6. Engineering Study on the Highway Link

6.1 Conditions for Design

This study assumed the following conditions for designing the Highway Link:

1) Locations of Krabi and Khanom ports are those indicated in the paper "Thailand's New Strategic Thinking towards the Year 2000 and Beyond, May 1990" prepared by the OSSB;

2) A focus is given to the Highway Link between Krabi and Khanom ports;

3) Three alternative routes are to be studied as an input to the SSDP master plan study;

4) Access control will be introduced to ensure higher vehicle speed than otherwise; and

5) Measures for disaster prevention and environmental protection will be taken into account.

6.2 Design Standard

6.2.1 Design Speed

Terrain along the Krabi - Khanom Landbridge is mostly flat excluding the mountain area near Krabi city. Design standard for this study was fixed through discussions with the DOH to attain two hour travelling between Krabi and Khanom. Design speed is fixed at 120 km/hour as shown in Table 6.2.1.

6.2.2 Geometric Design Criteria

Geometric Design Criteria corresponding to design speed were determined referring to the criteria for high standard expressway in Europe and Japan as shown in Table 6.2.1.

Table 6.2.1 Geometric Design Criteria

Terrain		Flat	Rolling or Mountainous
Design Speed (km/h)		120	120
Max Gradient (%)	Standard	2	2
	Allowable	3	4
Min Radius of Curvature (m)	Standard	1,500	1,000
	Allowable	1,030	710
Min Stopping Sight Distance (m)	Standard	400	
	Allowable	290	

6.2.3 Typical Cross Section

Typical cross sections were determined as shown in Fig. 6.2.1 through studies on DOH standard as well as other standards adopted in expressways in overseas countries. Specifications of typical cross section is as shown in Table 6.2.2.

Table 6.2.2 Typical Cross Section

Section	Earthwork	Bridge	Tunnel
Carriageway Width (m)	7.50	7.50	7.50
Left Shoulder Width (m)	3.25	3.25	1.00
Right Shoulder Width (m)	1.75	1.75	1.00
Offset Distance between Two-lane Centers (m)	30	30	30

Note: Tunnel only for Alternative B

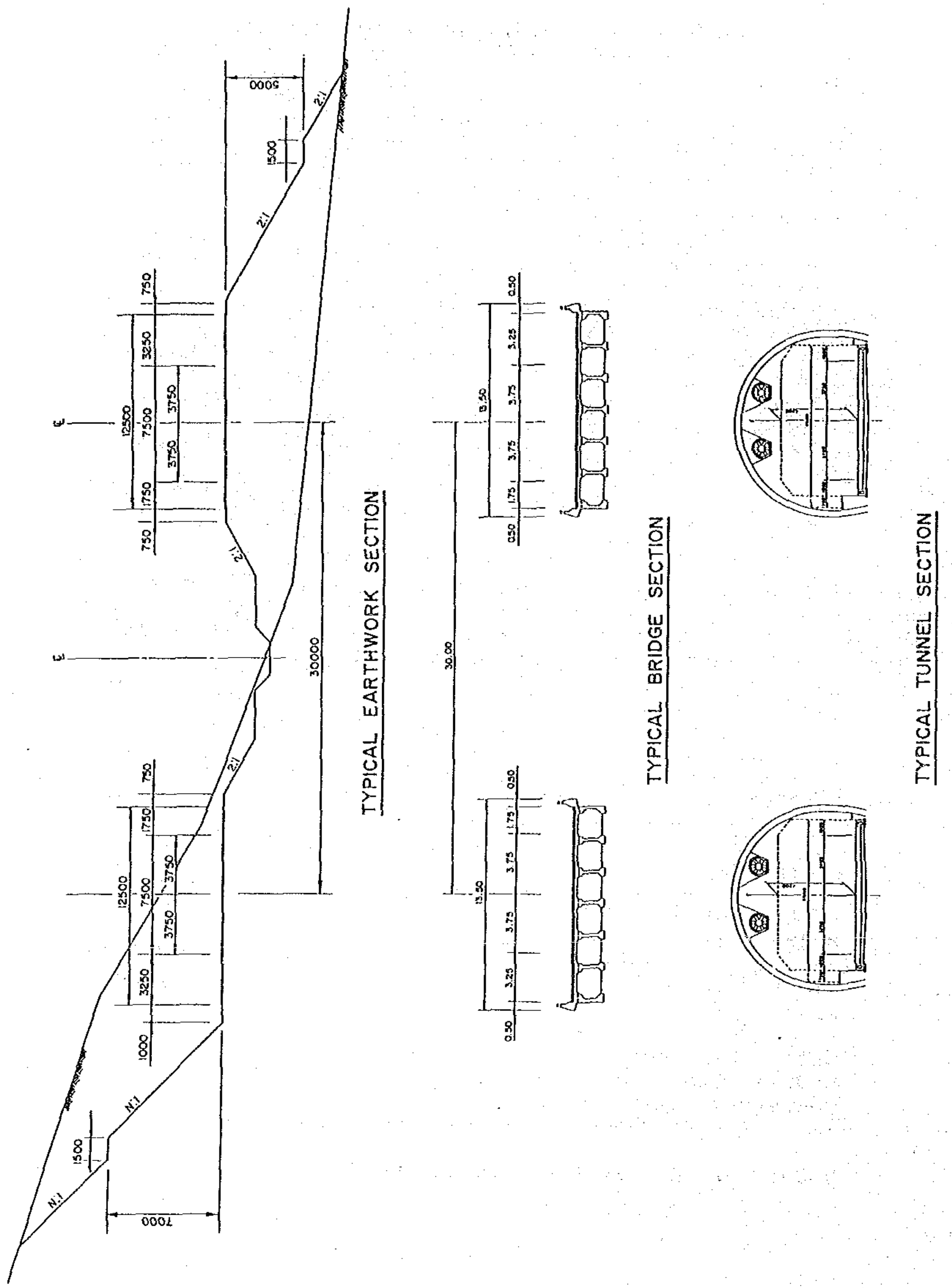


FIG. 6.2.1 TYPICAL CROSS SECTION

6.2.4 Vertical Clearance at Control Points

Vertical clearance for the existing highways, railways and rivers is determined based on the DOH standard, the SRT standard and discussions with DOH engineers.

1) Crossing with the Existing Highways

- Major Highways (Route 4, 41, 401)

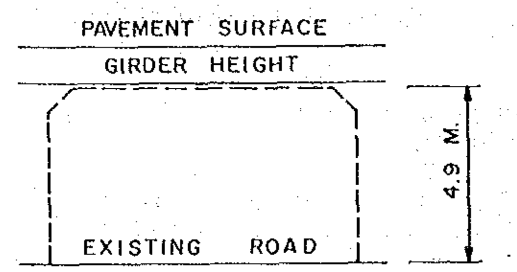


Figure 6.2.2

- Provincial Highways and Rural Roads

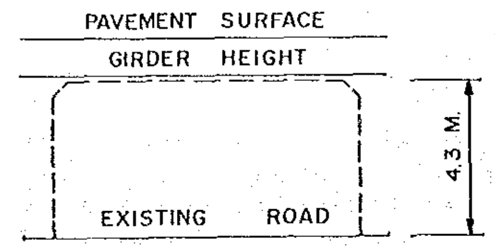


Figure 6.2.3

- Other Small Roads

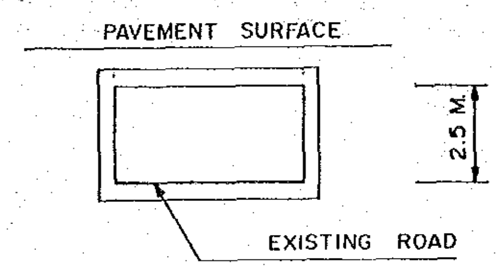


Figure 6.2.4

2) Crossing with Rivers

- Tapi River

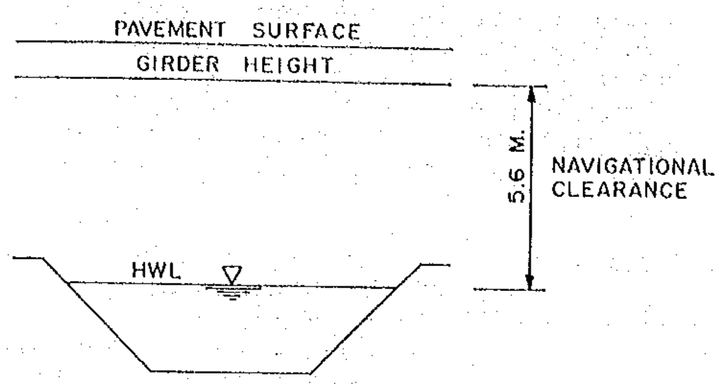


Figure 6.2.5

- Other Small Rivers and Khlongs

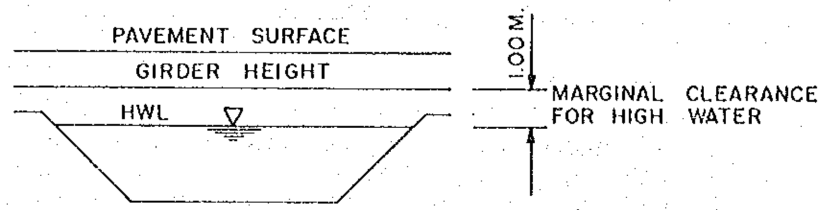


Figure 6.2.6

3) Crossing with Railway

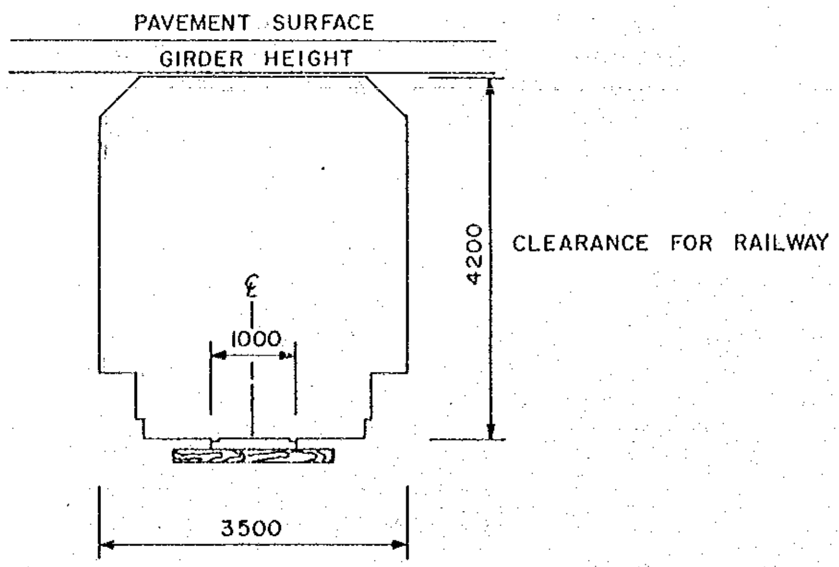


Figure 6.2.7

6.3 Alignment Alternatives

The alignment of the Krabi - Khanom Highway is based on the SSDP concept to connect the deep sea ports on both sides of the Peninsula at a possible shortest distance whithin two hours. Three alternative alignments were studied to pass the mountain area near Krabi city as shown in Fig. 6.3.1. There is no specific geographical constraints in Surat Thani side to the east of the mountain area near Krabi city.

Length of alignment alternatives by type of terrain is as shown in Table 6.3.1. Alternative B has the shortest distance of 189.0 kilometers while alternative C has the longest distance of 197.5 kilometers. Difference between the shortest and longest is less than 10 kilometers.

Table 6.3.1 Alternative Length

unit: kilometer

	Flat Terrain in Krabi side	Hilly Terrain	Flat Terrain in Khanom side	Total Length
Alt-A	25.0	60.0	108.5	193.5
Alt-B	21.0	59.5	108.5	189.0
Alt-C	24.0	65.0	108.5	197.5

Alternative-A: This alignment, which provides better accessibility to Phuket direction, has favorable geographical and geological conditions and is away from Krabi city where land price is high.

Alternative-B: This is an alignment of the shortest distance but has more geographical constraints than others. Mountain is traversed by tunnel.

Alternative-C: This is an alignment of the longest distance. This alignment has the best geographical conditions with some unfavorable geological conditions.

6.4 Major Design Components

6.4.1 Earthwork

1) Embankment

The DOH has a new policy to supply fill materials for embankment from borrow-pits in place of side-borrowing along highways. The study follows the new DOH policy. According to the findings of material survey, a large number of borrow-pits can be found in the Krabi- Khanom corridor.

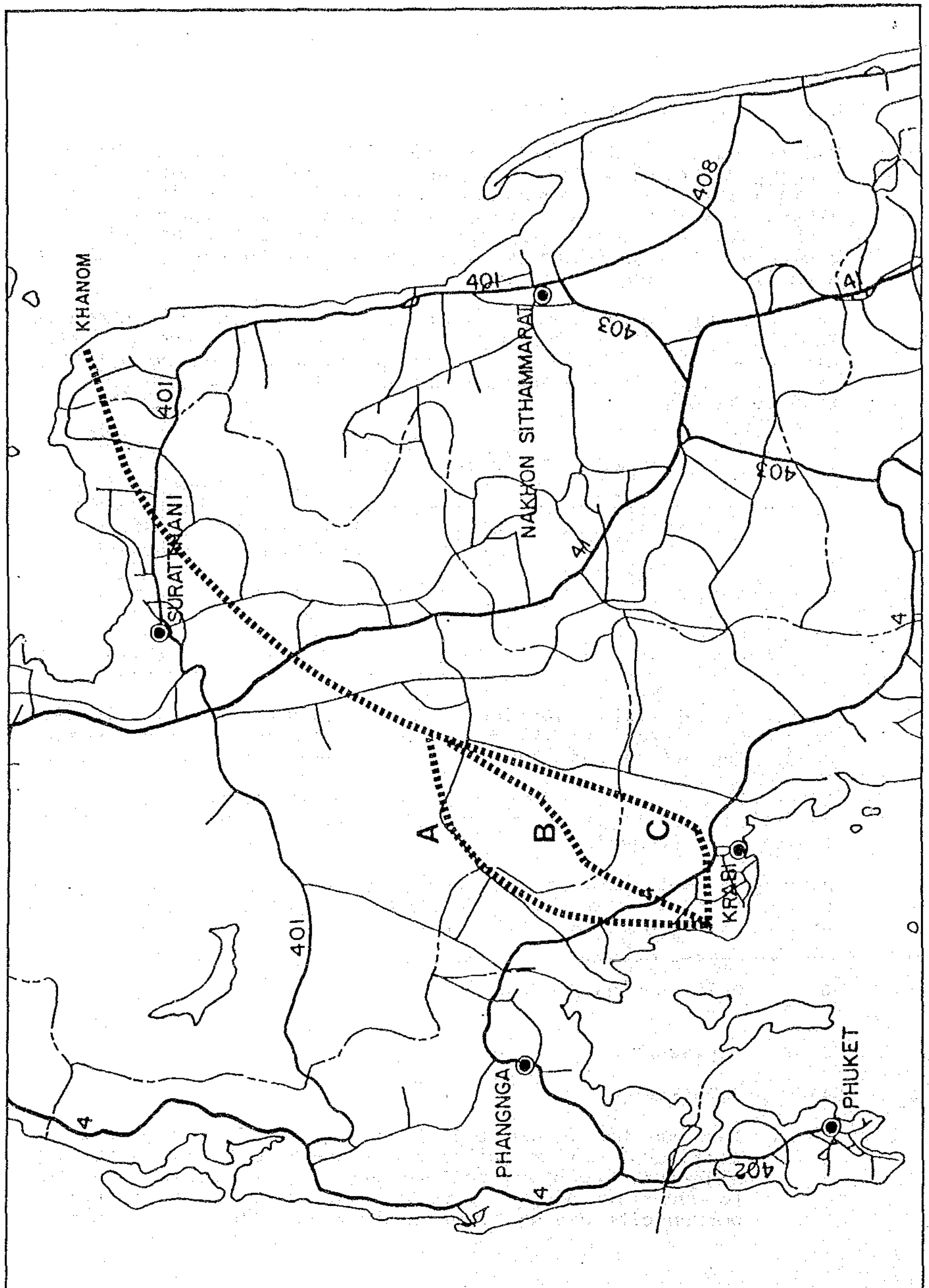


Fig. 6.3.1 ALIGNMENT ALTERNATIVE

The height of the embankment was dicided based on high water level in the past, required vertical clearance at control points, and the stability of embankment. Average height of embankment is 3.5 - 3.8 meters for three alternatives and the length of embankment is 171 - 176 kilometers, accounting for about 90 % of the total length, as shown in Table 6.4.1.

Table 6.4.1 Average Height and Length of Embankment

	Embankment Length (km)	Average Height of Embankment (m)
Alternative-A	172.8	3.6
Alternative-B	170.7	3.8
Alternative-C	175.6	3.5

Gradient of embankment slope was decided at 2:1 on an assumption that laterite is used as fill material. A berm of 1.5 meter width is installed at every 5 meter to prevent slope failure as shown in Fig.6.2.1. Embankment slope is protected by strip sodding except for some flood-prone sections which are protected by block sodding.

Rather thick soft alluvium layer is found at the Tapi River and the Kra Dae River basins with the length of 1.0 km and 6.5 km respectively. These rivers flow into the Gulf of Thailand near Surat Thani. At these soft ground areas, sand-pile method is to be introduced to cope with possible subsidence as illustrated in Fig. 6.4.1.

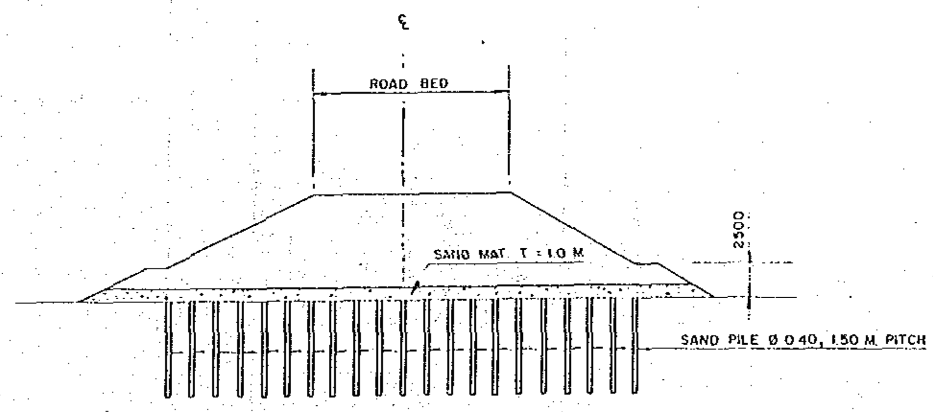


Figure 6.4.1 Sand Pile Method

2) Cut

Cut section of 3.5 - 5.1 meter depth amounts to 14 - 19 kilometers in total length for three alternatives, accounting for slightly less than 10 % of the total highway length as shown in Table 6.4.2.

Table 6.4.2 Average Cutting Depth and Length

	Total length of cut section (km)	Average Cutting Depth (m)
Alternative-A	17.7	5.1
Alternative-B	14.0	3.5
Alternative-C	18.7	4.0

Gradient of cut slope was decided depending on kind of soil based on a slope stability study as follows:

Soft Rock	0.8 : 1
Weathered Rock	1 : 1
Laterite	1.5 : 1

A berm of 1.5 meter width is to be installed at every 7.0 meter as illustrated in Figure 6.2.1 .

Earth slope is to be fixed by sodding while rock slope is to be fixed by shot-crete to prevent slope failure.

6.4.2 Pavement

1) Design Conditions

a) Design CBR:...........5%

Design CBR at subgrade was assumed at 5% based on the survey results of CBR value at the existing borrow pits in the Krabi-Khanom corridor.

b) Design Method:........AASHTO

The "AASHTO Design Guide for Pavement Structure 1986 (AASHTO Method)" was applied to this study.

c) Design Period:........10 years

Design period of 10 years was adopted in this sudy based on AASHTO Method of "the first ten years after construction".

d) Heavy Vehicle Traffic:

The estiamted heavy vehicle traffic on the Krabi - Khanom Highway Link was used to decide thickness of the pavement. Table 6.4.3 shows truck and bus traffics estimated on the section of Khanom - Route 401 for Alternative C.

Table 6.4.3 Truck and Bus Traffic on the Krabi - Khanom Highway Link

unit: vehicles/day

YEAR	TRUCK	BUS
2001	1,689	389
2006	5,555	966

e) Pavement Type: Asphalt Concrete Pavement

Asphalt concrete pavement was selected from the following point of view:

- high efficiency of construction;
- easy maintenance; and
- low cost of construction and maintenance.

2) Pavement Design

Total thickness of pavement structure was determined to be 50cm based on the above design conditions.

- Pavement Structure Number (SN)
  SN was calculated 3.5 based on design CBR at subgrade and traffic volumes of heavy vehicles.
- Thickness of Pavement Structure
  Based on estimated SN, the thickness of Pavement structure was determined as follows:

		SN
Asphalt Concrete	10cm	1.76
Base Course	20cm	1.12
Subbase Course	20cm	0.72
Total	50cm	3.60

The thickness of asphalt concrete on carriageway is 10cm together with surface coarse and binder coarse. The thickness of asphalt concrete on the left shoulder was deduced to 5cm without subbase in view of saving construction cost.

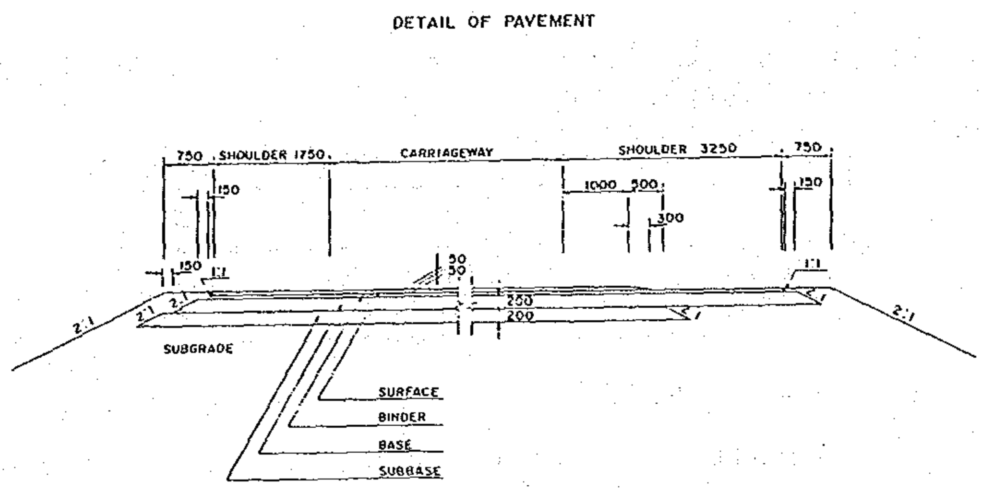


Figure 6.4.2 Pavement Structure

6.4.3 Drainage

1) Discharge

Design discharge is calculated based on the map in a scale of 1:50,000 with the following design conditions:

- Rainfall Intensity

  Rainfall intensity duration curves obtained at Songkhla and Chumphon stations were applied to the design discharge culculation in the Krabi - Khanom corridor.

- Return Period

  Return periods for designing drainage structures were assumed as follows:

Pipe culvert and box culvert	10 years
Minor bridge	20 years
Major bridge	30 years

2) Drainage Facilities

Drainage facilities are to be provided at:

- Crossing with river and canal;
- Crossing with hollow or sag;
- Intervals of minimum 200 meter in flat area; and
- Intervals of minimum 300 meters in the hilly or mountainous area.

Number of drainage facilities by type is as shown in Table 6.4.4. The Alternative C requires the largest number of bridges of 57, followed by Alternative A of 54 and Alternative B of 47. The number of box culvert required is in the order of 18 - 28 and that of pipe culvert is in the order of 1,420 - 1,500.

Reinforced concrete box culvert has one and two cell types of 2.4m x 2.4m while reinforced concrete pipe culvert has two size of 1.0 and 1.5 meters in diameter to let the calculated discharge flow.

Table 6.4.4 Number of Drainage Facilities by Type and by Alternative

	Bridge	Box-Culvert (locations)	Pipe-Culvert	Catch Basin (sq-km)
Alt-A	54	26	1,444	8,391
Alt-B	47	28	1,424	7,855
Alt-C	57	18	1,502	8,612

6.4.4 Bridge

1) Bridge Design Concept

Reinforced and prestressed concrete is used for bridges from a view point of material supply and cost saving. Reinforced concrete slab is used for bridges of span length of ten meters, and prestressed concrete slab is used for those bridges of which span length is equal to or longer than twenty meters.

Span length and spacing of pier are designed in consideration of disaster prevention and possible widening of the existing bridges in the future:

a) span length should not disturb water flow even in the high level of discharge, blockade by piers being less than 7 % of the section of river;

b) extra spacing is to be prepared on both sides of a bridge for accepting possible widening of the highway line; and

c) sub-structures should be located also to allow possible widening.

Concrete covering is designed to be installed in front of abutment of major bridges to mitigate damages.

The bridge crossing the Tapi River needs longer span length than the others. In view of this, prestressed concrete box girder by cantilever method is to be applied to the bridge.

2) Summary of Bridges

Table 6.4.5 shows summary of designed bridges. Total length bridges amounts to 5.0 - 5.9 kilometers, accounting for about 3 % of the total highway length.

6.4.5 Interchange

Proposed location of interchanges and toll gates are illustrated in Figure 6.4.3. Interchanges in the initial stage are proposed at the intersecting points with Route 4, Route 4035, Route 41, and Route 401. Toll gates are proposed at Krabi and Khanom.

In the future, together with development of the existing highway network, interchange should be located within 30 kilometer distance. It would also become necessary to develop an interchange with the national toll highway which is now under planning stage.

An all directional interchange of double trumpet type is planned at four interchanges. Design speed on loop ramps is planned at 40 kilometers per hour. Fig. 6.4.4 illustrates skeleton of interchanges.

6.4.6 Disaster Prevention

The Krabi- Khanom corridor is likely to be hit by such natural disasters as flooding, debris flow from weathered granite slope, and rockfall from the steep slope of monadnock. To prevent road facilities from these natural disasters, special attentions was paid to the designing of the Krabi - Khanom Highway Link.

Measures to prevent damages caused by natural disaster are taken into account in designing the Krabi - Khanom Highway Link in the following way:

- Alignment should keep away from alluvial fan;

Table 6.4.5 Summary of Bridges (for 2 direction)

Bridge Function	Type and Span (m)	< Total Length by Section (m) > A-Rt.	B-Rt.	C1-Rt.	C2-Rt.	C3-Rt.	<Length by Alternative(m)> A + C3	B+C2+C3	C1+C2+C3
<1> Bridge Crossing River or Valley (Width=2x12.5m)	RC.SLAB-10	1,780	760	1,280	20	1,600	3,380	2,380	2,900
	PC.SLAB-20	120	120	200			120	120	200
	PC.GRDR-25					100	100	100	100
	PC.GRDR-28			56		112	112	112	168
	PC.GRDR-30	60				60	120	60	60
	PC.GRDR-35			70					70
	PC.GRDR-50					340	340	340	340
	(Subtotal)	(1,960)	(880)	(1,606)	(20)	(2,212)	(4,172)	(3,112)	(3,838)
<2> Bridge Crossing Road or Railway (Width=2x12.5m)	RC.SLAB-10					20	20	20	20
	PC.SLAB-20		360	200		600	600	960	800
	PC.GRDR-30	480	240	420		660	1,140	900	1,080
	(Subtotal)	(480)	(600)	(620)		(1,280)	(1,760)	(1,880)	(1,900)
<3>=<1>+<2> Total of Bridge for Main Link (Width=2x12.5m)	RC.SLAB-10	1,780	760	1,280	20	1,620	3,400	2,400	2,920
	PC.SLAB-20	120	480	400		600	720	1,080	1,000
	PC.GRDR-25					100	100	100	100
	PC.GRDR-28			56		112	112	112	168
	PC.GRDR-30	540	240	420		720	1,260	960	1,140
	PC.GRDR-35			70					70
	PC.GRDR-50					340	340	340	340
	(Total)	(2,440)	(1,480)	(2,226)	(20)	(3,492)	(5,932)	(4,992)	(5,738)
<4> Viaduct for PWD and ARD Road (Width= 6.0m)	PC.GRDR-30	240		240			240		240

Note RC.SLAB: Reinforced Concrete Slab
PC.SLAB: Prestressed Concrete Slab
PC.GRDR: Prestressed Concrete Girder

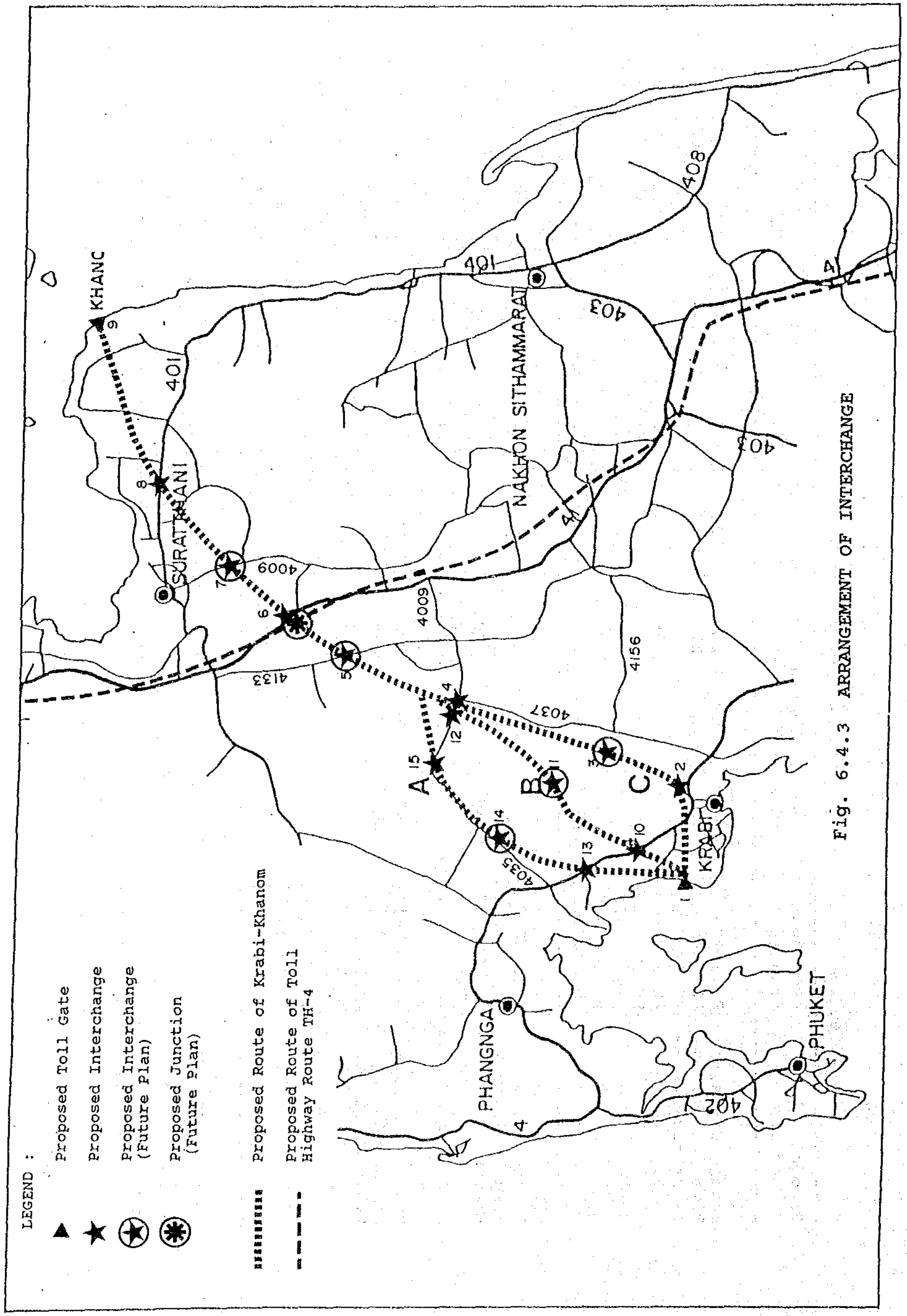


Fig. 6.4.3 ARRANGEMENT OF INTERCHANGE

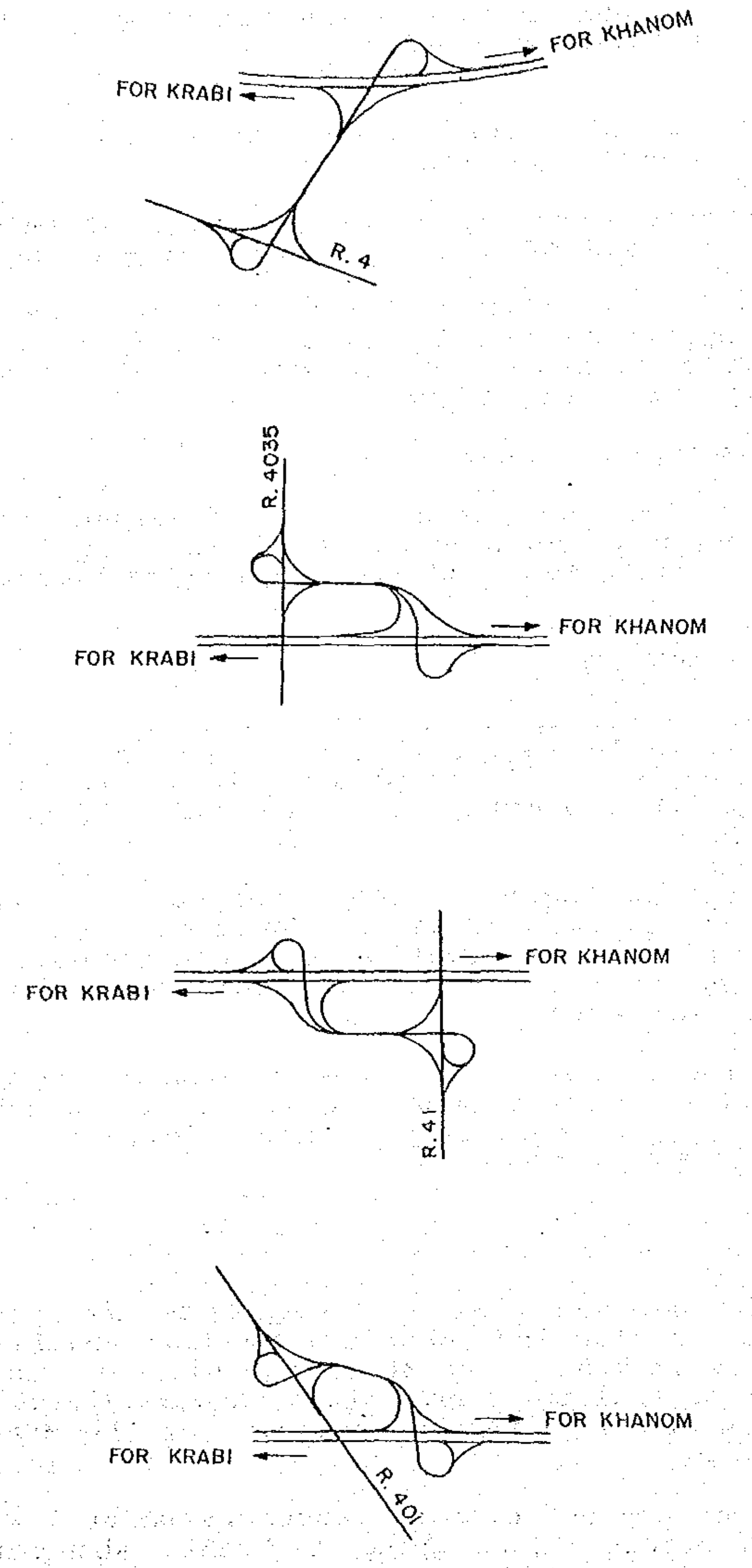


Fig. 6.4.4 CONFIGURATION OF INTERCHANGE

- In case it is inevitable to pass valley plain, a distance of 5 kilometers should be preserved from granite mountain stream and mouth of hollow;
- A distance of 2 kilometers should be preserved from mountain stream, outlet of valley, etc.;
- In case the route passes monadnock composed of limestone in alluvial plain, the route should be away from monadnock as far as three times of the height of monadnock;
- Large cut and fill should be avoided as much as possible;
- Embankment should be higher than the highest flood level in the past by 70 cm;
- Transversing drain facilities should be installed sufficiently enough to allow water flow from one side to another;
- Bridge should be designed to flow unrooted trees as much as possible so as not to disturb water flow;
- Abutment of bridge should be protected by concrete cover;
- Embankment should be protected by block-sodding as high as 1.5 meters from the root especially in flood prone area; and
- Additional shoulder width should be provided to protect the carriageway from rockfall.

6.5 Project Cost

Project cost was estimated for three alternative alignments of A, B and C based on the quantities of construction works and the prevailing unit costs in 1990.

Project costs for three alternatives are estimated:

million baht	Project Cost	(Construction Cost)
Alternative A	8,442.2	6,365.5
Alternative B	9,419.6	7,264.4
Alternative C	8,438.8	6,354.9

Project costs of Alternative A and C are estimated at around 8.4 billion baht while that of Alternative B is estimated at around 9.4 billion baht. The difference of project cost is attributable to tunnel cost for Alternative B.

Table 6.5.1 shows the details of project costs for each alternative. In case of Alternative C, earth work accounts for the highest composition rate of 52 % of the total construction cost, followed by surface works with 15 % and structure works with 13 %. Of the earth work, material cost for embankment is the largest cost item, accounting for as high as 41 % of the total construction cost.

6.6 Project Implementation Schedule

It will take five years to construct the Krabi - Khanom Highway Link as shown in Fig. 6.6.1 (Alternative C). The whole stretch of the project will be divided into fifteen - twenty sections.

The most critical factor for timely completion will be land acquisition. With the target year of completion at the end of 1998, land acquisition should be started section by section even before 1994.

6.7 Pipeline and Railway

This study focuses on the Krabi - Khanom Highway Link. The Highway Link follows the most gently sloping terrain in the Krabi - Khanom Corridor to allow the maximum gradient of 2 %. As shown in Fig. 6.2.1, the average width of highway is in the range of 80 - 100 meters between interchanges. This width includes additional lane space to the center side. At interchanges, however, width of the area required reaches 500 - 550 meters.

It is likely that the proposed alignment of the Highway Link will also be the best alignment for pipeline and railway with a view to keeping the gradient as gentle as possible.

Pipeline can be laid down along the Highway Link with no particular problems. For developing oil refinery and petrochemical industries at the earliest stage of the SSDP, however, pipeline might be required to be constructed earlier than the Highway Link. In this case, highway construction work will be constrained to some degree.

Railway construction along the Highway Link will cause problems particularly at interchange areas. Proposed interchanges should be modified to allow vertical clearance requirements of the railway.

Table 6.5.1 PROJECT COST FOR THE KRABI - KHANOM HIGHWAY LINK

Quantities and Construction costs

ITEM	Unit	Financial Unit Cost Baht	Alternative A Quantity	Alternative A Financial Total cost 1000 Baht	Alternative B Quantity	Alternative B Financial Total cost 1000 Baht	Alternative C Quantity	Alternative C Financial Total cost 1000 Baht
EARTH WORK								
Clearing & Grubbing	SQ.M	1	11,668,488	11,668	11,413,922	11,414	11,804,997	11,805
Roadway Excavation(Unclassified)	CU.M	30	3,832,921	114,988	1,766,343	52,990	2,739,670	82,190
Embankment(Borrowed Material)	CU.M	100	26,611,418	2,661,142	28,011,652	2,801,165	26,134,246	2,613,425
Slope Protection								
Stripe Sodding	SQ.M	6	4,534,246	27,205	4,598,650	27,592	4,408,049	26,448
Sodding	SQ.M	9	362,515	3,263	206,260	1,856	319,885	2,879
Shot Crete(Ferro Cement)	SQ.M	600	40,279	24,167	22,918	13,751	35,540	21,324
Block Sodding	SQ.M	450	525,950	236,678	477,375	214,819	632,145	284,465
Sand Mat	CU.M	260	463,500	120,510	463,500	120,510	463,500	120,510
Sand Pile (0.40 m)	M	100	1,123,556	112,356	1,123,556	112,356	1,123,556	112,356
SUB TOTAL				3,311,977		3,356,453		3,275,402
SUBBASE AND BASE								
Subbase(Soil Aggregate)	CU.M	190	904,560	171,866	877,592	166,742	924,108	175,581
Base Coarses(Crush Stone)	CU.M	280	1,014,297	284,003	984,056	275,536	1,036,215	290,140
SUB TOTAL				455,870		442,278		465,721
SURFACE								
Asphaltic Prime coat	SQ.M	13	4,800,960	62,412	4,657,820	60,552	4,904,700	63,761
Asphaltic Tack coat	SQ.M	7	3,972,220	27,806	3,853,780	26,976	4,058,060	28,406
Asphalt concrete (Surfacing)	CU.M	1,900	198,611	377,361	192,689	366,109	202,903	385,516
(Binder Coarse)	CU.M	1,900	240,048	456,091	232,891	442,493	245,235	465,947
SUB TOTAL				923,670		896,130		943,630
STRUCTURES(Equivalent)								
RC Pipe Culvert(D=1000 m)	M	2,650	34,993	92,731	34,244	90,747	35,474	94,006
(D=1500 m)	M	4,900	502	2,460	359	1,759	756	3,704
RC Box Culvert(1-2.40*2.40 m)	M	5,700	204	1,163	204	1,163	136	775
(2-2.40*2.40 m)	M	11,400	517	5,894	519	5,917	297	3,386
(1-3.00*2.50 m)	M	6,600	2,672	17,635	2,282	15,061	2,666	17,596
RC Bridge (W=13.5 m) L=10 m	M	86,400	3,400	293,760	2,400	207,360	2,920	252,288
PC Bridge (W=13.5 m) L=20 m	M	135,000	820	110,700	1,180	159,300	1,100	148,500
(W=13.5 m) L=30 m	M	162,000	1,372	222,264	1,072	173,664	1,378	223,236
(W=13.5 m) L=50 m	M	202,500	340	68,850	340	68,850	340	68,850
Over Bridge (W=6.0 m) L=30 m	M	84,000	120	10,080	0	0	120	10,080
Bearing Unit	Ls	100,000	200	20,000	200	20,000	200	20,000
SUB TOTAL				845,537		743,820		842,421
TUNNEL								
Tunnel	Ls				432,216,000	864,432		
Tunnel Facility	Ls				37,000,000	74,000		
SUB TOTAL						938,432		
Interchange	Ls	100,000,000	4	400,000	4	400,000	4	400,000
Center Toll Gate	Ls	6,000,000	2	12,000	2	12,000	2	12,000
SUB TOTAL				412,000		412,000		412,000
TOTAL (a)				5,949,053		6,789,113		5,939,173
Miscellaneous Works [(a)*7%]	Ls	1		416,434		475,238		415,742
CONTRACT AMOUNT (b)				6,365,487		7,264,351		6,354,915
PHYSICAL CONTINGENCIES[(b)*10%](c)				636,549		726,435		635,492
ENGINEERING & SUPERVISION [((b)+(c))*10%](d)	Ls	1		700,204		799,079		699,041
LAND ACQUISITION(Average) (e)	SQ.M	19	38,696,000	739,990	37,466,000	629,750	39,500,000	749,380
PROJECT COST [(b)+(c)+(d)+(e)]				8,442,229		9,419,615		8,438,828
AVERAGE COST PER KM				43,634		49,852		42,728
		Km		Project Length L=193.48Km		Project Length L=188.95Km		Project Length L=197.50Km

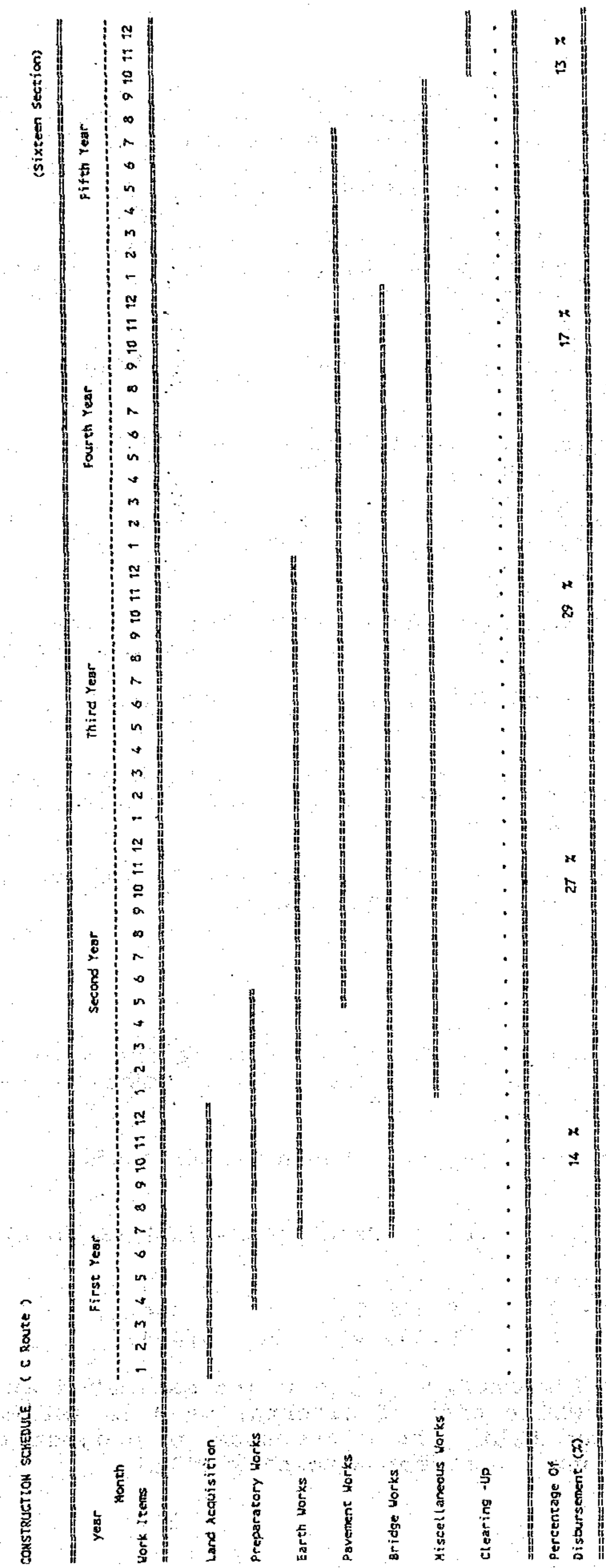


Fig. 6.6.1 CONSTRUCTION SCHEDULE OF THE KRABI - KHANOM HIGHWAY LINK (ALTERNATIVE C)

7. Project Evaluation

7.1 Specific Characteristics of the Project

Economic benefits of the Krabi - Khanom Highway Link would exist in:

1) Formation of the SSDP by connecting the Krabi Seaboard on the west coast with the Khanom Seaboard on the east coast to promote international investments;

2) Accelerating development of the Southern Region through the formation of the SSDP;

3) Encouraging decentralization of economic activities away from Bangkok through the formation of the SSDP;

4) Improving accessibility in the Krabi - Khanom Corridor to induce higher productivity;

5) Encouraging international trade between Bangkok and the Middle Asia; and

6) Possible foreign exchange earnings by way of diverting container transport from the Strait of Malacca to the Land Bridge.

The most important role of the Land Bridge is to turn the Krabi - Khanom Corridor into one of the most advantageous industrial location in an international trading context. In case of without the Land Bridge, Krabi and Khanom areas remain as an independent seaboard, just facing to one side of the Peninsula, calling for a detour to the Strait of Malacca as in the past. Development momentum of the SSDP would be greatly reduced in this case.

The SSDP will be non-existent in case of without the Land Bridge. In consequence, measurable economic benefit accruing to the Land Bridge will be some part of the production increment by the SSDP or some part of the possible land price rise reflecting improvement of the land productivity in the Krabi - Khanom Corridor.

It seems uncertain at the present time that the Land Bridge will contribute to earn foreign exchange to the country through passage charges on containers. As explained before, additional loading and unloading charges required for the Land Bridge is likely to exceed the operation cost of container ships through the Strait of Malacca over the extra 850 kilometers. This infers that passage charges over the Land Bridge should be kept minimum in case of trying to make the Land Bridge competitive with the Strait of Sunda. It would be unlikely that the passage charges will produce residual reserves of foreign exchange earnings after compensating actual construction and operation costs incurred. In case of competing with the straits of Sunda and Lombok, the Land Bridge might contribute to earn foreign exchanges to the country.

Major economic benefit of the Land Bridge would be in the production increment coupled with the increased employment opportunities or the land price rise through the formation of the SSDP.

It is likely that international community participating in the SSDP would have substantial economic benefit particularly in terms of logistics of oil products. At the moment, however, it is still intangible.

7.2 Economic Viability Test

Economic viability of the project was tested based on the project cost stream and benefit stream which was derived from the production increment by the SSDP.

Economic project cost excluding maintenance cost was estimated as shown below:

Alternative A:	7,442.4 million baht
Alternative B:	8,503.1
Alternative C:	7,443.0

The project cost was distributed for the five years from 1994 to 1998 in accordance with the implementation schedule.

Economic benefit of the project was assumed to be a part of the production increment of the SSDP as discussed in Section 3.2:

Year 2001:	18,080 million baht
2006:	60,950
(2011:	138,000 - per capita of the Southern Region equal to the national average)

Table 7.2.1 summarizes the viability check of the project. The table indicates that the project will be viable if the contribution of the project to the SSDP can be counted at 3 % of the production increment. Economic internal rate of return (EIRR) at 3 % contribution is calculated at 14.8 % for Alternative A and C, and at 13.7 % for Alternative B.

Table 7.2.1 Viability Check of the Krabi - Khanom Highway Link

	Part	NPV(12%)	B/C(12%)	EIRR
Alternative A	5 %	4,833.4	2.4	19.3
	4 %	3,151.1	1.9	17.3
	3 %	1,468.8	1.4	14.8
	2 %	-213.5	0.9	11.5
Alternative B	5 %	4,338.8	2.1	18.1
	4 %	2,656.5	1.7	16.1
	3 %	974.2	1.2	13.7
	2 %	-708.1	0.8	10.5
Alternative C	5 %	4,833.9	2.4	19.3
	4 %	3,151.6	1.9	17.3
	3 %	1,469.3	1.4	14.8
	2 %	-213.0	0.9	11.5

Note: "Part" indicates a part of the production increment of the SSDP counted in the economic benefit.
NPV - Net Present Value at 12 %
B/C - Benefit Cost Ratio at 12 %
EIRR - Economic Internal Rate of Return

In Alternative C at 3 % contribution, the EIRR will be declined to 13.3 % by 20 % cost up and to 13.0 % by 20 % benefit down. Combined effect of cost up and benefit down by 20 % each will lower the EIRR to 11.5 %.

7.3 Land Acquisition Requirements

In the above viability test, it was assumed that the right of way for the Krabi - Khanom Highway Link would be acquired in 1994. In case that the land acquisition is started earlier, for instance, 50 % in 1992 and 25 % each in 1993 and 1994, the EIRR will slightly decline to 14.6 % for Alternative A of 3 % contribution.

Land price along the highway corridor is likely to rise faster than the average price index by reflecting the involvement of speculation. If the land price is tripled, the EIRR for Alternative A will further decline to 12.7 %.

Land acquisition cost for Alternative A is estimated at 740 million baht, accounting for 8.8 % of the total investment of 8,442 million baht. If the land price is tripled, it amounts to 2,220 million baht to increase the total investment to 9,922 million baht, 17.5 % higher than the estimated investment cost.

In order to prevent land price hike, land transaction in the highway corridor should be regulated and restricted at the earliest possible time although undefined land ownership might disturb the effective regulation. Rules and regulations on the land transaction seem essential to the successful implementation of the SSDP not only for the Land Bridge but also for industrial estates, distribution centers and urban centers.

II ENGINEERING STUDY

1. SUMMARY

This part summarzises the results of the engineering study on the Krabi - Khanom Highway Link as a part of the "Trans-Thai Land Bridge" which forms a core component of the Southern Seaboard Development Program (SSDP).

Based on the basic concept of the Land Bridge to connect east and west coasts of the Peninsula at the shortest distance, alignment of the Krabi - Khanom Highway Link follows the possible shortest route as long as the maximum gradient of 2 percent can be attained for the Highway Link with no difficulty.

In terms of alignment, however, the mountain area near Krabi city is the only obstacle to find the shortest distance with gentle gradient. This study proposes three alternatives how to pass the mountain area with a view to preparing a wider selection for the coming SSDP master plan study to be carried out by the Office of the Southern Seaboard (OSSB).

The SSDP is expected to be developed based on an active participation of international community. The planning framework of the SSDP, therefore, will be vulnerable to change by reflecting the international economic situations. Infrastructure investment should be developed in a phased manner so as to cope with the possible change of development pace.

This study proposes the four lane highway development for the initial stage with possible addition of two lanes in the later stage. Traffic demand forecast indicates that four lane highway will be sufficient for about ten years after the completion of the Krabi - Khanom Highway Link on an assumption that pipeline to carry oil and its products will be constructed at the same time.

Measures to prevent damages caused by natural disaster are particularly important in the corridor to ensure undisturbed transport service between Krabi and Khanom ports. Alignment was selected to avoid mud flow and measures were installed to prevent flooding damages.

Construction cost of the Highway Link is estimated at about 8.5 billion baht for two alternatives and 9.4 billion baht for the remaining alternative which needs tunnel construction. Construction period is estimated at about five years although it depends largely on the period required for land acquisition.

2. TRAFFIC FORECAST

unit: vehicle/day

Section		1	2	3	4	5
ALTERNATIVE A:						
2001	ADT	310	3,800	3,182	3,457	4,661
	Car	0	1,257	1,036	1,324	2,365
	Truck	310	2,111	1,726	1,814	1,863
	Bus	0	432	420	319	433
2006	ADT	1,718	9,217	9,738	9,706	11,947
	Car	0	3,011	3,242	3,381	5,211
	Truck	1,718	5,280	5,451	5,396	5,651
	Bus	0	926	1,045	929	1,085
ALTERNATIVE B:						
2001	ADT	312	4,209	3,265	3,158	4,654
	Car	0	1,414	1,049	1,216	2,359
	Truck	312	2,322	1,775	1,643	1,862
	Bus	0	473	441	299	433
2006	ADT	1,721	8,924	10,106	9,429	10,671
	Car	0	2,891	3,316	3,333	4,633
	Truck	1,721	5,126	5,726	5,171	5,071
	Bus	0	907	1,064	925	967
ALTERNATIVE C:						
2001	ADT	775	3,187	2,695	2,883	4,227
	Car	0	981	818	1,086	2,149
	Truck	775	1,814	1,495	1,518	1,689
	Bus	0	392	382	279	389
2006	ADT	2,601	8,682	9,231	9,036	11,456
	Car	0	2,758	3,001	3,028	4,937
	Truck	2,601	5,011	5,229	5,165	5,553
	Bus	0	913	1,001	843	966

Note: Section 1: Krabi Port - Route No. 4
Section 2: Route No. 4 - Route No. 4035
Section 3: Route No. 4035 - Route No. 41
Section 4: Route No. 41 - Route No. 401
Section 5: Route No. 401 - Khanom Port

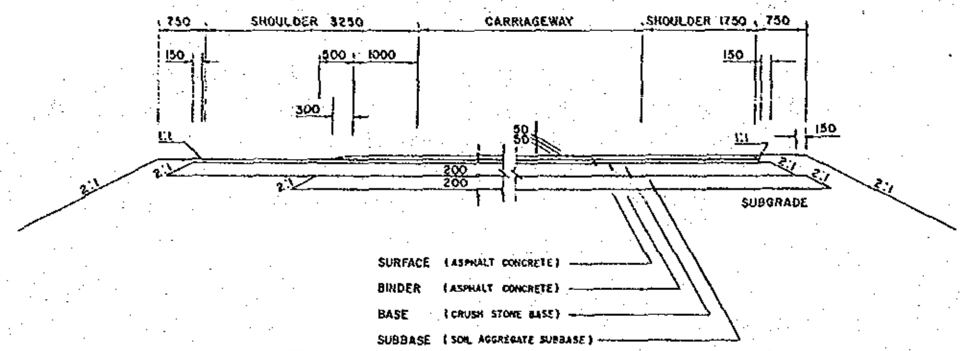
3. DESIGN STANDARD AND CONDITIONS

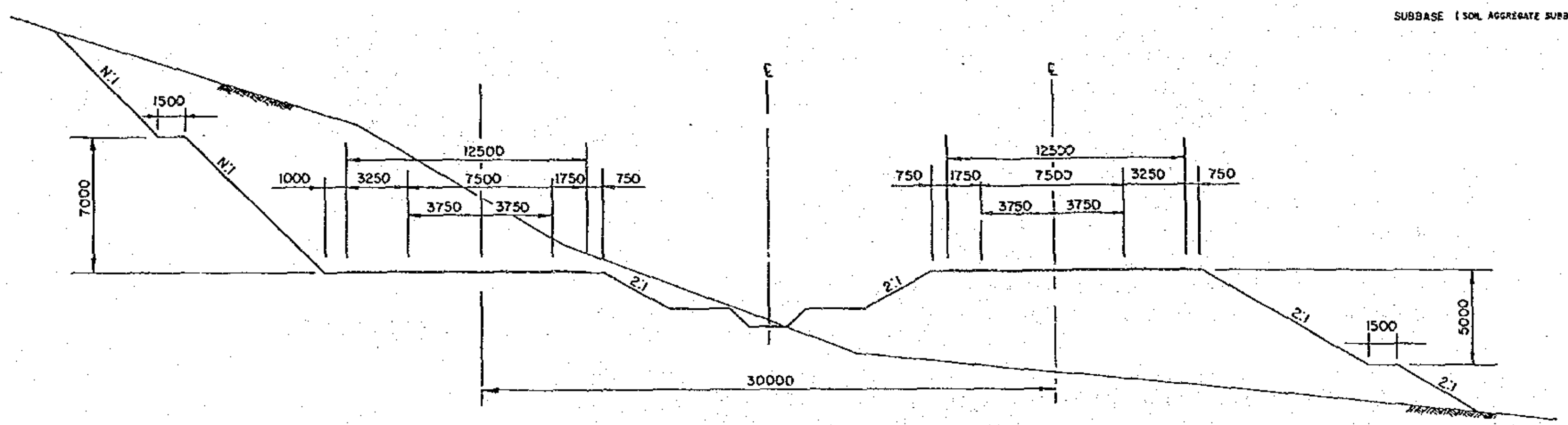
Geometric Design Criteria

Terrain		Flat	Rolling or Mountainous
Design Speed (km/h)	:	120	120
Max. Gradient (%)	:	2 (3)	2 (4)
Min. Radius & Curvature (m)	:	1,500 (1,030)	1,000 (710)
Min. Stopping Sight Distance (m)	:	400 (290)	400 (290)

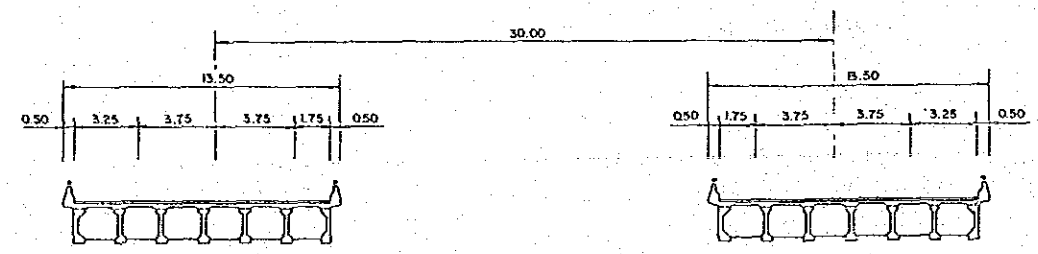
Note ( ): Allowable Value

DETAIL OF PAVEMENT

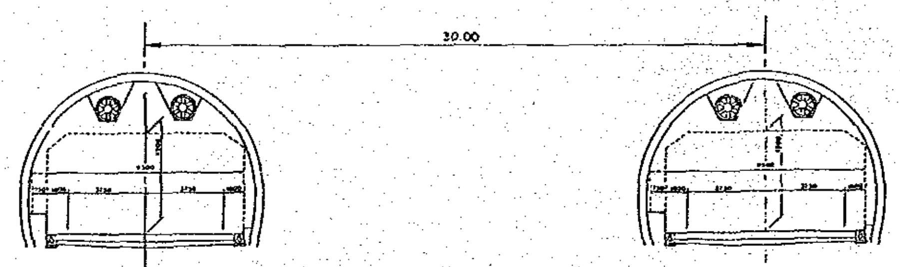




TYPICAL EARTHWORK SECTION



TYPICAL BRIDGE SECTION



TYPICAL TUNNEL SECTION

4. LIST OF BRIDGES

Bridges Crossing River on Alternative-A

Station	Name of River/Khlong	F/L (m)	B/L (m)	Angle (deg.)	D/A (km2)	D (qm)	Bridge Type	Length (m)	Spans	Remarks
0 + 120	K.Sai	3.3	-2.1	90	5	40	RC.SLAB	20.0	= 2@10.0	Type L
1 + 430	K.Hin Pun	5.2	-2.1	60	6	35	RC.SLAB	20.0	= 2@10.0	Type H
2 + 300	K.Bo Kang	8.2	-1.5	60	7	24	RC.SLAB	10.0	= 1@10.0	Type H
4 + 450		26.0	20.0	90			RC.SLAB	10.0	= 1@10.0	Type L
5 + 320	K.Tha Hin Dan	17.5	8.0	60	16	53	RC.SLAB	20.0	= 2@10.0	Type H
7 + 450	K.Sai	33.6	27.0	60	10	46	RC.SLAB	20.0	= 2@20.0	Type H
12 + 600	K.Nai Nang (B1)	19.1	10.0	60	67	66	PC.GRDR	30.0	= 1@30.0	
							RC.SLAB	220.0	=22@10.0	Type H
15 + 570	K.Khrai	19.4	14.0	90	4	32	RC.SLAB	20.0	= 2@10.0	Type L
17 + 770	K.Hin	40.8	32.2	60	49	65	RC.SLAB	30.0	= 3@10.0	Type H
23 + 670	K.Ao Luk Noi	33.3	27.0	90	41	68	RC.SLAB	30.0	= 3@10.0	Type L
32 + 500		57.7	48.6	90			RC.SLAB	10.0	= 1@10.0	Type H
40 + 950	K.Bang Lieo	42.6	36.9	80	16	38	RC.SLAB	20.0	= 2@10.0	Type L
42 + 350	K.Bang Lieo	37.6	32.0	60	16	38	RC.SLAB	20.0	= 2@10.0	Type L
43 + 50	K.Bang Lieo	39.8	32.2	60	16	38	RC.SLAB	20.0	= 2@10.0	Type H
46 + 350	K.Bang Lieo	30.2	22.7	90	154	266	RC.SLAB	90.0	= 9@10.0	Type H
50 + 970	K.Ya	26.3	21.0	60	14	45	RC.SLAB	20.0	= 2@10.0	Type L
52 + 260	K.Ya	26.0	20.9	90	51	106	RC.SLAB	40.0	= 4@10.0	Type L
57 + 370	K.I PAN	27.5	22.2	80	520	500	RC.SLAB	170.0	=17@10.0	Type L
59 + 000		36.8	28.0	90			RC.SLAB	10.0	= 1@10.0	Type H
59 + 400	K.I PAN	40.5	31.0	90	5	29	RC.SLAB	10.0	= 1@10.0	Type H
67 + 990	K.I PAN	28.9	23.0	80	791	751	PC.GRDR	60.0	= 3@20.0	
70 + 560		35.5	27.1	90			RC.SLAB	10.0	= 1@10.0	Type H
71 + 470	K.Bang Yot	40.8	34.8	60	14	48	RC.SLAB	20.0	= 2@10.0	Type L
72 + 630	Bang Tao	59.5	53.0	60	6	31	RC.SLAB	10.0	= 1@10.0	Type H
76 + 200	Bang Di	88.3	82.0	60	4	53	RC.SLAB	20.0	= 2@10.0	Type L
79 + 500		71.7	63.0	90			RC.SLAB	10.0	= 1@10.0	Type H
82 + 100	K.Bang Pha	69.0	62.7	80	2	19	RC.SLAB	10.0	= 1@10.0	Type L
				(Subtotal	Main Link : 28 Bridges in 980.0m)					
82 + 100	<Intersecting Control Point with C-Route>									

Bridges Crossing River on Alternative-B

Station	Name of River/Khlong	F/L (m)	B/L (m)	Angle (deg.)	D/A (km2)	D (qm)	Bridge Type	Length (m)	Spans	Remarks
1 + 480	K.Hin Pun	7.5	-2.0	60	5	29	RC.SLAB	10.0	= 1@10.0	Type H
3 + 350	K.Bo Kang	15.0	6.4	80	6	29	RC.SLAB	10.0	= 1@10.0	Type H
6 + 700	K.Tha Hin Dan	13.4	5.7	60	12	66	RC.SLAB	30.0	= 3@10.0	Type H
8 + 300	K.Sai	24.3	15.5	80	6	39	RC.SLAB	20.0	= 2@10.0	Type H
13 + 950	K.Haeng	21.6	16.0	80	12	61	RC.SLAB	30.0	= 3@10.0	Type L
15 + 30	K.Khao Mai Kaeo	22.8	16.2	60	34	70	RC.SLAB	30.0	= 3@10.0	Type H
21 + 50	K.Ta Khong	40.8	33.9	60	21	41	RC.SLAB	20.0	= 2@10.0	Type H
30 + 370	K.Ya	73.4	67.0	70	28	77	RC.SLAB	30.0	= 3@10.0	Type L
33 + 460	K.Ya	74.3	69.4	90	10	43	RC.SLAB	20.0	= 2@10.0	Type L
36 + 100	K.Khao Khaeo	64.2	55.8	90	4	32	RC.SLAB	20.0	= 2@10.0	Type H
39 + 800	K.Pho Thak	62.4	53.8	60	7	52	RC.SLAB	20.0	= 2@10.0	Type H
41 + 970	Huai Mae Mu	52.0	45.3	70	24	63	RC.SLAB	30.0	= 3@10.0	Type H
48 + 320	K.Phang	76.5	71.0	90	17	80	RC.SLAB	30.0	= 3@10.0	Type L
51 + 950	K.Bang Hoi	74.6	69.5	60	3	22	RC.SLAB	10.0	= 1@10.0	Type L
53 + 400	Ban Plai K.	64.4	59.2	90	9	37	RC.SLAB	20.0	= 2@10.0	Type L
56 + 230	K.Sok	50.2	43.2	60	13	27	RC.SLAB	10.0	= 1@10.0	Type H
65 + 750	K.I PAN	28.2	22.5	70	1012	841	PC.GRDR	60.0	= 3@20.0	
69 + 100	Bang Ton Madua	32.6	25.5	90	7	26	RC.SLAB	10.0	= 1@10.0	Type H
69 + 650	Bang Ton Madua	38.3	33.0	60	4	35	RC.SLAB	20.0	= 2@10.0	Type L
71 + 950		72.2	62.7	90			RC.SLAB	10.0	= 1@10.0	Type H
				(Subtotal	Main Link : 20 Bridges in 440.0m)					
72 + 150	<Intersecting Control Point with C-Route>									

Bridges Crossing River on Alternative-C

Station	Name of River/Khlong	F/L (m)	B/L (m)	Angle (deg.)	D/A (km2)	D (qm)	Bridge Type	Length (m)	Spans	Remarks
0 + 200	K.Sai	3.8	-1.9	60	7	64	RC.SLAB	30.0	= 3@10.0	Type L
2 + 280	K.Hin Pun	23.2	13.4	70	3	32	RC.SLAB	20.0	= 2@10.0	Type H
5 + 200	K.Khao Klom	44.0	37.0	80	40	69	RC.SLAB	30.0	= 3@10.0	Type H
9 + 0	K.Nong Thale	37.5	32.0	70	5	43	RC.SLAB	20.0	= 2@10.0	Type L
14 + 440		23.2	18.8	90			RC.SLAB	10.0	= 1@10.0	Type L
16 + 630	K.Krabi Yai (B2)	21.5	12.2	60	144	202	PC.GRDR	28.0	= 1@28.0	
23 + 800	Huai Somchaek	20.9	14.0	60	12	54	RC.SLAB	20.0	= 2@10.0	Type L
24 + 730	Huai Chong Lom	11.2	6.0	90	10	61	RC.SLAB	30.0	= 3@10.0	Type L
27 + 100	K.Krabi Noi (B3)	25.6	15.3	60	15	56	PC.GRDR	60.0	= 3@20.0	
27 + 870	K.Phraek San	22.0	16.0	60	10	59	RC.SLAB	20.0	= 2@10.0	Type L
35 + 100	K.Haeng	62.8	56.0	80	27	130	RC.SLAB	50.0	= 5@10.0	Type H
36 + 670	K.Pakasai	64.5	56.0	90	18	61	RC.SLAB	30.0	= 3@10.0	Type H
42 + 300	K.Chang Tai	55.4	48.9	60	12	64	RC.SLAB	30.0	= 3@10.0	Type H
42 + 530	K.Chang Tai	53.0	46.8	80	12	64	RC.SLAB	30.0	= 3@10.0	Type L
46 + 220	K.Yik	62.4	55.8	80	2	29	RC.SLAB	10.0	= 1@10.0	Type H
48 + 100	K.Bang San	41.8	33.2	80	164	232	RC.SLAB	80.0	= 8@10.0	Type H
50 + 650		40.9	34.9	90			RC.SLAB	10.0	= 1@10.0	Type L
52 + 900		40.5	36.2	90			RC.SLAB	10.0	= 1@10.0	Type L
54 + 800		43.0	38.0	90			RC.SLAB	10.0	= 1@10.0	Type L
55 + 900		42.4	37.0	90			RC.SLAB	10.0	= 1@10.0	Type L
57 + 530	Huai Bang Taen	48.8	39.0	70	32	34	RC.SLAB	20.0	= 2@10.0	Type H
60 + 280	K.Phang	38.4	32.2	90	71	128	RC.SLAB	50.0	= 5@10.0	Type L
63 + 160	K.Bang Hoi	38.1	31.5	60	34	49	RC.SLAB	20.0	= 2@10.0	Type H
65 + 650	Ban Khlong Sok	27.2	20.4	70	43	65	RC.SLAB	30.0	= 3@10.0	Type H
71 + 250	Bang Lo	31.2	22.3	60	18	46	RC.SLAB	20.0	= 2@10.0	Type H
74 + 180	K.I PAN (B4)	34.3	23.2	90	1283	1070	PC.GRDR	40.0	= 2@20.0	
							PC.GRDR	35.0	= 1@35.0	
77 + 600	Bang Ton Madua	33.3	26.4	80	7	34	RC.SLAB	20.0	= 2@10.0	Type H
78 + 150	Bang Ton Madua	39.2	34.4	60	4	40	RC.SLAB	20.0	= 2@10.0	Type L
80 + 500		72.3	63.0	90			RC.SLAB	10.0	= 1@10.0	Type H
				(Subtotal	Main Link : 30 Bridges in 803.0m)					
80 + 700	<Intersecting Control Point with B-Route>									
82 + 850	K.Bang Pha	77.0	71.9	80	2	27	RC.SLAB	10.0	= 1@10.0	Type L
				(Subtotal	Main Link : 1 Bridges in 10.0m)					
86 + 120	<Intersecting Control Point with A-Route>									
86 + 150	K.Bang Pha	69.2	63.6	60	22	64	RC.SLAB	30.0	= 3@10.0	Type L
99 + 550	K.Bang Pra	41.3	36.0	80	113	286	RC.SLAB	100.0	=10@10.0	Type L
110 + 450	MAE NAM TA PI (B5)	27.1	10.1	80	4948	(2454)	PC.GRDR	170.0	= 4@30.0 +1@50.0	
110 + 850		30.5	21.1	90			RC.SLAB	10.0	= 1@10.0	Type H
111 + 430	Huai Wang Phai	35.5	27.0	60	16	26	RC.SLAB	10.0	= 1@10.0	Type H
112 + 750		45.1	40.1	90			RC.SLAB	10.0	= 1@10.0	Type L
114 + 000		43.7	39.0	90			RC.SLAB	10.0	= 1@10.0	Type L
115 + 000		42.3	39.0	90			RC.SLAB	10.0	= 1@10.0	Type L
118 + 200		38.1	31.7	90			RC.SLAB	10.0	= 1@10.0	Type L
120 + 560	K.Lon Phun	23.4	16.8	60	198	292	RC.SLAB	100.0	=10@10.0	Type H
121 + 600	K.Ya (B6)	22.7	15.1	70	108	195	PC.GRDR	50.0	= 2@25.0	
							RC.SLAB	40.0	= 4@10.0	Type H
126 + 150	Nong Chut	16.0	10.2	90	20	32	RC.SLAB	20.0	= 2@10.0	Type L
133 + 340	K.Tha Rae	21.0	13.2	60	40	35	RC.SLAB	20.0	= 2@10.0	Type H
138 + 900	K.Bang Duan	19.9	12.2	60	185	339	RC.SLAB	120.0	=12@10.0	Type H
148 + 450	K.Thap Thon	11.8	6.4	70	103	189	RC.SLAB	70.0	= 7@10.0	Type L
153 + 350	K.Kradae (B7)(22.0)	25.4	16.3	60	251	357	PC.GRDR	30.0	= 1@30.0	
160 + 270	K.Ram	17.3	11.5	60	82	177	RC.SLAB	60.0	= 6@10.0	Type L
159 + 360		24.7	19.0	90			RC.SLAB	10.0	= 1@10.0	Type L
167 + 80	K.Na	20.3	13.0	80	61	136	RC.SLAB	50.0	= 5@10.0	Type H
170 + 600	K.Tha Thong (B8)	23.3	12.0	80	325	389	PC.GRDR	56.0	= 2@28.0	
174 + 900	K.Ban Niak	26.5	19.6	60	33	108	RC.SLAB	40.0	= 4@10.0	Type H
177 + 800	K.Tha Lamphu	34.9	29.0	70	9	48	RC.SLAB	20.0	= 2@10.0	Type L
182 + 50	K.Bang Som	35.3	30.0	70	27	88	RC.SLAB	30.0	= 3@10.0	Type L
183 + 350		31.0	25.0	90			RC.SLAB	10.0	= 1@10.0	Type L
190 + 550	K.Ban Nian	26.6	21.0	70	29	56	RC.SLAB	20.0	= 2@10.0	Type L
				(Subtotal	Main Link : 26 Bridges in 1,106.0m)					

Bridges Crossing Road on Alternative-A

Station	Name of Road		F/L (m)	G/L (m)	Clearance(m) Vert.	Clearance(m) Hor'l.	Angle (deg.)	Bridge Type	Length Spans	Remarks
4 + 500	DOH	Rt.4034	25.8	20.4	4.3	9.0	60	PC.GRDR	30.0=1@30.0	
21 + 650	DOH	Rt.4	47.5	41.5	4.9	2x11.0	60	PC.GRDR	60.0=2@30.0	
31 + 300	OV		50.4	56.3	4.9	2x12.5	90	PC.GRDR	60.0=2@30.0	W= 6.0m
32 + 800	OV		59.1	65.0	4.9	2x12.5	70	PC.GRDR	60.0=2@30.0	W= 6.0m
46 + 600	DOH	Rt.4035	31.8	25.4	4.3	9.0	60	PC.GRDR	30.0=1@30.0	
49 + 400	DOH	Rt.4035	34.2	29.1	4.3	9.0	60	PC.GRDR	30.0=1@30.0	
54 + 130	DOH	Rt.4035	35.2	29.9	4.3	9.0	60	PC.GRDR	30.0=1@30.0	
59 + 500	DOH	Rt.4035	42.2	36.3	4.3	9.0	60	PC.GRDR	30.0=1@30.0	
66 + 550	DOH	Rt.4035	37.2	32.0	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
					(Subtatal Main Link : 7 Bridges, 240.0m)					
					(Over Roads : 2 Bridges, 120.0m)					
82 + 100 <Intersecting Control Point with C-Route>										

Bridges Crossing Road on Alternative-B

Station	Name of Road		F/L (m)	G/L (m)	Clearance(m) Vert.	Clearance(m) Hor'l.	Angle (deg.)	Bridge Type	Length Spans	Remarks
5 + 750	DOH	Rt.4034	32.3	27.0	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
7 + 150	PWD,ARD		24.8	19.5	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
8 + 0	PWD,ARD		25.1	19.5	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
11 + 250	PWD,ARD		34.8	29.5	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
13 + 0	PWD,ARD		28.5	13.0	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
19 + 300	DOH	Rt.4	39.2	33.3	4.9	2x11.0	60	PC.GRDR	60.0=2@30.0	
22 + 900	PWD,ARD		44.2	38.7	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
25 + 980	PWD,ARD		63.7	58.4	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
29 + 70	PWD,ARD		85.4	80.0	4.3	5.0	90	PC.SLAB	20.0=1@20.0	
36 + 530	PWD,ARD		68.0	63.0	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
40 + 70	PWD,ARD		61.0	55.6	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
66 + 730	DOH	Rt.4035	31.7	26.7	4.3	9.0	90	PC.GRDR	30.0=1@30.0	
					(Subtotal Main Link : 12 Bridges, 300.0m)					
72 + 150 <Intersecting Control Point with C-Route>										

Bridges Crossing Road and Railway on Alternative-C

Station	Name of Road		F/L (m)	G/L (m)	Clearance(m) Vert.	Clearance(m) Hor'l.	Angle (deg.)	Bridge Type	Length Spans	Remarks
5 + 100	DOH	Rt.4034	44.7	39.4	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
12 + 320			55.2	49.9	4.3	5.0	70	PC.SLAB	20.0=1@20.0	
13 + 450	DOH	Rt.4	38.8	32.8	4.9	2x11.0	60	PC.GRDR	60.0=2@30.0	
17 + 220	PWD,ARD		24.7	19.4	4.3	5.0	80	PC.SLAB	20.0=1@20.0	
18 + 560			23.3	18.0	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
27 + 230	PWD,ARD		26.2	20.9	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
37 + 700	OV(PWD,ARD)		84.5	91.0	4.9	2x12.5	60	PC.GRDR	60.0=2@30.0	W= 6.0m
42 + 930			54.6	49.3	4.3	5.0	80	PC.SLAB	20.0=1@20.0	
47 + 700	PWD,ARD		49.0	43.6	4.3	5.0	70	PC.SLAB	20.0=1@20.0	
53 + 900	DOH	Rt.4037	43.6	38.3	4.3	10.0	60	PC.GRDR	30.0=1@30.0	
56 + 250	DOH	Rt.4037	43.9	38.5	4.3	10.0	60	PC.GRDR	30.0=1@30.0	
58 + 50	DOH	Rt.4037	54.3	49.0	4.3	10.0	60	PC.GRDR	30.0=1@30.0	
65 + 120	OV		35.0	41.0	4.9	2x12.5	80	PC.GRDR	60.0=2@30.0	W= 6.0m
75 + 500	DOH	Rt.4035	38.2	32.2	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
					(Subtotal Main Link : 12 Bridges, 330.0m)					
					(Over Roads : 2 Bridges, 120.0m)					
80 + 700 <Intersecting Control Point with B-Route>										
86 + 120 <Intersecting Control Point with A-Route>										
106 + 400	DOH	Rt.4133	45.0	39.6	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
107 + 200	DOH	Rt.4212	42.3	36.8	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
114 + 400	PWD,ARD		45.6	40.1	4.3	5.0	80	PC.SLAB	20.0=1@20.0	
121 + 250	DOH	Rt.41	25.3	19.4	4.9	2x11.0	80	PC.GRDR	60.0=2@30.0	
125 + 370	Rail Way		20.7	25.4	4.2	3.5	60	RC.SLAB	10.0=1@10.0	
131 + 170	PWD,ARD		22.0	16.6	4.3	5.0	90	PC.SLAB	20.0=1@20.0	
133 + 520			21.3	16.0	4.3	5.0	70	PC.SLAB	20.0=1@20.0	
135 + 750			21.3	16.0	4.3	5.0	80	PC.SLAB	20.0=1@20.0	
136 + 800	DOH	Rt.4009	21.4	16.0	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
137 + 820			24.0	18.7	4.3	5.0	80	PC.SLAB	20.0=1@20.0	
138 + 630			21.4	16.1	4.3	5.0	70	PC.SLAB	20.0=1@20.0	
143 + 930	PWD,ARD		16.5	11.0	4.3	5.0	90	PC.SLAB	20.0=1@20.0	
147 + 130	PWD,ARD		18.4	13.0	4.3	5.0	90	PC.SLAB	20.0=1@20.0	
153 + 300	DOH	Rt.4143	25.0	19.0	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
161 + 100	DOH	RT.401	24.9	19.0	4.9	2x11.0	70	PC.GRDR	60.0=2@30.0	
163 + 0	PWD,ARD		21.4	16.0	4.3	5.0	90	PC.SLAB	20.0=1@20.0	
168 + 420	DOH	Rt.4177	25.4	20.0	4.3	9.0	80	PC.GRDR	30.0=1@30.0	
176 + 0	DOH	Rt.4142	38.3	33.0	4.3	9.0	60	PC.GRDR	30.0=1@30.0	
183 + 400	PWD,ARD		31.0	25.4	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
184 + 200	PWD,ARD		36.2	30.4	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
186 + 850	PWD,ARD		44.5	39.2	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
188 + 550	DOH	Rt.4142	38.7	33.0	4.3	9.0	60	PC.GRDR	30.0=1@30.0	
189 + 570	PWD,ARD		33.5	28.2	4.3	5.0	60	PC.SLAB	20.0=1@20.0	
193 + 200	PWD,ARD		20.5	15.2	4.3	5.0	90	PC.SLAB	20.0=1@20.0	
196 + 20	PWD,ARD		10.4	5.0	4.3	5.0	90	PC.SLAB	20.0=1@20.0	
					(Subtotal Main Link : 25 Bridges, 640.0m)					

5. LIST OF CULVERTS

LIST OF BOX CULVERTS ON ALTERNATIVE-A

Station	Culvert Type No. of Cells x Clear Span x Depth x Length	Number of Locations
1+150	RC-B2x2.40x2.40x32.00	2
3+400	RC-B1x3.00x2.50x20.00	2
5+800	RC-B1x3.00x2.50x29.00	2
7+700	RC-B1x3.00x2.50x19.00	2
10+000	RC-B1x3.00x2.50x19.00	2
10+650	RC-B1x3.00x2.50x19.00	2
10+920	RC-B2x2.40x2.40x24.00	2
11+400	RC-B1x3.00x2.50x19.00	2
12+000	RC-B1x3.00x2.50x19.00	2
12+450	RC-B1x3.00x2.50x19.00	2
13+450	RC-B1x3.00x2.50x19.00	2
14+170	RC-B1x3.00x2.50x19.00	2
16+950	RC-B1x3.00x2.50x21.00	2
18+020	RC-B1x3.00x2.50x19.00	2
19+160	RC-B1x3.00x2.50x19.00	2
23+200	RC-B1x3.00x2.50x21.00	2
24+550	RC-B1x3.00x2.50x19.00	2
24+900	RC-B1x3.00x2.50x21.00	2
27+320	RC-B1x3.00x2.50x19.00	2
27+970	RC-B1x3.00x2.50x19.00	2
30+100	RC-B1x3.00x2.50x19.00	2
33+950	RC-B1x3.00x2.50x23.00	2
35+170	RC-B1x3.00x2.50x21.00	2
37+000	RC-B1x3.00x2.50x19.00	2
40+050	RC-B1x3.00x2.50x19.00	2
40+550	RC-B1x3.00x2.50x19.00	2
42+650	RC-B1x3.00x2.50x19.00	2
43+300	RC-B1x3.00x2.50x19.00	2
45+750	RC-B1x3.00x2.50x19.00	2
47+850	RC-B1x3.00x2.50x19.00	2
48+180	RC-B1x3.00x2.50x19.00	2
48+500	RC-B1x3.00x2.50x25.00	2
51+130	RC-B2x2.40x2.40x22.00	2
56+300	RC-B1x3.00x2.50x19.00	2
63+800	RC-B1x3.00x2.50x19.00	2
65+300	RC-B1x3.00x2.50x19.00	2
67+260	RC-B1x3.00x2.50x25.00	2
67+580	RC-B1x3.00x2.50x21.00	2
68+870	RC-B1x2.40x2.40x34.00	2
69+420	RC-B2x2.40x2.40x26.00	2
74+560	RC-B2x2.40x2.40x27.00	2

Station	Culvert Type No. of Cells x Clear Span x Depth x Length	Number of Locations
78+700	RC-B2x2.40x2.40x82.00	1
97+800	RC-B1x3.00x2.50x21.00	2
100+050	RC-B1x3.00x2.50x19.00	2
100+100	RC-B2x2.40x2.40x28.00	2
103+550	RC-B1x3.00x2.50x19.00	2
106+700	RC-B1x2.40x2.40x32.00	2
108+050	RC-B1x3.00x2.50x19.00	2
111+350	RC-B1x3.00x2.50x21.00	2
115+900	RC-B1x3.00x2.50x19.00	2
117+580	RC-B1x3.00x2.50x19.00	2
117+980	RC-B1x3.00x2.50x19.00	2
119+750	RC-B1x3.00x2.50x19.00	2
121+550	RC-B1x3.00x2.50x25.00	2
122+000	RC-B1x3.00x2.50x19.00	2
123+500	RC-B1x3.00x2.50x19.00	2
124+400	RC-B2x2.40x2.40x20.50	2
127+580	RC-B1x3.00x2.50x19.00	2
140+040	RC-B1x3.00x2.50x19.00	2
141+250	RC-B1x3.00x2.50x19.00	2
142+320	RC-B1x3.00x2.50x19.00	2
144+500	RC-B1x2.40x2.40x18.00	2
145+500	RC-B1x2.40x2.40x18.00	2
146+450	RC-B1x3.00x2.50x23.00	2
150+030	RC-B1x3.00x2.50x19.00	2
154+250	RC-B1x3.00x2.50x21.00	2
156+600	RC-B1x3.00x2.50x25.00	2
158+700	RC-B1x3.00x2.50x19.00	2
160+450	RC-B1x3.00x2.50x19.00	2
161+500	RC-B1x3.00x2.50x23.00	2
162+650	RC-B1x3.00x2.50x21.00	2
163+900	RC-B1x3.00x2.50x19.00	2
166+550	RC-B1x3.00x2.50x19.00	2
167+450	RC-B1x3.00x2.50x19.00	2
169+900	RC-B1x3.00x2.50x19.00	2
170+300	RC-B1x3.00x2.50x19.00	2
172+000	RC-B1x3.00x2.50x19.00	2
174+700	RC-B1x3.00x2.50x19.00	2
177+100	RC-B1x3.00x2.50x19.00	2
193+130	RC-B2x2.40x2.40x76.00	1
195+200	RC-B1x3.00x2.50x19.00	2

LIST OF BOX CULVERTS ON ALTERNATIVE-B

Station	Culvert Type No. of Cells x Clear Span x Depth x Length	Number of Locations
1+150	RC-B1x2.40x2.40x34.00	2
1+780	RC-B1x3.00x2.50x31.00	2
3+020	RC-B1x2.40x2.40x30.00	2
4+000	RC-B1x3.00x2.50x19.00	2
6+950	RC-B1x3.00x2.50x25.00	2
8+350	RC-B1x3.00x2.50x19.00	2
10+400	RC-B1x3.00x2.50x19.00	2
13+250	RC-B1x3.00x2.50x23.00	2
13+500	RC-B1x3.00x2.50x23.00	2
17+040	RC-B1x3.00x2.50x19.00	2
18+100	RC-B1x3.00x2.50x19.00	2
18+900	RC-B1x3.00x2.50x21.00	2
20+080	RC-B1x3.00x2.50x19.00	2
20+650	RC-B1x3.00x2.50x19.00	2
21+600	RC-B1x3.00x2.50x19.00	2
24+000	RC-B1x3.00x2.50x19.00	2
24+900	RC-B1x3.00x2.50x19.00	2
27+850	RC-B1x3.00x2.50x19.00	2
29+750	RC-B1x3.00x2.50x19.00	2
32+150	RC-B1x3.00x2.50x23.00	2
32+550	RC-B2x2.40x2.40x22.00	2
34+050	RC-B1x2.40x2.40x30.00	2
50+100	RC-B1x2.40x2.40x27.00	2
52+570	RC-B2x2.40x2.40x22.00	2
53+950	RC-B1x2.40x2.40x20.00	2
54+700	RC-B1x3.00x2.50x19.00	2
56+030	RC-B1x3.00x2.50x19.00	2
57+550	RC-B1x3.00x2.50x19.00	2
65+350	RC-B1x3.00x2.50x19.00	2
65+930	RC-B1x3.00x2.50x19.00	2
68+150	RC-B1x3.00x2.50x19.00	2
68+550	RC-B1x3.00x2.50x19.00	2
81+130	RC-B2x2.40x2.40x22.00	2
97+800	RC-B1x3.00x2.50x21.00	2
100+050	RC-B1x3.00x2.50x19.00	2
100+100	RC-B2x2.40x2.40x28.00	2

Station	Culvert Type No. of Cells x Clear Span x Depth x Length	Number of Locations
103+550	RC-B1x3.00x2.50x19.00	2
106+700	RC-B1x2.40x2.40x32.00	2
108+050	RC-B1x3.00x2.50x19.00	2
111+350	RC-B1x3.00x2.50x21.00	2
115+900	RC-B1x3.00x2.50x19.00	2
117+580	RC-B1x3.00x2.50x19.00	2
117+980	RC-B1x3.00x2.50x19.00	2
119+750	RC-B1x3.00x2.50x19.00	2
121+550	RC-B1x3.00x2.50x25.00	2
122+000	RC-B1x3.00x2.50x19.00	2
123+500	RC-B1x3.00x2.50x19.00	2
124+400	RC-B2x2.40x2.40x20.50	2
127+580	RC-B1x3.00x2.50x19.00	2
140+040	RC-B1x3.00x2.50x19.00	2
141+250	RC-B1x3.00x2.50x19.00	2
142+320	RC-B1x3.00x2.50x19.00	2
144+500	RC-B1x2.40x2.40x18.00	2
145+500	RC-B2x2.40x2.40x18.00	2
146+450	RC-B1x3.00x2.50x23.00	2
150+030	RC-B1x3.00x2.50x19.00	2
154+250	RC-B1x3.00x2.50x21.00	2
156+600	RC-B1x3.00x2.50x25.00	2
158+700	RC-B1x3.00x2.50x19.00	2
160+450	RC-B1x3.00x2.50x19.00	2
161+500	RC-B1x3.00x2.50x23.00	2
162+650	RC-B1x3.00x2.50x21.00	2
163+900	RC-B1x3.00x2.50x19.00	2
166+550	RC-B1x3.00x2.50x19.00	2
167+450	RC-B1x3.00x2.50x19.00	2
169+900	RC-B1x3.00x2.50x19.00	2
170+300	RC-B1x3.00x2.50x19.00	2
172+000	RC-B1x3.00x2.50x19.00	2
174+700	RC-B1x3.00x2.50x19.00	2
177+100	RC-B1x3.00x2.50x19.00	2
193+130	RC-B2x2.40x2.40x76.00	1
195+200	RC-B1x3.00x2.50x19.00	2

LIST OF BOX CULVERTS ON ALTERNATIVE-C

Station	Culvert Type No. of Cells x Clear Span x Depth x Length	Number of Locations
1+080	RC-B1x3.00x2.50x21.00	2
2+720	RC-B1x3.00x2.50x19.00	2
5+750	RC-B1x3.00x2.50x21.00	2
6+290	RC-B2x2.40x2.40x18.00	2
8+130	RC-B1x3.00x2.50x19.00	2
15+750	RC-B1x3.00x2.50x19.00	2
20+950	RC-B1x3.00x2.50x19.00	2
23+970	RC-B1x3.00x2.50x19.00	2
27+700	RC-B1x3.00x2.50x23.00	2
28+880	RC-B1x3.00x2.50x19.00	2
29+430	RC-B2x2.40x2.40x22.00	2
30+000	RC-B1x3.00x2.50x19.00	2
31+030	RC-B1x3.00x2.50x19.00	2
33+450	RC-B1x3.00x2.50x21.00	2
35+050	RC-B1x3.00x2.50x19.00	2
36+000	RC-B1x3.00x2.50x19.00	2
36+800	RC-B1x3.00x2.50x35.00	2
39+330	RC-B1x3.00x2.50x19.00	2
40+200	RC-B1x3.00x2.50x19.00	2
40+950	RC-B1x3.00x2.50x19.00	2
42+150	RC-B1x3.00x2.50x19.00	2
44+070	RC-B1x3.00x2.50x19.00	2
45+170	RC-B1x3.00x2.50x19.00	2
48+350	RC-B1x3.00x2.50x19.00	2
48+620	RC-B1x3.00x2.50x19.00	2
51+200	RC-B1x3.00x2.50x19.00	2
51+800	RC-B1x3.00x2.50x19.00	2
56+550	RC-B1x3.00x2.50x25.00	2
57+350	RC-B1x3.00x2.50x19.00	2
58+600	RC-B1x3.00x2.50x19.00	2
59+950	RC-B1x3.00x2.50x19.00	2
63+030	RC-B1x3.00x2.50x19.00	2
65+800	RC-B1x3.00x2.50x19.00	2
66+760	RC-B1x3.00x2.50x19.00	2
68+250	RC-B1x3.00x2.50x19.00	2
69+500	RC-B1x3.00x2.50x19.00	2
74+650	RC-B1x3.00x2.50x21.00	2
76+480	RC-B1x3.00x2.50x19.00	2
81+130	RC-B2x2.40x2.40x22.00	2
97+800	RC-B1x3.00x2.50x21.00	2

Station	Culvert Type No. of Cells x Clear Span x Depth x Length	Number of Locations
100+050	RC-B1x3.00x2.50x19.00	2
100+100	RC-B2x2.40x2.40x28.00	2
103+550	RC-B1x3.00x2.50x19.00	2
106+700	RC-B1x2.40x2.40x32.00	2
108+050	RC-B1x3.00x2.50x19.00	2
111+350	RC-B1x3.00x2.50x21.00	2
115+900	RC-B1x3.00x2.50x19.00	2
117+580	RC-B1x3.00x2.50x19.00	2
117+980	RC-B1x3.00x2.50x19.00	2
119+750	RC-B1x3.00x2.50x19.00	2
121+550	RC-B1x3.00x2.50x25.00	2
122+000	RC-B1x3.00x2.50x19.00	2
123+500	RC-B1x3.00x2.50x19.00	2
124+400	RC-B2x2.40x2.40x20.50	2
127+580	RC-B1x3.00x2.50x19.00	2
140+040	RC-B1x3.00x2.50x19.00	2
141+250	RC-B1x3.00x2.50x19.00	2
142+320	RC-B1x3.00x2.50x19.00	2
144+500	RC-B1x2.40x2.40x18.00	2
145+500	RC-B1x2.40x2.40x18.00	2
146+450	RC-B1x3.00x2.50x23.00	2
150+030	RC-B1x3.00x2.50x19.00	2
154+250	RC-B1x3.00x2.50x21.00	2
156+600	RC-B1x3.00x2.50x25.00	2
158+700	RC-B1x3.00x2.50x19.00	2
160+450	RC-B1x3.00x2.50x19.00	2
161+500	RC-B1x3.00x2.50x23.00	2
162+650	RC-B1x3.00x2.50x21.00	2
163+900	RC-B1x3.00x2.50x19.00	2
166+550	RC-B1x3.00x2.50x19.00	2
167+450	RC-B1x3.00x2.50x19.00	2
169+900	RC-B1x3.00x2.50x19.00	2
170+300	RC-B1x3.00x2.50x19.00	2
172+000	RC-B1x3.00x2.50x19.00	2
174+700	RC-B1x3.00x2.50x19.00	2
177+100	RC-B1x3.00x2.50x19.00	2
193+130	RC-B2x2.40x2.40x76.00	1
195+200	RC-B1x3.00x2.50x19.00	2

LIST OF PIPE CULVERTS ON ALTERNATIVE-A (1)

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
0+120～1+150	RC-P1x⊙1.00x28.00	8
1+430～2+300	RC-P1x⊙1.00x24.00	6
2+300～5+320	RC-P1x⊙1.00x24.00	14
5+320～5+830	RC-P1x⊙1.00x16.00	2
5+830	RC-P1x⊙1.50x39.00	2
5+830～7+450	RC-P1x⊙1.00x16.00	4
7+450～9+000	RC-P1x⊙1.00x24.00	8
9+000	RC-P1x⊙1.00x22.00	2
9+000～9+450	RC-P1x⊙1.00x16.00	2
9+450	RC-P1x⊙1.00x18.00	2
9+450～10+150	RC-P1x⊙1.00x20.00	2
10+150	RC-P1x⊙1.00x32.00	2
10+150～10+920	RC-P1x⊙1.00x24.00	6
10+920～12+600	RC-P1x⊙1.00x26.00	14
12+600～15+300	RC-P1x⊙1.00x24.00	24
15+300	RC-P1x⊙1.00x18.00	2
15+570～16+600	RC-P1x⊙1.00x20.00	2
16+600	RC-P1x⊙1.50x72.00	1
16+600～17+770	RC-P1x⊙1.00x28.00	6
17+770～22+100	RC-P1x⊙1.00x24.00	26
22+100	RC-P1x⊙1.50x32.00	2
22+100～23+670	RC-P1x⊙1.00x24.00	8
23+670～25+400	RC-P1x⊙1.00x22.00	10
25+400	RC-P1x⊙1.00x18.00	2
25+400～29+300	RC-P1x⊙1.00x24.00	16
29+300	RC-P1x⊙1.00x26.00	2
29+770	RC-P1x⊙1.00x20.00	2
30+230	RC-P1x⊙1.00x26.00	2
30+230～31+500	RC-P1x⊙1.00x18.00	2
31+500	RC-P1x⊙1.00x18.00	2
31+950	RC-P1x⊙1.00x34.00	2
31+950～33+230	RC-P1x⊙1.00x26.00	4
33+230	RC-P1x⊙1.00x18.00	2
33+600	RC-P1x⊙1.00x71.00	1
33+960	RC-P1x⊙1.00x28.00	2
33+960～40+950	RC-P1x⊙1.00x24.00	44
40+950～42+350	RC-P1x⊙1.00x20.00	10
42+500	RC-P1x⊙1.00x22.00	2
42+500～43+050	RC-P1x⊙1.00x22.00	4
43+050～43+500	RC-P1x⊙1.00x26.00	2
43+500	RC-P1x⊙1.00x22.00	2
43+500～44+300	RC-P1x⊙1.00x28.00	4
44+300	RC-P1x⊙1.00x28.00	2
44+300～44+800	RC-P1x⊙1.00x26.00	4
44+800	RC-P1x⊙1.00x28.00	2
44+800～45+650	RC-P1x⊙1.00x22.00	6
45+650	RC-P1x⊙1.00x24.00	2
45+650～46+350	RC-P1x⊙1.00x22.00	4
46+350～48+490	RC-P1x⊙1.00x32.00	18
48+490	RC-P1x⊙1.00x28.00	2
48+490～50+970	RC-P1x⊙1.00x26.00	22
51+130～52+260	RC-P1x⊙1.00x24.00	8
53+000	RC-P1x⊙1.00x20.00	2
53+000～53+520	RC-P1x⊙1.00x16.00	2
53+520	RC-P1x⊙1.00x26.00	2
53+520～57+370	RC-P1x⊙1.00x28.00	36
57+370～59+400	RC-P1x⊙1.00x20.00	10
59+400～61+000	RC-P1x⊙1.00x26.00	6
61+000	RC-P1x⊙1.00x28.00	2
61+000～62+300	RC-P1x⊙1.00x26.00	2
62+300	RC-P1x⊙1.00x30.00	2
62+300～63+790	RC-P1x⊙1.00x26.00	12
63+790	RC-P1x⊙1.00x22.00	2
64+100	RC-P1x⊙1.00x22.00	2
64+350	RC-P1x⊙1.00x28.00	2
64+350～67+990	RC-P1x⊙1.00x20.00	34
67+990～68+870	RC-P1x⊙1.00x20.00	6
68+870～69+420	RC-P1x⊙1.00x22.00	2
69+420～71+000	RC-P1x⊙1.00x26.00	8
71+000	RC-P1x⊙1.00x20.00	2
71+470～72+630	RC-P1x⊙1.00x16.00	2
72+630～73+500	RC-P1x⊙1.00x22.00	2
73+500	RC-P1x⊙1.00x18.00	2
73+500～74+250	RC-P1x⊙1.00x20.00	2
74+250	RC-P1x⊙1.00x18.00	2
74+560～76+200	RC-P1x⊙1.00x18.00	2
76+200～78+700	RC-P1x⊙1.00x16.00	8
78+700～80+500	RC-P1x⊙1.00x32.00	10
80+500	RC-P1x⊙1.00x24.00	2
80+500～82+100	RC-P1x⊙1.00x20.00	8
86+150～87+890	RC-P1x⊙1.00x18.00	10
87+890	RC-P1x⊙1.00x30.00	2
87+890～92+040	RC-P1x⊙1.00x18.00	28
92+040	RC-P1x⊙1.00x20.00	2
92+040～94+300	RC-P1x⊙1.00x20.00	14
94+300	RC-P1x⊙1.50x24.00	2
94+300～99+550	RC-P1x⊙1.00x20.00	50
99+550～100+100	RC-P1x⊙1.00x22.00	2
100+100～101+450	RC-P1x⊙1.00x16.00	2
101+450	RC-P1x⊙1.00x22.00	2
101+450～105+940	RC-P1x⊙1.00x24.00	28
105+940	RC-P1x⊙1.00x28.00	2
105+940～106+700	RC-P1x⊙1.00x30.00	6
106+700～107+550	RC-P1x⊙1.00x68.00	6
107+550	RC-P1x⊙1.00x68.00	1
107+550～109+950	RC-P1x⊙1.00x26.00	22
109+950	RC-P1x⊙1.00x30.00	2
109+950～110+450	RC-P1x⊙1.00x76.00	1
110+450～111+430	RC-P1x⊙1.00x76.00	1
111+430～116+000	RC-P1x⊙1.00x26.00	14

LIST OF PIPE CULVERTS ON ALTERNATIVE-A (2)

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
116+000	RC-P1x⊙1.00x24.00	2
116+000~117+200	RC-P1x⊙1.00x16.00	2
117+200	RC-P1x⊙1.00x16.00	2
117+600	RC-P1x⊙1.00x24.00	2
117+600~120+560	RC-P1x⊙1.00x24.00	12
120+560~121+600	RC-P1x⊙1.00x32.00	8
121+600~123+700	RC-P1x⊙1.00x22.00	20
123+700	RC-P1x⊙1.00x26.00	2
123+700~124+400	RC-P1x⊙1.00x20.00	6
124+400~126+150	RC-P1x⊙1.00x26.00	16
126+150~127+560	RC-P1x⊙1.00x24.00	12
127+560	RC-P1x⊙1.00x24.00	2
127+560~133+340	RC-P1x⊙1.00x22.00	56
133+340~138+900	RC-P1x⊙1.00x26.00	54
138+900~143+500	RC-P1x⊙1.00x22.00	42
143+500	RC-P1x⊙1.50x22.00	2
143+500~144+500	RC-P1x⊙1.00x30.00	8
144+500~145+500	RC-P1x⊙1.00x22.00	8
145+500~146+300	RC-P1x⊙1.00x24.00	6
146+300	RC-P1x⊙1.00x28.00	2
146+300~148+450	RC-P1x⊙1.00x30.00	20
148+450~149+900	RC-P1x⊙1.00x20.00	12
149+900	RC-P1x⊙1.50x20.00	2
149+900~151+600	RC-P1x⊙1.00x20.00	16
151+600	RC-P1x⊙1.00x18.00	2
151+600~153+220	RC-P1x⊙1.00x26.00	14
153+220	RC-P1x⊙1.00x74.00	1
153+350~156+000	RC-P1x⊙1.00x24.00	24
156+000	RC-P1x⊙1.00x26.00	2
156+000~160+270	RC-P1x⊙1.00x22.00	40
160+500	RC-P1x⊙1.00x26.00	2
160+500~162+600	RC-P1x⊙1.00x30.00	18
162+600	RC-P1x⊙1.00x26.00	2
162+600~163+920	RC-P1x⊙1.00x26.00	12
163+920	RC-P1x⊙1.00x22.00	2
163+920~166+500	RC-P1x⊙1.00x30.00	24
166+500	RC-P1x⊙1.00x24.00	2
166+500~167+080	RC-P1x⊙1.00x24.00	4
167+080~167+750	RC-P1x⊙1.00x24.00	4
167+750	RC-P1x⊙1.00x26.00	2
167+750~168+260	RC-P1x⊙1.00x24.00	4
168+260~170+030	RC-P1x⊙1.00x22.00	16
170+030	RC-P1x⊙1.00x28.00	2
170+030~170+600	RC-P1x⊙1.00x26.00	4
170+850	RC-P1x⊙1.00x22.00	2
170+850~173+800	RC-P1x⊙1.00x24.00	28
173+800	RC-P1x⊙1.00x18.00	2
174+500	RC-P1x⊙1.00x26.00	2
174+500~174+900	RC-P1x⊙1.00x24.00	2
174+900~177+800	RC-P1x⊙1.00x24.00	28
177+800~179+220	RC-P1x⊙1.00x20.00	12
179+220	RC-P1x⊙1.00x26.00	2
179+220~179+850	RC-P1x⊙1.00x24.00	4
179+850	RC-P1x⊙1.00x22.00	2
179+850~180+450	RC-P1x⊙1.00x18.00	2
180+450	RC-P1x⊙1.50x30.00	2
180+450~181+350	RC-P1x⊙1.00x20.00	4
181+350	RC-P1x⊙1.50x18.00	2
181+350~182+050	RC-P1x⊙1.00x16.00	2
182+050~185+790	RC-P1x⊙1.00x30.00	28
185+790	RC-P1x⊙1.00x18.00	2
185+790~186+230	RC-P1x⊙1.00x18.00	2
186+230	RC-P1x⊙1.00x22.00	2
186+230~190+550	RC-P1x⊙1.00x30.00	42
190+550~193+130	RC-P1x⊙1.00x18.00	24
193+130~197+250	RC-P1x⊙1.00x28.00	40
197+250	RC-P1x⊙1.00x22.00	2

LIST OF PIPE CULVERTS ON ALTERNATIVE-B (1)

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
0+000～1+150	RC-P1x⊙1.00x26.00	10
1+850	RC-P1x⊙1.50x71.00	1
1+850～3+020	RC-P1x⊙1.00x16.00	2
3+850	RC-P1x⊙1.00x24.00	2
3+850～6+700	RC-P1x⊙1.00x30.00	12
6+700～7+500	RC-P1x⊙1.00x72.00	3
7+500	RC-P1x⊙1.00x71.00	1
7+500～8+300	RC-P1x⊙1.00x72.00	2
8+300～13+950	RC-P1x⊙1.00x24.00	54
13+950～15+030	RC-P1x⊙1.00x26.00	8
15+030～21+050	RC-P1x⊙1.00x24.00	58
21+050～25+850	RC-P1x⊙1.00x30.00	36
25+850	RC-P1x⊙1.00x28.00	2
25+850～30+370	RC-P1x⊙1.00x28.00	28
30+370～32+160	RC-P1x⊙1.00x20.00	10
32+160	RC-P1x⊙1.00x28.00	2
33+460～34+050	RC-P1x⊙1.00x28.00	2
35+220	RC-P1x⊙1.00x20.00	2
35+450	RC-P1x⊙1.00x28.00	2
35+450～36+100	RC-P1x⊙1.00x76.00	1
36+100～39+800	RC-P1x⊙1.00x30.00	10
39+800～41+970	RC-P1x⊙1.00x26.00	12
41+970～43+750	RC-P1x⊙1.00x20.00	10
43+750	RC-P1x⊙1.00x20.00	2
43+750～44+350	RC-P1x⊙1.00x18.00	2
44+350	RC-P1x⊙1.00x22.00	2
44+350～48+320	RC-P1x⊙1.00x22.00	24
48+320～50+100	RC-P1x⊙1.00x20.00	10
50+100～51+950	RC-P1x⊙1.00x20.00	10
53+950～56+230	RC-P1x⊙1.00x24.00	14
57+230	RC-P1x⊙1.00x75.00	1
57+230～58+300	RC-P1x⊙1.00x22.00	4
58+300	RC-P1x⊙1.00x28.00	2
58+300～60+930	RC-P1x⊙1.00x18.00	8
60+930	RC-P1x⊙1.00x20.00	2
60+930～65+750	RC-P1x⊙1.00x28.00	56
65+750～69+100	RC-P1x⊙1.00x26.00	32
69+100～69+650	RC-P1x⊙1.00x16.00	2
69+650～70+400	RC-P1x⊙1.00x16.00	2
70+400	RC-P1x⊙1.00x18.00	2
71+400	RC-P1x⊙1.00x28.00	2
71+400～72+000	RC-P1x⊙1.00x20.00	6
72+000	RC-P1x⊙1.00x24.00	2
81+130～82+850	RC-P1x⊙1.00x18.00	6
82+850～83+600	RC-P1x⊙1.00x16.00	2
83+600	RC-P1x⊙1.00x22.00	2
83+600～86+150	RC-P1x⊙1.00x22.00	16
86+150～87+890	RC-P1x⊙1.00x18.00	10
87+890	RC-P1x⊙1.00x30.00	2
87+890～92+040	RC-P1x⊙1.00x18.00	28

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
92+040	RC-P1x⊙1.00x20.00	2
92+040～94+300	RC-P1x⊙1.00x20.00	14
94+300	RC-P1x⊙1.50x24.00	2
94+300～99+550	RC-P1x⊙1.00x20.00	50
99+550～100+100	RC-P1x⊙1.00x22.00	2
100+100～101+450	RC-P1x⊙1.00x16.00	2
101+450	RC-P1x⊙1.00x22.00	2
101+450～105+940	RC-P1x⊙1.00x24.00	28
105+940	RC-P1x⊙1.00x28.00	2
105+940～106+700	RC-P1x⊙1.00x30.00	6
106+700～107+550	RC-P1x⊙1.00x68.00	6
107+550	RC-P1x⊙1.00x68.00	2
107+550～109+950	RC-P1x⊙1.00x26.00	22
109+950	RC-P1x⊙1.00x30.00	2
109+950～110+450	RC-P1x⊙1.00x76.00	1
110+450～111+430	RC-P1x⊙1.00x76.00	1
111+430～116+000	RC-P1x⊙1.00x26.00	14
116+000	RC-P1x⊙1.00x24.00	2
116+000～117+200	RC-P1x⊙1.00x16.00	2
117+200	RC-P1x⊙1.00x16.00	2
117+600	RC-P1x⊙1.00x24.00	2
117+600～120+560	RC-P1x⊙1.00x24.00	12
120+560～121+600	RC-P1x⊙1.00x32.00	8
121+600～123+700	RC-P1x⊙1.00x22.00	20
123+700	RC-P1x⊙1.00x26.00	2
123+700～124+400	RC-P1x⊙1.00x20.00	6
124+400～126+150	RC-P1x⊙1.00x26.00	16
126+150～127+560	RC-P1x⊙1.00x24.00	12
127+560	RC-P1x⊙1.00x24.00	2
127+560～133+340	RC-P1x⊙1.00x22.00	56
133+340～138+900	RC-P1x⊙1.00x26.00	54
138+900～143+500	RC-P1x⊙1.00x22.00	42
143+500	RC-P1x⊙1.50x22.00	2
143+500～144+500	RC-P1x⊙1.00x30.00	8
144+500～145+500	RC-P1x⊙1.00x22.00	8
145+500～146+300	RC-P1x⊙1.00x24.00	6
146+300	RC-P1x⊙1.00x28.00	2
146+300～148+450	RC-P1x⊙1.00x30.00	20
148+450～149+900	RC-P1x⊙1.00x20.00	12
149+900	RC-P1x⊙1.50x20.00	2
149+900～151+600	RC-P1x⊙1.00x20.00	16
151+600	RC-P1x⊙1.00x18.00	2
151+600～153+220	RC-P1x⊙1.00x26.00	14
153+220	RC-P1x⊙1.00x74.00	1
153+350～156+000	RC-P1x⊙1.00x24.00	24
156+000	RC-P1x⊙1.00x26.00	2
156+000～160+270	RC-P1x⊙1.00x22.00	40
160+500	RC-P1x⊙1.00x26.00	2
160+500～162+600	RC-P1x⊙1.00x30.00	18
162+600	RC-P1x⊙1.00x26.00	2

LIST OF PIPE CULVERTS ON ALTERNATIVE-B (2)

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
162+600～163+920	RC-P1x⊙1.00x26.00	12
163+920	RC-P1x⊙1.00x22.00	2
163+920～166+500	RC-P1x⊙1.00x30.00	24
166+500	RC-P1x⊙1.00x24.00	2
166+500～167+080	RC-P1x⊙1.00x24.00	4
167+080～167+750	RC-P1x⊙1.00x24.00	4
167+750	RC-P1x⊙1.00x26.00	2
167+750～168+260	RC-P1x⊙1.00x24.00	4
168+260～170+030	RC-P1x⊙1.00x22.00	16
170+030	RC-P1x⊙1.00x28.00	2
170+030～170+600	RC-P1x⊙1.00x26.00	4
170+850	RC-P1x⊙1.00x22.00	2
170+850～173+800	RC-P1x⊙1.00x24.00	28
173+800	RC-P1x⊙1.00x18.00	2
174+500	RC-P1x⊙1.00x26.00	2
174+500～174+900	RC-P1x⊙1.00x24.00	2
174+900～177+800	RC-P1x⊙1.00x24.00	28
177+800～179+220	RC-P1x⊙1.00x20.00	12
179+220	RC-P1x⊙1.00x26.00	2
179+220～179+850	RC-P1x⊙1.00x24.00	4
179+850	RC-P1x⊙1.00x22.00	2
179+850～180+450	RC-P1x⊙1.00x18.00	2
180+450	RC-P1x⊙1.50x30.00	2
180+450～181+350	RC-P1x⊙1.00x20.00	4
181+350	RC-P1x⊙1.50x18.00	2
181+350～182+050	RC-P1x⊙1.00x16.00	2
182+050～185+790	RC-P1x⊙1.00x30.00	28
185+790	RC-P1x⊙1.00x18.00	2
185+790～186+230	RC-P1x⊙1.00x18.00	2
186+230	RC-P1x⊙1.00x22.00	2
186+230～190+550	RC-P1x⊙1.00x30.00	42
190+550～193+130	RC-P1x⊙1.00x18.00	24
193+130～197+250	RC-P1x⊙1.00x28.00	40
197+250	RC-P1x⊙1.00x22.00	2

LIST OF PIPE CULVERTS ON ALTERNATIVE-C (1)

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
0+200～0+950	RC-P1x⊙1.00x26.00	6
0+950	RC-P1x⊙1.00x28.00	2
0+950～2+280	RC-P1x⊙1.00x22.00	10
2+600	RC-P1x⊙1.50x76.00	2
5+040	RC-P1x⊙1.50x28.00	2
5+200～6+290	RC-P1x⊙1.00x24.00	6
6+290～6+800	RC-P1x⊙1.00x16.00	2
6+800	RC-P1x⊙1.00x16.00	2
6+800～8+120	RC-P1x⊙1.00x16.00	2
8+120	RC-P1x⊙1.00x20.00	2
8+120～9+000	RC-P1x⊙1.00x20.00	4
9+000～10+450	RC-P1x⊙1.00x18.00	6
10+450	RC-P1x⊙1.00x22.00	2
10+450～13+400	RC-P1x⊙1.00x32.00	12
13+400	RC-P1x⊙1.50x30.00	2
13+400～14+440	RC-P1x⊙1.00x26.00	4
14+440～15+740	RC-P1x⊙1.00x20.00	12
15+740	RC-P1x⊙1.00x22.00	2
15+740～16+630	RC-P1x⊙1.00x18.00	4
16+630～18+500	RC-P1x⊙1.00x26.00	16
18+500	RC-P1x⊙1.50x28.00	2
18+500～23+800	RC-P1x⊙1.00x22.00	50
23+800～24+330	RC-P1x⊙1.00x24.00	2
24+330	RC-P1x⊙1.00x30.00	2
24+330～24+730	RC-P1x⊙1.00x22.00	2
24+730～25+500	RC-P1x⊙1.00x24.00	4
25+500	RC-P1x⊙1.00x24.00	2
25+500～27+100	RC-P1x⊙1.00x22.00	14
27+100～27+870	RC-P1x⊙1.00x32.00	6
27+870～29+430	RC-P1x⊙1.00x22.00	14
29+430～31+430	RC-P1x⊙1.00x22.00	18
31+430	RC-P1x⊙1.00x28.00	2
31+430～32+470	RC-P1x⊙1.00x28.00	4
32+470	RC-P1x⊙1.50x30.00	2
33+300	RC-P1x⊙1.50x20.00	2
34+000	RC-P1x⊙1.00x26.00	2
34+000～35+100	RC-P1x⊙1.00x26.00	6
35+100～36+340	RC-P1x⊙1.00x20.00	4
36+340	RC-P1x⊙1.00x28.00	2
36+670～38+380	RC-P1x⊙1.00x26.00	2
38+380	RC-P1x⊙1.00x24.00	2
38+800	RC-P1x⊙1.00x23.00	2
39+220	RC-P1x⊙1.00x24.00	2
39+220～40+750	RC-P1x⊙1.00x22.00	8
40+750	RC-P1x⊙1.00x72.00	2
41+150	RC-P1x⊙1.00x74.00	1
41+150～42+300	RC-P1x⊙1.00x24.00	6
42+870	RC-P1x⊙1.00x32.00	2
43+450	RC-P1x⊙1.50x28.00	2
43+920	RC-P1x⊙1.00x22.00	2

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
44+400	RC-P1x⊙1.00x22.00	2
44+870	RC-P1x⊙1.00x32.00	2
45+160	RC-P1x⊙1.00x24.00	2
45+160～46+220	RC-P1x⊙1.00x16.00	4
46+220～47+350	RC-P1x⊙1.00x26.00	2
47+350	RC-P1x⊙1.00x32.00	2
47+350～48+100	RC-P1x⊙1.00x32.00	4
48+100～49+700	RC-P1x⊙1.00x26.00	14
49+700	RC-P1x⊙1.00x26.00	2
49+700～53+200	RC-P1x⊙1.00x22.00	32
53+200	RC-P1x⊙1.00x18.00	2
53+200～55+470	RC-P1x⊙1.00x18.00	18
55+470	RC-P1x⊙1.00x18.00	2
55+470～56+500	RC-P1x⊙1.00x68.00	4
56+500	RC-P1x⊙1.00x68.00	1
56+900	RC-P1x⊙1.00x20.00	2
56+900～57+530	RC-P1x⊙1.00x20.00	2
57+530～60+280	RC-P1x⊙1.00x26.00	18
60+280～61+900	RC-P1x⊙1.00x22.00	14
61+900	RC-P1x⊙1.00x28.00	2
61+900～63+160	RC-P1x⊙1.00x18.00	2
63+730	RC-P1x⊙1.00x30.00	2
65+650～68+850	RC-P1x⊙1.00x24.00	30
68+850	RC-P1x⊙1.00x18.00	2
68+850～71+250	RC-P1x⊙1.00x24.00	22
71+250～72+000	RC-P1x⊙1.00x20.00	6
72+000	RC-P1x⊙1.00x24.00	2
72+000～74+180	RC-P1x⊙1.00x24.00	20
74+180～75+550	RC-P1x⊙1.00x28.00	12
75+550	RC-P1x⊙1.50x32.00	2
75+550～77+250	RC-P1x⊙1.00x26.00	16
77+250	RC-P1x⊙1.00x24.00	2
77+250～77+600	RC-P1x⊙1.00x16.00	2
77+600～78+150	RC-P1x⊙1.00x16.00	2
78+150～78+930	RC-P1x⊙1.00x20.00	4
78+930	RC-P1x⊙1.00x26.00	2
78+930～79+900	RC-P1x⊙1.00x20.00	4
79+900	RC-P1x⊙1.00x28.00	2
81+130～82+850	RC-P1x⊙1.00x18.00	6
82+850～83+600	RC-P1x⊙1.00x16.00	2
83+600	RC-P1x⊙1.00x22.00	2
83+600～86+150	RC-P1x⊙1.00x22.00	16
86+150～87+890	RC-P1x⊙1.00x18.00	10
87+890	RC-P1x⊙1.00x30.00	2
87+890～92+040	RC-P1x⊙1.00x18.00	28
92+040	RC-P1x⊙1.00x20.00	2
92+040～94+300	RC-P1x⊙1.00x20.00	14
94+300	RC-P1x⊙1.50x24.00	2
94+300～99+550	RC-P1x⊙1.00x20.00	50
99+550～100+100	RC-P1x⊙1.00x22.00	2

LIST OF PIPE CULVERTS ON ALTERNATIVE-C (2)

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
100+100～101+450	RC-P1x⊙1.00x16.00	2
101+450	RC-P1x⊙1.00x22.00	2
101+450～105+940	RC-P1x⊙1.00x24.00	28
105+940	RC-P1x⊙1.00x28.00	2
105+940～106+700	RC-P1x⊙1.00x30.00	6
106+700～107+550	RC-P1x⊙1.00x68.00	3
107+550	RC-P1x⊙1.00x68.00	1
107+550～109+950	RC-P1x⊙1.00x26.00	22
109+950	RC-P1x⊙1.00x30.00	2
109+950～110+450	RC-P1x⊙1.00x76.00	1
110+450～111+430	RC-P1x⊙1.00x76.00	1
111+430～116+000	RC-P1x⊙1.00x26.00	14
116+000	RC-P1x⊙1.00x24.00	2
116+000～117+200	RC-P1x⊙1.00x16.00	2
117+200	RC-P1x⊙1.00x16.00	2
117+600	RC-P1x⊙1.00x24.00	2
117+600～120+560	RC-P1x⊙1.00x24.00	12
120+560～121+600	RC-P1x⊙1.00x32.00	8
121+600～123+700	RC-P1x⊙1.00x22.00	20
123+700	RC-P1x⊙1.00x26.00	2
123+700～124+400	RC-P1x⊙1.00x20.00	6
124+400～126+150	RC-P1x⊙1.00x26.00	16
126+150～127+560	RC-P1x⊙1.00x24.00	12
123+560	RC-P1x⊙1.00x24.00	2
127+560～133+340	RC-P1x⊙1.00x22.00	56
133+340～138+900	RC-P1x⊙1.00x26.00	54
138+900～143+500	RC-P1x⊙1.00x22.00	42
143+500	RC-P1x⊙1.50x22.00	2
143+500～144+500	RC-P1x⊙1.00x30.00	8
144+500～145+500	RC-P1x⊙1.00x22.00	8
145+500～146+300	RC-P1x⊙1.00x24.00	6
146+300	RC-P1x⊙1.00x28.00	2
146+300～148+450	RC-P1x⊙1.00x30.00	20
148+450～149+900	RC-P1x⊙1.00x20.00	12
149+900	RC-P1x⊙1.50x20.00	2
149+900～151+600	RC-P1x⊙1.00x20.00	16
151+600	RC-P1x⊙1.00x18.00	2
151+600～153+220	RC-P1x⊙1.00x26.00	14
153+220	RC-P1x⊙1.00x74.00	1
153+350～156+000	RC-P1x⊙1.00x24.00	24
156+000	RC-P1x⊙1.00x26.00	2
156+000～160+270	RC-P1x⊙1.00x22.00	40
160+500	RC-P1x⊙1.00x26.00	2
160+500～162+600	RC-P1x⊙1.00x30.00	18
162+600	RC-P1x⊙1.00x26.00	2
162+600～163+920	RC-P1x⊙1.00x26.00	12
163+920	RC-P1x⊙1.00x22.00	2
163+920～166+500	RC-P1x⊙1.00x30.00	24
166+500	RC-P1x⊙1.00x24.00	2
166+500～167+080	RC-P1x⊙1.00x24.00	4

Station	Culvert Type No. of Row x Diameter x Length	Number of Locations
167+080～167+750	RC-P1x⊙1.00x24.00	4
167+750	RC-P1x⊙1.00x26.00	2
167+750～168+260	RC-P1x⊙1.00x24.00	4
168+260～170+030	RC-P1x⊙1.00x22.00	16
170+030	RC-P1x⊙1.00x28.00	2
170+030～170+600	RC-P1x⊙1.00x26.00	4
170+850	RC-P1x⊙1.00x22.00	2
170+850～173+800	RC-P1x⊙1.00x24.00	28
173+800	RC-P1x⊙1.00x18.00	2
174+500	RC-P1x⊙1.00x26.00	2
174+500～174+900	RC-P1x⊙1.00x24.00	2
174+900～177+800	RC-P1x⊙1.00x24.00	28
177+800～179+220	RC-P1x⊙1.00x20.00	12
179+220	RC-P1x⊙1.00x26.00	2
179+220～179+850	RC-P1x⊙1.00x24.00	4
179+850	RC-P1x⊙1.00x22.00	2
179+850～180+450	RC-P1x⊙1.00x18.00	2
180+450	RC-P1x⊙1.50x30.00	2
180+450～181+350	RC-P1x⊙1.00x20.00	4
181+350	RC-P1x⊙1.50x18.00	2
181+350～182+050	RC-P1x⊙1.00x16.00	2
182+050～185+790	RC-P1x⊙1.00x30.00	28
185+790	RC-P1x⊙1.00x18.00	2
185+790～186+230	RC-P1x⊙1.00x18.00	2
186+230	RC-P1x⊙1.00x22.00	2
186+230～190+550	RC-P1x⊙1.00x30.00	42
190+550～193+130	RC-P1x⊙1.00x18.00	24
193+130～197+250	RC-P1x⊙1.00x28.00	40
197+250	RC-P1x⊙1.00x22.00	2

6. COMPARATIVE LIST ON ROUTE ALTERNATIVES

		Alternative-A	Alternative-B	Alternative-C
General		-alignment passes between the west coast and R.4 to avoid Krabi City center. -alignment passes along R.4 and 4035 to minimize the length of construction road	-the shortest alignment -a tunnel is installed to traverse the mountainous area	-alignment passes in the flatest terrain -alignment passes along R.4037 to minimize the construction road cost
Total length		L = 193.5 km	L = 189.0 km (tunnel section 1.6 km)	L = 197.5 km
Terrain	Flat	138.5 km	133.5 km	132.5 km
	Hilly	55.0 km	52.5 km	65.0 km
	Mountainous	--	3.0 km	--
Alignment	Vertical	-more rolling than Alt-C -max gradient = 2 %	-more rolling than Alt-A,C -max gradient = 2 %	-less rolling than Alt-A,B -max gradient = 2 %
	Horizontal	-more curved sections than Alt-C	---	-less curved section than Alt-A,B
Accessibility		-easier access to Phuket than Alt-B,C -easy access to existing roads (R-4,4035)	-longer access to existing road than Alt-A,C	-easy access to lower south -easy access to existing roads (R-4,4037)
Traveling time		-longer than Alt-C	-shortest	-the longest
Land use of roadside		-more plantation area -less impact to Krabi city than Alt-C	-the least impact to residential area	-alignment in the residential area is more than Alt-A,B
Grade separation with existing road		-more grade separation than Alt-B -less grade separation than Alt-C	-the least grade separation	-grade separation with existing road at Krabi city area is more than Alt-A,B
Crossing with major river		-no relative merits	-no relative merits	-no relative merits
Environment		-no problem in particular	-cross the wildlife sanctuary with a tunnel	-more environmental impact to the residential area
Geological condition		-better than Alt-C	-better than Alt-C	-alluvium layer is thicker than Alt-A,B
Disaster prevention		-rockfall from monadnock	-rockfall from monadnock	-mudflow from weathered granite slope
Construction		-easy access to existing borrow pit -cost for construction road is less than Alt-B -total construction cost 8,442 M.Baht	-construction cost of tunnel section is more expensive than embankment section -cost for construction road is higher than Alt-A,C -total construction cost 9,420 M.Baht	-easy access to existing borrow pit -cost for construction road is less than Alt-B -total construction cost 8,439 M.Baht
Land acquisition		740 M.Baht	630 M.Baht	749 M.Baht
Others		---	-running and operation cost for tunnel is more expensive than embankment section	---

7. CONSTRUCTION QUANTITIES AND COSTS

Alternative A
Quantities and Construction costs
Project Length L = 193.48 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								
Clearing & Grubbing	SQ.M	1	11,668,488	11,668	85	9,918	90	893
Roadway Excavation(Unclassified)	CU.M	30	3,832,921	114,988	84	96,590	90	8,693
Embankment(Borrowed Material)	CU.M	100	26,611,418	2,661,142	84	2,235,359	90	201,182
Slope Protection								
Stripe Sodding	SQ.M	6	4,534,246	27,205	86	23,397	90	2,106
Sodding	SQ.M	9	362,515	3,263	86	2,806	90	253
Shot Crete(Ferro Cement)	SQ.M	600	40,279	24,167	86	20,784	90	1,871
Concrete Block	SQ.M	450	525,950	236,678	86	203,543	90	18,319
Sand Mat	CU.M	260	463,500	120,510	86	103,639	90	9,327
Sand Pile (φ 0.40 m)	M	100	1,123,556	112,356	86	96,626	90	8,696
SUB TOTAL				3,311,977		2,792,661		251,339
SUBBASE AND BASE								
Subbase(Soil Aggregate)	CU.M	190	904,560	171,866	84	144,368	50	7,218
Base Coarses(Crush Stone)	CU.M	280	1,014,297	284,003	83	235,723	50	11,786
SUB TOTAL				455,870		380,090		19,005
SURFACE								
Asphaltic Prime coat	SQ.M	13	4,800,960	62,412	93	58,044	50	2,902
Asphaltic Tack coat	SQ.M	7	3,972,220	27,806	93	25,859	50	1,293
Asphalt concrete (Surfacing)	CU.M	1,900	198,611	377,361	90	339,625	50	16,981
(Binder Coarse)	CU.M	1,900	240,048	456,091	90	410,482	50	20,524
SUB TOTAL				923,670		834,010		41,700
STRUCTURES(Equivalent)								
RC Pipe Culvert(D=1000 m)	M	2,650	34,993	92,731	88	81,604	50	4,080
(D=1500 m)	M	4,900	502	2,460	88	2,165	50	108
RC Box Culvert(1-2.40*2.40 m)	M	5,700	204	1,163	90	1,047	50	52
(2-2.40*2.40 m)	M	11,400	517	5,894	90	5,304	50	265
(1-3.00*2.50 m)	M	6,600	2,672	17,635	90	15,872	50	794
RC Bridge (W=13.5 m) L=10 m	M	86,400	3,400	293,760	87	255,571	50	12,779
PC Bridge (W=13.5 m) L=20 m	M	135,000	820	110,700	87	96,309	50	4,815
(W=13.5 m) L=30 m	M	162,000	1,372	222,264	87	193,370	50	9,668
(W=13.5 m) L=50 m	M	202,500	340	68,850	87	59,900	50	2,995
Over Bridge (W=6.0 m) L=30 m	M	84,000	120	10,080	87	8,770	50	438
Bearing Unit	Ls	100,000	200	20,000	87	17,400	50	870
SUB TOTAL				845,537		737,310		36,865
INTERCHANGE/Center Toll Gate								
Interchange	Ls	100,000,000	4	400,000	85	340,000	50	17,000
Center Toll Gate	Ls	6,000,000	2	12,000	85	10,200	50	510
SUB TOTAL				412,000		350,200		17,510
TOTAL (a)				5,949,053		5,094,270		366,420
Miscellaneous Works [(a)*7%]	Ls	1		416,434	87	362,297	0	0
CONTRACT AMOUNT (b)				6,365,487		5,456,568		366,420
PHYSICAL CONTINGENCIES[(b)*10%](c)				636,549		545,657		36,642
ENGINEERING & SUPERVISION [((b)+(c))*10%](d)	Ls	1		700,204	100	700,204	0	0
LAND ACQUISITION(Average) (e)	SQ.M	19	38,696,000	739,990	100	739,990	100	739,990
PROJECT COST [(b)+(c)+(d)+(e)]				8,442,229		7,442,418		1,143,052
AVERAGE COST PER KM				43,634				

MAINTENANCE BUDEGE CALCULATION

Project Road No, A Route   Na= 8,200 Baht/Km/year
(Proposed Road)   Km= 1.001
Length = 193.48 Km

Asphalt Pavement

	ITEMS		Proposed Road Condition	Proposed Road Factor
1.	Surface /Bace Type	X1	AC	0.00
2.	Subgrade CBR	X2	6 %	0.00
3.	A.D.T	X3	1,300(2,600)	0.33
4.	Service Life (year)	X4	10	1.40
5.	Pavement Width (m)	X5	7.5 m * 2	0.38
6.	R-O-W Width (m)	Y1	200 m	0.60
7.	Shoulder,Access,Median Width (m)	Y2	3,25 m * 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(Existing) =1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5)= 2.405
Maintenance cost + Overhead= Ka * Km * Na * 1.28 = 25,268 Baht/Km/year
Total Cost(Existing) =Length *(Baht/Km/year)= 4,888,876 Baht/year
Financial Cost = 4,889,000 Baht/year
Economic Cost = 4,058,000 Baht/year
(4,057,870)Baht/year

Alternative B
Quantities and Construction costs
Project Length L = 188.95 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								
Clearing & Grubbing	SQ.M	1	11,413,922	11,414	85	9,702	90	873
Roadway Excavation(Unclassified)	CU.M	30	1,766,343	52,990	84	44,512	90	4,006
Embankment(Borrowed Material)	CU.M	100	28,011,652	2,801,165	84	2,352,979	90	211,768
Slope Protection								
Stripe Sodding	SQ.M	6	4,598,650	27,592	86	23,729	90	2,136
Sodding	SQ.M	9	206,260	1,856	86	1,596	90	144
Shot Crete(Ferro Cement)	SQ.M	600	22,918	13,751	86	11,826	90	1,064
Concrete Block	SQ.M	450	477,375	214,819	86	184,744	90	16,627
Sand Mat	CU.M	260	463,500	120,510	86	103,639	90	9,327
Sand Pile (0.40 m)	M	100	1,123,556	112,356	86	96,626	90	8,696
SUB TOTAL				3,356,453		2,829,352		254,642
SUBBASE AND BASE								
Subbase(Soil Aggregate)	CU.M	190	877,592	166,742	84	140,064	50	7,003
Base Coarses(Crush Stone)	CU.M	280	984,056	275,536	83	228,695	50	11,435
SUB TOTAL				442,278		368,758		18,438
SURFACE								
Asphaltic Prime coat	SQ.M	13	4,657,820	60,552	93	56,313	50	2,816
Asphaltic Tack coat	SQ.M	7	3,853,780	26,976	93	25,088	50	1,254
Asphalt concrete (Surfacing)	CU.M	1,900	192,689	366,109	90	329,498	50	16,475
(Binder Coarse)	CU.M	1,900	232,891	442,493	90	398,244	50	19,912
SUB TOTAL				896,130		809,143		40,457
STRUCTURES(Equivalent)								
RC Pipe Culvert(D=1000 m)	M	2,650	34,244	90,747	88	79,857	50	3,993
(D=1500 m)	M	4,900	359	1,759	88	1,548	50	77
RC Box Culvert(1-2.40*2.40 m)	M	5,700	204	1,163	90	1,047	50	52
(2-2.40*2.40 m)	M	11,400	519	5,917	90	5,325	50	266
(1-3.00*2.50 m)	M	6,600	2,282	15,061	90	13,555	50	678
RC Bridge (W=13.5 m) L=10 m	M	86,400	2,400	207,360	87	180,403	50	9,020
PC Bridge (W=13.5 m) L=20 m	M	135,000	1,180	159,300	87	138,591	50	6,930
(W=13.5 m) L=30 m	M	162,000	1,072	173,664	87	151,088	50	7,554
(W=13.5 m) L=50 m	M	202,500	340	68,850	87	59,900	50	2,995
Over Bridge (W=6.0 m) L=30 m	M	84,000	0	0	87	0	50	0
Bearing Unit	Ls	100,000	200	20,000	87	17,400	50	870
SUB TOTAL				743,820		648,713		32,436
TUNNEL								
Tunnel	Ls	2	432,216,000	864,432	85	734,767	50	36,738
Tunnel Facility	Ls	2	37,000,000	74,000	85	62,900	50	3,145
SUB TOTAL				938,432		797,667		39,883
INTERCHANGE/Center Toll Gate								
Interchange	Ls	100,000,000	4	400,000	85	340,000	50	17,000
Center Toll Gate	Ls	6,000,000	2	12,000	85	10,200	50	510
SUB TOTAL				412,000		350,200		17,510
TOTAL (a)				6,789,113		5,803,834	0	403,366
Miscellaneous Works [(a)*7%]	Ls	1		475,238	87	413,457	0	0
CONTRACT AMOUNT (b)				7,264,351		6,217,291		403,366
PHYSICAL CONTINGENCIES[(b)*10%](c)				726,435		621,729		40,337
ENGINEERING & SUPERVISION [((b)+(c))*10%](d)	Ls	1		799,079	100	799,079	0	0
LAND ACQUISITION(Average) (e)	SQ.M	17	37,466,000	629,750	100	629,750	100	629,750
PROJECT COST [(b)+(c)+(d)+(e)]				9,419,615		8,267,848		1,073,452
AVERAGE COST PER KM				49,852				

MAINTENANCE BUDEGE CALCULATION

Project Road No, B Route Na= 8,200 Baht/Km/year
(Proposed Road) Km= 1.001
Length = 188.95 Km

Asphalt Pavement

	ITEMS		Proposed Road Condition	Factor
1.	Surface /Bace Type	X1	AC	0.00
2.	Subgrade CBR	X2	6 %	0.00
3.	A.D.T	X3	1,300(2,600)	0.33
4.	Service Life (year)	X4	10	1.40
5.	Pavement Width (m)	X5	7.5 m * 2	0.38
6.	R-O-W Width (m)	Y1	200 m	0.60
7.	Shoulder,Access,Median Width (m)	Y2	3,25 m * 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(Existing) =1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5)= 2.405
Maintenance cost + Overhead= Ka * Km * Na * 1.28 = 25,268 Baht/Km/year
Total Cost(Existing) =Length *(Baht/Km/year)= 4,774,412 Baht/year
Financial Cost = 4,774,000 Baht/year
Economic Cost = 3,962,000 Baht/year
(3,962,420)Baht/year

Alternative C
Quantities and Construction costs
Project Length L = 197.50 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								
Clearing & Grubbing	SQ.M	1	11,804,997	11,805	85	10,034	90	903
Roadway Excavation(Unclassified)	CU.M	30	2,739,670	82,190	84	69,040	90	6,214
Embankment(Borrowed Material)	CU.M	100	26,134,246	2,613,425	84	2,195,277	90	197,575
Slope Protection								
Stripe Sodding	SQ.M	6	4,408,049	26,448	86	22,746	90	2,047
Sodding	SQ.M	9	319,885	2,879	86	2,476	90	223
Shot Crete(Ferro Cement)	SQ.M	600	35,540	21,324	86	18,339	90	1,650
Concrete Block	SQ.M	450	632,145	284,465	86	244,640	90	22,018
Sand Mat	CU.M	260	463,500	120,510	86	103,639	90	9,327
Sand Pile (0.40 m)	M	100	1,123,556	112,356	86	96,626	90	8,696
SUB TOTAL				3,275,402		2,762,815		248,653
SUBBASE AND BASE								
Subbase(Soil Aggregate)	CU.M	190	924,108	175,581	84	147,488	50	7,374
Base Coarses(Crush Stone)	CU.M	280	1,036,215	290,140	83	240,816	50	12,041
SUB TOTAL				465,721		388,304		19,415
SURFACE								
Asphaltic Prime coat	SQ.M	13	4,904,700	63,761	93	59,298	50	2,965
Asphaltic Tack coat	SQ.M	7	4,058,060	28,406	93	26,418	50	1,321
Asphalt concrete (Surfacing)	CU.M	1,900	202,903	385,516	90	346,964	50	17,348
(Binder Coarse)	CU.M	1,900	245,235	465,947	90	419,352	50	20,968
SUB TOTAL				943,630		852,032		42,602
STRUCTURES(Equivalent)								
RC Pipe Culvert(D=1000 m)	M	2,650	35,474	94,006	88	82,725	50	4,136
(D=1500 m)	M	4,900	756	3,704	88	3,260	50	163
RC Box Culvert(1-2.40*2.40 m)	M	5,700	136	775	90	698	50	35
(2-2.40*2.40 m)	M	11,400	297	3,386	90	3,047	50	152
(1-3.00*2.50 m)	M	6,600	2,666	17,596	90	15,836	50	792
RC Bridge (W=13.5 m) L=10 m	M	86,400	2,920	252,288	87	219,491	50	10,975
PC Bridge (W=13.5 m) L=20 m	M	135,000	1,100	148,500	87	129,195	50	6,460
(W=13.5 m) L=30 m	M	162,000	1,378	223,236	87	194,215	50	9,711
(W=13.5 m) L=50 m	M	202,500	340	68,850	87	59,900	50	2,995
Over Bridge (W=6.0 m) L=30 m	M	84,000	120	10,080	87	8,770	50	438
Bearing Unit	Ls	100,000	200	20,000	87	17,400	50	870
SUB TOTAL				842,421		734,536		36,727
INTERCHANGE/Center Toll Gate								
Interchange	Ls	100,000,000	4	400,000	85	340,000	50	17,000
Center Toll Gate	Ls	6,000,000	2	12,000	85	10,200	50	510
SUB TOTAL				412,000		350,200		17,510
TOTAL (a)				5,939,173		5,087,887		364,907
Miscellaneous Works [(a)*7%]	Ls	1		415,742	87	361,696	0	0
CONTRACT AMOUNT (b)				6,354,915		5,449,583		364,907
PHYSICAL CONTINGENCIES[(b)*10%](c)				635,492		544,958		36,491
ENGINEERING & SUPERVISION [((b)+(c))*10%](d)	Ls	1		699,041	100	699,041	0	0
LAND ACQUISITION(Average) (e)	SQ.M	19	39,500,000	749,380	100	749,380	100	749,380
PROJECT COST [(b)+(c)+(d)+(e)]				8,438,828		7,442,962		1,150,778
AVERAGE COST PER KM				42,728				

MAINTENANCE BUDEGE CALCULATION

Project Road No, C Route	Na=	8,200 Baht/Km/year
(Proposed Road)	Km=	1.001
	Length =	*197.5 Km*

Asphalt Pavement

	ITEMS		Proposed Road Condition	Proposed Road Factor
1.	Surface /Bace Type	X1	AC	0.00
2.	Subgrade CBR	X2	6 %	0.00
3.	A.D.T	X3	1,300(2,600)	0.33
4.	Service Life (year)	X4	10	1.40
5.	Pavement Width (m)	X5	7.5 m * 2	0.38
6.	R-O-W Width (m)	Y1	200 m	0.60
7.	Shoulder,Access,Median Width (m)	Y2	3,25 m * 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(Existing) =1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5)= 2.405
Maintenance cost + Overhead= Ka * Km * Na * 1.28 = 25,268 Baht/Km/year
Total Cost(Existing) =Length *(Baht/Km/year)= 4,990,454 Baht/year
Financial Cost = 4,990,000 Baht/year
Economic Cost = 4,142,000 Baht/year
(4,141,700)Baht/year

CONSTRUCTION SCHEDULE

ALTERNATIVE A

(Sixteen Section)

Work Items / year	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Month	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	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 (%)	14 %	27 %	29 %	17 %	13 %

Work Items	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Miscellaneous Works		------	------------	---	
Clearing -Up					
Percentage Of Disbursement (%)					

ALTERNATIVE B

(Sixteen Section)

Work Items / year	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Month	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	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 Works	=======	============	============	======	
Miscellaneous Works		============	============	============	==========
Clearing -Up					===
Percentage Of Disbursement (%)	14 %	27 %	29 %	17 %	13 %

ALTERNATIVE C

(Sixteen Section)

Work Items / year	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Month	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	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 (%)	14 %	27 %	29 %	17 %	13 %

9. Project Evaluation

Alternative A

unit: million baht

	Year	Cost (1) Const	(2) Land	(3) S. Total	(4) Maint.	(5) Total	Benefit (6) GPP100%	Balance (7)	Benefit (8) GPP 3 %	Balance (9)
1	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1994	926.1	740.0	1666.1	0.0	1666.1	0.0	-1666.1	0.0	-1666.1
6	1995	2029.1	0.0	2029.1	0.0	2029.1	0.0	-2029.1	0.0	-2029.1
7	1996	2153.6	0.0	2153.6	0.0	2153.6	0.0	-2153.6	0.0	-2153.6
8	1997	1036.5	0.0	1036.5	0.0	1036.5	0.0	-1036.5	0.0	-1036.5
9	1998	557.1	0.0	557.1	0.0	557.1	0.0	-557.1	0.0	-557.1
10	1999				4.1	4.1	11120.0	11115.9	333.6	329.5
11	2000				4.1	4.1	14179.0	14174.9	425.4	421.3
12	2001				4.1	4.1	18080.0	18075.9	542.4	538.3
13	2002				4.1	4.1	23054.0	23049.9	691.6	687.5
14	2003				4.1	4.1	29397.0	29392.9	881.9	877.8
15	2004				4.1	4.1	37486.0	37481.9	1124.6	1120.5
16	2005				4.1	4.1	47799.0	47794.9	1434.0	1429.9
17	2006				4.1	4.1	60950.0	60945.9	1828.5	1824.4
18	2007				4.1	4.1	71772.0	71767.9	2153.2	2149.1
19	2008				4.1	4.1	84515.0	84510.9	2535.5	2531.4
20	2009				4.1	4.1	99522.0	99517.9	2985.7	2981.6
21	2010				4.1	4.1	117192.0	117187.9	3515.8	3511.7
22	2011				4.1	4.1	138000.0	137995.9	4140.0	4135.9
23	2012				4.1	4.1	149751.0	149746.9	4492.5	4488.4
24	2013				4.1	4.1	162503.0	162498.9	4875.1	4871.0
25	2014				4.1	4.1	176340.0	176335.9	5290.2	5286.1
26	2015				4.1	4.1	191356.0	191351.9	5740.7	5736.6
27	2016				4.1	4.1	207650.0	207645.9	6229.5	6225.4
28	2017				4.1	4.1	216310.0	216305.9	6489.3	6485.2
29	2018				4.1	4.1	225332.0	225327.9	6760.0	6755.9
Total				7442.4	82.0	7524.4	2082308.0	2074783.6	62469.2	54944.8
					EIRR			64.1		14.8
					NPV	3578.1	168230.1	164652.0	5046.9	1468.8
					B/C			47.0		1.4

Alternative B

unit: million baht

	Year	Cost (1) Const	(2) Land	(3) S. Total	(4) Maint.	(5) Total	Benefit (6) GPP100%	Balance (7)	Benefit (8) GPP 3 %	Balance (9)
1	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1994	1140.1	629.8	1769.9	0.0	1769.9	0.0	-1769.9	0.0	-1769.9
6	1995	2376.9	0.0	2376.9	0.0	2376.9	0.0	-2376.9	0.0	-2376.9
7	1996	2497.7	0.0	2497.7	0.0	2497.7	0.0	-2497.7	0.0	-2497.7
8	1997	1233.0	0.0	1233.0	0.0	1233.0	0.0	-1233.0	0.0	-1233.0
9	1998	625.6	0.0	625.6	0.0	625.6	0.0	-625.6	0.0	-625.6
10	1999				4.0	4.0	11120.0	11116.0	333.6	329.6
11	2000				4.0	4.0	14179.0	14175.0	425.4	421.4
12	2001				4.0	4.0	18080.0	18076.0	542.4	538.4
13	2002				4.0	4.0	23054.0	23050.0	691.6	687.6
14	2003				4.0	4.0	29397.0	29393.0	881.9	877.9
15	2004				4.0	4.0	37486.0	37482.0	1124.6	1120.6
16	2005				4.0	4.0	47799.0	47795.0	1434.0	1430.0
17	2006				4.0	4.0	60950.0	60946.0	1828.5	1824.5
18	2007				4.0	4.0	71772.0	71768.0	2153.2	2149.2
19	2008				4.0	4.0	84515.0	84511.0	2535.5	2531.5
20	2009				4.0	4.0	99522.0	99518.0	2985.7	2981.7
21	2010				4.0	4.0	117192.0	117188.0	3515.8	3511.8
22	2011				4.0	4.0	138000.0	137996.0	4140.0	4136.0
23	2012				4.0	4.0	149751.0	149747.0	4492.5	4488.5
24	2013				4.0	4.0	162503.0	162499.0	4875.1	4871.1
25	2014				4.0	4.0	176340.0	176336.0	5290.2	5286.2
26	2015				4.0	4.0	191356.0	191352.0	5740.7	5736.7
27	2016				4.0	4.0	207650.0	207646.0	6229.5	6225.5
28	2017				4.0	4.0	216310.0	216306.0	6489.3	6485.3
29	2018				4.0	4.0	225332.0	225328.0	6760.0	6756.0
Total				8503.1	80.0	8583.1	2082308.0	2073724.9	62469.2	53886.1
					EIRR			61.4		13.7
					NPV	4072.7	168230.1	164157.5	5046.9	974.2
					B/C			41.3		1.2

Alternative C

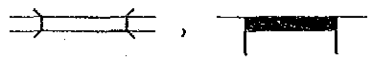
unit: million baht

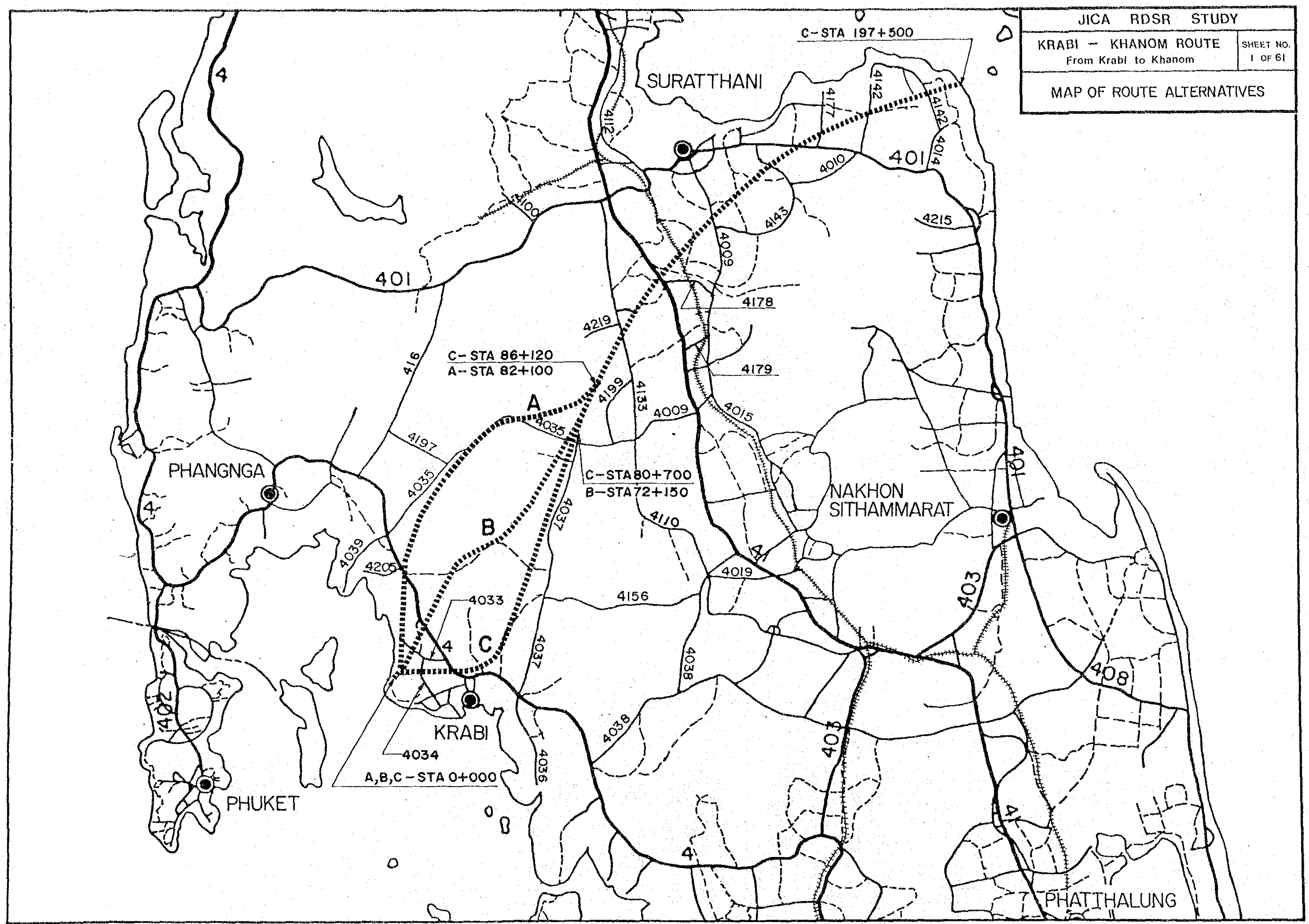
	Year	Cost (1) Const	(2) Land	(3) S. Total	(4) Maint.	(5) Total	Benefit (6) GPP100%	Balance (7)	Benefit (8) GPP 3 %	Balance (9)
1	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1994	919.4	749.4	1668.8	0.0	1668.8	0.0	-1668.8	0.0	-1668.8
6	1995	2021.2	0.0	2021.2	0.0	2021.2	0.0	-2021.2	0.0	-2021.2
7	1996	2148.4	0.0	2148.4	0.0	2148.4	0.0	-2148.4	0.0	-2148.4
8	1997	1043.2	0.0	1043.2	0.0	1043.2	0.0	-1043.2	0.0	-1043.2
9	1998	561.4	0.0	561.4	0.0	561.4	0.0	-561.4	0.0	-561.4
10	1999				4.1	4.1	11120.0	11115.9	333.6	329.5
11	2000				4.1	4.1	14179.0	14174.9	425.4	421.3
12	2001				4.1	4.1	18080.0	18075.9	542.4	538.3
13	2002				4.1	4.1	23054.0	23049.9	691.6	687.5
14	2003				4.1	4.1	29397.0	29392.9	881.9	877.8
15	2004				4.1	4.1	37486.0	37481.9	1124.6	1120.5
16	2005				4.1	4.1	47799.0	47794.9	1434.0	1429.9
17	2006				4.1	4.1	60950.0	60945.9	1828.5	1824.4
18	2007				4.1	4.1	71772.0	71767.9	2153.2	2149.1
19	2008				4.1	4.1	84515.0	84510.9	2535.5	2531.4
20	2009				4.1	4.1	99522.0	99517.9	2985.7	2981.6
21	2010				4.1	4.1	117192.0	117187.9	3515.8	3511.7
22	2011				4.1	4.1	138000.0	137995.9	4140.0	4135.9
23	2012				4.1	4.1	149751.0	149746.9	4492.5	4488.4
24	2013				4.1	4.1	162503.0	162498.9	4875.1	4871.0
25	2014				4.1	4.1	176340.0	176335.9	5290.2	5286.1
26	2015				4.1	4.1	191356.0	191351.9	5740.7	5736.6
27	2016				4.1	4.1	207650.0	207645.9	6229.5	6225.4
28	2017				4.1	4.1	216310.0	216305.9	6489.3	6485.2
29	2018				4.1	4.1	225332.0	225327.9	6760.0	6755.9
Total				7443.0	82.0	7525.0	2082308.0	2074783.0	62469.2	54944.2
					EIRR			64.1		14.8
					NPV	3577.6	168230.1	164652.6	5046.9	1469.3
					B/C			47.0		1.4

10. Drawings

SHEET NO.	LIST OF DRAWINGS
1.	Map of Route Alternatives
2. - 11.	Plan and Profile of Alternative A
12. - 20.	Plan and Profile of Alternative B
21. - 42.	Plan and Profile of Alternative C
43.	Interchange with Route 4 and Alternative C
44.	Interchange with Route 4035 and Alternative C
45.	Interchange with Route 41
46.	Interchange with Route 401
47.	Bridge for Khlong Noi Nang (B1)
48.	Bridge for Khlong Krabi Yai (B2)
49.	Bridge for Khlong Krabi Noi (B3)
50.	Bridge for Khlong I-Pan (B4)
51.	Bridge for MAE NAM TAPI (B5)
52.	Bridge for Khlong Ya (B6)
53.	Bridge for Khlong Kradae (B7)
54.	Bridge for Khlong Tha Thong (B8)
55.	Bridge for Highway Crossing (1)
56.	Bridge for Highway Crossing (2)
57.	Viaduct for PWD/ARD Road
58.	Bridge for Railway Crossing
59.	Reinforced Concrete Slab Bridge
60.	Box Culvert
61.	Pipe Culvert

ABBREVIATION AND SYMBOLS FOR PROFILE AND PLAN

	: Alignment of Proposed Route
	: Proposed Bridge
	: Proposed Box Culvert
	: Proposed Pipe Culvert
	: High Water Level
NO.	: Number
R	: Radius of Curvature
L	: Length of Curve
BR.RC.SLAB n x i = l	: Reinforced Concrete Bridge (No. of Spans x Span Length = Bridge Length)
BR.PC.GRDR n x i = l	: Prestressed Concrete Bridge (No. of Spans x Span Length = 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)
RC-P m -Oø x i	: Pipe Culvert (No. of Locations - Diameter x Length)



JICA RDSR STUDY
KRABI - KHANOM ROUTE
From Krabi to Khanom
SHEET NO. 1 OF 61
MAP OF ROUTE ALTERNATIVES
C-STA 197+500
SURATTHANI
C-STA 86+120
A-STA 82+100
C-STA 80+700
B-STA 72+150
A
B
C
PHANGNGA
NAKHON SITHAMMARAT
KRABI
PHUKET
PHATTHALUNG
A,B,C-STA 0+000
401
4
41
402
403
408
416
4009
4010
4014
4015
4019
4033
4034
4035
4036
4037
4038
4039
4100
4110
4112
4133
4142
4143
4156
4177
4178
4179
4197
4199
4205
4215
4219