

Chapter 7

Palian - Khuan Kalong Highway (WD6-1)

7. Palian - Khuan Kalong Highway (WD6-1)

7.1 Natural Conditions and Land Use

The project is located on the west coast facing to the Andaman Sea between Palian in Trang Province and Khuan Kalong in Satun Province in a distance of 83 kilometers. About 80 % of the project highway passes on a flatland and the remaining 20 % in a rolling terrain. Mean annual rainfall of the area amounts to 2,400 mm. The area near Palian and Khuan Kalong belongs to natural conservation area.

Agricultural land use is predominant along the highway. About 70 % of the area belongs to crop and cultivation area including rubber plantation, paddy field and coconut orchard.

Paddy Field	24 %
Rubber Plantation	36 %
Coconut Orchard	11 %
Grass Land	29 %

No land acquisition is required for this project. Land price is in the range of B1,500 - 100,000 per rai. Land of the highest price is located close to the village at about 15 kilometers from Palian.

7.2 Socio-Economic Conditions

Total population of the amphoes along the highway reached 161,300 persons in 1989, The largest Amphoe Palian accounts for 41%, followed by Amphoe La Nga for 29%, Amphoe Khuan Kalong for 20% and Amphoe Thung Wa for 10 %. Population density ranges from 53 persons per sq.kilometer to 125 persons, which shows lower density than the other project areas. The project area has higher population growth rates than the other project areas: Khuan Kalong shows the highest growth rate of 4.4 %, followed by Thung Wa of 3.8 %, La Nga of 3.3 % and Palian of 2.3 % as shown in Table 7.2.1.

Table 7.2.1 POPULATION IN WD6-1 CORRIDOR

	A.Khuan Kalong	A.La Nga	A.Thung Wa	A.Palian
Area (km ²)	620	380	294	
Total Pop. (1989)	31,791	47,352	15,565	66,530
Pop.Density (per./km ²)	51	125	53	
Pop.Growth Rate (% per annum) 1979-89	4.37	3.29	3.79	2.30

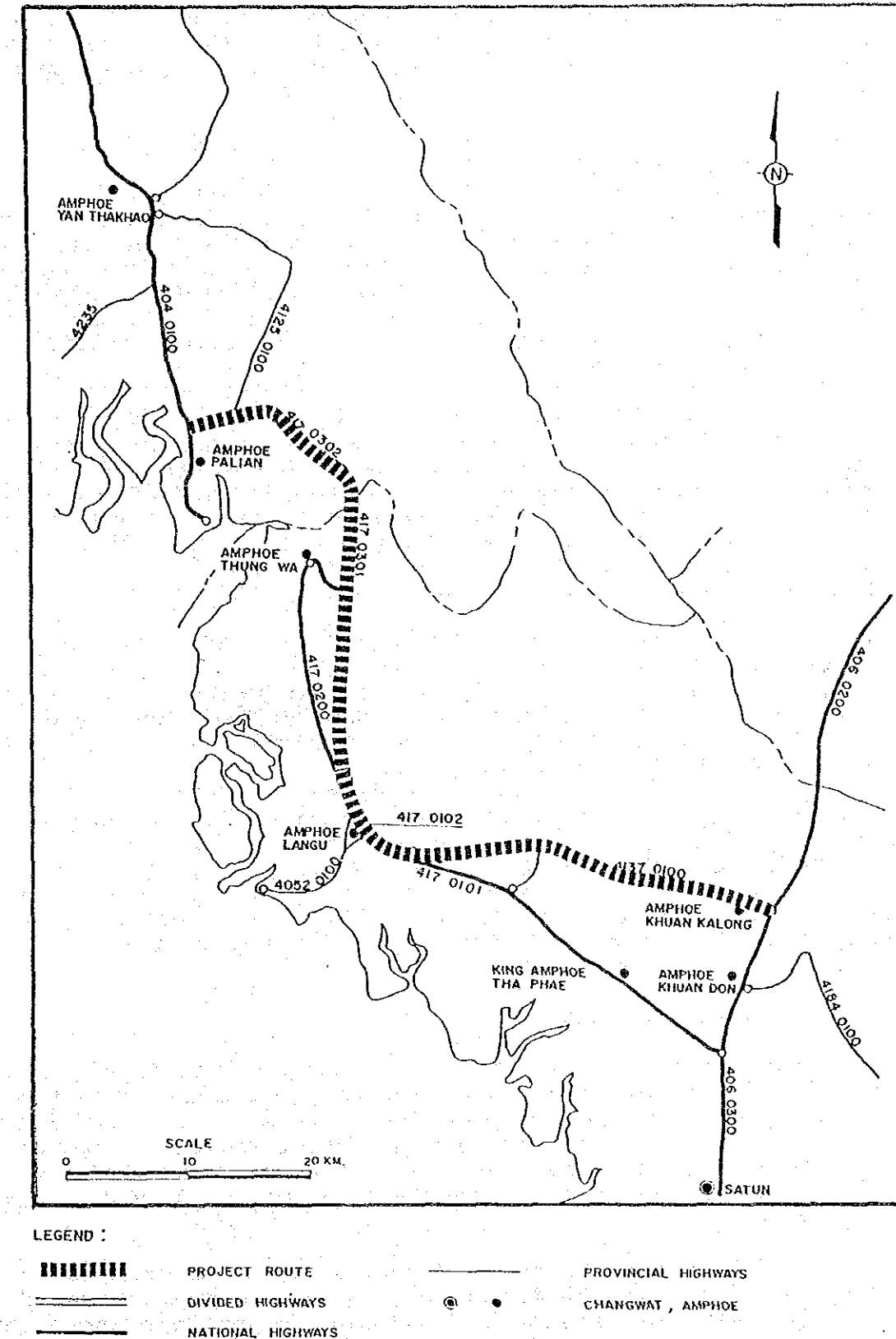


Fig. 7.1.1 PALIAN - KHUAN KALONG HIGHWAY (WD6-1)

Employment structure of the project area is characterized by high dependence on agriculture (70 %) and service sectors (30 %). It infers that manufacturing sector has not been developed in the project area.

7.3 Traffic Conditions

The project covers a section of about 83 kilometers of Route 417 and 4137 from Palian to Khuan Kalong. Route 417 and 4137 are of F4 standard with Double Surface Treatment of 5 meter carriageway width which is narrower than the design specification by 0.5 meter. Traffic volume on the highways in 1989 was in the order of 700 - 1,200 AADT which was nearly equal to the design traffic capacity of normal F4 standard.

The roadside OD survey carried out near La Ngu on Route 417 indicated that 30 % of trucks carried manufactured products, 20 % rubber, 10 % fish, 9 % vegetable & fruit, and 8% construction materials and petroleum products. Pickup truck is the popular means of transport in the project area with less dependence on heavy trucks. As to trip purposes of passengers, work and business trip occupied as high as 63 % of car trips, followed by private purpose trip of 30 % and tourism purpose trip of 7 %.

The project aims to develop a better highway link along the west coast connecting Trang with Satun/Hat Yai directions. Future traffic volume is estimated, as shown in Fig. 7.3.1, at 1,500 AADT in 1996, 2,200 AADT in 2001 and 3,000 AADT in 2006 between Palian and Thung Wa, and at 2,100 AADT in 1996, 3,600 AADT in 2001 and 4,400 AADT in 2006 on Route 4137.

The improved highway is proposed to be of S3 standard which will be partially insufficient to accommodate the estimated traffic volume in 2001. The study team, however, proposes S3 standard by taking account of the prevailing high dependence on rubber plantation and fishery activities in the project area leading to an extremely low composition ratio of heavy vehicles.

7.4 Project Evaluation

The EIRR was calculated at 19.2 % though it was 22.4 % in the pre-feasibility study. The reason for the lower EIRR this time is the cost increase incurred by realignment of the existing highway over a distance of 26.1 kilometers. The EIRR would be lowered to 14.0 % in a case of 20 % cost up and 20 % benefit down. The project is judged still viable although the EIRR is the lowest of the eight projects.

The highway passes through a mountainous area of Khao Ya Ra near Khuan Kalong. Small effects on environment are envisaged in this area in terms of erosion and siltation, possible encroachment to ecology and air pollution hazards at climbing sections.

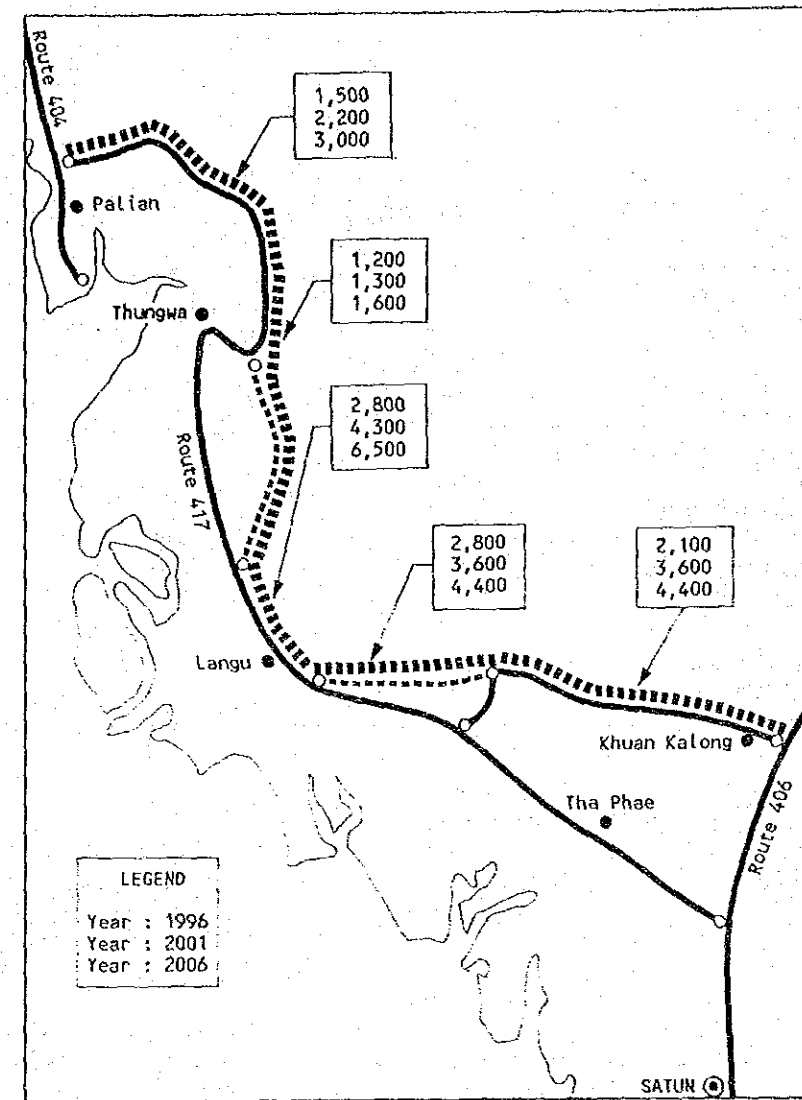


Fig. 7.3.1 TRAFFIC VOLUME ON WD6-1

7.5 Engineering Study

1) Summary

The alignment basically follows the existing highway Route 417 and 4137 except for realignment sections. The realignment is proposed at two sections with the length of 16.4 km and 9.7 km. Both of them pass on the hilly and mountainous terrain to save the distance of about 16 km. The realignment improves the existing curve sections with small radius of curvature.

The applied maximum gradient is 9.0 % for the widening sections, while, for the realignment section, the maximum gradient of 6.5 % is applied.

Widening is proposed on both sides of the existing embankment for a distance of 55.5 km. A four lane with no center-median is planned in the town area of Palian, 1 km in length.

Existing pavement is proposed to be overlaid by 7.5 cm for widening section. The pavement of realignment section comprises surface course of 7.5 cm, base course of 15 cm and subbase course of 20 cm, 42.5 cm in total.

Five new bridges are proposed in the realignment section, while the existing seven bridges in the widening section are to be used without any widening work due to sufficient width.

WD6-1	Description
Changwat	: Satun and Trang
Name or Location	: Rt.4137/417, Khuan Kalong - Palian
Road Class	: S3, SD (F4)
Cross Section (m):S3	: 2.0 + 6.0 + 2.0 (1.5 + 5.0 + 1.5)
SD	: 0.5 + 7.0 + 7.0 + 0.5
Surface Type: S3	: SA / ASC / SA
SD	: ASC
Bridge: New	: 5 sites, 108 m
Without Work	: 17 sites, 490 m
Length: Total	: 82.6 km
Realignment	: 26.1 km
Widening to S3	: 55.5 km
Widening to SD	: 1.0 km
AADT ('96/'01/'06)	: 1,800 / 2,400 / 3,000
Financial Cost	: 318.3 million baht (in 1990 price)
NPV	: 144 million baht (12% discount rate)
B/C	: 1.8 (12% discount rate)
EIRR	: 19.2 %

(): Existing Condition

2) Design Standard and Conditions

(1) Design Criteria

Road Class : Widening-----S3
 : Additional Two Lane---SD
 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

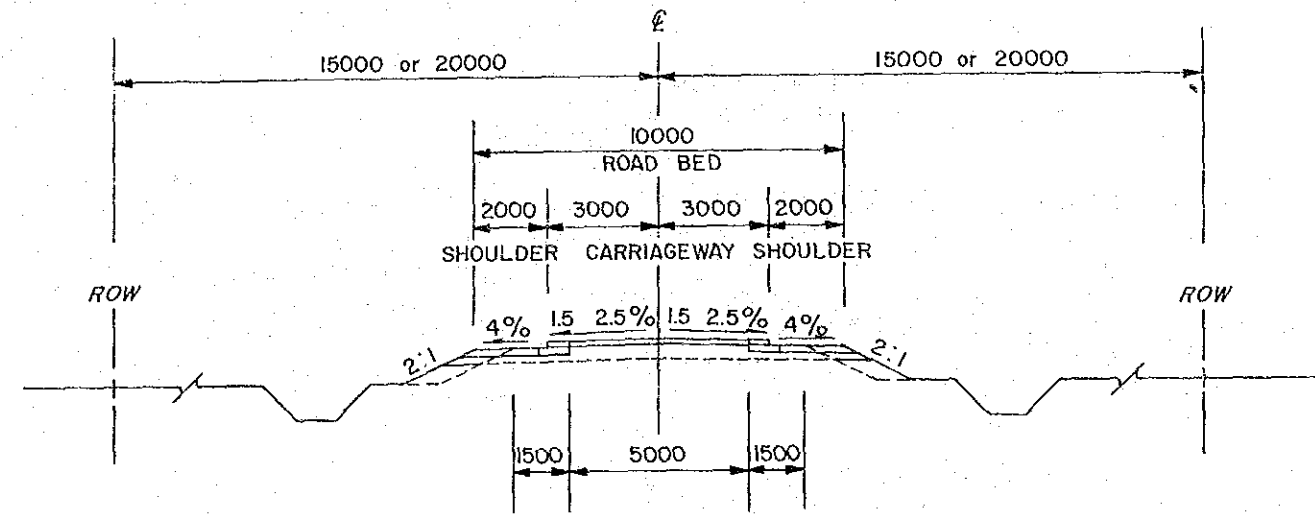
Design CBR : 6 %
 Design Method : AASHTO
 Design Period : 7 years

(3) Drainage Design Conditions

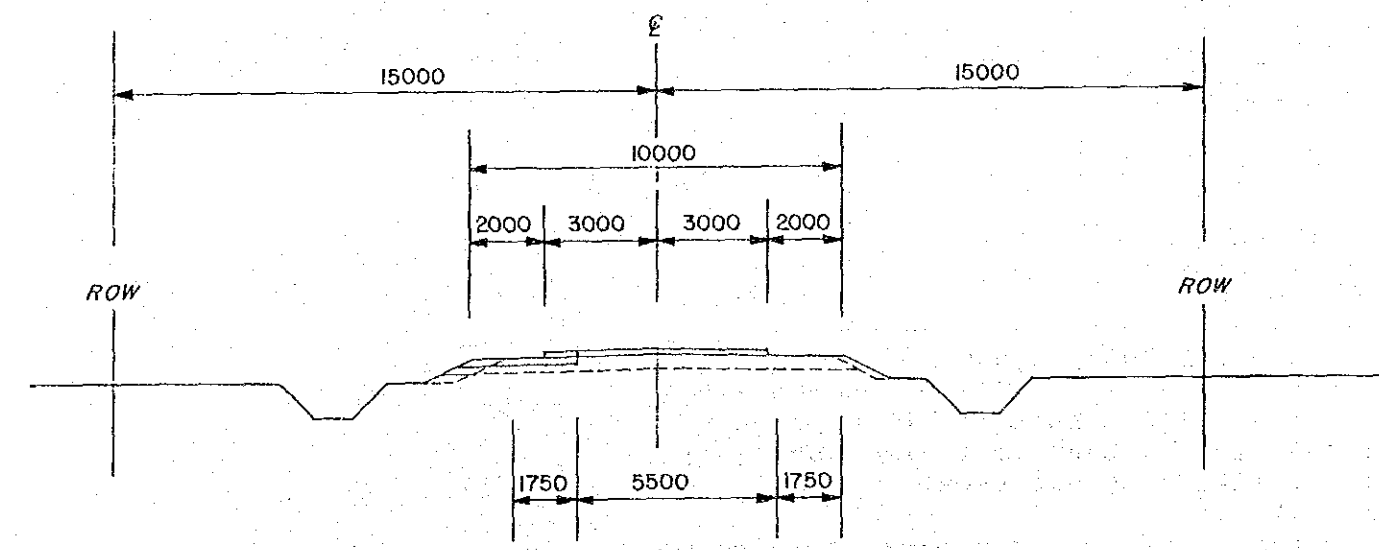
Rainfall Intensity : Rainfall Intensity Duration Curve at Songkhla Observatory
 Return Period : Culvert -----10 years
 : Minor Bridge-----20 years
 : Major Bridge-----30 years

3) Typical Cross Section

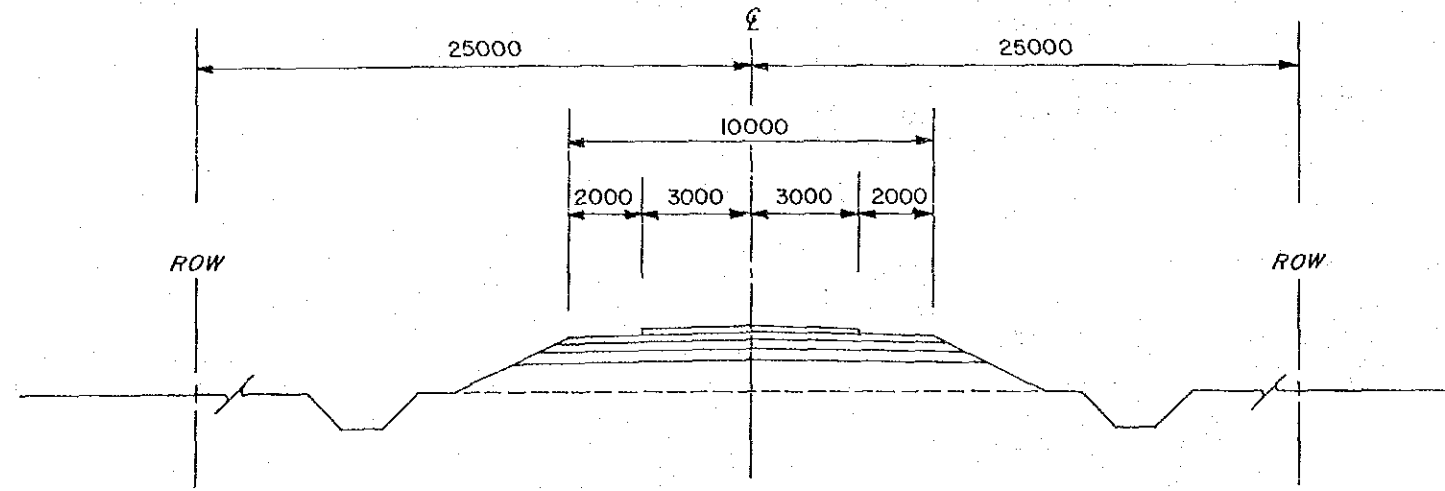
STA. 0 + 000 ~ STA. 15 + 270
 STA. 18 + 500 ~ STA. 22 + 781
 STA. 32 + 450 ~ STA. 41 + 340
 STA. 57 + 750 ~ STA. 77 + 910
 STA. 78 + 960 ~ STA. 82 + 585



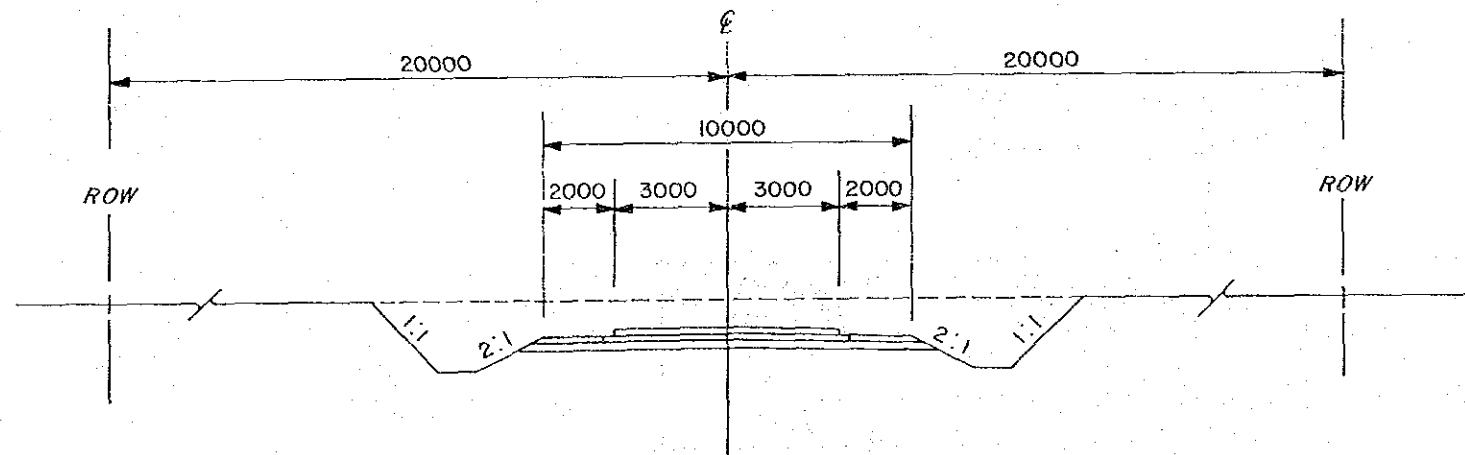
STA. 15 + 270 ~ STA. 18 + 500



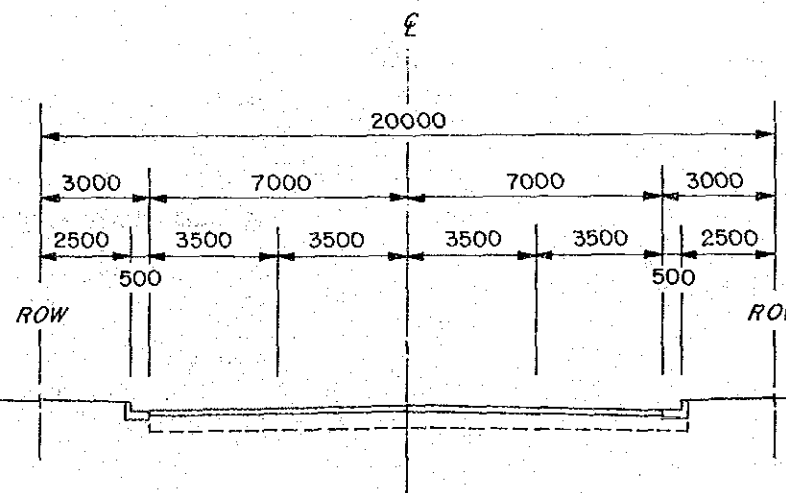
STA. 22 + 781 ~ STA. 32 + 450
 STA. 41 + 340 ~ STA. 57 + 750 (EMBANKMENT SECTION)



STA. 41 + 340 ~ STA. 57 + 750 (CUT SECTION)



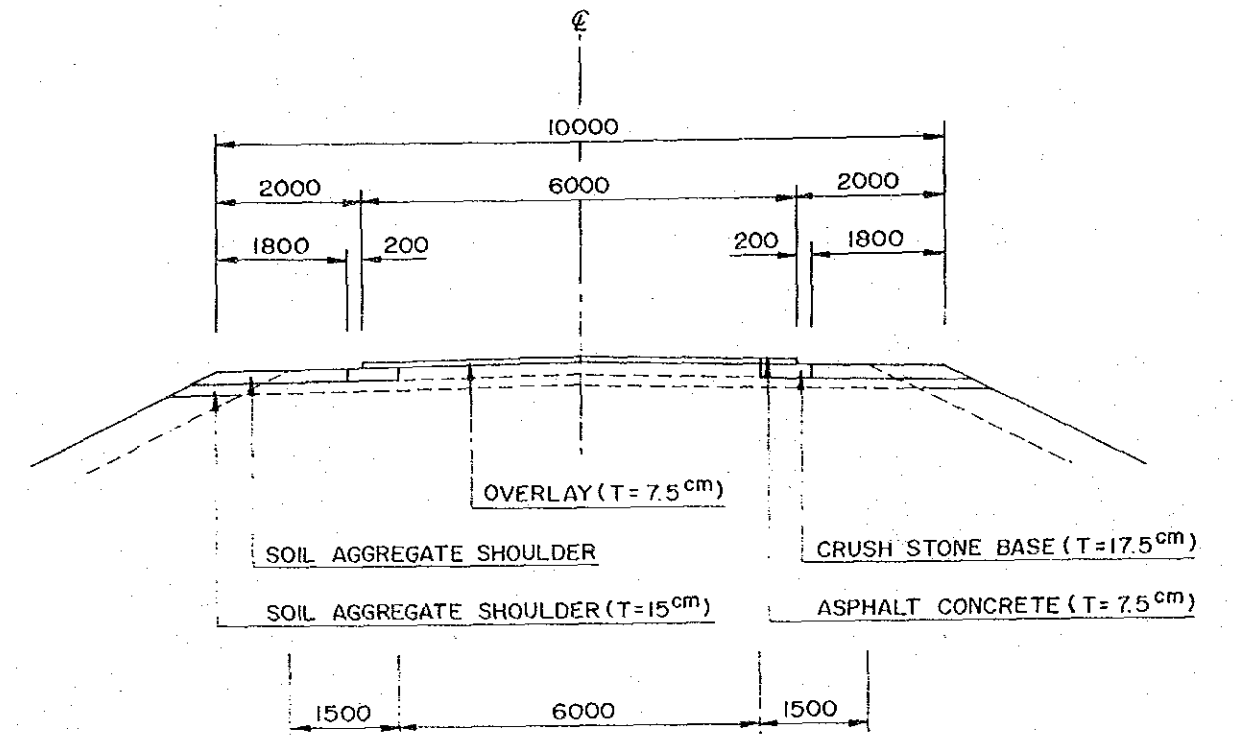
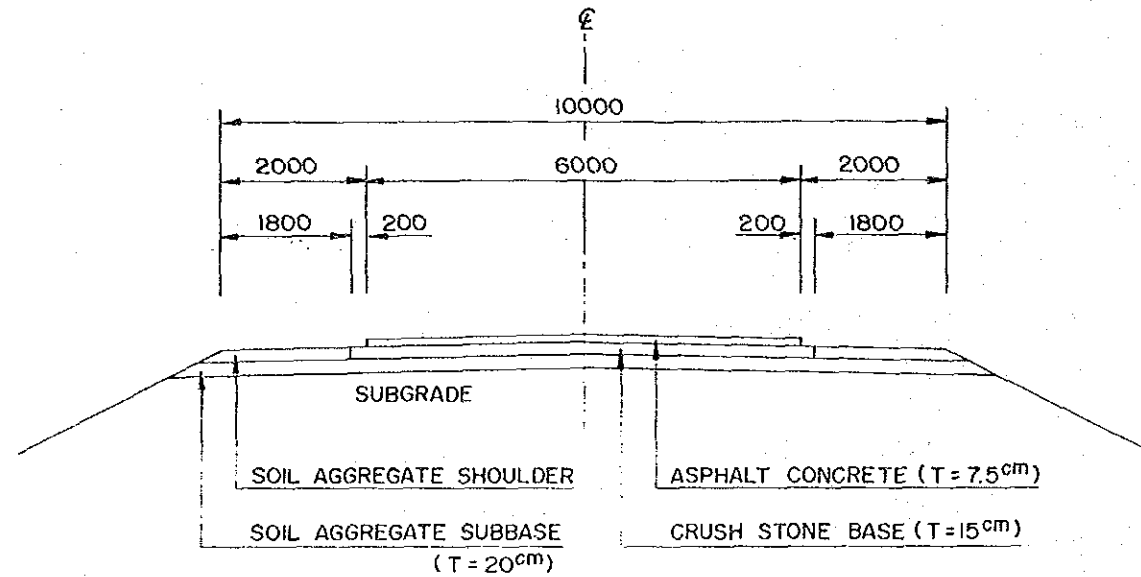
STA. 77 + 910 ~ STA. 78 + 960



4) Pavement Design

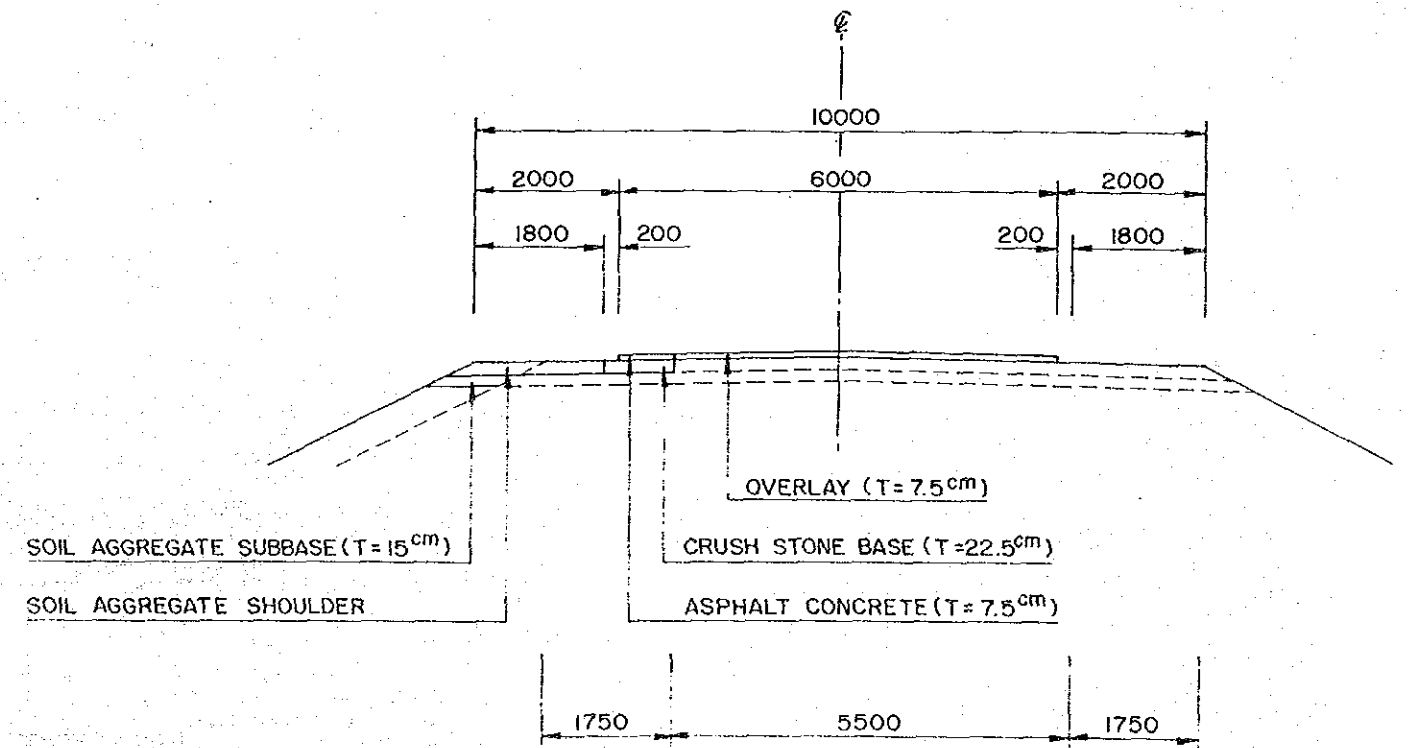
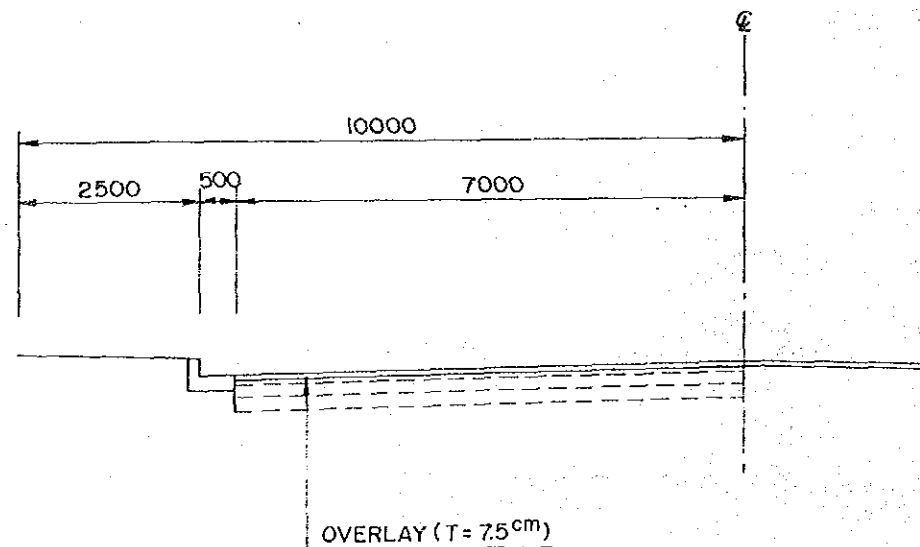
New Road

Design CBR of Subgrade	Cumulative No. ₃ of ESA W18 x 10 ³ (7 years)	Thickness of Pavement Structure (cm)
6.0	1,582	Surface 7.5 Base 15 Subbase 20



Existing Road

Existing Road	Design CBR of Subgrade	Cumulative No. ₃ of ESA W18 x 10 ³ (7 years)	Thickness of Overlay (cm)
Route No. 417	6.0	1,582	7.5
Route No. 4137	6.0	1,582	7.5



7.6 Construction Cost

Table 7.5.1 CONSTRUCTION COST

1) CONSTRUCTION QUANTITIES AND COSTS

(Project WD -6-1 Length = 82.585 Km)
(Improved Length 82.585 Km)

ITEM	Unit	Financial Unit Cost Baht	Quantity	Financial Total cost 1000 Baht	Economic cost % 1000 Baht	Residual Value % 1000 Baht
EARTH WORK						
Clearing & Grubbing	SQ.M	1	832,704	833	83	90
Roadway Excavation(classified)	CU.M	85	21,658	1,841		
Embankment(Borrowed Material)	CU.M	100	903,096	90,310		
Slope Protection(Stripe Sodding)	SQ.M	6	393,926	2,364		
(Sodding)	SQ.M	9	2,548	23		
(Shot Concrete)	SQ.M	500	0	0		
(Concrete Block)	SQ.M	450	0	0		
Sand Mat (t=0.5m)	SQ.M	100	7,200	720		
Excavate Existing Thickness Over 10cm (2 Lay)	SQ.M	14	176,087	2,465		
SUB TOTAL				98,555	81,801	73,621
SUBBASE AND BASE						
Subbase(Soil Aggregate)	CU.M	190	39,902	7,581	83	50
Base Coarses(Crush Stone)	CU.M	440	38,118	16,772		
Shoulder(Soil Aggregate)	CU.M	190	52,490	9,973		
SUB TOTAL				34,326	28,491	14,245
SURFACE						
Asphaltic Prime coat	SQ.M	13	240,920	3,132	83	50
Asphaltic Tack coat	SQ.M	7	291,135	2,038		
Asphalt concrete Surfacing Overlay (7.5cm)	CU.M	1,900	15,689	29,809		
SUB TOTAL				41,488	63,468	31,734
STRUCTURES(Equivalent)						
RC Pipe Culvert(D= 600 m)	M	1,380	1,070	1,477	83	50
(D= 800 m)	M	1,950	310	605		
(D=1000 m)	M	2,650	977	2,589		
(D=1200 m)	M	3,850	22	85		
(D=1500 m)	M	4,900	2	10		
(D=600m*2)	M	2,760	12	33		
(D=800m*2)	M	3,900	18	70		
(D=800m*3)	M	5,850	6	35		
(D=1.0m*2)	M	5,300	14	74		
(D=1.0m*3)	M	7,950	2	16		
RC Box Culvert(1-1.80*1.80 m)	M	4,200	363	1,525		
(1-2.10*2.10 m)	M	5,000	56	280		
(1-2.40*2.40 m)	M	5,900	2	12		
(2-1.00*1.50 m)	M	6,000	3	18		
(2-2.10*2.10 m)	M	10,000	14	140		
(2-2.40*2.40 m)	M	11,800	4	47		
(2-3.00*3.00 m)	M	16,200	2	32		
(2-3.30*3.30 m)	M	18,800	2	38		
(2-3.40*2.50 m)	M	15,400	3	46		
(4-1.50*1.50 m)	M	14,000	2	28		
RC Bridge Widening	SQ.M	9,600	0	0		
RC Bridge (W=12.0 m)	M	76,800	108	8,294		
PC Bridge (W=12.0 m)	M	120,000	0	0		
Bearing Unit Of Bridge	Ls	500,000	5	2,500		
SUB TOTAL				17,953	14,901	7,451
SIDE WALK						
Side Walk (W=2.5 m)	M	700	2,100	1,470	83	50
SUB TOTAL				1,470	1,220	610
INTERSECTION						
T-Intersection(Unsignal)	Ls	80,000	6	480	90	90
SUB TOTAL				480	432	389
TOTAL (a)				229,252	190,313	128,049
Miscellaneous Works [(a)*7%]	Ls	1	16,048	13,322		
CONTRACT AMOUNT (b)				245,300	203,635	137,013
PHYSICAL CONTINGENCIES [(b)*10%] (c)	Ls	1	24,530	20,363		
ENGINEERING & SUPERVISION [(b)+(c)*10%] (d)	Ls	1	26,983	22,936	85	0
LAND ACQUISITION & COMPENSATION						
Land Acquisition (Average)	SQ.M	12	1,298,550	15,972	100	100
Compensation	Ls	5,500,000	1	5,500	100	100
TOTAL (e)				21,472	21,472	21,472
PROJECT COST [(b)+(c)+(d)+(e)]				318,285	268,406	172,186
AVERAGE COST PER KM				3,854		

2) MAINTENANCE COST

Project Road No, WD 6-1 (Existing Road) Na= 9,300 Baht/Km/year
Km= 1.162
Length = 56.506 Km

Laterite Surface

ITEMS	Existing		
	Condition	Factor	
1. A.D.T	A1 >400	0.95	
2. Width Of Embankment (Surface & Shoulder)	A3 8.0 m	0.33	
3. R-O-W Width	B1 40 m	0.13	
4. Traffic Service Operation Topography	B2 0 - 3 %	0.05	
5. Drainage Topography	B3 0 - 3 %	0.00	
6. Bridge Quantity (m/Km)	B4 7	0.02	
7. NO. Of Lanes	2		

Ks (Existing)= 1+0.7(A1+A3)+0.3(B1+B2+B3+B4) = 1.956
Maintenance cost + Overhead = Ks * Km * Na * 1.28 = 27,056 Baht/Km/year
Total Cost (Financial) = Length *(Baht/Km/year)= 1,528,841 Baht/year
(Economic) = 1,268,938 Baht/year

Project Road No, WD 6-1 (Proposed Road) Na= 8,200 Baht/Km/year
Km= 1.001
Length = 82.585 Km

Asphalt Pavement

ITEMS	Proposed Road (1996)			(2001)	(2006)
	Condition	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 1,900	0.57	0.94	1.37	
4. Service Life (year)	X4 NEW	0.00	0.00	0.00	
5. Pavement Width (m)	X5 6 m	0.05	0.05	0.05	
6. R-O-W Width (m)	Y1 40 m	0.00	0.00	0.00	
7. Shoulder, Access, Median Width (m)	Y2 2.0 m	0.00	0.00	0.00	
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 7	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)= 1.560 1.745 1.960
Maintenance cost + Overhead= Ka * Km * Na * 1.28 = 16,390 18,334 20,593 Baht/Km
Total Cost (Financial) = Length *(Baht/Km/year)= 1,353,579 Baht/year
(1996) (Economic) = 1,123,471 Baht/year
Total Cost (Financial) = ADT(2,800 CAR/DAY) = 1,514,100 Baht/year
(2001) (Economic) = 1,256,703 Baht/year
Total Cost (Financial) = ADT(3,700 CAR/DAY) = 1,700,651 Baht/year
(2006) (Economic) = 1,411,540 Baht/year

Overlay Cost (2004) = 64,693,786 Baht

3) CONSTRUCTION SCHEDULE

Project WD 6-1

(Three 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 (%)	29 %												47 %												24 %											

4) ECONOMIC EVALUATION

Cost and Benefit Flows of the Project
Project; WD6-1

(unit ; 1000 Baht)

Year	Const- ruction Cost	Mainte- nance	Total Cost	VOC Benefit	Time Benefit	Balance Benefit= Cost=	Sensi. Analysis 0.8 1.2
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	92,125	0	92,125	0	0	(92,125)	(110,549)
1994	125,072	0	125,072	0	0	(125,072)	(150,087)
1995	51,209	0	51,209	0	0	(51,209)	(61,451)
1996	0	(145)	(145)	1,743	20,780	22,668	18,193
1997	0	(145)	(145)	3,785	26,011	29,942	24,012
1998	0	(145)	(145)	5,827	31,242	37,215	29,830
1999	0	(145)	(145)	7,870	36,474	44,489	35,649
2000	0	(145)	(145)	9,912	41,705	51,762	41,468
2001	0	(12)	(12)	11,954	46,936	58,902	47,127
2002	0	(12)	(12)	20,763	66,507	87,282	69,831
2003	0	(12)	(12)	29,572	86,078	115,663	92,535
2004	0	64,682	64,682	38,381	105,650	79,349	37,606
2005	0	(12)	(12)	47,190	125,221	172,423	137,943
2006	0	143	143	55,999	144,792	200,648	160,462
2007	0	143	143	55,999	144,792	200,648	160,462
2008	0	143	143	55,999	144,792	200,648	160,462
2009	0	143	143	55,999	144,792	200,648	160,462
2010	0	143	143	55,999	144,792	200,648	160,462
Total	268,407	64,619	333,026	456,992	1,310,564	1,434,531	1,014,414
						IRR = 19.22%	14.01%
						NPV (i;12% 144,376	
						B/C (i;12% 1.77	