4) The delivery from outside to Phnom Penh by river passing through Vietnam territory should be kept a enough time.

5) Road RN 5 passes under the approach span of the bridge. It must be considered to ensure the safety for the traffic passing through the site during the construction period.

4-4-4 Detailed Design and Construction Supervision Plan

(1) Basic Policy of Detailed Design and Supervision

a) Detailed Design

It would be most appropriate to proceed with the detailed design by the Consultant which has undertaken the basic design study. This will contribute to the cost saving, as the work is required to be done in a short period of time and furthermore he fully understands the design policy than anybody else.

b) Construction Supervision

As described above, it would be most appropriate that the construction supervision is to be carried out by the Consultant which has performed the detailed design. A local staff will be requested to participate in the supervision services to supplement the needs of the Consultant in such a manner that the transfer of technical know-how can be made satisfactorily.

(2) Organization of Implementing the Detailed Design

In the preparation of the detailed design including the tender documents after the consulting contract was entered into, the Japanese staff composed of the following expertises will be needed:

a) General tasks
b) Bridge superstructure design
c) Bridge substructure design
d) Foundation design
e) Approach road design
f) Construction plan and cost estimate

(3) Organization of Implementing Supervision

The tender evaluation will be performed by the Japanese staff. With reference to the supervision organization during the construction period, a Japanese resident engineer as well as some supervisory engineers for cardinal portions of works as outlined below will be required. In addition, some local staff will be employed as auxiliary staff.

a) Resident engineer
b) Foundation engineer
c) Bridge superstructure engineer
d) Road repair engineer

4-4-5 Procurement Plan for Materials

(1) Materials Procurement

The materials needed in the construction, in principle, will be procured locally in so far as they are available.

a) Materials to be procured locally

The materials mentioned below can be made available within the city of Phnom Penh with adequate quantity and quality:

① Coarse aggregate for concrete work
② Fine aggregate for concrete work
③ Cement (produced in Indonesia and/or Thailand)
④ Concrete forms

b) Materials to be procured in Japan

① Steel box girder with steel plate deck bridge
② Steel pipe pile and steel pipe sheet pile for foundation
③ Bridge shoe
④ Reinforcing steel deformed bar
⑤ Shape steel for wale and strut

c) Procurement other than from Japan

Principal materials will be procured from Japan and from Cambodia, therefore, no procurement other than from Japan can be considered fundamentally.

(2) Procurement of Construction Equipment

There is no big scale company to lend out any construction equipment within the city of Phnom Penh. Because of this, all of the cardinal construction equipment need to bring from outside of Cambodia and to bring back to there. Procurement from Singapore which is a neighboring country is thinkable. The proposed main construction equipment to be brought from outside of Cambodia are as tabulated in Table 4.8 shown below.

Table 4.8 List of Proposed Main Construction Equipment to be Brought from Outside

Type of Equipment	Specifications	Application
Floating crane	1,000 ton suspension	For erection of superstructure
Steel pontoon with 150 ton crawler crane	1,500 ton	For foundation works
Steel pontoon with 50 ton crawler crane	1,000 ton	For foundation works
Tag boat	250 PS	For steel pontoon
Truck crane	35 ton suspension	For assembling of superstructure
Oil jack	300 ton capacity	For assembling of superstructure
Vibro hammer Water jet cutter	90 kW, 150 kW	For foundation works
Concrete mixer ship	0.5 m^3 mixer	For piers
Concrete boom car	65 m^3/hr	For piers
Diesel hammer	W = 7.0 ton	For foundation works
High pressure grout pump		For foundation works
Grant mixer	800 lit. x 2	For foundation works

4-4-6 Implementation Schedule

Implementation schedule for this project scheme will be such that the consultant's contract will be entered into after the Exchange of Notes for the detailed design and supervision has been concluded, and the detailed design and the preparation of the design drawings and tender documents will be prepared.

The construction schedule will comprise the tendering, tender evaluation and construction. The tendering and the tender evaluation will take about 2.0 months, and the construction period was estimated to 16 months time. These activities are presented in the form of the bar chart as seen in Table 4.9. The whole construction scheme will be divided into two phases due to the restriction of the budget.

(1) Detailed Design (Phase I & II)

As soon as the Exchange of Notes has been concluded the consultant's contract should be entered into immediately. The work will primarily comprise the preparation of the design drawings and the tender documents, all of which are necessary to the commencement of the construction works.

(2) Tender and Contract (Phase I & II)

In the first step, the Consultant will carry out the contractor's prequalification on behalf of the executing agency of the Cambodia. The tender evaluation as well as the selection of a successful tenderer will be conducted in the presence of the JICA officials, and the authorities of the Cambodia. Consultant's staff and tenderers will attend thereto.

(3) Construction Work (Phase I & II)

The construction work comprises a variety of works such as, mobilization, preparatory works, delivery of materials, foundation work, substructural work, superstructural work, bridge deck work, approach road repair work and some incidental works related thereto. It is mandatory to prepare a realistic construction planning taking into account a possible high water level which will take place in the rainy season on the river.

The Phase I of the construction covers as far as the erection of superstructure.

(4) Implementation Time Schedule

Because of the short construction period and the limitation of foundation works, the total implementation schedule is very tight as shown in the drawing.

Phase I of the construction	:	12 months
Phase II of the construction (parallel work to Phase I)	:	7 months

Total construction period is estimated at 16 months.

Table 4.9 Implementation Schedule

Description		Month 1	2	3	4	5	6	7	8	9	10	11	12	Required Period (month)
Phase-1	Detailed Design	Field Survey												4
			Works in Japan											
						Field Survey								
	Construction		Preparatory Works											12
				Substructure Works										
											Superstructure Works			
Phase-2	Detailed Design	Field Survey												6.5
			Works in Japan											
							Field Survey							
	Construction		Preparatory Works											7
				Construction										

4-4-7 Scope of Work

The division of works to be shared by both countries with respect to the execution of this project scheme will be as summarized in the following:

a) Works to be undertaken by the Japanese side

- Construction of the new bridge foundations, and piers;
- Repair of approach roads;
- Construction of bridge superstructures, bridge deck, shoes, bridge deck pavement, expansion joints and bridge hand-rail and placing lane marks over the pavement;
- Installation of water drainage and lighting facilities over the bridge deck;
- Expenses of using water, electric power and telephone which are necessary in performing the construction works referred to above; and
- Cost of the Consultants required in the implementation of the construction works.

b) Works to be undertaken by the Cambodia side

- Land clearing at site for temporary works;
- Traffic control at the site during the course of the construction works;
- Others such as,

  ① To provide tax exemption privilege in Cambodia for materials to be delivered and to ensure smooth customs clearance and convenience of inland transportation;

  ② To insure the Japanese nationals to be exempted from any taxes, duties, fees, levies and other impositions imposed under the laws and regulations in effect in the Cambodia for the performance of the services and the products furnished under the authenticated contract;

③ To ensure appropriate maintenance and use of the bridges and roads constructed under the Japanese Grant Aid; and

④ To bear all of the expenses other than those related to the Japanese Grant Aid, which are necessary to deliver the materials and the construction of the bridges and roads.

4-4-8 Maintenance Operation Plan

(1) The present condition of maintenance operation for bridges

The maintenance operation for bridges within the country is not carried out at all. Due to this reason, it is afraid that the durability of the bridges might be shortened.

(2) Establishment of maintenance organization

Road and Bridge Department will be in charge of the bridges under this project and the budget allocation is not enough and not divided into construction and maintenance separately and therefore, no adequate administrative control can be expected. In view of this, the understanding of the importance of the maintenance operation will be emphasized through the construction activities.

(3) Major points of maintenance

Some of the cardinal itemized maintenance with respect to the completed bridges will be as follows:

a) Damages to the bridge hand-rail and pavement caused by collision of vehicles;

b) Corrosion of the steel girders and bearing shoes caused by rain water and/or dust;

c) Damages to the approach road for bridges due to deterioration as traffic volume increases.

Particularly, it is necessary to emphasize that the area on the bridge and approach road should be kept clean habitually.

Chapter 5: Project Evaluation and Conclusion

CHAPTER 5: PROJECT EVALUATION AND CONCLUSION

5-1 Project Evaluation

The Project Site lies on National Route 6A which serves nine provinces in the north-east region of the country, having a population of 3 million. The Chroy Changwar Bridge, which is located on this route as a starting point, was only one bridge transverse over the Tonle Sap river. The bridge has played a vital role to connect Phnom Penh City with the north-eastern region through Routes 6A, 6 and 7. The restoration of the bridge has been given the highest priority in the improvement plan of infrastructure in Cambodia.

Yet 444m long bridge structure out of 709m long original bridge remains usable and only 265m long collapsed central three spans make this bridge unusable and connecting National Route 6A was not used for the past twenty years.

In case that the 265m long central span is reconstructed Chroy Changwar Bridge as well as National Route 6A will be able to be restored. Thus, it is obvious that the Project can expect economically high return. The major significance of the Project are summarized as follows:

1) The eastern side of the Tonle Sap River had been developed as a growth pole in Phnom Penh metropolitan since Chroy Changwar Bridge was constructed in 1963. Nevertheless, the urban function, population and socio-economy have declined considerably after the central span of the bridge was collapsed. Therefore, high development impact in both Phnom Penh and the eastern side of the Tonle Sap River can be expected after the bridge becomes passable to traffic.

2) The connecting National Route 6A has been suffered damages from the civil war and floods and has been disrupted at several points. However, starting the 11km stretch is still in passable condition. Therefore, it is possible to make use of National Route 6A partially.

In addition, the following effects are expected:

1) It will enable to facilitate and promote the rehabilitation of National Route 6A.

2) It will be possible to make realistic a new Phnom Penh port which is planned along the Mechong River in the Chroy Changwar area.

3) It will be possible to supply water, power and telecommunication to the eastern side of the river along to the bridge. The Project will promote the stabilization of livelihood to satisfy the Basic Human Needs (BHN), and improve the level of life in the Chroy Changwar area.

4) It will be possible to create effective job opportunities for returnees and demobilized soldiers. It will also contribute to stabilize public welfare.

5) It will raise the quality skilled labours whom the reconstruction and development of the country will require to a large extent.

6) At present, local traffic consisting of pedestrians, bicycles and motorcycles are forced to use small boats to cross the river and pay a charge. The transport cost will be reduced after the completion of the Project.

5-2 Conclusion

In view of the above-mentioned effects, the implementation of the Project is indispensable not only for providing Chroy Changwar Bridge for use as a traffic function, but also for promoting the stabilization of livelihood and improving the level of life.

Thus, it is concluded that the implementation of the Project by Japan's Grant Aid System is evaluated as appropriate.

Appendices

APPENDICES

Appendix-1	Member List of the JICA Survey Team
Appendix-2	Schedule of Study Team
Appendix 3	Member List of Counterpart Agency
Appendix-4	Signed Minutes of Discussions
Appendix-5	Survey Results
Appendix-6	Preliminary Study on the Rehabilitation of National Route 6A

Appendix-1: Member List of the JICA Study Team

Team Leader

Name	Mr. Yutaka Yokoi
Present Post	Deputy Director, Grant Aid Division
	Economic Cooperation Bureau, Ministry of Foreign Affairs

Bridge Planner

Name	Mr. Minoru Fujiwara
Present Post	Director, Structure and Bridge Department
	Public Works Research Institute, Ministry of Construction

Road and Traffic Planner

Name	Mr. Shiro Takada
Present Post	Deputy Director, Engineering Department
	Honshu-Shikoku Bridge Authority

Grant Aid Planner

Name	Mr. Takeo Kai
Present Post	Civil Engineering Development Specialist
	Institute for International Cooperation, JICA

Project Coordinator

Name	Mr. Yuki Aratsu
Present Post	Study Division Second Basic Design
	Grant Aid Study and Design Department, JICA

Technical Experts

Name	Assignment
Mr. Takesi Nakayama	Chief, Overall Design Manager
Mr. Yoshinori Kotani	Structure Engineer
Mr. Yuichiro Motomura	Transport Planner
Mr. Osamu Nogoshi	Geodetic Engineer
Mr. Sakae Takada	Geo-technical Engineer
Mr. Kenji Maruoka	Highway Engineer
Mr. Hiroyuki Endo	Construction Management/Cost Estimator
Mr. Kazuhiro Ogawa	Translator/Interpreter

Appendix-2: Schedule of Study Team

Date	Activities
For the 1st Field Survey	(from April 5 to May 26, 1992)
April 5 (Sunday)	M/S Nakayama/Maruoka/Ogawa departed from Narita Arrived in Bangkok
April 6 (Monday) (National Holiday in Thailand)	Data Collection and making preparatory work for site survey in Bangkok
April 7 (Tuesday)	M/S Nakayama/Maruoka/Ogawa departed from Bangkok Arrived in Phnom Penh Internal meeting with staff of EOJ
April 8 (Wednesday)	Courtesy call on Road and Bridge Department Explanation of contents and tentative schedule of the field survey
April 9 (Thursday) - April 14 (Tuesday)	Field Investigation Mr. Nogoshi arrived in Phnom Penh (April 13)
April 15 (Wednesday) (National Holiday)	M/S Yokoi/Fujiwara/Takada/Kai/Aratsu arrived in Phnom Penh Internal meeting with staff of EOJ
April 16 (Thursday) (National Holiday)	Site inspection with RBD Mr. Motomura arrived in Phnom Penh
April 17 (Friday)	Courtesy call on Ministry of Communications, Transport and Post Discussion with RBD about Minutes of Discussion

April 18 (Saturday) - April 19 (Sunday)	Inspection on Routes No. 3 and 4
April 20 (Monday)	Inspection on Route 6A Mr. Takeda (PCI) arrived in Phnom Penh
April 21 (Tuesday)	Courtesy call on Ministry of Foreign Affairs Discussion with RBD about Minutes of Discussion Signing of Minutes of Discussion Attended MCTP's dinner party
April 22 (Wednesday)	Mr. Yokoi left Phnom Penh for Bangkok Conducted field survey
April 23 (Thursday)	M/S Fujiwara/Takada/Kai/Aratsu visited EOJ to discuss the results of survey
April 24 (Friday)	M/S Fujiwara/Takada/Kai/Aratsu left Phnom Penh for Bangkok Conducted field survey
April 25 (Saturday) - May 2 (Saturday)	Technical studies and field survey Mr. Nogoshi left (April 25) Mr. Motomura left (April 26)
May 3 (Sunday)	M/S Nakayama/Maruoka/Ogawa left Phnom Penh for Bangkok
May 26 (Tuesday)	Mr. Takada (PCI) left Phnom Penh

Date		Activities
For the 2nd Field Survey (from July 12 to August 2, 1992)		
July 12	(Sunday)	Departed from Narita Arrived in Bangkok
July 13	(Monday)	Site Investigation, Data Collection and Survey
July 14	(Tuesday)	Site Investigation, Data Collection and Survey
July 15	(Wednesday)	Site Investigation, Data Collection and Survey
July 16	(Thursday)	Courtesy call on Cambodian Government Agencies and Embassy of Japan
July 17	(Friday)	Site Investigation, Data Collection
July 18	(Saturday)	Explanation of Interim Report
July 19	(Sunday)	Site Investigation
July 20	(Monday)	Data Collection
July 21	(Tuesday)	Discussion with RBD
July 22	(Wednesday)	Discussion about Bridge Repair
July 23	(Thursday)	Survey
July 24	(Friday)	Geological Survey
July 25	(Saturday)	Hydrological Survey
July 26	(Sunday)	Discussion with RBD about Minutes of Discussion
July 27	(Monday)	
July 28	(Tuesday)	Signing of Minutes of Discussion
July 29	(Wednesday)	Survey
July 30	(Thursday)	Geological Survey
July 31	(Friday)	Hydrological Survey
August 1	(Saturday)	Hydrological Survey
August 2	(Sunday)	Arrived at Narita

Date		Activities
For the 3rd Field Survey (from September 21 to September 30)		
Sep. 21	(Mon.)	Departed from Narita Arrived in Bangkok
Sep. 22	(Tue.)	Lv. Bangkok Ar. Phnom Penh Mr. Nakayama/Endo/Kotani/Ogawa - Courtesy call on Japanese Embassy/MOFA - Meeting with RBD/MCTP Draft Final Report Draft Minutes of Discussion
Sep. 23	(Wed.)	- Meeting with RBD/MCTP - Courtesy call on MOP
Sep. 24	(Thu.)	Ar. Phnom Penh Mr. Fujimoto/Sasaki - Meeting with RBD/MCTP - Courtesy call on MCTP, MDP, MOFA - Signing of Minutes of Discussion
Sep. 25	(Fri.)	- Meeting with RBD/MCTP on the further process of the Project - Site visit (E/N)
Sep. 26	(Sat.)	- Site visit - Internal meeting
Sep. 27	(Sun.)	Lv. Phnom Penh Mr. Fujimoto/Sasaki
Sep. 28	(Mon.)	- Confirmation on the further process
Sep. 29	(Tue.)	- Lv. Phonm Penh Mr. Nakayama, Endo, Kotani, Ogawa
Sep. 30	(Wed.)	Arrived at Narita

Appendix-3: Member List of Counterpart Agency

Mr. So Khun	Minister, Ministry of Communication, Transport and Post
Mr. Uk Chaun	Director, Road and Bridge Department
Mr. Toch Chaun Kosal	Deputy Director, Technical and Planning
Mr. Em Sophy	Deputy Director, Administration
Mr. Roy Van	Deputy Director, Finance
Mr. Toch Chaun Prekal	Deputy Director of Bridge Construction Company
Mr. Tong Poeng Song	Chief of Administration Office
Mr. Pheng Sovicheano	Chief of Road and Bridge Survey Group
Mr. Men Vichet	Assistant of Director
Mr. Keo Leap	Staff of Technical Office
Mr. Thong Chautha	Staff of Technical Office

Appendix-4: Signed Minutes of Discussions

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MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY ON

THE PROJECT FOR REPAIR OF CHROY CHANGWAR BRIDGE

IN CAMBODIA

In response to a request from the Government of Cambodiana, the Government of Japan decided to conduct a Basic Design Study on the Project for Repair of Chroy Changwar bridge (herinafter referred to as the Project), and entrusted the study to the Japan International Cooperation Agency (hereinafter referrered to as "JICA").

JICA sent to Cambodia a study team, which is headed by Mr. Yutaka YOKOI, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, and is scheduled to stay in the country from April 13 to May 7, 1992.

The team held discussions with the officials concerned of the Government of Cambodia and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items described attached sheets. The team will proceed to further works and consider about preparing the Basic Design Study report.

Phnom Penh April 21, 1992

横井裕

Yutaka YOKOI
Leader
Basic Design Study Team
JICA

SO KHUN
Minister
Ministry of Communication, Transport and Post
for Supreme National Council

ATTACHMENT

1. Objective

The objective of the Project is to repair the bridge over the Tonle Sap River to contribute toward the enhancement of the nation's economic activities..

2. Project Site

The location of the Project site is shown in Annex I.

3. Executing Agency

Road and Bridge Department (R B D). Ministry of Communication, Transport and Post is the Government agency responsible for the implementation of the Project.

4. Contents of request from the Government of Cambodia

After discussions with the Basic Disign Study Team, the following items were finally requested by the Cambodian side.

1)	Bridge Length	:	709 m (Collapsed Portion 265 m)
2)	Superstructure	:	Steel Box Girder with Steel Plate Deck
3)	Pier Columns	:	Reinforced Concrete
4)	Foundations	:	Spread Foundation
5)	Number of Lanes of Bridge and Approach Roads	:	2 Lanes (One Lane Each Direction) with Cycle Track and sidewalk
6)	Width of Bridge	:	7.0 m wide (3.50m x 2) for Bridge with 3.80m wide (1.90m x 2) for Cycle Track and 2.20m wide (1.10m x 2) for sidewalk

However, the final components of the Project will be decided after further studies.

5. Japan's Grant Aid System

(1) The Government of Cambodia has understood the system of Japan's Grant Aid explained by the team

(2) The Government of Cambodia will take necessary measures, described in Annex II for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

(3) Budget for Undertakings by Cambodian Side

RBD has agreed to secure the budget for fulfiling the undertakings to be covered by Cambodian side before the Project starts.

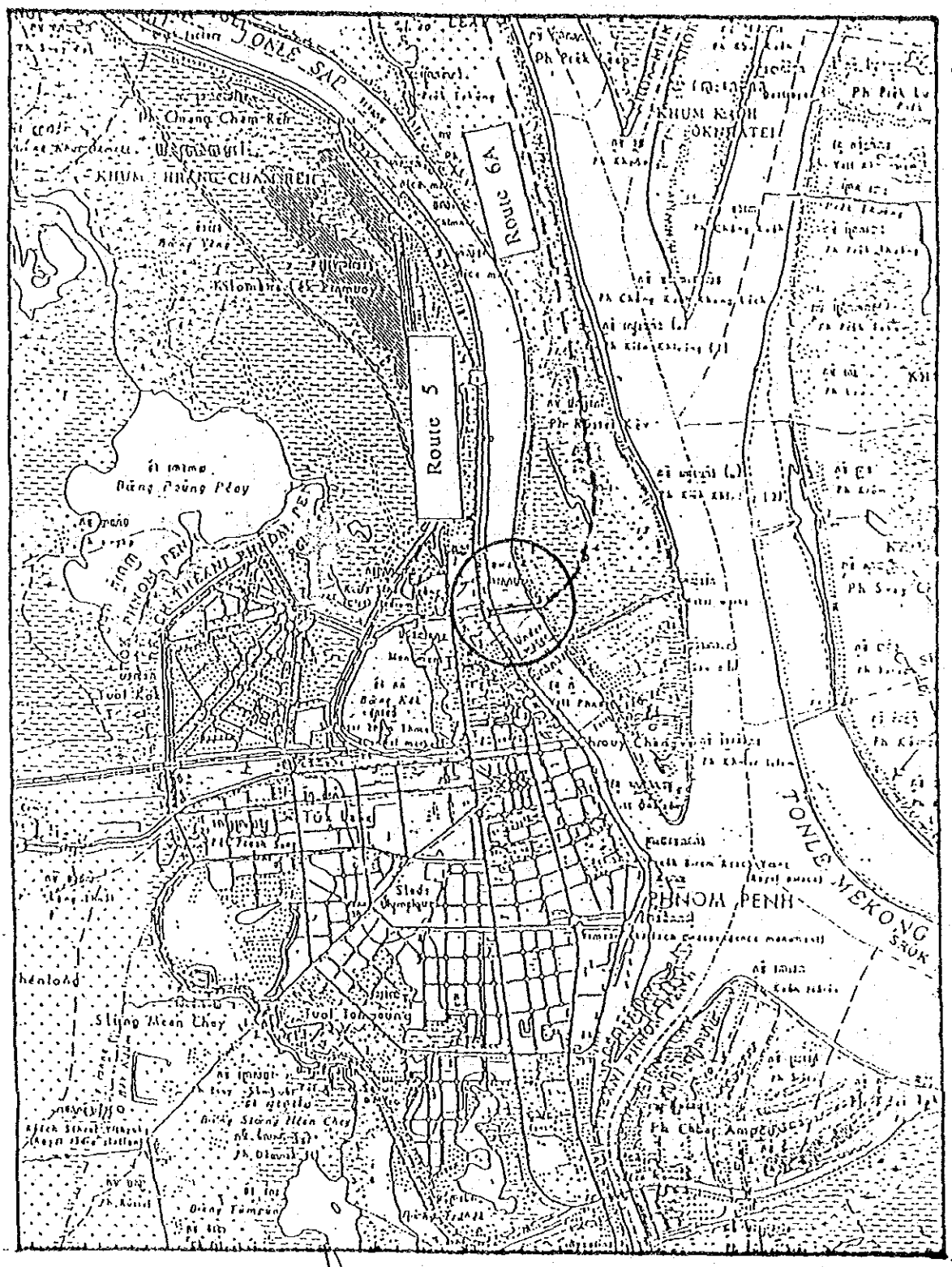
(4) Necessity and Urgency of Rehabilitation of Route 6A

RBD stressed the necessity and urgency of rehabilitation of Route 6A (approximately 42 km) as well and requested the Study Team to convey his intention to the Government of Japan.

6. Schedule of the Study

The consultants will proceed to further studies in Cambodia until July 1, 1992.

ANNEX I



Project Location Map

ANNEX II

Necessary measures to be taken by the Government of Cambodia.

1. Major undertakings to be taken by each government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	Repair of bridge structures and approach roads	0	
2	Secure the necessary space and provide the spaces for the base camps (office, residence, stock yard and motor pool), aggregates processing and mixing plant and other necessary temporary works		0
3	Control of ferry operation during the construction		0

2. Other items

1) To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the Project at the port of disembarkation.

2) To exempt study members from income taxes and other fiscal charges payable under the legislation of the Government of Cambodia in respect of any emoluments or allowances remitted to them from overseas.

3) To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into Cambodia and stay therein for the performance of their work.

4) To maintain and use properly and effectively that the facilities repaired and equipment purchased under the Grant.

5) To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and the installation of the equipment.

6) To ensure prompt processing of required internal formalities to secure the implementation time schedule of the Project.

7) To ensure the safety of study members when and as it is required in the course of the study.

ក្រសួងគមនាគមន៍ដឹកជញ្ជូន និងប្រៃសណីយ៍

រដ្ឋកម្ពុជា

ឯករាជ្យ សន្តិភាព សេរីភាព សុភមង្គល

ភ្នំពេញ, ថ្ងៃទី 11 ខែ 04 ឆ្នាំ ១៩៩២

សូមគោរពជូន លោក យូតាកា យូកូយ ប្រធានក្រុមសិក្សាគម្រោងជាមូលដ្ឋាន
នៃ អង្គការ ចៃកា

លោកប្រធាន

ផ្អែកទៅតាមសំណូមពររបស់លោកក្នុងលិខិតដែលលោកបានផ្ញើជូនយើងខ្ញុំ និងទៅលើភាពចាំបាច់ស្តីពីការធានាអះអាងទៅលើភាពសុខសាន្តនិងសុវត្ថិភាព ទាក់ទិនទៅនឹងគំរោងការជួសជុលស្ពានជ្រោយចង្វារទៀងវិញនោះ យើងខ្ញុំយល់ឃើញថាការងារការពារសុខសុវត្ថិភាពដល់សមាជិកសិក្សាស្រាវជ្រាវ បុគ្គលិកអ្នកម៉ៅការ និងសម្ភារៈផ្សេងៗទាំងអស់ដែលត្រូវចុះអនុវត្តការងារសិក្សាស្រាវជ្រាវស្ពានជ្រោយចង្វារនោះ ជាវិធានការដ៏ចាំបាច់បំផុតដែលពុំអាចខ្វះបាន ហើយយើងខ្ញុំសូមធានា និងចាត់វិធានការណ៍ការពារសុវត្ថិភាពអោយបានដ៏ល្អ ដល់បុគ្គលិក អ្នកម៉ៅការ និងសម្ភារៈទាំងឡាយសំរាប់ការងារសិក្សាស្រាវជ្រាវស្ពានជ្រោយចង្វារនោះ ។

សូមលោកប្រធាន ទទួលនូវសេចក្តីគោរពរាប់អានដ៏ខ្ពង់ខ្ពស់អំពីយើងខ្ញុំ ។

ជ/រដ្ឋមន្ត្រីក្រសួងគមនាគមន៍ដឹកជញ្ជូន និងប្រៃសណីយ៍

ស. ខុន

Mr. Yutaka Yokoi
Team Leader
Basic Design Study Team
JICA

Dear Sir,

Re : Confirmation of Safety related to the Chroy Changwar Bridge Repair Project

The Project for the repair of Chroy Changwar Bridge has been given the highest priority in the plans for the improvement of the infrastructure in Cambodia.
In the light of its importance and urgency, the Government of Cambodia is also aware that it is indispensable to secure the safety of study members and the contractor and his sub-contractors, appointed to perform the work, especially against explosive materials.
The Government of Cambodia confirms that it will take the necessary measures to secure the safety of personnel and project materials at the project site, on access, haul and approach roads and related areas during whole period of the project.
The Government of Cambodia also understands that this project shall not be implemented without securing safety.

Very Truly Yours

So Khun
Minister

Ministry of Communication,
Transport and Post

Minutes of Discussion
Basic Design Study on
the Project for Repair of Chroy Changwar Bridge
in Cambodia

Based on the results of the Basic Design Study (Phase-I), the Japan International Cooperation Agency (JICA) decided to conduct the Basic Design Study (Phase-II) on the Project for Repair of Chroy Changwar Bridge (hereinafter refrred to as "the Project").

JICA sent to Cambodia a study team, which is headed by Mr. Minoru Fujiwara, Director, Structure and Bridge Department, Public Works Research Institute, Ministry of Construction and is scheduled to stay in the country from July 13 to August 1, 1992.

The team held discussions with the officials concerned of Cambodia and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets. The team will proceed to further works and consider about preparing the Basic Design Study report.

Phnom Penh July 28, 1992

For H.E. HOR NAMHONG, member of
S.N.C., Coordinator for Economic
Cooperation with Japan

M. Fujiwara

MINORU FUJIWARA
Leader
Basic Design Study Team
JICA

TRAM IV-TEK
Vice Minister
Ministry of Communication,
Transport and Post (MCTP)
of Cambodia

Attachment

1. Project Title

The bridge name in the project title was corrected as "Chroy Changwar" from "Chroy Chamgwar".

2. Project Profile

The project profile is shown in Annex I.

3. Design Criteria

Road and Bridge Department (RBD), MCTP has confirmed that the design criteria for the first grade bridge specified in Specification for Highway Bridges of Japan will be adopted to conduct the design of the Project.

4. Sub-Contractor and Labourer

RBD/MCTP has confirmed that there will be some possibility that Non-Japanese and Non-Cambodian Nationalities will be involved as sub-contractors and labourers of the contractor for the Project as well as of the study team.

5. Outline of the Project

After the study team held discussions with RBD/MCTP, the outline of the Project was finally confirmed as follows:

1) 265m long New Bridge Construction

a) Bridge Span Arrangement	:	65m + 135m + 65m
b) Type of Superstructure	:	Steel Box Girder with Steel Deck
c) Type of Pier Columns	:	Reinforced Concrete
d) Type of Foundations	:	Well with Steel Pipe Sheet Pile
e) Number of Lanes of Bridge and Approach Roads	:	2 Lanes (One Lane each direction) with Cycle Track and Sidewalk
f) Width of Bridge	:	7.0m wide (3.50m x 2) for Through Lanes with 3.80m wide (1.90m x 2) for Cycle Track and 2.20m wide (1.10m x 2) for Sidewalk

2) Other necessary works as described in 6. of this Attachment

6. Cost Demarcation of the Project Items

No.	Items	To be covered by Grant Aid	To be covered by Cambodia
1.	Secure and provide the spaces for the Site and other necessary temporary works		o
2.	Control of vessels across under the bridge, access to/from Phnom Penh Port and control of ferry operation during construction		o
3.	Construction of superstructure in between piers No.3 and No.6	o	
4.	Construction of No.4 and No.5 pier columns and foundations	o	
5.	Repair of damaged approach roads including approach slab	o	
6.	Removal of old surface pavement and construction of surface pavement on bridge and approaches	o	
7.	Removal of rust, repair of local damages and repainting on the bridge	o	
8.	Local reinforcement of the existing substructures, if any	o	
9.	Installation of illumination above bridge and approaches	o	
10.	Supply of power line from Substation to Distribution Board for illumination on bridge and approaches		o
11.	Reinstatement of median strip, channel islands, traffic signals, traffic signs, guard rail, fence, separator, plantation, right-of-way stakes or monuments, lighting, etc.	o	

No.	Items	To be covered by Grant Aid	Cambodia
12.	(1) Reinstatement of damaged pavement on the existing road caused by the Japanese bridge works	o	
	(2) Other part of damaged pavement		o
13.	Road traffic controlling during construction		o
14.	Traffic management facilities for road and river during construction : cones, barricades, rope, twinkler sign board, and pre-warnig signs and lights	o	
15.	Supply of water pipe, power line and telephone cable to the Site for construction work		o
16.	Charge for installation and use of water supply, power and telephone of the Site during construction	o	

Note : 1) The Site means construction site, project office, housing for labour, motor pool, material stockyard and assembling yard as shown in Annex II.

2) Item Nos. 1, 10 and 15 described here-above shall be completed and be brought into use by the end of November, 1992.

7. Necessary Measures to be taken by Cambodian Side

1) To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the Project at the port of disembarkation.

2) To exempt study members from income taxes and other fiscal charges payable under the legislation of Cambodia in respect of any emoluments or allowances remitted to them from overseas.

3) To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into Cambodia and stay therein for the performance of their work.

4) To maintain and use properly and effectively that the facilities repaired and equipment purchased under the Grant.

5) To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and the installation of the equipment.

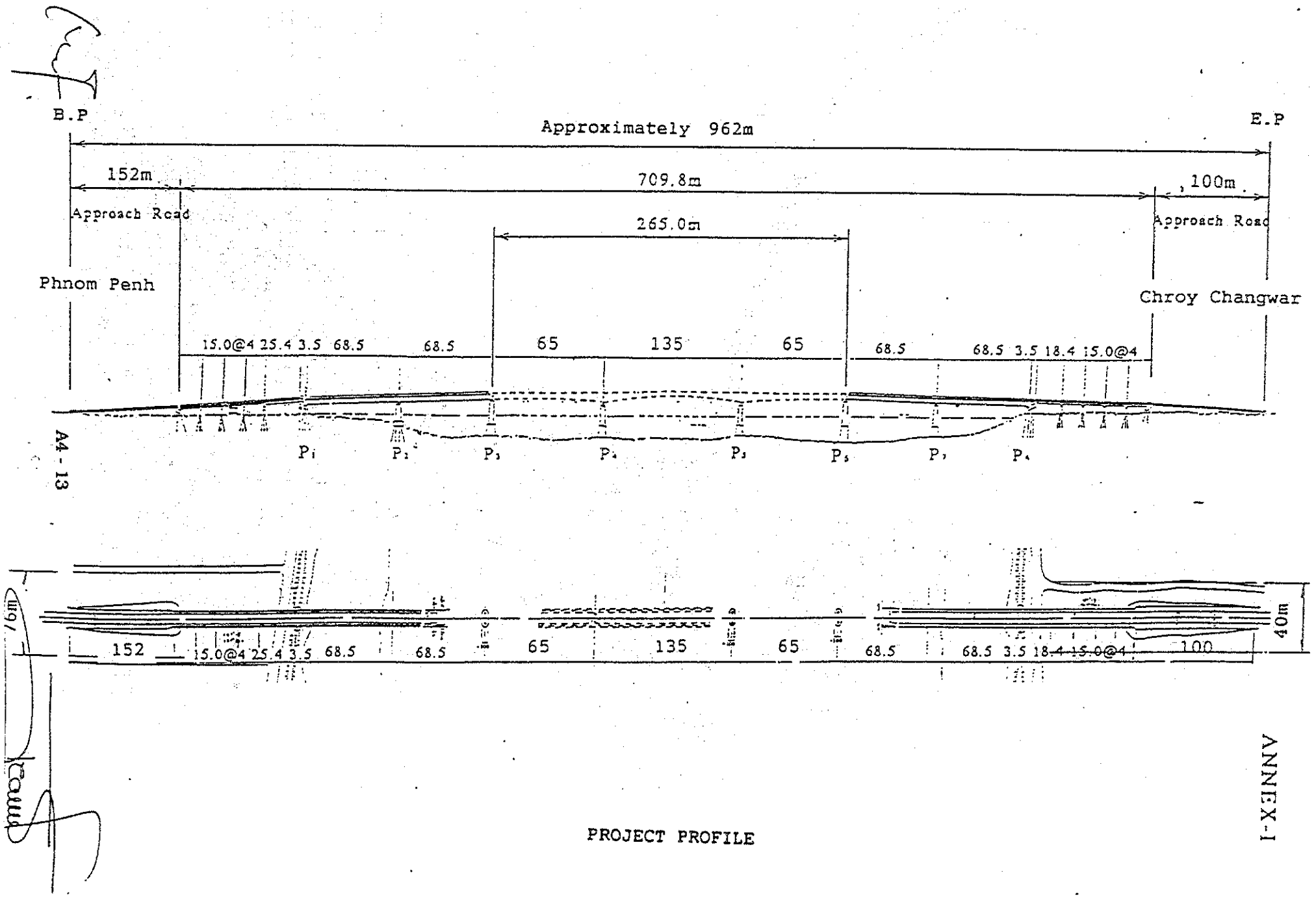
6) To ensure prompt processing of required internal formalities to secure the implementaion time schedule of the Project.

7) To ensure the safety of study members when and as it is required in the course of the study.

8. Schedule of the Study

(1) JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around October, 1992.

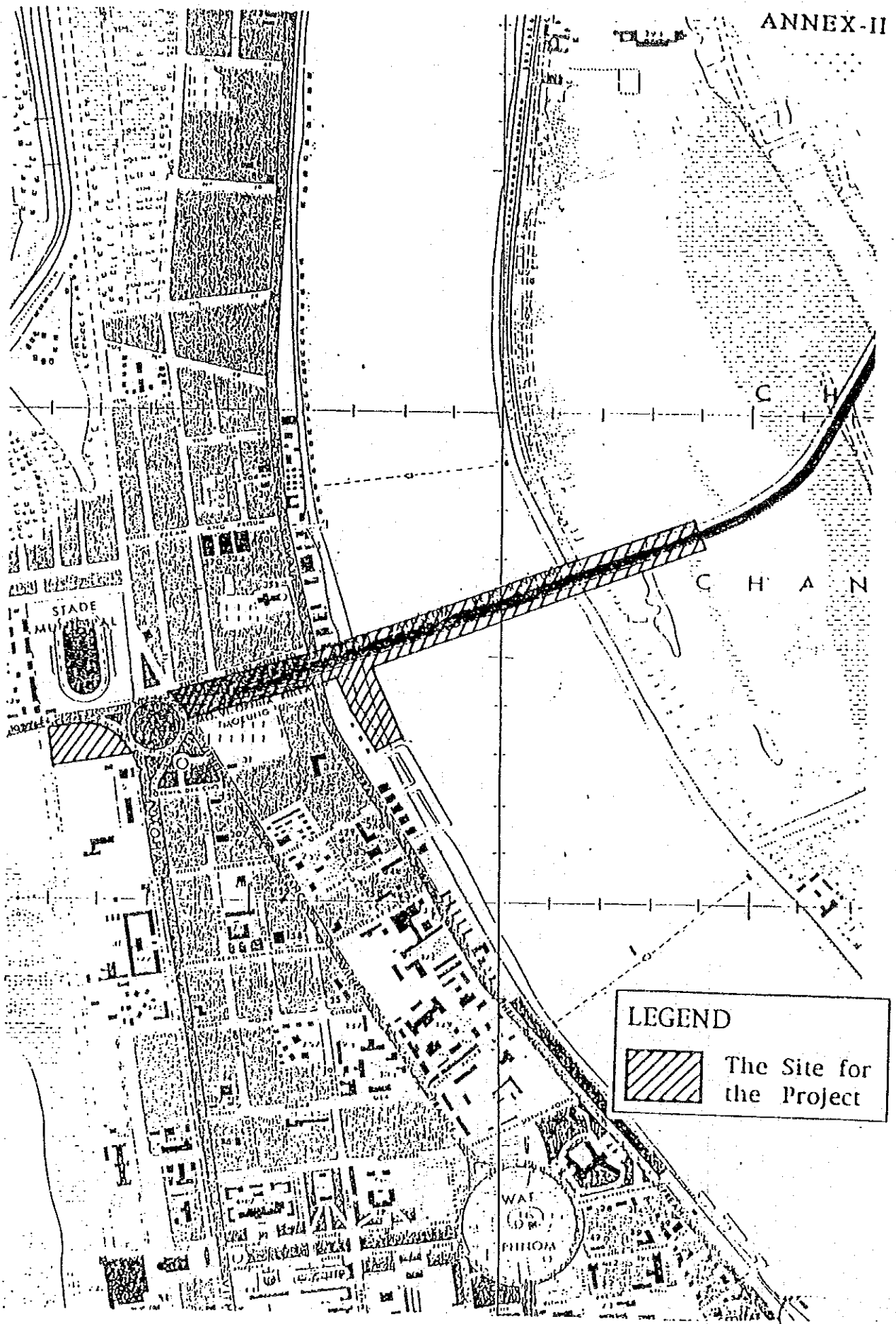
(2) In case that the contents of the report is accepted in principle by Cambodian side, JICA will complete the final report and send it to Cambodia by December, 1992.



PROJECT PROFILE

ANNEX-I

ANNEX-II



MAP OF THE SITE

A4 - 14

Minutes of Discussion
Basic Design Study on
The Project for Repair of Chroy Changwar Bridge
in Cambodia

In July 1992, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team on the Project of Chroy Changwar Bridge (hereinafter referred to as "the Project") to Cambodia. Through discussions, field survey, and technical examination of the results in Japan, JICA has prepared the draft report of the Study.

In order to explain and to consult the Cambodian side on the components of the draft report, JICA sent to Cambodia a study team, which is headed by Mr. Akira Fujimoto, Coordinator for International Research Cooperation, Public Works Research Institute, Ministry of Construction, and is scheduled to stay in the country from September 22 to 29, 1992.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Phnom Penh September 24, 1992

For H.E. HOR NAMHONG, member of S.N.C., Coordinator for Economic Cooperation with Japan

AKIRA FUJIMOTO
藤本昭
Leader
Basic Design Study Team
JICA

SO KHUN
Minister
Ministry of Communication, Transport and Post (MCTP) of Cambodia

ATTACHMENT

1. Components of Draft Report

Road and Bridge Department (RBD), MCTP has agreed and accepted in principle the components of the Draft Report proposed by the team.

2. Japan's Grant Aid System

(1) RBD/MCTP has understood the system of Japanese Grant Aid explained by the team.

(2) RBD/MCTP will take the necessary measures, described in Annex I, for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

3. Further Schedule

Both sides recognized the necessity of further investigation focusing on the structural soundness of 30-year-old remaining structures of Chroy Changwar Bridge during the implementation of the Project.

The team will make the Final Report in accordance with the confirmed items and send it to Cambodia by the end of November, 1992.

藤井

Annex I: Necessary Measures to be taken by the Cambodian Side

1. To secure and to provide the space for the site and other necessary temporary works.

2. To control vessels across under the bridge, access to/from Phnom Penh port and to control ferry operation during construction.

3. To control road traffic during construction.

4. To supply power line from Sub-station to Distribution Board for illumination on bridge and approaches.

5. To supply water pipe, power line and telephone cable to the site for construction work.

6. To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the Project at the port of disembarkation.

7. To exempt study members from income taxes and other fiscal charges payable under the legislation of Cambodiain respect of any emoluments or allowances remitted to them from overseas.

8. To accord Japanese Nationals whose services may be required inconnection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into Cambodia and stay therein for the performance of their work.

9. To maintain and use properly and effectively that the facilities repaired and equipment purchased under the Grant.

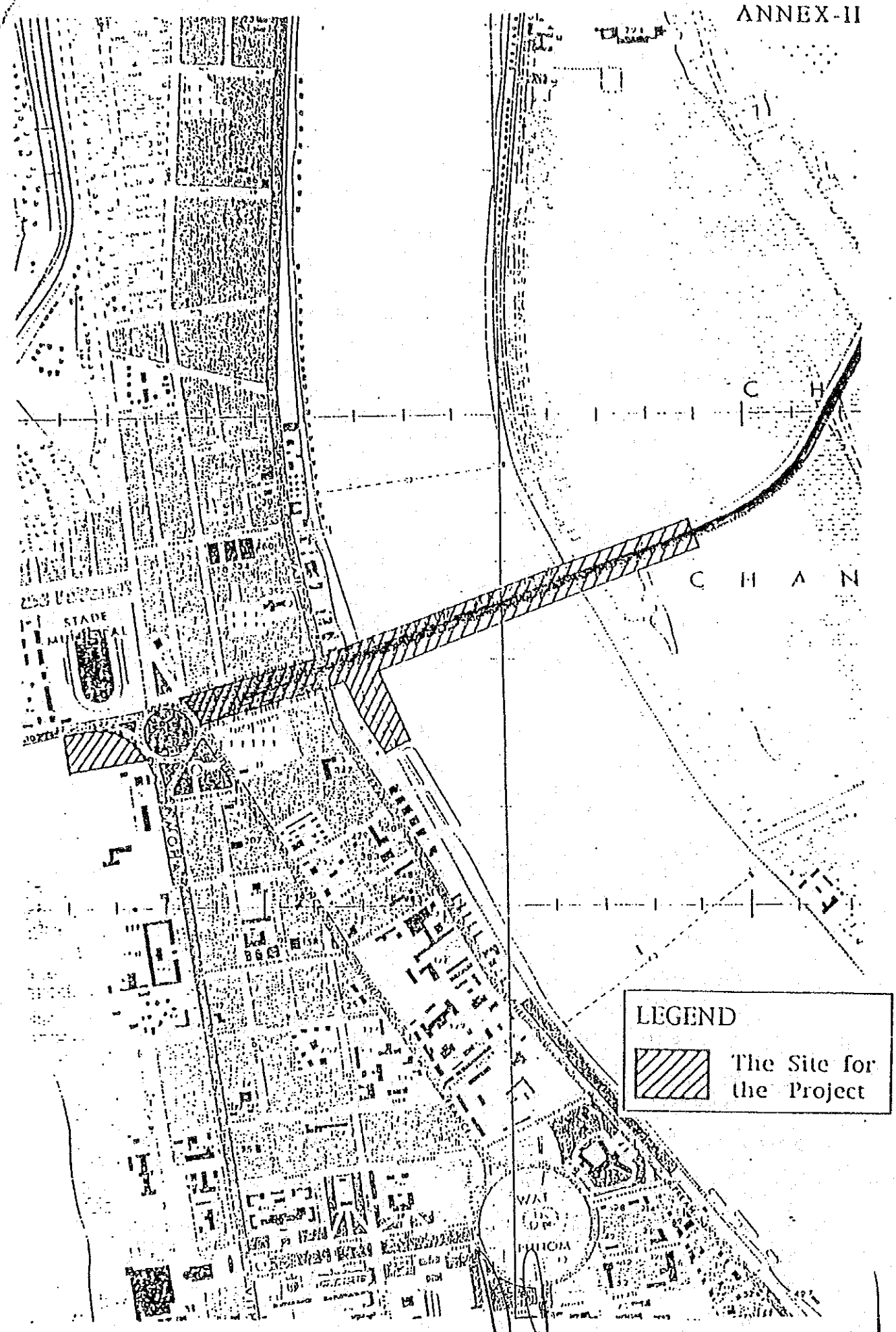
10. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and the installation of the equipment.

11. To ensure prompt processing of required internal formalities to secure the implementation time schedule of the Project.

12. To ensure the safety of study members when and as it is required in the course of the study.

Note: 1) The Site means construction site, project office, housing for labour, motor pool, material stockyard and assembling yard as shown in Annex II.

2) Item Nos. 1, 3 and 4 described here-above shall be completed and be brought into use by the end of November.



MAP OF THE SITE

Appendix-5 : Survey Results

5.1 : Visual Inspection of Piers in the Air

Fig.A-5.1.1 Location of Cracks at Piers No.3 and No.7

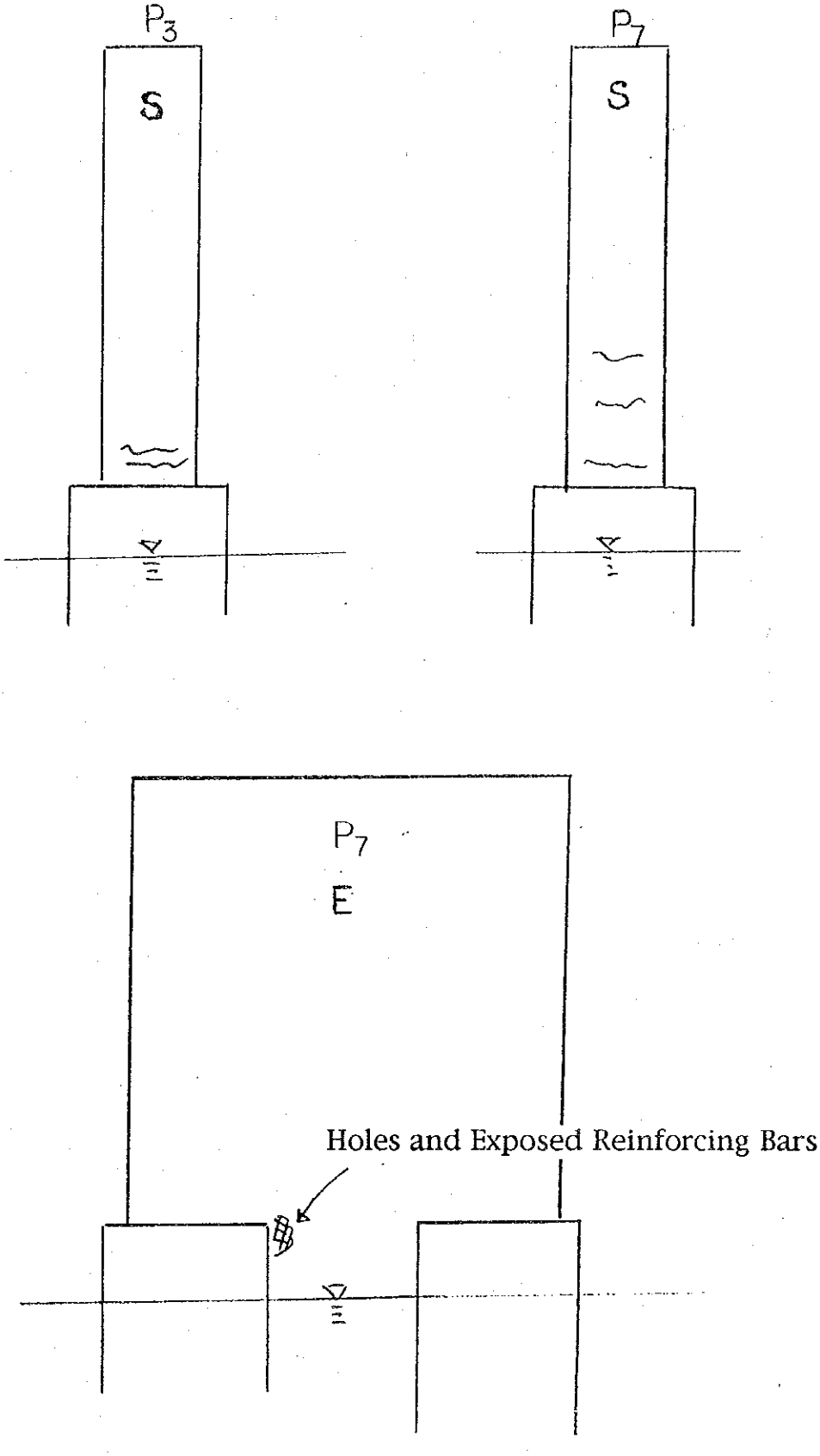
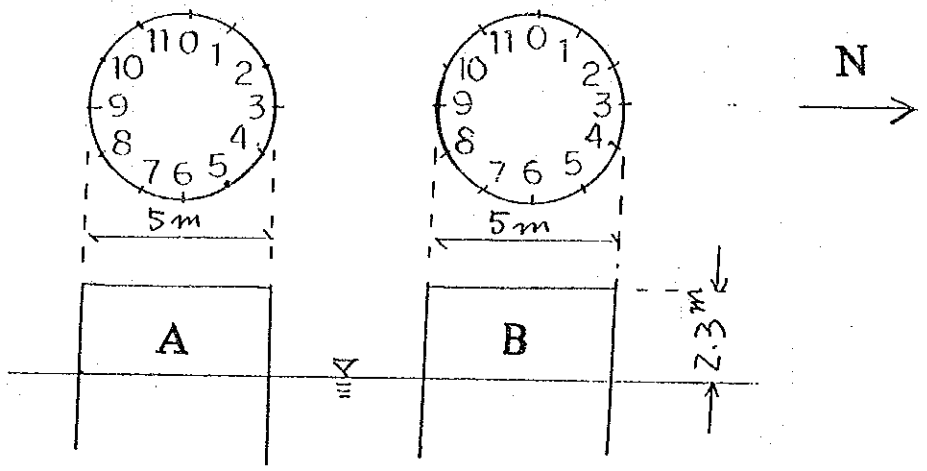
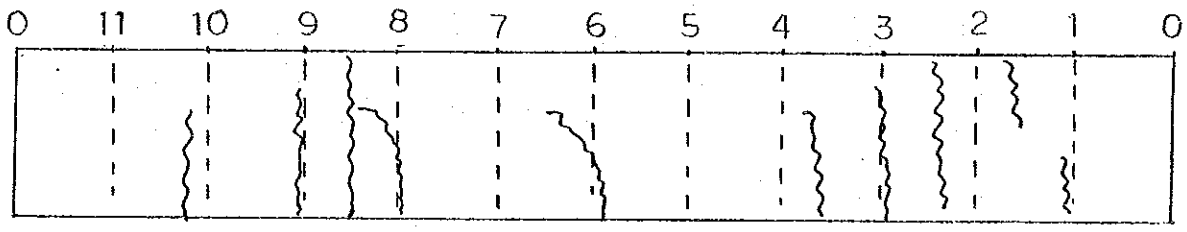


Fig.A-5.1.2 Location of Cracks at Pier No.4





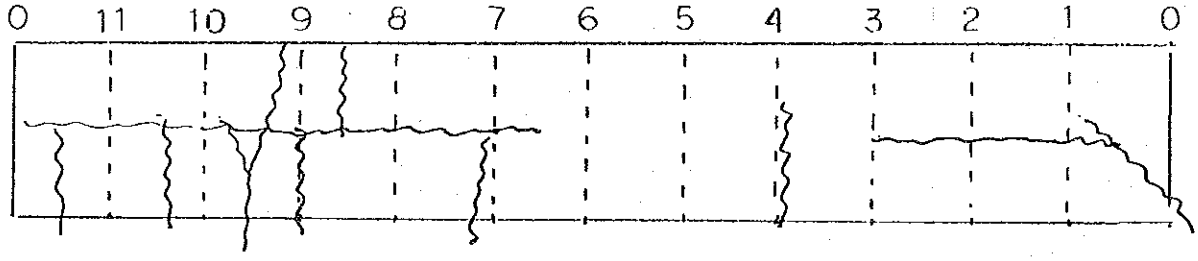
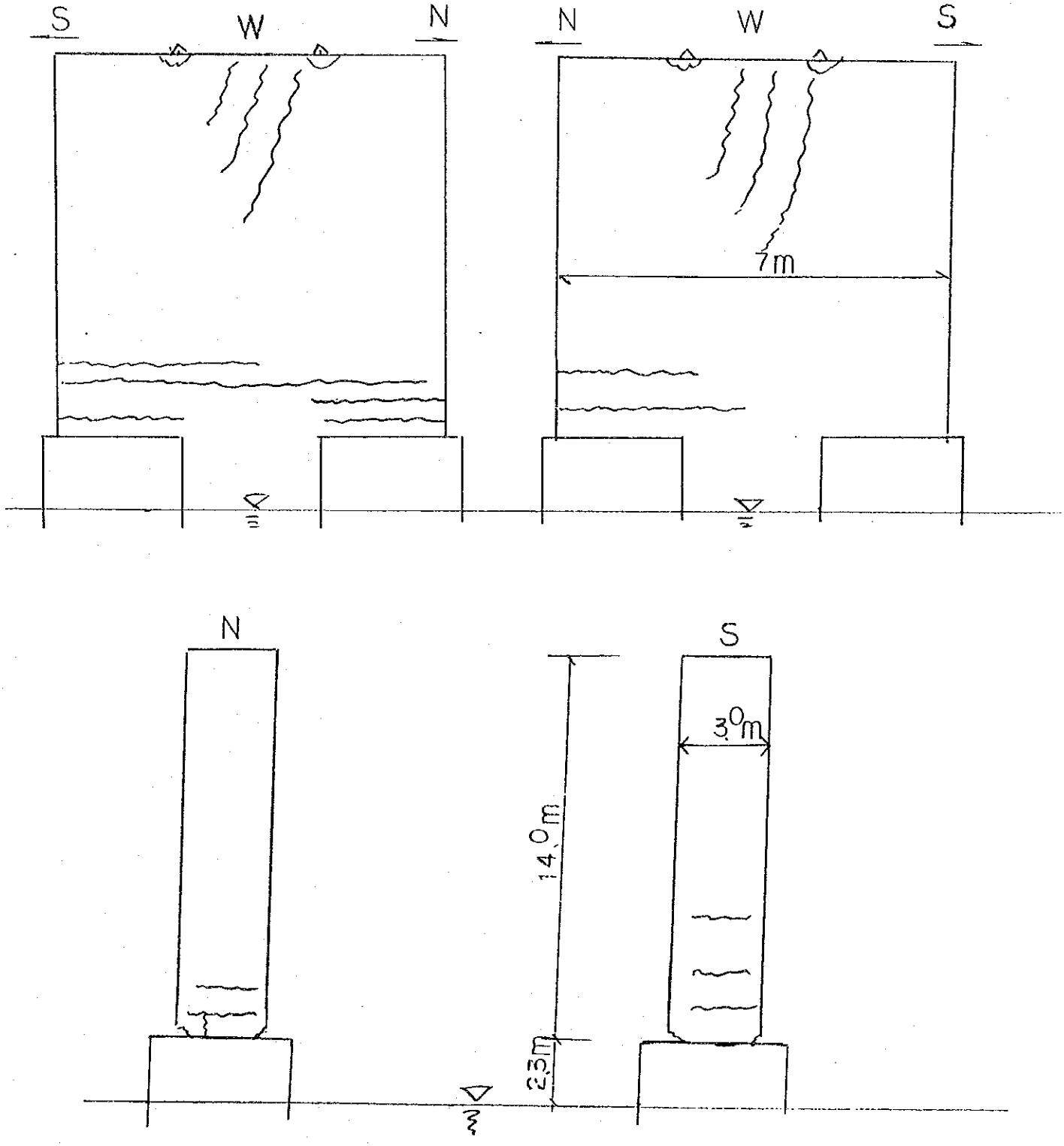
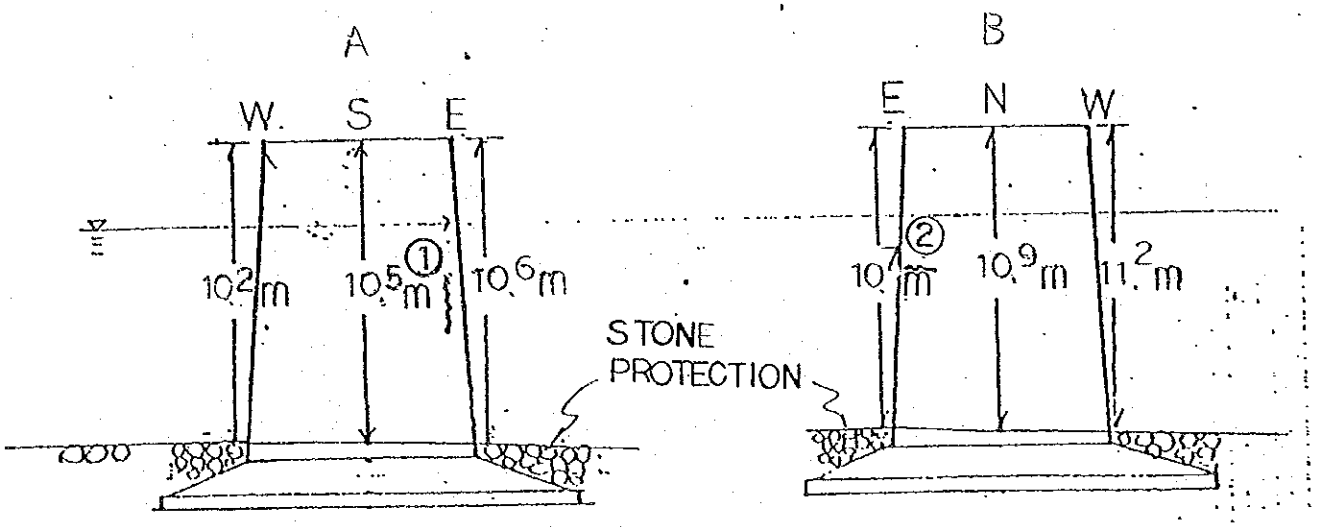


Fig.A-5.1.3 Location of Cracks at Pier No.5



5.2 : Visual Inspection of Piers in the Water

Fig.A-5.2.1 Visual Inspection Cracking at Pier 3-A,B



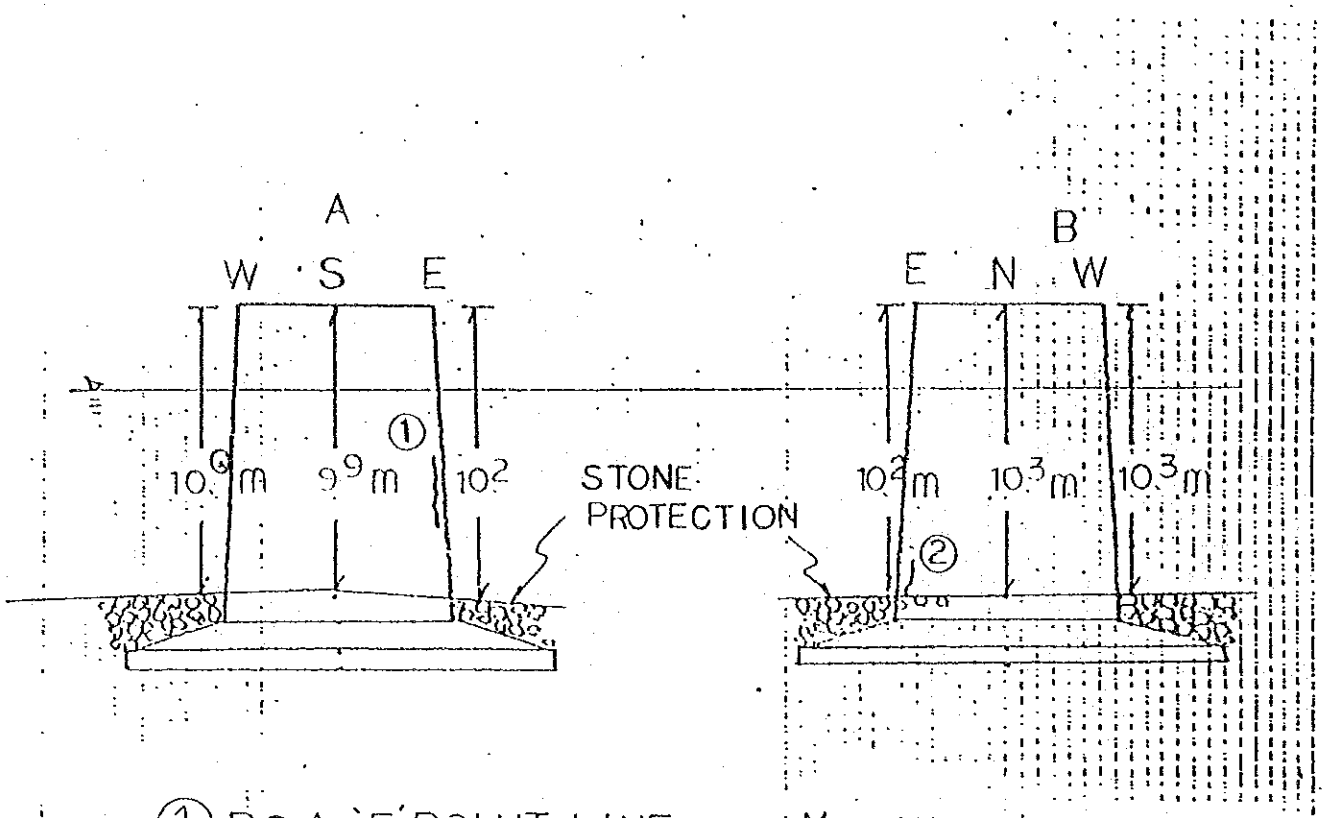
① P3-A 'E' POINT LINE -5.0M DOWN FROM PIER TOP

CRACKING SIZE L=1.0m, W=15m/m, D=10m/m

② P3-B 'E' POINT LINE -4.5M DOWN FROM PIER TOP

CRACKING SIZE L=0.4m, W=150m/m, D=70m/m

Fig.A-5.2.2 Visual Inspection Cracking at Pier 6-A,B



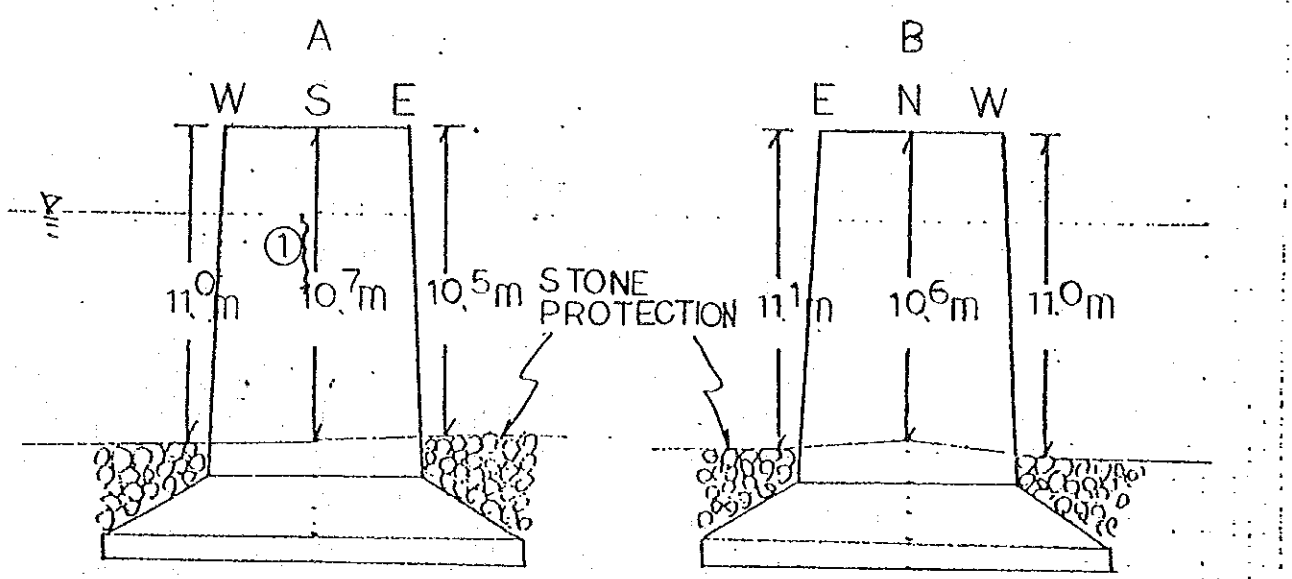
① P6-A 'E' POINT LINE -5.7M DOWN FROM PIRE TOP

CRACKING SIZE L=1.5m, W=10m/m, D=10m/m

② P6 B 'E' POINT LINE -8.5M DOWN FROM PIRE TOP

CRACKING SIZE L=1.5m, W=15m/m, D=10m/m

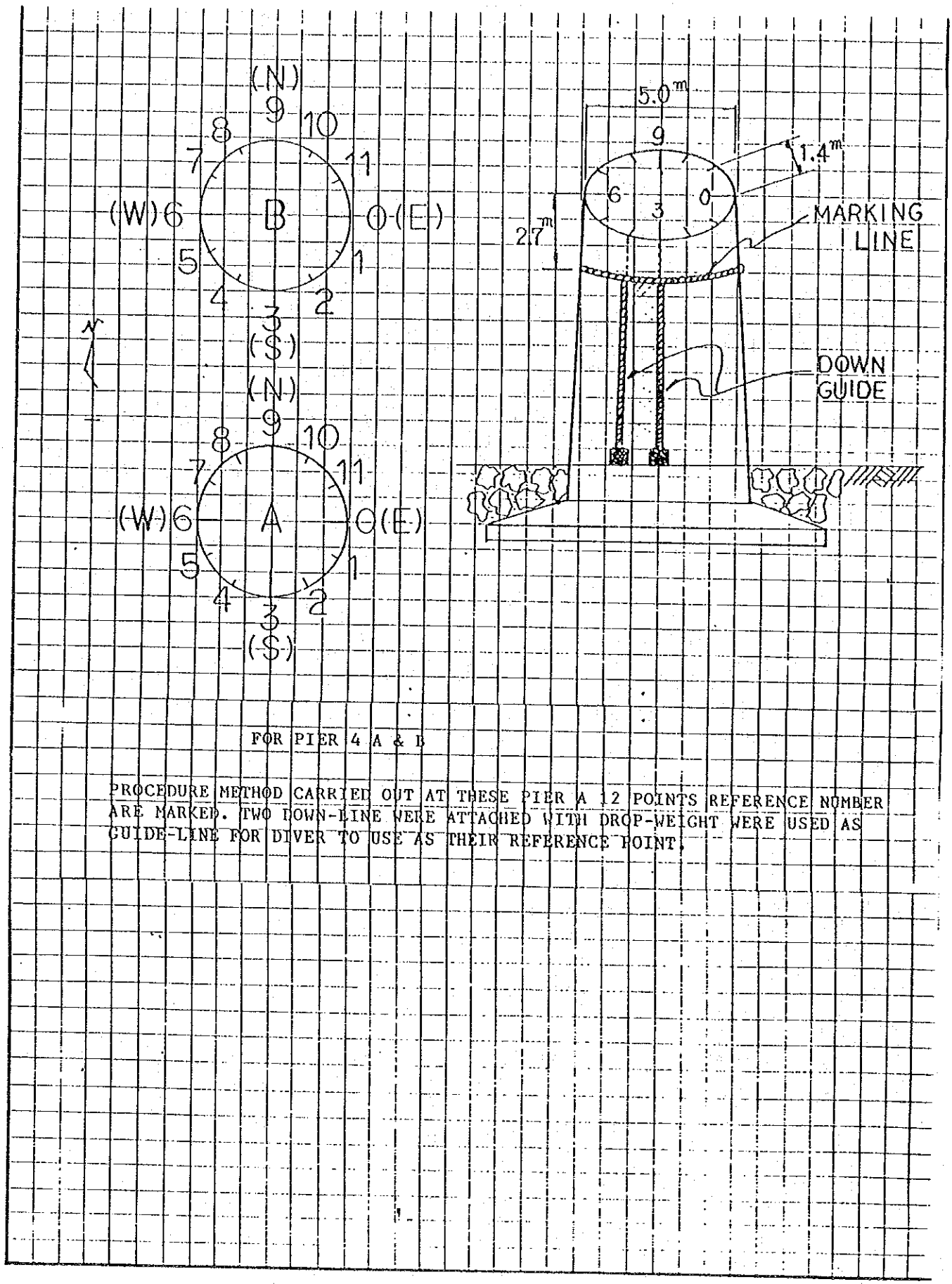
Fig.A-5.2.3 Visual Inspection Cracking at Pier 7-A,B



① P7-A 'S' POINT LINE −3.0M DOWN FROM PIER TOP

CRACKING SIZE L=3.0m, W=10m/m, D=10m/m

Fig.A-5.2.4 Method of Visual Inspection for Cracking at Pier 4



FOR PIER 4 A & B

PROCEDURE METHOD CARRIED OUT AT THESE PIER A 12 POINTS REFERENCE NUMBER ARE MARKED. TWO DOWN-LINE WERE ATTACHED WITH DROP-WEIGHT WERE USED AS GUIDE-LINE FOR DIVER TO USE AS THEIR REFERENCE POINT.

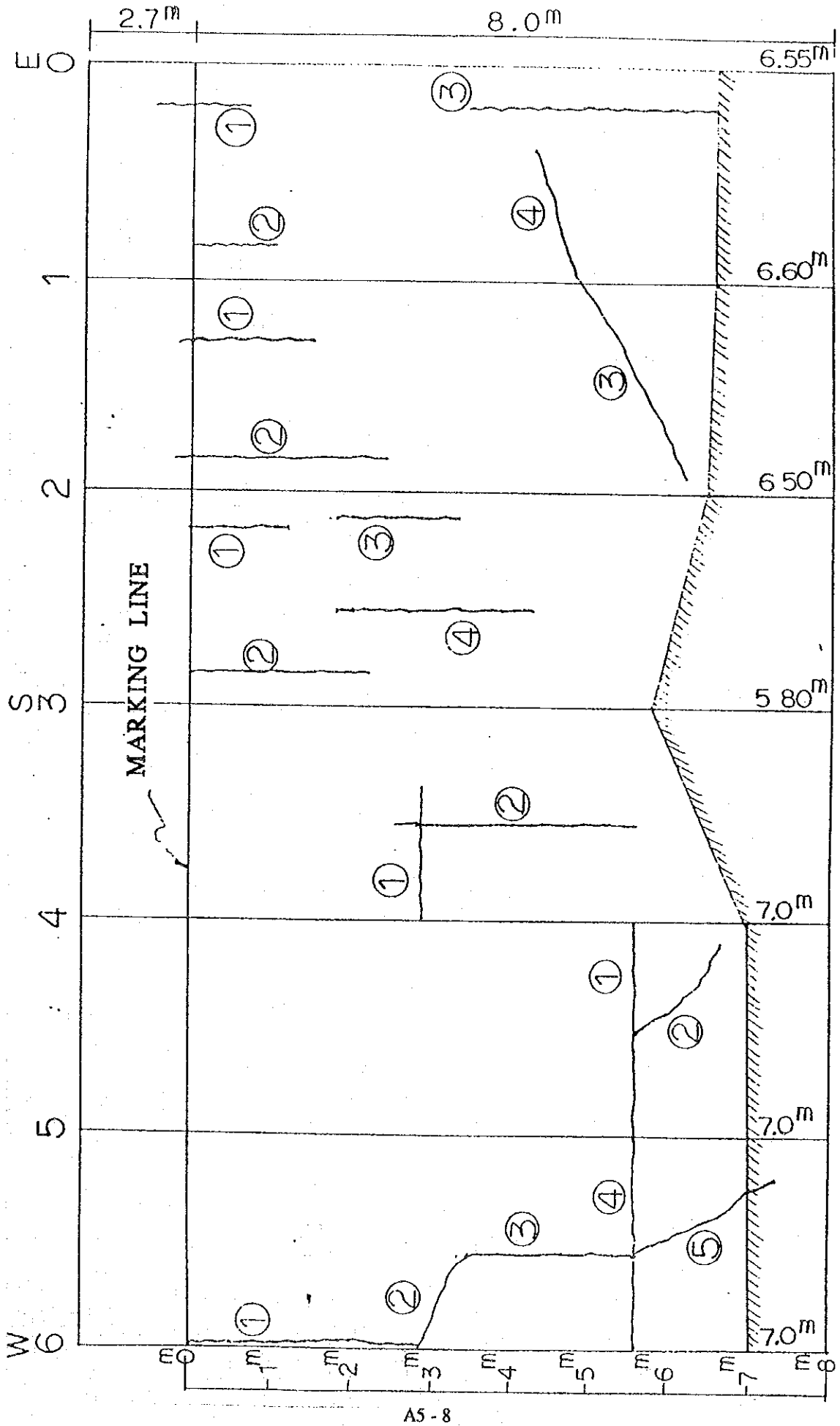


Fig.A-5.2.5 P4-A Developed Sketch(W-S-E)

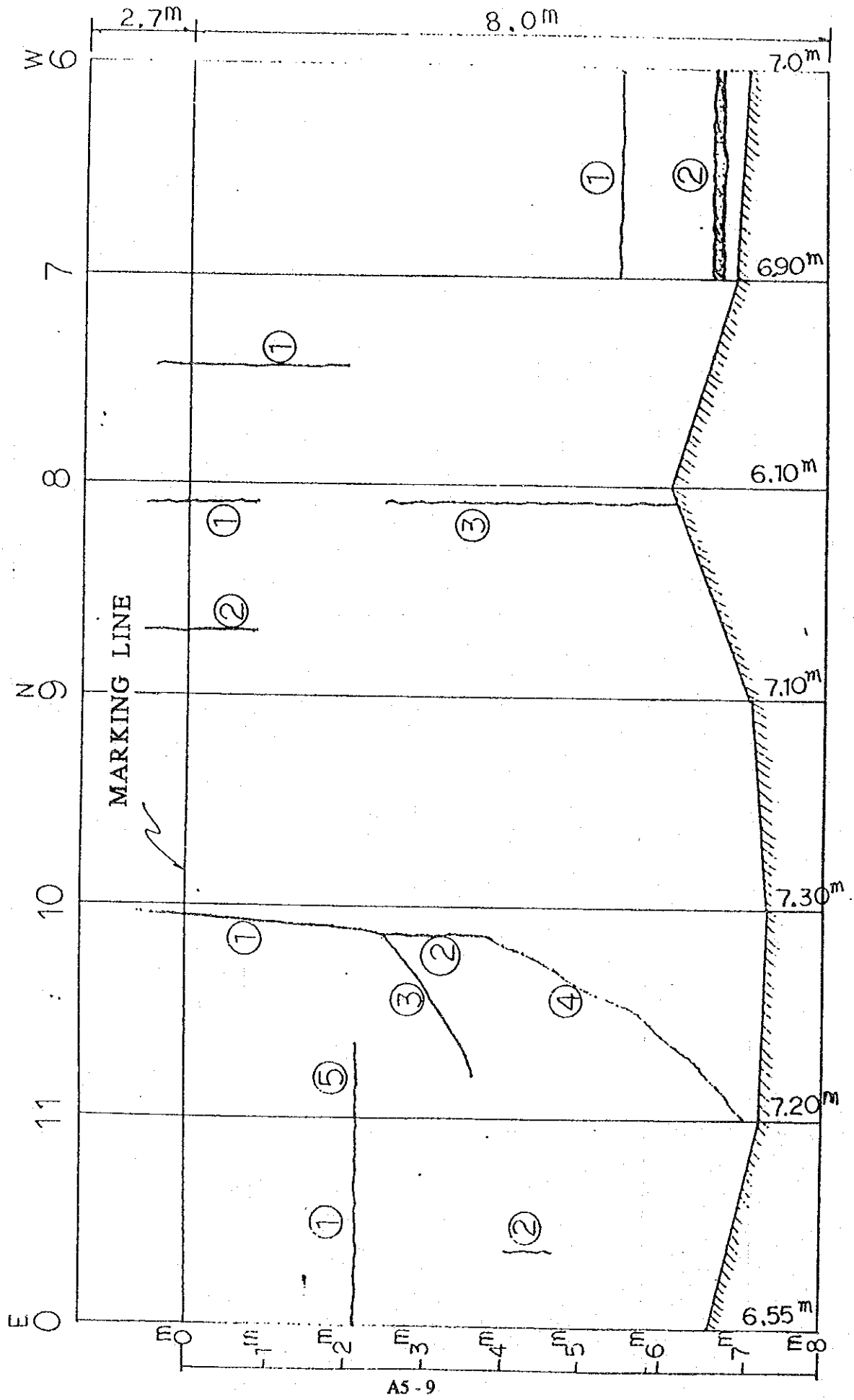


Fig.A-5.2.6 P4-A Developed Sketch(E-N-W)

Table A-5.2.1 Cracking Size P4-A

		L= , W= , D=
⓪	①	0.75m, 10m/m, 10m/m
|	②	1.0 m, 10m/m, 10 m/m
	③	3.0 m, 20m/m, 10m/m
①	④	0.8 m, 15m/m, 30m/m
①	①	1.4 m, 20m/m, 30m/m
|	②	2.4 m, 30m/m, 40m/m
②	③	1.4 m, 15m/m, 30m/m
②	①	1.4 m, 20m/m, 10m/m
|	②	2.2 m, 30m/m, 20m/m
	③	1.5 m, 30m/m, 30m/m
③	④	2.4 m, 50m/m, 60m/m
③	①	3.0 m, 10m/m, 10m/m
④	②	0.8 m, 20m/m, 20m/m
④	①	1.4 m, 10m/m, 10 m/m
⑤	②	1.5 m, 15m/m, 30 m/m
⑤	①	2.8 m, 15m/m, 25m/m
|	②	0.8 m, 15m/m, 25 m/m
	③	2.0 m, 25m/m, 40 m/m
	④	1.4 m, 10m/m, 10 m/m
⑥	⑤	2.0 m, 25m/m, 40m/m
⑥	①	1.4 m, 10m/m, 10m/m
⑦	②	1.4 m, 80m/m, 150m/m
⑦	①	2.0m, 20m/m, 25m/m
⑧	◯	

		L= , W= , D=
⑧	①	0.8m, 20m/m, 20m/m
|	②	0.8m, 20m/m, 20m/m
⑨	③	3.6m, 25m/m, 20m/m
⑨	①	NO CRACKING
⑩	②	
⑩	①	2.5m, 20m/m, 20m/m
|	②	1.4m, 20 m/m, 20m/m
	③	1.5m, 20 m/m, 20m/m
	④	3.8m, 20 m/m, 20m/m
⑪	⑤	0.4m, 10 m/m, 20m/m
⑪	①	1.4m, 10 m/m, 10m/m
⑫	②	0.5m, 15m/m, 10m/m

Fig.A-5.2.7 P4-B Developed Sketch(W-S-E)

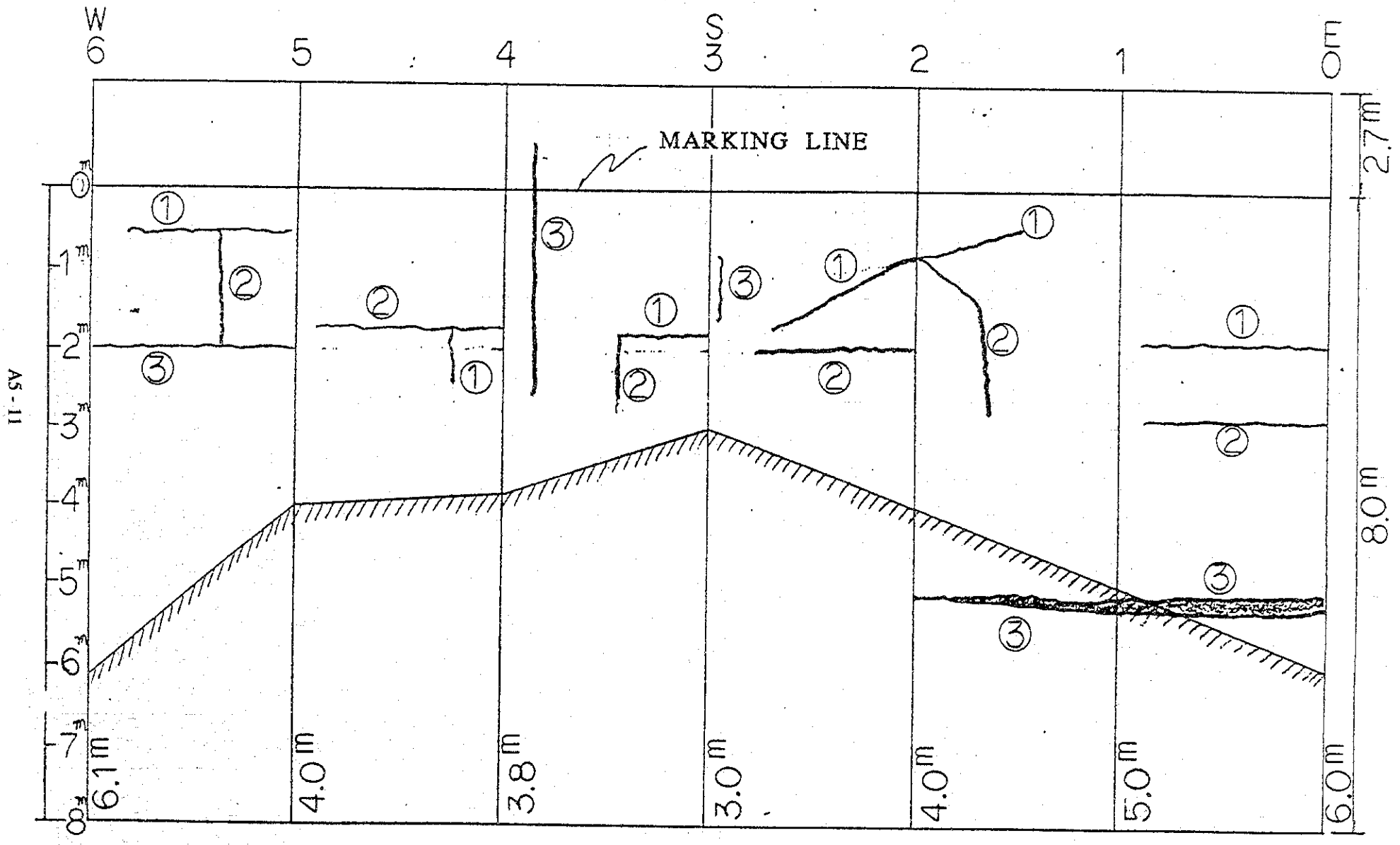


Table A-5.2.2 Cracking Size P4-B

		L= , W= , D=
0	1	1.2 m, 10 m/m, 30 m/m
|	2	1.2 m, 10 m/m, 30 m/m
1	3	1.4 m, 150 m/m, 200 m/m
1	1	1.0 m, 6 m/m, 30 m/m
|	2	0.1 m 1.4 m, 6 m/m, 50 m/m
2	3	—, 50 m/m, 40 m/m
2	1	1.15 m, 10 m/m, 25 m/m
|	2	1.1 m, 10 m/m, 25 m/m
3	3	0.8 m, 10 m/m, 10 m/m
3	1	0.6 m, 5 m/m, 5 m/m
|	2	0.6 m, 5 m/m, 5 m/m
4	3	2.6 m, 200 m/m, 500 m/m , 500 m/m, 800 m/m
4	1	0.8 m, 75 m/m, 45 m/m
5	2	1.3 m, 30 m/m, 75 m/m
5	1	1.1 m, 25 m/m, 20 m/m
|	2	1.4 m, 30 m/m, 50 m/m
6	3	1.4 m, 10 m/m, 20 m/m
6	1	1.1 m, 10 m/m, 20 m/m
|	2	1.1 m, 10 m/m, 20 m/m
7	3	1.4 m, 800 m/m, 1.0 m OVER
7	1	1.4 m, 10 m/m, CRACK LINE ONLY
|	2	1.4 m, 5 m/m, CRACK LINE ONLY
|	3	0.4 m, 280 m/m, 100 m/m
8	4	1.4 m, 150 m/m, 300 m/m OVER
	○	

		L= , W= , D=
8	1	1.2 m, 10 m/m, CRACK LINE ONLY
|	2	1.3 m, 100 m/m, 20 m/m
9	3	1.4 m, 1.5 m, 1.0 m OVER
9	1	1.4 m, 10 m/m, CRACK LINE ONLY
10	2	1.4 m, 150 m/m, 1.0 m OVER
10	1	2.0 m, 20 m/m, 10 m/m
|	2	1.2 m, 20 m/m, 10 m/m
|	3	2.0 m, 20 m/m, 10 m/m
|	4	1.4 m, 150 m/m, 1.0 m OVER
11	5	1.4 m, 20 m/m, 20 m/m
11	1	0.5 m, 20 m/m, 20 m/m
|	2	3.8 m, 50 m/m, 80 m/m
|	3	0.9 m, 20 m/m, 20 m/m
|	4	1.4 m, 150 m/m, 1.0 m OVER
0	5	0.65 m, 20 m/m, 1.0 m OVER

Fig.A-5.2.8 P4-B Developed Sketch(E-N-W)

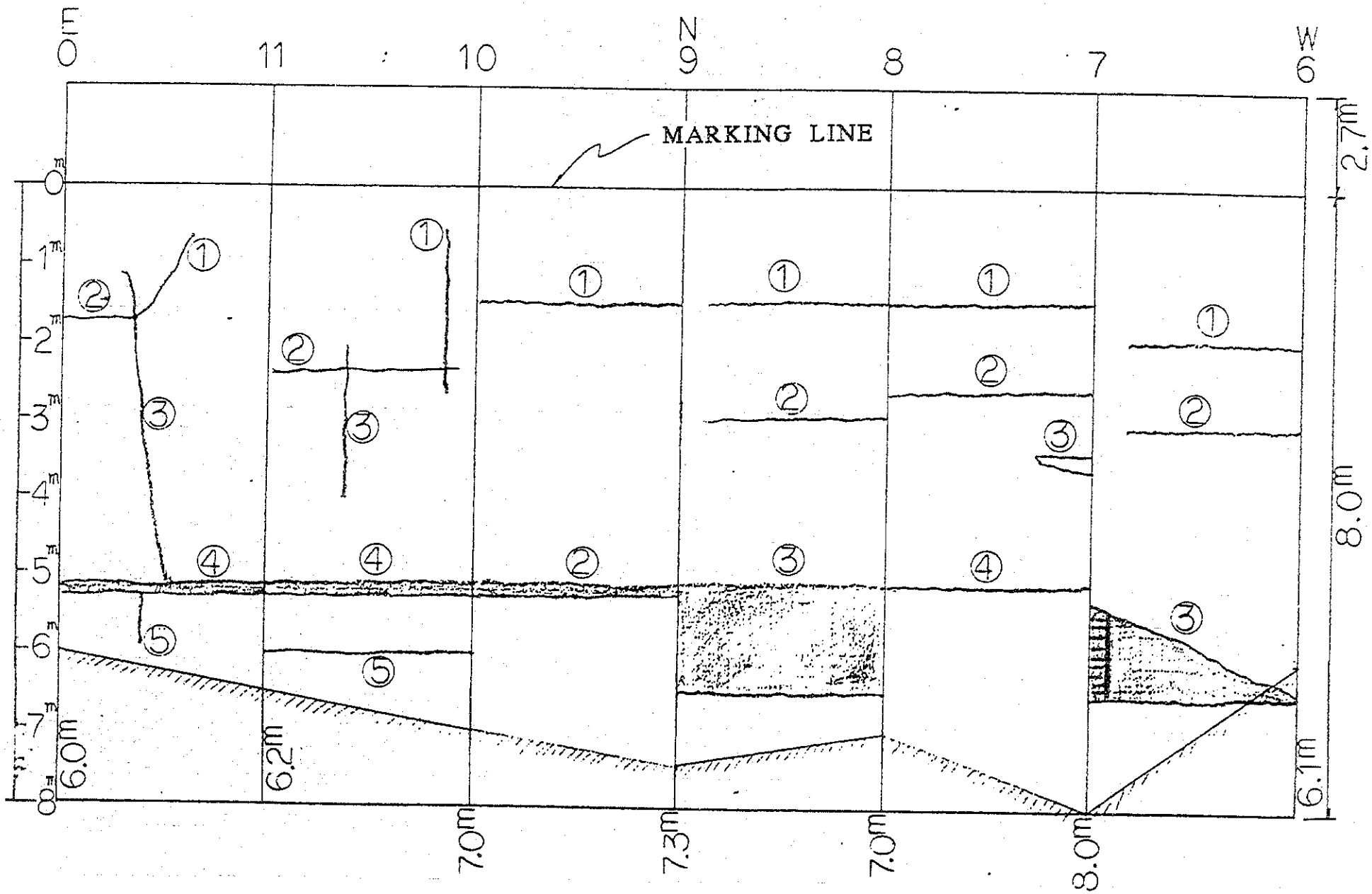
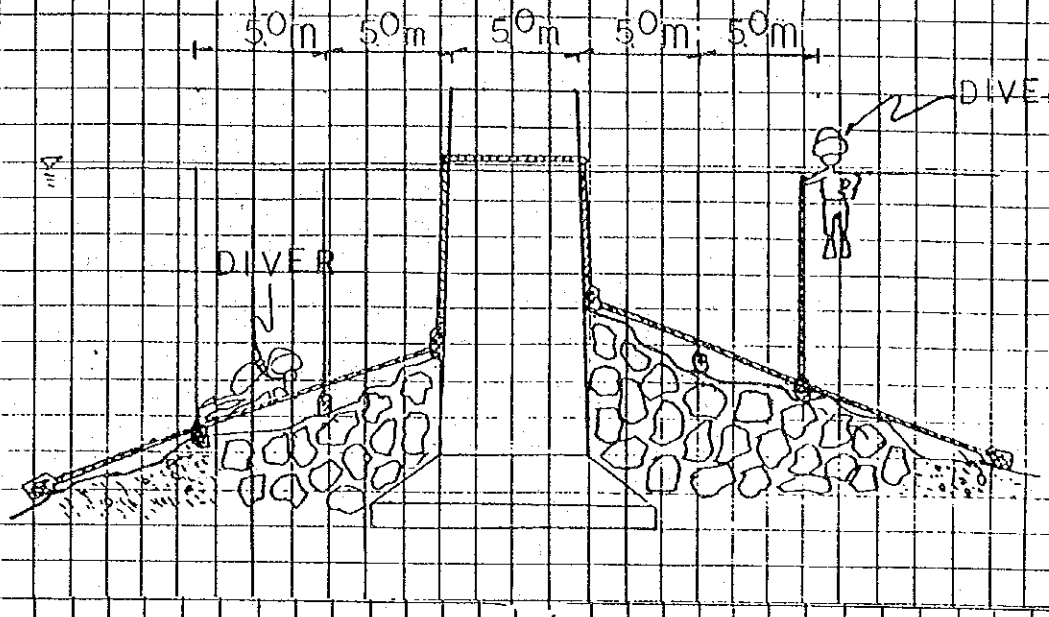


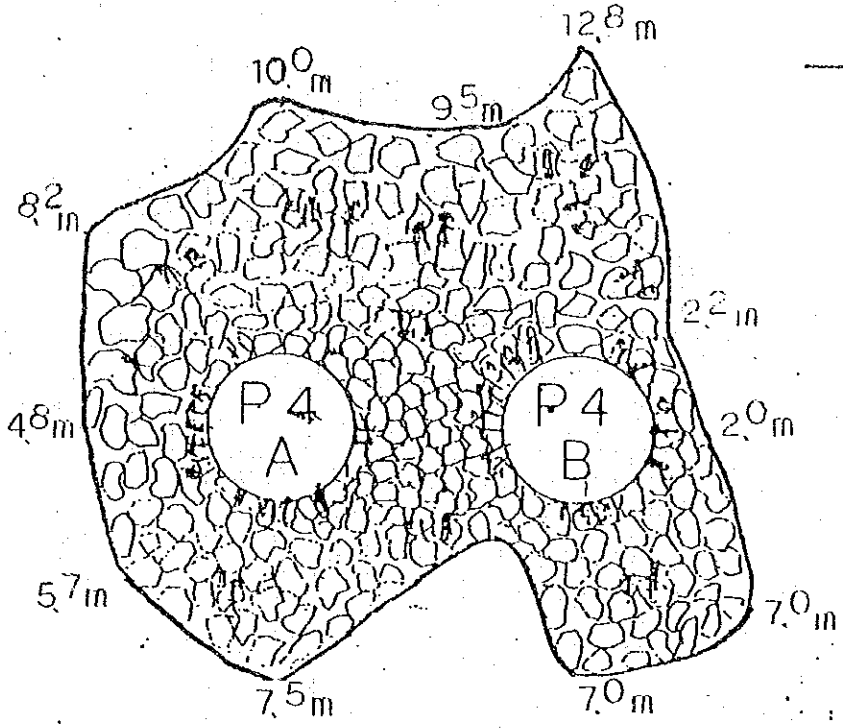
Fig.A-5.2.9 Method of Visual Inspection for Debris at Pier-4 A&B



NOTE : DEBRIS INSPECTION

DIVERS TAKE DEBRIS SOUNDING BY USING DEPTH READING AT SURFACE AND ALSO DIVER SWIM AROUND WITH ATTACHED 20 METER ROPE TO CHECK AREA FOR DEBRIS.

Fig.A-5.2.10 P4-A,B Debris Area Survey Inspection 1/300.



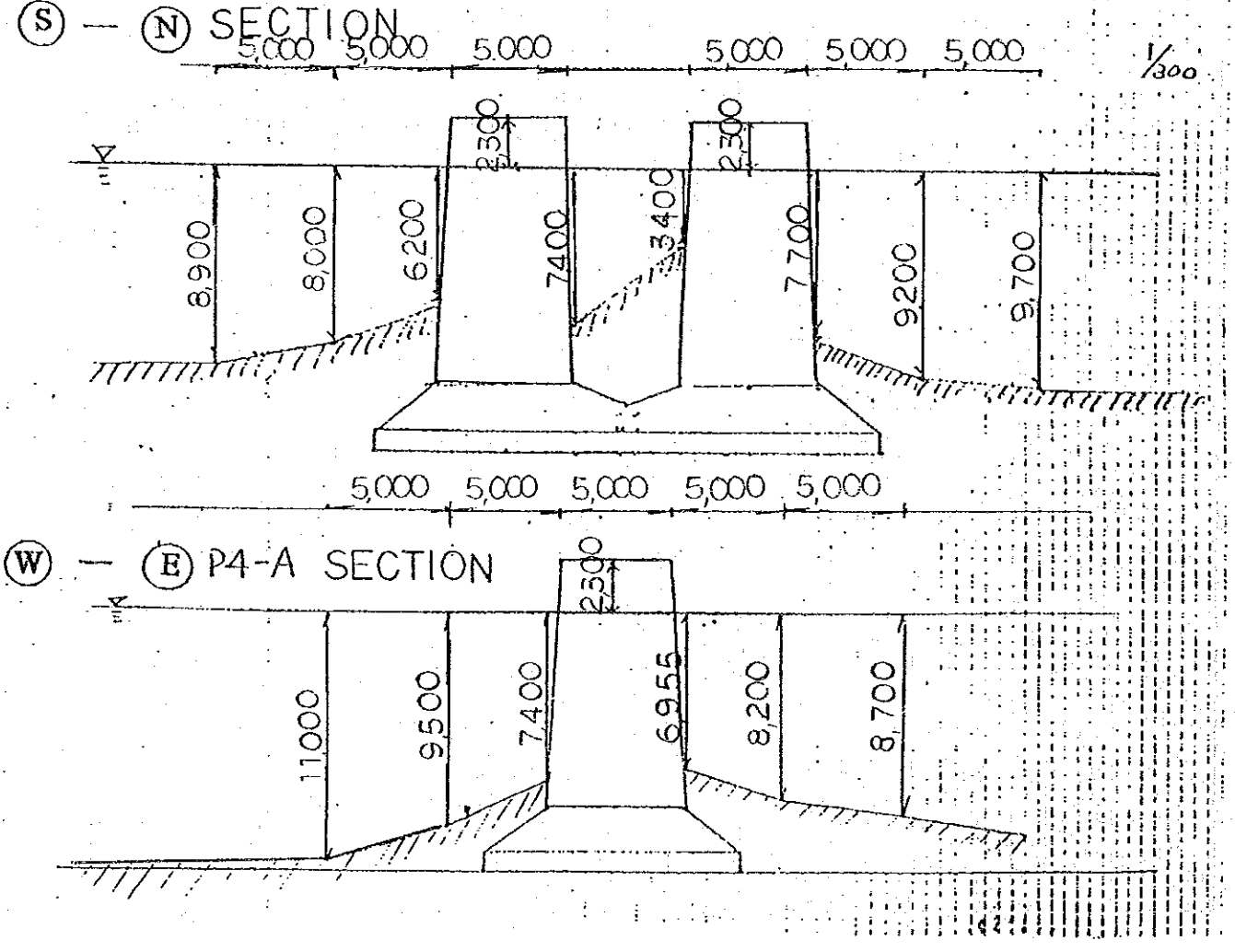
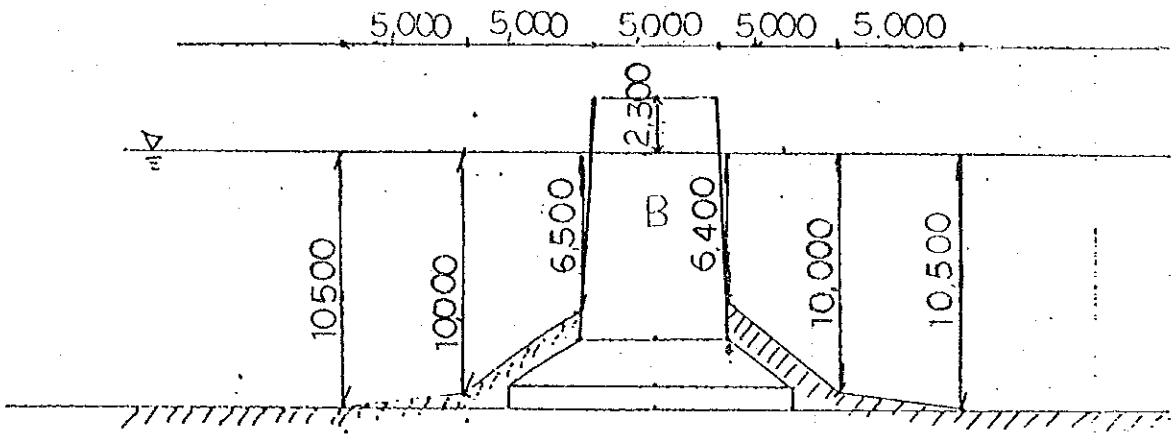


Fig.A-5.2.11 P4-B Section(W-E)



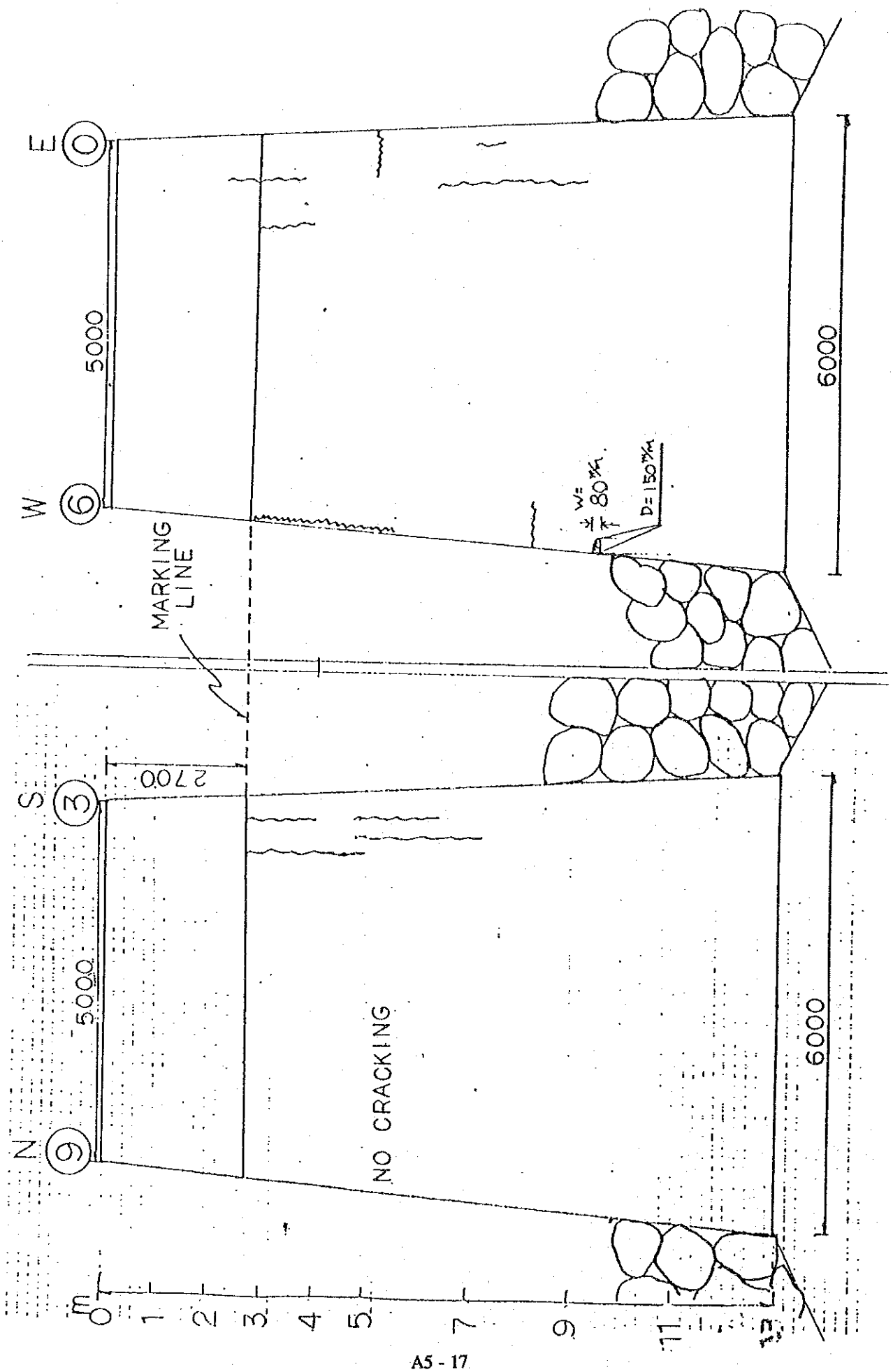


Fig.A-5.2.12P4-A Section

Fig.A-5.2.13 P4-B Section

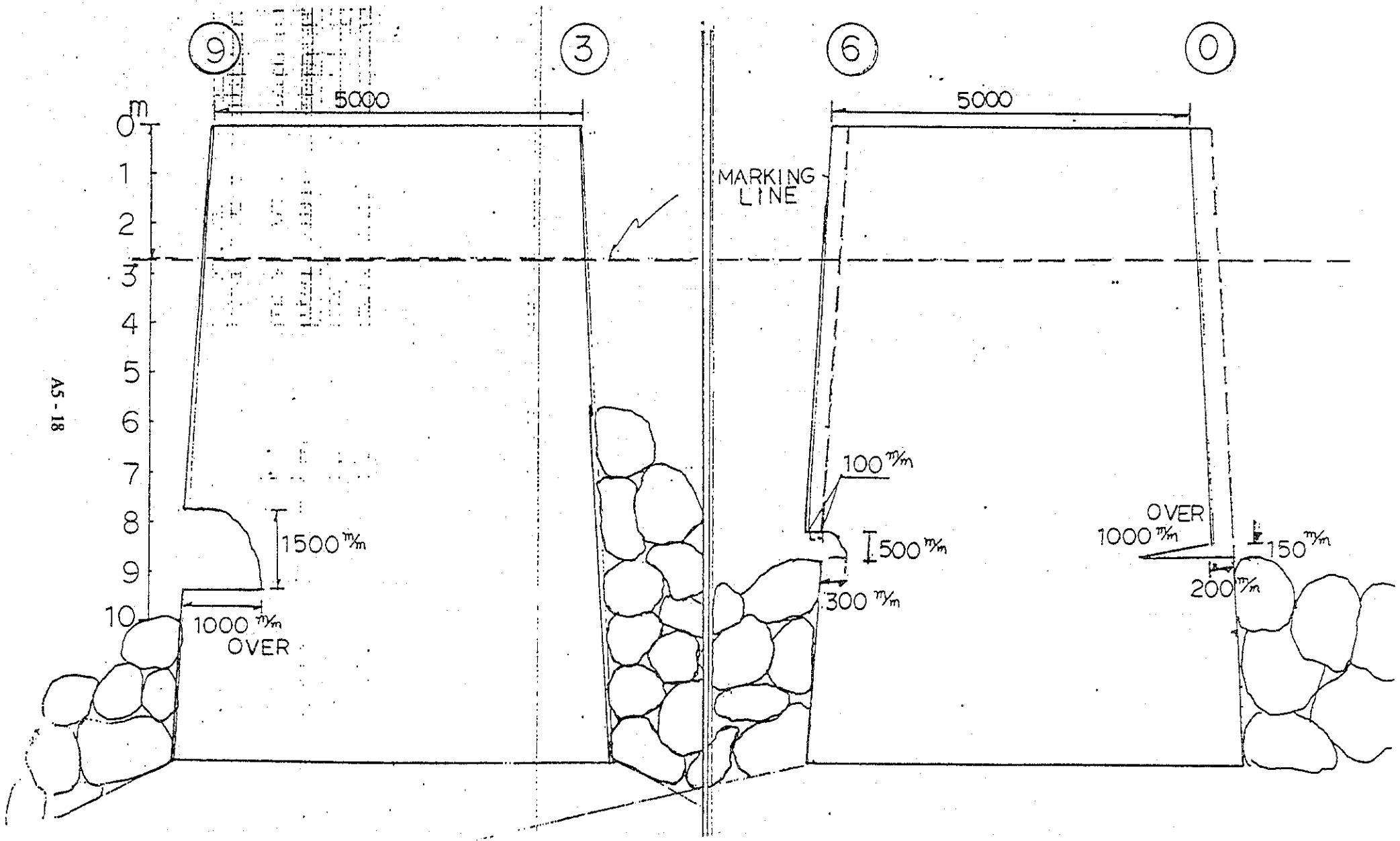
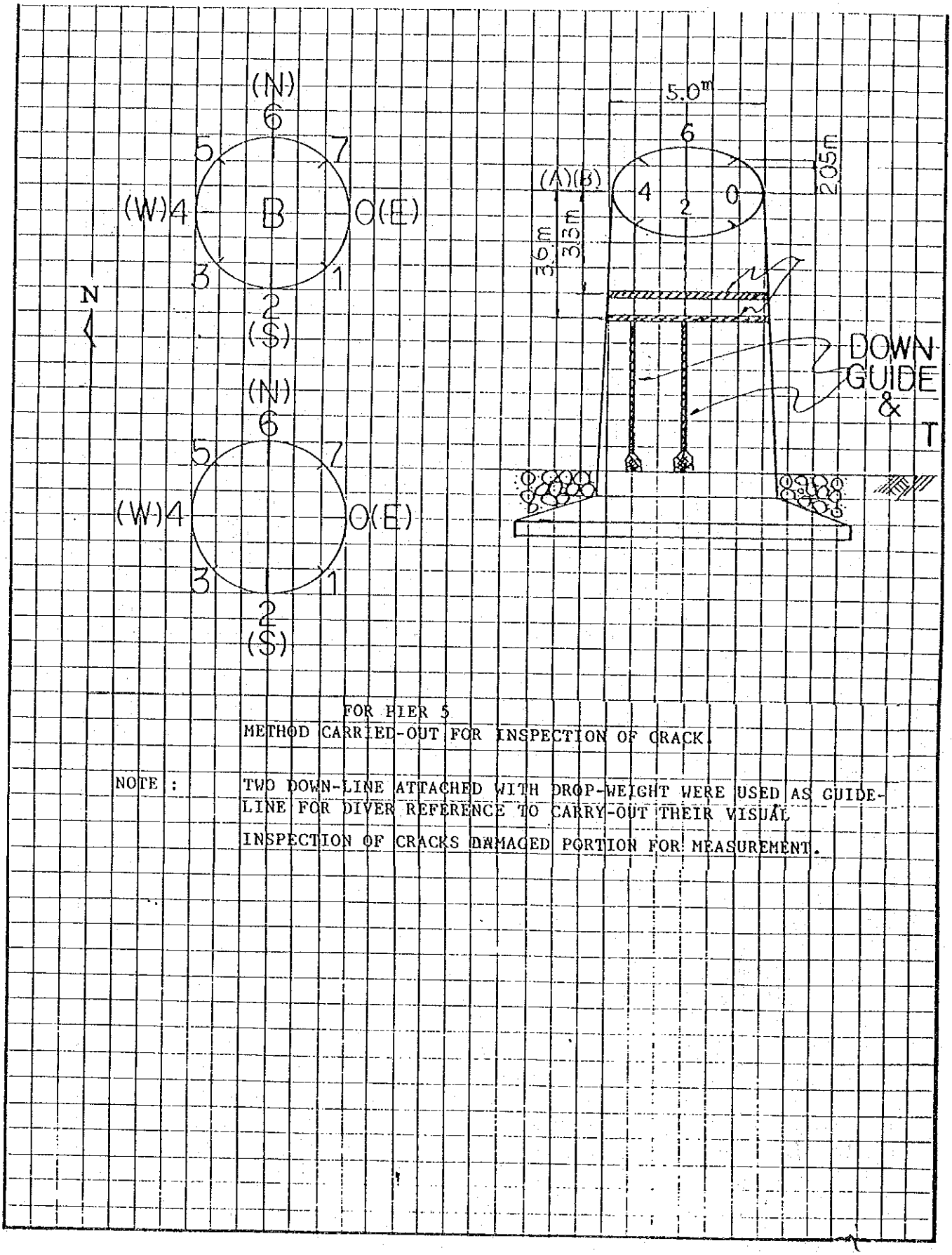


Fig.A-5.2.14 Method of Visual Inspection for Cracking at Pier 5



FOR PIER 5
METHOD CARRIED-OUT FOR INSPECTION OF CRACK.

NOTE : TWO DOWN-LINE ATTACHED WITH DROP-WEIGHT WERE USED AS GUIDE-LINE FOR DIVER REFERENCE TO CARRY-OUT THEIR VISUAL INSPECTION OF CRACKS DAMAGED PORTION FOR MEASUREMENT.

Fig.A-5.2.15 P5-A Developed Sketch

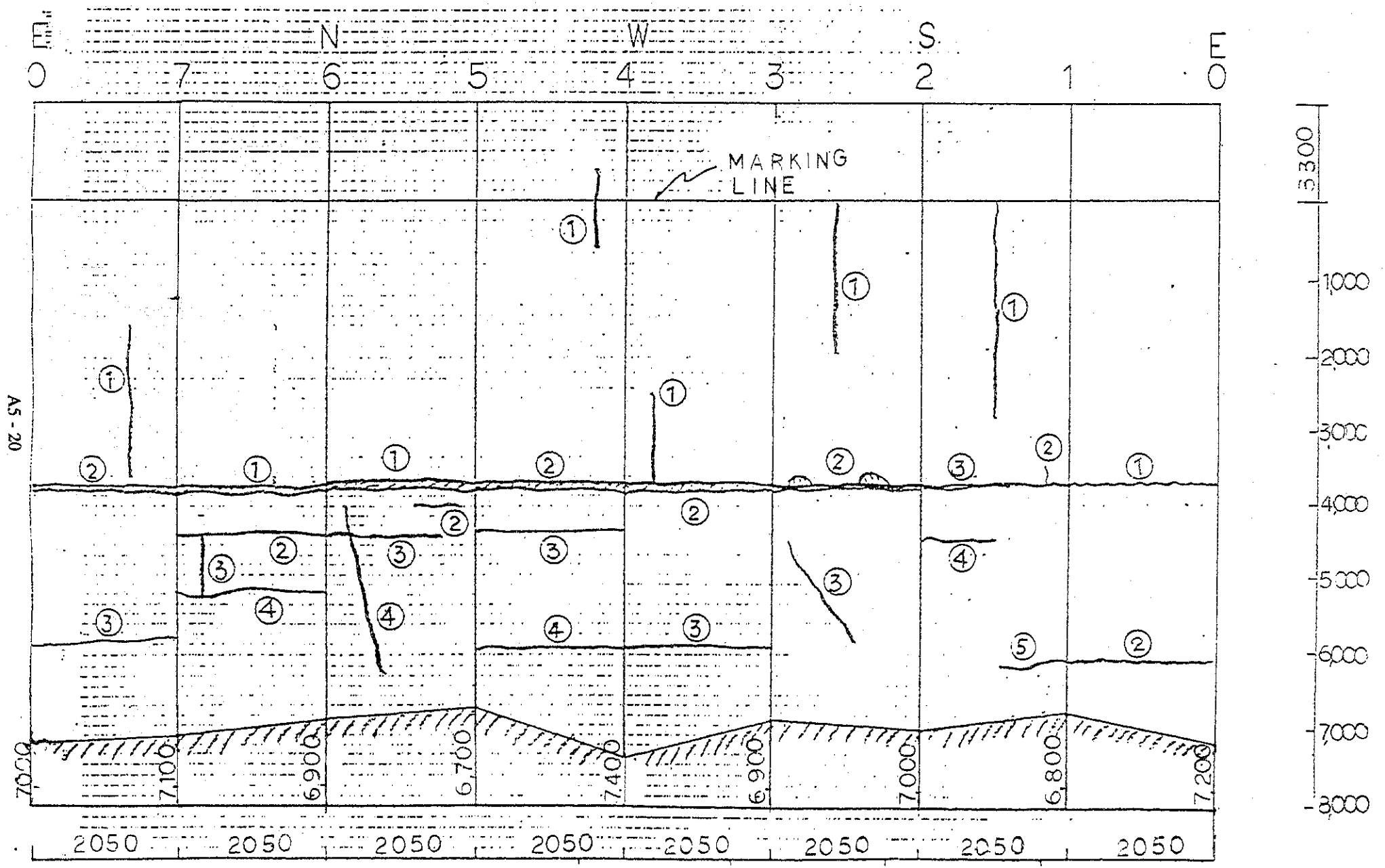


Fig.A-5.2.16 P5-B Developed Sketch

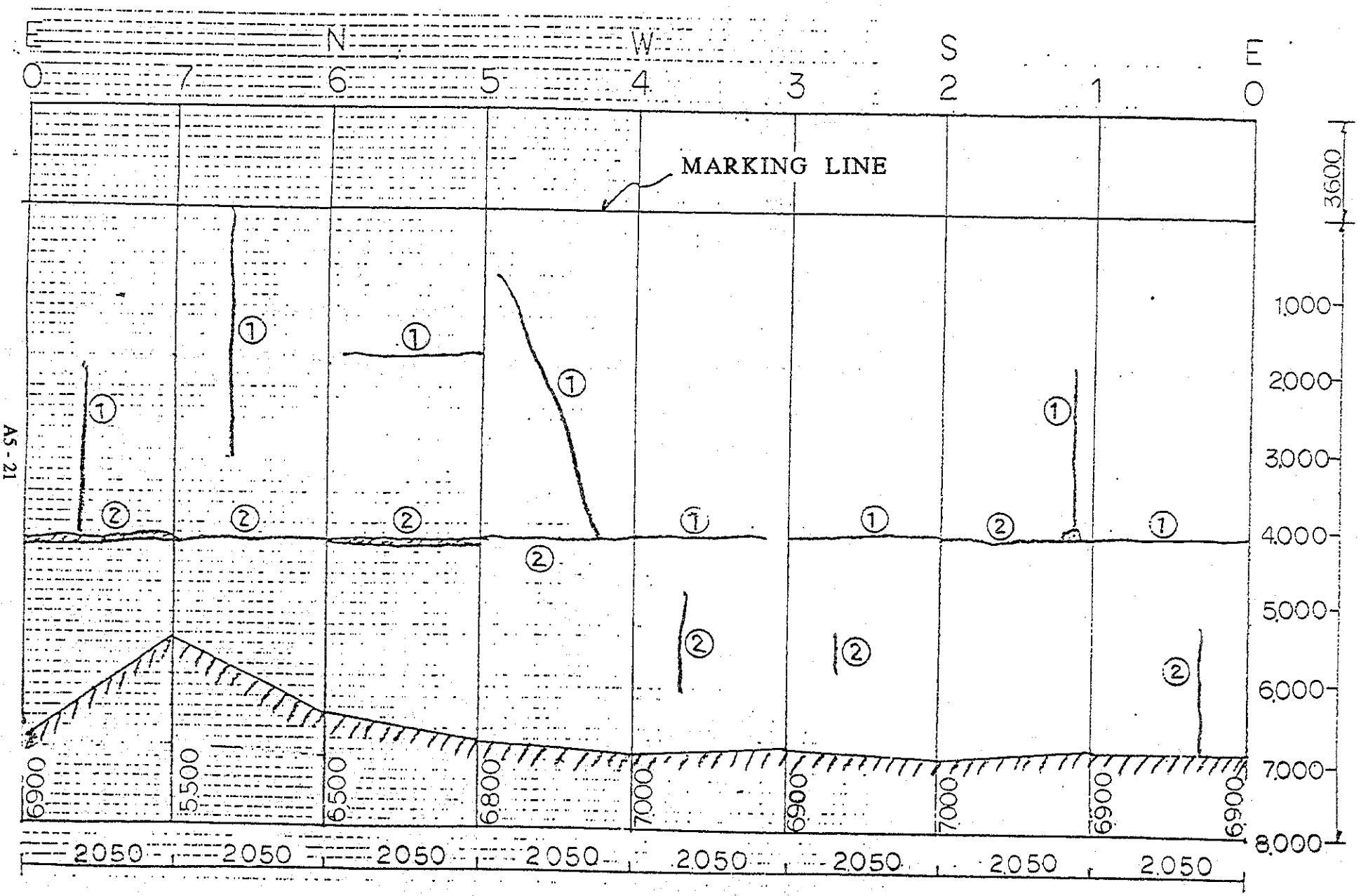


Table A-5.2.3 Cracking Size P5-A,B

		L= , W= , D=
0	1	2.05m, 30m/m, 30m/m
1	2	2.05m, 20m/m, 10m/m
1	1	2.9m, 20 m/m, 10 m/m
		, 50 , 40
	2	0.4m, 30m/m, 25m/m
|	3	2.05m, 40m/m, 50m/m
	4	1.0m, 50m/m, 20m/m
2	5	0.8m, 20m/m, 10m/m
2	1	3.0m, 15m/m, 10m/m
|	2	2.05m, 40 m/m, 30 m/m
		, 150 , 100
3	3	1.8m, 20m/m, 20m/m
3	1	1.2m, 20m/m, 20m/m
|	2	2.05m, 200m/m, 180m/m
4	3	2.05m, 20m/m, 20m/m
4	1	1.2m, 100m/m, 40m/m
|	2	2.05m, 50 m/m, 50 m/m
		, 150 , 600
	3	2.05m, 20m/m, 10m/m
5	4	2.05m, 30m/m, 15m/m
5	1	2.05m, 50 m/m, 180m/m
		, 100 ,
|	2	0.6m, 20m/m, 30m/m
	3	2.2m, 20m/m, 20m/m
6	4	1.4m, 20m/m, 20m/m
6	1	2.05m, 20 m/m, 50 m/m
		, 130 , 150
|	2	2.05m, 20m/m, 10m/m
	3	0.8m, 10m/m, 10m/m
7	4	2.05m, 20m/m, 10m/m

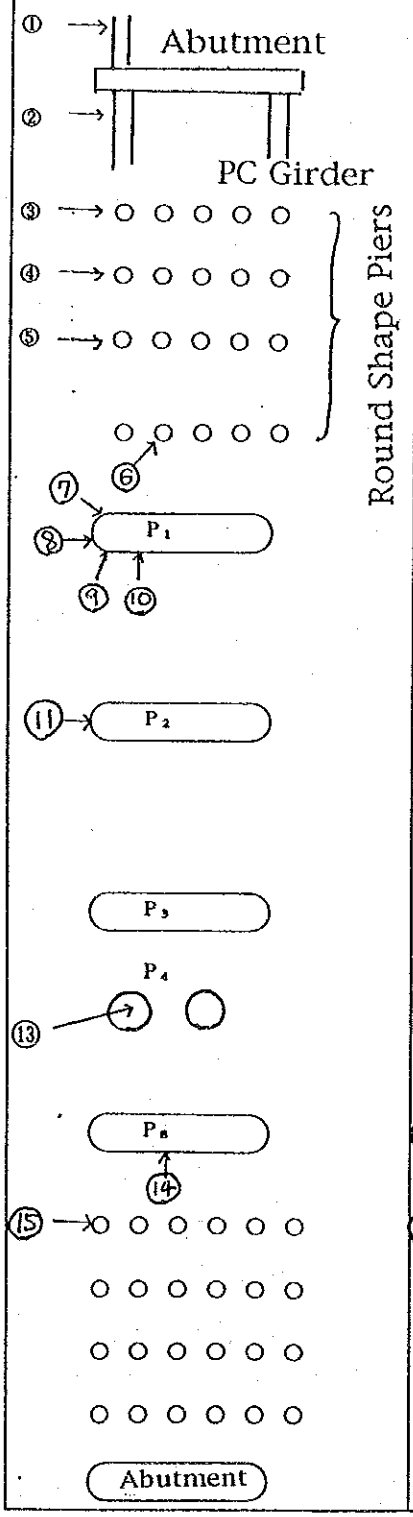
		L= , W= , D=
7	1	2.1m, 30m/m, 30m/m
|	2	2.05m, 20 m/m, 100 m/m
		100 , 300
0	3	2.05m, 10m/m, 20m/m
		, ,
0	1	2.05m, 10 m/m, 20 m/m
1		, 50 , 60
1	2	1.6m, 20m/m, 20m/m
1	1	2.0m, 10m/m, 10m/m
2	2	2.05m, 20 m/m, 20m/m
		, 150 ,
2	1	1.7m, 30m/m, 50m/m
3	2	0.5m, 10m/m, 15m/m
3	1	1.75m, 30m/m, 60m/m
4	2	1.2m, 20m/m, 20m/m
4	1	3.6m, 20m/m, 30m/m
5	2	2.05m, 50m/m, 40m/m
5	1	1.9m, 15m/m, 10m/m
6	2	2.0m, 10 m/m, 10 m/m
		, 100 , 30
6	1	4.7m, 10m/m, 10m/m
7	2	2.0m, 40 m/m, 30m/m
		, 10 ,
7	1	2.8m, 20m/m, 20m/m
0	2	2.0m, 20m/m, 10m/m
		, 120 , 80

P5-B

P5-B

P5-A

5.3 : In-situ Compression Strength Test by Schmidt Hammer

Location	Value Measured by Schmidt Hammer		equivalent strength	70% Value (kg／cm²)
	① 45, 50, 52, 48, 42≒48.2 52	Vertical	500	350
	② 58, 57, 61, 60, 60≒59.2		510	357
	③ 60, 63, 60, 58, 60≒60.2		650	455
	④ 56, 56, 58, 59, 58≒57.4		620	434
	⑤ 58, 58, 57, 57, 58≒57.6		620	434
	⑥ 55, 58, 57, 57, 58≒57.0		620	434
	⑦ 52, 55, 53, 62, 55≒55.4		600	420
	⑧ 53, 56 ⑨ 54, 52, 46, 56, 46 ⑩ 55	≒52.3	530	371
	⑪ 53, 54, 48 ⑫ 47, 55	≒54.1	520	367
	⑬ 34, 39, 36, 33, 35≒35.4		280	196
	⑭ 48, 55, 52, 52, 53≒52		510	357
	⑮ 55, 58, 60, 52, 55≒56		620	434

5.4 : Deformation/Aberration Investigation of Bridge by Survey Equipment

Fig.A-5.4.1 Aberration of Centerline in between P3 and P6

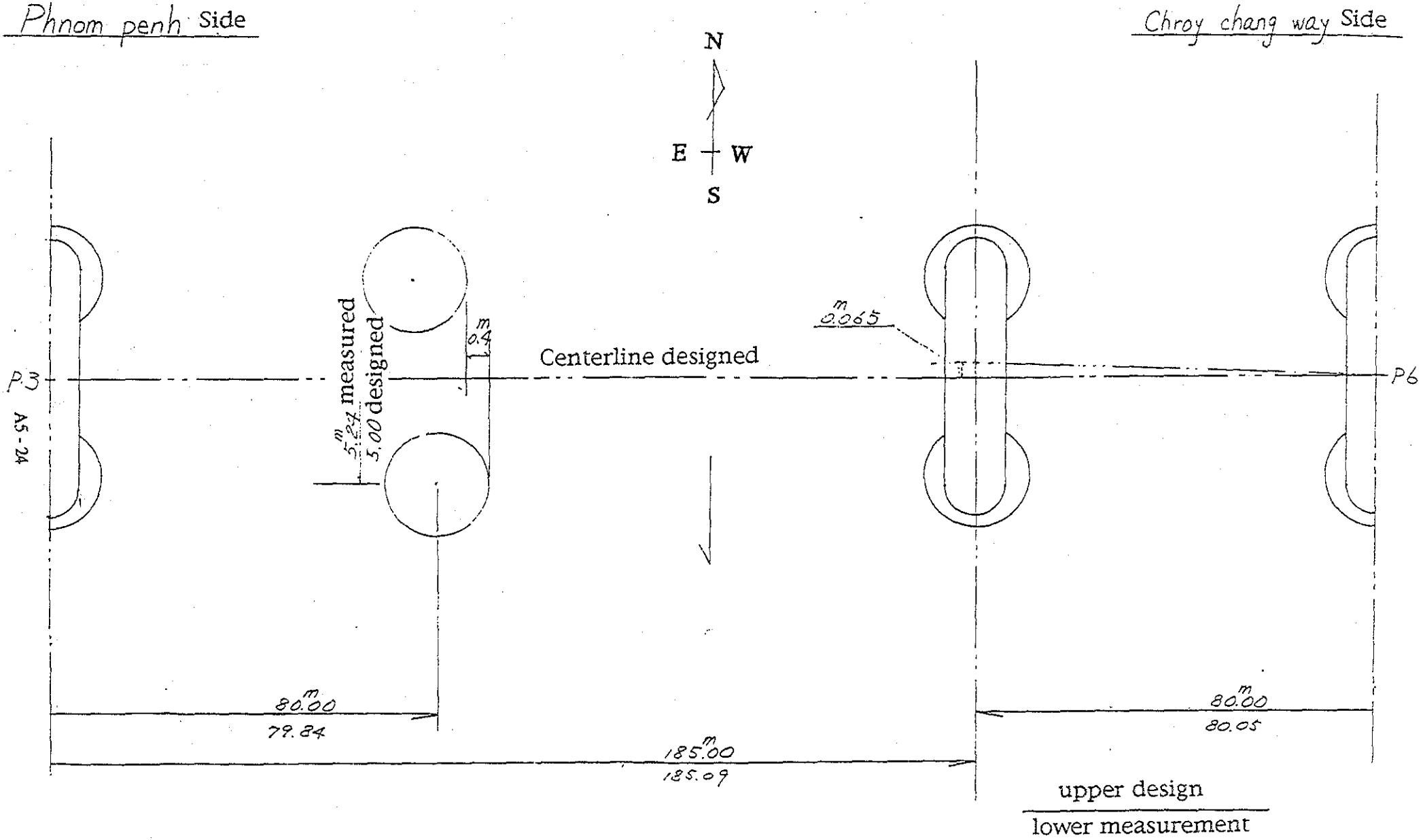


Fig.A-5.4.2 Elevation of Piers

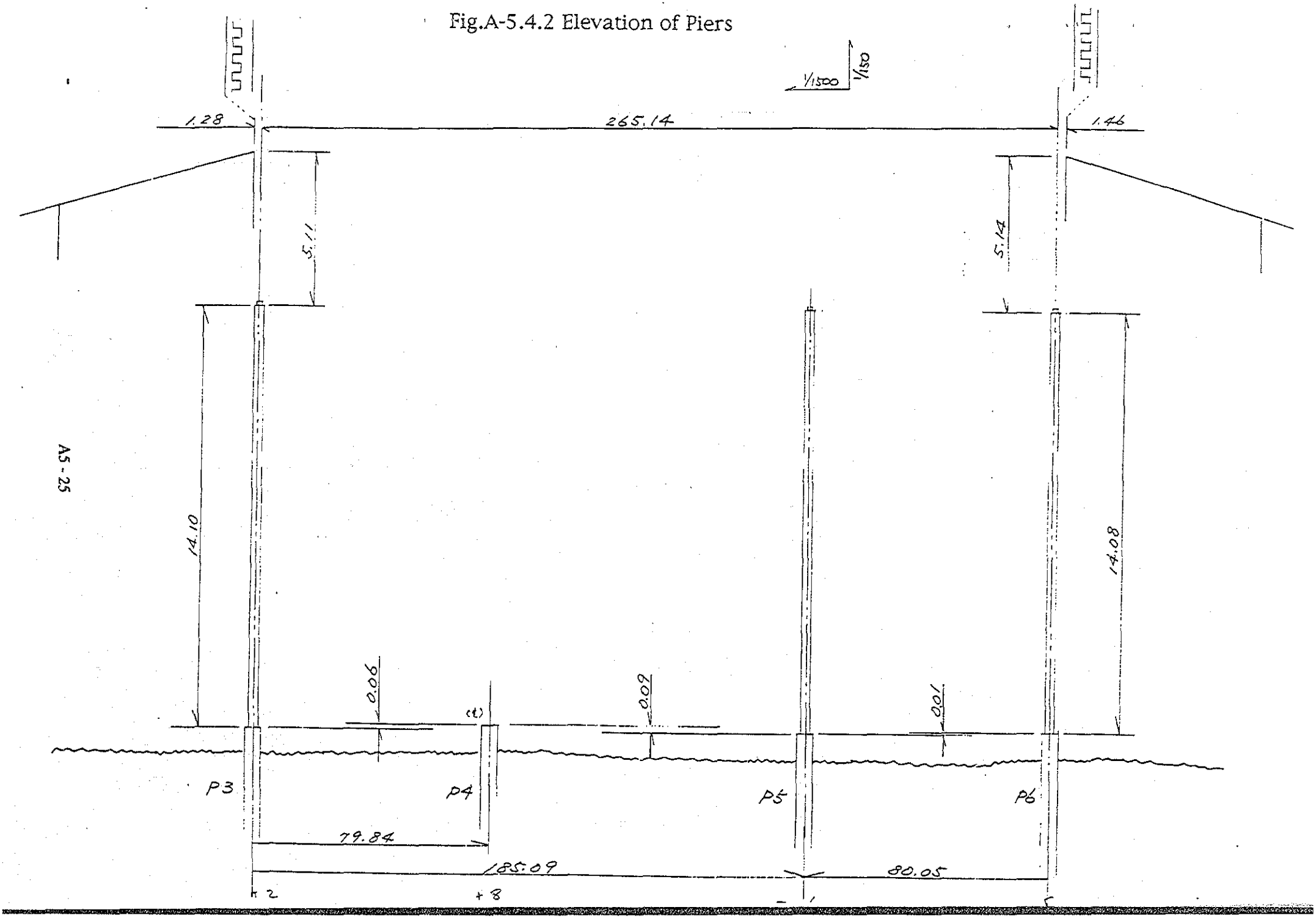
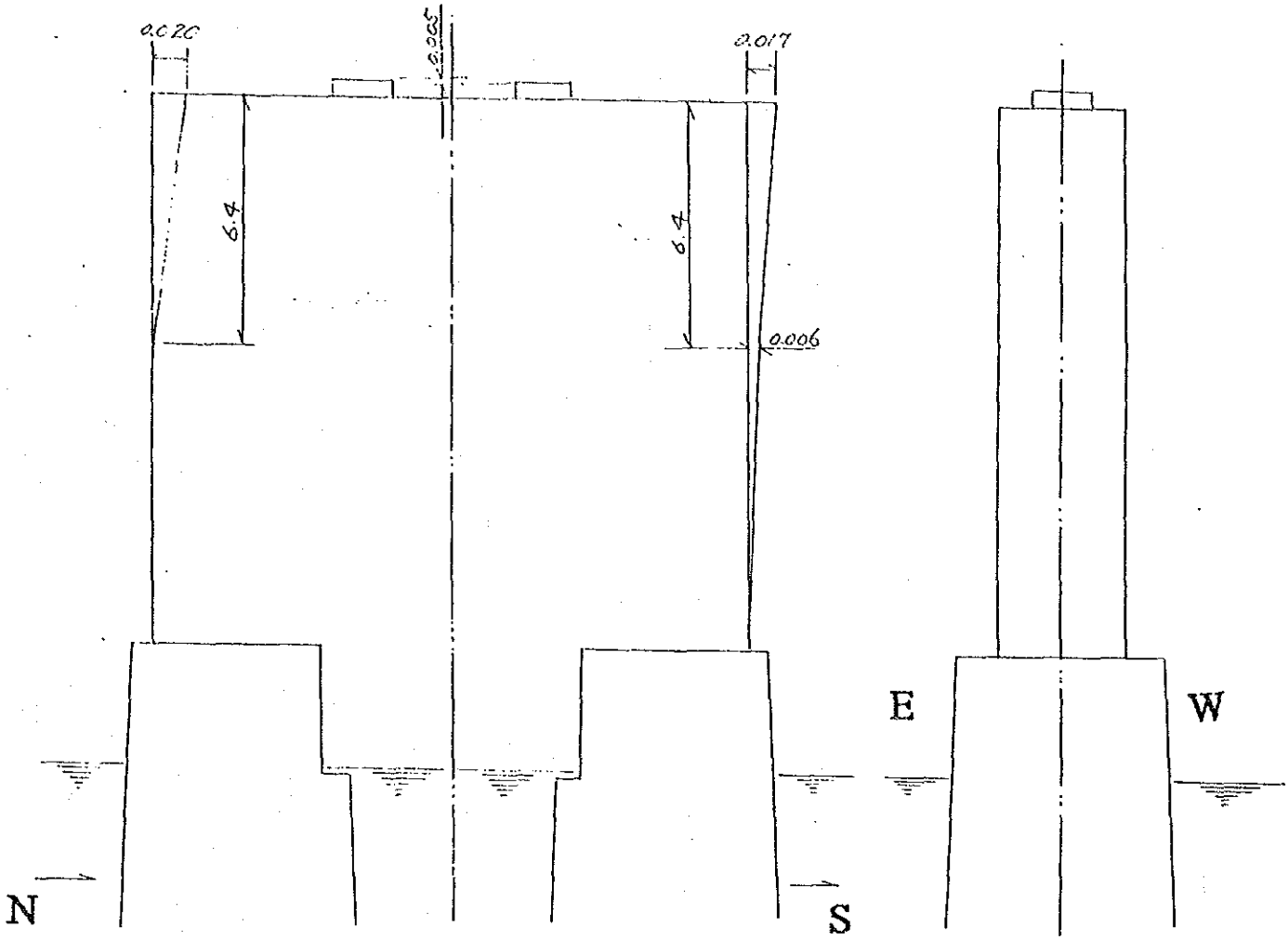


Fig.A-5.4.3 Slant of Pier No.2



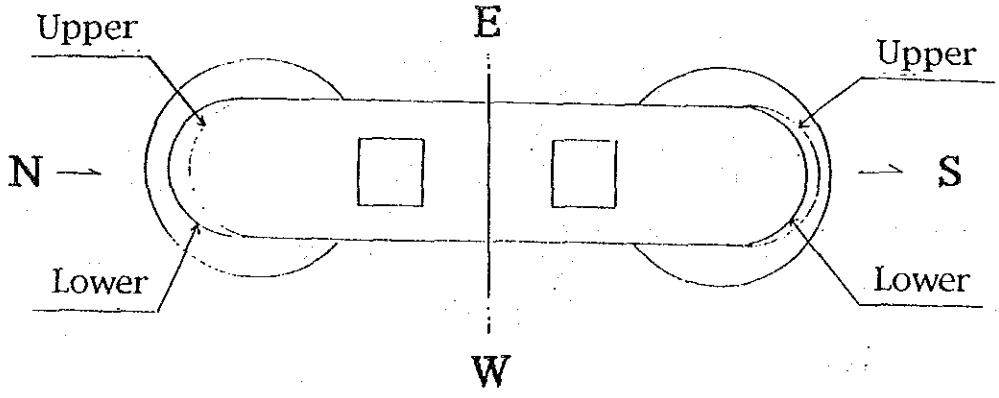
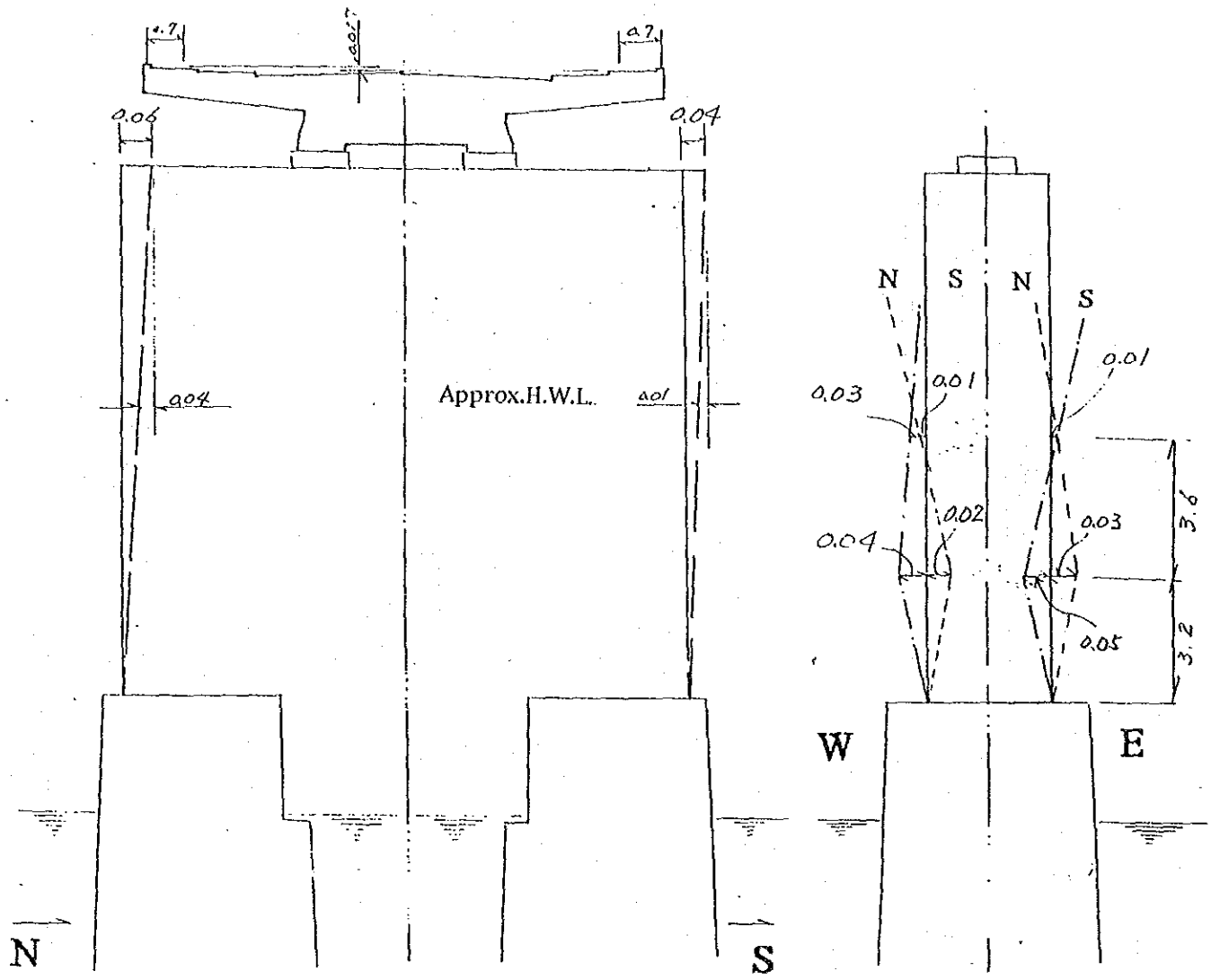


Fig.A-5.4.4 Slant of Pier No.3



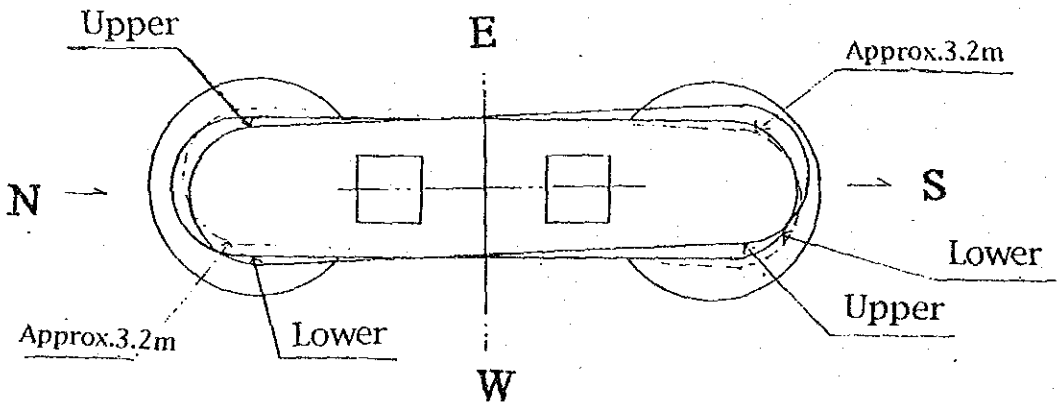


Fig.A-5.4.5 Slant of Pier No.4

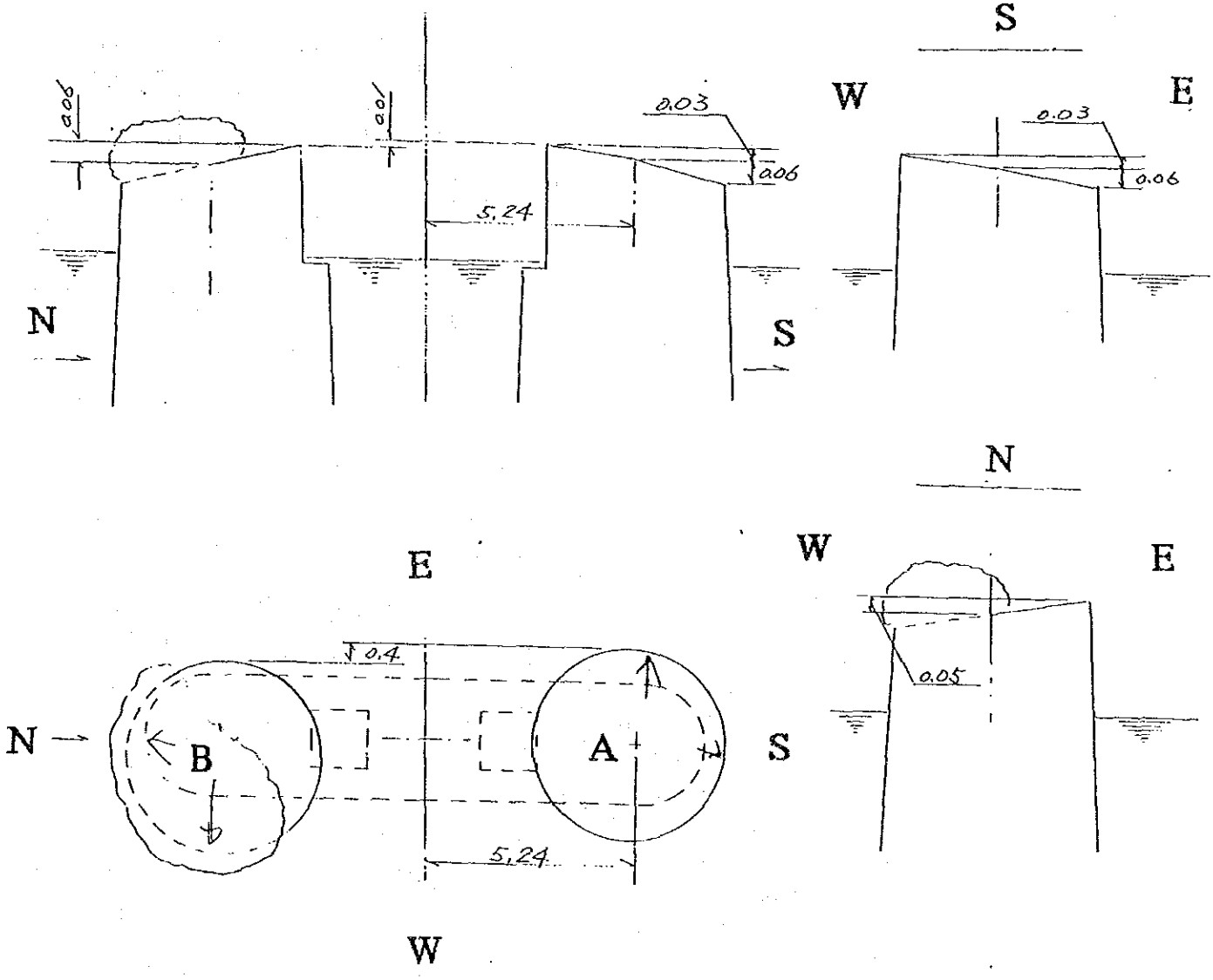


Fig.A-5.4.6 Slant of Pier No.5

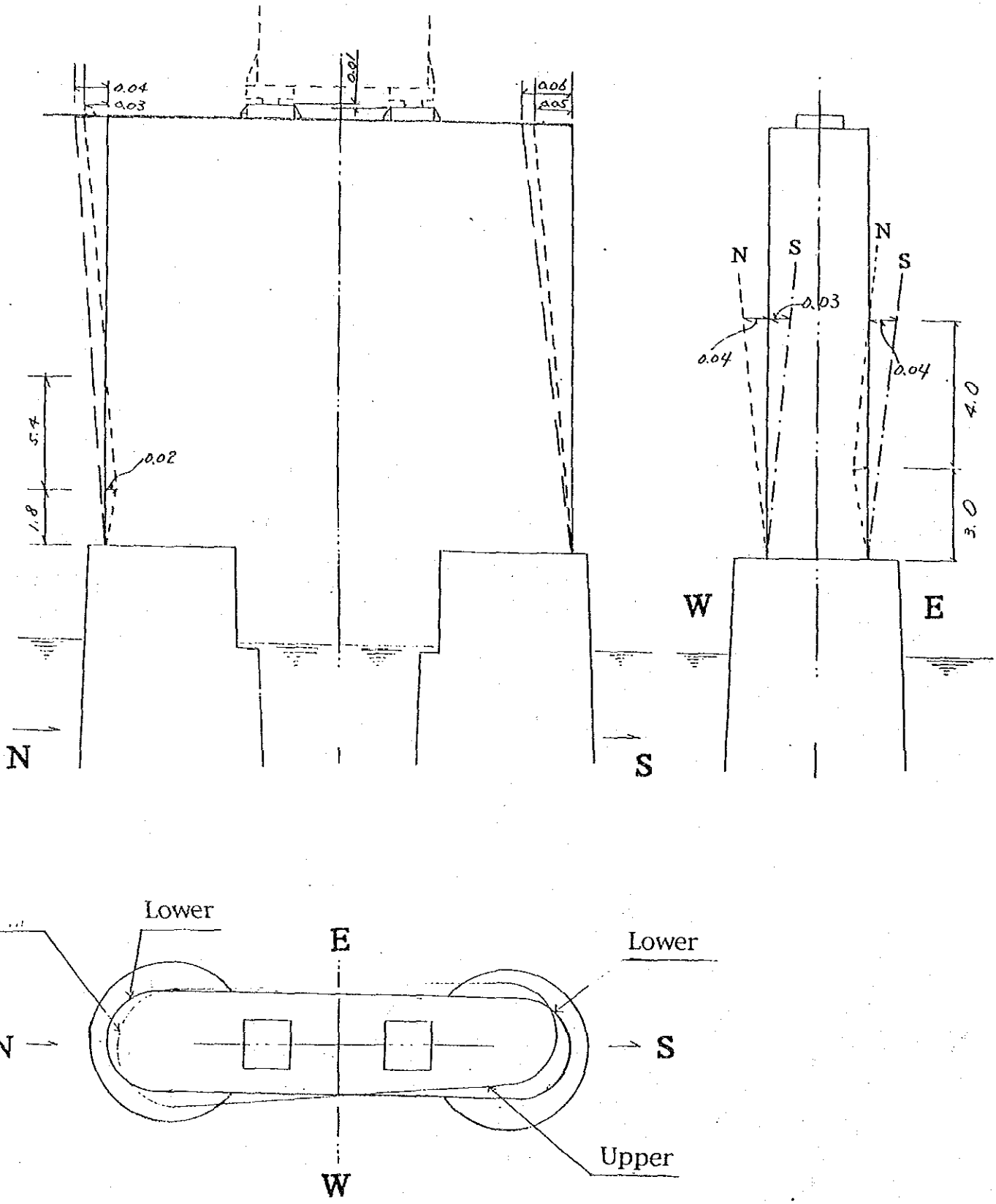


Fig.A-5.4.7 Slant of Pier No.6

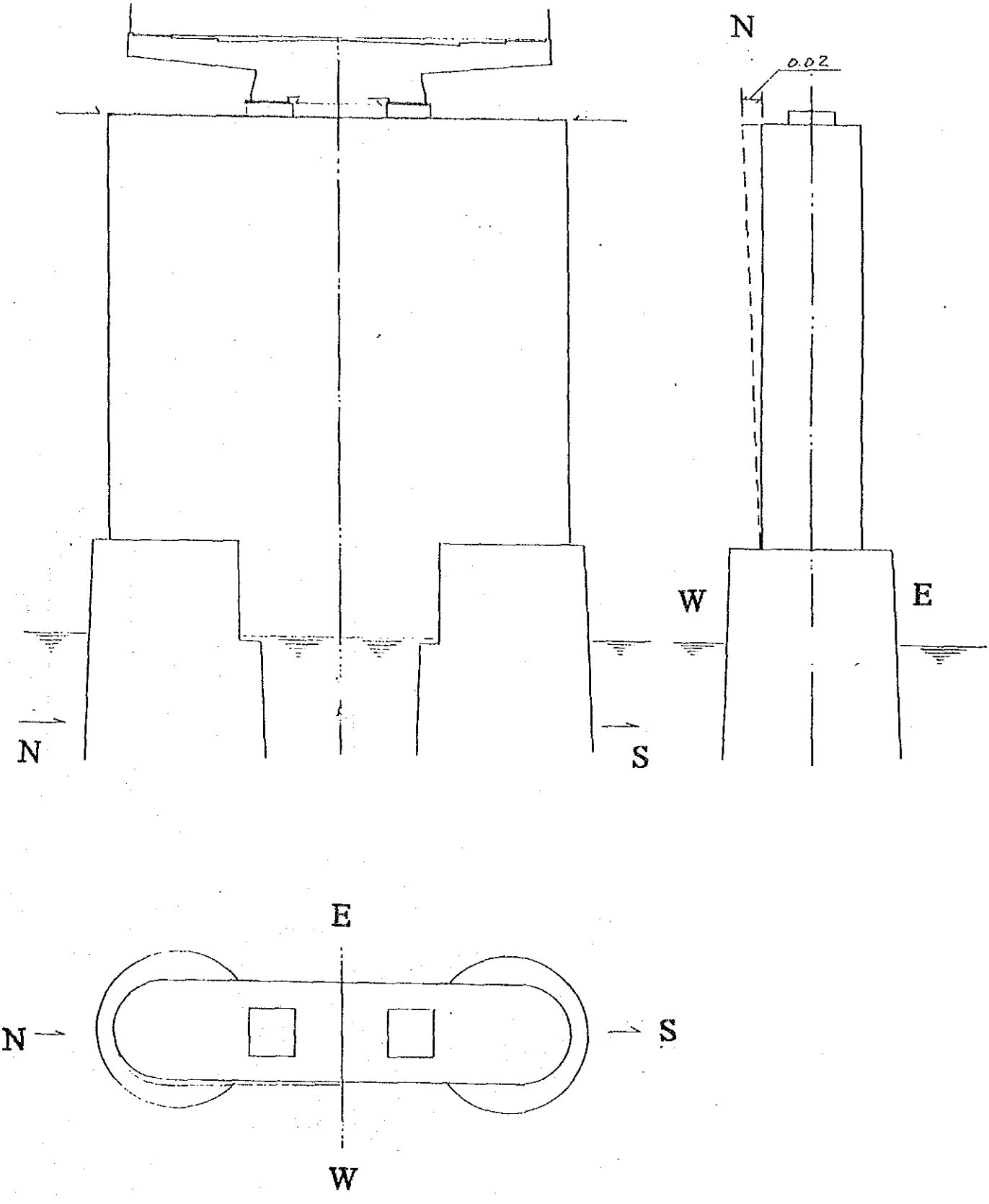
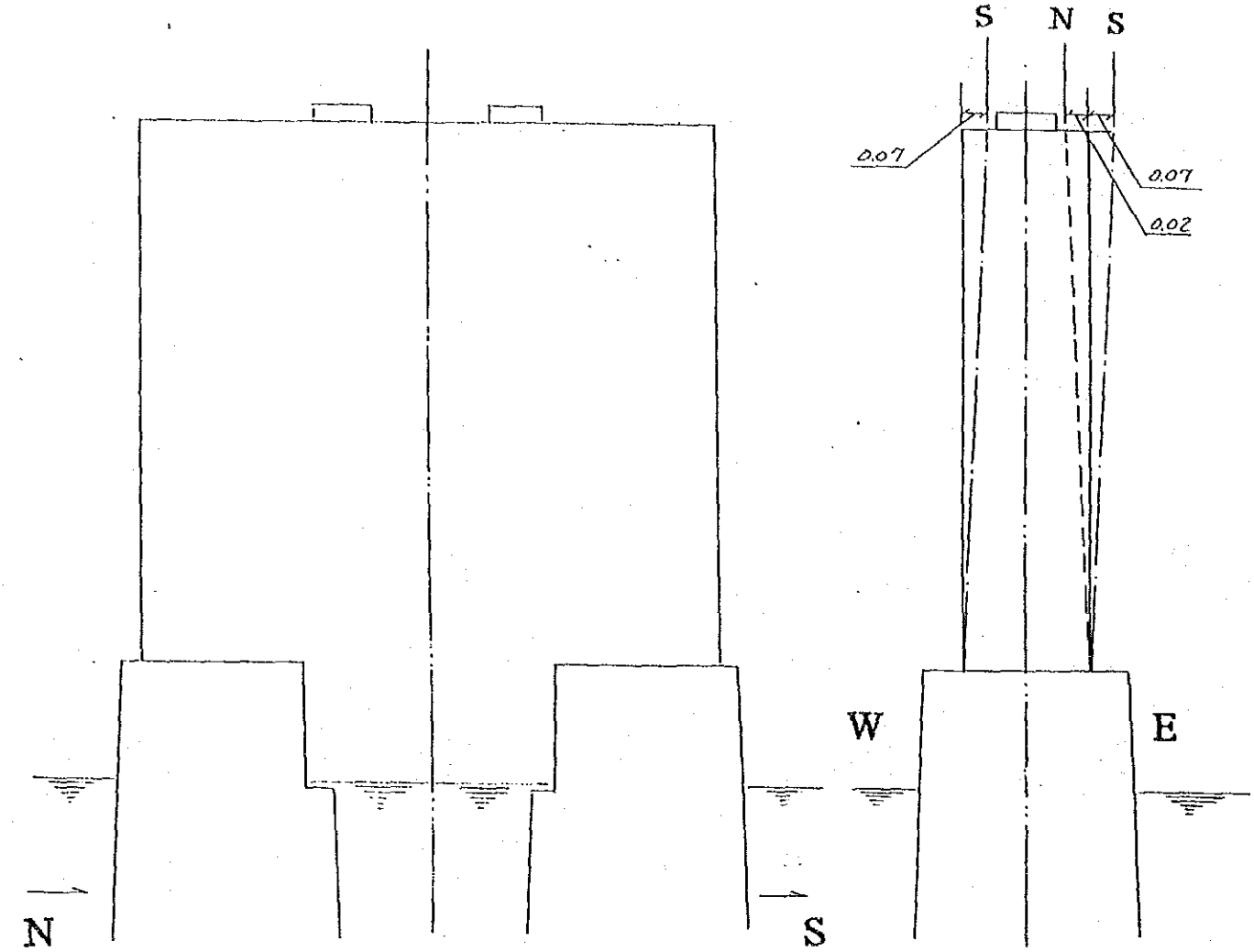


Fig.A-5.4.8 Slant of Pier No.7



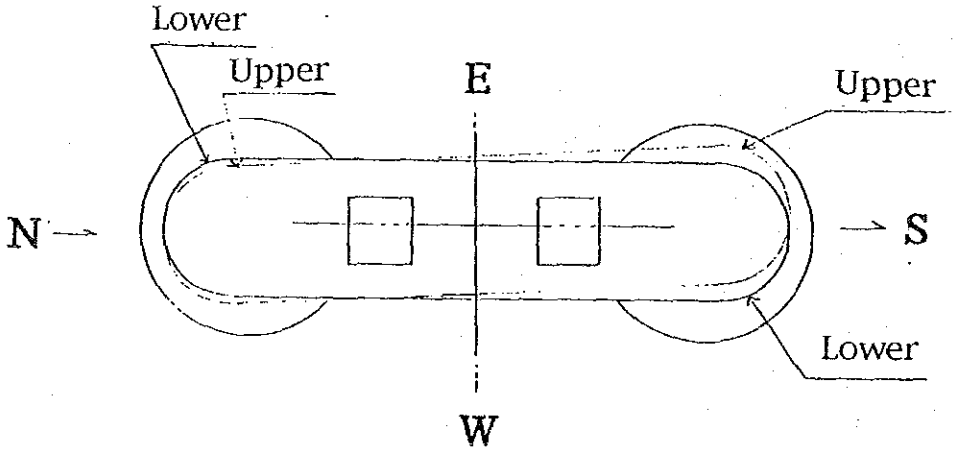
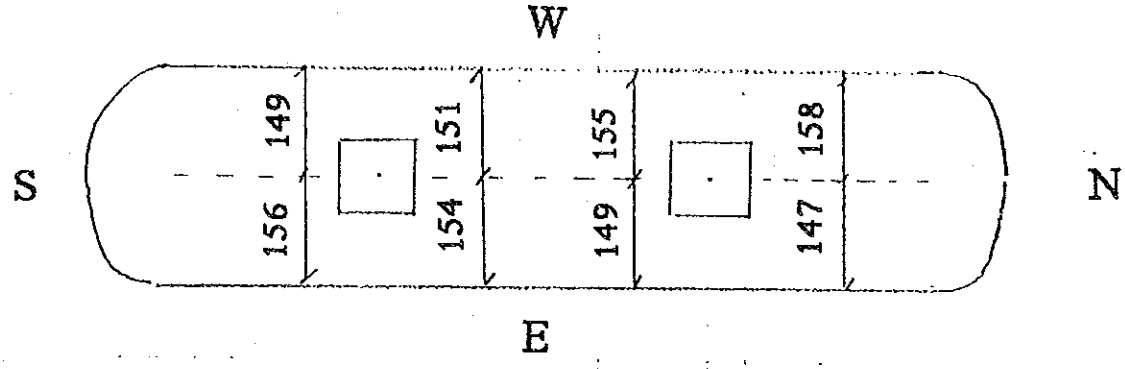
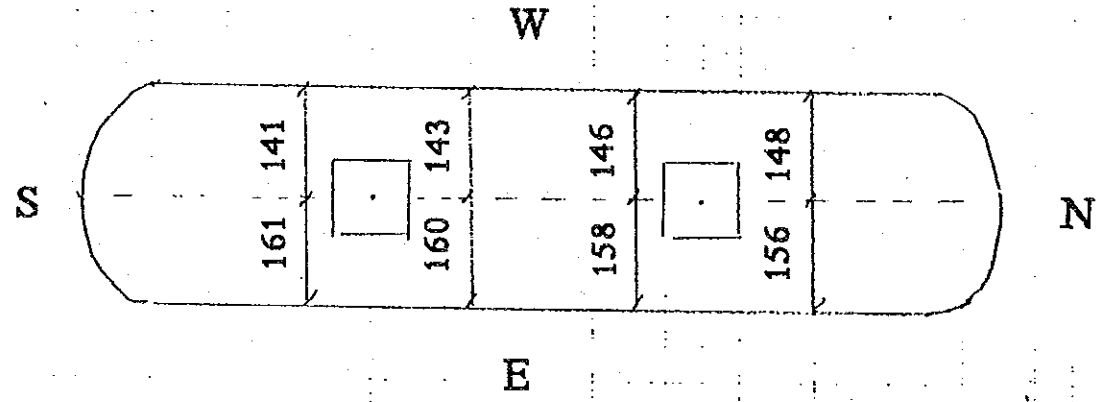


Fig.A-5.4.9 Location of Bearing Shoe

Pier No.2



Pier No.7



APPENDIX-6: PRELIMINARY STUDY ON THE REHABILITATION OF NATIONAL ROUTE 6A

1. General Description

(1) Location

Administration Unit Moukampoul, in which Route 6 passes, is located in the north of Phnom Penh and is under its influence area. This route runs municipal units Russey Koy and Chroy Changwar in the south, Russey Keo and Pongea Loen in the west, Ksach Kandal and Batheay in the east and Batheay and Kang Meas of Kompong cham Province in the north.

(2) Terrain

The terrain of Moukampoul is generally flat, but in particular, central portion is comparatively depressed and its surroundings are rather high. It is similar to a trapezoid shape. In June to October, the season of flooding, the Mechong river overflows and discharge flooding water toward the Tonle Sap river. The depressed portion becomes the retention pond of flooding water.

(3) Land Use and Industry along the Road

Phnom Penh is connected with Kompong Cham by the Mechong river or Routes 6A, 6 and 7, while Phnom Penh is connected with Kompong Chenang by the Tonle Sap river or Route 5. These two rivers are connected each other by the Moukampoul river and the Prek Koy river. Land use of 275 km^2 area of Monkampoul is summarized as follows.

Total Area	Rice Field	Other Arable Land	Fruit	Lakes & Marshes	Urban Area	Forest	Arable Forest	River
27,500 ha	4,128 ha	1,307 ha	5,614 ha	35 ha	1,285 ha	10,031 ha	1,765 ha	4,382 ha

The population of this district is of 60,661 and the number of families are 11,858, about half times as many as it was before the break-out of civil war. The industries along the road are as follows.

Rice Mill	Saw Mill	Blocks & Bricks	Water Pot	Ice Plant	Silk Hand-woven	Other Hand-woven
45	6	6	2	3	1,000	750

The number of public facilities along the road are as follows:

Hospital	Clinic	Elementary School	Other School	Junior/ Senior High	Kinder-garten	Pacoda	Bonze	Mosque
2	11	36	6	1	8	30	201	2

Total area of rice field in dry season is of 3,200 ha as average turn-out is 9,817 ton (3.19 ton/ha). Other arable land is 835 ha in dry season and main products are kidney bean, peanuts, egg plants, tobacco. Total area of rice field in rainy season is of 302 ha and average turnout is 585.3 ton. Domestic animals are as follows.

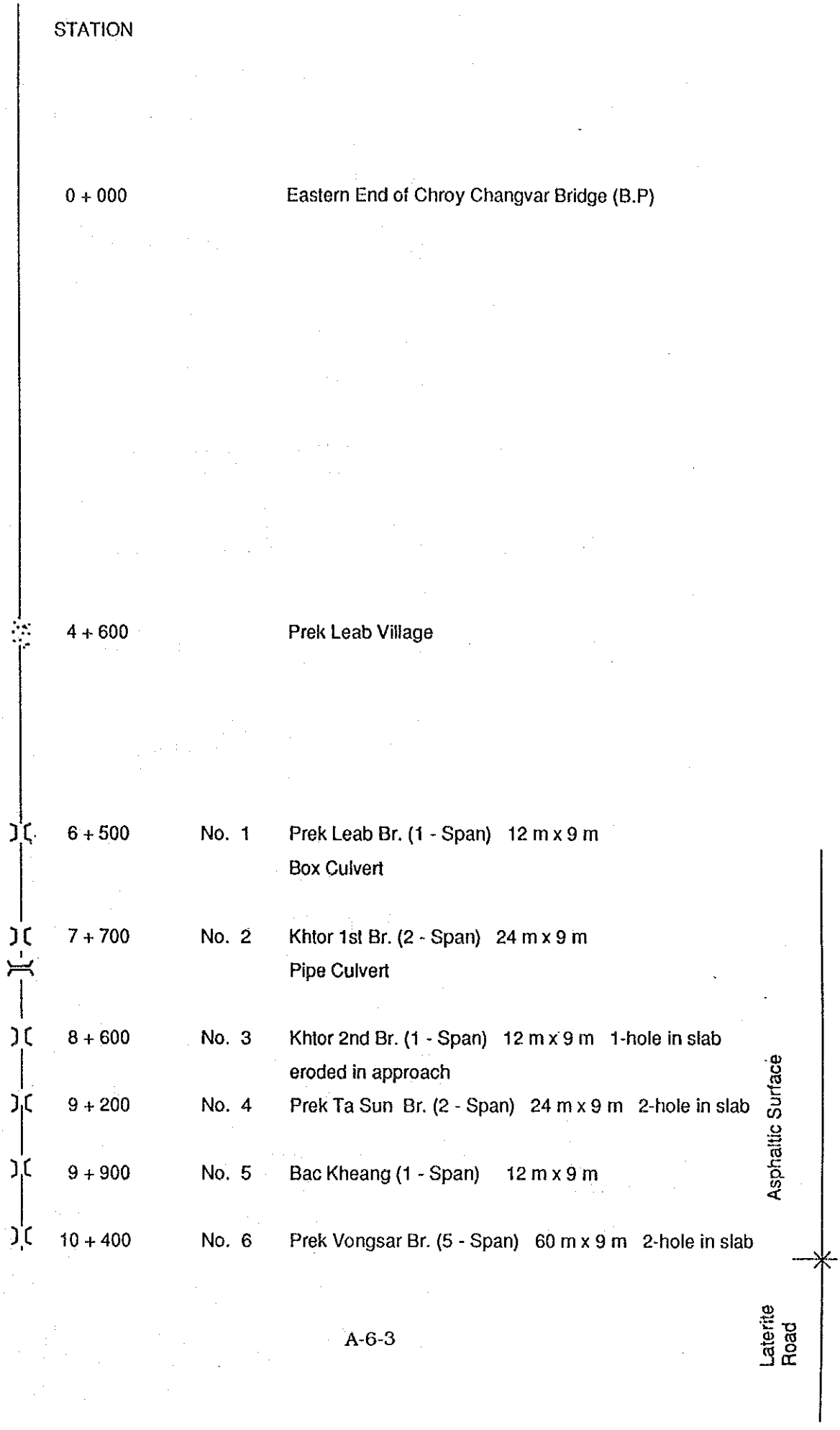
Cow	Buffalo	Horse	Pig	Domestic Fowl
20,191	418	160	10,365	48,313

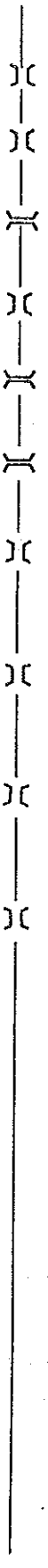
2. Roads and Road Traffic (Please refer to Fig. 1)

National Route 6A, total length of 44.7 km, is undivided two-lane highway, starting from Chroy Changwar Bridge in the north of Phnom Penh City and ending at Chun Chunok where Route 6A connects to Route 6. Width of road is 9m, 6m wide paved throughway and 1.5m wide shoulder in both sides. The Road was open at the time when the construction of Chroy Changwar Bridge was completed in 1963. The terrain is flat and predominant land use is agriculture.

To avoid overflow of flooding water and to keep higher elevation of road than flooding water level, the configuration of road structure is mostly 3m to 10m high embankment and drainage structures such as box culvert and pipe culvert and bridges are installed to secure required opening for flooding water. Old surface pavement on the road is entirely damaged and disappears because of neither use nor maintenance in past two decades.

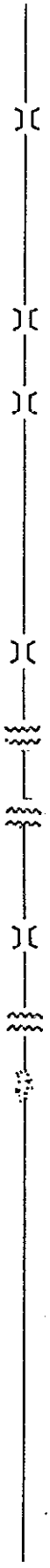
Fig. 1. Outline of Route 6A





11 + 400	No. 7	Prek Chik Br. (1 - Span) 12 m x 9 m No backfill in abutment 1 - Span extension in both sides is required
11 + 900	No. 8	Prek Suon Choeurn Br. (3 - Span) 36 m x 9 m
		Box Culvert
13 + 100	No. 9	Prek Tamin Br. (2 - Span) 24 m x 9 m
		Pipe Culvert
		Pipe Culvert
15 + 500	No. 10	Prek Ta Soam Br. (1 - Span) 12 m x 9 m
16 + 500	No. 11	Prek Ta Pich Br. (1 - Span) 12 m x 9 m
17 + 500	No. 12	Prek Tabek Br. (2 - Span) 24 m x 9 m
18 + 600	No. 13	Prek Thmei Br. (2 - Span) 24 m x 9 m
20 + 000		
		Low Embankment
22 + 000		

23 + 000		Low Embankment
27 + 100		Rea Sey Chroy Village
29 + 000	No.14	Prek Kheng Br. (10 - Span) 120 m x 9 m Central 3 - Span Collapsed
29 + 600	No.15	Prek Tambang 1st Br. (2 - Span) 24 m x 9 m
29 + 800	No.16	Prek Tambang 2nd Br. (3 - Span) 36 m x 9 m
31 + 700	No.17	Prek Hok Leng Br. (3 - Span) 36 m x 9 m
32 + 100	No.18	Prek Ta Oun Br. (3 - Span) 36 m x 9 m Central Pier and slab destroyed.
32 + 600	No.19	Deam Chrey Br. (2 - Span) 24 m x 9 m
33 + 500	No.20	Prek Bak Br. (3 - Span) 36 m x 9 m Central Pier and slab Destroyed.
34 + 000		



35 + 400	No.21	Chung Prek Br. (2 - Span) 24 m x 9 m
37 + 100	No.22	Prek Kra Poes (10 - Span) 120 m x 9 m Central Pier and slab Destroyed.
37 + 800	No.23	Kompong Prasath Br. (3 - Span) 60 m x 9 m Northern abutment Destroyed.
40 + 100	No.24	Kompong Pras 1st Br. (7 - Span) 84 m x 9 m Northern 1 - Span and abutment Destroyed.
		1 - Span and abutment destroyed.
40 + 500		30 m long embankment excavated
		70 m long embankment excavated
41 + 100	No.25	Kompong Pras 2nd Br. (1 - Span) 12 m x 9 m
		No backfill in abutment, 3 - hole in slab
41 + 800	No.26	Kompong Pras 3rd Br. (3 - Span) 36 m x 9 m
		No backfill in abutment
		Total 180 m long embankment excavated
43 + 000		Panom Del Village
44 + 700		Chun Chunok (E.P.)

Major erosion and wash-out of road embankment were caused by the recorded floods occurred in 1973 and 1990. However, some local damages caused by oxcarts across the road are found.

In the vicinity of ending point, several considerable wash-out of embankment were taken place. It was learned that some sections were excavated by local people to facilitate to discharge flooding water.

Four-wheel drive vehicle and motorcycle can pass the whole stretch of road in dry season.

3. Damaged Bridges

3.1 General Description

Twenty six bridges exist on National Route 6A and total length of bridge is 936m. Width of each bridge is commonly 9m. Type of bridge is that superstructure is reinforced concrete girder bridge with standard 12m long span except Kompong Prasath bridge (20m long span). And substructure is steel pipe pile filled up with reinforced concrete (Kompong Prasath bridge has reinforced concrete pier and foundation).

It is seen that a standard design was adopted to all the bridges except Kompong Prasath bridge.

3.2 Damaged Bridges

Table 4-1 shows damaged bridges and its details. Damaged parts of bridge are classified into slab, parapet, girder, pier and abutment. Explosive forces caused all damages. As shown in Table 4-1, many damages exist but they are limited to be local. It is likely possible to utilize existing damaged bridge at large. Consequently, six spans of superstructure, four piers and one abutment should be reconstructed to make this road passable.

4. Preliminary Study on the Rehabilitation Plan

4.1 Outline of Study

The following three phases of rehabilitation of Route 6A are considered:

Phase-1: Reinstatement of non-passable sections

Phase-2: Rehabilitation to functional road, namely passable through a year in all weather

Phase-3: Improvement of road to prevent from flood

Major work items in each phase are summarized as follows:

	Phase-1	Phase-2	Phase-3
Major Work Items	- Road embankment - Bridge construction	- Construction of subbase and base courses - Surfacing	- Raising grade of road - Installation of culverts - Construction of new bridges

4.2 Road Rehabilitation Plan

1) Earthwork

Wash-out of road embankment are taken place at approach sections of ten bridges and seven locations in 2.5 km long stretch in the vicinity of Panom Del Village. It is practical that the construction method of embankment will be the same as the road was constructed, namely excavating land along the road and filling. It is recommended that borrow pits will be designed to be a reservoir in dry season.

2) Subbase and Base Course

The existing subbase and base course materials remain in 10km stretch in beginning point and 3km stretch in ending point. It is assumed to be utilized these materials as subbase and base course, probably with some grade stabilization.

The construction of subbase and base course therefore will be done in central 30km stretch and on new embankment. A pavement structure, of which total thickness of subbase and base course is 25cm, is assumed to satisfy light traffic (100 large vehicles/day) with pavement stiffness.

3) Surfacing

The original surfacing was penetration Macadam. If Route 6A becomes passable, surfacing will be deemed necessary, considering forecasted traffic demand and land use along the road. However, since uncertainty in political and business circles will make traffic demand variable and motorcycles will occupy eighty percent of traffic, minimum thickness (5cm) of asphalt concrete surfacing will be the most suitable to avoid excessive initial investment.

Asphalt concrete surfacing has advantages that it is not necessary to control traffic during construction.

4) Countermeasures against flood

Raising grade of road or providing additional opening in damaged stretch caused by flood are assumed practical countermeasures against flood. If sufficient opening enable to make flooding level lower based on the hydrological analysis, raising grade of road will become unnecessary. It is necessary for Prek Chick bridge (KM 11+400) to increase span arrangement from one to three. Damaged stretch in between KM 40+500 and KM 43+000 will require the same scale of opening as that in the similar stretch between KM 6+500 and KM 18+600, and then three times as long as the existing bridge length (L=48m) will be required.

4.3 Bridge Repair Plan

Generally, two ways will be considered to repair a damaged bridge.

a) to construct new structure after removing damaged portion
b) to reinforce damaged portion

a) Construction of New Structure

The following four bridges are required a new structure.

i) Prek Kheng Bridge : Construction of 3 spans and 2 piers
ii) Prek Bak Bridge : Construction of 2 spans and 1 pier
iii) Prek Kra Poes Bridge : Construction of 1 pier
iv) Kompong Prass Bridge: Construction of 1 span and 1 abutment

Table 1 Route 6A Survey Result of Damage for Bridge

No.	BRIDGE NAME	LENGTH OF BRIDGE (m)	WIDTH (m)	HEIGHT (m)	LOCATION (FROM PHNON PENH)	DEGREE OF SITUATION						
						SLAB	PARAPET	GIRDER	PIER	ABUTMENT	BACK FILL	
1	Prek Leah	1×12= 12	9	5	6+500	○	○	○	—	○	○	—
2	Khtor 1st	2×12= 24	9	5	6+700	○	1panel	Partially stripping concrete	○	○	○	Partially repair
3	Khtor 2nd	1×12= 12	9	4	8+600	1hole	3panel	○	—	○	○	Partially repair
4	Prek Ta Sun	2×12= 24	9	6	9+900	1hole	2panel	Partially damage of end girder	○	Partially damage of bearing shoe		Partially repair
5	Bac Kheang	1×12= 12	9	5	9+900	○	○	○	○	○	○	—
6	Prek Vongsar	5×12= 60	9	5	10+400	2hole	4panel	○	○	○	○	Partially repair
7	Prek Chik	1×12= 12	9	8	11+400	○	○	○	○	○	Wash-out	—
8	Prek Suon Choeurn	3×12= 36	9	5	11+900	1hole	5panel	○	○	○	○	Partially repair
9	Prek Tamin	2×12= 24	9	4	13+100	○	1panel	○	○	○	○	Partially repair
10	Prek Ta Soam	1×12= 12	9	4	15+500	○	1panel	○	○	○	○	Partially repair
11	Prek Ta Pich	1×12= 12	9	4	16+500	○	1panel	○	○	○	○	Partially repair
12	Prek Tabek	2×12= 24	9	4	17+500	○	○	○	○	○	○	—
13	Prek Thmei	2×12= 24	9	5	18+600	○	2panel	○	○	○	○	Partially repair
14	Prek Kheng	10×12=120	9	5	29+000	3span	allpanel	3span	2pier	○	○	New Construction of 36m
15	Prek Tambang 1st	2×12= 24	9	7	29+600	○	○	○	○	○	○	—
16	Prek Tambang 2nd	3×12= 36	9	7	29+500	○	○	○	○	○	○	—
17	Prek Hok Leng	3×12= 36	9	6	31+700	○	○	○	○	○	○	—
18	Prek Ta Oun	3×12= 36	9	5	32+100	○	○	○	○	○	○	—
19	Deam Chrey	2×12= 24	9	6	32+600	○	1panel	○	○	○	○	Partially repair
20	Prek Bak	3×12= 36	9	6	33+500	6 m × 4 m	2span	2span	1pier	○	○	New Construction of 24m
21	Chung Prek	2×12= 24	9	6	35+400	○	○	○	○	○	○	—
22	Prek Kra Poes	10×12=120	9	7	37+100	4 m × 4 m	○	○	1pier	○	○	Partially repair
23	Kompong Prasath	3×20= 60	9	13	37+800	○	○	North part of end girder	○	○	Partially Wash-out	Partially repair
24	Kompong Pras 1st	7×12= 84	9	10	40+100	1span	1span	1span	○	1pier	Partially Wash-out	New Construction of 12m
25	Kompong Pras 2nd	1×12= 12	9	6	41+100	3hole	3panel	1girder	—	○	Partially Wash-out	Partially repair
26	Kompong Pras 3rd	3×12= 36	9	10	41+800	○	○	○	○	○	Wash-out	—
	Total	936m										

Note : ○ : Nothing damage —— : Nothing 1panel is about 3meters. 1span is about 12meters

Before the construction of above-mentioned structures, damaged portions of bridges should be removed. The removal of damaged portions requires blasting and concrete breakers to make them portable debris and cranes and dump trucks to haul out of site. It seems to be possible to adopt the same design of superstructure and substructure as the original.

It is noted that dry season enables dry construction work (construction on land) so that no serious technical problem is expected.

Major quantities and rough estimate of construction period are summarized as follows:

No.	Name of Bridge	Area of Bridge	No. of Pier/ Abutment	Period of Removal	Period of Construction	Total (Month)
14	Pred Kheng	36x9 = 324	2	1.5	3.0	4.5
20	Pred Bak	24x9 = 216	1	1.0	2.0	3.0
22	Prek Kra Poes	-	1	1.0	1.0	2.0
24	Kompong Prass	12x9 = 108	1	1.0	1.0	2.0

b) Reinforcement of Existing Structure

The following three repair works are required;

i) Repair of T-type concrete girder
ii) Repair of concrete slab
iii) Repair of concrete parapet

<u>T-Girder</u>

Names of bridge, damages, repair method and construction period are summarized as follows:

No.	Name of Bridge	Damages	Method	Period (days)
4	Prek Ta Sun	- Stripping of Concrete - Exposure of rebars	- Chipping concrete around damaged portion - filling up void by adhesive agent or non-shrinkage concrete	10
23	Kompong Prasath	- 1m long functional loss in girders 2 locations	- Construction of supports - Chipping concrete around damaged portion - Additional reinforcing - Filling up void by adhesive agent and non-shrinkage concrete	15
25	Kompong Pras 2nd	- 1m long functional loss in a girder	- the same as above	10

Concrete Slab

Name of bridge, damaged area, repair method and construction period are summarized as follows:

No.	Name of Bridge	Damages (Area m^2)	Method	Period (days)
3	Khtar 2nd	0.1	- Chipping concrete	1
4	Prek Ta Sun	0.25	around damaged portion	1
6	Prek Vangsar	0.25	- Additional reinforcing	1
8	Prek Suon Choeurn	4.0	- Filling up void by	5
20	Prek Bak	24.0	adhesive agent, non-	7
22	Prek Kra Poes	16.0	shrinkage concrete	7
25	Kompong Pras 2nd	1.5		2

Concrete Parapet

Fourteen bridges among twenty six bridges are suffered damages in bridge railing parapet. Damages vary from one panel (approximately 3m) to all

panels, totaling 128 panels, 384m long. The construction method is as follows:

- removal of remainder
- Chipping concrete to expose reinforcing bars
- forming additional reinforcing bars
- placing Portland cement concrete after forming

The construction period will require four months in case that twenty panels require 10 days to recycle forming materials.

4.4 New Bridge Construction

To cope with countermeasures against flood, new bridge or several box/pipe culverts will be required in damaged section in the vicinity of Pamon Del village to secure sufficient opening for flood water.

Although the selection of structure type will depend upon the hydrological analysis, additional totaling 100m long bridges or other drainage structures equivalent to giving opening will be required. Estimated construction period is about 6 months.

4.5 Summary of Rehabilitation Plan

The existing National Route 6A can serve only for four-wheel drive vehicles and motorcycles in dry season. To rehabilitate this road to enable to serve all types of vehicle through a year, the following major work items and its quantities should be done;

	Major Work Items	Quantities	Remarks
1.	Earthwork		
	Cut and fill	30,500 m^3	Excavating along the road and filling
2.	Pavement		
	Subbase and Base Course	213,500 m^2	Total thickness t=25cm
	Surfacing	268,200 m^2	Thickness t=5cm,Width w=6m
3.	Bridge Work		
	Superstructure	72 m	6 span
	Substructure	5 locs	1-abutment, 4-piers

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