

Chapter 6

Hua Sai - Songkhla Highway (WD7-4)

6. Hua Sai - Songkhla Highway (WD7-4)

6.1 Natural Conditions and Land Use

The project locates along the east coast of the Gulf of Thailand between Hua Sai and Songkhla. The terrain is completely flat at about 5 meter height from sea level. In every November - January, north-east monsoon attacks the area, causing flooding and other type of disasters. Mean annual rainfall of the area amounts to 2,100 - 2,400 mm. General geology is of alluvium and terrace deposits. There are two major canals passing through the area; Ranot canal and Ta Kharai canal.

Paddy field and grass land are the main land use along the existing Route 408, both accounting for about 40 % of the whole stretch.

Residential Land	5 %
Paddy field	40 %
Grass Land	40 %
Others (Shrimp Farm)	15 %

Land price along the highway varies in the range of B50,000 - 100,000 per rai. Land price near Hua Sai and Songkhla is relatively high compared with the other section of this highway while land price in the middle part is comparatively low.

6.2 Socio-Economic Conditions

It is estimated that the total population in the project corridor is 360,000 persons including Songkhla as shown in Table 6.2.1. Ranot and Sathing Phra have relatively high population density. Population growth rates during 1979 - 1989 were stagnant for four amphoes of Hua Sai, Ranot, Krasae Sin and Sathing Phra. It is conceived that due to the limited availability of arable land in the area, a substantial number of people have out-migrated.

Table 6.2.1 POPULATION IN WD7-4 CORRIDOR

	Hua Sai	Ranot	Krasae Sin	Sathing Phra	Songkhla
Area (km ²)	454.6	83.4	96.4	120.0	368.4
Total Pop. (1989)	70,700	75,400	17,200	50,300	143,200
Pop. Density (per./km ²)	156	904	178	419	389
Pop. Growth (% per annum) 1979-89	0.69	0.88	0.47	0.99	3.66

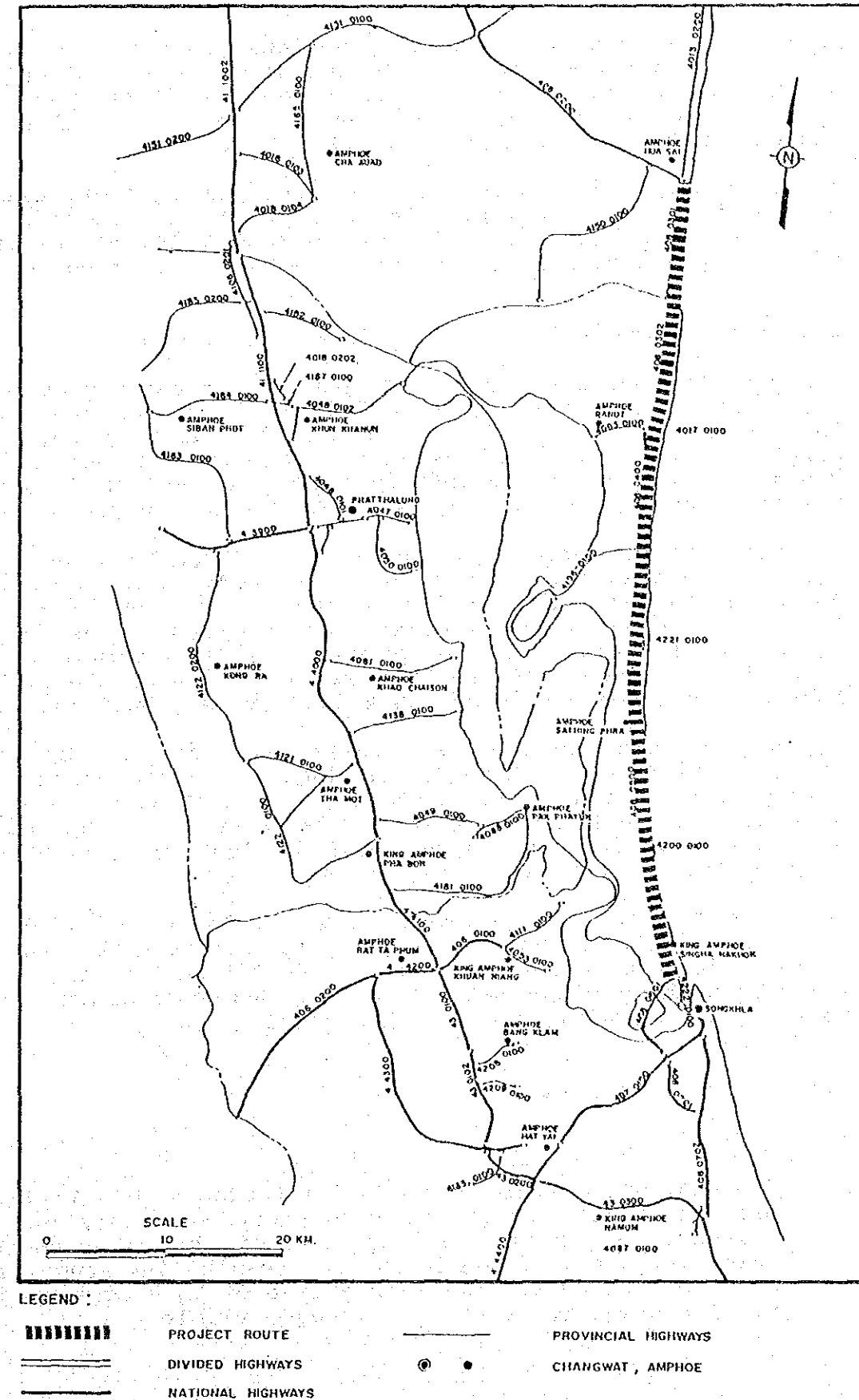


Fig. 6.1.1 HUA SAI - SONGKHLA HIGHWAY (WD7-4)

As for the employment structure, agriculture has about 70-80% of the total employment, followed by the services of 10%. Only Amphoe Hua Sai has slightly higher share of service (17%). Manufacturing sector is almost negligible for every amphoe. Songkhla, however, has manufacturing employment of 5.3 %.

A number of prawn feeding farm has been growing every year. A lot of investment has been invested in this business and more will be invested in the future. It is estimated that 80% of the area near the sea in Amphoe Hua Sai is designated as prawn feeding area.

6.3 Traffic Conditions

The project covers a section of about 96 kilometers of Route 408 from the intersection with Route 4013 in the north to the intersection with 4222 in the south. The existing highway is of S3/F3 standard mostly of asphaltic concrete surface of 6 meter width. Traffic volume in 1989 was 2,500 - 2,700 AADT between Hua Sai and Ranot and 3,100 - 3,900 between Ranot and Khau Daeng.

The roadside OD survey carried out near Khau Daeng on Route 408 revealed that 23 % of trucks carried manufactured products, 20 % construction materials, 10 % live stock, 9 % fish, 8 % vegetable & fruit. Compared with the other project areas, transportation of agricultural products is conspicuously high, including rice and fertilizer transport. As to trip purposes of passengers, 58 % was for private purpose trip and 38 % for work and business trip.

The project aims to increase traffic capacity by improving the standard to S1 with 7 meter carriageway width. Future traffic volume is estimated, as shown in Fig. 6.3.1, at 3,200 AADT in 1996, 5,000 AADT in 2001 and 7,400 in 2006 between Hua Sai and Ranot, and at 6,200 AADT in 1996, 9,600 AADT in 2001 and 13,900 in 2006 between Krasae Sin and Sathing Phara.

Based on the future framework in which there is no particular development plans in Hua Sai area, it is envisaged that there seems no specific requirement to construct additional two lanes along the existing highway. Flood protection measures could be more important to facilitate traffic flow in this section.

6.4 Project Evaluation

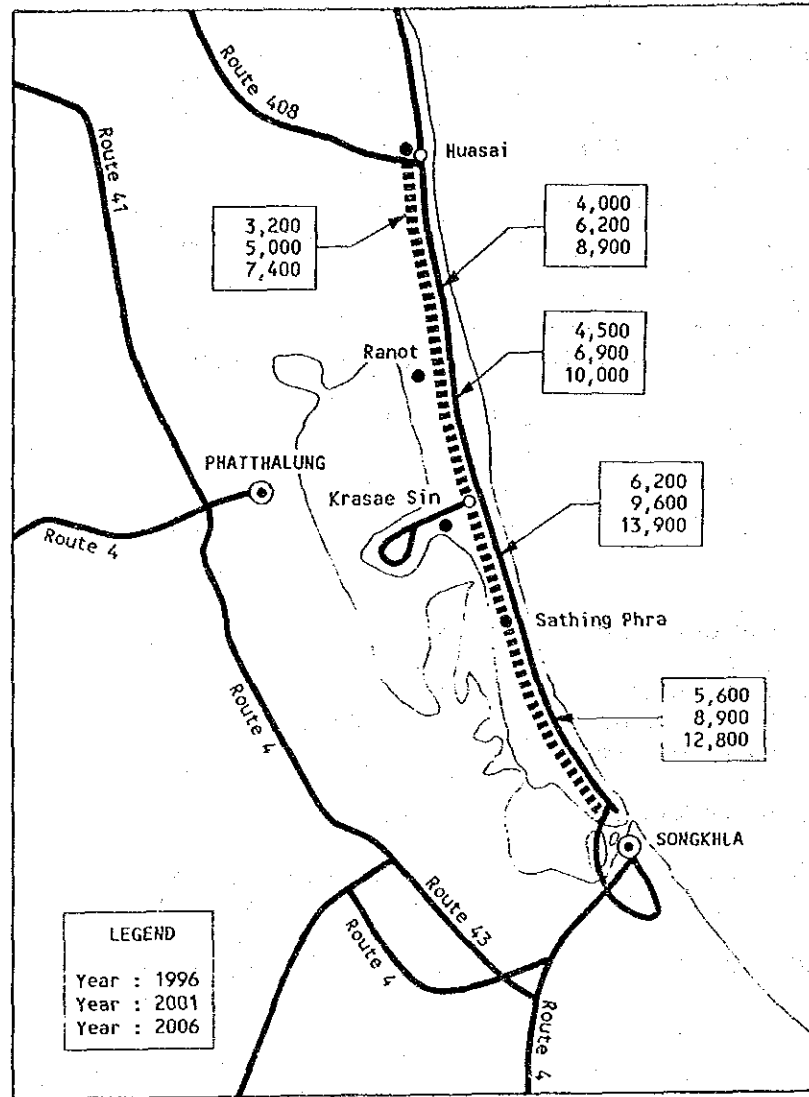
1) WD7-4-1

The EIRR was calculated at 34.3 % though it was 46.3 % in the pre-feasibility study. This was caused mainly due to the introduction of the overlay cost of the existing pavement which was not included in the pre-feasibility study. The EIRR will be lowered to 25.3 % in a case of 20 % cost up and 20 % benefit down. The project is judged viable.

No significant effects on environment is envisaged as the project is just a widening of the existing carriageway. Although the highway is located in a flat low land along the coastal line, there have not been flooding damages except for some section near Hua Sai.

2) WD7-4-2

The EIRR was calculated at 29.9 %, slightly lower than that of WD7-4-1. The EIRR will be lowered to 21.7 % in a case of 20 % cost up and 20 % benefit down. Though the project is judged viable, WD7-4-1 should firstly be implemented. The timing of introducing WD7-4-2 should secondly be determined through observation of future traffic increase near Hua Sai city.



Note; Average of ADTs on Route 408 is 3,100 in 1990.

Fig. 6.3.1 TRAFFIC VOLUME ON WD7-4

6.5 Engineering Study

1) WD7-4-1

(1) Summary

The alignment follows the existing highway Route 408. Widening is planned on the inland side of the existing alignment.

The existing pavement is to be overlaid with a thickness of 7.5 cm. Pavement of the widening portion from station No.0.0 to 29.0 comprises surface course of 12.5 cm, base course of 15 cm and subbase course of 15 cm, 42.5 cm in total. Pavement of the section from station No.29.0 to 96.3 comprises surface course of 12.5 cm, base course of 17 cm and subbase course of 15 cm, 44.5 cm in total.

All bridges situating in the project area are planned to be used with no widening work.

Drainage capability at the section close to Hua Sai with a length of 5 km is improved by additional drainage facilities in consideration of flooding history.

WD7-4-1	Description
Changwat	: Nakhon Si Thammarat and Songkhla
Name or Location	: Rt.408, Hua Sai - Songkhla
Road Class	: S1 (S3 and F3)
Cross Section (m)	: 2.5 + 7.0 + 2.5 (2.0 + 6.0 + 2.0)
Surface Type	: SA / ASC / SA
Bridge: Without Work	: 3 sites, 136 m
Length: Total	: 96.3 km
AAADT ('96/'01/'06)	: 4,500 / 6,900 / 10,000
Financial Cost	: 215.6 million baht (in 1990 price)
NPV	: 263 million baht (12% discount rate)
B/C	: 3.1 (12% discount rate)
EIRR	: 34.3 %

(): Existing Condition

(2) Design Standard and Conditions

(a) Design Criteria

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

Geometric Design Criteria

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

(b) Pavement Design Conditions

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

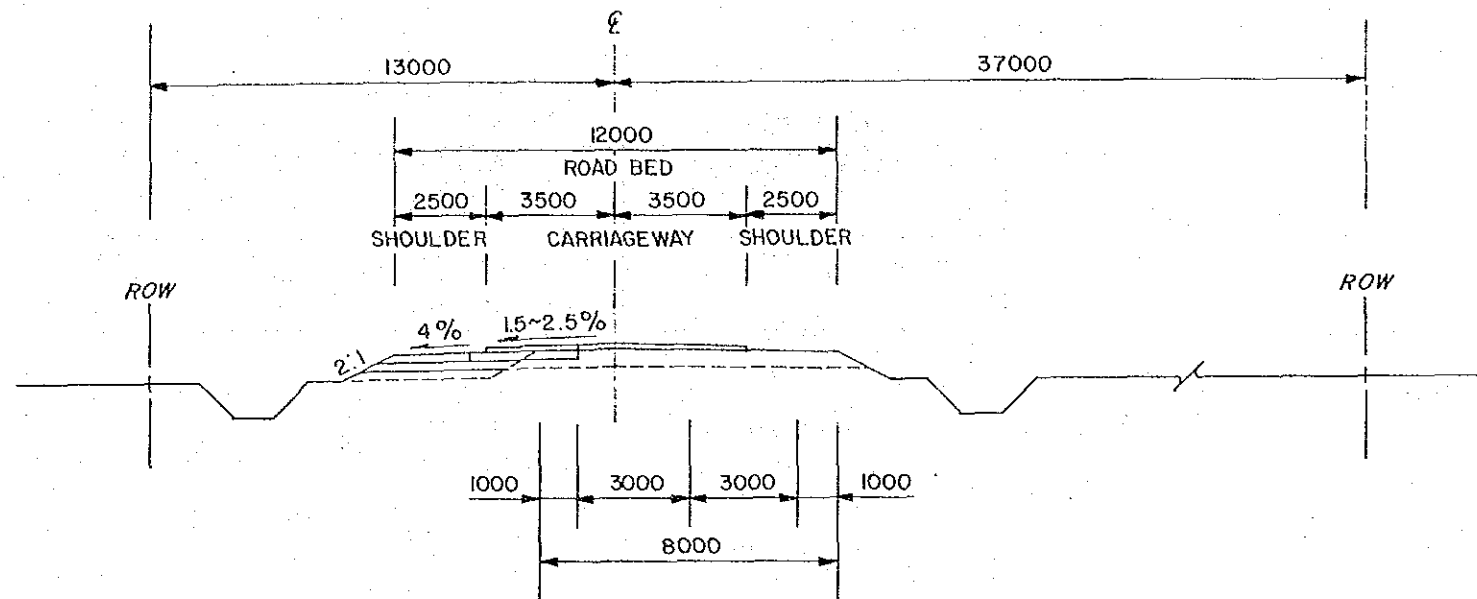
(c) Drainage Design Conditions

Rainfall Intensity : Rainfall Intensity Duration Curve at Songkhla Observatory

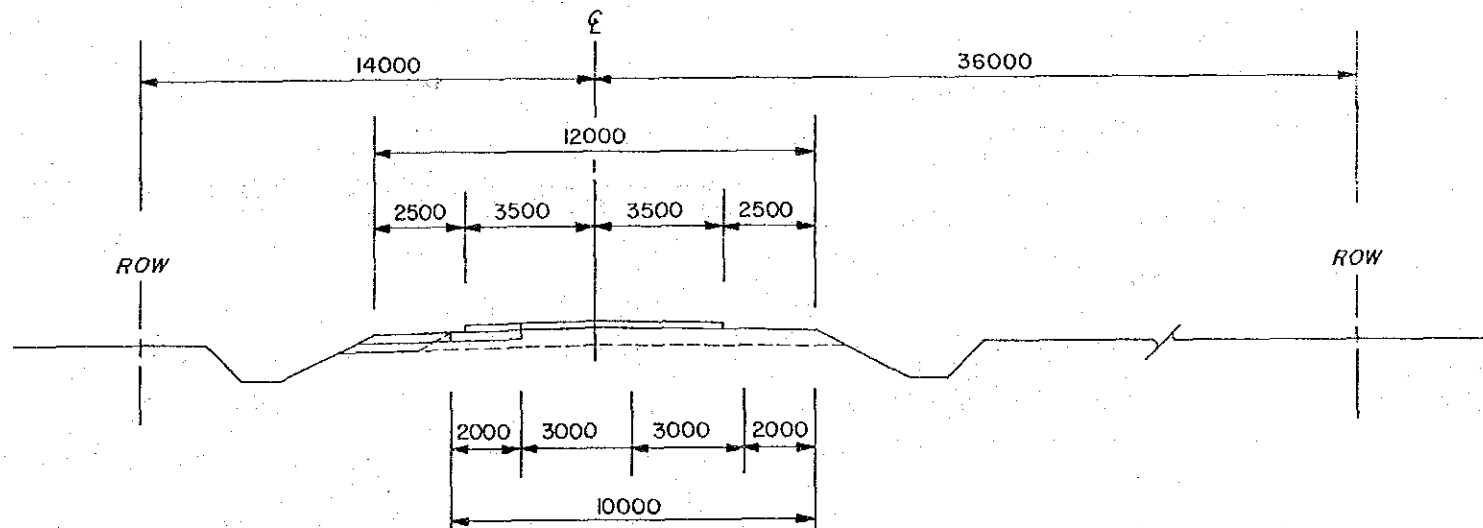
Return Period : Culvert-----10 years
: Minor Bridge---20 years

(3) Typical Cross Section

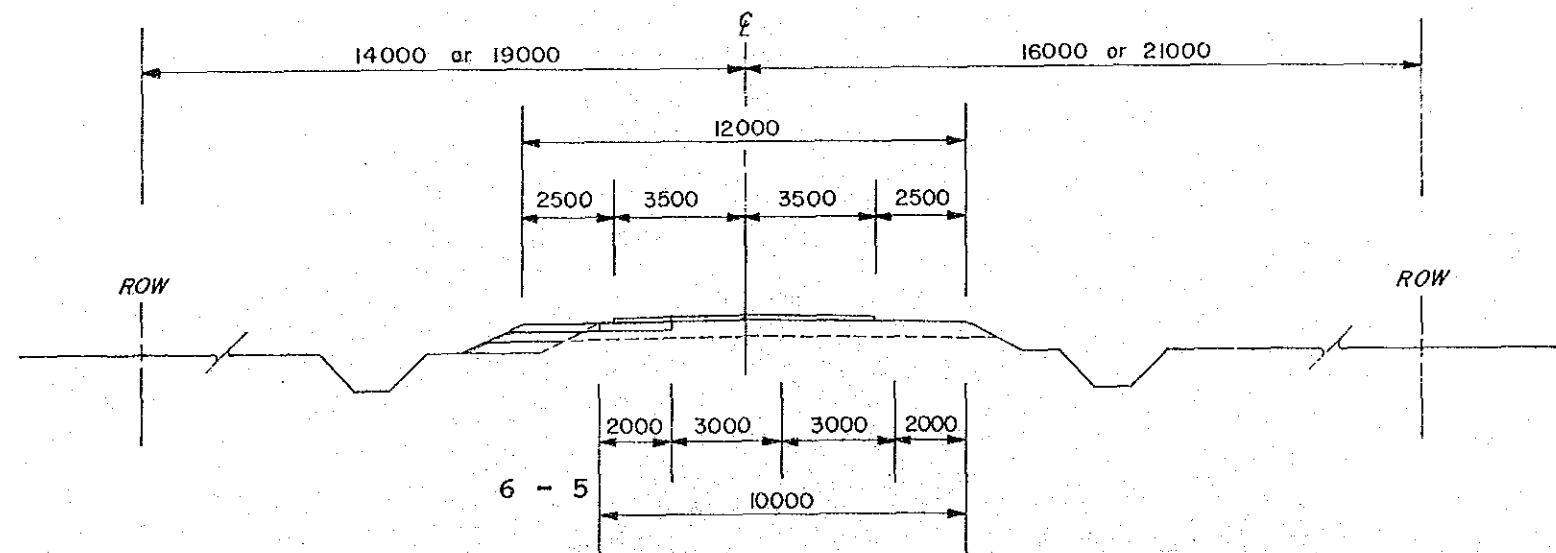
STA. 0 + 000 ~ STA. 11 + 904



STA. 11 + 904 ~ STA. 29 + 017



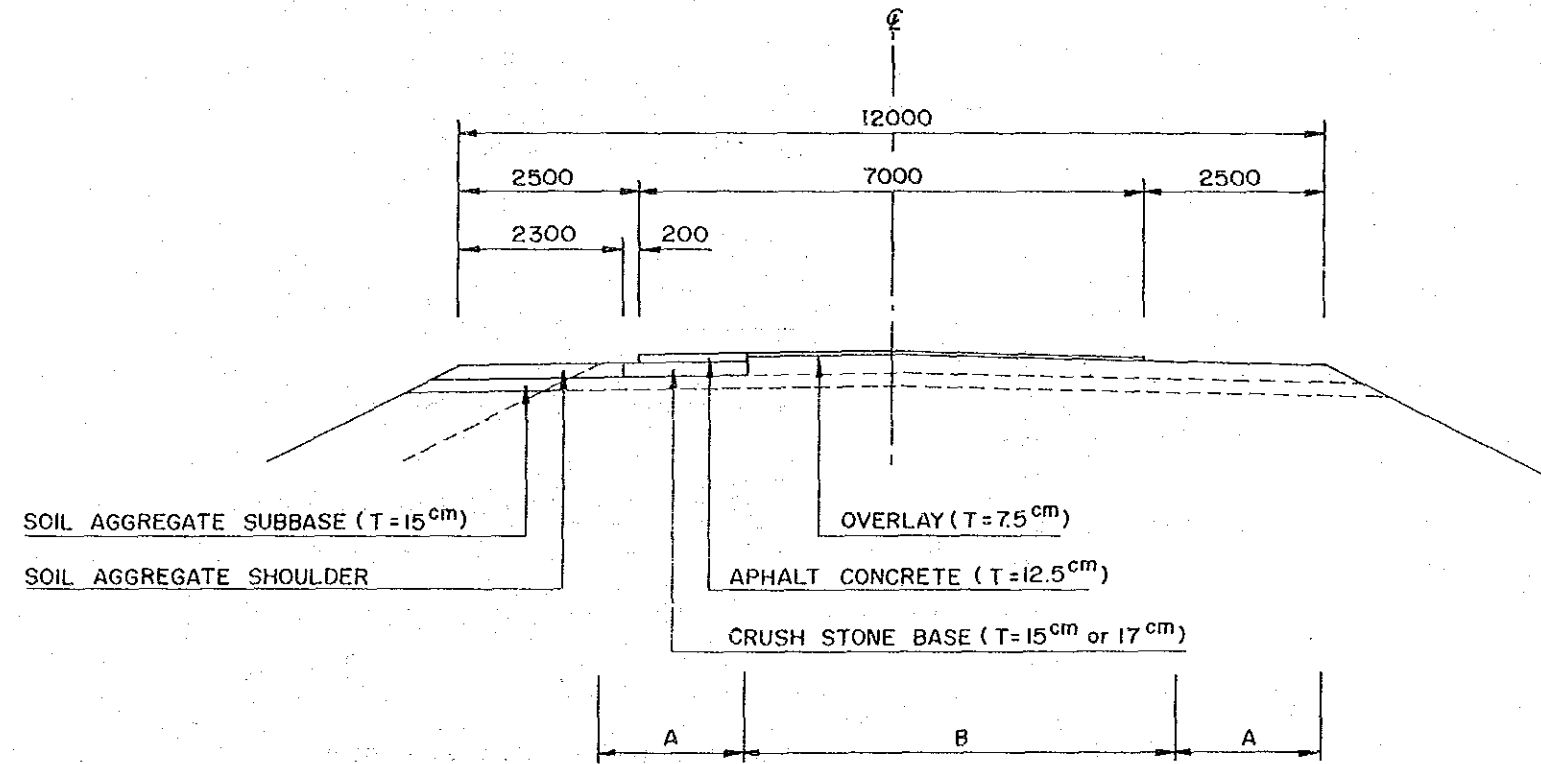
STA. 29 + 017 ~ STA. 95 + 408



(4) Pavement Design

Existing Road

Existing Road	Design CBR of Subgrade	Cumulative No. of ESA W18 x 10 ³ (7 years)	Thickness of Overlay (cm)
Route No. 408	6.0	4,817	7.5



2) WD7-4-2

(1) Summary

The project is an alternative for WD7-4-1 to construct additional two lanes on the first section of 11.9 km starting from amphoe Hua Sai and ending at the changwat boundary between Nakhon Si Thammarat and Songkhla. "SD" standard is applied to the four lane section and "S1" standard is applied to the remaining section as WD7-4-1.

Since the existing embankment is located to the inland side of the right of way, the embankment for additional two lanes is planned on the seaside.

Pavement for additional two lanes comprises surface course of 12.5 cm, base course of 15 cm and subbase course of 15 cm, 42.5 cm in total. One bridge is proposed in parallel with the existing bridge for accommodating additional two lanes.

An intersection with Route 4013 at Hua Sai is proposed to be signalized.

WD7-4-2	Description
Changwat	: Nakhon Si Thammarat and Songkhla
Name or Location	: Rt.408, Hua Sai - Songkhla
Road Class	: SD, S1 (S3 and F3)
Cross Section (m):SD	: <2.5 + 7.0 + 1.5> x 2 (2.0 + 6.0 + 2.0)
S1	: 2.5 + 7.0 + 2.5 (2.0 + 6.0 + 2.0)
Surface Type	: SA / ASC / SA
Bridge: New	: 1 site, 59 m
Without Work	: 3 sites, 136 m
Length: Total	: 96.3 km
Additional 2 Lanes	: 11.9 km
Widening	: 96.3 km
AAADT ('96/'01/'06)	: 4,500 / 6,900 / 10,000
Financial Cost	: 271.8 million baht (in 1990 price)
NPV	: 256 million baht (12% discount rate)
B/C	: 2.7 (12% discount rate)
EIRR	: 29.9 %

(): Existing Condition

(2) Design Standard and Conditions

(a) Design Criteria

Road Class : Additional Two Lane---SD
 : Widening -----S1
 Design Speed : 70 - 90 km/h

Geometric Design Criteria

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

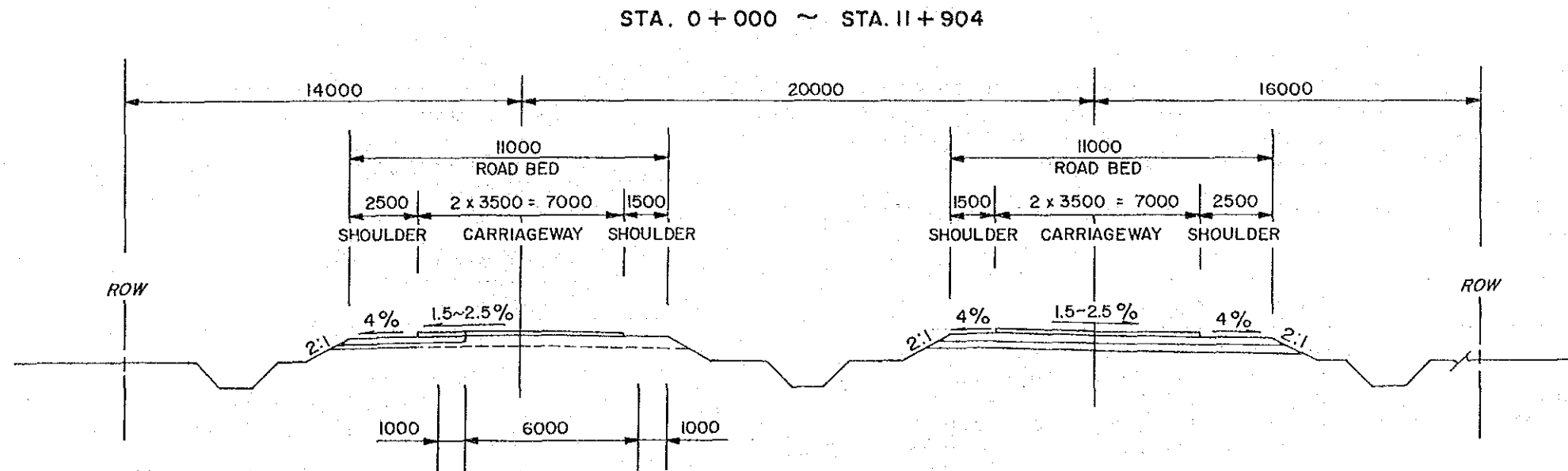
(b) Pavement Design Conditions

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

(c) Drainage Design Conditions

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

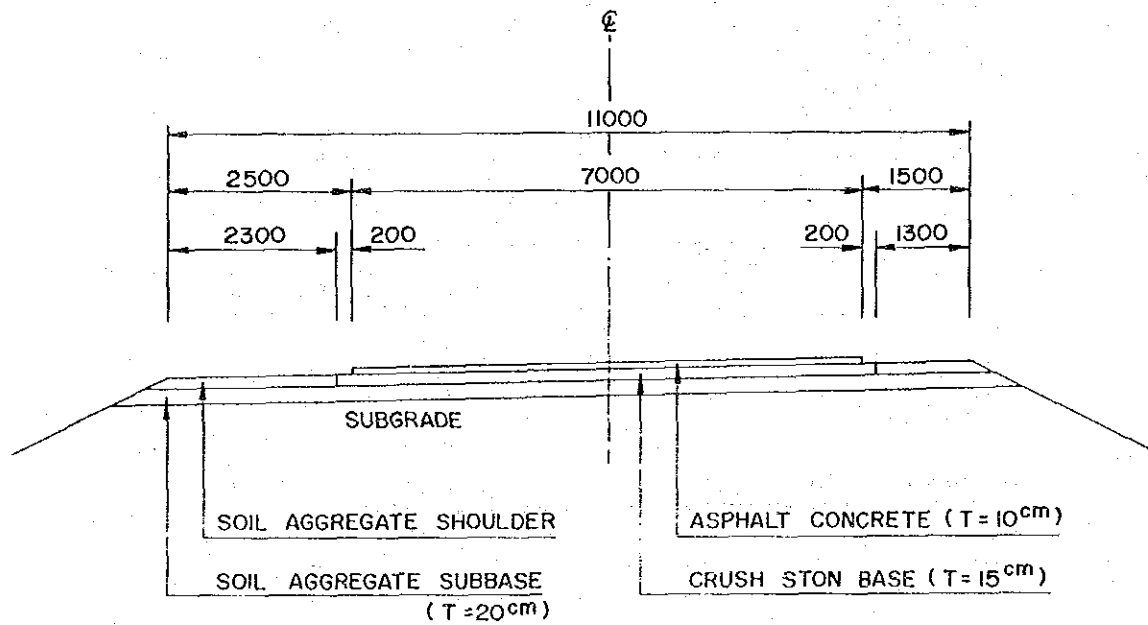
(3) Typical Cross Section



(4) Pavement Design

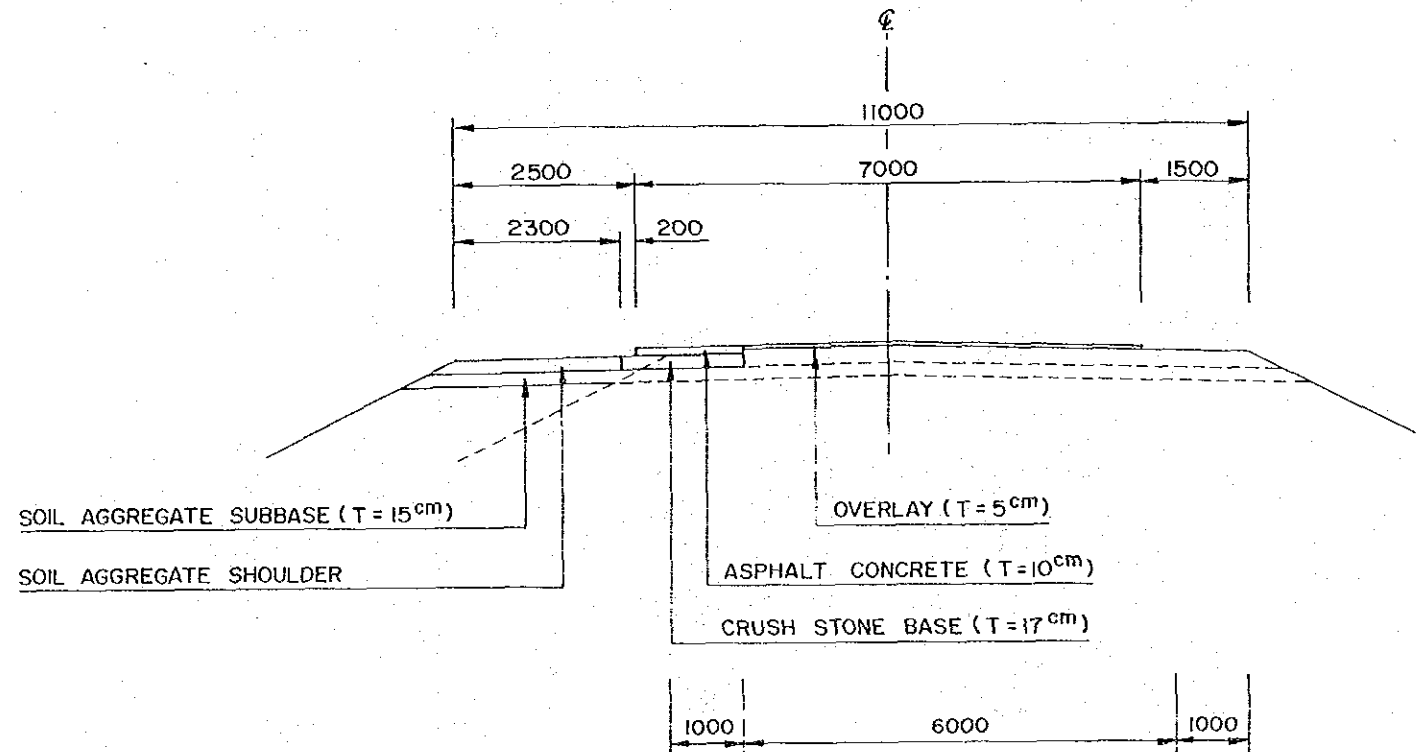
New Road

Design CBR of Subgrade	Cumulative No. of ESA W18 x 10 ³ (7 years)	Thickness of Pavement Structure (cm)
6.0	4,817	Surface 10 Base 15 Subbase 20



Existing Road

Existing Road	Design CBR of Subgrade	Cumulative No. of ESA W18 x 10 ³ (7 years)	Thickness of Overlay (cm)
Route No. 408	6.0	4,817	7.5



6.6 Construction Cost

Table 6.5.1 CONSTRUCTION COST

1) WD 7-4-1

(1) CONSTRUCTION QUANTITIES AND COSTS

(Project WD 7-4-1 Length = 96.287 Km)
(Improved Length 96.287 Km)

ITEM	Unit	Financial		Financial		Economic cost		Residual Value	
		Unit Cost Baht	Quantity	Total cost 1000 Baht	%	% 1000 Baht	%	% 1000 Baht	
EARTH WORK									
Clearing & Grubbing	SQ.M	1	215,992	216		83		90	
Roadway Excavation(classified)	CU.M	85	5,111	434					
Embankment(Borrowed Material)	CU.M	100	80,731	8,073					
Slope Protection(Stripe Sodding)	SQ.M	6	159,919	960					
(Sodding)	SQ.M	9	0	0					
(Shot Concrete)	SQ.M	500	0	0					
(Concrete Block)	SQ.M	450	17,768	7,996					
Sand Mat (t=0.5m)	SQ.M	100	0	0					
Excavate Existing Thickness Over 10cm (2 Lay)	SQ.M	14	194,880	2,728					
SUB TOTAL				20,407		16,938		15,244	
SUBBASE AND BASE									
Subbase(Soil Aggregate)	CU.M	190	32,399	6,156		83		50	
Base Coarses(Crush Stone)	CU.M	440	31,858	14,018					
Shoulder(Soil Aggregate)	CU.M	190	35,335	6,714					
SUB TOTAL				26,887		22,316		11,158	
SURFACE									
Asphaltic Prime coat	SQ.M	13	175,302	2,279		83		50	
Asphaltic Tack coat	SQ.M	7	673,057	4,711					
Asphalt concrete Surfacing Overlay (7.5cm)	CU.M	1,900	19,509	37,067					
SUB TOTAL				73,671		97,714		48,857	
STRUCTURES(Equivalent)									
RC Pipe Culvert(D= 500 m)	M	1,200	4	5		83		50	
(D= 600 m)	M	1,380	280	386					
(D= 800 m)	M	1,950	142	277					
(D=1000 m)	M	2,650	26	69					
(D=600m*2)	M	2,760	14	39					
(D=800m*2)	M	3,900	10	39					
(D=1.5m*2)	M	9,800	2	20					
RC Box Culvert(1-2.40*2.40 m)	M	5,900	0	0					
(2-1.80*1.50 m)	M	7,600	2	15					
(2-2.10*2.10 m)	M	10,000	2	20					
(3-1.80*1.80 m)	M	12,600	2	25					
(3-3.00*2.70 m)	M	22,500	2	45					
(3-3.60*2.40 m)	M	23,400	2	47					
(4-1.80*1.20 m)	M	14,000	4	56					
(4-2.10*1.80 m)	M	18,400	4	74					
(4-3.80*2.00 m)	M	28,400	4	114					
RC Bridge Widening	SQ.M	9,600	0	0					
RC Bridge (W=12.5 m)	M	80,000	0	0					
PC Bridge (W=12.5 m)	M	125,000	0	0					
Bearing Unit Of Bridge	Ls	500,000	0	0					
SUB TOTAL				1,230		1,021		510	
INTERSECTION									
T-Intersection(Unsignal)	Ls	80,000	3	240		90		90	
SUB TOTAL				240		216		194	
TOTAL (a)				166,492		138,205		75,964	
Miscellaneous Works [(a)*7%]	Ls	1		11,654		9,674		5,317	
CONTRACT AMOUNT (b)				178,146		147,879		81,281	
PHYSICAL CONTINGENCIES [(b)*10%] (c)	Ls	1		17,815		14,788		8,128	
ENGINEERING & SUPERVISION [(b)+(c)*10%] (d)	Ls	1		19,596	85	16,657	0	0	
LAND ACQUISITION & COMPENSATION									
Land Acquisition (Average)	SQ.M	0	0	0	100	0	100	0	
Compensation	Ls	0	0	0	100	0	100	0	
TOTAL (e)				0		0		0	
PROJECT COST [(b)+(c)+(d)+(e)]				215,557		179,324		89,410	
AVERAGE COST PER KM				2,239					

(2) MAINTENANCE COST

Project Road No, WD 7-4-1 Na= 8,200 Baht/Km/year
(Existing Road) Km= 1.00
Length = 96.287 Km

Asphalt Pavement

ITEMS	Proposed Road		
	Condition	Factor	
1. Surface /Bace Type	X1	AC	0.00
2. Subgrade CBR	X2	4 %	0.50
3. A.D.T	X3	4,000	1.51
4. Service Life (year)	X4	4	0.20
5. Pavement Width (m)	X5	6 m	0.05
6. R-O-W Width (m)	Y1	50 m	0.05
7. Shoulder, Access, Median Width (m)	Y2	1.00 m	0.00
8. Traffic Service Operation Topography	Y3	0 - 3 %	0.00
9. Drainage Topography	Y4	0 - 3 %	0.00
10. Bridge Quantity (m/Km)	Y5	2	0.00
11. NO. Of Lanes		2	

$$Ka = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5) = 2.16$$

$$\text{Maintenance cost + Overhead} = Ka * Km * Na * 1.28 = 22,641 \text{ Baht/Km/}$$

$$\text{Total Cost (Financial)} = \text{Length} * (\text{Baht/Km/year}) = 2,180,082 \text{ Baht/yea}$$

$$\text{(Economic)} = 1,809,468 \text{ Baht/yea}$$

Project Road No, WD 7-4-1 Na= 8,200 Baht/Km/year
(Proposed Road) Km= 1.00
Length = 96.287 Km

Asphalt Pavement

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

$$Ka = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5) = 2.15 \quad 2.52 \quad 2.52$$

$$\text{Maintenance cost + Overhead} = Ka * Km * Na * 1.28 = 22,589 \quad 26,476 \quad 26,476 \text{ Baht/Km/year}$$

$$\text{Total Cost (Financial)} = \text{Length} * (\text{Baht/Km/year}) = 2,175,024 \text{ Baht/year}$$

$$\text{(1996) (Economic)} = 1,805,270 \text{ Baht/year}$$

$$\text{Total Cost (Financial)} = \text{ADT}(7,000 \text{ CAR/DAY}) = 2,549,330 \text{ Baht/year}$$

$$\text{(2001) (Economic)} = 2,115,944 \text{ Baht/year}$$

$$\text{Total Cost (Financial)} = \text{ADT}(10,000 \text{ CAR/DAY}) = 2,549,330 \text{ Baht/year}$$

$$\text{(2006) (Economic)} = 2,115,944 \text{ Baht/year}$$

Overlay Cost (2004) = =87,998,615 Baht

(3) CONSTRUCTION SCHEDULE

Project WD 7-4-1

(Three Section)

year and Month	First Year												Second 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
Land Acquisition																								
Preparatory Works																								
Earth Works																								
Pavement Works																								
Bridge Works																								
Miscellaneous Works																								
Clearing -Up																								
Percentage Of Disbursement (%)	36 %												64 %											

4) ECONOMIC EVALUATION

Cost and Benefit Flows of the Project
Project; WD7-4-1

(unit ; 1000 Baht)

Year	Const- ruction Cost	Mainte- nance Cost	Total Cost	VOC Saving	Time Saving	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	0	0	0	0	0	0	0
1994	51,391	0	51,391	0	0	(51,391)	(61,669)
1995	127,933	0	127,933	0	0	(127,933)	(153,520)
1996	0	(4)	(4)	5,247	25,420	30,671	24,539
1997	0	(4)	(4)	6,439	39,339	45,783	36,628
1998	0	(4)	(4)	7,632	53,258	60,894	48,717
1999	0	(4)	(4)	8,824	67,177	76,005	60,806
2000	0	(4)	(4)	10,016	81,096	91,117	72,895
2001	0	306	306	11,209	95,015	105,917	84,611
2002	0	306	306	12,278	108,121	120,092	95,951
2003	0	306	306	13,347	121,226	134,267	107,291
2004	0	88,305	88,305	14,416	134,332	60,443	13,032
2005	0	306	306	15,486	147,437	162,616	129,971
2006	0	306	306	16,555	160,543	176,791	141,310
2007	0	306	306	16,555	160,543	176,791	141,310
2008	0	306	306	16,555	160,543	176,791	141,310
2009	0	306	306	16,555	160,543	176,791	141,310
2010	0	306	306	16,555	160,543	176,791	141,310
Total	179,324	91,042	270,366	187,667	1,675,136	1,592,437	1,165,803
						IRR =	34.32%
						NPV (i;12%)	262,888
						B/C (i;12%)	3.12

2) WD 7-4-2

(1) CONSTRUCTION QUANTITIES AND COSTS

(Project WD 7-4-2 Length = 96.287 Km)
(Improved Length 96.287 Km)

ITEM	Unit	Financial Unit Cost Baht	Quantity	Financial Total cost 1000 Baht	Economic cost		Residual Value	
					%	1000 Baht	%	1000 Baht
EARTH WORK								
Clearing & Grubbing	SQ.M	1	440,579	441				
Roadway Excavation(classified)	CU.M	85	34,343	2,919				
Embankment(Borrowed Material)	CU.M	100	123,420	12,342				
Slope Protection(Stripe Sodding)	SQ.M	6	195,742	1,174				
(Sodding)	SQ.M	9	0	0				
(Shot Concrete)	SQ.M	500	0	0				
(Concrete Block)	SQ.M	450	17,768	7,996				
Sand Mat (t=0.5m)	SQ.M	100	0	0				
Excavate Existing Thickness Over 10cm (2 Lay)	SQ.M	14	194,880	2,728				
SUB TOTAL				27,600		22,908		20,617
SUBBASE AND BASE								
Subbase(Soil Aggregate)	CU.M	190	62,146	11,808				
Base Coarses(Crush Stone)	CU.M	440	45,113	19,850				
Shoulder(Soil Aggregate)	CU.M	190	44,112	8,381				
SUB TOTAL				40,039		33,232		16,616
SURFACE								
Asphaltic Prime coat	SQ.M	13	263,665	3,428				
Asphaltic Tack coat	SQ.M	7	673,057	4,711				
Asphalt concrete Surfacing	CU.M	1,900	27,868	52,949				
Overlay (7.5cm)	CU.M	1,900	38,774	73,671				
SUB TOTAL				134,759		111,850		55,925
STRUCTURES(Equivalent)								
RC Pipe Culvert(D= 500 m)	M	1,200	4	5				
(D= 600 m)	M	1,380	397	548				
(D= 800 m)	M	1,950	524	1,022				
(D=1000 m)	M	2,650	59	156				
(D=600m*2)	M	2,760	14	39				
(D=800m*2)	M	3,900	27	105				
(D=1.5m*2)	M	9,800	2	20				
RC Box Culvert(2-1.80*1.50 m)	M	7,600	0	0				
(2-2.10*2.10 m)	M	10,000	2	20				
(3-1.80*1.80 m)	M	12,600	2	25				
(3-3.00*2.70 m)	M	22,500	2	25				
(3-3.60*2.40 m)	M	23,400	2	45				
(4-1.80*1.20 m)	M	14,000	2	47				
(4-2.10*1.80 m)	M	18,400	4	56				
(4-3.80*2.00 m)	M	28,400	4	74				
RC Bridge Widening	SQ.M	9,600	0	0				
RC Bridge (W=12.5 m)	M	80,000	59	4,720				
PC Bridge (W=12.5 m)	M	125,000	0	0				
Bearing Unit Of Bridge	Ls	500,000	1	500				
SUB TOTAL				7,406		6,147		3,074
INTERSECTION								
T-Intersection(Unsignal)	Ls	80,000	2	160				
SUB TOTAL				160		144		130
TOTAL (a)				209,964		174,281		96,361
Miscellaneous Works [(a)*7%]	Ls	1	14,697	12,200				6,745
CONTRACT AMOUNT (b)				224,661		186,481		103,107
PHYSICAL CONTINGENCIES [(b)*10%] (c)	Ls	1	22,466	18,648				10,311
ENGINEERING & SUPERVISION [(b)+(c)*10%] (d)	Ls	1	24,713	21,006	85	21,006	0	0
LAND ACQUISITION & COMPENSATION								
Land Acquisition (Average)	SQ.M	0	0	0	100	0	100	0
Compensation	Ls	0	0	0	100	0	100	0
TOTAL (e)				0		0		0
PROJECT COST [(b)+(c)+(d)+(e)]				271,840		226,135		113,417
AVERAGE COST PER KM				2,823				

(2) MAINTENANCE COST

Project Road No, WD 7-4-2 (Existing Road) Na= 8,200 Baht/Km/year Km= 1.00 Length = 96.287 Km

Asphalt Pavement

ITEMS	Proposed Road		
	Condition	Factor	
1. Surface /Base Type	X1 AC		0.00
2. Subgrade CBR	X2 4 %		0.50
3. A.D.T	X3 4,000		1.51
4. Service Life (year)	X4 4		0.20
5. Pavement Width (m)	X5 6 m		0.05
6. R-O-W Width (m)	Y1 50 m		0.05
7. Shoulder, Access, Median Width (m)	Y2 1.00 m		0.00
8. Traffic Service Operation Topography	Y3 0 - 3 %		0.00
9. Drainage Topography	Y4 0 - 3 %		0.00
10. Bridge Quantity (m/Km)	Y5 2		0.00
11. NO. Of Lanes	2		

Ka = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5) = 2.16
 Maintenance cost + Overhead = Ka * Km * Na * 1.28 = 22,641 Baht/Km/year
 Total Cost (Financial) = Length * (Baht/Km/year) = 2,180,082 Baht/year
 (Economic) = 1,809,468 Baht/year

Project Road No, AD 7-4-2 (Proposed Road) Na= 8,200 Baht/Km/year Km= 1.00 Length = 11.904 Km (4 Lanes) 84.383 Km (2 Lanes)

Asphalt Pavement

ITEMS	Proposed Road (4 Lanes)		Proposed Road (2 Lanes)	
	Condition	Factor	Condition	Factor
1. Surface /Base Type	X1 AC	0.00	AC	0.00
2. Subgrade CBR	X2 4 %	0.50	4 %	0.50
3. A.D.T	X3 4,000	3.02	4,000	1.51
4. Service Life (year)	X4 NEW	0.00	NEW	0.00
5. Pavement Width (m)	X5 7 m * 2	0.38	7 m	0.19
6. R-O-W Width (m)	Y1 50 m	0.05	50 m	0.05
7. Shoulder, Access, Median Width (m)	Y2 2.50m * 2	0.10	2.50m	0.05
8. Traffic Service Operation Topography	Y3 0 - 3 %	0.00	0 - 3 %	0.00
9. Drainage Topography	Y4 0 - 3 %	0.00	0 - 3 %	0.00
10. Bridge Quantity (m/Km)	Y5 2	0.00	2	0.00
11. NO. Of Lanes	4		2	

Ka (1996) = 1+0.5(X1+X2+X3+X4+X5+Y1+Y2+Y3+Y4+Y5) = 3.03 (4 Lanes) 2.15 (2 Lanes)
 (2001,2006) = [4 Lanes; X3=4.5, 2 Lanes; X3=2.25] = 3.77 2.52
 Maintenance cost + Overhead = Ka * Km * Na * 1.28 = 31,782 (4 Lanes) 22,589 (2 Lanes)
 (2001,2006) = -do- = 39,557 26,476
 Total Cost (Financial) = Length * (Baht/Km/year), [4 Lanes+2 Lanes] = 2,284,459 Baht/year
 (1996) (Economic) = 1,896,101 Baht/year
 Total Cost (Financial) = ADT(7,000 CAR/DAY) = 2,705,042 Baht/year
 (2001) (Economic) = 2,245,184 Baht/year
 Total Cost (Financial) = ADT(10,000 CAR/DAY) = 2,705,042 Baht/year
 (2006) (Economic) = 2,245,184 Baht/year

Overlay Cost (2004) = 98,877,919 Baht

(3) CONSTRUCTION SCHEDULE

Project WD 7-4-2

(Three Section)

year and Month	First Year												Second 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
Land Acquisition																								
Preparatory Works	=====																							
Earth Works	=====												=====											
Pavement Works													=====											
Bridge Works	=====																							
Miscellaneous Works	=====												=====											
Clearing -Up													=====											
Percentage Of Disbursement (%)	38 %												62 %											

4) ECONOMIC EVALUATION

Cost and Benefit Flows of the Project
Project; WD7-4-2

(unit ; 1000 Baht)

Year	Const- ruction Cost	Mainte- nance Cost	Total Cost	VOC Saving	Time Saving	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	0	0	0	0	0	0	0
1994	69,541	0	69,541	0	0	(69,541)	(83,449)
1995	156,594	0	156,594	0	0	(156,594)	(187,913)
1996	0	87	87	5,010	27,005	31,929	25,508
1997	0	87	87	6,283	40,986	47,182	37,711
1998	0	87	87	7,555	54,967	62,436	49,914
1999	0	87	87	8,828	68,949	77,690	62,117
2000	0	87	87	10,100	82,930	92,943	74,320
2001	0	436	436	11,372	96,911	107,848	86,104
2002	0	436	436	12,953	112,594	125,112	99,915
2003	0	436	436	14,535	128,277	142,376	113,726
2004	0	99,314	99,314	16,116	143,960	60,761	8,884
2005	0	436	436	17,697	159,642	176,903	141,348
2006	0	436	436	19,278	175,325	194,167	155,159
2007	0	436	436	19,278	175,325	194,167	155,159
2008	0	436	436	19,278	175,325	194,167	155,159
2009	0	436	436	19,278	175,325	194,167	155,159
2010	0	436	436	19,278	175,325	194,167	155,159
Total	226,135	103,668	329,803	206,837	1,792,846	1,669,880	1,203,982
					IRR =	29.89%	21.72%
					NPV (i;12%)	255,999	
					B/C (i;12%)	2.66	