Chapter 5

Thap Put Bypass (NC-3)

5. Thap Put Bypass (NC-3)

5.1 Natural Conditions and Land Use

The project of new bypass construction locates in the southern part of Route 4 between Route 416 and 415 in a distance of 8 kilometers. The project area is mostly in open forest in the upper stream of small rivers. The terrain is flat. General geology is of tertiary sediments.

Land use along the proposed NC-3 is mostly rubber plantation accounting for about two-thirds of the whole stretch. About 10 % is used as paddy field. In the middle part of the highway, houses are located in the proposed right of way in the range of twenty houses. At the junction point with Route 416, coconut farm land is spreading.

Residential Area	4 %
Paddy Field	15 %
Rubber Plantation	70 %
Coconut Orchard	2 %
Grass Land	9 %

Land price varies from B12,000 - 80,000 per rai. The highest price is found at the land adjacent to Route 416.

5.2 Socio-Economic Conditions

Amphoe Thap Phut to Amphoe Muang Phangnga had a population of 52,600 in the area of 823 square kilometers in 1989 as shown in Table 5.2.1. Population density of the two amphoes together was 64 persons per square kilometer, characterizing the region as a sparsely-populated rural area. Population growth rate during 1979 - 1989 was 1.9 % for Thap Put and 2.1 % for Muang Phangnga.

Table 5.2.1 POPULATION IN NC-3 CORRIDOR

	A. Thap Phut	A. Muang Phangnga
Area (km2)	274.4	549
Total Pop. (1989)	20,198	32,400
Pop. Density (per./km2)	74	59
Pop. Growth Rate (% per annum)		
1979-89	1.91	2.15

Agriculture sector accounted for the highest share of employment of about 60%, followed by the service sector of 38%. Manufacturing sector played only a limited share.

3.5 Thap Put Bypass (NC-3)

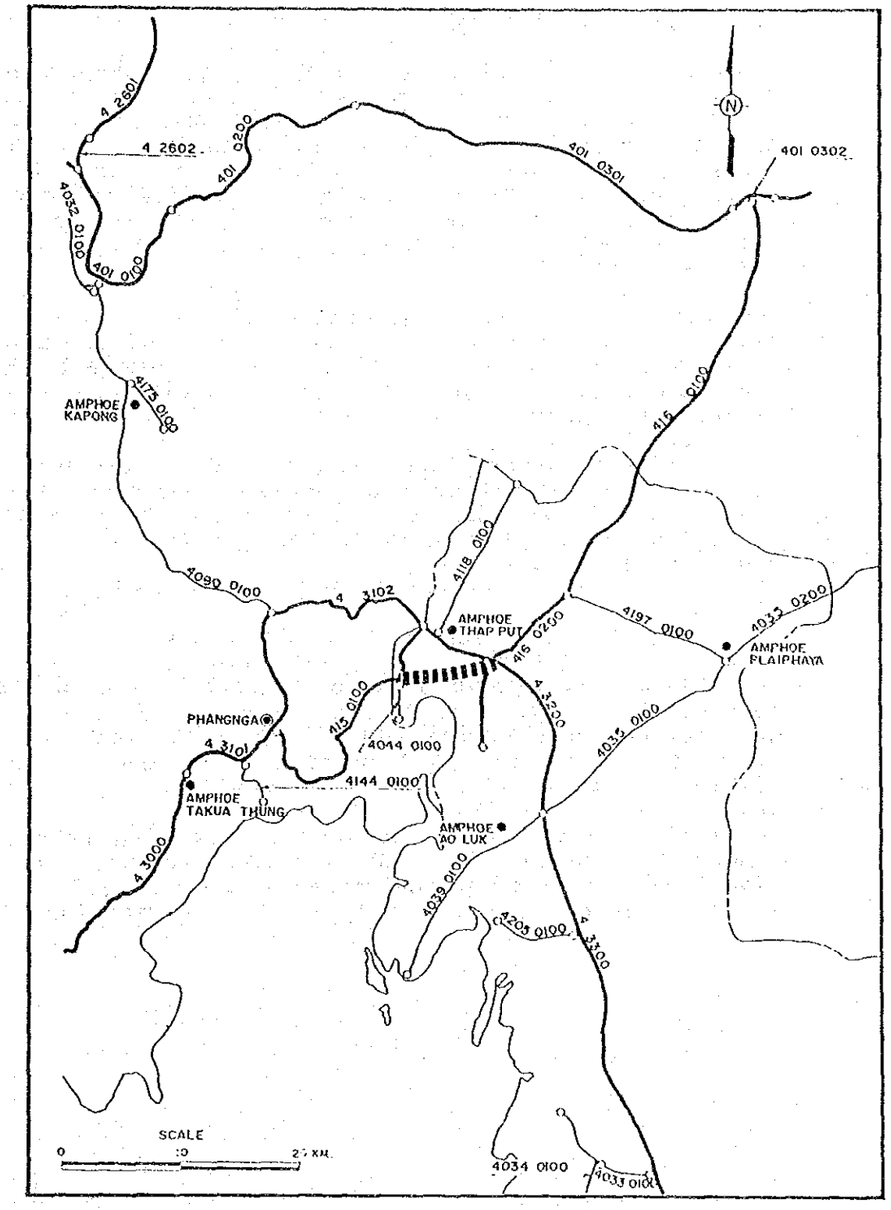


Fig. 5.1.1 THAP PUT BYPASS (NC-3)

5.3 Traffic Conditions

The main highway link between Thap Put and Phangnga was previously Route 4 which has steep ups and downs as well as sharp curves in mountain area. Route 415 was constructed in a low land as an alternative route to the mountain crossing link of Route 4. Route 415 is of F4 standard with asphaltic concrete surface of 5.5 meter width. Due to a large traffic diversion from Route 4, traffic volume on Route 415 amounted to 2,800 AADT in 1989 while traffic volume on Route 4 in the mountain area was as low as 300 AADT.

The roadside OD survey on Route 415 revealed that 31 % trucks on the highway carried construction materials, 27 % manufactured products, 16 % fish and 11 % live stock. As to trip purposes of passengers, 40 % of cars was for private purpose trip, followed by tourism purpose trip of 32 % which was the highest percentage share of the eight project areas.

The proposed highway which connects Route 416 directly with Route 415 aims to facilitate traffic flow between Phuket and Surat Thani/Krabi directions. The future traffic volume on the highway is estimated at 4,300 in 1996, 5,600 in 2001 and 7,300 in 2006 as shown in Fig. 5.3.1.

5.4 Project Evaluation

The EIRR was calculated at 23.0 % though it was 30.4 % in the pre-feasibility study. This is mainly because of the increased earth work for embankment. The EIRR will be lowered to 17.0 % in a case of 20 % cost up and 20 % benefit down. This project is judged viable.

The highway lies in a flat land mostly with rubber plantation. Mangrove forest is not found in this upstream of small rivers. No significant effect on environment is envisaged. Traffic safety would be improved particularly at the intersection with Route 4.

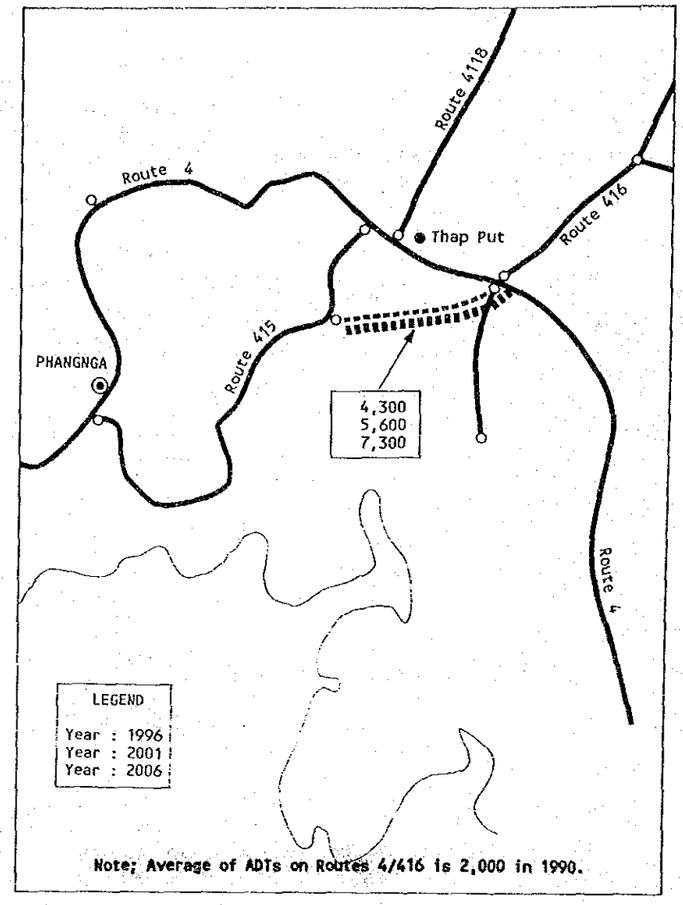


Fig. 5.3.1 TRAFFIC VOLUME ON NC-3

5.5 Engineering Study

1) Summary

The first section of 6.85 km passes through open forest area in a straight line and remaining section of 1.1 km follows the existing DOH route.

Since the alignment passes on flat terrain which is likely to be hit by flooding, the height of embankment is planned to be rather high, 3.5 m in average, 2.5 m in minimum. The embankment is protected by block- sodding and installed with sufficient drainage facilities.

The pavement structure comprises surface course of 5 cm, base course of 20 cm and subbase course of 20 cm, 45 cm in total.

One bridge of reinforced concrete and prestressed concrete is planned to cross the kalong with 110 m in length.

The intersection with Route 4 is planned to be signalized.

NC-3	Description
Changwat	: Phangnga
Name or Location	: Thap Put Bypass
Road Class	: S1
Cross Section (m)	: 2.5 + 7.0 + 2.5
Surface Type	: SA / ASC / SA
Bridge: New	: 1 site, 110 m
Length: Total	: 7.95 km
New	: 6.85 km
Reconstruction	: 1.1 km (DOH)
AADT ('96/'01/'06)	: 4,300 / 5,600 / 7,300
Financial Cost	: 120.3 million baht (in 1990 price)
NPV	: 76 million baht (12% discount rate)
B/C	: 2.2 (12% discount rate)
EIRR	: 23.0 %

( ): Existing Condition

2) Design Standard and Conditions

(1) Design Criteria

Road Class : S1
Design Speed : 70 - 90 km/h

Geometric Design Criteria

Description	Design Speed (km/h)		
	90	80	70
Minimum Radius of Curvature (m)	280	220	160
Minimum Stopping Sight Distance (m)	150	120	100
Maximum Gradient (%)	6	7	7
Minimum Gradient for Drainage (%)	0.3	0.3	0.3

(2) Pavement Design Conditions

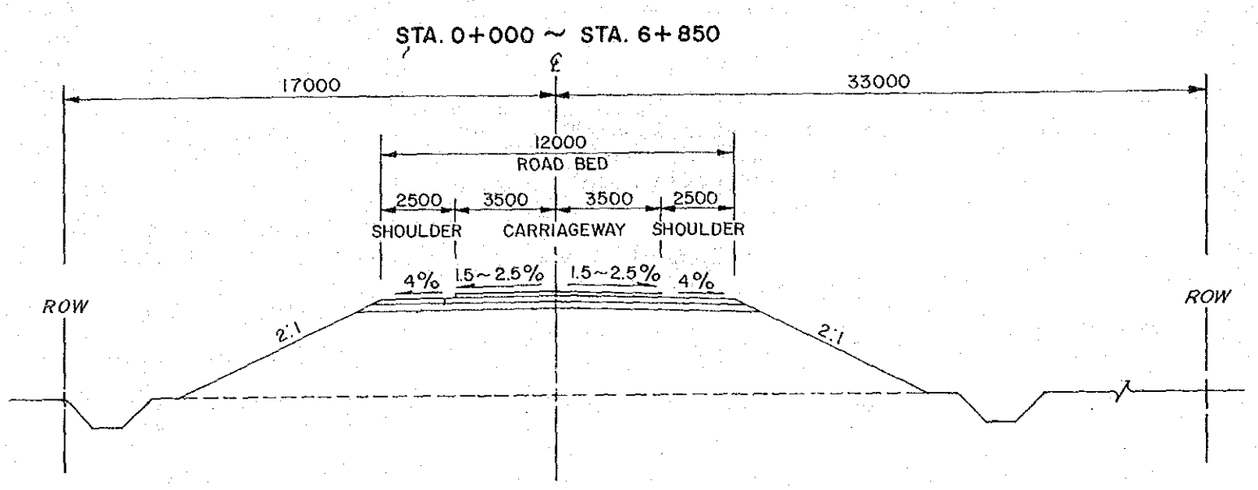
Design CBR : 10 %
Design Method : AASHTO
Design Period : 7 years

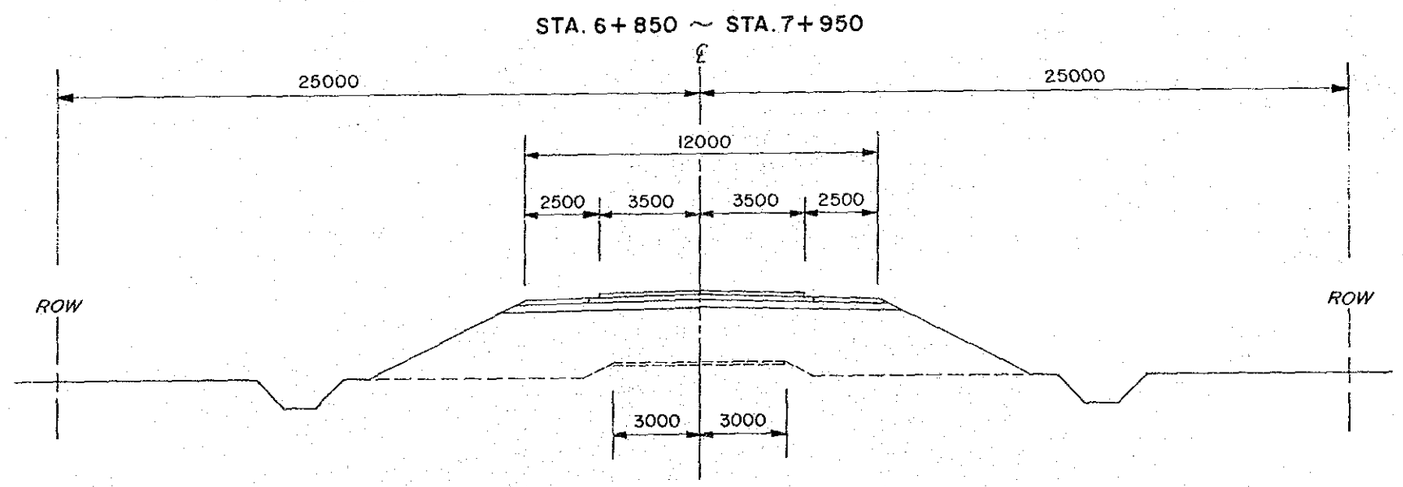
(3) Drainage Design Conditions

Rainfall Intensity : Rainfall Intensity Duration Curve at Chumphon Observatory

Return Period : Culvert ---------10 years
: Minor Bridge-----20 years

3) Typical Cross Section

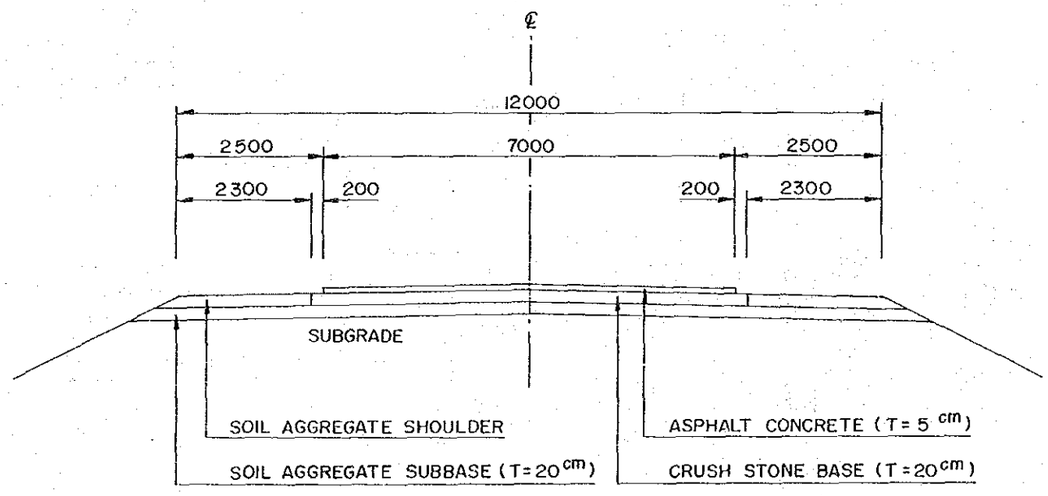




4) Pavement Design

New Road

Design CBR of Subgrade	Cumulative No. of ESA W18 x 10^3 (7 years)	Thickness of Pavement Structure (cm)
10.0	2,682	Surface 5 Base 20 Subbase 20



5.6 Construction Cost

Table 5.5.1 CONSTRUCTION COST

1) CONSTRUCTION QUANTITIES AND COSTS

(Project NC -3 Length = 7.950 Km)
(Improved Length 7.950 Km)

ITEM	Unit	Financial Unit Cost Baht	Quantity	Financial Total cost 1000 Baht	Economic cost %	Economic cost 1000 Baht	Residual Value %	Residual Value 1000 Baht
EARTH WORK					83		90	
Clearing & Grubbing	SQ.M	1	271,680	272				
Roadway Excavation(classified)	CU.M	85	0	0				
Embankment(Borrowed Material)	CU.M	100	449,491	44,949				
Slope Protection(Stripe Sodding)	SQ.M	6	112,574	675				
(Sodding)	SQ.M	9	0	0				
(Shot Concrete)	SQ.M	500	0	0				
(Concrete Block)	SQ.M	450	5,330	2,399				
Sand Mat (t=0.5m)	SQ.M	100	4,800	480				
Excavate Existing Thickness Over 10cm (2Lay)	SQ.M	14	0	0				
SUB TOTAL				48,775		40,483		36,435
SUBBASE AND BASE					83		50	
Subbase(Soil Aggregate)	CU.M	190	20,698	3,933				
Base Coarses(Crush Stone)	CU.M	295	11,603	3,423				
Shoulder(Soil Aggregate)	CU.M	190	7,840	1,490				
SUB TOTAL				8,845		7,341		3,671
SURFACE					83		50	
Asphaltic Prime coat	SQ.M	13	58,016	754				
Asphaltic Tack coat	SQ.M	7	0	0				
Asphalt concrete Surfacing	CU.M	1,900	2,744	5,214				
SUB TOTAL				5,968		4,953		2,477
STRUCTURES(Equivalent)					83		50	
RC Pipe Culvert(D= 600 m)	M	1,300	194	252				
(D= 800 m)	M	1,780	134	239				
(D=1000 m)	M	2,445	346	846				
(D=1200 m)	M	3,575	0	0				
RC Box Culvert(1-1.80*1.80 m)	M	4,200	71	298				
(2-1.80*1.80 m)	M	8,400	17	143				
(3-3.80*3.00 m)	M	29,100	19	553				
RC Bridge Wideing	SQ.M	9,600	0	0				
RC Bridge (W=14.0 m)	M	89,600	50	4,480				
PC Bridge (W=14.0 m)	M	140,000	60	8,400				
Bearing Unit Of Bridge	Ls	500,000	1	500				
SUB TOTAL				15,711		13,040		6,520
INTERSECTION					90		90	
Four-Leg Intersection (Signal)	Ls	1,000,000	1	1,000				
T-Intersection (Unsignal)	Ls	80,000	1	80				
SUB TOTAL				1,080		972		875
TOTAL (a)				80,378		66,790		49,977
Miscellaneous Works [(a)*7%]	Ls	1		5,626		4,675		3,498
CONTRACT AMOUNT (b)				86,005		71,465		53,475
PHYSICAL CONTINGENCIES [(b)*10%] (c)	Ls	1		8,600		7,146		5,348
ENGINEERING & SUPERVISION [((b)+(c))*10%] (d)	Ls	1		9,461	85	8,041	0	0
LAND ACQUISITION & COMPENSATION								
Land Acquisition (Average)	SQ.M	33	359,000	11,775	100	11,775	100	11,775
Conpensation	Ls	4,500,000	1	4,500	100	4,500	100	4,500
TOTAL (e)				16,275		16,275		16,275
PROJECT COST [(b)+(c)+(d)+(e)]				120,341		102,928		75,098
AVERAGE COST PER KM				15,137				

2) MAINTENANCE COST

Project Road No, NC -3 Na= 9,300 Baht/Km/year
(Existing Road) Km= 1.162
Length = 1.100 Km

Laterite Surface

	ITEMS		Existing Condition	Factor
1.	A.D.T	A1	151-200	0.24
2.	Width Of Embankment (Surface & Shoulder)	A3	5.0 m	0.00
3.	R-O-W Width	B1	55 m	0.21
4.	Traffic Service Operation Topography	B2	0 - 3 %	0.05
5.	Drainage Topography	B3	0 - 3 %	0.00
6.	Bridge Quantity (m/Km)	B4	1-20	0.02
7.	NO. Of Lanes		2	

Ks (Existing)= 1+0.7(A1+A3)+0.3(B1+B2+B3+B4) = 1.252
Maintenance cost + Overhead = KS * Km * Na * 1.28 = 17,318 Baht/Km/year
Total Cost (Financial) = Length *(Baht/Km/year)= 19,050 Baht/year
(Economic) = = 15,812 Baht/year

Project Road No, NC -3 Na= 8,200 Baht/Km/year
(Proposed Road) Km= 1.001
Length = 7.950 Km

Asphalt Pavement

	ITEMS		Proposed Road (1996) Condition	Factor	(2001) Factor	(2006) Factor
1.	Surface /Bace Type	X1	AC	0.00	0.00	0.00
2.	Subgrade CBR	X2	4 %	0.50	0.50	0.50
3.	A.D.T	X3	4,000	1.51	2.25	2.25
4.	Service Life (year)	X4	NEW	0.00	0.00	0.00
5.	Pavement Width (m)	X5	7 m	0.19	0.19	0.19
6.	R-O-W Width (m)	Y1	50 m	0.05	0.05	0.05
7.	Shoulder,Access,Median Width (m)	Y2	2.50 m	0.05	0.05	0.05
8.	Traffic Service Operation Topography	Y3	0 - 3 %	0.00	0.00	0.00
9.	Drainage Topography	Y4	0 - 3 %	0.00	0.00	0.00
10.	Bridge Quantity (m/Km)	Y5	13	0.00	0.00	0.00
11.	NO. Of Lanes		2			

Ka = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5)= 2.150 2.520 2.520
Maintenance cost + Overhead= Ka * Km * Na * 1.28 = 22,589 26,476 26,476 Baht/Km/year
Total Cost (Financial) = Length *(Baht/Km/year)= 179,582 Baht/year
(1996) (Economic) = = 149,053 Baht/year
Total Cost (Financial) = ADT(6,000 CAR/DAY) = 210,487 Baht/year
(2001) (Economic) = = 174,704 Baht/year
Total Cost (Financial) = ADT(7,000 CAR/DAY) = 210,487 Baht/year
(2006) (Economic) = = 174,704 Baht/year

Overlay Cost (2004) = = 7,265,664 Baht

3) CONSTRUCTION SCHEDULE

Project NC-3

(One Section)

year and Month / Work Items	First Year 1 2 3 4 5 6 7 8 9 10 11 12	Second Year 1 2 3 4 5 6 7 8 9 10 11 12
Land Acquisition	=========	
Preparatory Works	=========	
Earth Works	==========	==========
Pavement Works		==========
Bridge Works	==========	==========
Miscellaneous Works	==========	=========
Clearing -Up		=========
Percentage Of Disbursement (%)	43 %	57 %

4) ECONOMIC EVALUATION

Cost and Benefit Flows of the Project
Project; NC-3

(unit ; 1000 Baht)

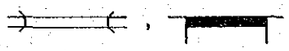
Year	Construction Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Balance	Sensi. Analysis
						Benefit=	0.80
						Cost=	1.20
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	50,435	0	50,435	0	0	(50,435)	(60,522)
1995	52,492	0	52,492	0	0	(52,492)	(62,990)
1996	0	133	133	5,904	5,413	11,184	8,894
1997	0	133	133	6,306	7,814	13,986	11,136
1998	0	133	133	6,707	10,214	16,788	13,377
1999	0	133	133	7,109	12,615	19,590	15,619
2000	0	133	133	7,510	15,015	22,393	17,861
2001	0	159	159	7,912	17,416	25,169	20,072
2002	0	159	159	10,350	26,296	36,487	29,126
2003	0	159	159	12,788	35,176	47,805	38,181
2004	0	7,425	7,425	15,227	44,055	51,857	38,516
2005	0	159	159	17,665	52,935	70,441	56,289
2006	0	159	159	20,103	61,815	81,759	65,344
2007	0	159	159	20,103	61,815	81,759	65,344
2008	0	159	159	20,103	61,815	81,759	65,344
2009	0	159	159	20,103	61,815	81,759	65,344
2010	0	159	159	20,103	61,815	81,759	65,344
Total	102,926	9,521	112,447	197,993	536,024	621,570	452,277
				IRR =		23.02%	16.97%
				NPV (i;12%) =		76,092	
				B/C (i;12%) =		2.19	

5.7 Drawings

Drawing

SHEET NO.	LIST OF DRAWINGS
1.	Plan and Profile
2.	Plan of Intersection
3.	(A) Bridge of Khlong Sai Mat
4.	Box Culvert
5.	Pipe Culvert

ABBREVIATION AND SYMBOLS FOR PROFILE AND PLAN

———	: Alignment of Proposed Route
	: Proposed Bridge
	: Proposed Box Culvert
	: High Water Level
	: Water Level
No.	: Number
R	: Radius of Curvature
L	: Length of Curve
BR.RC.SP.SL L	: Reinforced Concrete Bridge (Bridge Length)
BR.PC.GRDR L	: Prestressed Concrete Bridge (Bridge Length)
BR.ST.SP.TR L	: Steel Bridge (Bridge Length)
RC-B m - n x a x b x i	: Box Culvert (No. of Locations - No. of Cells x Clear Span x Depth x Length)

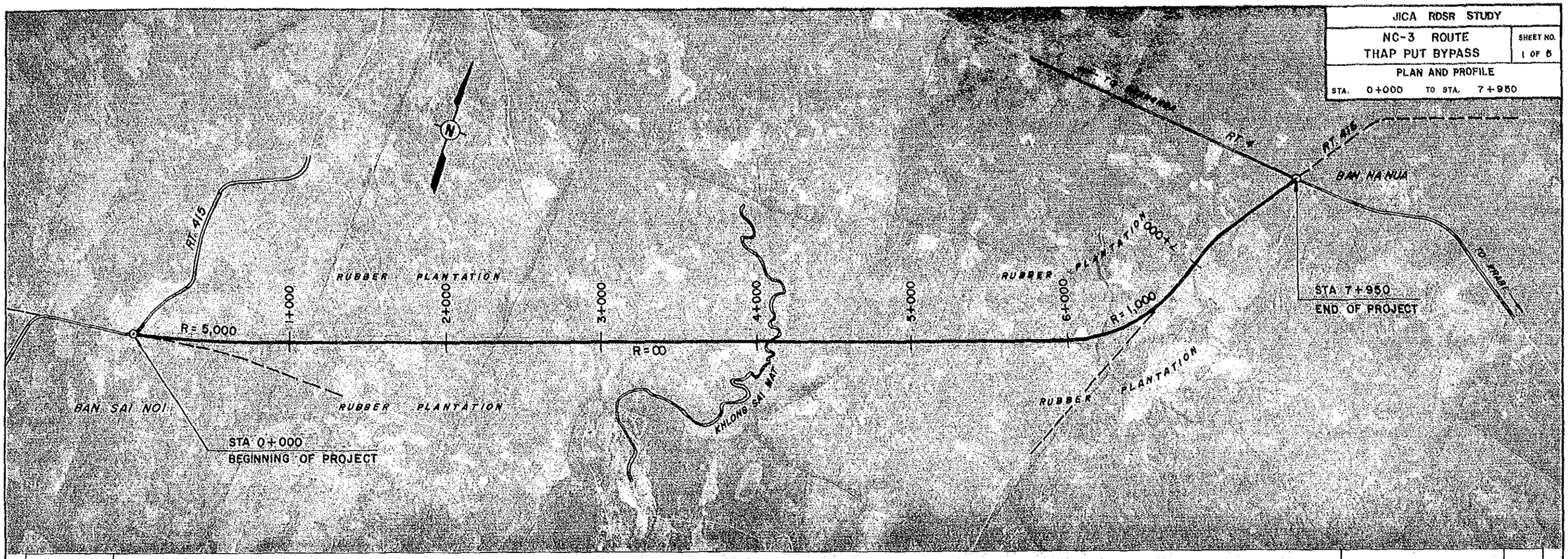
JICA RDSR STUDY

NC-3 ROUTE
THAP PUT BYPASS

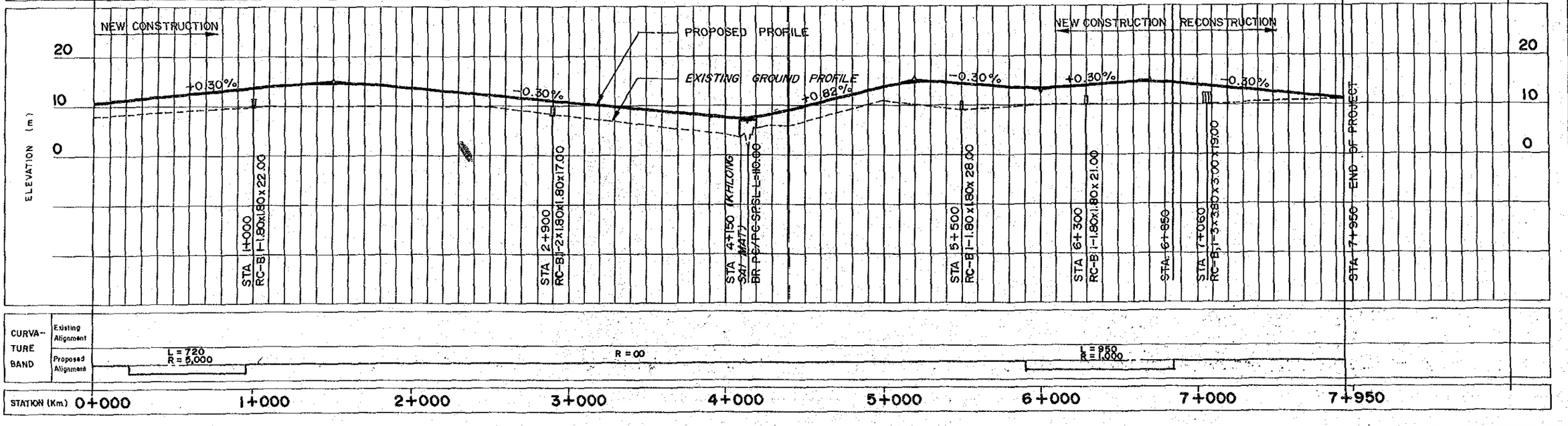
SHEET NO. 1 OF 6

PLAN AND PROFILE

STA. 0+000 TO STA. 7+950



TERRAIN		FLAT
PAVEM'T	Type	AC PAVEMENT
	Existing Condition	– / POOR
FLOODING	Length (Km.) / Hight (m.)	–
RIGHT OF WAY (m.)	L.	25.00
	R.	25.00



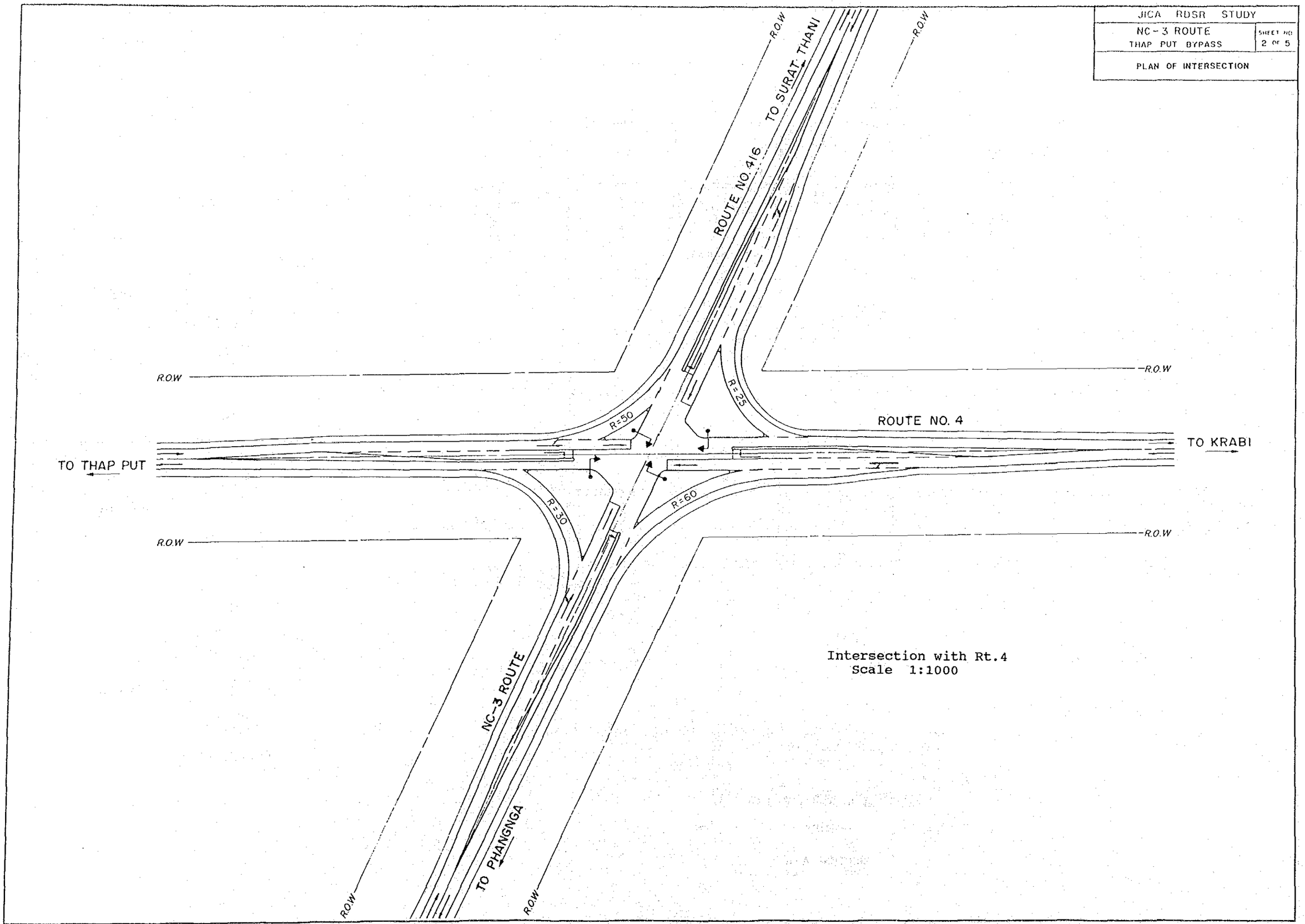
CURVATURE BAND	Existing Alignment	–
	Proposed Alignment	L = 720, R = 5,000 / R = ∞ / L = 950, R = 1,000
STATION (Km.)		0+000 1+000 2+000 3+000 4+000 5+000 6+000 7+000 7+950

JICA RDSR STUDY

NC-3 ROUTE
THAP PUT BYPASS

SHEET NO 2 OF 5

PLAN OF INTERSECTION



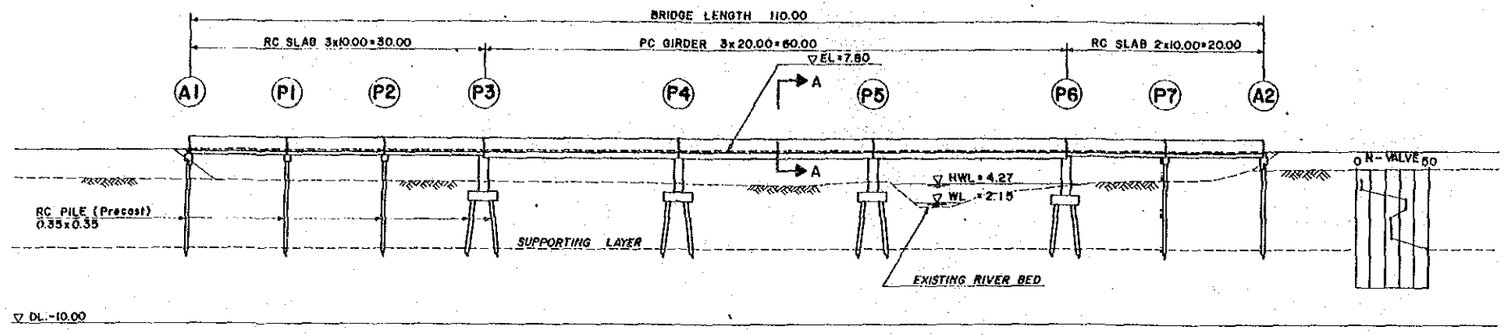
Intersection with Rt.4
Scale 1:1000

JICA RDSR STUDY

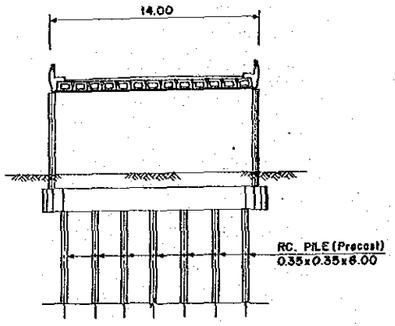
NC-3 ROUTE
THAP PUT BYPASS

SHEET NO 3 OF 5

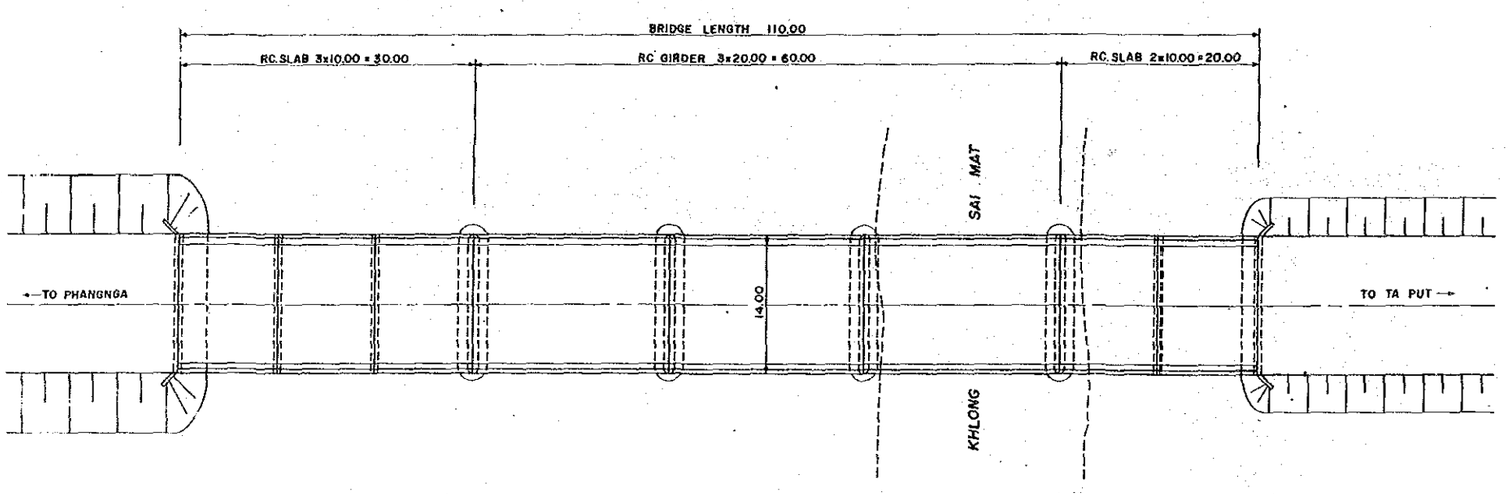
BRIDGE FOR KHLONG SAI MAT



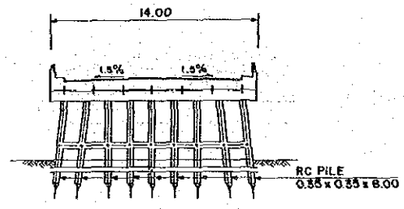
ELEVATION
SCALE 1:600



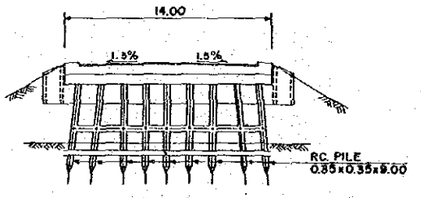
(P4), (P5)



PLAN
SCALE 1:600

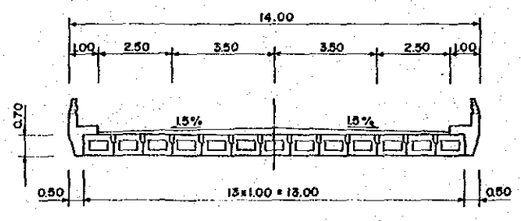


(P1), (P2), (P7)



(A1), (A2)

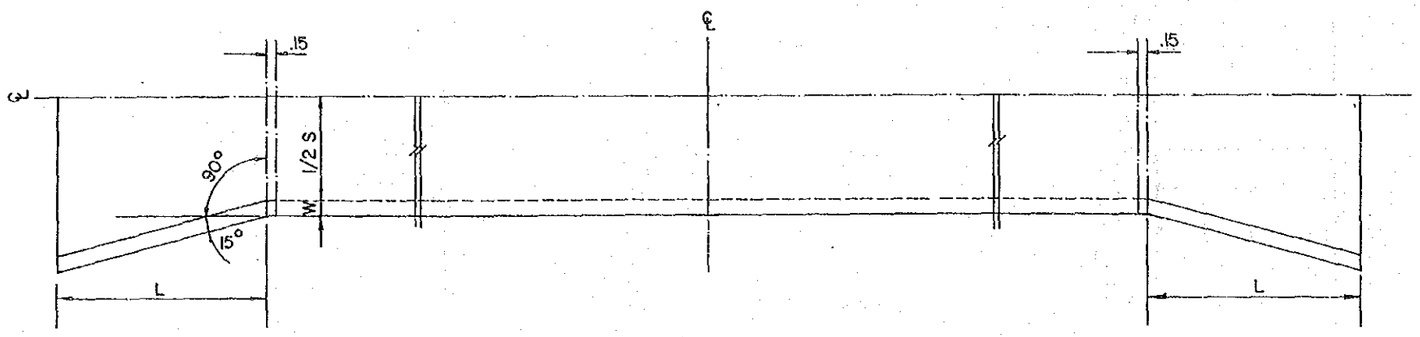
FRONT ELEVATION
SCALE 1:400



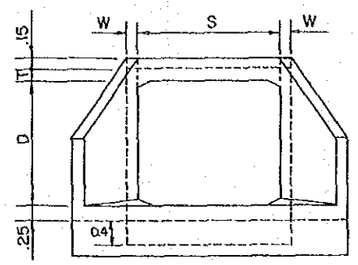
SECTION A-A
SCALE 1:200

JICA RDSR STUDY	
NC-3 ROUTE THAP PUT BYPASS	SHEET NO. 4 OF 5
BOX CULVERT	

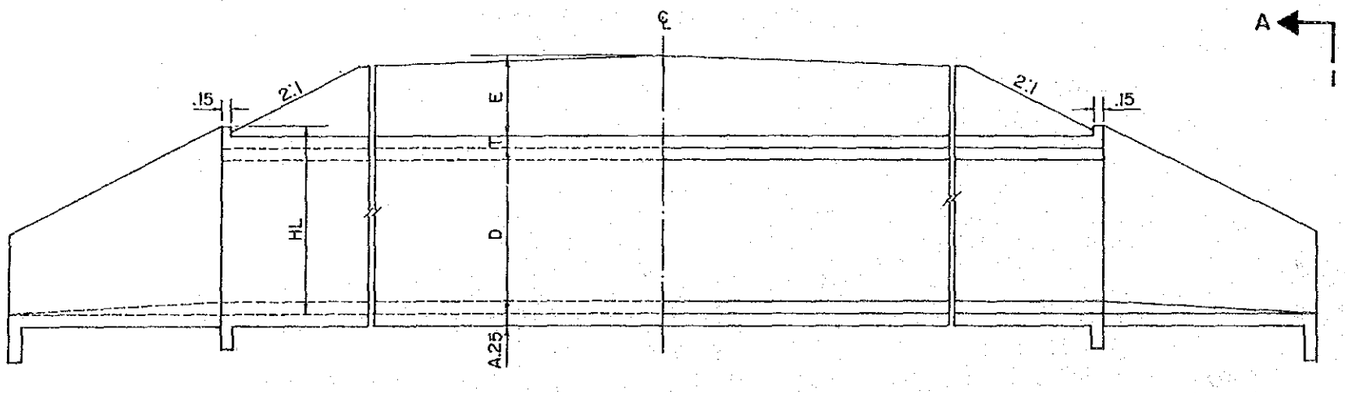
BOX CULVERT



HALF LONGITUDINAL PLAN

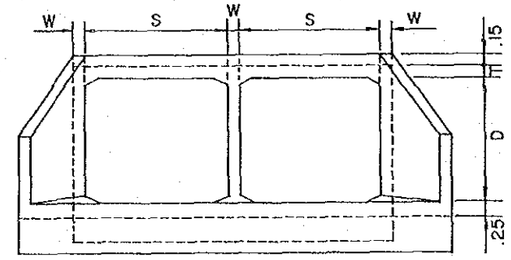


SINGLE TYPE



HALF LONGITUDINAL ELEVATION

HALF LONGITUDINAL SECTION

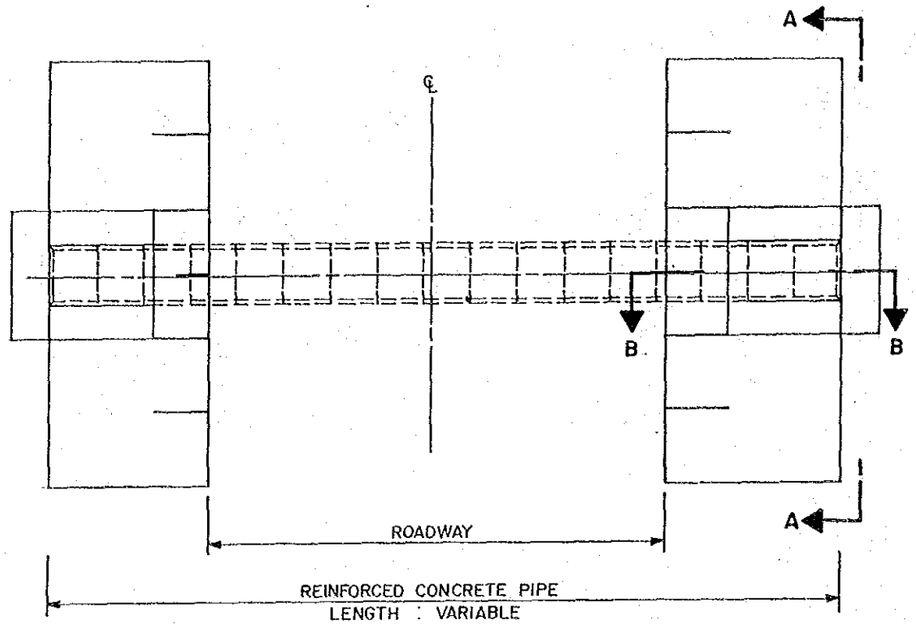


DOUBLE TYPE

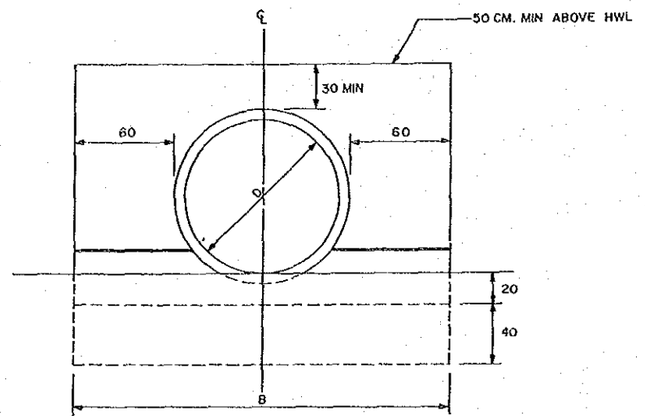
SECTION A-A

JICA RDSR STUDY	
NC-3 ROUTE THAP PUT BYPASS	SHEET NO. 5 OF 5
PIPE CULVERT	

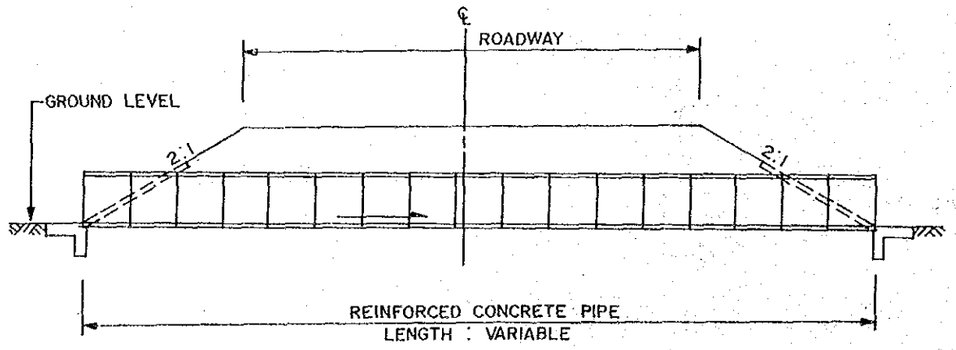
PIPE CULVERT



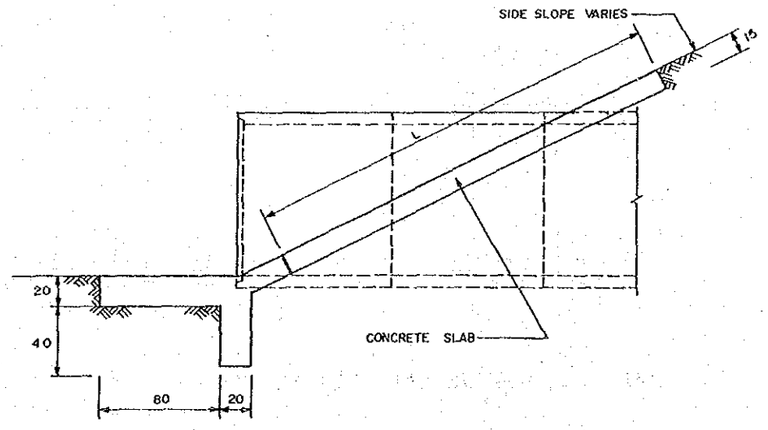
PLAN



SECTION A-A



PROFILE



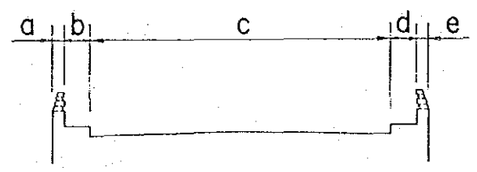
SECTION B-B

List of Bridge

LIST OF BRIDGES (NC-3:S1)

Station	Materials	Structural System	Width (a+b+c+d+e:m)	Span and Length (m)	Remarks	(Fig.)
4+150	PC/RC	SP.SL	0.3+0.7+12.0+0.7+0.3=14.0	3*10.0+3*20.0+2*10.0=110.0	New construction	

Note: (1) Materials
RC: Reinforced Concrete Bridge
PC: Prestressed Concrete Bridge
(2) Structural System
SP.SL: Simply Supported Slab



List of Culvert

LIST OF BOX AND PIPE CULVERT

STATION	CULVERT TYPE	CULVERT SIZE (m)		NO. of LOCATIONS	CULVERT LENGTH (m)		
		PIPE	BOX				
		NO. of ROW x DIAMETER	NO. of CELLS (CLEAR SPAN x DEPTH)		EXISTING	EXTENDED CONST-RUCTION	NEW CONST-RUCTION
0+000-1+960	Pipe	1x⊙1.00		5			26.0
	Pipe	1x⊙0.80		1			26.0
	Pipe	1x⊙0.60		3			26.0
1+000	Box		1(1.80x1.80)	1			22.0
1+960-2+900	Pipe	1x⊙1.00		3			20.0
2+900	Box		2(1.80x1.80)	1			17.0
5+000-5+900	Pipe	1x⊙0.80		1			30.0
	Pipe	1x⊙0.60		3			30.0
5+500	Box		1(1.80x1.80)	1			28.0
5+900-7+950	Pipe	1x⊙1.00		6			26.0
	Pipe	1x⊙0.80		3			26.0
	Pipe	1x⊙0.60		1			26.0
6+300	Box		1(1.80x1.80)	1			21.0
7+060	Box		3(3.80x3.00)	1			19.0