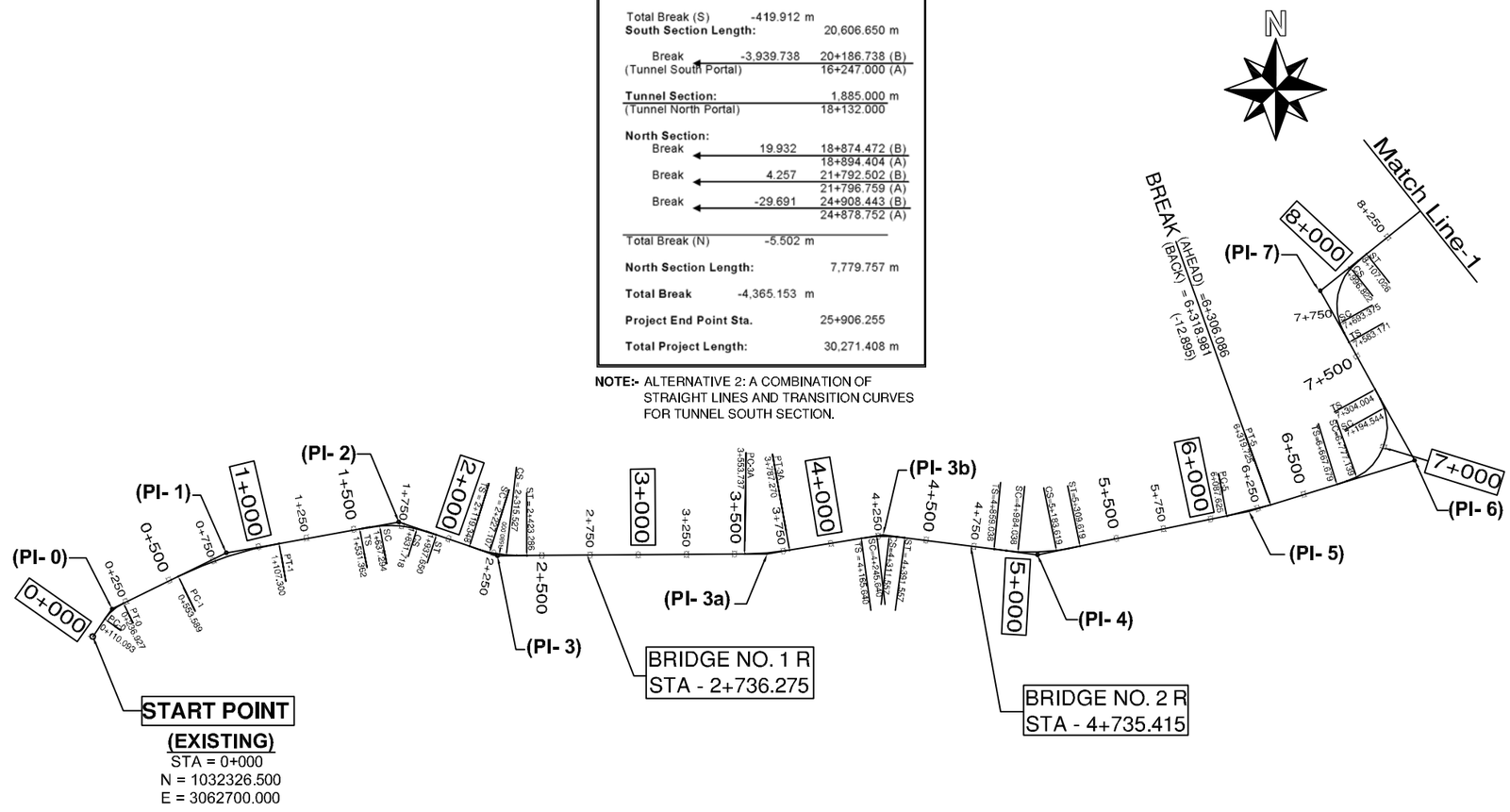
ALTERNATIVE 2

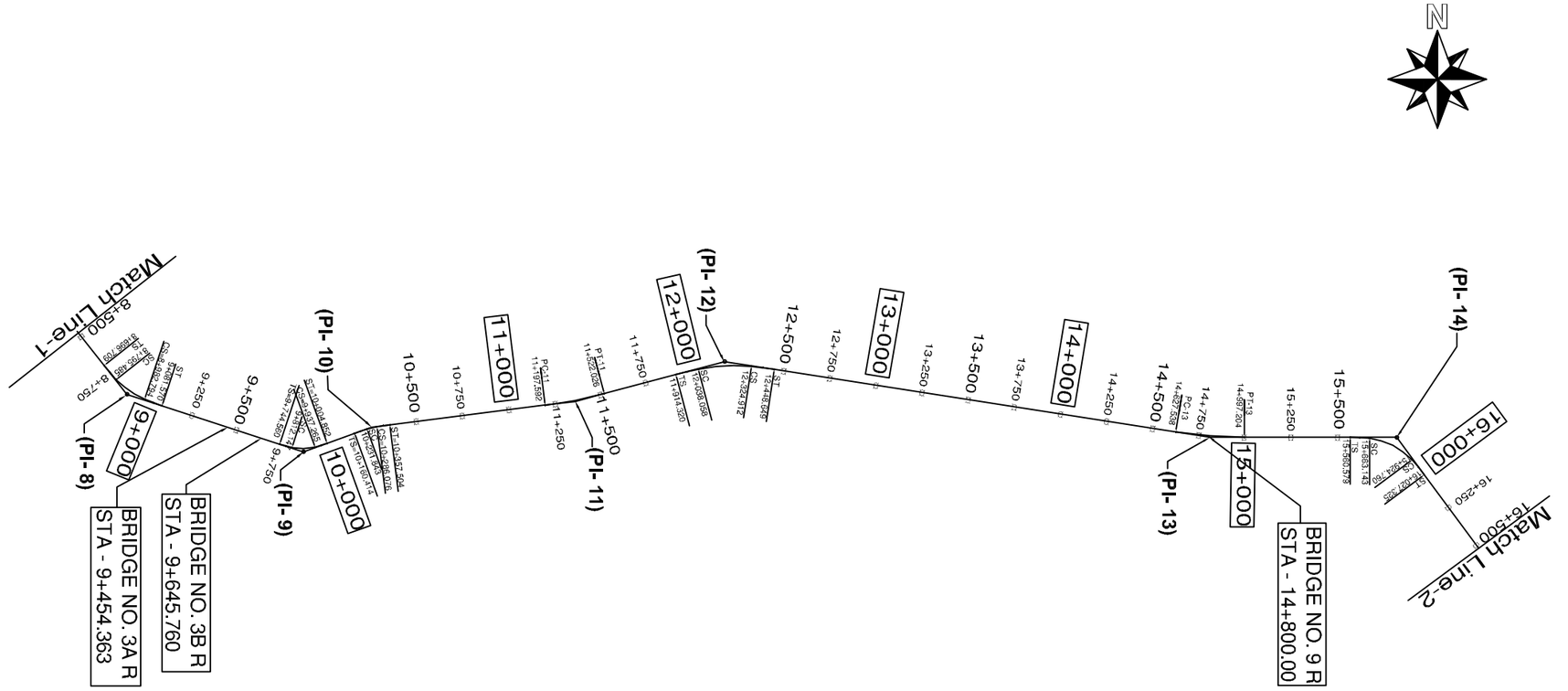
Project Length

South Section:	Length	Station
Project Start Point		0+000.000
Break ←	-12.895	6+318.981 (B)
		6+306.086 (A)
Break ←	-407.017	19+607.017 (B)
		19+200.000 (A)
Total Break (S)	-419.912 m	
South Section Length:		20,606.650 m
Break ←	-3,939.738	20+186.738 (B)
(Tunnel South Portal)		16+247.000 (A)
Tunnel Section:		1,885.000 m
(Tunnel North Portal)		18+132.000
North Section:		
Break ←	19.932	18+874.472 (B)
		18+894.404 (A)
Break ←	4.257	21+792.502 (B)
		21+796.759 (A)
Break ←	-29.691	24+908.443 (B)
		24+878.752 (A)
Total Break (N)	-5.502 m	
North Section Length:		7,779.757 m
Total Break	-4,365.153 m	
Project End Point Sta.		25+906.255
Total Project Length:		30,271.408 m

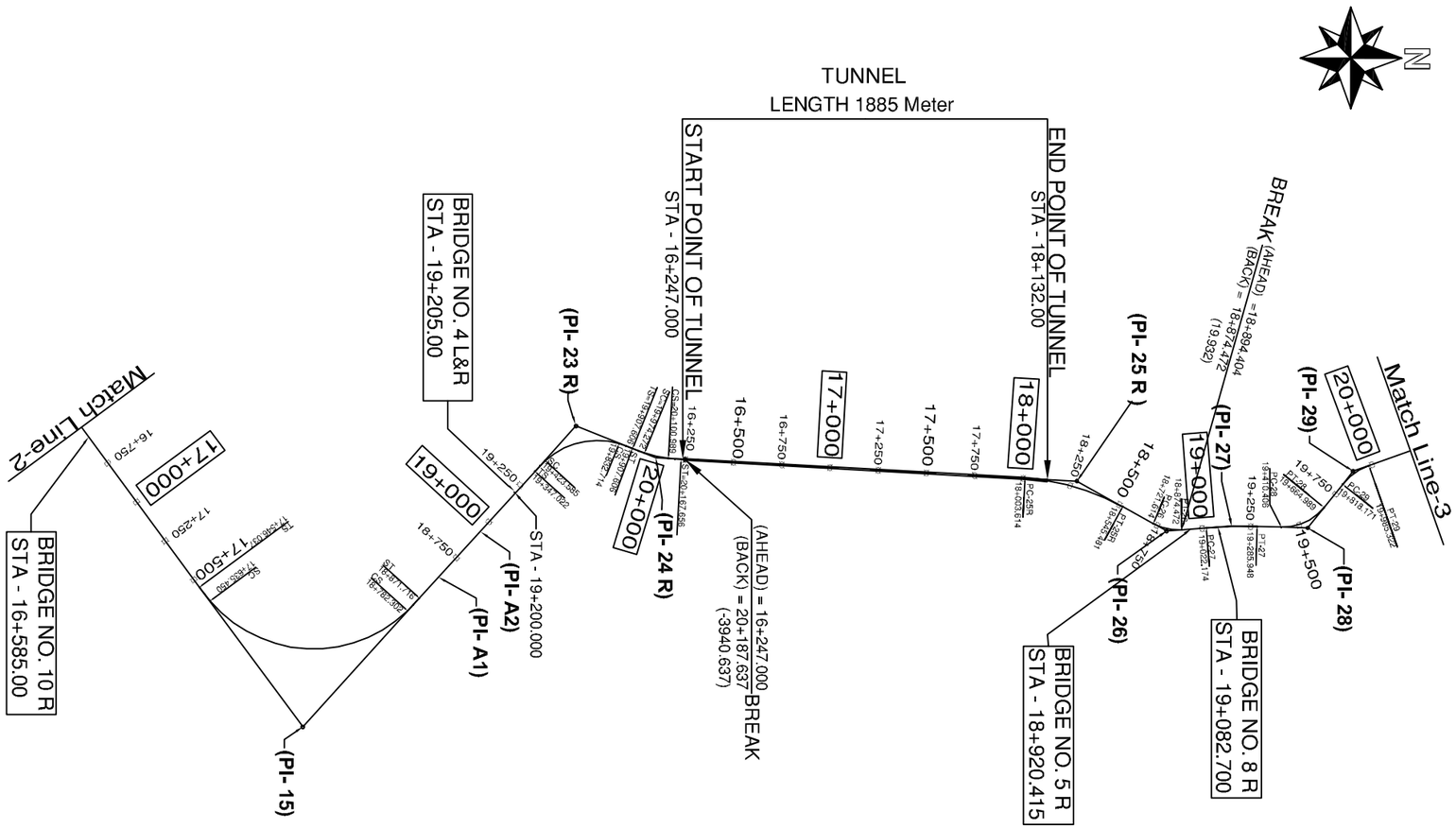
NOTE:- ALTERNATIVE 2: A COMBINATION OF STRAIGHT LINES AND TRANSITION CURVES FOR TUNNEL SOUTH SECTION.



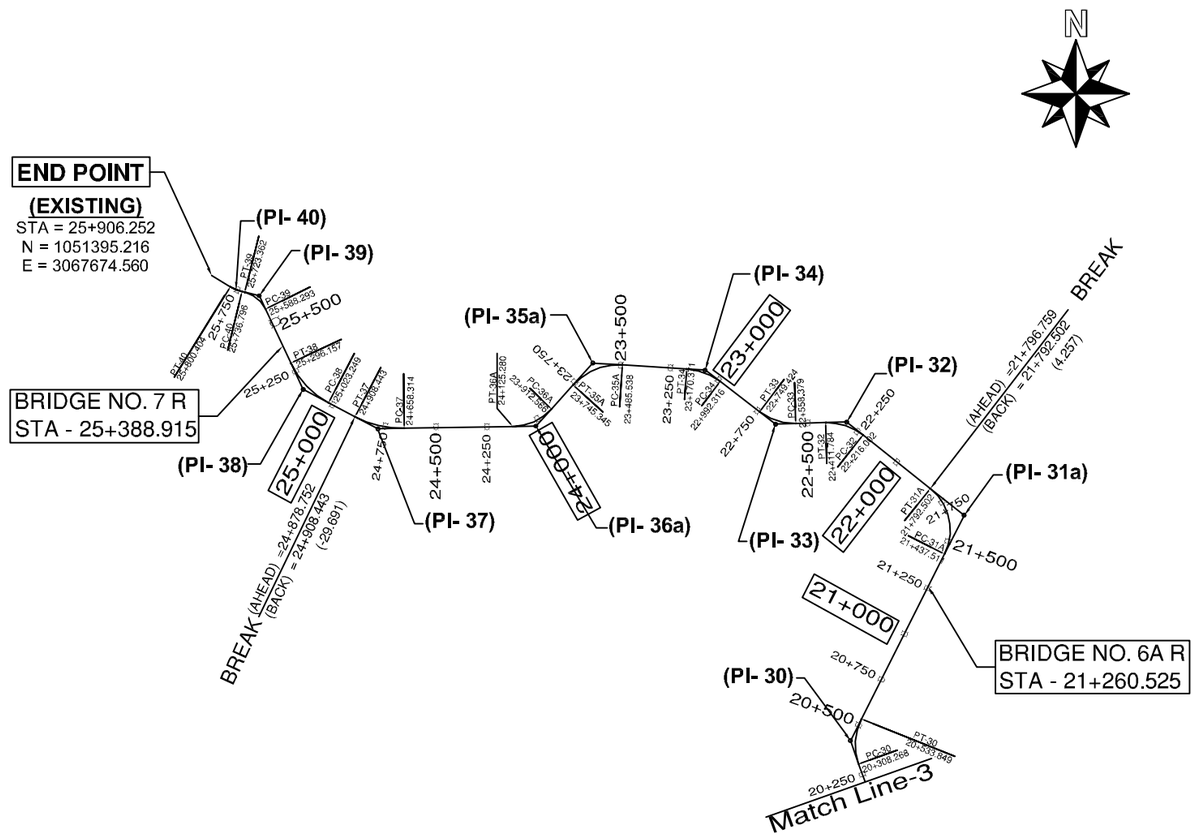
PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	SETTING OUT SCHEDULE (4) ALTERNATIVE-2	1:30,000	G-5



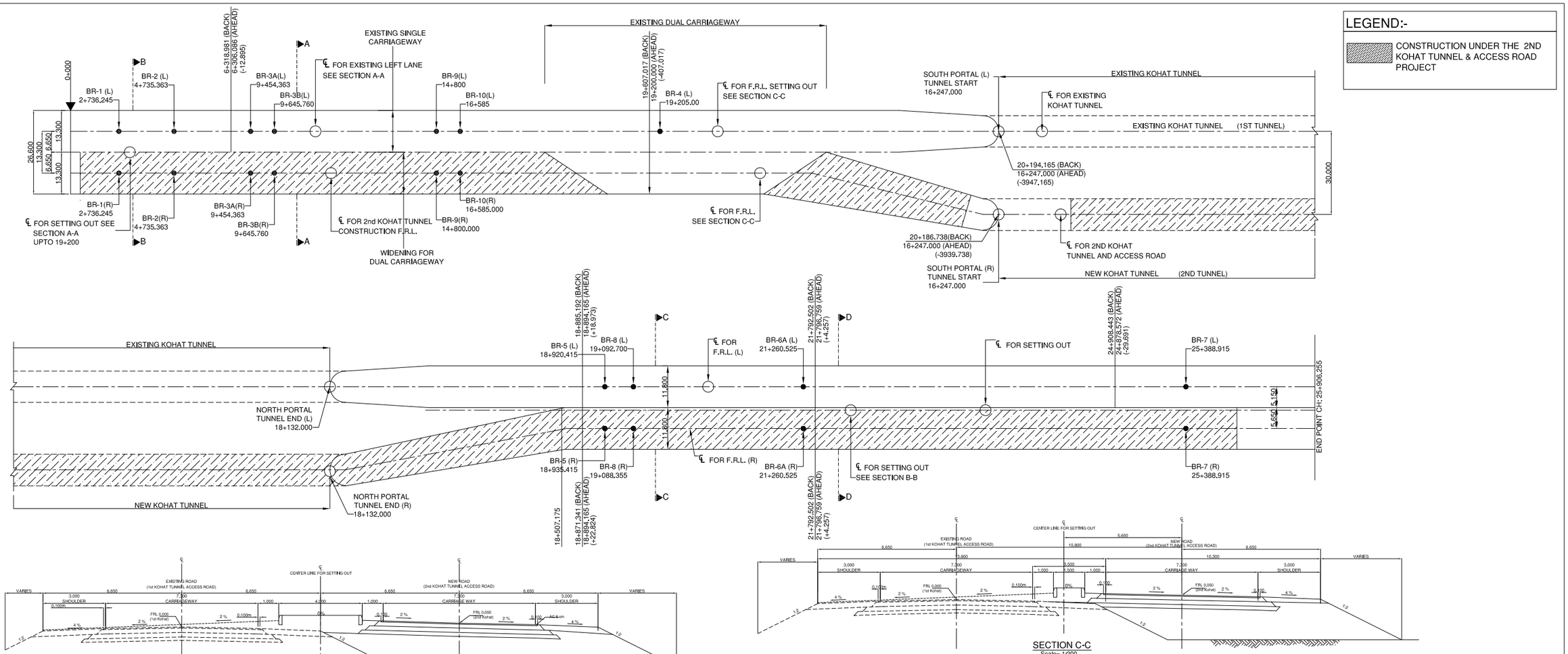
PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	SETTING OUT SCHEDULE (5) ALTERNATIVE-2	1:30,000	G-5



PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	SETTING OUT SCHEDULE (6) ALTERNATIVE-2	1:30,000	G-5



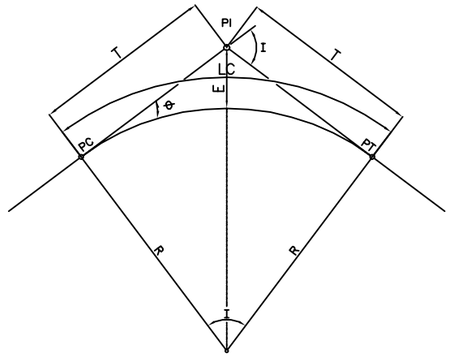
PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	SETTING OUT SCHEDULE (7) ALTERNATIVE-2	1:30,000	G-5



NOTES:

1. BASED ON ALTERNATIVE-2 FOR THE RIGHT-HAND LANE
2. FRL for the 2nd Tunnel & Access Roads is approx. 5cm higher than that In the 1st Kohat Tunnel & Access Roads

PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	LINEAR DIAGRAM FOR CENTER LINE SETTING OUT	1:400	G-6



WHERE:

PI = POINT OF INTERSECTION
I = INTERSECTION ANGLE
R = CURVE RADIUS
T = TANGENT LENGTH
Lc = CURVE LENGTH
E = EXTERNAL DISTANCE
PC = BEGINNING OF CIRCULAR CURVE
PT = END OF CIRCULAR CURVE

FORMULAS:

$D = \frac{1145.910}{R}$

$T = R\ (\tan I/2)$

$Lc = \frac{\pi R\ I}{180}$

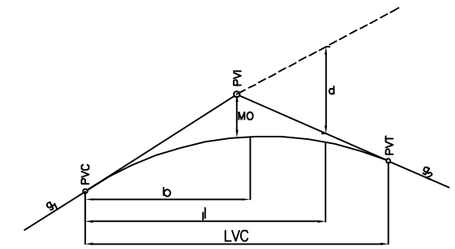
$E = T(\tan I/4)$

$E = R\ (\sec\frac{I}{2} - 1)$

NOTE :

NO HORIZONTAL CURVE IS REQUIRED WHEN THE INTERSECTION ANGLE IS LESS THAN ONE DEGREE (1°)

HORIZONTAL CURVE (CIRCULAR)



SYMMETRICAL VERTICAL CURVES:

ELEMENTS:

g_1, g_2 = GRADIENTS IN PERCENT
PVC = BEGINNING OF VERTICAL CURVE
PVI = POINT OF GRADIENT INTERSECTION
PVT = END OF VERTICAL CURVE
MO = EXTERNAL DISTANCE (MID ORDINATE) IN METERS
d = ELEVATION DIFFERENCE FRON g TO THE VERTICAL CURVE IN METERS
LVC = LENGTH OF PARABOLIC CURVE IN METERS
l = LENGTH TO ANY POINT ON THE VERTICAL CURVE IN METER
lo = LENGTH TO THE LEVEL POINT ON THE VERTICAL CURVE IN METER

EQUATIONS:

$MO = LVC\left(\frac{g_1 - g_2}{800}\right)$

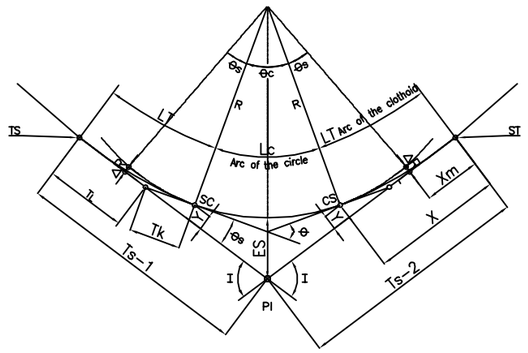
$d = E\left[\frac{l^2}{(1/2\ LVC^2)}\right]$

$lo = \frac{g_1}{g_1 - g_2}(LVC)$

NOTE:

$g_1 - g_2$ IN THESE EQUATIONS IS THE ALGEBRAIC DIFFERENCE (A) IN GRADIENT.

VERTICAL PARABOLIC CURVE (SYMMETRICAL)



WHERE :

PI = POINT OF INTERSECTION
I = INTERSECTION ANGLE
R = CURVE RADIUS
Es = EXTERNAL DISTANCE
Ls = LENGTH OF SPIRAL
A = PARAMETER OF CLOTHOID
θs = SPIRAL ANGLE
X,Y = COORDINATES OF POINTS SC AND CS WITH RESPECT TO MAIN TANGENTS
ΔR = OFFSET BETWEEN CIRCULAR CURVE AND MAIN TANGENT ("THROW" OF SPIRAL)
Xm = LENGTHENING OF TANGENT DUE TO INSERTION OF SPIRAL

Ts = TOTAL TANGENT DISTANCE
TL = LONG TANGENT OF SPIRAL
Tk = SHORT TANGENT OF SPIRAL
Ls = LENGTH OF SPIRAL
θc = CENTRAL ANGLE OF CIRCULAR CURVE
Lc = LENGTH OF CIRCULAR CURVE
TS = BEGINNING OF TRANSITION CURVE
SC = BEGINNING OF CIRCULAR CURVE
CS = END OF CIRCULAR CURVE
ST = END OF TRANSITION CURVE

SPIRAL CURVE FORMULA:

$R = A^2/Ls$

$\theta s = Ls/2R$

$x = Ls[1 - Ls^2/40R^2 + Ls^4/3456\ R^4 - Ls^6/599040\ R^6 + \ldots\ldots]$

$Y = Ls^2/6R[1 - Ls^2/56R^2 + Ls^4/7040\ R^4 - Ls^6/1612800\ R^6 + \ldots\ldots]$

$\Delta R = Y + R\cos\theta s - R$

$Xm = X - R\sin\theta s$

$Ts = Xm + W$

$T_L = X - Y\cot\theta s$

$Tk = Y / \sin\theta$

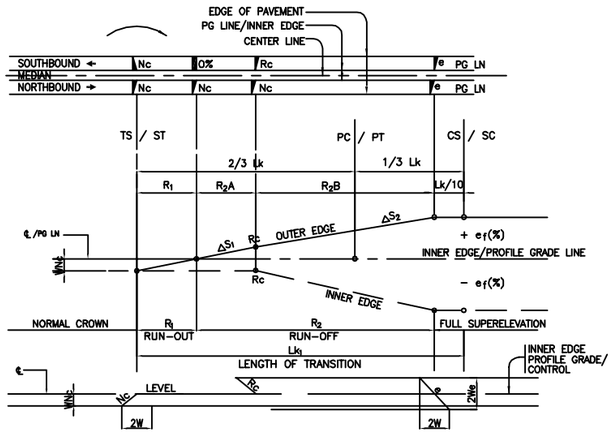
$Es = \frac{[R + \Delta R]}{\cos I/2} - R$

$Ic = I - 2\theta$

$L = \pi R\ Ic/180$

HORIZONTAL CURVE (SPIRAL)

PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	ROAD GEOMETRY DETAILS SOUTH SECTION (1)	NTS	G-7



WHERE :

- ΔS = RELATIVE SLOPE OF OUTER EDGE–OF–PAVEMENT WITH ITS INNER EDGE ALONG THE MEDIAN SIDE (PROFILE CONTROL)
- Lk = LENGTH OF TRANSITION, SUPERELEVATION RUN–OFF
- R_1 = SUPERELEVATION RUNOUT LENGTH (WITHIN CLOHOID)
- R_2 = SUPERELEVATION RUNOFF LENGTH
- R_1, R_2 = LENGTH NECESSARY TO ATTAIN REVERSING CROWN
- TS = BEGINNING OF TRANSITION CURVE
- SC = BEGINNING OF CIRCULAR CURVE
- CS = END OF CIRCULAR CURVE
- ST = END OF TRANSITION CURVE
- * OTHER AUTHORITIES PLACE R1 ALONG THE TANGENT
- e_f = FULL SUPERELEVATION
- Rc = REVERSE CROWN
- Nc = NORMAL CROWN SLOPE, (Nc=2.00%)
- W = CARRIAGEWAY (ONE DIRECTION)
- A = CLOTHOID PARAMETER

FORMULAS:

ΔS_1=0.44 % for V=100 kph

$A^2 = R\ Lk$

$R_1 = \frac{WNc}{\Delta S_1}$

$R_2A = \frac{WNc}{\Delta S}$

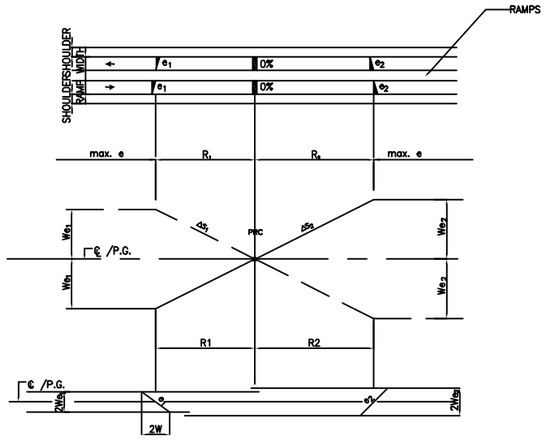
$R_2B = \frac{W\ (e-Nc)}{\Delta S_2}$

$\Delta S_2 = \frac{W\ (e-Nc)}{R_2B}$

$\Delta S_1 = \frac{WNc}{R_1}$

$Lk = R_1 + R_2A + R_2B + Lk/10$

SECTION DIAGRAMMATIC PROFILE OF SUPPERELEVATION
PAVEMENT REVOLVED ABOUT INNER EDGE/PG LINE



WHERE :

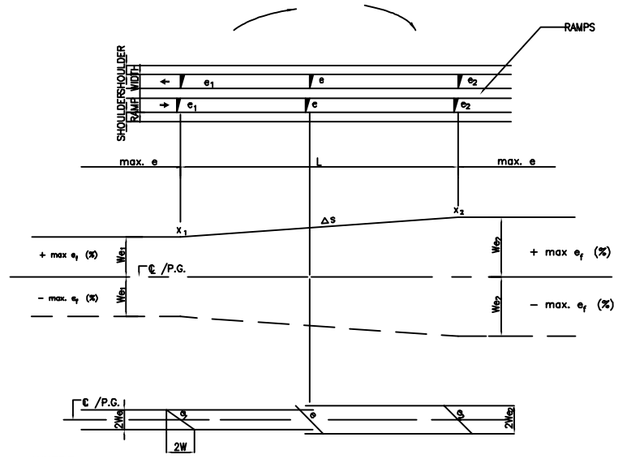
- R1 = LENGTH OF SUPERELEV. RUNOFF (1st CURVE)
- R2 = LENGTH OF SUPERELEV. RUNOFF (2nd CURVE)
- ΔS = RELATIVE SLOPE OF OUTER EDGE–OF–PAVEMENT WITH ITS INNER EDGE ALONG THE MEDIAN SIDE (PROFILE CONTROL)
- e_1 = SUPERELEVATION RATE 1st CURVE
- e_2 = SUPERELEVATION RATE 2nd CURVE
- W = LANE WIDTH (CARRIAGEWAY)
- PRC = POINT OF REVERSE CURVE

FORMULAS:

$\Delta S_1 = \frac{We_1}{R1}$

$\Delta S_2 = \frac{We_2}{R2}$

SUPERELEVATION (REVERSE CURVE)



WHERE :

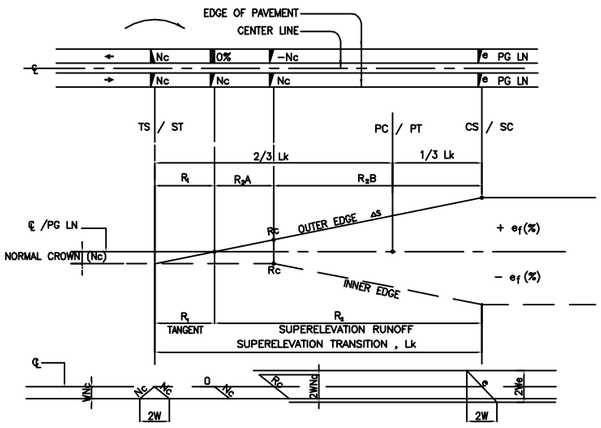
- L = LENGTH OF TRANSITION, SUPERELEVATION RUNOFF
- X_1 = STATION AT MAXIMUM SUPERELEVATION 1st CURVE
- X_2 = STATION AT MAXIMUM SUPERELEVATION 2nd CURVE
- ΔS = RELATIVE SLOPE OF OUTER EDGE–OF–PAVEMENT WITH ITS INNER EDGE ALONG THE MEDIAN SIDE (PROFILE CONTROL)
- e_1 = SUPERELEVATION RATE 1st CURVE
- e_2 = SUPERELEVATION RATE 2nd CURVE
- W = LANE WIDTH (CARRIAGEWAY)

FORMULAS:

$L = X_2 - X_1$

$\Delta S = \frac{W(e_2 - e_1)}{L}$

SUPERELEVATION (COMPOUND CURVE)



WHERE :

- ΔS = RELATIVE SLOPE OF OUTER EDGE–OF–PAVEMENT WITH ITS INNER EDGE ALONG THE MEDIAN SIDE (PROFILE CONTROL)
- Lk = LENGTH OF TRANSITION, SUPERELEVATION RUN–OFF (FOR CLOTHOID)
- R_1 = SUPERELEVATION RUNOUT LENGTH (WITHIN CLOTHOID)
- R_2 = SUPERELEVATION RUNOFF LENGTH
- e_f = FULL SUPERELEVATION
- Rc = REMOVED ADVERSE CROWN
- Nc = NORMAL CROWN SLOPE, (Nc=2.00%)
- W = CARRIAGEWAY (ONE DIRECTION)
- A = CLOTHOID PARAMETER
- * OTHER AUTHORITIES PLACE R1 ALONG THE TANGENT

FORMULAS:

ΔS_1=0.44 % for V=100 kph

$A^2 = R\ Lk$

$R_1 = \frac{WNc}{\Delta S_1}$

$R_2A = \frac{WNc}{\Delta S}$

$R_2B = \frac{W\ (e-Nc)}{\Delta S_2}$

$\Delta S_2 = \frac{W\ (e-Nc)}{R_2B}$

$\Delta S_1 = \frac{WNc}{R_1}$

$Lk = R_1 + R_2A + R_2B + Lk/10$

PROFILE SHOWING METHODS OF ATTAINING SUPPERELEVATION

Item	Unit	Design Standard			
		1st Kohat Access Road		2nd Kohat Access Road	
Section		South	North	South	North
Design Speed	km/hr	90	80	90	80
Cross Section Elements:					
- Lane width	m	3.65	3.65	3.65	3.65
- Outer Shoulder Width	m	3.00	3.00	3.00	3.00
- Outer Shoulder Width for climbing lane	m	1.00	1.00	-	-
- Inner Shoulder Width	m	1.00 (Future 4-lanes)	1.00	1.00	1.00
- Median Width	m	6.00 (Future 4-lanes)	3.00	6.00	3.50
- Climbing Lane Width	m	3.00	-	-	-
- Crossfall of Traveled Way	%	2	2	2	2
- Crossfall of Shoulder	%	4	4	4	4
- Vertical Clearance	m	5.03	5.03	5.03	5.03
- Railway Vertical Clearance	m	6.71	6.71	6.71	6.71
- Stopping Sight Distance	m	137	120	160	130
- Passing Sight Distance	m	600	550	615	540

Note: based on the NHA Standard and a Policy on Geometric Design of Highways and Streets 2001, AASHTO

* recommended max. radius for use of a transition curve if site condition allows

Item	Unit	Design Standard			
		1st Kohat Access Road		2nd Kohat Access Road	
Section		South	North	South	North
Design Speed	km/hr	90	80	90	80
Horizontal Alignment:					
Circular Curve:					
- Min. Radius	m	270	220	275	210
- Min. Superelevation Runoff Length	m	50 (one lane rotated)	46	115 (two lane rotated)	108
- Max. Superelevation Rate	%	10	10	10	10
- Tangent Run out	m	16	15	23	22
Transition Curve:					
- Type of transition curve		-	-	Spiral Curve (Clothoid)	-
- Min. Transition Curve Length	m	-	-	50	40
- Max. Radius for Use of a Spiral Curve Transition *	m	-	-	480 (1200)	380 (900)
Vertical Alignment:					
- Max. Grade	%	7	7	4	4
Crest Curve					
- Stopping Sight Distance	m	-	-	160	130
- Passing Sight Distance	m	600	550	615	540
Sag Curve					
- Stopping Sight Distance	m	-	-	160	130

PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
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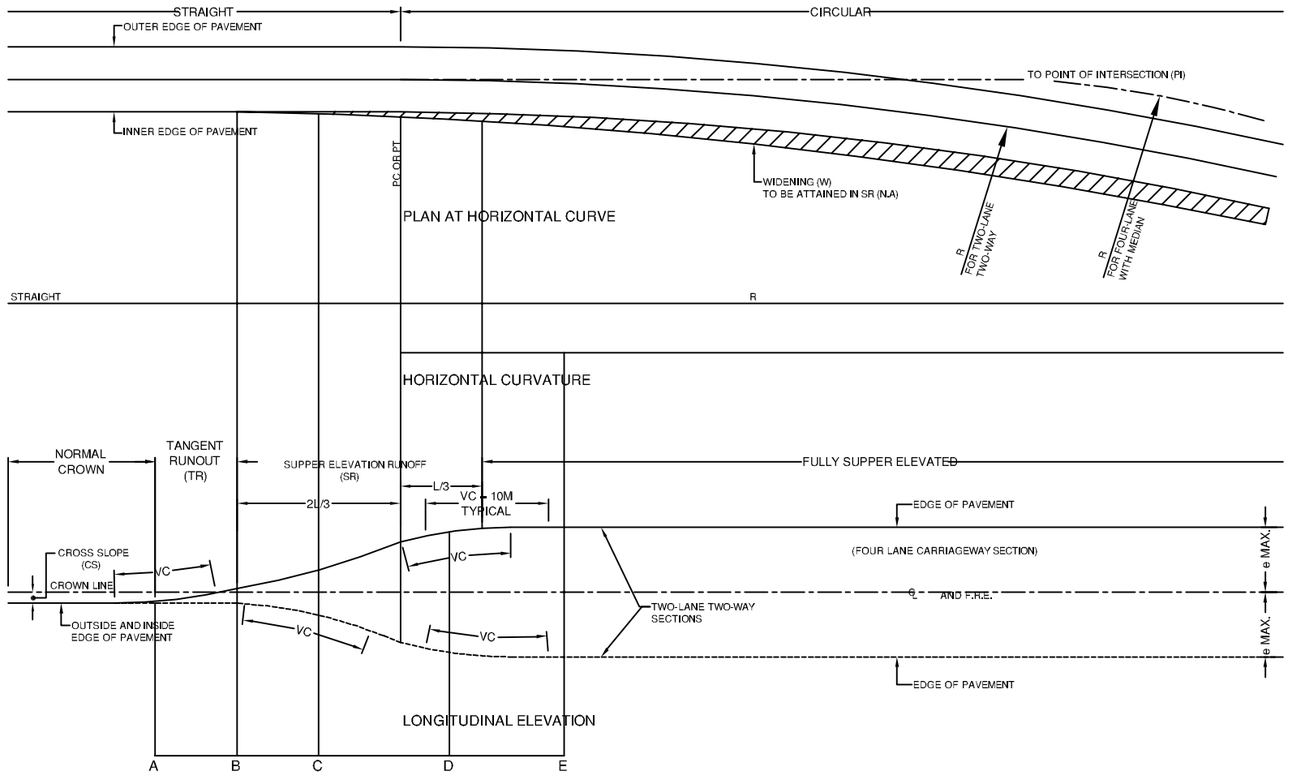
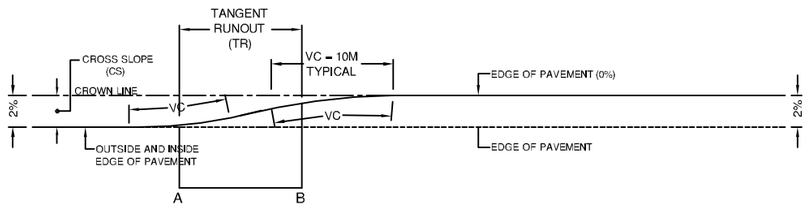


LOCATION OF CROSS SECTIONS

ILLUSTRATION OF SUPPER ELEVATION ATTAINMENT
ROTATION AROUND $\mathcal{C}_L$

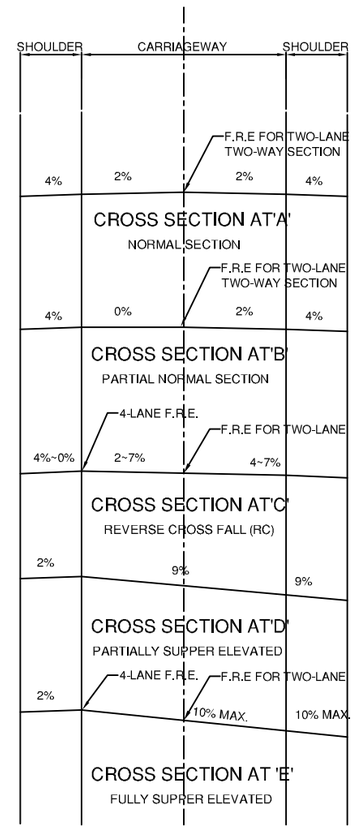


LONGITUDINAL ELEVATION AT APPROACHES TO BRIDGES
AND OTHER LOCATIONS WHERE SHOWN IN DRAWINGS

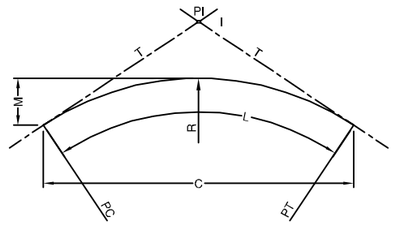
NOTES.

SPEED LIMITS

1. DESIGN SPEED FOR THE PROJECT ROAD TO BE 90 Km/HR. EXCEPT,
   Km14+400~25+906 IN CHANGAI ALGAD-DARA ADAM KHEL SECTION
   WHERE DESIGN SPEED TO BE LIMITED TO 80 Km/HR.
2. F.R.E. (FINISHED ROAD ELEVATION) TO BE LOCATED AT THE ROAD CENTER LINE FOR TWO-WAY TWO-LANE SECTIONS AND AT THE MEDIAN PAVEMENT EDGE FOR DUAL CARRIAGE WAY SECTIONS.
3. ALIGNMENT SEPARATE SECTIONS STA 19+200~18+561.28

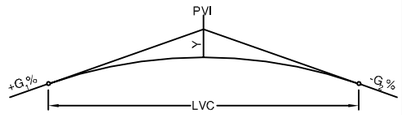


CROSS SECTIONS SHOWING
SUPPER ELEVATION ATTAINMENT



PI = POINT OF INTERSECTION
I = ANGLE OF DEFLECTION
R = RADIUS OF CURVATURE (METER)
D = DEGREE OF CURVE (DEGREE)
T = TANGENT LENGTH (METER)
E = EXTERNAL DISTANCE (METER)
PC = POINT OF CURVATURE
PT = POINT OF TANGENCY
L = LENGTH OF CURVE (METER)
e = SUPPER ELEVATION (%AGE)
C = CHORD LENGTH (METER)
M = MID ORDINATE (METER)

DETAILS OF HORIZONTAL CURVE



PVI = POINT OF VERTICAL INTERSECTION
Y = VERTICAL OFFSET
G_1G_2 = GRADES(+/-) A=LVC/800
LVC = LENGTH OF VERTICAL CURVE
A = G1, G2
$R = \frac{L}{G2-G1}$

DETAILS OF VERTICAL CURVE

Item	Unit	Design Standard			
		1st Kohat Access Road		2nd Kohat Access Road	
Section		South	North	South	North
Design Speed	km/hr	90	80	90	80
Cross Section Elements:					
- Lane width	m	3.65	3.65	3.65	3.65
- Outer Shoulder Width	m	3.00	3.00	3.00	3.00
- Outer Shoulder Width for climbing lane	m	1.00	1.00	-	-
- Inner Shoulder Width	m	1.00 (Future 4-lanes)	1.00	1.00	1.00
- Median Width	m	6.00 (Future 4-lanes)	3.00	6.00	3.50
- Climbing Lane Width	m	3.00	-	-	-
- Crossfall of Traveled Way	%	2	2	2	2
- Crossfall of Shoulder	%	4	4	4	4
- Vertical Clearance	m	5.03	5.03	5.03	5.03
- Railway Vertical Clearance	m	6.71	6.71	6.71	6.71
- Stopping Sight Distance	m	137	120	160	130
- Passing Sight Distance	m	600	550	615	540

Note: based on the NHA Standard and a Policy on Geometric Design of Highways and Streets 2001, AASHTO
* recommended max. radius for use of a transition curve if site condition allows

Item	Unit	Design Standard			
		1st Kohat Access Road		2nd Kohat Access Road	
Section		South	North	South	North
Design Speed	km/hr	90	80	90	80
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Circular Curve:					
- Min. Radius	m	270	220	275	210
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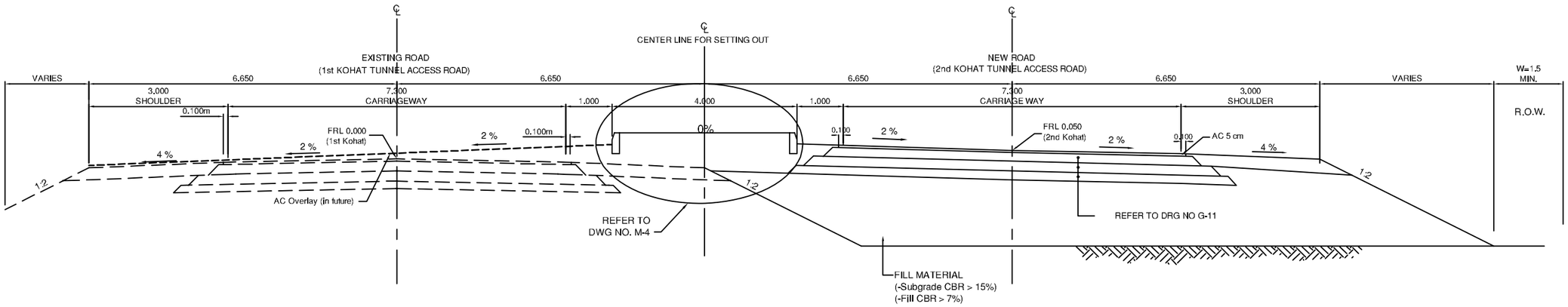
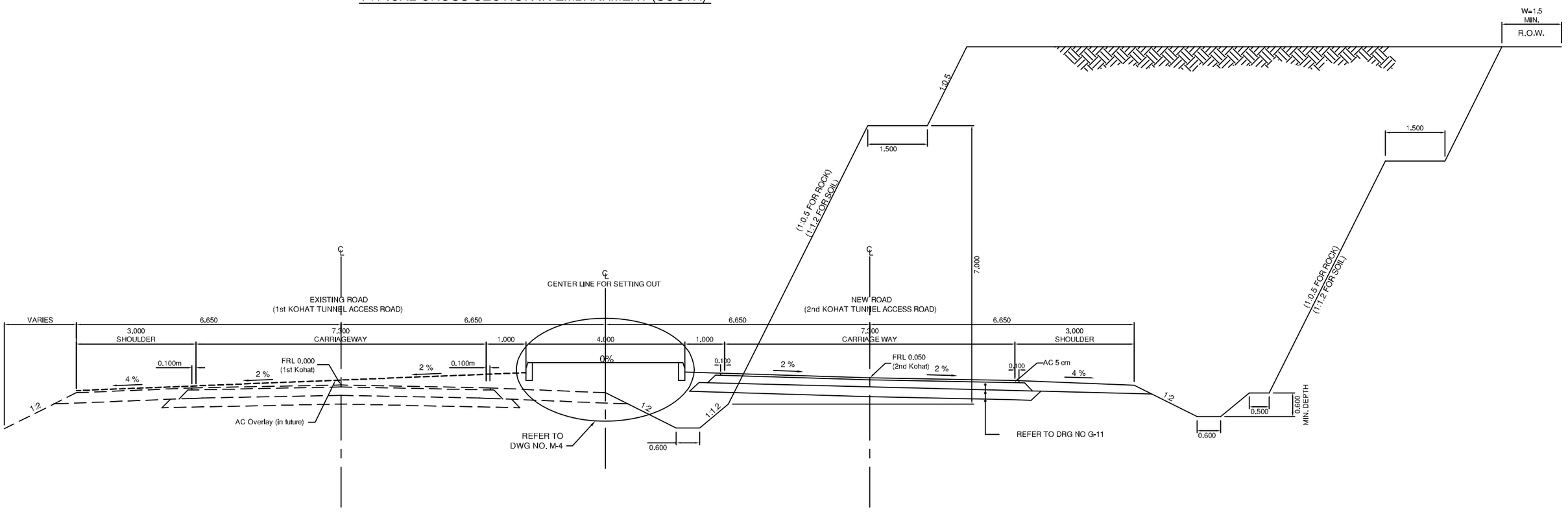
- Tangent Run out	m	16	15	23	22
Transition Curve:					
- Type of transition curve		-	-	Spiral Curve (Clothoid)	-
- Min. Transition Curve Length	m	-	-	50	40
- Max. Radius for Use of a Spiral Curve Transition *	m	-	-	480 (1200)	380 (900)
Vertical Alignment:					
- Max. Grade	%	7	7	4	4
Crest Curve					
- Stopping Sight Distance	m	-	-	160	130
- Passing Sight Distance	m	600	550	615	540
Sag Curve					
- Stopping Sight Distance	m	-	-	160	130

PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	ROAD GEOMETRY DETAILS NORTH SECTION	NTS	G-8

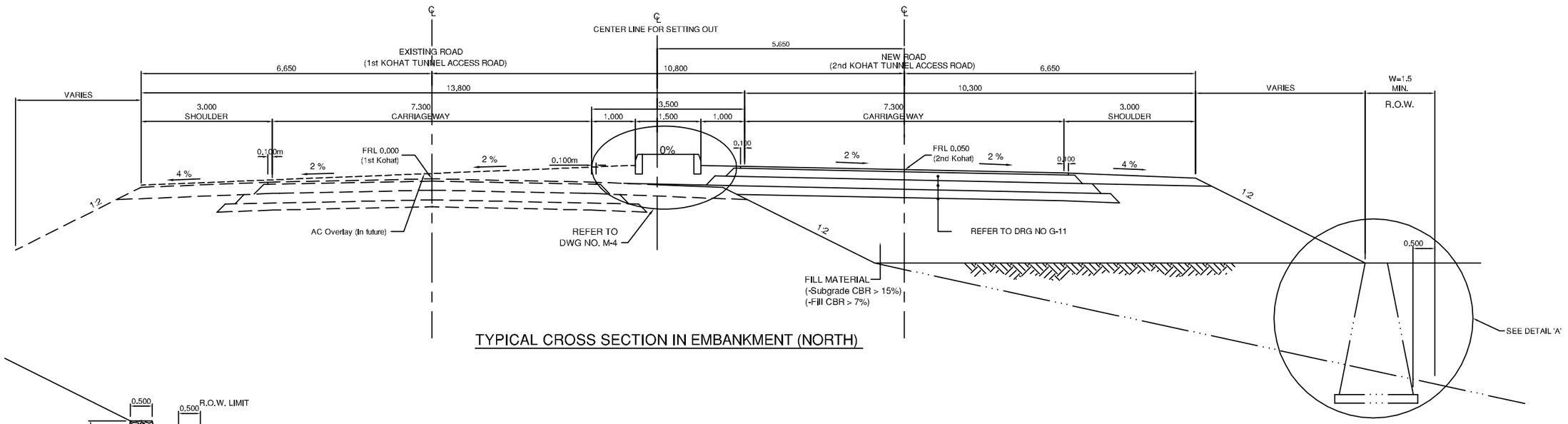


TYPICAL CROSS SECTION IN EMBANKMENT (SOUTH)

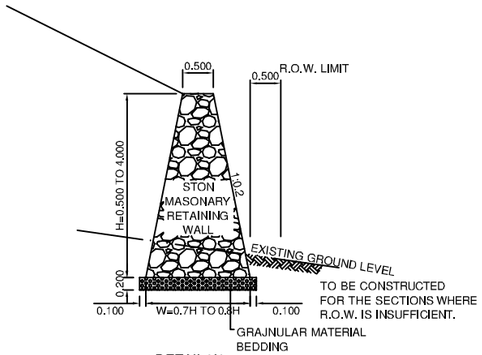


TYPICAL CROSS SECTION IN EMBANKMENT AND CUT (SOUTH)

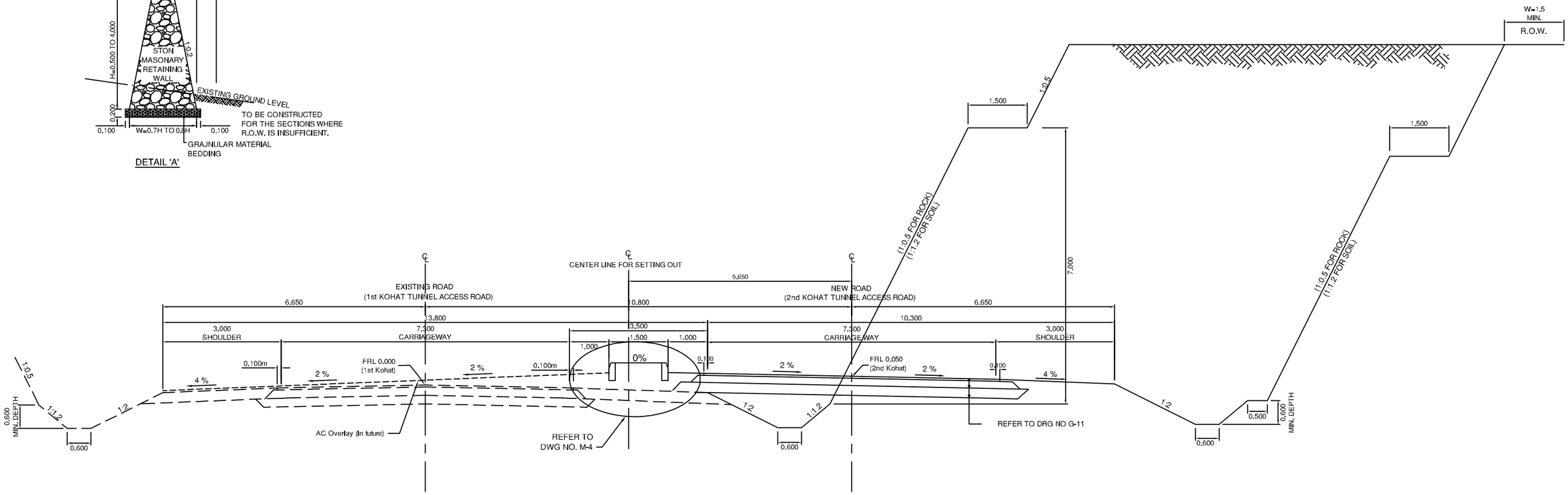
PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	TYPICAL CROSS SECTION (SOUTH SECTION)	1:100	G-9



TYPICAL CROSS SECTION IN EMBANKMENT (NORTH)

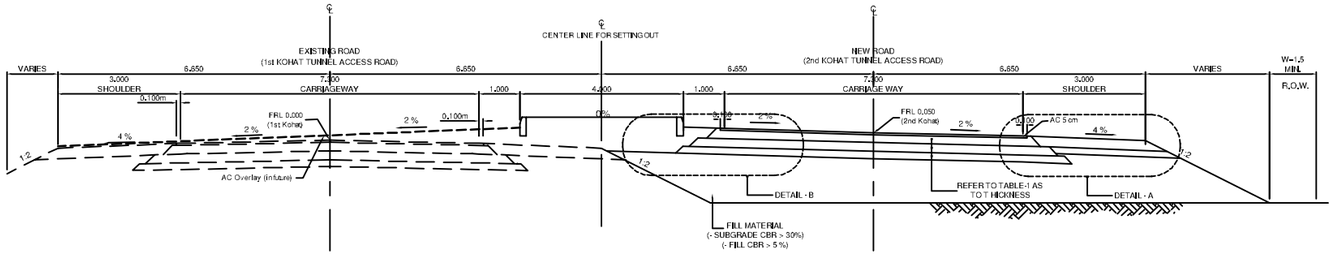


DETAIL 'A'



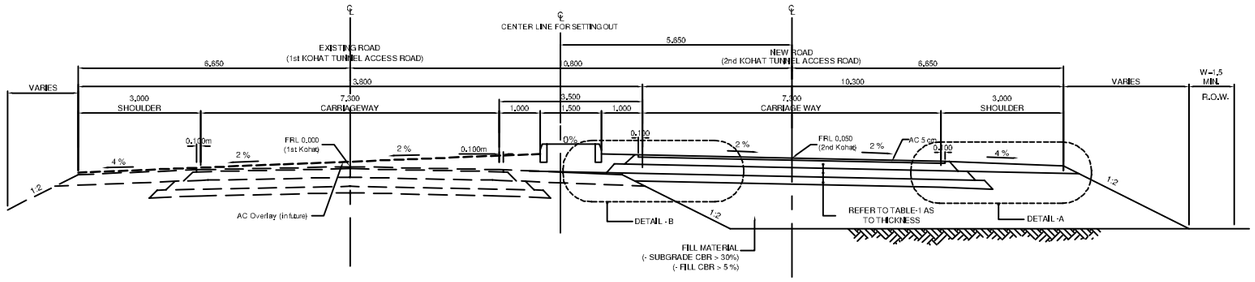
TYPICAL CROSS SECTION IN CUT (NORTH)

PROJECT NAME	CLIENTS		CONSULTANTS	DRAWING TITLE	SCALE	DWG NO
FEASIBILITY STUDY ON THE 2ND KOHAT TUNNEL AND ACCESS ROADS PROJECT	GOVERNMENT OF PAKISTAN MINISTRY OF COMMUNICATIONS NATIONAL HIGHWAY AUTHORITY	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO., LTD AND ALMEC CORPORATION	TYPICAL CROSS SECTION (NORTH SECTION)	1:100	G-10



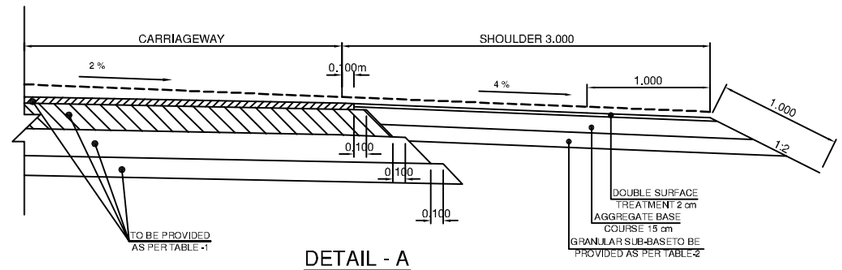
TYPICAL CROSS SECTION IN EMBANKMENT (SOUTH)

SCALE = 1:150

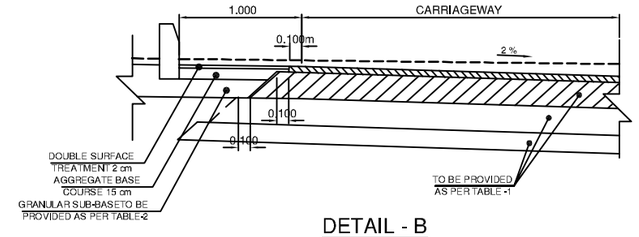


TYPICAL CROSS SECTION IN EMBANKMENT (NORTH)

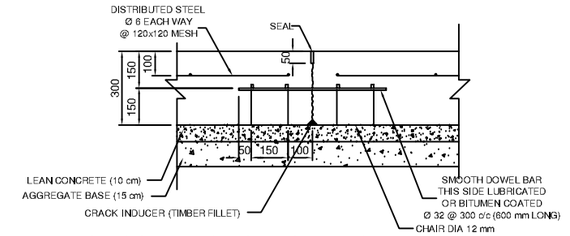
SCALE = 1:150



DETAIL - A

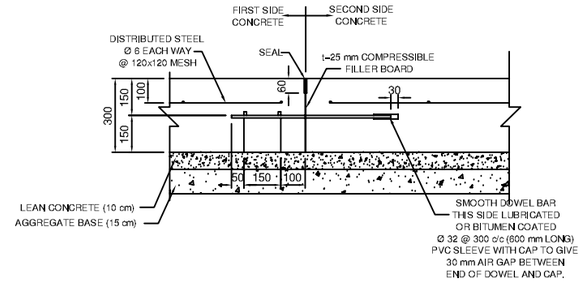


DETAIL - B



DETAIL OF CONTRACTION JOINT FOR RGID PAVEMENT

NOTE:- CONTRACTION JOINT AT 10.0m



DETAIL OF EXPANSION JOINT FOR RGID PAVEMENT

(TABLE -1) THICKNESS OF PAVEMENT

TYPE	CHAINAGE	A.C. WEARING (CLASS A)	A.C. BASE COURSE (CLASS - B)	A.C. BASE COURSE (CLASS A)	AGG. BASE COURSE (CBR >80%)	GRANULAR SUB BASE (CBR >50%)
A	STA. 0+450 ~ 15+000	5 cm	8 cm	9 cm	15 cm	15 cm
B	STA. 15+000 ~ 20+038	5 cm	8 cm	10 cm	15 cm	15 cm
C	STA. 18+282 ~ 25+500	5 cm	8 cm	10 cm	15 cm	15 cm

(TABLE -2) SHOULDER PAVEMENT

SR.NO	CHAINAGE	D.B.S.T	AGG. BASE (CBR >80%)	GRANULAR SUB BASE (CBR >50%)
		2 cm	15 cm	10 cm

(TABLE -3) LOCATION OF RIGED PAVEMENT

SR.NO	LOCATION	LENGTH
1	TOLL PLAZA	100 M
2	TUNNEL APPROACH (SOUTH)	150 M
3	TUNNEL APPROACH (NORTH)	150 M
4	TUNNEL	1885 M

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