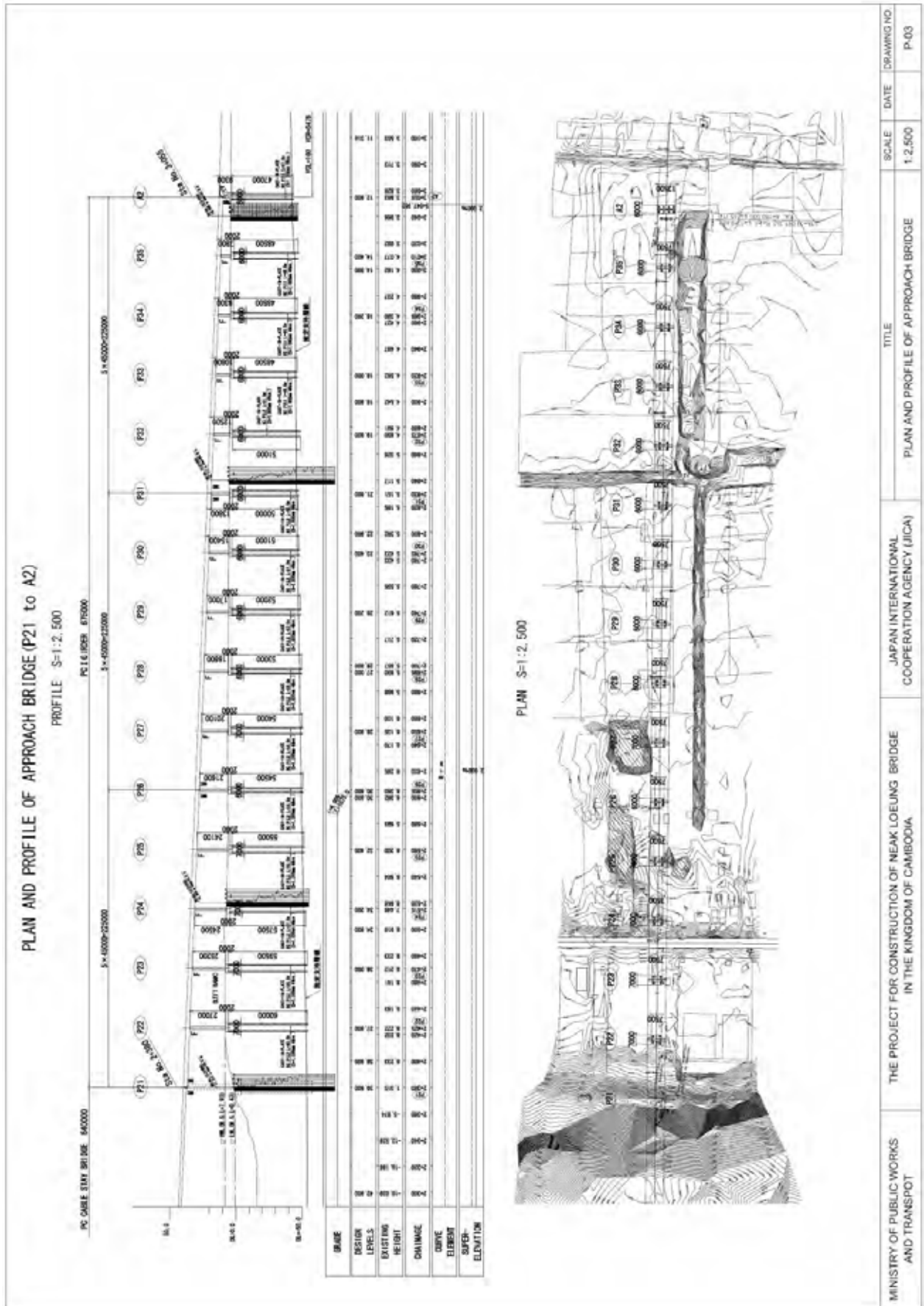


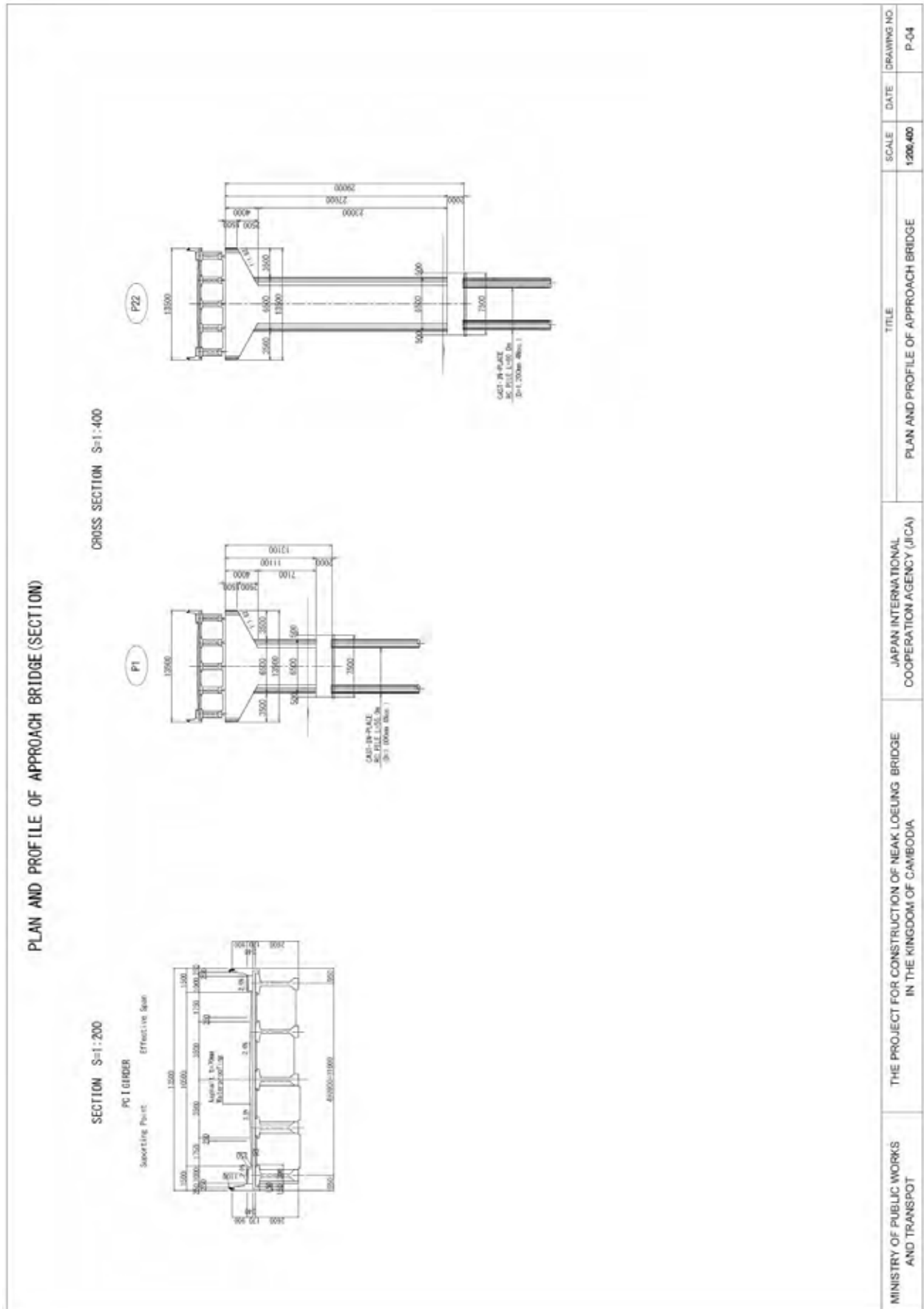
**PREPARATORY SURVEY ON THE PROJECT FOR CONSTRUCTION OF NEAK LOEUNG BRIDGE
IN THE KINGDOM OF CAMBODIA**

PREPARATORY SURVEY REPORT



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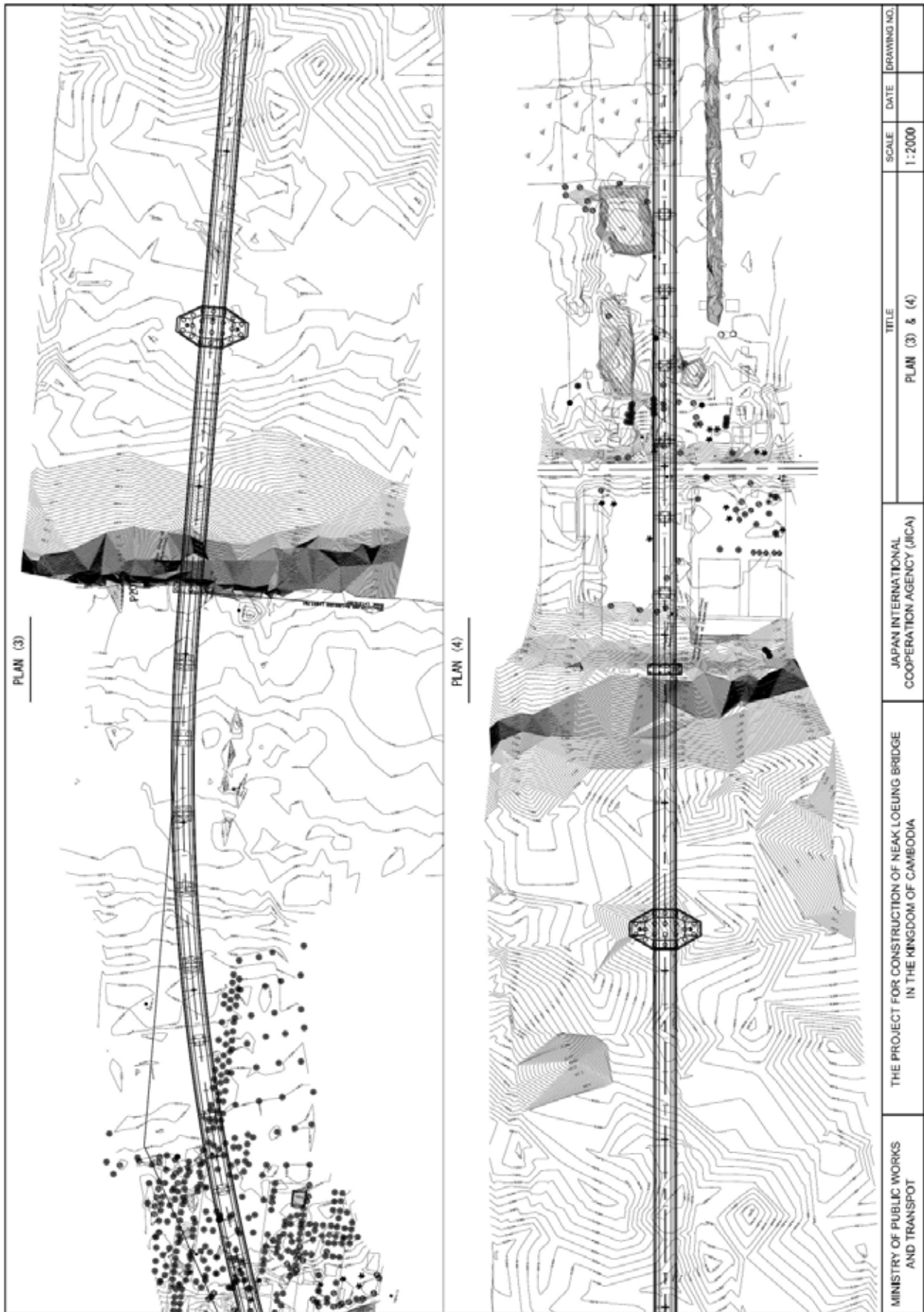
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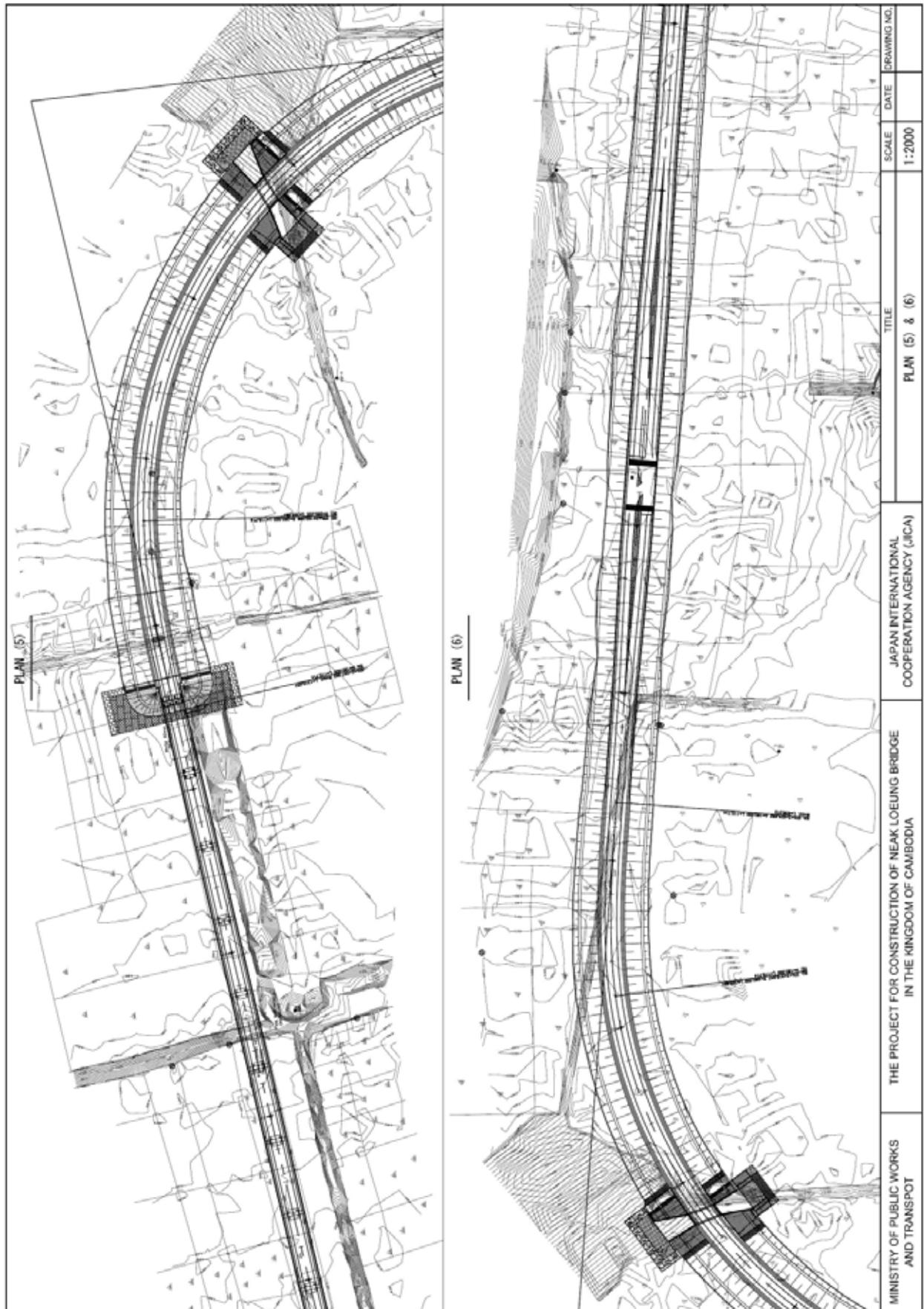
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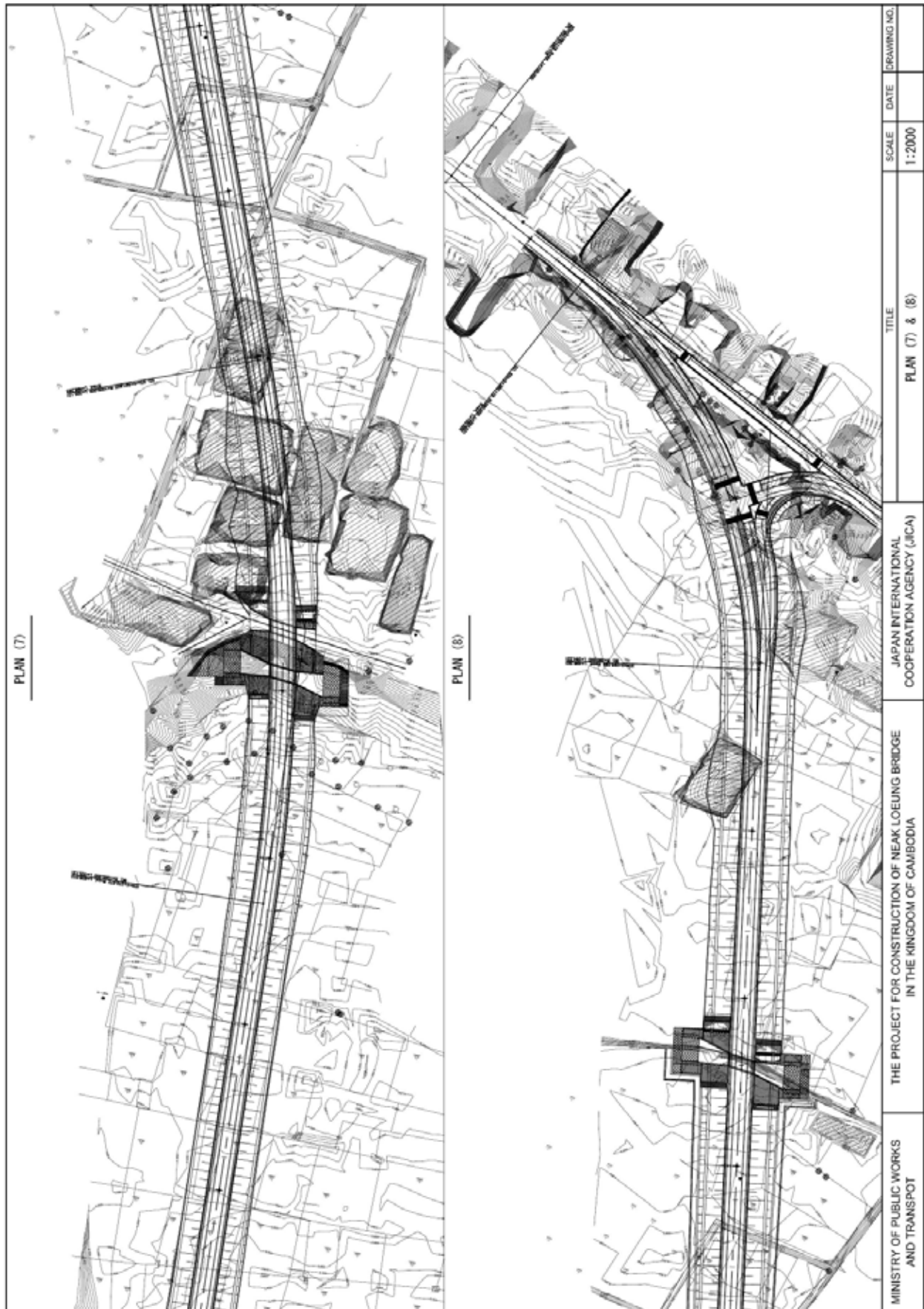
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3.2.4 Implementation Plan

(1) Construction Plan

1) Implementation Policy

This Project is composed of three sections, namely the PC cable-stayed bridge section spanning the main stream of the Mekong River, the PC composite girder approach bridge section, and the embankment section. The basic policies of this construction project are described below.

- Bridge construction at the site is extremely difficult, because the water level of the Mekong River varied by about 6.0m with a season, as shown in Figure 3.2-. In addition, the velocity of water flow is quite fast, at 2.2m/sec, as shown in Figure 3.2-54. Therefore, fluctuation of the seasonal water level shall be taken into account in the construction planning of the bridge.
- Fluctuation of the water level limits the workable construction period roughly half a year. The work schedule must be adjusted in order to complete the construction in a limited period. When building structures such as the foundation and pile caps, the number of working hours per day should be extended during the dry season.
- A rational, efficient plan for the construction of the foundation and pile caps is necessary because of the need to use heavy equipment such as pile drivers, crawler cranes and large barges.
- Since construction in deep, fast-flowing water is anticipated, safe and accurate construction methods must be adopted and full consideration given to safety measures.
- As most construction include the work at high elevation, appropriate safety measures must be employed, for example to prevent falls from scaffoldings.
- In order to protect the local environment, appropriate construction management shall be implemented in accordance with the environmental standards set by the Government of Cambodia.

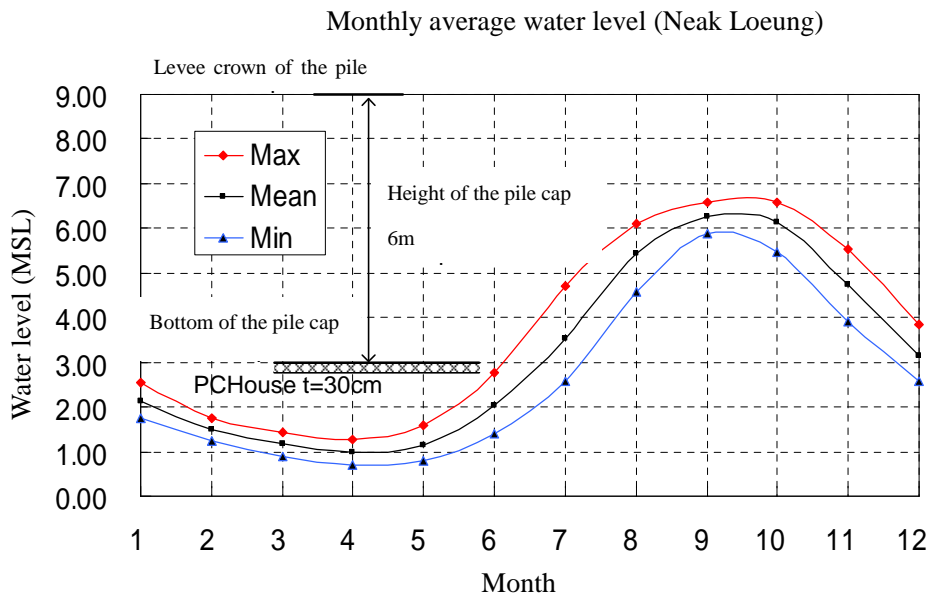


Figure 3.2-53 Water level fluctuation (Measurement results for 1988 - 2008)

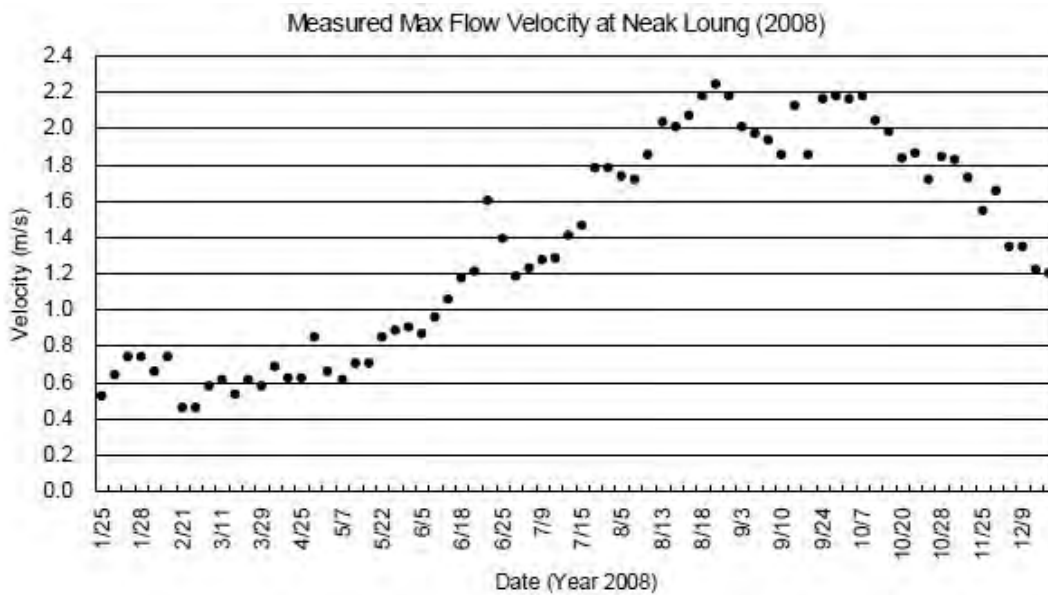


Figure 3.2-54 Current speed measurement record (2008)

2) Implementation Conditions

Since the two tower foundations for the cable-stayed bridge are built at the locations of water depth from 20m at the dry season to 26m at the rainy season with a velocity of water (0.8m/sec in the dry season, 2.2m/sec in the rainy season), the bridge will be constructed under a difficult conditions. Construction of structure in 20m of water depth with a current speed of 0.8m/sec or more requires advanced engineering technology and safety management. Therefore, the construction plan must be examined carefully, taking these conditions into consideration.

Consideration shall be given to the following points:

- Safety measures regarding the use of large construction machineries and vessels
- Safe, reliable construction with no shift of pile positions or a misalignment of the axis line caused by the influence of water level or current velocity
- Avoidance of insufficient stand pipe dig-in depth
- Confirmation of bearing capacity of piles
- Waterproof measures for installation of pre-cast formwork
- Concrete quality control including quality deterioration check due to rise in casting temperature
- Safety of shoring and scaffolding for temporary work at high elevation
- Safety of shoring for concrete casting of tower beams and the tower girder
- Measures during the erection of the towers and the girders to ensure stability in stormy weather
- Securing high-quality banking materials
- Stability of temporary shipping structure (jetty) adapting to water level fluctuation

3) Scope of Works

Table 3.2-48 shows the demarcation of work for the project between Japan and Cambodia.

Table 3.2-48 Demarcation of Construction Work

| Work to be carried out by Japan | Work to be carried out by Cambodia |
|---|---|
| <ul style="list-style-type: none"> - Construction of the cable-stayed bridge and the approach bridge indicated in the basic plan - Construction and removal of temporary on-site offices and management offices - Formulation and implementation of safety measures during the construction period - Procurement and transportation of construction materials and equipment and re-export to the country of procurement according to the material and equipment procurement plan - Preparation of the detailed design and tender documents specified in the construction management plan, and supervision of construction work | <ul style="list-style-type: none"> - Order of commencement and administration of the project - Reservation of the site required for this project - Compensation for the residents to be resettled affected by this project - Procedures for issuing the Banking Arrangement (B/A) and Authorization to Pay (A/P) and bearing its cost - Support for customs clearance procedures for the materials and equipment to be brought into Cambodia by Japanese contractor - Support for tax exemption including the customs duties and domestic taxes normally incurred by the services and products supplied by Japanese contractor for this project - Maintenance, management, and conservation of the facilities constructed in this project - Relocation and removal of existing utilities (power, water, etc.) at the project site - Establishment of necessary traffic regulations and vessel navigation regulations - Provision and cleaning-up of temporary yards - Reservation of a site for treating the waste generated by this project - Acquisition of environmental approvals (reflecting the detail design) - Securing safety of the project site including detect and removal of unexploded ordinance and/or land mines) |

4) Construction Supervision Plan

Construction supervision will be implemented for quality control, schedule management and safety management. Quality control will be implemented in accordance with the manufacturers' material test certificates and on-site material tests for the the quality of construction materials and the management of the construction accuracy of the structure. Schedule management will be implemented to check the progress based on the schedule plan, to monitor the critical construction processes, and to ensure completion of the construction within the specified period. Safety management requires that the contractors provide education for safety for construction workers and verifies that the necessary measures and actions are taken to prevent accidents during construction.

(2) Safety Plan

1) Overview

The scale of this project is large and safety is demanded in the course of this complicated and extremely difficult construction. Accidents in bridge construction may occur even in common structure type bridges and small to medium size bridges, further more, in case of large bridges and special-type bridges require special attention with advanced technology. An accident will be occurred not only by simple mistakes made by the workers or supervisors but also to the absence of an appropriate safety management system.

The laws and regulations relating to safety in Cambodia were verified and an on-site survey of similar projects in Cambodia and neighboring countries was carried out prior to the examination of the safety plan. The safety measures to be employed were checked based on the examination and works safety, health management plan to be carried out for this project was studied.

2) Laws and regulations related to safety in Cambodia

a. Department of Occupational Safety and Health, Ministry of Labor and Vocational Training

- Interviews were held with the Manager, Assistant Manager and other staff of the Department of Occupational Safety and Health, and a copy of the labour law of Cambodia and the rules for its implementation were obtained; the status of the labour safety and health management rules were explained.
- The Ministry of Labour and Vocational Training drew up the Labour Law and rules for its implementation (Prakas, Implementing Regulations of the Labour Law).
- The executive class, including the manager of the ministry, has an insight into the current state of the international labour safety and health regulations including the ILO.
- The Labour Law deals with definitions, employer responsibility, apprenticeships, labour conditions, accidents, and unions with regard to labour safety and health in general. This Labour Law applies to construction work on Neak Loeung bridge. As far as could be ascertained through the interviews, there is no functioning organization equivalent to the Japanese labour standards supervision office. The Labour Law advocates the establishment of a Labour Advisory Committee to provide advice on labour problems. However, since this is the committee headed by the Minister, the organization does not directly supervise a construction work.
- The actual implementation of safety and health in construction is specified in the implementation regulations (Prakas). However the Prakas specify only the compensation for accidents and handicap recognition, but do not cover actual rules such as the organization of safety and health management during construction, or details of the safety facilities to be established.
- The Labour Law and regulations for its implementation that are established in Cambodia will apply to health and safety during the construction, but since the construction work will be carried

out by Japanese contractors, it is expected that the advanced safety facilities and health and safety management organization of Japan will be introduced in the construction.

b. National Social Security Fund: NSSF

The following items were confirmed through the interview with the Commissioner of the NSSF.

- This organization administrates an insurance for labour-related accidents based on Clause 256 of the Labour Law.
- In Cambodia, accident insurance in public works is covered by the employer providing the labourers.
- The accident insurance to cover a project will be selected by the contractors, including the NSSF.

c. Phnom Penh Autonomous Port Authority: PPAPA

- The PPAPA is in charge of the implementation of domestic traffic control and facility maintenance and management for the navigation of Mekong River.
- The laws and regulations regarding navigation safety come under the jurisdiction of the National Mekong River Commission.
- In accordance with the project of the Mekong River Commission (MRC), "Procurement, Installation, and Training on Aids to Navigation on the Mekong River between Phnom Penh Port and the Cambodia - Vietnam Border", 56 buoys, 12 markers and beacons were installed in a one-year plan starting in April 2007 in the 100km section between Phnom Penh and the Vietnam border, as shown in Figure 3.2. This has enabled 24-hour safe navigation of vessels and barges on Mekong River in Cambodia.



Figure 3.2-55 Types of buoys set up in the Mekong River

- Consultant submit the plan including the restricted water area zone during construction, navigation safety plan, and navigation safety aid facilities after bridge completion to the PPAPA and the PPAPA agreed the plan. Further detailed deliberation is planned at the implementation stage.
- Navigation will not be disturbed during the cable-stayed girder installation of Neak Loeung bridge. Therefore, support facilities required for safe navigation for vessels pass through the water area shall be examined at the time of construction. The navigation safety support facilities shall be examined before the construction is started.
- In addition to the navigation safety facility installed in the 100km section between Phnom Penh and the border, navigation safety facilities including four buoys in the water and channel lights on the bridge girders are installed at the Kizuna Bridge constructed upstream of Phnom Penh.

3) Development of health and safety management plan

Recently, there is greater recognition of the importance of the prevention of accidents and disasters in overseas construction works. As the construction is carried out mainly by local subcontractors or subcontractors from neighboring countries, precaution against accident is poor. Special attention for the safety shall be paid to the construction activities by the subcontractors.

Construction to be carried out under these conditions, it is necessary to prepare a health and safety management plan and obliging to the contractor to carry out in accordance with the plan. To this end, the following two points should be considered.

A tender applicant should submit a health and safety management plan at the time of tender, and the contractor shall have obligation to carry out this plan.

The health and safety management plan should be submitted to the consultant prior to the commencement of construction, and construction should not be commenced until approval has been issued.

The health and safety management plan document is taken as a declaration of intent by the tenderer or subcontractor to ensure health and safety during construction. The main points to be included in the health and safety management plan document are as follows.

- 1) A shift from regulation to voluntary management of a labour health and safety management system suited to the risk conditions of the business activities of each contractor
- 2) Implementation of preventative safety management based on risk assessment

3.3 Obligations of the Recipient Country

3.3.1 General items in Japan's Grant Aid Scheme

- Order of commencement and administration of the project
- Reservation of the site required for this project
- Compensation for the residents to be relocated affected by this project
- Procedures for issuing the Banking Agreement (B/A) and Authorization to Pay (A/P)
- Support for the customs clearance for the materials and equipment to be brought into Cambodia by Japanese contractors for this project
- Support for the tax exemption including the customs duties and domestic taxes incurred by the services and products supplied by Japanese contractors for this project
- Maintenance, management, and conservation of the facilities constructed by this project

3.3.2 Special items of the Project

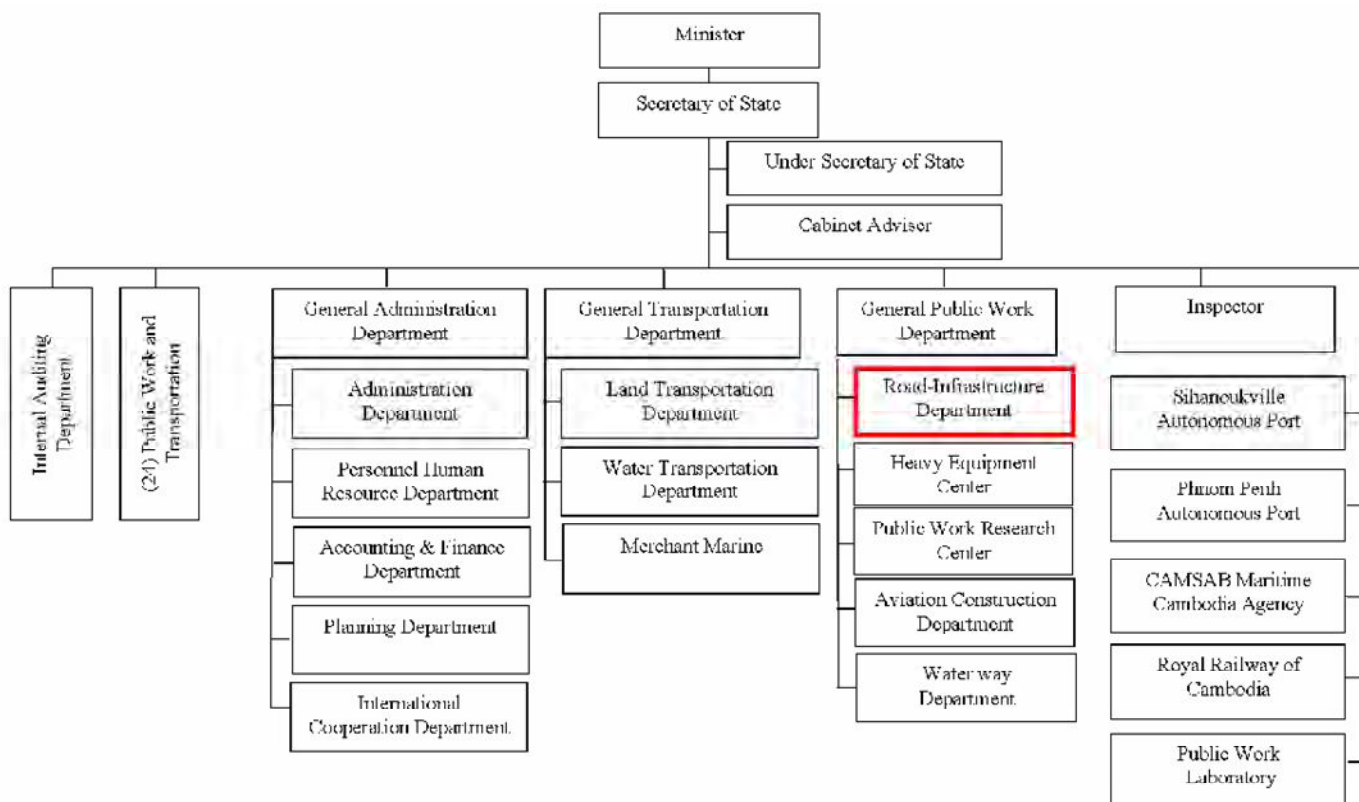
- Relocation and removal of existing utilities (power, water, etc.) at the project site
- Control of traffic and navigation of vessel during construction
- Provision and clearing of temporary yards
- Reservation of a site for treating the waste generated by this project
- Acquisition of environmental approvals reflecting the results of the detailed design
- Securing the safety of the project site including detection and removal of unexploded ordnances and/or land mines

3.4 Project Maintenance Plan

3.4.1 Current Status of the Road and Bridge Maintenance Organization

(1) Implementation Organization

Until recently, the Government of Cambodia had been focusing on constructing new roads and bridges, while maintenance activities are poor. However, recognizing the importance of maintenance, the MPWT started maintenance activities from around 2006. The Departments of Public Works and Transport (DPWT) in each of the 24 state governments carry out maintenance work under the supervision of the Road Infrastructure Department (RID) of the MPWT. Figure 3.4-1 shows the MPWT organization.



*Prepared by JICA Study Team

Figure 3.4-1 MPWT Organization

(2) Budget

The maintenance budget for roads and bridges is divided into three categories, as shown in Table 3.4-1.

Table 3.4-1 Categories of maintenance budget

| Category | Content |
|---|--|
| 1. Routine Maintenance | Routine inspection and planned maintenance |
| 2. Periodical Maintenance | Repair of damaged sections detected by routine inspection |
| 3. Other Maintenance (Emergency and Flood) | Repair of damage to roads and bridges caused by accidents and floods |

As shown in Table 3.4-2, the size of the budget for routine maintenance is growing year by year, and the unit cost is also increasing dramatically. This indicates that the Government of Cambodia recognizes the importance of road maintenance and is trying to implement it continuously.

Table 3.4-2 Budget for routine maintenance

| Year | Road Length (km) | Total Budget (USD) | Unit Cost (USD/km) |
|------|------------------|--------------------|--------------------|
| 2006 | 1,369.87 | 2,424,169 | 1,770 |
| 2007 | 1,960.30 | 5,344,192 | 2,726 |
| 2008 | 2,463.01 | 8,028,806 | 3,260 |
| 2009 | 3,708.78 | 17,012,013 | 4,587 |

(3) Current Status of Maintenance

In 2008, road maintenance guidelines were formulated through the efforts of JICA experts. These guidelines, which were developed to improve the capabilities of RID staff and to expand road maintenance capacity, include the following four volumes.

1: Guidelines for Regular Inspection:

Specifies the following items for appropriate routine inspection of roads: 1. Inspection methods, 2. Inspection items, 3. Judgment of damage and recording methods, 4. Reporting methods

2: Guidelines for Supervision of Routine Maintenance:

Specifies the following items for appropriate supervision by RID of routine maintenance work by DPWT: 1. Supervision of progress, 2. Supervision of budget, 3. Quality assurance, 4. Supervision of work method

3: Guidelines for Supervision of Periodic Maintenance:

Specifies the following items for appropriate supervision by RID of periodic maintenance work by DPWT: 1. Supervision of progress, 2. Supervision of budget, 3. Quality assurance, 4. Supervision of work method

4: Guidelines for Road Repairing Work:

Specifies the following items for implementation of appropriate repair work: 1. Repair work procedures, 2. Notes on materials and equipment used

As mentioned above, the road maintenance guidelines have been prepared and are in the process of being put into regular use. Although the maintenance of bridges is not yet being implemented, the RID is considering the start of appropriate bridge maintenance.

3.4.2 Operation and Maintenance Plan of This Project

(1) Maintenance items

Table 3.4-3 shows the items and frequency of the facility maintenance work.

Table 3.4-3 Facility maintenance work

| Category | Section | Work details | Frequency |
|--------------------|---------------------------------------|---|------------------------|
| Embankment section | Entire facility | Cleaning (road surface, roadside, slope, waterway) | Once a month |
| | Pavement | Check visually and repair any pot holes | About once a year |
| | | Cutting overlay | About once in 10 years |
| | | Repaving | About once in 30 years |
| | Shoulder | Check visually and if necessary remove weeds and reshape | About once a year |
| | Slope | Check visually and repair any slope erosion | About once a year |
| | Lights | Check visually and replace any malfunctioning lamps | About once a year |
| Bridge section | Entire section | Check visually (main girder, cable-stayed bridge cables, tower of the cable-stayed bridge) and photograph any change of condition or damage and record aging. | Once a year |
| | Shoes, pavement, accessories | Cleaning (road surface, shoes, pavement, expansions, drains and drainage pipes) | Once a month |
| | Pavement | Cutting overlay | About once in 20 years |
| | | Repaving (including waterproofing) | About once in 40 years |
| | Shoes | Check the amount of shift, metal corrosion, and rubber deterioration. If there is any change, photograph and record. | Once a year |
| | Railing, guard fence | Check any damage. If there is any damage, photograph and record. | Once a year |
| | | Re-painting | About once in 10 years |
| | Expansion | Visual check. If there is any damage, photograph and record. | Once a year |
| | Drainage system | Visual check. If there is any damage, photograph and record. | Once a year |
| | Route s and aircraft warning lights | Visual check. Replace any dead lamps. | Once a year |
| | Tower ladder and manhole cover | Visual check. If there is any damage, photograph and record. | Once a year |
| | Cable-stayed bridge cable damper | Visual check. If there is any damage, photograph and record. | Once a year |
| | Cable-stayed bridge cable mantle pipe | Visual check. If there is any damage, photograph and record. | Once a year |
| Re-painting | | About once in 10 years | |

(2) Maintenance

Visual inspection is sufficient for the first decade after completion of the bridge. Therefore, it is not necessary to organize a specific maintenance system for the bridge during this period. After the first decade, periodic maintenance including repainting of bridge railings, etc. is necessary every 10 years, and it will cost approximately 2 million dollars each time. Therefore it is strongly recommended that an appropriate budget for maintenance shall be prepared after the completion of construction.

3.5 Project Cost Estimate

3.5.1 Project Cost Estimate

(1) Expenses to be borne by Cambodia

The operation costs to be borne by Cambodia for implementation of this project are as follows.

- 1) Compensation costs : 1,421.2 million riel (About 33 million yen)
- 2) Land acquisition costs : 3,284.4 million riel (About 77 million yen)
- 3) Asset investigation costs and resettlement costs:
764.2 million riel (About 18 million yen)
- 4) Search for removal of unexploded ordnances and land mines
722.3 million riel (About 17 million yen)
- 5) Environmental monitoring plan cost:
219.8 million riel (About 5million yen)
- 6) Payment of bank charges for bank arrangement (B/A) and authorization to pay (A/P)
522.7 million riel (About 12 million yen)
- 7) Electrical power and water supply for the construction and operation:
1,119.2 million riel (About 26 million yen)

This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant. Also, the cost estimate for land acquisition and resettlement is subject to be changed after the results of the Detailed Measurement Survey (DMS).

3.5.2 Maintenance Costs

The main maintenance and management items for the bridges and roads to be provided in this project include periodic inspection and repair of each section of the bridge, repaving of the bridge surface, painting of bridge railings, reshaping of the shoulder of the embankment section, repair of slope erosion, and replacement of lighting. The maintenance and management costs for these items (annual average) are estimated to be 1,527 million riel. Table 3.5-1 shows the major maintenance works and their estimated costs.

Table 3.5-1 Major maintenance work

(Unit: Million riel)

| Item | Frequency | Inspection section | Work details | Total estimated cost (annual) |
|---|------------------|--|--|-------------------------------|
| Maintenance of the earthwork section | Once a year | Roadside and slope | Weeding and slope reshaping | 75 |
| Maintenance and repair of road pavement | Once in 10 years | Pavement | Overlay | 192 |
| | Once in 30 years | Pavement | Repaving | 114 |
| Bridge inspection and cleaning | Once a month | Road surface, guard fence, expansion joint, lighting, etc. | Inspection and cleaning | 122 |
| Repair of each section of the bridge | Once in 30 years | Bridge members, bearings, pavement, accessories, etc. | Repair and replacement of members, overlay, painting, etc. | 1,024 |
| Total | | | | 1,527 |

Chapter 4. Project Effect

4.1 Project Effect

The following effects can be anticipated as a result of the implementation of this Project.

Table 4.1-1 Project Effects

| Current Conditions and Problems | Project Countermeasures | Direct Effects and Level of Improvement | Indirect Effects and Level of Improvement |
|---|---|--|--|
| <p>The transport by ferry has come to the limit of capacity, and the crossing point of Mekong River at Neak Loeung has become a bottleneck to the transportation.</p> <p>Waiting time for ferry is increasing.</p> <p>Waiting time for ferry: (17:00): 20 min. (20:00): 38 min.</p> | <p>Construction of a bridge</p> <p>Main Bridge: 0.64km</p> <p>Approach Bridge: 1.585km</p> <p>Embankment: 3.235km</p> <p>Total: 5.460km</p> | <p>The ferry will become unnecessary, and the travel time will be reduced. (Elimination of waiting time)</p> | <p>Reduction of travel time and distance between Vietnam and Cambodia (Ho Chi Minh City and Phnom Penh)</p> <p>→ The mobility of goods and passengers will be accelerated.</p> <p>→ Activation of investment and regional development</p> <p>→ Economic development</p> <p>Distribution of goods will be activated between East Bank of Mekong River and Phnom Penh.</p> <p>→ The local products (fishery and agricultural) will be easily transported to Phnom Penh.</p> <p>→ Development of local industries</p> <p>Easy access of the residents in the East Bank of Mekong River to Phnom Penh.</p> <p>→ Increase of opportunity to enjoy services such as health care and education</p> <p>→ Enhancement of standard of living</p> |
| <p>No midnight operation. Operating hours: 5:00-24:00</p> | | <p>24-hours available, no limit of hours for traffic.</p> | |
| <p>Higher risk of accidents by bad weather.</p> | | <p>Safe crossing under bad weather.</p> | |
| <p>Risk of ferry collision with vessels navigating Mekong River.</p> | | <p>Risk of ferry collision with vessels can be avoided.</p> | |
| | | | |

4.2 Recommendations

4.2.1 Issues to be tackled by the Cambodian Side

In order to ensure and sustain the effects of Project implementation, it will be necessary for the Cambodian side to tackle the following issues:

(1) Establishment of Maintenance Structure

1) Organization

Maintenance work of the roads in Cambodia is carried out under the supervision of the RID (Road Infrastructure Department) of the MPWT in cooperation with the DPWT (Department of Public Works and Transport) in each of the 24 state governments. Although this structure is getting on track recently, its main scope is road pavement, and there is no maintenance system for bridge structures, especially for special bridge types such as cable-stayed bridges. In order to maintain the function of bridge in good state, an organization to manage bridges while doing routine inspection, cleaning and small repair work. The organization may be in charge of the bridges all over the country. However, if possible, it is preferable to establish an organization which is specialized in bridge engineering and is focused on the maintenance of Neak Loeung Bridge.

2) Human Resources

Specialized bridge engineers shall be arranged for the maintenance of bridges. It is also important to develop human resources for the purpose above. It would be worth considering the planning and implementation of “human resource development programme including on-the-job training” aside from this Project.

3) Budget

Although not much maintenance cost is required in the early period after the bridge is opened to traffic, bridge surface work (pavement, railings, expansion joints etc.) may sometimes be deteriorated in 7 ~ 10 years. As large cost is required for the repair of them, its budget shall be secured systematically.

(2) Prevention of Overloaded Vehicles

Although bridge structures are not probably damaged by one overloaded vehicle, its frequent passage causes serious damages. In order to keep bridges in healthy state (not only Neak Loeung Bridge), it is essential to eliminate the passage of overloaded vehicles.

(3) Control of Vessel Navigation

There are many reports regarding bridge accidents caused by vessel collision. 5,000ton vessels are planned to navigate under Neak Loeung Bridge, and it is necessary to maintain navigation aids and to control the entry of vessels, in order to prevent vessel collisions.

(4) Erosion of Sandbar

For the countermeasure to the erosion of sandbar, P15 ~ P19 of this Bridge is designed as multi-column foundations in order to ensure the safety of the bridge even in case of erosion. The Cambodian side shall monitor the state of erosion of sandbar and speed of erosion, and, if the erosion at P15 during bridge life is predicted, they shall adopt adequate countermeasure against erosion or apply adequate protection for the Bridge.

(5) Living Environment of Residents

The movement of passengers, goods and traffic will be changed at Neak Loeung from ferry to bridge, and this will also affect the social structure itself. There is a proposal to provide “roadside stations” apart from this Project, and if they are realized, infrastructures (power lines, waterways, communications) to support them are required. If the ferry service is abolished, it is also important to introduce the substitute public transport service such as buses. Also, activities for prevention of traffic accident due to the increase of traffic is required.

4.2.2 Technical Assistance and Cooperation with Other Donors

The east bank side of the NR1 (Vietnam border – Neak Loeung) was already improved by ADB, and the west bank side (Neak Loeung – Phnom Penh) is under improvement by Japanese Grant Aid. At the starting point of the NR1 in Phnom Penh, the 2nd Monivong Bridge was already completed and opened to traffic. As this Project for Construction of Neak Loeung Bridge is a latecomer in the NR1 (Vietnam border – Phnom Penh), direct opportunities for cooperation with other donors are limited.

However, this Project is related to the projects such as the installation of truck scales for the prevention of overloaded vehicles, the installation of navigation aids for Mekong River, and the other projects on the NR1. It is thus also important to keep continuous cooperation with other donors.