ISLAMIC REPUBLIC OF AFGHANISTAN
KABUL MUNICIPALITY
MINISTRY OF TRANSPORT

DATA COLLECTION SURVEY ON URBAN TRANSPORT IN AFGHANISTAN

FINAL REPORT

PART 2-3 DESIGN REVIEW OF SARA-E-SHAMALI INTERSECTION

MARCH 2023

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

YACHIYO ENGINEERING CO., LTD.

VOLUME I.

DESIGN REVIEW &

INTERSECTION PLANNING

Data Collection Survey for Urban Transport in Afghanistan
Design Review for Sara-E-Shamali Intersection

Volume I. Design Review & Intersection Planning

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Chapter 1. Outline

1.1 Background

Sara-e Shamali Intersection is a one of heavily congested intersections in Kabul City, and solving this traffic congestion has been a longstanding issue for Kabul Municipality (KM). It was proposed to improve into a grade-separated intersection in the project "Data Collection Survey on Road and Bridge in Kabul City" conducted by JICA in 2013. In 2017, KM outsourced the design of Baraki – Sara-e Shamali road improvement to a Lebanese consultant, Khatib & Alami. Based on this design, the road improvement has been implemented except for the Sara-e Shamali intersection improvement.

This report is to review the design of the Sara-e Shamali intersection done by Khatib & Alami, and to propose ideal design and project cost.

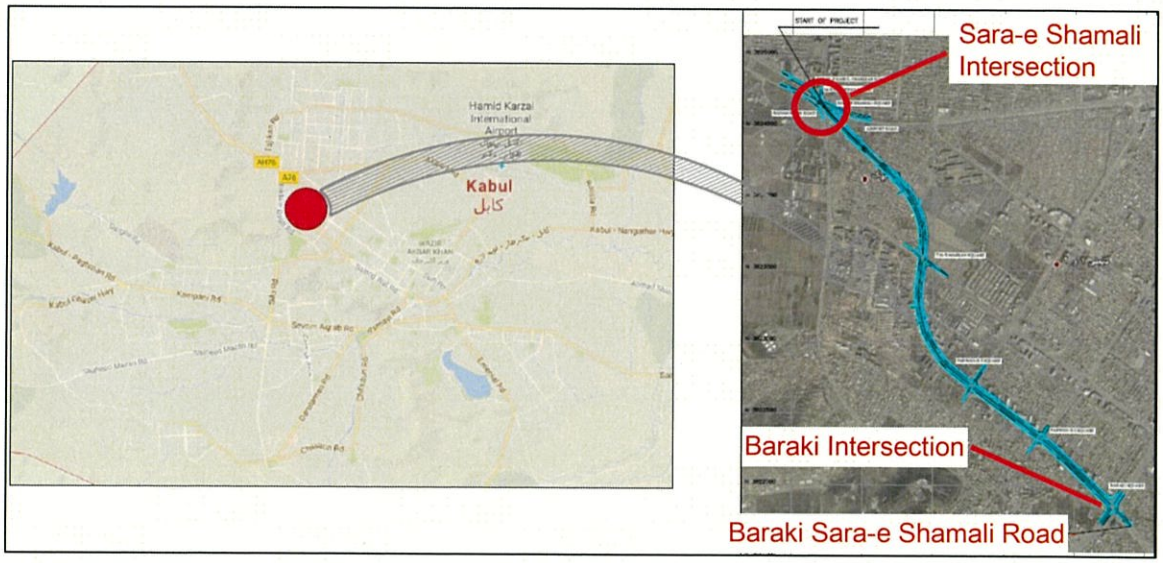


Figure 1-1 Location Map of Barali Sara-e Shamali Road

1.2 Documents to be reviewed

The Table 1-1 shows components of the Sara-e Shamali Intersection Design Documents made by Khatib & Alami and they are target documents for this review.

Table 1-1 Design Documents to be reviewed

S/N	Document Name
1	Sara-e Shamali Intersection Final Design Drawings (May 2017)
2	Baraki Sara-e Shamali Road Final Design Survey Report (Nov. 15 2016)
3	Sara-e Shamali Interchange-Geotechnical Report (Revised Jul. 31, 2017)
4	Baraki Sara-e-Shamali Road Final Engineering report (July 2017)
5	APPENDICES A: Project Road B: Typical Intersection Volume (Kabul City) C: Synchro Operational Analysis of SSI – Year 2035 Volume D: T-Intersection E: Empirical Design Method Output – AASHTO 1993 F: Mechanistic Design Method Output - CIRCLY 5
6	Baraki Sara-e-Shamali Road Final Design Hydrology & Storm Water Drainage Report
7	Baraki Sara-e-Shamali Road Final Design Electrical report (July 2017)
8	Baraki Sara-e Shamali Road Final Design Structural Report (July 2017)
9	Baraki Sara-e-Shamali Road Final Design Specifications Report

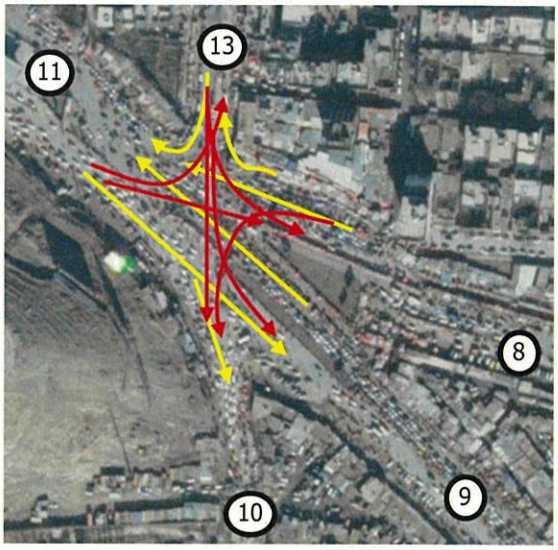
	(August 2017)
10	Sara-e Shamali Intersection Final Design Bill of Quantities (Dec. 2017)

1.3 Current Condition

This intersection has been roundabout, but the central island of the roundabout was removed in 2018 in order to ease the traffic congestion. Table 1-2 shows satellite images and issues on both the previous roundabout and current condition after removal of the central island.

As there are still several issues on the current intersection, further improvement is urgently required.

Table 1-2 Issues on Intersection

Roundabout (2016)	Current (2020)
	
At the previous roundabout type, traffic heading to (11) and traffic heading from (13) intersected.	After removal of the central island, the traffic indicated by the yellow arrows is secured, but the traffic indicated by the red arrowed are blocked by concrete blocks or traffic police. Since this intersection is not able to accommodate traffic from/to the 5 legs, the traffic congestion gets worse.

Source: JICA Study Team

Chapter 2. Results of Review

The following table shows the issues identified as a result of the review and their corresponding responses in this report.

Items	Issues	Details	Corresponding Responses in the Report
Design Standard	AHSGDS (Afghan Highways & Streets Geometric Design Code/Standards) was applied.	Since AHSGDS has several missing items and errors, it is not possible to design properly.	Ideal design standards are proposed in the Chapter 3, and recommendation to DD is shown in the Chapter 5 (1).
Topographic Information	No topographic data are shown in the plan view drawings.	Since no information is available for the area between connected roads and ramp, it is not possible to review whether construction work can be done on the site. As no existing drainage/canal is shown, appropriate drainage planning is not possible.	Recommendation to DD is shown in the Chapter 5 (2).
	Inconsistency of terrain elevations	There is a difference of about 30 meters between the elevations in the plan view CAD data and the elevations shown in the profiles and cross-section drawings. BM and elevations of the drawing are consistent, but inconsistent in boring wellhead heights and heights shown on the drawings other than profile & cross sections.	
	Existing road width is different between topographic map, plan view and cross section.	It is not possible to confirm which width is correct.	It was confirmed with KM that land acquisition is not done yet. Recommendation to DD is shown in the Chapter 5 (2).
Correspondence with Adjoining Section	Sarak-E Kabul Charikar Road	KM has an improvement plan for the western section of the intersection toward Charikar town. It is unclear whether this design (horizontal and vertical alignments) are consistent with the plan of the western section.	Recommendation to DD is shown in the Chapter 5 (3).
	Airport Road	In the technical cooperation project supported by JICA, a detailed design of the Airport Road improvement was conducted. Both design should be consistent.	

Items	Issues	Details	Corresponding Responses in the Report
Plan View	Beginning and End points of the project is not clear.	It is not possible to calculate the quantities and project cost.	Ideal design standards are proposed in the Chapter 3, and recommendation to DD is shown in the Chapter 5 (4).
	Construction of the ramp 2 will affect the cemetery.	Land acquisition of cemetery area seems to be difficult. As the improvement of the Charikar Road is under planning, it is required to confirm consistency of the plan with the Charikar Road.	
	Some curve radii are bigger than minimum radius specified in the standard.	Concerns about traffic accidents occurring in winter due to lack of superelevation. The horizontal alignment needs to be revised and, consequently, the land availability needs to be confirmed.	
	Necessary spiral curve is not applied.	Traffic safety is not ensured. There is section where the superelevation is applied in the opposite direction.	
	No crosswalk is proposed in the drawings.	Pedestrian pathways needs to be secured.	
Profile	The vertical alignment of the main road and the ramp are separated within the vertical curve.	It is necessary to make horizontal alignment continuous.	Ideal design standards are proposed in the Chapter 3, and recommendation to DD is shown in the Chapter 5 (5).
	Convex vertical curve on profiles of ramp and main road	Due to the small curve radius, the stopping sight distance is insufficient.	
	Concave vertical curve of the main road is too big.	63 for a minimum K=30, and the vertical alignment of the service road begins within the curve.	
	No profile of the service road beside the ramp is available	Height of the retaining wall is unknown.	
	Superelevations on ramp and main road are inconsistent and their changing points are not shown.	Transition of the superelevation to be made within a spiral curve is not possible. The transition ratio of the superelevation is unknown.	
	Profiles of the 1st Khair Khana Road and Badam Bagh Road are not provided. Proposed elevation of the level crossing under the overpass are not available.	It is not possible to check the clearance under the overpass.	

Items	Issues	Details	Corresponding Responses in the Report
Cross Sections	Road width between plan view and cross-sections is not consistent for Sta. 0+420 to 0+600.	ROW is not shown in the plan view and cross sections. Sta. 0+420 where retaining wall is installed does not match the width of the existing road.	Recommendation to DD is shown in the Chapter 5 (6).
	Inconsistency between the superelevation section on the main road profile and the cross sections.	Superelevation is not given on the cross sections.	
	Lack of the service road cross-sections around the intersection section, cross-sections of the ramp section, cross-sections of the Airport Road and Badam Bagh Road.	It is not possible to conduct the design review, quantity calculation and cost estimation.	
Intersection	In the report, the intersection is studied as a signalized intersection.	It is not possible to ensure the traffic flow as the signalized roundabout.	Ideal design as a signalized intersection is proposed in the Chapter 4, and recommendation to DD is shown in the Chapter 5 (5).
		Many left turn traffic from the west. There is another plan to improve the road with a U-turn on the west side. The amount of left-turn traffic will decrease.	Recommendation to DD is shown in the Chapter 5 (7).
Retaining Wall of Approach Section	The detailed drawing is shown in the dimension list.	General structural drawings, front view and re-bar arrangement are required.	Recommendation to DD is shown in the Chapter 5 (8).
	Reason why retaining walls are installed between ramps is unclear.	Installing a retaining wall would make land use and drainage between ramps difficult. Changing to embankment will decrease the project cost.	
Pavement Design	There is no detailed drawing of the carriageway pavement.	The drawings do not show the configuration of the carriageway pavement, making it difficult to construct. It is also impossible to confirm whether the pavement design in the report is correct.	Recommendation to DD is shown in the Chapter 5 (9).
	It is unclear which roads are covered by the pavement design calculation.	The traffic volume is different on the overpass main road and the service road. It is unclear which road the traffic volume used in the calculation is for.	

Items	Issues	Details	Corresponding Responses in the Report
	The thickness of the paving blocks for the sidewalk is only 60 mm.	The bearing capacity of the paving blocks is insufficient in the vehicle access area of the sidewalk.	
Drainage Design	Drawings and report related to drainage are missing.	The drainage methods for the intersection, main road, ramp and space between ramps (which would be ponds in the existing design) is unknown. The drainage calculations do not include the intersection area.	Recommendation to DD is shown in the Chapter 5 (10).
Detail Drawings	Safety barrier	There is no detail drawings for concrete barrier on the retaining wall.	Recommendation to DD is shown in the Chapter 5 (11).
Quantity Calculation	Quantity calculation is not provided.	Unable to verify the drawings and quantities.	Recommendation to DD is shown in the Chapter 5 (12).
	Drainage items are not included in the BOQ.	Since the intersection area is not included in the drainage design, the quantity cannot be assumed.	
Bidding Documents	BOQ and tender documents are available, but the drawings are insufficient.	Since there are many missing drawings as detailed design drawings, construction is not possible.	Recommendation to DD is shown in the Chapter 5 (13).
	Quantity of rebar is not included in the BOQ.	The BOQ does not include rebar, but the specifications state that it will be settled at ton, thus, there is a discrepancy between the BOQ and the specifications.	
	Specification of the traffic signal is given by the British standard.	Other items follow the US standard, but it is unclear why only traffic signals follows the British standard.	
Land Issue	Gas station between ramps	The alignment of the ramp was set up to avoid the gas station, but it will be impossible to access the gas station after the construction.	Recommendation to DD is shown in the Chapter 5 (14).
	Land acquisition of the approach section	It seems that the land acquisition is not in progress.	
Construction Plan	The construction plan is not shown in the report and design drawings.	It is not possible to confirm how to divert the traffic during construction.	Recommendation to DD is shown in the Chapter 5 (15).

Source: JICA Study Team

Chapter 3. Design Conditions

3.1 Design Standards

The "Afghan Highways & Streets Geometric Design Code / Standards" (AHSGDS) used in the original design is in accordance with the "A Policy on Geometric Design of Highways and Streets 2011" (AASHTO), but the AHSGDS has some errors in the curve radius used in the original design. Therefore, it is proposed to follow the AASHTO, and, for the parts which are not clearly described on the AASHTO, Japanese standard "Explanation and Operation of the Road Structure Ordinance" is applied in the following.

3.2 Design Speed

In the original design report, design speeds were set as shown on the following table. The section where the main road separates for overpass was referred to as "Ramp" and was regarded as also main road. These design speeds are deemed appropriate.

Table- 3-1 Design Speed

Road Type	Design Speed
Main Road and Ramp Way	80 km/h
Service Road	60 km/h

Source: Final Design Report

3.3 Horizontal Alignment

3.3.1 Maximum Superelevation in Kabul

Since Kabul city is located in the cold region, the composite slope of the cross slope and vertical slope must be 8% or less. As the maximum cross slope is 6%, the maximum vertical slope must be less than 6% based on the following calculation. The steepest slope set in this review is 4.3%, which satisfies the maximum composite slope.

$$e_s = \sqrt{8\%^2 - 5\%^2} = 6.0\%$$

3.3.2 Minimum Horizontal Curve on Main Road

The curve radius R=250m used in the original design cannot be used because the required single slope exceeds 6% and the composite slope with the vertical slope of 6% exceeds 8%. In addition, a spiral curve has not been installed. Therefore, the horizontal alignment needs to be modified as shown in Table 3-2. The length of the spiral curve must satisfy the transition length of the superelevation. The revised horizontal alignment is shown in the attached document.

Table- 3-2 Minimum Radius for Main Road and Ramp Way

Road Name	Curve No.	Horizontal Curves(m)		Superelevation (%)		Spiral Curve *1	Minimum Trandition /Spiral Length (m)		
		Orig.	Proporsed	Orig.	Proporsed		Minimum	Orig.	Proporsed
Pamp-1	1	250	500	> 6.0	4.8	Must	44	Non	80 *3-2
	2	250		> 6.0			44	Non	
Ramp-2	1	250	300	> 6.0	6.0	Needed	44	Non	40 *3-3
	2	300		6.0		Needed	44	Non	
Main Road	1	2,400	-	NC	-	-		Non	-
	2	2,400	-	NC	-	-		Non	-
	3	1,000	-	3.1	3.2	Needed	44	81 *2	130 *3-4

Note *1: Maximum Radius for Use of a Spiral Curve Transition, R ≤ 379m
*2: Transition Length
*3-1: Maximum relative gradient 0.5% on V=80km/h
*3-2: (1.75+3.50) x (0.025+0.048)/0.005=76.65, nearly 80m
*3-3: (1.75+3.50) x (0.06-0.025)/0.005=36.76, nearly 40m
*3-4: (1.10+3.50x3) x (0.025+0.031)/0.005=129.92, nearly 130m

Table- 3-3 Minimum Radii for Design Superelevation

Metric												
	V_d = 20 km/h	V_d = 30 km/h	V_d = 40 km/h	V_d = 50 km/h	V_d = 60 km/h	V_d = 70 km/h	V_d = 80 km/h	V_d = 90 km/h	V_d = 100 km/h	V_d = 110 km/h	V_d = 120 km/h	V_d = 130 km/h
e (%)	R (m)	R (m)	R (m)	R (m)	R (m)	R (m)	R (m)	R (m)	R (m)	R (m)	R (m)	R (m)
NC	194	421	738	1050	1440	1910	2360	2880	3510	4060	4770	5240
RC	138	299	525	750	1030	1380	1710	2090	2560	2970	3510	3880
2.2	122	265	465	668	919	1230	1530	1880	2300	2670	3160	3500
2.4	109	236	415	599	825	1110	1380	1700	2080	2420	2870	3190
2.6	97	212	372	540	746	1000	1260	1540	1890	2210	2630	2930
2.8	87	190	334	488	676	910	1150	1410	1730	2020	2420	2700
3.0	78	170	300	443	615	831	1050	1290	1590	1870	2240	2510
3.2	70	152	269	402	561	761	959	1190	1470	1730	2080	2330
3.4	61	133	239	364	511	697	882	1100	1360	1600	1940	2180
3.6	51	113	206	329	465	640	813	1020	1260	1490	1810	2050
3.8	42	96	177	294	422	586	749	939	1170	1390	1700	1930
4.0	36	82	155	261	380	535	690	870	1090	1300	1590	1820
4.2	31	72	136	234	343	488	635	806	1010	1220	1500	1720
4.4	27	63	121	210	311	446	584	746	938	1140	1410	1630
4.6	24	56	108	190	283	408	538	692	873	1070	1330	1540
4.8	21	50	97	172	258	374	496	641	812	997	1260	1470
5.0	19	45	88	156	235	343	457	594	755	933	1190	1400
5.2	17	40	79	142	214	315	421	549	701	871	1120	1330
5.4	15	36	71	128	195	287	386	505	648	810	1060	1260
5.6	13	32	63	115	176	260	351	463	594	747	980	1190
5.8	11	28	56	102	156	232	315	416	537	679	900	1110
6.0	8	21	43	79	123	184	252	336	437	560	756	951

Source: A Policy on Geometric Design of Highways and Streets 2011 AASHTO, table 3-9

Table- 3-4 Maximum Radius for Use of a Spiral Curve Transition

Metric		U.S. Customary	
Design speed (km/h)	Maximum radius (m)	Design speed (mph)	Maximum radius (ft)
20	24	15	114
30	54	20	203
40	95	25	317
50	148	30	456
60	213	35	620
70	290	40	810
80	379	45	1025
90	480	50	1265
100	592	55	1531
110	716	60	1822
120	852	65	2138
130	1000	70	2479
		75	2846
		80	3238

Note: The effect of spiral curve transitions on lateral acceleration is likely to be negligible for larger radii.

Source: A Policy on Geometric Design of Highways and Streets 2011 AASHTO, table 3-20

Table- 3-5 Desirable Length of Spiral Curve Transition

Metric		U.S. Customary	
Design Speed (km/h)	Spiral Length (m)	Design Speed (mph)	Spiral Length (ft)
20	11	15	44
30	17	20	59
40	22	25	74
50	28	30	88
60	33	35	103
70	39	40	117
80	44	45	132
90	50	50	147
100	56	55	161
110	61	60	176
120	67	65	191
130	72	70	205
		75	220
		80	235

Source: A Policy on Geometric Design of Highways and Streets 2011 AASHTO, table 3-21

3.3.3 Minimum Horizontal Curve on Service Road

Since the design speed is low and it is parallel to the main road and ramp, the service road is designed from its cross sections without setting the centerline.

Since the AASHTO does not provide the information for the service road, standards of the U.S. Texas Department of Transportation shown in Table 3-7 are used as a special case for urban streets.

Table- 3-6 Minimum Radius for Service Road

Road Name	Curve No.	Horizontal Curves(m)		Superelevation (%)		Spiral Curve *1
		Orig.	Proporsed	Orig.	Proporsed	
Pamp-1	1	250	500+11.4	-	-	-
	2	250		-		
Ramp-2	1	250	300-11.4	-	-	-
	2	300		-		
Main Road	1	2,400	-	-	-	-
	2	2,400	-	-	-	-
	3	1,000	-	-	-	-

Source: JICA Study Team

Table- 3-7 Minimum Radii and Superelevation Low-Speed Urban Streets

e(%)	V_d=20km/h R (m)	V_d=30km/h R (m)	V_d=40km/h R (m)	V_d=50km/h R (m)	V_d=60km/h R (m)	V_d=70km/h R (m)
-4.0	10	30	66	131	218	351
-3.0	10	28	63	123	202	322
-2.8	10	28	62	122	200	316
-2.6	10	28	62	120	197	311
-2.4	10	28	61	119	194	306
-2.2	10	27	61	117	192	301
-2.0	10	27	60	116	189	297
-1.5	9	27	59	113	183	286
0	9	25	55	104	167	257
1.5	9	24	51	96	153	234
2.0	9	24	50	94	149	227
2.2	8	23	50	93	148	224
2.4	8	23	50	92	146	222
2.6	8	23	49	91	145	219
2.8	8	23	49	90	143	217
3.0	8	23	48	89	142	214
3.2	8	23	48	89	140	212
3.4	8	23	48	88	139	210
3.6	8	22	47	87	138	207
3.8	8	22	47	86	136	205
4.0	8	22	47	86	135	203

Source: Roadway design manual of Texas department of transportation, Table 2-5, Metric

3.4 Vertical Alignment

3.4.1 Vertical Curve

In the vertical curve of the original design, the curvature (K-value) that secures the stopping sight distance for the design speed was not applied. As a result of reviewing the vertical alignment against the revised horizontal alignment, the vertical slope needs to be reduced to about 4% to secure the K-value. Refer to the profile shown in the attached document.

Table 3-8 Minimum K Value for Main Road and Ramp Way

Road Name	Curve No.	Vertical Curves K Value (m)			
		Type	Specified	Origenal.	Proporsed
Pamp-1	1	Sug	30	28	30.2
Ramp-2	1	Sug	30	27	30.9
Main Road	1	Crest	26	17	26.4
	2	Sug	30	63	30.8

Note: K=VCR/100

Source: JICA Study Team

The K-values at which the stopping sight distance can be ensured are shown in the following tables.

Table- 3-9 Design Control for Crest Vertical Curve Based on Stopping Sight Distance

Metric				U.S. Customary			
Design Speed (km/h)	Stopping Sight Distance (m)	Rate of Vertical Curvature, K^a		Design Speed (mph)	Stopping Sight Distance (ft)	Rate of Vertical Curvature, K^a	
		Calculated	Design			Calculated	Design
20	20	0.6	1	15	80	3.0	3
30	35	1.9	2	20	115	6.1	7
40	50	3.8	4	25	155	11.1	12
50	65	6.4	7	30	200	18.5	19
60	85	11.0	11	35	250	29.0	29
70	105	16.8	17	40	305	43.1	44
80	130	25.7	26	45	360	60.1	61
90	160	38.9	39	50	425	83.7	84
100	185	52.0	52	55	495	113.5	114
110	220	73.6	74	60	570	150.6	151
120	250	95.0	95	65	645	192.8	193
130	285	123.4	124	70	730	246.9	247
				75	820	311.6	312
				80	910	383.7	384

[a] Rate of vertical curvature, K, is the length of curve per percent algebraic difference in intersecting grades (A), $K = L/A$.

Source: A Policy on Geometric Design of Highways and Streets 2011 AASHTO, table 3-34

Table- 3-10 Design Control for Sag Vertical Curves

Metric				U.S. Customary			
Design Speed (km/h)	Stopping Sight Distance (m)	Rate of Vertical Curvature, K^a		Design Speed (mph)	Stopping Sight Distance (ft)	Rate of Vertical Curvature, K^a	
		Calculated	Design			Calculated	Design
20	20	2.1	3	15	80	9.4	10
30	35	5.1	6	20	115	16.5	17
40	50	8.5	9	25	155	25.5	26
50	65	12.2	13	30	200	36.4	37
60	85	17.3	18	35	250	49.0	49
70	105	22.6	23	40	305	63.4	64
80	130	29.4	30	45	360	78.1	79
90	160	37.6	38	50	425	95.7	96
100	185	44.6	45	55	495	114.9	115
110	220	54.4	55	60	570	135.7	136
120	250	62.8	63	65	645	156.5	157
130	285	72.7	73	70	730	180.3	181
				75	820	205.6	206
				80	910	231.0	231

[a] Rate of vertical curvature, K, is the length of curve (m) per percent algebraic difference intersecting grades (A), $K = L/A$.

Source: A Policy on Geometric Design of Highways and Streets 2011 AASHTO, table 3-36

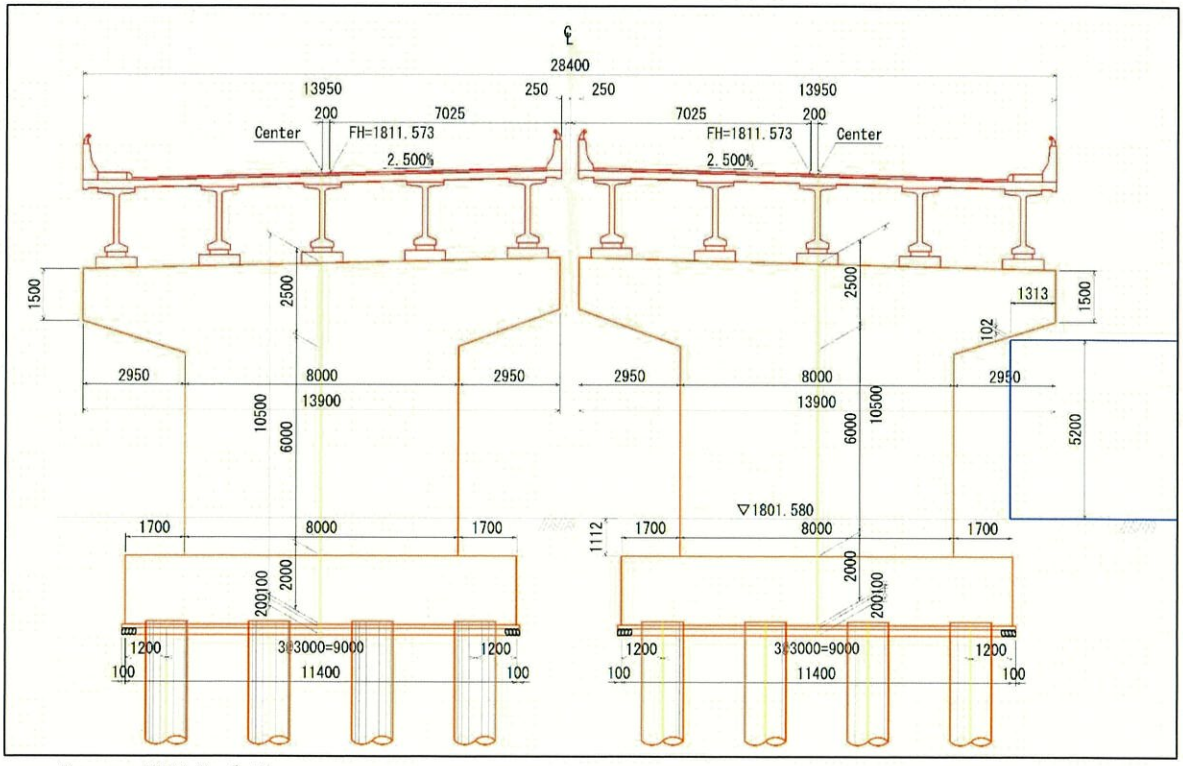
3.4.2 Control Points for Setting the Piers

The planned height in the intersection is assumed to be the current height because it is difficult to change the height of the connecting road. The proposed elevation of the main road is set by the vertical profile that can secure the heights shown in Table 3-11. In this review, since the clearance of P3 is the control, it is confirmed that the clearance is secured against the existing height as shown in Figure 3-1. During the DD, the vertical alignment of the service road should be set along the existing height in the intersection to secure the necessary clearance.

Table- 3-11 Control Point for Proposed Level at Pier

Pier Number	Station of Ramp-1	Descriptions	Height
P1 (Ramp-2)	-0 -1.0	Super-elevation, (1.75+3.5+1.5+0.245)x4.006%	0.280
		Pavement, Slab,	2.150
		Clearance	5.200
		Total	7.630
P2	0 +44.0	Super-elevation, (1.75+3.5+1.5+0.245)x2.5%	0.175
		Pavement, Slab, Girder, Shoe	2.600
		Beam	2.500
		Clearance	5.200
		Total	10.475
P3	0+104.0	Ditto	Ditto

Source: JICA Study Team



Source: JICA Study Team

Figure- 3-1 Clearance of P3

3.5 Pavement Design

After reviewing the original design, it is understood that the freezing depth has been secured and it seems to be appropriate, so the original design will be followed.

Table- 3-12 Summary of Pavement Design Factors

Design Factor	Value
Traffic Data	
• AADT (2016), veh/day	23,805
• Design Life (years)	20
• Annual Growth Rate (%)	3
• Directional Distribution Factor (DDF)	0.55
• Lane Distribution Factors (LDF)	0.90
• Equivalent Single Axle Load (ESAL)	37 Million
Material Data	
• Design CBR	9
• Layers Coefficients (a_1, a_2 & a_3)	0.42, 0.13 & 0.10
• Drainage Coefficients (m_2 & m_3)	1.0 & 0.7
Pavement Design Data	
• Reliability (R)	90
• Overall Standard Deviation (S_o)	0.45
• Serviceability Loss (ΔPSI)	2.0

Source: Final Design Report

Based on this analysis, the recommended pavement structure is as follows:

• HMA surface course	50.0 mm	
• HMA base course	110.0 mm	
• Crushed Aggregate Base Course	300.0 mm	(CBR ≥ 80)
• Aggregate Sub-base Course	400.0 mm	(CBR ≥ 25)
• Subgrade		(CBR ≥ 9)

During construction, the field CBR should be confirmed. If at any location the CBR was found to be less than 9, the subgrade soil should be improved to raise the subgrade CBR to a minimum 9 or higher.

Source: Final Design Report

Figure- 3-2 Pavement Thickness

3.6 Intersection Design

3.6.1 Vertical Curve

Since AASHTO does not specify the width of the car track channel in relation to the radius of the curve, the drawing method (see Figure 3-3) and the width in relation to the radius of the curve (see Table 3-13) given in the Japanese "Explanation and Operation of the Road Structure Ordinance" were adopted in this review.

The Method for drawing the channels

Set outer curve radius R0 with contacts E and E' on the outer line of turning lane.

Select the turning path width W in the table. And offset inner curve of width w from outer arc.

Set transit curve with contacts B and B' on inner curve, contacts A and A' on the both side inner line of turning lane.

The transit curves radius Rr is 3 to 4 times inner curve radius.

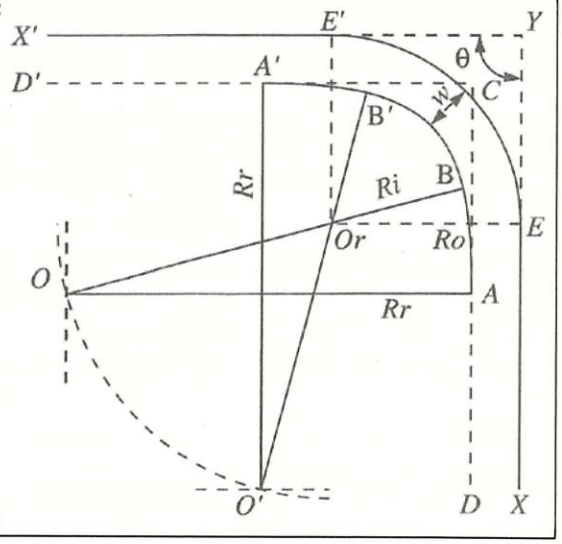


Figure- 3-3 Method for drawing the car track channels

Table- 3-13 Turning path width W

Outside radius of turning path R0 (m)	Turning path width W (m)		
	Semi-trailer combination	Regular vehicles	Passenger vehicles
8 ≤ R < 9	—	—	4.0
9 ≤ R < 12	—	—	3.5
12 ≤ R < 13	—	—	3.0
13 ≤ R < 14	8.5	5.5	
14 ≤ R < 15	8.0		
15 ≤ R < 16	7.5	5.0	
16 ≤ R < 17	7.0		2.75
17 ≤ R < 19	6.5		
19 ≤ R < 21	6.0	4.5	
21 ≤ R < 25	5.5		
25 ≤ R < 30	5.0	4.0	
30 ≤ R < 40	4.5		
40 ≤ R < 60	4.0	3.5	
≥60	3.5		

Note: Semi-trailer combination: Vehicle length 16.5m

Source; Explanation and Operation of the Road Structure Ordinance, Japan

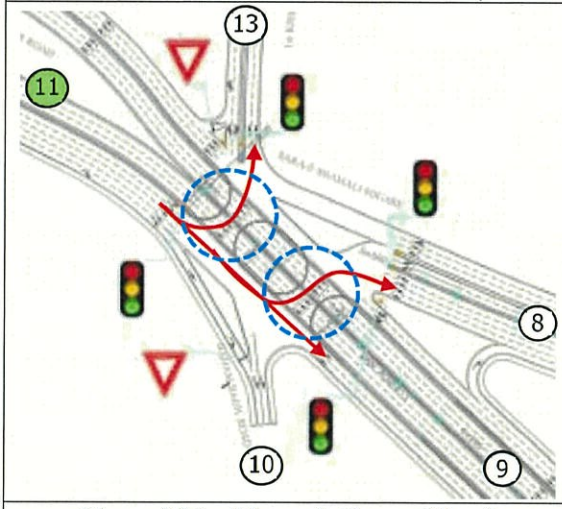
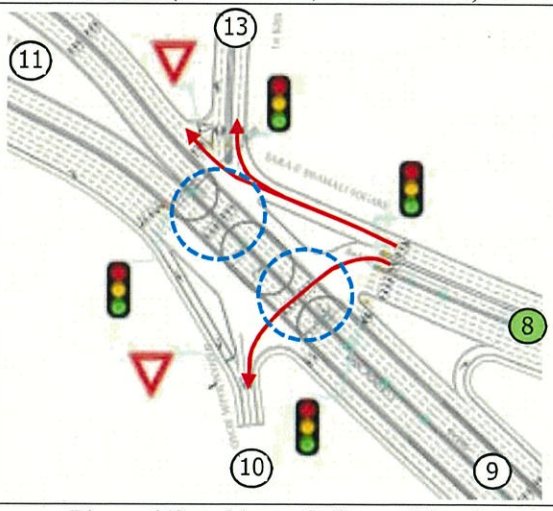
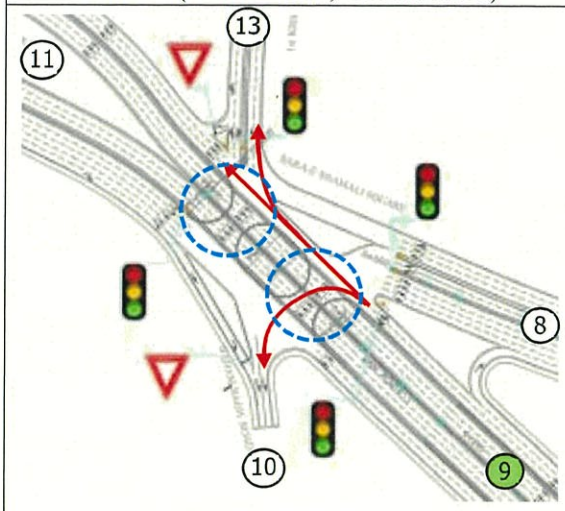
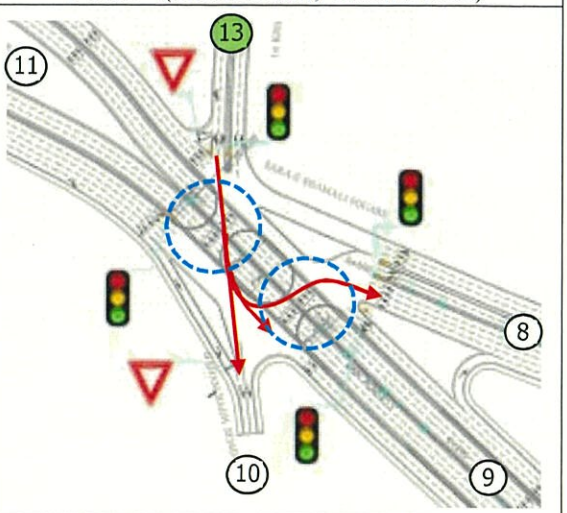
Chapter 4. Intersection Design

4.1 Issues on the Original Design

The problems in the original design are shown below. (yellow 3 sec, red (clearance time) 3 sec)

- ✓ Since there is no directional guidance in the intersection, drivers are not sure where to go.
- ✓ As a signalized roundabout, green time is provided for each leg, which reduces the traffic capacity of the intersection.
- ✓ Since the traffic flows in the intersection are complicated and the distance is long, the clearance time should be insufficient at 3 seconds.
- ✓ At the blue circles shown on the Table 4-1, there is a concern that a serious accident may occur due to the complicated traffic flows.
- ✓ As two multi-pillar piers are located in the intersection, the sight distance in the intersection should be insufficient.

Table- 4-1 Signal Timing of Original Intersection

Phase-1(Eastbound, Green:32sec)	Phase-2(Westbound, Green:28sec)
	
Phase-3(Northbound, Green:24sec)	Phase-4(Southbound, Green:26sec)
	
Legend ← Traffic flow Complication of traffic flows	Note: ① is one-way traffic toward south

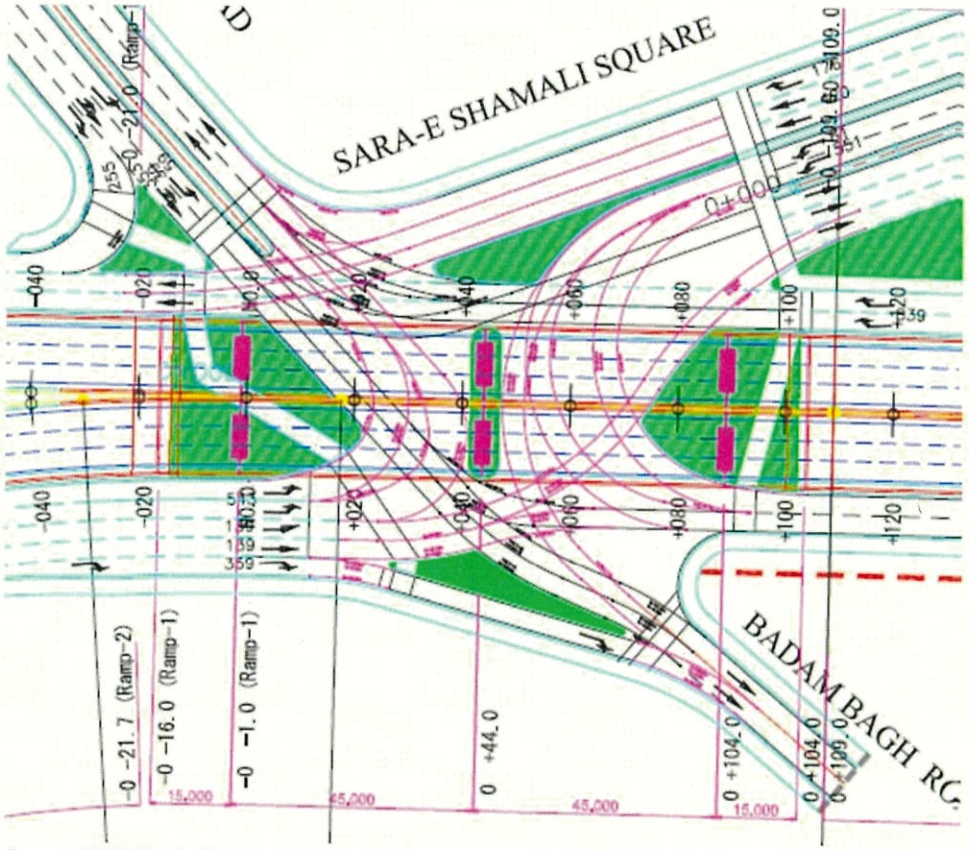
Source: JICA Study Team

4.2 Improved Plan

The intersection that has designed as a signalized roundabout was redesigned as a signalized intersection in this review.

The major points to consider for the redesign are as follows;

- ✓ A traffic island was placed in the center of the intersection to secure the location of the bridge piers.
- ✓ The traffic channels were designed to consider the signalization of the east-west traffic (Sarak-E Kabul Charikar Road and Airport Road) marked in magenta and the north-south traffic (Baraki Sara-E Shamali Road and Airport Road) marked in black.
- ✓ To ensure flow to the right-turn lane, a taper was installed to avoid the queue length.
- ✓ The bridge abutments were moved back to provide walkways.



Source: JICA Study Team

Figure- 4-1 Improved Plan after Review

4.3 Queue Length

The future traffic volume for 2035 shown in the original design report was calculated based on the "DATA COLLECTION SURVEY ON ROAD AND BRIDGE IN KABUL CITY, AFGHANISTAN 2013" with a growth rate of 3% per year, and this traffic volumes by direction (see Table 4-2) are applied.

For redesigning the intersection, the number of lanes and the queue length are calculated as shown in Table 4-3. The improved intersection plan after the review reflects these results.

Table- 4-2 Traffic Volume of Sara-E Shamali Intersection

Approach		Traffic volume 2035, pcu/hr				
		A	B	C	D	E
A	Sarak-E Kabul Charikar Road		359	139	139	543
B	Badam Bagh Road	0		0	0	0
C	Baraki Sara-E Shamali Road	0	0		430	839
D	Airport Road	420	61	551		176
E	1st Khair Khana Road	255	353	39	59	

Source: JICA Study Team

Table- 4-3 Queue Length of Sara-E Shamali Intersection

Inflow	Sara-E Kabul Charikar Road				Baraki Sara-E Shamali Road		Airport Road			1st Khair Khana Road	
Outflow	E	D	C	B	E	D	C/B	A	E	D/C/B	A
Lane & Sharing											
Right Tune	-	-	-	Free	-	Free	-	-	Free	-	Free
Traffic Volume	543	139	139	359	839	430	612	420	176	451	255
Number of Lane	2	1	1	1	2	1	2	2	1	2	1
Queue Length	81	21	21	-	126	-	92	63	-	68	-

Note: Cycle Length=90sec, 40cycles/hour, Headway=6m (Regular vehicles)

Source: JICA Study Team

Chapter 5. Recommendation to DD

The recommendations to the detailed design are summarized as follows.

(1) Design Standards

Design standards should follow AASHTO's A Policy on Geometric Design of Highways and Streets 2011; where AASHTO is lacking, refer to the other standards, such as the Japanese Road Structure Ordinance, as shown in the Chapter 3.

(2) Topographic Information

The following measures should be taken to address the lack and deviation of topographical information including the elevations.

- ✓ Topographic survey should be carried out to confirm the correct elevation based on the existing BM, and the vertical alignment should be reviewed if necessary.
- ✓ Confirm the land boundary with KM, update the topographic information on the plan and cross-sections to the latest one, and mark the ends of existing waterways and drainage channels.

(3) Consistency with Adjoining Sections

Since improvements of the Sarak-E Kabul Charikar Road and Airport Road are planned separately, it is necessary to harmonize them as follows.

- ✓ Based on the BM used in the original design, survey the BM of each route and adjust the coordinates if there are any differences.
- ✓ If there are any differences in the horizontal and vertical alignments, the plan should be adjusted based on the results of this review.

(4) Plan View

In response to the issues presented in the Chapter 2, the plan view was modified by proposing a revised horizontal and vertical alignments of the main road and ramp. During detailed design, the following actions should be taken.

- ✓ The targeted construction section was clearly indicated on the plan view prepared in this review. In the detailed design, the targeted section should be reviewed based on the results in Chapter 5 (3) above.
- ✓ In order to avoid the cemetery affected by the Ramp-2, the horizontal and vertical alignments shall be reviewed based on the topographic survey results in accordance with the adjusting result with Charikal road.
- ✓ To address the issues of minimum curve radius and spiral curve of the horizontal alignment and the lack of walkways, the revised horizontal alignment and intersection geometry were proposed in this review. When reviewing the horizontal alignment, the design conditions shown in the Chapter 3 should be satisfied.

(5) Profile

In response to the issues presented in the Chapter 2, the vertical alignment was also reviewed along with the horizontal alignment. In the detailed design, the following measures should be taken.

- ✓ When reviewing the vertical alignment of the ramp and main road, the vertical slope, vertical curve, superelevation, and transition section should be such that the design conditions shown in Chapter 3 are satisfied.
- ✓ In this review, the vertical alignments of the service road and connecting roads within the intersection were assumed to be the existing elevation. In the detailed design, the vertical alignments of the missing profiles shall be set for the construction considering the ground elevation at each FH location and the ground elevation along the road.

- ✓ Clearance of the bridge section shall be secured as shown in Chapter 3.
- ✓ The vertical alignments of the ramp section and the Airport Road shall be consistent with the vertical alignments of the adjacent sections.

(6) Cross Sections

In response to the issues presented in Chapter 2, the plan view was modified by proposing a revised horizontal and vertical alignment of the main road and ramp. In the detailed design, the following actions should be taken.

- ✓ The cross sections of the revised ramp and main road should be prepared based on the review results. In particular, the total width of the proposed road should be adjusted to the width of the land acquisition. The area between Ramp-1 and Ramp-2 should be constructed with embankment to facilitate drainage design and reduce the project cost.
- ✓ Add the missing cross-section of the service road at the intersection and prepare cross sections of the ramp, Airport Road and Badam Bagh Road.

(7) Intersection

The intersection geometry was reviewed for the issues presented in the Chapter 2, and the countermeasures were proposed in this review, and their design conditions were presented in the Chapter 3. During the detailed design, the following actions should be taken.

- ✓ The signalized roundabout in the original design was changed to a signalized intersection in order to accommodate the heavy traffic. As a result, the traffic volume of this intersection is accommodated by the signal control, and it should be followed in the detailed design.
- ✓ Based on the results of the topographic survey, the intersection design should be modified to match the Ramp-2 horizontal alignment, avoiding the cemetery to prevent new land acquisition. The horizontal alignment shall be consistent with the improvement plan of the adjacent Sarak-E Kabul Charikar Road.
- ✓ It is assumed that there will be no change in the intersection geometry although the traffic volume on Ramp-2 will be reduced due to the U-turn facility to be installed on the adjacent Sarak-E Kabul Charikar Road.

(8) Retaining Wall of Approach Section

The following measures should be taken during the detailed design to address the issues presented in Chapter 2.

- ✓ The space between Ramp-1 and Ramp-2 should be filled as an embankment structure and the retaining wall should be minimized because there is no meaning in leaving a gas station that will eventually become inaccessible.
- ✓ Due to the high height of the retaining wall and the inability to ensure the ground bearing capacity, the retaining wall was proposed to be Mechanically Stabilized Earth (MSE) retaining wall. For the details, refer to the Volume II.
- ✓ The MSE wall structure is advantageous in terms of economy and workability compared to reinforced concrete retaining walls because the MSE wall is constructed at the same time as the embankment is constructed.
- ✓ A plan view, front view, structural drawings and rebar arrangement shall be prepared to show the starting and ending points of the retaining wall and the dimensions of each construction phase. The drawings shall be used as the basis for quantity calculations according to the specifications.

(9) Pavement Design

In the Chapter 3, the review was performed for the pavement of the ramp to main road. In the detailed design, the following measures should be taken.

- ✓ Since traffic volumes on service roads and other roads are different, separate studies should be conducted to determine the pavement structures.

- ✓ The pavement thickness of the carriageway shall be secured at the freezing depth of 80 cm in Kabul City.
- ✓ For the vehicle access area of the sidewalk pavement, 80 mm thick blocks with high load bearing capacity shall be used in accordance with the road design guidelines of Kabul City.

(10)Drainage Design

The following measures need to be taken during detailed design to address the issues presented in the Chapter 2.

- ✓ Drainage design for the north side of the intersection shall be carried out based on the topographic survey results.
- ✓ The drainage system should be studied, paying attention to the drainage end treatment on the Ramp section and on the bridge. The results of the study shall be clearly indicated on the plan and the drained water flow shall be led to the appropriate existing canal.
- ✓ If the infiltration type drainage facilities which have been installed in the Baraki Sara-E Shamali Road are used, the study and design shall be done in accordance with the KM's Road Design Guidelines.

(11)Detail Drawings

For the issue of lack of detailed drawings for concrete safety barrier, detailed drawings should be prepared after the detailed design along with detailed drawings for drainage. The following points should be considered in the detailed design.

- ✓ The concrete safety barriers should be designed as an L-shape retaining wall considering the collision load of vehicles.
- ✓ The soil cover on the top of the footing should be 50 cm or more or the pavement thickness should be secured.

(12)Quantity Calculation

As the original design documents were not including the quantity calculation report, a review could not be conducted for the quantity calculation. The following points should be kept in mind during the detailed design.

- ✓ The unit price items should be consistent with the specifications, and the quantities required for the unit price calculation should be calculated.
- ✓ In the quantity calculations, details and evidences of the quantities should be provided so that they can be checked.
- ✓ Since there is no item for drainage works in the BOQ, the cost of drainage works in this review was assumed to be 30% of the costs of earthworks and pavement works. At the time of detailed design, quantities of the drainage works shall be calculated and the construction cost shall be precisely estimated.

(13)Bidding Documents

For the issues presented in the Chapter 2, the design drawings, BOQ and specifications should be harmonized during the detailed design stage.

- ✓ The missing design drawings should be prepared in the detailed design.
- ✓ The BOQ should be prepared in accordance with the design drawings and specifications.
- ✓ If US-standard products are not available for traffic signals, products that satisfy the both other standards and US standards shall be selected.

(14)Land Issue

Referring to the attached drawing "PLAN OF INTERSECTION WITH SATELLITE IMAGE", the following items should be verified during the detailed design.

- ✓ The gas station located between the ramps has been confirmed by KM to be relocatable.

- ✓ The layout of the Ramp-2 and the cemetery shown in the Chapter 5 (7) should be clarified and the extent of land available for construction should be confirmed.
- ✓ The road formation width on the plan in the original design is 54.8m and the ROW shown on the plan is 60m. However, the road width in the master plan of Kabul City is only 50m. The width of actual ROW should be confirmed in site and reflected in the detailed design.
- ✓ At the time of the review, it has been confirmed that the land acquisition for the approach section of Baraki Sara-E Shamali Road is still in progress. At the time of detailed design, the progress of land acquisition shall be confirmed with KM.

(15)Construction Plan

During the detailed design, the following items shall be studied and a construction plan shall be prepared.

- ✓ The method of securing the safety of the existing traffic and the construction yard shall be studied, and the plan for diverting the existing traffic at each construction phase shall be made.
- ✓ In this review, the following construction steps were assumed as a construction sequence in which the existing traffic can be easily diverted.

Step-1: When constructing the two abutments and P2 pier

- When P2 pier is constructed before P1 and P3, it is easier to divert the traffic. In addition, it is possible to divert traffic within the intersection, leaving the area of the traffic island of P2 pier.
- Since sufficient space for diverting the existing traffic can be secured, it is possible to construct A1 and A2 abutments at the same time for the construction of P2 pier.

Step-2: construction of P1 and P3 piers and retaining walls on the approach section

- The remaining P1 and P3 piers are constructed.
- After the abutments are constructed, the retaining walls at the approaches can be constructed.
- Since the MSE wall method is used, excavation of the footings is not necessary, and the affected area of the construction can be minimized.

Step-3: construction of superstructure

- If a truck crane can be secured to meet the lifting load, crane lifting method is the cheapest way and shortest construction period. However, it is necessary to secure a yard to manufacture the girders and to confirm their transportation. During the installation, it is necessary to regulate the traffic in the intersection.
- If the girders are to be fabricated in the area of the retaining wall behind the abutment, the incremental launching method is considered to be superior for the girder installation.

Step-4: construction of the intersection

- As usual, construction should be carried out in the following order: drainage, base course, concrete curb, pavement, road markings, street lighting, traffic signals, and traffic signage.

(16)Others

As this is a five-leg intersection, it is suggested to install guide signs that clearly indicate the destination of each lane. The following are two options to install the guide signs.

Option-1: Provide a destination sign for each lane and destination signs at the junction.

Option-2: Destination is indicated on a signboard that resembles the intersection.

VOLUME II.

BRIDGE PLANNING

Data Collection Survey for Urban Transport in Afghanistan
Design Review for Sara-E-Shamali Intersection

Volume II. Bridge Planning

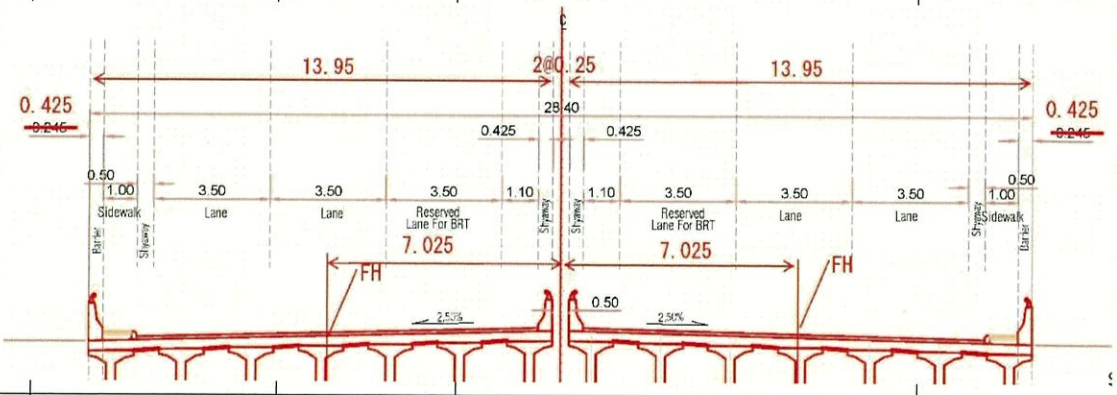
Table of Contents

Chapter 1. Design Condition

1.1 Basic Condition

A list of basic conditions to be considered in the preparation of general view is given in Table 1-1

Table 1-1 Basic Conditions

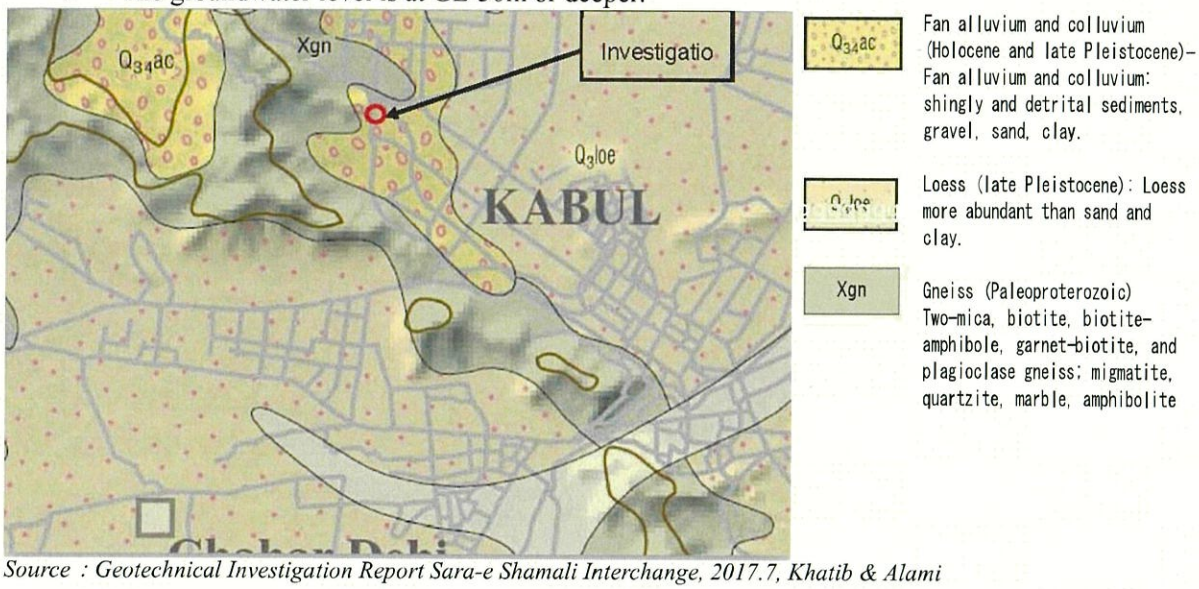
No.	Item	Deatails	Value	Source
1	Design Standard		● Afghan Bridge Design Code A.B.D.C(here after, *1) ● AASHTO LRFD Bridge Design Specification 2014(here after, *2) ● Preliminary Earthquake Hazard Map of Afghanistan(here after, *3) ● ASCE 41-06 Seismic Rehabilitation Existing Buildings(here after, *4)	Final Engineering Report, Baraki Sara-e-Shamali, Kabul, Afghanistan, July 2017(here after, *5)
2	Route Name		Baraki to Sara-e Shamali Arterial Road	
3	Road Classification		Arterial Road	
4	Design Speed		80 km/h	*5
5	Cross Section			*5
				
6	Alignment	Horizontal	Ramp-1: ∞ Ramp-2: A= 120～ ∞	Refer to Vol. 1 and Appendix 1.
7		Profile	Ramp-1, 2: 0+53.000 4.020% 1814.160 4.036% VCL=220m, VCR=2640m	Refer to Vol. 1 and Appendix 1.
8		Superelevation	Ramp-1: 2.50% Ramp-2: 5.17%～2.50%	Refer to Vol. 1 and Appendix 1.
9	Superstructure		Main Span: Post-tension type PC T Girder Side Span: RC T Girder	Refer to Chap. 2 and Appendix 1.
10	Substructure (Foundation)		RC Type (Cast-in-Place Pile)	Refer to Chap. 2 and Appendix 1.
11	Bridge Length		Ramp-1: L= 120.000 m Ramp-2: L= 120.005 m	Refer to Chap. 2 and Appendix 1.
12	Span Arrangement		Ramp-1: 15.0m + 2@45.0m + 15.0m Ramp-2: 15.005m + 2@45.0m + 15.0m	Refer to Chap. 2 and Appendix 1.
13	Live Road	Live Road	HL-93	*5
		Impact Factor	1.33	*5
		Footpath	3.6kN/m^2	*5
14	Pavement		Asphalt Pavement	*5
15	Vertical Clearance		5.03 m (16.5 ft)	*2, CDOT LRFD Bridge Design Manual, 2021.4

Source: JICA Study Team

1.2 Geotechnical Condition

The borehole Logs in the vicinity of the bridge is shown in Appendix 4. The geology of the site, based on previous geological investigation reports, is summarized below.

- The biridge site consists of alluvial and colluvium (see Figure 1-1).
- The surficial to bearing layers are silty clay and silty sand with N values >10.
- The bearing layer (N value >30) consists of silty sand, silty gravel and silty clay.
- The depth of the bearing layer is approximately GL-8m.
- The groundwater level is at GL-30m or deeper.



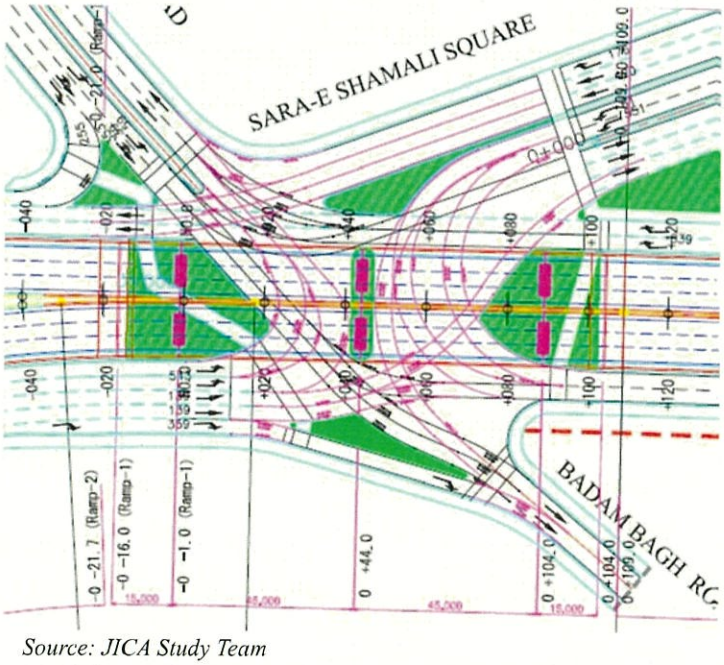
Source : Geotechnical Investigation Report Sara-e Shamali Interchange, 2017.7, Khatib & Alami

Figure 1-1 Geological Map of Bridge Site

1.3 Condition to Be Controlled

1.3.1 Possible Positions for Substructure

Based on the results of the intersection planning study in Volume 1, the possible positions for the substructure are the green-filled areas in the red frame shown in Figure 1-2.



Source: JICA Study Team

Figure 1-2 Possible Positions for the substructure (Green-filled areas in the red frame)

1.3.2 Vertical Clearance

The vertical clearance shall be in accordance with Clause 15 of Table 1-1, but as the longitudinal alignment of the service roads are yet to be determined, a margin of 0.2m shall be taken into account to ensure a clearance of 5.2m (see Volume I for verification results).

Chapter 2. Bridge Plan & Preparation of General View

2.1 Bridge Length & Span Arrangement

Bridges overpassing the intersection will be planned according to the intersection plan in Volume 1. As in previous years' results (*5), the bridges have separate structures for each track.
Figure 1-2 shows that the shortest bridge length is 120m. On the other hand, the maximum span of a post-tensioned simple PC girder, which has been constructed by a domestic contractor in Afghanistan, is 45m. Therefore, it is impossible to apply 2 spans bridge. In addition, the required distance between the pier in the middle of the intersection and the side piers is 45m. As a result, the span arrangement is 15.0m+2@45.0m+15.0m with 4 spans.

2.2 Bridge Type

The following bridge types, which have been constructed in Afghanistan, are adopted.

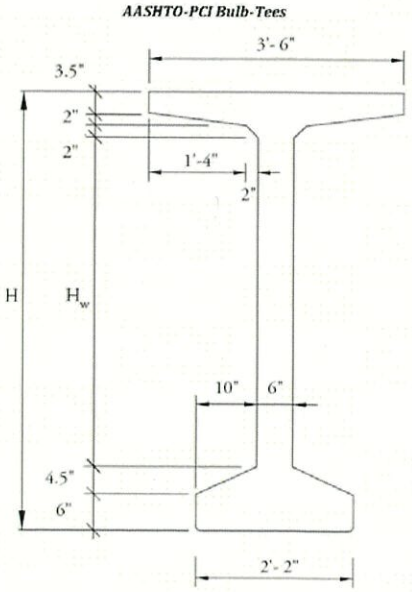
- Main span (45m span): Post-tensioned simple PCT girder bridge
- Side span (15m span): Reinforced concrete simple T-girder bridge

2.3 Superstructure

2.3.1 Main Span Section

(1) Cross Section and Arrangement of Main Girder

The girders are BT-72 from AASHTO-PCI Bulb-Tees (see).
The girder spacing is 2.4 m due to 45 m span (see). Based on this, the number of girders is 6 and the overhang length is 0.975m, from a bridge width of 13.950m.

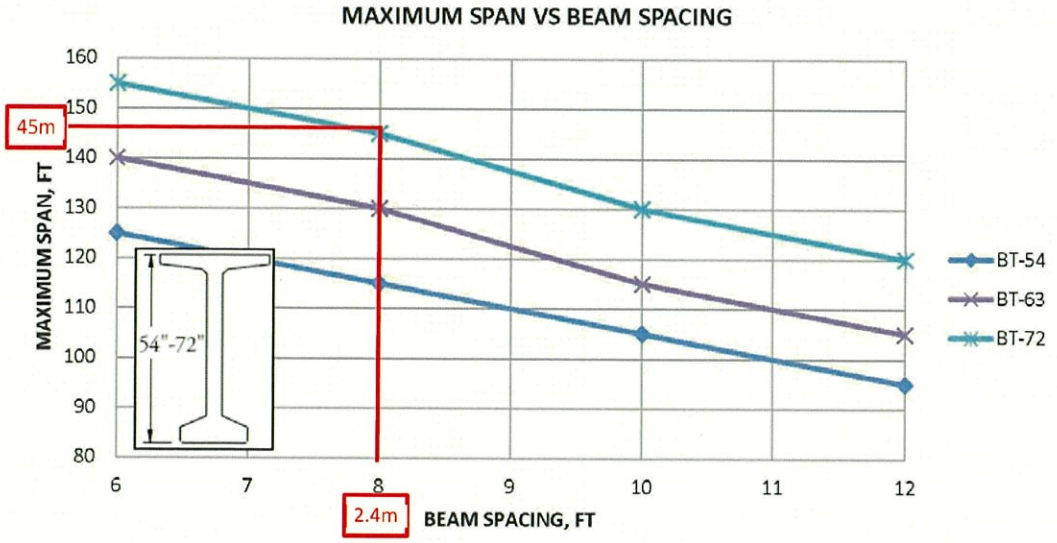


Properties

Type	H in.	H_w in.	Area in.²	Inertia in.⁴	y_{bottom} in.	Weight kip/ft
BT-54	54	36	659	268,077	27.63	0.686
BT-63	63	45	713	392,638	32.12	0.743
BT-72	72	54	767	545,894	36.6	0.799

Source: PCI BRIDGE DESIGN MANUAL, Nov. 2011

Figure 2-1 Girder Cross Section (Main Span)



Source: PCI BRIDGE DESIGN MANUAL, Nov. 2011

Figure 2-2 Relation between Span Length and Girder Spasing

(2) Deck Slab

A slab thickness of 240 mm is adopted based on a girder spacing of 2.4 m (8 ft) (see Table 1-1).

Table 2-1 Deck Slab Thicness

Beam Type	Beam Spacing ft	C.I.P Deck Thickness in.
Box Beams 48 in. wide	Adjacent	6.0
	6, 8, 10, 12	8.0
Box Beams 36 in. wide	Adjacent	6.0
	6, 8, 10	8.0
	12	8.5
Bulb-Tees BT-54, BT-63, BT-72	6, 8, 10	8.0
	12	9.0
Deck Bulb-Tees	Adjacent	None
I-Beams Types II, III, IV	6, 8	8.0
	10	8.5
	12	9.5
I-Beams Types V, VI	6, 8, 10	8.0
	12	9.0
NEXT Beams Type D	Adjacent	None
NEXT Beams Type F	Adjacent	8.0
U-Beams	10, 14	8.0
	18	10

出典：*PCI BRIDGE DESIGN MANUAL, Nov. 2011*

2.3.2 Side Span Section

This is based on the preliminary design results of previous replacement bridges carried out by local consultants.

- Girder height: 1.0m (based on the ratio of girder height to span: 1/15 to 1/17)
- Girder spacing: 2.4m (the same as that of the main span, based on the ratio to the width)
- Slab thickness: 200mm (based on preliminary design results of the replacement bridge)

2.4 Substructure

(1) Common

- Footing penetration: The footing penetration was set at 1.0m, the same as the previous results, considering the margin for the installation of drainage works.
- Foundation type: Pile foundation (cast-in-place pile φ1.2m) was applied because the bearing layer is approximately GL-8m.

(2) Abutment

- The abutment was the cantilever type, which is a common type of structure because of the height H<15m.
- The abutments were designed as a single abutment because of the narrow separation between the tracks.

(3) Pier

- The pier type was chosen to be a cantilever type pier, which is a common structural type, has simple seismic behaviour and is relatively easy to design, and supports the load transmitted from the superstructure by the beams.
- The width of the pier in the axial direction was set taking into account the amount of the load and the width of bridge seat.

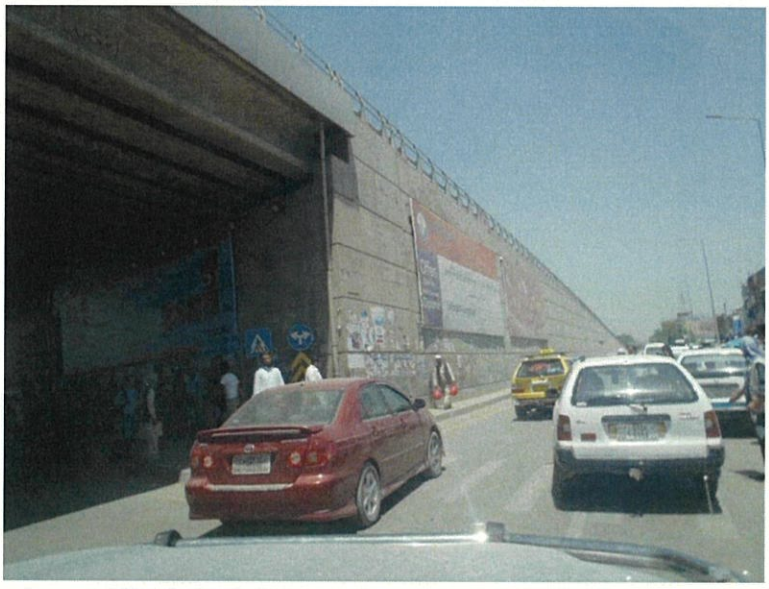
2.5 Approach Section

- As the height of the retaining wall exceeds 10 m, concrete type retaining walls are generally not applicable (see Table 2-2). Therefore, a Mechanically Stabilized Earth Type retaining wall, which has been adopted in Afghanistan, is planned.
- Due to the depth of the bearing layer, ground improvement should be planned at the surface.

Table 2-2 Appied Height of Concrete Type Retaining Wall

Type \ Height (H)	2.0	4.0	6.0	8.0 - (m)
Concrete Block Retaining Type	■	■		
Leaning Type		■	■	
Small Gravity Type	■			
Gravity Type	■	■		
Cantilever Type		■	■	
L-Shaped Type		■		

Source: Standard Design of Civil Engineering Structures, 2000, Japan Construction Engineers' Association



Source: Official of Kabul Municipality

Figure 2-3 Mechanically Stabilized Earth Type retaining wall in Kabul

2.6 Preparation of General View

See Appendix 1 for a general view of the bridge prepared from the above.

2.7 3D Image

See Appendix 4 for a figure prepared to confirm the image of the completed project.

Chapter 3. Recommendation to Detailed Design & Construction Stage

The issues to be considered during detailed design and construction stage are summarised below.

(1) Reconfirmation of ground conditions

- The existing borehole elevations are not consistent with the topographic survey results. In this design, the borehole elevation is changed to the topographic surveyed elevation at the boring location to set the bearing layer depth. It is recommended that at least one boring per one substructure should be carried out during detailed design to set the depth of bearing leyer.
- Although the groundwater level has not been confirmed in the previous geological survey, it is desirable to confirm at the time of boring whether the same is true in the rainy season.

(2) Reconfirmation of topographic survey results

- There is a discrepancy of approximately 30m between the current ground elevation in the longitudinal drawings and the current ground elevation in the plan view. In this design, the current ground elevation in the longitudinal drawing is assumed to be correct after confirming the benchmark in the topographic survey results. When the detailed design is carried out, the topographic survey shall be carried out again, the consistency between the plan and the longitudinal drawing shall be checked, and the longitudinal alignment shall be reviewed if necessary.

(3) Detailed design of service roads and intersection

- In this design, the longitudinal plan was carried out only for the Main Road with the bridge. For the intersection, only the plan drawing is available and no longitudinal planning has been carried out, including the service roads. Therefore, the vertical clearances were checked against the existing height. In the detailed design stage, the design of the intersection and service roads should be carried out, and the vertical clearance should be reconfirmed.

(4) Implementation of design calculation in bridge section

- Design calculations have not been carried out for the bridge general view prepared in this design, because the drawings were prepared for the purpose of calculating the approximate construction cost on an actual basis. In the detailed design stage, the design conditions should be carefully examined and the shape should be revised if necessary.
- The design calculations for the retaining walls in the approach section should be carried out in the detailed design as well.

(5) Construction plan

- The construction plan of the bridge should be based on the following conditions, and the construction procedure and method should be considered. In the calculation of the approximate construction cost, truck crane erection is assumed to be the most common method of erection. If the construction conditions make it difficult to install the truck crane, the construction cost is likely to increase. The same applies to the case where temporary earth retaining is required for the footing construction.
  - Whether and to what extent the current road can be regulated
  - Location and size of the construction yard

APPENDIX

Data Collection Survey for Urban Transport in Afghanistan
Design Review for Sara-E-Shamali Intersection

Appendix

Table of Contents

APPENDIX 1. DESIGN DRAWINGS

Japan International Cooperation Agency (JICA)

Data Collection Survey for Urban Transport in Afghanistan

DESIGN OF SARA-E-SHAMALI INTERSECTION

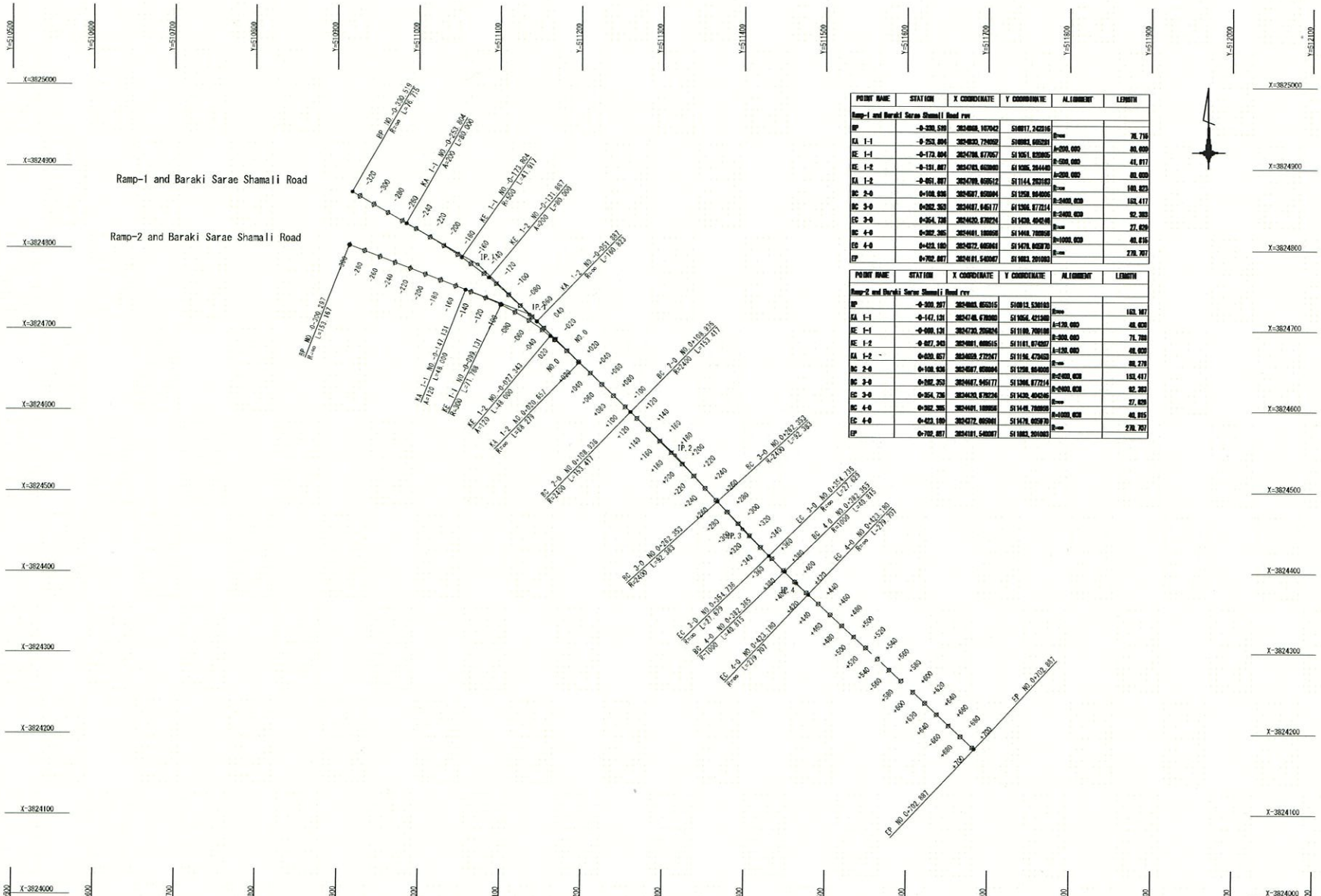
September-21

YACHIYO ENGINEERING Co.,LTD.,

Drawing table of contents

No.	Drawing Titile	
I-1	SARAE SHAMALI HORIZONTAL ALIGNMENT	
I-2	PLAN OF INTERSECTION	
I-3~4	PLAN	(1/2 ~ 2/2)
I-5~8	PROFILE	(1/4 ~ 4/4)
I-9~10	TYPICAL CROSSSECTION	(1/2 ~ 2/2)
I-11	PLAN OF INTERSECTION WITH SATELLITE IMAGE	
I-12~14	GENERAL VIEW	(1/3 ~ 3/3)

SARAE SHAMALI HORIZONTAL ALIGNMENT SCALE = 1:5000



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KA 1-1	-0+253.804	3824833.774052	514883.685291	R=∞	76.715
KE 1-1	-0+173.804	3824798.677057	514951.835852	A=200.000	80.000
KE 1-2	-0+131.887	3824783.662840	514995.294440	R=300.000	41.917
KA 1-2	-0+051.887	3824799.659512	515044.282162	A=200.000	80.000
BC 2-0	0+108.936	3824587.658694	515258.994055	R=∞	160.823
BC 3-0	0+262.353	3824487.945177	515366.877214	R=2400.000	153.417
EC 3-0	0+354.736	3824430.878224	515439.494245	A=2400.000	92.383
BC 4-0	0+382.355	3824491.188958	515448.788859	R=∞	27.620
EC 4-0	0+423.169	3824372.658961	515478.605878	R=1000.000	40.815
EP	0+702.887	3824181.540067	515683.201083	R=∞	279.707

POINT NAME	STATION	X COORDINATE	Y COORDINATE	ALIGNMENT	LENGTH
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KE 1-1	-0+099.121	3824730.265824	515100.709196	R=300.000	71.788
KE 1-2	-0+027.343	3824681.688515	515161.674357	A=170.000	48.000
KA 1-2	0+020.657	3824659.772247	515196.479403	R=∞	88.279
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BC 3-0	0+262.353	3824487.945177	515366.877214	R=2400.000	92.383
EC 3-0	0+354.736	3824430.878224	515439.494245	R=∞	27.620
BC 4-0	0+382.355	3824491.188958	515448.788859	R=1000.000	40.815
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EP	0+702.887	3824181.540067	515683.201083		

ISLAMIC REPUBLIC OF AFGHANISTAN KABUL MUNICIPALITY	JAPAN INTERNATIONAL COOPERATION AGENCY	Prepared by YACHIYO ENGINEERING Co., LTD.	PROJECT TITLE DATA COLLECTION SURVEY FOR URBAN TRANSPORT IN AFGHANISTAN Design Review for Sarae Shamali Intersection	DRAWING TITLE SARAE SHAMALI HORIZONTAL ALIGNMENT SCALE 1:5000	PROJECT LOCATION 34°33'48.21"N, 69° 7'21.51"E	DRAWING NO. P1-3-TP-01 OF 02	SHEET NO. ●●/●●	DATE SEP.-2021	
					REV	REVISION INFRMATION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
					R0	Draft Final Submission	30-Sep.-2021	YEC	YEC	YEC	

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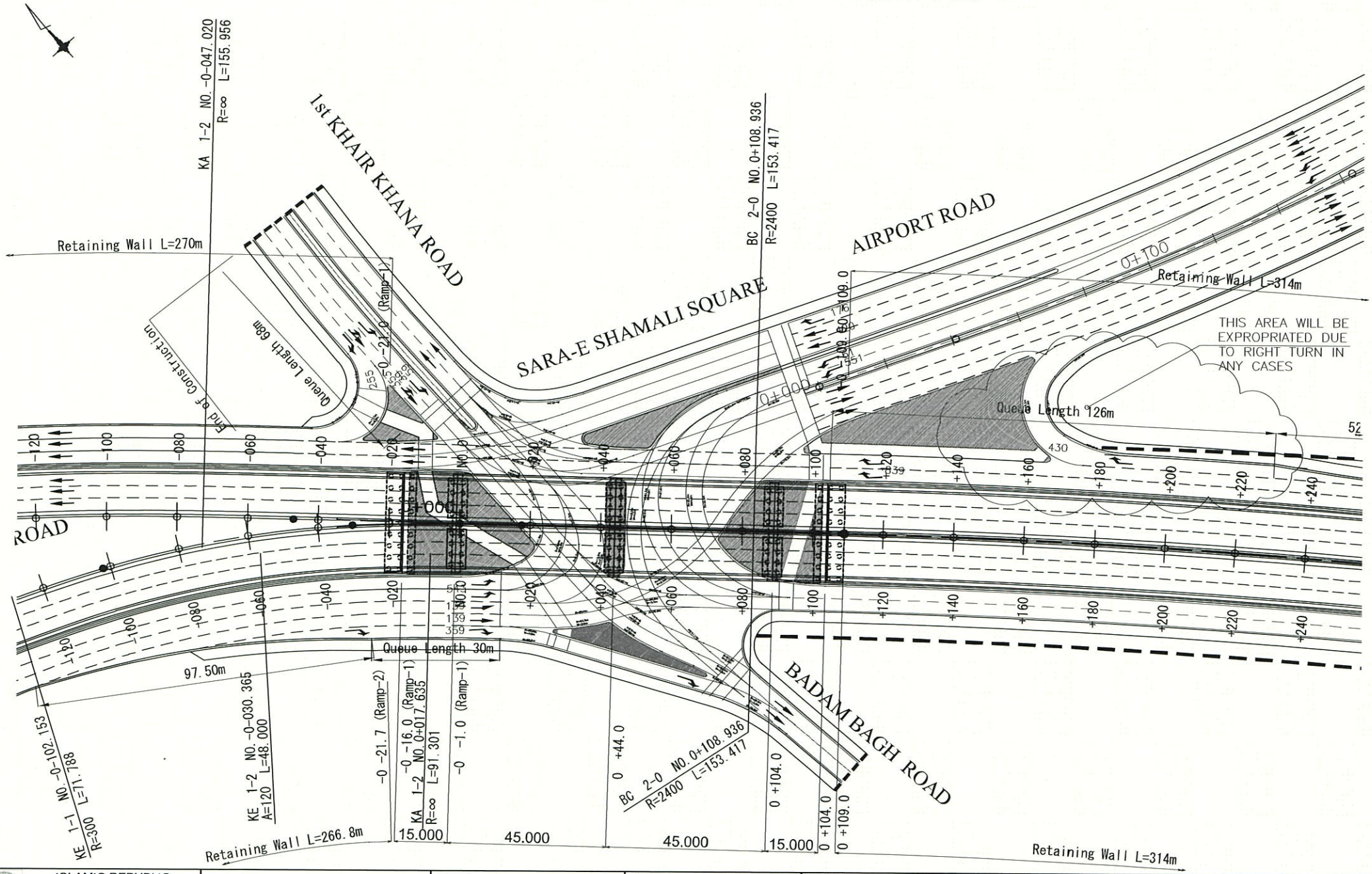

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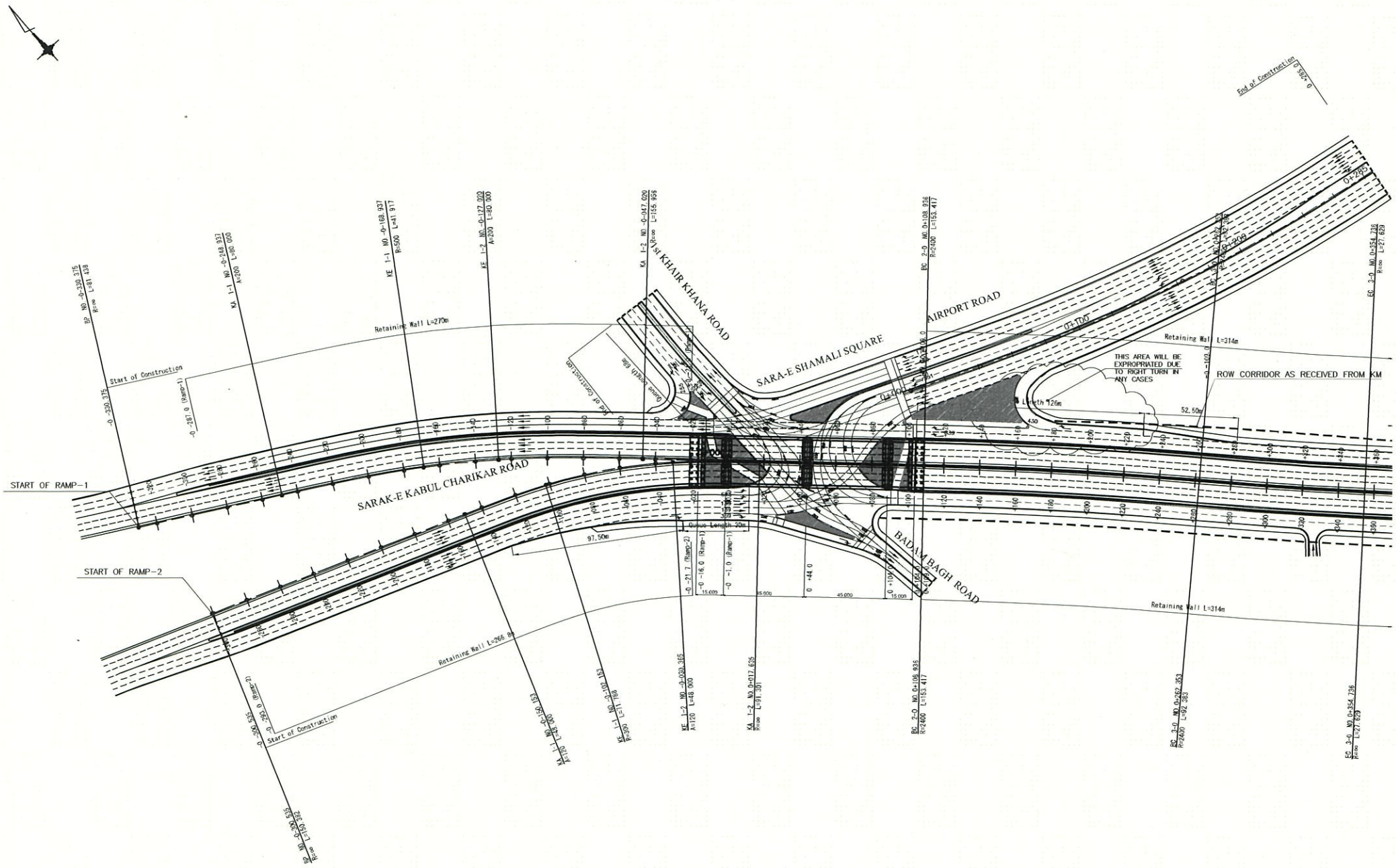

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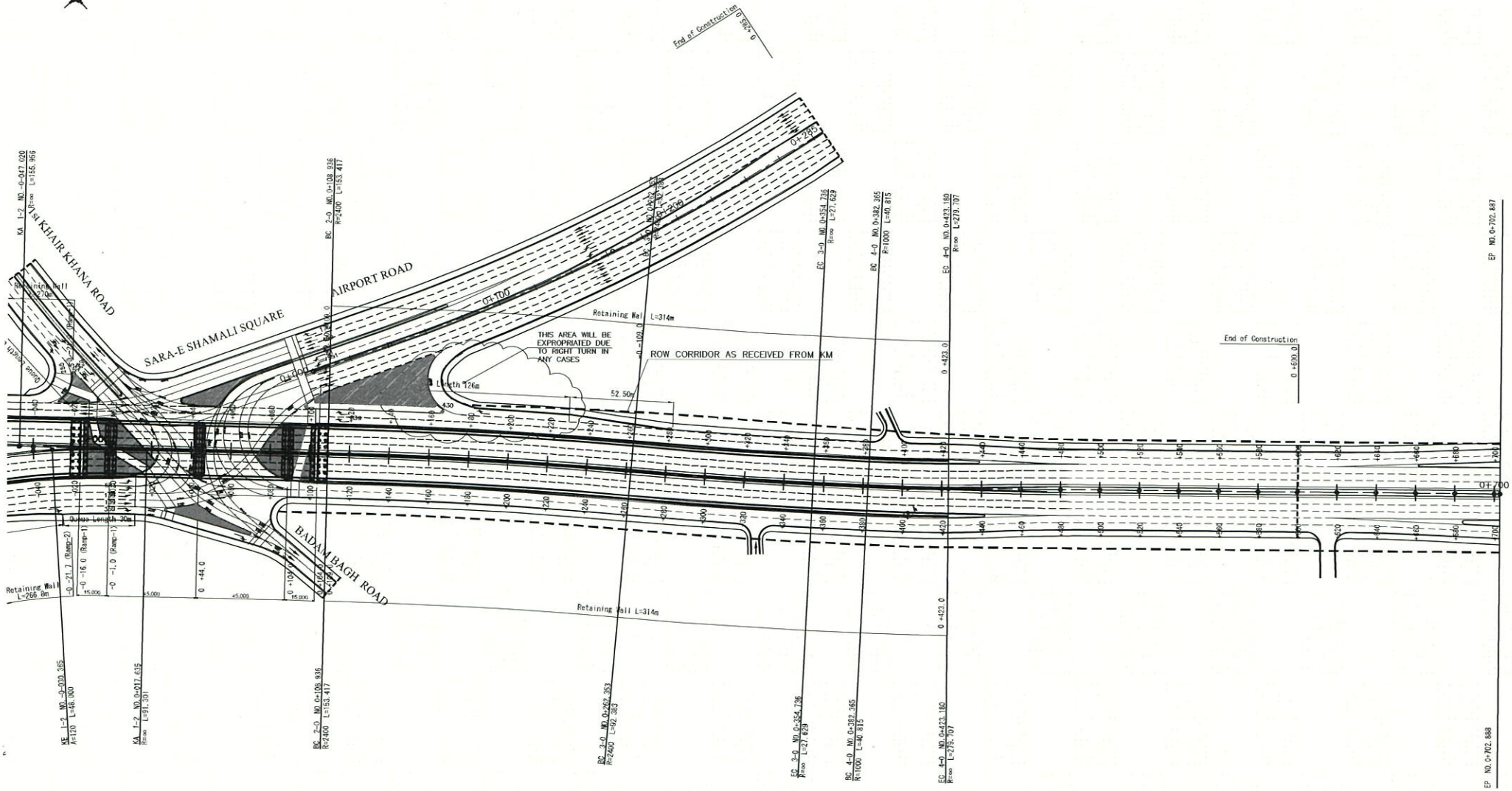

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DATE SEP.-2021

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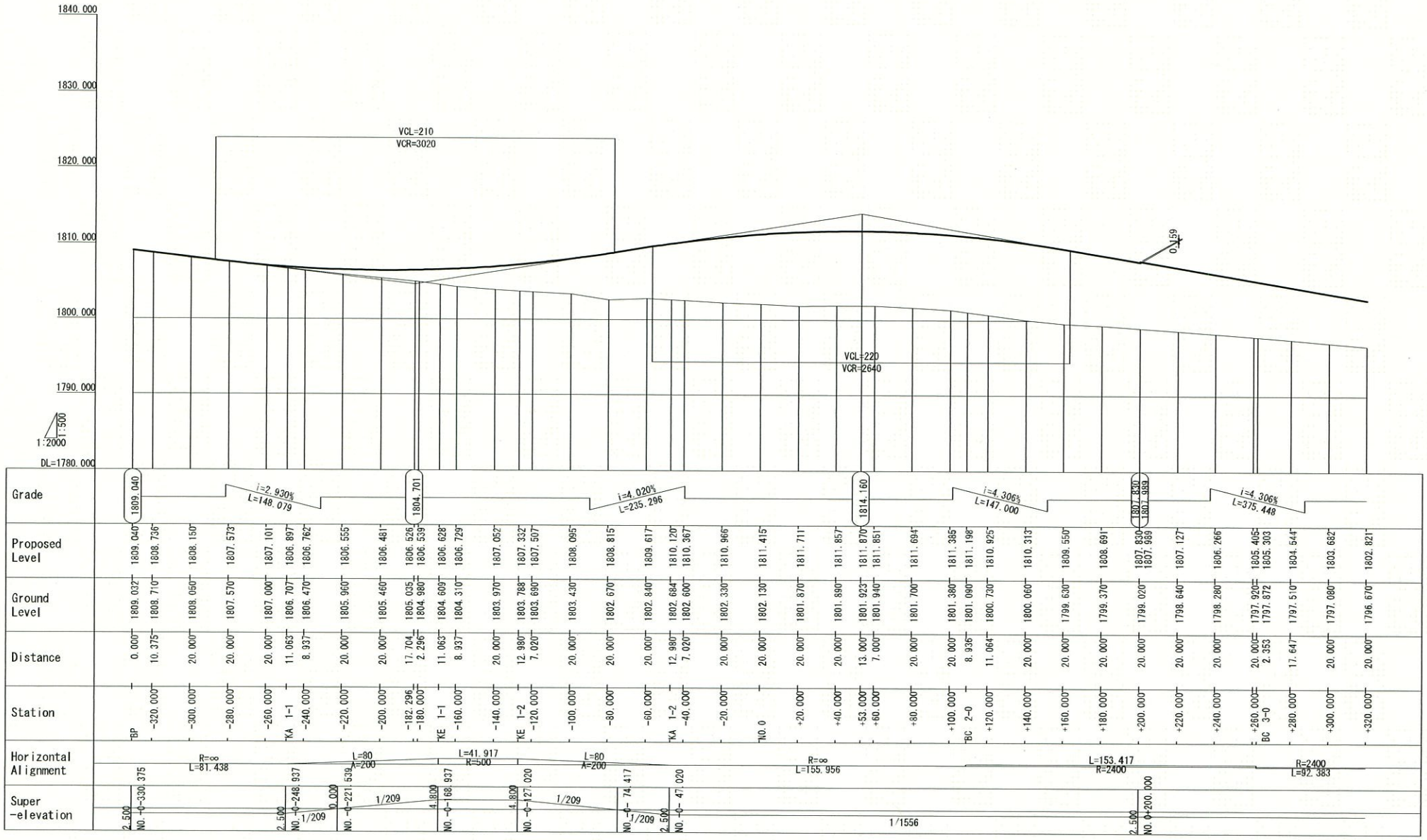

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●●/●●	SEP.-2021

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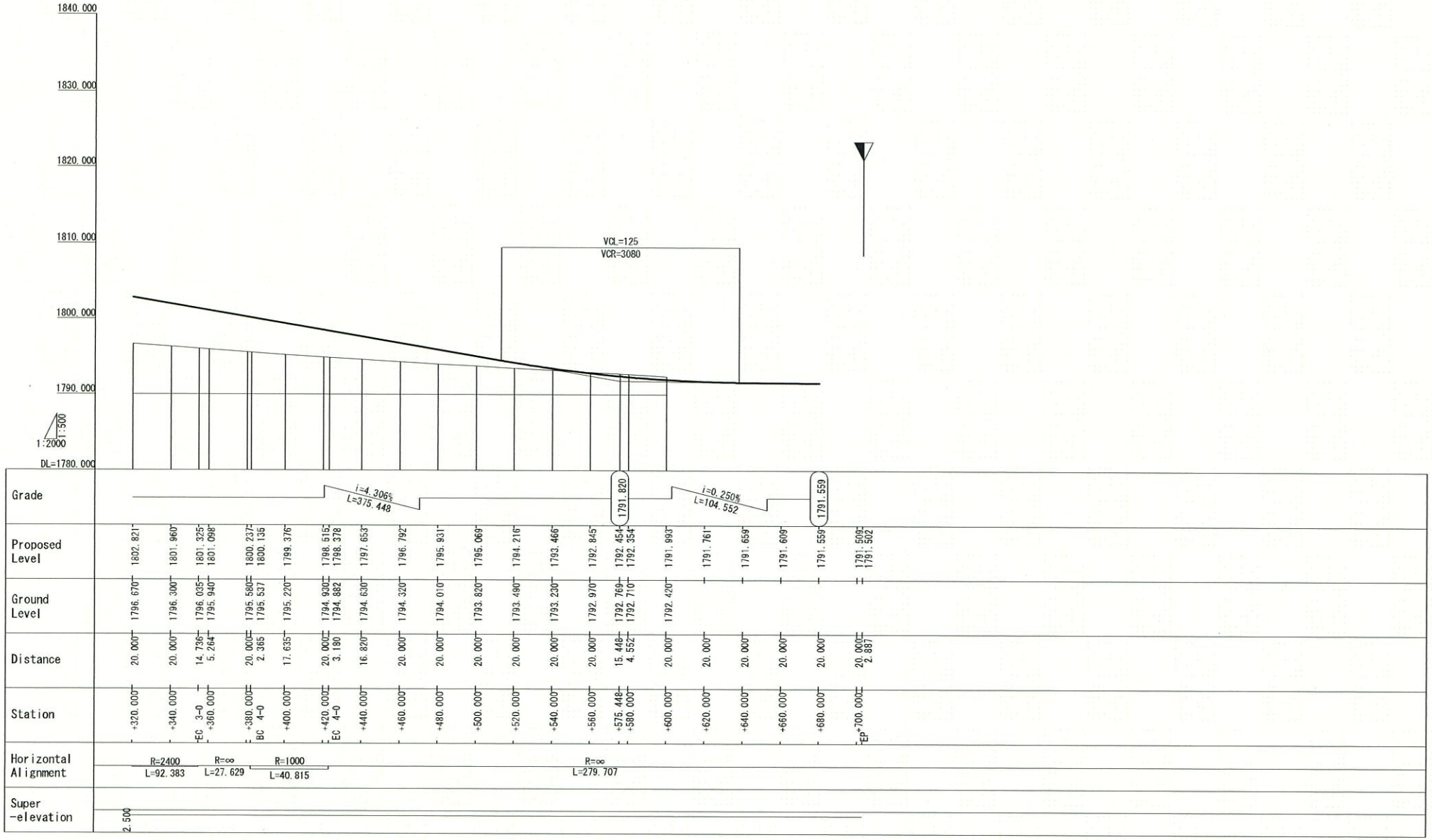

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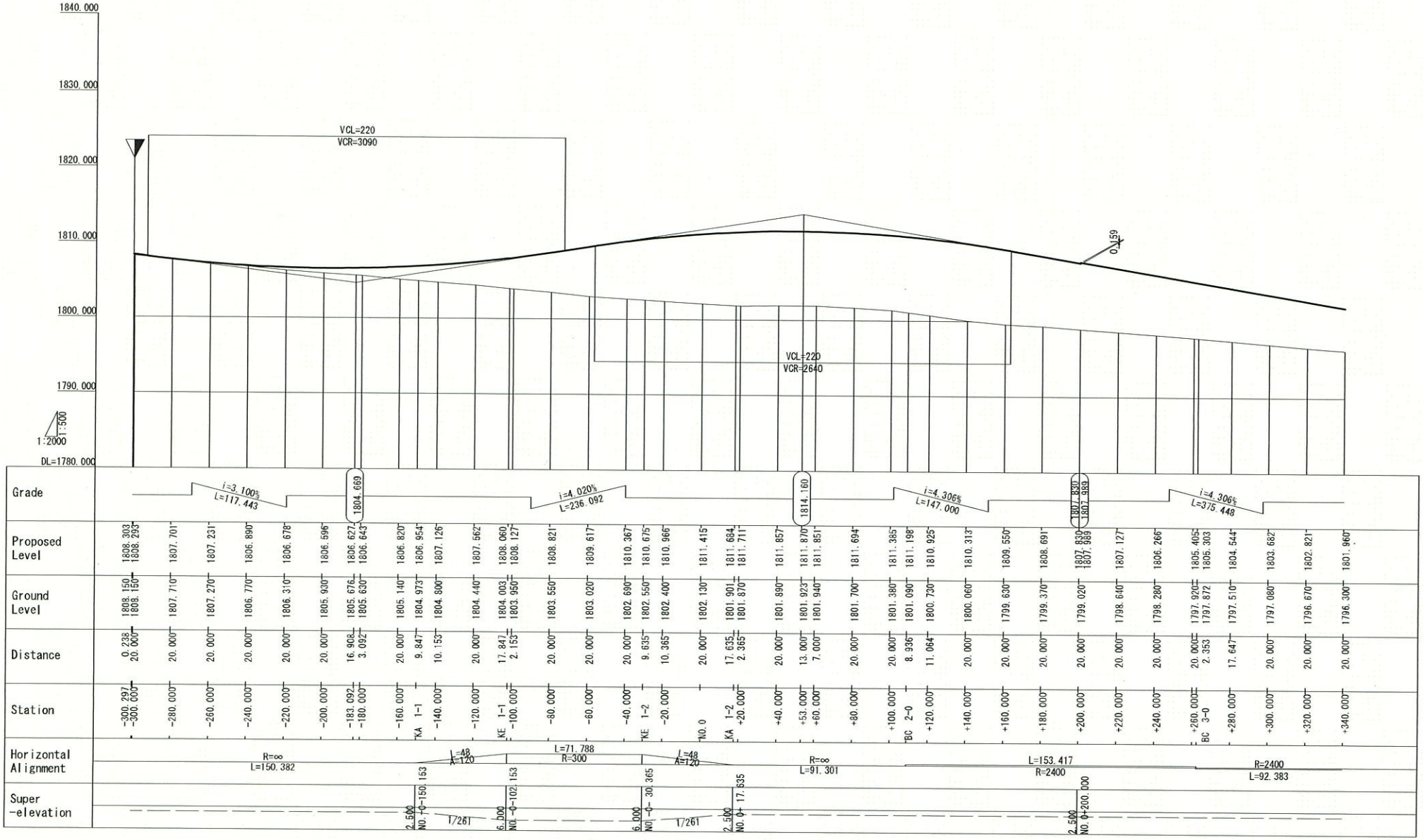

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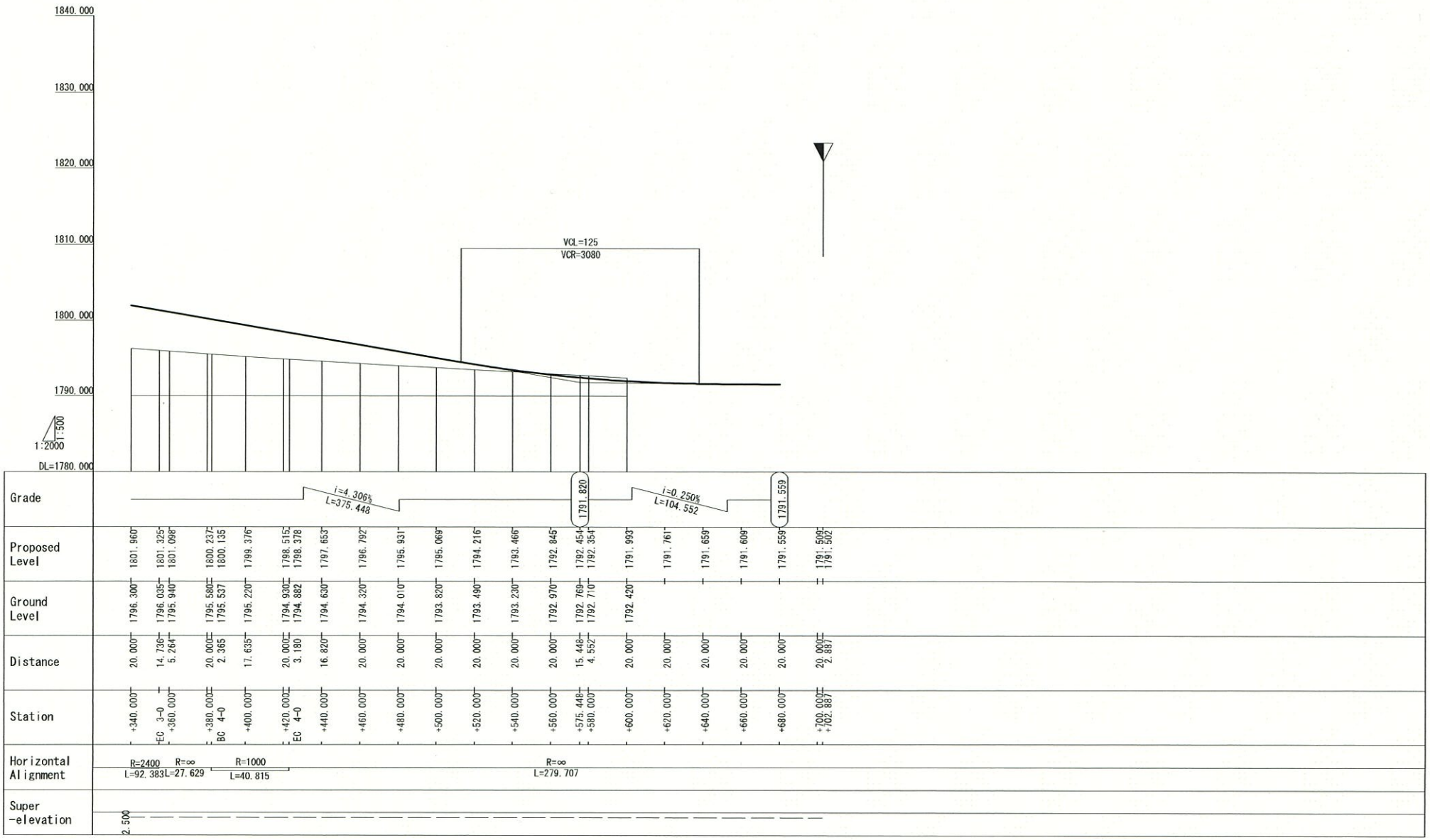

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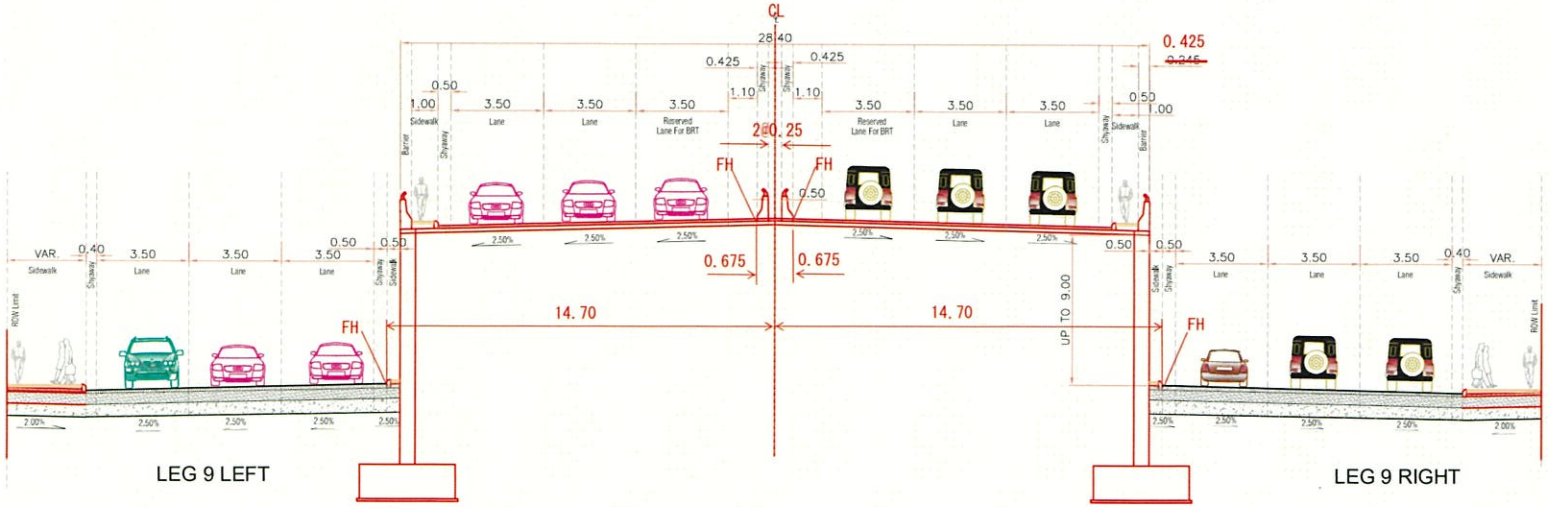

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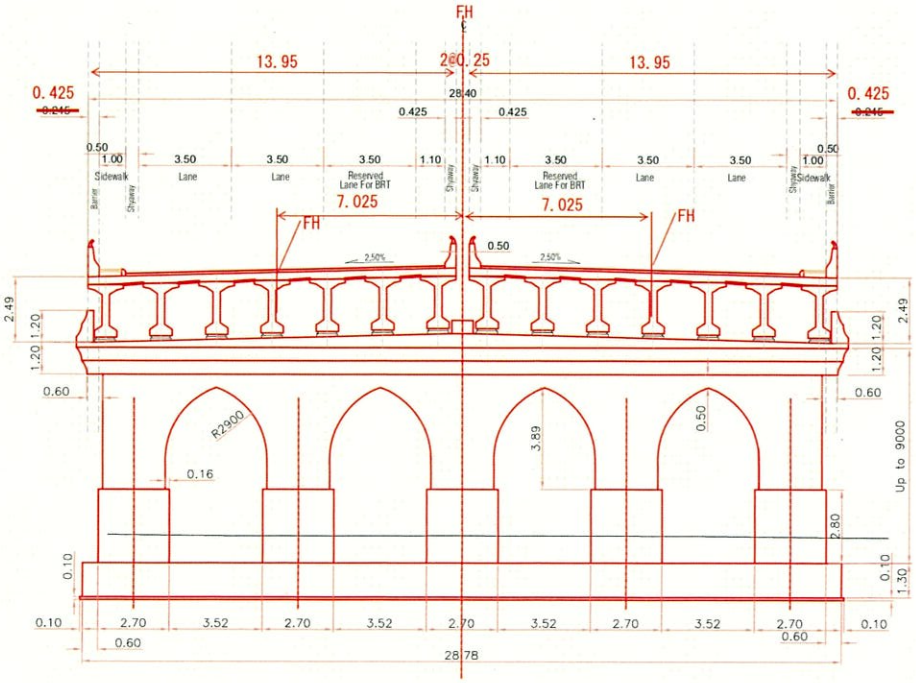

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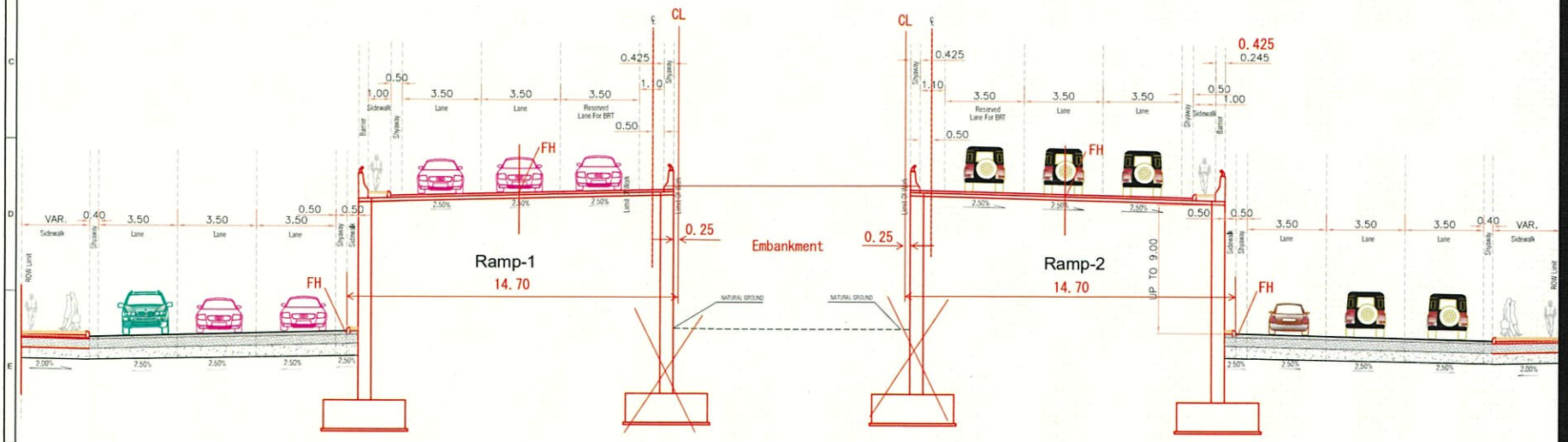

BARAKI SARA-E SHAMALI ROAD TYPICAL SECTION PRIOR TO BRIDGE APPROACH

RAMP 1 & 2

[redacted]

AP-1014-TR028 01

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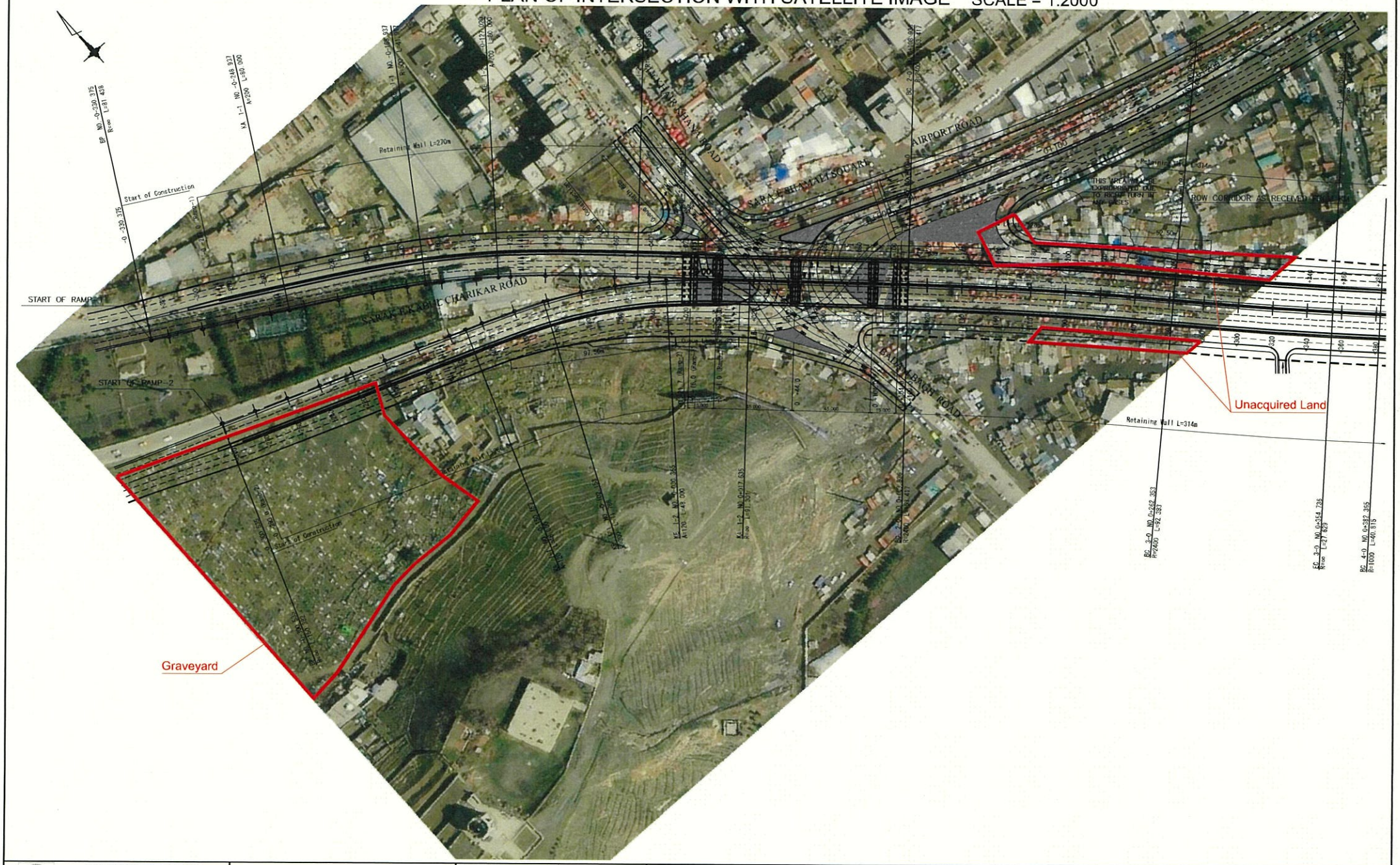

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PROJECT LOCATION: 34°33'48.21"N, 69° 7'21.51"E | DRAWING NO.: P1-3-TP-01 OF 02 | SHEET NO.: ●●/●● | DATE: SEP.-2021

REV	REVISION INFORMATION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
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GENERAL VIEW (1)

(RAMP-1)

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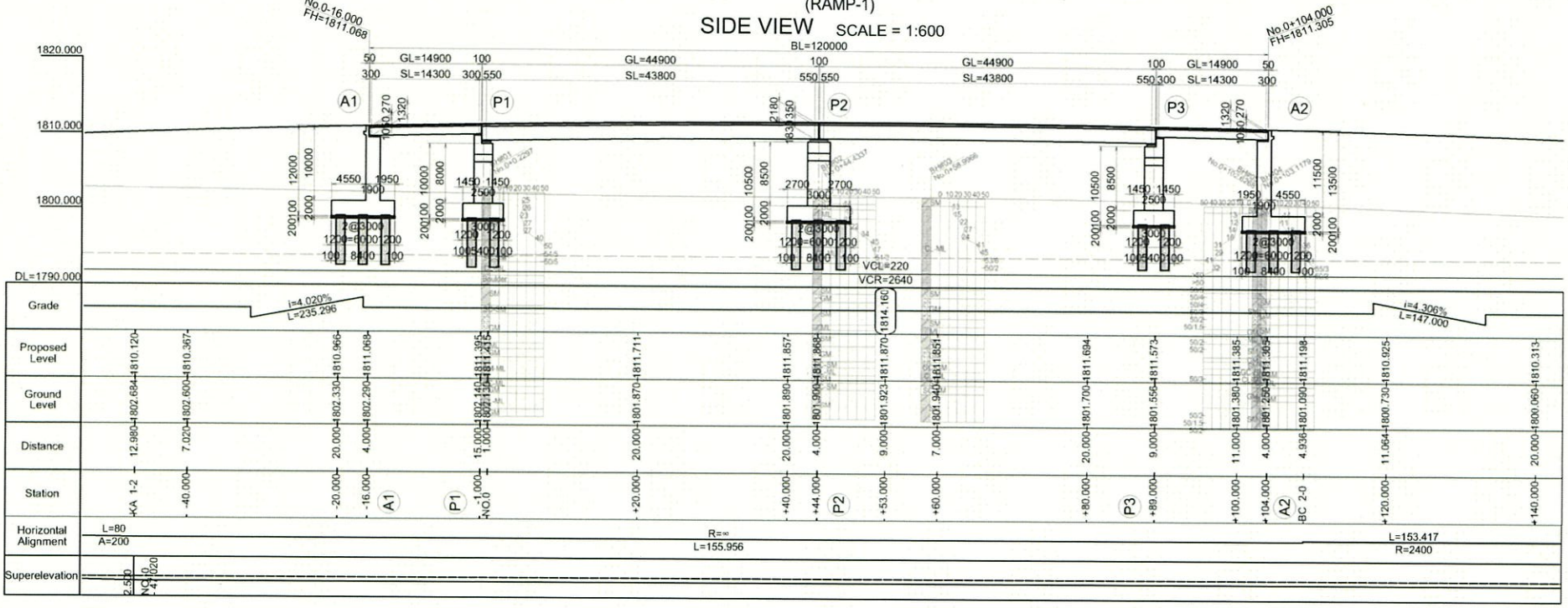

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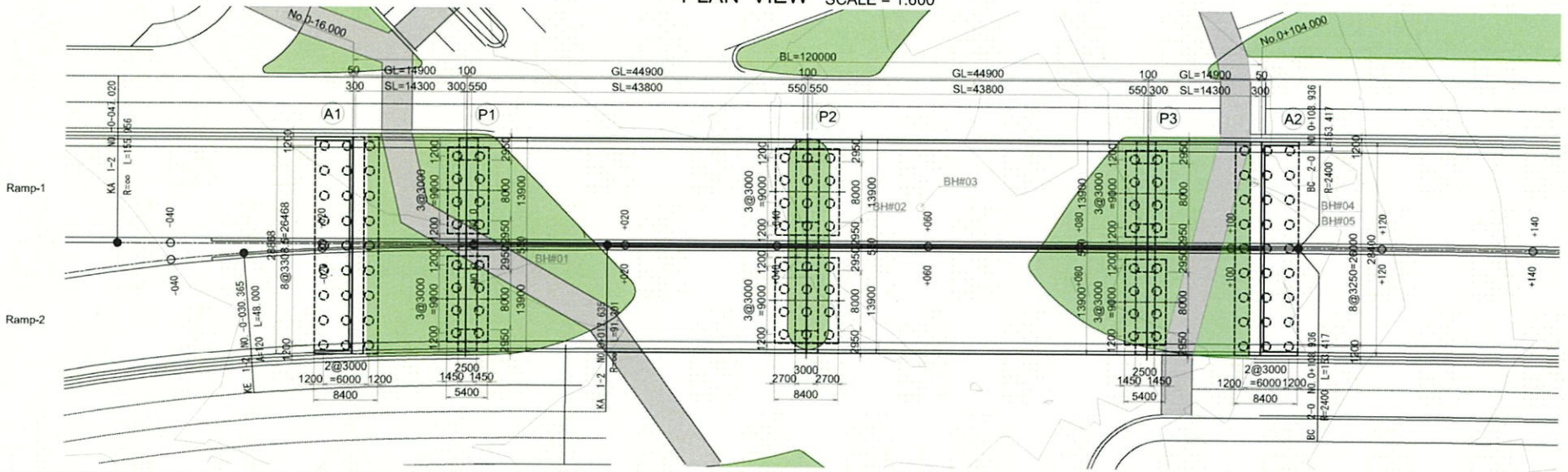

Remarks
BL:Bridge Length
GL:Girder Length
SL:Span Length

ISLAMIC REPUBLIC OF AFGHANISTAN / KABUL MUNICIPALITY	JAPAN INTERNATIONAL COOPERATION AGENCY	Prepared by: YACHIYO ENGINEERING Co., LTD.	PROJECT TITLE: DATA COLLECTION SURVEY FOR URBAN TRANSPORT IN AFGHANISTAN — Design Review for Sarae Shamali Intersection	DRAWING TITLE: GENERAL VIEW (1)	SCALE: 1:600	PROJECT LOCATION: 34°33'48.21"N, 69° 7'21.51"E

DRAWING NO.	SHEET NO.	DATE
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GENERAL VIEW (2)

(RAMP-2)

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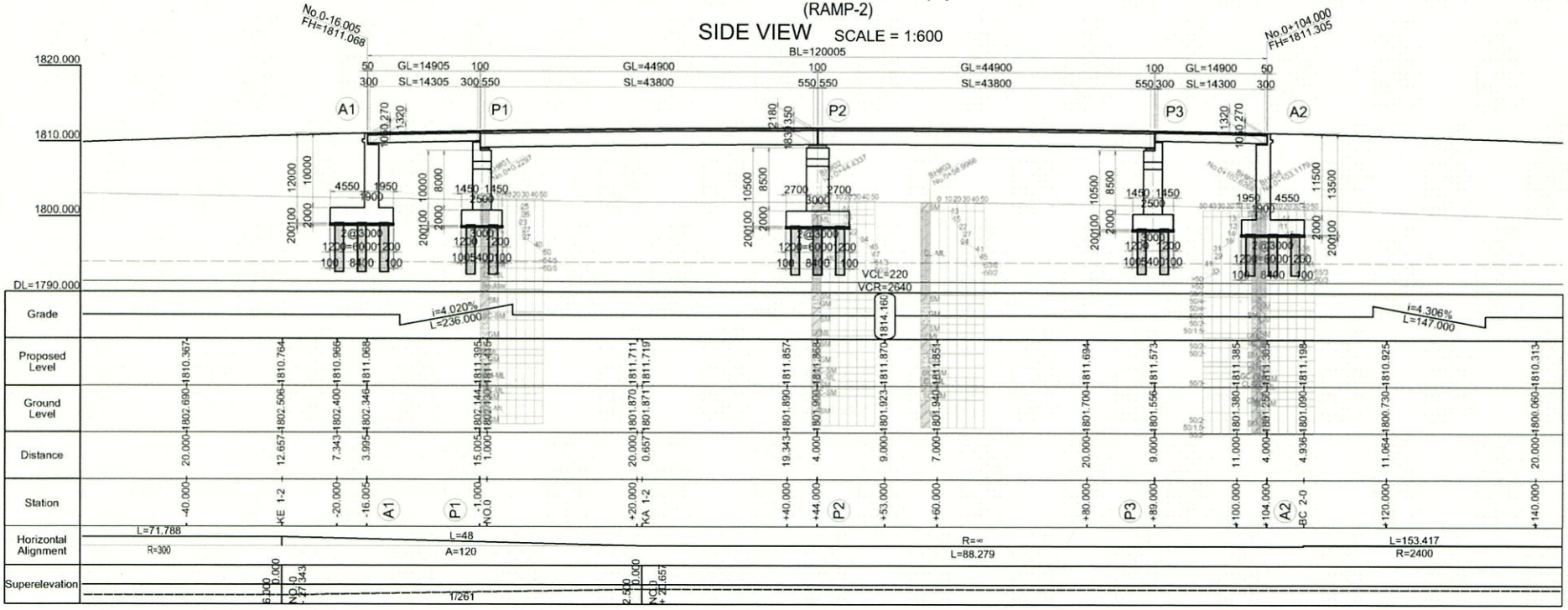

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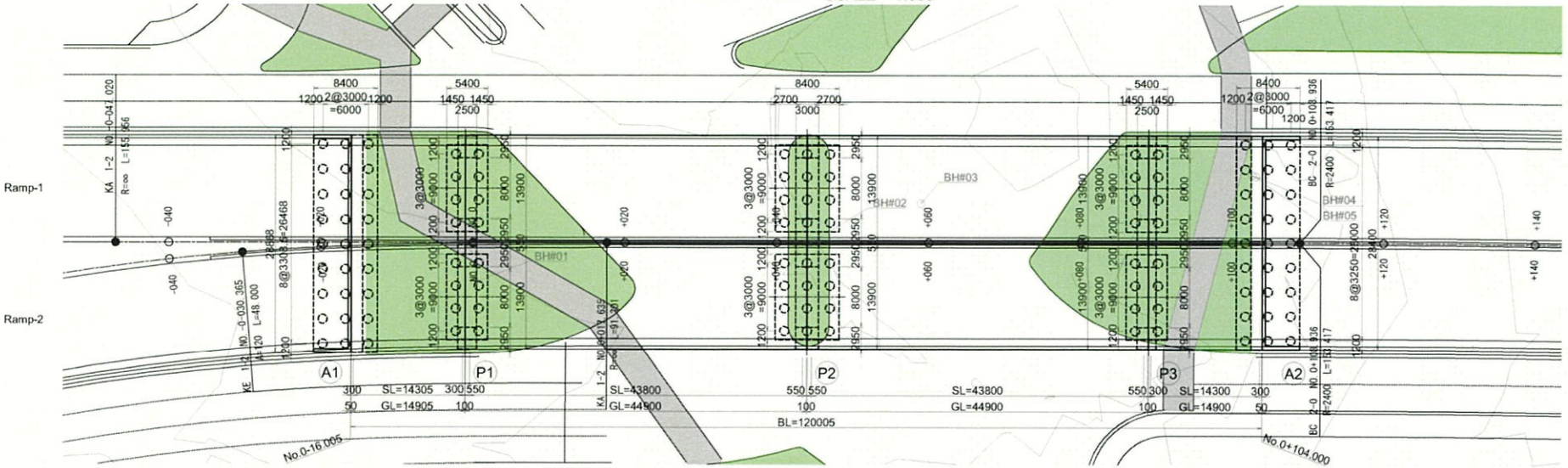

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GL:Girder Length
SL:Span Length

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GENERAL VIEW (3)

CROSS SECTION SCALE = 1:200

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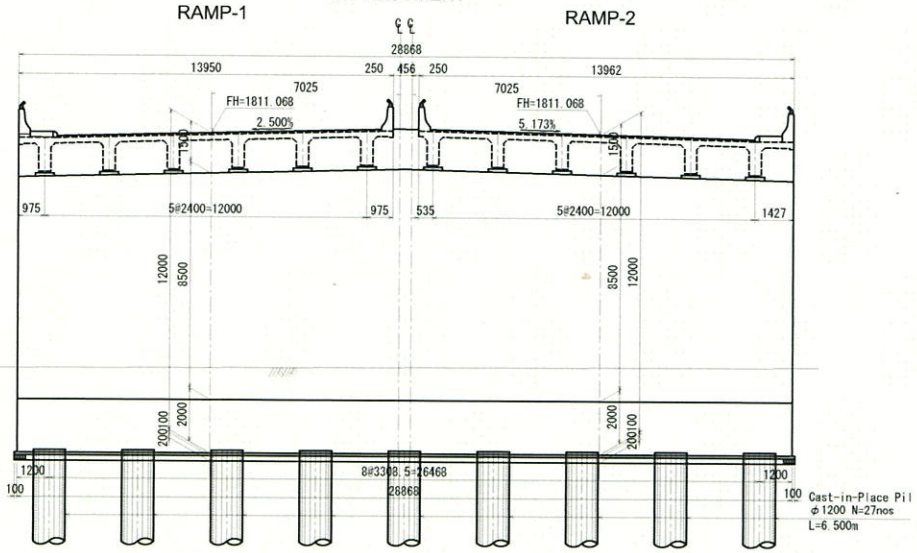

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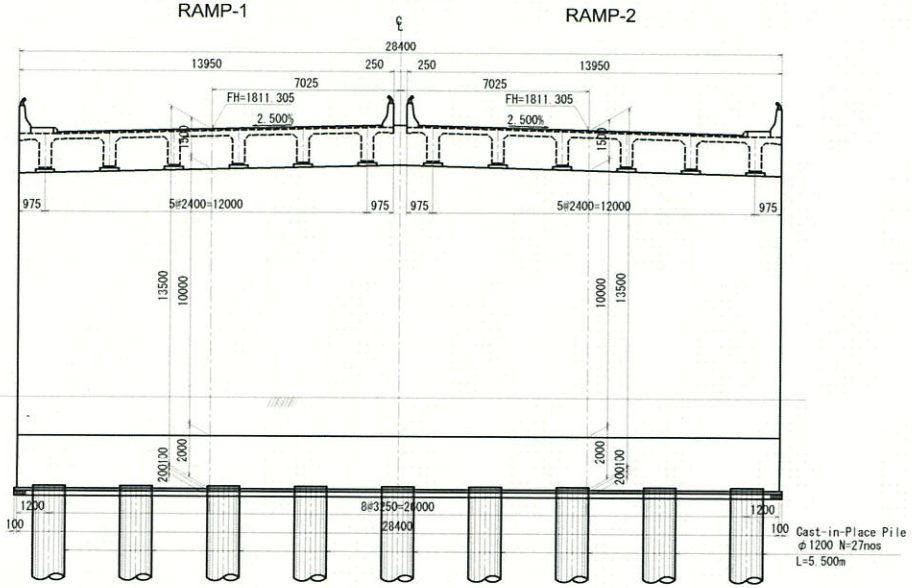

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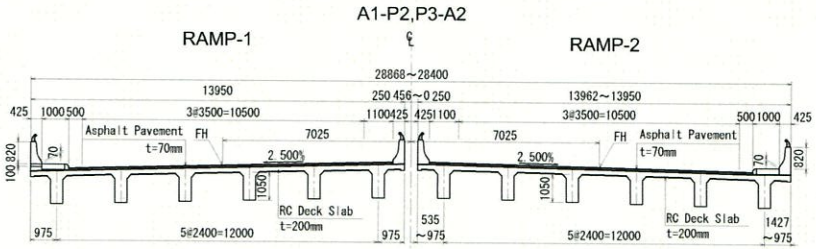
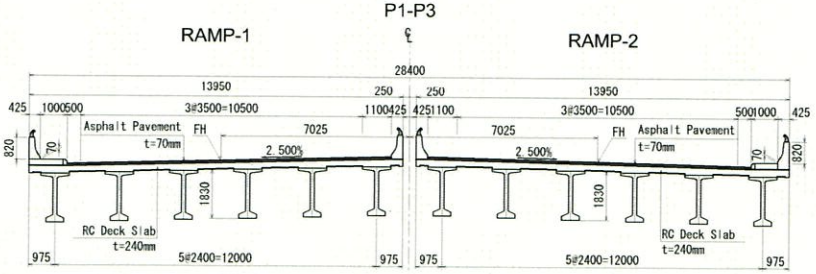


P1-P3



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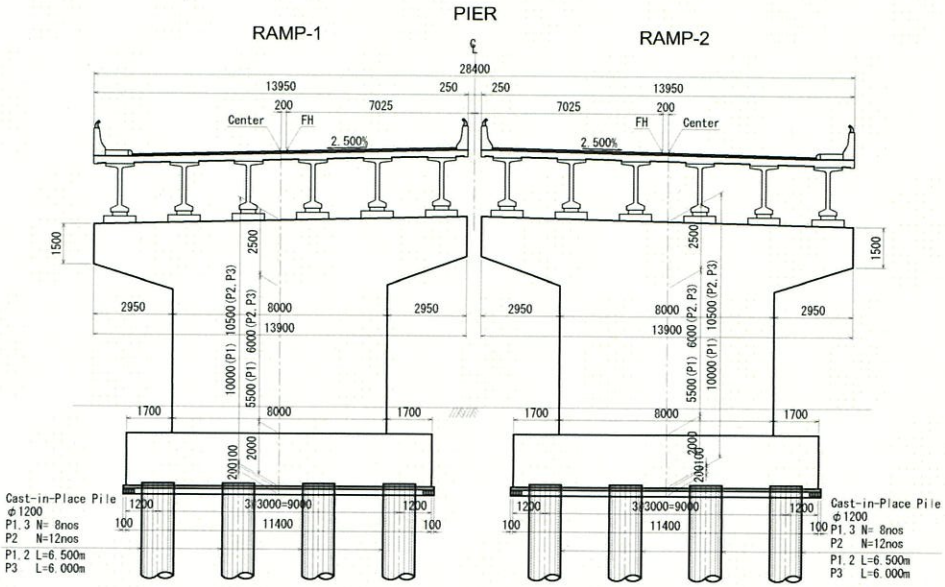

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APPENDIX 2.

ESTIMATED CONSTRUCTION COST

Cost Estimation for Grade Separated Project at Salae Shamali Intersection

Item	Amount M JPY	Amount M USD	Remarks
General	0.8	0.01	
Bridge Work	1,151.0	10.37	Post-tension PC Girder + RC Girder
Retaining Wall Work	851.2	7.67	Mechanically Stabilized Earth Type
Earth Work, Paving Work	283.6	2.55	
Drainage Work	85.1	0.77	Assumed to be 30% of Paving Work
Lighting Work	85.8	0.77	
Subtotal	2,457.5	22.14	
Contingency	122.9	1.11	5%
Total	2,580.4	23.3	1 USD = 111.00 JPY

Sarai Shamali Intersection Cost Estimation [Bridge Work]

Item				Symbol	Unit	Value	Remarks
Bridge Work	Superstructure	Total Width		B	m	26.2	
		Length	Main Span	L1	m	90	2@45m
			Side Span	L2	m	30	2@15m
		Bridge Area	Main Span	A1	m2	2,358	B*L1
			Side Span	A2	m2	786	B*L2
		Unit Cost	Main Span	q1	JPY/m2	219,000	L=45m
			Side Span	q2	JPY/m2	150,000	L=15m
		Cost	Main Span	Q1	M JPY	516.402	
			Side Span	Q2	M JPY	117.900	
			Total		M JPY	634.302	
	Substructure	Abutment	No. of Abutment	N	nos	2	
			Unit Cost	q3	JPY/nos	104,320,800	
			Total	Q3	M JPY	208.642	
		Pier	No. of Pier	N	nos	6	
			Unit Cost	q4	JPY/nos	51,343,333	
			Total	Q4	M JPY	308.06	
	Total			QBR	MJPY	1151.004	ΣQ1～Q4

Sarai Shamali Intersection Cost Estimation [Retaining Wall Work]

Item				Symbol	Unit	Value	Remarks
Retaining Wall Work	Mechanically Stabilized Earth Wall	Origin Side	Average Height	H1	m	6.75	L=268m
			Length	L1	m	536	
			Wall Area	A1	m2	3,618	
			Unit Cost	q51	JPY/m2	91,000	
			Cost	Q51	M JPY	329.238	
		End Side	Average Height	H2	m	7.5	L=314.0
			Length	L2	m	628	
			Wall Area	A2	m2	4,710	
			Unit Cost	q52	JPY/m2	96,000	
			Cost	Q52	M JPY	452.160	
	Ground Reinforcement Work	Origin Side	Depth	D1	m	3.0	Average
			Width	B1	m	5.0	
			Volume	V1	m2	8,040	
			Unit Cost	q53	JPY/m2	4,000	
			Cost	Q53	M JPY	32.160	
		End Side	Depth	D2	m	3.0	Average
			Width	B2	m	5.0	
			Volume	V2	m2	9,420	
			Unit Cost	q54	JPY/m2	4,000	
			Cost	Q54	M JPY	37.680	
	Total			Q5	M JPY	851.2	

Item No.	Description	BOQ			
		Qty.	Unit	RateUSD	Amount USD
1. General					
1.1	Project sign board including illumination during the night taking down and removing at the completion of the project.	2	No.	4,000.00	8,000
	Total amount of bill no.1				**8,000**
2. Earthwork, Pavement					
2.1	Excavation in any type of soil to road work and drainage works, including haulage and transport to an approved dump area	20,020	m3	5.00	100,100
2.4	Embankment fill.	1,960	m3	2.00	3,920
2.6	Fill to bridge and retaining walls	**74,020**	m3	3.00	222,060
2.9	Subgrade preparation	**55,650**	m2	1.00	55,650
2.10	Crushed Aggregate base coarse	**22,260**	m3	10.00	222,600
2.11	Granular Sub-base coarse.	**16,695**	m3	7.50	125,212
2.12	Bituminous prime coat	**51,436**	m2	1.00	51,435
2.13	Bituminous AC wearing coarse	**55,650**	m2	1.00	55,650
2.14	Bituminous AC binder base coarse	**6,122**	m3	144.00	881,496
2.15	Bituminous AC wearing coarse	**2,783**	m3	150.00	417,375
2.16	Line paint marking type (M1-B, M3-B) (yellow).	2,900	m	3.00	8,700
2.17	Line paint marking type (M1-A, M4-A, M4-B, M5, M5-A, M7 (white)	14,970	m	3.00	44,910
2.18	Line paint marking (chevron hatch).	153	m2	3.00	459
2.19	Line paint marking type M9 (pedestrian crossing marking area).	176	m2	3.00	528
2.20	Direction arrow - straight.	72	No.	15.00	1,080
2.21	Direction arrow - curved.	13	No.	15.00	195
2.22	Direction arrow - with two arrows	6	No.	15.00	90
2.23	Raised pavement stud	1,063	No.	30.00	31,890
2.24	Sign R=90cm.	19	No.	70.00	1,330
2.26	Peltophrum inerme (trees)	13	No.	100.00	1,300
2.27	Agapanthus africanus (ground cover).	332	No.	5.00	1,660
2.28	Juniperus horizontalis (shrubs).	458	No.	30.00	13,740
2.29	Colorful Concrete bench with back rest 1800x600x500	19	No.	200.00	3,800
2.30	Concrete trash bin	19	No.	50.00	950
2.31	Pavement 1: Pre-Cast Concrete block paving 100 x 100 x 60 mm Thick, Grid Pattern, Color: Light orange.	4,523	m2	26.00	117,598
2.32	Pavement 2: Pre-Cast Concrete block paving 100 x 100 x 60 mm Thick, Grid Pattern, Color: Dark beige.	1,816	m2	26.00	47,216
2.33	Pavement 3: Pre-Cast Concrete block paving 100 x 100 x 60 mm Thick, Grid Pattern, Color: Sea green.	359	m2	26.00	9,334
2.34	Pavement 4: Pre-Cast Concrete block paving 100 x 100 x 60 mm Thick, Grid Pattern, Color: Off White.	1,635	m2	26.00	42,510
3.25	Supply and install curbstones size 150 x 300 mm, all complete as specified and as shown on drawings between tiling and asphalt	7,405	m	10.00	74,050
3.26	Ditto size 100 x 200 mm, between walkway and building area.	1,540	m	10.00	15,400
3.27	Ditto size 100 x 300 mm, between walkway and planted area.	279	m	10.00	2,790
	Total amount of bill no. 3				**2,555,028**

5. ELECTRICAL WORK					
5.1	Dismantling of electrical pylons, overhead cables, transformers, electrical boxes, accessories and handover to concerned authority	13	No.	50.00	650
5.2	Supply and install aerial utilities including electrical pylons with all related accessories(isolators, surge arrestors,….), overhead lines(same number of circuits and same size of cables as the existing), transformers, outgoing low voltage cables, low voltage panels, electrical boxes having same characteristics as the existing where applicable as per Kabul electricity company requirements and approvals.	650	m	20.00	13,000
5.3	Install civil works related to telecom networks including 4 PVC pipes Ø 4 inch, handholes, manholes, excavation trenches, backfilling and all required accessories as per telecom authorities requirements.	300	m	100.00	30,000
5.4	Power duct banks(2x3x6 inch pipes) including ducts, excavation trenching, backfilling and Concrete Encasement as per drawings and Kabul electricity company requirements	170	m	50.00	8,500
5.5	Telephone duct banks(2x2x4 inch pipes) including ducts, excavation trenching , backfilling and Concrete Encasement as per drawings and as per telecom authorities requirements	170	m	50.00	8,500
5.6	Telephone manholes -inner size -120x120x120cm and including excavation trenching, backfilling steel cover, etc. as per drawings, and telecom authorities requirements	8	No.	50.00	400
5.7	Dismantling of existing lighting poles	5	No.	20.00	100
5.8	Dismantling of existing street lighting feeder pillar	1	No.	20.00	20
5.9	Supply, Install and Connect 12m height lighting pole including: 2 brackets of 2m length, 2 luminaires 116w, solar panels, batteries with their weatherproof boxes, charger controller, fire resistant wires, earth rod, the foundation of the pole and all accessories needed as per specifications and drawings	48	No.	320.00	15,360
5.10	Supply, Install and Connect 12m height lighting pole including: 1 bracket of 2m length, 1 luminaire 95w, solar panels, batteries with their weatherproof boxes, charger controller, fire resistant wires, earth rod, the foundation of the pole and all accessories needed as per specifications and drawings.	17	No.	320.00	5,440
5.11	Supply, Install and Connect 12m height lighting pole including: 1 bracket of 2m length, 1 luminaire 116w, solar panels, batteries with their weatherproof boxes, charger controller, fire resistant wires, earth rod, the foundation of the pole and all accessories needed as per specifications and drawings.	117	No.	320.00	37,440
5.12	Traffic controller (including feeder cable to the controller and all power and control cables between the controller and the signal heads).	1	No.	50,000.00	50,000
5.13	Traffic signal heads Primary and Secondary as per drawings and specifications, including poles, heads, lamps as per authority approvals, foundations etc. complete system including Ducts, cables, junction boxes, loop detectors, feeder pillars, programming, testing & commissioning	12	No.	50,000.00	600,000
5.14	Supply and install manhole 100 cm x 100 cm x 60 cm as per specifications and drawings	2	No.	2,000.00	4,000
	Total amount of bill no. 5				**773,410**

6. DAY WORKS					
6.1	Bulldozer 215 hp min	60	hr		-
6.2	Motor Grader 135 hp min	40	hr		-
6.3	Vibratory Compactor 8-12 T min	60	hr		-
6.4	Vibratory Compactor 2-5 T min	150	hr		-
6.5	Excavator 1.5 m3 min	80	hr		-
6.6	Truck 150 hp min	60	hr		-
6.7	Pump 70-100 mm dia	450	hr		-
6.8	Concrete mixer 0.5 m3 capacity min	90	hr		-
6.9	Concrete mixer 2 m3 capacity min and air tools	180	hr		-
6.10	Crushed stone chips (10 mm) base	130	m3		-
6.11	Bitumen Grade 80/100	9	ton		-
6.12	Cement	18	ton		-
6.13	Reinforcing steel	18	ton		-
6.14	Supervisor	600	hr		-
6.15	Skilled Labour	600	hr		-
6.16	Un-skilled Labour	1,200	hr		-
	Total amount of bill no. 5				**-**
	Total amount of bill works				**3,336,438**
	Contingency	5	%		**166,821**
	Total amount of Project				**3,503,259**

Quantity of Pavement

Calculation of Pavement Area

Area	Unit	Base Area	Island 1	Island 2	Island 3	Subtotal
Northside	M2	35,188	-152	-218	-1,063	33,755
Southside	M2	22,057	-162			21,895
T0tal	M2					55,650

Quantity of Pavement

Description	Thickness	Unit	Quantity
Subgrade preparation	-	m2	55,650
Crushed Aggregate base coarse	0.40	m3	22,260
Granular Sub-base coarse.	0.30	m3	16,695
Bituminous AC binder base	-	m2	51,436
Bituminous AC wearing coarse	-	m2	55,650
Bituminous AC binder base coarse	0.11	m3	6,122
Bituminous AC wearing coarse	0.05	m3	2,783
Thickness of Pavement	0.86	m	

Description	Original Quantity	Rate
Bituminous AC binder base coarse	39,240	0.92427
Bituminous AC wearing coarse	42,455	

Embankment for Retaining Wall

Station	Distance	Area	Ave. Area	Volume	Remark
-0-290		0.0			
-0-200	90.0	27.7	13.8	1,245.2	Gradient change point
-0-022	177.9	214.2	120.9	21,517.0	A1 Abutment
					Bridge
0+109		254.8			A2 Abutment
0+400	290.6	90.8	172.8	50,213.8	Gradient change point
0+423	23.0	0.0	45.4	1,044.3	
Total				74,020.3	

APPENDIX 3. BOREHOLE LOGS

Geological Log

LOG OF BH# 01

Completion Depth Of Borehole: 30 (meter)

Client : Kabul Municipality

Contractor: Khatib&Alami

[redacted]

Project: Sara-e Shamali Interchange, Kabul Province, Afghanistan

Coordinate : E-511178.113, N-3824669.665

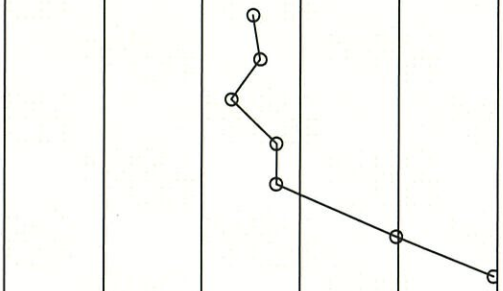
Elevation : 1808.38 m

Weather: Sunny

Depth: 30 m

Water Table: Dry

DEPTH (M)	GRAPHIC LOG	CORE RECOVERY (%)	SAMPLING TYPE	MATERIAL DESCRIPTION	USCS CLASSIFICATION	Depth of SPT Test (m)	BLOW COUNTS (N VALUE)
1		100		Silty Clay	CL-ML	1	25
2						2	26
3				Silty clay with sand	CL-ML	3	23
4						4	27
5		100		Sandy Silty Clay with Gravel	CL-ML	5	27
6				Silty Clay with Sand	CL-ML	6	40
7				Sandy Silty Clay	CL-ML	7	50
8						8	54 / 5 Cm
9		100		Silty Clayey Sand with Gravel	SC-SM	9	50 / 5 Cm
10				Sandy Silty Clay with Gravel	CL-ML	10	Refusal
11				Boulder		11	Refusal
12		100				12	Refusal
13				Silty sand with gravel	SM	13	Refusal
14						14	Refusal
15		100		Silty Clayey Sand with Gravel	SC-SM	15	Refusal
16						16	Refusal
17		100		Silty Gravel with Sand	GM	17	Refusal
18						18	Refusal
19						19	Refusal
20		100		Sandy Silt with Gravel	ML	20	Refusal
21				Silty Gravel with Sand	GM	21	Refusal
22				Silty Clay with Sand	CL-ML	22	Refusal
23				Sandy Silty Clay	CL-ML	23	Refusal
24				Sandy Silty Clay with Gravel	CL-ML	24	Refusal
25		100		Silty Clayey Sand with Gravel	SC-SM	25	Refusal
26				Silty Gravel with Sand	GM	26	Refusal
27						27	Refusal
28		100		Sandy Silty Clay with Gravel	CL-ML	28	Refusal
29						29	Refusal
30				Silty Gravel with Sand	GM	30	Refusal



Sample Types :

Shelby Tube (SH)

Continued Core Barrel Samples

NOTE

1-CONTINUAL SOIL SAMPLE RECOVERED FROM BOREHOLE AND STORED IN WOODEN BOXES.

Drilling Method : Geotechnical Rotary

Sampling Method : Continuous Soil Sampling - Split Spoon

SPT Hammer : 63.5-Kg/30 inch drop-Split Spoon via ASTM D-1586

[redacted]

Source: Geotechnical Investigation Report Sara-e Shamali Interchange, Jul. 2017, Khatib & Alami

Geological Log

LOG OF BH# 02

Completion Depth Of Borehole: 30 (meter)

Client : Kabul Municipality

Contractor: Khatib&Alami

[redacted]

Project: Sara-e Shamali Interchange, Kabul Province, Afghanistan

Coordinate : E-511213.579, N-3824642.758

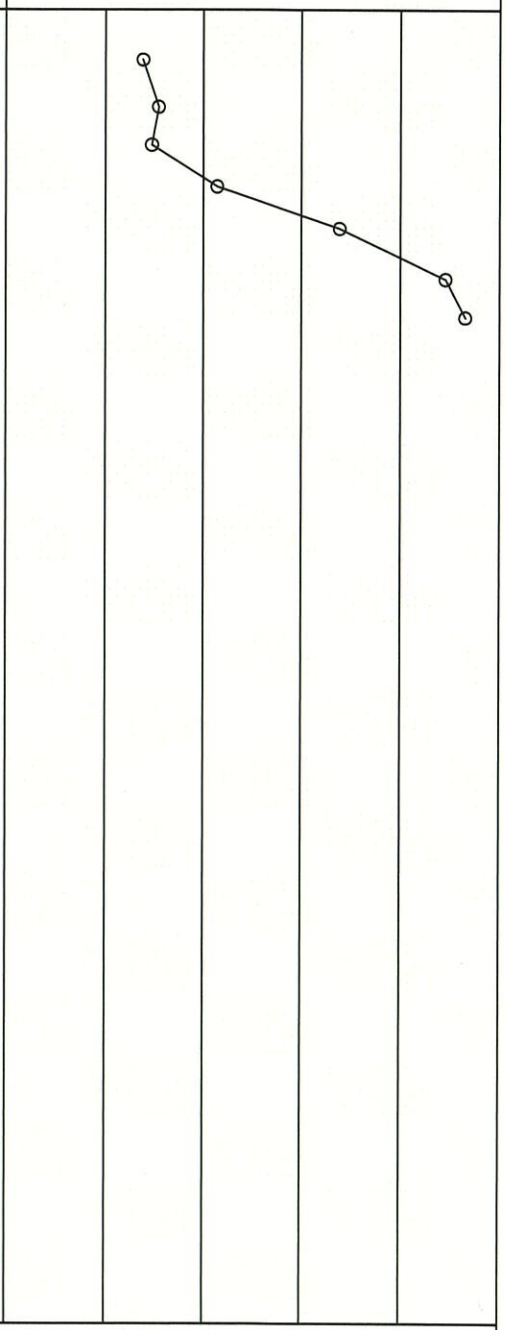
Elevation : 1805.03 m

Weather: Sunny

Depth: 30 m

Water Table: Dry

DEPTH (M)	GRAPHIC LOG	CORE RECOVERY (%)	SAMPLING TYPE	MATERIAL DESCRIPTION	USCS CLASSIFICATION	Depth of SPT Test (m)	BLOW COUNTS (N VALUE)
1				Silty Sand	SM	1	14
2		100		Clayey Sand	SC	2	16
3				Sandy Silt	ML	3	15
4						4	22
5		100		Silty Clay with Sand	CL-ML	5	34
6						6	45
7						7	47
8				Sandy Silty Clay with Gravel	CL-ML	8	51 / 3 Cm
9		100		Sandy Silty Clay	CL-ML	9	50 / 2 Cm
10						10	Refusal
11				Sandy Silty Clay with Gravel	CL-ML	11	Refusal
12		100				12	Refusal
13				Silty sand with gravel	SM	13	Refusal
14				Silty Gravel with Sand	GM	14	Refusal
15		100		Silty sand with gravel	SM	15	Refusal
16						16	Refusal
17						17	Refusal
18		100		Sandy Silt with Gravel	ML	18	Refusal
19				Silty sand with gravel	SM	19	Refusal
20		100				20	Refusal
21				Silty Gravel with Sand	GM	21	Refusal
22				Silty Clayey Sand with Gravel	SC-SM	22	Refusal
23				Sandy Silty Clay	CL-ML	23	Refusal
24				Silty sand with gravel	SM	24	Refusal
25		100		Silty Clayey Sand with Gravel	SC-SM	25	Refusal
26						26	Refusal
27						27	Refusal
28		100		Silty sand with gravel	SM	28	Refusal
29						29	Refusal
30						30	Refusal



Sample Types :

Shelby Tube (SH)

Continued Core Barrel Samples

NOTE

1-CONTINUAL SOIL SAMPLE RECOVERED FROM BOREHOLE AND STORED IN WOODEN BOXES.

Drilling Method : Geotechnical Rotary

Sampling Method : Continuous Soil Sampling - Split Spoon

SPT Hammer : 63.5-Kg/30 inch drop-Split Spoon via ASTM D-1586

[redacted]

Source: Geotechnical Investigation Report Sara-e Shamali Interchange, Jul. 2017, Khatib & Alami

Geological Log

LOG OF BH# 03

Completion Depth Of Borehole: 30 (meter)

Client : Kabul Municipality

Contractor: Khatib&Alami

[redacted]

Project: Sara-e Shamali Interchange, Kabul Province, Afghanistan

Coordinate : E-511227.683, N-3824636.400

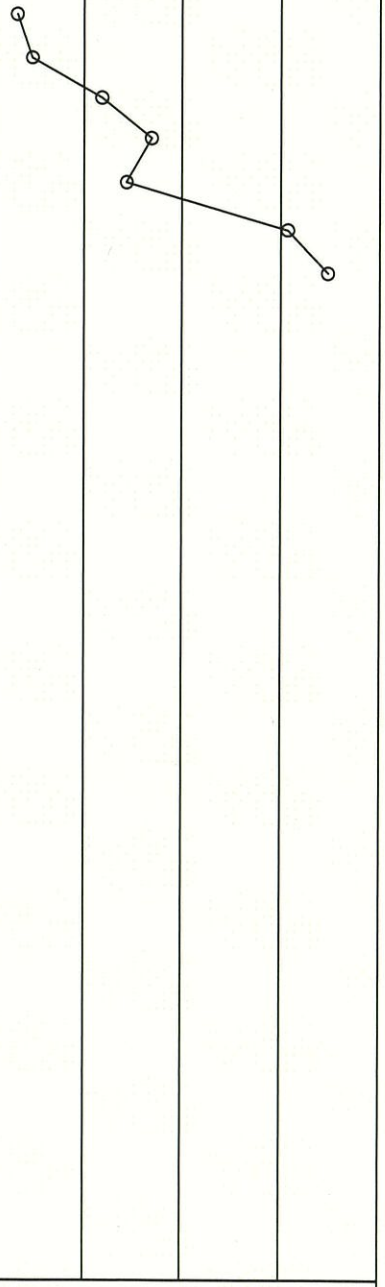
Elevation : 1803.50 m

Weather: Sunny

Depth: 30 m

Water Table: Dry

DEPTH (M)	CORE RECOVERY (%)	SAMPLING TYPE	MATERIAL DESCRIPTION	USCS CLASSIFICATION	Depth of SPT Test (m)	BLOW COUNTS (N VALUE)
1			Silty Sand	SM	1	13
2	100		Sandy Silty	CL-ML	2	15
3			Sandy Silt	ML	3	22
4					4	27
5	100		Silty Clay with Sand	CL-ML	5	24
6					6	41
7					7	45
8			Sandy Silty Clay with Gravel	CL-ML	8	53 / 6 Cm
9	100		Sandy Silty Clay	CL-ML	9	50 / 2 Cm
10					10	Refusal
11			Sandy Silty Clay with Gravel	CL-ML	11	Refusal
12	100				12	Refusal
13			Silty sand with gravel	SM	13	Refusal
14					14	Refusal
15	100		Silty Gravel with Sand	GM	15	Refusal
16					16	Refusal
17			Silty sand with gravel	SM	17	Refusal
18	100		Sandy Silt with Gravel	ML	18	Refusal
19			Silty sand with gravel	SM	19	Refusal
20	100				20	Refusal
21			Silty Gravel with Sand	GM	21	Refusal
22			Silty clayey gravel with sand	GC-GM	22	Refusal
23			Sandy Silty Clay	CL-ML	23	Refusal
24			Silty sand with gravel	SM	24	Refusal
25	100		Silty Clayey Sand with Gravel	SC-SM	25	Refusal
26					26	Refusal
27					27	Refusal
28	100		Silty sand with gravel	SM	28	Refusal
29					29	Refusal
30					30	Refusal



Sample Types :

Shelby Tube (SH)

Continued Core Barrel Samples

NOTE

1-CONTINUAL SOIL SAMPLE RECOVERED FROM BOREHOLE AND STORED IN WOODEN BOXES.

Drilling Method : Geotechnical Rotary

Sampling Method : Continuous Soil Sampling - Split Spoon

SPT Hammer : [redacted] 63.5-Kg/30 inch drop-Split Spoon via ASTM D-1586

Source: Geotechnical Investigation Report Sara-e Shamali Interchange, Jul. 2017, Khatib & Alami

Geological Log

LOG OF BH# 04

Completion Depth Of Borehole: 30 (meter)

Client : Kabul Municipality

Contractor: Khatib&Alami

[redacted]

Project: Sara-e Shamali Interchange, Kabul Province, Afghanistan

Coordinate : E-511261.893, N-3824608.311

Elevation : 1801.98 m

Weather: Sunny

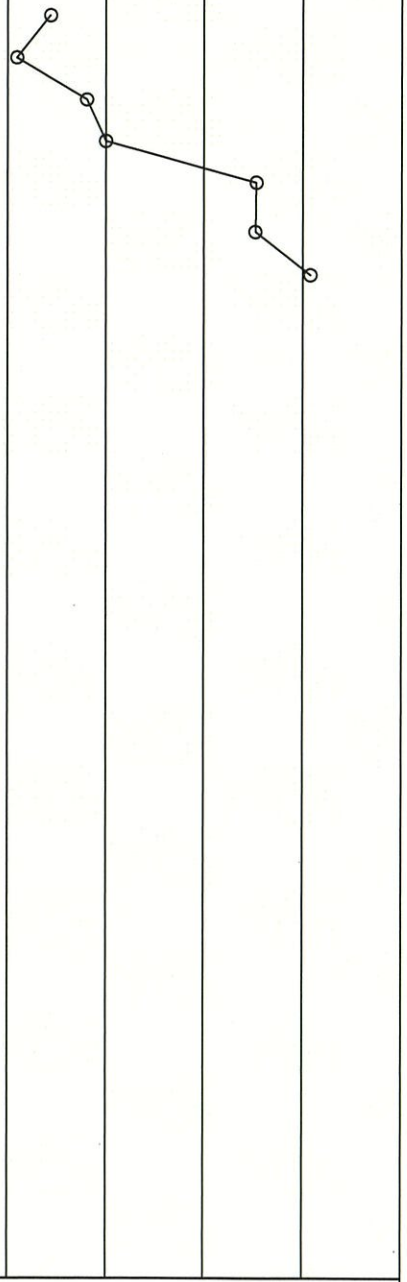
Depth: 30 m

Water Table: Dry

DEPTH (M)	CORE RECOVERY (%)	MATERIAL DESCRIPTION	USCS CLASSIFICATION	Depth of SPT Test (m)	BLOW COUNTS (N VALUE)
1		Silty Sand	SM	1	14
2	100	Clayey Sand	ML	2	11
3		Sandy Silt	ML	3	18
4				4	20
5	100	Silty Clay with Sand	CL-ML	5	36
6				6	35
7				7	41
8		Sandy Silty Clay with Gravel	CL-ML	8	55 / 3 Cm
9	100	Sandy Silty Clay	CL-ML	9	50 / 3 Cm
10				10	Refusal
11		Sandy Silty Clay with Gravel	CL-ML	11	Refusal
12	100			12	Refusal
13		Silty sand with gravel	SM	13	Refusal
14		Silty Gravel with Sand	GM	14	Refusal
15	100			15	Refusal
16		Silty sand with gravel	SM	16	Refusal
17				17	Refusal
18	100	Sandy Silt with Gravel	ML	18	Refusal
19		Silty sand with gravel	SM	19	Refusal
20	100			20	Refusal
21		Silty Gravel with Sand	GM	21	Refusal
22		Silty clayey gravel with sand	GC-GM	22	Refusal
23		Sandy Silty Clay	CL-ML	23	Refusal
24				24	Refusal
25	100	Silty sand with gravel	SM	25	Refusal
26		Silty Clayey Sand with Gravel	SC-SM	26	Refusal
27				27	Refusal
28	100	Silty sand with gravel	SM	28	Refusal
29				29	Refusal
30				30	Refusal

SPT/ (N VALUE)

10 20 30 40



Sample Types :

Shelby Tube (SH)

Continued Core Barrel Samples

NOTE

1-CONTINUAL SOIL SAMPLE RECOVERED FROM BOREHOLE AND STORED IN WOODEN BOXES.

Drilling Method : Geotechnical Rotary

Sampling Method : Continuous Soil Sampling - Split Spoon

SPT Hammer : 63.5-Kg/30 inch drop-Split Spoon via ASTM D-1586

[redacted]

Source: Geotechnical Investigation Report Sara-e Shamali Interchange, Jul. 2017, Khatib & Alami

Geological Log

LOG OF BH# 05

Completion Depth Of Borehole: 30 (meter)

Client : Kabul Municipality

Contractor: Khatib&Alami

[redacted]

Project: Sara-e Shamali Interchange, Kabul Province, Afghanistan

Coordinate : E-511261.693, N-3824608.811

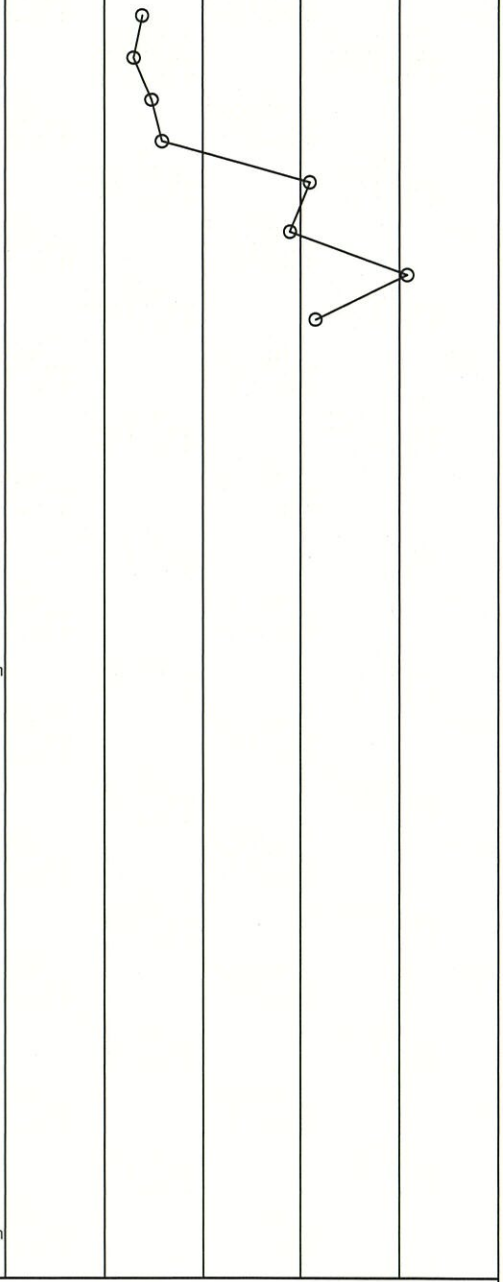
Elevation : 1801.57 m

Weather: Sunny

Depth: 30 m

Water Table: Dry

DEPTH (M)	CORE RECOVERY (%)	MATERIAL DESCRIPTION	USCS CLASSIFICATION	Depth of SPT Test (m)	BLOW COUNTS (N VALUE)
1		Silty Sand	SM		
2	100	Sandy Silty Clay	CL-ML	1	13
3				2	12
4		Silty Clay with Sand	CL-ML	3	14
5		Silty Clay	CL-ML	4	16
6	100	Silty Clay with Sand	CL-ML	5	31
7				6	29
8				7	41
9	100	Sandy Silty Clay	CL-ML	8	32
10				9	>50
11		Sandy Silty Clay with Gravel	CL-ML	10	>50
12	100	Silty Sand with Gravel	SM	11	50 / 5 Cm
13				12	50 / 4 Cm
14		Silty Sand	SM	13	50 / 4 Cm
15	100	Silty Sand with Gravel	SM	14	50 / 3 Cm
16				15	50 / 2 Cm
17		Silty Gravel with Sand	GM	16	50 / 1.5 Cm
18	100	Sandy Silt with Gravel	ML	17	Refusal
19		Silty Sand	SM	18	50 / 2 Cm
20		Silty Sand with Gravel	SM	19	50 / 2 Cm
21	100	Silty Gravel with Sand	GM	20	Refusal
22		Silty Sand with Gravel	SM	21	Refusal
23		Silty Clayey Gravel with Sand	GC-GM	22	Refusal
24		Sandy Silty Clay	CL-ML	23	50 / 3 Cm
25	100	Silty Gravel with Sand	GM	24	Refusal
26				25	Refusal
27				26	Refusal
28	100	Silty Sand with Gravel	SM	27	Refusal
29				28	50 / 2 Cm
30				29	50 / 1.5 Cm
				30	50 / 2 Cm



Sample Types :

Shelby Tube (SH)

Continued Core Barrel Samples

NOTE

1-CONTINUAL SOIL SAMPLE RECOVERED FROM BOREHOLE AND STORED IN WOODEN BOXES.

Drilling Method : Geotechnical Rotary

Sampling Method : Continuous Soil Sampling - Split Spoon

SPT Hammer : 63.5-Kg/30 inch drop-Split Spoon via ASTM D-1586

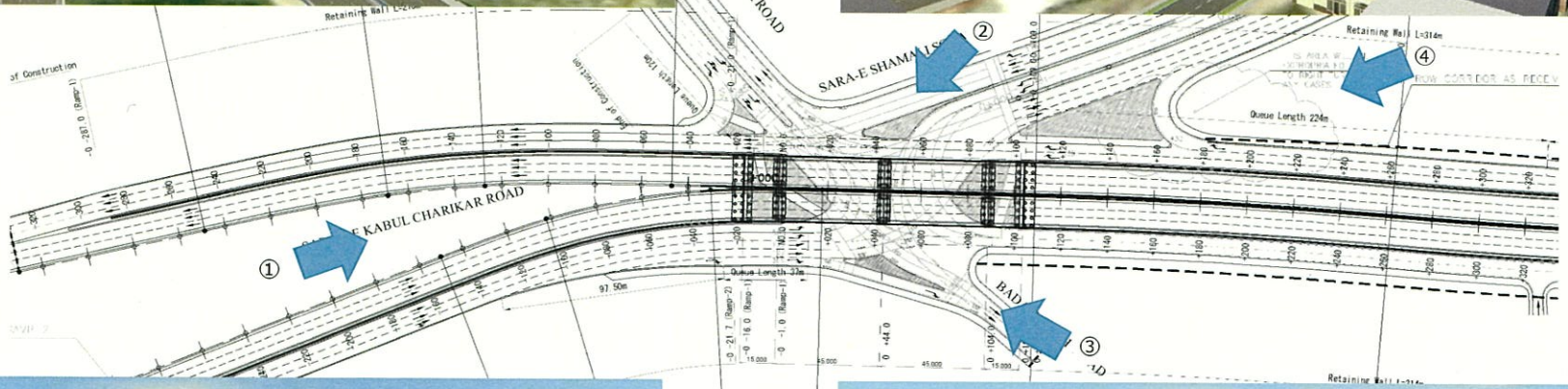
[redacted]

Source: Geotechnical Investigation Report Sara-e Shamali Interchange, Jul. 2017, Khatib & Alami

APPENDIX 4. 3D IMAGE


①


②


KHAIR KHANA ROAD
KABUL CHARIKAR ROAD
Retaining Wall L=314m
Queue Length 224m
Queue Length 31m
97.50m
①
②
③
④


③


④

APPENDIX 5. RESOLT OF ANALYZED INTERSECTION

Lane Group	EBL	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	SBL2	SBT	SBR	NWR	NWR2
Lane Configurations													
Traffic Volume (vph)	543	139	139	359	74	61	420	176	59	392	255	839	430
Future Volume (vph)	543	139	139	359	74	61	420	176	59	392	255	839	430
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.95	0.95	1.00	0.88	1.00
Frt			0.850	0.850				0.850			0.850	0.850	0.850
Flt Protected	0.950				0.950	0.950			0.950	0.999			
Satd. Flow (prot)	3395	1842	1566	1566	1750	1750	3500	1566	1662	1748	1566	2756	1566
Flt Permitted	0.241				0.492	0.492			0.133				
Satd. Flow (perm)	861	1842	1566	1566	906	906	3500	1566	233	1750	1566	2756	1566
Right Turn on Red				Yes				Yes			Yes		Yes
Satd. Flow (RTOR)				390				191			277		397
Link Speed (k/h)		48					48			48			
Link Distance (m)		392.8					233.0			253.1			
Travel Time (s)		29.5					17.5			19.0			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	590	151	151	390	80	66	457	191	64	426	277	912	467
Shared Lane Traffic (%)									10%				
Lane Group Flow (vph)	590	151	151	390	80	66	457	191	58	432	277	912	467
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Right	Left	Left	Left	Right	Left	Left	Right	Right	Right
Median Width(m)		7.0					7.0			3.5			
Link Offset(m)		0.0					0.0			0.0			
Crosswalk Width(m)		4.9					4.9			4.9			
Two way Left Turn Lane													
Headway Factor	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Turning Speed (k/h)	24		14	14	24	24		14	24		14	14	14
Turn Type	pm+pt	NA	Prot	Free	pm+pt	pm+pt	NA	Free	pm+pt	NA	Free	Perm	Free
Protected Phases	2!	1!	1!		6!	6!	5!		8	3			
Permitted Phases	1			Free	5	5		Free	3	3	Free	7	Free
Minimum Split (s)	20.0	20.0	20.0		20.0	20.0	20.0		20.0	20.0		20.0	

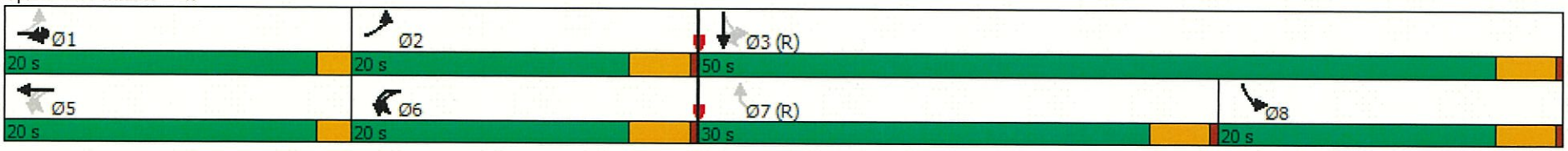
Lane Group	EBL	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	SBL2	SBT	SBR	NWR	NWR2
Total Split (s)	20.0	20.0	20.0		20.0	20.0	20.0		20.0	50.0		30.0	
Total Split (%)	22.2%	22.2%	22.2%		22.2%	22.2%	22.2%		22.2%	55.6%		33.3%	
Maximum Green (s)	16.0	18.0	18.0		16.0	16.0	18.0		16.0	46.0		26.0	
Yellow Time (s)	3.5	2.0	2.0		3.5	3.5	2.0		3.5	3.5		3.5	
All-Red Time (s)	0.5	0.0	0.0		0.5	0.5	0.0		0.5	0.5		0.5	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0		0.0	
Total Lost Time (s)	4.0	2.0	2.0		4.0	4.0	2.0		4.0	4.0		4.0	
Lead/Lag	Lag	Lead	Lead		Lag	Lag	Lead		Lag			Lead	
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes		Yes			Yes	
Walk Time (s)	5.0	5.0	5.0		5.0	5.0	5.0		5.0	5.0		5.0	
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0	11.0		11.0	11.0		11.0	
Pedestrian Calls (#/hr)	0	0	0		0	0	0		0	0		0	
Act Effct Green (s)	32.0	18.0	18.0	90.0	32.0	32.0	18.0	90.0	46.0	46.0	90.0	26.0	90.0
Actuated g/C Ratio	0.36	0.20	0.20	1.00	0.36	0.36	0.20	1.00	0.51	0.51	1.00	0.29	1.00
v/c Ratio	0.78	0.41	0.48	0.25	0.17	0.14	0.65	0.12	0.16	0.48	0.18	1.15	0.30
Control Delay	38.7	35.3	37.9	0.4	19.4	18.9	38.2	0.2	18.3	16.6	0.2	111.6	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.7	35.3	37.9	0.4	19.4	18.9	38.2	0.2	18.3	16.6	0.2	111.6	0.5
LOS	D	D	D	A	B	B	D	A	B	B	A	F	A
Approach Delay		26.6					25.5			10.8			
Approach LOS		C					C			B			

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 3:SBTL and 7:NWR, Start of Green			
Natural Cycle: 90			
Control Type: Pretimed			
Maximum v/c Ratio: 1.15			
Intersection Signal Delay: 39.0		Intersection LOS: D	
Intersection Capacity Utilization 88.4%		ICU Level of Service E	
Analysis Period (min) 15			

Description: Sarai-Shamali Traffic Simulation

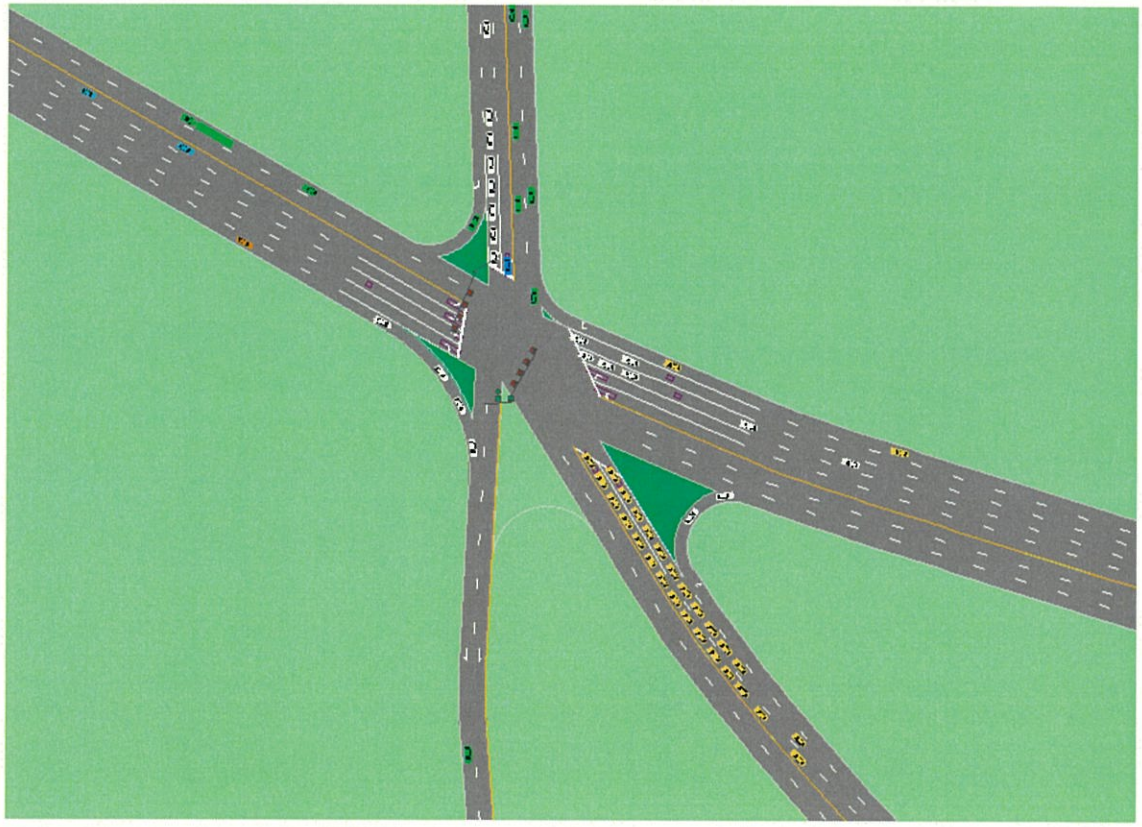
! Phase conflict between lane groups.

Splits and Phases: 4:

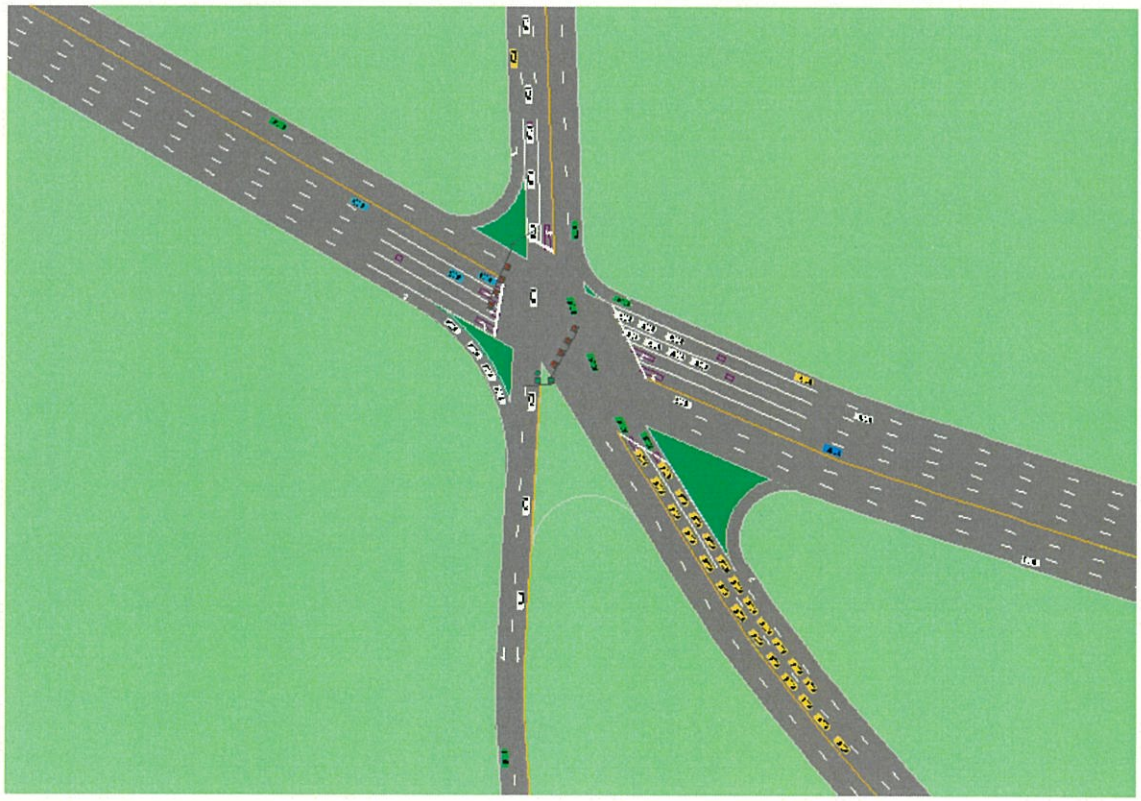


APPENDIX 6. RESOLT OF TRAFIC FLOW SYMULATION

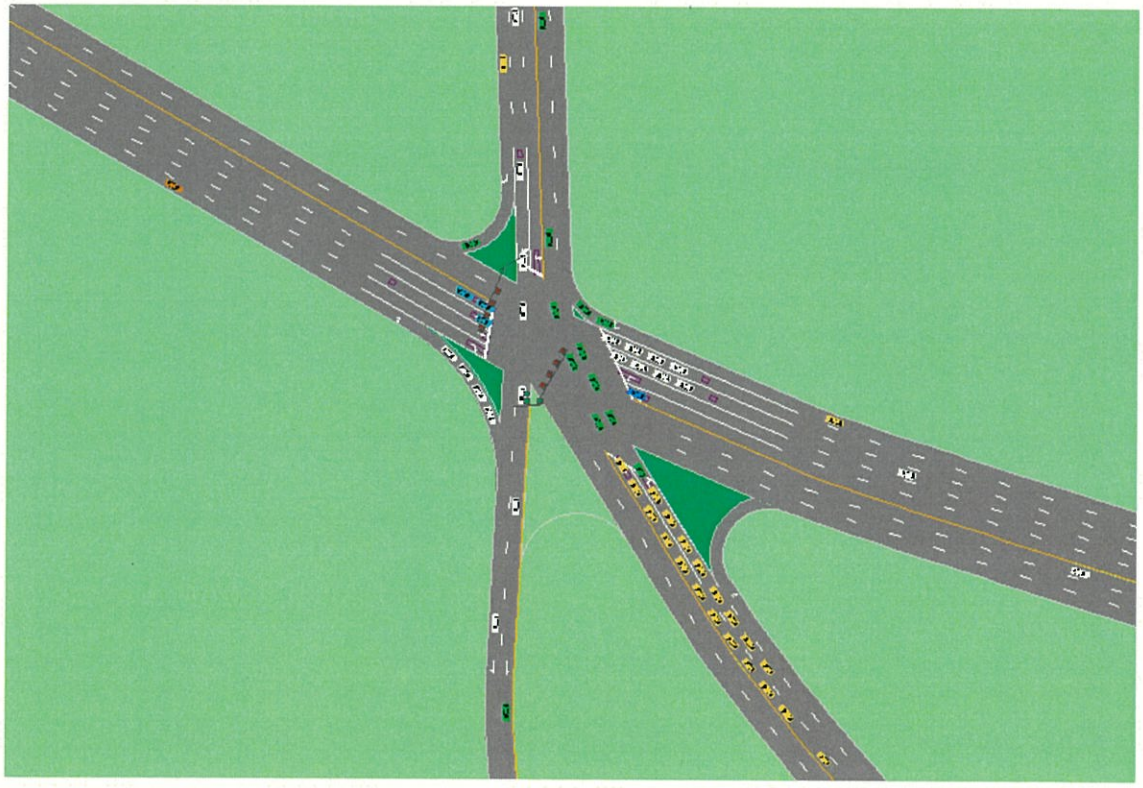
Beginning of Phase-1; 0sec



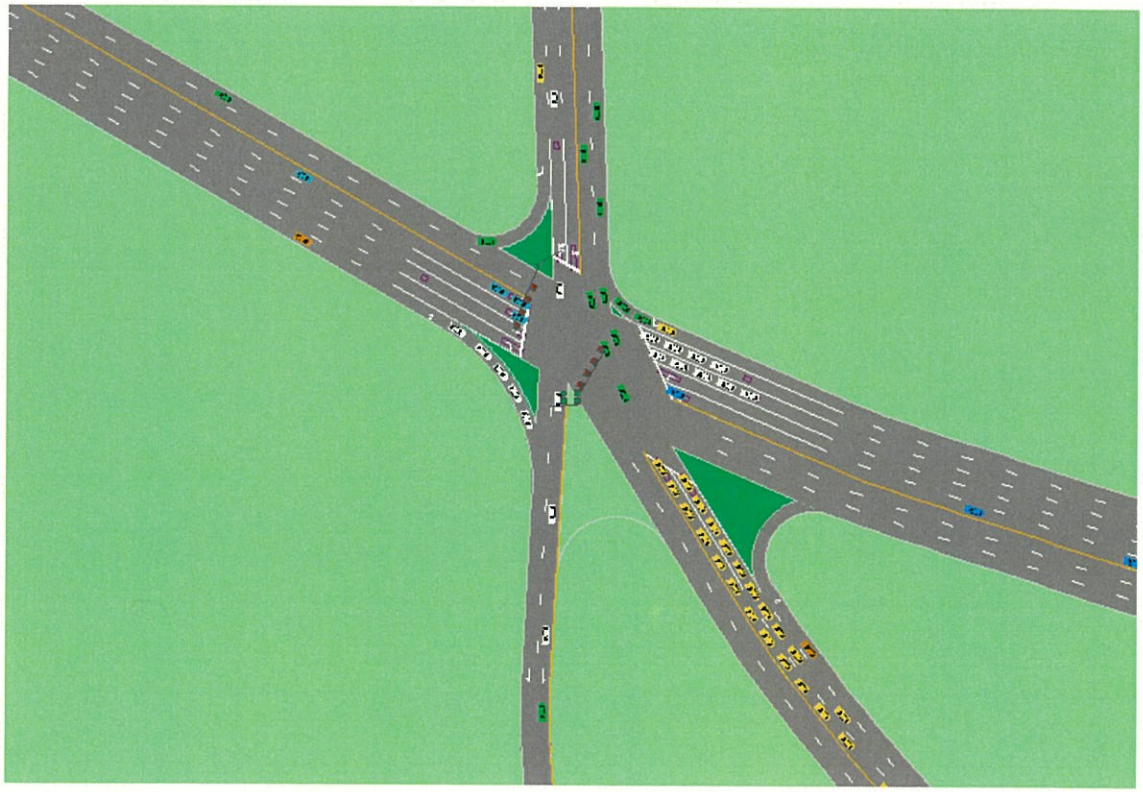
Between Phase-1 and Phase-2; 10sec



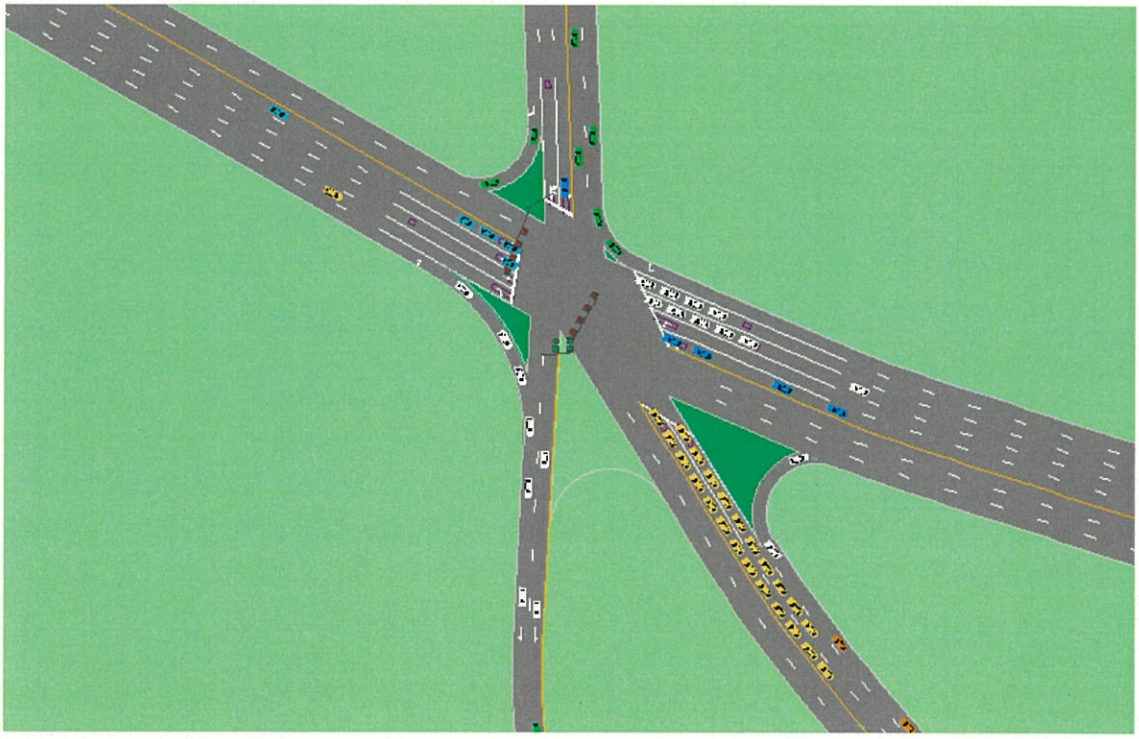
Beginning of Phase-2; 20sec



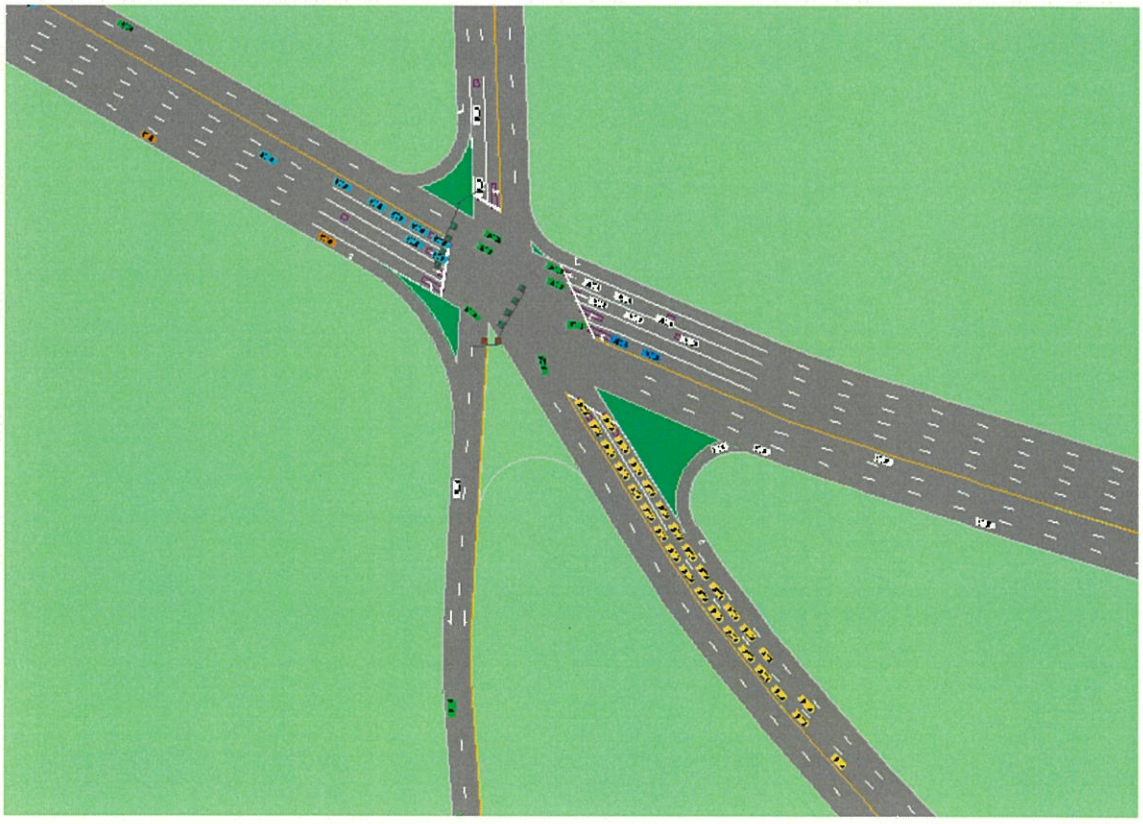
Between Phase-2 and Phase-3; 30sec



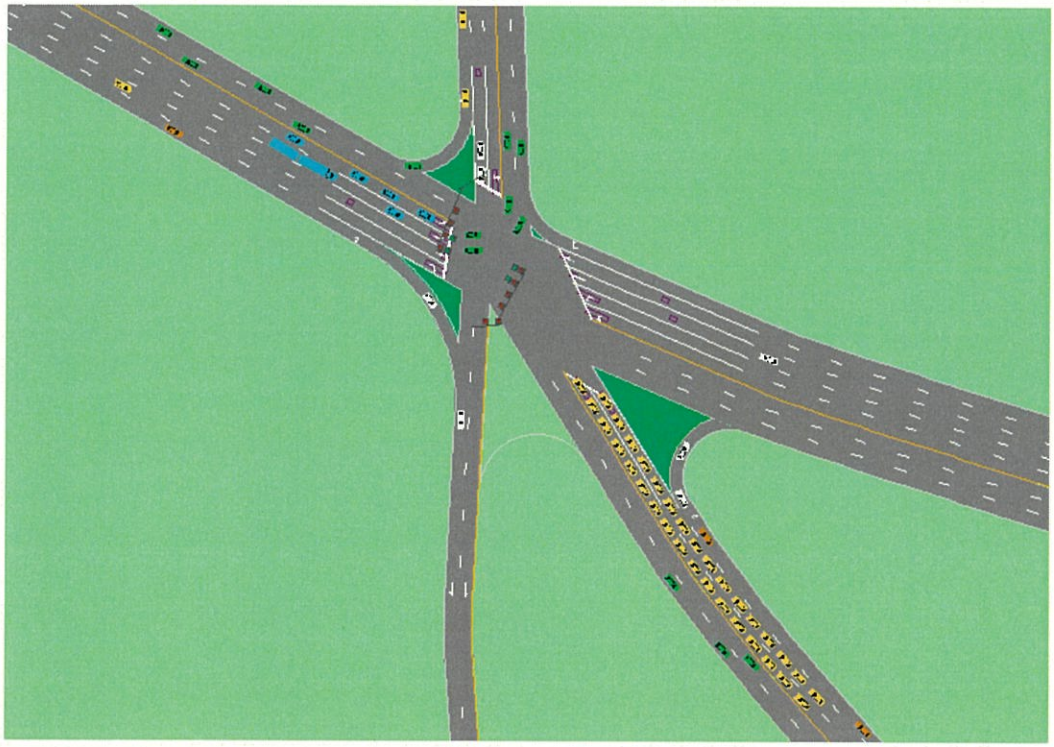
Beginning of Phase-3; 40sec



Between Phase-2 and Phase-3; 55sec



Beginning of Phase-4; 70sec



Between Phase-4 and next cycle; 80