

Chapter 9

**Yala - Narathiwat Highway (RW7-1)**

9. Yala - Narathiwat Highway (RW7-1)

9.1 Natural Conditions and Land Use

The project forms almost a straight line from Yala city to Narathiwat city in a distance of 53 kilometers. About 85 % of the highway passes on a flat terrain while the remaining 15 % in a mountain area. Average height in the mountain area is in the range of 60 - 240 meters from sea level. Mean annual rainfall in Narathiwat is 2,600 mm, being the second highest following Ranong. General geology is of khorat series and granite.

The existing Routes of 4063, 4066 and 4107 are often flooded in rainy season mainly in a distance of 25 kilometers from Route 410.

Main land use along the project highway is grass land, covering 80 % of the whole stretch. Rubber plantation is the major agricultural land use along the highway. Coconut orchard and paddy field are located alongside with minimal percentage share.

Residential Land	6 %
Paddy Field	1 %
Rubber Plantation	12 %
Coconut Orchard	1 %
Grass Land	80 %

This project need land acquisition of about 200 houses now located in the proposed right of way, particularly in the section between Route 4060 and 42 where the existing ARD road is to be reconstructed and missing links are to be constructed.

Land price along RW7-1 varies from B8,000 - 150,000 per rai. The highest land price is marked at 2 kilometers from the western edge of Route 4063. Land price of the area where land acquisition is required is in the range of B8,000 - 40,000 per rai.

9.2 Socio-Economic Conditions

Total Population in four amphoes of Yala, Raman, Ruso and Yi Ngo is 294,000 persons in 1989. Population density is in the range of 130 - 160 persons per sq. kilometer except Amphoe Muang Yala which has higher density of 375 persons per sq. kilometer. Population growth rate during the period 1979 - 1989 was 1.5 - 3.3 %, Yi Ngo with the lowest rate of 1.5 % and Yala with the highest rate of 3.3 % as shown in Table 9.2.1.

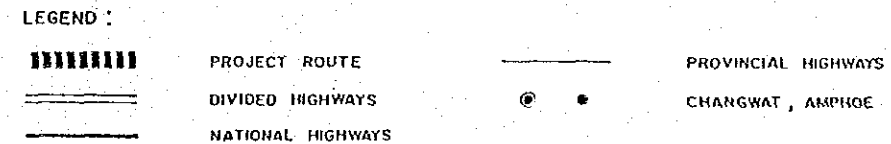
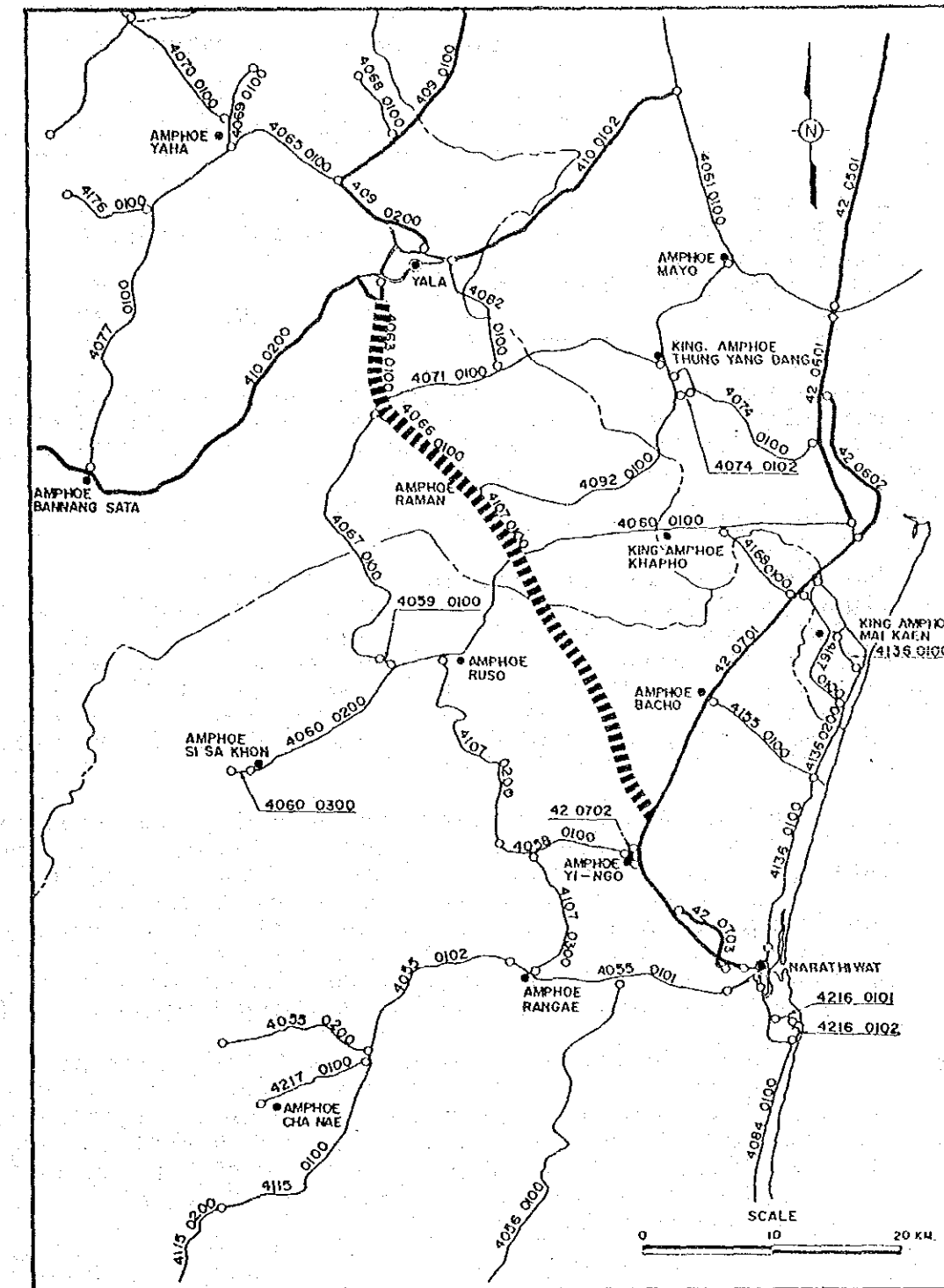


Fig. 9.1.1 YALA - NARATHIWAT HIGHWAY (RW7-1)

Table 9.2.1

POPULATION IN RW7-1 CORRIDOR

	A. Muang Yala	A. Raman	A. Ruso	A. Yi Ngo
Area (km <sup>2</sup> )	449	516		201
Total Pop. (1989)	150,500	64,200	46,700	32,700
Pop. Density (Per./km <sup>2</sup> )	335	124		163
Pop. Growth Rate (% per annum)				
1979-89	3.26	2.70	2.49	1.49

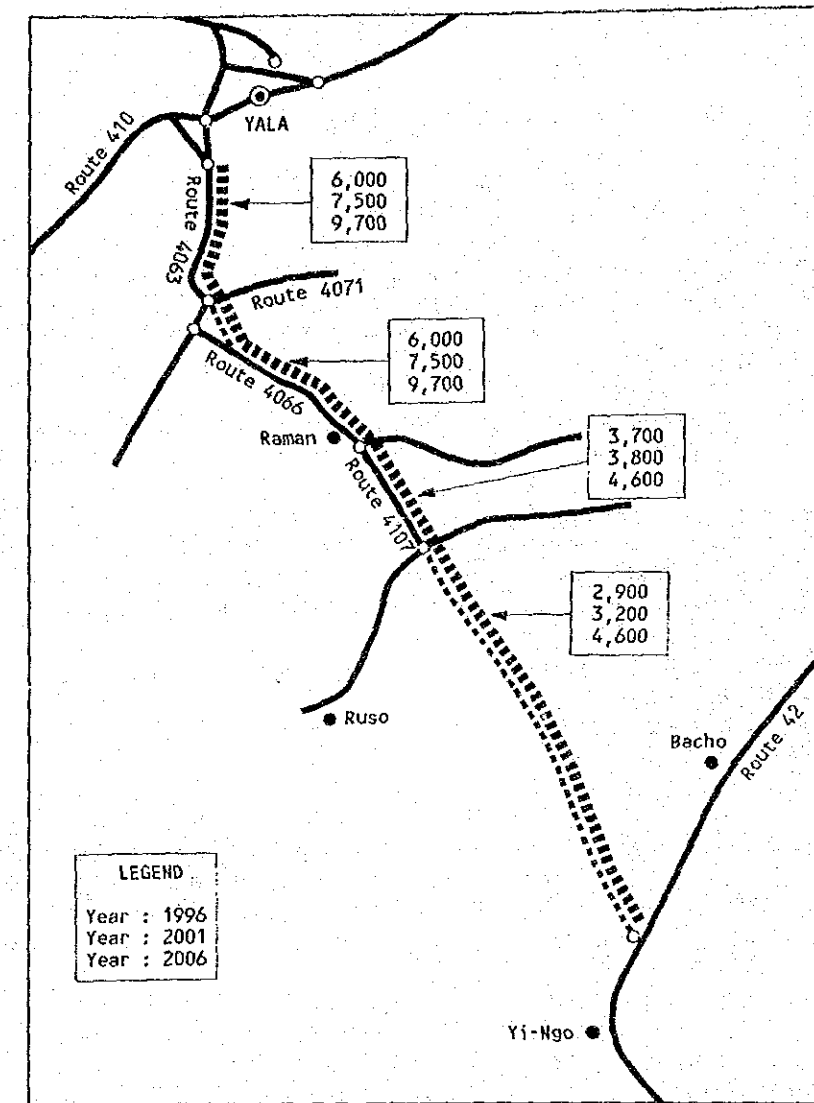
Employment structure in the project area is highly dependent on agriculture, accounting for higher than 80 %. Service sector accounts for 16 % and manufacturing sector only for 3 %.

9.3 Traffic Conditions

The project highway comprises: (1) widening of the existing highways of Route 4063, 4066 and 4107; (2) a reconstruction section of ARD roads between Route 4060 and 42; and (3) new construction of missing links in between. The existing highways are of F4 standard with double surface treatment and penetration macadam of 5 - 6 meter wide carriageway. Traffic volume in 1989 was 2,300 AADT on Route 4063, 2,200 AADT on Route 4066 and 1,900 AADT on Route 4107.

The roadside OD survey carried out on Route 4063 indicated that 38 % of trucks carried manufactured products, 19 % construction materials, 11% timber and 9 % rubber. About two-thirds of timber transport depended on 6 and 10 wheeled trucks. Transport of agriculture related materials and products in this project area was far less than the other project areas. As to trip purposes of passengers, 51 % of cars was for work and business trip and 42 % for private purpose trip. Tourism purpose trip was negligible.

The project highway aims to provide better linkage between two provincial centers of Yala and Narathiwat in the southern border area. Traffic demand is estimated, as shown in Fig. 9.3.1, at 6,000 AADT in 1996, 7,500 AADT in 2001 and 9,700 AADT in 2006 on Route 4063 and 4066, and 2,900 AADT in 1996, 3,200 AADT in 2001 and 4,600 AADT in 2006 on the sections of reconstruction and new construction in the southern part.



Note: Average of AADTs on Routes 4063/4066/4107 is 1,800 in 1990.

Fig. 9.3.1 TRAFFIC VOLUME ON RW7-1

#### 9.4 Project Evaluation

The EIRR was calculated at 24.7 % almost equal to the one calculated in the pre-feasibility study. The EIRR will be lowered to 17.8 % in a case of 20 % cost up and 20 % benefit down. The project is judged viable.

Of the total length of 53.0 kilometers, 36.7 kilometers (69 %) are for widening and reconstruction, and 16.3 kilometers (31 %) are for new construction and realignment. No significant effect on environment is envisaged for the section of widening and reconstruction. For the section of new construction and realignment, however, small or moderate effects on environment are envisaged in terms of encroachment on ecology, erosion and siltation, and environmental aesthetics although special attention was paid to minimize the cut and fill works.

This project is deemed important for stimulating economic development in the Southern Border Provinces. Without the project, economic development would be deferred for many years, inland Yala and Narathiwat in particular. Engineering design in the next stage should fully take into account of the local environmental factors with a view to attaining a better balance between natural conditions and highway construction in the area for regional development.

## 9.5 Engineering Study

### 1) Summary

The alignment of widening section follows the existing DOH highways (Route 4063, 4066 and 4107) excluding a realignment section of 2.5 km near the intersection with Route 4071. The alignment of the reconstruction section follows the existing ARD road as much as possible.

Some sharp horizontal curves are needed to pass a distance of 8 km in mountainous area. The applied minimum radius of curvature is 150 m. To pass on the mountainous terrain, the gradient is designed to be 10 % in maximum.

For the widening section, 8.5 km of Route 4063 is newly designed in terms of vertical alignment. Route 4063 is located close to the Pattani river and the traffic has been frequently blocked by flooding. Height of the embankment is not high enough to be free from flooding damages. To solve the problem, reconstruction of the existing embankment is proposed in the study to make the height to 2.0 m on average.

For the widening section, Seven bridges are planned to be widened with the remaining five bridges unchanged. Fourteen new bridges are proposed for the sections of new construction, realignment and reconstruction.

The existing pavement is planned to be overlaid by 7.5 cm on Route 4066 and 10 cm on Route 4107. Pavement for new construction section comprises surface course of 5 cm, base course of 20 cm and subbase course of 20 cm, 45 cm in total.

RW7-1	Description
Changwat	: Yala and Narathiwat
Name or Location	: Rt.4063/4066/4107, Yala - Narathiwat
Road Class	: F1 (F4)
Cross Section (m)	: 2.5 + 7.0 + 2.5 (DOH:1.5 + 5.0 + 1.5)
Surface Type	: SA / ASC / SA
Bridge: New	: 14 sites, 388 m
Widening	: 7 sites, 124 m
Removal	: 1 site, 18 m
Without Work	: 5 sites, 384 m
Length: Total	: 53.0 km
New	: 13.8 km
Widening	: 14.6 km
Realignment	: 2.5 km
Reconstruction	: 22.1 km (DOH, ARD)
AAADT ('96/'01/'06)	: 4,200 / 4,800 / 6,200
Financial Cost	: 385.9 million baht (in 1990 price)
NPV	: 282 million baht (12% discount rate)
B/C	: 2.2 (12% discount rate)
EIRR	: 24.7 %

( ): Existing Condition

### 2) Design Standard and Conditions

#### (1) Design Criteria

Road Class : F1  
Design Speed : 40 - 90 km/h

#### Geometric Design Criteria

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

#### (2) Pavement Design Conditions

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

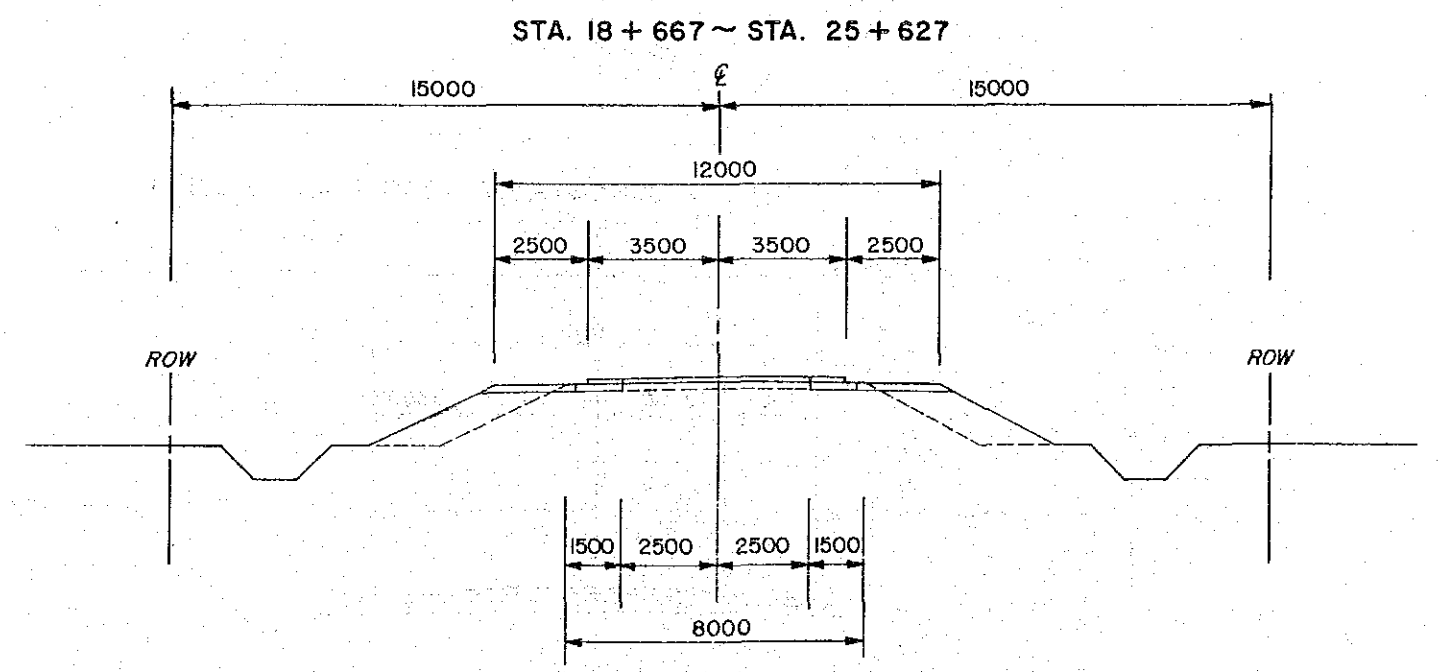
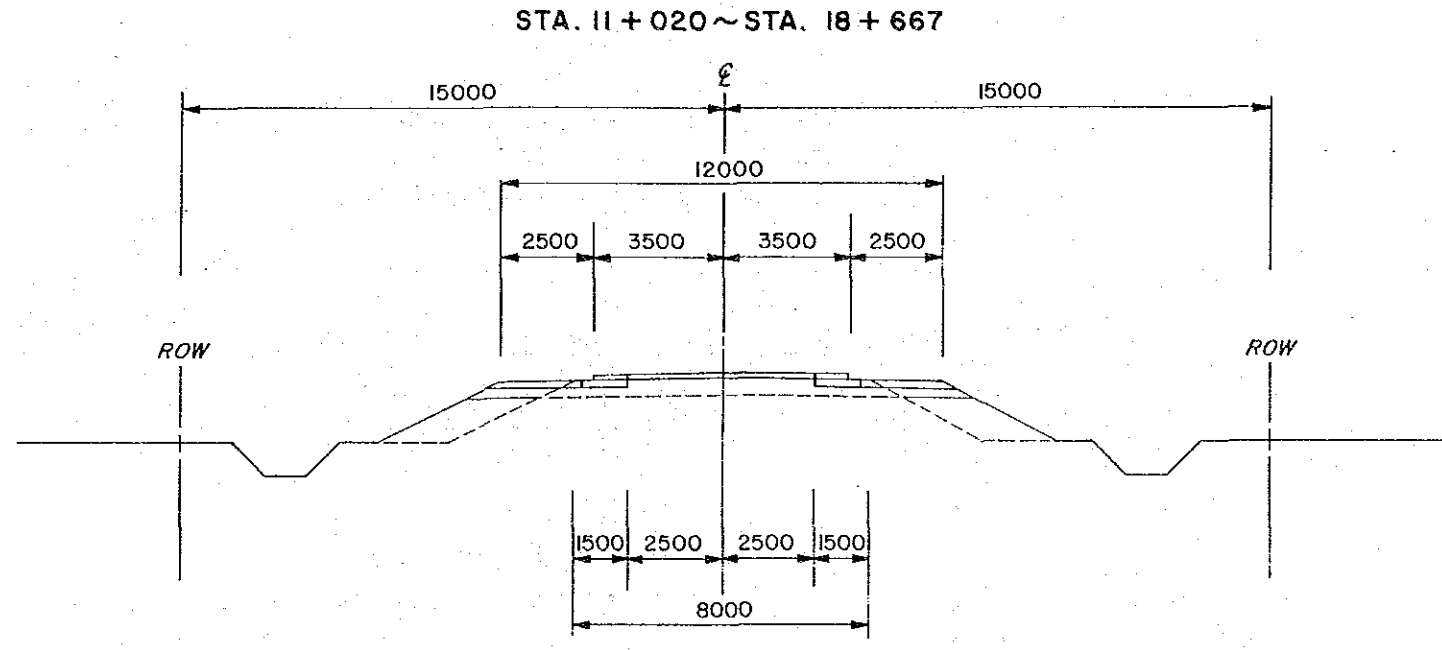
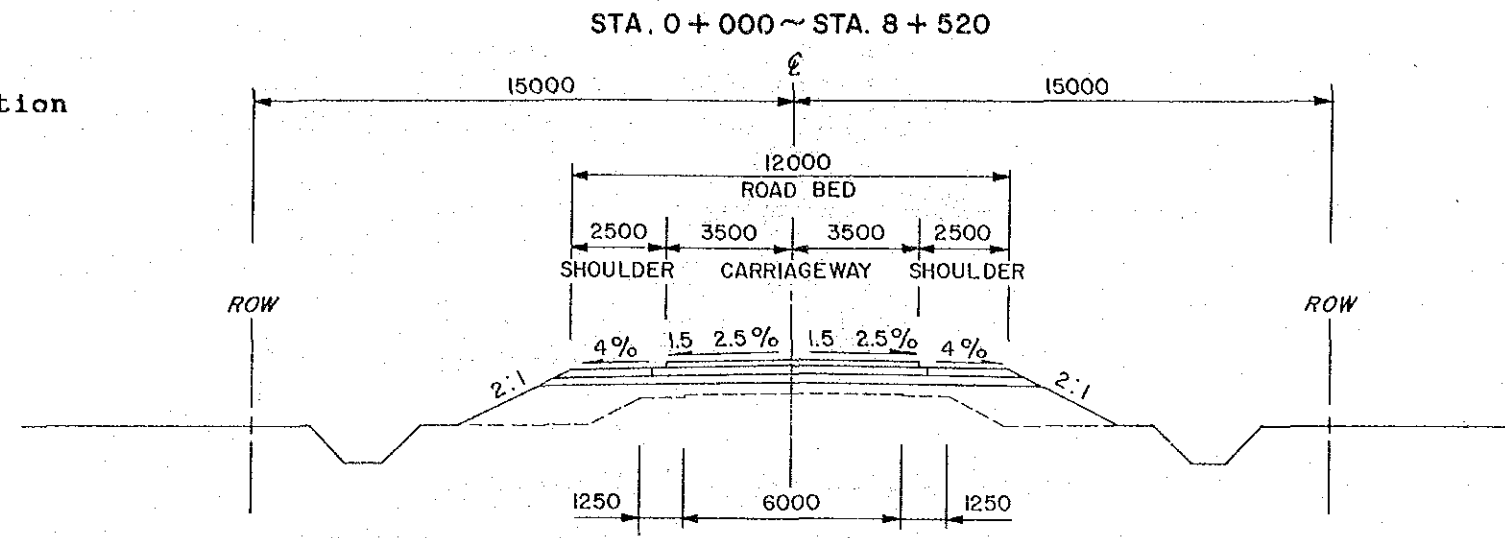
#### (3) Drainage Design Conditions

Rainfall Intensity : Rainfall Intensity Duration Curve at Songkhla Observatory

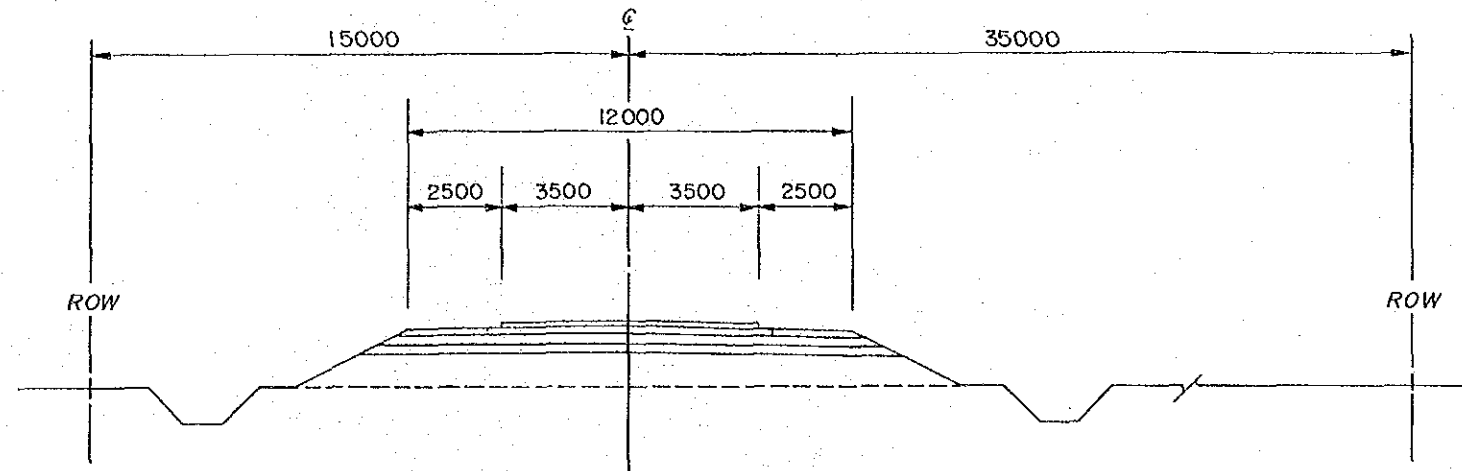
Return Period : Culvert-----10 years  
: Minor Bridge---20 years  
: Major Bridge---30 years



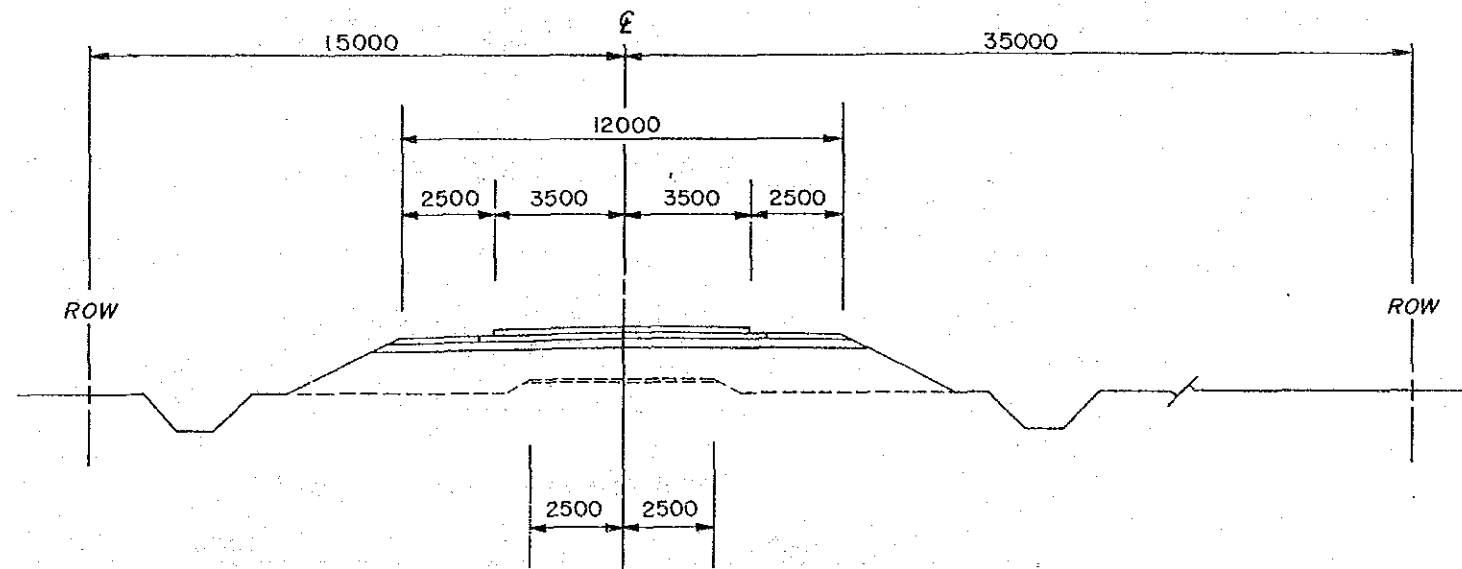
3) Typical Cross Section



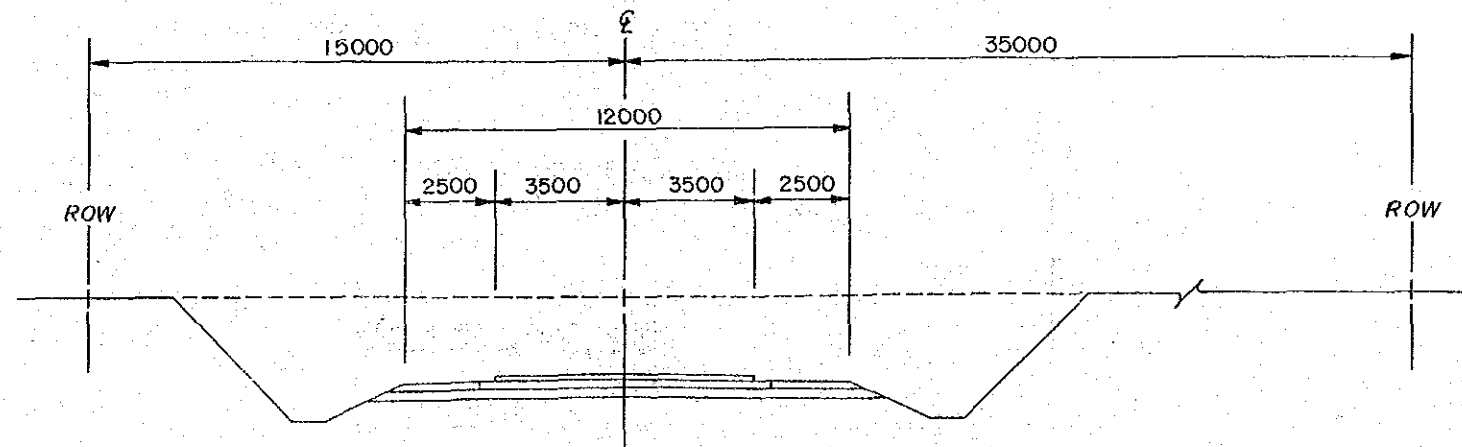
STA. 8+520 ~ STA. 11+900  
 STA. 29+600 ~ STA. 32+500  
 STA. 40+000 ~ STA. 50+900 (EMBANKMENT SECTION)



STA. 25+627 ~ STA. 29+600  
 STA. 32+500 ~ STA. 40+000  
 STA. 53+900 ~ STA. 53+000



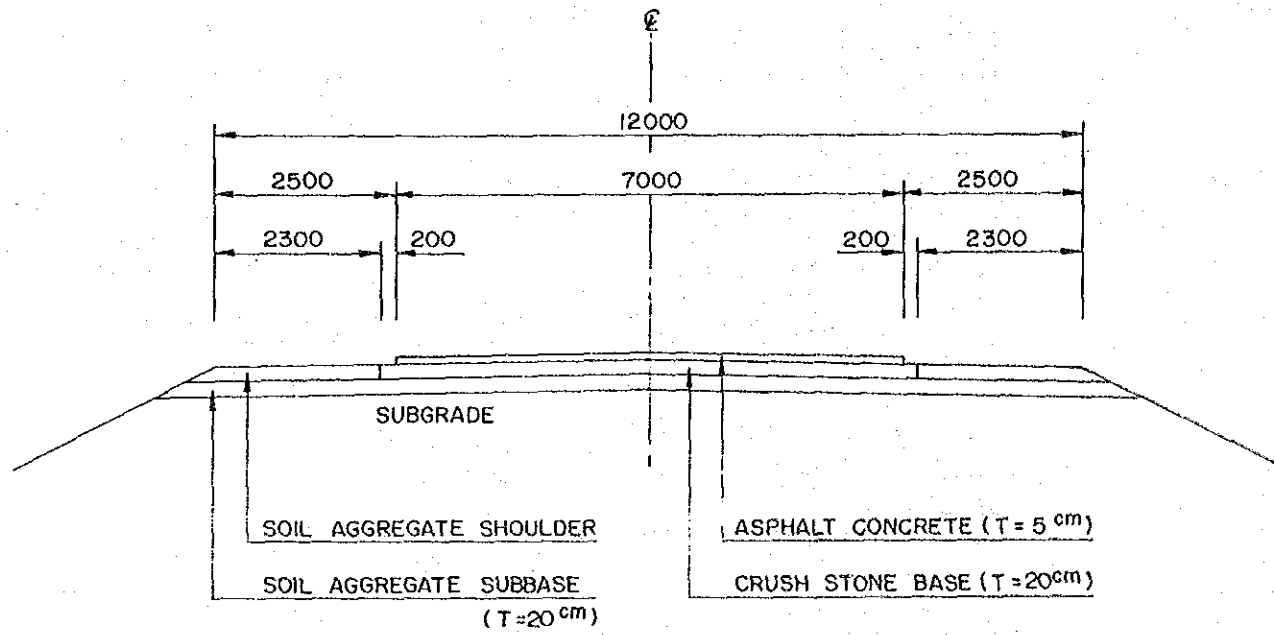
STA. 40+000 ~ STA. 50+900 (CUT SECTION)



4) Pavement Design

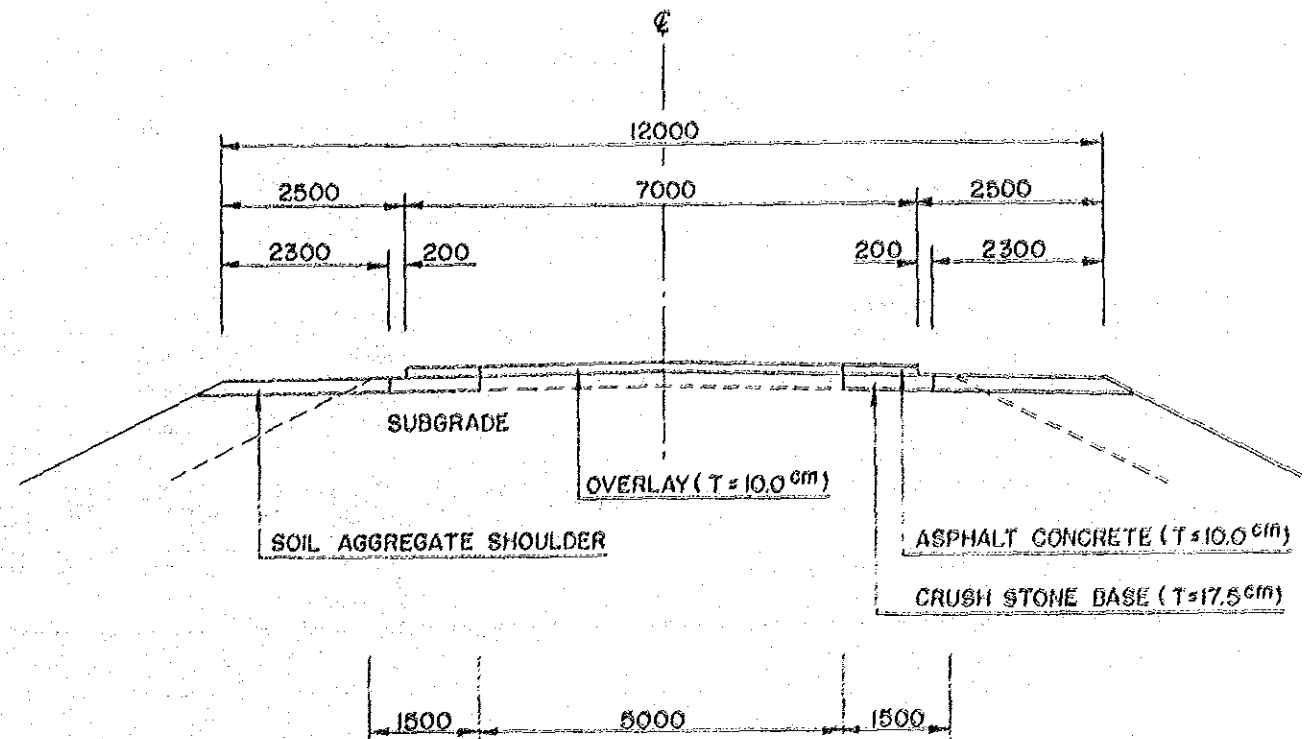
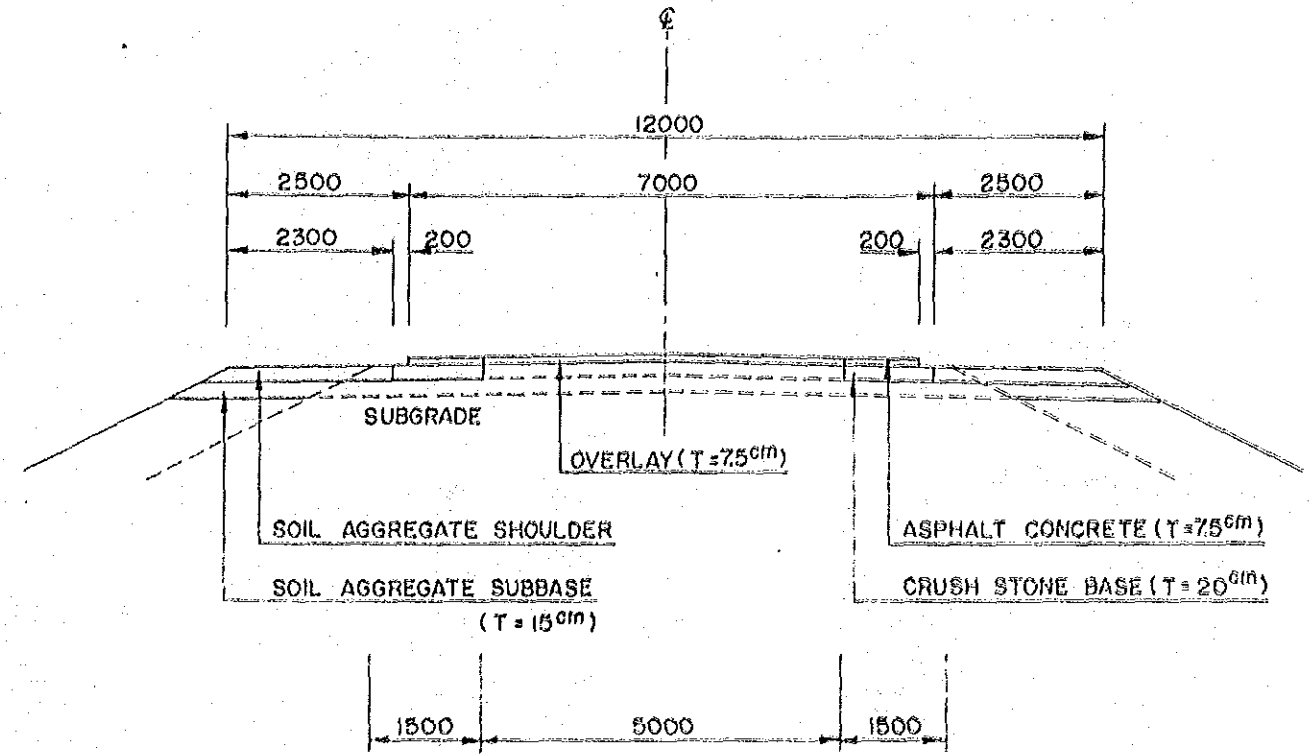
New Road

Design CBR of Subgrade	Cumulative No. of ESA W18 x 10 <sup>3</sup> (7 years)	Thickness of Pavement Structure (cm)
10.0	3,393	Surface 5 Base 20 Subbase 20



Existing Road

Existing Road	Design CBR of Subgrade	Cumulative No. of ESA W18 x 10 <sup>3</sup> (7 years)	Thickness of Overlay (cm)
Route No. 4066	10.0	3,393	7.5
Route No. 4107	10.0	3,393	10.0





9.6 Construction Cost

Table 9.5.1 CONSTRUCTION COST

1) CONSTRUCTION QUANTITIES AND COSTS

(Project RW7-1 Length = 53.000 Km)  
(Improved Length 53.000 Km)

ITEM	Unit	Financial		Economic cost		Residual Value	
		Unit Cost Baht	Quantity	Total cost 1000 Baht	% 1000 Baht	% 1000 Baht	% 1000 Baht
<b>EARTH WORK</b>							
Clearing & Grubbing	SQ.M	1	894,276	894	83	90	
Roadway Excavation(classified)	CU.M	85	222,473	18,910			
Embankment(Borrowed Material)	CU.M	100	636,249	63,625			
Slope Protection(Stripe Sodding)	SQ.M	6	382,881	2,297			
(Sodding)	SQ.M	9	1,582	14			
(Shot Concrete)	SQ.M	500	22,295	11,148			
(Concrete Block)	SQ.M	450	17,131	7,709			
Sand Mat (t=0.5m)	SQ.M	100	5,880	588			
Excavate Existing Surface	SQ.M	2	51,000	102			
Thickness Over 10cm (2 Lay)	SQ.M	14	76,373	1,069			
<b>SUB TOTAL</b>				106,357	88,276	79,448	
<b>SUBBASE AND BASE</b>							
Subbase(Soil Aggregate)	CU.M	190	107,201	20,368	83	50	
Base Coarces(Crush Stone)	CU.M	320	62,610	20,035			
Shoulder(Soil Aggregate)	CU.M	190	51,276	9,742			
<b>SUB TOTAL</b>				50,146	41,621	20,811	
<b>SURFACE</b>							
Asphaltic Prime coat	SQ.M	13	315,021	4,095	83	50	
Asphaltic Tack coat	SQ.M	7	116,877	818			
Asphalt concrete Surfacing	CU.M	1,900	15,745	29,916			
Overlay ( 7.5cm,10cm )	CU.M	1,900	6,135	11,657			
<b>SUB TOTAL</b>				46,485	38,583	19,291	
<b>STRUCTURES(Equivalent)</b>							
RC Pipe Culvert( D= 600 m)	M	1,330	2,024	2,692	83	50	
( D= 800 m)	M	1,850	78	144			
( D=1000 m)	M	2,550	763	1,946			
( D=1200 m)	M	3,700	0	0			
( D=600m*2)	M	2,660	32	85			
( D=600m*3)	M	3,990	6	24			
( D=800m*2)	M	3,700	24	89			
( D=800m*3)	M	5,550	0	0			
( D=1.0m*2)	M	5,100	70	357			
( D=1.0m*3)	M	7,650	32	245			
RC Box Culvert(1-1.20*1.20 m)	M	3,000	4	12			
(1-1.80*1.80 m)	M	4,200	207	869			
(1-2.10*2.10 m)	M	5,000	34	170			
(1-2.40*2.40 m)	M	5,900	51	301			
(2-1.50*1.50 m)	M	7,000	4	28			
(2-1.80*1.80 m)	M	8,400	4	34			
(2-2.10*1.80 m)	M	9,200	10	92			
(3-1.80*1.80 m)	M	12,600	4	50			
RC Bridge Widening	SQ.M	9,600	719	6,902			
RC Bridge (W=14.0 m)	M	89,600	368	32,973			
PC Bridge (W=14.0 m)	M	140,000	0	0			
Bearing Unit Of Bridge	Ls	500,000	13	6,500			
Remove Of Existing Bridge	SQ.M	3,000	417	1,251			
Temporary Bridge	SQ.M	5,000	144	720			
<b>SUB TOTAL</b>				55,484	46,052	23,026	
<b>INTERSECTION</b>							
T-Intersection(Unsignal)	Ls	80,000	3	240	90	90	
Four-Leg Intersection(Unsignal)	Ls	100,000	2	200			
<b>SUB TOTAL</b>				440	396	356	
<b>TOTAL (a)</b>				258,912	214,928	142,933	
Miscellaneous Works [(a)*7%]	Ls	1		18,124	15,045	10,005	
<b>CONTRACT AMOUNT (b)</b>				277,036	229,973	152,938	
PHYSICAL CONTINGENCIES [(b)*10%] (c)	Ls	1		27,704	22,997	15,294	
ENGINEERING & SUPERVISION [(b)+(c))*10%] (d)	Ls	1		30,474	25,903	0	0
LAND ACQUISITION & COMPENSATION							
Land Acquisition (Average)	SQ.M	24	1,171,474	28,233	100	28,233	100
Compensation	Ls	22,500,000	1	22,500	100	22,500	100
<b>TOTAL (e)</b>				50,733	50,733	50,733	
<b>PROJECT COST [(b)+(c)+(d)+(e)]</b>				385,946	329,605	218,964	
<b>AVERAGE COST PER KM</b>				7,282			

2) MAINTENANCE COST

Project Road No, RW 7-1 (Existing Road) Na= 9,300 Baht/Km/year Km= 1.162 Length = 36.700 Km

Laterite Surface

ITEMS	Existing		
	Condition	Factor	
1. A.D.T	A1	>400	0.95
2. Width Of Embankment (Surface & Shoulder)	A3	8.5 m	0.44
3. R-O-W Width	B1	30 m	0.08
4. Traffic Service Operation Topography	B2	0 - 3 %	0.05
5. Drainage Topography	B3	0 - 3 %	0.00
6. Bridge Quantity (m/Km)	B4	12	0.02
7. NO. Of Lanes		2	

Ks (Existing)= 1+0.7(A1+A3)+0.3(B1+B2+B3+B4) = 2.018  
Maintenance cost + Overhead = Ks \* Km \* Na \* 1.28 = 27,914 Baht/Km/year  
Total Cost (Financial) = Length \*(Baht/Km/year)= 1,024,439 Baht/year  
(Economic) = 850,285 Baht/ye

Project Road No, RW 7-1 (Proposed Road) Na= 8,200 Baht/Km/year Km= 1.001 Length = 53.000 Km

Asphalt Pavement

ITEMS	Proposed Road (1996)			(2001) (2006)	
	Condition	Factor	Factor	Factor	Factor
1. Surface /Bace Type	X1	AC	0.00	0.00	0.00
2. Subgrade CBR	X2	4 %	0.50	0.50	0.50
3. A.D.T	X3	4,000	1.51	1.76	2.25
4. Service Life (year)	X4	NEW	0.00	0.00	0.00
5. Pavement Width (m)	X5	7 m	0.19	0.19	0.19
6. R-O-W Width (m)	Y1	30 m	0.00	0.00	0.00
7. Shoulder, Access, Median Width (m)	Y2	2.5 m	0.05	0.05	0.05
8. Traffic Service Operation Topography	Y3	0 - 3 %	0.00	0.00	0.00
9. Drainage Topography	Y4	0 - 3 %	0.00	0.00	0.00
10. Bridge Quantity (m/Km)	Y5	12	0.00	0.00	0.00
11. NO. Of Lanes		2			

Ka = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5)= 2.125 2.250 2.495  
Maintenance cost + Overhead= Ka \* Km \* Na \* 1.28 = 22,326 23,640 26,214 Baht/Km/year  
Total Cost (Financial) = Length \*(Baht/Km/year)= 1,183,294 Baht/year  
(1996) (Economic) = 982,134 Baht/year  
Total Cost (Financial) = ADT(4,600 CAR/DAY) = 1,252,900 Baht/year  
(2001) (Economic) = 1,039,907 Baht/year  
Total Cost (Financial) = ADT(6,000 CAR/DAY) = 1,389,326 Baht/year  
(2006) (Economic) = 1,153,141 Baht/year

Overlay Cost (2004) = 48,437,760 Baht

3) CONSTRUCTION SCHEDULE

Project RW 7-1

(Two Section)

year and Month	First Year												Second Year												Third Year											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Land Acquisition	=====																																			
Preparatory Works	=====																																			
Earth Works													=====																							
Pavement Works																									=====											
Bridge Works													=====																							
Miscellaneous Works	=====												=====												=====											
Clearing -Up																									=====											
Percentage Of Disbursement (%)	38 %												43 %												19 %											

4) ECONOMIC EVALUATION

Cost and Benefit flows of the Project  
Project; RW-7-1

(unit ; 1000 Baht)

Year	Const- ruction Cost	Mainte- nance Cost	Total Cost	VOC Benefit	Time Benefit	Balance	Sensi. Analysis
						Benefit= Cost=	0.8 1.2
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	147,000	0	147,000	0	0	(147,000)	(176,400)
1994	132,413	0	132,413	0	0	(132,413)	(158,895)
1995	50,193	0	50,193	0	0	(50,193)	(60,232)
1996	0	132	132	66,143	20,868	86,879	69,451
1997	0	132	132	68,206	23,904	91,978	73,530
1998	0	132	132	70,269	26,940	97,077	77,609
1999	0	132	132	72,333	29,975	102,176	81,688
2000	0	132	132	74,396	33,011	107,275	85,767
2001	0	190	190	76,459	36,047	112,316	89,777
2002	0	190	190	92,181	40,620	132,611	106,013
2003	0	190	190	107,903	45,193	152,906	122,249
2004	0	48,628	48,628	123,624	49,765	124,762	80,359
2005	0	190	190	139,346	54,338	193,495	154,720
2006	0	303	303	155,068	58,911	213,676	170,820
2007	0	303	303	155,068	58,911	213,676	170,820
2008	0	303	303	155,068	58,911	213,676	170,820
2009	0	303	303	155,068	58,911	213,676	170,820
2010	0	303	303	155,068	58,911	213,676	170,820
<b>Total</b>	<b>329,606</b>	<b>51,560</b>	<b>381,166</b>	<b>1,666,200</b>	<b>655,216</b>	<b>1,940,250</b>	<b>1,399,733</b>
				IRR =		24.66%	17.81%
				NPV (i;12%) =		281,922	
				B/C (i;12%) =		2.24	