11.4 Summary of Quantities

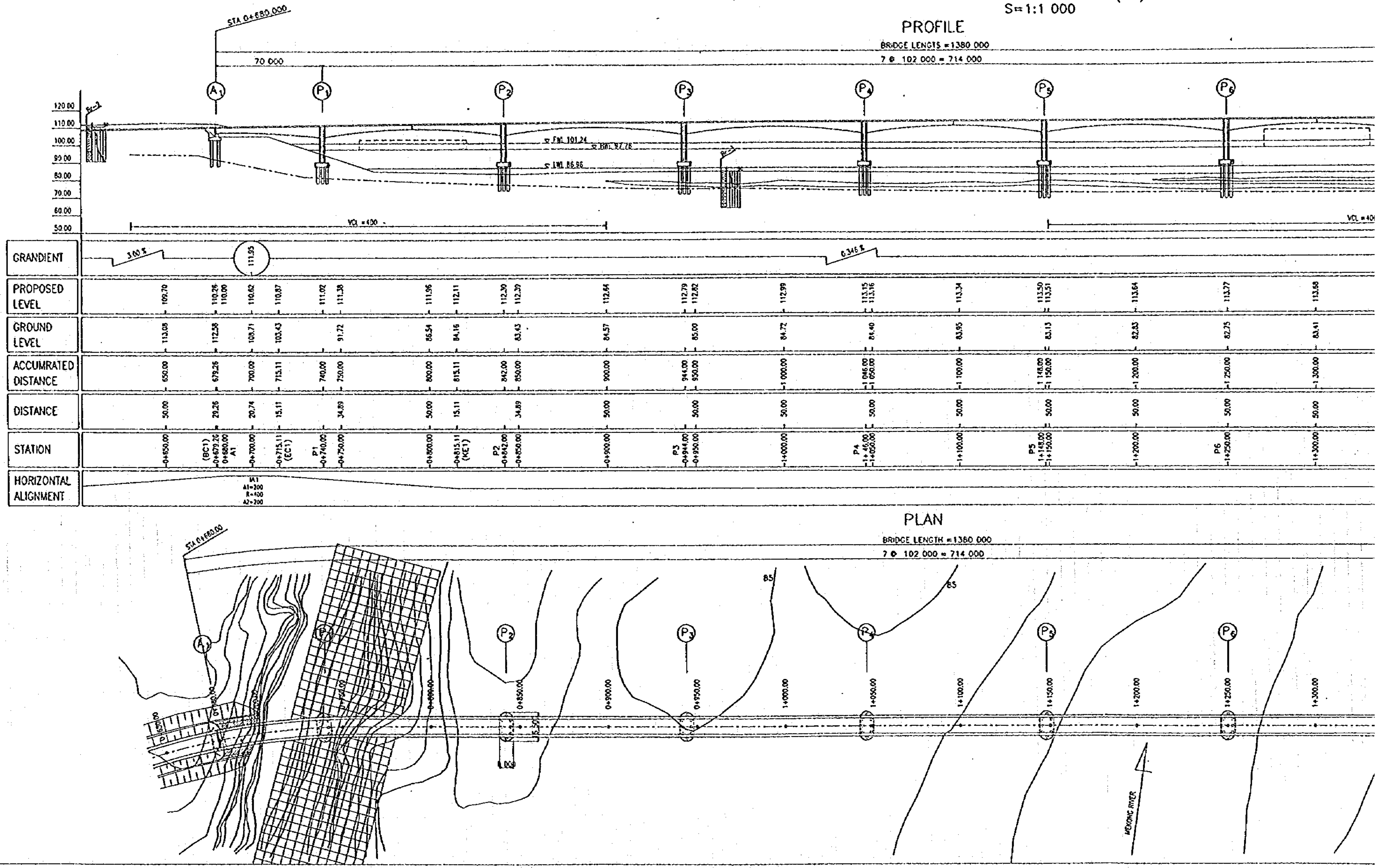
The construction quantities estimate based on the engineering studies on the proposed rout are summarized as follows:

ITEMS	UNIT	QUANTITIES
1. Bridge Structure		
1) Substructure and Foundation		
Abutment	nos.	2
Concrete,210kgf/cm2	m3	430
Reinforcement steel bar	m3	30
Piers	nos.	13
Steel casing concrete pile	m	2,420
Concrete,300kgf/cm2	m3	4,170
Concrete,240kgf/cm2	m3	8,520
Concrete, 350kgf/cm2	m3	1,010
Reinforcement bar	t	1,290
2) Superstructure		
PC box girder bridge		
Concrete, 350kgf/cm2	m3	14,100
Reinforcement bar	t	2,000
Prestressing PC Cable(12T12.7 mm)	t	696
Prestressing PC Cable(27T12.7 mm)	t	122
Prestressing PC Cable(12ø8 mm)	t	163
Prestressing PC bar (ø26 mm)	t	82
Expansion joints	pls	7
Bearing shoes	pls	4
Center hinge shoes	pls	4
Handrailing	pls	2,760
Road surface lighting	nos.	57
2. River Bank Protection		
1) Left bank	m2	12,000
2) Right bank	m2	10,000
3. Approach Roads		
1) Pakse side	m	680
Excavation, common	m3	21,000
Embankment, subgade	m3	22,900
Embankemnt, subgrade, selected	m3	1,360
Embankment sub-base course	m3	1,122
Embankment, base course	m3	1,496
Bitumen surface treatment (DBST)	m2	5,440

	Bitumen surface treatment (SBST)	m2	2,040
	Box culverts	nos.	2
	Slope protection (turffing)	m2	8,400
	Guard rail	m	400
2)	Phonthong side	m	2,350
	Excavation, common	m3	16,400
	Excavation, rock	m3	13,300
	Embankemnt, subgrade	m3	164,500
	Embankemnt, subgrade, selected	m3	4,920
	Embankment sub-base course	m3	3,878
	Embankment, base course	m3	5,170
	Bitumen surface treatment (DBST)	m2	18,800
	Bitumen surface treatment (SBST)	m2	7,050
	Box culverts	nos.	9
	Slope protection (turffing)	m2	39,200
	Guard rail	m	400

GENERAL VIEW (1)

S=1:1 000



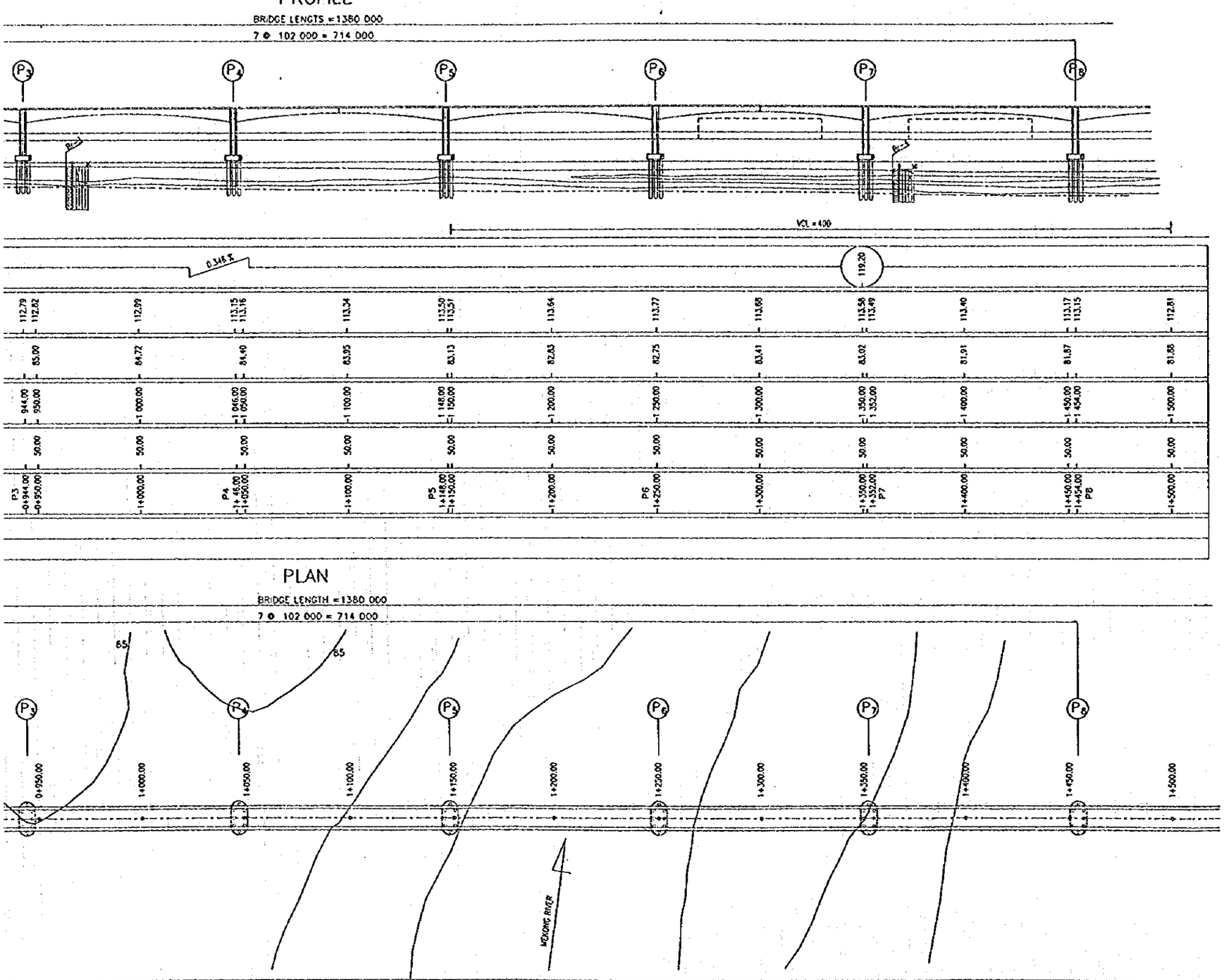
MINISTRY OF COMMUNICATION TRANSPORT POST AND CONSTRUCTION

THE FEASIBILITY STUDY ON THE CONSTRUCTION OF THE M
AT PAKSE IN THE LAO PEOPLE'S DEMOCRATIC RE

GENERAL VIEW (1)

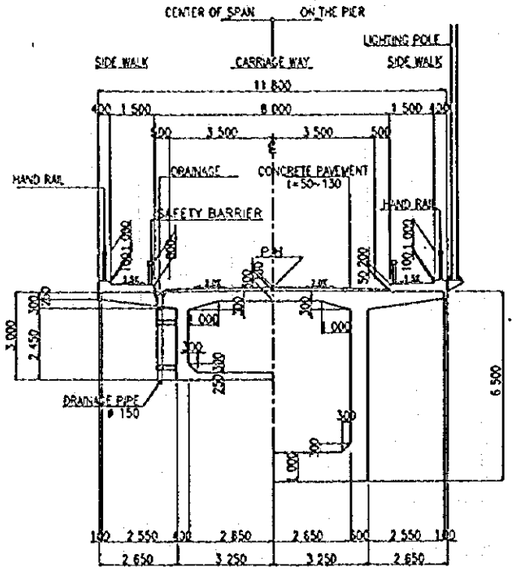
S=1:1 000

PROFILE



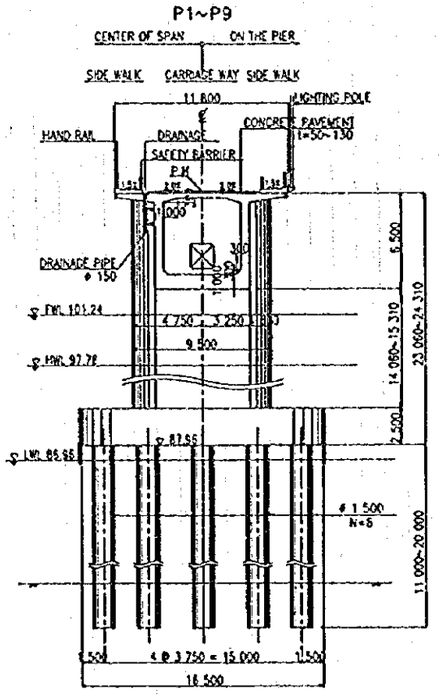
PLAN

TYPICAL CROSS SECTION S=1/100



CROSS SECTION S=1/200

P1~P9

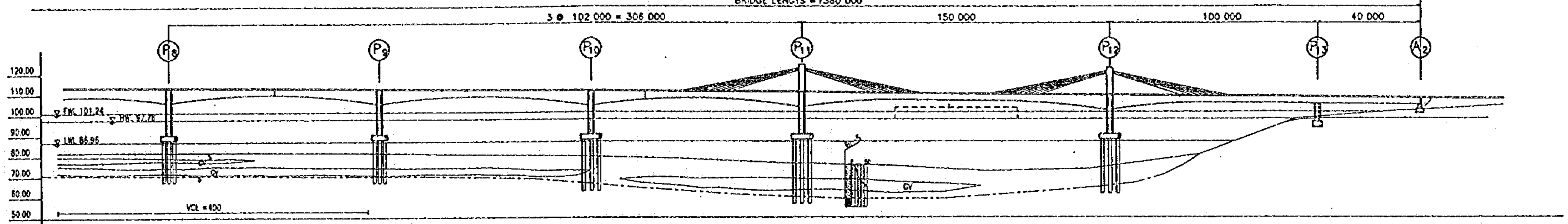


MMUNICATION TRANSPORT POST AND CONSTRUCTION	THE FEASIBILITY STUDY ON THE CONSTRUCTION OF THE MEKONG BRIDGE AT PAKSE IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	FIGURE 11.1-1 GENERAL VIEW OF BRIDGE (1)	DATE / SHEET No

GENERAL VIEW (2)

S=1:1 000

PROFILE

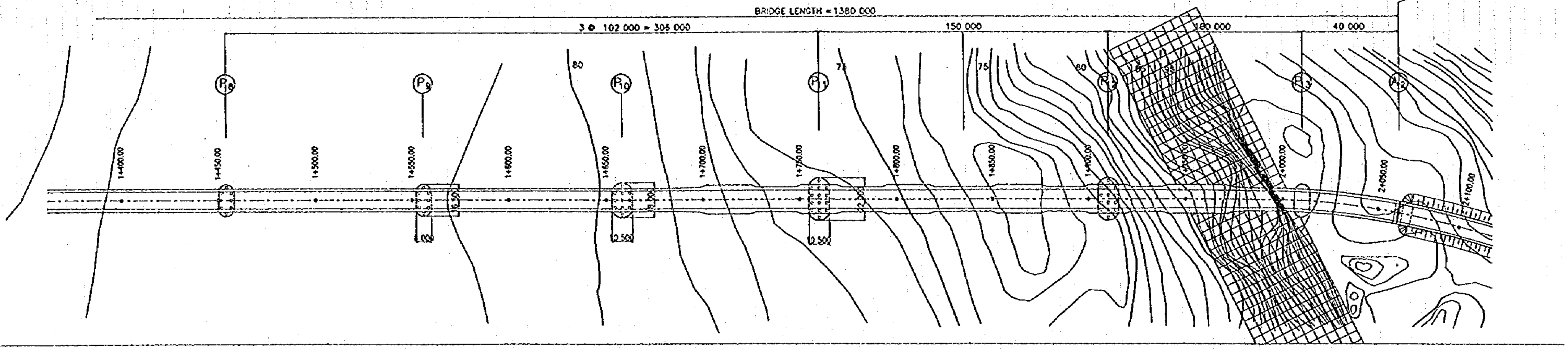


	Proposed Level	Ground Level	Accumrated Distance	Distance	Station
	113.40	81.91	1 400.00	50.00	1+400.00
	113.17	81.87	1 450.00	50.00	1+450.00
	113.15		1 454.00		1+454.00 P8
	112.81	81.88	1 500.00	50.00	1+500.00
	112.40	81.52	1 550.00	50.00	1+550.00
	112.27		1 556.00		1+556.00 P9
	111.95	80.70	1 600.00	50.00	1+600.00
	111.50	79.97	1 650.00	50.00	1+650.00
	111.35		1 658.00		1+658.00 P10
	111.05	78.73	1 700.00	50.00	1+700.00
	110.80	76.49	1 750.00	50.00	1+750.00
	110.43		1 760.00		1+760.00 P11
	110.15	75.45	1 800.00	50.00	1+800.00
	109.70	72.56	1 850.00	50.00	1+850.00
	109.25	73.57	1 900.00	50.00	1+900.00
	109.08	74.91	1 910.00		1+910.00 P12
	108.80	80.25	1 950.00	50.00	1+950.00
	108.77	80.81	1 953.64	3.64	1+953.64 (KA2)
	108.35	98.03	2 000.00	46.36	2+000.00
	108.18		2 010.00		2+010.00 P13
	107.90	101.88	2 050.00	50.00	2+050.00
	107.87	101.82	2 053.64	3.64	2+053.64 (BC?)
	107.73		2 060.00		2+060.00 A2
	107.45	104.50	2 100.00	46.36	2+100.00

GRANDIENT: −0.900 %; 112.45

HORIZONTAL ALIGNMENT: KA2 A1=200 R=400 A2=200

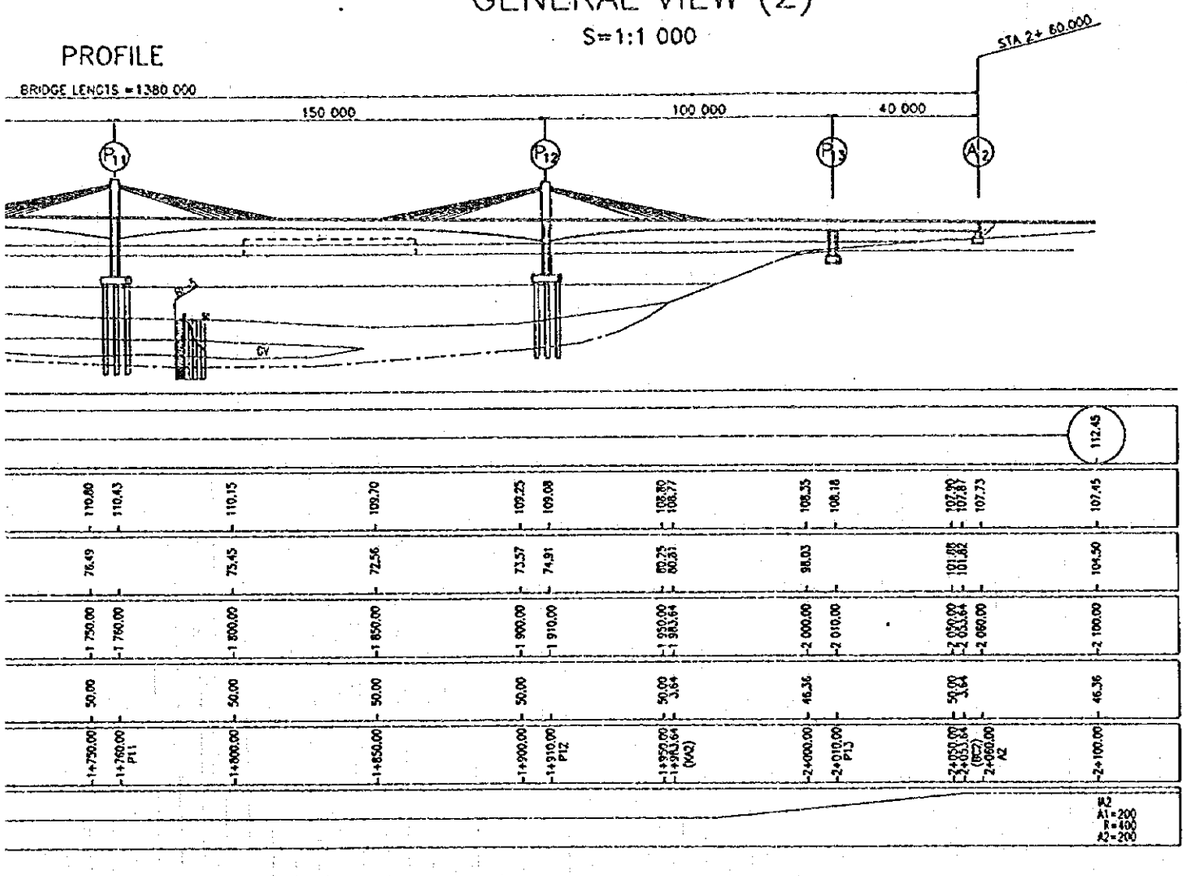
PLAN



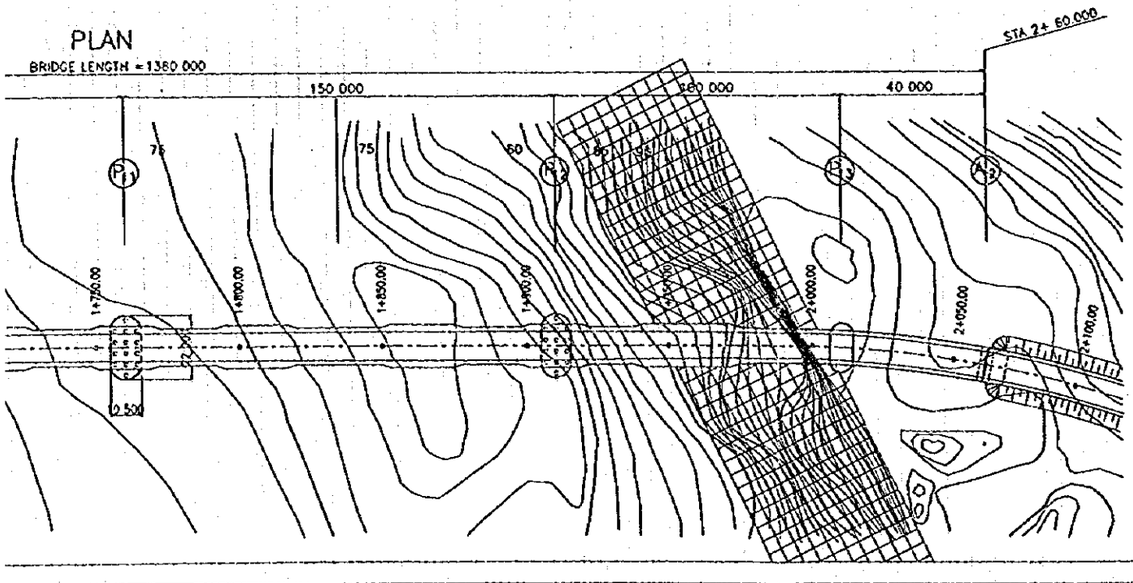
GENERAL VIEW (2)

S=1:1 000

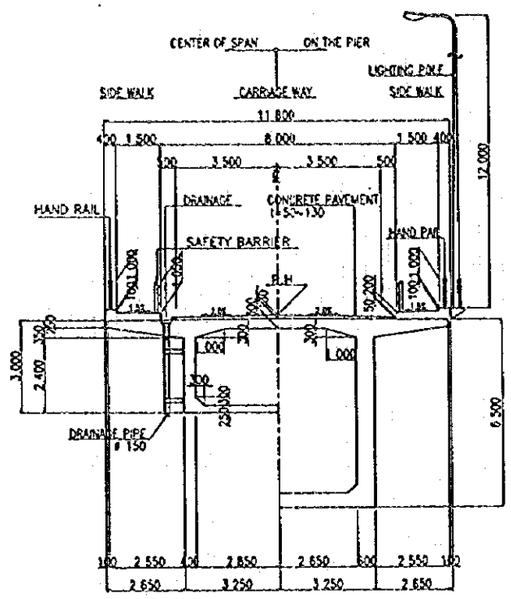
PROFILE



PLAN

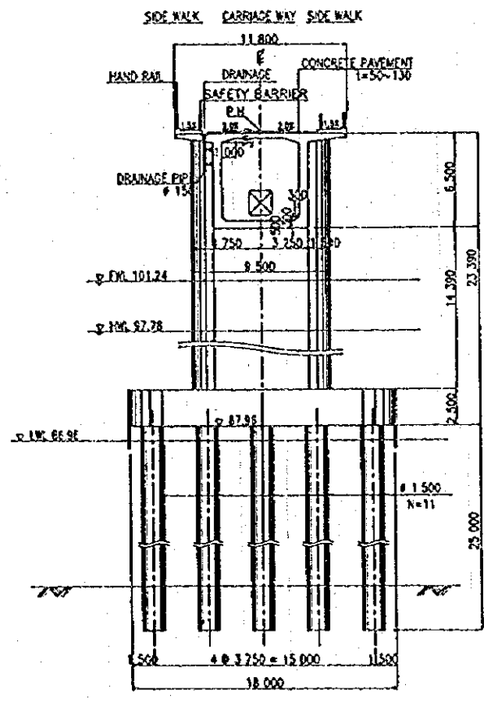


TYPICAL CROSS SECTION S=1/100



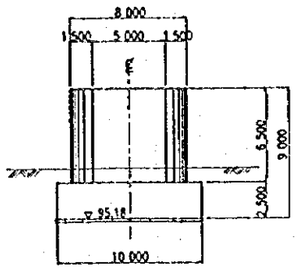
CROSS SECTION S=1/200

P10



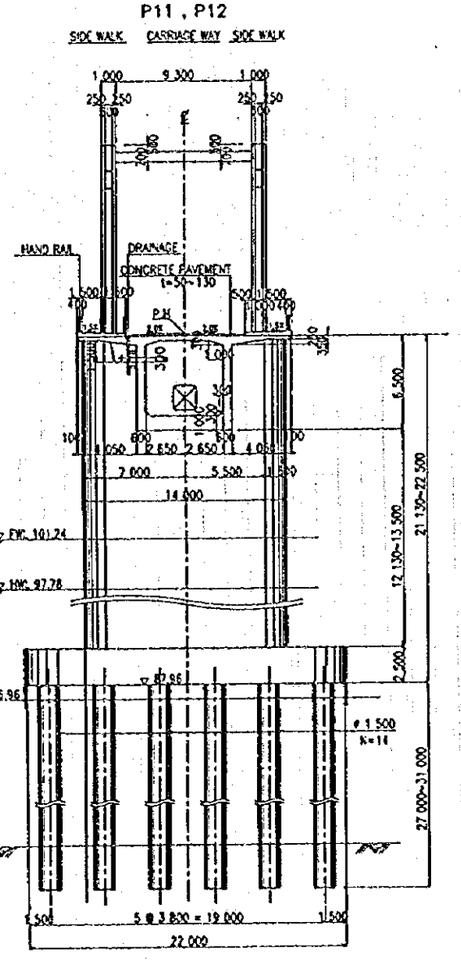
CROSS SECTION S=1/200

P13



CROSS SECTION S=1/200

P11 , P12



MINISTRY OF COMMUNICATION TRANSPORT POST AND CONSTRUCTION	THE FEASIBILITY STUDY ON THE CONSTRUCTION OF THE MEKONG BRIDGE AT PAKSE IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	FIGURE 11.1-2 GENERAL VIEW OF BRIDGE (2)

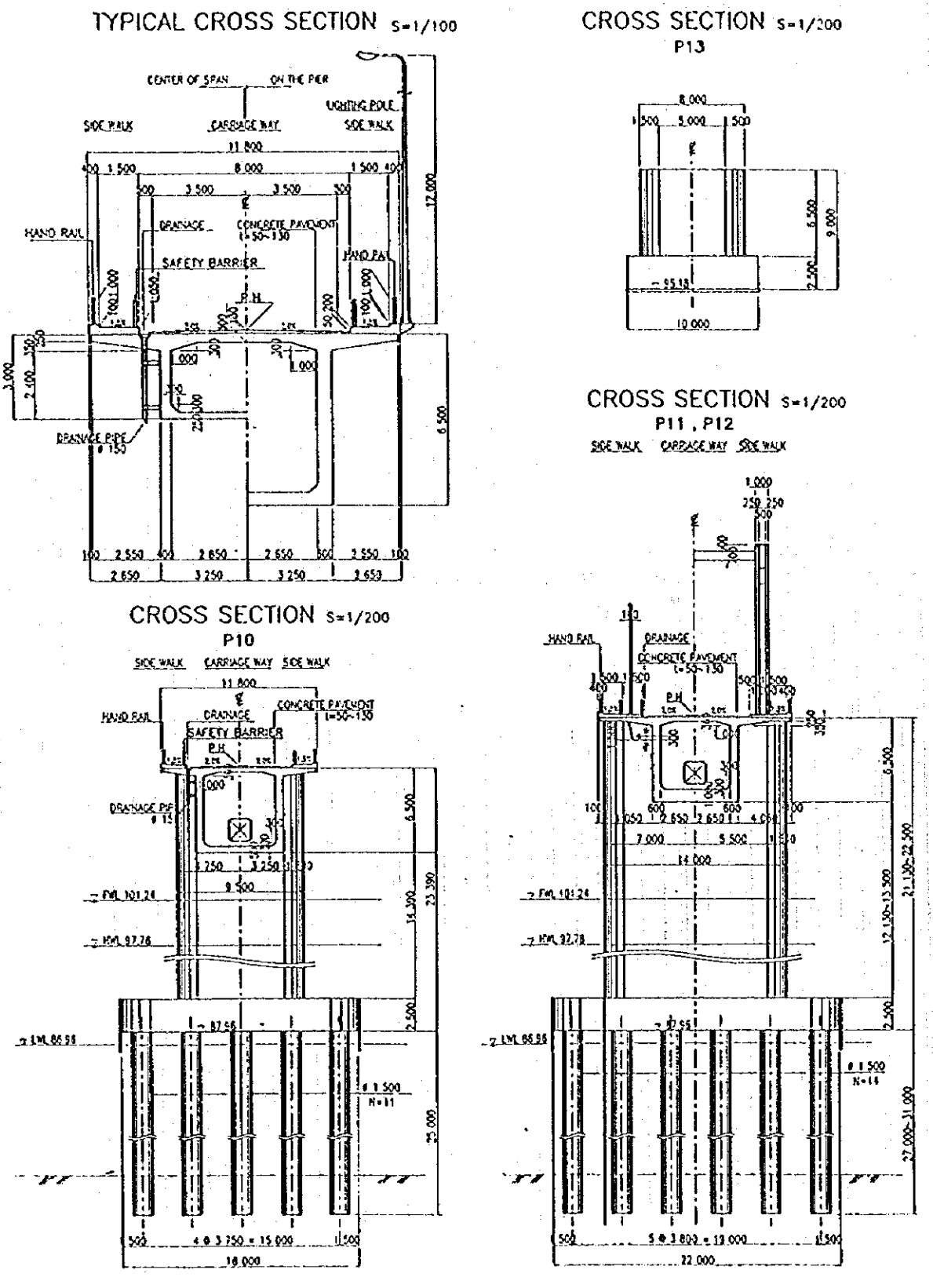


FIGURE 11.1-3 CROSS SECTION OF BRIDGE

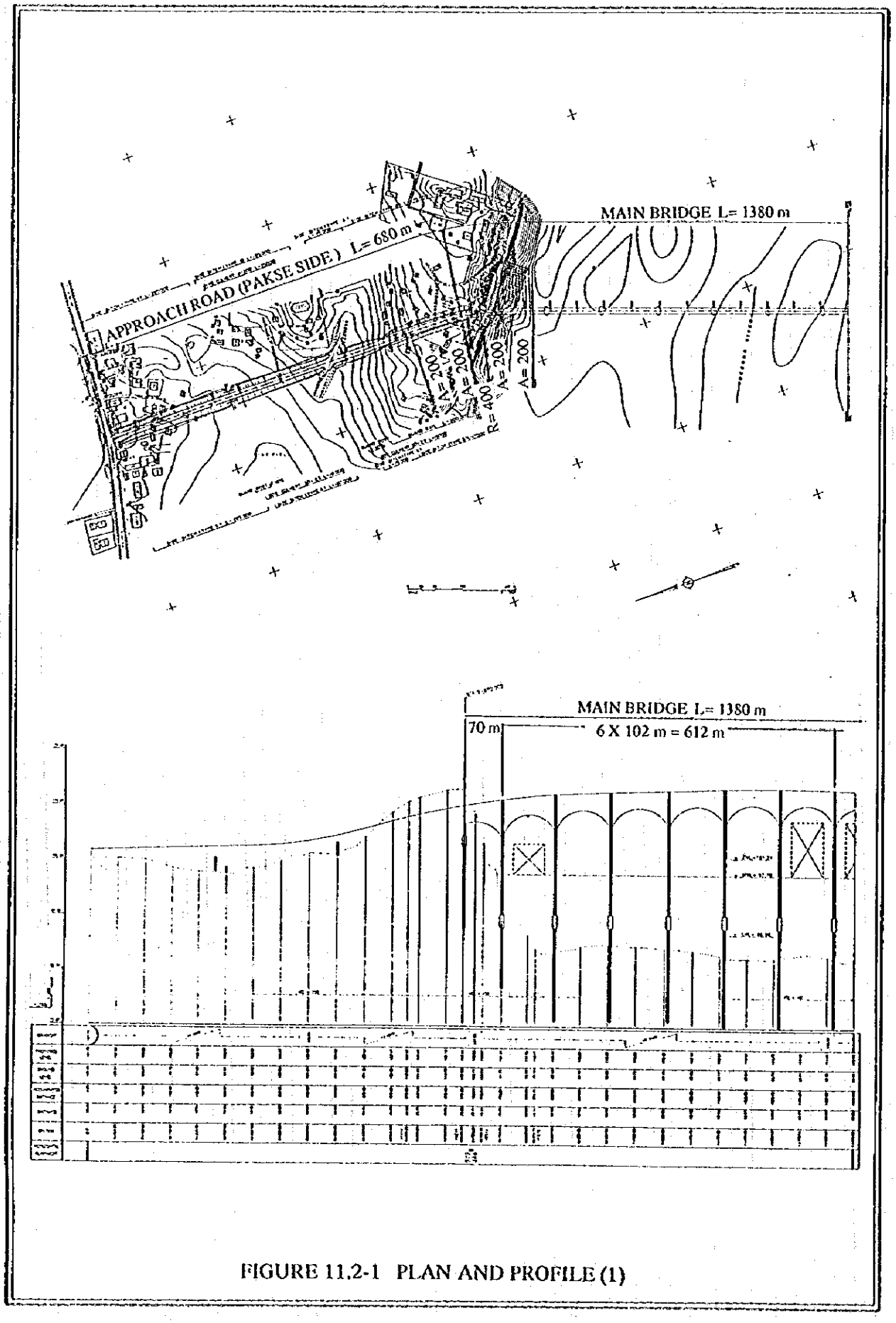


FIGURE 11.2-1 PLAN AND PROFILE (1)

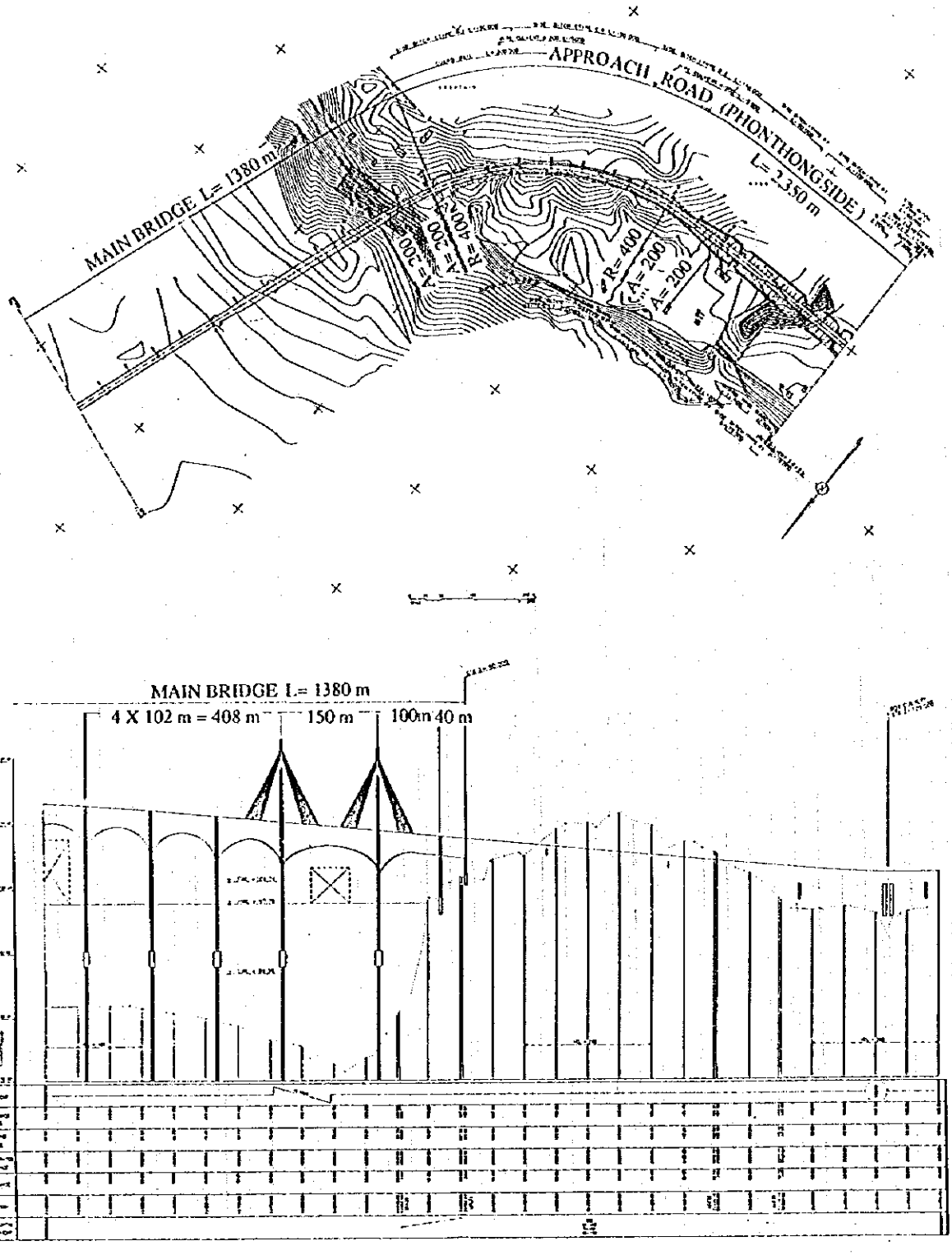


FIGURE 11.2-2 PLAN AND PROFILE (2)

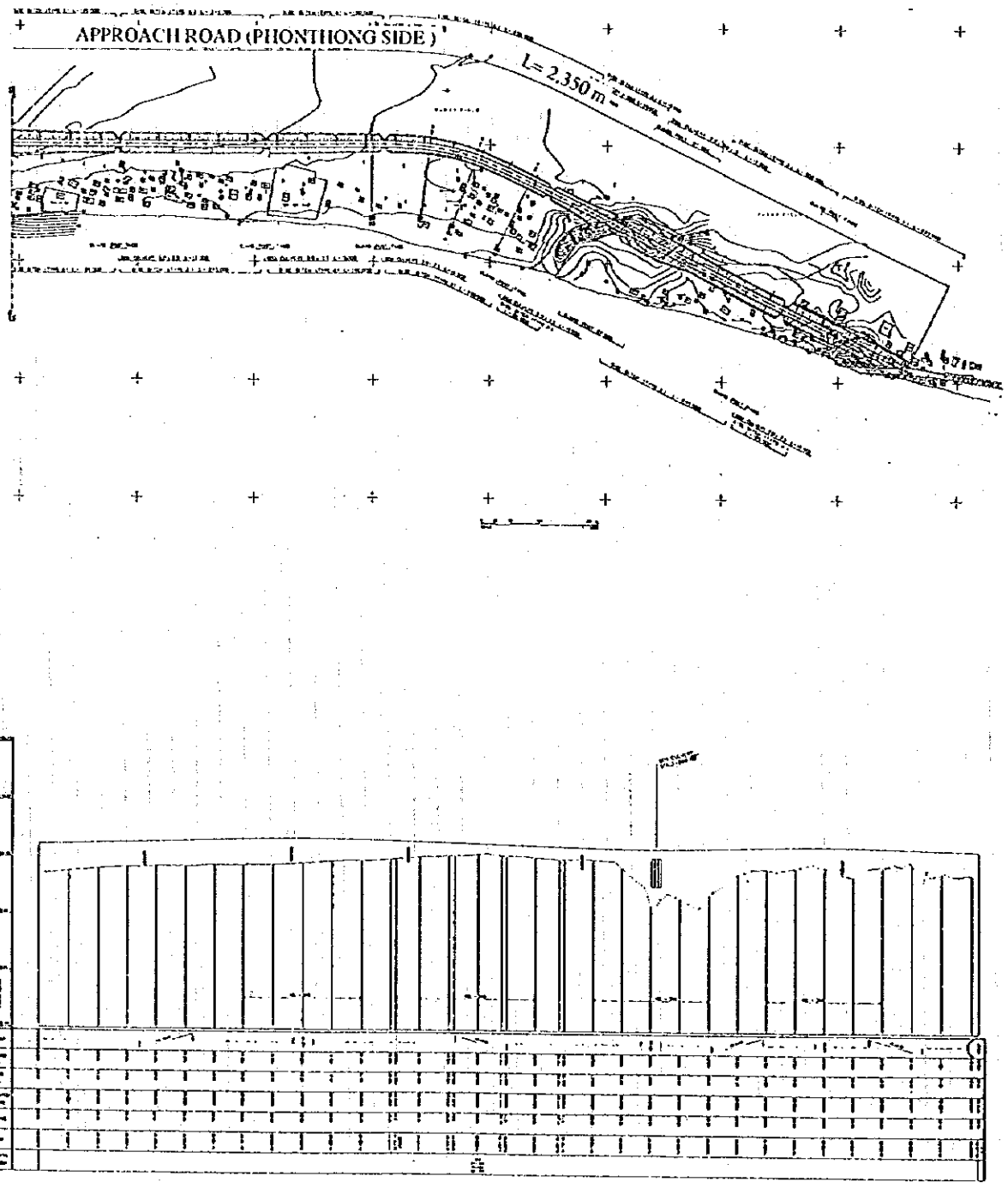


FIGURE 11.2-3 PLAN AND PROFILE (3)

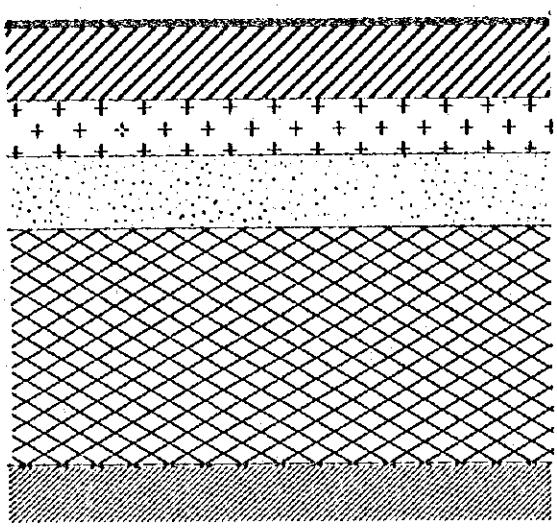


FIGURE 11.2-4 PAVEMENT STRUCTURE

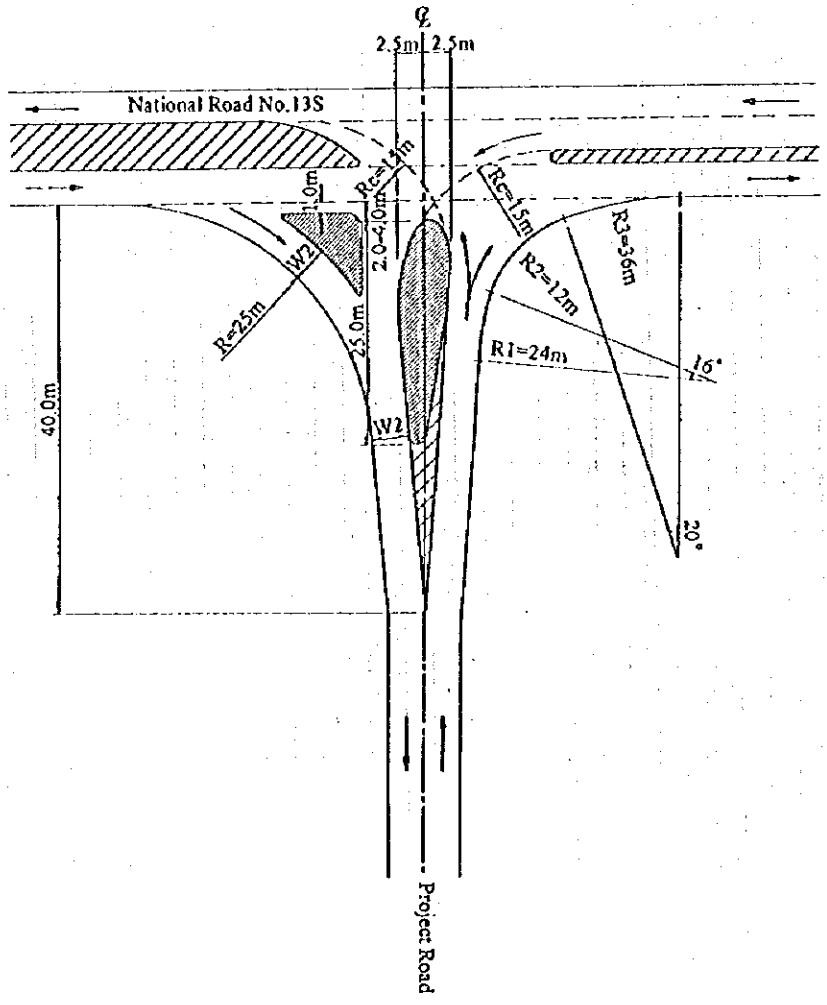


FIGURE 11.2-5 INTERSECTION WITH NR13S

CHAPTER 12

CONSTRUCTION PLAN

12. CONSTRUCTION PLAN

12.1 General

This chapter addresses the required construction materials, equipment, facilities, and construction condition and schedule. All construction planning are established to optimize the scale of construction to be proceeded as a package of contract containing the construction of bridge and approach roads.

12.2 Construction Materials Required

Required kinds of construction materials and their quantities were estimated based on the results of the design carried out in Chapter 11 and are summarized as shown in Table 12.2-1 and 12.2-2.

TABLE 12.2-1 MAJOR MATERIALS REQUIRED FOR BRIDGE CONSTRUCTION

Materials	Quantity required	Sources supplied
Cement	12,800 t	Imported (Thai)
Admixtures	50 t	Imported (Thai and others)
Aggregate for concrete	48,000 m3	Domestic
Steel pipe for pile	1,100 t	Imported (Thai)
Shaped steel	500 t	Imported (Thai)
Reinforcement bar	3,700 t	Imported (Thai)
PC strand	820 t	Imported (Thai and others)
PC wire	163 t	Imported (Thai)
PC bar	82 t	Imported (Other than Thai)
PC anchor set	13,980 pcs.	Imported (Other than Thai)

TABLE 12.2-2 MAJOR MATERIALS REQUIRED FOR APPROACH ROADS

Materials	Quantity required	Sources supplied
Embankment soil	176,000 m3	Domestic
Base course	12,500 m3	Domestic
Asphalt emulsion	150 m3	Imported (Thai)
Fuel oil	2,600 m3	Domestic

12.3 Procurement of the Materials and Equipment

12.3.1 Local Materials

(1) Concrete Aggregates and Stone materials

The raw materials for concrete aggregate and road pavement are planned to be procured from the licensed local suppliers, who collect them from the Mekong Rive by using pump dredger at some 5 km upstream of ferry site.

The raw materials procured will be washed and screened for concrete aggregate (25 - 5 and -5 mm) and the oversize materials (over 25 mm) will be crushed for road pavement aggregate (-16 and 3 mm) in screening plant at construction yard. The aggregates sized and crushed will be stacked in each stock piles.

The other stone materials, such as crushed stone for foundation of structures, cobble stones for revetment will be procured from the existing quarry sites at Blak some 20 km South of Pakse.

(2) Embankment Materials

The embankment soil for subgrade of approach roads will be borrowed from the borrow areas near the construction sites and materials for base course from the selected Laterite borrow areas shown on Figure A.7-6 (Volume II: Annexes).

(3) Wooden Materials

The wooden materials for construction, such as logs, squares, plank, etc. are available at sawmills in Pakse, except water-proof plywood for concrete forms.

12.3.2 Imported Material

(1) Cement and Concrete admixtures

There is a cement mill (Buffalo brand) in Laos, but the sufficiency of its quality and quantity is not proved yet on this kind of structures which need high quality and large quantity.

The cement, therefore is planned to be imported from Thailand and also available at Pakse market.

Excepting some special admixtures, almost of admixtures for concrete and mortar are available in Thailand.

(2) Steel Materials

Almost of common steel materials for construction use will be imported from Thailand, because of insufficient quality and quantity of Laotian products, such as small size shaped steel and reinforcement bars.

PC wire and strand for box girder construction will be imported from Thailand and PC strand for extradosed cable and PC bars may be imported from Asian countries other than Thailand.

The PC anchor sets for PC wires, cables and bars will be imported from Thai and other Asian countries.

(3) Others

The special construction materials such as epoxy glue for jointing the segment, etc. will also be procured from Thai and other Asian countries.

12.4 Transportation of Construction Materials and Equipment

12.4.1 Ocean Transportation

The construction materials and equipment to be required for the project, which will be brought from countries other than Thai, will be transported by sea to Bangkok port and Bangkok to the site by road.

12.4.2 Inland Transportation

The construction materials and equipment unloaded from ocean vessel at Bangkok or arranged in Thailand will be transported by road via Nakohon Ratchasima, Ubon Ratchathani, Kengkang in Thailand and Phonthong in Laos.

Some bridges on NR-10 from Thai border to Pakse may be required to be repaired or strengthen or made detour if transport a heavy cargo more than 30 tons.

12.5 Construction Facilities

12.5.1 Construction Yard

Major construction facilities consist of offices, store houses for cement and others, aggregate screening plant, concrete plant, steel pipe(for pile) fabrication yard, PC segment precast and stock yard, reinforcement bar processing yard, carpentry shop, motor-pool, repair shop, etc.

Land and temporary buildings required for the above facilities are estimated as shown in Table 12.5-1.

The locations of construction yard and office for supervisor and contractor are proposed as shown in Figure 12.5-1.

TABLE 12.5-1 CONSTRUCTION YARD

Construction Facilities	Req'red Land Area(m2)	Required Floor Area(m2)
Offices (supervisor & contractor)	2000	800
Store Houses	2000	1500
Aggregate screening plant	1100	
Concrete plant	1250	
Steel pipe fabrication yard	1500	400
PC segment precast yard	18500	200
Re-bar processing yard	600	120
Carpentry shop	600	120
Motor-pool and repair shop	800	200
Quarters for labors	1500	800

12.5.2 Access Road

The following access roads in the project area would be required for transportation of construction materials and equipment and embankment materials for the approach roads.

1) Access road (new construction) from Muang Kao near the ferry site on NR-10 to construction yard along the right bank approach road...Approx. 2.1 km

2) Haul road (widening and metalling of the existing village road) from the left bank approach road to borrow area for embankment materials...Approx. 3.0 km

The access road of the right bank will be utilized as village road after completion of the project.

12.5.3 Utilities Supply

(1) Electric power supply system

The construction yard needs to be supplied the electric power for operation of facilities installed on the right bank during whole construction period. The capacity required is estimated at 500 kW at peak time. Although there is also an existing distribution line on the right bank side, the capacity is insufficient for plant operation. The diesel generating sets are planned to be provided for this yard.

(2) Water supply system

The water required for operation of facilities mainly for screening plant and concrete plant will be 1 m3/min approximately and pumped up from the Mekong and filtered through filter sand bed.

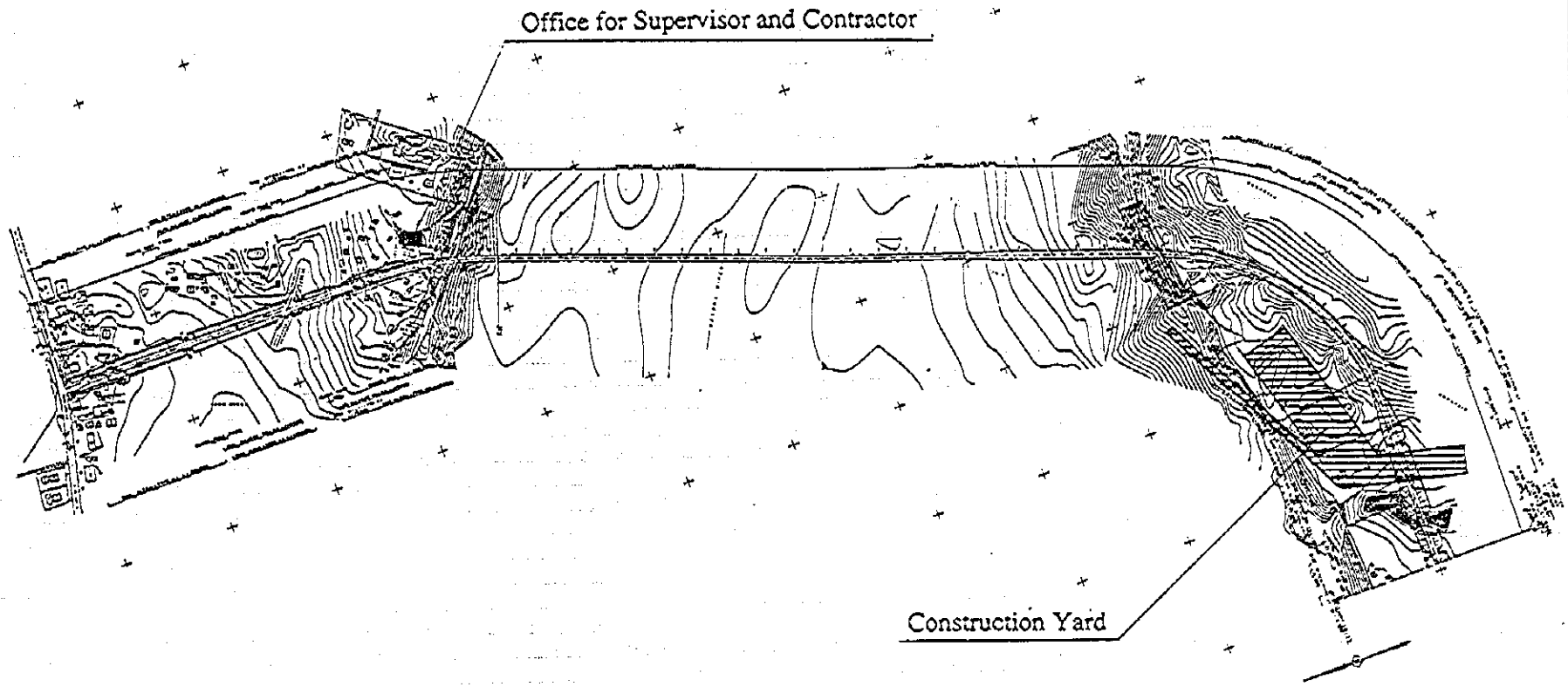


FIGURE 12.5-1 LOCATION MAP OF PROPOSED CONSTRUCTION OFFICE AND CONSTRUCTION YARD

Drinking water for workers will be supplied from Pakse municipal water supply system by using contractor's water tanker.

The haul roads, especially for Pakse side in dry season will be sprinkled with river water by using water sprinkler trucks for mitigating the dusts.

12.6 Working Conditions

The working conditions for the construction planning are as follows:-

(1) Workable days and hours

The estimation of workable days and hours is closely linked to labour regulation, weather conditions, kind of handling materials, etc. Based on the results of survey and studies the following have been observed:-

a) Labour regulation : According to the labour regulations the basic working days and hours are 5 days per week and 8 hours per day. There will be no work on Saturday and Sunday and National holidays.

   Actual working days and hours during construction are assumed to be 28 days per month and 8 hours per day including overtime. Two shift with actual working hour of 6.5 hours each will be adopted for effective construction of foundation and substructure works in the first dry season.

b) Weather conditions: The working days are estimated by reducting Sunday, National holiday, suspension days caused by rainfall and flood.

   The maximum average annual workable days are approximately 190 to 200 days for earth work and 270 to 280 days for structural work if providing the weather-proof measures on segment processing yard and erection noses.

(2) Labour force

Semi-skilled and common labours for the works will be recruited from the surrounding area of Pakse. However, skilled labours for construction of large scale bridge is insufficient in Laos and have to be recruited from outside of Laos.

12.7 Construction Method and Schedule

12.7.1 Construction Method for Bridge

(1) Substructure and foundation

The substructure of the bridge proposed consists of 2 abutments and 1 pier on land and 12 piers in the river. All piers constructed in the river have the pile

foundations of extrusion type. This foundation type, the pile caps of which are positioned above water surface in low water season, was selected to avoid under water construction as much as possible for the work. Therefore any shuttering device or cofferdam for foundation construction is not required to be applied.

The piles are installed in the river deposit layer and socketed in the rock. For this work the floating barge of more than 700 DWT for the work stage and pile construction equipment on the barge are to be mobilized.

1) Installation of steel casing

To construct cast-in-situ piles in the water steel pipes of internal diameter 1.5 m are installed first in the river deposit layer up to contact with bed rock. The installation of steel pipes are implemented by excavating of inside of steel pipe and using water jet installed outside of the pipe. The equipment configuration for this work is to be crawler crane with 80 ton capacity, 60 kw vibro-hammer, water jet sets of 130 horse power and such pile excavator as grab bucket or reverse circulation on drill (RCD).

2) Socketting of pile

The excavation of bed rock for socketting hole for cast-in-situ pile is carried out without casing by using RCD with bit for rock and/or percussion drill.

3) Concreting of pile

After bored hole is completed reinforcing cage is installed in the steel pipe and bored hall and concrete is cast in the hole using tremmee pipe. These works are conducted from floating barge.

4) Construction of pile cap

'The forming, reinforcement and concreting works for pile cap are conducted on the temporally stage connected with pile top.

All works mentioned above are to be conducted in the low water season.

(2) Superstructure

The superstructure of the bridge proposed consists of continuous rigid frame PC box girder of 102 m span length and extradosed rigid frame PC box girder of 150 m span length. As described in Subsection for these structural type the increasing cantilever erection with block by block is employed for the construction since any fixed staging on the ground is not useful. In the block cantilever erection method there are 2 methods which are cast-in situ method and precast segment method to

be selected. Traveling erection form is used for cast-in-situ method and erection nose is needed for precast segment method.

In case of cast-in-situ method the erection of superstructure blocks is to be conducted following block number ordered from pier top block. In this case the traveling erection form of 6 sets (12 units) will be mobilized to keep reasonable construction period for the bridge. In case of precast segment method the fabrication of superstructure blocks is executed without restriction of erection order of the blocks. In this method the erection noses of 2 set (4 units) will be mobilized to keep reasonable construction period for the bridge.

Considering the number of construction party, effectiveness of construction management and work quality it is proposed that the said precast segment is to be employed for the bridge erection. The hoisting capacity of erection nose of 90 tons will be recommended for reasonable investment for the bridge.

The work yard for the fabrication of girder blocks is able to be secured at Phonthong side behind the abutment of right bank as discussed in previous section. The precast segments are conveyed from the fabrication yard to erection position by floating barge.

The construction method and sequence of the super structure are illustrated in Fig. 12.7-1.

3) Approach Roads

The approach roads with 11 m width consist of Pakse side road with 680 m in length and Phonthong side road with 2350 min. length. The roads are planned to be constructed by using conventional mechanized construction method with bulldozer, hydraulic backhoe, dump truck, motor grader, compaction rollers, asphalt distributor, etc.

The embankment materials for subgrade will be borrowed from barrow area new construction sites and materials for base course from the selected laterite borrow areas.

Construction of the structures under the roads, such as drainage culverts and pedestrian culverts will be commenced in parallel with the embankment schedule of the roads.

After completing the embankment of base courses, the bitumen surface treatment will be carried out by using asphalt distributor, chip spreader and compaction rollers. Double bitumen surface treatment (DBST) and single bitumen surface treatment (SBST) will be applied for carriageway and shoulder respectively.

12.7.2 Construction Schedule

The construction schedule for bridge and approach roads is proposed as shown in Fig. 12.7-2 based on the studies in the previous sections.

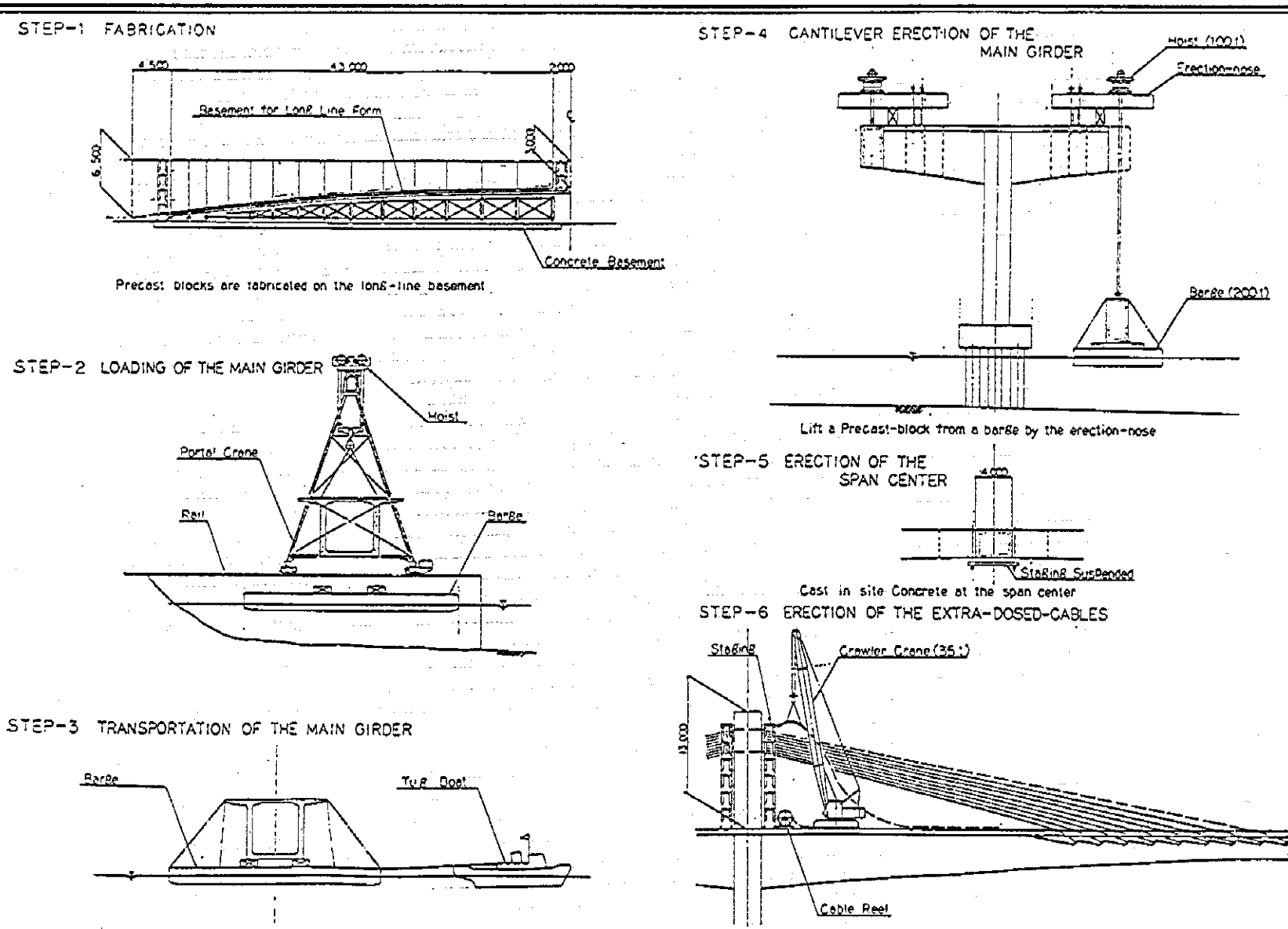
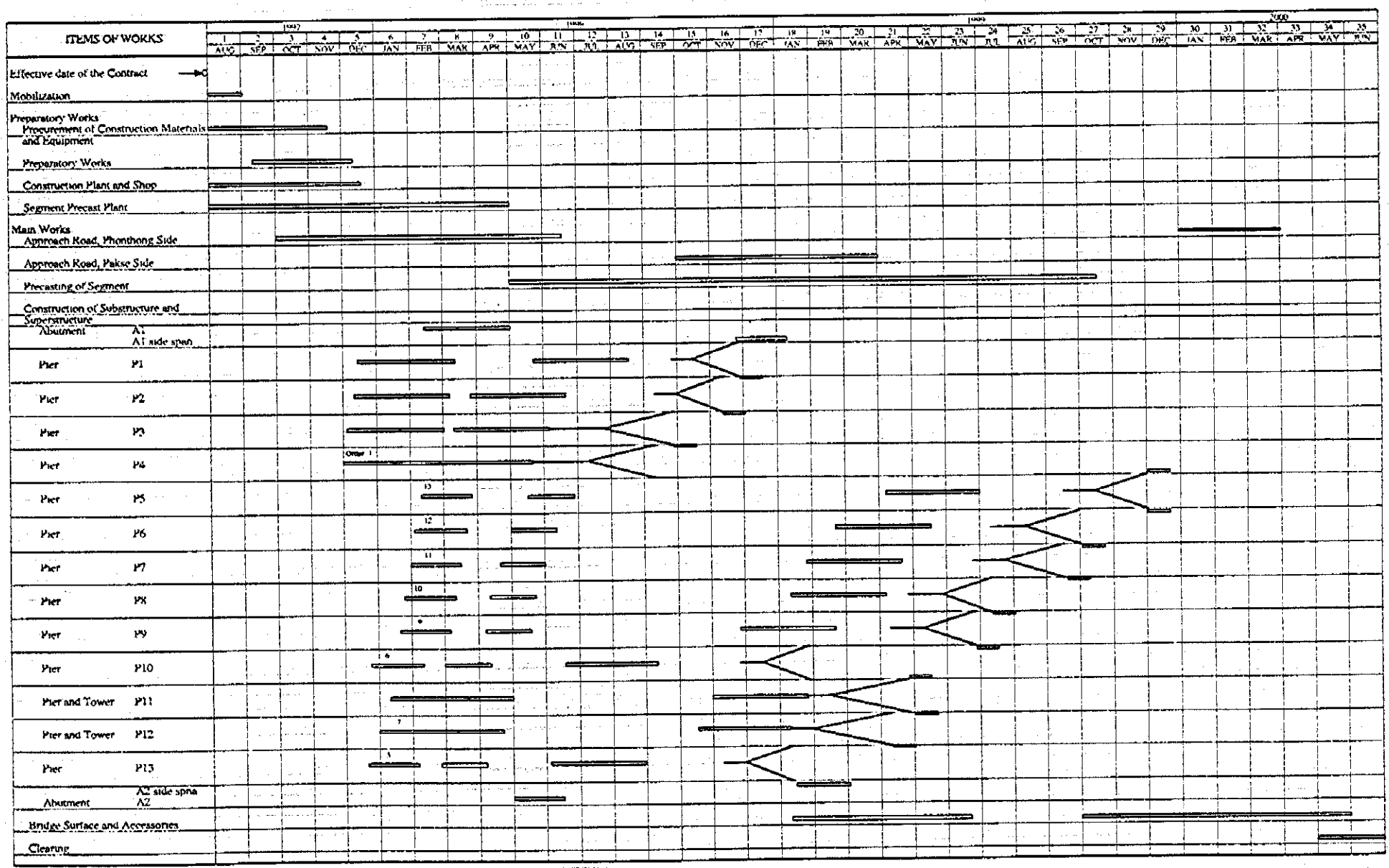


FIGURE 12.7-1 CONSTRUCTION METHOD FOR SUPER STRUCTURE



Source: The Study Team

Fig. 12.7-2 Construction Schedule for Bridge and Roads

CHAPTER 13

PROJECT COST ESTIMATE

13. PROJECT COST ESTIMATE

13.1 Basis of Project Costs

The costs, including costs of labour, construction materials and equipment were estimated in terms of US$ for the local currency portion and the foreign currency portion. The basic unit costs for Labour, materials and equipment applied for cost estimate are shown in Table A.13-1, Volume II Annexes.

Project execution method:

All the project works will be executed on contract basis. The construction materials, equipment and labour will be provided by contractor to be selected through international competitive bidding.

Price level:

All the direct construction costs were estimated at the price level of November 1995. The exchange rate applied for the cost estimation is as follows:

US$1.00 = J¥100 = Kip920 = Baht 24.0

13.2 Construction Costs

The unit construction cost for major work items were prepared by referring the cost data collected from MCTPC, contractors and suppliers in Laos and Thailand, and the prevailing construction unit prices employed by the similar project in South-East Asian countries.

The construction cost of the Project is shown in Table A.13-2, Volume II Annexes.

13.3 Land Acquisition and Compensation Costs

The land needed for the project such as approach roads, Construction Yard, etc. is acquired timely by MCTPC. Houses located on the land acquired are compensated for their removal. The land such as offices and construction yard utilized by the project but not occupied after completion of the works is also compensated. The unit costs for land acquisition and compensation were estimated as shown in Annex.

13.4 Engineering Service Costs

The cost of engineering services including detailed design and construction supervision was estimated at 7% of the total construction costs.

13.5 MCTPC's Administration Costs

The cost for the project administration by MCTPC is estimated at 1.5 % of total construction cost.

13.6 Taxes and Duties

The taxes and duties to be imposed on the imported materials and equipment for the project will be exempted. Therefore, the tax and duties were excluded from the project costs.

13.7 Contingencies

Physical contingency is estimated at 10 % for the sum of construction cost.

Price escalation is estimated by applying an annual inflation rate of 3% both for the local and foreign currency portions for all items. These costs are shown in Table A.13-2, Volume II Annexes.

13.8 Total Project Cost

13.8.1 Capital Cost

The Capital cost for the Project comprises the construction costs including bridge and approach roads construction, land acquisition and compensation costs, engineering services, project administration costs, and physical and price contingencies. The total project cost was estimated at US$68.4 million as shown in Table 13.8-1.

TABLE 13.8-1 PROJECT COST

(Unit: x 1000)

Item	L.C US$	F.C US$	Total US$
A. Construction Costs	9,884	42,884	52,768
1. Preparatory Works	816	4,887	5,703
2. Bridge Construction	7,551	35,909	43,460
1) Substructure	3,250	9,335	12,585
2) Superstructure	4,301	26,574	30,875
3. River Bank Protection	338	206	544
4. Approach Road Construction	1,179	1,882	3,061
B. Physical Contingency	988	4,288	5,277
C. Engineering Services	369	3,324	3,693
1. Detailed Design	146	1,314	1,460
2. Construction Supervision	223	2,010	2,233
D. Administration Costs	792	0	792
E. Land Acqusition and Compensation Costs	485	0	485
F Price Contingency	1,048	4,334	5,382
Total	13,566	54,831	68,397

13.8.2 Maintenance Cost

The maintenance cost comprises administration cost, routine and periodic inspection costs, routine maintenance cost and periodic maintenance cost. The annual maintenance cost of the bridge of a length of 1,380 m and the approach roads of a total length of 3.03 km (Pakse side: 0.68 km, Phontong side: 2.35 km) was estimated at US$15,000 per years. (Refer to Note A13.1 Maintenance Programme, Volume II: Annexes)

CHAPTER 14

ECONOMIC EVALUATION

14. ECONOMIC EVALUATION

14.1 General

The economic evaluation for the proposed bridge route is carried out based upon the detailed cost estimates presented in the previous chapter. The evaluation method is basically the same as adopted in the preliminary economic analysis of chapter 10.

14.2 Economic Cost

The costs for the implementation of the project bridge (and approach roads) consist of the following items :

1) Construction cost
2) Land acquisition and compensation cost
3) Administration cost
4) Engineering service cost
5) Contingency
6) Annual maintenance cost after opening

The economic project costs are obtained deducting all transfer portions such as taxes and duties from financial costs at market prices. Table 14.2-1 shows a summary of economic costs with its annual disbursement schedule.

TABLE 14.2-1 ECONOMIC PROJECT COST (1995 PRICES)

(US$1,000)

YEAR / ITEM	Total ('96-2000) (1995 Prices)	1996	1997	1998	1999	2000
– Construction Cost	52,768		19,124	14,833	15,729	3,082
– Physical Contingency	5,277		1,912	1,483	1,573	308
Sub-total	58,044		21,036	16,316	17,302	3,390
– Engineering Service	3,693	1,387	520	826	804	156
– Administration	792	79	158	238	238	79
– Land Acquisition and Compensation	485		436	49		
TOTAL	63,014	1,466	22,150	17,429	18,344	3,625

The total construction cost is US$52,768,000 and total project costs including land acquisition cost, contingency, engineering service, etc. are estimated at US$63,014,000 in 1995 prices.

The annual maintenance costs after opening are at US$15,000 per year as estimated in the previous chapter.

14.3 Economic Benefits

(1) Direct and Indirect Benefits

There exist many types of impacts on a society by the construction of a new bridge. Those are broadly classified into "Direct Benefits (or Users Benefits)" and "Indirect Benefits (or Non-users Benefits)".

The direct benefits are defined as the benefits enjoyed by direct users of a new bridge. Indirect benefits, on the other hand, are kinds of induced effects generated through the direct benefits and realized as regional development effects. Explanations of expected indirect benefits by the Pakse bridge project are given qualitatively below.

(2) Benefit Calculation

In chapter 10, the following benefits were already estimated quantitatively based on the With and Without Project comparison method:

- Direct benefits

1) Savings in time cost of vehicles crossing over the river
2) Savings in crew cost of commercial vehicles
3) Savings in time cost of passengers in vehicles
4) Losses (negative benefits) in the distance-related Vehicle Operating Cost (VOC)

- Other benefits

5) Savings in future additional investment, operation, maintenance, repair cost for ferry boats
6) Savings in future investment costs for the new slope type jetties in 2000. Those costs are estimated at about US$500,000 for the both sides of the Mekong river (refer to A.14-1, Volume II: Annexes).

The results of benefit estimation are summarized in Table 14.3-1.

TABLE 14.3-1 BENEFIT ESTIMATION

(US$1,000)

BENEFIT	TRAFFIC	Year		
		2000	2010	2020
Users Cost Savings (VOC and Time Cost)	Normal Traffic	371	2,101	4,275
	Induced Traffic	20	118	234
	Sub-total	391	2,219	4,509
Savings in Ferry Service Costs	Operations	781	3,750	5,823
	Investment(Boats)	215	0	215
	Investment(Jetties)	500		
	Sub-total	1,496	3,750	6,038
TOTAL		1,887	5,969	10,547

(3) Expected Indirect Benefits by the Pakse Bridge Project

The Pakse bridge is expected to generate many kinds of indirect benefits through realization of non-waiting, continuous and all-weather traffic flows. The project is apparently a basic infrastructure facility and, at the same time, is one of essential elements that compose Basic Human Needs in the community.

The followings are expected long-term effects which will accrue from the implementation of the project bridge :

- Regional Development

1) Agricultural Development Effects

- According to the Pakse office of the Ministry of Agriculture, the four districts along the western bank of the Mekong River (Phontong, Champasak, Soukhouma and Mounlapamoke) tend to produce rice more than their self-sufficiency level and transport its surplus rice to Pakse and other districts located on the eastern bank where the rice production is not sufficient to cover district population. At present, transportation of rice and other agricultural products are relying on the ferry services only. Considering the demand and supply pattern of rice, the project bridge will provide the most reliable and effective means to transport rice from western bank to eastern bank.

- The Boloven Plateau and its surrounding areas are the important hinterlands of the project bridge. Many agricultural development projects are on-going or planned in future such as "Lao Upland Agricultural Development Project (LUADP)", "Swedish International Development Agency (SIDA) Project" and "Integrated Agricultural and Rural Development Project". The project bridge is indispensable for these agricultural development projects in order to transport smoothly their input and output without bottleneck at the Mekong River crossing. Among the products of agricultural development projects, coffee from the Boloven Plateau is exported to Thailand and will contribute to earn foreign currencies.

2) Industrial Development Effects

- Although present manufacturing industry in the study area is dominated by small size factories, saved transport time and costs by the bridge will reduce the costs of raw materials, and on-time delivery of produced commodities will stimulate new locations of other industries.

- In addition, the new bridge will give foreign investors strong incentive to investment in this area. Up to now, the investment by foreigners in the Champasak province are counted at 14 companies. There are some more foreign investors continuing to do feasibility studies for some projects such as

sugar factory, coffee processing factory and others. There was also a contract investment on hydropower project in Houei Ho by a private company from South Korea. Construction of the new bridge will accelerate this tendency and then increase employment opportunities in the study area.

3) Betterment in Living Conditions

- The major shopping markets are located in Pakse. Number of trips to the market in Pakse (for purchases) can be infrequent as once per month especially from the more distant villages in the districts on the Phontong side. Reduced travel time and cost by the new bridge will result in improved access to the regional markets and other amenities.

- The present number of hospitals or health care centers in the Champasak province are : Provincial management hospital = 1, District management health centers = 10, and Sub-district dispensaries = 80. However, the only fully-equipped hospital is located in Pakse. Small dispensaries are located in most villages, but are not staffed by qualified doctors. It is, therefore, clear that all-weather and 24-hour operated bridge is very important for those living in the western bank areas remote from Pakse particularly in the case of emergency.

4) Promotion of Tourism Development

- Tourism in Lao PDR has experienced a rapid growth. According to the National Tourism Authority of Lao PDR, the total number of tourists has increased from 4,900 persons in 1991 to 16,000 persons in 1994 with an average annual increase rate of 48%. Of those, approximately 1,200 persons visited Champasak Province and about 65% of those were from Thailand. The accommodation capacity in Champasak province is just 8 hotels with a total 158 rooms in 1994. However, there are notable tourist attractions in the area such as Wat Phu, Khon Phapheng Waterfalls, Khong Island and Bolaven Plateau. The number of tourists visiting Champasak province by roads will be influenced by the construction of the Pakse bridge and, at the same time, will influence the need for the project bridge because poor road conditions and the bottleneck of crossing over the Mekong river will suppress tourism.

- <u>International Link</u>

- About 130 persons and 33 trucks per day have crossed the Lao - Thai border at Chongmek in 1994. The number of trucks crossing border are forecasted to increase to 60 vehicles per day in 2000. All coffee and a half of other agricultural products from the Boloven Plateau Agriculture Project are estimated to be exported to Thailand through Chongmek. The new bridge at Pakse will play an important role as a gateway to/from Thailand and promote the economic development not only for the region but also for the whole country of Lao P.D.R.

14.4 Evaluation Results

(1) Cost Benefit Analysis

1) Assumptions for the Analysis

The same conditions applied in the preliminary evaluation (chapter 10) are assumed here as explained below :

- The project bridge is scheduled to be opened to public at the middle of the year 2000.
- Benefits streams between each benchmark year (2000, 2010 and 2020) are estimated by means of interpolation (and extrapolation after 2020).
- The evaluation period of the project bridge is assumed as 30 years after opening.
- The residual value of the project bridge is estimated to be 40% of the total construction cost and 100% of land acquisition costs are counted as residual value.

2) Summary of Evaluation Results

Based on the conventional Discounted Cash Flow analysis, evaluation indicators were calculated as below and Cost Benefit Cash Flows are presented in Table 14.4-1.

Discount Rate	7%	9%	10%
- Net Present Value (NPV: US$'000)	8,996	-6,374	-11,571
- Benefit Cost Ratio (B/C)	1.18	0.87	0.75

- Economic Internal Rate of Return (EIRR) % = 8.0%

(2) Conclusions

EIRR of the project bridge is estimated at 8%. The results above are based on the only quantifiable direct benefits. In addition to the direct benefits, regionwide and nationwide development effects by the Project should be taken into account for the evaluation. Considering such wide range and long term indirect effects together with the direct benefits, the implementation of the Project will be sufficiently justified.

TABLE 14.4-1 COST BENEFIT CASH FLOWS

(Base Case)

(US$1,000)

No.	Year	COSTS			BENEFITS			B - C
		(1) Investment Cost	(2) Maintenance & Operation	(3) Total Cost	(4) User cost Savings	(5) Savings in Ferry Operation	(6) Total Benefit	(7) Net Cash Flow
	1996	1466		1466	0		0	-1466
	1997	22150		22150	0		0	-22150
	1998	17429		17429	0		0	-17429
	1999	18344		18344	0		0	-18344
	2000	3625	7.5	3633	391	1496	1887	-1745
1	2001		15.0	15.0	926	1705	2631	2616
2	2002		15.0	15.0	1069	1861	2930	2915
3	2003		15.0	15.0	1213	2246	3459	3444
4	2004		15.0	15.0	1357	2217	3573	3558
5	2005		15.0	15.0	1501	2419	3920	3905
6	2006		15.0	15.0	1644	2856	4500	4485
7	2007		15.0	15.0	1788	2883	4671	4656
8	2008		15.0	15.0	1932	3362	5293	5278
9	2009		15.0	15.0	2075	3650	5725	5710
10	2010		15.0	15.0	2219	3750	5969	5954
11	2011		15.0	15.0	2448	4131	6579	6564
12	2012		15.0	15.0	2677	4090	6767	6752
13	2013		15.0	15.0	2906	4487	7393	7378
14	2014		15.0	15.0	3135	4463	7598	7583
15	2015		15.0	15.0	3364	4664	8028	8013
16	2016		15.0	15.0	3593	5089	8682	8667
17	2017		15.0	15.0	3822	5094	8916	8901
18	2018		15.0	15.0	4051	5541	9592	9577
19	2019		15.0	15.0	4280	5568	9848	9833
20	2020		15.0	15.0	4509	6038	10547	10532
21	2021		15.0	15.0	4738	6305	11043	11028
22	2022		15.0	15.0	4967	6370	11337	11322
23	2023		15.0	15.0	5196	6879	12075	12060
24	2024		15.0	15.0	5425	6973	12398	12383
25	2025		15.0	15.0	5654	7512	13166	13151
26	2026		15.0	15.0	5883	7853	13736	13721
27	2027		15.0	15.0	6112	8211	14323	14308
28	2028		15.0	15.0	6341	8586	14927	14912
29	2029		15.0	15.0	6570	8766	15336	15321
30	2030	-21349	7.5	-21341	3399	4698	8098	29439
	TOTAL	41665	450	42115	105185	149764	254949	212833

EIRR	8.0%

14.5 Sensitivity Analysis

The benefit and cost estimation explained above requires many input parameters and setting these parameters are usually accompanied with uncertainty. As uncertainty will affect the evaluation results, it is necessary to carry out the sensitivity tests by changing the parameters within the probable range. In this analysis, the following factors are taken into account :

- Benefit Side
  1) Socio-economic condition (GDP Growth)
  2) Traffic demand
  3) Time value (crew and passengers)
  4) Time-related Vehicle Operating Cost (VOC)
  5) Distance-related VOC
  6) Ferry operation costs

- Cost Side
  7) Construction cost
  8) Maintenance cost

A summary of the sensitivity analysis is presented as below :

1) GDP Growth	EIRR
High case (10%, 8%, 6%)	8.5%
Base case (8%, 6.5%, 5%)	8.0
Low case (6%, 5%, 4%)	6.9

2) Traffic Demand	EIRR
+30%	9.8%
+20%	9.2
+10%	8.6
Base case	8.0
-10%	7.3
-20%	6.6
-30%	5.9

3) Time value (incl.VOC)	EIRR
+30%	8.8%
+20%	8.5
+10%	8.3
Base case	8.0
-10%	7.7
-20%	7.4
-30%	7.1

4) Distance-related VOC	EIRR
+30%	7.9%
+20%	8.0
+10%	8.0
Base case	8.0
-10%	8.0
-20%	8.0
-30%	8.0
zero	8.2

5) Ferry operation costs	EIRR
+30%	9.1%
+20%	8.7
+10%	8.4
Base case	8.0
-10%	7.6
-20%	7.2
-30%	6.8

6) Construction cost	EIRR	7) Maintenance cost	EIRR
+30%	6.5%	+30%	8.0%
+20%	7.0	+20%	8.0
+10%	7.4	+10%	8.0
Base case	8.0	Base case	8.0
-10%	8.6	-10%	8.0
-20%	9.3	-20%	8.0
-30%	10.2	-30%	8.0

As a matter of course, the evaluation results are affected most sensitively by the factors of traffic demands and construction cost. For example, if traffic demands increase by 10% and the construction cost decreases by 10% simultaneously from the base case, the value of EIRR will go up to 9.3%.

CHAPTER 15

FINANCIAL ANALYSIS

15. FINANCIAL ANALYSIS

The main contents of financial analysis are classified into the following two items :

- Possibility of introducing a toll system
- Financial bases for the implementation of the project bridge

15.1 Possibility of Toll Bridge

It is another issue to keep a stable financial resources for annual maintenance of the bridge after opening. One of the reasonable procedures is to levy toll charges on users of the project bridge. Imposing toll on users will be justified from a point of "Beneficiaries Pay Principle" and originally ferry tariff has been levied on the river crossing traffic.

(1) Toll Rates and Toll Revenues

The future toll revenues were calculated based on the future traffic demand and toll rates determined referring to the present Pakse ferry and other information. Table 15.1-1 shows the results of calculation of toll revenues. The following four cases were prepared to determine the toll rates:

1) Case 1 : Present Pakse ferry tariff
2) Case 2 : User benefit per vehicle
3) Case 3 : 50% of user benefit per vehicle
4) Case 4 : Existing Friendship bridge (Vientiane - Nongkhai Bridge)

The case 1 (present Pakse ferry tariff) will bring the highest revenues and the lowest will be the case 3 (50% of user benefit per vehicle).

(2) Financial Return and Maintenance Cost Recovery

1) Constant Price

Table A15-1 and Table A15-2 (Volume II: Annexes) show the financial cash flows in 1995 constant prices for the case 1 (present Pakse ferry tariff) and case 3 (50% of user benefit per vehicle). These tables indicate that the recovery of initial investment costs with the toll revenues will be very difficult because of low Financial Internal Rate of Return (FIRR : -0.6% in case 3 and 3.6% in case 1).

On the other hand, the annual maintenance costs can be covered sufficiently with the annual toll revenues.

TABLE 15.1-1 TOLL RATE AND TOLL REVENUES

(1995 prices)

TRAFFIC	YEAR	Vehicle Type MC	LV	Bus	Truck	Total
(Vehicles/day)	2000	891	224	28	317	1460
	2010	2104	512	58	777	3451
	2020	3656	903	107	1071	5737
TOLL RATES (1995 prices)		Kip/vehicle				Note
(Case 1)		300	3600	5500	7350	: Present ferry tariff
(Case 2)		500	3200	3680	6000	: User Benefit/vehicle
(Case 3)		250	1600	1840	3000	: 50% of benefit
(Case 4)		-	900	1500	6000	: Friendship Bridge
TOLL REVENUES	2000	US$1,000/Year				Total
(Case 1)		106	320	61	924	1411
(Case 2)		177	284	41	755	1257
(Case 3)		88	142	20	377	628
(Case 4)		-	80	17	755	851
	2010	US$1,000/Year				
(Case 1)		250	731	127	2266	3374
(Case 2)		417	650	85	1850	3002
(Case 3)		209	325	42	925	1501
(Case 4)		-	183	35	1850	2067
	2020	US$1,000/Year				
(Case 1)		435	1290	233	3123	5081
(Case 2)		725	1146	156	2549	4577
(Case 3)		363	573	78	1275	2289
(Case 4)		-	322	64	2549	2936

2) Cost Escalation and Revised Toll Rates

Instead of the constant price situation above, alternative analyses were carried out assuming cost escalation of 3% per annum and periodical toll revisions at every 5-year interval with an average increase rate of 3% per annum (16% increase at every 5-year). The results of these analyses are shown in Table A15-3 and Table A15-4 (Volume II: Annexes) and FIRRs are still low as follows.

- Case 1 (toll rate as the same of Pakse ferry) ; FIRR = 6.3%
- Case 3 (toll rate as 50% of user benefit per vehicle) ; FIRR = 1.9%

It is also pointed out, however, that the annual maintenance cost may be covered with annual toll revenues even in the case of cost escalation.

15.2 Financial Resources and Investment Capacity

(1) Recent Government Budget Situation

After the introduction of the new tax system in 1988-1989, the budget balance of the Government deteriorated sharply, passing from a surplus to a deficit. However, since 1990, mainly as a result of increasing tax revenues, the budget deficit (excluding capital expenditures) has improved. In 1992, domestic tax and non-tax revenues covered nearly all current expenditures, leaving the financing of capital expenditures to loans and foreign assistance (Table 15.2-1).

Although the fiscal reform in Laos has produced more rapid and better results, the budget situation is highly dependent upon external assistance. All most all portions of tax and non-tax revenues are input to cover the current expenditures and not for the capital expenditures. In 1992, about 90% of the deficit was financed by foreign assistance.

TABLE 15.2-1 GENERAL GOVERNMENT BUDGET

(1990 - 1992)

(Kip million)

Year	1990	1991	1992
REVENUE	60,960	74,672	90,456
Tax	37,644	54,355	63,513
Non-tax	23,316	20,317	26,943
Grants	22,960	32,550	39,946
EXPENDITURE	143,447	151,079	174,641
Current	69,864	81,956	92,424
Capital	73,583	69,123	82,217
Overall Balance (Commitment basis)	-59,527	-43,857	-44,239
Clearance of arrears (net)	-5,920	-4,982	463
OVERALL BALANCE (Cash basis)	-65,447	-48,839	-43,776
Financed by			
Domestic financing (net)	5,107	19,287	4,828
Bank	107	13,793	1,448
Non-bank	5,000	1,200	2,348
Asset sales	0	4,294	1,032
Foreign financing (net)	60,340	29,552	38,948
TOTAL FINANCING	65,447	48,839	43,776

Source : "ANNUAL REPORT 1992" Bank of the Lao PDR

(2) Budget for MCTPC

Table 15.2-2 shows approved budget and actual fund requirement in 1993/94. Total budget to MCTPC approved by the Government was 44,515 million Kip. On the other

hand, actual fund requirement (actual implementation) was 52,990 million Kip and resulted in the shortage of budget by 8,475 million Kip. The same situation was observed in the Communication Department (C.D.) in MCTPC with a shortage of budget amounted to 2,562 million Kip.

TABLE 15.2-2 SUMMARY OF FUND REQUIREMENT AND APPROVED BUDGET

(1993-94)

(Kip million)

BUDGET APPROVED BY THE GOVERNMENT TO C.T.P.C SECTOR	FUND REQUIREMENT (Actual Implementation)			APPROVED BUDGET			SHORTAGE OF BUDGET		
		1993-94			1993-94			1993-94	
	Local Fund	Foreign Fund	Total	Local Fund	Foreign Fund	Total	Local Fund	Foreign Fund	Total
Total Fund	15,836	62,158	77,994	14,007	45,037	59,044	1,829	17,121	18,950
Ministry Fund (MCTPC)	6,026	46,964	52,990	6,030	38,485	44,515	-4	8,479	8,475
Province Fund	6,891		6,891	4,700		4,700	2,191		2,191
Enterprise Fund	2,919	15,194	18,113	3,277	6,552	9,829	-358	8,642	8,284
Communication Department in MCTPC	5,431	40,614	46,045	5,516	37,967	43,483	-85	2,647	2,562
(% to total fund)	34.3%	65.3%	59.0%	39.4%	84.3%	73.6%			

Source : MCTPC

For 1994/95 fiscal year, the Government have approved 88,918 million Kip to C.T.P.C section of which 16,297 million Kip goes to local fund. MCTPC was allocated 5,924 million Kip as local fund, in addition to that 472 million Kip were managed by the State enterprises (Table 15.2-3 (A)). The Communication Department (C.D.) was approved 57,024 million Kip or 64% of total budget for CTPC sector (Table 15.2-3 (B)).

However, the performance in the early 6 months (up to March 1995) could not reach its target due to late budget. The amount actually paid in the first 6 months in 1994/95 was 10,773 million Kip or only 19% of the approved budget (Table 15.2-3 (C)). Regarding the local fund, at the same time, it is estimated that real amount to be paid up to March 1995 is 3,307 million Kip and thus 1,805 million Kip will remain as un-liquidated amount (Table 15.2-3 (D)).

The above explanations reveal an aspect of severe situation of the Government Budget.

TABLE 15.2-3 REVIEW OF 1994/95 BUDGET AND FUND REQUIREMENT

(March 1995)

(Kip million)

(A) BUDGET APPROVED FOR C.T.P.C SECTOR(1994-95)

ALLOCATION	BUDGET 1994-95 Local Fund	Foreign Fund	Total
Total Fund	16,297	72,621	88,918
Ministry Fund (MCTPC)	5,924	64,929	70,853
Province Fund	9,901	2,959	12,860
Enterprise Fund	472	4,733	5,205
Communication Department (C.D.) in MCTPC	5,416	51,608	57,024
(% to Total Fund)	33.2%	71.1%	64.1%

(B) BUDGET APPROVED FOR C.D. (1994-95)

Description	Local Fund	Foreign Fund	Total
1 Project Management	247		247
2 Feasibility Study & Design	126	2,219	2,345
3 Road & Bridge Construction	3,681	44,041	47,722
4 Road & Bridge Maintenance	1,091	4,378	5,469
5 Waterways	272	970	1,242
TOTAL	5,416	51,608	57,024

(C) AMOUNT PAID TO PERFORMANCE IN FIRST 6 MONTHS (Up to Mar.'95)

Description	Local Fund	Foreign Fund	Total
1 Project Management	112		112
2 Feasibility Study & Design	2	879	881
3 Road & Bridge Construction	1,260	8,223	9,483
4 Road & Bridge Maintenance	128	168	297
5 Waterways			
TOTAL	1,502	9,270	10,773

(D) AMOUNT LIQUIDATED BY 3/95 (LOCAL FUND)

Description	Amount to be paid by Mar.'95	Liquidation completed by Mar.'95	Amount not liquidated
1 Project Management	112	112	0
2 Feasibility Study & Design	12	2	10
3 Road & Bridge Construction	2,975	1,260	1,715
4 Road & Bridge Maintenance	171	128	43
5 Waterways	36	0	36
TOTAL	3,307	1,502	1,805

Source : "Summarizing of the First Semi-Annual of Communication Department for 1994-95", March 1995, MCTPC

(3) Future Road and Bridge Investment Plan

Future investment plan for the coming next 5 years (1994/5 - 1999/2000) is presented in the " Public Investment Program (PIP : 1994-2000)". Total amount of 438.9 US$ million is planned to be disbursed for the road and bridge sector in plan period. However, the budget for construction of the Pakse bridge is not included in the program. In order to compare the program budget by PIP and disbursement schedule of the Pakse bridge project, Table 15.2-4 was prepared.

The total project cost of the Pakse bridge will be more than 14% of the total budget for road and bridge sector by PIP and maximum 34% of annual budget of PIP.

TABLE 15.2-4 ROAD AND BRIDGE INVESTMENT PLAN

(1994/95 - 1999/00)

(US$ million)

Year	1994/5	1995/6	1996/7	1997/8	1998/9	1999/00	TOTAL
Public Investment Program (PIP)*							
Transport Sctor	53.7	65.5	74.7	87.3	108.1	108.7	498.0
[A] Road & Bridge Sector	51.0	60.2	66.0	75.7	92.5	93.5	438.9
[B] Pakse Bridge Project Costs Disbursement Schedule		1.47	22.66	17.49	18.36	3.59	63.57
(B/A) %		2.4%	34.3%	23.1%	19.8%	3.8%	14.5%

Source (*) : Public Investment Programme 1994 - 2000, Outline, June 1994.

(4) Concluding Remarks

1) Investment Capacity

The size of the Pakse bridge project in terms of the project cost (63 US$ million) is about 10 times of the total local fund of MCTPC budget of 1994/95 (5,924 million Kip = 6.4 US$ million) and also 3.6 times of the total local budget for all CTPC sectors (16,297 million Kip = 17.7 US$ million). Considering such project size and the present Government financial situation, implementation of the project only by the local fund or loans will impose a big burden to the Government budget.

2) Introducing the Toll System

Although it is very difficult to recover the total investment cost by the toll revenues, annual maintenance cost can be covered with the annual toll revenues.

CHAPTER 16

ENVIRONMENTAL IMPACT ANALYSIS, MITIGATION AND MONITORING

16. ENVIRONMENTAL IMPACT ANALYSIS, MITIGATION AND MONITORING

16.1 General

16.1.1 Environmental Policies, Regulations and Controls

The LPDR is presently developing their institutional process governing environmental planning and management[1] and thus has no approved environmental assessment guidelines nor any laws requiring development projects to have EIAs completed. The LPDR's Organization for Science, Technology and Environment (OSTE), under Prime Ministerial Decree 63, has the mandate to monitor, intervene and enforce proper environmental management practices. Under PMD No. 63, OSTE is required to:

- undertake policy coordination in the areas of science and technology;
- provide computer literacy and information services training;
- design and implementation of standards; and,
- coordinate all environmental management activities and facilitate inter-ministerial environmental affairs.

At present OSTE has very limited technical capacity, a very broad mandate as underscored by the 4 points above, no clear line of authority vis-á-vis the other line agencies and no linkages at the provincial level. It cannot rely on legal instruments to support actions it might want to take. As a result, OSTE, although lead by the Prime Minister's office, remains largely unable to fulfill its mandate.

A number of "line" ministries have primary responsibility for the specific technical aspects of the components of the environment as shown in Table 16.1-1

TABLE 16.1-1 SUMMARY OF LPDR "LINE" AGENCIES AND THEIR RESPONSIBILITY REGARDING ENVIRONMENTAL MATTERS.

Possible Impact Areas	Ministry Responsible	Department/Division at Provincial Level
Soil Quality and soil Loss	Public Health	
Sedimentation	Agriculture and Forestry	Dept. of Forestry
Air Quality	Public Health	
Noise (and possibly vibration)	Public Health	
Conservation and Watershed Mgt.	Agriculture and Forestry	Dept of Forestry
Water Quality (mostly Agriculture related.)	Agriculture and Forestry	Dept. of Irrigation and Macro.

[1] Organization for Science Technology and Environment. 1993. Lao People's Democratic Republic (Prime Minister's Office). Environmental Action Plan. 80 pg. + five Annexes

Mekong River Water Quality	Mekong Secretariat	
Land Use (agricultural)	Agriculture and Forestry	Dept. of Agric. & Extension
Urban Land Use and Water Quality	Industry and Handicraft	Environment Division
Water Resources (hydro-power) Dev't.	Forestry and Agriculture	Dept. of Irrigation and Power Planning
Resettlement (dealing with compensation)	Finance, & Prov. Govt.	Dept. of Lands
Urban Land Planning	MCTPC	Urban Planning Division
Extraction and Use of Aggregate Materials	Industry and Handicraft	Mineral Resources Mgt. Div.

The departments and divisions have many overlapping responsibilities related to specific resource use within a specific sector, for example the Min. of Public Health and the Min. of Industry and Handicraft both have responsibility for controlling water quality but from different sources and within the context of different minimally acceptable standards.

These line agencies function on the basis of a number of laws and decrees, summarized in ANNEX taken from the LPDR Environmental Action Plan of 1993[2].

In the case of the Pakse Bridge project, the work to be undertaken will fall largely under the control of the Champasak MCTPC Unit. In LPDR's Environmental Action Plan the OSTE states that MCTPC should be responsible for conducting its own EIAs of all development projects while adhering to any relevant regulations policies and should follow all established guidelines. In that regard the only existing, albeit preliminary, guidelines are those prepared in the Action Plan Annex V (pg. 9 - 12). It was decided that these (as well as JICA's EA requirements) form the basic framework for this Environmental Impact Assessment.

Resettlement is the direct responsibility of the Provincial Offices of MCTPC in collaboration with the central MCTPC office in Vientiane. Compensation amounts and new land allocations are determined jointly by the MCTPC and the District Administrator's office.

Provincial officials, including the Governor and/or Vice Governor as well as municipal heads, often play a hands-on role in planning issues of this type, and may undertake ad-hoc evaluations of proposed projects.

Within the next 12 months Lao will have its own EIA process to work with. In the absence of such a process, we have applied Japan's process as well as some

---

[2] Same reference as for footnote No. 3.

aspects of other international processes, including Canada's national environmental assessment process.

Based on our examination of the Lao PDR's environmental management instruments and institutions, this EIA is based on a blend of international and Lao standards. The implementation of mitigation measures, as well as monitoring for all impacts, except those associated with the construction period, will be the responsibility of MCTPC. This would include all aspects of resettlement (we have identified the scale and who is to be resettled) including compensation costs, as well as operational period environmental maintenance. The government of Japan will be responsible for implementing and covering costs of all mitigation of impacts associated with construction, including noise abatement measures and borrow area rehabilitation.

This division of responsibility is based on a bilateral agreement between the Government of Japan and the Government of the Lao PDR, signed before the start of this project.

16.2 Detailed Assessment of Impact of the Proposed Bridge Alignment and Proposed Mitigation Measures

16.2.1 Detailed Description

The proposed route (Route B) crosses the Mekong approximatly 2 km south of the existing car ferry crossing. From West to East it rises from an approach elevation of 107.8 m to 116 m as it meets the East bank of the river. As a result, this elevated vertical profile is carried forward along the East approach road requiring an elevated approach road some 3 - 4 m above grade until it meets NR-13.

The proposed East-side approach road would run for about 780 m from the intersection with National Highway 13, approximately 1.8 km south of the old Xe Don River bridge in Pakse to the Mekong River bank approximately 200 meters upstream of the existing Pakse water supply pumping station. Starting at the Hwy. 13 intersection, the road will pass through a densely populated residential area sloping toward a low lying (as much as 10 - 15 m below the level of Hwy. 13) wet depression, possibly a former wetland, then pass up towards the West past small wooden houses and disturbed areas, some with serious erosion problems. Drainage in this area is generally from the SE to the NW, nearly perpendicular to the approach road. Small gardens for growing vegetables for personal consumption as well as small dry goods and food stalls are found within the zone of influence within 100 m to the river bank. This alignment would also pass within 200 m of Wat Pan Sawan, located on a hill which is at about the same elevation as the future approach road (See Figure 4.3-3).

The West approach road, from its origin at the bridge, makes a 90° turn to the north then parallels the Mekong until it intersects NH-10 at the present ferry landing site for a total lenght of about 2.1 km. The road, elevated for most of the way, separates the communities located along the river and their agricultural lands,

several hundred meters inland. Two streams are also crossed by this alignment (See 16.2.2).

16.2.2 Impacts on the Biophysical Environment

Long term effects on the aquatic, fisheries and terrestrial environment will be minimal. Since the overall road-bridge lengths will be the shortest of the three, air emissions will also be the lowest of the three alternatives. However, given the significant vertical elevation, the noise and visual environment, within the 200 m impact zone, will be significantly degraded.

Natural vegetation is limited to a few mature teak trees, some bamboo stands and other grasses. Near the Mekong, on the East side, a few mature trees will need to be removed (see Table 6.7 for details).

The low lying area within 150 m of NR-1within 150 m of NR-13 is polluted with sewage and other wastes.

The river bank on both sides of the Mekong are highly erodible and on the West side are quite bare and actively eroding. The East bank is also erosion prone but now has considerable vegetation covering stabilizing the lateritic/clay silt shoreline deposits.

The West approach road would first traverse the base of Mount Salao (exposed bed-rock formation) and then turns toward the West and North passing through agricultural lands. The approach road must pass over two streams near the towns of Houayphek and Khan-Gneng. Both these streams are considered to be spawning streams for several locally important fish species (See Table 6.2) and therefore bridge or culvert design and construction will have to consider this important function. These streams, which, during the dry season, are nearly dry and have major flows of 300 - 400 m^3/sec during the monsoon period.

As well, several important fish migrations are said to take place along the western shore of the river at various times of the year (both up and downstream). It is not likely that they would be seriously affected by the project.

Approximately 200 m downstream of the East end of the bridge section is the Pakse water supply pumping station. Although probably small, the risk of an accidental spill of hazardous materials on the bridge, contaminating the water supply could lead to very serious health-related consequences for a large number of people. Secondly, chronic stormwater runoff contamination from the road and bridge, located so close to the water intake could also contribute to increased contaminant levels in the water supply (particularly since the water treatment is only for suspended materials and pathogens).

i) Air

Based on the purely numerical comparison of the 1995 values, estimated for the NR-13 section, and the 2020 values (Figure A6.1, Interim Report Vol II), air

contamination within the 200 m impact zone will more than double for all five parameters examined. Given the general pristine nature of the air mass in the area, and the relatively low levels of emissions, this amount of pollution will be at acceptable international standards. As fuel quality improves (this is likely since Lao PDR obtains all its fuel from Thailand) and engine efficiency grows, the pollution levels may even drop from the estimated values presented in this report.

There will however be more periods of noticable air pollution over Pakse during those seasonal periods when there is little wind and air mass movement is along the long axis of the town, i.e., from the SE to the WNW. These episodes exist now but are confined to only a few days at a time and generated primarily by refuse and dry vegetation burning.

Within the 40m wide ROW along the road, air pollution levels will be permanently elevated and the location of permanent residential dwellings should be restriced/limited in this area.

a) Mitigation Measures - The only feasible mitigation measures being proposed to deal with elevated air pollution levels within the 200 m wide impact zone, are, the application of strict landuse zoning regulations which restrict the construction of residential dwelling, schools, hospitals and any other highly sensitive facilities within at least 100 m of the roadway centerline and the management of traffic flows. Prevention of traffic congestion by proper traffic management at intersections (traffic light) will prevent unnecessary generation of air emissions from slow moving or idling vehicles.

b) Timing and Responsibility - During year one of the construction period the consultant, in close consultation with the Pakse MCTPC as well as the Governor's office, should prepare a zoning plan for the area along both sides ot the approach roads. This plan would apply to all new construction and would discourage reconstruction within the impact zone other then for compatible land uses.

ii) Noise

Discussion of noise in this section will be restricted to that which is generated on the approach roads during the operational period of the facility. Construction period noise is discussed in Section 16.4.4.

On the Paske side, which is predominantly urban residential, 550 m of the 780 m long approach road will be elevated to >4 meters above grade. The remaining 130 m will be in "cut". Noise levels within the 200 m wide impact zone will increase significantly, particularly during the morning and afternoon local traffic "rush hour" period. Since by 2020 the total projected traffic volume increase is expected to grow by about 65%, the increased general noise levels will be on the order of 4 - 6 dBA and will be, in large measure, a function the increased truck traffic in relation to the other 3 modes examined. This estimated increase is

expected to be 33% over 1995 levels. This means that there will be a distinctly audible change within that impact zone, with levels sometimes climbing to above the 65 dBA level.

Since the roadway is elevated the noise will not be readily attenuated and given that Lao houses in the area are virtually open to the elements, these noise conditions will create some discomfort until the residents become accsutomed to the increased ambient noise levels. Control of landuse types in the impact zone will help in reducing the exposure of people to uncomfortable and irritating noise levels.

On the Muang Kao side, noise will be a much more pronounced problem for the local residents, since the approach road will traverse rural, and barely mechanized, agricultural lands, with ambient noise levels in the 30-35dBA range. Much of this approach road will also be elevated, increasing the noise-broadcasting effect described above. Noise levels in the 55dBA range will be common near the alignment and within the 200m wide impact zone. The tranquil quiet of the small communities like Ban Houayphek and Ban Khan Gneng will be changed for every. Planting of a vegatation barrier, discussed in the next section, may help to significantly reduce this impact. For additional discussion of noise please see Section 16.4.6.

a) Mitigation Measures - On the Pakse approach road, noise abatement will be difficult since embankments are high and residences occur almost immediatly at the edge of the ROW and typical Lao houses are open to the elements. The only feasible approach to noise reduction, given that the pavement will be "Double Bitumin Layer Treatment (DMLT)" resulting in a very rough high noise generation surface, is to control traffic speed below 40kph and to plant as many trees and shrubs along the ROW as possible so as to create a natural vegetation buffer zone which is effective in reducing the noise levels (as well as the localized air pollution) by a few dBs.

On the Muang Kao side, speed controls will be more difficult since the roadway passes through a more rural setting. The planting of a vegetation buffer zone will be the key mitigation measure to be implemented. If possible, the construction of burms, composed of landscaped waste materials, along the roadways, particularly at sensitive areas such as Wat Kang Yang and the Kang Yang School, could also be effective noise barriers at these locations.

These plantings should be completed in the following four steps:

1. identify the most sensitive noise receptors along the ROW;

2. agree with, MOAF and local authorities on the tree, shrub and grass species to be planted, having consideration for noise attenuation quality and life history of the mature plant;

3. prepare a planting design and planting schedule; and,

4. undertake the planting and maintenance (watering and protection from grazing domestic animals).

b) Timing and Responsibility - Planning for noise reduction measures should be part of the engineering design exercise. For example, the planning of the use of waste material to create berm areas in sensitive locations would begin during the detailed design stage. The planning and design of the planting program should be undertaken during the construction period, so that as soon as the planting sites area free of construction activity, the plantings could begin. We assume that the start date could be during final year of the construction period. As well, the speed control plan should be part of the design element of the approach roads.

Responsibility for the traffic noise abatement during the operational period of the facility will initially be with the consultant with close collaboration of the Pakse MCTPC office. The feasibility and logistics of constructing berms, will be determined during the detailed design stage and if space and time permit will be constructed as the approach road is constructed.

Working closely with an environmental planner on the consultant team, MCTPC and MOAF technical staff will prepare a planting plan and schedule. The plan should be implemented by the contractor, who may retain a local subcontractor to do the work and to maintain (watering and protection) the new plantings.

Therefore,the overall responsibility for administering and planning this mitigation measure will be with the consultant, the work will be executed, as part of contractual requirements by the contractor(s) retained to undertake the road construction work.

iii) Water Resources

Generally, ground and surface water resources in the study area are minimally polluted, and are important sources of potable water for area residents and provide habitat for the rich fish resources in this water basin. Project impacts will occur primarily during construction and possibly from the bridge runoff, which, if uncontrolled, will flow directly into the river during each storm event. It is estimated that such storms could amount to an average of 1540 m^3 of runoff per event, of which only the first few minutes of flow will be contaminated Once operational, the risk, although small, will be from accidental spills of toxic or hazardous materials such as fuels or pesticides running directly into the river. On the Pakse side this could mean a contamination of the city's water supply, while on the Muang Kau side it could have a serious effect on the active fishery that takes

place in the nearshsore waters north from Ban Salao (See Figure 5.1-3 for detailed map of area).

On the Pakse side the approach road will necessitate the capping of one deep well and will eliminate the shallow wells belonging to the private dwellings removed for the road ROW. It is estimated that at least 50% of the houses (20) to be removed have shallow-well water supplies.

Petroleum based materials such as oils and fuels may be discharged from the bridge deck directly into the river during first flushes at the start of storm events. This discharge, will be a problem for the sensitive nearshore waters on both sides of the river as the Pakse water intake is located on the East side and the small commercial fishery uses the West side nearshore waters. Pollution of this area with even small amounts of petroleum products of a longer period, could contaminate the water supply as well as taint the fish.

a) ***Mitigation Measures*** - Since the bridge, is located within 200 m of the Pakse water intake, measures, or rather procedures, will need to be in place both during construction (discussed below) and for the life of the bridge to pervent the contamination and/or tainting of the intake water. During the opeartion period oil containment and skimming equipment, plus training or staff in its deployment and use will be supplied as part of the bilateral assistance to the Pakse Water Authority for use as required. This equipment will include the skimming and oil containment bouy system plus a 4 m long by 1.2 m wide work boat fully equipped to undertake such work. Finally an action sequence for whom to contact and what to do first, second, etc. in the event of a spill, will be prepared by the contractor and supplied to all work supervisors and trainess.

   Secondly new local water supplies, for those whose shallow wells had to be capped and closed, should be provided by the government of the Lao PDR. The compensation may be either well water or piped water from the city's water supply.

   Unless a stormwater drainage system, capable of rerouting runoff to catch basins is installed (which is not being planned), the stormwater will drain directly into the river. Drainage will be conveyed by vertical drainage pipes located at least every 60 meter on both sides of the bridge deck, permitting a rapid runoff during storm events. This would mean that the actual stormwater discharge near shore, where the water intakes could be fouled, is sigificantly reduced due to very small quantities of discharge at any one time. Thus the key mitigation measure to control stormwater contamination of the water supply will be the provision of frequent drainage pipes before water has a chance to run off into the near shore (within 20 - 30 m) waters.

b) ***Timetable and Schedule*** - the oils spill and tainting protection equipment will be in place when work begins and will be used during the

construction period then handed over to the Pakse officials when the Operational period begins. Training of operators will be done during the constuction period for a minimum of 4 individuals designated by local authorities. The consultant will be responsible for preparing the specification for the equipment and including them in the contract documentation for the contractor to purchase and execute the training as necessary (this may also be completed as a special assignmenet by the consultant).

Secondly,the stormwater drainage system, consisting of runoff pipes placed at a maximum distance 60m from each other on both sides of the bridge deck, will be an integral design element of the bridge.

iv) Fisheries Resources

The Mekong River in the general area of the bridge project has important (See Table 6.3-1) fisheries resources, including both an active artisanal fishery headquartered in Ban Salao, as well as a four to five migrating commercially fished species and spawning areas in riffles some 5 - 10 km upstream of the bridge alignment, near the Don Kho Islands.

The two tributary streams crossed by the Western approach road appear to host spawning "runs" of at least the Pa kot (Mystus nemurus), an important local food fish.

a) Mitigation Measures - To protect the fisheries resource number of measures are proposed. First, since the major fish migration and spawning period is from approximatly mid May through early November (the rainy season) aggregate collection for this project should be restricted to the period from early November through Mid May. Secondly, since the riffles just downstream of Don Koa islands are an important fish spawning area, they should remain off limits to aggregate and sand dredging operations. This could be achieved by the placement of permanent marker bouys in a semi-circle around the spawning zone. Final locations should be determined after the completion of the Mekong Committee fisheries study in the area,scheduled to end in June 1996. Thirdly, protect the downstream fishery from chronic oil films in the water (through which fish caught and eaten are pulled and thus tainted), by installing drip proof filling nozzels for on-the-water refueling of any equipment ,and provide drip pans for engine petroleum drips on the barge (see section 16.4.2. iii) for more on water resources protection).

b) Timing and Responsibility - Specifications, designs and isntructions for this type of fueling protocol should be included in the contract documents and should be a basic requirement for all operations on the water. Thus the timing would be to write the specifications during the contract preparations and have them implemented by the contractor on the day work starts. Responsibility would initially be with the consultant

(donor) to prepare the specifications in consultation with the MCTPC, then undertake regular compliance monitoring of the contractor(s) for as long as equipment is used on the water.

The planning of the fish protection measure will be completed prior to the tendering process, and all fueling protocal will be in place by the time construction begins. Specifications will be listed in the contract documents.

v) Terrestrial Resources

Aside from the removal of trees and vegetation (see Table A6-7) within the ROW, few terrestrial resources will be lost. These resources have already been extensively disturbed and no known rare endangered, unique or sensitive systems now exist in the study area. They were eliminated long ago and replaced with deforested and/or cultivated lands.

a) Mitigation measures - The only mitigation measure proposed is the replacement of the trees removed by new plantings of the same or some other useful species. Im fact it is recommended that whereever possible trees be planted along the ROW so as to create, with time a natural buffer zone between the roadway and the agricultural and residential areas on either side of the road.

b) Timing and Responsibility - the replanting should begin during the final year of construction and continue until the Western approach road ROW and selected sites on the Pakse side have also been replanted. Exact location and type of replantings will be decided between the consultant and the Pakse MCTPC office with input from the Min. of Forestry. Prior to commencing any planting, a rough planting plan, consisting of description of the location, species and number of plants to be placed, will be prepared by the three parties listed above.

16.2.3 Impacts on Human and Built Environment

i) Resettlement

On the Pakse side Proposed route will require the removal of 24 buildings (Table

A6-6 and Table A6-7, in Volume II). On the Muang Kao side 24 buildings are planned to be taken. The costs for compensation of the buildings only is estimated to be approximately $US372,000* and does not include any additional land aside from the 8 x 12 m lot in which the dwelling stands, nor the cost of relocating nor the cost of the lost crops or productive garden areas. Thus the LPDR government

* This total does not include the 4 building in the 'other' category, since their 'type' was not identified.

needs to provide addtional compensation (over and above the cost of the buildings) for the following items:

- any additional lands lost with the dwellings - at market values
- lost crop values--for next three growing seasons as prices assocatied with wholesale returns on products
- cost of new well-water supply
- cost of relocation of belongings and animals
- any costs of reconnection to power and water supply (where applicable)
- cost of provision of access road to Pakse at same level of service as original location

We estimate that, when factored in, these necessary and additional costs will increase the compensation for the "Building" category in Table A 10-1 by 30%; but must be based on a door- to-door inventory of the building and lands to be taken.

Within the 200 m wide impact zone, 191 buildings, two Wats and a School, will be affected by the East and West side approach roads. These effects will be from four main sources: heightened noise levels, local air pollution, visual intrusion and restricted access.

a) ***Mitigation Measures*** - Resettlement is a delicate matter, very stressful for all involved, thus good advance planning, and continuous consultation and information exchange with those being moved needs to be an integral part of any resettlement operation. Resettlement involves the compensation for lost homes, land, agricultural crops, special structures such as wells, and sheds as well as relocation costs, through land exchanges and cash payments. Arriving at the compensation package for each of the 44+ families (See Table A.6-7) being displaced will involve a door-to-door inventory in order to obtain a complete tally of the property and goods lost as a result of the project. In Table 6.3-3 of this report some of the standard compensation prices per unit are listed. For crop losses, the compensation formula usually applied is an amount equal to the average revenue generated (or possibly generated if products were sold) on that cultivated plot over the previous 3 year period. T Thus the compensation would equal the income from three years of agricultural crop sales. For rice field losses the price has been established per m^2, by the LaoPDR.

b) ***Timetable and Responsibility*** - the resettlement activity needs to be initiated as soon as final approval for the project has been given (this has already taken place with the GOJ). Immediate consultation with local MCTPC and the Governor's office needs to begin as soon as possible and a door-to-door inventory of the relocated dwellings and buindings completed. Secondly compensation packages need to be prepared for all people to be displaced and a deadline for vacatingthe dwelling set. Such deadline must be reasonable and giving the owner maximum time

(minimum 8 months) to prepare for and undertake the move. Compensation payments must be made in advance of the move so that the owner can pay for relocation costs without incurring (in some cases extreme hardships) added losses. Therefore, payment at the start of the project or within the first six months of the start of the construction phase of the project would seem appropriate.

Responsibility for the initial survey and count of the number of dwellings to be removed was completed by the donor. The implementation and monitoring of the resettlement and compensation is the responsibility of the government of the Lao PDR, but will be monitored from time to time by the consultant, as specified under JICA regulations.

ii) Loss of Agricultural Lands

An estimated total of 70,000 m^2 of productive rice field will be eliminated by the approach roads. Most of this land is on the Muang Kao side of the Mekong.

a) Mitigation - The loss of agricultural lands will be compensated by replacement with land of equivalent value and production capability, plus cash payment of an amount equal to the value of the crop lost at the time of relocation -- assuming that the crop is an annually planted crop and not something like fruit or nut trees, which would take several years to come to maturity. During the detailed resettlement inventory the crop -trees to be taken on each property will be inventoried and their appropriate compensation value established. The value of several tree species has already been established by the LPDR (See Table 6.3-3). Provision of a horticultural advisory service by the MOAF, to the displaced people, would help to assure the success of any replanting effort on the part of the resettled families.

b) Timetable and Responsibility - see above for timetable and responsibility

iii) Access Restrictions

A number of local travel routes (at least 6) on both sides of the river, as well as much of the farmers' direct access to their fields, and buffalo grazing areas, on the Muang Kao side, will be blocked by the West approach road. A similar but shorter blockage will exist on the Pakse side.

a) Mitigation Measure - Given the rather serious acess restriction created by the approach roads, 9 underpasses are planned to be installed along the approach roads, consisting of concrete box culverts 2.5 m high and 3 m wide and usually about 20 m long, they will permit the movement of people, livestock, small farm vehicles and trucks from one side of the road to the other without danger or undue delays. These underpasses will be placed at about every 250 m, with the exact location decided on

through local consultations to assure the best possible placement. The present plan calls for seven such underpasses on the Muang Kao approach road and two underpasses on the Pakse side.

b) Timetable and Responsibility - The underpasses will be designed by the consultant prior to the initiation of construction, constructed by the contractor as the approach road is built, and maintained by the MCTPC once the facility begins operating. The exact location will be determined in consultation with local residents in order to optimize the use of each underpass. Responsibility for the design sna construction of the facility will be with the donor as represented by the consultant.

iv) Visual Intrusion

In terms of visual intrusion, the impact of this alternative will be significant since residents on both sides of the approach road, particularly on the Pakse side, will no longer have an unobstructed view but have to look at a 3 - 4.5 m high embankment. A good example of just how obtrusive the approach roads will be is the Pakse bypass road, which is also elevated some 4 - 6 m above grade. For that road no mitigation measures of any kind were undertaken. The bridge will not intrude on the visual field of the local people since it wiill be 100s of meters from the nearest dwelling.

a) Mitigation Measures - two important measures for reducing the visual intrusion are reducing the vertical alignment by as much as possible and making certain that the approach roads receive early and proper landscaping and revegetation, to reduce the erosion and the visual scars on the land. By creating a vegetation buffer area, the proximity and intrusive nature of the road embankment will be reduced. Vertical alignments have already been reduced to the minimum level through careful roadway design.

b) Timetable and Responsibility - As soon as construction of a road section is complete, revegetation actions should be initiated. By the end of the construction period a significant portion of th revegation work should be completed.

16.3 Construction Period Activities and their Impacts on the Environment

There will be at least eight construction period activities which will result in environmental degradation of some sort. The extent of the degradation will depend largely on how well the impacts are anticipated and mitigated against.

i) Construction Materials Storage Workshops, and Concrete Batch Plant

Various construction materials, including caustic liquids, cement, oils, lubricants and paints will be stored at a construction materials yard to be located on the West (Muang Kao) side of the Mekong just North of the bridge's landfall. The site will

be L-shaped, requiring about 50,000 m^2 of land. All construction materials, construction equipment and vehicle servicing, repair and parking facilities, and fuels will be stored/located at this site. Without control in their handling and use, particularly near the Mekong River, accidental spills could occur, or worse, chronic toxic materials leachate, from surface drainage of the storage site, could be entering the river for the 3+ years of the project's life (for mitigation measures regarding fuels handing and use see item vii). These measures will be very important since the site slopes quite steeply toward the Mekong River.

The batch plant providing concrete for the entire operation and for all components of the bridge, will be located on the site and will produce air and noise pollution plus quantities of polluted water. Since the plant is in a remote location quit far from the nearest dwelling, noise pollution will not be a problem. As well, batch plant operation will be from 0700 - 1500, thus reducing even further the noise issue vis-a-vis this activity. the placement of the aggragate stockpile between the batch plant and the nearest settlement would also attenuate additional noise. Dust from the plant's operation will however need to to be controlled through the use of a dust supression system (generally consisting of water sprinklers) installed as a part of the standard batch plant design.

a) Mitigation Measures - All toxic and hazardous materials will be stored in a warehouse and/or a covered facility with a strictly controlled inventory system, such that the movement and use of these materials is traceable by anyone. All paints, caustic solids and lquids, paint thinners, cleaning fluids, hydraulic fluids, used engine parts such as filters and ignition systems and used petroleum products are within that category. Used petroleum products and paints, will be kept in an area which has spill protection measures such as a berm around the area or a small catch basin to contain materials tht have been accidentally spilled.

Vehicle will be serviced in one designated area only and the repair area's runoff will be collected in a storage tank, and all waste oils skimmed off. The remaining oily water will be pumped to the treatment facility on site or will be trucked to the Pakse Sewage Treatment Plant for treatment. Waste oils will be recycled and sent back to a reprocessing plant in Thailand on a regular basis.

Installation of dust supression equipment for the batch plant, plus the placement of the plant in a location on the site that takes advantage of any natural or engineered (aggragate stockpiles) noise attenuation potential.

b) Timing and Responsibility - As part of the projct design work the materials storage facility will be planned as an integral part of the workshop and storage area. As well, the runoff holding tanks will be installed prior to the commencement of any on-site vehicle servicing. The management of waste petroleum products, including making the

contractor responsible for implementaing these measures, will be organized prior to the commencemment of any field work.

The consultant will be responsible for preparing the contract clauses covering these items prior to the selection of a contractor and for undertaking periodic compliance monitoring to confirm that the procedures defined in the contract are being carried out. The contractor will be required to carry out the measures specified in the relevant contract clauses.

ii) Construction Traffic, Equipment Operations and Work Schedule

Construction traffic for this project consists of the daily movement of construction workers as well as the movement of supply vehicles to and from the work site as well as the movement of the construction vehicles and equipment (e.g, cranes and bulldozers) at the work site. In addition to the intermittent air pollution created by diesel equipement on site, construction traffic will create excessive noise levels, significantly above exisiting conditions and most probabaly, above the 55dBA threshold considered acceptable for outdoor values in residential areas. Therefore during any work schedule, there will be heightened construction noise.

The most visible and irritating traffic will be the heavy truck movements necessary to bring the more than 400,000 m^3 of fill material from a minimum distance of 2 km to the construction area. In terms of average truck loads this would mean more than 50,000 truck loads of material.. This number when translated into a hauling schedule could mean at least one load every 5 minutes for 9 hours a day 320 days per year for 1.5 years with the total still not exceed the 50,000 load mark (see details in item iv).

The present construction schedule calls for all work except the piling and drilling, to take place only during the first "dry-season", to be carried out from 0700 - 1500. The drilling and piling will be in two shifts; 0700 - 1500 and 1600 - 2400. Thus, in construction year one, during the dry season only, there will be noise and visual intrusion, six days a week, until midnight.

a) Mitigation Measures - no mitigation measures are proposed.

iii) Work Camp Operation

At the peak of the construction period, the workforce will be at 400 people. Of these about 1/3 or 135 people will live in a work camp, located in the vicinity of the workshop and storage area. These people plus the consultant staff, will generate approximately 10,000L of liquid waste (including gray water and sewage) per day, which will need to be treated using a primary treatment method via oxidation ponds and sludge management or a system of storage tanks which would be pumped and the sewage taken to the Pakse STP for treatment. In addition about 1.5t of solid waste will be generated by the resident workforce each day. Proper disposal through practice of recycling and reduction would include composting of organic

materials and the recycling of glass. plastics and metal and the burning of waste paper. The remaining waste could be buried in a small landfill site located in an area protected from flooding.

a) Mitigation Measures - the consultant will prepare clauses in the contract requiring the contractor to treat and dispose of the sewage by primary treatment, either via an STP or an engineered oxydation pond system, or some other means (chemical toilets and septic tanks) and that a qualified civil engineer be retained to properly design such a treatment system, with a capacity to treat at least 15,000L of waste water per day. With respect to effluent quality, it will have no fecal coliform bacteria and will have phosphorus concentrations less than 0.06 mg/L when discharged into the Mekong River. The consultant will undertake to monitor the operation of such a facility as part of the reagular inspection operations of the work site.

The consultant will also prepare clauses in the contract document, specifying that the contractor must provide for garbage collection, managementand disposal in a manner which emphasises recycling and reuse and would include, composting of organic wastes and recycling as indicated above.

b) Timing and Responsibility - The consultant will be responsible for writing the specific contract clauses which address these two requirements in sufficient detail to permit the contractor to design and operate the appropriate system. The successful contractor will be responsible for providing an effective design for both the sewage and solid waste management and to supply qualified operators who wiill train local conterparts in their operation and maintenance.

The preparation of the contract clauses will take place during the contract preparation stage of the project and the construction of the facilities (or the arrangement for treatment at an STP) will take place as soon as the contractor is selected.

iv) Quarry and Borrow Area Operation

Quarry and borrow pit areas are often sources of chronic erosion and sedimentation, if exposed surfaces are left unprotected and continue to wash away. In the Lao PDR, this is particulary important since the six month - long rainy season, acting on unstable sites, can lead to serious losses and related repair costs. The primary source of fill materials for the project approach road will be the existing laterite quarry located SE of the present power transfer station in Pakse (See Figure A 7-6 in Volume 2: Annexes) for the Pakse side approach road and from a new site located to near the foot of Mt. Salao within the 40m ROW near Houayphek for the Western approach road. About 220,000 m^3 of laterite fill will be used from these sites.

More than 200,000 m^3 of sand and gravel, used in concrete production, will be taken from the Mekong River in an area from Ban Houaylao upstream to Kho Island located some 6km from the project site. The Kho Island area and the riffle zone (shallow fast flowing waters) immediately downstream from there are important spawning grounds for a number of Mekong River fish species (See Sect. 4.0) and should not be disturbed. Their exact location will be determined by the Mekong Comission Study scheduled to be complete by mid 1996, but generally the portection zone would extend throughout the riffle area downstream of the island. Gravel and sand extraction will generate a large and continuous amount of suspended sediment and if undertaken during the main spawning migrations, from May through September, may have longer term consequences for local fish stocks, such as reduced populations numbers.

The Paske quarry has an exisiting access road which will have to be improved somewhat to accomodate the trucks and heavy equipment and a new short road will be constructed to the West side borrow pit, located close to the alignment.

a) Mitigation Measures - During the operation of the borrow sites a complete schedule of dust supression needs to be prepared and implemented by the contractor. Secondly measures to protect the quarries during the rainy seasons needs to be implemented such that runnoff from these sites does not run directly into the Mekong River or its tributaries. Standard erosion protection mefasures need to be designed into the operation of the borrow areas. Thirdly, a program of rehabilitation/reuse of the new borrow area needs to be prepared and implemented. Finally, to protect the fish spawning habitat around the Kho Islands an exclusion zone will be marked off using bouys and a dredging operating period established (May - November).

b) Timetable and Responsibility- Preparation of the specifictions will be completed in time for the clauses to be put into sample contracts being distributed to prospective contractors. The consultant will be responsible for preparing the contract clauses addressing this requirements and for compliance monitoring of the contractor.

v) Construction Site Excavation

Soils in the study area consist primarily of clays, silts and decomposed sandstone, all highly erodible materials. Once exposed, particulary during the monsoon period, rapid and highly degradative erosion and sedimentation into receiving waters will take place. This will be particulary sensitive at the two shoreline constuction sites where banks will need to be deeply excavated requiring the extensive movement of heavy equipment. The second sensitive erosion site will be at the two stream crossing along the West appraoch road. Without careful and accurate sizing and placement of crossing structures, the highly variable water flows could easily create major erosion areas either downstream of the crossing or upstream due to a "damming" effect of an undersized crossing structure (e.g.

culvert). The third potential and sensitive site will be at any area along the approach road alignment where "cuts" (430 m) into side slopes will need to made (primarily on the West or Muang Kau side of the project, around the foot of Mt. Salao). The fourth sensitive area will be all the "fill" slopes of the approach roads, which in some locations will be 3 - 4 m high. Wiithout the implementation of adequate stabilization measures while the road is being built, these embankments will rapidly exhibit "rill" erosion and eventually the new road bed will be lost.

a) Mitigation Measures - No special mitigation measures are planned since the standard clean up and slope stablization techniques to be used during this project, should prevent the erosion from taking place. Secondly the proposed revegetation program proposed for the noise and visual intrusion reduction, will also help to further control erosion.

vi) In-River Construction Activity

Since this project will require the placement of >120 1.5 m diameter pilings into ther river bottom, using the "cast in situ" protrusion method), activity on the water will be intensive. Given a 10-month-per-year work schedule, all pile drilling and placement will be completed within a first 6-7 month dry season.

Each piling (1.5 m in diameter) will be socketed into the river bottom to an average depth of 1.5 meters, requiring the drilling, excavation and disposal of >2800 m^3 of waste plus thousands of litres of drilling water. Based on preliminary borehole results, these materials appear to be a gradation of sands and gravel, hard clay, and basalt, relatively harmless in the context of the volumes being generated and the existing level of turbidity of the Mekong. It is unlikely that any of the overburden waste materials are toxic or hazardous as there is no history of toxic waste generation in the area or within 50 km upstream of the crossing site. Therefore, the impact from the pile placement activity will be temporary and will be the result of physical activity on the water and underwater noise created by the piling activity and vessel movement. Nevertheless the specifications for sedimentation tanks on the barges will be prepared such that all drilling waste will be pumped into a settling tank and then allowed to drain off into the Mekong once most of the silt and clay materials have settled out.

Although the drilling, placement of the steel casings and the pouring of the reinforced concrete piles themselves is expected to be completed in one construction season, the work on the pile caps, the superstructure foundations and the precasting of the bridge deck elements is expected to continue for about two years. Nearly all of the foundation work will be cast in situ, thus requiring continuous handling of concrete over the river. Proper handling and management of waste water from these operations will be an essential part of the construction management process to be implemented by the selected contractor.

a) Mitigation Measures - the key mitigation measure will be the installation of sedimentation tanks on the barges ,capable of holding drilling waste water for at least several hours, permitting fine materials to

settle out prior to discharge to the Mekong. The exact size of the tanks will need to be determined, based on the rate at which waste water is produced.

b) Timetable and Responsibility - The requirement for drilling water sedimentation tanks on the barges and their proper sizing will be specified in the contract documentation, prepared prior to tendering. The specifications will be the responsibility of the consultant while the constuction, operation and maintenance of the tanks will be with the contractor.

vii) Fuel and Lubricant Use

Projects in relatively remote areas such as Pakse, require a fuel storage area so that fuel is available on demand and minimaly dependent on trucking schedules. Storage tanks will need to hold at least 20,000 L of diesel fuel and as such will require a location and handling protocal both on the land and on the water. Fueling of barges, and on board equipment such as cranes and batch plants, will be done by small service vessles which will move from barge to barge refueling the equipment several time per day (See Section 16.4.2 - iii on Water Resources for further details). Refueling will also be completed over the water with increased risk of small spills.

a) Mitigation Measures - To protect the area against possible accidental leaks or rupture of the tank an impervious berm will need to be built around the tank such that, if the entire 20,000 L of fuel leak out, the fuel will be contained inside the berm. A procedure for pumping the spilled fuel into another holding tank needs also be assembled such that it can be easily deployed should an emergency develop. Secondly, a drip proof fuel filling system will be used by the contractor and a general fuel handling protocol will be specified to the supplier.

b) Timetable and Responsibility - The berm and the spill pumping measure need to be in place prior to the tank being filled. As with the previous item, responsibility for designing this mitigation measure and defining it in the contract documents will rest with the consultant and the responsibility for the construction and maintance of the facility will be with the contractor.

viii) Operation of Heavy Equipment

DUST: Of concern during the construction period will be the dust on all construction roads, which, during the dry season, and given the lateriitic soils, produce particulary dense dust clouds as vehicles pass.

The second source will come from the concrete batch plant, which during the process of mixing the aggragate, sand and cement, produces large quantities dust, which, although generally settling to the ground within a few hunderd meters of the

plant, can cause significant damage to buildings, gardens or fields within the dust plume's range. The exact location of the plant is not known but it will be on the West side work area as far away from the nearest dwelling as possible, including the housing for the workers (see 16.4 -i for further details).

NOISE: Noise will be generated by the operation of heavy construction equipment, large trucks hauling fill materials, the opertion of the concrete batch plant, as well as from the pile driving operations (lasting one work season). During the operating hours, noise levels within 50m of the operations can be expected to reach >80 dBAs from time to time(See Section 16.4-iii for further details).

a) Mitigation Measures - Dust supression equipment for the concrete batch plant is discussed earlier in this section, as is the provision of two road sprinkling trucks. Noise mitigation will consist of limiting work periods from 0700 - 1500 for all but the pile drilling and placement which will need two work shifts, the second extending from 1600 - 2400 but for only the first dry season (for details see 16.4-ii).

16.4 Summary

Potentially serious impacts could occur during the construction period, if mitigation measures, defined in Section 16.3, are not followed and if proper prompt compensation of the resettled families is not provided by the government of the Lao PDR. The consultant will be responsible for monitoring all the construction work as well as monitoring how well the mitigation measures are implemented by the contractor and reporting findings to the Government of the Lao PDR.

Permanent impacts will include:

- elevated ambient noise levels by 4-8 dBA within the 200 m-wide impact zone
- increased levels of air pollutants over Pakse Town
- visual intrusion from the elevated approach roads for the local residents
- the loss of >70,000 m^2 of agricultural lands; and,
- the removal of >44 dwellings

The provision of underpassed every 250 meters along the approach roads will greatly improve the severe access restrictions that would have occured otherwise. Secondly, the planting of vegetation buffer strips along the roads and embankments will significantly reduce the noise and visual intrusion impacts.

Essential to the success of these mitigation measures is that they be written into the contract documents and the competing contractors, evaluated on how well they are able to respond to these requirements.

In Table 16.4-1, list all proposed mitigation measures.

Table 16. 4-1 Summary of Proposed Mitigation Measures

Activity	Environmental Component Affected	Predicted Impact	Rating[1] of Potential Impact and Severity	Proposed Mitigation Measure
PLANNING AND OPERATIONAL PERIOD				
Vehicle Traffic	Air	Periodic air pollution over Pakse Town	A	1. Good traffic management to prevent congestion at intersections 2. Establish landuse controls within ROW and within the 200m wide impact zone
	Noise	Increase in overall ambient noise level plus periodic annoying noise episodes	S	1. Provide vegetation buffers (plantings of trees, shrubs) 2. Create noise berms and use natural attenuation features
stormwater runoff from bridge deck	Aquatic	Chronic water pollution of Pakse water supply intake area	V	1. design drainage so that good amount drains into river before reaching shore area
Accidental Spill on bridge	Aquatic	Contamination of river and Pakse water supply	V	Provide spill clean up equipment, i.e. boat and containment curtain , plus training in use (installed during construction and left behind)
Capping of existing wells in ROW	Aquatic and Human	Loss of potable water supply	V	Reconnection of water supply
Aggregate Mining in Mekong	Aquatic Fisheries	silt and sediment resuspension fish habitat loss	D V	1. restricting dredging to non-migratory period for key fishes 2. marking dredging exclusion zone and establishing an aggregate dredging operating schedule.
In-river pile drilling and construction	Aquatic	introduction of fine sediment into river from pile drilling waste water	D	provide for drill waste water sedimentation tanks on drilling barges
		loss of tributary fish habitat through poor crossing structure design	V	Assure proper sizing of crossing structures/culverts to permit unobstructed flows without velocity increase
		Oil slicks from engine drips , tainting fish as pulled from water by Ban Salao fishery	V	provide barge equipment with drip pans which are regularly drained and waste stored and treated on shore
Resettlement	Human/Built	Community and family stress	V	Compensation and relocation assistance
		Financial losses and hardships	V	Same
		Relocation of 44+ families	V	Same
Clearing of ROW and approach road alignment	Human/Built and Agriculture	Removal of 70,000 m^2 of rice fields plus many market garden and grazing plots	V	Compensation and assistance Revegetation
Construction of a vertically elevated approach road	Human/Built	access restrictions to fields and property	V	Placement of nine 2.5m x 3m box culverts along approach road, with location based on engineering limits and consultation with residents. Specification of operational period maintenance needs
	Visual	Obstruction of views with embankment walls	S	Vegetation screens and buffer zones planted and maintenance of these once operational period begins

Table 16.4-1 continued

Activity	Environmental Component Affected	Predicted Potential Impact	Rating[1] of Potential Impact and Severity	Proposed Mitigation Measure
CONSTRUCTION PERIOD				
Materials storage, workshop and concrete batch plant operation	Air	Dust from concrete batch plant	D	Dust suppression equipment installed on batch plant
	Aquatic	Discharge of sediment leaden water into Mekong, runoff from improperly stored toxic and haz. materials	D S	1. runoff water control from service areas, workshops and batch plant 2. Toxic and haz. materials storage and handling specs prepared
	Noise	Excessive noise levels at night during pile drilling operation	A	Limit night construction activity to first season (pile drilling and pouring)
Work Camp Operation	Aquatic	Sewage and waste water discharge into water courses	S	Sewage treatment/management through one of a number of options listed in text
	Terrestrial	Garbage and litter in area	D	Provision for solid waste (garbage) recycling and reuse, including composting of organic food wastes
Quarry and laterite borrow area operation	Air	Dust from truck traffic to and from borrow areas	S	Provision of dust suppression through water sprinkling trucks
	Aquatic	Sediment runoff from borrow areas into watercourses	D	protection of borrow areas during wet season through ground and slope erosion protection/management
	Fisheries	Habitat loss from dredging operation	S	Establishment of a dredging exclusion zone around Kho Don and define a dredging schedule, restricting operations during the rainy season
Construction area excavation and removal of topsoil	Aquatic	Erosion and sedimentation	S	Application of good construction site management practices
Construction activities in the Mekong River	Aquatic	Sediment laiden discharge from drilling operation discharged to river	S	Provision of drill water sedimentation tanks on drilling barges; including proper servicing and on-shore deposition of sedimentation tank contents
Fuel and Lubricant Usage	Aquatic	Accidental spills and fouling of ecosystem including food fish	V	Provision of spill protection around diesel storage tank with a berm and pumping system to contain accidental spill
General operation of heavy equipment	Air/Human	Dust and noise added to basically rural subsistence farming area	A	Limit work hours to 0700 - 1500 (except for drilling of piles which will require 2 shifts for first dry season only)

CLASSIFICATIONS USED IN THE TABLE

1. M= minor impact; A= annoying but tolerable impact; D= damaging but not permanent impact; S= significant degradation; V= very severe impact needing immediate mitigation to prevent occurrence .
2. 1= prior to tendering stage and/or designed for inclusion in contracts; 2= sometime prior to start of construction; 3=during Yr.-1 of construction period and throughout the work time; 4= during last year of construction; 5= at start of and during operational period.
3. C= consultant ; CON = contractor; MC= MCTPC/ Govt. of LPDR.
4. NA means that this mitigation measure is already an integral part of the planned design of the bridge and does not need a specific mitigation budget allocation

CHAPTER 17

IMPLEMENTATION PLANS

17. IMPLEMENTATION PLANS

17.1 General

The implementation schedule was studied considering the optimal commencement time in a year for foundation construction in the river and using the condition that the construction project would be completed by Middle of 2000. Prior to the commencement of the construction it is necessary to carry out such pre-construction works as soils and geological investigation, detailed design, land acquisition, financial arrangement, etc.

17.2 Project Outline

The construction project of the Mekong bridge at Pakse is outlined as follows:

(1) Bridge

• Location	:	2 km downstream of existing ferry route	
• Bridge width	:	Total width	11.8 m
		Carriageway	3.5 m each in both direction
		Shoulder	0.5 m each on both sides
		Sidewalk	1.5 m each on both sides
• Bridge length	:	1,380 m	
• Span length	:	Main spans	102 m x 10, 150 m, 100m
		Side spans	70 m, 40 m
• Bridge type	:	Continuous rigid frame PC (extra-dosed) box girder	
• Foundation type	:	Extrusion type cast-in-situ RC pile	

(2) Approach roads

• Road width	:	11 m	
• Carriageway	:	3.5 m each in both direction	
• Shoulder	:	2 m each on both sides	
• Total length	:	3,030 m	
		Pakse side	680 m
		Phontong side	2,350 m
• Pavement	:	DBST for carriageway and SBST for shoulder	

17.3 Project Cost

Based on the studies of the preliminary engineering, construction cost, construction procedure, etc. the Implementation cost for the Project is summarized in Table 17.3-1.

TABLE 17.3-1 IMPLEMENTATION COST

(Unit: US$'000)

Classified Cost	Foreign Currency	Local Currency	Total
Construction Cost	42,884	9,884	52,768
Engineering Cost	3,324	369	3,693
Land Acquisition Cost	-	485	485
MCTPC' administration Cost	-	792	792
Contingency	8,622	2,036	10,658
Total	54,830	13,566	68,396

Source: The Study Team

17.4 Implementation Schedule

The overall project implementation schedule that was prepared based on the above-mentioned consideration is shown in Fig. 17.4-1. The economic and financial studies were carried out following this schedule. The requirement of each major activity is as described below:

(1) Detailed Engineering Design

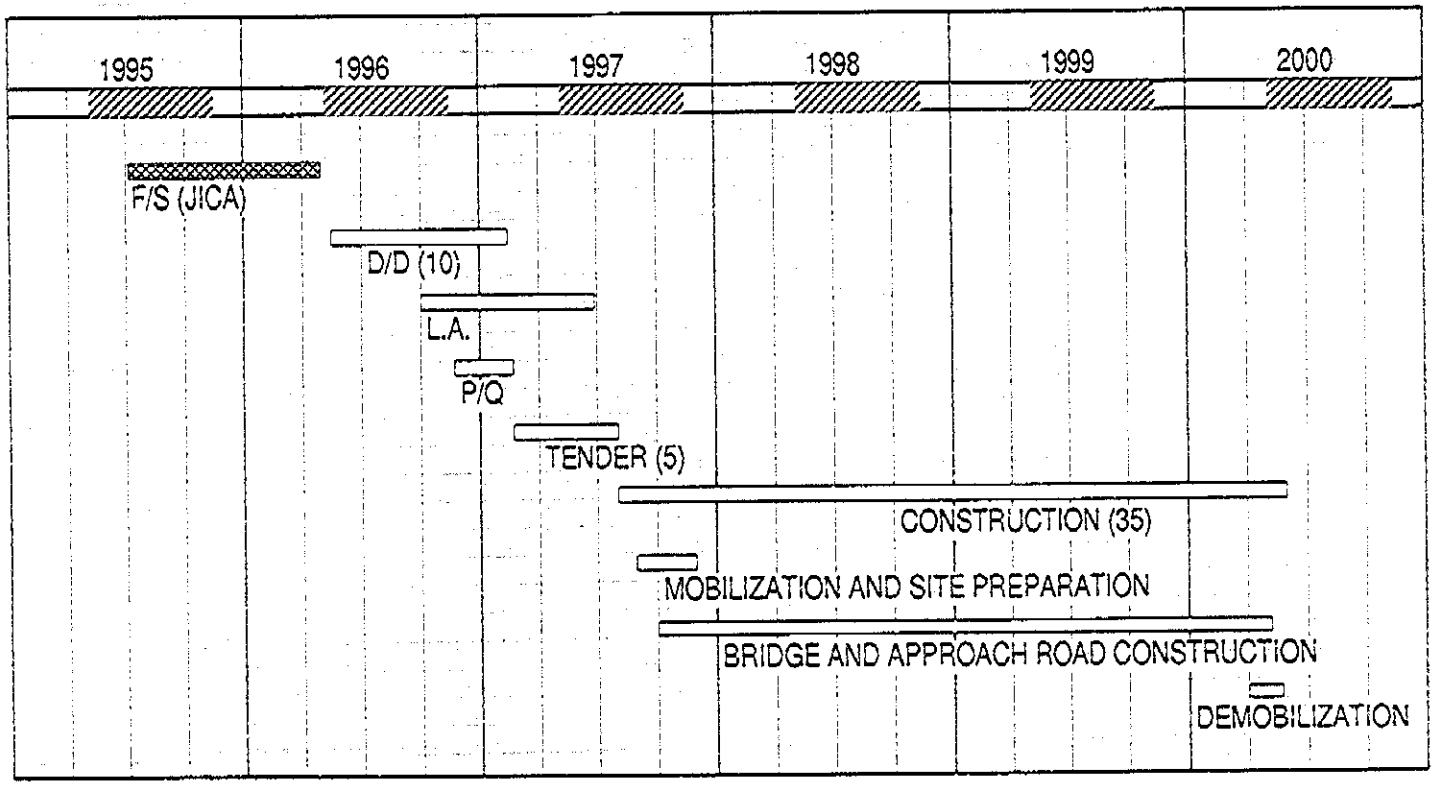
The detailed engineering design work comprises supplemental geographical survey, geological investigation, detailed design of bridge and approach roads and preparation of a complete set of tender documents. These works will require about 8 months for its completion. Due consideration should be given to the commencement of the works because some activities of the works will have a seasonal restriction, for example, geological investigation and the other site survey work the data of which are required at the initial stage of the design work can be conducted in the dry season or in the low water season.

(2) Tender Process

For the tender process after the detailed engineering design and financial arrangement at least 6 months will be required including tender period and evaluation period. The pre-qualification of contractors will also be required for 3 months at least before invitation of tenders.

(3) Land Acquisition and Compensation

The land acquisition will not cause many serious problems since the Project site locates in a rural area. The main compensation matter will be the resettlement of habitants living in the project site. It is expected that the land acquisition and compensation shall be done within some 10 months on the schedule as shown in Figure 17.4-1.



LEGEND :

F/S	:	FEASIBILITY STUDY
D/D	:	DETAILED ENGINEERING DESING
L.A.	:	LAND ACQUISITION AND COMPENSATION
P/Q	:	PREQUALIFICATION
////	:	REAINY SEASON

FIG. 17.4-1 OVERALL IMPLEMENTATION SCHEDULE OF MEKONG BRIDGE CONSTRUCTION AT PAKSE

(4) Construction

As described in Subsection 12.8 the preparatory work should start before dry season in order that the initial stage of actual construction should be in the dry season. For the foundation construction works 2 dry seasons should be required. Therefore the construction period was estimated at 35 month in the shortest case.

The disbursement schedule of the Project was prepared conforming to the above-mentioned requirements and is presented in Table 17.4-1.

TABLE 17.4-1 DISBURSEMENT SCHEDULE OF THE PROJECT COST

(US$ x 10^5, December 1995)

Cost Items	Amount	1996	1997	1998	1999	2000
Construction Cost	527	-	191	148	157	31
Engineering Services	37	14	5	8	8	2
Administration	8	1	2	2	2	1
Land Acquisition and Compensation	5	0	4	1		
Contingency	107	-	32	30	37	8
Total:	685	15	234	190	204	42

Source: The Study Team

CHAPTER 18

CONCLUSIONS AND RECOMMENDATIONS

18. CONCLUSIONS AND RECOMMENDATIONS

18.1 Conclusions

NR 10 is the most important and only trunk road connecting directly southern provinces of Lao PDR with Thailand bearing the heavy trade traffic. However the traffic running on the route will be compelled to continue to spend many hours waiting for ferry crossing at Pakse, unless the Bridge to replace the existing ferry is constructed. Without the construction of bridge the increase in traffic volume across the Mekong river will force to bring about demand for the increase in ferry facilities will result in higher investment of capital in the long run.

The future traffic volume on the existing ferry route is expected 5,700 vehicles, 2050 TRU equivalent according to the traffic demand forecast carried out in the course of the study, while the present traffic volume as of August 1995 was 600 vehicles, 230 TRU equivalent.

Based on the results of the study it is found that the Project of the construction of the Mekong bridge at Pakse is technically feasible. The construction of the Mekong bridge also is judged viable by the economic evaluation which shows an IRR of 8 % considering the present economic status in Lao PDR.

The Project will accompany various intangible benefits that will contribute to the development and well-being of the region in and around the project area.

The Project also will contribute to forming a prospective transportation network of the East West corridor formulation in Indochina.

The bridge route study has selected alternative Route-B, crossing over the Mekong river at 2 km downstream of the existing ferry route.

The proposed route, dual single lane, has the whole length of 4,410 m, composed of the bridge length of 1,380 m, the approach roads of 680 m on Pakse side and 2,350 m on Phonthong side.

The construction of bridge will not be anticipated to cause any serious technical, environmental and social issues in the course of bridge construction and after the completion.

It is found that the bridge should be designed and constructed with prestressed concrete structure supported with concrete shafts and cast-in-situ pile foundations of extrusion type to meet construction conditions in the Project site.

It is concluded that the Mekong Bridge construction at Pakse is an indispensable project and that it is a realistic solution for the development of economy as well as road transportation of the country.

18.2 Recommendations

The Project is expected to proceed to implementation stage as soon as possible and it is advisable for financing the Project to get a generous grant or a soft loan of favorable condition at the earliest stage.

It is preferable that the completion date of the Project will be set taking into consideration the time of the completion of the relevant Projects ADB 7th projects going on currently.

The detailed design stage for the execution of the Project, the works of which comprise site investigation, design of roads and structures and preparation of tender documents should be started before the beginning of rainy season.

It is most desirable to raise at one time the fund needed for the whole cost of the Project, US$68.4 million, at the outset of the Project.

VOLUME II : ANNEXES (Contents)

VOLUME III : DRAWINGS (Contents)

FINAL REPORT

VOLUME II : ANNEXES (Contents)

5. TRAFFIC STUDY

6. PRELIMINARY ENVIRONMENTAL OBSERVATIONS

7. ENGINEERING SITE SURVEYS

8. DESIGN STANDARDS AND CRITERIA

10. OPTIMAL BRIDGE ROUTE

11. ENGINEERING STUDY ON PROPOSED ROUTE

13 PROJECT COST ESTIMATE

14. ECONOMIC EVALUATION

15. FINANCIAL ANALYSIS

VOLUME III : DRAWINGS (Contents)