4.5 Engineering Study

1) AD-2-1

(1) Summary

The alignment follows that of the existing Route 402 except for the realignment section of 3.3 km at amphoe Thalang. The additional lanes are proposed on both sides of the existing carriageway without shifting the center line of the existing highway. This is because the existing highway is located along the center of the right of way and the width of the right of way is not wide enough to accommodate the new two lanes on one side,

Due to some difficulties of land acquisition, a center median is not installed at some sections, 2.5 km in length, where road side is fully occupied by shops and houses.

Motorcycle lane is installed on both sides of carriageway at the section from amphoe Thalang to Phuket city, 16.1 km in length.

The existing pavement is overlaid by 5 cm to satisfy the standard of proposed road class and estimated traffic volume. Pavement for new construction comprises surface course of 10 cm, base course of 15 cm and subbase course of 15 cm, 40 cm in total.

Six existing reinforced concrete slab bridges are widened on both sides to accommodate undivided four lanes, center-median and sidewalks. New two bridges are proposed on realignment section.

New intersection with Route 4030 is planned to be signalized. An intersection of unsignalized roundabout at Thao Thep Kasattri monument is proposed to be a signalized roundabout without any change to the monumental statue.

AD-2-1	Description
Changwat	: Phuket
Name or Location	: Rt.402, Ban Yit - Phuket City
Road Class	: SD (S3)
Cross Section (m)	: 2.5 + 7.0 + 4.2* + 7.0 + 2.5 (2.5+7.0+2.5)
	: 0.5 + 7.0 + 7.0 + 0.5 (2.5+7.0+2.5)
Surface Type	: SA / ASC / SA
Bridge: New	: 2 sites, 24 m
Widening	: 6 sites, 97 m
Length: Total	: 38.4 km
Widening	: 35.1 km
Realignment	: 3.3 km
Motorcycle Lane	: 16.1 km
AADT ('96/'01/'06)	: 13,900 / 21,100 / 30,800
Financial Cost	: 612.6 million baht (in 1990 price)
NPV	: 4,260 million baht (12% discount rate)
B/C	: 12.0 (12% discount rate)
EIRR	: 69.2 %

(2) Design Standard and Conditions

(a) Design Criteria

Road Class : SD
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 (%)	0.3	0.3	0.3

(b) Pavement Design Conditions

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

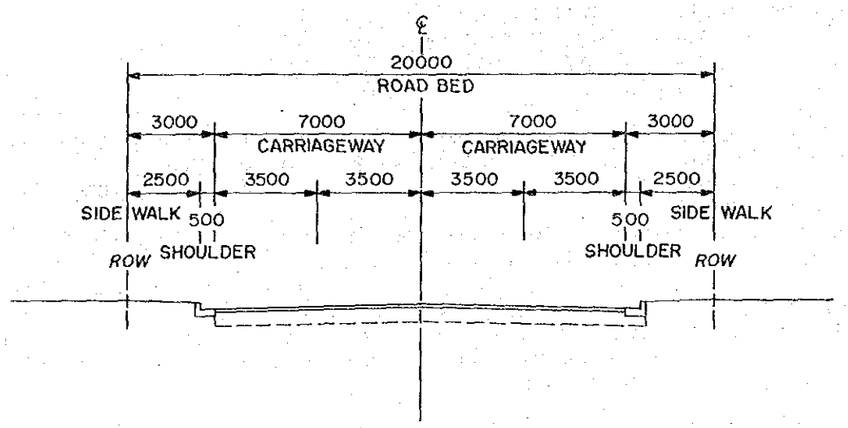
(c) Drainage Design Conditions

Rainfall Intensity : Rainfall Intensity Duration Curve at Chumphon Observatory

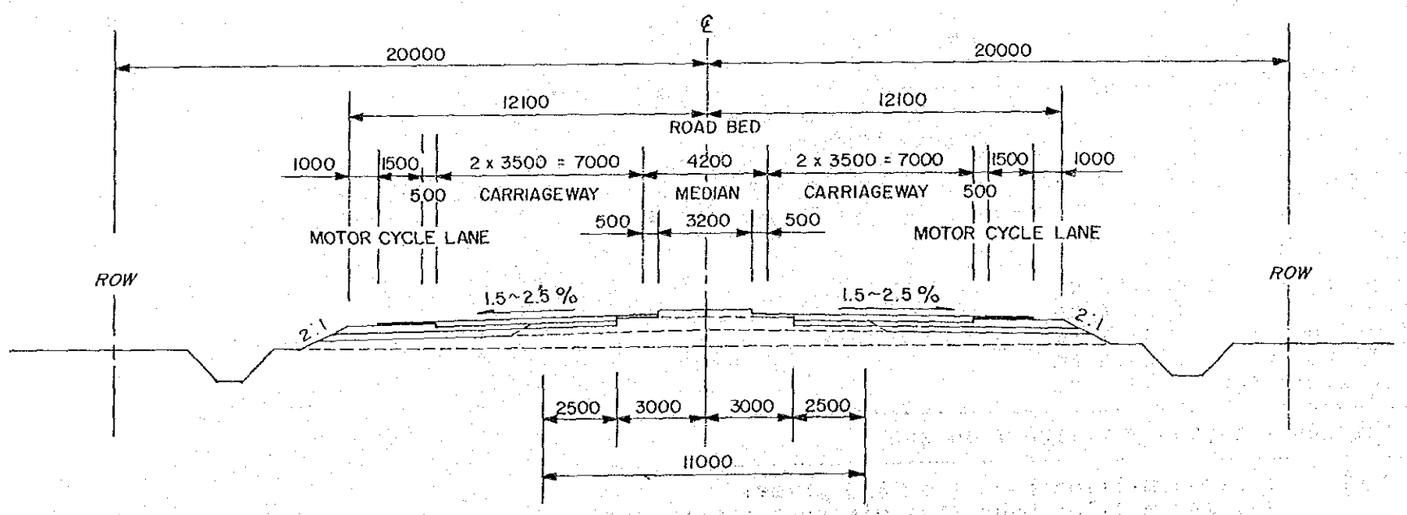
Return Period : Culvert--------10 years
: Minor Bridge---20 years

(3) Typical Cross Section

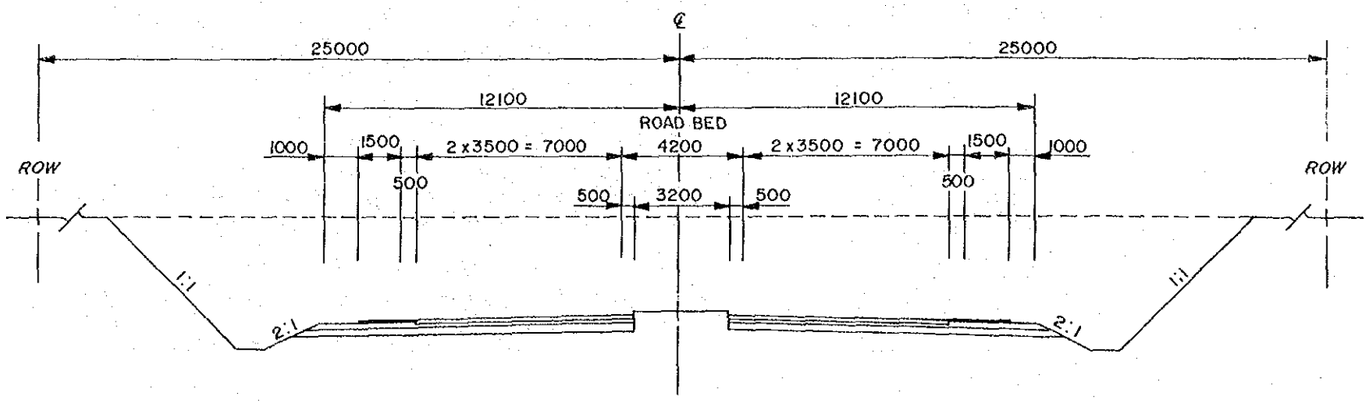
STA. 0 + 000 ~ STA. 1 + 450
STA. 4 + 800 ~ STA. 5 + 800



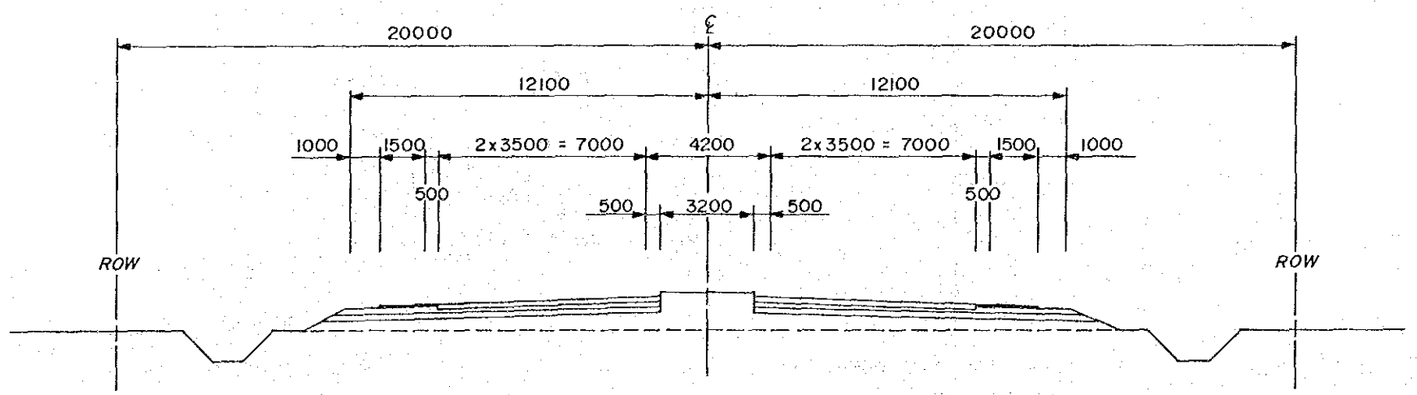
STA. 1 + 450 ~ STA. 4 + 800
STA. 5 + 800 ~ STA. 15 + 300
STA. 18 + 550 ~ STA. 38 + 400



STA. 15 + 300 ~ STA. 18 + 550 (CUT SECTION)



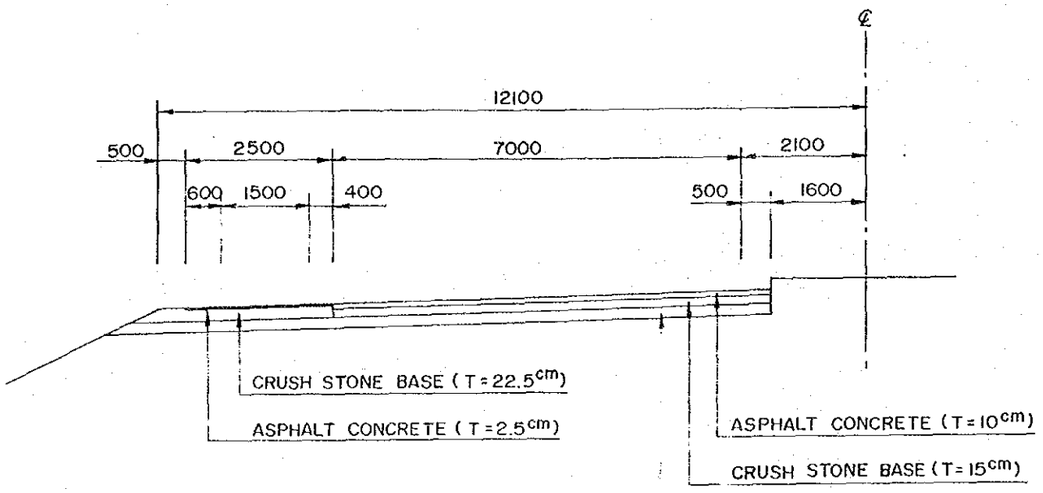
STA 15+300 ~ STA 18+550 (EMBANKMENT SECTION)

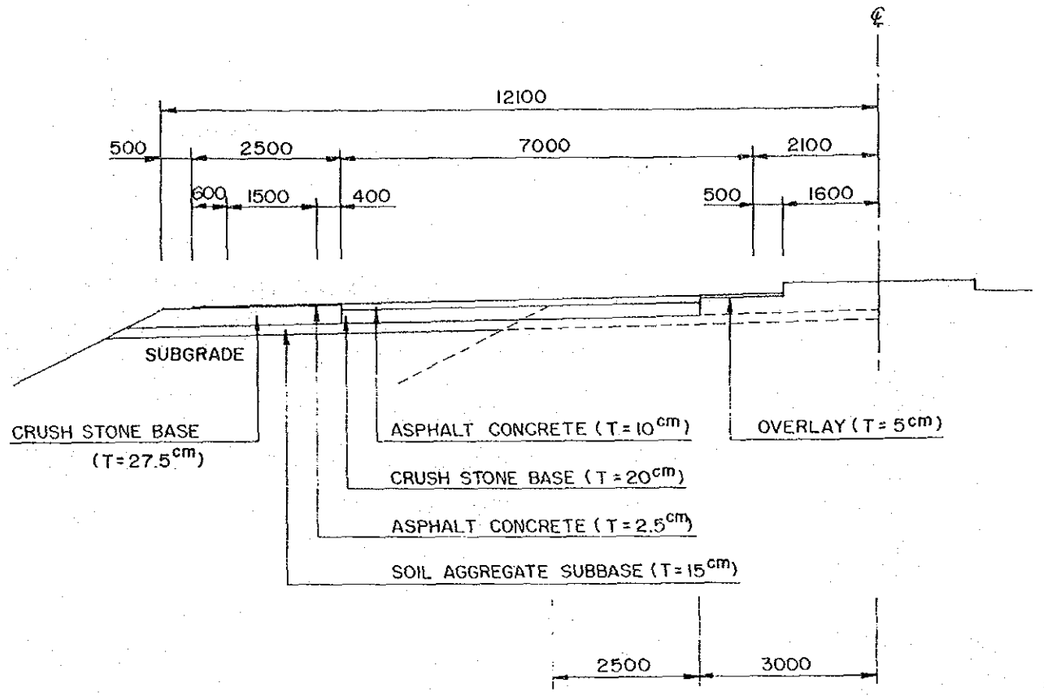


(4) Pavement Design

New Road

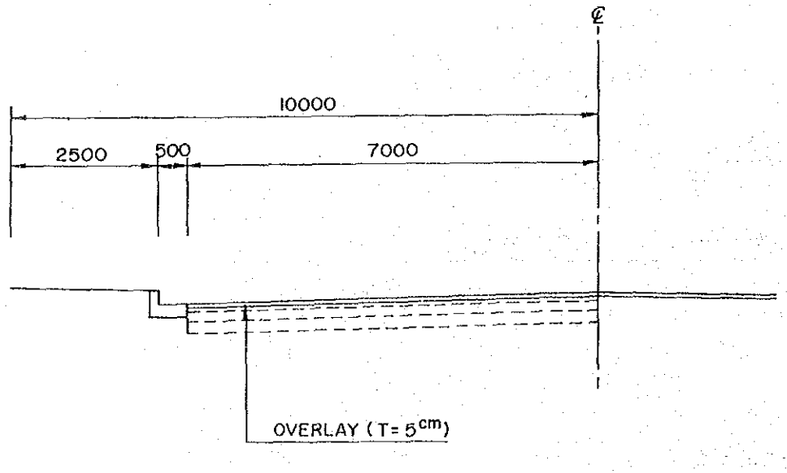
Design CBR of Subgrade	Cumulative No. of ESA W18 x 10^3 (7 years)	Thickness of Pavement Structure (cm)	
10.0	5,819	Surface Base Subbase	10 15 15

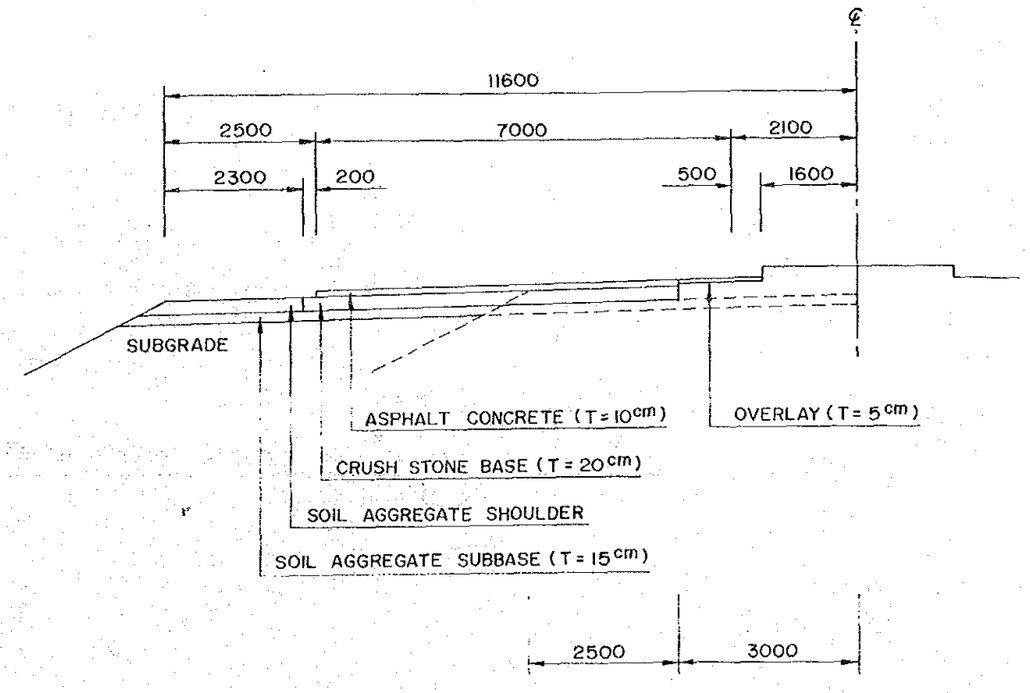




Existing Road

Existing Road	Design CBR of Subgrade	Cumulative No. of ESA W18 x 10 (7 years)	Thickness of Overlay (cm)
Route No. 402	10.0	5,819	5





2) AD-2-2

(1) Summary

The aim of the project is to provide a better access to the beach resort area located along the west coast of Phuket island for tourism promotion. For this aim, the alignment is proposed as close to the west coast as possible and, as a result, passes on mountainous terrain around 6 km in length and crosses the Phuket airport property through tunnel.

To pass on mountainous terrain, a tunnel and some hillside bridges are proposed to moderate the gradient. The maximum gradient in mountainous terrain is 10 %. Another tunnel and some depressed structures are proposed to pass the airport under the runway and the taxiway.

The existing pavement is planned to be overlaid by 7.5 cm for Route 4031, Route 4025, Route 4020 and Route 4030. Pavement for new construction comprises surface course of 5 cm, base course of 15 cm and subbase course of 20 cm, 40 cm in total.

Ten bridges are proposed to cross rivers in flat terrain and six hillside bridges are planned to pass on mountainous terrain.

Measures for preventing slope failure and mud-flow are introduced to cope with possible natural disasters in mountainous terrain.

AD-2-2	Description
Changwat	: Phuket
Name or Location	: Phuket West Coast Link
	: J.Rt.402 - Phuket City
Road Class	: S1
Cross Section (m)	: 2.5 + 7.0 + 2.5 (5.0 - 6.5:DOH)
Surface Type	: SA / ASC / SA (ASC:DOH, SA:ARD)
Bridge:New	: 16 sites, 525 m
Tunnel	: 2 sites, 900 m
Length: Total	: 35.2 km
New	: 20.5 km
Widening	: 10.1 km (DOH)
Reconstruction	: 4.6 km (ARD)
AADT ('96/'01/'06)	: 4,000 / 5,000 / 6,000
Financial Cost	: 1,401.0 million baht (in 1990 price)
NPV	: 1,220 million baht (12% discount rate)
B/C	: 2.5 (12% discount rate)
EIRR	: 27.4 %

( ): Existing Condition

(2) Design Standard and Conditions

(a) Design Criteria

Road Class : S1
Design Speed : 40 - 90 km/h

Geometric Design Criteria

Description	Design Speed (km/h)				
	90	80	70	55	40
Minimum Radius of Curvature (m)	280	220	160	90	50
Minimum Stopping Sight Distance (m)	150	120	100	70	40
Maximum Gradient (%)	6	7	7	8	10
Minimum Gradient (%)	0.3	0.3	0.3	0.3	0.3

(b) Clearance for Tunnel

Vertical Clearance : 5.0 m

(c) Pavement Design Conditions

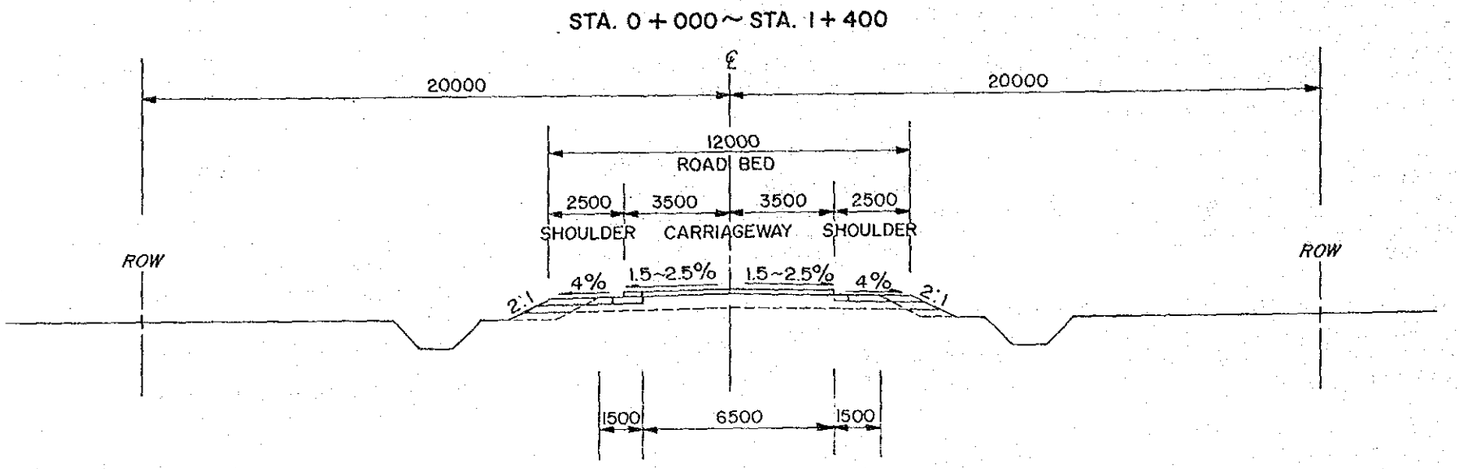
Design CBR : 10 %
Design Method : AASHTO
Design Period : 7 years

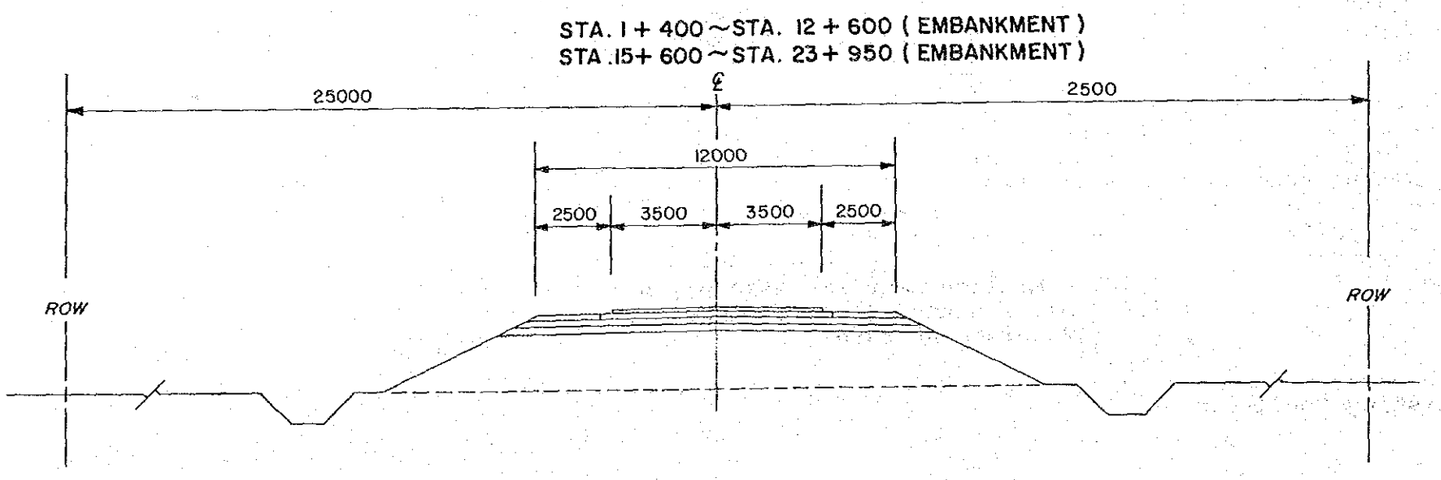
(d) Drainage Design Conditions

Rainfall Intensity : Rainfall Intensity Duration Curve at Chumphon Observatory

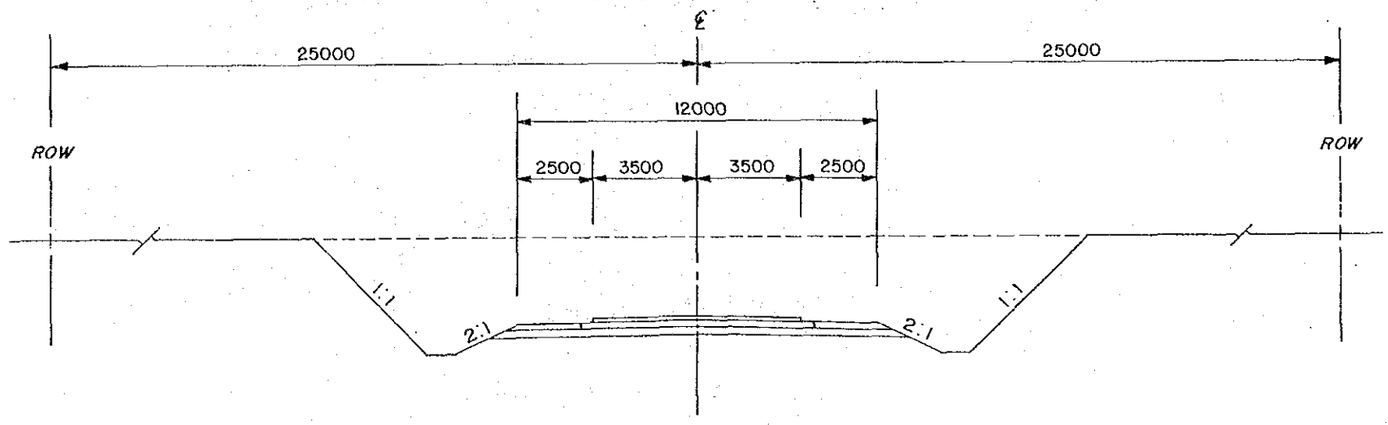
Return Period : Culvert--------10 years
: Minor Bridge---20 years

(3) Typical Cross Section

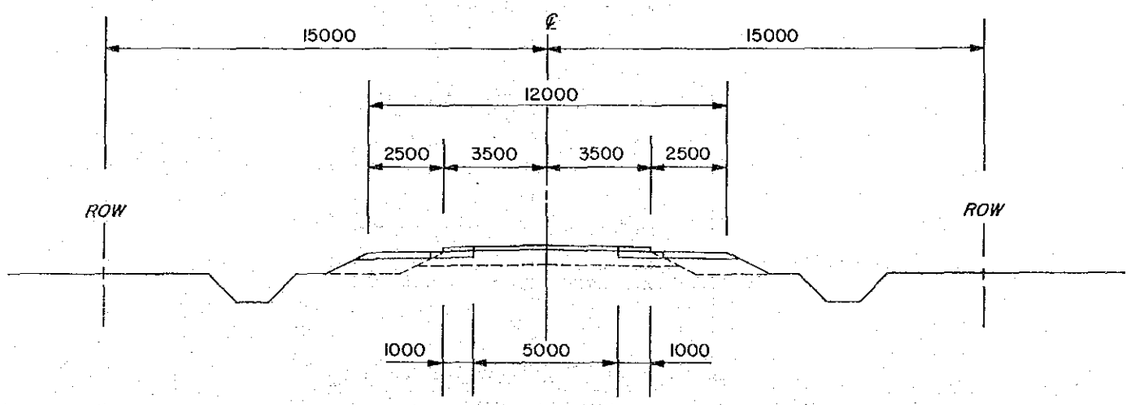




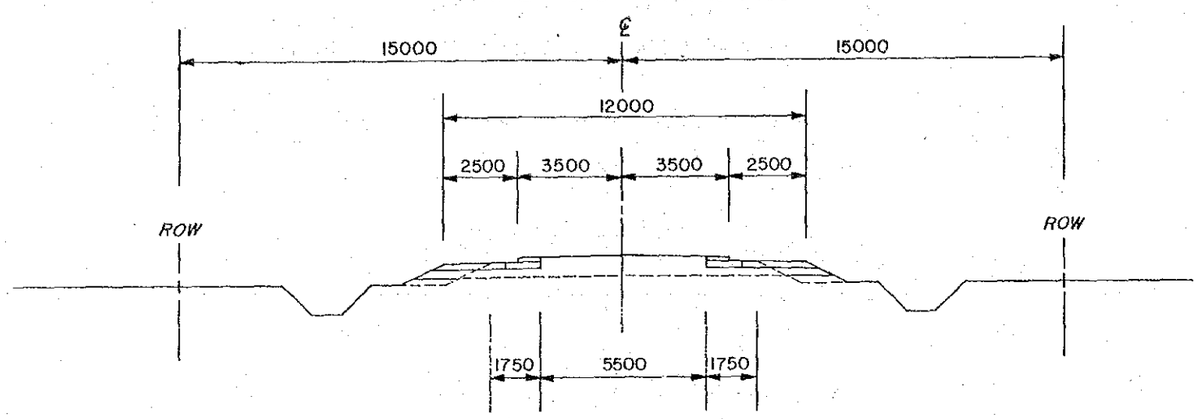
STA. 1+400 ~ STA. 12+600 (CUT SECTION)
STA. 15+600 ~ STA. 23+950 (CUT SECTION)



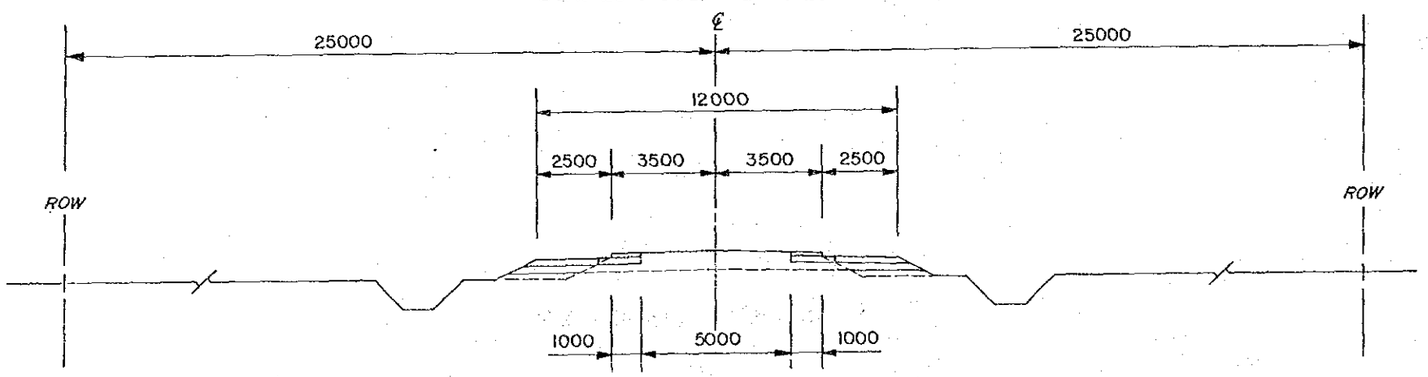
STA. 15 + 100 ~ STA. 15 + 600



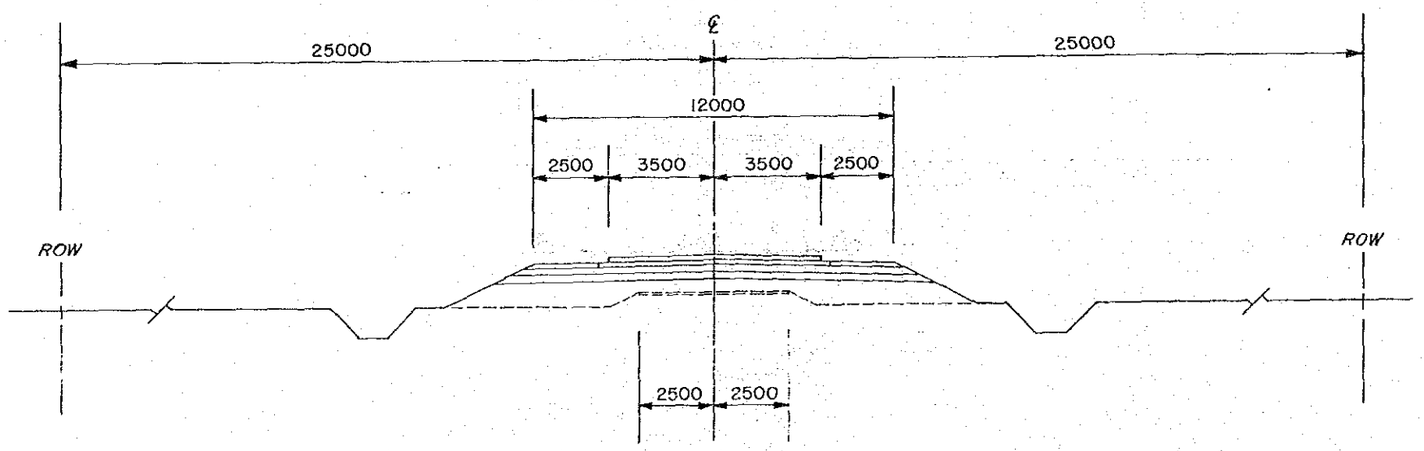
STA. 12 + 600 ~ STA. 15 + 100



STA. 23 + 950 ~ STA. 29 + 520



STA. 30 + 670 ~ STA. 35 + 200



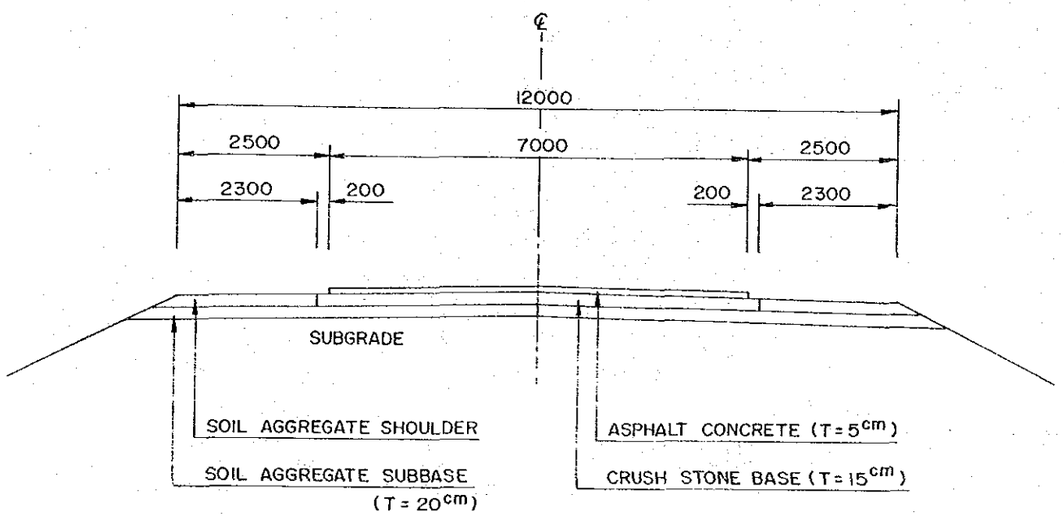
(4) Pavement Design

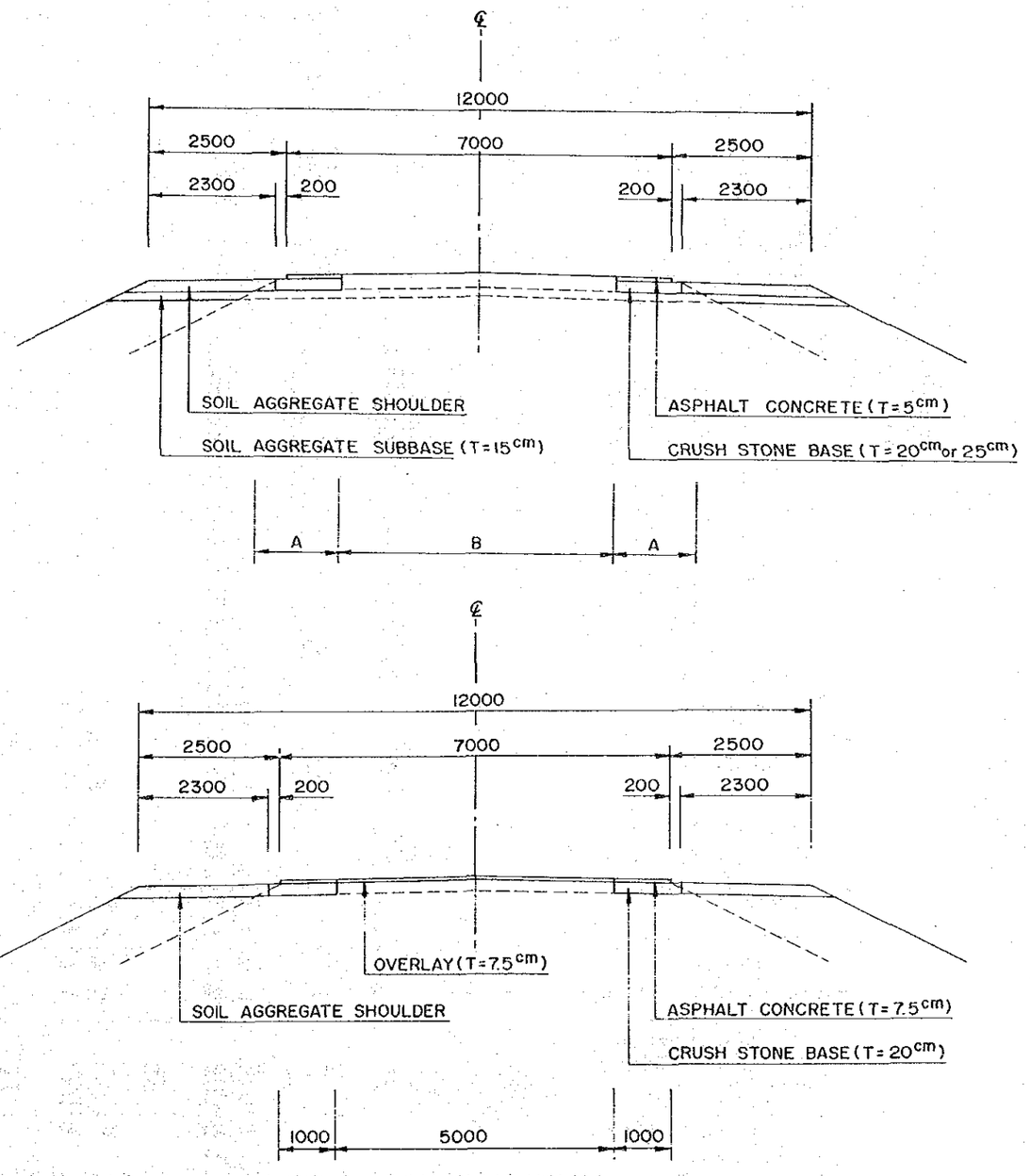
New Road

Design CBR of Subgrade	Cumulative No. of ESA W18 x 10^3 (7 years)	Thickness of Pavement Structure (cm)
10.0	1,638	Surface 5 Base 15 Subbase 20

Existing Road

Existing Road	Design CBR of Subgrade	Cumulative No. of ESA W18 x 10^3 (7 years)	Thickness of Overlay (cm)
Route No. 4030	10.0	1,638	7.5





4.6 Construction Cost

Table 4.5.1 CONSTRUCTION COST

1) AD 2-1

(1) CONSTRUCTION QUANTITIES AND COSTS

(Project AD -2-1 Length = 38.400 Km)
(Improved Length 38.400 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	536,353	536				
Roadway Excavation(classified)	CU.M	85	86,518	7,354				
Embankment(Borrowed Material)	CU.M	100	181,764	18,176				
Slope Protection(Stripe Sodding)	SQ.M	6	157,808	947				
(Sodding)	SQ.M	9	6,317	57				
(Shot Concrete)	SQ.M	500	0	0				
(Concrete Block)	SQ.M	450	0	0				
Sand Mat (t=0.5m)	SQ.M	100	0	0				
Excavate Existing Thickness Over 10cm (2 Lay)	SQ.M	14	234,913	3,289				
SUB TOTAL				30,359		25,198		22,678
SUBBASE AND BASE					83		50	
Subbase(Soil Aggregate)	CU.M	190	77,939	14,808				
Base Coarses(Crush Stone)	CU.M	295	116,358	34,326				
Shoulder(Soil Aggregate)	CU.M	190	14,562	2,767				
SUB TOTAL				51,901		43,078		21,539
SURFACE					83		50	
Asphaltic Prime coat	SQ.M	13	534,569	6,949				
Asphaltic Tack coat	SQ.M	7	79,670	558				
Asphalt concrete Surfacing	CU.M	1,900	46,649	88,633				
Overlay (5cm)	CU.M	1,900	3,984	7,570				
SUB TOTAL				103,710		86,079		43,040
STRUCTURES(Equivalent)					83		50	
RC Pipe Culvert(D= 400 m)	M	900	23	21				
(D= 600 m)	M	1,300	562	731				
(D= 800 m)	M	1,780	145	258				
(D=1000 m)	M	2,445	97	237				
(D=400m*2)	M	1,800	14	25				
(D=600m*2)	M	2,600	36	94				
(D=600m*3)	M	3,900	13	51				
(D=800m*2)	M	3,560	40	142				
(D=800m*3)	M	5,340	13	69				
(D=1.0m*2)	M	4,890	109	533				
(D=1.0m*3)	M	7,335	28	205				
RC Box Culvert(1-2.40*2.40 m)	M	5,900	13	77				
(2-1.20*1.80 m)	M	7,000	14	98				
(2-1.80*1.50 m)	M	7,600	28	213				
(2-2.10*2.10 m)	M	10,000	14	140				
(3-1.50*1.20 m)	M	9,600	26	250				
(3-1.50*1.50 m)	M	10,500	14	147				
(3-1.80*1.20 m)	M	10,500	14	147				
(3-1.80*1.50 m)	M	11,400	14	160				
(3-2.10*1.80 m)	M	13,800	14	193				
RC Bridge Wideing	SQ.M	9,600	1,586	15,226				
RC Bridge (W=12.5 m)	M	80,000	48	3,840				
PC Bridge (W=12.5 m)	M	125,000	0	0				
Bearing Unit Of Bridge	Ls	500,000	2	1,000				
SUB TOTAL				23,856		19,800		9,900
MEDIAN & SIDE WALK					83		50	
Median (W= 3.2 m)	M	1,000	35,853	35,853				
Side Walk (W= 2.5 m)	M	700	4,856	3,399				
SUB TOTAL				39,252		32,579		16,290
INTERSECTION					90		90	
T-Intersection (Unsignal)	Ls	80,000	4	320				
T-Intersection (Signal)	Ls	800,000	1	800				
Four-Leg Intersection (Signal)	Ls	1,000,000	1	1,000				
SUB TOTAL				2,120		1,908		1,717
TOTAL (a)				251,198		208,643		115,164
Miscellaneous Works [(a)*7%]	Ls	1		17,584		14,605		8,061
CONTRACT AMOUNT (b)				268,782		223,248		123,225
PHYSICAL CONTINGENCIES [(b)*10%] (c)	Ls	1		26,878		22,325		12,323
ENGINEERING & SUPERVISION [((b)+(c))*10%] (d)	Ls	1		29,566	85	25,131	0	0
LAND ACQUISITION & COMPENSATION								
Land Acquisition (Average)	SQ.M	1,654	170,226	281,554	100	281,554	100	281,554
Compensation	Ls	5,800,000	1	5,800	100	5,800	100	5,800
TOTAL (e)				287,354		287,354		287,354
PROJECT COST [(b)+(c)+(d)+(e)]				612,580		558,057		422,902
AVERAGE COST PER KM				15,953				

(2) MAINTENANCE COST

Project Road No, AD -2-1 Na= 8,200 Baht/Km/year
(Existing Road) Km= 1.001
Length = 35.150 Km

Asphalt Pavement

	ITEMS		Proposed Road Condition	Factor
1.	Surface /Bace Type	X1	AC	0.00
2.	Subgrade CBR	X2	4 %	0.50
3.	A.D.T	X3	>5,700	2.25
4.	Service Life (year)	X4	4	0.20
5.	Pavement Width (m)	X5	7 m	0.19
6.	R-O-W Width (m)	Y1	40 m	0.00
7.	Shoulder,Access,Median Width (m)	Y2	2.50 m	0.05
8.	Traffic Service Operation Topography	Y3	0 - 3 %	0.00
9.	Drainage Topography	Y4	0 - 3 %	0.00
10.	Bridge Quantity (m/Km)	Y5	3	0.00
11.	NO. Of Lanes		2	

Ka = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5)= 2.595
Maintenance cost + Overhead= Ka * Km * Na * 1.28 = 27,264 Baht/Km/year
Total Cost (Financial) = Length *(Baht/Km/year)= 958,342 Baht/year
(Economic) = = 795,424 Baht/year

Project Road No, AD -2-1 Na= 8,200 Baht/Km/year
(Proposed Road) Km= 1.001
Length = 38.400 Km

Asphalt Pavement

	ITEMS		Proposed Road Condition	Factor
1.	Surface /Bace Type	X1	AC	0.00
2.	Subgrade CBR	X2	4 %	0.50
3.	A.D.T	X3	>5,700	4.50
4.	Service Life (year)	X4	NEW	0.00
5.	Pavement Width (m)	X5	7 m * 2	0.38
6.	R-O-W Width (m)	Y1	50 m	0.05
7.	Shoulder,Access,Median Width (m)	Y2	2.50m * 2	0.10
8.	Traffic Service Operation Topography	Y3	0 - 3 %	0.00
9.	Drainage Topography	Y4	0 - 3 %	0.00
10.	Bridge Quantity (m/Km)	Y5	3	0.00
11.	NO. Of Lanes		4	

Ka = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5)= 3.765
Maintenance cost + Overhead= Ka * Km * Na * 1.28 = 39,557 Baht/Km/year
Total Cost (Financial) = Length *(Baht/Km/year)= 1,518,987 Baht/year
(Economic) = = 1,260,759 Baht/year

Overlay Cost (2004) = = 70,189,056 Baht

(3) CONSTRUCTION SCHEDULE

Project AD 2-1

(Two Section)

year and Month	First Year												Second Year												Third Year											
Work Items	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	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 (%)						50 %												22 %												28 %						

4) ECONOMIC EVALUATION

Cost and Benefit Flows of the Project
Project; AD-2-1

(unit ; 1000 Baht)

Year	Construction Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Balance	Benefit= / Cost=	Sensi. Analysis 1 / 1
1991	0	0	0	0	0	0		0
1992	0	0	0	0	0	0		0
1993	341,984	0	341,984	0	0	-341984		-410380
1994	79,361	0	79,361	0	0	-79361		-95233
1995	136,712	0	136,712	0	0	-136712		-164055
1996	0	465	465	112133	596571	708239		566405
1997	0	465	465	119495	699244	818274		654433
1998	0	465	465	126857	801917	928309		742461
1999	0	465	465	134219	904590	1038344		830489
2000	0	465	465	141581	1007263	1148379		918517
2001	0	465	465	148943	1109936	1258414		1006545
2002	0	465	465	147624	1206208	1353366		1082507
2003	0	465	465	146305	1302480	1448319		1158469
2004	0	70,654	70,654	144985	1398752	1473083		1150205
2005	0	465	465	143666	1495024	1638225		1310394
2006	0	465	465	142347	1591296	1733178		1386356
2007	0	465	465	142347	1591296	1733178		1386356
2008	0	465	465	142347	1591296	1733178		1386356
2009	0	465	465	142347	1591296	1733178		1386356
2010	0	465	465	142347	1591296	1733178		1386356
Total	558,057	77,170	635,227	2,077,543	18,478,465	19,920,781		15,682,534
				EIRR =		69.15%		55.25%
				NPV (i;12%) =		4,259,858		
				B/C (i;12%) =		11.99		

2) AD 2-2

(1) CONSTRUCTION QUANTITIES AND COSTS

(Project AD -2-2 Length = 35.200 Km)
(Improved Length 35.200 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	758,828	759				
Roadway Excavation(classified)	CU.M	85	699,552	59,462				
Roadway Excavation(Unclassified)	CU.M	25	117,123	2,928				
Embankment(Selected Material)	CU.M	60	21,427	1,286				
Slope Protection(Stripe Sodding)	SQ.M	6	225,490	1,353				
(Sodding)	SQ.M	9	8,104	73				
(Shot Concrete)	SQ.M	500	61,149	30,575				
(Concrete Block)	SQ.M	450	10,178	4,580				
Sand Mat (t=0.5m)	SQ.M	100	0	0				
Excavate Existing Thickness Over 10cm (2 Lay)	SQ.M	14	30,000	420				
SUB TOTAL				101,435		84,191		75,772
SUBBASE AND BASE					83		50	
Subbase(Soil Aggregate)	CU.M	190	65,613	12,466				
Base Coarses(Crush Stone)	CU.M	295	30,902	9,116				
Shoulder(Soil Aggregate)	CU.M	190	29,308	5,569				
SUB TOTAL				27,151		22,535		11,268
SURFACE					83		50	
Asphaltic Prime coat	SQ.M	13	190,390	2,475				
Asphaltic Tack coat	SQ.M	7	30,180	211				
Asphalt concrete Surfacing	CU.M	1,900	8,899	16,908				
Overlay (7.5cm)	CU.M	1,900	179	340				
SUB TOTAL				19,935		16,546		8,273
STRUCTURES(Equivalent)					83		50	
RC Pipe Culvert(D= 400 m)	M	900	12	11				
(D= 600 m)	M	1,300	1,784	2,319				
(D= 800 m)	M	1,780	74	132				
(D=1000 m)	M	2,445	920	2,249				
(D=1200 m)	M	3,575	16	57				
(D=1500 m)	M	4,400	40	176				
RC Box Culvert(1-1.80*1.80 m)	M	4,200	310	1,302				
(1-2.10*2.10 m)	M	5,000	6	30				
(1-2.40*2.40 m)	M	5,900	0	0				
(2-2.10*2.10 m)	M	10,000	22	220				
RC Bridge Wideing	SQ.M	9,600	0	0				
RC Bridge (W=14.0 m)	M	89,600	525	47,040				
PC Bridge (W=14.0 m)	M	140,000	0	0				
Bearing Unit Of Bridge	Ls	500,000	16	8,000				
SUB TOTAL				61,536		51,075		25,538
TUNNEL					83		50	
Tunnel(Mountain)	M	255,000	600	153,000				
(Open Cut & Pipe Roof)	Ls	360,000,000	1	360,000				
SUB TOTAL				513,000		425,790		212,895
INTERSECTION					90		90	
T-Intersection (Unsignal)	Ls	80,000	6	480				
SUB TOTAL				480		432		389
TOTAL (a)				723,537		600,569		334,134
Miscellaneous Works [(a)*7%]	Ls	1		50,648		42,040		23,389
CONTRACT AMOUNT (b)				774,184		642,609		357,523
PHYSICAL CONTINGENCIES [(b)*10%] (c)	Ls	1		77,418		64,261		35,752
ENGINEERING & SUPERVISION [((b)+(c))*10%] (d)	Ls	1		85,160	85	72,386	0	0
LAND ACQUISITION & COMPENSATION								
Land Acquisition (Average)	SQ.M	356	1,281,070	456,061	100	456,061	100	456,061
Compensation	Ls	8,200,000	1	8,200	100	8,200	100	8,200
TOTAL (e)				464,261		464,261		464,261
PROJECT COST [(b)+(c)+(d)+(e)]				1,401,024		1,243,517		857,536
AVERAGE COST PER KM				39,802				

(2) MAINTENANCE BUDEGE CALCULATION

Project Road No, AD -2-2 (Existing Road)
Na= 8,200 Baht/Km/year
Km= 1.001
Length = 14.500 Km

Asphalt Pavement

	ITEMS		Proposed Road Condition	Factor
1.	Surface /Bace Type	X1	AC	0.00
2.	Subgrade CBR	X2	4 %	0.50
3.	A.D.T	X3	3,000	1.02
4.	Service Life (year)	X4	4	0.20
5.	Pavement Width (m)	X5	7 m	0.19
6.	R-O-W Width (m)	Y1	40 m	0.00
7.	Shoulder,Access,Median Width (m)	Y2	2.50 m	0.05
8.	Traffic Service Operation Topography	Y3	0 - 3 %	0.00
9.	Drainage Topography	Y4	0 - 3 %	0.00
10.	Bridge Quantity (m/Km)	Y5	3	0.00
11.	NO. Of Lanes		2	

Ka = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5)= 1.980
Maintenance cost + Overhead= Ka * Km * Na * 1.28 = 20,803 Baht/Km/year
Total Cost (Financial) = Length *(Baht/Km/year)= 301,642 Baht/year
(Economic) = = 250,362 Baht/year

Project Road No, AD 2-2 (Proposed Road)
Na= 8,200 Baht/Km/year
Km= 1.001
Length = 35.200 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	1.88	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	3	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	2.335	2.520		
Maintenance cost + Overhead= Ka * Km * Na * 1.28 =	22,589	24,533	26,476	Baht/Km/year	
Total Cost (Financial) = Length *(Baht/Km/year)=	795,132	Baht/year			
(1996) (Economic) = =	659,959	Baht/year			
Total Cost (Financial) = ADT(5,000 CAR/DAY) =	863,550	Baht/year			
(2001) (Economic) = =	716,746	Baht/year			
Total Cost (Financial) = ADT(9,000 CAR/DAY) =	931,968	Baht/year			
(2006) (Economic) = =	773,534	Baht/year			

Overlay Cost (2004) = = 32,169,984 Baht

(3) CONSTRUCTION SCHEDULE

Project AD 2-2

(Two Section)

year and Month / Work Items	First Year												Second Year												Third Year											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Land Acquisition	=========																																			
Preparatory Works		=========																																		
Earth Works			==========										==========																							
Pavement Works																									==========											
Bridge Works			==========										==========												==========											
Tunnel			==========										==========												==========											
Miscellaneous Works			==========										==========												==========											
Clearing -Up																																				=========
Percentage Of Disbursement (%)	46 %												32 %												22 %											

4) ECONOMIC EVALUATION

Cost and Benefit Flows of the Project

Project; AD-2-2

(unit ; 1000 Baht)

Year	Construction Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Balance	Sensi. Analysis
						Benefit=	0.8
						Cost=	1.2
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	700,647	0	700,647	0	0	(700,647)	(840,776)
1994	337,322	0	337,322	0	0	(337,322)	(404,786)
1995	205,548	0	205,548	0	0	(205,548)	(246,658)
1996	0	410	410	74,840	358,318	432,748	346,035
1997	0	410	410	74,632	381,174	455,397	364,153
1998	0	410	410	74,425	404,030	478,045	382,272
1999	0	410	410	74,217	426,885	500,693	400,391
2000	0	410	410	74,010	449,741	523,341	418,509
2001	0	466	466	73,802	472,597	545,933	436,560
2002	0	466	466	78,281	486,072	563,887	450,923
2003	0	466	466	82,760	499,547	581,840	465,286
2004	0	32,636	32,636	87,238	513,022	567,624	441,045
2005	0	466	466	91,717	526,497	617,748	494,012
2006	0	523	523	96,196	539,972	635,645	508,307
2007	0	523	523	96,196	539,972	635,645	508,307
2008	0	523	523	96,196	539,972	635,645	508,307
2009	0	523	523	96,196	539,972	635,645	508,307
2010	0	523	523	96,196	539,972	635,645	508,307
Total	1,243,517	39,166	1,282,682	1,266,902	7,217,743	7,201,963	5,248,497
					EIRR =	27.44%	19.75%
					NPV (i;12%) =	1,220,310	
					B/C (i;12%) =	2.46	

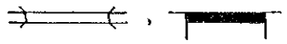
4.7 Drawings

1) AD-2-1

Drawing

SHEET NO.	LIST OF DRAWINGS
1. - 5.	Plan and Profile
6.	Plan of Intersection
7.	(A) Reinforced Concrete Slab Bridge
8.	(B) Reinforced Concrete Slab Bridge
9.	(C) Reinforced Concrete Slab Bridge
10.	(D) Reinforced Concrete Slab Bridge
11.	Box Culvert
12.	Pipe Culvert

ABBREVIATION AND SYMBOLS FOR PROFILE AND PLAN

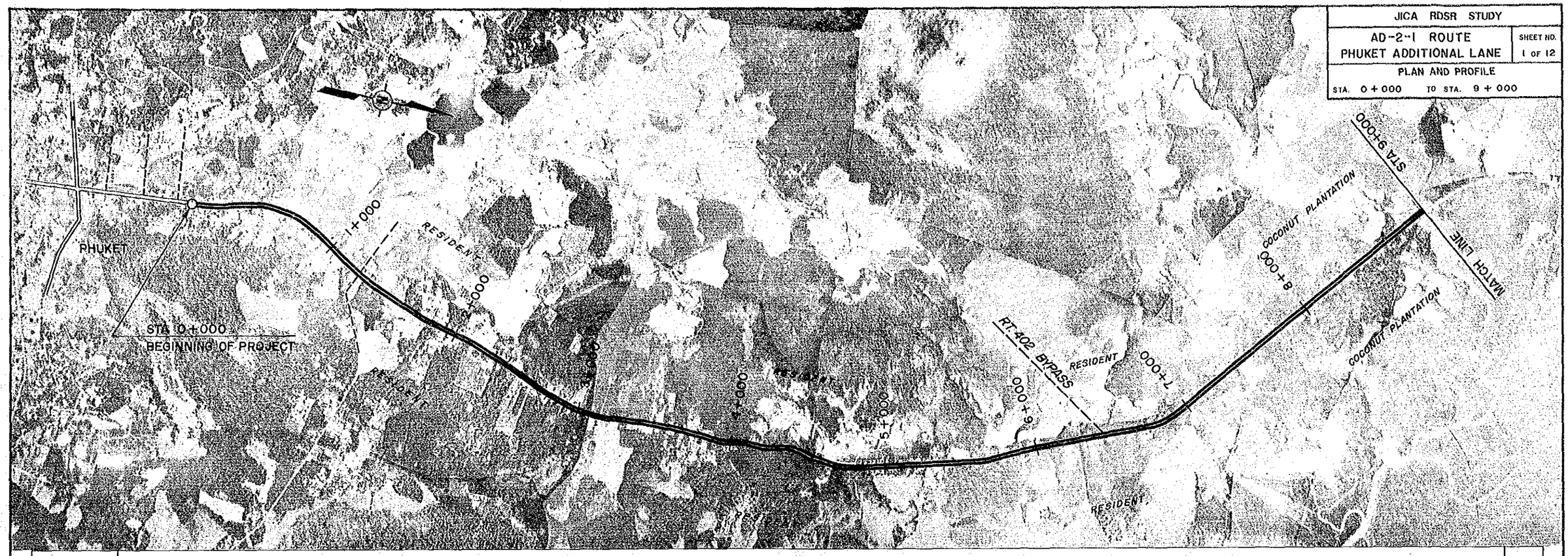
———	: Alignment of Proposed Route
	: Proposed Bridge
	: Proposed Box Culvert
	: High Water Level
	: Water Level
No.	: Number
R	: Radius of Curvature
L	: Length of Curve
BR.RC.SP.SL L	: Reinforced Concrete Bridge (Bridge Length)
BR.PC.GRDR L	: Prestressed Concrete Bridge (Bridge Length)
BR.ST.SP.TR L	: 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

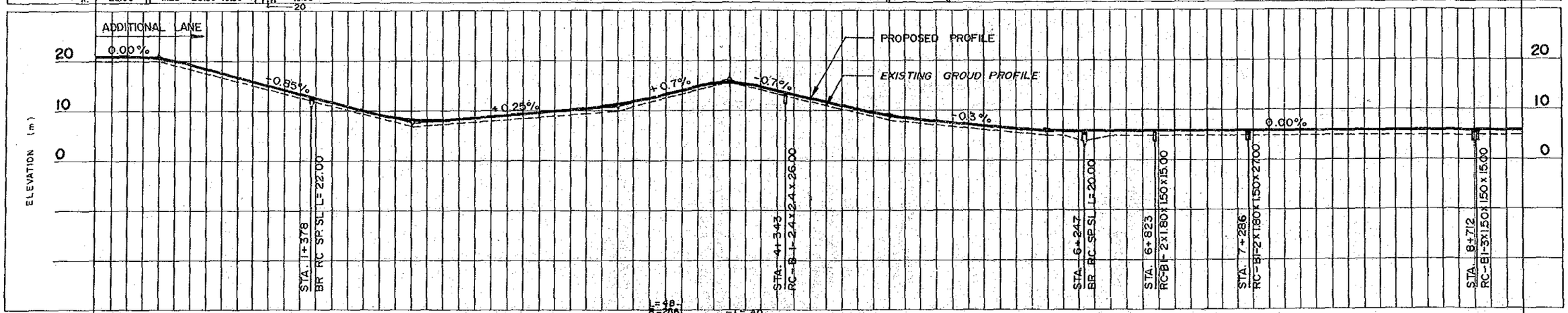
AD-2-1 ROUTE PHUKET ADDITIONAL LANE | SHEET NO. 1 OF 12

PLAN AND PROFILE

STA. 0+000 TO STA. 9+000



TERRAIN		FLAT
PAVEM'T	Type	AC. PAVEMENT
	Existing Condition	GOOD
FLOODING	Length (Km) / Hight (m.)	— FLOODING — FLOODING
RIGHT OF WAY (m)	L.	20.00 | 10.00 | 14.60 | 10.00 | 20.00 | 20 | 20 | 15.00 | 20.00 | 10.00 | 15.00 | 2 | 10.00 | 20.00
	R.	20.00 | 11.25 | 20.00 | 10.00 | 15.50 | 20 | 20.00 | 10.00 | 20.00 | 10.00 | 20.00



CURVATURE BAND	Existing Alignment	L=182 L=74 R=440 R=229 | L=82 R=409 | L=101 R=818 | L=61 R=440 | L=154 R=447 | L=80 R=260 | L=76 L=54 R=716 R=80 | L=100 R=1,219 | L=36 R=110 | L=50 L=40 R=160 R=197 | L=57 R=204 | L=76 R=238 | L=129 R=818 | L=115 R=716 | L=57 R=179 | L=150 L=150 R=682 R=817
	Proposed Alignment	L=182 L=74 R=440 R=229 | R=∞ | L=82 R=409 | R=∞ | L=101 R=818 | R=∞ | L=61 R=440 | R=∞ | L=154 R=447 | L=80 R=260 | R=∞ | L=76 L=54 R=716 R=80 | L=100 R=1,219 | L=53 R=160 | L=48 R=286 | L=76 L=57 R=460 R=204 | R=∞ | L=40 R=197 | L=76 R=238 | R=∞ | L=129 R=818 | R=∞ | L=115 R=716 | L=57 R=179 | R=∞ | L=150 L=150 R=682 R=817
STATION (Km.)		0+000 | 1+000 | 2+000 | 3+000 | 4+000 | 5+000 | 6+000 | 7+000 | 8+000 | 9+000

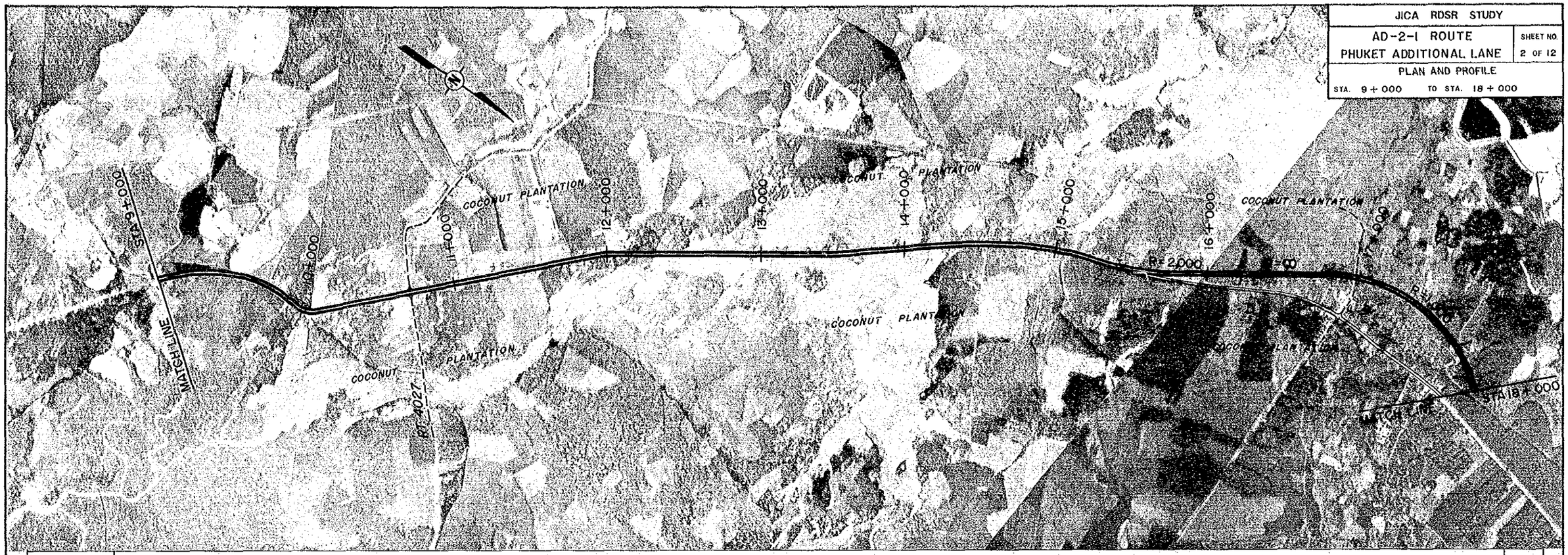
JICA RDSR STUDY

AD-2-1 ROUTE — SHEET NO. 2 OF 12

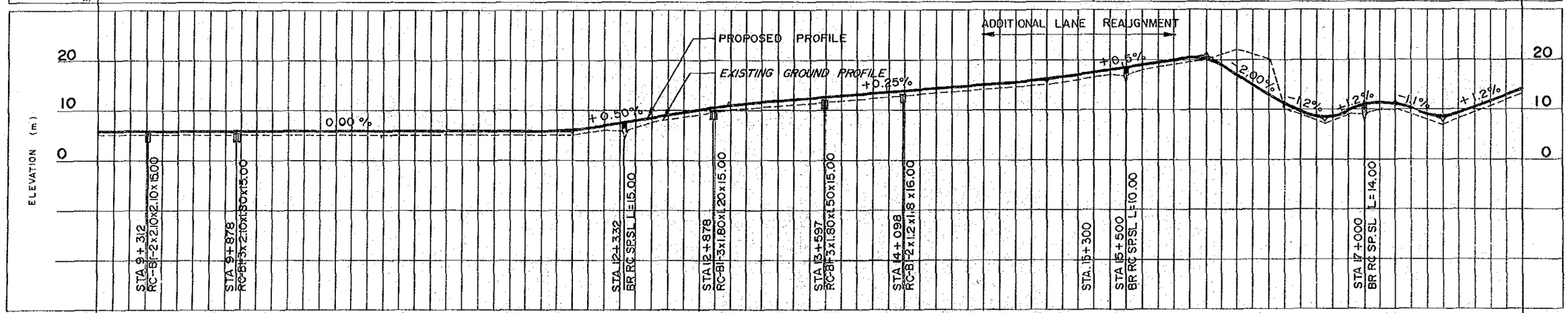
PHUKET ADDITIONAL LANE

PLAN AND PROFILE

STA. 9+000 TO STA. 18+000



TERRAIN		FLAT
PAVEM'T	Type	AC PAVEMENT
	Existing Condition	GOOD
FLOODING	Length(Km.) / Hight (m.)	FLOOD / — / FLOOD / —
RIGHT OF WAY (m.)	L.	20.00 / 25.00
	R.	20.00 / 25.00



CURVATURE BAND	Existing Alignment	L=100 L=139 R=572 R=572 / L=62 L=89 R=121 R=138 / L=200 R=1,145 / L=126 R=1,432 / L=145 R=1,909 / L=231 R=1,145 / L=169 R=2,994 / L=125 R=1,909
	Proposed Alignment	L=100 L=139 R=572 R=572 / L=82 L=89 R=160 R=138 / R=∞ / L=200 R=1,145 / R=∞ / L=126 R=1,432 / R=∞ / L=145 R=1,909 / R=∞ / L=231 R=1,145 / R=∞ / L=169 R=2994 / L=125 R=1909 / L=500 R=2,000 / R=∞ / L=1,300 R=1,000
STATION (Km.)		9+000 / 10+000 / 11+000 / 12+000 / 13+000 / 14+000 / 15+000 / 16+000 / 17+000 / 18+000

JICA RDSR STUDY

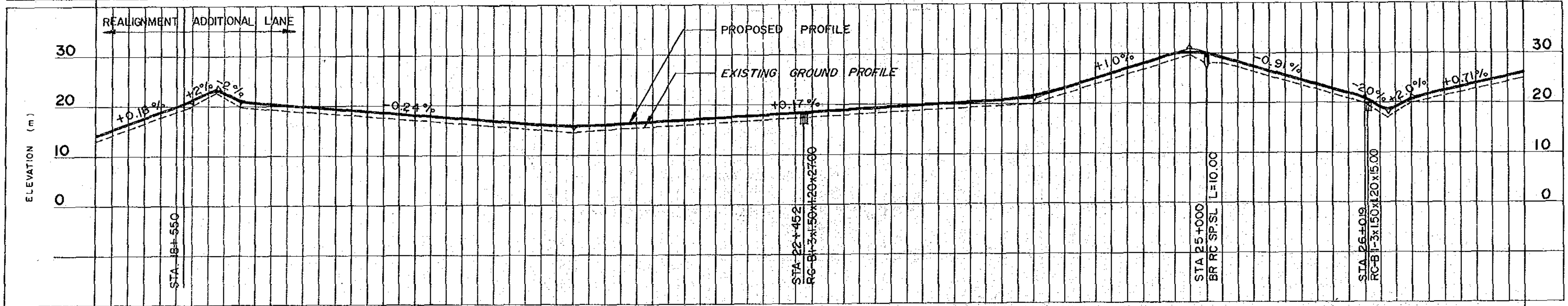
AD-2-1 ROUTE
PHUKET ADDITIONAL LANE

SHEET NO. 3 OF 12

PLAN AND PROFILE

STA. 18+000 TO STA. 27+000

TERRAIN		FLAT
PAVEM'T	Type	AC PAVEMENT
	Existing Condition	GOOD
FLOODING	Length (Km) / Hight (m.)	—
RIGHT OF WAY (m)	L.	25.00 / 20.00
	R.	25.00 / 20.00



CURVATURE BAND

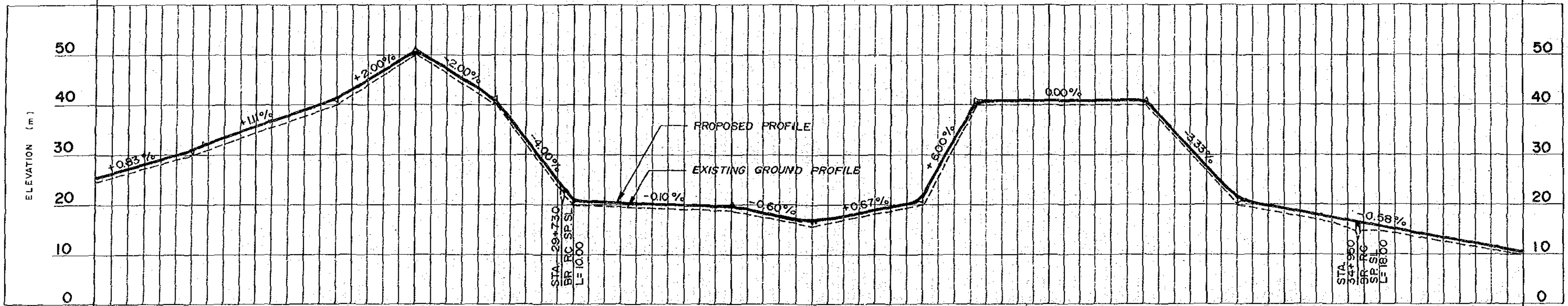
Existing Alignment: L=106 R=358; L=129 R=636; L=61 R=477; L=77 R=716; L=102 R=358; L=69 R=358; L=158 R=572; L=102 R=440; L=107 R=716

Proposed Alignment: L=650 R=1,500; R=∞; L=106 R=358; R=∞; L=129 R=636; R=∞; L=61 R=477; R=∞; L=77 R=716; R=∞; L=102 R=358; L=69 R=358; L=258 R=572; R=∞; L=102 R=440; R=∞; L=107 R=716; R=∞

STATION (Km.)	18+000	19+000	20+000	21+000	22+000	23+000	24+000	25+000	26+000	27+000

JICA RDSR STUDY	
AD-2-1 ROUTE PHUKET ADDITIONAL LANE	SHEET NO. 4 OF 12
PLAN AND PROFILE STA. 27 + 000 TO STA. 36 + 000	

TERRAIN		FLAT
PAVEM'T	Type	AC. PAVEMENT
	Existing Condition	GOOD
FLOODING	Length(Km) Hight (m.)	—
RIGHT OF WAY (m)	L.	20.00
	R.	20.00



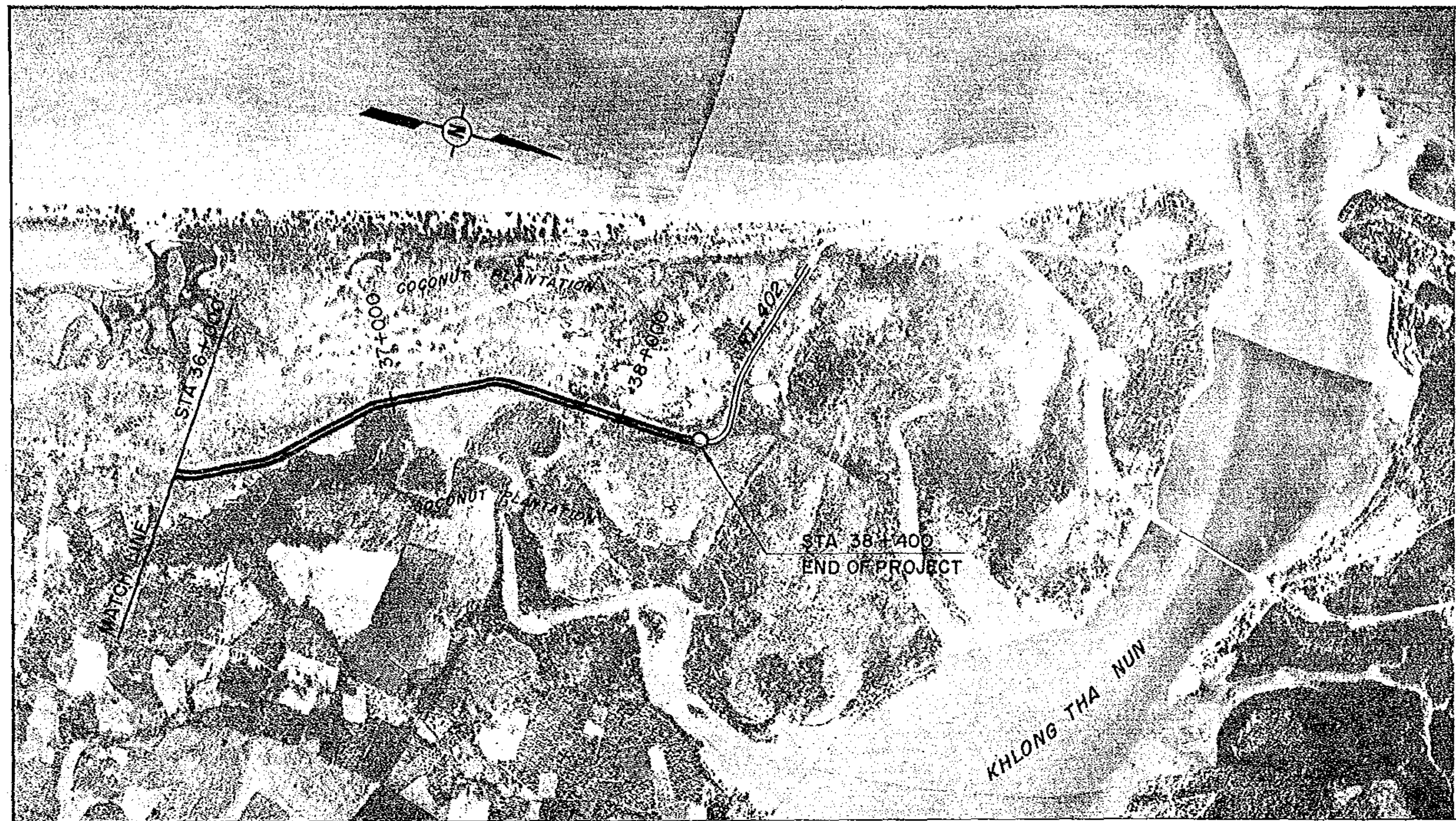
CURVATURE BAND

Existing Alignment: L=73 R=636; L=61 R=440; L=111 R=954; L=123 R=381; L=73 R=212; L=73 R=121; L=67 R=381; L=79 R=143; L=63 R=114; L=41 R=190; L=149 R=212; L=67 R=572; L=64 R=100; L=64 R=100; L=131 R=190; L=81 R=119; L=119 R=440; L=88 R=220; L=152 R=301; L=122 R=168; L=90 R=160; L=91 R=191; L=74 R=225

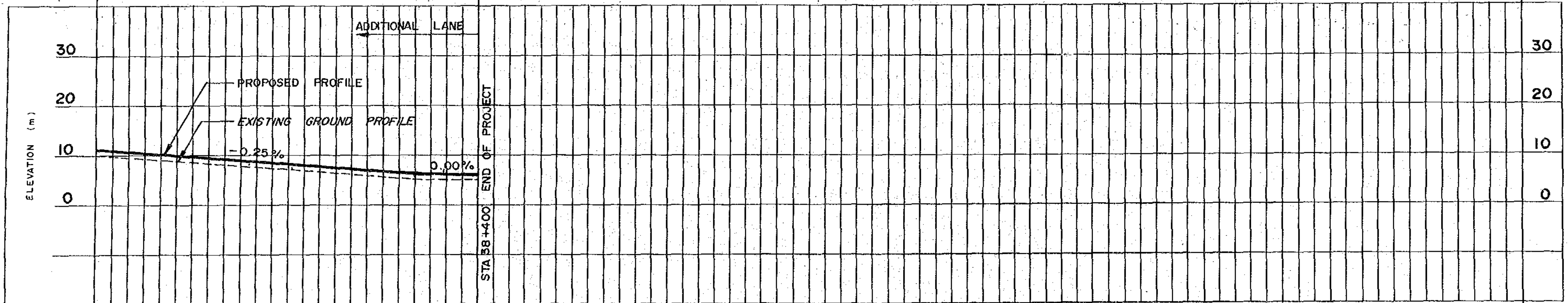
Proposed Alignment: L=73 R=636; R=∞; L=61 R=440; L=111 R=954; R=∞; L=123 R=381; L=73 R=212; R=∞; L=67 R=381; R=∞; L=88 R=160; L=66 R=160; R=∞; L=41 R=190; L=149 R=212; R=∞; L=67 R=572; R=∞; L=196 R=160; R=∞; L=131 R=190; R=∞; L=108 R=160; R=∞; L=119 R=440; L=88 R=220; R=∞; L=152 R=301; L=122 R=168; L=90 R=160; R=∞; L=91 R=191; R=∞; L=74 R=225

STATION (Km) 27+000 28+000 29+000 30+000 31+000 32+000 33+000 34+000 35+000 36+000

JICA RDSR STUDY	
AD-2-1 ROUTE PHUKET ADDITIONAL LANE	SHEET NO. 5 OF 12
PLAN AND PROFILE	
STA. 36 + 000 TO STA. 38 + 000	



TERRAIN		FLAT
PAVEM'T	Type	AC PAVEMENT
	Existing Condition	GOOD
FLOODING	Length (Km.) / Hight (m.)	—
RIGHT OF WAY (m)	L.	20.00
	R.	20.00



CURVATURE BAND		
Existing Alignment		L=102 R=318; L=93 R=160; L=92 R=96; L=86 R=121
Proposed Alignment		R=∞; L=102 R=318; R=∞; L=77 R=160; R=∞; L=266 R=160; R=∞

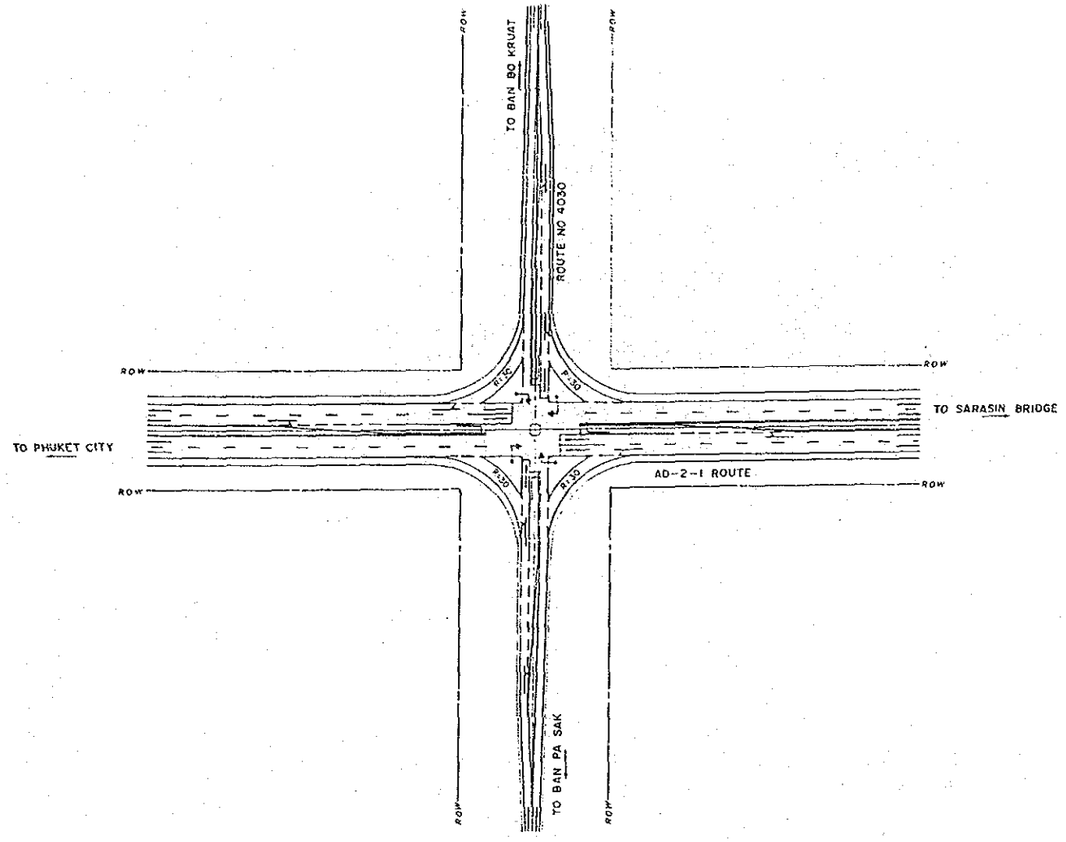
STATION (Km.) 36+000 37+000 38+000

JICA RDSR STUDY

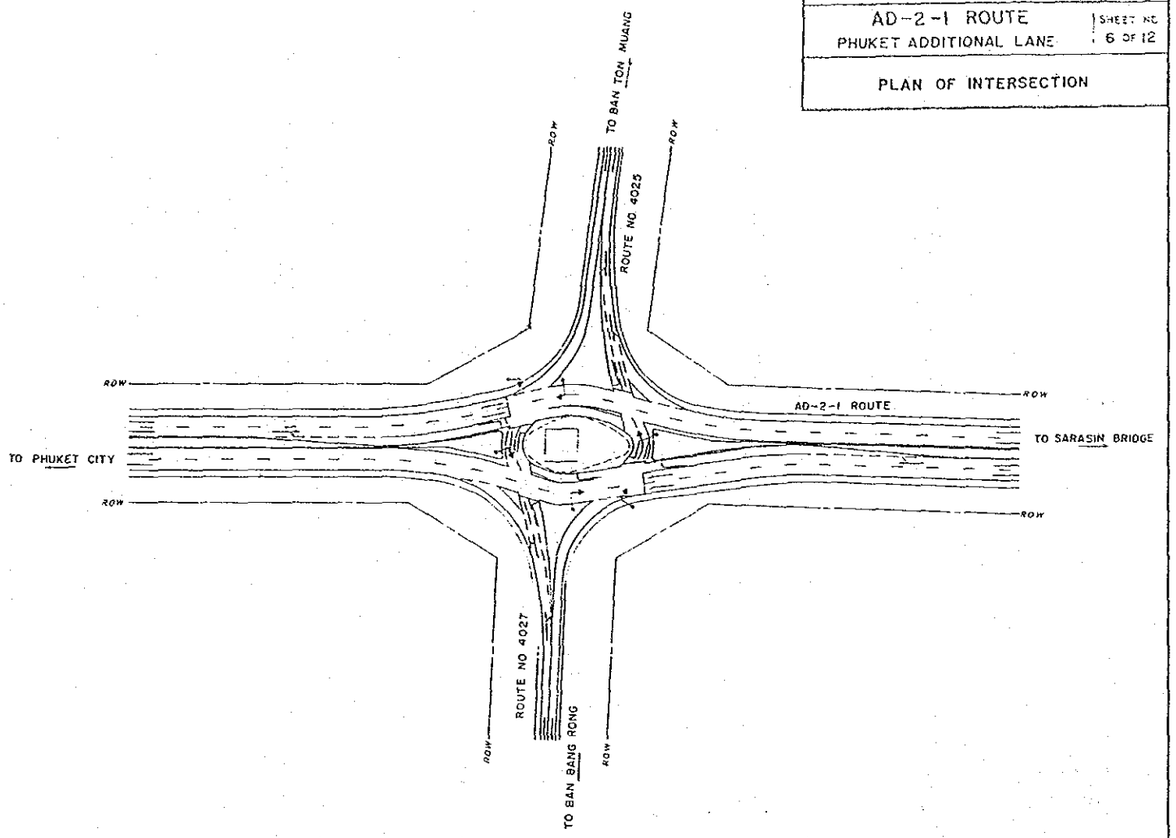
AD-2-1 ROUTE
PHUKET ADDITIONAL LANE

SHEET NO. 6 OF 12

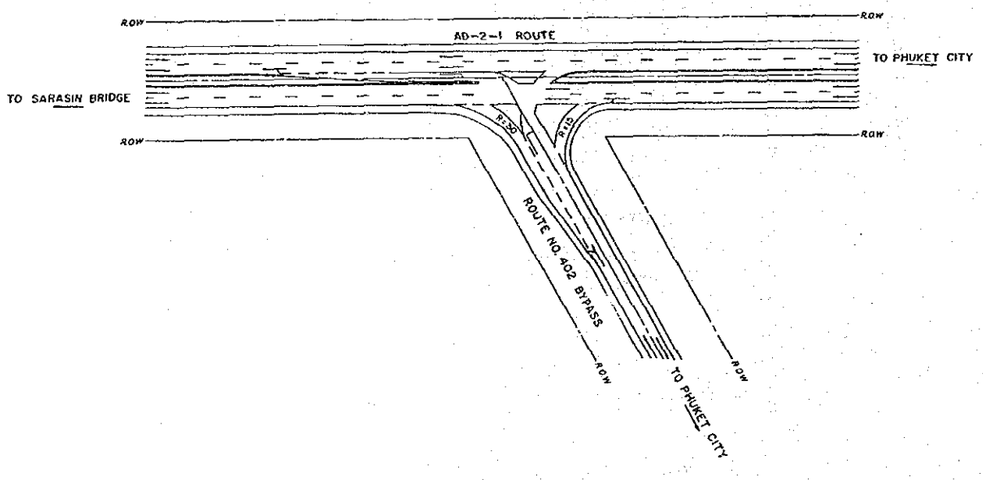
PLAN OF INTERSECTION



Intersection with Rt.4030
Scale 1:2000

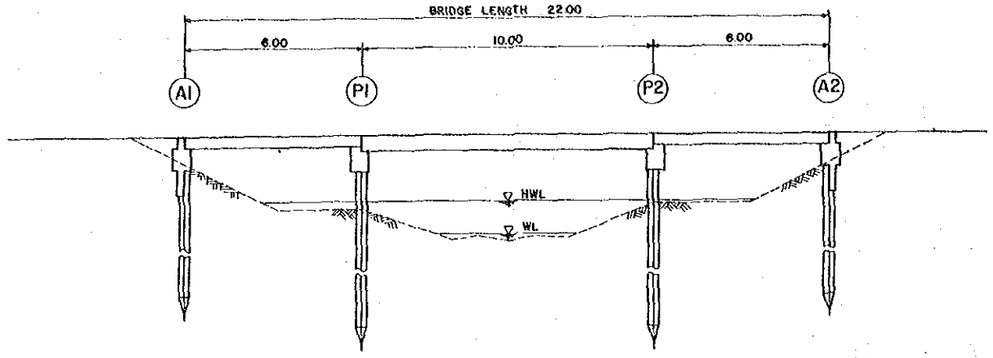


Intersection with Rt.4025, and Rt.4027
Scale 1:2000

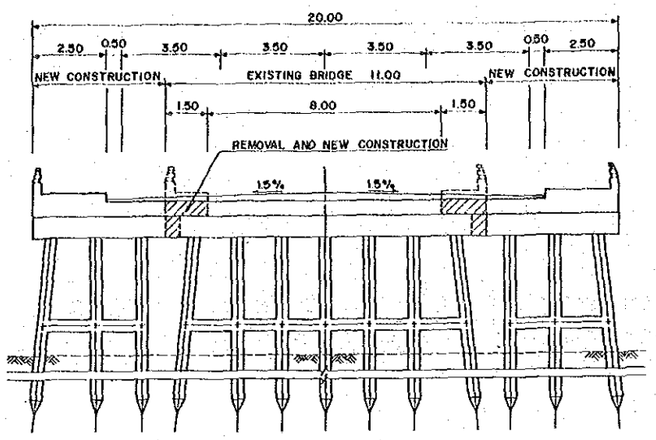


Intersection with Phuket bypass
Scale 1:2000

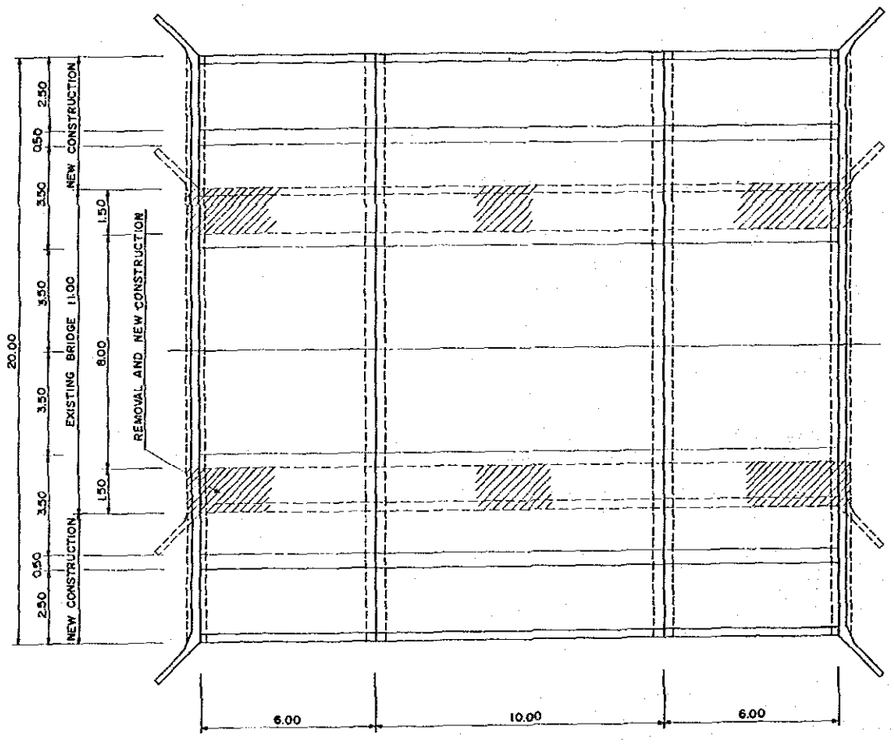
JICA RDSR STUDY	
AD-2-1 ROUTE PHUKET ADDITIONAL LANE	SHEET NO. 7 OF 12
REINFORCED CONCRETE SLAB BRIDGE WIDENING TO 20.00 M. (A)	



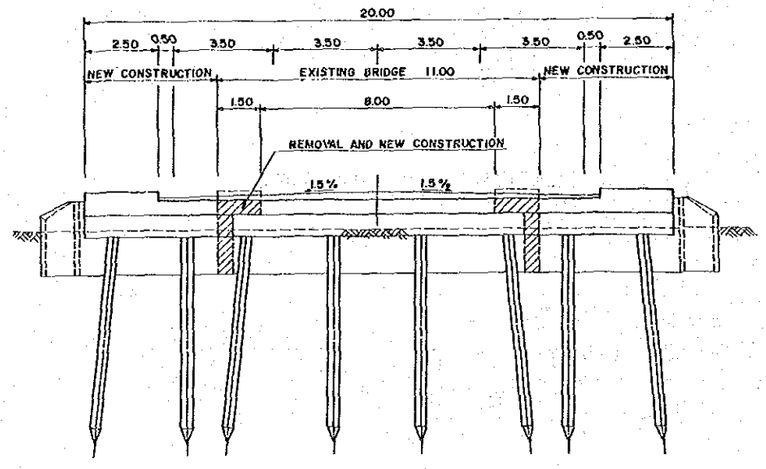
ELEVATION
SCALE 1:200



PILE BENT

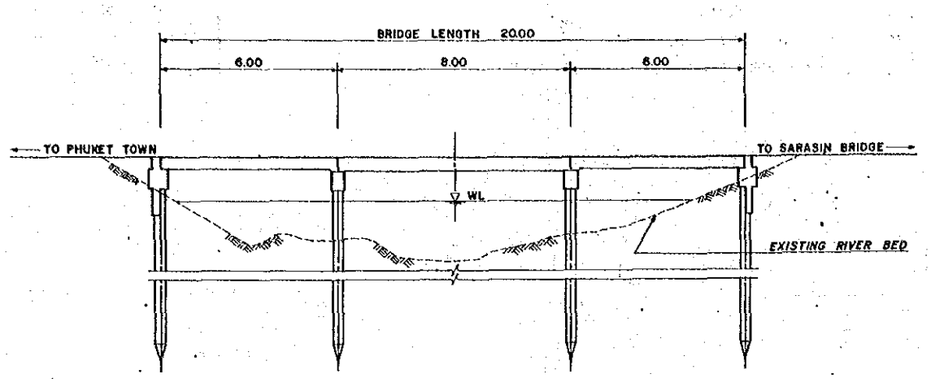


P L A N
SCALE 1:200

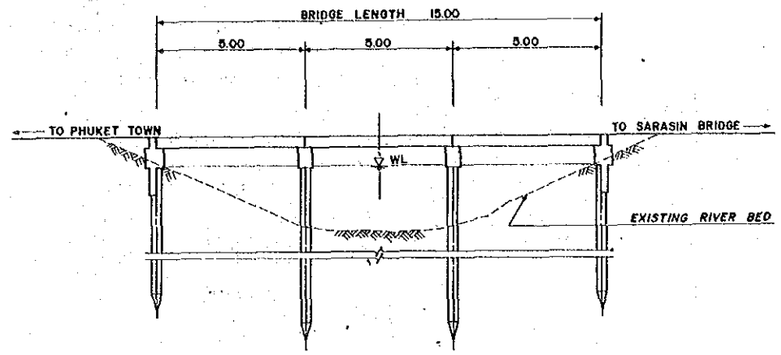


ABUTMENT
FRONT ELEVATION
SCALE 1:200

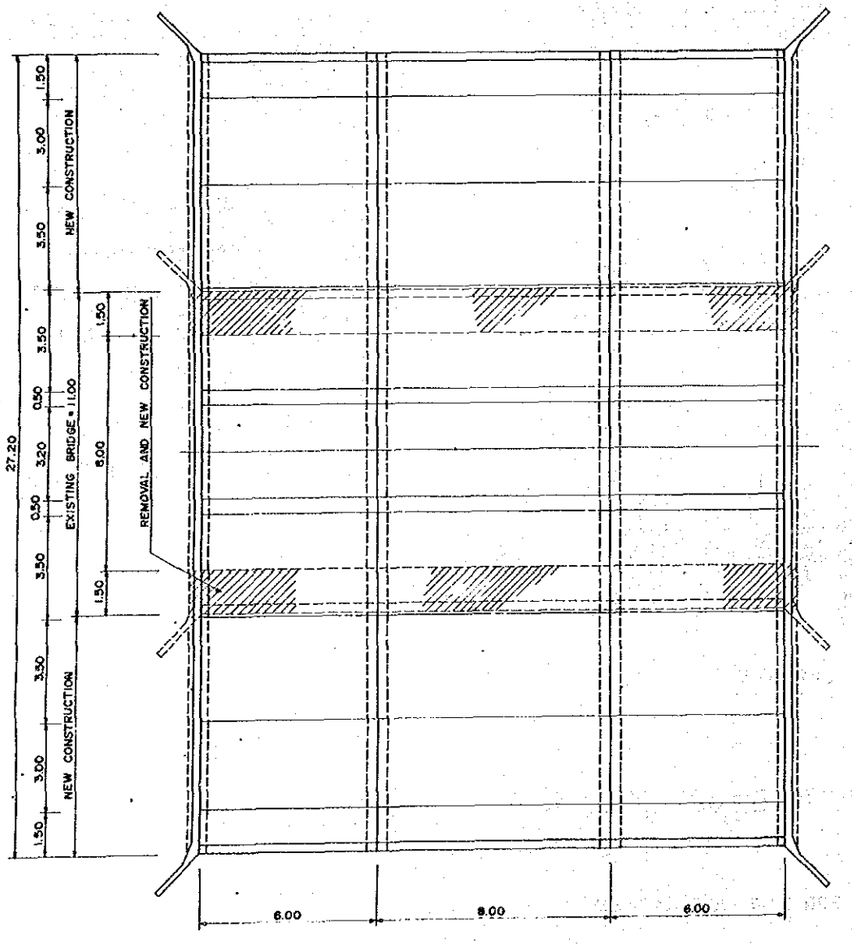
JICA RDSR STUDY	
AD-2-1 ROUTE PHUKET ADDITIONAL LANE	SHEET NO. 8 OF 12
REINFORCED CONCRETE SLAB BRIDGE WIDENING TO 27.20 M. (B)	



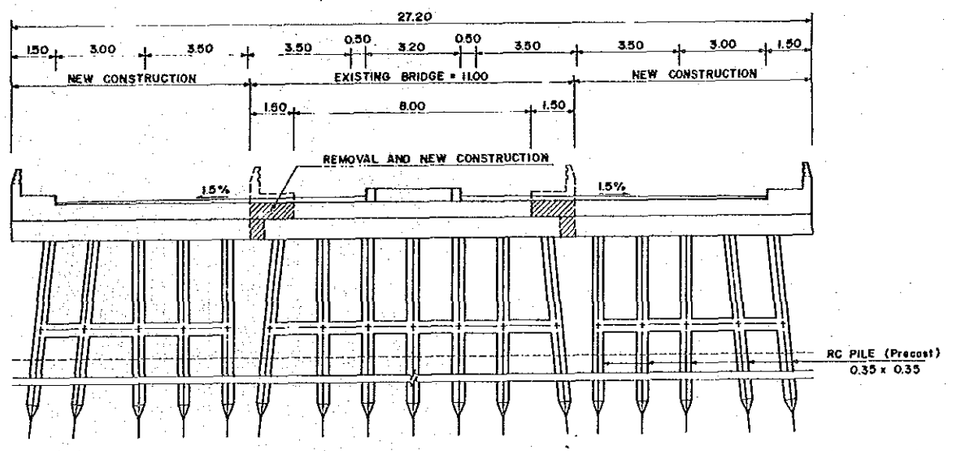
ELEVATION (KP 6+247)
SCALE 1:200



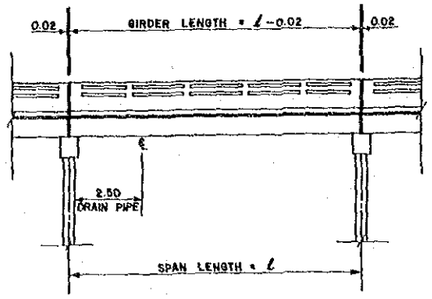
ELEVATION (KP 12+332)
SCALE 1:200



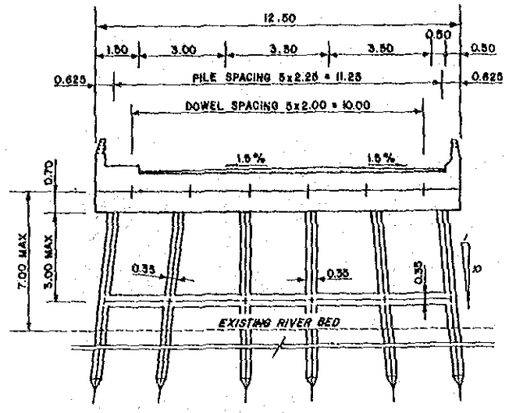
PLAN (KP 6+247)
SCALE 1:200



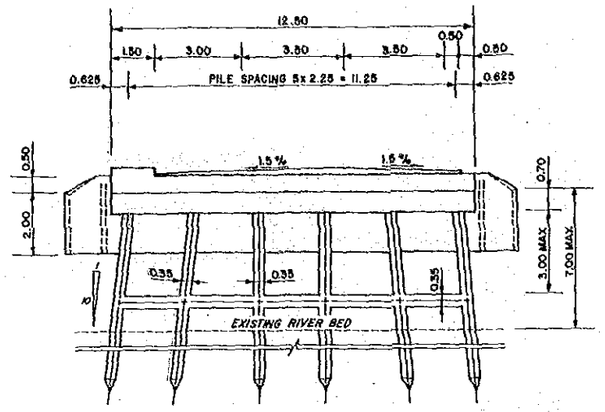
PILE BENT ELEVATION
SCALE 1:200



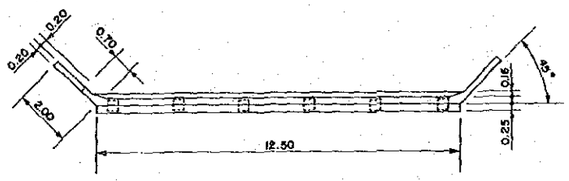
SECTION A–A
SCALE 1:200



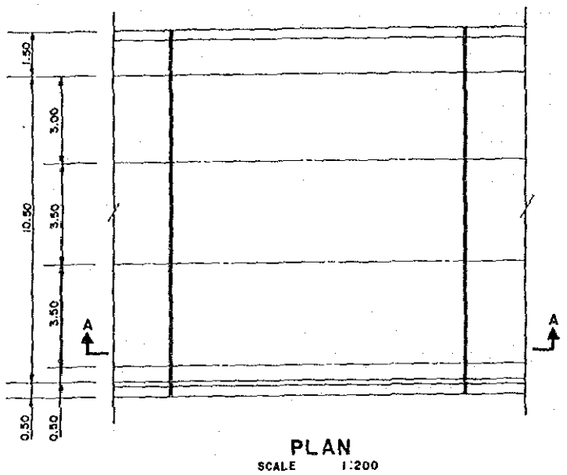
FOR 7.00 – 8.00 M. SPAN



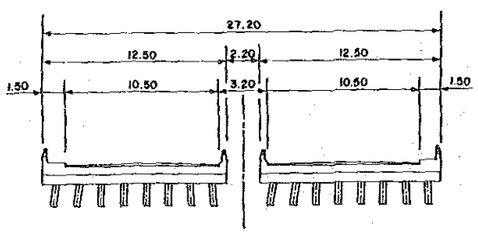
ELEVATION
SCALE 1:200



ABUTMENT FOR 7.00 – 8.00 M. SPAN



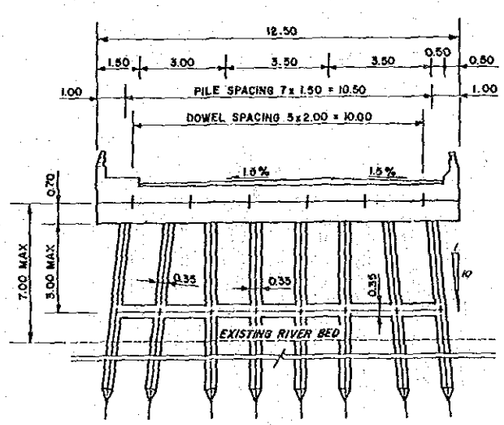
PLAN
SCALE 1:200



BRIDGE ARRANGEMENT
SCALE 1:400

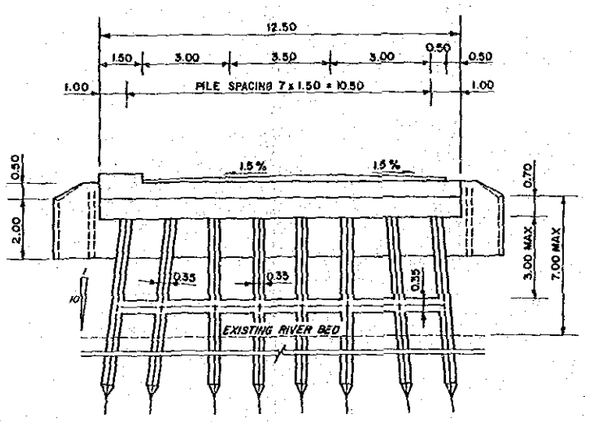
LIST OF BRIDGES

STATION	SPAN AND LENGTH (m)
15+500	1 x 10.00 = 10.00
17+000	2 x 7.00 = 14.00

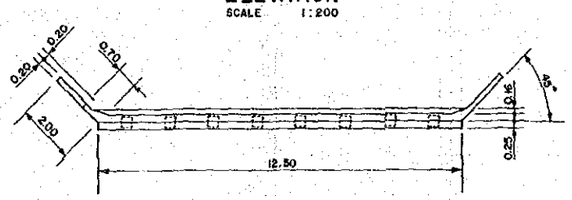


FOR 9.00 – 10.00 M. SPAN

PILE BENT ELEVATION
SCALE 1:200



ELEVATION
SCALE 1:200



ABUTMENT FOR 9.00 – 10.00 M. SPAN

PLAN
SCALE 1:200

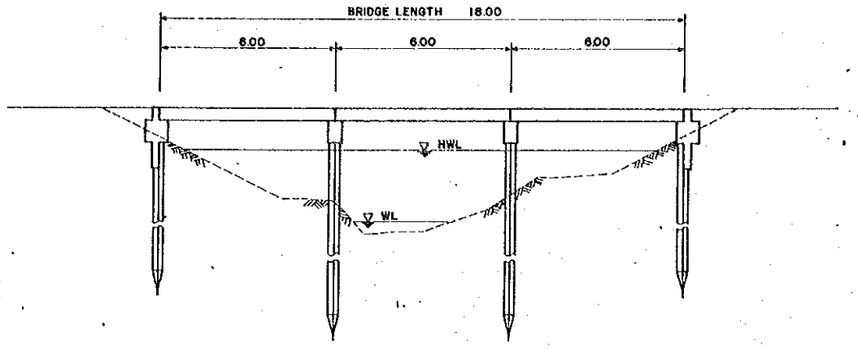
NOTES :

1. DESIGN STRESSES :
   a) CONCRETE , f_c = 70 KSC.
   b) STEEL , f_s = 1,400 KSC. (INTERMEDIATE GRADE)
   f_s = 1,200 KSC. (STRUCTURAL GRADE)
2. CONCRETE SHALL HAVE MINIMUM ULTIMATE COMPRESSIVE STRENGTH OF 210 KG/CM^2 FOR .15 X .15 X .15 CUBE AT 28 DAYS. AND APPROXIMATE MIX DESIGN PER CUBIC METER IS SUGGESTED AS FOLLOWS :

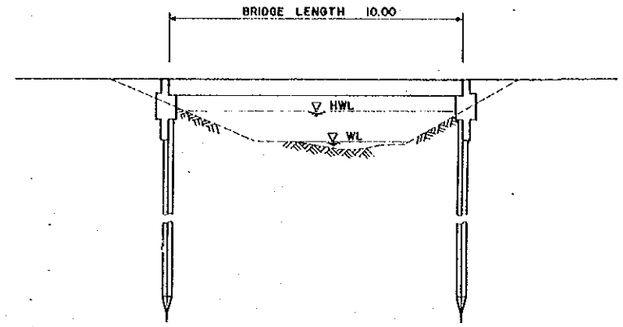
PORTLAND CEMENT, MIN.	350 KG.
SAND	0.43 M^3
CRUSHED ROCK OR GRAVEL	0.86 M^3
CONCRETE SLUMP, MAX	10 CM.

3. CLEAR CONCRETE COVER FOR TOP REINFORCEMENT IN SLAB BRIDGE SHALL BE 3.5 CM. ELSEWHERE OF SLAB BRIDGE AND SIDEWALK SHALL BE 2.5 CM.
4. ALL CONCRETE EXPOSED CORNERS SHALL HAVE 2 CM. CHAMFER UNLESS OTHERWISE INDICATED.
5. REBARS #4 OR LARGER SHALL BE INTERMEDIATE GRADE DEFORMED BARS, OTHERS SHALL BE STRUCTURAL GRADE PLAIN BARS UNLESS OTHERWISE INDICATED.
6. LOCATIONS OF LAP SPLICE OF REBARS SHALL BE APPROVED BY THE ENGINEER.
7. LAP LENGTH SHALL NOT BE LESS THAN 40 DIAMETERS OF BIGGER BAR IN CASE OF PLAIN BARS AND 24 DIAMETERS OF BIGGER BAR FOR DEFORMED BARS.
8. IN CASE OF SALINE PROTECTION, HIGH SULPHATE RESISTANT PORTLAND CEMENT TYPE 5 CONFORMED TO AASHTO SPECIFICATIONS SHALL BE USED AND ADDITIONAL CONCRETE COVER OF 2.5 CM. FROM NORMAL CASE ALL AROUND SHALL BE PROVIDED WITHOUT ALTERING THE LOCATIONS OF REBARS.
9. ALL MATERIALS SHALL BE USED UNDER THE APPROVAL OF THE ENGINEER.
10. PAINTING SHALL BE PROVIDED ON ALL SURFACES AT BRIDGE ENDS WHICH EXPOSED TO TRAFFIC. WHITE AND BLACK COLOUR SHALL BE PAINTED ALTERNATELY. WHITE COLOUR SHALL BE LIGHT REFLECTED TYPE.
11. ALL DIMENSIONS SHOWN ARE IN METERS UNLESS OTHERWISE INDICATED.
12. BAR MARK S101 MAY BE TAKEN OUT ONE BAR ON EACH SIDE OF THE BRIDGE WHEREVER THEY PASS THROUGH DRAIN PIPES. IF THE LOCATIONS OF THESE BARS ARE NEAR V-DRIP SUCH THAT CONCRETE COVER IS NOT ADEQUATE, THEY SHALL BE PLACED ON TOP OF ST 101. OTHER BARS WHICH PASS THROUGH DRAIN PIPES SHALL BE BENT ALONG THE PIPES.
13. ALL PIERS WHICH DO NOT HAVE LOG PROTECTION WALLS SHALL BE HAUNCH UNDER THE TOP CROSS BRACING.
14. IF ANY NOTES ON THE DRAWINGS OF PIERS CONTRADICT THE NOTES ON THIS DRAWING, THEY WILL BE SUPERSEDED BY THESE NOTES.
15. THIS DRAWING IS ADAPTED FROM DOH DWG NO. 3 AD5-106-14/1A IN CASE OF ANY DISCREPANCY BETWEEN SUCH DRAWINGS ARISES, THE DOH. STANDARD DRAWING WILL PREVAIL UNDER THE APPROVAL OF THE ENGINEER.

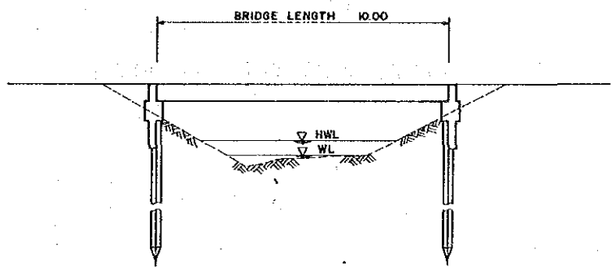
JICA RDSR STUDY	
AD-2-1 ROUTE PHUKET ADDITIONAL LANE	SHEET NO. 10 OF 12
REINFORCED CONCRETE SLAB BRIDGE WIDENING TO 26.20 M. (D)	



ELEVATION (KP 34+950)
SCALE 1:200

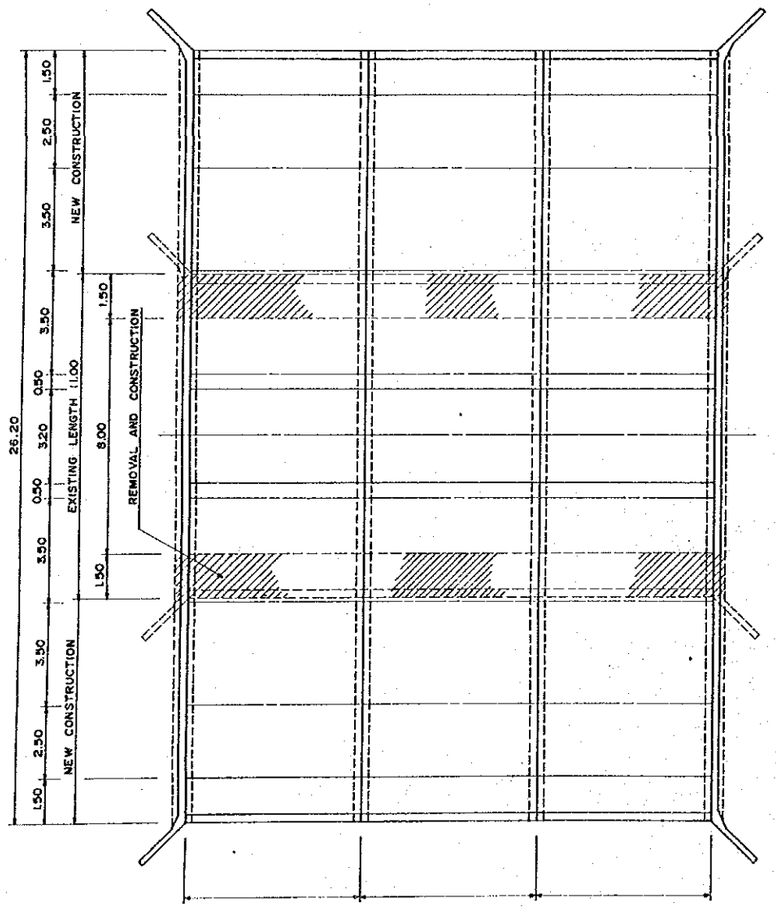


(KP 25+000)

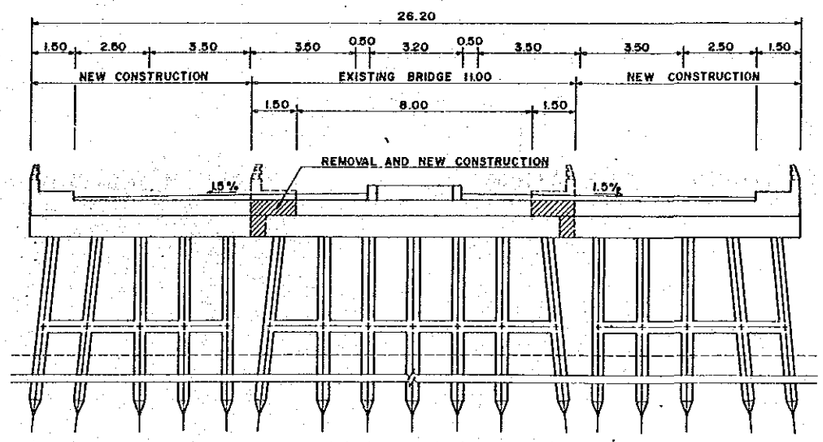


(KP 29+730)

ELEVATION
SCALE 1:200



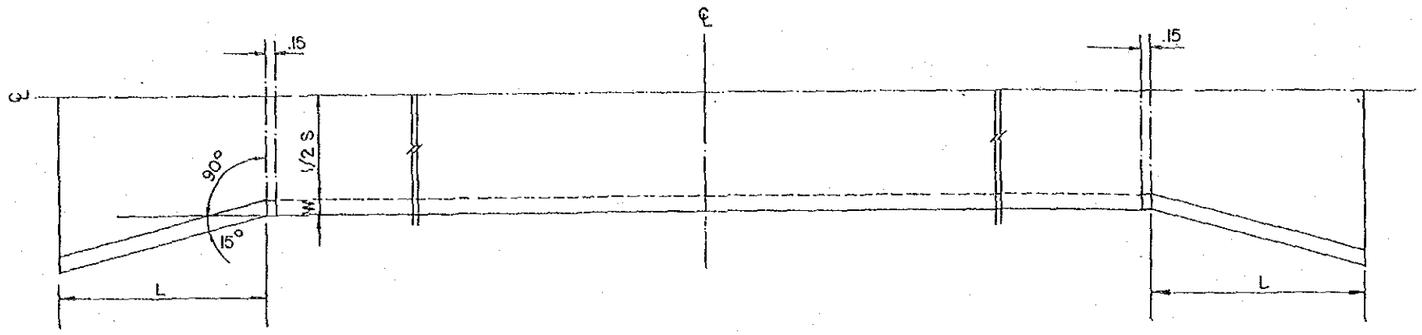
PLAN (KP 34+950)
SCALE 1:200



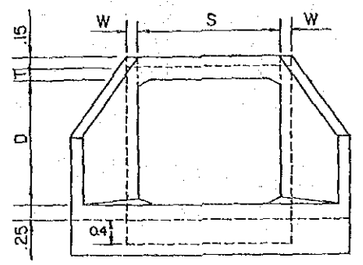
FRONT ELEVATION
SCALE 1:200

JICA RDSR STUDY	
AD-2-1 ROUTE PHUKET ADDITIONAL LANE	SHEET NO. 11 OF 12
BOX CULVERT	

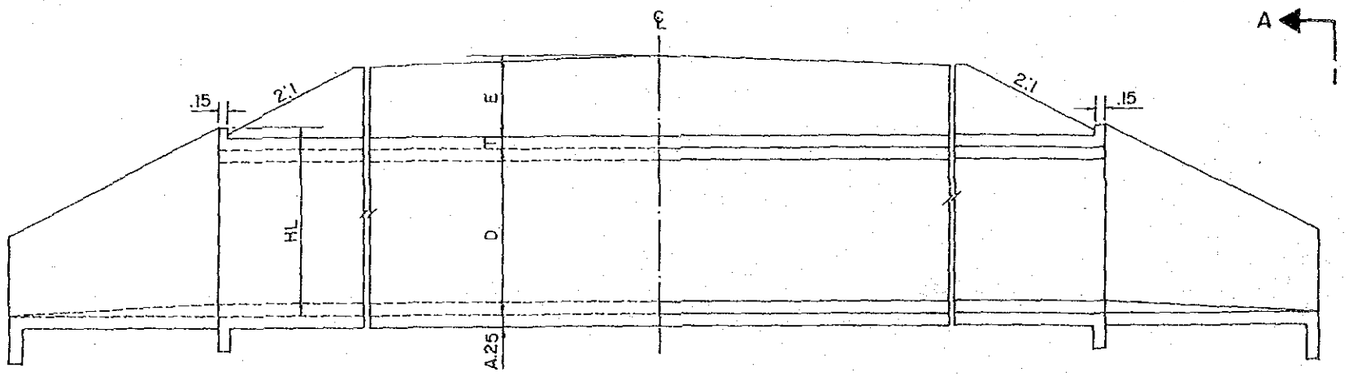
BOX CULVERT



HALF LONGITUDINAL PLAN

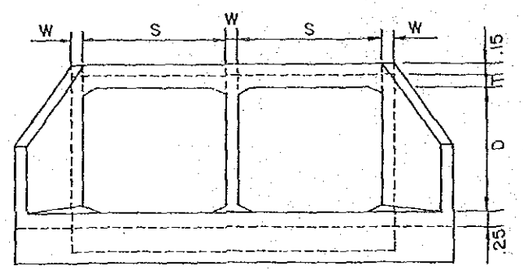


SINGLE TYPE



HALF LONGITUDINAL ELEVATION

HALF LONGITUDINAL SECTION

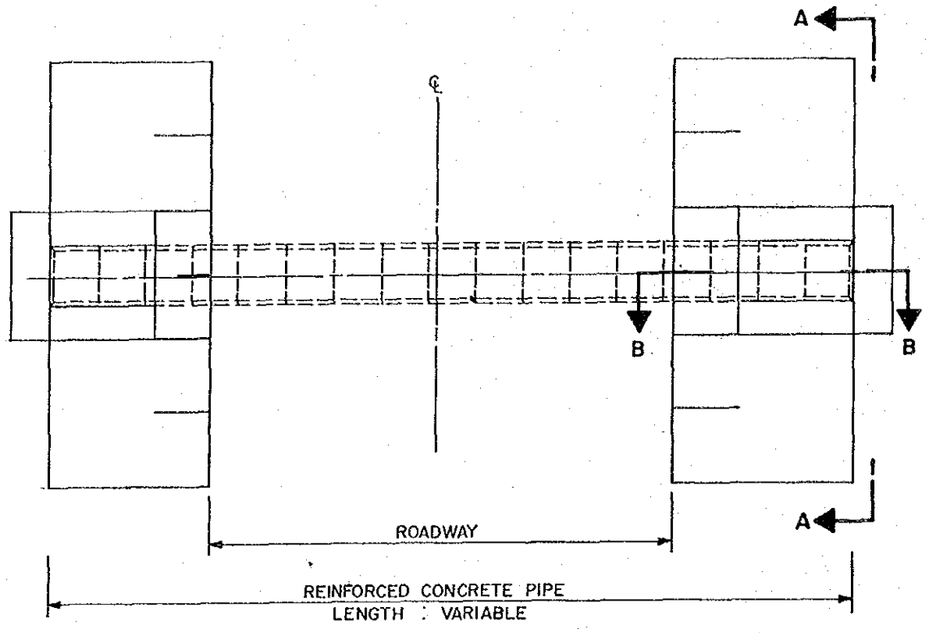


DOUBLE TYPE

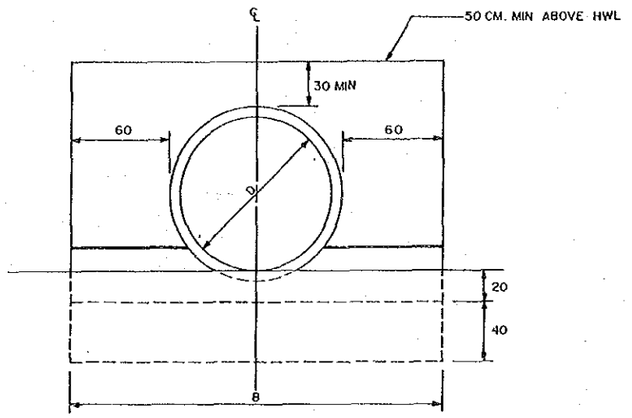
SECTION A-A

PIPE CULVERT

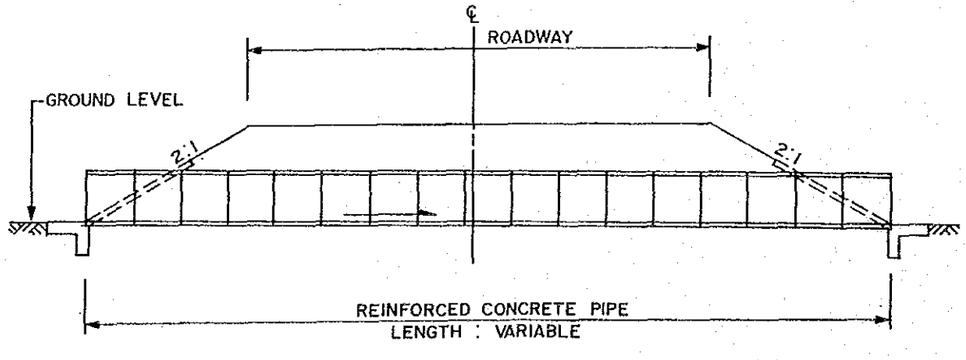
JICA RDSR STUDY	
AD-2-1 ROUTE PHUKET ADDITIONAL LANE	SHEET NO. 12 OF 12
PIPE CULVERT	



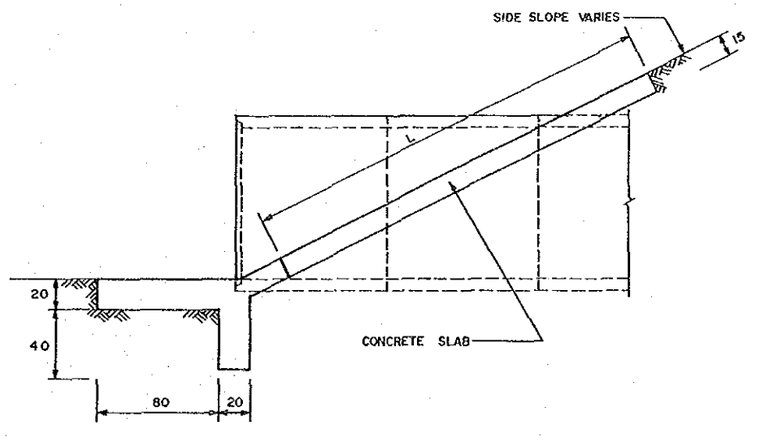
PLAN



SECTION A-A



PROFILE



SECTION B-B