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1. Scope of Work (S/W)

SCOPE OF WORK

FOR

THE FEASIBILITY STUDY

ON

THE CAN THO BRIDGE CONSTRUCTION

IN

SOCIALIST REPUBLIC OF VIET NAM

AGREED UPON BETWEEN

MINISTRY OF TRANSPORT

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

Hanoi, Dated the 25 of March 1997

Mr. Tran Doan Tho
Deputy Director General
Planning and Investment Department
Ministry of Transport

岩屋勝司

Mr. Katsushi IWAYA
Leader
Preparatory Study Team
Japan International Cooperation Agency

Mr. Le Long Dinh
Director General
Project Management Unit-My Thuan
Ministry of Transport

In witness of : Mr. Nguyen Ngoc Nhat
Director General
Infrastructure Department
Ministry of Planning and Investment

A . INTRODUCTION

In response to the request of the Government of the Socialist Republic of Viet Nam (hereinafter referred to as "the Government of Viet Nam"), the Government of Japan decided to implement the Feasibility Study on the Can Tho Bridge Construction in Socialist Republic of Viet Nam (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study, in close cooperation with the authorities concerned of the Government of Viet Nam.

Project Management Unit-My Thuan belonged to Ministry of Transport (hereinafter referred to as "MOT") shall act as the counterpart agency to the Japanese Study Team (hereinafter referred as" the Team") and also act as the coordinating body with other relevant organizations for the smooth implementation of the Study on behalf of MOT.

This document sets forth the Scope of Work with regard to the Study.

B. OBJECTIVES OF THE STUDY

The objective of the Study is to conduct feasibility study for the construction project of Can Tho Bridge including its approaches for the period up to the year of 2010.

C. SCOPE OF THE STUDY

To achieve the objectives mentioned above, the Study shall cover the following items;

1.Data collection and analysis;
- (1)Socio-economic data
- (2)Traffic and transport data, including domestic and international waterway transport
- (3)Soil and geological data
- (4)Climatic and seismic data
- (5)Hydrological data
- (6)Topographic data
- (7)Development plans
- (8)Others

2.Site survey;
- (1)Road and waterway traffic survey

(2)Topographic survey
(3)Soil and geological survey
(4)Hydrological survey
(5)Land use survey
(6)Survey on material mines for construction of road and bridge
(7)Survey on preconceiving positions for resettlement area
(8)Other necessary survey

3.Traffic forecast;
(1)Forecast of future socio-economic framework
(2)Forecast of future traffic demand

4.Comparative study of alternatives;
(1)Study on the construction of the bridge and approaches (routes, location, bridge type, architecture, tourism, culture developments and others)

5.Evaluation of alternatives;

6.Preliminary design;
(1)Design criteria
(2)Bridge design
(3)Approach roads
(4)Secondary facilities including toll collecting station
(5)Construction method
(6)Quantity estimate

7. Planning and scheduling of construction works;

8. Maintenance program;

9. Cost estimate;

10. Environmental impact assessment (EIA);
(1)Social impact assessment
(2)Natural environment

11. Economic and financial analysis and evaluation;

12. Implementation program; and

13. Conclusions and recommendations.

D. STUDY SCHEDULE

The Study shall be conducted in accordance with the attached tentative schedule.

E. REPORTS

JICA shall prepare the following reports in English and submit them to the Government of Viet Nam;

1. Inception Report
   Thirty (30) copies
   At the commencement of the Study;

2. Progress Report
   Thirty (30) copies
   Within four (4) months after the commencement of the Study;

3. Interim Report
   Fifty (50) copies including Executive Summary
   Within six (6) months after the commencement of the Study;

4.Draft Final Report
   Fifty (50) copies including Executive Summary
   Within eleven (11) months after the commencement of the Study;

The written comments on the Draft Final Report from the Vietnamese side shall be delivered to JICA within two (2) month after submission of the draft final reports.

5. Final Report
   Fifty (50) copies including Executive Summary
   Within one (1) month after the receipt of the written comments on the Draft Final Report from the Vietnamese side.

F. UNDERTAKINGS OF THE GOVERNMENT OF VIET NAM

1. To facilitate the smooth conduct of the Study, the Government of Viet Nam shall take necessary measures;

   (1) to secure the safety of the Japanese Study Team

   (2) to permit the members of the Team to enter, leave and sojourn in Viet Nam for the duration of their assignments therein, and exempt them from foreign registration requirements and consular fees

(3) to exempt the members of the Team from taxes, duties and any other charges on equipment, machinery and other material brought into Viet Nam for the conduct of the Study

(4) to exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study

(5) to provide necessary facilities to the Team for the remittance as well as utilization of the funds introduced into Viet Nam from Japan in connection with the implementation of the Study

(6) to obtain permission for the Team for entry into private properties or special areas for the conduct of the Study

(7) to secure permission for the Team to take all data and documents (including maps and photographs) related to the Study out of Viet Nam ; and

(8) to provide medical services as needed, while its expenses will be chargeable on members of the Team

2. The Government of Viet Nam shall bear claims, if any arises, against the members of the Team resulting from, occurring in the course of, or otherwise connected with,the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

3. The counterpart agency shall, at its own expenses, provide the Team with the following in cooperation with relevant organizations;

(1)data and information related to the Study available in MOT, including maps and photographs
(2)counterpart personnel
(3)arrangement of office with appropriate area and necessary equipment for the Study Team
(4)credentials or identification cards

G. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures:

1. to dispatch the Team to Viet Nam at its own expense; and

2. to pursue technology transfer and training to the Vietnamese counterpart personnel in the course of the Study.

H. OTHERS

JICA and MOT shall consult with each other in respect of any matter that may arise from or in connection with the Study.

TENTATIVE STUDY SCHEDULE

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Work in Viet Nam														
Work in Japan														
Report Presentation	△ IC/R			△ PR/R		△ IT/R					△ DF/R			△ F/R

IC/R : Inception Report
PR/R: Progress Report
IT/R : Interim Report
DF/R: Draft Final Report
F/R : Final Report

2. Minutes of Meeting (M/M)

MINUTES OF MEETING

ON

THE SCOPE OF WORK

FOR

THE FEASIBILITY STUDY

ON

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Infrastructure Department
Ministry of Planning and Investment

The preparatory study team for the Feasibility Study on the Can Tho Bridge Construction in Socialist Republic of Viet Nam (hereinafter referred to as "the Study") organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") headed by Mr. Katsushi IWAYA visited the Socialist Republic of Viet Nam from 16th March to 26th March, 1997, and had a series of discussions with the Vietnamese side, represented by Ministry of Transport (hereinafter referred to as "MOT"). List of participants is shown in Attachment 1.

As a result of the said discussions, both sides came to an agreement on the Scope of Work (hereinafter referred to as "S/W") of the Study, and signed it on 25th March, 1997.

This document summarizes major items discussed between both sides and is meant to supplement the S/W for the smooth conduct of the Study.

1. Title of the Study

Both sides agreed to use "The Feasibility Study on the Can Tho Bridge Construction of in Socialist Republic of Viet Nam" as the title of the Study.

2. Target year

Both sides agreed that the target year of the Study shall be 2010. The Vietnamese side indicated its strong intention to begin the Can Tho Bridge construction in 2000. The Japanese side agreed only to convey it to the relevant organizations in Japan.

3. Location of Can Tho Bridge

The Japanese side expressed the location of Can Tho Bridge will be decided in the course of the full-scale study, but it is necessary to be based on the future land use plan of Can Tho city, transport plan (road, waterway, port and airport), especially Master Plan of the Highway No.1A. The Japanese side requested the Vietnamese side should provide necessary data and information sufficiently for the full-scale study team, in cooperation with relevant organizations. The Vietnamese side agreed on this point.

4. Navigation Clearance and Width of Can Tho Bridge

The Japanese side considers the navigation clearance and width is a very important element to affect the bridge design, construction cost and economic feasibility. Therefore, the Japanese side requested that it should be provided as an initial condition by the Vietnamese side prior to the commencement of the Study, taking into account of the limited study schedule.

The Vietnamese side agreed it and proposed that an optimum alternative including the navigation clearance and width shall be selected in the course of the Study, according to the method applied to the Feasibility Study of My Thuan Bridge, and promised to provide the full-scale study team with necessary data and information related to the Study as soon as possible in cooperation with related

organizations.

The Japanese side agreed it.

5. Environmental Impact Assessment (EIA)

The Japanese side requested the Vietnamese side to fully cooperate with Environmental Impact Assessment conducted by the full-scale study team, especially on the resettlement of inhabitants. The Vietnamese side agreed it.

6. Steering Committee

Both sides agreed that Government of Viet Nam would establish a Steering Committee under the chairmanship of the MOT. The Steering Committee will consist of following organizations such as; Ministry of Planning and Investment, Can Tho People's Committee, Vinh Long People's Committee, Ministry of Construction and so on.

7. Undertaking of the Government of Viet Nam

(1) MOT shall arrange the office space for the full-scale study team and recommended that it would be convenient for the team to rent two rooms; one is in Ho Chi Minh city and the other is in Can Tho city.

(2) MOT agreed to arrange appropriate number of technical staff to supervise traffic count survey, the O-D survey and traffic police assistance.

(3) MOT shall take procedures required to get data and information related to the Study.

(4) The Japanese side requested to ensure the safety of the full-scale study team. The Vietnamese side agreed it. The Vietnamese side shall undertake the survey and clearance of bombs and mines for the period of the Study in Viet Nam.

8. Undertaking of JICA

(1) The Vietnamese side requested that the Vietnamese counterpart personnel take advantage of training in Japan related to the Study to promote effective technology transfer. The Japanese side promised to convey this request to the JICA Headquarters in Tokyo.

(2) The Vietnamese side requested that JICA will bear the following costs. The Japanese side agreed that JICA shall bear:

(a) fee to rent the office space and necessary equipment (electricity, telephone, fax machine, furniture) , and vehicles for the full-scale study team.

(b) costs relevant to the setting of meetings at the stage of report's submission and seminar for technical transfer (hiring of interpreters, translation fee, rent of space and so on) except for travel fee of the Vietnamese participants.

Attachment 1

PARTICIPANTS LIST

THE VIETNAMESE SIDE

1. Mr. Nguyen Ngoc Nhat	Director General, Infrastructure Department, Ministry of Planning and Investment
2. Mr. Nguyen Van Vien	Senior Expert, Infrastructure Department, Ministry of Planning and Investment
3. Mr. Tran Doan Tho	Deputy Director General, Planning and Investment Department, MOT
4. Mr. Le Long Dinh	Director General, Project Management Unit-My Thuan, MOT
5. Mr. Nguyen Trung Cu	Expert, Planning and Investment Department, MOT
6. Ms. Nguyen Thanh Hang	Expert, Planning and Investment Department, MOT
7. Mr. Pham Ngoc Dung	Expert, International Relation Department, MOT
8. Mr. Nguyen Anh Tuan	Deputy Manager, Planning and Investment Division Project Management Unit-My Thuan, MOT
9. Ms. Duong Tram Anh	Chief, Hanoi Office, Project Management Unit-My Thuan, MOT
10. Mr. Nguyen Xuan Giang	Director, Bridge & Tunnel Engineering Consultants, Transport Engineering Design Incorporation
11. Mr.Phan Ba Dung	Vice Manager, Transport Engineering Design Incorporated South
12. Mr. Do Minh Dung	Engineer, Bridge & Tunnel Engineering Consultants, Transport Engineering Design Incorporation

THE JAPANESE SIDE

1. Mr. Katsushi IWAYA	Team Leader, Preparatory Study Team
2. Mr. Tadashi OKUTANI	Road planning, Preparatory Study Team
3. Mr. Keiichi SAKAEBARA	Natural conditions/ Environment, Preparatory Study Team
4. Mr. Koichi KITO	Study planning, Preparatory Study Team
5. Mr. Yasuyuki ITO	Second Secretary, Embassy of Japan
6. Mr. Hiroshi TSUJINO	Assistant Resident Representative, JICA Viet Nam Office

3. Terms of Reference (TOR)

(DRAFT)

TERMS OF REFERENCE

for

FEASIBILITY STUDY

on

THE CAN THO BRIDGE CONSTRUCTION

NOV. 1995

(DRAFT)
TERMS OF REFERENCE
for
FEASIBILITY STUDY
on
THE CAN THO BRIDGE CONSTRUCTION

I. BACK GROUND

National Highway No.1 is an arterial road running about 2,300 km through Vietnam territory from China border in the North to Namcan in the South. The rehabilitation and improvement of Highway No.1 is the top prior project in the infrastructure development strategy of Vietnam from now to the year 2010. At present, on such road WB and ADB funded road rehabilitation and improvement projects and OECF funded bridge improvement and rebuild projects are being carried out. There has still remained 2 unsolved large river-crosses in the Southern section of Highway No.1: My Thuan crossing Tien River and Can Tho crossing Hau River. My Thuan bridge Feasibility Study has now been completed and its construction is planned to commence at the end of 1996, mainly using Australia grant aid.

For the smooth going on the whole Highway No.1 before 2010 as in the Transport Development Strategy and to meet the transport demand for promoting socio-economic development of Cuulong (Mekong) Delta and Indochina, it is of a necessity to conduct the Feasibility Study for Can Tho Bridge. It is for applying for Japanese development sudy fund in 1996 fiscal year.

II. OBJECTIVE AND SCALE OF THE STUDY

II.1. Objective of the Study

- Identify the necessity of the construction of a bridge crossing Hau River at Can Tho to deal with the increasing North-South transport demand and that of Mekong Delta.
- Decide the project scale.
- Identify the project socio-economic benefit for Mekong Delta, Vietnam economy as well as Indochina area.

II.2. Expected Scale of the Study

- Name : Can Tho Bridge
- Location: at Km 2069 of Highway No.1, crossing Hau River, on the territory of Vinh Long and Can Tho Provinces.

- Length: about 2,580 m, of which:
  + Main bridge : 1,500 m
  + Leading bridge : 1,080 m
- Bridge width : 16,6 m
- Access road:
  + Length : 5.2 km
  + Pavement width : 16.6 m
  + Embankment width : 25 m
- Navigation clearance: 40 m (navigable for 7,000 - 10,000 DWT ships)
- Longitudinal gradient : 4%
- Bridge type : two tower cable stayed bridge.

III. SCOPE OF WORK

- Socio-economic assessment of Mekong Delta.
- Description of present ferry-boat service at Can Tho and road network at Mekong Delta.
- Collection of present and forecasted expenditures data for ferry and vehicle.
- Population growth forecast.
- Investigation of present situations and data of the development history of Can Tho and transport demand forecast for it in either case that bridge is built or not built.
- Review region transportation plan, taking into account the related existing data of My Thuan Bridge.
- Investigation of natural conditions (temperature, humidity, rain fall, wind and storm etc.), hydrography, hydraulics, etc. of the river.
- Geotechnic survey at the site.
- Investigation of material sources.
- Natural environment and ecology investigation including air pollution, surface water, underground water, water flow, land use etc.
- Social environmental investigation on population, resettlement, social activities, cultural and historical inheritances, etc.

- Formulate and assessment of alternatives on:
  + Construction scale, technical specifications such as bridge size, grade of load, navigable space, viaduct, fly-over, access road, architect requirements, operation regulations etc.
  + Superstructure and infrastructure preliminary design of the bridge.
  + General implementation schedule, total estimated investment cost.
- Preliminary analyze and assessment on economic benefit and finance and investment source for the project.

IV. DURATION OF THE STUDY AND REPORTS

It is expected that the study will be completed within 12 months from the commencement of the study. The following reports shall be submitted to the Vietnamese side:

- Inception Report: This report shall include a program of the study and survey schedule. It will be submitted after one month of the study.

- Interim Report 1: This report is to be prepared on the basis of the first field survey and findings, containing the results of the analysis of the collected data and information and initial studies. It will be submitted after two months of the last report.

- Interim Report 2: This report shall contain a draft alternatives, environmental impact assessment. It will be submitted after four months of the last report.

- Draft Final Report: This report shall contain an assessment of alternatives, superstructure and infrastructure preliminary design of the alternative selected, proposal of financial sources. It will be submitted after three months of the last report and can be used as pre-feasibility study to submit to Vietnamese side.

- Final Report: This report shall be summated to Vietnamese side within two months after receiving the comments from Vietnamese side on the draft final report.

These reports shall be made in English and distributed as follows:
- Inception Report : 20 copies
- Interim Report 1 : 20 copies
- Interim Report 2 : 20 copies
- Draft Final Report : 20 copies
- Final Report : 40 copies

V. SEMINARS

Seminars are held at the time of submission of Interim Report 1, Interim Report 2, and Final Report, inviting every related agencies of the central and local authorities and people concerned, at HoChiMinh City or Hanoi.

VI. UNDERTAKING OF THE GOVERNMENT OF VIETNAM

- To assign the counterpart for the study.
- To provide the study team with the existing data necessary for the study.

- To exempt the study team from taxes and duties on the materials, equipment and personal effects brought into Vietnam by the team, according to the Government of Vietnam regulations.

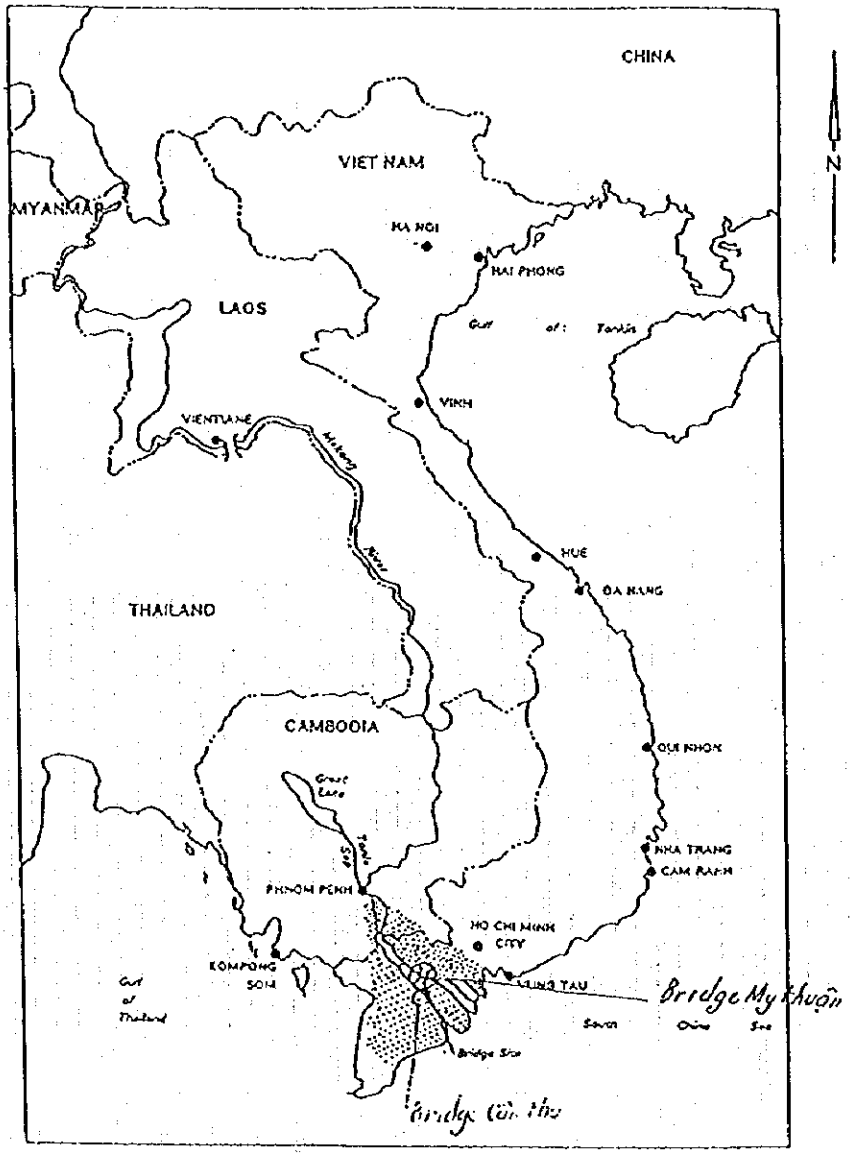
VII. UNDERTAKING OF THE GOVERNMENT OF JAPAN

- To dispatch, at its own expense, a study team to Vietnam.
- To pursue technology transfer to Vietnam counterpart personnel in the course of the study.
- To train Vietnamese personnel related to the study.
- To cover the expenditures for seminars, reports presenting, travel fees for Vietnamese officials and counterpart.

VIII. SPECIFIC FIELDS OF THE STUDY TEAM

Specialists in the following fields shall be assigned for the Study:

- Project Management
- Traffic survey and development planning
- Economic assessment and financial analyze.
- Socio-economic and natural environment impact assessment.
- Geotechnic
- Hydrology and hydraulic
- Bridge structural design
- Long-span structure
- Architect

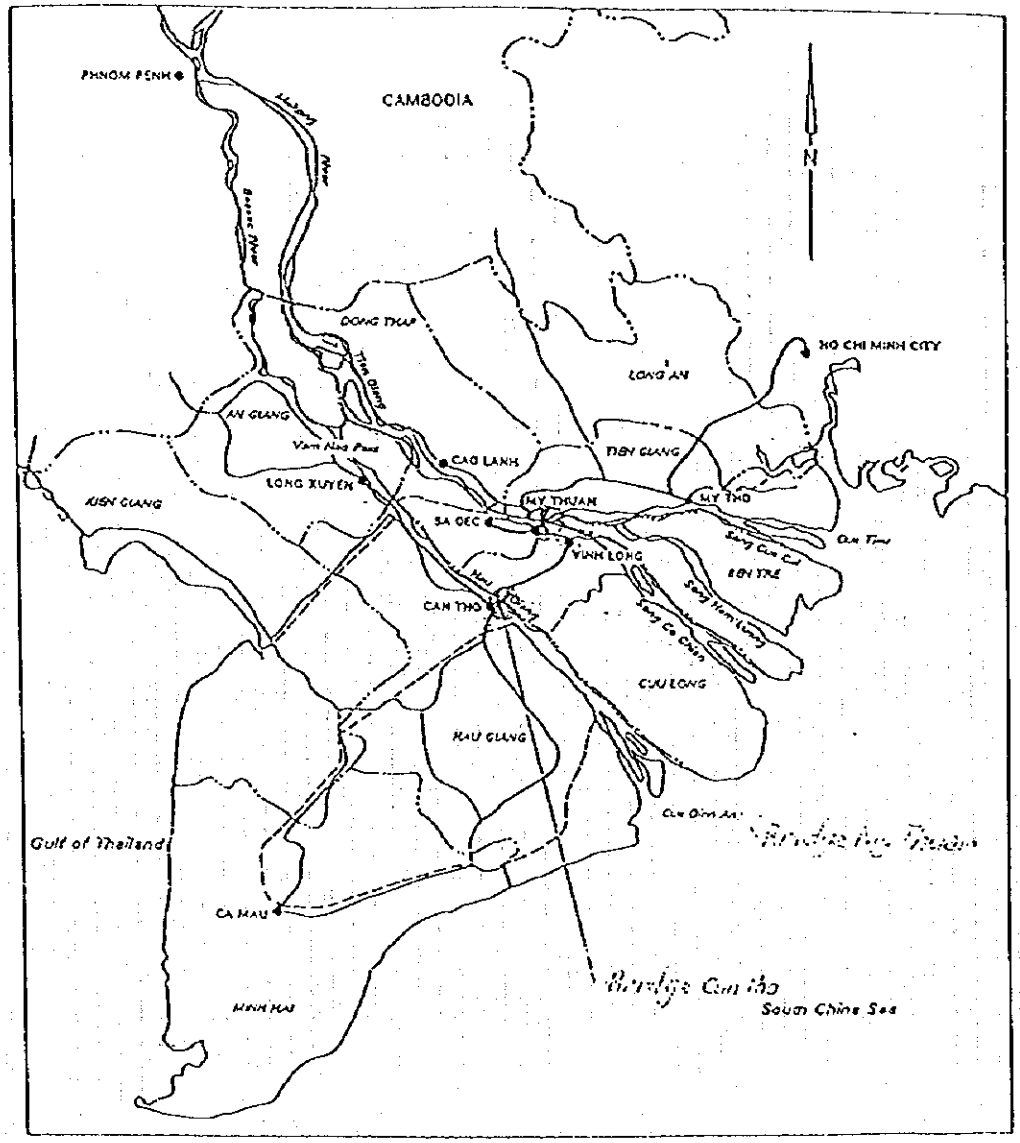


LEGEND

International Boundaries

Mekong Delta

0 100 200 300 400 KILOMETRES



LEGEND

- Highway No 1
- Main Provincial Highways
- Major Canals
- Towns
- International Border
- Provincial Borders

0 10 20 30 40 KILOMETRES

4. Questionnaire

QUESTIONNAIRE

FOR

THE FEASIBILITY STUDY

ON

THE CANTHO BRIDGE CONSTRUCTION

IN

SOCIALIST REPUBLIC OF VIET NAM

MARCH, 1997

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

Note ;

- Please mark O for the Data/Item in the "Availability" which is available
- Please mark X for the Data/Item in the "Availability" which is not available
- List of required data/reports are as per attached

The objective of this questionnaire is for the Preparatory Study Team (hereinafter referred to as "the Team") to collect materials and information for the smooth planning and conduct of the full-scale study.

The Team hopes this questionnaire will be distributed to relevant personnel or agencies prior to the Team's arrival, so that necessary materials and information will be ready and the Team can implement the study efficiently and effectively. It would be appreciated if the sincere understanding and cooperation for this questionnaire are obtained from your organization. Thank you.

March, 1997

The Preparatory Study Team
Japan International Cooperation Agency

I. ORGANIZATIONS CONCERNING THE IMPLEMENTATION OF THE STUDY

ITEM	DESCRIPTION	AVAILABILITY		NAME OF MATERIALS
		AVAILABILITY	PLACE OF DATA AVAILABLE	
1. Agencies which are responsible for the followings: (A) Road development planning (B) Road construction (C) Road improvement/betterment (D) Road maintenance/management	(1) For the National roads (2) For the Provincial roads (3) For the Toll roads	O		MOT
2. Agencies in charge of and/or concerned with the followings: (A) Permission of aerial photo taking (B) Custody of topographic maps and aerial photos (C) Area conservation (D) Geological data/information	(1) Name of Agencies and Departments (2) Name and position of the responsible persons in charge for the Japanese Study Team to contact	O O O O	 General Dept for Geology	Ministry of Interior General Depart. for Land Registration Ministry of Science, Technology and Environment
3. Administration of the Central Government (A) Change in revenue and expenditure (by ministry) of the government (in recent 10 years) (B) Public investment of the last 10 years by sector (C) Amount of foreign assistance		O		MoF

II. TECHNICAL DATA / INFORMATION

ITEM	DESCRIPTION	AVAILABILITY		NAME OF MATERIALS
		AVAILABILITY	PLACE OF DATA AVAILABLE	
1. Maps to be used for field investigation	(1) Topographic maps covering the Study area (of smaller scale)	O - purchase	TEDi	
2. Availability of aerial photos and topographic maps	(1) Aerial photos (1/5,000) (2) Topographic maps (1/2,000), etc	X	check with Dept. For Mapping - General Dept. for Land Registration	
3. Geological data	(1) Geological maps covering the Study area (2) Existing report about data/ information such as : - Location of soft ground - Results of geological/soil investigation	O - purchase O - " O - "	TEDi	
4. Geodetic data	(1) Triangulation point network (2) Bench-mark network (3) Points description (Control points, Bench-mark) (4) Triangulation point data lists	O - purchase	TEDi	
5. Meteorological data	(1) Monthly rainfall data (daily rainfall data, if possible) (2) Temperature (3) Others	O - purchase	General Dept. for meteology.	
6. Hydrological data of rivers		O - purchase	as above	

7. Data/information on related roads in the study area	(1) Road maps (2) Road inventories (class, length, surface type, etc.) (3) Record of past disaster (flood, slope failure, etc.)	O - purchase	Regional road management unit 7	
8. Traffic survey system	(1) Location of periodic traffic count stations in the Study Area (2) Period (ex. once a year, seasonal, etc.)	O - purchase	TeDi / My Thuan Joorg Co. Can Tho	- -
9. Traffic data on the related roads	(1) Traffic volume by vehicle types (2) Number of registered vehicles (3) Record of traffic accidents (type, causes, location, etc.)	O - purchase	Regional Road management unit 7	
10. Land use plans and maps		O - purchase	Peoplec provincial committees	
11. Specification and standard	(1) Highway capacity manual (2) Geometric standard (3) Bridge standard (4) Pavement standard (5) Environmental quality standard (6) Maintenance manual (7) Others	O - purchase	Dept. for Science and Technical - MOT	
12. Transportation Network Map	(1) Network maps and capacity of national transport system roads, railways, commercial flights (2) Traffic Flow data and forecasts of cargo/ passengers by each mode (3) Transportation cost of each mode (by type of vehicle) (4) Development / improvement policies (5) Related materials, if any (national transportation studies, etc.)	O - purchase	TESI - MOT	

13. Reports/information of the road development projects closely related to the Study	(1) Intersection improvement plan (2) Widening plan for major road (3) Bridge plan - New construction - Reconstruction	O - purchase	TESI - MOT	
14. Road-related budget	(1) Road construction budget (2) Road maintenance budget	O O	Planning & Investment Dept. - MOT VIETNAM Road Administration	
15. Road related cost	(1) Construction cost by type of road and location (2) Maintenance cost by type of road and location	O O	Dept. Evaluation & Quality Control - MOT VIETNAM Road ADMINISTRATION	
16. Data of the other existing bridges more than 100 meter in length - type, length, width, span, clearance, load, limitation, etc		O - purchase	VIETNAM ROAD ADMINISTRATION	
17. Navigational Restriction along the Mekon River		O - purchase	VIETNAM Inland waterway ADMINISTRATION	

III. SOCIO-ECONOMIC DATA/INFORMATION

ITEM	DESCRIPTION	AVAILABILITY		NAME OF MATERIALS
		AVAILABILITY	PLACE OF DATA AVAILABLE	
1. Latest socio-economic indices	(1) GNP and GDP (2) Population (3) Past and future population growth rate (4) Industrial, agricultural and mining products (by main sort) (5) Foreign trade (quantity and value) (6) Tourism development plans (7) Others	O	MPI	
2. Existing development plans and reports	(1) Economic development plans (2) Transportation development plans (3) Industrial development plans (4) Mining and agricultural development plans (5) Forecast of socio-economic indicators	O	MPI	
3. Existing and on-going road development plans and road development projects	(1) Design, implementation schedule and current project status	O	planing & Development Dept - MoT	

IV. ENVIRONMENTAL ISSUES

ITEM	DESCRIPTION	AVAILABILITY		NAME OF MATERIALS
		AVAILABILITY	PLACE OF DATA AVAILABLE	
1. Legislation	(1) Law/guidelines on environmental impact assessment (2) Quality standards	O	Ministry of Science, Technology & Environment.	
2. International conventions on environmental conservation	(1) Bilateral convention (2) Multilateral convention	X	as above	
3. Present situation of the project area	(1) Socio-economic environment - Number of people to be resettled and plan of resettlement or compensation - Main industry or source of income of the residents - Number and distribution of schools, hospitals, religious facilities - Location of the community which might be split by the project - Cultural property or archaeological site - Use of river/lake water i.e. domestic industrial and agricultural - Existence of common land	O Purchase	Peoples' provincial Committee + Ministry of Science, Technology & Environment	
	(2) Natural environment - Availability of meteorological data - Availability of land use and vegetation map - History of natural disaster, landslide earthquake and flood - Areas affected by soil erosion - Change of water level of rivers and lakes in recent years - Location of environmentally vulnerable areas such as wetland - Species of valuable animals and plants living in the project area - Location of particular areas officially protected such as national parks	O purchase	peoples' provincial Committee + Ministry of Science, Technology & Environment	

	- Distribution of important landscape or scenery for tourism		
	(3) Quality of life - Present air quality - Regulation on emission gas - Present water quality - Regulation on effluent - Present condition of soil contamination - Regulation for prevention of soil contamination - Present condition of noise and vibration - Regulation for prevention of noise and vibration	O - purchase	Peoples' provincial committee & Ministry of Science, Technology & Environment
4. Present organization executing environmental study and environmental impact assessment (EIA) (A) Organization (public/private)		O	- Ministry of Science, Technology & Environment
(B) Experiences of executing environmental study and EIA		O	- Ministry of Science, Technology & Environment - Institutes in MoT

	- Distribution of important landscape or scenery for tourism (3) Quality of life - Present air quality - Regulation on emission gas - Present water quality - Regulation on effluent - Present condition of soil contamination - Regulation for prevention of soil contamination - Present condition of noise and vibration - Regulation for prevention of noise and vibration	O - purchase	Peoples' provincial committee & Ministry of Science, Technology & Environment	
4. Present organization executing environmental study and environmental impact assessment (EIA) (A) Organization (public/private) (B) Experiences of executing environmental study and EIA		O O	- Ministry of Science, Technology & Environment - Institutes in MoT	

5．収集資料リスト

収集資料リスト

番号	資料の名称	形態(図書・ビデオ・地図・写真等)	発行機関
1	KANTHO BRIDGE 3 ALTERNATIVE ROUTES	地図	PMU My Thuan
2	MY THUAN BRIDGE PROJECT - VIETNAM Phase 3: Detailed Design and Documentation FINAL BRIDGE DESIGN REPORT NOVEMBER 1996	図書	AUS AID, MOT, MAUNSELL
3	PRE-F/S ON CANTHO BRIDGE	コピー	MOT
4	VIETNAM NATIONAL ATLAS (注)	図書	IMEGEA
5	REPORT ON METEOROLOGICAL, HYROLOGICAL & HYDRAULICAL CONDITIONS OF CANTHO BRIDGE	コピー	MOT
6	ヴィエトナム統計年鑑１９９５ (注)	図書	General Statistical Office
7	EOD ECHINICAL AUDIT MYTHUAN BRIDGE REPORT	コピー	AMUNSELL & MILSEARCH
8	LAW ON ENVIRONMENTAL PROTECTION (注)	図書	NEA
9	ENVIRONMENTAL IMPACT ASSESSMENT (注)	図書	NEA

(注) ：同時期に実施した「タインチ橋建設計画調査（事前調査）」収集資料との共通資料。

6. Highway No.1A Can Tho Bridge Prefeasibility Study

SOCIALIST REPUBLIC OF VIETNAM
MINISTRY OF TRANSPORT
TRANSPORT DESIGN CONSULTANT INCORPORATION

HIGHWAY No. 1A
CAN THO BRIDGE
PREFEASIBILITY STUDY

HANOI - 1996

SOCIALIST REPUBLIC OF VIETNAM
MINISTRY OF TRANSPORT
TRANSPORT DESIGN CONSULTANT INCORPORATION

HIGHWAY No. 1A
CAN THO BRIDGE
PREFEASIBILITY STUDY

Design section No.2 : By NGUYEN TRUNG CU
Major Bridge & Tunnel Company : By PHAN KHAC LE
Overall project responsibility : By VU KHAC THANH

Hanoi, 19th March, 1996
Chief Engineer

VU KHAC THANH

FEASIBILITY STUDY OF CAN THO BRIDGE ON HIGHWAY NO. 1A

A. Project financial manager : MINISTRY OF TRANSPORT

B. Project executing agency : My Thuan project Management Unit

Project formulation agency : Transport Design Consultant corporation.

C. Legal basis :

- Decision No. 2983/KHDT dated 27 May 1995 issued by the Ministry of Transport to allocate budget for carrying out feasibility study of Can Tho Bridge on highway No.1.

- Economic contract No. 124/HDKT dated 02 June 1995 signed between the My Thuan Project Management Unit and The Transport Design and consulting corporation for the implementation of research and design of Can Tho bridge in its feasibility study.

D. Main documents to be used for reference.

- Draft Report on "Overall planning for socio-economy" of the Can Tho Province to the year 2010 prepared by the People's Committee in 1995.

- "Transport Planning for Can Tho province till the year 2010" prepared by the people's Committee in 1995.

- Overall planning of Mekong River Delta coded vie 87/031-1993.

- "Orientation for Development of Transport System" by the Ministry of Transport in 1993.

- Feasibility Study of My Thuan Bridge Project in 1995.

PRE-FEASIBILITY STUDY OF CAN THO BRIDGE ON HIGHWAY No.1A.

CHAPTER 1

BACKGROUND

Road section of the highway No.1 from Ho Chi Minh City to Ca Mau is the principle arterial route of the Southern part of Vietnam. This is also the main road to provide access for inter - province of Cuu Long river Delta and to link to Ho Chi Minh industrial center. This road section on highway No.1 is, therefore said to play a decisive role in the development of social, economic and military aspects for the Southern part of the country.

Anyhow, there's still a lot of traffic bottlenecks on this road section, especially at the two river crossing points where ferry service has to be provided to cross Tien Giang and Hau Giang rivers. Out of these two ferry crossings, Can Tho ferry one is the bigger with the ferry operation length of about 1.2 km. Travel time to cross river by ferry is still long, creating traffic bottlenecks to all kinds of transport means along this route. Although, the ferry service is constantly strengthened and improved by adding more ferries but still not meeting the increasing traffic demand in this area. Traffic congestion is a permanent phenomenon at these crossing points.

Based on the national overall study of transport section in combination with the forecast economic growth of the Southern provinces, the volume of traffic at the year 2000 shall reach 7000 to 8000 vehicle units per day.

It show that in the comming years, Can tho ferry system will not meet the traffic demand of this area ; that will slow down the economic development and social activities of Southern part of Vietnam. To confront with the actual demand, the feasibility study for the construction of My Thuan bridge was approved in 1995 and will be followed by funding for construction. What necessary to do next is to carry out a study for the possible construction of a bridge crossing the river in the

replacement of existing ferry service which hence creates great socio-economic significance.

The content of the feasibility study for Can Tho bridge is firstly aimed at providing overall and intensive assessment of economic, social and transport aspects and then formulating forecast development of the Region. Based on this information, it studies and analysis the size of investment and related matters of this project in order to set plan for the construction of a suitable bridge which carters for the future traffic demand.

CHAPTER 2

DETERMINATION OF NECESSITY OF INVESTMENT IN THE CONSTRUCTION OF THE BRIDGE.

I. SOCIO-ECONOMIC ENVIRONMENT OF THE REGION

1. Cuu Long River Delta Region.

Natural Condition :

Cuu Long River Delta composes 11 provinces of the Southern part of Vietnam which cover an area of 39,000 km2 (about 12% of the whole country's area) and has 16.2 million inhabitants.

Cuu Long Delta is a vast flood plain built up long time by alluvial deposit by the Mekong river system topography of the region is therefore rather flat, generally from 0.5m to 1.2m above Mean Sea Level. At present, there is a high density of channels in this area.

In addition, the region which is favoured by its natural position and climate condition creates rich potentials for the development of agriculture, forestry, water product exploitation and food processing.

Agriculture :

Agriculture plays an essential role in the development of this area's economy in which agriculture produce is based on cropping/planting with rice crops as the

main produce. The rice planting area accounts for 2.3 million ha (about 40% of rice planting area of the whole country. Favoured by nature, rice crop production reaches 8-10 tonnes per ha of which output of rice produce accounts for 3/4 of planting production output.

In recent years, thanks to the agricultural based policy of the Government, rice production is speedily and stably increasing. In 1993, rice production reached 11.2 million tonnes (accounts for 50% of the country's rice production). It's estimated that rice output can reach 13 million tonnes by the year 2000 and 16 million tonne by the year 2015 with growth rate from 5% to 7% annually.

Industry :

Generally, the industrial sector of Cuu Long River Delta is not yet developed. It mainly concentrates on light industry, such as chemical and construction material production. In addition, industry sector included the processing of agricultural and water products, such as food and food staff processing. Other industrial activities are leather tanning, fertilizer producing, cigarette and fine arts works manufacture, which are of small-scale and low technology.

Except industrial centre located in Ho Chi Minh City, industrial complexes the Southern part of Vietnam are located mainly in Kien Giang, Minh Hai and Can Tho provinces, as these areas are in terms of land transport, in land-water transport and shipping.

At present, industrial output of Cuu Long river Delta is responsible for only 13% of the whole country's industrial GDP value. In recent years, due to the increasing investment and new technology (through joint ventures with foreign companies), the grow rate of industry sector of this region is from 8% to 10% at average.

Commercial service and export.

One of the potentials of Cuu Long river Delta is an area of economic diversification reflected in the fields of animal breeding, fruit tree planting, forestry and fishing, of which products are of wide ranges and high values. The volume of

these products not only meet the local demand, but also are the supplying source of food for Ho Chi Minh City. At present, more and more joint ventures with foreign partners are established to produce consumable goods for export. Particularly in the fields of rice export and water products processing, the value of exported products n this area accounts for 50% of the whole country's exported value.

Trading and commercial services are mainly concentrates in Ho Chi Minh City where the Cuu long river Delta produces a great variety of goods as well as supplies to agricultural products for local consumption and export. The access route to and from Cuu Long River Delta is through highway No.1A with Can Tho City as its centre where there are advantages in connecting provinces and having international access to Kampuchea through the existing inland waterway network.

2. Socio-economic environment of Can Tho city.

Can Tho City which is a big and central province in Cuu Long River Delta with 2,946.7km2 in size and 1.82 million inhabitants is a hub to connect by road and waterway systems to and from Ho Chi Minh City and Ca Mau, and to and from Kampuchea to the sea. Given such convenient position, Can Tho province is in a better position compared to other provinces in Cuu Long River Delta to develop its socio-economy and plays an important role to linking other provinces in this region to Ho Chi Minh industrial centre.

At present, there are various established socio-economic, transport plans with the aim to make Can tho province to be an industrial and commercial centre of Cuu Long River Delta. Can Tho City is recognized by the Government of Vietnam the second class metropolitant city.

Can tho province's economy is of fairly high development compared to the overall economy of the Cuu Long River Delta and the country as a whole . In 1993, the province ranked the second in term of GDP among provinces of Cuu Long River Delta accounts for 11.6% of the region's GDP and 2.6% of the whole country. The growth rate of GDP of the province was 8.24% (in the period from 1986 to 1990) and 9.61% (in 1991 - 1994).

Anyhow, agriculture is still the major economic activity, affecting the province's economy, of which main products are made from planting (accounting

for 80%). In 1991, rice output of the province was of 1.21 million tonnes and 194 increased to 1.63 million tonnes.

In term of industrial output, the province ranks the third to Kien Giang and Minh Hai provinces. Industrial output covers 12.14% of GDP of Cuu Long River Delta and 1.6% of the whole country's GDP in term of industrial value. The primary industries are chemical and construction material manufacture. In addition, there are some food staff processings and industrial product manufacturing at medium and small scale.

Trading and commercial services are concentrated in Can Tho which are affected by the economic centre in Ho Chi Minh City via the main traffic route on Highway No.1A where traffic constraint takes place at Can Tho ferry crossing which is across Hau river, adjacent to outlet of Can Tho City to Ho Chi Minh City.

II. FORECAST ON DEMOGRAPHIC AND ECONOMIC DEVELOPMENT.

1. According to the census of population, Can Tho province itself has 1.69 million inhabitants in the year 1991 and increased 1.82 million inhabitants in 1994 with fluctuated growth rate of population from 2.2 to 2.01%.

DEMOGRAPHIC FORECAST OF THE CUU LONG RIVER DELTA

Name of province	Year-wise (million inhabitants)			Growth rate (%)	
	1993	2000	2015	1993-2000	2000-2015
Long an	1.227	1.467	1.857	2.6	1.6
Dong Thap	1.463	1.680	2.163	2.0	1.7
Tien giang	1.622	1.935	2.529	2.6	1.8
Ben Tre	1.316	1.542	2.016	2.3	1.1
Vinh Long	1.046	1.218	1.568	2.2	1.7
Tra vinh	0.94	1.102	1.461	2.3	1.9
An Giang	1.935	2.222	2.861	2.0	1.7
Can Tho	1.785	2.064	2.697	2.1	1.8
Soc Trang	1.173	1.347	1.734	2.0	1.7
Kien Giang	1.336	1.599	2.152	2.6	2.0
Minh Hai	1.721	2.004	2.619	2.2	1.8
Total	15.544	18.181	23.657	2.1	1.7

2. The assessment of economic development and growth rate forecast is made by the analysis of recorded economic data of the region in the part years. Generally, the average annual growth rate of this region is relative high, compared to the relative level of the whole country. The recorded statistics showed that GDP in this area from 1986 to 1990 hand annual growth rate at average 8.24%, while it was 5.5% in the whole country. In the period 1991 - 1994, growth rate was 9.61% (while for the country was 8 to 8.2%).

Generally, in the comming years, the growth rate in this region is still increasing at a high rate. Given the favourable conditions in natural and social environment, the expansion of international infrastructure will facilitate a momentum for speedy development of the region.

Based on the previous economic analytical studies and plannings at national and local scales with a view to define an average level of growth, taking into account the recent recorded data, and assumed that the region is the stage of high development scenario of which a leap jump in economic development might be expected due to proper investments, the below is the economic development forecast of the region.

FORECAST ECONOMIC GROWTH RATE (5)

	Area/country	1995 - 2000	2000 - 2015
Medium Economic growth	Cuu long Delta	9.0	10
	The whole country	10	11
High Economic growth	Cuu long Delta	10	11
	The whole country	11	12

III. ROAD TRAFFIC SITUATION OF THE REGION.

1. Road traffic system.

Highway No.1A is a lifeline of the Southern part of Vietnam and which starts from Ho Chi Minh City via Can Tho and ends at Ca Mau in a total length of 280km of which 42.5 km is of the road section going via Can Tho province. This road is generally in good condition and able to accommodate 2 motor-vehicle lanes and two side lanes for motor cycles and bicycles. Anyhow, there remain some narrow-

width bridges and poor road sections. The road vehicle load capacity is generally from 15 to 25 tonnes at average speed of 50 to 60km/h.

There are some other important routes in this region. Highway No.21 stems from Can Tho, going to An Giang and connects to Kampuchea, and of which road stretch in Can tho province is 57km long. The condition of these roads is fairly good as that of the Highway No.1A. Should Can Tho bridge is built, would considerable traffic be created thereon, attractive access to international and local traffic. Other roads through Can Tho are Highway No.80 to connect with Kien Giang and the Highway No.61 (formally named inter-provincial road No.31) and Inter-provincial road No. 42 and which both start at Can Tho to Long My. All national highways are paved, except provincial roads are made of macadam or earth.

One of the specific charateristics of Cuu long Delta is that there's no railway (previously, railway ran to My Tho province). Road network in the region is therefore playing an important role in passenger and goods transportation. Compared to inland waterway transport, road transport accounts for 75% to 80% of passenger traffic and 30% to 35% of freight traffic according to 1991 statistics. Which is equivalent to 202.9 million passenger and 14.1 million tonnes transported. It is forecast that 478 million passengers and 39.1 million tonnes of goods are the traffic volume to reach by the year 2000 (at average growth of traffic rate of 10 to 12% yearly).

In the "Orientation for the Development of Cuu long Delta Region" in the comming years, focus is given to the upgrading of Highway No.1 section from Ho Chi Minh City to Ca Mau at Delta road class 1 and 2, the construction of My thuan bridge in the period 1996 - 1998 and the construction of Can Tho bridge by year 2000. This plan also includes the continuous uprading of other road network, such as Highway No. 80, Highway 91 at Delta road class 3.

2. Can Tho ferry service and volume of ferry crossing traffic.

Can Tho terminal crossing the Hau is located at the gate way of Can tho City, connecting to the Highway No.1A, leading to Ho Chi Minh City. This is the biggest ferry terminal is Southern Vietnam.

INTEGRATED VOLUME OF TRAFFIC DAILY AT CAN THO FERRY CROSSING
(From 1990 to 1995)

Year	No.of pedestrian	Bicycle	Pull	Motor. cycle	Car	Pass. vehicle <15 seats	Pass. Vehicle 15-30 Seats	Pass. Vehicle 30-50 Seats	Pass. Vehicle >50 Seats	Trucks 3-5 Tenner	Trucks 5-10 (t)	Trucks 10-15 (t)	Trucks 15 - 18 (t)	Special vehicle	
1990	6012143	246144	29443	569977	147250		85267	52710		34296	25106	107574	33094	45443	3017
1991	5639607	388929	33816	592693	112208	65363	41473	6003	61379	11778	21678	75717	16930	6947	2773
1992	6104445	267319	44587	601183	75415	109859	49506	16403	62963	7463	7997	52777	45955	15379	2863
1993	5874614	313365	46480	587037	111563	37403	58337	12802	59136	3242	9222	69123	47539	7577	2747
1994	5903845	306279	48253	386174	120325	19797	73686	16167	61516	2243	11497	107649	32456	5786	2842
6 months in 1995	3125540	158212	29983	312864	61898	11516	47272	8463	32924	1846	8976	63436	9942	1828	3073

The ferry service was established in the prewar time and later maintained and strengthened. From 1945 till 1975, ferries of 15 tonne capacity and 1000 tonne capacity were timely wise operated. At present, to meet the current traffic demand, ferry terminals are widened with twice landings, provided on each side of the river with 6 ferries of 100 to 200 tonne capacity in operation to serve 4 wheel motor of vehicles of about 1400 vehicles per day.

Although ferry crossing service is strengthened, but traffic congestions still occur. At average, the crossing takes 30 to 40 minutes and during the peak hours, many vehicles have to wait for crossing in 2 to 3 hours.

Survey and collection of vehicle counting data obtained during period 1990 - 1995 at Can Tho ferry terminals are given in the below table. Figures indicates in the table is the average volume of traffic in each year and daily motorised traffic at average.

3. Traffic volume forecast in the future.

To form a basis for calculation of traffic growth in the fulume, the vehicle converted ratio (passenger car unit - PCU) is

Motor cycle	: 0.5
Tourist car	: 1.1
Bus	: 3.05
Truck 3 - 5 tonne	: 2
5-10 tonne	: 2.5
10-15 tonne	: 3.5
15-18 tonne	: 4.5
Special vehicle	: 4.5

Daily passenger car unit (PCU) - conversion table

1990	1991	1992	1993	1994	6 months of 1995
4737	4839	4404	3965	4190	4554

The assessment of traffic demand growth is derived from the statistically recorded data at the average volume of traffic in 1995 as the basis for calculation.

The growth rate of traffic volume is calculated by using data on economic growth, the attractiveness and diversion of traffic modes due to the planning and improvement of transport networks, and the clearance of bottlenecks caused by ferry service. The average growth rate of traffic, therefore will be about 8 to 12% till the year 2015 and take place as follows :

From 1995 to 2000 growth rate 10%

From 2000 to 2015 growth rate 12%

From 2015 onward 8%

The table below forecasts traffic volume an term of passenger car unit (PCU) through Can Tho bridge.

Counting Station	Yearly corresponding Number of vehicles	Daily volume of PCU		
		Till 2000 q = 10%	Till 2010 q = 12%	Till 2015 q = 8%
Can Tho	4554 PCU/day	7334	22778	33468

"q" means growth rate of traffic demand.

IV. CONCLUSION.

Based on the existing traffic demand at Can Tho ferry crossing and traffic demand forecast in the future, it is necessary to carry out a study on the possible investment for a newly built bridge at Can Tho in order to avoid traffic delays and congestions caused by existing ferry crossings, and carter for traffic demand in the coming years.

CHAPTER 3

OPTIONS OF BRIDGE LOCATION

I. TOPOGRAPHIC ENVIRONMENT OF PROPOSED BRIDGE SITE.

Bridge site represents typical characters of Cuu Long River Delta which was longly formed by alluvial deposit of Mekong river system. The natural land is rather flat with average elevation in between 0.5m to 1.5m above Mean Sea level (MSL). On the Eastern side of the river there are paddy fields scattered with populated communities. Located on the western bank of the river is Can Tho City and its vicinity.

The Hau is one of two main river distributors of Me Kong River, having fairly wide river bed of which some locations have width of nearly 2 km. Anyhow, at Can Tho river bed is not so wide with average length of 1100m and has river islets associated with centuries of habitation.

The Highway No. 1A crossing the Hau by Can tho ferry at the Eastern outlet of Can Tho City approaches to the centre of the city where are located many houses, military area and narrow streets. From the city centre, the Highway No.1A again crosses Can tho river in the Southern west direction or converts its direction to the North to connect with Highway No. 91.

It is noted that Can Tho city - the city of national second city class is under expansion. There have been established some development plans for the setting up of Hung Phu economic processing zone, rehabilitation of Can Tho and Tra Noc airport. It is therefore essential that harmonization between the Master Plan for the Highway No.1A construction and the Master Plan for the development of Can Tho City.

2. Meteorological, hydrological and geological environments.

1. Climate :

Climate at Can Tho province is influenced by typically tropical monsoon weather which are devided remarkably by two seasons.

Rainy season occurs from April to November.

Dry reason occurs from December to March.

In rainy season, the rainfall accounts for 90% that of the whole year which is about 1829 mm/year at average or 200mm to 400 mm per month at average. it is importantly noted that there is a lot of thunderstorms in this area but very few big typhoons.

- In dry season, it is clear and sunshine. The radioactivity is of 100 KCL per cm2. That is equivalent to 150 to 200 sun shinning hours per month and 1800 to 2000 sun shinning hours per year at average.

- Humidity : it is high in rainy season (85%) and yearly average of 82%. Monthly average humility is from 76 to 86%.

- Yearly temperature is 26.7°C at average, 36.5°C at maximum and 17.7°C at minimum.

- There is rarely very big typhoon in this region. Wind-velocity measured is 31m/second.

2. Hydrology :

Hydrological study and calculation are made on the basis of recorded data available at hydrau-meter stations located on the Tien and the Hau during 1939 and 1985. The data which were observed and measured during the surveys conducted for My Thuan bridge project between 1985-1988 are also incorporated.

Hydro - graphical data are calculate as follows :

	Location 1	Location 3
- Design water level 41%	1.56	1.87
- Navigational water level 45%	1.54	1.85
- Design water discharge	1 %	26100 m3/s

The above height is based on the 1972 Hon Dau National Height standard. The river section of the Hau which runs along Can Tho city is rather stable, indicative of no clear change of river platform.

To pursue further implementation, it is necessary to carry out investigation and survey the possible change of river planform and to establish hydrau-metric and water level recorded stations. These activities will take from 1 to 3 years to complete.

3. Geotechnical investigation

According the data obtained from the 6 drilling holes (for two bridge location options) under Standard Penetration Test (SPT) the primary findings for option 1 is as follows :

- Surface layer : clayed silt is found in thickness of 15m of surface soil with high plasticity approaching to the two bank of the river. The next is dark brown clay with medium and high level of plasticity. This layer appears at the two banks of the river at a depth of about RL - 30m (Reduced Level).

- Second layer is dark black fine sand, relatively compressed. This layer is 16m thick and found on the Northern bank of the river with depth of about 16m (appeared at a depth of between RL- 33 to - 49m. This layer can be used as the loading layer for laying foundation of approaching bridge.

On the bank at Can Tho side, this layer is found at a depth of between RL - 42 to RL - 60m with higher compressibility. This layer is also suitable for laying foundation of approaching bridge.

At the bottom of river bed, there appears a rather thick unstable layer of clay which consists of dark brown and grayish green clays changed from high to medium level of plasticity at the depth of RL - 40 to - 55m, indicative of low number of SPT (No = 10 to 15). Next to this layer is another layer of clay having higher compressive strength (40 to 50) and with thickness of 5 to 8m

The main loading layer is the layer of sand and mixture of pebble and grit which appear at the depth of RL - 69,0m. Its properties compose a mixture of sand and yellow - brown mottling. Below this layer is the layer of gravel and grit and pure sand at a depth of RL - 75 having high compressibility (N > 50). This layer is the most suitable loading one for laying on the foundation of the main bridge.

For the Option III of bridge location, the soil properties are most identical to those in the Option I. Anyhow, the suitable loading layer for laying on foundation of approaching bridge is very thin, uneven with thickness of 3 - 4m and unconsolidated. Where the foundation of the main bridge is to be laid, the suitable loading layer is found at the depth of RL - 74m which is move or less identical to the soil properties in the Option I.

III. SELECTION OF THE BEST OPTION FOR BRIDGE LOCATION

The determination of the best option for bridge location shall base on the following principles :

- The linkage from the two ends of the bridge to highway No 1A (on both river banks) shall be in harmonization and in conformity with technical standard of the highway network, the Master plan of the Highway No 1A network, the Master plan of the development of Can Tho city and other related infrastructure.

- In conformity with the geographical, topographical and hydrographical characteristics of the bridge site and with insurance of water flow and navigable traffic.

- The volume of bridge construction is to be lowest and the route alignment is shortest. The construction cost is to be lowest.

Having considered the above principles and based on the intensive studies including consultations with Can Tho authority, two bridge locations are selected with detailed justifications as follows :

Option 1 :

The proposed bridge location shall be about 2.7 km downstream from the existing ferry crossings and is still in upstream position compared to the future proposed location of Can Tho port. This alignment will go straight and connect with the Highway No 1A at the rear of Cai Rang town.

Advantages : It is in conformity with the Master Plant of the Highway No. 1A and located in the Southern suburb of Can Tho city, and facilitate traffic movement on the Highway No 1A.

- Bridge crosses a less populated area which requires less compensation costs and possibly maintains clean environment.

- It improves natural scenery of the city's image.

Disadvantages

- As bridge has to cross Con Au (river islet), the main flow of the river will be deviated to the East.

- For the immediate use, a bridge namely Quang Trung shall be built to connect this bridge and the city or a link road and some bridges should be built to make a continuous connection between the bridge and Cai Rang town.

Option No 3

- It is in conformity with the Master Plan of Can Tho city's development.

The proposed bridge location will be about 3.3 km upstream from the present ferry crossing. It will then cross cut a football playground of the military zone No. 9 and some streets of Can Tho city.

Advantages

The location is in conformity with the Master Plan of Can Tho city's development.

Disadvantages :

- The bridge will cut obliquely the river flow

- It cuts through the city, creating problems in settlement of traffic junctions / intersections between Highway No. 1A and city was system which limits traffic movement on Highway No. 1A

- Traffic safety and environmental features are less comparable to option1.

- Lastly since the location is very close to Tra Noc airport, more precautions should be taken when there are high structures built in this Option (such as cable stayed bridge or hanging bridge).

IV. COMPARISON AND RECOMMENDATION OF ALTERNATIVE OPTIONS OF BRIDE LOCATION

Based on advantageous and disadvantageous points of the two options and on the comparision table in term of volume of construction, and taken into consideration of unanimous views of local competent authorities, the Option 1 as primarily assessed is found to be an option more suitable to the Master Plan of Highway No. 1A and to the requirement of the Master plan of the City's development. Option 1 is there for recommendable for selection.

CHAPTER 4

INLAND WATERWAYS IN THE CUU LONG DELTA AND REQUIREMENT FOR NAVIGATION ON THE HAU RIVER AT CAN THO

The Cuu Long Delta has potential and convenient inland waterways through an intensive system of rivers, channels and man-made canals in which the Tien and the Hau are regarded as the "backbone" of this inland waterway system.

In fact, seagoing vessels make travel on the Tien and the Hau through Tien an Dinh An mouths upstream to Phnom Penh.

In accordance with studies which have been adopted in the My Thuan Bridge project, the Tien is recognized to be the international navigation channel to and from Phnom Penh with design capacity of vessels calculated as follows :

Dead Weight Tonnage (DWT)	3610 tonnes
Length overall (LOA)	90.7 m
Width of vessel (beam)	13.0 m
Vessel width	5.7 m
Air draft	28.9

Owing to the previous to the previous agreement with the concerned countries, vertical clearance of 37.5m corresponding to water level + 2m (at the hydrau-metric station) prently remains applied as design standard.

The Hau is not yet recognized as international shipping channel via Vam Nao channel to Phnom Penh. Government of Vietnam has declared to register Can Tho port as a port opened to international vessels (international port) and vessels up to 5000 DWT Capacity have already arrived at this port via Dinh An Mouth.

Can Tho port is a big port in Cuu Long Delta with present capacity of 200,000 tonnes per year.

In future planning, Can Tho port will be shifted to the site near an industrial park in the south side of the city (5 km downstream from the existing ferry crossing) with design capacity from 1 to 2 million tonne yearly and 5000 DWT vessel accommodated. Upstream the existing Can Tho port which is about 5 km from Long Xuyen - provincial town, a port will be established to accommodate 3000 DWT vessels with throughput capacity from yearly 700,000 to 1 million tonnes in accordance with overall planning of An Giang Province.

Phnom Penh port has been designed to accommodate 5000 to 6000 DWT vessels. Generally inland waterway navigation through the Hau is more convenient than that on the Tien. It is, therefore possible to provide bigger vessels to navigate on the Hau to and from Phnom Penh than on the Tien with vertical clearance higher 28.9m.

It is viewed that the recommended location for Can Tho bridge can apply vertical clearance at least 37.5m as adopted for My Thuan bridge.

CHAPTER 5

SELECTION OF TECHNICAL STANDARD CRITERIA AND SIZE OF CONSTRUCTION CAPITAL

I. DESIGN CRITERIA

1. Bridge design criteria

The design criteria is prepared in accordance with structural limits (Bridge design code) issued in 1979 by the Ministry of Transport, taking into account foreign standards, such as snip (CHUTI) 2 - 05 - 03 - 8 of the former Soviet Union or ASSHTO Guide specification (USA).

2. Live load :

In conformity with design traffic loads H30 and XB 80 and other corresponding values.

3. Deck width

Stage 1 (till the year 2015) 2 x 3.5m traffic lanes, 2 x 2.2m motor cycle lanes and 2 x 2m for footways.

Stage 2 (after 2015) be widened into four traffic lanes : 4 x 2.5m traffic lanes, 2 x 2m footways.

4. Earth quake loads : Seismic level 6

5. Design vessel navigation clearance

Navigable clearance + 1.54
Vertical clearance : 37.5 to 40m
Horizontal clearance : 200 to 300 m

6. Bridge Gradient :

Maximum gradient for Can Tho Bridge will be equal to or less than 5%

II. OPTIONS FOR BRIDGE STRUCTURE

1. Main Bridge

It is required that the main girder should be longer than 200m long in order to maintain adequate vertical clearance below the bridge. The main bridge design can follow the following options :

- Pre-stressed concrete balanced cantilever box girder with maximum span of 250m.

- Cable stayed bridge steel girders and reinforced concrete deck with main span of up to 550m .

2. Approach bridge

- Approach bridge will be arranged by 40 - 60m pre-stressed concrete box girder consuetude by incremental launching method.

- 30 to 40m pre-stressed concrete girder constructed by overhead truss erection method with T and I shape segments.

3. Foundation

- For main bridge foundation, cast in - situ large diameter reinforced concrete piles with size of piles from 150 to 200 cm are considered appropriate.

- For approach span foundation, 1.0m diameter spun driven piles. or piles in round shape of 55cm diameter or square shape 45 x 45cm hamerring piles are considered appropriate.

III. ALTERNATIVE OPTIONS OF BRIDGE STRUCTURE

1. Option I :

Span arrangement

930 m + 145m +, 3 x 250 m + 145 + 540m

Total length of the bridge : 2,510m

In which :

Main bridge span is made of pre-stressed concrete balanced cantilever box girders constructed by balanced cantilever method.

Approach bridge spans are made of pre-stressed concrete box girders. constructed by incremental launching method.

- Foundation for main bridge is made of case - in - situ 180m diameter bored reinforced concrete piles.

- Foundation for approach bridge is made of 110 cm diameter reinforced concrete spun driven piles.

2. Option II

Span arrangements

920 m + 264m + 550m + 264m + 360m

Total length of the bridge : 2,358 m

In which :

- Main bridge span is of cable stayed bridge type with two pylons.

- Approach bridge is of pre-stressed concrete grinders constructed by incremental launching method.

Foundation :

It is identical to the pile foundation

In the option I

IV. ESTIMATED COSTS FOR DIFFERENT BRIDGE OPTIONS AND FOR ROAD CONSTRUCTION

1. In order to estimate project costs, some unit costs have been calculated. taking into consideration of similar ones in other projects implemented in the world.

- For main spans by using balanced cantilever PSC : 49.5 million dong per m2 equivalent to US$ 4,500.

- For main spans by using cable stayed deck : 51.7 million dong per m2 equivalent to US$ 4,700 per ms.

- For incremental launching PCS : 15.5 million dong per m2. equivalent to US$ 1,500 per m2.

2. Estimated costs for bridge, approach roads and resettlement are calculated in accordance with prevailing stipulated levels as defined in legal cost level Document No 56/BXD - VKT, and Machine costs level Document No. 57/BXD - VKT issued by the Ministry of Construction on 30 March 1994.

ALTERNATIVE OPTION FOR CONTINUOS PRE STRESSED CONCRETE BRIDGE

Unit = million dong

Sense No	Project components	Unit	Unit cost Mil. Dong	Location Option I		Location Option II	
				Volume	Costs	Volume	Cost
I	Main Bridge (1040 x 16,5) m2	m2	49,5	17160	849420	17160	849420
	Approach Bridge (1470 x 16,5) m2	m2	16,5	24255	400208	24255	400208
	Sub total for main a approach				1.249.628		1.249.628
II	Northern Access Road (including precasted drains)	km	3033	3,65	11.070	5,36	16.257
	North side bridges K=16,5m (width)	m2	13,86	1320	18.295	990	13.721
	Southern Access Road	km	3033	6,65	20.169	10,1	30.633
	South side bridges K=16,5m (width)	m2	13,86	3630	50.312	4125	57.173
	Sub Total				99.847		117.784
III	Cost for compensation of resettlement	m2	0,105	188000	19.740	278800	29.274
	Cost for clearance of 4th class houses	m2	0,42	5376	2.258	5980	2.516
	Cost for clearance of storeyed buildings	m2	1,05	2304	2.419	13978	14.677
	Initial cost and cost for acquisition of land	m2	1,155	7680	8870	19968	23063
	Subtotal for compensation				33288		69530
	Total				1382762		1436941

Note : K = Bridge width

ALTERNATIVE OPTION FOR CABLE STAYED BRIDGE

Unit = million dong

Sense No	Project components	Unit	Unit cost Mil. Dong	Location Option I		Location Option II	
				Volume	Costs	Volume	Cost
I	Main Bridge (1078 x 16,5) m2	m2	51,7	17787	919588	17787	919588
	Approach Bridge (1280 x 16,5) m2	m2	16,5	21120	348480	21120	348480
	Sub total for main a approach				1.268.068		1.268.068
II	Northern Access Road (including precasted drains)	km	3033	3,65	11.070	5,36	16.257
	North side bridges K=16,5m (width)	m2	13,86	1320	18.295	990	13.721
	Southern Access road	km	3033	6,65	20.169	10,1	30.633
	South side bridges K=16,5m (width)	m2	13,86	3630	50.312	4125	57.173
	Sub Total				99.847		117.784
III	Cost for compensation of resettlement	m2	0,105	188000	19.740	278800	29.274
	Cost for clearance of 4th class houses	m2	0,42	5376	2.258	5990	2.516
	Cost for clearance of storeyed buildings	m2	1,05	2304	2.419	13978	14.677
	Initial cost and cost for acquisition of land	m2	1,155	7680	8870	19968	23063
	Subtotal for compensation				33.288		69.530
	Total				1.401.202		1.455.382

Note : K = Bridge width

ROADS TO THE BRIDGE (IN OPTION I)
LENGTH 10.3 KM : WIDTH 13.5 M

Code No	Project Component	Unit	Volume	Unit Cost (đ)	Total Costs (đ)
I	Costs for road construction				99.847.000.000
A	Estimated Erection Costs				86.441.010.000
1	Embankment, transport length 10km	m3	203.225	30.000	6.096.750.000
2	Enforcement of vertical drains	m	59.900	15.400	922.460.000
3	Enforcement of road sides	m2	51.000	30.000	1.530.000.000
4	Asphalt concrete surface 12cm thick	m2	77.660	150.000	11.649.000.000
5	Macadam foundation 50cm thick	m2	77.660	80.000	6.212.800.000
6	Round Culverts 100cm diameter	m	420	1.500.000	630.000.000
7	Bridge 10m x 16.5m x 2 nos	m2	2.310	12.000.000	27.720.000.000
8	Bridge 30m x16,4m x 2nos	m2	2.640	12.000.000	31.680.000.000
B	Other costs	%	10	A	3.644.101.000
C	Contingency cost	%		(A + B)	4.761.889.000
II	Cost for road clearance				33.287.520.000
	Costs for compensations				31.702.400.000
1	For acquisition of land	m2	188.000	100.000	18.800.000.000
2	For clearance of 4th class houses	m2	5.376	400.000	2.150.400.000
3	For clearance of one storey houses	m2	2.304	1.000.000	2.304.000.000
4	For initial cost and acquisition of land	m2	7.680	1.100.000	8.448.000.000
	CONTINGENCY COST 5% (I)	%	5		1.585.120.000

ROADS TO THE BRIDGE (IN OPTION III)
LENGTH 15,46 KM : WIDTH 13.5 M

Code No	Project Component	Unit	Volume	Unit Cost (đ)	Total Costs (đ)
I	Costs for road construction				117.784.000.000
A	Estimated Erection Costs				104.438.120.000
1	Embankment, transport length 10km	m3	401.570	30.000	12.047.100.000
2	Enforcement of vertical drains	m	63.800	15.400	982.520.000
3	Enforcement of road sides	m2	77.000	30.000	2.310.000.000
4	Asphalt concrete surface 12cm thick	m2	116.550	150.000	17.482.500.000
5	Macadam foundation 50cm thick	m2	116.550	80.000	9.324.000.000
6	Round Culverts 100cm diameter	m	608	1.500.000	912.000.000
7	Bridge 60m x 16.5m	m2	990	12.000.000	11.880.000.000
8	Bridge 250m x 16.5m	m2	4.125	12.000.000	49.500.000.000
B	Other costs	%		A	8.643.812.000
C	Contingency cost	%		(A + B)	4.702.068.000
II	Cost for road clearance				69.529.740.000
	Costs for compensations				66.218.800.000
1	For acquisition of land	m2	278.800	100.000	27.880.000.000
2	For clearance of 4th class houses	m2	5.990	400.000	2.396.000.000
3	For clearance of one storey houses	m2	13.978	1.000.000	13.978.000.000
4	For acquisition of house land and initial cost	m2	19.968	1.100.000	21.964.800.000
	CONTINGENCY COST 5% (I)	%	5		3.310.940.000

V. CONCLUSION

Selection of an low-cost and technical effective option will require an intensive study and efforts in the subsequent process of surveys and designs.

Anyhow, through primary comparision of the two options, it is found that Options II of bridge structure where cable stayed bridge type is applied is more preferable on the basis of natural conditions and river mophorlogical flow and creation of surrounding scenery in this area.

CHAPTER 6

ANALYSIS OF ECONOMIC EFFECTIVENESS AND OF ENVIRONMENT IMPACT

I. ECONOMIC EVALUATION

1. General Data

Traffic recorded data carried out in June 1995 at Can Tho ferry crossing indicated.

+ Daily traffic volume : 3073 vehicles/day

- Total number of motor vehicles.

In which :

Motor cycles : 1715

Motor vehicles : 1348 categorized into

399 (tourist) cars

548 buses/passenger vehicles.

461 trucks.

+ Traffic growth across the bridge.

Forecast traffic growth.

- From present till the opening of the bridge (1995-2003) : growth rate (q) = 10%

- 10 years after the bridged opened

(2003 - 2013) : growth rate (q) = 12%

- Subsequent years (after 2013) : growth rate (q) = 8%.

- Discounted rate applied in calculation : 10%

+ Ferry crossing time : $\Delta T1 = 20$ minutes

- Ferry travelling time : 100t ferry takes 10 minutes.

200t ferry takes 15 minutes.

So average ferry travelling time is 12 min.

- Times taken by vehicles to get on board vessels and depart from terminals will be :

2 to 5 minutes for trucks, cars, tourist cars

5 to 10 minutes for passenger vehicles and buses.

Average time taken is 5 min

So average ferry crossing time $\Delta T1 = 37$min.

+ Travelling time taken by vehicles on road : *T2

Vehicles have to pass the existing road section from Cai Von town to the end of Cai Rang town (this endless ferry crossing time) at the average speed of 30km/h due to passing road streets.

Times taken by vehicles will be.

$$\text{Average consumable time} = \frac{12 \times 60}{30} = 24 \text{ min}$$

After the construction of the bridge and with through road connection at average speed of 60km/h.

$$T \text{ Aver.} = \frac{12 \times 60}{60} = 12 \text{ min.}$$

So, after having new bridge and road, travelling time on road will be reduced as :

$\Delta t2$ = 24 min.- 12min.= 12 min.

+ Total time last due to maintaining ferry service.

$\Delta t = \Delta t1 + \Delta t2$ = 37min + 12 min = 49 min/one vehicle trip.

In the following years, ferries and ferry terminals should be strengthened to maintain the specific time as of the present.

2. Evaluation of investment's effectiveness.

a. Project costs : In accordance with the prepared option, total project costs will be 1,401,202 billion Vietnam dong (equivalent to US$ 127.39 million excluding inflation and interests of the loan).

In economic evaluation, assuming that there is a deducted amount of 15% project costs (this amount is tax). The project costs which will be economically evaluated is US$ 108.3 million.

This cost will be devided by 4 construction years as proposed.

COST BENEFIT ANALYSIS OF CAN THO BRIDGE

Unit : 1000 USD

Traff. Growth	Year	Traff. Vol.	Costs (C)		Benefit (B) from					B-C	NPV disc. rate=10%)
			Con.	Main.	Ferry	Ter.	Ferry	Travel time	Bec		
1	2	3	4	5	6	7	8	9	10	11	12
10%											
	1995	1348									
	96	1482									
	97	1631									
	98	1744									
	99	1974									
	2000	2170	30.000							30.000	-39.930
	01	2387	30.000							30.000	-36.300
	02	2626	25.000							25.000	-27.500
	03	2888	23.300							23.300	-23.300
12%	04	3234		500	1400	500	432	6.378		8.210	7.464
	05	3622		500			484	7.143		7.127	5.890

	06	4057		500	1400		542	8.000		9.442	7.089
	07	4544		500		500	607	8.960		9.567	6.553
	08	5098		500			680	10.035		10.217	6.346
	09	5700		500	1400		762	11.240		12.902	7.289
	2010	6384		500		600	853	12.589		13.542	6.945
	11	7150		500	1400		956	14.099		15.955	5.081
	12	8008		500		600	1070	15.791		16.961	7.926

1	2	3	4	5	6	7	8	9	10	11	12
8%	13	8970		500	2000		1199	17.686		20.385	7.871
	14	9687		500			1294	19.101		19.895	6.981
	15	10.462		500		1400	1399	20.629		22.928	7.302
	16	11.300		500	2000		1510	22.279		25.284	7.330
	17	12.203		500			1631	24.062		25.193	6.630
	18	12.203		500		1400	1761	25.987		28.648	6.870
	19	14.243		500	3000		1903	28.066		32.469	7.074
	2020	15.373		500			2054	30.311		31.865	6.300
	21	16.660		500		1400	2219	32.736		35.855	6.449
	22	17.931		500	4000		2397	35.355		41.252	6.752
	23	19.365		500		1400	2586	38.183		41.669	6.201
	24	20.914		500	2000		2796	41.238		45.534	6.153
	25	22.588	30.000	500	2000		3019	44.537		19.556	2.402
	26	24.395	30.000	500	2000	2100	3261	48.100		25.461	2.845
	27	26.346	25.000	5000	2000		3521	51.948		32.469	3.296
	28	28.454	23.300	500	2000	2100	3803	56.104		40.707	3.759
	29	30.730		500	2000		4108	60.592		66.200	5.554
	2030	33.189		500	3000	2100	4436	65.438		74.474	5.681
	31	35.844		500	2000	1400	4791	70.675		78.366	5.435
	32	38.711		500	3000		5174	76.329		84.003	5.297
	33	41.808		500	3000	2800	5588	82.436		93.324	5.348
											182.132

First year	US$ 30 million
Second year	US$ 30 million
Third year	US$ 25 million
Fourth year	US$ 23.3 million

Year of project commencing and completing will be 2000 and 2003 respectively.

+ Yearly maintenance costs.

Every year, it takes US$ 500,000 to spend for regular maintenance.

b. Benefits.

b-1. Saving in travelling time.

* Saving in personal travel time. Saving is calculated with assumption that personal one hour lost is valued at US$ 0.12 and total number of passengers crossing river by ferry is 7.25 million per year (as of 1995).

B11 = 0.12 x 7.25 x 105 x 49/60 = US$ 0.71 million

* Assumming that saving from vehicle operating costs as being applied in some foreign invested projects in Vietnam (this cost is identical to that calculated available in Vietnam) will be.

US$ 2.0 for car

US$ 5.8 for truck and buses

B12 = (1,009 x 5.8 + 339 x 2.0) 365 x 49/60

= (5,882.2 + 678) x 298 = US$ 1,946.544 mil

Total benefits in term of time saving.

B1 = B11 + B12 = US$ 2,56544 mil

b.2. Saving in the cost of strengthening of ferry infrastructure capacity (ferries and ferry terminal structure)

In comparison between benefits and costs for the bridge construction and that of maintaining ferry service, it is assummed that corresponding to the increase of traffic demand, more capital will be needed to provide additional ferries and terminal infrastructure, and operation cost of ferries.

Assumed also that the current volume of traffic is 1348 vehicles per day that needs 7 ferries, terminals with two landings at each side.

This means that for additional 200 vehicles per day, one additional ferry will be required.

The calculation is therefore detailed with assumption that.

- An additional 200 vehicle trips per day, it is required one 100 tonne capacity ferry with operating cost of US$ 200,000 per ferry.

- An additional 1500 vehicle trips per day shall require one additional landing position with estimated costs of US$ 500,000 to 700,000 per one ferry landing location and access roads.

b.3. Saving from ferry operating cost.

In order to maintain the current operation of ferries, it is required to spend an amount of US$ 180,000 covering.

- Cost for maintaining ferry operation : US$ 130,000

- Cost for dredging : US$ 50,000

Benefit accrued from savings in ferry operation costs and time reduction is calculated on the basis of the current traffic (as of 1995) and so correspondingly added up with traffic increase in the following years.

3. Conclusion, economic evaluation of this project will be.

- Net present value = US$ 55.102 mil. (NPV)

- Rate : benefits over costs = US$ 1.43 (B/C)

- Economic rate of internal return = 12.7% (EIRR)

II. EVALUATION OF ENVIRONMENTAL EFFECTS.

1. Impact of the project to environment.

The Cuu Long River Delta in general and Can Tho city in particular have more and more cost the natural environment in their life evolution. The process of urbanisation has turne he natural forests and wild animals into human communities and man-made works. The proposed major construction works as the Can Tho bridge will therefore have impacts on regional ecosystem in terms of the following issues.

- Area of cultivated land is reduced due to the occupancy of land for the construction of approach/access roads and traffic intersections as well as the expected resettlement of some communes in new places.

In addition, ferry management staff and pedlars trading on the ferry and ferry access roads have changed their jobs when the bridge construction is completed. A great consideration should be given to the problems of the use of cultivated land, relocation of people and job creation of the affected commune groups, when the project is formulated.

- When the works is put into operation, not only the bridge brings in good scenery to the surrounding area but also disturbs the life style of areas adjacent to the both sides of the river ; noise generated by traffic movement, vehicle exhaust fumes and hazards might affect the surrounding environment including the effects to the Hau due to the sewage disposal released into the river. Although this area is still covered by plenty green trees and not densely populated, the possible polluted effects will mitigate, if bridge is built across the city. Appropriate measures to limit such effects should be given.

- Traffic safety on and under the bridge should be duely considered during the phase of detailed design. Intersections between the Highway No.1A and city roads should be arranged in good manner with adequate signs and signals. Traffic safety of inland water way under the bridge should be properly considered to ensure the safety of vessels, prevent from collision between a ship and bridge piers and erosion of each ride of river bank.

- During the process of bridge construction, should construction not be well monitored, ecosystem of the surrounding environment shall be considerably affected such as noise and disturbance of equipment operation and air-born pollutants and dust etc. ..., which released into the air affecting health, ecosystem and underground water quality. In addition, since the construction period might take 4 to 5 years, operation of transport vehicles in the materials handling, soil excavation and machine site workshop shall deteriorate the surrounding sights.

These adverse effects should be scientifically taken care of whilst planning and performing construction phases.

- Other social impacts should also be fully anticipated such as income source, dislocation of dwellings, job creations to make use of labour force.

mitigation of social evils and contagious diseases and other psychologica percepsion of local people which might occur during the period of construction.

2. Measures to mitigate environmental impacts.

The section of bridge location option where its alightment be designed in the vicinity of the city will have active significance in solving the problem of environmental pollution, occupation of houses and cultivated land, and limiting the problem of people's material and moral welfare. On other hand, the attractive appearance of a new route in the local and adjacent areas, especially in terms of further trading activities will contribute to economic welfare of those unemployed due to the bridge construction. How to gain these objectives depend much upon the organization and assortment by the control and local Governmental agencies.

All plans to mitigate pollution should be carried out right away in the process of design and construction in order to limit noise and vibration of the equipment. All disposals should be collected in a designated place in accordance with regulations stipulated, and hazardz should be treated before released so that ecosystem related to river system and underground waters can be prevented.

It's necessary to establish social and environmental organs and programmes to monitor, assist and settle any matters related to the living conditions and life-hood of the people, not only in the construction period but also the past construction period.