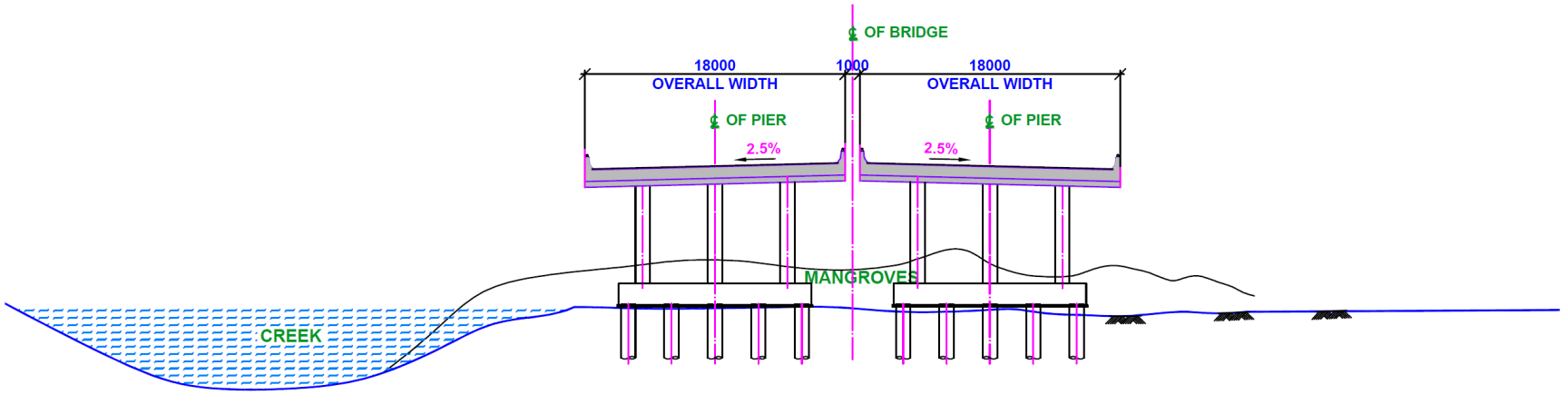
TYPICAL LAND FILLED ROAD
(PRIYADARSHINI TO MAHALAKSHMI & BARODA PALACE TO WORLI DAIRY)

Figure 3-2 **TCS-02 Typical Land Filled Road With Existing Road**



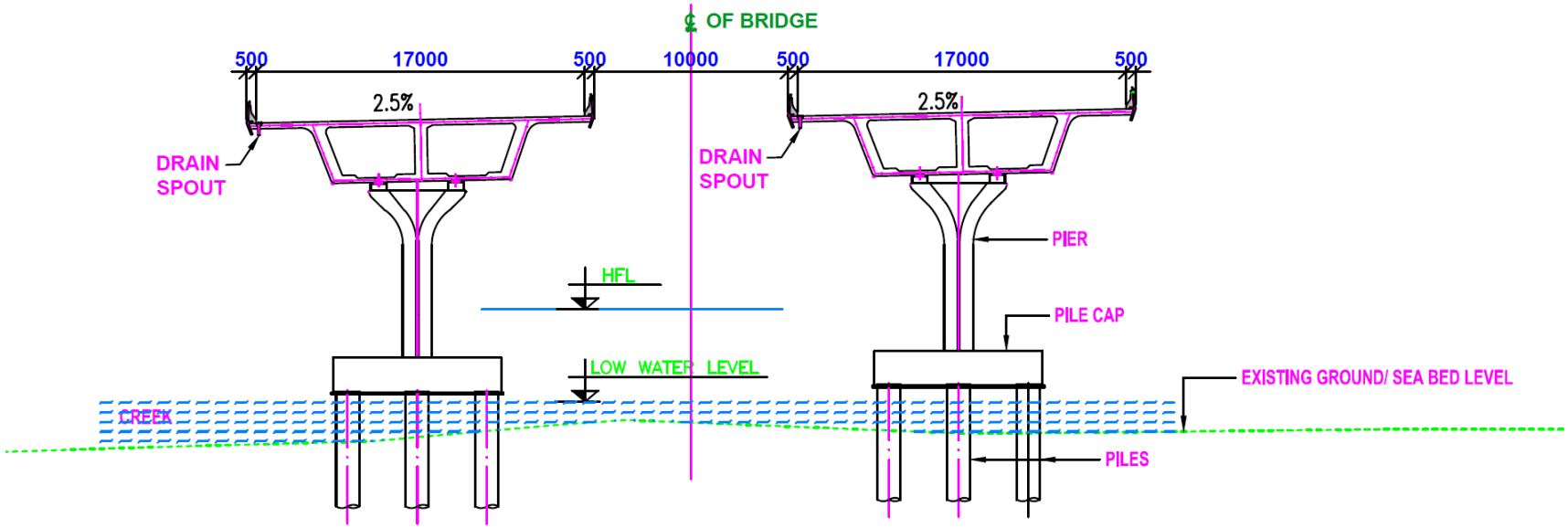
TYPICAL LAND FILLED ROAD WITH EXISTING ROAD (WORLI, BANDRA)

Figure 3-3 TCS-03 Typical Stilted Road over Mangroves



TYPICAL ROAD ON STILT IN MANGROVE AREA

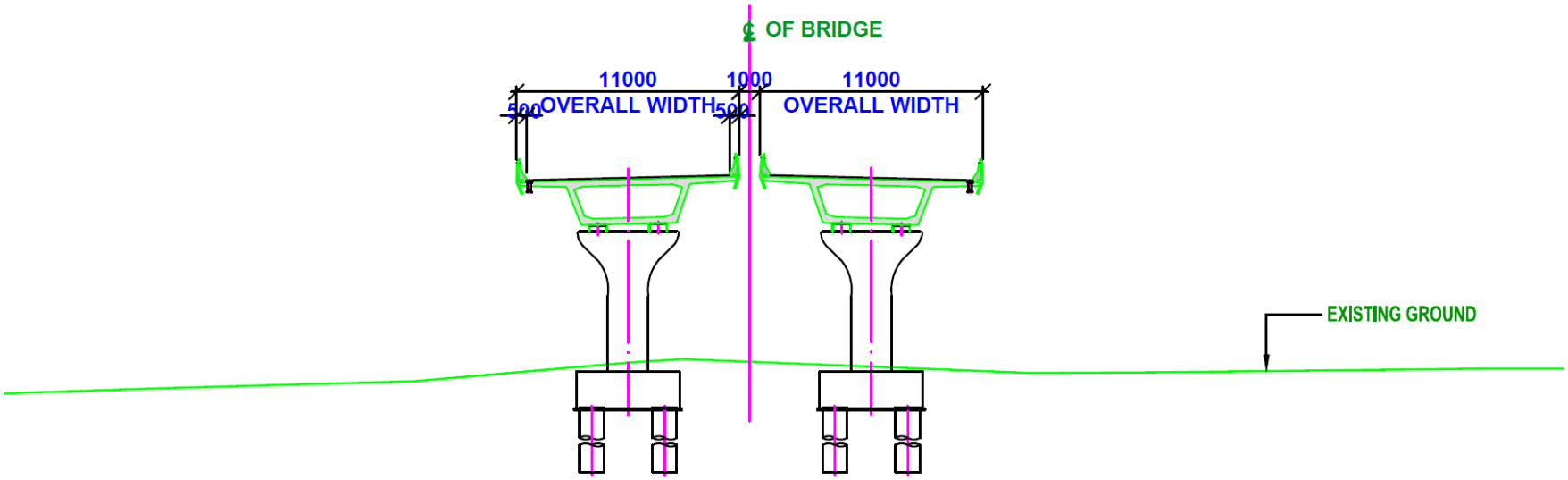
Figure 3-4 TCS-05 Typical Bridge (Sea Bridge, Nala & Creek Crossing Bridge)



TYPICAL BRIDGE

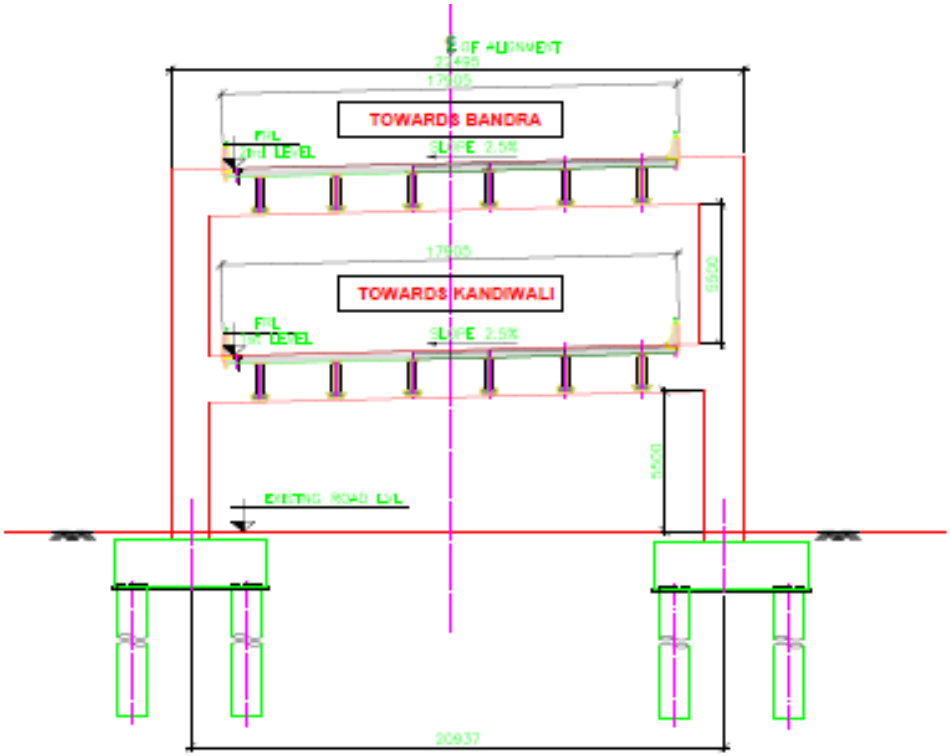
(SEA BRIDGE, NALA & CREEK CROSSING BRIDGE)

Figure 3-5 **TCS-14 Typical 2+2 Lane Bridge**



TYPICAL CROSS SECTION OF BRIDGE FROM KANDIVALI JUNCTION

Figure 3-6 **TCS-06 Typical Double Deck Elevated Bridge**



TYPICAL DOUBLE DECK ELEVATED ROAD
(RITUMBRA COLLEGE TO MADH ISLAND INTERCHANGE)

Figure 3-7 TCS-07 Typical Cross Section Of 2 Lane 2 Tunnel By TBM (South)

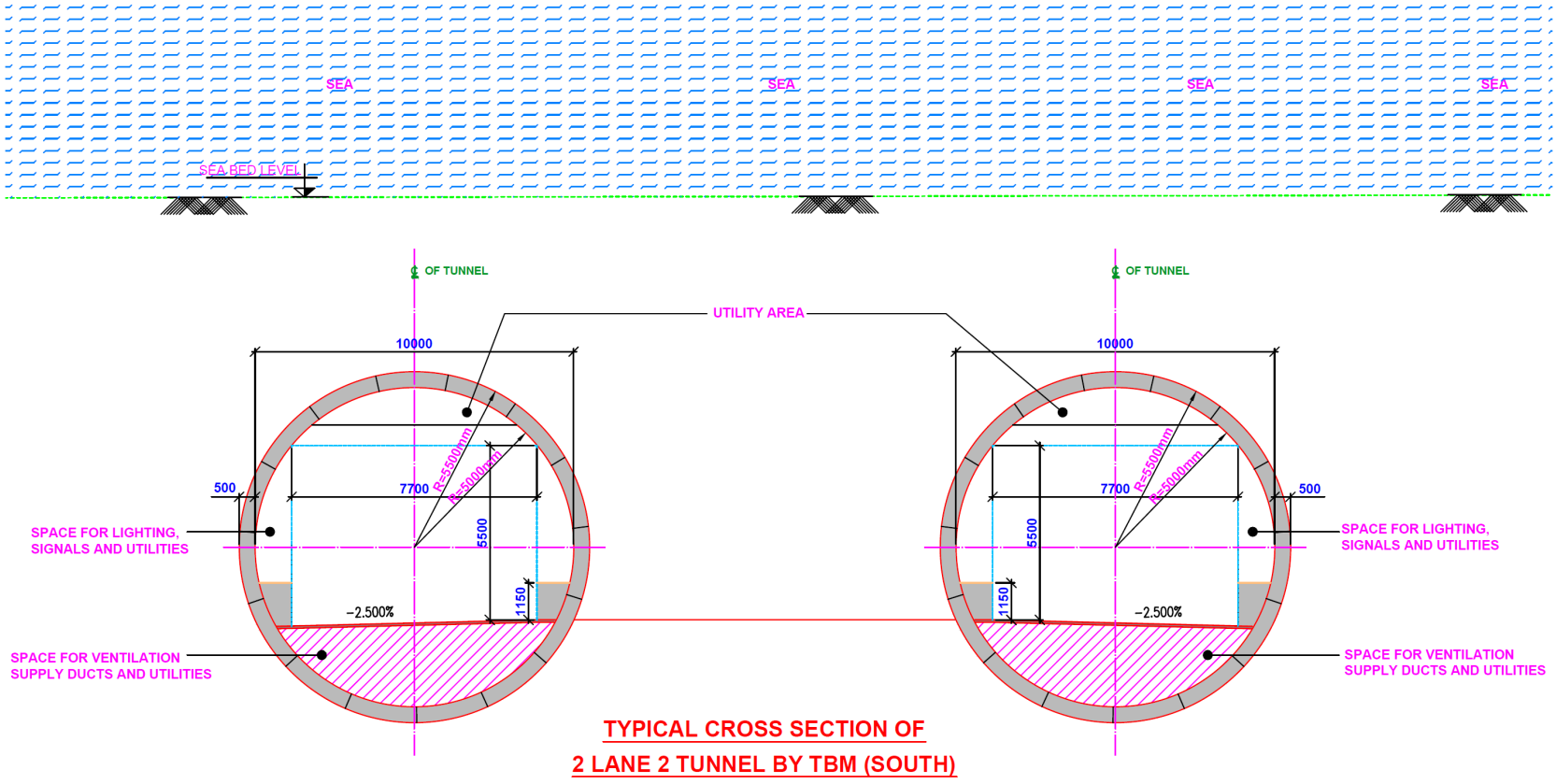
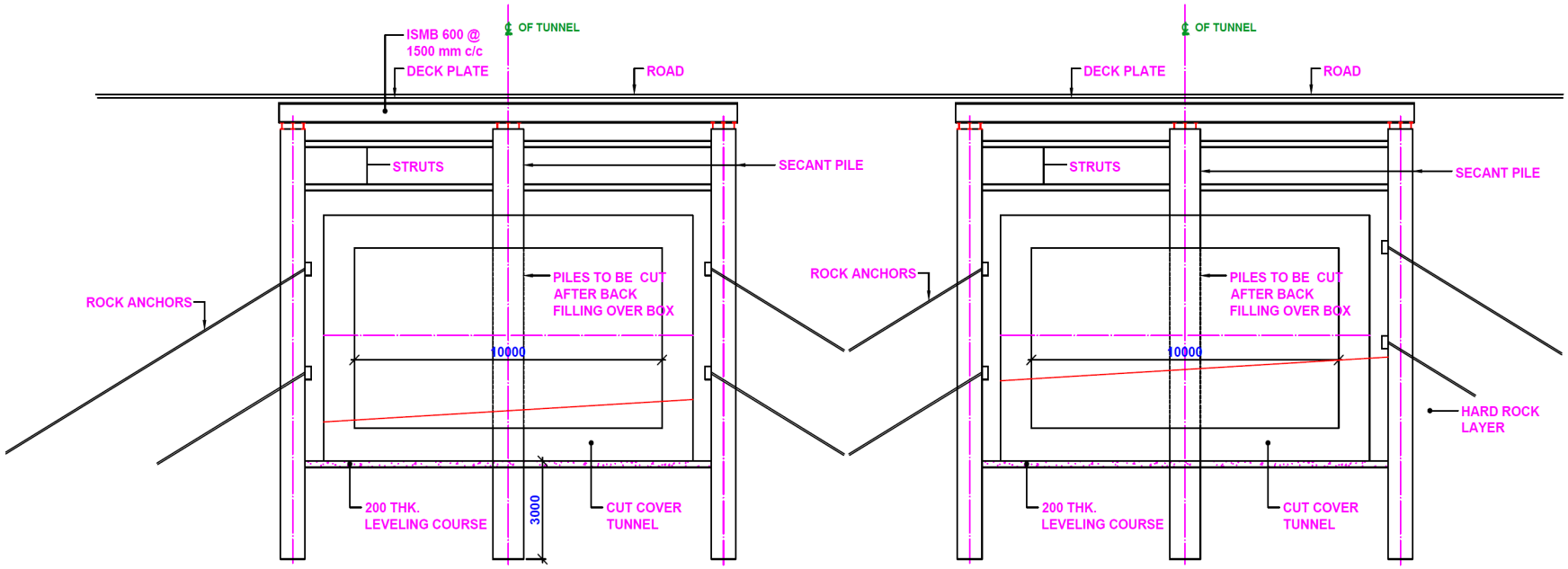


Figure 3-8 TCS-08 Cut & Cover Tunnel With Secant Pile Walls Cross Section



CUT & COVER TUNNEL WITH SECANT PILE WALLS CROSS SECTION

Figure 3-9 TCS-09 Typical Land Filled Road With Arch Opening

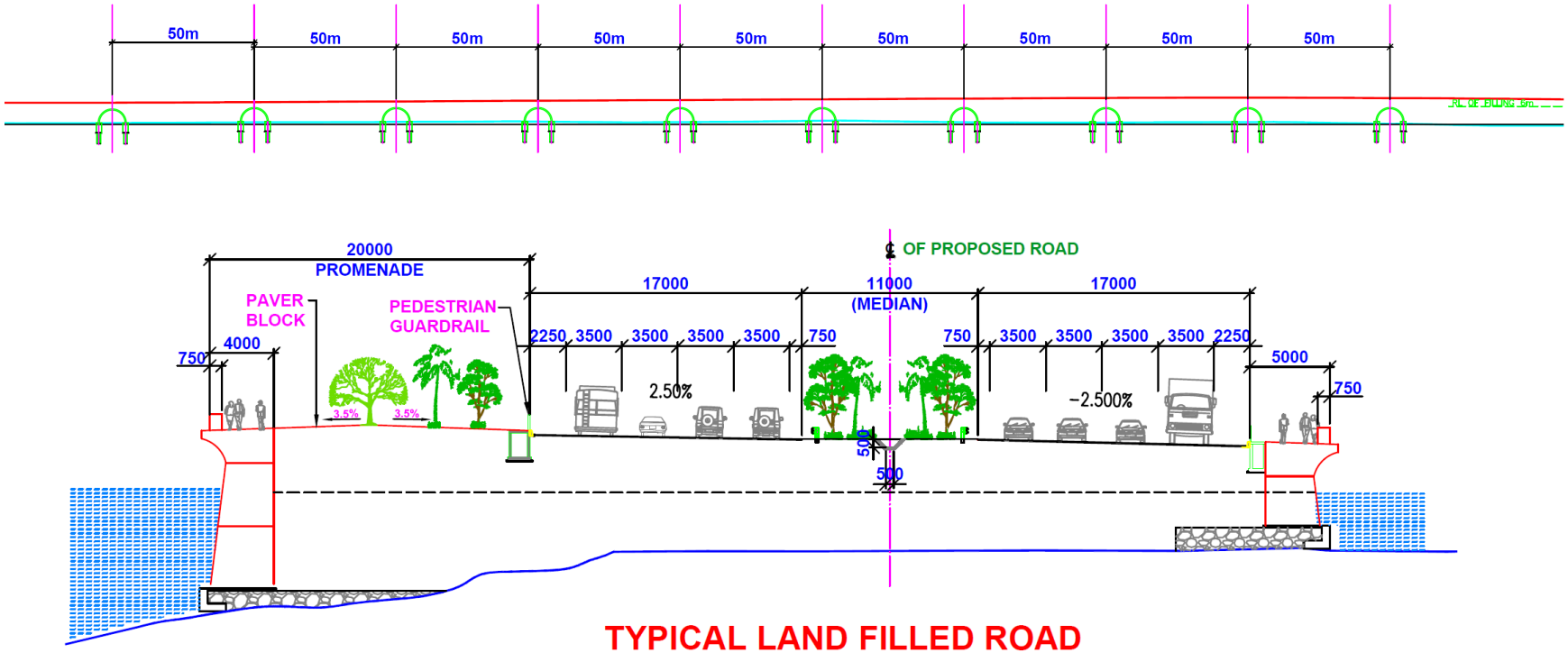
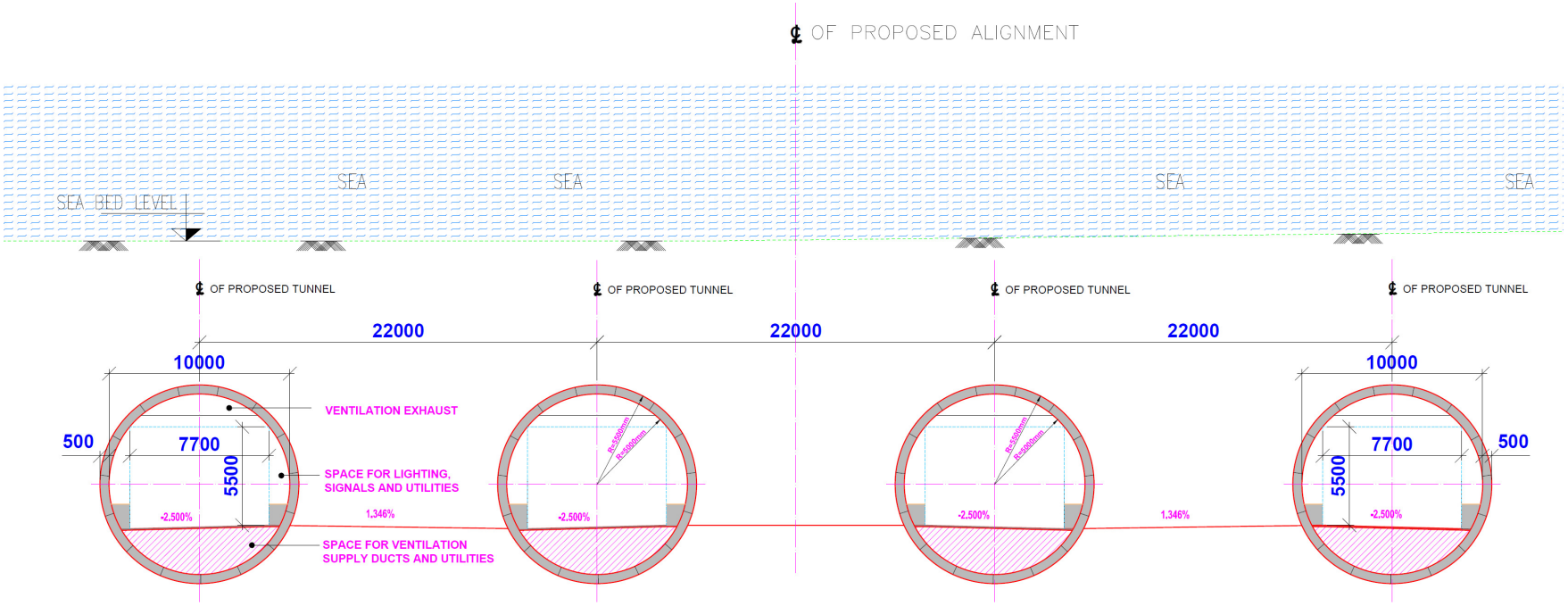
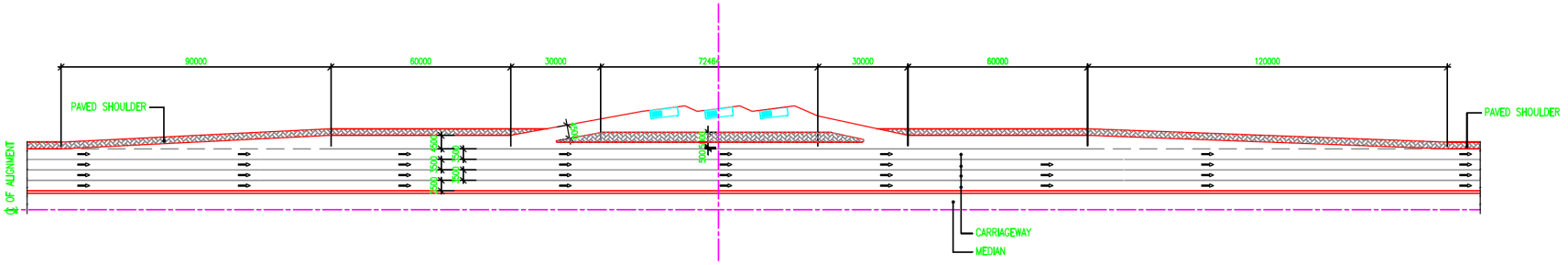


Figure 3-10 TCS-11 Typical Cross Section Of 2 Lane 4 Tunnel By TBM (North)

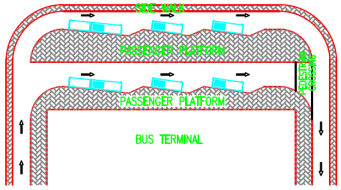


TYPICAL CROSS SECTION OF
2 LANE 4 TUNNEL BY TBM (NORTH)

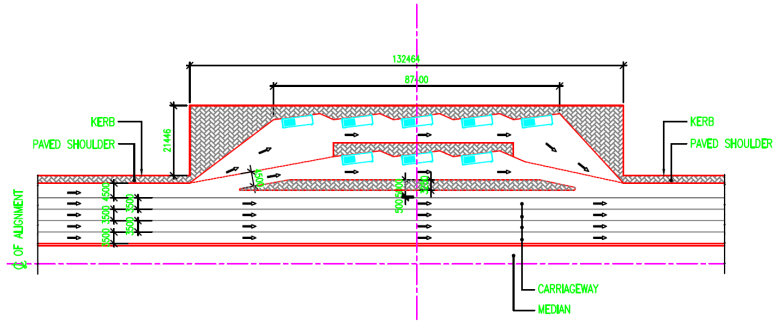
Figure 3-11 Typical Details of Bus Bay



TYPICAL DETAILS OF BUS BAY (FOR NARIMAN POINT TO KANDIVALI JUNCTION)
(BUS STOP DEPEND UPON LOCATION)

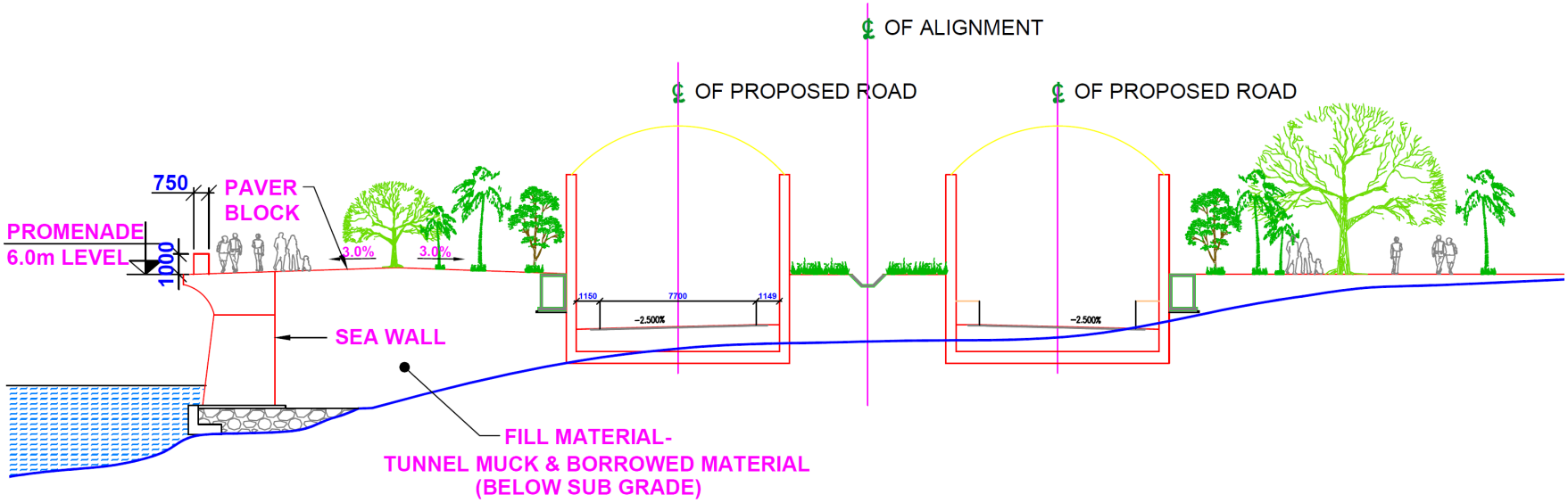


BUS TERMINAL OPTION –I



BUS TERMINAL OPTION –II

Figure 3-12 Typical Cross Section of Ramp 2 Lane 2 Tunnel by TBM (South)



TYPICAL CROSS SECTION OF
2 LANE 2 TUNNEL BY TBM (SOUTH)

Figure 3-13 Typical Cross Section of RE Wall With Promenade

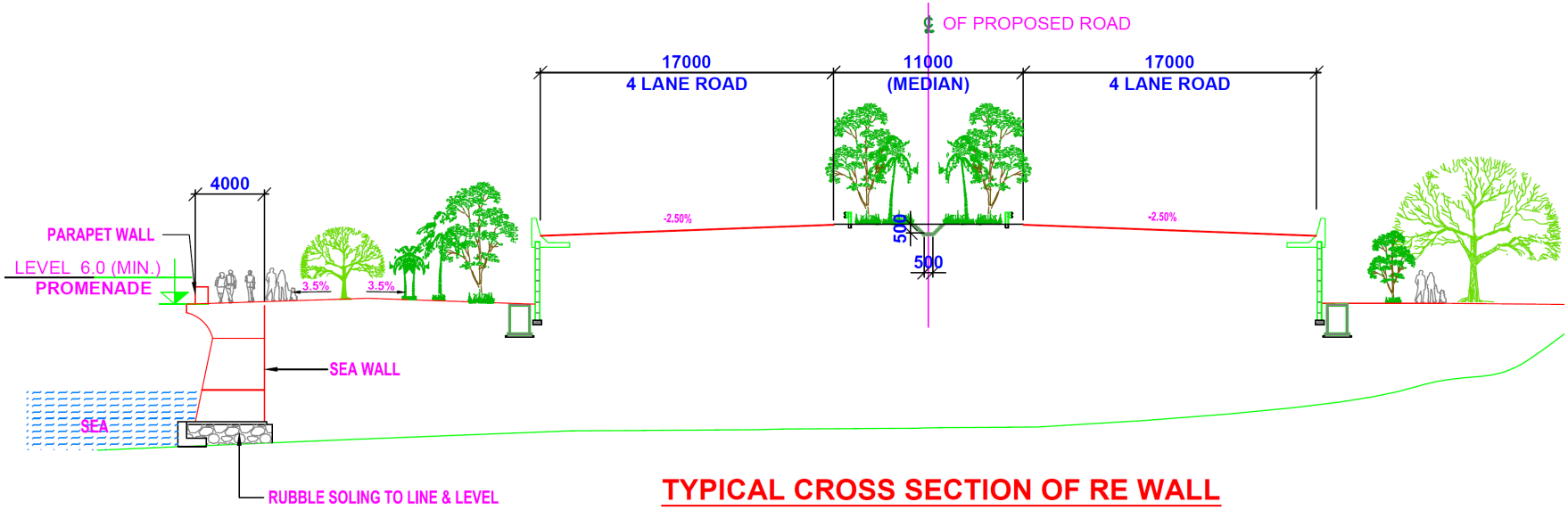
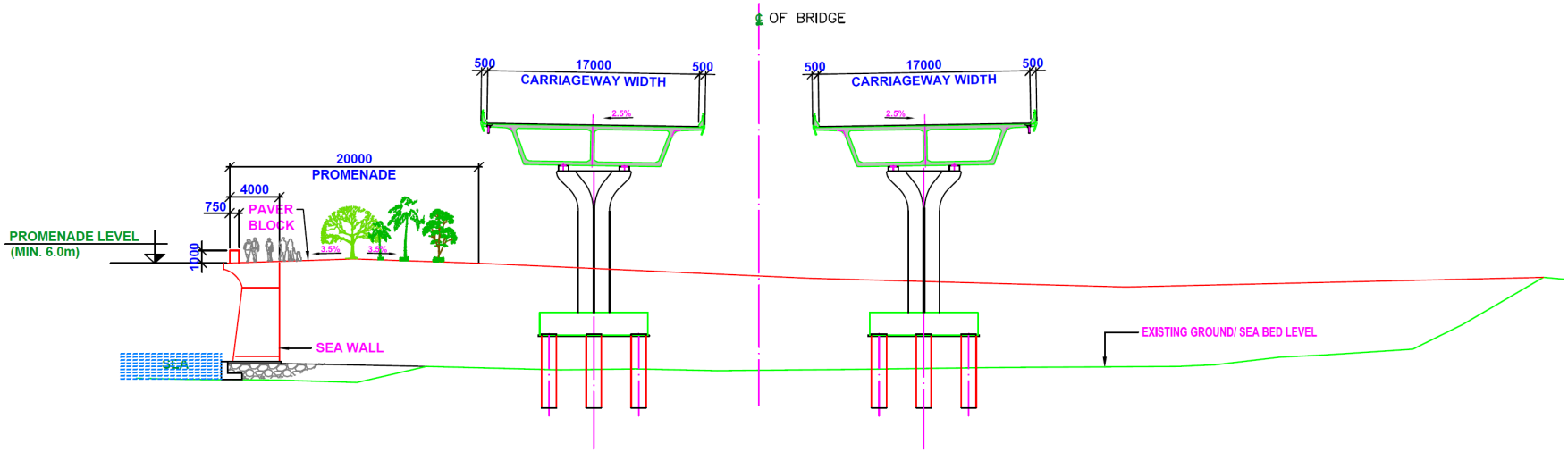
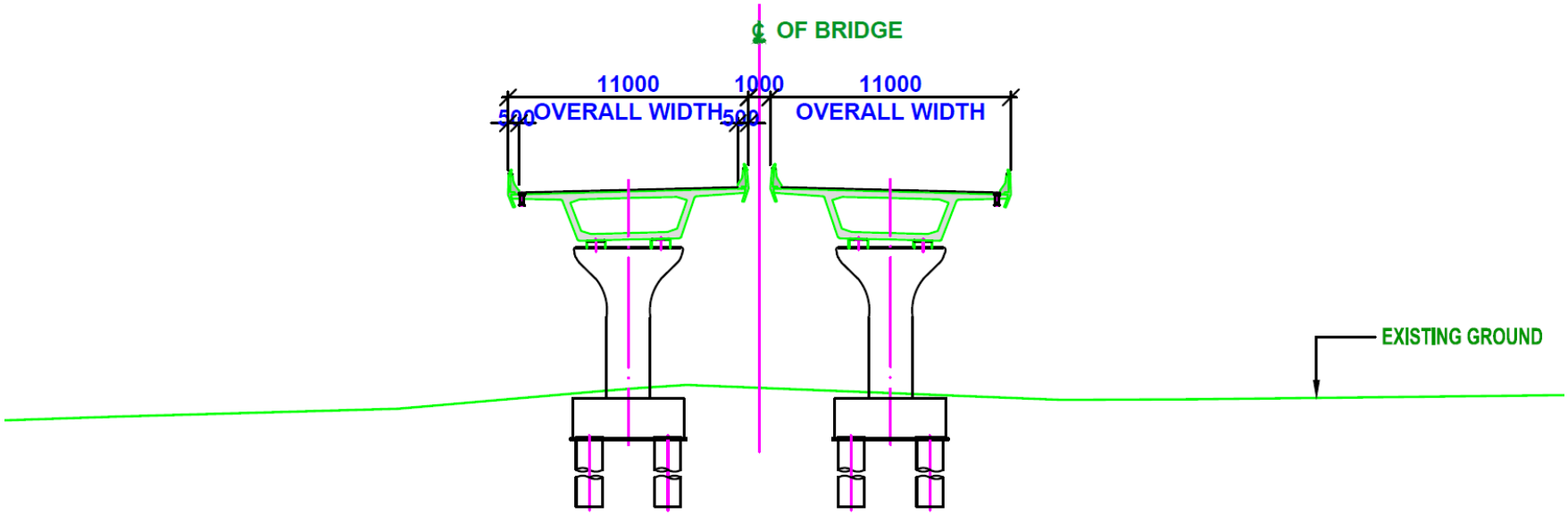


Figure 3-14 Typical Cross Section of Bridge with promenade



TYPICAL BRIDGE WITH PROMENADE
(HAJI ALI , BANDRA)

Figure 3-15 Typical Cross Section of Bridge from Kandivali Junction



TYPICAL CROSS SECTION OF BRIDGE FROM KANDIVALI JUNCTION

4. Project Alignment Description

4.1 General

We have studied various options for the proposed road, based on the objectives. Satellite imagery and levels extracted from Google Earth Pro software, assisted by site visits/reconnaissance survey were used to determine various alignment options. Six alignment options were considered including two options of joint Technical Committee and evaluated considering socio economic parameters. For each alternative block cost estimate is prepared. Option-7 was developed as a final option by combining preferred option for each section.

Total alignment is divided into two parts considering the terrain classification and further sub divided in sections as detailed below.

Part 1: South (Princes Flyover to Worli end of Sea Link)

Section 1: Phase 1: Princes Flyover to Priya Darshini Park

Phase 2: Jagaannath Bhossale Road

Section 2: Priya Darshini Park to Mahalaxmi

Section 3: Mahalaxmi to Markandershwar Temple

Section 4: Markandershwar Temple to Worli End of Sea Link

Part 2: North (Bandra end of Sea Link to Kandivali Junction)

Section 5: Bandra End of Sea Link to Start of Tunnel

Section 6: Start of Tunnel to Bharat Nagar

Section 7: Bharat Nagar to Kandivali Junction and Central Institute of Fisheries, Versova to Madh Island

Section wise alignment is described in subsequent paragraphs.

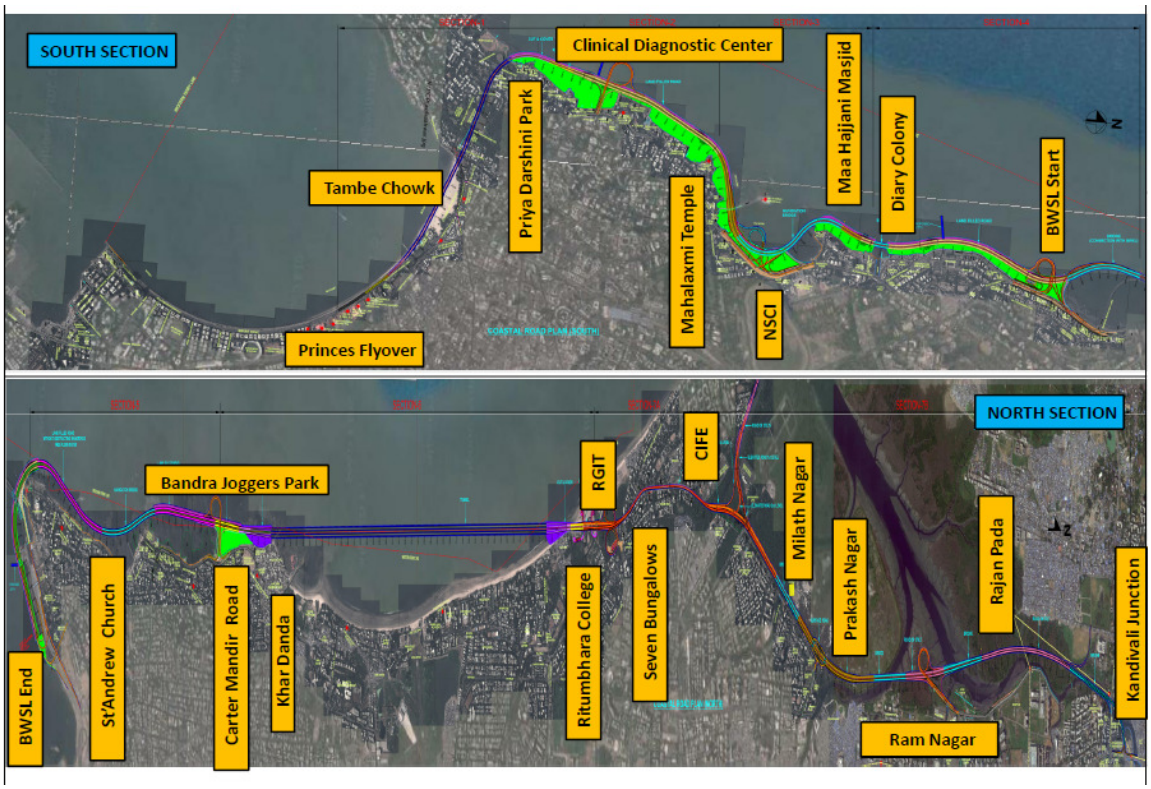


Figure 4-1 **Project Alignment with Sub Divided Sections Detail**

4.2 Section 1:

4.2.1 Phase1 :Princes Flyover to Priya Darshini Park (Km. 2+448 to Km.5+900)

Section-1 starts from Princes Flyover and ends at Priyadarshini garden sea front. The section is characterised by requirement of provision of tunnel. The alignment designed with smooth curves to desired standards improving safety and minimising operation requirement. The alignment is away from structures of archaeological importance, roads and buildings. Alignment requires minimal traffic management during construction.

Figure 4-2 **Section 1-Phase2: Princes Flyover to Priya Darshini Park**

Table 4-1 **Section 1-Phase 1:Alignment Detail**

Section No.	Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
	Princes Flyover to Priyadarshini Park	Ramp Portion	2+448	2+950	502	
		Cut& cover portion Tunnel Entry	2+950	3+360	410	
		Tunnel	3+360	5+270	1910	Tunnel
		Cut& cover portion Tunnel Entry	5+270	5+650	380	
		Ramp Portion	5+650	5+900	250	

4.2.2 Phase2 : Jagannath Bhosale Road (Km. 0+000 to Km.5+800)

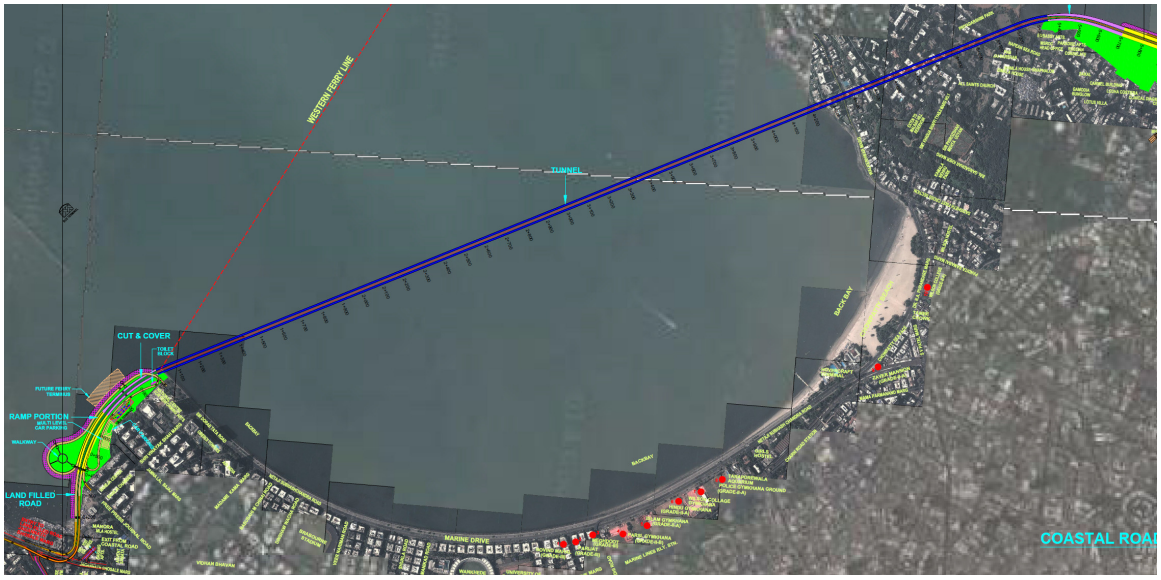


Figure 4-3 **Section 1-Phase2: Jagannath Bhosale Road to Priya Darshini Park**

The section is characterised by requirement of provision of tunnel for the length. The alignment makes provision for two straight under sea tunnels for south bound and north bound traffic separately as per project traffic requirement. This section is considered under Phase 2 of the project.

Table 4-2 **Section 1-Phase 2: Alignment Detail**

Section No.	Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
1	Jagannath Bhosale Road to Priyadarshini Park	Land Filled Road	0+000	0+410	410	
		Ramp Portion	0+410	0+700	290	
		Cut& cover	0+700	1+000	300	
		Tunnel	1+000	4+340	3340	Under sea Tunnel
		Cut& cover	4+340	5+700	1360	
		Ramp Portion	5+700	5+800	100	

4.3 Section 2: Priya Darshini Park to Mahalaxmi (Km. 5+900to Km. 7+520)

The section runs from Priyadarshini park to Mahalaxmi temple area and is characterized by land-fill road in inter-tidal zone.

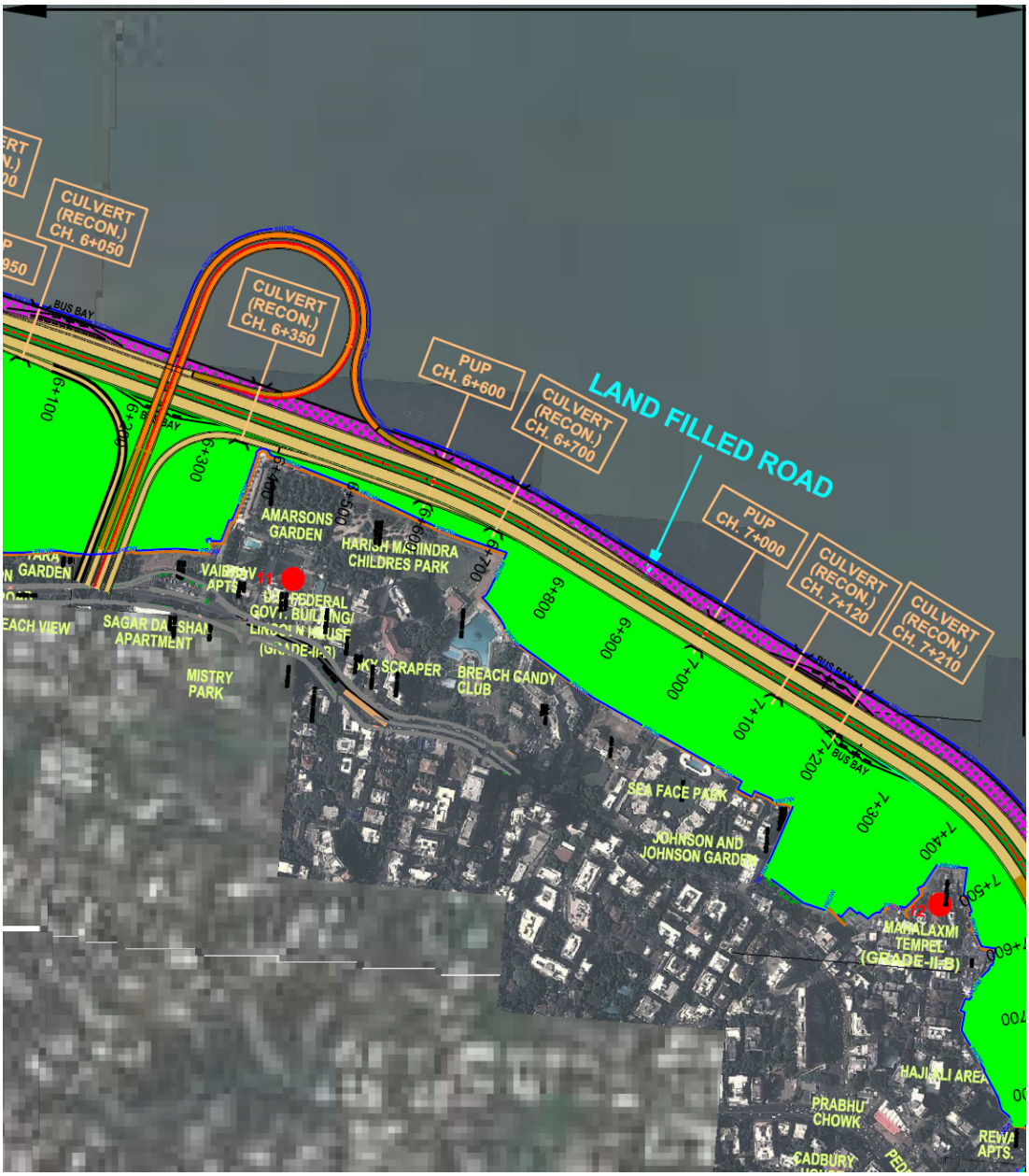


Figure 4-4 Section 2: Priya Darshini Park to Mahalaxmi

Table 4-3 Section 2 Alignment detail

Section No.	Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
2	**Priyadarshini Park to Mahalaxmi**	Land Filled Road	5+900	7+520	1620	

4.4 Section 3: Mahalaxmi to Markandershwar Temple (Km. 7+520 to km. 9+720)

Section -3 is characterised by presence of structures of religious importance i.e. Mahalaxmi temple and Haji Ali along with Baroda Palace. The religious centres attract huge crowd of devotees. Thus has high pedestrian circulation requirement.

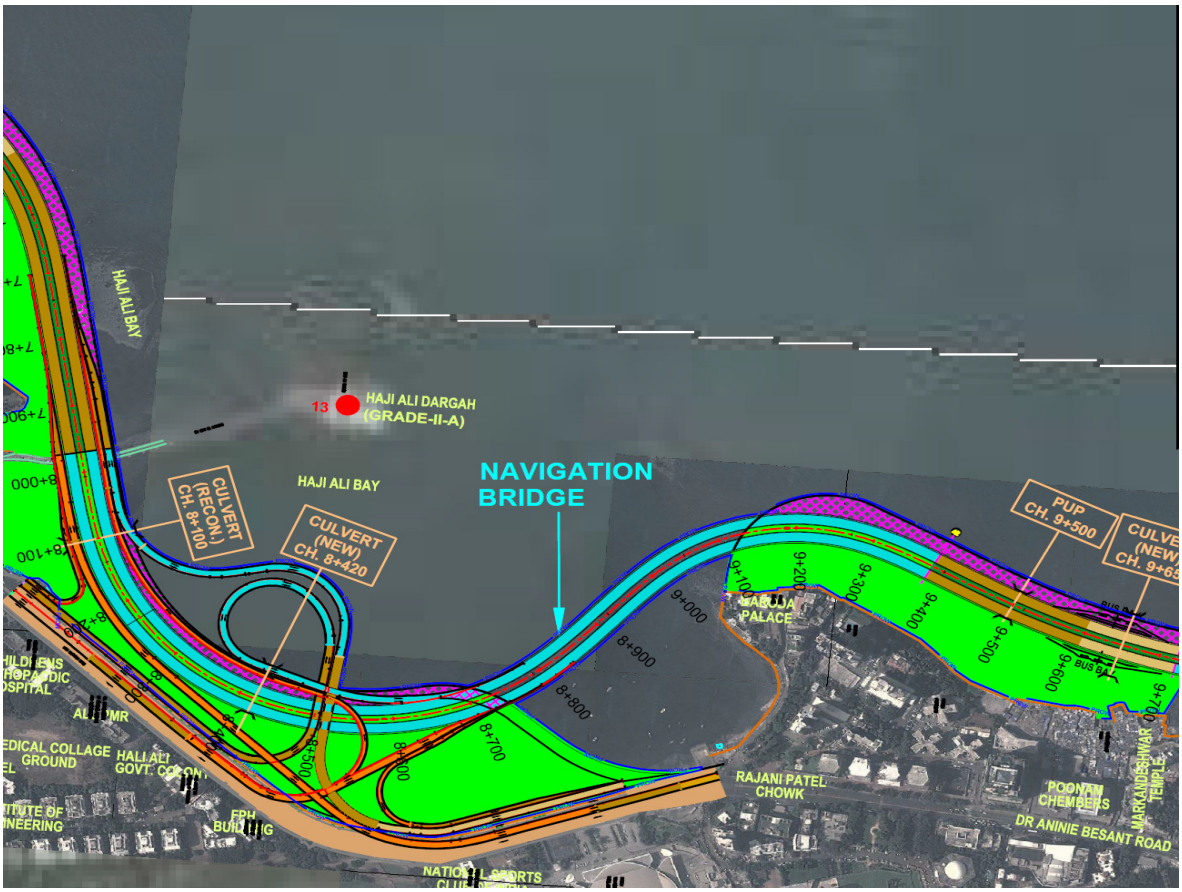


Figure 4-5 **Section 3 Mahalaxmi Temple to Markandershwar Temple**

Table 4-4 **Section 3 Alignment detail**

Section No.	Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
3	Mahalaxmi to Markandershwar Temple	RE Wall	7+520	7+970	450	
		Bridge on Sea	7+970	9+380	1410	Religious Structure View and Navigational Clearance
		RE Wall	9+380	9+600	220	
		Land Filled Road	9+600	9+720	120	

The Alignment provides for a continuous bridge inside sea abutting existing shore line. Although the Alignment does not impact on religious value of Haji Ali dargah.

4.5 Section 4 Markandershwar Temple to Worli End of Sea Link (Km. 9+720 to Km. 12+430)

Section 4 is characterised by proposal to reclaim on sea ward side of existing shore protection. The area is marked by open rock outcrop and construction of embankment over same is proposed for alignment.

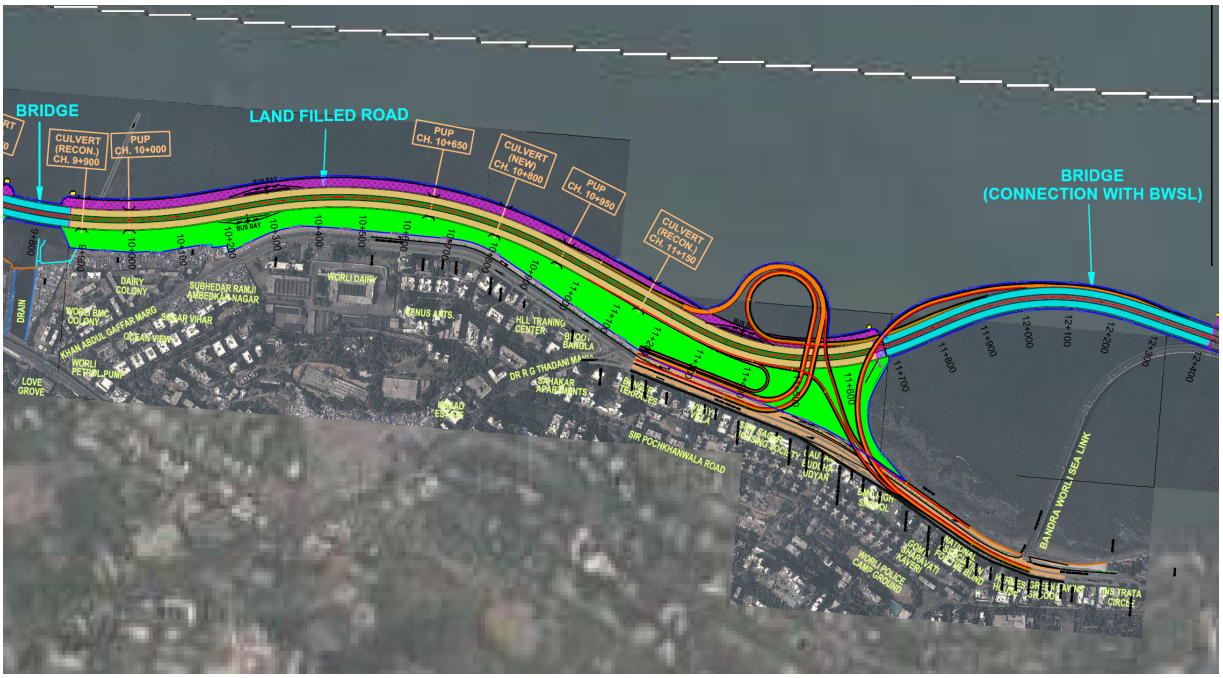


Figure 4-6 Section-4 Markandershwar Temple to Worli End of Sea Link

Table 4-5 **Section-4 Alignment detail**

Section No.	Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
	Markandershwar Temple to BWSL (Worli)	Bridge	9+720	9+870	150	Existing Nala
		Land Filled Road	9+870	11+680	1810	
		Bridge	11+680	12+430	750	BWSl Worli Merging

4.6 Section 5 Bandra End of Sea Link to start of Tunnel (km. 0+000 to km. 4+325)

The alignment hugs existing coastal line and runs from Bandra end of Sea Link till Khardanda Village. The area has several fishermen communities and dense mangrove forest (notified reserve forest) adjoining Otters club. It was decided to provide a bridge on sea ward side of Chimbai Village to allow navigational facility for the fishermen. Section 5 is characterised by proposed land filled road without obstructing mangroves free flow water.

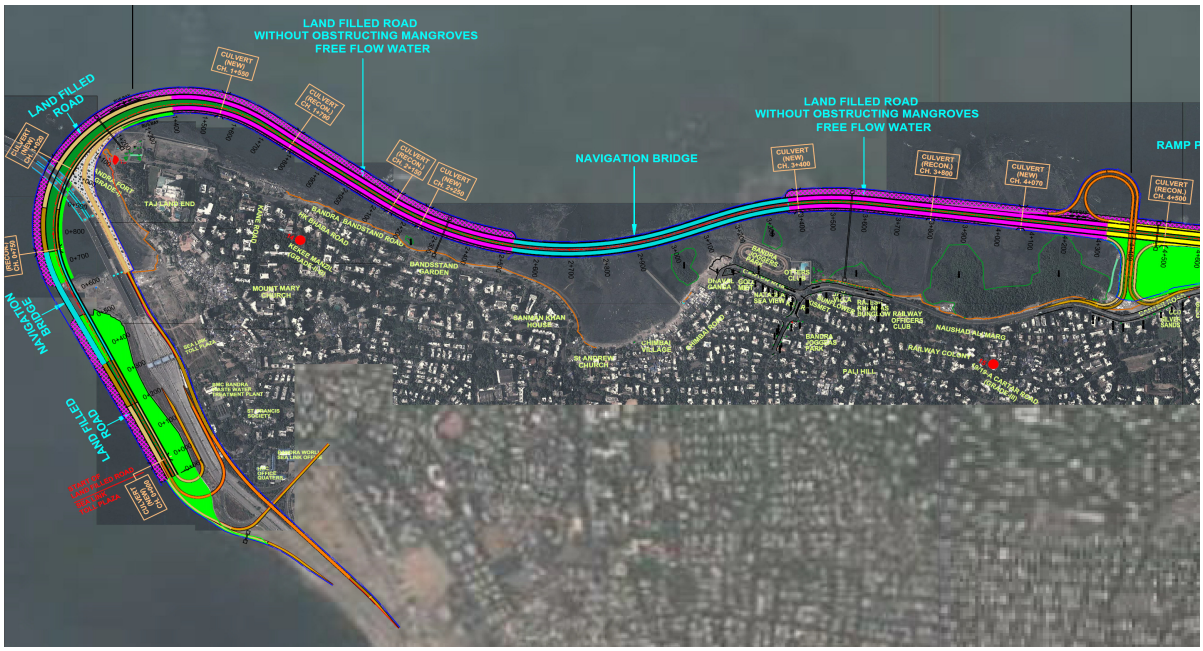


Figure 4-7 **Section 5 Bandra End of Sea Link to Start of Tunnel**

Table 4-6 **Section 5 Alignment detail**

Section No.	Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
5	BWSL(Bandra) to start of Tunnel (Carter Road Mandir)	Land Filled	0+000	0+120	120	
		RE Wall	0+120	0+355	235	
		Bridge	0+355	0+745	390	
		RE Wall	0+745	0+880	135	
		Land Filled Road	0+880	1+400	520	
		Land Filled Road with Arch opening	1+400	2+530	1130	Flow of sea water for Mangrove

		Bridge on Sea	2+530	3+370	840	
		Land Filled Road with Arch opening	3+370	4+325	955	

4.7 Section 6 Start of Tunnel (Carter Road Mandir to Bharat Nagar (End of Tunnel), (km. 4+325 to Km. 10+100)

The Alignment proposes four TBM tunnels with straight alignment with cut and cover portion limited to start and end of tunnel. TBM entry shafts shall be located near Ritumbara College by forming a temporary platform to +6m GTS level through reclamation. A shaft of 130m x 50m will be constructed to a depth of -13m GTS level for entry of TBM. Vertical faces shall be constructed and retained with touch piles. Necessary dewatering arrangements shall be made to tackle water seepage. Similarly exit shaft shall be constructed near tunnel end near Khar Danda Village.

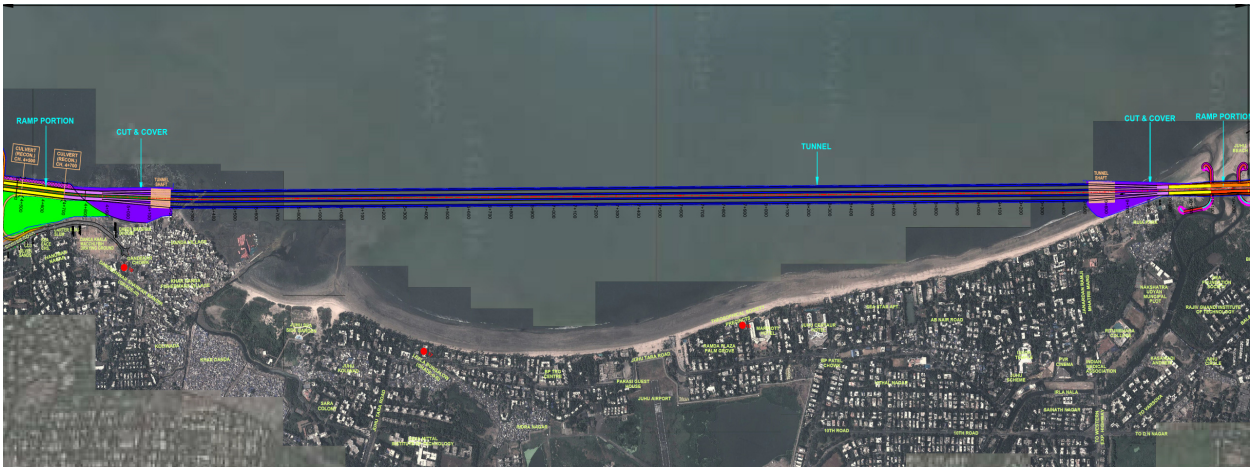


Figure 4-8 **Section 6 Start of Tunnel to Bharat Nagar**

Table 4-7 **Section 6 Alignment Detail**

Section No.	Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
6	Start of Tunnel to Bharat Nagar	Ramp Portion	4+325	4+700	375	
		Cut& cover Portion Tunnel Entry	4+700	5+240	540	
		Tunnel	5+240	9+360	4120	Due to Airport clearance and Juhu sea beach
		Cut& cover Portion Tunnel Entry	9+360	9+900	540	
		Ramp Portion	9+900	10+100	200	

4.8 Section 7 Bharat Nagar (End of Tunnel) to Kandivali Junction (Km. 10+100 to Km. 19+220)

The section of project road alignment traverses through Nana Nani Park, slum area of Andheri West followed by Mangrove Area up to Kandivali. In Alignment it is proposed to construct a double deck elevated corridor up to Institute of fisheries on existing road. This will affect very few structures erected on existing road land. However, minimum resettlement and rehabilitation will be necessary. The project road will then traverse through dense mangrove area on back of the Institute of Fisheries to include spur to Madh Island. Continuity of the double deck bridge over existing road will lead in to road on stilts in this dense mangrove area also crossing various perennial water bodies. Small sections of land fill over mangroves are proposed in this area for cost reduction.

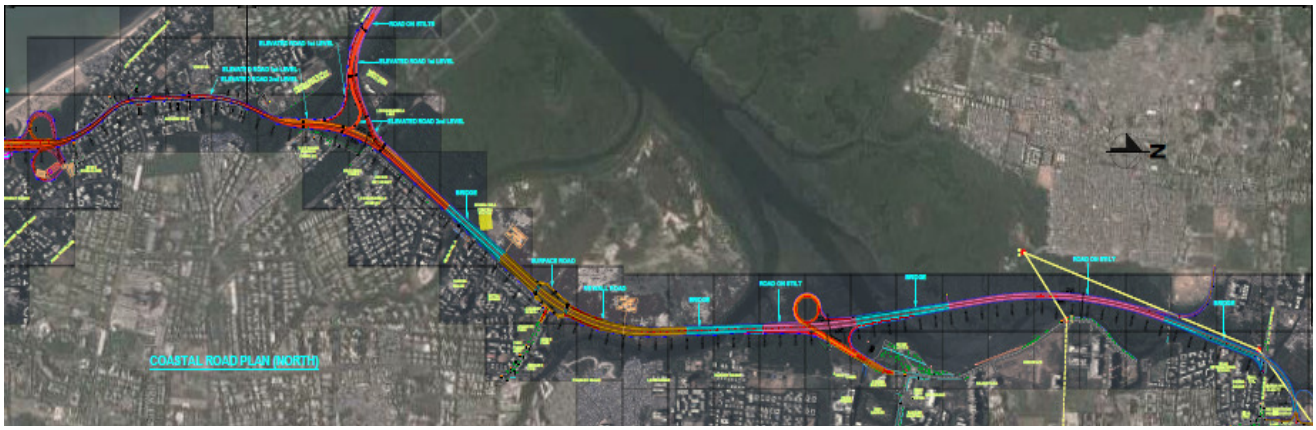


Figure 4-9 Section 7 Alignment Bharat Nagar to Kandivali Junction

Table 4-8 **Section 7 Alignment Detail**

Section No.	Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
7	Bharat Nagar (End of Tunnel) to Kandivali	Elevated Road	10+100	13+350	3250	
		Bridge on Creek	13+350	13+800	450	Creek Crossing
		RE Wall	13+800	14+076	276	Open Land
		Bridge (VUP)	14+076	14+106	30	Creek Crossing
		RE Wall	14+106	14+296	190	Mangrove Area
		Bridge (VUP)	14+296	14+326	30	Creek Crossing
		RE Wall	14+326	15+100	774	Mangrove Area
		Bridge on Creek	15+100	15+600	500	Malad marg Road Crossing
		Road on Stilts	15+600	16+200	600	

		Bridge on Creek	16+200	16+800	600	
		Road on Stilts	16+800	18+200	1400	
		Bridge on Creek	18+200	19+220	1020	

4.9 Mhad Island Connectivity (Institute of Fisheries Madh Interchange to Madh Island)

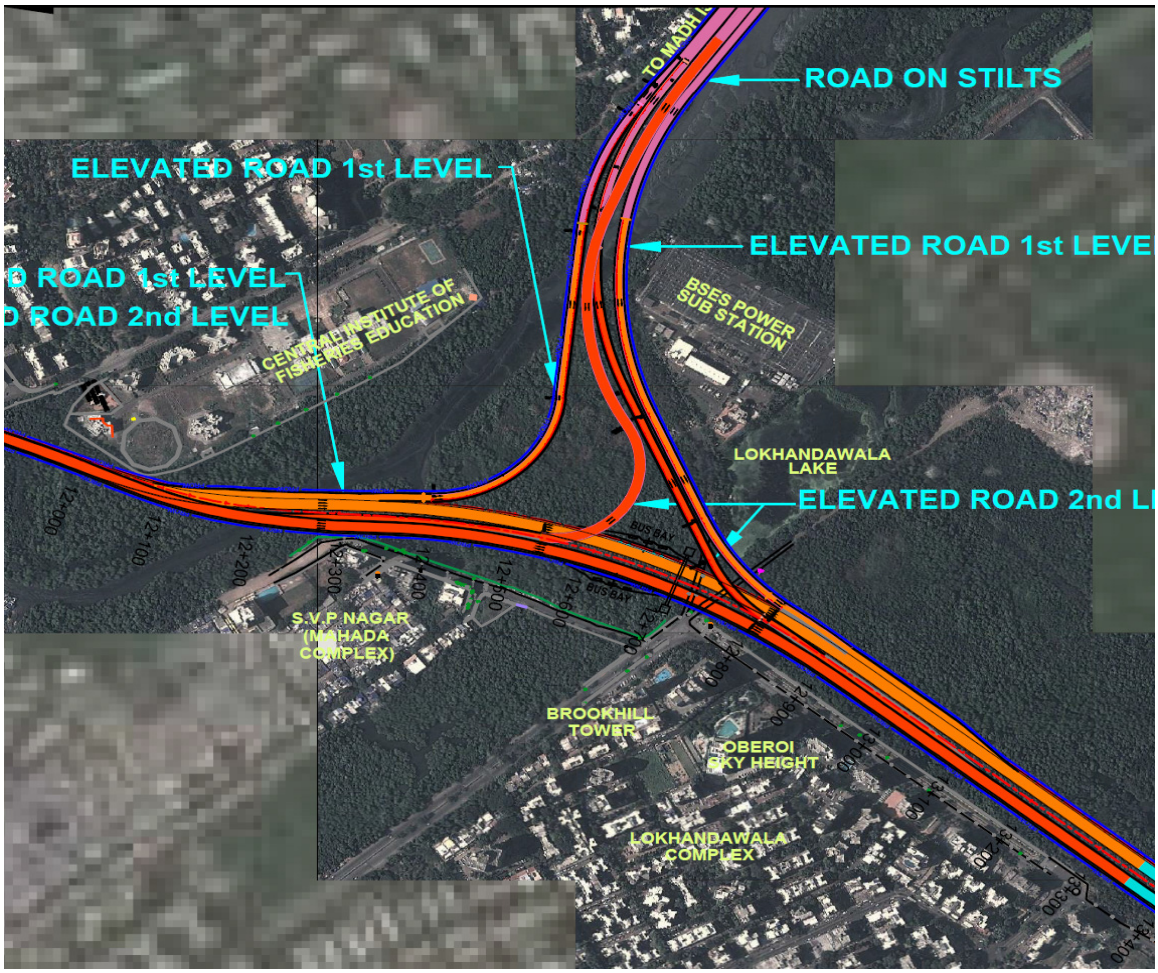


Figure 4-10 Mhad Island Connectivity

Table 4-9 **Mhad Island Connectivity Alignment detail**

Section	Type of Road / Structure	Start of Road	End of Road	Length of Alignment (m)	Remarks
Mudh Island Connectivity	Bridge	12+100	12+800	700	Connectivity to Madh Island

Typical Cross Section drawing gives in Drawing no. 8098/E/DD-401 to 8098/E/DD-416 Volume IV Drawings .

Plan and Profile of South Costal road Alignment gives in Drawing no. 8098/E/DD-503 to 8098/E/DD-513 Volume IV Drawings.

Plan and Profile of North Costal road Alignment gives in Drawing no. 8098/E/DD-551 to 8098/E/DD-570 Volume IV Drawings.

5. Horizontal and Vertical design detail of coastal Road Alignment.

5.1 Coastal Road South Alignment Design

5.1.1 Horizontal Alignment Report

Horizontal Alignment Report
Model: MAINLINE SOUTH 4
String: MC00
Units: Metric
Date : 4/10/2016 2:41:22 PM

********Element 1 Straight********

Bearing 327 30 27.890
Length 108.178
Begin on Straight Chainage 2+447.851
Straight End Chainage 2+556.029

********Element 2 Arc********

Intersection Point Chainage 2+628.587
Intersection Point X 270514.056
Intersection Point Y 2096439.962
Radius 1500.000
Arc Length 145.005
Hand of Arc Left
Included Angle 05 32 19.553
Arc Start Chainage 2+556.029
Arc End Chainage 2+701.033

********Element 3 Straight********

Bearing 321 58 08.337
Length 191.242
Straight Start Chainage 2+701.033
Straight End Chainage 2+892.275

********Element 4 Arc********

Intersection Point Chainage 3+253.284
Intersection Point X 270129.118
Intersection Point Y 2096932.111
Radius 1500.000
Arc Length 708.543

Hand of Arc Left
Included Angle 27 03 51.672
Arc Start Chainage 2+892.275
Arc End Chainage 3+600.818

********Element 5 Straight********

Bearing 294 54 16.665
Length 584.790
Straight Start Chainage 3+600.818
Straight End Chainage 4+185.608

********Element 6 Arc********

Intersection Point Chainage 4+319.644
Intersection Point X 269149.697
Intersection Point Y 2097386.839
Radius 2200.000
Arc Length 267.742
Hand of Arc Left
Included Angle 06 58 22.584
Arc Start Chainage 4+185.608
Arc End Chainage 4+453.350

********Element 7 Straight********

Bearing 287 55 54.081
Length 435.783
Straight Start Chainage 4+453.350
Straight End Chainage 4+889.132

********Transition********

Intersection Point Chainage 4+976.262
Transition Length 130.000
Transition Start Chainage 4+889.132
Transition End Chainage 5+019.132

********Element 8 Arc********

Intersection Point Chainage 5+290.454
Intersection Point X 268245.136
Intersection Point Y 2097733.082
Radius 400.000
Arc Length 476.813
Hand of Arc Right

Included Angle	68 17 54.180
Arc Start Chainage	5+019.132
Arc End Chainage	5+495.945

********Transition********

Intersection Point Chainage	5+539.388
Transition Length	130.000
Transition Start Chainage	5+495.945
Transition End Chainage	5+625.945

********Element 9 Straight********

Bearing	14 51 04.324
Length	905.042
Straight Start Chainage	5+625.945
Straight End Chainage	6+530.987

********Transition********

Intersection Point Chainage	6+570.995
Transition Length	60.000
Transition Start Chainage	6+530.987
Transition End Chainage	6+590.987

********Element 10 Arc********

Intersection Point Chainage	6+662.922
Intersection Point X	268566.214
Intersection Point Y	2099131.856
Radius	1000.000
Arc Length	143.622
Hand of Arc	Right
Included Angle	08 13 44.164
Arc Start Chainage	6+590.987
Arc End Chainage	6+734.609

********Transition********

Intersection Point Chainage	6+754.611
Transition Length	60.000
Transition Start Chainage	6+734.609
Transition End Chainage	6+794.609

********Element 11 Straight********

Bearing 26 31 04.376
Length 466.516
Straight Start Chainage 6+794.609
Straight End Chainage 7+261.126

********Transition********

Intersection Point Chainage 7+348.255
Transition Length 130.000
Transition Start Chainage 7+261.126
Transition End Chainage 7+391.126

********Element 12 Arc********

Intersection Point Chainage 7+503.905
Intersection Point X 268961.119
Intersection Point Y 2099872.862
Radius 400.000
Arc Length 219.852
Hand of Arc Right
Included Angle 31 29 29.500
Arc Start Chainage 7+391.126
Arc End Chainage 7+610.978

********Transition********

Intersection Point Chainage 7+654.420
Transition Length 130.000
Transition Start Chainage 7+610.978
Transition End Chainage 7+740.978

********Element 13 Straight********

Bearing 76 37 49.938
Length 265.934
Straight Start Chainage 7+740.978
Straight End Chainage 8+006.911

********Transition********

Intersection Point Chainage 8+094.183
Transition Length 130.000
Transition Start Chainage 8+006.911
Transition End Chainage 8+136.911

********Element 14 Arc********

Intersection Point Chainage	8+609.903
Intersection Point X	270004.673
Intersection Point Y	2100244.884
Radius	350.000
Arc Length	653.621
Hand of Arc	Left
Included Angle	106 59 57.377
Arc Start Chainage	8+136.911
Arc End Chainage	8+790.533

********Transition********

Intersection Point Chainage	8+877.804
Transition Length	130.000
Transition Start Chainage	8+790.533
Trans-Trans Chainage	8+920.533

********Transition********

Intersection Point Chainage	9+008.295
Transition Length	130.000
Trans-Trans Chainage	8+920.533
Transition End Chainage	9+050.533

********Element 15 Arc********

Intersection Point Chainage	9+167.731
Intersection Point X	269431.999
Intersection Point Y	2100870.294
Radius	260.000
Arc Length	220.214
Hand of Arc	Right
Included Angle	48 31 41.257
Arc Start Chainage	9+050.533
Arc End Chainage	9+270.746

********Transition********

Intersection Point Chainage	9+358.509
Transition Length	130.000
Transition Start Chainage	9+270.746
Trans-Trans Chainage	9+400.746

********Transition********

Intersection Point Chainage 9+477.464
Transition Length 115.000
Trans-Trans Chainage 9+400.746
Transition End Chainage 9+515.746

********Element 16 Arc********

Intersection Point Chainage 9+818.096
Intersection Point X 269662.650
Intersection Point Y 2101491.050
Radius 1000.000
Arc Length 587.222
Hand of Arc Left
Included Angle 33 38 43.212
Arc Start Chainage 9+515.746
Arc End Chainage 10+102.968

********Transition********

Intersection Point Chainage 10+179.686
Transition Length 115.000
Transition Start Chainage 10+102.968
Trans-Trans Chainage 10+217.968

********Transition********

Intersection Point Chainage 10+294.686
Transition Length 115.000
Trans-Trans Chainage 10+217.968
Transition End Chainage 10+332.968

********Element 17 Arc********

Intersection Point Chainage 10+623.739
Intersection Point X 269491.160
Intersection Point Y 2102295.949
Radius 1000.000
Arc Length 565.935
Hand of Arc Right
Included Angle 32 25 32.571
Arc Start Chainage 10+332.968
Arc End Chainage 10+898.904

********Transition********

Intersection Point Chainage 10+937.249

Transition Length 115.000
Transition Start Chainage 10+898.904
Transition End Chainage 11+013.904

********Element 18 Straight********

Bearing 24 18 22.938
Length 201.204
Straight Start Chainage 11+013.904
Straight End Chainage 11+215.108

********Transition********

Intersection Point Chainage 11+302.071
Transition Length 130.000
Transition Start Chainage 11+215.108
Transition End Chainage 11+345.108

********Element 19 Arc********

Intersection Point Chainage 11+514.511
Intersection Point X 269820.968
Intersection Point Y 2103139.147
Radius 500.000
Arc Length 326.668
Hand of Arc Left
Included Angle 37 26 00.145
Arc Start Chainage 11+345.108
Arc End Chainage 11+671.776

********Transition********

Intersection Point Chainage 11+758.739
Transition Length 130.000
Transition Start Chainage 11+671.776
Trans-Trans Chainage 11+801.776

********Transition********

Intersection Point Chainage 11+888.739
Transition Length 130.000
Trans-Trans Chainage 11+801.776
Transition End Chainage 11+931.776

********Element 20 Arc********

Intersection Point Chainage 12+054.814
Intersection Point X 269606.174
Intersection Point Y 2103647.349
Radius 500.000
Arc Length 241.284
Hand of Arc Right
Included Angle 27 38 56.591
Arc Start Chainage 11+931.776
Arc End Chainage 12+173.059

********Transition********

Intersection Point Chainage 12+216.462
Transition Length 130.000
Transition Start Chainage 12+173.059
Transition End Chainage 12+303.059

********Element 21 Straight********

Bearing 14 31 19.384
Length 225.941
Straight Start Chainage 12+303.059
Finish on Straight Chainage 12+529.000

5.1.2 Vertical Alignment Report

Vertical Alignment Report
Model: MAINLINE SOUTH 4
String: MC00
Units: Metric
Date : 4/10/2016 2:45:21 PM

********Element 1 Grade********

Gradient Length 225.926
Gradient .071
Begin on Gradient Chainage 2+447.851
Gradient End Chainage 2+673.777
Begin on Gradient Level 4.000
Gradient End Level 4.160

********Element 2 Vertical Curve********

IP Chainage 2+845.909
Curve Length 344.263
Vertical Radius -9900.993

Curve Start Gradient	.071
Curve End Gradient	-3.406
K Value	99.010
Curve Type	Hog
Sight Distance	200.062
Curve Start Chainage	2+673.777
Curve End Chainage	3+018.041
Curve Start Level	4.160
Curve End Level	-1.582

********Element 3 Grade********

Gradient Length	340.927
Gradient	-3.406
Gradient Start Chainage	3+018.041
Gradient End Chainage	3+358.967
Grade Start Level	-1.582
Gradient End Level	-13.196

********Element 4 Vertical Curve********

IP Chainage	3+500.000
Curve Length	282.066
Vertical Radius	9704.892
Curve Start Gradient	-3.406
Curve End Gradient	-.500
K Value	97.049
Curve Type	Sag
Curve Start Chainage	3+358.967
Curve End Chainage	3+641.033
Curve Start Level	-13.196
Curve End Level	-18.705

********Element 5 Grade********

Gradient Length	418.967
Gradient	-.500
Gradient Start Chainage	3+641.033
Gradient End Chainage	4+060.000
Grade Start Level	-18.705
Gradient End Level	-20.800

********Element 6 Vertical Curve********

IP Chainage	4+310.000
Curve Length	500.000

Vertical Radius	45141.479
Curve Start Gradient	-.500
Curve End Gradient	.608
K Value	451.415
Curve Type	Sag
Curve Start Chainage	4+060.000
Curve End Chainage	4+560.000
Curve Start Level	-20.800
Curve End Level	-20.531

********Element 7 Grade********

Gradient Length	555.089
Gradient	.608
Gradient Start Chainage	4+560.000
Gradient End Chainage	5+115.089
Grade Start Level	-20.531
Gradient End Level	-17.158

********Element 8 Vertical Curve********

IP Chainage	5+254.741
Curve Length	279.304
Vertical Radius	8753.514
Curve Start Gradient	.608
Curve End Gradient	3.798
K Value	87.535
Curve Type	Sag
Curve Start Chainage	5+115.089
Curve End Chainage	5+394.393
Curve Start Level	-17.158
Curve End Level	-11.005

********Element 9 Grade********

Gradient Length	264.165
Gradient	3.798
Gradient Start Chainage	5+394.393
Gradient End Chainage	5+658.558
Grade Start Level	-11.005
Gradient End Level	-.971

********Element 10 Vertical Curve********

IP Chainage	5+900.000
Curve Length	482.884

Vertical Radius	-11234.050
Curve Start Gradient	3.798
Curve End Gradient	-.500
K Value	112.340
Curve Type	Hog
Sight Distance	213.105
Curve Start Chainage	5+658.558
Curve End Chainage	6+141.442
Curve Start Level	-.971
Curve End Level	6.993

********Element 11 Grade********

Gradient Length	183.133
Gradient	-.500
Gradient Start Chainage	6+141.442
Gradient End Chainage	6+324.575
Grade Start Level	6.993
Gradient End Level	6.077

********Element 12 Vertical Curve********

IP Chainage	6+400.000
Curve Length	150.851
Vertical Radius	15000.004
Curve Start Gradient	-.500
Curve End Gradient	.506
K Value	150.000
Curve Type	Sag
Curve Start Chainage	6+324.575
Curve End Chainage	6+475.425
Curve Start Level	6.077
Curve End Level	6.081

********Element 13 Grade********

Gradient Length	235.623
Gradient	.506
Gradient Start Chainage	6+475.425
Gradient End Chainage	6+711.048
Grade Start Level	6.081
Gradient End Level	7.273

********Element 14 Vertical Curve********

IP Chainage	6+874.616

Curve Length	327.135
Vertical Radius	-32478.113
Curve Start Gradient	.506
Curve End Gradient	-.502
K Value	324.781
Curve Type	Hog
Sight Distance	364.238
Curve Start Chainage	6+711.048
Curve End Chainage	7+038.184
Curve Start Level	7.273
Curve End Level	7.280

********Element 15 Grade********

Gradient Length	104.607
Gradient	-.502
Gradient Start Chainage	7+038.184
Gradient End Chainage	7+142.790
Grade Start Level	7.280
Gradient End Level	6.755

********Element 16 Vertical Curve********

IP Chainage	7+333.170
Curve Length	380.760
Vertical Radius	35698.798
Curve Start Gradient	-.502
Curve End Gradient	.565
K Value	356.988
Curve Type	Sag
Curve Start Chainage	7+142.790
Curve End Chainage	7+523.550
Curve Start Level	6.755
Curve End Level	6.876

********Element 17 Grade********

Gradient Length	480.016
Gradient	.565
Gradient Start Chainage	7+523.550
Gradient End Chainage	8+003.565
Grade Start Level	6.876
Gradient End Level	9.588

********Element 18 Vertical Curve********

IP Chainage	8+076.516
Curve Length	145.902
Vertical Radius	22507.137
Curve Start Gradient	.565
Curve End Gradient	1.213
K Value	225.071
Curve Type	Sag
Curve Start Chainage	8+003.565
Curve End Chainage	8+149.467
Curve Start Level	9.588
Curve End Level	10.885

********Element 19 Grade********

Gradient Length	460.219
Gradient	1.213
Gradient Start Chainage	8+149.467
Gradient End Chainage	8+609.686
Grade Start Level	10.885
Gradient End Level	16.469

********Element 20 Vertical Curve********

IP Chainage	8+694.686
Curve Length	170.000
Vertical Radius	-14011.849
Curve Start Gradient	1.213
Curve End Gradient	.000
K Value	140.118
Curve Type	Hog
Sight Distance	251.597
Curve Start Chainage	8+609.686
Curve End Chainage	8+779.686
Curve Start Level	16.469
Curve End Level	17.500

********Element 21 Grade********

Gradient Length	270.314
Gradient	.000
Gradient Start Chainage	8+779.686
Gradient End Chainage	9+050.000
Grade Start Level	17.500
Gradient End Level	17.500

********Element 22 Vertical Curve********

IP Chainage	9+225.000
Curve Length	350.000
Vertical Radius	-14000.000
Curve Start Gradient	.000
Curve End Gradient	-2.500
K Value	140.000
Curve Type	Hog
Sight Distance	237.897
Curve Start Chainage	9+050.000
Curve End Chainage	9+400.000
Curve Start Level	17.500
Curve End Level	13.125

********Element 23 Grade********

Gradient Length	150.000
Gradient	-2.500
Gradient Start Chainage	9+400.000
Gradient End Chainage	9+550.000
Grade Start Level	13.125
Gradient End Level	9.375

********Element 24 Vertical Curve********

IP Chainage	9+625.000
Curve Length	150.000
Vertical Radius	6000.000
Curve Start Gradient	-2.500
Curve End Gradient	.000
K Value	60.000
Curve Type	Sag
Curve Start Chainage	9+550.000
Curve End Chainage	9+700.000
Curve Start Level	9.375
Curve End Level	7.500

********Element 25 Grade********

Gradient Length	183.836
Gradient	.000
Gradient Start Chainage	9+700.000
Gradient End Chainage	9+883.836
Grade Start Level	7.500
Gradient End Level	7.500

********Element 26 Vertical Curve********

IP Chainage	9+923.836
Curve Length	80.000
Vertical Radius	-16000.004
Curve Start Gradient	.000
Curve End Gradient	-.500
K Value	160.000
Curve Type	Hog
Sight Distance	444.250
Curve Start Chainage	9+883.836
Curve End Chainage	9+963.836
Curve Start Level	7.500
Curve End Level	7.300

********Element 27 Grade********

Gradient Length	218.796
Gradient	-.500
Gradient Start Chainage	9+963.836
Gradient End Chainage	10+182.632
Grade Start Level	7.300
Gradient End Level	6.206

********Element 28 Vertical Curve********

IP Chainage	10+257.632
Curve Length	150.000
Vertical Radius	15000.005
Curve Start Gradient	-.500
Curve End Gradient	.500
K Value	150.000
Curve Type	Sag
Curve Start Chainage	10+182.632
Curve End Chainage	10+332.632
Curve Start Level	6.206
Curve End Level	6.206

********Element 29 Grade********

Gradient Length	179.895
Gradient	.500
Gradient Start Chainage	10+332.632
Gradient End Chainage	10+512.528
Grade Start Level	6.206
Gradient End Level	7.105

********Element 30 Vertical Curve********

IP Chainage	10+587.528
Curve Length	150.000
Vertical Radius	-15000.005
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	150.000
Curve Type	Hog
Sight Distance	277.125
Curve Start Chainage	10+512.528
Curve End Chainage	10+662.528
Curve Start Level	7.105
Curve End Level	7.105

********Element 31 Grade********

Gradient Length	181.230
Gradient	-.500
Gradient Start Chainage	10+662.528
Gradient End Chainage	10+843.757
Grade Start Level	7.105
Gradient End Level	6.199

********Element 32 Vertical Curve********

IP Chainage	10+918.757
Curve Length	150.000
Vertical Radius	15000.002
Curve Start Gradient	-.500
Curve End Gradient	.500
K Value	150.000
Curve Type	Sag
Curve Start Chainage	10+843.757
Curve End Chainage	10+993.757
Curve Start Level	6.199
Curve End Level	6.199

********Element 33 Grade********

Gradient Length	184.449
Gradient	.500
Gradient Start Chainage	10+993.757
Gradient End Chainage	11+178.207
Grade Start Level	6.199

Gradient End Level	7.122

********Element 34 Vertical Curve********

IP Chainage	11+253.207
Curve Length	150.000
Vertical Radius	-15000.001
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	150.000
Curve Type	Hog
Sight Distance	277.125
Curve Start Chainage	11+178.207
Curve End Chainage	11+328.207
Curve Start Level	7.122
Curve End Level	7.122

********Element 35 Grade********

Gradient Length	84.629
Gradient	-.500
Gradient Start Chainage	11+328.207
Gradient End Chainage	11+412.836
Grade Start Level	7.122
Gradient End Level	6.698

********Element 36 Vertical Curve********

IP Chainage	11+487.836
Curve Length	150.000
Vertical Radius	10326.120
Curve Start Gradient	-.500
Curve End Gradient	.953
K Value	103.261
Curve Type	Sag
Curve Start Chainage	11+412.836
Curve End Chainage	11+562.836
Curve Start Level	6.698
Curve End Level	7.038

********Element 37 Grade********

Gradient Length	735.406
Gradient	.953
Gradient Start Chainage	11+562.836
Gradient End Chainage	12+298.241

Grade Start Level	7.038
Gradient End Level	14.044

********Element 38 Vertical Curve********

IP Chainage	12+348.778
Curve Length	101.074
Vertical Radius	-23761.159
Curve Start Gradient	.953
Curve End Gradient	.527
K Value	237.612
Curve Type	Hog
Sight Distance	525.707
Curve Start Chainage	12+298.241
Curve End Chainage	12+399.315
Curve Start Level	14.044
Curve End Level	14.791

********Element 39 Grade********

Gradient Length	129.685
Gradient	.527
Gradient Start Chainage	12+399.315
End on Gradient Chainage	12+529.000
Grade Start Level	14.791
Gradient End Level	15.475

5.2 Coastal Road North Alignment Design

5.2.1 Horizontal Alignment Report

Horizontal Alignment Report
Model: MAINLINE NORTH 7
String: MC20
Units: Metric
Date : 4/10/2016 2:48:26 PM

********Element 1 Straight********

Bearing	242 42 41.789
Length	623.405
Begin on Straight Chainage	-0+060.693
Straight End Chainage	0+562.712

********Transition********

Intersection Point Chainage 0+649.841
Transition Length 130.000
Transition Start Chainage 0+562.712
Transition End Chainage 0+692.712

********Element 2 Arc********

Intersection Point Chainage 1+595.097
Intersection Point X 269896.070
Intersection Point Y 2106465.390
Radius 400.000
Arc Length 922.843
Hand of Arc Right
Included Angle 132 11 14.928
Arc Start Chainage 0+692.712
Arc End Chainage 1+615.554

********Transition********

Intersection Point Chainage 1+658.997
Transition Length 130.000
Transition Start Chainage 1+615.554
Transition End Chainage 1+745.554

********Element 3 Straight********

Bearing 33 31 12.780
Length 307.439
Straight Start Chainage 1+745.554
Straight End Chainage 2+052.994

********Transition********

Intersection Point Chainage 2+129.712
Transition Length 115.000
Transition Start Chainage 2+052.994
Transition End Chainage 2+167.994

********Element 4 Arc********

Intersection Point Chainage 2+584.041
Intersection Point X 270772.725
Intersection Point Y 2108113.241
Radius 1000.000
Arc Length 788.526
Hand of Arc Left

Included Angle	45 10 45.199
Arc Start Chainage	2+167.994
Arc End Chainage	2+956.520

********Transition********

Intersection Point Chainage	3+056.634
Transition Length	150.000
Transition Start Chainage	2+956.520
Trans-Trans Chainage	3+106.520

********Transition********

Intersection Point Chainage	3+183.238
Transition Length	115.000
Trans-Trans Chainage	3+106.520
Transition End Chainage	3+221.520

********Element 5 Arc********

Intersection Point Chainage	3+391.545
Intersection Point X	270536.919
Intersection Point Y	2108930.703
Radius	1000.000
Arc Length	336.829
Hand of Arc	Right
Included Angle	19 17 55.961
Arc Start Chainage	3+221.520
Arc End Chainage	3+558.349

********Transition********

Intersection Point Chainage	3+596.694
Transition Length	115.000
Transition Start Chainage	3+558.349
Transition End Chainage	3+673.349

********Element 6 Straight********

Bearing	06 38 13.908
Length	985.515
Straight Start Chainage	3+673.349
Straight End Chainage	4+658.864

********Element 7 Arc********

Intersection Point Chainage 4+758.326
Intersection Point X 270683.335
Intersection Point Y 2110292.591
Radius 2500.000
Arc Length 198.821
Hand of Arc Left
Included Angle 04 33 23.873
Arc Start Chainage 4+658.864
Arc End Chainage 4+857.684

********Element 8 Straight********

Bearing 02 04 50.035
Length 358.597
Straight Start Chainage 4+857.684
Straight End Chainage 5+216.281

********Element 9 Arc********

Intersection Point Chainage 5+270.352
Intersection Point X 270701.928
Intersection Point Y 2110804.383
Radius 2500.000
Arc Length 108.124
Hand of Arc Left
Included Angle 02 28 40.890
Arc Start Chainage 5+216.281
Arc End Chainage 5+324.406

********Element 10 Straight********

Bearing 359 36 09.145
Length 4026.995
Straight Start Chainage 5+324.406
Straight End Chainage 9+351.401

********Element 11 Arc********

Intersection Point Chainage 9+500.659
Intersection Point X 270672.582
Intersection Point Y 2115034.606
Radius 15000.000
Arc Length 298.507
Hand of Arc Left
Included Angle 01 08 24.765
Arc Start Chainage 9+351.401

Arc End Chainage 9+649.908

********Element 12 Straight********

Bearing 358 27 44.380
Length 774.441
Straight Start Chainage 9+649.908
Straight End Chainage 10+424.349

********Transition********

Intersection Point Chainage 10+511.191
Transition Length 130.000
Transition Start Chainage 10+424.349
Transition End Chainage 10+554.349

********Element 13 Arc********

Intersection Point Chainage 10+690.886
Intersection Point X 270622.710
Intersection Point Y 2116223.120
Radius 650.000
Arc Length 269.160
Hand of Arc Left
Included Angle 23 43 32.796
Arc Start Chainage 10+554.349
Arc End Chainage 10+823.509

********Transition********

Intersection Point Chainage 10+910.351
Transition Length 130.000
Transition Start Chainage 10+823.509
Trans-Trans Chainage 10+953.509

********Transition********

Intersection Point Chainage 11+041.272
Transition Length 130.000
Trans-Trans Chainage 10+953.509
Transition End Chainage 11+083.509

********Element 14 Arc********

Intersection Point Chainage 11+096.520
Intersection Point X 270404.658

Intersection Point Y	2116568.877
Radius	260.000
Arc Length	26.000
Hand of Arc	Right
Included Angle	05 43 46.554
Arc Start Chainage	11+083.509
Arc End Chainage	11+109.509

********Transition********

Intersection Point Chainage	11+153.102
Transition Length	130.000
Transition Start Chainage	11+109.509
Transition End Chainage	11+239.509

********Element 15 Straight********

Bearing	357 39 17.580
Length	272.269
Straight Start Chainage	11+239.509
Straight End Chainage	11+511.778

********Transition********

Intersection Point Chainage	11+598.561
Transition Length	130.000
Transition Start Chainage	11+511.778
Transition End Chainage	11+641.778

********Element 16 Arc********

Intersection Point Chainage	11+757.619
Intersection Point X	270376.593
Intersection Point Y	2117227.719
Radius	800.000
Arc Length	230.082
Hand of Arc	Right
Included Angle	16 28 42.224
Arc Start Chainage	11+641.778
Arc End Chainage	11+871.860

********Transition********

Intersection Point Chainage	11+958.643
Transition Length	130.000
Transition Start Chainage	11+871.860

Trans-Trans Chainage 12+001.860

********Transition********

Intersection Point Chainage 12+088.823
Transition Length 130.000
Trans-Trans Chainage 12+001.860
Transition End Chainage 12+131.860

********Element 17 Arc********

Intersection Point Chainage 12+153.093
Intersection Point X 270514.682
Intersection Point Y 2117599.693
Radius 500.000
Arc Length 42.441
Hand of Arc Left
Included Angle 04 51 48.188
Arc Start Chainage 12+131.860
Arc End Chainage 12+174.301

********Transition********

Intersection Point Chainage 12+261.264
Transition Length 130.000
Transition Start Chainage 12+174.301
Trans-Trans Chainage 12+304.301

********Transition********

Intersection Point Chainage 12+391.059
Transition Length 130.000
Trans-Trans Chainage 12+304.301
Transition End Chainage 12+434.301

********Element 18 Arc********

Intersection Point Chainage 12+648.345
Intersection Point X 270573.333
Intersection Point Y 2118091.193
Radius 900.000
Arc Length 420.280
Hand of Arc Right
Included Angle 26 45 21.010
Arc Start Chainage 12+434.301
Arc End Chainage 12+854.581

********Transition********

Intersection Point Chainage	12+897.936
Transition Length	130.000
Transition Start Chainage	12+854.581
Transition End Chainage	12+984.581

********Element 19 Straight********

Bearing	38 42 55.612
Length	1024.418
Straight Start Chainage	12+984.581
Straight End Chainage	14+008.999

********Transition********

Intersection Point Chainage	14+072.352
Transition Length	95.000
Transition Start Chainage	14+008.999
Transition End Chainage	14+103.999

********Element 20 Arc********

Intersection Point Chainage	14+491.297
Intersection Point X	271702.877
Intersection Point Y	2119556.521
Radius	1200.000
Arc Length	749.266
Hand of Arc	Left
Included Angle	35 46 29.358
Arc Start Chainage	14+103.999
Arc End Chainage	14+853.265

********Transition********

Intersection Point Chainage	14+884.937
Transition Length	95.000
Transition Start Chainage	14+853.265
Transition End Chainage	14+948.265

********Element 21 Straight********

Bearing	358 24 16.957
Length	888.970
Straight Start Chainage	14+948.265

Straight End Chainage 15+837.235

********Element 22 Arc********

Intersection Point Chainage 16+012.969
Intersection Point X 271676.392
Intersection Point Y 2121103.066
Radius 3000.000
Arc Length 351.067
Hand of Arc Left
Included Angle 06 42 17.569
Arc Start Chainage 15+837.235
Arc End Chainage 16+188.302

********Element 23 Straight********

Bearing 351 41 59.388
Length 848.980
Straight Start Chainage 16+188.302
Straight End Chainage 17+037.281

********Element 24 Arc********

Intersection Point Chainage 17+645.678
Intersection Point X 271440.637
Intersection Point Y 2122719.071
Radius 2500.000
Arc Length 1193.592
Hand of Arc Right
Included Angle 27 21 18.415
Arc Start Chainage 17+037.281
Arc End Chainage 18+230.874

********Element 25 Straight********

Bearing 19 03 17.804
Length 548.753
Straight Start Chainage 18+230.874
Straight End Chainage 18+779.627

********Transition********

Intersection Point Chainage 18+866.865
Transition Length 130.000
Transition Start Chainage 18+779.627
Transition End Chainage 18+909.627

********Element 26 Arc********

Intersection Point Chainage 19+061.599
Intersection Point X 271942.703
Intersection Point Y 2124065.145
Radius 360.000
Arc Length 287.604
Hand of Arc Right
Included Angle 45 46 25.154
Arc Start Chainage 18+909.627
Arc End Chainage 19+197.231

********Transition********

Intersection Point Chainage 19+240.699
Transition Length 130.000
Transition Start Chainage 19+197.231
Transition End Chainage 19+327.231

********Element 27 Straight********

Bearing 85 31 07.472
Length 5.973
Straight Start Chainage 19+327.231
Finish on Straight Chainage 19+333.204

5.2.2 Vertical Alignment Report

Vertical Alignment Report
Model: MAINLINE NORTH 7
String: MC20
Units: Metric
Date : 4/10/2016 2:49:09 PM

********Element 1 Grade********

Gradient Length 184.859
Gradient .518
Begin on Gradient Chainage -0+060.693
Gradient End Chainage 0+124.166
Begin on Gradient Level 6.650
Gradient End Level 7.607

********Element 2 Vertical Curve********

IP Chainage	0+200.000
Curve Length	151.667
Vertical Radius	9333.333
Curve Start Gradient	.518
Curve End Gradient	2.143
K Value	93.333
Curve Type	Sag
Curve Start Chainage	0+124.166
Curve End Chainage	0+275.834
Curve Start Level	7.607
Curve End Level	9.625

********Element 3 Grade********

Gradient Length	117.256
Gradient	2.143
Gradient Start Chainage	0+275.834
Gradient End Chainage	0+393.090
Grade Start Level	9.625
Gradient End Level	12.138

********Element 4 Vertical Curve********

IP Chainage	0+550.000
Curve Length	313.820
Vertical Radius	-7143.878
Curve Start Gradient	2.143
Curve End Gradient	-2.250
K Value	71.439
Curve Type	Hog
Sight Distance	169.939
Curve Start Chainage	0+393.090
Curve End Chainage	0+706.910
Curve Start Level	12.138
Curve End Level	11.970

********Element 5 Grade********

Gradient Length	128.090
Gradient	-2.250
Gradient Start Chainage	0+706.910
Gradient End Chainage	0+835.000
Grade Start Level	11.970
Gradient End Level	9.087

********Element 6 Vertical Curve********

IP Chainage	0+950.000
Curve Length	230.000
Vertical Radius	8363.636
Curve Start Gradient	-2.250
Curve End Gradient	.500
K Value	83.636
Curve Type	Sag
Curve Start Chainage	0+835.000
Curve End Chainage	1+065.000
Curve Start Level	9.087
Curve End Level	7.075

********Element 7 Grade********

Gradient Length	60.000
Gradient	.500
Gradient Start Chainage	1+065.000
Gradient End Chainage	1+125.000
Grade Start Level	7.075
Gradient End Level	7.375

********Element 8 Vertical Curve********

IP Chainage	1+200.000
Curve Length	150.000
Vertical Radius	-15000.000
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	150.000
Curve Type	Hog
Sight Distance	277.125
Curve Start Chainage	1+125.000
Curve End Chainage	1+275.000
Curve Start Level	7.375
Curve End Level	7.375

********Element 9 Grade********

Gradient Length	168.750
Gradient	-.500
Gradient Start Chainage	1+275.000
Gradient End Chainage	1+443.750
Grade Start Level	7.375
Gradient End Level	6.531

********Element 10 Vertical Curve********

IP Chainage	1+500.000
Curve Length	112.500
Vertical Radius	14999.998
Curve Start Gradient	-.500
Curve End Gradient	.250
K Value	150.000
Curve Type	Sag
Curve Start Chainage	1+443.750
Curve End Chainage	1+556.250
Curve Start Level	6.531
Curve End Level	6.391

********Element 11 Grade********

Gradient Length	499.167
Gradient	.250
Gradient Start Chainage	1+556.250
Gradient End Chainage	2+055.417
Grade Start Level	6.391
Gradient End Level	7.639

********Element 12 Vertical Curve********

IP Chainage	2+100.000
Curve Length	89.167
Vertical Radius	-12000.000
Curve Start Gradient	.250
Curve End Gradient	-.493
K Value	120.000
Curve Type	Hog
Sight Distance	316.602
Curve Start Chainage	2+055.417
Curve End Chainage	2+144.583
Curve Start Level	7.639
Curve End Level	7.530

********Element 13 Grade********

Gradient Length	72.703
Gradient	-.493
Gradient Start Chainage	2+144.583
Gradient End Chainage	2+217.286
Grade Start Level	7.530
Gradient End Level	7.172

********Element 14 Vertical Curve********

IP Chainage	2+325.533
Curve Length	216.493
Vertical Radius	7232.924
Curve Start Gradient	-.493
Curve End Gradient	2.500
K Value	72.329
Curve Type	Sag
Curve Start Chainage	2+217.286
Curve End Chainage	2+433.779
Curve Start Level	7.172
Curve End Level	9.344

********Element 15 Grade********

Gradient Length	36.214
Gradient	2.500
Gradient Start Chainage	2+433.779
Gradient End Chainage	2+469.993
Grade Start Level	9.344
Gradient End Level	10.250

********Element 16 Vertical Curve********

IP Chainage	2+640.000
Curve Length	340.014
Vertical Radius	-13599.999
Curve Start Gradient	2.500
Curve End Gradient	.000
K Value	136.000
Curve Type	Hog
Sight Distance	234.474
Curve Start Chainage	2+469.993
Curve End Chainage	2+810.007
Curve Start Level	10.250
Curve End Level	14.500

********Element 17 Grade********

Gradient Length	79.993
Gradient	.000
Gradient Start Chainage	2+810.007
Gradient End Chainage	2+890.000
Grade Start Level	14.500

Gradient End Level	14.500

********Element 18 Vertical Curve********

IP Chainage	3+060.000
Curve Length	340.000
Vertical Radius	-13600.000
Curve Start Gradient	.000
Curve End Gradient	-2.500
K Value	136.000
Curve Type	Hog
Sight Distance	234.474
Curve Start Chainage	2+890.000
Curve End Chainage	3+230.000
Curve Start Level	14.500
Curve End Level	10.250

********Element 19 Grade********

Gradient Length	65.959
Gradient	-2.500
Gradient Start Chainage	3+230.000
Gradient End Chainage	3+295.959
Grade Start Level	10.250
Gradient End Level	8.601

********Element 20 Vertical Curve********

IP Chainage	3+370.959
Curve Length	150.000
Vertical Radius	5000.000
Curve Start Gradient	-2.500
Curve End Gradient	.500
K Value	50.000
Curve Type	Sag
Curve Start Chainage	3+295.959
Curve End Chainage	3+445.959
Curve Start Level	8.601
Curve End Level	7.101

********Element 21 Grade********

Gradient Length	204.733
Gradient	.500
Gradient Start Chainage	3+445.959
Gradient End Chainage	3+650.691

Grade Start Level	7.101
Gradient End Level	8.125

********Element 22 Vertical Curve********

IP Chainage	3+750.691
Curve Length	200.000
Vertical Radius	-20000.002
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	200.000
Curve Type	Hog
Sight Distance	302.125
Curve Start Chainage	3+650.691
Curve End Chainage	3+850.691
Curve Start Level	8.125
Curve End Level	8.125

********Element 23 Grade********

Gradient Length	161.443
Gradient	-.500
Gradient Start Chainage	3+850.691
Gradient End Chainage	4+012.135
Grade Start Level	8.125
Gradient End Level	7.317

********Element 24 Vertical Curve********

IP Chainage	4+087.135
Curve Length	150.000
Vertical Radius	15000.002
Curve Start Gradient	-.500
Curve End Gradient	.500
K Value	150.000
Curve Type	Sag
Curve Start Chainage	4+012.135
Curve End Chainage	4+162.135
Curve Start Level	7.317
Curve End Level	7.317

********Element 25 Grade********

Gradient Length	130.925
Gradient	.500
Gradient Start Chainage	4+162.135

Gradient End Chainage	4+293.060
Grade Start Level	7.317
Gradient End Level	7.972

********Element 26 Vertical Curve********

IP Chainage	4+543.060
Curve Length	500.000
Vertical Radius	-11111.023
Curve Start Gradient	.500
Curve End Gradient	-4.000
K Value	111.110
Curve Type	Hog
Sight Distance	211.935
Curve Start Chainage	4+293.060
Curve End Chainage	4+793.060
Curve Start Level	7.972
Curve End Level	-.778

********Element 27 Grade********

Gradient Length	409.017
Gradient	-4.000
Gradient Start Chainage	4+793.060
Gradient End Chainage	5+202.077
Grade Start Level	-.778
Gradient End Level	-17.139

********Element 28 Vertical Curve********

IP Chainage	5+302.077
Curve Length	200.000
Vertical Radius	4761.865
Curve Start Gradient	-4.000
Curve End Gradient	.200
K Value	47.619
Curve Type	Sag
Curve Start Chainage	5+202.077
Curve End Chainage	5+402.077
Curve Start Level	-17.139
Curve End Level	-20.939

********Element 29 Grade********

Gradient Length	1894.570
Gradient	.200

Gradient Start Chainage	5+402.077
Gradient End Chainage	7+296.648
Grade Start Level	-20.939
Gradient End Level	-17.150

********Element 30 Vertical Curve********

IP Chainage	7+371.647
Curve Length	150.000
Vertical Radius	-37499.999
Curve Start Gradient	.200
Curve End Gradient	-.200
K Value	375.000
Curve Type	Hog
Sight Distance	580.312
Curve Start Chainage	7+296.648
Curve End Chainage	7+446.648
Curve Start Level	-17.150
Curve End Level	-17.150

********Element 31 Grade********

Gradient Length	1877.570
Gradient	-.200
Gradient Start Chainage	7+446.648
Gradient End Chainage	9+324.218
Grade Start Level	-17.150
Gradient End Level	-20.905

********Element 32 Vertical Curve********

IP Chainage	9+424.218
Curve Length	200.000
Vertical Radius	4761.949
Curve Start Gradient	-.200
Curve End Gradient	4.000
K Value	47.619
Curve Type	Sag
Curve Start Chainage	9+324.218
Curve End Chainage	9+524.218
Curve Start Level	-20.905
Curve End Level	-17.105

********Element 33 Grade********

Gradient Length	875.782

Gradient	4.000
Gradient Start Chainage	9+524.218
Gradient End Chainage	10+400.000
Grade Start Level	-17.105
Gradient End Level	17.926

********Element 34 Vertical Curve********

IP Chainage	10+550.000
Curve Length	300.000
Vertical Radius	-7500.074
Curve Start Gradient	4.000
Curve End Gradient	.000
K Value	75.001
Curve Type	Hog
Sight Distance	174.124
Curve Start Chainage	10+400.000
Curve End Chainage	10+700.000
Curve Start Level	17.926
Curve End Level	23.926

********Element 35 Grade********

Gradient Length	2500.000
Gradient	.000
Gradient Start Chainage	10+700.000
Gradient End Chainage	13+200.000
Grade Start Level	23.926
Gradient End Level	23.926

********Element 36 Vertical Curve********

IP Chainage	13+375.000
Curve Length	350.000
Vertical Radius	-14000.000
Curve Start Gradient	.000
Curve End Gradient	-2.500
K Value	140.000
Curve Type	Hog
Sight Distance	237.897
Curve Start Chainage	13+200.000
Curve End Chainage	13+550.000
Curve Start Level	23.926
Curve End Level	19.551

********Element 37 Grade********

Gradient Length	220.012
Gradient	-2.500
Gradient Start Chainage	13+550.000
Gradient End Chainage	13+770.012
Grade Start Level	19.551
Gradient End Level	14.051

********Element 38 Vertical Curve********

IP Chainage	13+845.012
Curve Length	150.000
Vertical Radius	5000.216
Curve Start Gradient	-2.500
Curve End Gradient	.500
K Value	50.002
Curve Type	Sag
Curve Start Chainage	13+770.012
Curve End Chainage	13+920.012
Curve Start Level	14.051
Curve End Level	12.551

********Element 39 Grade********

Gradient Length	170.004
Gradient	.500
Gradient Start Chainage	13+920.012
Gradient End Chainage	14+090.016
Grade Start Level	12.551
Gradient End Level	13.400

********Element 40 Vertical Curve********

IP Chainage	14+200.016
Curve Length	220.000
Vertical Radius	-22002.784
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	220.028
Curve Type	Hog
Sight Distance	312.150
Curve Start Chainage	14+090.016
Curve End Chainage	14+310.016
Curve Start Level	13.400
Curve End Level	13.400

********Element 41 Grade********

Gradient Length	19.984
Gradient	-.500
Gradient Start Chainage	14+310.016
Gradient End Chainage	14+330.000
Grade Start Level	13.400
Gradient End Level	13.300

********Element 42 Vertical Curve********

IP Chainage	14+470.000
Curve Length	280.000
Vertical Radius	-14018.328
Curve Start Gradient	-.500
Curve End Gradient	-2.497
K Value	140.183
Curve Type	Hog
Sight Distance	238.053
Curve Start Chainage	14+330.000
Curve End Chainage	14+610.000
Curve Start Level	13.300
Curve End Level	9.104

********Element 43 Grade********

Gradient Length	44.643
Gradient	-2.497
Gradient Start Chainage	14+610.000
Gradient End Chainage	14+654.643
Grade Start Level	9.104
Gradient End Level	7.989

********Element 44 Vertical Curve********

IP Chainage	14+739.643
Curve Length	170.000
Vertical Radius	5006.560
Curve Start Gradient	-2.497
Curve End Gradient	.898
K Value	50.066
Curve Type	Sag
Curve Start Chainage	14+654.643
Curve End Chainage	14+824.643
Curve Start Level	7.989
Curve End Level	6.630

********Element 45 Grade********

Gradient Length	143.235
Gradient	.898
Gradient Start Chainage	14+824.643
Gradient End Chainage	14+967.878
Grade Start Level	6.630
Gradient End Level	7.916

********Element 46 Vertical Curve********

IP Chainage	15+032.878
Curve Length	130.000
Vertical Radius	-14474.088
Curve Start Gradient	.898
Curve End Gradient	.000
K Value	144.741
Curve Type	Hog
Sight Distance	290.044
Curve Start Chainage	14+967.878
Curve End Chainage	15+097.878
Curve Start Level	7.916
Curve End Level	8.500

********Element 47 Grade********

Gradient Length	1702.122
Gradient	.000
Gradient Start Chainage	15+097.878
Gradient End Chainage	16+800.000
Grade Start Level	8.500
Gradient End Level	8.500

********Element 48 Vertical Curve********

IP Chainage	16+875.000
Curve Length	150.000
Vertical Radius	-29999.996
Curve Start Gradient	.000
Curve End Gradient	-.500
K Value	300.000
Curve Type	Hog
Sight Distance	479.250
Curve Start Chainage	16+800.000
Curve End Chainage	16+950.000

Curve Start Level	8.500
Curve End Level	8.125

********Element 49 Grade********

Gradient Length	125.636
Gradient	-.500
Gradient Start Chainage	16+950.000
Gradient End Chainage	17+075.636
Grade Start Level	8.125
Gradient End Level	7.497

********Element 50 Vertical Curve********

IP Chainage	17+150.636
Curve Length	150.000
Vertical Radius	14999.998
Curve Start Gradient	-.500
Curve End Gradient	.500
K Value	150.000
Curve Type	Sag
Curve Start Chainage	17+075.636
Curve End Chainage	17+225.636
Curve Start Level	7.497
Curve End Level	7.497

********Element 51 Grade********

Gradient Length	184.841
Gradient	.500
Gradient Start Chainage	17+225.636
Gradient End Chainage	17+410.477
Grade Start Level	7.497
Gradient End Level	8.421

********Element 52 Vertical Curve********

IP Chainage	17+485.477
Curve Length	150.000
Vertical Radius	-15000.003
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	150.000
Curve Type	Hog
Sight Distance	277.125
Curve Start Chainage	17+410.477

Curve End Chainage	17+560.477
Curve Start Level	8.421
Curve End Level	8.421

********Element 53 Grade********

Gradient Length	182.889
Gradient	-.500
Gradient Start Chainage	17+560.477
Gradient End Chainage	17+743.366
Grade Start Level	8.421
Gradient End Level	7.507

********Element 54 Vertical Curve********

IP Chainage	17+843.366
Curve Length	200.000
Vertical Radius	7712.790
Curve Start Gradient	-.500
Curve End Gradient	2.093
K Value	77.128
Curve Type	Sag
Curve Start Chainage	17+743.366
Curve End Chainage	17+943.366
Curve Start Level	7.507
Curve End Level	9.100

********Element 55 Grade********

Gradient Length	128.407
Gradient	2.093
Gradient Start Chainage	17+943.366
Gradient End Chainage	18+071.774
Grade Start Level	9.100
Gradient End Level	11.787

********Element 56 Vertical Curve********

IP Chainage	18+182.065
Curve Length	220.582
Vertical Radius	-13846.152
Curve Start Gradient	2.093
Curve End Gradient	.500
K Value	138.462
Curve Type	Hog
Sight Distance	237.167

Curve Start Chainage	18+071.774
Curve End Chainage	18+292.356
Curve Start Level	11.787
Curve End Level	14.647

********Element 57 Grade********

Gradient Length	431.921
Gradient	.500
Gradient Start Chainage	18+292.356
Gradient End Chainage	18+724.277
Grade Start Level	14.647
Gradient End Level	16.807

********Element 58 Vertical Curve********

IP Chainage	18+900.000
Curve Length	351.446
Vertical Radius	-8786.156
Curve Start Gradient	.500
Curve End Gradient	-3.500
K Value	87.862
Curve Type	Hog
Sight Distance	188.462
Curve Start Chainage	18+724.277
Curve End Chainage	19+075.723
Curve Start Level	16.807
Curve End Level	11.535

********Element 59 Grade********

Gradient Length	74.277
Gradient	-3.500
Gradient Start Chainage	19+075.723
Gradient End Chainage	19+150.000
Grade Start Level	11.535
Gradient End Level	8.936

********Element 60 Vertical Curve********

IP Chainage	19+241.602
Curve Length	183.204
Vertical Radius	6476.870
Curve Start Gradient	-3.500
Curve End Gradient	-.671
K Value	64.769

Curve Type	Sag
Curve Start Chainage	19+150.000
Curve End Chainage	19+333.204
Curve Start Level	8.936
Curve End Level	5.114

5.2.3 Horizontal Alignment Report

Horizontal Alignment Report
Model: MAINLINE NORTH 7
String: MC30
Units: Metric
Date : 4/12/2016 4:51:46 PM

********Element 1 Straight********

Bearing	358 27 44.294
Length	434.353
Begin on Straight Chainage	9+845.000
Straight End Chainage	10+279.353

********Element 2 Arc********

Intersection Point Chainage	10+322.024
Intersection Point X	270628.049
Intersection Point Y	2115855.081
Radius	2300.000
Arc Length	85.332
Hand of Arc	Right
Included Angle	02 07 32.615
Arc Start Chainage	10+279.353
Arc End Chainage	10+364.686

********Element 3 Straight********

Bearing	00 35 16.909
Length	117.407
Straight Start Chainage	10+364.686
Straight End Chainage	10+482.093

********Transition********

Intersection Point Chainage	10+569.125
Transition Length	130.000
Transition Start Chainage	10+482.093

Transition End Chainage 10+612.093

********Element 4 Arc********

Intersection Point Chainage 10+673.997
Intersection Point X 270616.493
Intersection Point Y 2116206.285
Radius 450.000
Arc Length 123.036
Hand of Arc Left
Included Angle 15 39 55.371
Arc Start Chainage 10+612.093
Arc-Arc (Same Hand) Chainage 10+735.128

********Element 5 Arc********

Intersection Point Chainage 10+778.527
Intersection Point X 270574.750
Intersection Point Y 2116302.960
Radius 650.000
Arc Length 86.669
Hand of Arc Left
Included Angle 07 38 22.628
Arc-Arc (Same Hand) Chainage 10+735.128
Arc End Chainage 10+821.797

********Transition********

Intersection Point Chainage 10+908.639
Transition Length 130.000
Transition Start Chainage 10+821.797
Trans-Trans Chainage 10+951.797

********Transition********

Intersection Point Chainage 11+039.560
Transition Length 130.000
Trans-Trans Chainage 10+951.797
Transition End Chainage 11+081.797

********Element 6 Arc********

Intersection Point Chainage 11+094.808
Intersection Point X 270404.658
Intersection Point Y 2116568.877
Radius 260.000

Arc Length	26.000
Hand of Arc	Right
Included Angle	05 43 46.553
Arc Start Chainage	11+081.797
Arc End Chainage	11+107.797

********Transition********

Intersection Point Chainage	11+151.390
Transition Length	130.000
Transition Start Chainage	11+107.797
Transition End Chainage	11+237.797

********Element 7 Straight********

Bearing	357 39 17.580
Length	272.269
Straight Start Chainage	11+237.797
Straight End Chainage	11+510.066

********Transition********

Intersection Point Chainage	11+596.849
Transition Length	130.000
Transition Start Chainage	11+510.066
Transition End Chainage	11+640.066

********Element 8 Arc********

Intersection Point Chainage	11+747.736
Intersection Point X	270376.263
Intersection Point Y	2117219.555
Radius	800.000
Arc Length	214.053
Hand of Arc	Right
Included Angle	15 19 49.606
Arc Start Chainage	11+640.066
Arc End Chainage	11+854.120

********Transition********

Intersection Point Chainage	11+940.902
Transition Length	130.000
Transition Start Chainage	11+854.120
Trans-Trans Chainage	11+984.120

********Transition********

Intersection Point Chainage	12+071.249
Transition Length	130.000
Trans-Trans Chainage	11+984.120
Transition End Chainage	12+114.120

********Element 9 Arc********

Intersection Point Chainage	12+122.324
Intersection Point X	270499.455
Intersection Point Y	2117574.322
Radius	400.000
Arc Length	16.406
Hand of Arc	Left
Included Angle	02 21 00.172
Arc Start Chainage	12+114.120
Arc End Chainage	12+130.526

********Transition********

Intersection Point Chainage	12+217.656
Transition Length	130.000
Transition Start Chainage	12+130.526
Trans-Trans Chainage	12+260.526

********Transition********

Intersection Point Chainage	12+347.279
Transition Length	130.000
Trans-Trans Chainage	12+260.526
Transition End Chainage	12+390.526

********Element 10 Arc********

Intersection Point Chainage	12+632.663
Intersection Point X	270539.621
Intersection Point Y	2118082.759
Radius	925.000
Arc Length	473.647
Hand of Arc	Right
Included Angle	29 20 18.061
Arc Start Chainage	12+390.526
Arc End Chainage	12+864.173

********Transition********

Intersection Point Chainage 12+907.527
Transition Length 130.000
Transition Start Chainage 12+864.173
Transition End Chainage 12+994.173

********Element 11 Straight********

Bearing 38 42 55.612
Length 1024.026
Straight Start Chainage 12+994.173
Finish on Straight Chainage 14+018.199

5.2.4 Vertical Alignment Report

Vertical Alignment Report
Model: MAINLINE NORTH 7
String: MC30
Units: Metric
Date : 4/12/2016 4:54:29 PM

********Element 1 Grade********

Gradient Length 229.776
Gradient 4.000
Begin on Gradient Chainage 9+845.000
Gradient End Chainage 10+074.776
Begin on Gradient Level -4.699
Gradient End Level 4.492

********Element 2 Vertical Curve********

IP Chainage 10+172.276
Curve Length 195.000
Vertical Radius -3611.111
Curve Start Gradient 4.000
Curve End Gradient -1.400
K Value 36.111
Curve Type Hog
Sight Distance 120.822
Curve Start Chainage 10+074.776
Curve End Chainage 10+269.776
Curve Start Level 4.492
Curve End Level 7.027

********Element 3 Grade********

Gradient Length	.291
Gradient	-1.400
Gradient Start Chainage	10+269.776
Gradient End Chainage	10+270.067
Grade Start Level	7.027
Gradient End Level	7.023

********Element 4 Vertical Curve********

IP Chainage	10+342.567
Curve Length	145.000
Vertical Radius	2685.185
Curve Start Gradient	-1.400
Curve End Gradient	4.000
K Value	26.852
Curve Type	Sag
Curve Start Chainage	10+270.067
Curve End Chainage	10+415.067
Curve Start Level	7.023
Curve End Level	8.908

********Element 5 Grade********

Gradient Length	.451
Gradient	4.000
Gradient Start Chainage	10+415.067
Gradient End Chainage	10+415.517
Grade Start Level	8.908
Gradient End Level	8.926

********Element 6 Vertical Curve********

IP Chainage	10+565.517
Curve Length	300.000
Vertical Radius	-7500.000
Curve Start Gradient	4.000
Curve End Gradient	.000
K Value	75.000
Curve Type	Hog
Sight Distance	174.123
Curve Start Chainage	10+415.517
Curve End Chainage	10+715.517
Curve Start Level	8.926
Curve End Level	14.926

********Element 7 Grade********

Gradient Length	2504.839
Gradient	.000
Gradient Start Chainage	10+715.517
Gradient End Chainage	13+220.357
Grade Start Level	14.926
Gradient End Level	14.926

********Element 8 Vertical Curve********

IP Chainage	13+270.357
Curve Length	100.000
Vertical Radius	-19999.994
Curve Start Gradient	.000
Curve End Gradient	-.500
K Value	200.000
Curve Type	Hog
Sight Distance	454.250
Curve Start Chainage	13+220.357
Curve End Chainage	13+320.357
Curve Start Level	14.926
Curve End Level	14.676

********Element 9 Grade********

Gradient Length	519.462
Gradient	-.500
Gradient Start Chainage	13+320.357
Gradient End Chainage	13+839.819
Grade Start Level	14.676
Gradient End Level	12.079

********Element 10 Vertical Curve********

IP Chainage	13+879.819
Curve Length	80.000
Vertical Radius	8001.035
Curve Start Gradient	-.500
Curve End Gradient	.500
K Value	80.010
Curve Type	Sag
Curve Start Chainage	13+839.819
Curve End Chainage	13+919.819
Curve Start Level	12.079
Curve End Level	12.079

********Element 11 Grade********

Gradient Length	98.380
Gradient	.500
Gradient Start Chainage	13+919.819
End on Gradient Chainage	14+018.199
Grade Start Level	12.079
Gradient End Level	12.570

6. Horizontal and Vertical design detail of all Interchanges alignment of Costal Road.

6.1 Amersons garden interchange Design:-

Detail of Arms Gives in table below,

Table 6-1 Amersons garden interchange Arms Detail

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MCA0	South CR	North Ex Road	Flyover	2
2	MCB0	South EX Road	North CR	Flyover	2
3	MCD0	South EX Road	South CR	At grade	2
4	MCC0	North CR	North Ex Road	At grade	2

Plan and Profile of AMERSONS GARDEN INTERCHANGE DESIGN gives in Drawing no. 8098/E/DD-1110 to 8098/E/DD-1114 Volume IV Drawings.

6.1.1 Horizontal Alignment Report Arm 01

Horizontal Alignment Report

Model: INTERCH AMERSONS R1

String: MCA0

Units: Metric

Date : 4/10/2016 2:59:44 PM

********Element 1 Straight********

Bearing 11 43 55.235
Length 26.502
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+026.502

********Transition********

Intersection Point Chainage	0+056.809
Transition Length	45.000
Transition Start Chainage	0+026.502
Transition End Chainage	0+071.502

********Element 2 Arc********

Intersection Point Chainage	0+244.215
Intersection Point X	268454.126
Intersection Point Y	2099031.343
Radius	100.000
Arc Length	419.125
Hand of Arc	Left
Included Angle	119 51 31.631
Arc Start Chainage	0+071.502
Arc End Chainage	0+490.628

********Transition********

Intersection Point Chainage	0+505.700
Transition Length	45.000
Transition Start Chainage	0+490.628
Transition End Chainage	0+535.628

********Element 3 Straight********

Bearing	105 48 27.717
Length	381.662
Straight Start Chainage	0+535.628
Finish on Straight Chainage	0+917.290

6.1.2 Vertical Alignment Report Arm 01

Vertical Alignment Report

Model: INTERCH AMERSONS R1

String: MCA0

Units: Metric

Date : 4/10/2016 3:13:23 PM

********Element 1 Grade********

Gradient Length	12.885

Gradient	.500
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+012.885
Begin on Gradient Level	5.714
Gradient End Level	5.778

********Element 2 Vertical Curve********

IP Chainage	0+120.000
Curve Length	214.230
Vertical Radius	10236.698
Curve Start Gradient	.500
Curve End Gradient	2.593
K Value	102.367
Curve Type	Sag
Curve Start Chainage	0+012.885
Curve End Chainage	0+227.115
Curve Start Level	5.778
Curve End Level	9.091

********Element 3 Grade********

Gradient Length	300.135
Gradient	2.593
Gradient Start Chainage	0+227.115
Gradient End Chainage	0+527.250
Grade Start Level	9.091
Gradient End Level	16.873

********Element 4 Vertical Curve********

IP Chainage	0+590.000
Curve Length	125.499
Vertical Radius	-1682.232
Curve Start Gradient	2.593
Curve End Gradient	-4.868
K Value	16.822
Curve Type	Hog
Sight Distance	82.465
Curve Start Chainage	0+527.250
Curve End Chainage	0+652.750
Curve Start Level	16.873
Curve End Level	15.446

********Element 5 Grade********

Gradient Length	177.131
Gradient	-4.868
Gradient Start Chainage	0+652.750
Gradient End Chainage	0+829.881
Grade Start Level	15.446
Gradient End Level	6.824

********Element 6 Vertical Curve********

IP Chainage	0+867.349
Curve Length	74.936
Vertical Radius	2505.144
Curve Start Gradient	-4.868
Curve End Gradient	-1.876
K Value	25.051
Curve Type	Sag
Curve Start Chainage	0+829.881
Curve End Chainage	0+904.817
Curve Start Level	6.824
Curve End Level	4.297

********Element 7 Grade********

Gradient Length	12.472
Gradient	-1.876
Gradient Start Chainage	0+904.817
End on Gradient Chainage	0+917.290
Grade Start Level	4.297
Gradient End Level	4.063

6.1.3 Horizontal Alignment Report Arm 02

Horizontal Alignment Report

Model: INTERCH AMERSONS R1

String: MCB0

Units: Metric

Date : 4/10/2016 3:15:16 PM

********Element 1 Straight********

Bearing	103 44 37.109
Length	2.214
Begin on Straight Chainage	0+000.000

Straight End Chainage 0+002.214

********Element 2 Arc********

Intersection Point Chainage 0+074.428
Intersection Point X 268457.761
Intersection Point Y 2098941.242
Radius 100.000
Arc Length 125.087
Hand of Arc Left
Included Angle 71 40 10.600
Arc Start Chainage 0+002.214
Arc End Chainage 0+127.301

********Transition********

Intersection Point Chainage 0+142.373
Transition Length 45.000
Transition Start Chainage 0+127.301
Transition End Chainage 0+172.301

********Element 3 Straight********

Bearing 19 10 56.928
Length 36.793
Straight Start Chainage 0+172.301
Finish on Straight Chainage 0+209.093

6.1.4 Vertical Alignment Report Arm 02

Vertical Alignment Report
Model: INTERCH AMERSONS R1
String: MCB0
Units: Metric
Date : 4/10/2016 3:16:33 PM

********Element 1 Grade********

Gradient Length 34.518
Gradient -2.324
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+034.518
Begin on Gradient Level 8.424
Gradient End Level 7.622

********Element 2 Vertical Curve********

IP Chainage	0+070.000
Curve Length	70.964
Vertical Radius	2498.953
Curve Start Gradient	-2.324
Curve End Gradient	.515
K Value	24.990
Curve Type	Sag
Curve Start Chainage	0+034.518
Curve End Chainage	0+105.482
Curve Start Level	7.622
Curve End Level	6.980

********Element 3 Grade********

Gradient Length	103.611
Gradient	.515
Gradient Start Chainage	0+105.482
End on Gradient Chainage	0+209.093
Grade Start Level	6.980
Gradient End Level	7.514

6.1.5 Horizontal Alignment Report Arm 03

Horizontal Alignment Report
Model: INTERCH AMERSONS R1
String: MCD0
Units: Metric
Date : 4/10/2016 3:03:06 PM

********Element 1 Straight********

Bearing	286 00 09.879
Length	124.271
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+124.271

********Transition********

Intersection Point Chainage	0+154.578
Transition Length	45.000
Transition Start Chainage	0+124.271
Transition End Chainage	0+169.271

********Element 2 Arc********

Intersection Point Chainage 0+231.420
Intersection Point X 268488.302
Intersection Point Y 2098678.027
Radius 100.000
Arc Length 111.215
Hand of Arc Left
Included Angle 63 43 17.457
Arc Start Chainage 0+169.271
Arc End Chainage 0+280.486

********Transition********

Intersection Point Chainage 0+295.558
Transition Length 45.000
Transition Start Chainage 0+280.486
Transition End Chainage 0+325.486

********Element 3 Straight********

Bearing 196 29 53.259
Length 9.369
Straight Start Chainage 0+325.486
Finish on Straight Chainage 0+334.854

6.1.6 Vertical Alignment Report Arm 03

Vertical Alignment Report
Model: INTERCH AMERSONS R1
String: MCD0
Units: Metric
Date : 4/10/2016 3:08:12 PM

********Element 1 Grade********

Gradient Length 334.854
Gradient .786
Begin on Gradient Chainage 0+000.000
End on Gradient Chainage 0+334.854
Begin on Gradient Level 4.063
Gradient End Level 6.694

6.1.7 Horizontal Alignment Report Arm 04

Horizontal Alignment Report
Model: INTERCH AMERSONS R1
String: MCC0

Units: Metric
Date : 4/10/2016 3:06:23 PM

********Element 1 Straight********

Bearing 192 49 46.914
Length 28.990
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+028.990

********Transition********

Intersection Point Chainage 0+059.298
Transition Length 45.000
Transition Start Chainage 0+028.990
Transition End Chainage 0+073.990

********Element 2 Arc********

Intersection Point Chainage 0+133.197
Intersection Point X 268507.249
Intersection Point Y 2098740.191
Radius 100.000
Arc Length 106.912
Hand of Arc Left
Included Angle 61 15 22.447
Arc Start Chainage 0+073.990
Arc End Chainage 0+180.903

********Transition********

Intersection Point Chainage 0+195.975
Transition Length 45.000
Transition Start Chainage 0+180.903
Transition End Chainage 0+225.903

********Element 3 Straight********

Bearing 105 47 25.304
Length 125.266
Straight Start Chainage 0+225.903
Finish on Straight Chainage 0+351.169

6.1.8 Vertical Alignment Report Arm 04

Vertical Alignment Report

Model: INTERCH AMERSONS R1
String: MCC0
Units: Metric
Date : 4/10/2016 3:10:04 PM

********Element 1 Grade********

Gradient Length	10.000
Gradient	.500
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+010.000
Begin on Gradient Level	5.511
Gradient End Level	5.561

********Element 2 Vertical Curve********

IP Chainage	0+050.000
Curve Length	80.000
Vertical Radius	-7519.821
Curve Start Gradient	.500
Curve End Gradient	-.564
K Value	75.198
Curve Type	Hog
Sight Distance	229.993
Curve Start Chainage	0+010.000
Curve End Chainage	0+090.000
Curve Start Level	5.561
Curve End Level	5.536

********Element 3 Grade********

Gradient Length	261.169
Gradient	-.564
Gradient Start Chainage	0+090.000
End on Gradient Chainage	0+351.169
Grade Start Level	5.536
Gradient End Level	4.063

6.2 Haji Ali interchange Design:-

Detail of Arms Gives in table below,

Table 6-2 Haji Ali interchange Arms Detail

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MC10	South CR	North Ex Road	Flyover	2
2	MC20	South EX Road	North CR	Flyover	2
3	MC30	North Ex Road	South CR	2nd Flyover	2
4	MC40	North CR	South EX Road	Flyover	2
5	MC50	South CR	South EX Road	2nd Flyover	1
6	MC60	South EX Road	South CR	At grade	1
7	MC70	North CR	North Ex Road	At grade	1

Plan and Profile of Haji Ali Interchange Design gives in Drawing no. 8098/E/DD-1120 to 8098/E/DD-1127 Volume IV Drawings.

6.2.1 Horizontal Alignment Report Arm 01

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC10**

Arm No: **01**

********Element A005 Straight********

Bearing 76 34 51.344
Length 70.083

********Transition********

Intersection Point Chainage 0+086.752
Transition Length 25.000
Transition Start Chainage 0+070.083
Transition End Chainage 0+095.083

********Element A012 Arc********

Intersection Point Chainage	0+102.342
Intersection Point X	269222.310
Intersection Point Y	2099985.294
Radius	500.000
Hand of Arc	Left
Arc Length	14.518
Arc Start Chainage	0+095.083
Arc End Chainage	0+109.601
Included Angle	01 39 48.901

********Transition********

Intersection Point Chainage	0+117.934
Transition Length	25.000
Transition Start Chainage	0+109.601
Transition End Chainage	0+134.601

********Element A013 Straight********

Bearing	72 03 09.203
Length	17.786

********Transition********

Intersection Point Chainage	0+169.055
Transition Length	25.000
Transition Start Chainage	0+152.387
Transition End Chainage	0+177.387

********Element A014 Arc********

Intersection Point Chainage	0+184.646
Intersection Point X	269300.842
Intersection Point Y	2100009.912
Radius	500.000
Hand of Arc	Right
Arc Length	14.518
Arc Start Chainage	0+177.387
Arc End Chainage	0+191.904
Included Angle	01 39 48.900

********Transition********

Intersection Point Chainage 0+200.238
Transition Length 25.000
Transition Start Chainage 0+191.904
Transition End Chainage 0+216.904

********Element A004 Straight********

Bearing 76 34 51.343
Length 141.385

********Transition********

Intersection Point Chainage 0+378.343
Transition Length 30.000
Transition Start Chainage 0+358.289
Transition End Chainage 0+388.289

********Element A003 Arc********

Intersection Point Chainage 0+493.217
Intersection Point X 269597.107
Intersection Point Y 2100094.601
Radius 130.000
Hand of Arc Left
Arc Length 176.560
Arc Start Chainage 0+388.289
Arc End Chainage 0+564.850
Included Angle 77 48 59.596

********Transition********

Intersection Point Chainage 0+574.862
Transition Length 30.000
Transition Start Chainage 0+564.850
Transition End Chainage 0+594.850

********Element A002 Straight********

Bearing 345 32 32.177
Length 27.730

********Element A006 Arc********

Intersection Point Chainage 0+711.198
Intersection Point X 269547.370
Intersection Point Y 2100340.509

Radius	80.000
Hand of Arc	Right
Arc Length	133.835
Arc Start Chainage	0+622.579
Arc End Chainage	0+756.414
Included Angle	95 51 07.001

********Transition********

Intersection Point Chainage	0+769.827
Transition Length	40.000
Transition Start Chainage	0+756.414
Transition End Chainage	0+796.414

********Element A007 Straight********

Bearing	95 43 05.380
Length	125.521

********Transition********

Intersection Point Chainage	0+948.773
Transition Length	40.000
Transition Start Chainage	0+921.935
Transition End Chainage	0+961.935

********Element A008 Arc********

Intersection Point Chainage	1+044.683
Intersection Point X	269922.174
Intersection Point Y	2100345.507
Radius	112.000
Hand of Arc	Left
Arc Length	142.534
Arc Start Chainage	0+961.935
Arc End Chainage	1+104.469
Included Angle	72 54 58.088

********Transition********

Intersection Point Chainage	1+117.843
Transition Length	40.000
Transition Start Chainage	1+104.469
Transition End Chainage	1+144.469

********Element A009 Straight********

Bearing 02 20 21.290
Length 14.014

********Element A010 Arc********

Intersection Point Chainage 1+179.940
Intersection Point X 269945.633
Intersection Point Y 2100501.457
Radius 100.000
Hand of Arc Left
Arc Length 42.274
Arc Start Chainage 1+158.483
Arc End Chainage 1+200.757
Included Angle 24 13 15.730

********Element A011 Straight********

Bearing 338 07 05.560
Length 226.396

6.2.2 Vertical Alignment Report Arm 01

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC10**

Arm No: **01**

*******Element 1 Grade********
Gradient Length 33.526
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+033.526

********Element 2 Vertical Curve********

IP Chainage 0+073.526
IP Level 7.148
Curve Length 80.000
Curve Type Sag
Vertical Radius 9895.006
K Value 98.950
Curve Start Chainage 0+033.526
Curve End Chainage 0+113.526

********Element 3 Grade********

Gradient Length	392.474
Gradient Start Chainage	0+113.526
Gradient End Chainage	0+506.001

********Element 4 Vertical Curve********

IP Chainage	0+581.001
IP Level	11.251
Curve Length	150.000
Curve Type	Hog
Vertical Radius	-3938.570
K Value	39.386
Curve Start Chainage	0+506.001
Curve End Chainage	0+656.001

********Element 5 Grade********

Gradient Length	83.364
Gradient Start Chainage	0+656.001
Gradient End Chainage	0+739.365

********Element 6 Vertical Curve********

IP Chainage	0+789.365
IP Level	5.000
Curve Length	100.000
Curve Type	Sag
Vertical Radius	3333.333
K Value	33.333
Curve Start Chainage	0+739.365
Curve End Chainage	0+839.365

********Element 7 Grade********

Gradient Length	110.000
Gradient Start Chainage	0+839.365
Gradient End Chainage	0+949.365

********Element 8 Vertical Curve********

IP Chainage	0+999.365
IP Level	5.000
Curve Length	100.000
Curve Type	Hog
Vertical Radius	-10000.000

K Value	100.000
Curve Start Chainage	0+949.365
Curve End Chainage	1+049.365

********Element 9 Grade********

Gradient Length	137.563
Gradient Start Chainage	1+049.365
Gradient End Chainage	1+186.927

********Element 10 Vertical Curve********

IP Chainage	1+236.927
IP Level	2.624
Curve Length	100.000
Curve Type	Sag
Vertical Radius	14638.072
K Value	146.381
Curve Start Chainage	1+186.927
Curve End Chainage	1+286.927

********Element 11 Grade********

Gradient Length	140.226
Gradient Start Chainage	1+286.927
End on Gradient Chainage	1+427.153

6.2.3 Horizontal Alignment Report Arm 02

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC20**

Arm No: **02**

********Element E007 Straight********

Bearing	39 05 00.952
Length	337.354

********Transition********

Intersection Point Chainage	0+360.983
Transition Length	35.000
Transition Start Chainage	0+337.354
Transition End Chainage	0+372.354

********Element E001 Arc********

Intersection Point Chainage	0+448.267
Intersection Point X	269880.453
Intersection Point Y	2100306.482
Radius	70.000
Hand of Arc	Left
Arc Length	115.626
Arc Start Chainage	0+372.354
Arc End Chainage	0+487.980
Included Angle	94 38 28.678

********Transition********

Intersection Point Chainage	0+499.717
Transition Length	35.000
Transition Start Chainage	0+487.980
Transition End Chainage	0+522.980

********Element E010 Straight********

Bearing	275 47 39.871
Length	67.029

********Transition********

Intersection Point Chainage	0+623.764
Transition Length	50.000
Transition Start Chainage	0+590.009
Transition End Chainage	0+640.009

********Element E005 Arc********

Intersection Point Chainage	0+680.608
Intersection Point X	269618.171
Intersection Point Y	2100340.629
Radius	100.000
Hand of Arc	Left
Arc Length	77.132
Arc Start Chainage	0+640.009
Arc-Arc (Same Hand) Chainage	0+717.141
Included Angle	44 11 36.817

********Element E004 Arc********

Intersection Point Chainage 2+828.947
Intersection Point X 268314.529
Intersection Point Y 2098627.922
Radius 67.000
Hand of Arc Left
Arc Length 214.737
Arc-Arc (Same Hand) Chainage 0+717.141
Arc End Chainage 0+931.878
Included Angle 176 21 56.306

********Transition********

Intersection Point Chainage 0+943.621
Transition Length 35.000
Transition Start Chainage 0+931.878
Transition End Chainage 0+966.878

********Element E003 Straight********

Bearing 18 40 38.020
Length 53.451

********Transition********

Intersection Point Chainage 1+053.746
Transition Length 50.000
Transition Start Chainage 1+020.329
Transition End Chainage 1+070.329

********Element E009 Arc********

Intersection Point Chainage 1+136.913
Intersection Point X 269762.231
Intersection Point Y 2100426.175
Radius 225.000
Hand of Arc Left
Arc Length 129.472
Arc Start Chainage 1+070.329
Arc-Arc (Same Hand) Chainage 1+199.801
Included Angle 32 58 11.541

********Element E002 Arc********

Intersection Point Chainage 1+258.727
Intersection Point X 269717.951
Intersection Point Y 2100543.613

Radius	329.750
Hand of Arc	Left
Arc Length	116.620
Arc-Arc (Same Hand) Chainage	1+199.801
Finish on Arc Chainage	1+316.421
Included Angle	20 15 47.780

6.2.4 Vertical Alignment Report Arm 02

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC20**

Arm No: **02**

********Element 1 Grade********

Gradient Length	70.272
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+070.272

********Element 2 Vertical Curve********

IP Chainage	0+120.272
IP Level	5.956
Curve Length	100.000
Curve Type	Hog
Vertical Radius	-8287.662
K Value	82.877
Curve Start Chainage	0+070.272
Curve End Chainage	0+170.272

********Element 3 Grade********

Gradient Length	123.380
Gradient Start Chainage	0+170.272
Gradient End Chainage	0+293.652

********Element 4 Vertical Curve********

IP Chainage	0+343.652
IP Level	5.000
Curve Length	100.000

Curve Type	Sag
Vertical Radius	23363.743
K Value	233.637
Curve Start Chainage	0+293.652
Curve End Chainage	0+393.652

********Element 5 Grade********

Gradient Length	186.348
Gradient Start Chainage	0+393.652
Gradient End Chainage	0+580.000

********Element 6 Vertical Curve********

IP Chainage	0+630.000
IP Level	5.000
Curve Length	100.000
Curve Type	Sag
Vertical Radius	3333.333
K Value	33.333
Curve Start Chainage	0+580.000
Curve End Chainage	0+680.000

********Element 7 Grade********

Gradient Length	135.227
Gradient Start Chainage	0+680.000
Gradient End Chainage	0+815.227

********Element 8 Vertical Curve********

IP Chainage	0+865.227
IP Level	12.057
Curve Length	100.000
Curve Type	Hog
Vertical Radius	-5888.279
K Value	58.883
Curve Start Chainage	0+815.227
Curve End Chainage	0+915.227

********Element 9 Grade********

Gradient Length	233.153
Gradient Start Chainage	0+915.227
Gradient End Chainage	1+148.380

********Element 10 Vertical Curve********

IP Chainage	1+218.380
IP Level	16.654
Curve Length	140.000
Curve Type	Hog
Vertical Radius	-11812.832
K Value	118.128
Curve Start Chainage	1+148.380
Curve End Chainage	1+288.380

********Element 11 Grade********

Gradient Length	28.041
Gradient Start Chainage	1+288.380
End on Gradient Chainage	1+316.421

6.2.5 Horizontal Alignment Report Arm 03

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC30**

Arm No: **03**

********Element A001 Straight********

Bearing	157 53 52.067
Length	293.637

********Transition********

Intersection Point Chainage	0+323.732
Transition Length	45.000
Transition Start Chainage	0+293.637
Transition End Chainage	0+338.637

********Element A002 Arc********

Intersection Point Chainage	0+417.515
Intersection Point X	269968.388
Intersection Point Y	2100454.057
Radius	180.000
Hand of Arc	Right
Arc Length	148.682
Arc Start Chainage	0+338.637

Arc End Chainage 0+487.319
Included Angle 47 19 36.854

********Transition********

Intersection Point Chainage 0+502.342
Transition Length 45.000
Transition Start Chainage 0+487.319
Transition End Chainage 0+532.319

********Element A003 Straight********

Bearing 219 32 55.123
Length 256.086

6.2.6 Vertical Alignment Report Arm 03

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC30**

Arm No: **03**

********Element 1 Grade********

Gradient Length 8.613
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+008.613

********Element 2 Vertical Curve********

IP Chainage 0+038.613
IP Level 4.613
Curve Length 60.000
Curve Type Sag
Vertical Radius 1478.105
K Value 14.781
Curve Start Chainage 0+008.613
Curve End Chainage 0+068.613

********Element 3 Grade********

Gradient Length 350.832
Gradient Start Chainage 0+068.613
Gradient End Chainage 0+419.444

********Element 4 Vertical Curve********

IP Chainage 0+469.444

IP Level	24.000
Curve Length	100.000
Curve Type	Hog
Vertical Radius	-2222.222
K Value	22.222
Curve Start Chainage	0+419.444
Curve End Chainage	0+519.444

********Element 5 Grade********

Gradient Length	40.185
Gradient Start Chainage	0+519.444
Gradient End Chainage	0+559.629

********Element 6 Vertical Curve********

IP Chainage	0+609.629
IP Level	24.000
Curve Length	100.000
Curve Type	Hog
Vertical Radius	-3030.303
K Value	30.303
Curve Start Chainage	0+559.629
Curve End Chainage	0+659.629

********Element 7 Grade********

Gradient Length	281.640
Gradient Start Chainage	0+659.629
Gradient End Chainage	0+941.269

********Element 8 Vertical Curve********

IP Chainage	0+991.269
IP Level	11.406
Curve Length	100.000
Curve Type	Sag
Vertical Radius	5542.059
K Value	55.421
Curve Start Chainage	0+941.269
Curve End Chainage	1+041.269

********Element 9 Grade********

Gradient Length	74.924
Gradient Start Chainage	1+041.269

Gradient End Chainage 1+116.194

********Element 10 Vertical Curve********

IP Chainage 1+170.795
IP Level 8.721
Curve Length 109.202
Curve Type Sag
Vertical Radius 15027.973
K Value 150.280
Curve Start Chainage 1+116.194
Curve End Chainage 1+225.396

********Element 11 Grade********

Gradient Length 203.522
Gradient Start Chainage 1+225.396
End on Gradient Chainage 1+428.918

6.2.7 Horizontal Alignment Report Arm 04

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC40**

Arm No: **04**

********Element A012 Straight********

Bearing 133 31 29.512
Length 3.960

********Transition********

Intersection Point Chainage 0+020.631
Transition Length 25.000
Transition Start Chainage 0+003.960
Transition End Chainage 0+028.960

********Element A009 Arc********

Intersection Point Chainage 0+074.488
Intersection Point X 269726.024
Intersection Point Y 2100599.390
Radius 370.250
Hand of Arc Right

Arc Length	90.601
Arc Start Chainage	0+028.960
Arc End Chainage	0+119.561
Included Angle	14 01 13.547

********Transition********

Intersection Point Chainage	0+136.232
Transition Length	25.000
Transition Start Chainage	0+119.561
Trans-Trans Chainage	0+144.561

********Transition********

Intersection Point Chainage	0+161.230
Transition Length	25.000
Trans-Trans Chainage	0+144.561
Transition End Chainage	0+169.561

********Element A010 Arc********

Intersection Point Chainage	0+187.365
Intersection Point X	269782.403
Intersection Point Y	2100501.087
Radius	500.000
Hand of Arc	Left
Arc Length	35.592
Arc Start Chainage	0+169.561
Arc End Chainage	0+205.153
Included Angle	04 04 42.685

********Transition********

Intersection Point Chainage	0+213.487
Transition Length	25.000
Transition Start Chainage	0+205.153
Transition End Chainage	0+230.153

********Element A007 Straight********

Bearing	144 28 14.536
Length	121.923

********Transition********

Intersection Point Chainage	0+368.828

Transition Length	25.000
Transition Start Chainage	0+352.076
Transition End Chainage	0+377.076

********Element A006 Arc********

Intersection Point Chainage	0+417.651
Intersection Point X	269909.051
Intersection Point Y	2100309.251
Radius	78.500
Hand of Arc	Right
Arc Length	74.898
Arc Start Chainage	0+377.076
Arc End Chainage	0+451.974
Included Angle	54 40 00.683

********Transition********

Intersection Point Chainage	0+460.328
Transition Length	25.000
Transition Start Chainage	0+451.974
Transition End Chainage	0+476.974

********Element A005 Straight********

Bearing	217 23 04.648
Length	87.528

********Element A004 Arc********

Intersection Point Chainage	0+583.278
Intersection Point X	269811.207
Intersection Point Y	2100168.427
Radius	1000.000
Hand of Arc	Right
Arc Length	37.549
Arc Start Chainage	0+564.502
Arc End Chainage	0+602.051
Included Angle	02 09 05.019

********Element A003 Straight********

Bearing	219 32 09.667
Length	165.263

********Element A002 Arc********

Intersection Point Chainage	0+777.185
Intersection Point X	269687.771
Intersection Point Y	2100018.879
Radius	2500.000
Hand of Arc	Left
Arc Length	19.741
Arc Start Chainage	0+767.314
Arc End Chainage	0+787.055
Included Angle	00 27 08.715

********Element A001 Straight********

Bearing	219 05 00.951
Length	91.026

6.2.8 Vertical Alignment Report Arm 04

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC40**

Arm No: **04**

********Element 1 Grade********

Gradient Length	29.691
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+029.691

********Element 2 Vertical Curve********

IP Chainage	0+069.691
IP Level	18.336
Curve Length	80.000
Curve Type	Hog
Vertical Radius	-8176.136
K Value	81.761
Curve Start Chainage	0+029.691
Curve End Chainage	0+109.691

********Element 3 Grade********

Gradient Length	18.129
Gradient Start Chainage	0+109.691
Gradient End Chainage	0+127.819

********Element 4 Vertical Curve********

IP Chainage	0+157.819
IP Level	17.953
Curve Length	60.000
Curve Type	Sag
Vertical Radius	13802.580
K Value	138.026
Curve Start Chainage	0+127.819
Curve End Chainage	0+187.819

********Element 5 Grade********

Gradient Length	88.503
Gradient Start Chainage	0+187.819
Gradient End Chainage	0+276.323

********Element 6 Vertical Curve********

IP Chainage	0+326.323
IP Level	17.953
Curve Length	100.000
Curve Type	Hog
Vertical Radius	-3333.333
K Value	33.333
Curve Start Chainage	0+276.323
Curve End Chainage	0+376.323

********Element 7 Grade********

Gradient Length	316.824
Gradient Start Chainage	0+376.323
Gradient End Chainage	0+693.147

********Element 8 Vertical Curve********

IP Chainage	0+743.147
IP Level	5.448
Curve Length	100.000
Curve Type	Sag
Vertical Radius	3536.954
K Value	35.370
Curve Start Chainage	0+693.147
Curve End Chainage	0+793.147

********Element 9 Grade********

Gradient Length	84.934
Gradient Start Chainage	0+793.147
End on Gradient Chainage	0+878.080

6.2.9 Horizontal Alignment Report Arm 05

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC50**

Arm No: **05**

********Element A001 Straight********

Bearing	76 34 51.344
Length	350.646

********Transition********

Intersection Point Chainage	0+373.991
Transition Length	35.000
Transition Start Chainage	0+350.646
Transition End Chainage	0+385.646

********Element A003 Arc********

Intersection Point Chainage	0+567.517
Intersection Point X	269672.404
Intersection Point Y	2100102.224
Radius	350.000
Hand of Arc	Left
Arc Length	335.461
Arc Start Chainage	0+385.646
Arc End Chainage	0+721.107
Included Angle	54 54 56.691

********Transition********

Intersection Point Chainage	0+732.776
Transition Length	35.000
Transition Start Chainage	0+721.107
Transition End Chainage	0+756.107

********Element A007 Straight********

Bearing 15 56 08.173
Length 38.968

********Element A008 Arc********

Intersection Point Chainage 0+901.783
Intersection Point X 269781.181
Intersection Point Y 2100447.956
Radius 70.000
Hand of Arc Right
Arc Length 138.631
Arc Start Chainage 0+795.075
Arc-Arc (Same Hand) Chainage 0+933.706
Included Angle 113 28 14.384

********Element A002 Arc********

Intersection Point Chainage 0+964.997
Intersection Point X 269887.809
Intersection Point Y 2100360.352
Radius 100.000
Hand of Arc Right
Arc Length 60.653
Arc-Arc (Same Hand) Chainage 0+933.706
Arc-Arc (Same Hand) Chainage 0+994.359
Included Angle 34 45 06.592

********Element A010 Arc********

Intersection Point Chainage 1+019.652
Intersection Point X 269903.256
Intersection Point Y 2100305.916
Radius 74.000
Hand of Arc Right
Arc Length 48.744
Arc-Arc (Same Hand) Chainage 0+994.359
Arc End Chainage 1+043.103
Included Angle 37 44 28.253

********Transition********

Intersection Point Chainage 1+056.530
Transition Length 40.000
Transition Start Chainage 1+043.103
Transition End Chainage 1+083.103

********Element A006 Straight********

Bearing	217 23 04.647
Length	82.273

6.2.10 Vertical Alignment Report Arm 05

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC50**

Arm No: **05**

********Element 1 Grade********

Gradient Length	39.528
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+039.528

********Element 2 Vertical Curve********

IP Chainage	0+079.528
IP Level	7.198
Curve Length	80.000
Curve Type	Sag
Vertical Radius	11309.229
K Value	113.092
Curve Start Chainage	0+039.528
Curve End Chainage	0+119.528

********Element 3 Grade********

Gradient Length	67.834
Gradient Start Chainage	0+119.528
Gradient End Chainage	0+187.362

********Element 4 Vertical Curve********

IP Chainage	0+237.362
IP Level	8.413
Curve Length	100.000
Curve Type	Sag
Vertical Radius	3952.433
K Value	39.524
Curve Start Chainage	0+187.362
Curve End Chainage	0+287.362

********Element 5 Grade********

Gradient Length	412.602
Gradient Start Chainage	0+287.362
Gradient End Chainage	0+699.964

********Element 6 Vertical Curve********

IP Chainage	0+774.964
IP Level	26.154
Curve Length	150.000
Curve Type	Hog
Vertical Radius	-1807.229
K Value	18.072
Curve Start Chainage	0+699.964
Curve End Chainage	0+849.964

********Element 7 Grade********

Gradient Length	315.412
Gradient Start Chainage	0+849.964
End on Gradient Chainage	1+165.376

6.2.11 Horizontal Alignment Report Arm 06

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC60**

Arm No: **06**

********Element A001 Straight********

Bearing	39 05 00.952
Length	36.076

********Transition********

Intersection Point Chainage	0+042.797
Transition Length	10.000
Transition Start Chainage	0+036.076
Transition End Chainage	0+046.076

********Element A002 Arc********

Intersection Point Chainage	0+096.303
Intersection Point X	269659.557
Intersection Point Y	2100034.445
Radius	25.000
Hand of Arc	Left
Arc Length	55.448
Arc Start Chainage	0+046.076
Arc End Chainage	0+101.524
Included Angle	127 04 38.363

********Transition********

Intersection Point Chainage	0+104.870
Transition Length	10.000
Transition Start Chainage	0+101.524
Transition End Chainage	0+111.524

********Element A010 Straight********

Bearing	249 05 16.666
Length	35.434

********Transition********

Intersection Point Chainage	0+163.633
Transition Length	25.000
Transition Start Chainage	0+146.958
Transition End Chainage	0+171.958

********Element A011 Arc********

Intersection Point Chainage	0+175.904
Intersection Point X	269540.123
Intersection Point Y	2100000.860
Radius	250.000
Hand of Arc	Right
Arc Length	7.891
Arc Start Chainage	0+171.958
Arc End Chainage	0+179.849
Included Angle	01 48 30.659

********Transition********

Intersection Point Chainage	0+188.184
Transition Length	25.000
Transition Start Chainage	0+179.849

Transition End Chainage 0+204.849

********Element A009 Straight********

Bearing 256 37 33.806
Length 74.767

********Transition********

Intersection Point Chainage 0+289.617
Transition Length 15.000
Transition Start Chainage 0+279.616
Transition End Chainage 0+294.616

********Element A005 Arc********

Intersection Point Chainage 0+299.585
Intersection Point X 269419.883
Intersection Point Y 2099971.949
Radius 250.000
Hand of Arc Right
Arc Length 9.937
Arc Start Chainage 0+294.616
Arc End Chainage 0+304.552
Included Angle 02 16 38.379

********Transition********

Intersection Point Chainage 0+309.553
Transition Length 15.000
Transition Start Chainage 0+304.552
Transition End Chainage 0+319.552

********Element A006 Straight********

Bearing 262 20 28.074
Length 58.169

********Transition********

Intersection Point Chainage 0+394.390
Transition Length 25.000
Transition Start Chainage 0+377.721
Transition End Chainage 0+402.721

********Element A003 Arc********

Intersection Point Chainage	0+415.141
Intersection Point X	269305.474
Intersection Point Y	2099955.739
Radius	500.000
Hand of Arc	Left
Arc Length	24.834
Arc Start Chainage	0+402.721
Arc End Chainage	0+427.556
Included Angle	02 50 44.895

********Transition********

Intersection Point Chainage	0+435.889
Transition Length	25.000
Transition Start Chainage	0+427.556
Transition End Chainage	0+452.556

********Element A004 Straight********

Bearing	256 37 49.938
Length	116.799

6.2.12 Vertical Alignment Report Arm 06

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC60**

Arm No: **06**

********Element 1 Grade********

Gradient Length	27.462
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+027.462

********Element 2 Vertical Curve********

IP Chainage	0+057.462
IP Level	5.246
Curve Length	60.000
Curve Type	Sag
Vertical Radius	1833.010
K Value	18.330
Curve Start Chainage	0+027.462

Curve End Chainage 0+087.462

********Element 3 Grade********

Gradient Length 53.351
Gradient Start Chainage 0+087.462
Gradient End Chainage 0+140.813

********Element 4 Vertical Curve********

IP Chainage 0+190.813
IP Level 9.647
Curve Length 100.000
Curve Type Hog
Vertical Radius -2457.633
K Value 24.576
Curve Start Chainage 0+140.813
Curve End Chainage 0+240.813

********Element 5 Grade********

Gradient Length 328.542
Gradient Start Chainage 0+240.813
End on Gradient Chainage 0+569.355

6.2.13 Horizontal Alignment Report Arm 07

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC70**

Arm No: **07**

********Element A004 Arc********

Intersection Point Chainage 0+023.667
Intersection Point X 269725.457
Intersection Point Y 2100596.783
Radius 370.250
Hand of Arc Right
Arc Length 47.269
Begin on Arc Chainage 0+000.000
Arc-Arc (Reverse) Chainage 0+047.269
Included Angle 07 18 53.630

********Element A005 Arc********

Intersection Point Chainage 0+061.378
Intersection Point X 269746.366

Intersection Point Y 2100565.322
Radius 900.000
Hand of Arc Left
Arc Length 28.215
Arc-Arc (Reverse) Chainage 0+047.269
Arc End Chainage 0+075.485
Included Angle 01 47 46.483

********Element A002 Straight********

Bearing 144 35 47.560
Length 41.484

********Element A012 Arc********

Intersection Point Chainage 0+125.181
Intersection Point X 269783.330
Intersection Point Y 2100513.315
Radius 250.000
Hand of Arc Left
Arc Length 16.419
Arc Start Chainage 0+116.969
Arc End Chainage 0+133.388
Included Angle 03 45 46.984

********Element A003 Straight********

Bearing 140 50 00.576
Length 15.168

********Element A011 Arc********

Intersection Point Chainage 0+156.494
Intersection Point X 269803.110
Intersection Point Y 2100489.033
Radius 250.000
Hand of Arc Right
Arc Length 15.870
Arc Start Chainage 0+148.556
Arc End Chainage 0+164.426
Included Angle 03 38 13.961

********Element A001 Straight********

Bearing 144 28 14.537
Length 48.229

********Element A007 Arc********

Intersection Point Chainage	0+266.705
Intersection Point X	269867.159
Intersection Point Y	2100399.337
Radius	55.000
Hand of Arc	Left
Arc Length	85.435
Arc Start Chainage	0+212.656
Arc-Arc (Same Hand) Chainage	0+298.091
Included Angle	89 00 04.872

********Element A009 Arc********

Intersection Point Chainage	0+323.091
Intersection Point X	269932.282
Intersection Point Y	2100444.146
Radius	50.000
Hand of Arc	Left
Arc Length	46.365
Arc-Arc (Same Hand) Chainage	0+298.091
Arc End Chainage	0+344.455
Included Angle	53 07 48.372

********Element A006 Straight********

Bearing	02 20 21.293
Length	10.922

********Element A008 Arc********

Intersection Point Chainage	0+374.904
Intersection Point X	269934.545
Intersection Point Y	2100499.548
Radius	91.000
Hand of Arc	Left
Arc Length	38.469
Arc Start Chainage	0+355.378
Arc End Chainage	0+393.847
Included Angle	24 13 15.734

********Element A010 Straight********

Bearing	338 07 05.560
Length	225.566

6.2.14 Vertical Alignment Report Arm 07

Model: **HAJI ALI INTERCHANGE DESIGN**

String: **MC70**

Arm No: **07**

********Element 1 Grade********

Gradient Length	69.093
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+069.093

********Element 2 Vertical Curve********

IP Chainage	0+119.093
IP Level	18.237
Curve Length	100.000
Curve Type	Hog
Vertical Radius	-2500.106
K Value	25.001
Curve Start Chainage	0+069.093
Curve End Chainage	0+169.093

********Element 3 Grade********

Gradient Length	373.928
Gradient Start Chainage	0+169.093
Gradient End Chainage	0+543.021

********Element 4 Vertical Curve********

IP Chainage	0+573.021
IP Level	.080
Curve Length	60.000
Curve Type	Sag
Vertical Radius	1500.000
K Value	15.000
Curve Start Chainage	0+543.021
Curve End Chainage	0+603.021

********Element 5 Grade********

Gradient Length	16.392

Gradient Start Chainage	0+603.021
End on Gradient Chainage	0+619.413

6.3 BWSL Worli Interchange Design:-

Detail of Arms Gives in table below,

Table 6-3 BWSL Worli Interchange Arms detail

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MC40	South CR	South EX Road	Flyover	2
2	MC50	South EX Road	North CR	Flyover	2
3	MC60	North Ex Road	North CR	Flyover	2
4	MC70	South CR	North Ex Road	Flyover	1
5	MC80	North Ex Road	South CR	Flyover	1
6	MC90	South EX Road	South CR	At grade	1

Plan and Profile of BWSL Worli Interchange gives in Drawing no. 8098/E/DD-1130 to 8098/E/DD-1136 Volume IV Drawings.

6.3.1 Horizontal Alignment Report Arm 01

Horizontal Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC40

Units: Metric

Date : 4/10/2016 3:41:59 PM

********Element 1 Straight********

Bearing 20 17 44.582
Length .576
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+000.576

********Transition********

Intersection Point Chainage 0+010.590

Transition Length	15.000
Transition Start Chainage	0+000.576
Transition End Chainage	0+015.576

********Element 2 Arc********

Intersection Point Chainage	0+081.897
Intersection Point X	269729.672
Intersection Point Y	2102958.884
Radius	90.000
Arc Length	114.311
Hand of Arc	Left
Included Angle	72 46 22.063
Arc Start Chainage	0+015.576
Arc End Chainage	0+129.887

********Transition********

Intersection Point Chainage	0+134.891
Transition Length	15.000
Transition Start Chainage	0+129.887
Transition End Chainage	0+144.887

********Element 3 Straight********

Bearing	297 58 25.051
Length	1.569
Straight Start Chainage	0+144.887
Straight End Chainage	0+146.457

********Transition********

Intersection Point Chainage	0+156.471
Transition Length	15.000
Transition Start Chainage	0+146.457
Transition End Chainage	0+161.457

********Element 4 Arc********

Intersection Point Chainage	0+464.834
Intersection Point X	269391.263
Intersection Point Y	2103174.406
Radius	90.000
Arc Length	230.833
Hand of Arc	Right
Included Angle	146 57 10.501

Arc Start Chainage 0+161.457
Arc End Chainage 0+392.290

********Transition********

Intersection Point Chainage 0+400.639
Transition Length 25.000
Transition Start Chainage 0+392.290
Transition End Chainage 0+417.290

********Element 5 Straight********

Bearing 97 39 32.176
Length 98.212
Straight Start Chainage 0+417.290
Straight End Chainage 0+515.502

********Transition********

Intersection Point Chainage 0+532.234
Transition Length 25.000
Transition Start Chainage 0+515.502
Transition End Chainage 0+540.502

********Element 6 Arc********

Intersection Point Chainage 0+620.368
Intersection Point X 269918.348
Intersection Point Y 2103134.748
Radius 90.000
Arc Length 130.645
Hand of Arc Right
Included Angle 83 10 17.111
Arc Start Chainage 0+540.502
Arc End Chainage 0+671.147

********Transition********

Intersection Point Chainage 0+679.496
Transition Length 25.000
Transition Start Chainage 0+671.147
Transition End Chainage 0+696.147

********Element 7 Straight********

Bearing 196 44 45.066

Length	256.722
Straight Start Chainage	0+696.147
Finish on Straight Chainage	0+952.870

6.3.2 Vertical Alignment Report Arm 01

Vertical Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC40

Units: Metric

Date : 4/10/2016 3:44:08 PM

********Element 1 Grade********

Gradient Length	2.500
Gradient	.000
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+002.500
Begin on Gradient Level	6.805
Gradient End Level	6.805

********Element 2 Vertical Curve********

IP Chainage	0+032.500
Curve Length	60.000
Vertical Radius	2191.547
Curve Start Gradient	.000
Curve End Gradient	2.738
K Value	21.915
Curve Type	Sag
Curve Start Chainage	0+002.500
Curve End Chainage	0+062.500
Curve Start Level	6.805
Curve End Level	7.626

********Element 3 Grade********

Gradient Length	323.338
Gradient	2.738
Gradient Start Chainage	0+062.500
Gradient End Chainage	0+385.838
Grade Start Level	7.626
Gradient End Level	16.479

********Element 4 Vertical Curve********

IP Chainage	0+415.838
Curve Length	60.000
Vertical Radius	-2002.194
Curve Start Gradient	2.738
Curve End Gradient	-.259
K Value	20.022
Curve Type	Hog
Sight Distance	97.449
Curve Start Chainage	0+385.838
Curve End Chainage	0+445.838
Curve Start Level	16.479
Curve End Level	17.222

********Element 5 Grade********

Gradient Length	171.732
Gradient	-.259
Gradient Start Chainage	0+445.838
Gradient End Chainage	0+617.570
Grade Start Level	17.222
Gradient End Level	16.778

********Element 6 Vertical Curve********

IP Chainage	0+647.570
Curve Length	60.000
Vertical Radius	-1549.245
Curve Start Gradient	-.259
Curve End Gradient	-4.132
K Value	15.492
Curve Type	Hog
Sight Distance	82.190
Curve Start Chainage	0+617.570
Curve End Chainage	0+677.570
Curve Start Level	16.778
Curve End Level	15.460

********Element 7 Grade********

Gradient Length	184.885
Gradient	-4.132
Gradient Start Chainage	0+677.570
Gradient End Chainage	0+862.455

Grade Start Level 15.460
Gradient End Level 7.821

********Element 8 Vertical Curve********

IP Chainage 0+892.455
Curve Length 60.000
Vertical Radius 2025.901
Curve Start Gradient -4.132
Curve End Gradient -1.170
K Value 20.259
Curve Type Sag
Curve Start Chainage 0+862.455
Curve End Chainage 0+922.455
Curve Start Level 7.821
Curve End Level 6.231

********Element 9 Grade********

Gradient Length 30.415
Gradient -1.170
Gradient Start Chainage 0+922.455
End on Gradient Chainage 0+952.870
Grade Start Level 6.231
Gradient End Level 5.875

6.3.3 Horizontal Alignment Report Arm 02

Horizontal Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC50

Units: Metric

Date : 4/10/2016 3:45:52 PM

********Element 1 Straight********

Bearing 16 40 35.195
Length 258.295
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+258.295

********Transition********

Intersection Point Chainage 0+275.056

Transition Length 25.000
Transition Start Chainage 0+258.295
Transition End Chainage 0+283.295

********Element 2 Arc********

Intersection Point Chainage 0+346.178
Intersection Point X 269898.586
Intersection Point Y 2103124.784
Radius 75.000
Arc Length 104.661
Hand of Arc Left
Included Angle 79 57 19.004
Arc Start Chainage 0+283.295
Arc End Chainage 0+387.957

********Transition********

Intersection Point Chainage 0+396.312
Transition Length 25.000
Transition Start Chainage 0+387.957
Transition End Chainage 0+412.957

********Element 3 Straight********

Bearing 277 37 21.256
Length 104.964
Straight Start Chainage 0+412.957
Straight End Chainage 0+517.921

********Transition********

Intersection Point Chainage 0+534.681
Transition Length 25.000
Transition Start Chainage 0+517.921
Transition End Chainage 0+542.921

********Element 4 Arc********

Intersection Point Chainage 0+635.923
Intersection Point X 269592.100
Intersection Point Y 2103160.760
Radius 75.000
Arc Length 337.417
Hand of Arc Left
Included Angle 102 13 55.572

Arc Start Chainage 0+542.921
Arc End Chainage 0+880.338

********Transition********

Intersection Point Chainage 0+888.694
Transition Length 25.000
Transition Start Chainage 0+880.338
Transition End Chainage 0+905.338

********Element 5 Straight********

Bearing 00 45 21.925
Length 47.679
Straight Start Chainage 0+905.338
Straight End Chainage 0+953.017

********Transition********

Intersection Point Chainage 0+966.354
Transition Length 20.000
Transition Start Chainage 0+953.017
Transition End Chainage 0+973.017

********Element 6 Arc********

Intersection Point Chainage 0+979.829
Intersection Point X 269763.610
Intersection Point Y 2103174.906
Radius 300.000
Arc Length 13.622
Hand of Arc Left
Included Angle 02 36 05.679
Arc Start Chainage 0+973.017
Arc End Chainage 0+986.639

********Transition********

Intersection Point Chainage 0+993.307
Transition Length 20.000
Transition Start Chainage 0+986.639
Transition End Chainage 1+006.639

********Element 7 Straight********

Bearing 354 20 05.259

Length 3.385
Straight Start Chainage 1+006.639
Finish on Straight Chainage 1+010.024

6.3.4 Vertical Alignment Report Arm 02

Vertical Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC50

Units: Metric

Date : 4/10/2016 3:56:02 PM

********Element 1 Grade********

Gradient Length 79.035
Gradient .781
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+079.035
Begin on Gradient Level 5.875
Gradient End Level 6.492

********Element 2 Vertical Curve********

IP Chainage 0+110.852
Curve Length 63.635
Vertical Radius 2300.000
Curve Start Gradient .781
Curve End Gradient 3.548
K Value 23.000
Curve Type Sag
Curve Start Chainage 0+079.035
Curve End Chainage 0+142.670
Curve Start Level 6.492
Curve End Level 7.870

********Element 3 Grade********

Gradient Length 226.523
Gradient 3.548
Gradient Start Chainage 0+142.670
Gradient End Chainage 0+369.193
Grade Start Level 7.870

Gradient End Level 15.907

********Element 4 Vertical Curve********

IP Chainage 0+400.000
Curve Length 61.614
Vertical Radius -1800.000
Curve Start Gradient 3.548
Curve End Gradient .125
K Value 18.000
Curve Type Hog
Sight Distance 89.856
Curve Start Chainage 0+369.193
Curve End Chainage 0+430.807
Curve Start Level 15.907
Curve End Level 17.039

********Element 5 Grade********

Gradient Length 31.767
Gradient .125
Gradient Start Chainage 0+430.807
Gradient End Chainage 0+462.574
Grade Start Level 17.039
Gradient End Level 17.078

********Element 6 Vertical Curve********

IP Chainage 0+493.512
Curve Length 61.875
Vertical Radius -1500.000
Curve Start Gradient .125
Curve End Gradient -4.000
K Value 15.000
Curve Type Hog
Sight Distance 79.937
Curve Start Chainage 0+462.574
Curve End Chainage 0+524.449
Curve Start Level 17.078
Curve End Level 15.879

********Element 7 Grade********

Gradient Length 176.827
Gradient -4.000
Gradient Start Chainage 0+524.449

Gradient End Chainage 0+701.276
Grade Start Level 15.879
Gradient End Level 8.806

********Element 8 Vertical Curve********

IP Chainage 0+738.076
Curve Length 73.599
Vertical Radius 2000.000
Curve Start Gradient -4.000
Curve End Gradient -.320
K Value 20.000
Curve Type Sag
Curve Start Chainage 0+701.276
Curve End Chainage 0+774.875
Curve Start Level 8.806
Curve End Level 7.217

********Element 9 Grade********

Gradient Length 235.149
Gradient -.320
Gradient Start Chainage 0+774.875
End on Gradient Chainage 1+010.024
Grade Start Level 7.217
Gradient End Level 6.464

6.3.5 Horizontal Alignment Report Arm 03

Horizontal Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC60

Units: Metric

Date : 4/10/2016 3:58:59 PM

********Element 1 Straight********

Bearing 195 47 05.593
Length 13.890
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+013.890

********Transition********

Intersection Point Chainage 0+033.893
Transition Length 30.000
Transition Start Chainage 0+013.890
Transition End Chainage 0+043.890

********Element 2 Arc********

Intersection Point Chainage 0+088.497
Intersection Point X 270175.963
Intersection Point Y 2103580.725
Radius 500.000
Arc Length 88.979
Hand of Arc Right
Included Angle 10 11 46.558
Arc Start Chainage 0+043.890
Arc End Chainage 0+132.869

********Transition********

Intersection Point Chainage 0+142.870
Transition Length 30.000
Transition Start Chainage 0+132.869
Transition End Chainage 0+162.869

********Element 3 Straight********

Bearing 209 25 08.040
Length 95.986
Straight Start Chainage 0+162.869
Straight End Chainage 0+258.854

********Element 4 Arc********

Intersection Point Chainage 0+270.151
Intersection Point X 270088.058
Intersection Point Y 2103421.505
Radius 600.000
Arc Length 22.590
Hand of Arc Right
Included Angle 02 09 25.962
Arc Start Chainage 0+258.854
Arc End Chainage 0+281.445

********Element 5 Straight********

Bearing 211 34 34.002

Length 22.339
Straight Start Chainage 0+281.445
Straight End Chainage 0+303.784

********Transition********

Intersection Point Chainage 0+323.801
Transition Length 30.000
Transition Start Chainage 0+303.784
Transition End Chainage 0+333.784

********Element 6 Arc********

Intersection Point Chainage 0+750.416
Intersection Point X 269813.358
Intersection Point Y 2103027.668
Radius 230.000
Arc Length 490.537
Hand of Arc Right
Included Angle 122 11 55.100
Arc Start Chainage 0+333.784
Arc End Chainage 0+824.320

********Transition********

Intersection Point Chainage 0+834.324
Transition Length 30.000
Transition Start Chainage 0+824.320
Transition End Chainage 0+854.320

********Element 7 Straight********

Bearing 341 14 53.207
Length 28.214
Straight Start Chainage 0+854.320
Straight End Chainage 0+882.534

********Transition********

Intersection Point Chainage 0+902.538
Transition Length 30.000
Transition Start Chainage 0+882.534
Transition End Chainage 0+912.534

********Element 8 Arc********

Intersection Point Chainage 0+941.156
Intersection Point X 269616.926
Intersection Point Y 2103523.388
Radius 500.000
Arc Length 57.181
Hand of Arc Right
Included Angle 06 33 08.716
Arc Start Chainage 0+912.534
Arc End Chainage 0+969.715

********Transition********

Intersection Point Chainage 0+979.716
Transition Length 30.000
Transition Start Chainage 0+969.715
Transition End Chainage 0+999.715

********Element 9 Straight********

Bearing 351 14 17.811
Length 16.137
Straight Start Chainage 0+999.715
Finish on Straight Chainage 1+015.852

6.3.6 Vertical Alignment Report Arm 03

Vertical Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC60

Units: Metric

Date : 4/10/2016 4:00:26 PM

********Element 1 Grade********

Gradient Length 10.000
Gradient .518
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+010.000
Begin on Gradient Level 6.293
Gradient End Level 6.345

********Element 2 Vertical Curve********

IP Chainage	0+040.000
Curve Length	60.000
Vertical Radius	2044.636
Curve Start Gradient	.518
Curve End Gradient	3.452
K Value	20.446
Curve Type	Sag
Curve Start Chainage	0+010.000
Curve End Chainage	0+070.000
Curve Start Level	6.345
Curve End Level	7.536

********Element 3 Grade********

Gradient Length	227.342
Gradient	3.452
Gradient Start Chainage	0+070.000
Gradient End Chainage	0+297.342
Grade Start Level	7.536
Gradient End Level	15.383

********Element 4 Vertical Curve********

IP Chainage	0+328.019
Curve Length	61.353
Vertical Radius	-2056.340
Curve Start Gradient	3.452
Curve End Gradient	.468
K Value	20.563
Curve Type	Hog
Sight Distance	98.422
Curve Start Chainage	0+297.342
Curve End Chainage	0+358.695
Curve Start Level	15.383
Curve End Level	16.586

********Element 5 Grade********

Gradient Length	246.252
Gradient	.468
Gradient Start Chainage	0+358.695
Gradient End Chainage	0+604.947
Grade Start Level	16.586
Gradient End Level	17.740

********Element 6 Vertical Curve********

IP Chainage	0+634.947
Curve Length	60.000
Vertical Radius	-2535.318
Curve Start Gradient	.468
Curve End Gradient	-1.898
K Value	25.353
Curve Type	Hog
Sight Distance	115.408
Curve Start Chainage	0+604.947
Curve End Chainage	0+664.947
Curve Start Level	17.740
Curve End Level	17.311

********Element 7 Grade********

Gradient Length	255.053
Gradient	-1.898
Gradient Start Chainage	0+664.947
Gradient End Chainage	0+920.000
Grade Start Level	17.311
Gradient End Level	12.469

********Element 8 Vertical Curve********

IP Chainage	0+950.000
Curve Length	60.000
Vertical Radius	3160.984
Curve Start Gradient	-1.898
Curve End Gradient	.000
K Value	31.610
Curve Type	Sag
Curve Start Chainage	0+920.000
Curve End Chainage	0+980.000
Curve Start Level	12.469
Curve End Level	11.900

********Element 9 Grade********

Gradient Length	35.852
Gradient	.000
Gradient Start Chainage	0+980.000
End on Gradient Chainage	1+015.852
Grade Start Level	11.900
Gradient End Level	11.900

6.3.7 Horizontal Alignment Report Arm 04

Horizontal Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC70

Units: Metric

Date : 4/10/2016 3:49:44 PM

********Element 1 Straight********

Bearing	89 47 19.069
Length	9.747
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+009.747

********Transition********

Intersection Point Chainage	0+021.752
Transition Length	18.000
Transition Start Chainage	0+009.747
Transition End Chainage	0+027.747

********Element 2 Arc********

Intersection Point Chainage	0+054.247
Intersection Point X	269772.991
Intersection Point Y	2103187.375
Radius	200.000
Arc Length	52.693
Hand of Arc	Left
Included Angle	15 05 43.576
Arc Start Chainage	0+027.747
Arc End Chainage	0+080.440

********Transition********

Intersection Point Chainage	0+090.445
Transition Length	30.000
Transition Start Chainage	0+080.440
Transition End Chainage	0+110.440

********Element 3 Straight********

Bearing	67 49 03.717
Length	75.092
Straight Start Chainage	0+110.440
Straight End Chainage	0+185.532

********Transition********

Intersection Point Chainage	0+205.554
Transition Length	30.000
Transition Start Chainage	0+185.532
Transition End Chainage	0+215.532

********Element 4 Arc********

Intersection Point Chainage	0+267.043
Intersection Point X	269969.379
Intersection Point Y	2103269.473
Radius	200.000
Arc Length	100.831
Hand of Arc	Left
Included Angle	28 53 09.078
Arc Start Chainage	0+215.532
Arc End Chainage	0+316.362

********Transition********

Intersection Point Chainage	0+326.368
Transition Length	30.000
Transition Start Chainage	0+316.362
Transition End Chainage	0+346.362

********Element 5 Straight********

Bearing	30 20 14.918
Length	220.886
Straight Start Chainage	0+346.362
Finish on Straight Chainage	0+567.248

6.3.8 Vertical Alignment Report Arm 04

Vertical Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC70

Units: Metric

Date : 4/10/2016 3:51:05 PM

********Element 1 Grade********

Gradient Length	63.889
Gradient	.056
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+063.889
Begin on Gradient Level	16.600
Gradient End Level	16.635

********Element 2 Vertical Curve********

IP Chainage	0+090.000
Curve Length	52.223
Vertical Radius	-1032.973
Curve Start Gradient	.056
Curve End Gradient	-5.000
K Value	10.330
Curve Type	Hog
Sight Distance	66.092
Curve Start Chainage	0+063.889
Curve End Chainage	0+116.111
Curve Start Level	16.635
Curve End Level	15.344

********Element 3 Grade********

Gradient Length	140.429
Gradient	-5.000
Gradient Start Chainage	0+116.111
Gradient End Chainage	0+256.540
Grade Start Level	15.344
Gradient End Level	8.323

********Element 4 Vertical Curve********

IP Chainage	0+280.000
Curve Length	46.920
Vertical Radius	1007.109
Curve Start Gradient	-5.000
Curve End Gradient	-.341
K Value	10.071
Curve Type	Sag
Curve Start Chainage	0+256.540
Curve End Chainage	0+303.460
Curve Start Level	8.323
Curve End Level	7.070

********Element 5 Grade********

Gradient Length	263.789
Gradient	-.341
Gradient Start Chainage	0+303.460
End on Gradient Chainage	0+567.248
Grade Start Level	7.070
Gradient End Level	6.170

6.3.9 Horizontal Alignment Report Arm 05

Horizontal Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC80

Units: Metric

Date : 4/10/2016 4:03:30 PM

********Element 1 Straight********

Bearing	220 42 26.871
Length	10.221
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+010.221

********Transition********

Intersection Point Chainage	0+030.237
Transition Length	30.000
Transition Start Chainage	0+010.221
Transition End Chainage	0+040.221

********Element 2 Arc********

Intersection Point Chainage	0+060.692
Intersection Point X	270002.025
Intersection Point Y	2103290.752
Radius	240.000
Arc Length	40.844
Hand of Arc	Right
Included Angle	09 45 02.416
Arc Start Chainage	0+040.221
Arc End Chainage	0+081.065

********Transition********

Intersection Point Chainage	0+091.069
Transition Length	30.000
Transition Start Chainage	0+081.065
Transition End Chainage	0+111.065

********Element 3 Straight********

Bearing	237 37 12.388
Length	107.338
Straight Start Chainage	0+111.065
Straight End Chainage	0+218.403

********Transition********

Intersection Point Chainage	0+235.135
Transition Length	25.000
Transition Start Chainage	0+218.403
Transition End Chainage	0+243.403

********Element 4 Arc********

Intersection Point Chainage	0+273.852
Intersection Point X	269826.153
Intersection Point Y	2103170.612
Radius	90.000
Arc Length	58.722
Hand of Arc	Left
Included Angle	37 23 00.464
Arc Start Chainage	0+243.403
Arc End Chainage	0+302.125

********Transition********

Intersection Point Chainage 0+310.474
Transition Length 25.000
Transition Start Chainage 0+302.125
Transition End Chainage 0+327.125

********Element 5 Straight********

Bearing 184 19 16.144
Length 1.604
Straight Start Chainage 0+327.125
Finish on Straight Chainage 0+328.729

6.3.10 Vertical Alignment Report Arm 05

Vertical Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC80

Units: Metric

Date : 4/10/2016 4:05:02 PM

********Element 1 Grade********

Gradient Length 10.000
Gradient 1.210
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+010.000
Begin on Gradient Level 17.616
Gradient End Level 17.737

********Element 2 Vertical Curve********

IP Chainage 0+040.000
Curve Length 60.000
Vertical Radius -1015.693
Curve Start Gradient 1.210
Curve End Gradient -4.697
K Value 10.157
Curve Type Hog
Sight Distance 64.216
Curve Start Chainage 0+010.000
Curve End Chainage 0+070.000

Curve Start Level	17.737
Curve End Level	16.691

********Element 3 Grade********

Gradient Length	163.533
Gradient	-4.697
Gradient Start Chainage	0+070.000
Gradient End Chainage	0+233.533
Grade Start Level	16.691
Gradient End Level	9.009

********Element 4 Vertical Curve********

IP Chainage	0+263.533
Curve Length	60.000
Vertical Radius	1469.234
Curve Start Gradient	-4.697
Curve End Gradient	-.614
K Value	14.692
Curve Type	Sag
Curve Start Chainage	0+233.533
Curve End Chainage	0+293.533
Curve Start Level	9.009
Curve End Level	7.416

********Element 5 Grade********

Gradient Length	35.196
Gradient	-.614
Gradient Start Chainage	0+293.533
End on Gradient Chainage	0+328.729
Grade Start Level	7.416
Gradient End Level	7.200

6.3.11 Horizontal Alignment Report Arm 06

Horizontal Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC90

Units: Metric

Date : 4/10/2016 3:38:33 PM

********Element 1 Straight********

Bearing 16 30 11.372
Length 250.582
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+250.582

********Transition********

Intersection Point Chainage 0+253.920
Transition Length 5.000
Transition Start Chainage 0+250.582
Transition End Chainage 0+255.582

********Element 2 Arc********

Intersection Point Chainage 0+784.751
Intersection Point X 269978.985
Intersection Point Y 2103558.255
Radius 29.000
Arc Length 87.931
Hand of Arc Left
Included Angle 173 43 34.804
Arc Start Chainage 0+255.582
Arc End Chainage 0+343.512

********Transition********

Intersection Point Chainage 0+343.846
Transition Length 1.000
Transition Start Chainage 0+343.512
Transition End Chainage 0+344.512

********Element 3 Straight********

Bearing 196 50 58.829
Length 2.329
Straight Start Chainage 0+344.512
Finish on Straight Chainage 0+346.841

6.3.12 Vertical Alignment Report Arm 06

Vertical Alignment Report

Model: INTERCH BWSL WORLI R1

String: MC90

Units: Metric

Date : 4/10/2016 3:39:57 PM

********Element 1 Grade********

Gradient Length	270.000
Gradient	.542
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+270.000
Begin on Gradient Level	5.875
Gradient End Level	7.338

********Element 2 Vertical Curve********

IP Chainage	0+300.000
Curve Length	60.000
Vertical Radius	-5131.179
Curve Start Gradient	.542
Curve End Gradient	-.628
K Value	51.312
Curve Type	Hog
Sight Distance	202.857
Curve Start Chainage	0+270.000
Curve End Chainage	0+330.000
Curve Start Level	7.338
Curve End Level	7.312

********Element 3 Grade********

Gradient Length	16.841
Gradient	-.628
Gradient Start Chainage	0+330.000
End on Gradient Chainage	0+346.841
Grade Start Level	7.312
Gradient End Level	7.206

Vertical Alignment Report
Model: INTERCH BWSL WORLI R1
String: MC90
Units: Metric
Date : 4/10/2016 3:39:57 PM

********Element 1 Grade********

Gradient Length	270.000
Gradient	.542
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+270.000
Begin on Gradient Level	5.875
Gradient End Level	7.338

********Element 2 Vertical Curve********

IP Chainage	0+300.000
Curve Length	60.000
Vertical Radius	-5131.179
Curve Start Gradient	.542
Curve End Gradient	-.628
K Value	51.312
Curve Type	Hog
Sight Distance	202.857
Curve Start Chainage	0+270.000
Curve End Chainage	0+330.000
Curve Start Level	7.338
Curve End Level	7.312

********Element 3 Grade********

Gradient Length	16.841
Gradient	-.628
Gradient Start Chainage	0+330.000
End on Gradient Chainage	0+346.841
Grade Start Level	7.312
Gradient End Level	7.206

6.4 BWSL Bandra Interchange Design:-

Detail of Arms Gives in table below,

Table 6-4 BWSL Bandra Interchange Arms detail

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MC10	North CR	BKC	Flyover	2
2	MC40	South CR	North CR	Flyover	2
3	MC50	North CR	South CR	At grade	2
4	MC60	Bndra Underpass	North CR	At grade	2
5	MC70	BKC	North CR	At grade	2

Plan and Profile of BWSL Bandra Interchange gives in Drawing no. 8098/E/DD-1140 to 8098/E/DD-1145 Volume IV Drawings.

6.4.1 Horizontal Alignment Report Arms 01

Horizontal Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC10

Units: Metric

Date : 4/10/2016 5:12:55 PM

********Element 1 Straight********

Bearing 127 23 29.100
Length 19.376
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+019.376

********Transition********

Intersection Point Chainage 0+056.433
Transition Length 55.000
Transition Start Chainage 0+019.376
Transition End Chainage 0+074.376

********Element 2 Arc********

Intersection Point Chainage 0+113.160
Intersection Point X 270446.260
Intersection Point Y 2106808.413
Radius 120.000
Arc Length 75.024
Hand of Arc Left
Included Angle 35 49 17.038
Arc Start Chainage 0+074.376
Arc End Chainage 0+149.401

********Transition********

Intersection Point Chainage 0+167.826
Transition Length 55.000
Transition Start Chainage 0+149.401
Transition End Chainage 0+204.401

********Element 3 Straight********

Bearing 65 18 34.026
Length 339.925
Straight Start Chainage 0+204.401
Straight End Chainage 0+544.325

********Transition********

Intersection Point Chainage 0+581.014
Transition Length 55.000
Transition Start Chainage 0+544.325
Transition End Chainage 0+599.325

********Element 4 Arc********

Intersection Point Chainage 0+608.584
Intersection Point X 270902.286
Intersection Point Y 2107005.436
Radius 500.000
Arc Length 18.515
Hand of Arc Left

Included Angle 02 07 18.061
Arc Start Chainage 0+599.325
Arc End Chainage 0+617.841

********Transition********

Intersection Point Chainage 0+636.179
Transition Length 55.000
Transition Start Chainage 0+617.841
Transition End Chainage 0+672.841

********Element 5 Straight********

Bearing 56 53 06.836
Length 15.397
Straight Start Chainage 0+672.841
Straight End Chainage 0+688.238

********Transition********

Intersection Point Chainage 0+718.250
Transition Length 45.000
Transition Start Chainage 0+688.238
Transition End Chainage 0+733.238

********Element 6 Arc********

Intersection Point Chainage 0+769.218
Intersection Point X 271038.849
Intersection Point Y 2107089.961
Radius 500.000
Arc Length 71.836
Hand of Arc Right
Included Angle 08 13 54.327
Arc Start Chainage 0+733.238
Arc End Chainage 0+805.074

********Transition********

Intersection Point Chainage 0+820.076
Transition Length 45.000
Transition Start Chainage 0+805.074
Transition End Chainage 0+850.074

********Element 7 Straight********

Bearing 70 16 24.996
Length 23.155
Straight Start Chainage 0+850.074
Straight End Chainage 0+873.229

********Transition********

Intersection Point Chainage 0+909.902
Transition Length 55.000
Transition Start Chainage 0+873.229
Transition End Chainage 0+928.229

********Element 8 Arc********

Intersection Point Chainage 1+099.752
Intersection Point X 271347.247
Intersection Point Y 2107209.143
Radius 900.000
Arc Length 338.982
Hand of Arc Left
Included Angle 21 34 48.840
Arc Start Chainage 0+928.229
Arc End Chainage 1+267.210

********Transition********

Intersection Point Chainage 1+285.545
Transition Length 55.000
Transition Start Chainage 1+267.210
Transition End Chainage 1+322.210

********Element 9 Straight********

Bearing 45 11 31.084
Length 385.232
Straight Start Chainage 1+322.210
Straight End Chainage 1+707.442

********Transition********

Intersection Point Chainage 1+724.111
Transition Length 25.000
Transition Start Chainage 1+707.442
Transition End Chainage 1+732.442

********Element 10 Arc********

Intersection Point Chainage	1+733.860
Intersection Point X	271804.211
Intersection Point Y	2107654.535
Radius	500.000
Arc Length	2.836
Hand of Arc	Right
Included Angle	00 19 30.101
Arc Start Chainage	1+732.442
Arc End Chainage	1+735.278

********Transition********

Intersection Point Chainage	1+743.612
Transition Length	25.000
Transition Start Chainage	1+735.278
Transition End Chainage	1+760.278

********Element 11 Straight********

Bearing	48 22 54.426
Length	121.747
Straight Start Chainage	1+760.278
Finish on Straight Chainage	1+882.025

6.4.2 Vertical Alignment Report Arms 01

Vertical Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC10

Units: Metric

Date : 4/11/2016 6:47:40 PM

********Element 1 Grade********

Gradient Length	167.226
Gradient	.526
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+167.226
Begin on Gradient Level	6.936
Gradient End Level	7.815

********Element 2 Vertical Curve********

IP Chainage	0+250.000
Curve Length	165.548
Vertical Radius	6219.219
Curve Start Gradient	.526
Curve End Gradient	3.187
K Value	62.192
Curve Type	Sag
Curve Start Chainage	0+167.226
Curve End Chainage	0+332.774
Curve Start Level	7.815
Curve End Level	10.888

********Element 3 Grade********

Gradient Length	212.431
Gradient	3.187
Gradient Start Chainage	0+332.774
Gradient End Chainage	0+545.205
Grade Start Level	10.888
Gradient End Level	17.660

********Element 4 Vertical Curve********

IP Chainage	0+650.000
Curve Length	209.589
Vertical Radius	-6575.362
Curve Start Gradient	3.187
Curve End Gradient	.000
K Value	65.754
Curve Type	Hog
Sight Distance	163.036
Curve Start Chainage	0+545.205
Curve End Chainage	0+754.795
Curve Start Level	17.660
Curve End Level	21.000

********Element 5 Grade********

Gradient Length	301.353
Gradient	.000
Gradient Start Chainage	0+754.795
Gradient End Chainage	1+056.147
Grade Start Level	21.000
Gradient End Level	21.000

********Element 6 Vertical Curve********

IP Chainage	1+150.000
Curve Length	187.705
Vertical Radius	-6147.484
Curve Start Gradient	.000
Curve End Gradient	-3.053
K Value	61.475
Curve Type	Hog
Sight Distance	157.643
Curve Start Chainage	1+056.147
Curve End Chainage	1+243.853
Curve Start Level	21.000
Curve End Level	18.134

********Element 7 Grade********

Gradient Length	462.981
Gradient	-3.053
Gradient Start Chainage	1+243.853
Gradient End Chainage	1+706.834
Grade Start Level	18.134
Gradient End Level	3.998

********Element 8 Vertical Curve********

IP Chainage	1+737.878
Curve Length	62.088
Vertical Radius	2496.609
Curve Start Gradient	-3.053
Curve End Gradient	-.566
K Value	24.966
Curve Type	Sag
Curve Start Chainage	1+706.834
Curve End Chainage	1+768.922
Curve Start Level	3.998
Curve End Level	2.874

********Element 9 Grade********

Gradient Length	113.103
Gradient	-.566
Gradient Start Chainage	1+768.922
End on Gradient Chainage	1+882.025
Grade Start Level	2.874
Gradient End Level	2.233

6.4.3 Horizontal Alignment Report Arms 02

Horizontal Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC40

Units: Metric

Date : 4/10/2016 4:22:01 PM

********Element 1 Straight********

Bearing	130 37 35.916
Length	318.477
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+318.477

********Transition********

Intersection Point Chainage	0+331.873
Transition Length	20.000
Transition Start Chainage	0+318.477
Transition End Chainage	0+338.477

********Element 2 Arc********

Intersection Point Chainage	0+375.969
Intersection Point X	271602.377
Intersection Point Y	2107292.708
Radius	66.000
Arc Length	68.191
Hand of Arc	Right
Included Angle	59 11 51.503
Arc Start Chainage	0+338.477
Arc End Chainage	0+406.668

********Transition********

Intersection Point Chainage	0+413.349
Transition Length	20.000
Transition Start Chainage	0+406.668
Transition End Chainage	0+426.668

********Element 3 Straight********

Bearing 207 11 11.906
Length 35.443
Straight Start Chainage 0+426.668
Straight End Chainage 0+462.111

********Transition********

Intersection Point Chainage 0+478.784
Transition Length 25.000
Transition Start Chainage 0+462.111
Transition End Chainage 0+487.111

********Element 4 Arc********

Intersection Point Chainage 0+572.743
Intersection Point X 271512.071
Intersection Point Y 2107110.866
Radius 300.000
Arc Length 166.828
Hand of Arc Right
Included Angle 31 51 42.327
Arc Start Chainage 0+487.111
Arc End Chainage 0+653.939

********Transition********

Intersection Point Chainage 0+662.274
Transition Length 25.000
Transition Start Chainage 0+653.939
Transition End Chainage 0+678.939

********Element 5 Straight********

Bearing 243 49 22.967
Length 37.989
Straight Start Chainage 0+678.939
Finish on Straight Chainage 0+716.928

6.4.4 Vertical Alignment Report Arms 02

Vertical Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC40

Units: Metric

Date : 4/10/2016 4:24:09 PM

********Element 1 Grade********

Gradient Length	491.000
Gradient	.439
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+491.000
Begin on Gradient Level	3.668
Gradient End Level	5.824

********Element 2 Vertical Curve********

IP Chainage	0+531.000
Curve Length	80.000
Vertical Radius	100870.491
Curve Start Gradient	.439
Curve End Gradient	.518
K Value	1008.705
Curve Type	Sag
Curve Start Chainage	0+491.000
Curve End Chainage	0+571.000
Curve Start Level	5.824
Curve End Level	6.207

********Element 3 Grade********

Gradient Length	145.928
Gradient	.518
Gradient Start Chainage	0+571.000
End on Gradient Chainage	0+716.928
Grade Start Level	6.207
Gradient End Level	6.964

6.4.5 Horizontal Alignment Report Arms 03

Horizontal Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC50

Units: Metric

Date : 4/10/2016 5:07:43 PM

********Element 1 Straight********

Bearing 219 07 55.301
Length 117.234
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+117.234

********Transition********

Intersection Point Chainage 0+130.569
Transition Length 20.000
Transition Start Chainage 0+117.234
Transition End Chainage 0+137.234

********Element 2 Arc********

Intersection Point Chainage 0+207.102
Intersection Point X 271645.054
Intersection Point Y 2107396.390
Radius 400.000
Arc Length 138.339
Hand of Arc Left
Included Angle 19 48 56.420
Arc Start Chainage 0+137.234
Arc End Chainage 0+275.574

********Transition********

Intersection Point Chainage 0+282.241
Transition Length 20.000
Transition Start Chainage 0+275.574
Transition End Chainage 0+295.574

********Element 3 Straight********

Bearing 196 27 05.640
Length 19.767
Straight Start Chainage 0+295.574
Straight End Chainage 0+315.341

********Transition********

Intersection Point Chainage 0+335.355
Transition Length 30.000
Transition Start Chainage 0+315.341

Transition End Chainage 0+345.341

********Element 4 Arc********

Intersection Point Chainage 0+360.866
Intersection Point X 271597.826
Intersection Point Y 2107248.618
Radius 250.000
Arc Length 31.011
Hand of Arc Right
Included Angle 07 06 25.698
Arc Start Chainage 0+345.341
Arc End Chainage 0+376.352

********Transition********

Intersection Point Chainage 0+386.355
Transition Length 30.000
Transition Start Chainage 0+376.352
Transition End Chainage 0+406.352

********Element 5 Straight********

Bearing 210 26 03.115
Length 44.166
Straight Start Chainage 0+406.352
Finish on Straight Chainage 0+450.518

6.4.6 Vertical Alignment Report Arms 03

Vertical Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC50

Units: Metric

Date : 4/10/2016 5:09:44 PM

********Element 1 Grade********

Gradient Length 149.756
Gradient .044
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+149.756
Begin on Gradient Level 3.005
Gradient End Level 3.071

********Element 2 Vertical Curve********

IP Chainage	0+179.756
Curve Length	60.000
Vertical Radius	6532.666
Curve Start Gradient	.044
Curve End Gradient	.962
K Value	65.327
Curve Type	Sag
Curve Start Chainage	0+149.756
Curve End Chainage	0+209.756
Curve Start Level	3.071
Curve End Level	3.372

********Element 3 Grade********

Gradient Length	240.762
Gradient	.962
Gradient Start Chainage	0+209.756
End on Gradient Chainage	0+450.518
Grade Start Level	3.372
Gradient End Level	5.689

6.4.7 Horizontal Alignment Report Arms 04

Horizontal Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC60

Units: Metric

Date : 4/10/2016 4:26:48 PM

********Element 1 Straight********

Bearing	63 55 04.730
Length	57.179
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+057.179

********Element 2 Arc********

Intersection Point Chainage	0+063.829
Intersection Point X	271193.307
Intersection Point Y	2107139.124

Radius	1200.000
Arc Length	13.300
Hand of Arc	Right
Included Angle	00 38 06.090
Arc Start Chainage	0+057.179
Arc End Chainage	0+070.479

********Element 3 Straight********

Bearing	64 33 10.820
Length	182.987
Straight Start Chainage	0+070.479
Straight End Chainage	0+253.466

********Transition********

Intersection Point Chainage	0+280.466
Transition Length	40.000
Transition Start Chainage	0+253.466
Transition End Chainage	0+293.466

********Element 4 Arc********

Intersection Point Chainage	0+587.825
Intersection Point X	271690.601
Intersection Point Y	2107291.945
Radius	80.500
Arc Length	209.920
Hand of Arc	Right
Included Angle	149 24 35.900
Arc Start Chainage	0+293.466
Arc End Chainage	0+503.386

********Transition********

Intersection Point Chainage	0+516.798
Transition Length	40.000
Transition Start Chainage	0+503.386
Transition End Chainage	0+543.386

********Element 5 Straight********

Bearing	242 25 58.550
Length	65.753
Straight Start Chainage	0+543.386
Finish on Straight Chainage	0+609.139

6.4.8 Vertical Alignment Report Arms 04

Vertical Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC60

Units: Metric

Date : 4/10/2016 4:28:02 PM

********Element 1 Grade********

Gradient Length	17.342
Gradient	.349
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+017.342
Begin on Gradient Level	5.293
Gradient End Level	5.353

********Element 2 Vertical Curve********

IP Chainage	0+077.342
Curve Length	120.000
Vertical Radius	2671.662
Curve Start Gradient	.349
Curve End Gradient	4.840
K Value	26.717
Curve Type	Sag
Curve Start Chainage	0+017.342
Curve End Chainage	0+137.342
Curve Start Level	5.353
Curve End Level	8.466

********Element 3 Grade********

Gradient Length	35.000
Gradient	4.840
Gradient Start Chainage	0+137.342
Gradient End Chainage	0+172.342
Grade Start Level	8.466
Gradient End Level	10.161

********Element 4 Vertical Curve********

IP Chainage	0+292.989

Curve Length	241.294
Vertical Radius	-2785.947
Curve Start Gradient	4.840
Curve End Gradient	-3.821
K Value	27.859
Curve Type	Hog
Sight Distance	106.123
Curve Start Chainage	0+172.342
Curve End Chainage	0+413.635
Curve Start Level	10.161
Curve End Level	11.390

********Element 5 Grade********

Gradient Length	67.239
Gradient	-3.821
Gradient Start Chainage	0+413.635
Gradient End Chainage	0+480.874
Grade Start Level	11.390
Gradient End Level	8.821

********Element 6 Vertical Curve********

IP Chainage	0+539.000
Curve Length	116.251
Vertical Radius	2678.640
Curve Start Gradient	-3.821
Curve End Gradient	.519
K Value	26.786
Curve Type	Sag
Curve Start Chainage	0+480.874
Curve End Chainage	0+597.126
Curve Start Level	8.821
Curve End Level	6.902

********Element 7 Grade********

Gradient Length	12.014
Gradient	.519
Gradient Start Chainage	0+597.126
End on Gradient Chainage	0+609.139
Grade Start Level	6.902
Gradient End Level	6.964

6.4.9 Horizontal Alignment Report Arms 05

Horizontal Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC70

Units: Metric

Date : 4/10/2016 4:31:52 PM

********Element 1 Straight********

Bearing 62 42 41.788
Length 48.909
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+048.909

********Transition********

Intersection Point Chainage 0+062.429
Transition Length 20.000
Transition Start Chainage 0+048.909
Transition End Chainage 0+068.909

********Element 2 Arc********

Intersection Point Chainage 0+201.009
Intersection Point X 271524.779
Intersection Point Y 2107188.968
Radius 38.000
Arc Length 98.093
Hand of Arc Left
Included Angle 147 54 10.604
Arc Start Chainage 0+068.909
Arc End Chainage 0+167.002

********Transition********

Intersection Point Chainage 0+173.713
Transition Length 20.000
Transition Start Chainage 0+167.002
Transition End Chainage 0+187.002

********Element 3 Straight********

Bearing 244 39 10.758
Length 258.626
Straight Start Chainage 0+187.002

Finish on Straight Chainage 0+445.628

6.4.10 Vertical Alignment Report Arms 05

Vertical Alignment Report

Model: INTERCH BWSL BANDRA R1

String: MC70

Units: Metric

Date : 4/10/2016 4:33:52 PM

********Element 1 Grade********

Gradient Length	50.000
Gradient	-.518
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+050.000
Begin on Gradient Level	6.964
Gradient End Level	6.705

********Element 2 Vertical Curve********

IP Chainage	0+100.000
Curve Length	100.000
Vertical Radius	42204.677
Curve Start Gradient	-.518
Curve End Gradient	-.281
K Value	422.047
Curve Type	Sag
Curve Start Chainage	0+050.000
Curve End Chainage	0+150.000
Curve Start Level	6.705
Curve End Level	6.305

********Element 3 Grade********

Gradient Length	166.029
Gradient	-.281
Gradient Start Chainage	0+150.000
Gradient End Chainage	0+316.029
Grade Start Level	6.305
Gradient End Level	5.839

********Element 4 Vertical Curve********

IP Chainage	0+355.320
Curve Length	78.582
Vertical Radius	-39082.365
Curve Start Gradient	-.281
Curve End Gradient	-.482
K Value	390.824
Curve Type	Hog
Sight Distance	1044.544
Curve Start Chainage	0+316.029
Curve End Chainage	0+394.612
Curve Start Level	5.839
Curve End Level	5.539

********Element 5 Grade********

Gradient Length	51.016
Gradient	-.482
Gradient Start Chainage	0+394.612
End on Gradient Chainage	0+445.628
Grade Start Level	5.539
Gradient End Level	5.293

6.5 Carter Road Interchange Design:-

Detail of Arms Gives in table below,

Table 6-5 Carter Road Interchange Arms detail

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MC50	South CR	North EX Road	Flyover	2
2	MC60	South EX Road	North CR	Flyover	2
3	MC70	South EX Road	South CR	At grade	2
4	MC80	North CR	North EX Road	At grade	2

Plan and Profile of Carter Road Interchange gives in Drawing no. 8098/E/DD-1210 to 8098/E/DD-1214 Volume IV Drawings.

6.5.1 Horizontal Alignment Report Arms 01

Horizontal Alignment Report

Model: INTERCH CARTER ROAD R1

String: MC50

Units: Metric

Date : 4/10/2016 5:19:03 PM

********Element 1 Straight********

Bearing 04 27 23.708
Length 20.592
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+020.592

********Element 2 Arc********

Intersection Point Chainage 0+087.746
Intersection Point X 270592.747
Intersection Point Y 2109758.840
Radius 90.000
Arc Length 115.386

Hand of Arc	Left
Included Angle	73 27 26.058
Arc Start Chainage	0+020.592
Arc End Chainage	0+135.978

********Transition********

Intersection Point Chainage	0+177.116
Transition Length	60.000
Transition Start Chainage	0+135.978
Transition End Chainage	0+195.978

********Element 3 Arc********

Intersection Point Chainage	0+429.753
Intersection Point X	270305.085
Intersection Point Y	2109968.929
Radius	80.000
Arc Length	198.572
Hand of Arc	Right
Included Angle	142 13 01.274
Arc Start Chainage	0+195.978
Arc End Chainage	0+394.551

********Element 4 Straight********

Bearing	94 42 08.227
Length	261.508
Straight Start Chainage	0+394.551
Straight End Chainage	0+656.058

********Transition********

Intersection Point Chainage	0+676.311
Transition Length	30.000
Transition Start Chainage	0+656.058
Transition End Chainage	0+686.058

********Element 5 Arc********

Intersection Point Chainage	0+767.058
Intersection Point X	270908.477
Intersection Point Y	2109941.901
Radius	60.000
Arc Length	111.990
Hand of Arc	Left

Included Angle	106 56 32.320
Arc Start Chainage	0+686.058
Arc End Chainage	0+798.048

********Element 6 Straight********

Bearing	333 26 09.710
Length	4.287
Straight Start Chainage	0+798.048
Straight End Chainage	0+802.335

********Element 7 Arc********

Intersection Point Chainage	0+804.384
Intersection Point X	270869.420
Intersection Point Y	2110020.018
Radius	99.998
Arc Length	4.097
Hand of Arc	Left
Included Angle	02 20 50.598
Arc Start Chainage	0+802.335
Arc End Chainage	0+806.432

********Element 8 Straight********

Bearing	331 05 19.112
Length	45.913
Straight Start Chainage	0+806.432
Straight End Chainage	0+852.345

********Element 9 Arc********

Intersection Point Chainage	0+864.203
Intersection Point X	270840.500
Intersection Point Y	2110072.382
Radius	100.000
Arc Length	23.606
Hand of Arc	Right
Included Angle	13 31 29.875
Arc Start Chainage	0+852.345
Arc End Chainage	0+875.951

********Element 10 Straight********

Bearing	344 36 48.988
Length	68.215

Straight Start Chainage 0+875.951
Finish on Straight Chainage 0+944.166

6.5.2 Vertical Alignment Report Arms 01

Vertical Alignment Report

Model: INTERCH CARTER ROAD R1

String: MC50

Units: Metric

Date : 4/10/2016 5:20:57 PM

********Element 1 Grade********

Gradient Length 38.898
Gradient .049
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+038.898
Begin on Gradient Level 6.705
Gradient End Level 6.724

********Element 2 Vertical Curve********

IP Chainage 0+066.411
Curve Length 55.025
Vertical Radius 2000.000
Curve Start Gradient .049
Curve End Gradient 2.800
K Value 20.000
Curve Type Sag
Curve Start Chainage 0+038.898
Curve End Chainage 0+093.923
Curve Start Level 6.724
Curve End Level 7.508

********Element 3 Grade********

Gradient Length 314.582
Gradient 2.800
Gradient Start Chainage 0+093.923
Gradient End Chainage 0+408.505
Grade Start Level 7.508
Gradient End Level 16.316

********Element 4 Vertical Curve********

IP Chainage	0+436.505
Curve Length	56.000
Vertical Radius	-2000.000
Curve Start Gradient	2.800
Curve End Gradient	.000
K Value	20.000
Curve Type	Hog
Sight Distance	100.187
Curve Start Chainage	0+408.505
Curve End Chainage	0+464.505
Curve Start Level	16.316
Curve End Level	17.100

********Element 5 Grade********

Gradient Length	59.222
Gradient	.000
Gradient Start Chainage	0+464.505
Gradient End Chainage	0+523.727
Grade Start Level	17.100
Gradient End Level	17.100

********Element 6 Vertical Curve********

IP Chainage	0+568.727
Curve Length	90.000
Vertical Radius	-2000.000
Curve Start Gradient	.000
Curve End Gradient	-4.500
K Value	20.000
Curve Type	Hog
Sight Distance	89.917
Curve Start Chainage	0+523.727
Curve End Chainage	0+613.727
Curve Start Level	17.100
Curve End Level	15.075

********Element 7 Grade********

Gradient Length	219.619
Gradient	-4.500
Gradient Start Chainage	0+613.727
Gradient End Chainage	0+833.346
Grade Start Level	15.075

Gradient End Level 5.192

********Element 8 Vertical Curve********

IP Chainage 0+855.869
Curve Length 45.046
Vertical Radius 1000.000
Curve Start Gradient -4.500
Curve End Gradient .005
K Value 10.000
Curve Type Sag
Curve Start Chainage 0+833.346
Curve End Chainage 0+878.392
Curve Start Level 5.192
Curve End Level 4.180

********Element 9 Grade********

Gradient Length 65.773
Gradient .005
Gradient Start Chainage 0+878.392
End on Gradient Chainage 0+944.166
Grade Start Level 4.180
Gradient End Level 4.183

6.5.3 Horizontal Alignment Report Arms 02

Horizontal Alignment Report

Model: INTERCH CARTER ROAD R1

String: MC60

Units: Metric

Date : 4/10/2016 5:22:49 PM

********Element 1 Straight********

Bearing 345 47 28.993
Length 89.934
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+089.934

********Element 2 Arc********

Intersection Point Chainage 0+113.732

Intersection Point X	270864.442
Intersection Point Y	2109767.919
Radius	90.000
Arc Length	46.532
Hand of Arc	Right
Included Angle	29 37 22.453
Arc Start Chainage	0+089.934
Arc End Chainage	0+136.466

********Element 3 Straight********

Bearing	15 24 51.446
Length	11.854
Straight Start Chainage	0+136.466
Straight End Chainage	0+148.319

********Element 4 Arc********

Intersection Point Chainage	0+152.692
Intersection Point X	270875.081
Intersection Point Y	2109806.503
Radius	99.999
Arc Length	8.739
Hand of Arc	Right
Included Angle	05 00 26.309
Arc Start Chainage	0+148.319
Arc End Chainage	0+157.058

********Element 5 Straight********

Bearing	20 25 17.754
Length	23.219
Straight Start Chainage	0+157.058
Straight End Chainage	0+180.278

********Element 6 Arc********

Intersection Point Chainage	0+183.441
Intersection Point X	270885.812
Intersection Point Y	2109835.325
Radius	60.000
Arc Length	6.321
Hand of Arc	Left
Included Angle	06 02 09.000
Arc Start Chainage	0+180.278
Arc End Chainage	0+186.598

********Element 7 Straight********

Bearing	14 23 08.754
Length	6.812
Straight Start Chainage	0+186.598
Straight End Chainage	0+193.411

********Element 8 Arc********

Intersection Point Chainage	0+248.744
Intersection Point X	270902.038
Intersection Point Y	2109898.586
Radius	60.000
Arc Length	89.395
Hand of Arc	Left
Included Angle	85 21 56.473
Arc Start Chainage	0+193.411
Arc End Chainage	0+282.805

********Transition********

Intersection Point Chainage	0+292.865
Transition Length	30.000
Transition Start Chainage	0+282.805
Transition End Chainage	0+312.805

********Element 9 Straight********

Bearing	274 41 46.084
Length	280.205
Straight Start Chainage	0+312.805
Straight End Chainage	0+593.010

********Element 10 Arc********

Intersection Point Chainage	0+671.886
Intersection Point X	270462.341
Intersection Point Y	2109950.939
Radius	75.000
Arc Length	349.652
Hand of Arc	Left
Included Angle	92 53 07.084
Arc Start Chainage	0+593.010
Arc End Chainage	0+942.663

********Element 11 Straight********

Bearing 07 34 53.168
Length 25.103
Straight Start Chainage 0+942.663
Finish on Straight Chainage 0+967.766

6.5.4 Vertical Alignment Report Arms 02

Vertical Alignment Report

Model: INTERCH CARTER ROAD R1

String: MC60

Units: Metric

Date : 4/10/2016 5:23:51 PM

********Element 1 Grade********

Gradient Length 92.019
Gradient .663
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+092.019
Begin on Gradient Level 3.616
Gradient End Level 4.226

********Element 2 Vertical Curve********

IP Chainage 0+125.390
Curve Length 66.743
Vertical Radius 2000.000
Curve Start Gradient .663
Curve End Gradient 4.000
K Value 20.000
Curve Type Sag
Curve Start Chainage 0+092.019
Curve End Chainage 0+158.762
Curve Start Level 4.226
Curve End Level 5.782

********Element 3 Grade********

Gradient Length 245.947
Gradient 4.000
Gradient Start Chainage 0+158.762

Gradient End Chainage	0+404.709
Grade Start Level	5.782
Gradient End Level	15.620

********Element 4 Vertical Curve********

IP Chainage	0+444.345
Curve Length	79.273
Vertical Radius	-2000.000
Curve Start Gradient	4.000
Curve End Gradient	.036
K Value	20.000
Curve Type	Hog
Sight Distance	90.631
Curve Start Chainage	0+404.709
Curve End Chainage	0+483.982
Curve Start Level	15.620
Curve End Level	17.220

********Element 5 Grade********

Gradient Length	46.431
Gradient	.036
Gradient Start Chainage	0+483.982
Gradient End Chainage	0+530.413
Grade Start Level	17.220
Gradient End Level	17.237

********Element 6 Vertical Curve********

IP Chainage	0+570.776
Curve Length	80.727
Vertical Radius	-2000.000
Curve Start Gradient	.036
Curve End Gradient	-4.000
K Value	20.000
Curve Type	Hog
Sight Distance	90.440
Curve Start Chainage	0+530.413
Curve End Chainage	0+611.140
Curve Start Level	17.237
Curve End Level	15.637

********Element 7 Grade********

Gradient Length	141.477

Gradient	-4.000
Gradient Start Chainage	0+611.140
Gradient End Chainage	0+752.616
Grade Start Level	15.637
Gradient End Level	9.978

********Element 8 Vertical Curve********

IP Chainage	0+789.875
Curve Length	74.518
Vertical Radius	2000.000
Curve Start Gradient	-4.000
Curve End Gradient	-.274
K Value	20.000
Curve Type	Sag
Curve Start Chainage	0+752.616
Curve End Chainage	0+827.134
Curve Start Level	9.978
Curve End Level	8.385

********Element 9 Grade********

Gradient Length	140.632
Gradient	-.274
Gradient Start Chainage	0+827.134
End on Gradient Chainage	0+967.766
Grade Start Level	8.385
Gradient End Level	8.000

6.5.5 Horizontal Alignment Report Arms 03

Horizontal Alignment Report

Model: INTERCH CARTER ROAD R1

String: MC70

Units: Metric

Date : 4/10/2016 5:25:55 PM

********Element 1 Arc********

Intersection Point Chainage	0+034.081
Intersection Point X	270859.123

Intersection Point Y 2109798.554
Radius 146.297
Arc Length 66.967
Hand of Arc Right
Included Angle 26 13 37.286
Begin on Arc Chainage 0+000.000
Arc-Arc (Reverse) Chainage 0+066.967

********Element 2 Arc********

Intersection Point Chainage 0+133.861
Intersection Point X 270903.909
Intersection Point Y 2109889.053
Radius 55.000
Arc Length 97.093
Hand of Arc Left
Included Angle 101 08 44.532
Arc-Arc (Reverse) Chainage 0+066.967
Arc End Chainage 0+164.060

********Transition********

Intersection Point Chainage 0+170.748
Transition Length 20.000
Transition Start Chainage 0+164.060
Transition End Chainage 0+184.060

********Element 3 Straight********

Bearing 274 46 00.888
Length 67.451
Straight Start Chainage 0+184.060
Straight End Chainage 0+251.511

********Transition********

Intersection Point Chainage 0+271.673
Transition Length 30.000
Transition Start Chainage 0+251.511
Transition End Chainage 0+281.511

********Element 4 Arc********

Intersection Point Chainage 0+326.650
Intersection Point X 270677.595
Intersection Point Y 2109910.276

Radius	75.000
Arc Length	81.266
Hand of Arc	Left
Included Angle	62 04 58.135
Arc Start Chainage	0+281.511
Arc End Chainage	0+362.778

********Transition********

Intersection Point Chainage	0+372.816
Transition Length	30.000
Transition Start Chainage	0+362.778
Transition End Chainage	0+392.778

********Element 5 Straight********

Bearing	189 45 56.831
Length	4.508
Straight Start Chainage	0+392.778
Finish on Straight Chainage	0+397.285

6.5.6 Vertical Alignment Report Arms 03

Vertical Alignment Report

Model: INTERCH CARTER ROAD R1

String: MC70

Units: Metric

Date : 4/10/2016 5:27:55 PM

********Element 1 Grade********

Gradient Length	57.201
Gradient	2.750
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+057.201
Begin on Gradient Level	4.200
Gradient End Level	5.773

********Element 2 Vertical Curve********

IP Chainage	0+080.826
Curve Length	47.250
Vertical Radius	-2000.001
Curve Start Gradient	2.750
Curve End Gradient	.387
K Value	20.000
Curve Type	Hog
Sight Distance	109.180
Curve Start Chainage	0+057.201
Curve End Chainage	0+104.451
Curve Start Level	5.773
Curve End Level	6.514

********Element 3 Grade********

Gradient Length	292.834
Gradient	.387
Gradient Start Chainage	0+104.451
End on Gradient Chainage	0+397.285
Grade Start Level	6.514
Gradient End Level	7.649

6.5.7 Horizontal Alignment Report Arms 04

Horizontal Alignment Report

Model: INTERCH CARTER ROAD R1

String: MC80

Units: Metric

Date : 4/10/2016 5:30:42 PM

********Element 1 Straight********

Bearing	183 49 04.680
Length	8.218
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+008.218

********Element 2 Arc********

Intersection Point Chainage	0+082.913

Intersection Point X	270672.739
Intersection Point Y	2109950.383
Radius	75.000
Arc Length	117.503
Hand of Arc	Left
Included Angle	89 45 57.533
Arc Start Chainage	0+008.218
Arc End Chainage	0+125.722

********Element 3 Straight********

Bearing	94 03 07.147
Length	67.868
Straight Start Chainage	0+125.722
Straight End Chainage	0+193.590

********Element 4 Arc********

Intersection Point Chainage	0+273.112
Intersection Point X	270894.268
Intersection Point Y	2109934.690
Radius	48.000
Arc Length	98.662
Hand of Arc	Left
Included Angle	117 46 09.344
Arc Start Chainage	0+193.590
Arc End Chainage	0+292.252

********Element 5 Straight********

Bearing	336 16 57.803
Length	71.030
Straight Start Chainage	0+292.252
Finish on Straight Chainage	0+363.281

6.5.8 Vertical Alignment Report Arms 04

Vertical Alignment Report

Model: INTERCH CARTER ROAD R1

String: MC80

Units: Metric

Date : 4/10/2016 5:31:43 PM

********Element 1 Grade********

Gradient Length	247.962
Gradient	-.170
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+247.962
Begin on Gradient Level	6.962
Gradient End Level	6.540

********Element 2 Vertical Curve********

IP Chainage	0+271.261
Curve Length	46.597
Vertical Radius	-1999.999
Curve Start Gradient	-.170
Curve End Gradient	-2.500
K Value	20.000
Curve Type	Hog
Sight Distance	110.052
Curve Start Chainage	0+247.962
Curve End Chainage	0+294.559
Curve Start Level	6.540
Curve End Level	5.918

********Element 3 Grade********

Gradient Length	68.722
Gradient	-2.500
Gradient Start Chainage	0+294.559
End on Gradient Chainage	0+363.281
Grade Start Level	5.918
Gradient End Level	4.200

6.6 Seven Bungalow Interchange Design (Ritumbra Interchange):-

Detail of Arms Gives in table below,

Table 6-6 Seven Bungalow Interchange Design (Ritumbra Interchange) Arms Detail

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MC01	South CR	Varsova Link Road	Stilt	2
2	MC02	Varsova Link Road	North CR	Flyover	2
3	MC03	North CR	Varsova Link Road	2nd Flyover	2
4	MC04	Varsova Link Road	South CR	Flyover	2

Plan and Profile of Seven Bungalow Interchange Design (Ritumbra Interchange) gives in Drawing no. 8098/E/DD-1160 to 8098/E/DD-1164 Volume IV Drawings.

6.6.1 Horizontal Alignment Report Arms 01

Horizontal Alignment Report

Model: INTERCHANGE RITUMBARA R1

String: MC01

Units: Metric

Date : 4/10/2016 5:43:53 PM

********Element A001 Straight********

Bearing 359 31 47.560
Length 29.263
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+029.263

********Transition********

Intersection Point Chainage 0+046.002
Transition Length 25.000
Transition Start Chainage 0+029.263
Transition End Chainage 0+054.263

********Element A002 Arc********

Intersection Point Chainage	0+102.306
Intersection Point X	270617.186
Intersection Point Y	2115934.663
Radius	85.000
Arc Length	87.456
Hand of Arc	Left
Included Angle	58 57 04.853
Arc Start Chainage	0+054.263
Arc End Chainage	0+141.719

********Transition********

Intersection Point Chainage	0+150.069
Transition Length	25.000
Transition Start Chainage	0+141.719
Transition End Chainage	0+166.719

********Element A008 Straight********

Bearing	283 43 36.588
Length	5.985
Straight Start Chainage	0+166.719
Straight End Chainage	0+172.704

********Transition********

Intersection Point Chainage	0+189.462
Transition Length	25.000
Transition Start Chainage	0+172.704
Transition End Chainage	0+197.704

********Element A009 Arc********

Intersection Point Chainage	0+388.570
Intersection Point X	270343.540
Intersection Point Y	2116043.591
Radius	76.000
Arc Length	181.162
Hand of Arc	Right
Included Angle	136 34 35.844
Arc Start Chainage	0+197.704
Arc End Chainage	0+378.866

********Transition********

Intersection Point Chainage 0+387.221
Transition Length 25.000
Transition Start Chainage 0+378.866
Transition End Chainage 0+403.866

********Element A003 Straight********

Bearing 79 09 02.697
Length 83.375
Straight Start Chainage 0+403.866
Straight End Chainage 0+487.241

********Transition********

Intersection Point Chainage 0+507.264
Transition Length 30.000
Transition Start Chainage 0+487.241
Transition End Chainage 0+517.241

********Element A005 Arc********

Intersection Point Chainage 0+537.046
Intersection Point X 270677.119
Intersection Point Y 2116143.009
Radius 200.000
Arc Length 39.481
Hand of Arc Left
Included Angle 11 18 37.542
Arc Start Chainage 0+517.241
Arc End Chainage 0+556.722

********Transition********

Intersection Point Chainage 0+566.727
Transition Length 30.000
Transition Start Chainage 0+556.722
Transition End Chainage 0+586.722

********Element A004 Straight********

Bearing 59 14 45.434
Length 39.423
Straight Start Chainage 0+586.722
Finish on Straight Chainage 0+626.145

6.6.2 Vertical Alignment Report Arms 01

Vertical Alignment Report

Model: INTERCHANGE RITUMBARA R1

String: MC01

Units: Metric

Date : 4/10/2016 5:45:49 PM

********Element 1 Grade********

Gradient Length	353.748
Gradient	-.557
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+353.748
Begin on Gradient Level	6.709
Gradient End Level	4.740

********Element 2 Vertical Curve********

IP Chainage	0+411.017
Curve Length	114.538
Vertical Radius	25714.286
Curve Start Gradient	-.557
Curve End Gradient	-.111
K Value	257.143
Curve Type	Sag
Curve Start Chainage	0+353.748
Curve End Chainage	0+468.286
Curve Start Level	4.740
Curve End Level	4.358

********Element 3 Grade********

Gradient Length	53.884
Gradient	-.111
Gradient Start Chainage	0+468.286
Gradient End Chainage	0+522.170
Grade Start Level	4.358
Gradient End Level	4.298

********Element 4 Vertical Curve********

IP Chainage	0+552.170

Curve Length	60.000
Vertical Radius	-3176.471
Curve Start Gradient	-.111
Curve End Gradient	-2.000
K Value	31.765
Curve Type	Hog
Sight Distance	137.007
Curve Start Chainage	0+522.170
Curve End Chainage	0+582.170
Curve Start Level	4.298
Curve End Level	3.665

********Element 5 Grade********

Gradient Length	43.975
Gradient	-2.000
Gradient Start Chainage	0+582.170
End on Gradient Chainage	0+626.145
Grade Start Level	3.665
Gradient End Level	2.785

6.6.3 Horizontal Alignment Report Arms 02

Horizontal Alignment Report

Model: INTERCHANGE RITUMBARA R1

String: MC02

Units: Metric

Date : 4/10/2016 5:47:20 PM

********Element A001 Straight********

Bearing	239 14 45.434
Length	44.639
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+044.639

********Transition********

Intersection Point Chainage	0+061.319
Transition Length	25.000
Transition Start Chainage	0+044.639
Transition End Chainage	0+069.639

********Element A002 Arc********

Intersection Point Chainage	0+091.972
Intersection Point X	270675.647
Intersection Point Y	2116140.367
Radius	200.000
Arc Length	44.481
Hand of Arc	Right
Included Angle	12 44 34.164
Arc Start Chainage	0+069.639
Arc End Chainage	0+114.120

********Transition********

Intersection Point Chainage	0+122.456
Transition Length	25.000
Transition Start Chainage	0+114.120
Transition End Chainage	0+139.120

********Element A007 Straight********

Bearing	259 09 02.698
Length	79.712
Straight Start Chainage	0+139.120
Straight End Chainage	0+218.832

********Transition********

Intersection Point Chainage	0+239.003
Transition Length	30.000
Transition Start Chainage	0+218.832
Transition End Chainage	0+248.832

********Element A003 Arc********

Intersection Point Chainage	0+406.195
Intersection Point X	270377.076
Intersection Point Y	2116046.417
Radius	73.000
Arc Length	292.751
Hand of Arc	Left
Included Angle	130 13 38.565
Arc Start Chainage	0+248.832
Arc End Chainage	0+541.583

********Transition********

Intersection Point Chainage 0+551.623
Transition Length 30.000
Transition Start Chainage 0+541.583
Transition End Chainage 0+571.583

********Element A004 Straight********

Bearing 05 49 54.905
Length 36.223
Straight Start Chainage 0+571.583
Finish on Straight Chainage 0+607.806

6.6.4 Vertical Alignment Report Arms 02

Vertical Alignment Report

Model: INTERCHANGE RITUMBARA R1

String: MC02

Units: Metric

Date : 4/10/2016 5:48:07 PM

********Element 1 Grade********

Gradient Length 184.099
Gradient .136
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+184.099
Begin on Gradient Level 4.139
Gradient End Level 4.390

********Element 2 Vertical Curve********

IP Chainage 0+215.097
Curve Length 61.997
Vertical Radius 3000.000
Curve Start Gradient .136
Curve End Gradient 2.203
K Value 30.000
Curve Type Sag
Curve Start Chainage 0+184.099
Curve End Chainage 0+246.096
Curve Start Level 4.390
Curve End Level 5.115

********Element 3 Grade********

Gradient Length	361.710
Gradient	2.203
Gradient Start Chainage	0+246.096
End on Gradient Chainage	0+607.806
Grade Start Level	5.115
Gradient End Level	13.083

6.6.5 Horizontal Alignment Report Arms 03

Horizontal Alignment Report

Model: INTERCHANGE RITUMBARA R1

String: MC03

Units: Metric

Date : 4/10/2016 5:50:12 PM

********Element A001 Straight********

Bearing	162 58 29.273
Length	53.317
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+053.317

********Transition********

Intersection Point Chainage	0+073.429
Transition Length	30.000
Transition Start Chainage	0+053.317
Transition End Chainage	0+083.317

********Element A007 Arc********

Intersection Point Chainage	6+689.678
Intersection Point X	273645.312
Intersection Point Y	2110098.671
Radius	90.000
Arc Length	280.291
Hand of Arc	Left
Included Angle	178 26 20.360
Arc Start Chainage	0+083.317
Arc End Chainage	0+363.608

********Transition********

Intersection Point Chainage	0+373.635
Transition Length	30.000
Transition Start Chainage	0+363.608
Transition End Chainage	0+393.608

********Element A002 Straight********

Bearing	325 26 13.977
Length	82.715
Straight Start Chainage	0+393.608
Straight End Chainage	0+476.324

********Element A006 Arc********

Intersection Point Chainage	0+500.782
Intersection Point X	270775.531
Intersection Point Y	2116199.248
Radius	22.000
Arc Length	36.883
Hand of Arc	Right
Included Angle	96 03 25.557
Arc Start Chainage	0+476.324
Arc End Chainage	0+513.207

********Element A005 Straight********

Bearing	61 29 39.534
Length	41.176
Straight Start Chainage	0+513.207
Finish on Straight Chainage	0+554.383

6.6.6 Vertical Alignment Report Arms 03

Vertical Alignment Report

Model: INTERCHANGE RITUMBARA R1

String: MC03

Units: Metric

Date : 4/10/2016 5:51:39 PM

********Element 1 Grade********

Gradient Length	431.386

Gradient -4.106
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+431.386
Begin on Gradient Level 23.021
Gradient End Level 5.307

********Element 2 Vertical Curve********

IP Chainage 0+482.603
Curve Length 102.433
Vertical Radius 2287.382
Curve Start Gradient -4.106
Curve End Gradient .372
K Value 22.874
Curve Type Sag
Curve Start Chainage 0+431.386
Curve End Chainage 0+533.819
Curve Start Level 5.307
Curve End Level 3.394

********Element 3 Grade********

Gradient Length 20.564
Gradient .372
Gradient Start Chainage 0+533.819
End on Gradient Chainage 0+554.383
Grade Start Level 3.394
Gradient End Level 3.470

6.6.7 Horizontal Alignment Report Arms 04

Horizontal Alignment Report

Model: INTERCHANGE RITUMBARA R1

String: MC04

Units: Metric

Date : 4/10/2016 5:53:31 PM

********Element A006 Straight********

Bearing 239 14 45.436
Length 13.885
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+013.885

********Transition********

Intersection Point Chainage	0+030.574
Transition Length	25.000
Transition Start Chainage	0+013.885
Transition End Chainage	0+038.885

********Element A001 Arc********

Intersection Point Chainage	0+108.563
Intersection Point X	270671.818
Intersection Point Y	2116114.582
Radius	155.000
Arc Length	130.965
Hand of Arc	Left
Included Angle	48 24 40.662
Arc Start Chainage	0+038.885
Arc End Chainage	0+169.850

********Transition********

Intersection Point Chainage	0+178.189
Transition Length	25.000
Transition Start Chainage	0+169.850
Transition End Chainage	0+194.850

********Element A002 Straight********

Bearing	181 35 36.257
Length	1.425
Straight Start Chainage	0+194.850
Straight End Chainage	0+196.275

********Transition********

Intersection Point Chainage	0+216.277
Transition Length	30.000
Transition Start Chainage	0+196.275
Transition End Chainage	0+226.275

********Element A004 Arc********

Intersection Point Chainage	0+235.283
Intersection Point X	270662.120
Intersection Point Y	2115979.934

Radius	850.000
Arc Length	18.014
Hand of Arc	Left
Included Angle	01 12 51.311
Arc Start Chainage	0+226.275
Arc End Chainage	0+244.289

********Transition********

Intersection Point Chainage	0+254.290
Transition Length	30.000
Transition Start Chainage	0+244.289
Transition End Chainage	0+274.289

********Element A005 Straight********

Bearing	178 21 25.011
Length	52.315
Straight Start Chainage	0+274.289
Straight End Chainage	0+326.604

********Element A007 Arc********

Intersection Point Chainage	0+331.203
Intersection Point X	270664.535
Intersection Point Y	2115884.046
Radius	5000.000
Arc Length	9.196
Hand of Arc	Right
Included Angle	00 06 19.370
Arc Start Chainage	0+326.604
Arc End Chainage	0+335.801

********Element A003 Straight********

Bearing	178 27 44.381
Length	138.532
Straight Start Chainage	0+335.801
Straight End Chainage	0+474.333

********Element A009 Arc********

Intersection Point Chainage	0+481.202
Intersection Point X	270668.561
Intersection Point Y	2115734.100
Radius	250.000

Arc Length	13.736
Hand of Arc	Left
Included Angle	03 08 53.150
Arc Start Chainage	0+474.333
Arc End Chainage	0+488.069

********Element A008 Straight********

Bearing	175 18 51.231
Length	43.206
Straight Start Chainage	0+488.069
Finish on Straight Chainage	0+531.275

6.6.8 Vertical Alignment Report Arms 04

Vertical Alignment Report

Model: INTERCHANGE RITUMBARA R1

String: MC04

Units: Metric

Date : 4/10/2016 5:54:29 PM

********Element 1 Grade********

Gradient Length	15.397
Gradient	-2.055
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+015.397
Begin on Gradient Level	2.749
Gradient End Level	2.432

********Element 2 Vertical Curve********

IP Chainage	0+045.397
Curve Length	60.000
Vertical Radius	990.909
Curve Start Gradient	-2.055
Curve End Gradient	4.000
K Value	9.909
Curve Type	Sag
Curve Start Chainage	0+015.397
Curve End Chainage	0+075.397
Curve Start Level	2.432
Curve End Level	3.016

********Element 3 Grade********

Gradient Length	209.672
Gradient	4.000
Gradient Start Chainage	0+075.397
Gradient End Chainage	0+285.068
Grade Start Level	3.016
Gradient End Level	11.403

********Element 4 Vertical Curve********

IP Chainage	0+360.068
Curve Length	150.000
Vertical Radius	-1875.000
Curve Start Gradient	4.000
Curve End Gradient	-4.000
K Value	18.750
Curve Type	Hog
Sight Distance	87.061
Curve Start Chainage	0+285.068
Curve End Chainage	0+435.068
Curve Start Level	11.403
Curve End Level	11.403

********Element 5 Grade********

Gradient Length	96.206
Gradient	-4.000
Gradient Start Chainage	0+435.068
End on Gradient Chainage	0+531.275
Grade Start Level	11.403
Gradient End Level	7.554

6.7 Madh Island Interchange Design:-

Detail of Arms Gives in table below,

Table 6-7 Madh Island Interchange Arms detail

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MCA0	North CR	Mhad Island	2nd Flyover	2
2	MCB0	Madh Island	South CR	2nd Flyover	2
3	MCC0	South CR	Mhad Island	Flyover	2
4	MCD0	Madh Island	North CR	Flyover	2
5	MCX0	Madh Island Connectivity		Bridge	2+2

Plan and Profile of Madh Island Interchange gives in Drawing no. 8098/E/DD-1170 to 8098/E/DD-1175 Volume IV Drawings.

6.7.1 Horizontal Alignment Report Arm 01

Horizontal Alignment Report

Model: NORTH IC09

String: MCA0

Units: Metric

Date : 4/10/2016 6:06:36 PM

********Element 1 Straight********

Bearing 126 00 55.172
Length 46.162
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+046.162

********Element 2 Arc********

Intersection Point Chainage 0+275.913
Intersection Point X 270162.090
Intersection Point Y 2117980.469
Radius 400.000

Arc Length 417.093
Hand of Arc Left
Included Angle 59 44 38.893
Arc Start Chainage 0+046.162
Arc End Chainage 0+463.254

********Element 3 Straight********

Bearing 66 16 16.279
Length 242.197
Straight Start Chainage 0+463.254
Straight End Chainage 0+705.452

********Element 4 Arc********

Intersection Point Chainage 0+755.452
Intersection Point X 270639.912
Intersection Point Y 2118190.505
Radius 200.000
Arc Length 97.991
Hand of Arc Left
Included Angle 28 04 20.344
Arc Start Chainage 0+705.452
Finish on Arc Chainage 0+803.443

6.7.2 Vertical Alignment Report Arm 01

Vertical Alignment Report

Model: NORTH IC09

String: MCA0

Units: Metric

Date : 4/10/2016 6:08:10 PM

********Element 1 Grade********

Gradient Length 92.075
Gradient -.500
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+092.075
Begin on Gradient Level 8.288
Gradient End Level 7.828

********Element 2 Vertical Curve********

IP Chainage	0+241.943
Curve Length	299.736
Vertical Radius	6660.649
Curve Start Gradient	-.500
Curve End Gradient	4.000
K Value	66.606
Curve Type	Sag
Curve Start Chainage	0+092.075
Curve End Chainage	0+391.812
Curve Start Level	7.828
Curve End Level	13.073

********Element 3 Grade********

Gradient Length	276.326
Gradient	4.000
Gradient Start Chainage	0+391.812
Gradient End Chainage	0+668.138
Grade Start Level	13.073
Gradient End Level	24.126

********Element 4 Vertical Curve********

IP Chainage	0+703.138
Curve Length	70.000
Vertical Radius	-1186.441
Curve Start Gradient	4.000
Curve End Gradient	-1.900
K Value	11.864
Curve Type	Hog
Sight Distance	69.254
Curve Start Chainage	0+668.138
Curve End Chainage	0+738.138
Curve Start Level	24.126
Curve End Level	24.861

********Element 5 Grade********

Gradient Length	.305
Gradient	-1.900
Gradient Start Chainage	0+738.138
Gradient End Chainage	0+738.443
Grade Start Level	24.861
Gradient End Level	24.855

********Element 6 Vertical Curve********

IP Chainage	0+768.443
Curve Length	60.000
Vertical Radius	3797.469
Curve Start Gradient	-1.900
Curve End Gradient	-.320
K Value	37.975
Curve Type	Sag
Curve Start Chainage	0+738.443
Curve End Chainage	0+798.443
Curve Start Level	24.855
Curve End Level	24.189

********Element 7 Grade********

Gradient Length	5.000
Gradient	-.320
Gradient Start Chainage	0+798.443
End on Gradient Chainage	0+803.443
Grade Start Level	24.189
Gradient End Level	24.173

6.7.3 Horizontal Alignment Report Arm 02

Horizontal Alignment Report

Model: NORTH IC09

String: MCB0

Units: Metric

Date : 4/10/2016 6:09:11 PM

********Element 1 Straight********

Bearing	126 00 55.171
Length	214.683
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+214.683

********Element 2 Arc********

Intersection Point Chainage	0+293.846
Intersection Point X	270014.335
Intersection Point Y	2118112.605
Radius	700.000
Arc Length	157.657

Hand of Arc Left
Included Angle 12 54 15.941
Arc Start Chainage 0+214.683
Arc End Chainage 0+372.340

********Element 3 Straight********

Bearing 113 06 39.231
Length 55.953
Straight Start Chainage 0+372.340
Straight End Chainage 0+428.293

********Element 4 Arc********

Intersection Point Chainage 0+584.820
Intersection Point X 270282.573
Intersection Point Y 2117998.132
Radius 300.000
Arc Length 288.541
Hand of Arc Left
Included Angle 55 06 26.249
Arc Start Chainage 0+428.293
Arc-Arc (Reverse) Chainage 0+716.834

********Element 5 Arc********

Intersection Point Chainage 0+938.505
Intersection Point X 270603.316
Intersection Point Y 2118198.526
Radius 100.000
Arc Length 229.403
Hand of Arc Right
Included Angle 131 26 16.693
Arc-Arc (Reverse) Chainage 0+716.834
Finish on Arc Chainage 0+946.236

6.7.4 Vertical Alignment Report Arm 02

Vertical Alignment Report

Model: NORTH IC09

String: MCB0

Units: Metric

Date : 4/10/2016 6:10:56 PM

********Element 1 Grade********

Gradient Length	75.314
Gradient	-.500
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+075.314
Begin on Gradient Level	9.363
Gradient End Level	8.987

********Element 2 Vertical Curve********

IP Chainage	0+125.314
Curve Length	100.000
Vertical Radius	2222.222
Curve Start Gradient	-.500
Curve End Gradient	4.000
K Value	22.222
Curve Type	Sag
Curve Start Chainage	0+075.314
Curve End Chainage	0+175.314
Curve Start Level	8.987
Curve End Level	10.737

********Element 3 Grade********

Gradient Length	247.687
Gradient	4.000
Gradient Start Chainage	0+175.314
Gradient End Chainage	0+423.001
Grade Start Level	10.737
Gradient End Level	20.644

********Element 4 Vertical Curve********

IP Chainage	0+473.001
Curve Length	100.000
Vertical Radius	-2941.177
Curve Start Gradient	4.000
Curve End Gradient	.600
K Value	29.412
Curve Type	Hog
Sight Distance	109.449
Curve Start Chainage	0+423.001
Curve End Chainage	0+523.001
Curve Start Level	20.644
Curve End Level	22.944

********Element 5 Grade********

Gradient Length	296.648
Gradient	.600
Gradient Start Chainage	0+523.001
Gradient End Chainage	0+819.649
Grade Start Level	22.944
Gradient End Level	24.724

********Element 6 Vertical Curve********

IP Chainage	0+849.649
Curve Length	60.000
Vertical Radius	-3251.038
Curve Start Gradient	.600
Curve End Gradient	-1.246
K Value	32.510
Curve Type	Hog
Sight Distance	139.519
Curve Start Chainage	0+819.649
Curve End Chainage	0+879.649
Curve Start Level	24.724
Curve End Level	24.530

********Element 7 Grade********

Gradient Length	2.970
Gradient	-1.246
Gradient Start Chainage	0+879.649
Gradient End Chainage	0+882.619
Grade Start Level	24.530
Gradient End Level	24.493

********Element 8 Vertical Curve********

IP Chainage	0+912.619
Curve Length	60.000
Vertical Radius	5713.102
Curve Start Gradient	-1.246
Curve End Gradient	-.195
K Value	57.131
Curve Type	Sag
Curve Start Chainage	0+882.619
Curve End Chainage	0+942.619
Curve Start Level	24.493

Curve End Level 24.061

********Element 9 Grade********

Gradient Length 3.618
Gradient -.195
Gradient Start Chainage 0+942.619
End on Gradient Chainage 0+946.236
Grade Start Level 24.061
Gradient End Level 24.054

6.7.5 Horizontal Alignment Report Arm 03

Horizontal Alignment Report

Model: NORTH IC09

String: MCC0

Units: Metric

Date : 4/10/2016 6:12:16 PM

********Element 1 Straight********

Bearing 124 53 31.553
Length 16.956
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+016.956

********Element 2 Arc********

Intersection Point Chainage 0+101.385
Intersection Point X 270081.481
Intersection Point Y 2118038.493
Radius 330.000
Arc Length 165.312
Hand of Arc Left
Included Angle 28 42 07.269
Arc Start Chainage 0+016.956
Arc End Chainage 0+182.268

********Element 3 Straight********

Bearing 96 11 24.284
Length 217.369
Straight Start Chainage 0+182.268

Straight End Chainage 0+399.637

********Element 4 Arc********

Intersection Point Chainage 0+534.858
Intersection Point X 270515.952
Intersection Point Y 2117991.371
Radius 150.000
Arc Length 220.088
Hand of Arc Right
Included Angle 84 04 03.222
Arc Start Chainage 0+399.637
Finish on Arc Chainage 0+619.725

6.7.6 Vertical Alignment Report Arm 03

Vertical Alignment Report

Model: NORTH IC09

String: MCC0

Units: Metric

Date : 4/10/2016 6:13:04 PM

********Element 1 Grade********

Gradient Length 10.000
Gradient -.610
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+010.000
Begin on Gradient Level 7.825
Gradient End Level 7.764

********Element 2 Vertical Curve********

IP Chainage 0+050.000
Curve Length 80.000
Vertical Radius 3816.834
Curve Start Gradient -.610
Curve End Gradient 1.486
K Value 38.168
Curve Type Sag
Curve Start Chainage 0+010.000
Curve End Chainage 0+090.000
Curve Start Level 7.764
Curve End Level 8.114

********Element 3 Grade********

Gradient Length	439.725
Gradient	1.486
Gradient Start Chainage	0+090.000
Gradient End Chainage	0+529.725
Grade Start Level	8.114
Gradient End Level	14.649

********Element 4 Vertical Curve********

IP Chainage	0+569.725
Curve Length	80.000
Vertical Radius	-4429.732
Curve Start Gradient	1.486
Curve End Gradient	-.320
K Value	44.297
Curve Type	Hog
Sight Distance	151.920
Curve Start Chainage	0+529.725
Curve End Chainage	0+609.725
Curve Start Level	14.649
Curve End Level	15.115

********Element 5 Grade********

Gradient Length	10.000
Gradient	-.320
Gradient Start Chainage	0+609.725
End on Gradient Chainage	0+619.725
Grade Start Level	15.115
Gradient End Level	15.083

6.7.7 Horizontal Alignment Report Arm 04

Horizontal Alignment Report

Model: NORTH IC09

String: MCD0

Units: Metric

Date : 4/10/2016 6:14:12 PM

********Element 1 Straight********

Bearing 126 00 55.172
Length 153.671
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+153.671

********Element 2 Arc********

Intersection Point Chainage 0+400.653
Intersection Point X 270176.535
Intersection Point Y 2118002.111
Radius 430.000
Arc Length 448.375
Hand of Arc Left
Included Angle 59 44 38.893
Arc Start Chainage 0+153.671
Arc End Chainage 0+602.046

********Element 3 Straight********

Bearing 66 16 16.279
Length 149.479
Straight Start Chainage 0+602.046
Straight End Chainage 0+751.524

********Element 4 Arc********

Intersection Point Chainage 0+828.158
Intersection Point X 270609.635
Intersection Point Y 2118192.488
Radius 300.000
Arc Length 150.059
Hand of Arc Left
Included Angle 28 39 33.178
Arc Start Chainage 0+751.524
Finish on Arc Chainage 0+901.583

6.7.8 Vertical Alignment Report Arm 04

Vertical Alignment Report

Model: NORTH IC09

String: MCD0

Units: Metric

Date : 4/10/2016 6:15:07 PM

********Element 1 Grade********

Gradient Length	2.000
Gradient	-.090
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+002.000
Begin on Gradient Level	8.811
Gradient End Level	8.809

********Element 2 Vertical Curve********

IP Chainage	0+032.000
Curve Length	60.000
Vertical Radius	7104.926
Curve Start Gradient	-.090
Curve End Gradient	.754
K Value	71.049
Curve Type	Sag
Curve Start Chainage	0+002.000
Curve End Chainage	0+062.000
Curve Start Level	8.809
Curve End Level	9.009

********Element 3 Grade********

Gradient Length	774.583
Gradient	.754
Gradient Start Chainage	0+062.000
Gradient End Chainage	0+836.583
Grade Start Level	9.009
Gradient End Level	14.853

********Element 4 Vertical Curve********

IP Chainage	0+866.583
Curve Length	60.000
Vertical Radius	-6286.115
Curve Start Gradient	.754
Curve End Gradient	-.200
K Value	62.861
Curve Type	Hog
Sight Distance	241.763
Curve Start Chainage	0+836.583
Curve End Chainage	0+896.583
Curve Start Level	14.853
Curve End Level	15.019

********Element 5 Grade********

Gradient Length	5.000
Gradient	-.200
Gradient Start Chainage	0+896.583
End on Gradient Chainage	0+901.583
Grade Start Level	15.019
Gradient End Level	15.009

Madh Island Connectivity Design:-

6.7.9 Horizontal Alignment Report Arm 05

Horizontal Alignment Report

Model: NORTH IC09

String: MCX0

Units: Metric

Date : 4/10/2016 6:16:24 PM

********Element 1 Straight********

Bearing	61 38 50.418
Length	502.965
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+502.965

********Element 2 Arc********

Intersection Point Chainage	0+899.452
Intersection Point X	269359.779
Intersection Point Y	2118576.072
Radius	630.000
Arc Length	707.763
Hand of Arc	Right
Included Angle	64 22 04.752
Arc Start Chainage	0+502.965
Arc End Chainage	1+210.728

********Element 3 Straight********

Bearing	126 00 55.170

Length	326.774
Straight Start Chainage	1+210.728
Finish on Straight Chainage	1+537.502

6.7.10 Vertical Alignment Report Arm 05

Vertical Alignment Report

Model: NORTH IC09

String: MCX0

Units: Metric

Date : 4/10/2016 6:17:43 PM

********Element 1 Grade********

Gradient Length	19.793
Gradient	-.942
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+019.793
Begin on Gradient Level	3.901
Gradient End Level	3.715

********Element 2 Vertical Curve********

IP Chainage	0+049.793
Curve Length	60.000
Vertical Radius	1214.113
Curve Start Gradient	-.942
Curve End Gradient	4.000
K Value	12.141
Curve Type	Sag
Curve Start Chainage	0+019.793
Curve End Chainage	0+079.793
Curve Start Level	3.715
Curve End Level	4.632

********Element 3 Grade********

Gradient Length	274.207
Gradient	4.000
Gradient Start Chainage	0+079.793
Gradient End Chainage	0+354.000
Grade Start Level	4.632
Gradient End Level	15.600

********Element 4 Vertical Curve********

IP Chainage	0+389.000
Curve Length	70.000
Vertical Radius	-1750.035
Curve Start Gradient	4.000
Curve End Gradient	.000
K Value	17.500
Curve Type	Hog
Sight Distance	85.532
Curve Start Chainage	0+354.000
Curve End Chainage	0+424.000
Curve Start Level	15.600
Curve End Level	17.000

********Element 5 Grade********

Gradient Length	166.000
Gradient	.000
Gradient Start Chainage	0+424.000
Gradient End Chainage	0+590.000
Grade Start Level	17.000
Gradient End Level	17.000

********Element 6 Vertical Curve********

IP Chainage	0+630.000
Curve Length	80.000
Vertical Radius	-3200.000
Curve Start Gradient	.000
Curve End Gradient	-2.500
K Value	32.000
Curve Type	Hog
Sight Distance	120.850
Curve Start Chainage	0+590.000
Curve End Chainage	0+670.000
Curve Start Level	17.000
Curve End Level	16.000

********Element 7 Grade********

Gradient Length	253.012
Gradient	-2.500
Gradient Start Chainage	0+670.000
Gradient End Chainage	0+923.012
Grade Start Level	16.000

Gradient End Level 9.675

********Element 8 Vertical Curve********

IP Chainage	0+973.012
Curve Length	100.000
Vertical Radius	3333.333
Curve Start Gradient	-2.500
Curve End Gradient	.500
K Value	33.333
Curve Type	Sag
Curve Start Chainage	0+923.012
Curve End Chainage	1+023.012
Curve Start Level	9.675
Curve End Level	8.675

********Element 9 Grade********

Gradient Length	189.774
Gradient	.500
Gradient Start Chainage	1+023.012
Gradient End Chainage	1+212.786
Grade Start Level	8.675
Gradient End Level	9.624

********Element 10 Vertical Curve********

IP Chainage	1+262.786
Curve Length	100.000
Vertical Radius	-10000.001
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	100.000
Curve Type	Hog
Sight Distance	252.125
Curve Start Chainage	1+212.786
Curve End Chainage	1+312.786
Curve Start Level	9.624
Curve End Level	9.624

********Element 11 Grade********

Gradient Length	224.716
Gradient	-.500
Gradient Start Chainage	1+312.786
End on Gradient Chainage	1+537.502

Grade Start Level	9.624
Gradient End Level	8.500

6.8 Oshiwara (Malad) Interchange Design:-

Detail of Arms Gives in table below,

Table 6-8 Oshiwara (Malad) Interchange Arms Design

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MCA0	Existing Road		RE Wall	2+2
2	MCB0	Round about with VUP		At Grade	3
3	MCC0	South CR	Existing Road	RE wall	2
4	MCD0	Existing Road	North CR	RE wall	2
5	MCE0	North CR	Existing Road	RE wall	2
6	MCF0	Existing Road	South CR	RE wall	2

Plan and Profile of Oshiwara (Malad) Interchange Design gives in Drawing no. 8098/E/DD-1220 to 8098/E/DD-1226 Volume IV Drawings.

6.8.1 Horizontal Alignment Report Arm 01

Horizontal Alignment Report

Model: NORTH IC10

String: MCA0

Units: Metric

Date : 4/11/2016 12:54:18 PM

********Element 1 Straight********

Bearing 298 50 22.694
Length 88.647
Begin on Straight Chainage 0+000.000
Finish on Straight Chainage 0+088.647

6.8.2 Vertical Alignment Report Arm 01

Vertical Alignment Report

Model: NORTH IC10

String: MCA0

Units: Metric

Date : 4/10/2016 6:21:45 PM

********Element 1 Grade********

Gradient Length	40.000
Gradient	.043
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+040.000
Begin on Gradient Level	3.754
Gradient End Level	3.771

********Element 2 Vertical Curve********

IP Chainage	0+060.000
Curve Length	40.000
Vertical Radius	8752.733
Curve Start Gradient	.043
Curve End Gradient	.500
K Value	87.527
Curve Type	Sag
Curve Start Chainage	0+040.000
Curve End Chainage	0+080.000
Curve Start Level	3.771
Curve End Level	3.880

********Element 3 Grade********

Gradient Length	8.647
Gradient	.500
Gradient Start Chainage	0+080.000
End on Gradient Chainage	0+088.647
Grade Start Level	3.880
Gradient End Level	3.923

6.8.3 Horizontal Alignment Report Arm 02

Horizontal Alignment Report

Model: NORTH IC10

String: MCB0

Units: Metric

Date : 4/10/2016 6:23:24 PM

********Element 1 Straight********

Bearing	217 21 59.010
Length	72.330
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+072.330

********Element 2 Arc********

Intersection Point Chainage	0+122.902
Intersection Point X	271498.936
Intersection Point Y	2119199.582
Radius	50.500
Arc Length	79.398
Hand of Arc	Right
Included Angle	90 04 56.062
Arc Start Chainage	0+072.330
Arc End Chainage	0+151.728

********Element 3 Straight********

Bearing	307 26 55.071
Length	10.000
Straight Start Chainage	0+151.728
Straight End Chainage	0+161.728

********Element 4 Arc********

Intersection Point Chainage	0+212.155
Intersection Point X	271410.813
Intersection Point Y	2119267.076
Radius	50.500
Arc Length	79.253
Hand of Arc	Right
Included Angle	89 55 03.938
Arc Start Chainage	0+161.728
Arc End Chainage	0+240.980

********Element 5 Straight********

Bearing	37 21 59.010
Length	133.418

Straight Start Chainage 0+240.980
Straight End Chainage 0+374.398

********Element 6 Arc********

Intersection Point Chainage 0+415.800
Intersection Point X 271547.517
Intersection Point Y 2119446.096
Radius 50.500
Arc Length 69.359
Hand of Arc Right
Included Angle 78 41 31.757
Arc Start Chainage 0+374.398
Arc End Chainage 0+443.757

********Element 7 Straight********

Bearing 116 03 30.766
Length 10.198
Straight Start Chainage 0+443.757
Straight End Chainage 0+453.955

********Element 8 Arc********

Intersection Point Chainage 0+515.552
Intersection Point X 271649.208
Intersection Point Y 2119396.369
Radius 50.500
Arc Length 89.292
Hand of Arc Right
Included Angle 101 18 28.242
Arc Start Chainage 0+453.955
Arc End Chainage 0+543.246

********Element 9 Straight********

Bearing 217 21 59.008
Length 63.001
Straight Start Chainage 0+543.246
Finish on Straight Chainage 0+606.247

6.8.4 Vertical Alignment Report Arm 02

Vertical Alignment Report

Model: NORTH IC10

String: MCB0

Units: Metric

Date : 4/10/2016 6:24:19 PM

********Element 1 Grade********

Gradient Length	111.562
Gradient	.500
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+111.562
Begin on Gradient Level	3.922
Gradient End Level	4.480

********Element 2 Vertical Curve********

IP Chainage	0+151.562
Curve Length	80.000
Vertical Radius	-7999.997
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	80.000
Curve Type	Hog
Sight Distance	242.125
Curve Start Chainage	0+111.562
Curve End Chainage	0+191.562
Curve Start Level	4.480
Curve End Level	4.480

********Element 3 Grade********

Gradient Length	71.562
Gradient	-.500
Gradient Start Chainage	0+191.562
Gradient End Chainage	0+263.124
Grade Start Level	4.480
Gradient End Level	4.122

********Element 4 Vertical Curve********

IP Chainage	0+303.124
Curve Length	80.000
Vertical Radius	7999.997
Curve Start Gradient	-.500
Curve End Gradient	.500
K Value	80.000

Curve Type	Sag
Curve Start Chainage	0+263.124
Curve End Chainage	0+343.124
Curve Start Level	4.122
Curve End Level	4.122

********Element 5 Grade********

Gradient Length	71.562
Gradient	.500
Gradient Start Chainage	0+343.124
Gradient End Chainage	0+414.685
Grade Start Level	4.122
Gradient End Level	4.480

********Element 6 Vertical Curve********

IP Chainage	0+454.685
Curve Length	80.000
Vertical Radius	-8000.000
Curve Start Gradient	.500
Curve End Gradient	-.500
K Value	80.000
Curve Type	Hog
Sight Distance	242.125
Curve Start Chainage	0+414.685
Curve End Chainage	0+494.685
Curve Start Level	4.480
Curve End Level	4.480

********Element 7 Grade********

Gradient Length	111.562
Gradient	-.500
Gradient Start Chainage	0+494.685
End on Gradient Chainage	0+606.247
Grade Start Level	4.480
Gradient End Level	3.922

6.8.5 Horizontal Alignment Report Arm 03

Horizontal Alignment Report

Model: NORTH IC10

String: MCC0

Units: Metric

Date : 4/10/2016 6:25:43 PM

********Element 1 Straight********

Bearing 38 42 55.613
Length 184.167
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+184.167

********Element 2 Arc********

Intersection Point Chainage 0+203.202
Intersection Point X 271395.651
Intersection Point Y 2119188.313
Radius 5000.000
Arc Length 38.070
Hand of Arc Left
Included Angle 00 26 10.503
Arc Start Chainage 0+184.167
Arc End Chainage 0+222.237

********Element 3 Straight********

Bearing 38 16 45.111
Length 21.502
Straight Start Chainage 0+222.237
Straight End Chainage 0+243.739

********Element 4 Arc********

Intersection Point Chainage 0+263.123
Intersection Point X 271432.771
Intersection Point Y 2119235.350
Radius 80.000
Arc Length 38.035
Hand of Arc Left
Included Angle 27 14 24.762
Arc Start Chainage 0+243.739
Finish on Arc Chainage 0+281.773

6.8.6 Vertical Alignment Report Arm 03

Vertical Alignment Report

Model: NORTH IC10

String: MCC0

Units: Metric

Date : 4/10/2016 6:26:32 PM

********Element 1 Grade********

Gradient Length	10.307
Gradient	-.070
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+010.307
Begin on Gradient Level	12.103
Gradient End Level	12.096

********Element 2 Vertical Curve********

IP Chainage	0+045.307
Curve Length	70.000
Vertical Radius	-1781.171
Curve Start Gradient	-.070
Curve End Gradient	-4.000
K Value	17.812
Curve Type	Hog
Sight Distance	86.431
Curve Start Chainage	0+010.307
Curve End Chainage	0+080.307
Curve Start Level	12.096
Curve End Level	10.671

********Element 3 Grade********

Gradient Length	135.670
Gradient	-4.000
Gradient Start Chainage	0+080.307
Gradient End Chainage	0+215.977
Grade Start Level	10.671
Gradient End Level	5.244

********Element 4 Vertical Curve********

IP Chainage	0+245.977
Curve Length	60.000
Vertical Radius	1126.972
Curve Start Gradient	-4.000
Curve End Gradient	1.324
K Value	11.270

Curve Type	Sag
Curve Start Chainage	0+215.977
Curve End Chainage	0+275.977
Curve Start Level	5.244
Curve End Level	4.442

********Element 5 Grade********

Gradient Length	5.796
Gradient	1.324
Gradient Start Chainage	0+275.977
End on Gradient Chainage	0+281.773
Grade Start Level	4.442
Gradient End Level	4.518

6.8.7 Horizontal Alignment Report Arm 04

Horizontal Alignment Report

Model: NORTH IC10

String: MCD0

Units: Metric

Date : 4/10/2016 6:30:54 PM

********Element 1 Arc********

Intersection Point Chainage	0+117.420
Intersection Point X	271609.998
Intersection Point Y	2119537.671
Radius	1174.000
Arc Length	234.062
Hand of Arc	Left
Included Angle	11 25 23.344
Begin on Arc Chainage	0+000.000
Finish on Arc Chainage	0+234.062

6.8.8 Vertical Alignment Report Arm 04

Vertical Alignment Report

Model: NORTH IC10

String: MCD0

Units: Metric

Date : 4/10/2016 6:32:24 PM

********Element 1 Grade********

Gradient Length	5.718
Gradient	-1.929
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+005.718
Begin on Gradient Level	4.489
Gradient End Level	4.379

********Element 2 Vertical Curve********

IP Chainage	0+035.718
Curve Length	60.000
Vertical Radius	1011.975
Curve Start Gradient	-1.929
Curve End Gradient	4.000
K Value	10.120
Curve Type	Sag
Curve Start Chainage	0+005.718
Curve End Chainage	0+065.718
Curve Start Level	4.379
Curve End Level	5.000

********Element 3 Grade********

Gradient Length	104.936
Gradient	4.000
Gradient Start Chainage	0+065.718
Gradient End Chainage	0+170.654
Grade Start Level	5.000
Gradient End Level	9.198

********Element 4 Vertical Curve********

IP Chainage	0+200.654
Curve Length	60.000
Vertical Radius	-993.378
Curve Start Gradient	4.000
Curve End Gradient	-2.040
K Value	9.934
Curve Type	Hog
Sight Distance	63.464
Curve Start Chainage	0+170.654
Curve End Chainage	0+230.654

Curve Start Level 9.198
Curve End Level 9.786

********Element 5 Grade********

Gradient Length 3.408
Gradient -2.040
Gradient Start Chainage 0+230.654
End on Gradient Chainage 0+234.062
Grade Start Level 9.786
Gradient End Level 9.716

6.8.9 Horizontal Alignment Report Arm 05

Horizontal Alignment Report

Model: NORTH IC10

String: MCE0

Units: Metric

Date : 4/10/2016 6:35:55 PM

********Element 1 Arc********

Intersection Point Chainage 0+019.361
Intersection Point X 271613.050
Intersection Point Y 2119427.574
Radius 100.000
Arc Length 38.250
Hand of Arc Right
Included Angle 21 54 55.704
Begin on Arc Chainage 0+000.000
Arc-Arc (Reverse) Chainage 0+038.250

********Element 2 Arc********

Intersection Point Chainage 0+140.863
Intersection Point X 271664.061
Intersection Point Y 2119538.371
Radius 1226.000
Arc Length 204.750
Hand of Arc Left
Included Angle 09 34 07.592
Arc-Arc (Reverse) Chainage 0+038.250
Finish on Arc Chainage 0+243.000

6.8.10 Vertical Alignment Report Arm 05

Vertical Alignment Report

Model: NORTH IC10

String: MCE0

Units: Metric

Date : 4/10/2016 6:36:40 PM

********Element 1 Grade********

Gradient Length	5.000
Gradient	-1.408
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+005.000
Begin on Gradient Level	4.547
Gradient End Level	4.477

********Element 2 Vertical Curve********

IP Chainage	0+030.000
Curve Length	50.000
Vertical Radius	805.412
Curve Start Gradient	-1.408
Curve End Gradient	4.800
K Value	8.054
Curve Type	Sag
Curve Start Chainage	0+005.000
Curve End Chainage	0+055.000
Curve Start Level	4.477
Curve End Level	5.325

********Element 3 Grade********

Gradient Length	113.296
Gradient	4.800
Gradient Start Chainage	0+055.000
Gradient End Chainage	0+168.296
Grade Start Level	5.325
Gradient End Level	10.763

********Element 4 Vertical Curve********

IP Chainage	0+198.296

Curve Length	60.000
Vertical Radius	-860.832
Curve Start Gradient	4.800
Curve End Gradient	-2.170
K Value	8.608
Curve Type	Hog
Sight Distance	58.991
Curve Start Chainage	0+168.296
Curve End Chainage	0+228.296
Curve Start Level	10.763
Curve End Level	11.552

********Element 5 Grade********

Gradient Length	14.704
Gradient	-2.170
Gradient Start Chainage	0+228.296
End on Gradient Chainage	0+243.000
Grade Start Level	11.552
Gradient End Level	11.233

6.8.11 Horizontal Alignment Report Arm 06

Horizontal Alignment Report

Model: NORTH IC10

String: MCF0

Units: Metric

Date : 4/10/2016 6:39:58 PM

********Element 1 Straight********

Bearing	38 42 55.612
Length	283.895
Begin on Straight Chainage	0+000.000
Finish on Straight Chainage	0+283.895

6.8.12 Vertical Alignment Report Arm 05

Vertical Alignment Report

Model: NORTH IC10

String: MCF0

Units: Metric

Date : 4/10/2016 6:40:47 PM

********Element 1 Grade********

Gradient Length	10.000
Gradient	-1.990
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+010.000
Begin on Gradient Level	12.698
Gradient End Level	12.499

********Element 2 Vertical Curve********

IP Chainage	0+040.000
Curve Length	60.000
Vertical Radius	-2985.074
Curve Start Gradient	-1.990
Curve End Gradient	-4.000
K Value	29.851
Curve Type	Hog
Sight Distance	130.560
Curve Start Chainage	0+010.000
Curve End Chainage	0+070.000
Curve Start Level	12.499
Curve End Level	10.702

********Element 3 Grade********

Gradient Length	143.164
Gradient	-4.000
Gradient Start Chainage	0+070.000
Gradient End Chainage	0+213.164
Grade Start Level	10.702
Gradient End Level	4.975

********Element 4 Vertical Curve********

IP Chainage	0+243.164
Curve Length	60.000
Vertical Radius	1028.476
Curve Start Gradient	-4.000
Curve End Gradient	1.834
K Value	10.285
Curve Type	Sag
Curve Start Chainage	0+213.164
Curve End Chainage	0+273.164
Curve Start Level	4.975
Curve End Level	4.326

********Element 5 Grade********

Gradient Length	10.730
Gradient	1.834
Gradient Start Chainage	0+273.164
End on Gradient Chainage	0+283.895
Grade Start Level	4.326
Gradient End Level	4.522

6.9 MCGM Garden (Inorbit Mall) Interchange Design:-

Detail of Arms Gives in table below,

Table 6-9 MCGM Garden (Inorbit Mall) Interchange Arms Design

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MCA0	South CR	Ex road	Flyover	2
2	MCB0	Ex road	North CR	Flyover	2
3	MCC0	Ex road	South CR	Stilt	2
4	MCD0	North CR	Ex road	Stilt	2

Plan and Profile of MCGM Garden (Inorbit Mall) Interchange Design gives in Drawing no. 8098/E/DD-1190 to 8098/E/DD-1194 Volume IV Drawings.

6.9.1 Horizontal Alignment Report Arm 01

Horizontal Alignment Report

Model: INTERCH INORBITMALL R2

String: MCA0

Units: Metric

Date : 4/10/2016 6:55:07 PM

********Element 1 Straight********

Bearing 352 07 32.519
Length 2.624
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+002.624

********Element 2 Arc********

Intersection Point Chainage 0+026.968
Intersection Point X 271650.531
Intersection Point Y 2121006.148
Radius 75.000
Arc Length 424.161
Hand of Arc Left

Included Angle	35 57 53.794
Arc Start Chainage	0+002.624
Arc End Chainage	0+426.785

********Element 3 Straight********

Bearing	28 05 26.313
Length	461.502
Straight Start Chainage	0+426.785
Straight End Chainage	0+888.287

********Element 4 Arc********

Intersection Point Chainage	0+916.237
Intersection Point X	271876.206
Intersection Point Y	2121368.239
Radius	1000.000
Arc Length	55.884
Hand of Arc	Left
Included Angle	03 12 06.952
Arc Start Chainage	0+888.287
Arc End Chainage	0+944.171

********Element 5 Straight********

Bearing	24 53 19.360
Length	65.365
Straight Start Chainage	0+944.171
Straight End Chainage	1+009.537

********Element 6 Arc********

Intersection Point Chainage	1+045.597
Intersection Point X	271930.654
Intersection Point Y	2121485.599
Radius	300.000
Arc Length	71.775
Hand of Arc	Left
Included Angle	13 42 29.058
Arc Start Chainage	1+009.537
Arc End Chainage	1+081.312

********Element 7 Straight********

Bearing	11 10 50.303
Length	5.397

Straight Start Chainage 1+081.312
Finish on Straight Chainage 1+086.709

6.9.2 Vertical Alignment Report Arm 01

Vertical Alignment Report

Model: INTERCH INORBITMALL R2

String: MCA0

Units: Metric

Date : 4/10/2016 6:56:19 PM

********Element 1 Grade********

Gradient Length 24.150
Gradient -.170
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+024.150
Begin on Gradient Level 8.009
Gradient End Level 7.968

********Element 2 Vertical Curve********

IP Chainage 0+054.150
Curve Length 60.000
Vertical Radius 1680.073
Curve Start Gradient -.170
Curve End Gradient 3.401
K Value 16.801
Curve Type Sag
Curve Start Chainage 0+024.150
Curve End Chainage 0+084.150
Curve Start Level 7.968
Curve End Level 8.937

********Element 3 Grade********

Gradient Length 255.850
Gradient 3.401
Gradient Start Chainage 0+084.150
Gradient End Chainage 0+340.000
Grade Start Level 8.937
Gradient End Level 17.639

********Element 4 Vertical Curve********

IP Chainage	0+380.000
Curve Length	80.000
Vertical Radius	-2352.060
Curve Start Gradient	3.401
Curve End Gradient	.000
K Value	23.521
Curve Type	Hog
Sight Distance	99.426
Curve Start Chainage	0+340.000
Curve End Chainage	0+420.000
Curve Start Level	17.639
Curve End Level	19.000

********Element 5 Grade********

Gradient Length	140.000
Gradient	.000
Gradient Start Chainage	0+420.000
Gradient End Chainage	0+560.000
Grade Start Level	19.000
Gradient End Level	19.000

********Element 6 Vertical Curve********

IP Chainage	0+600.000
Curve Length	80.000
Vertical Radius	-1600.000
Curve Start Gradient	.000
Curve End Gradient	-5.000
K Value	16.000
Curve Type	Hog
Sight Distance	80.425
Curve Start Chainage	0+560.000
Curve End Chainage	0+640.000
Curve Start Level	19.000
Curve End Level	17.000

********Element 7 Grade********

Gradient Length	226.785
Gradient	-5.000
Gradient Start Chainage	0+640.000
Gradient End Chainage	0+866.785
Grade Start Level	17.000
Gradient End Level	5.661

********Element 8 Vertical Curve********

IP Chainage	0+906.785
Curve Length	80.000
Vertical Radius	1580.456
Curve Start Gradient	-5.000
Curve End Gradient	.062
K Value	15.805
Curve Type	Sag
Curve Start Chainage	0+866.785
Curve End Chainage	0+946.785
Curve Start Level	5.661
Curve End Level	3.685

********Element 9 Grade********

Gradient Length	139.924
Gradient	.062
Gradient Start Chainage	0+946.785
End on Gradient Chainage	1+086.709
Grade Start Level	3.685
Gradient End Level	3.772

6.9.3 Horizontal Alignment Report Arm 02

Horizontal Alignment Report

Model: INTERCH INORBITMALL R2

String: MCB0

Units: Metric

Date : 4/10/2016 6:57:26 PM

********Element 1 Straight********

Bearing	78 27 29.528
Length	11.145
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+011.145

********Element 2 Arc********

Intersection Point Chainage	0+060.609
Intersection Point X	271628.325
Intersection Point Y	2121064.184

Radius	75.000
Arc Length	87.457
Hand of Arc	Left
Included Angle	66 48 43.658
Arc Start Chainage	0+011.145
Arc End Chainage	0+098.602

********Transition********

Intersection Point Chainage	0+112.026
Transition Length	40.000
Transition Start Chainage	0+098.602
Transition End Chainage	0+138.602

********Element 3 Straight********

Bearing	356 22 01.922
Length	44.027
Straight Start Chainage	0+138.602
Finish on Straight Chainage	0+182.629

6.9.4 Vertical Alignment Report Arm 02

Vertical Alignment Report

Model: INTERCH INORBITMALL R2

String: MCB0

Units: Metric

Date : 4/10/2016 6:58:14 PM

********Element 1 Grade********

Gradient Length	5.000
Gradient	-3.578
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+005.000
Begin on Gradient Level	10.211
Gradient End Level	10.032

********Element 2 Vertical Curve********

IP Chainage	0+040.000
Curve Length	70.000
Vertical Radius	2542.596
Curve Start Gradient	-3.578

Curve End Gradient	-.824
K Value	25.426
Curve Type	Sag
Curve Start Chainage	0+005.000
Curve End Chainage	0+075.000
Curve Start Level	10.032
Curve End Level	8.491

********Element 3 Grade********

Gradient Length	31.164
Gradient	-.824
Gradient Start Chainage	0+075.000
Gradient End Chainage	0+106.164
Grade Start Level	8.491
Gradient End Level	8.235

********Element 4 Vertical Curve********

IP Chainage	0+141.164
Curve Length	70.000
Vertical Radius	7082.151
Curve Start Gradient	-.824
Curve End Gradient	.164
K Value	70.822
Curve Type	Sag
Curve Start Chainage	0+106.164
Curve End Chainage	0+176.164
Curve Start Level	8.235
Curve End Level	8.003

********Element 5 Grade********

Gradient Length	6.465
Gradient	.164
Gradient Start Chainage	0+176.164
End on Gradient Chainage	0+182.629
Grade Start Level	8.003
Gradient End Level	8.014

6.9.5 Horizontal Alignment Report Arm 03

Horizontal Alignment Report

Model: INTERCH INORBITMALL R2

String: MCC0

Units: Metric

Date : 4/10/2016 6:59:10 PM

********Element 1 Straight********

Bearing 203 22 27.854
Length 2.145
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+002.145

********Element 2 Arc********

Intersection Point Chainage 0+020.676
Intersection Point X 271837.341
Intersection Point Y 2121257.195
Radius 450.000
Arc Length 37.041
Hand of Arc Right
Included Angle 04 42 58.458
Arc Start Chainage 0+002.145
Arc End Chainage 0+039.186

********Element 3 Straight********

Bearing 208 05 26.312
Length 157.130
Straight Start Chainage 0+039.186
Straight End Chainage 0+196.316

********Element 4 Arc********

Intersection Point Chainage 0+292.068
Intersection Point X 271709.541
Intersection Point Y 2121017.754
Radius 400.000
Arc Length 187.966
Hand of Arc Left
Included Angle 26 55 26.811

Arc Start Chainage 0+196.316
Arc End Chainage 0+384.282

********Element 5 Straight********

Bearing 181 09 59.502
Length 60.293
Straight Start Chainage 0+384.282
Finish on Straight Chainage 0+444.575

6.9.6 Vertical Alignment Report Arm 03

Vertical Alignment Report

Model: INTERCH INORBITMALL R2

String: MCC0

Units: Metric

Date : 4/10/2016 6:59:54 PM

********Element 1 Grade********

Gradient Length 3.994
Gradient 4.820
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+003.994
Begin on Gradient Level 7.743
Gradient End Level 7.936

********Element 2 Vertical Curve********

IP Chainage 0+038.994
Curve Length 70.000
Vertical Radius -1315.789
Curve Start Gradient 4.820
Curve End Gradient -.500
K Value 13.158
Curve Type Hog
Sight Distance 72.993
Curve Start Chainage 0+003.994
Curve End Chainage 0+073.994
Curve Start Level 7.936
Curve End Level 9.448

********Element 3 Grade********

Gradient Length 256.162
Gradient -.500
Gradient Start Chainage 0+073.994
Gradient End Chainage 0+330.156
Grade Start Level 9.448
Gradient End Level 8.167

********Element 4 Vertical Curve********

IP Chainage 0+370.156
Curve Length 80.000
Vertical Radius 12903.203
Curve Start Gradient -.500
Curve End Gradient .120
K Value 129.032
Curve Type Sag
Curve Start Chainage 0+330.156
Curve End Chainage 0+410.156
Curve Start Level 8.167
Curve End Level 8.015

********Element 5 Grade********

Gradient Length 34.419
Gradient .120
Gradient Start Chainage 0+410.156
End on Gradient Chainage 0+444.575
Grade Start Level 8.015
Gradient End Level 8.056

6.9.7 Horizontal Alignment Report Arm 04

Horizontal Alignment Report

Model: INTERCH INORBITMALL R2

String: MCD0

Units: Metric

Date : 4/10/2016 7:01:01 PM

********Element 1 Straight********

Bearing 168 24 23.321
Length 76.252
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+076.252

********Element 2 Arc********

Intersection Point Chainage	0+268.196
Intersection Point X	271715.811
Intersection Point Y	2121112.423
Radius	75.000
Arc Length	179.745
Hand of Arc	Left
Included Angle	137 18 53.811
Arc Start Chainage	0+076.252
Arc End Chainage	0+255.997

********Element 3 Straight********

Bearing	31 05 29.510
Length	13.308
Straight Start Chainage	0+255.997
Finish on Straight Chainage	0+269.305

6.9.8 Vertical Alignment Report Arm 04

Vertical Alignment Report

Model: INTERCH INORBITMALL R2

String: MCD0

Units: Metric

Date : 4/10/2016 7:01:40 PM

********Element 1 Grade********

Gradient Length	5.000
Gradient	-.170
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+005.000
Begin on Gradient Level	8.014
Gradient End Level	8.006

********Element 2 Vertical Curve********

IP Chainage	0+040.000
Curve Length	70.000
Vertical Radius	6095.086
Curve Start Gradient	-.170

Curve End Gradient	.978
K Value	60.951
Curve Type	Sag
Curve Start Chainage	0+005.000
Curve End Chainage	0+075.000
Curve Start Level	8.006
Curve End Level	8.288

********Element 3 Grade********

Gradient Length	104.661
Gradient	.978
Gradient Start Chainage	0+075.000
Gradient End Chainage	0+179.661
Grade Start Level	8.288
Gradient End Level	9.313

********Element 4 Vertical Curve********

IP Chainage	0+214.661
Curve Length	70.000
Vertical Radius	-1563.377
Curve Start Gradient	.978
Curve End Gradient	-3.499
K Value	15.634
Curve Type	Hog
Sight Distance	80.142
Curve Start Chainage	0+179.661
Curve End Chainage	0+249.661
Curve Start Level	9.313
Curve End Level	8.430

********Element 5 Grade********

Gradient Length	19.644
Gradient	-3.499
Gradient Start Chainage	0+249.661
End on Gradient Chainage	0+269.305
Grade Start Level	8.430
Gradient End Level	7.743

6.10 Kandivali Interchange Design:-

Detail of Arms Gives in table below,

Table 6-10 Kandivali Interchange Arms Design

Arm No.	Sting Name	From	To	Level Type	No of Lanes
1	MCA0	Ex Link Road	South CR	Flyover	2
2	MCB0	South CR	Ex Link Road	At Grade	2
3	MCC0	South CR	Ex Road	Stilt	2
4	MCD0	Ex Malad Marve Road	South CR	At Grade	2

Plan and Profile of Kandivali Interchange Design gives in Drawing no. 8098/E/DD-1200 to 8098/E/DD-1204 Volume IV Drawings.

6.10.1 Horizontal Alignment Report Arm 01

Horizontal Alignment Report

Model: INTERCH KANDIWALI R1

String: MCA0

Units: Metric

Date : 4/11/2016 2:05:45 PM

********Element 1 Straight********

Bearing 260 30 07.772
Length 3.695
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+003.695

********Element 2 Arc********

Intersection Point Chainage 0+058.612
Intersection Point X 271878.424
Intersection Point Y 2123893.348
Radius 120.000
Arc Length 103.005
Hand of Arc Left
Included Angle 49 10 52.788
Arc Start Chainage 0+003.695

Arc End Chainage 0+106.701

********Transition********

Intersection Point Chainage 0+123.436
Transition Length 50.000
Transition Start Chainage 0+106.701
Transition End Chainage 0+156.701

********Element 3 Straight********

Bearing 199 23 03.149
Length 271.915
Straight Start Chainage 0+156.701
Finish on Straight Chainage 0+428.616

6.10.2 Vertical Alignment Report Arm 01

Vertical Alignment Report

Model: INTERCH KANDIWALI R1

String: MCA0

Units: Metric

Date : 4/11/2016 2:07:06 PM

********Element 1 Grade********

Gradient Length 39.249
Gradient .788
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+039.249
Begin on Gradient Level 5.896
Gradient End Level 6.205

********Element 2 Vertical Curve********

IP Chainage 0+076.737
Curve Length 74.975
Vertical Radius 2744.600
Curve Start Gradient .788
Curve End Gradient 3.519
K Value 27.446
Curve Type Sag

Curve Start Chainage	0+039.249
Curve End Chainage	0+114.224
Curve Start Level	6.205
Curve End Level	7.819

********Element 3 Grade********

Gradient Length	162.512
Gradient	3.519
Gradient Start Chainage	0+114.224
Gradient End Chainage	0+276.737
Grade Start Level	7.819
Gradient End Level	13.538

********Element 4 Vertical Curve********

IP Chainage	0+336.737
Curve Length	120.000
Vertical Radius	-3141.669
Curve Start Gradient	3.519
Curve End Gradient	-.300
K Value	31.417
Curve Type	Hog
Sight Distance	112.695
Curve Start Chainage	0+276.737
Curve End Chainage	0+396.737
Curve Start Level	13.538
Curve End Level	15.470

********Element 5 Grade********

Gradient Length	31.879
Gradient	-.300
Gradient Start Chainage	0+396.737
End on Gradient Chainage	0+428.616
Grade Start Level	15.470
Gradient End Level	15.374

6.10.3 Horizontal Alignment Report Arm 02

Horizontal Alignment Report

Model: INTERCH KANDIWALI R1

String: MCB0

Units: Metric

Date : 4/11/2016 2:08:22 PM

********Element 1 Straight********

Bearing 79 42 03.980
Length 73.808
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+073.808

********Element 2 Arc********

Intersection Point Chainage 0+112.979
Intersection Point X 272223.248
Intersection Point Y 2124131.247
Radius 50.000
Arc Length 66.455
Hand of Arc Left
Included Angle 76 09 05.553
Arc Start Chainage 0+073.808
Arc End Chainage 0+140.263

********Element 3 Straight********

Bearing 03 32 58.427
Length 153.833
Straight Start Chainage 0+140.263
Finish on Straight Chainage 0+294.096

6.10.4 Vertical Alignment Report Arm 02

Vertical Alignment Report

Model: INTERCH KANDIWALI R1

String: MCB0

Units: Metric

Date : 4/11/2016 2:09:43 PM

********Element 1 Grade********

Gradient Length 10.000

Gradient	-2.260
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+010.000
Begin on Gradient Level	6.856
Gradient End Level	6.630

********Element 2 Vertical Curve********

IP Chainage	0+060.000
Curve Length	100.000
Vertical Radius	4806.338
Curve Start Gradient	-2.260
Curve End Gradient	-.179
K Value	48.063
Curve Type	Sag
Curve Start Chainage	0+010.000
Curve End Chainage	0+110.000
Curve Start Level	6.630
Curve End Level	5.410

********Element 3 Grade********

Gradient Length	184.096
Gradient	-.179
Gradient Start Chainage	0+110.000
End on Gradient Chainage	0+294.096
Grade Start Level	5.410
Gradient End Level	5.080

6.10.5 Horizontal Alignment Report Arm 03

Horizontal Alignment Report

Model: INTERCH KANDIWALI R1

String: MCC0

Units: Metric

Date : 4/11/2016 2:10:55 PM

********Element 1 Straight********

Bearing	10 03 17.064
Length	170.716
Begin on Straight Chainage	0+000.000
Straight End Chainage	0+170.716

********Transition********

Intersection Point Chainage	0+204.180
Transition Length	50.000
Transition Start Chainage	0+170.716
Transition End Chainage	0+220.716

********Element 2 Arc********

Intersection Point Chainage	0+360.403
Intersection Point X	271628.221
Intersection Point Y	2123530.315
Radius	180.000
Arc Length	237.584
Hand of Arc	Left
Included Angle	75 37 31.455
Arc Start Chainage	0+220.716
Arc End Chainage	0+458.301

********Transition********

Intersection Point Chainage	0+474.998
Transition Length	50.000
Transition Start Chainage	0+458.301
Transition End Chainage	0+508.301

********Element 3 Straight********

Bearing	278 30 49.829
Length	111.819
Straight Start Chainage	0+508.301
Finish on Straight Chainage	0+620.120

6.10.6 Vertical Alignment Report Arm 03

Vertical Alignment Report

Model: INTERCH KANDIWALI R1

String: MCC0

Units: Metric

Date : 4/11/2016 2:11:43 PM

********Element 1 Grade********

Gradient Length	38.745
Gradient	1.700
Begin on Gradient Chainage	0+000.000
Gradient End Chainage	0+038.745
Begin on Gradient Level	12.038
Gradient End Level	12.697

********Element 2 Vertical Curve********

IP Chainage	0+130.000
Curve Length	182.510
Vertical Radius	-3561.042
Curve Start Gradient	1.700
Curve End Gradient	-3.425
K Value	35.610
Curve Type	Hog
Sight Distance	119.981
Curve Start Chainage	0+038.745
Curve End Chainage	0+221.255
Curve Start Level	12.697
Curve End Level	11.122

********Element 3 Grade********

Gradient Length	107.913
Gradient	-3.425
Gradient Start Chainage	0+221.255
Gradient End Chainage	0+329.168

Grade Start Level 11.122
Gradient End Level 7.426

********Element 4 Vertical Curve********

IP Chainage 0+400.000
Curve Length 141.664
Vertical Radius 4768.410
Curve Start Gradient -3.425
Curve End Gradient -.454
K Value 47.684
Curve Type Sag
Curve Start Chainage 0+329.168
Curve End Chainage 0+470.832
Curve Start Level 7.426
Curve End Level 4.678

********Element 5 Grade********

Gradient Length 149.288
Gradient -.454
Gradient Start Chainage 0+470.832
End on Gradient Chainage 0+620.120
Grade Start Level 4.678
Gradient End Level 4.000

6.10.7 Horizontal Alignment Report Arm 04

Horizontal Alignment Report

Model: INTERCH KANDIWALI R1

String: MCD0

Units: Metric

Date : 4/11/2016 2:13:54 PM

********Element 1 Straight********

Bearing 06 15 26.722
Length 108.381
Begin on Straight Chainage 0+000.000
Straight End Chainage 0+108.381

********Transition********

Intersection Point Chainage 0+128.633

Transition Length 30.000
Transition Start Chainage 0+108.381
Transition End Chainage 0+138.381

********Element 2 Arc********

Intersection Point Chainage 0+186.819
Intersection Point X 272206.974
Intersection Point Y 2124109.876
Radius 60.000
Arc Length 81.501
Hand of Arc Left
Included Angle 77 49 40.802
Arc Start Chainage 0+138.381
Arc End Chainage 0+219.882

********Transition********

Intersection Point Chainage 0+229.942
Transition Length 30.000
Transition Start Chainage 0+219.882
Transition End Chainage 0+249.882

********Element 3 Straight********

Bearing 259 46 53.517
Length 17.012
Straight Start Chainage 0+249.882
Finish on Straight Chainage 0+266.894

6.10.8 Vertical Alignment Report Arm 04

Vertical Alignment Report

Model: INTERCH KANDIWALI R1

String: MCD0

Units: Metric

Date : 4/11/2016 2:14:38 PM

********Element 1 Grade********

Gradient Length 105.855
Gradient .316
Begin on Gradient Chainage 0+000.000
Gradient End Chainage 0+105.855

Begin on Gradient Level	3.786
Gradient End Level	4.120

********Element 2 Vertical Curve********

IP Chainage	0+164.829
Curve Length	117.948
Vertical Radius	5365.395
Curve Start Gradient	.316
Curve End Gradient	2.514
K Value	53.654
Curve Type	Sag
Curve Start Chainage	0+105.855
Curve End Chainage	0+223.803
Curve Start Level	4.120
Curve End Level	5.789

********Element 3 Grade********

Gradient Length	43.091
Gradient	2.514
Gradient Start Chainage	0+223.803
End on Gradient Chainage	0+266.894
Grade Start Level	5.789
Gradient End Level	6.872