CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Target of the Project

The general policy for the Sri Lankan road sector is stated in the "National Transport Policy, June 2000" and "National Road Policy, December 2000". Supplementing the former one, the latter policy indicates basic the principles for road and bridge construction planning, maintenance planning, traffic management and financial resources. Recently, the National Road Master Plan (NRMP) was established in December 2007, and outlined the development plan for the road sector in Sri Lanka. In this master plan, it is recognized that increasing the number of lanes of national roads is one of the highest priorities. Consequently, national road No.5 (A005) and No.15 (A015), on which the objective bridges are located, are planned to be improved as 2-lane roads.

At the same time, according to the government economic policy; "Mahinda Chintana: Vision for New Sri Lanka, 2006 - 2016", the economic target is to narrow the income gap between people and economic gap between districts. Especially in Eastern Province, one of the areas most damaged by the Indian Ocean Tsunami in 2004 and also most affected area by the 20-year long conflict, the main target is developing the rural area through improving rural basic infrastructure, including access roads, and poverty reduction. As the supplemental development plan of "Mahinda Chintana", "Three Year Eastern Province Development Plan 2007～2010" was released for Eastern Provinces, and rural infrastructure projects, such as roads, electrical power supply, water supply and sewerage, are being implemented in Trincomalee, Batticaloa and Ampala districts.

Based on these superior plans mentioned above, the overall goal of "the Project for the Reconstruction of Five Bridges in Eastern Province" (here-in after referred as "the Project") is to stabilize and enhance socio-economic activities and to expedite progress and peace in the region by improving traffic access to Eastern Province. The target of the Project is to improve access to Eastern Province by rehabilitating medium to small size bridges on National Highway No.5, which connects Central Province to Eastern Province, and Panichchankerni causeway and a bridge in Eastern Province.

2-1-2 Objective Bridges

To achieve the target of the Project, four bridges on national road No.5 and one causeway with a bridge on national road No.15 were selected as the objective bridges. According to Japan's grant Aid scheme, Japanese side will construct the objective bridges, and Sri Lankan side shall

secure the land for the facilities, remove the existing bridge after completion of the new bridge(s) (if the new bridge is not on the existing bridge location), and implement maintenance work after completion of the Project.

Responding to the request of the Sri Lankan government on August 2007, the Japanese government decided to undertake a preparatory study and dispatched a study team in September 2008. The original request included five bridges in Eastern Province as shown in Table 2-1-2-1. However, bridge 241/3 and 247/2 were added at the time of the preparatory study, and bridges 241/2, 241/3 and 241/4 were combined as the new bridge No.2 because these three bridges are adjacent to each other and fall in the same river floodplain.

Table 2-1-2-1 List of Requested Bridges

Original Request (2007)	Revised Requested Bridge after JICA Preparatory Study (2008)	
240/4 on A005	Bridge No.1	240/4 on A005
241/2 on A005	Bridge No.2	241/2 on A005
		241/3 on A005*
241/4 on A005		241/4 on A005
	Bridge No.3	247/2 on A005*
283/7 on A005	Bridge No.4	283/7 on A005
59/1 on A015	Bridge No.5	59/1 on A015

＊）Additionally requested bridges on September 2008

Bridge No.3 (247/2) was added to the request because the bridge was once included in those bridges of CAARP (Conflict Affected Area Rehabilitation Program) by ADB fund, but since then, excluded from the program because of insufficient ADB fund and because the bridge location was actually not in the "Conflict Affected Area".

2-1-3 Environmental and Social Consideration

2-1-3-1 Characteristics of Social Environment in Eastern Province

(1) Racial Structure of Eastern Province

Sri Lanka is composed of multi racial groups, with 73% of the population being Sinhalese, 18% Tamil and 8% Moor as the major racial composition of the country. The predominant religion of each racial group is Buddhism for Sinhala, Hindu for Tamil, and Muslim for Moors recognized as being of Arabian descendant. Christians (Catholic) account for 11% of the whole population.

Meanwhile Eastern Province is composed of three districts i.e., Ampara, Batticaloa and Trincomalee. The project objective study bridges are located within the districts of Ampara and Batticaloa. The ethnic group composition in Ampara district is Sinhalese 37.5 %, Tamil 18.3%, Moor 44.0% and others 0.2%. Within Batticaloa District, the ethnic composition is Sinhalese 0.5 %, Tamil 74.5%, Moor 25.0% and others 0.5%. The difference in racial composition between Sinhalese and Tamil is distinctive and this situation has caused serious racial conflicts.

(2) Racial Structure within DS (Divisional Secretariat) Division in Batticaloa and Ampara District

Two of the five study bridges, Bridge No.4 and Bridge No.5 are located within Batticaloa District. The other three, Bridge No.1, Bridge No.2 and Bridge No.3, are located within Ampara District.

Bridge No.1, Bridge No.2 and Bridge No.3 are located within Hahaoya DS division, Mahaoya DS Division has a population of 17,801, and the racial composition is 99.7% Sinhalese and 0.3% Tamil, Moor, and Barger (European mixed). (Reference: 2007 year Preliminary Report, Ampara District)

Bridge No.4 is located in Eravurpattu DS division within Batticaloa District. Eravurpattu DS division has a population of 78,365, of which 97.0% is Tamil and Moor, Barger (European mixed) and Sinhalese are settled in quite small numbers. Religions are 86.7% Hindu, 2.8% Muslim, 5.4% Roman Catholic and 0.01% Buddhism.

Bridge No.5 is located in Koralaipattu North DS division within Batticaloa District. Koralaipattu North DS division has a population of 22,250, of which 96.3% is Tamil while Muslim, Barger (European mixed) and Sinhalese are settled in quite small numbers. Religious belief distribution is 92.0% Hindu, 3.3% Muslim, 4.3% Roman Catholic and 0.09% Buddhism. (Reference: 2006-2007 Statistical data 2006 year Report, Batticaloa District, Planning Department)

2-1-3-2 Landuse and Ecological Characteristics on the Objective Bridge Areas

Bridge No.1, No2 and No.3 are located at Maha Oya DS Division along NR (National Road) A005; Landuse along NR-A005 is composed of scattered paddies, agricultural fields, pasture, and teak plantations. Figures 2-1-3-1, 2-1-3-2, 2-1-3-3, 2-1-3-4 and 2-1-3-5 show impressionistic illustrations of bridges No.1 to No.3.

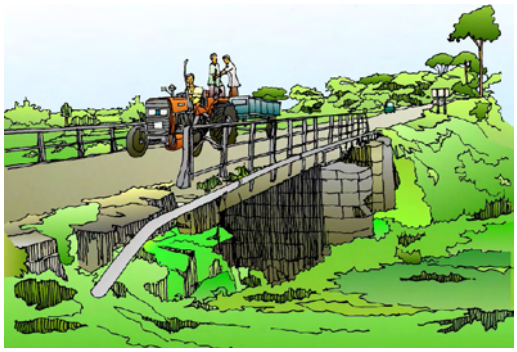


Figure 2-1-3-1 Bridge No.1

Figure 2-1-3-2 Bridge No.2 (241/2)

Figure 2-1-3-3 Bridge No.2 (241/3)

Figure 2-1-3-4 Bridge No.2 (241/4)

Figure 2-1-3-5 Bridge No.3

NR-A005 route is aligned on rather flat land and the water courses are often flooded in the rainy season in low-laying flood-prone areas. Pastures are grown within the flood prone areas in the dry season. Recently developed young tree plantations are often observed on the rolling hill areas. Remnant natural vegetation such as Leguminous trees are scattered about. Along NR-A005, there are many large significant rain forest trees with broad crowns (*Samanea saman*).

(1) Bridge No.4 is located in Eravurpatu DS Division along NR-A005. Landuse along NR-A005 is composed of scattered paddies, agriculture fields, pasture and many abandoned areas. NR-A005 route is aligned on rather flat land and the water courses are often flooded in the rainy season and formed in low laying flood prone areas. Pastures are

grown within the flood prone areas in the dry season and remaining small ponds have many aquatic plants. Tall palm trees are planted alongside NR-A005 and many species of Acacia occur as remnants of the natural vegetation. Figure 2-1-3-6 shows an impression of bridge No.4.

Figure 2-1-3-6 Bridge No.4

(2) Bridge No.5 is located at Koralaipattu North DS Division along NR-A015. Landuse along NR-A015 is composed of grassland for grazing or many abandoned areas and few cultivated land. Scattered coconut palms are common. NR-A015 route is aligned on flat land and the causeway with bridge, crosses a narrow channel of the lagoon. Mangrove vegetation are developed along the fringe of the lagoon, however these mangrove vegetation is growing mostly on the north side of the causeway. The Tsunami of 2004 damaged the mangrove vegetation, and dead and cut mangroves can be seen in some low laying areas. However, mangrove vegetation growing along the margin of the lagoon is in good condition.

(3) Sand bars to the ocean estuary area at the north eastern of the lagoon are believed by locals to have been had narrowed by the Tsunami effect, so that increased inflow of sea water has reduced the salinity of the lagoon water and resulted in some impacts on the mangrove vegetation and its ecological system. The habitat of shrimps, prawn, crabs and fishes have been affected such that their harvest has been reduced year by year. Figures 2-1-3-7 and 2-1-3-8 show impressions of bridge No.5 and the causeway surroundings.

Figure 2-1-3-7 Bridge No.5 in distance view

Figure 2-1-3-8 Causeway and lagoon bank with fishing boats at Bridge No.5

Figure 2-1-3-9 and 2-1-3-10 shows landuse and vegetation distribution of surrounding area of the lagoon.

2-1-3-3 Consideration on Lagoon Environment

(1) Need of Consideration on Ecological Changes Caused by Replacement of Bridge No.5 with Causeway Renovation and Site Monitoring Results

1) Necessity of understanding the existing ecosystem

Characteristics of the existing lagoon ecosystem are to be understood from the natural vegetation status along the lagoon margin and distribution of mangrove vegetation growing within brackish water area. Figure 2-1-3-9 shows the distribution of vegetation through landuse on Panichchankerni Lagoon.

Mangrove vegetation types (mainly Rhizophora sp. and Avicennia sp.,) are widely distributed around the northern zone of the lagoon (north lagoon: 2 large scale lagoon areas

are located). Mangrove colonies are predominant west of the causeway in the vicinity of bridge No.5. The north zone of the lagoon has been designated as a conservation area (Trikonamadu Nature Reserve), and is important in sustaining the natural environment. Figure 2-1-3-10 shows a map of the natural conservation area.

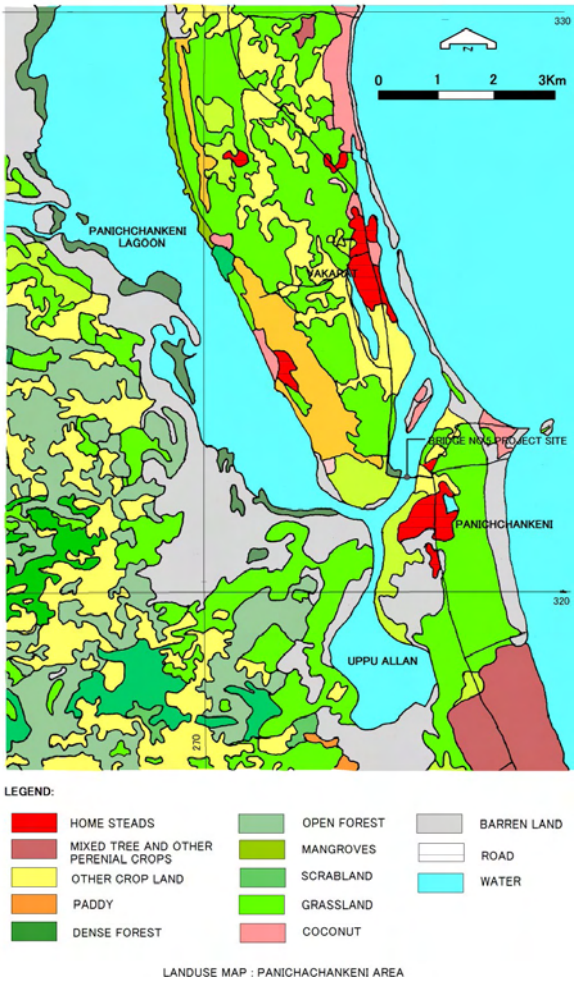


Figure 2-1-3-9 Landuse and vegetation distribution Panichchankerni lagoon vicinity

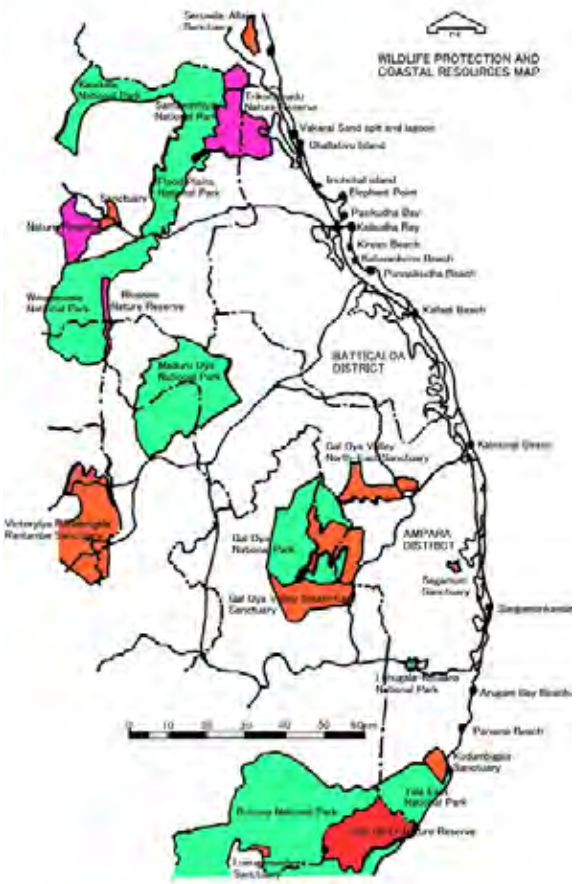


Figure 2-1-3-10 Distribution of at conservation area of natural ecology

The water system in the lagoon is affected by tidal movement of ocean water currents generated within the lagoon. The narrow channel at the causeway of bridge No.5 allows passage of ocean water. The inflow and outflow of water are to be given attention in considering the environmental impact on the north lagoon. The brackish water of the lagoon has mutual relation with mangrove ecology, and it is very important for the breeding and growing of shrimps, prawns, crabs and fishes etc, and these have a close economic bearing on the fishery activities of local communities.

2) Existing condition of the ecosystem

The lagoon is affected by ocean tidal phenomena, inflow and outflow of sea water from the sand bar in the north eastern estuary lead sea water into the lagoon. The inflow and outflow of sea water impact on the large lagoon space. The causeway becomes a bottleneck to water flow and the current velocity increases at high tide, reaching 2m/s. (It was observed 0.5m/s around high tide at the monitoring time.) The northern part of the lagoon receives tidal and current effects; however these effects are rather lower water current velocity due to wide lagoon area. The catchment area for the northern part is wide and the inflow of runoff is large in the rainy season. This runoff inflow carries volumes of eroded silt containing fertile nutrients and sediments to the lagoon margin, providing good environmental conditions for mangrove colonies to develop. Figure 2-1-3-11 shows catchment area of Panichchankerni lagoon, and Figure 2-1-3-12 shows the agro-ecological distribution of the Eastern Region.

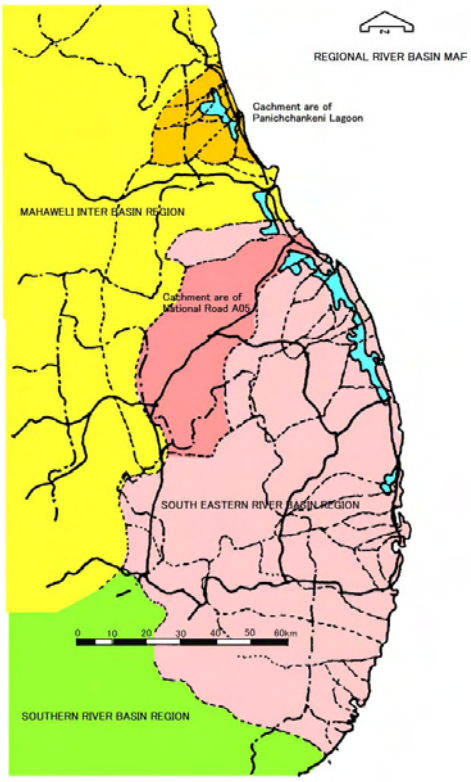


Figure 2-1-3-11 Catchment area of Panchchankerni Lagoon vicinity

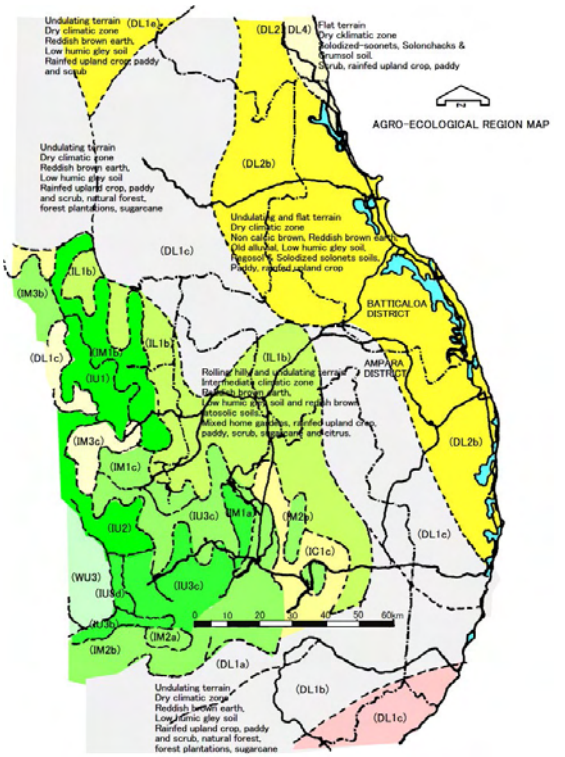


Figure 2-1-3-12 Argo-ecological distribution of Eastern Region

3) Ecosystem around bridge No.5 and causeway

Mangroves at the western bank and around the causeway and both sides of bridge No.5. At the time of the survey, the mangrove colony had been cut down in a strip 15m to 25m wide and 200m in length either side of the road approach to the causeway. This is mostly the result of clearance operation for defense against LTTE activities by National Security after

the Tsunami in 2004. (Security control station is facilitated on the north side of the west bank.) Figure 2-1-3-13 shows on environmental condition map of the causeway site. Figures 2-1-3-14 and 2-1-3-15 show photographs of cut down mangrove colonies along the road.

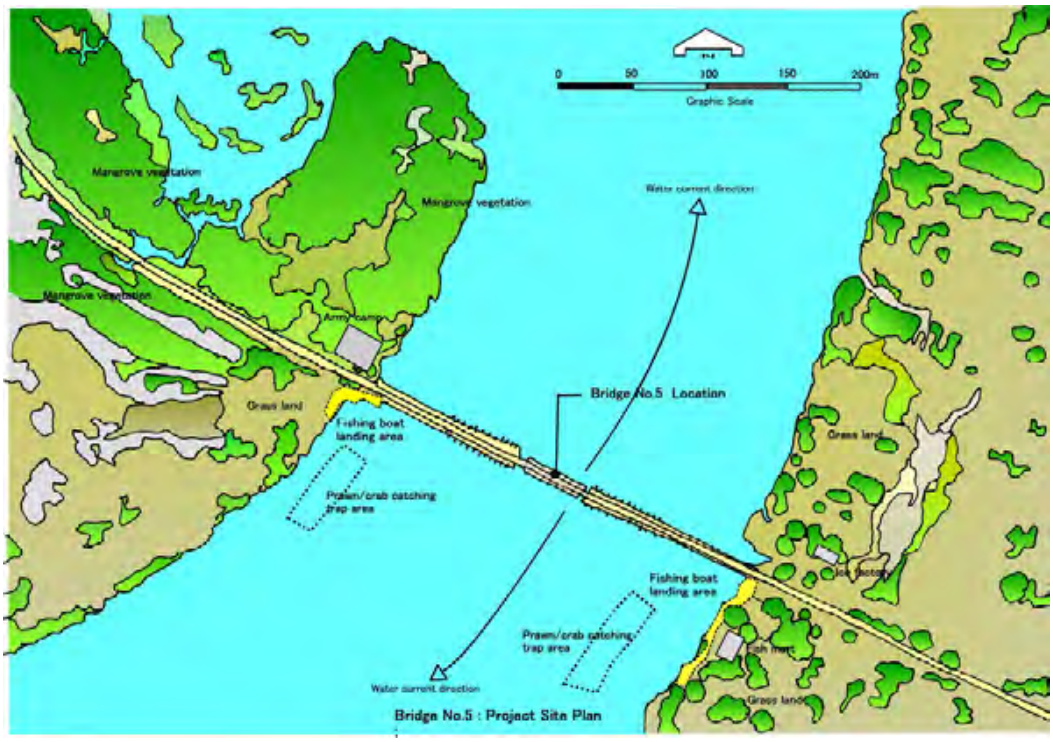


Figure 2-1-3-13 Vicinity environmental condition map of causeway site

Figure 2-1-3-14 and 2-1-3-15 Photographs of mangrove colonies cut down at road sides

The mangrove trees in the cleared strip are 1.0m to1.5m in height, and some are observed as new sprouts on stumps, so the vegetation may recover within several years. The soil in the

mangrove area is clay and silt Bermuda grass (*Cynodon dactiron*) and dwarf leguminous species occur sparsely.

The lagoon area around the causeway is 0.5m to 1m deep at high tide on the north western bank, and the bottom of lagoon can be seen. There is silt on the lagoon bottom and few aquatic plants are observed. Dead leaves and twigs, algae etc., are blown and accumulated by sea wind on the northern part of the west bank. The water flow current through pipe culverts under the causeway of the east side has a high velocity and the water flow regime is shifted to the eastside bank from the center of the causeway. The center of the flow regime is 2.5m to 3.5m in depth.

Fishes observed at the abutments of bridge were small, in the range of 10cm to 15cm. Egrets and cormorants catch small fish in the shallows of the west bank and local cast net fishermen make only poor catches of small fish.

The numbers of fixed net traps for prawns and crabs are regularly facilitated at both banks of west side of the causeway, but this type of trap is not seen in other areas.

Local fishermen know the behavior of prawns and crabs migrating from the northern lagoon to near the causeway section. Figure 2-1-3-16 and 2-1-3-17 shows a photograph of the distribution of fixed net traps and net casting activity of local fishermen.

Figure 2-1-3-16 Distribution of fixed net traps

Figure 2-1-3-17 Casting net activity of local fishermen

Terrestrial plants, consist of Acacia species, Tamarind species, neem, Terminaria species, Cocos nucifera and Washingtonia species. They form distinctive tall trees and are hardy for this arid climate and are sparsely distributed. No terrestrial fauna with the exception of cattle are observed. Small snakes are found near the margin of the lagoon.

(2) Environmental Impact to Lagoon Fishery by Causeway and Bridge Construction

1) Widening of the opening (proposed bridge section) of the proposed causeway will closely resemble the original channel width and the current flow regime will be more similar to the original form than that of the existing causeway and bridge. Environmental conditions will

be recovered closes to the original condition compared to the damaged existing causeway and bridge condition.

2) The opening of the lagoon to the sea was affected by the Tsunami in 2004, and the sand bar accumulated a lot of sand so that the in-and-out flow of ocean water has been somewhat blocked and the salinity of the lagoon water has become reduced. As a result of the salinity reduction, fish harvests in the lagoon have reduced. (Source: Hearing information at the site monitoring time)

3) At present, widening of the opening to improve the inflow of ocean water has been considered by the Coastal Management Agency. Local fishermen have desired the recovery of inflow condition of ocean water into the lagoon. (Source: Hearing information at the site monitoring time)

4) Fixed net traps for shrimps, prawns and crabs are located along both bank sides of the lagoon where pipe culverts are installed under the causeway (at a distance of 20 to 40m from both banks). The traps are mostly installed parallel to the banks and not in faster current portions including culvert sections.

5) Proposed bridge length of 133m will reduce the current velocity from the fastest current of 2m/s at high tide under the existing condition of 80m bridge length. The proposed causeway length of 75m to 85m at both sides will be shorter than the existing causeway length (the channel width is approximately 300m). Therefore the existing installed range of all fixed net traps will be located within the causeway length.

   No pipe culvert is installed across the proposed causeway and neither side of the proposed causeway is affected by fast currents; therefore, the slower current will create the possibility of installing more fixed net traps. However this possible contribution will need further monitoring after construction of the causeway and bridge.

6) Turbid water will be generated by bridge and causeway construction. Mitigation measures such as silt fence installation during construction will reduce turbidity of the water. Generally, lagoons are affected by the inflow of silt from the catchment area, and the silt and nutrients nourish the mangrove colony, contributing to a rich ecosystem including inhabiting and growth of shrimps, prawns and crabs.

   Major problems that could be caused by the construction activities are spillage of fuel, waste oils, lubricants, and other chemicals. These problems will be controlled and kept to a minimum with good management of the construction activities.

(3) Proposed Methodology and Necessity of Data Collection to allay concerns over Fish Harvest

Reduction not related to the Construction Activities

Based on the Environmental Mitigation Measures for replacement of the bridge, an Environmental Management Plan (EMP) and Environmental Monitoring Plan will be put in place. These are basic policies for protecting the existing lagoon environment and improving existing conditions. The following is the general scheme for fishery production in the lagoon.

1) Items necessary for data collection

a) Amount of annual fish catch (mainly shrimps, prawns and crabs) in the vicinity of the causeway before the Tsunami through interviews with local fishermen settled near the causeway. Amount of fishery product will be either weight/volume or sales.

b) Amount of annual fish catch (mainly shrimps, prawns and crabs) in the causeway vicinity after the Tsunami and before construction through interviews with the local fishermen settled near the causeway site. Amount of fishery product will be either weight/volume or sales.

c) Comparison of fish catch data from lagoon and ocean by caught fishermen settled near the causeway, and variation in harvesting area if any.

d) Variation in the numbers of fixed net traps and their location during the construction.

e) Data collection on fish catch by season, i.e., dry and rainy season.

f) Monitoring of water quality: the results of water quality monitoring will be made as baseline data conducted during the preparatory study period. Measurements will be air temperature, water temperature, salinity (electrical conductivity), clarity (SS), DO, BOD, COD and oils. The monitoring will be conducted at both ends of the bridge.

2) Item of monitoring data, monitoring period and responsibility

a) Above items a), b) and c) will be conducted during the design period before the construction. Responsible performance by the consultants, RDA/ESD (for supervision).

b) Above items d) and e) will be conducted two times in the dry season and rainy season during the construction. Responsible performance by the consultants, RDA/ESD (for supervision).

c) Monitoring of water quality: above items of f) will be conducted once every 2 to 3 months during the construction of the causeway (reclamation and embankment), abutments and piers. Responsible performance by the consultants, RDA/ESD (for supervision).

d) Monitoring of water quality during the construction: the contractor will conduct and be supervised by the consultants and RDA/ESD.

2-1-3-4 Water Quality Sampling Test

(1) Methodology of Water Sampling Test

Water quality sampling was conducted in the water system (rivers, ponding area and lagoon) near the objective five bridges during the period from 12th March 2009 to 14th March 2009. The sensor of a portable field instrument was directly inserted into the water body or a sample taken and tested. The items test by the field instruments were water temperature, dissolved oxygen level, pH, electrical conductivity (NaCl, saline content), and turbidity. The other tests by other instruments and chemical reagents were air temperature, water temperature, chemical oxygen demand, dissolved oxygen level, bio-chemical oxygen demand, total coliform and transparency level (total suspended substances).

(2) Test Instruments, Analyzer and Chemical Reagent for Sampling Test Use

The test instruments, analyzer and chemical reagents applied are shown in Appendix-3.

(3) Outline of Water Quality Sampling Tests

Water sampling tests were conducted at each of the 5 bridge sites at a total of 7 sampling points (include 1 point at residential well near bridge No.2 site, 2 points at bridge No 5 site.) Air temperature at sampling time ranged from 28℃ to 31℃, water temperature ranged from 27℃ to 29℃. There was rainfall 2 to 3 days before sampling days, which affected, suspended solids and turbidity. Outline of sampling water quality is as follows.

- pH: 6.6～7.4 (Well near to bridge No.2: pH 5.2 , acidity)
- Electric conductivity (NaCl) : 7.6～37.0 S/m (Bridge No.5: 990 S/m)
- Salinity : 0.004～0.018%, Almost fresh water level. (BridgeNo.5: 0.49%, low salinity brackish water)
- Turbidity : 1～16NTU
- Dissolved Oxygen(DO) : 3.5～6.2 mg/l
- Biological Dissolved Oxygen Demand(BOD) : 1～4.7 mg/l, relatively low level due to high temperature of water.
- Chemical Oxygen Demand(COD) : 1～8 mg/l
- Clarity : 35～60 cm above.
- Suspended Solid(SS) : 12.5 mg/l or less.
- Oil : Nil.（By visual observation）
- Total coliform : 5～51 n/ml, Relatively high level due to cattle having dissect access to the stream.

No settlements existed near any of the sampling points and minimal lesser pollution of the stream water was observed except high total coliform numbers due to cattle.

Detail survey results for each sampling point are shown in Appendix-5.

2-1-3-5 Review of IEE Study

(1) General review of IEE study

An Initial Environmental Examination (IEE) on the 5 bridges replacement project in 2 districts of Eastern Province was conducted as part of the JICA preparatory study in August 2008 and RDA/ESD as the project implementation organization of the Sri Lankan Government in 2008 October.

The IEE study done by RDA/ESD involved the project description, site description covering 5 bridge sites, and the description covers 12 social environment categories, 9 natural environment categories and 9 pollution categories. The environmental impact for each social, natural environment, and pollution category was rated A, B or C. A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (examination is needed. Impacts may become clear as study progresses.) No mark: No impact is expected. IEE/EIA is not necessary.

Within the 12 categories of social environment no categories were given A rating, but all 12 categories indicate that some impact will occur. The main consideration is temporary use of agricultural land for construction yards, camps or detours during bridge construction. Some impacts may occur to fishing activities during construction in Panichcchankerni Lagoon.

The category of flora, fauna and biodiversity was been given an A rating for all 9 categories of the natural environment, and a B rating in the construction phase covering 4 categories, 1) topography and geographical features, 2) soil erosion, 3) ground water, 4) landscape. Also C rating was given to 2 categories, 1) hydrological situation, 2) coastal zone.

Two categories of air pollution and accidents were given an A rating. Four categories of water pollution, soil contamination, bottom sediment were given B rating during both construction and operation phases. No marks were given to ground subsidence and offensive odor.

The IEE results of the JICA preparatory study were somewhat different to the ratings of the RDA/ESD results, which show one step more severe rating than the JICA study. However most of the adverse categories of the RDA/ESD study are considered temporary and mitagable features, and the two study results would be almost the same. The CEA issued a letter “08 /EIA /TRANS /03 /2004Vo1.1” of no need for EIA nor IEE procedure on the project.

(2) Stakeholder Meeting

RDA/ESD conducted public consultation with residents along the roads (close to the bridges) on 10 and 11 of September, 2008. Selected persons in the towns along the road, key government officers were consulted through a stake holder consultation meeting held at the Government Agent's office at Batticaloa on 13 September, 2008. A summary of the key points discussed is as follows.

1) It is important to reconstruct these bridges as soon as possible. Care should be taken to avoid/ minimize the removal of shade trees close to the road edges.

2) Keep the hume pipes on the causeway. Removal of all debris close to the damaged bridge on the lagoon. Additional openings to be considered during the detailed design stage. Once the new bridge is completed all remaining structures of the old bridge and debris will be removed.

3) More openings in the form of hume pipes will affect the hydrological balance in Panichchankeni lagoon. The new bridge will be designed to have better opening sizes that will maintain the normal flow situation.

RDA/ESD has shown the results of the stake holder meeting held on 13th September 2008 and 36 attendants participated with their signature in agreement to the discussion topics.

(3) Disclosure of Information

Disclosure of information at an early stage of the project has many benefits such as to negate any objections by the public towards the project, avoid misinformation getting to the affected persons from agitating groups and some NGOs. While disclosure of information can be done through the Divisional Secretariat and the Grama Niladari (village administrative officer) of the area, Farmer Based Organizations (FBOs), Community Based Organizations (CBO) and village societies are also possible sources of disseminating project related information. Village leaders such as the head priest of the temple can be resource persons for such activities. The use of mass media to advertise the availability of the report could help information disclosure to other interested groups outside the project area.

2-1-3-6 Screening of Potential Environmental Impacts

The Matrix for Scoping for the 5 bridges was prepared to identify presumed impacts on the environment during preconstruction, construction and operational stages of the project. The IEE scoping matrix for the 5 bridges is provided in Appendix 5-1.

2-1-3-7 Environmental Management and Monitoring Plan

(1) Aim of the Environmental Management Plan

The Environment Management Plan (EMP) represents the core of the IEE. It focuses on the environmental protection and mitigation of impacts that were reviewed in the preliminary JICA IEE study and RDA IEE study. It aims to ensure that adverse impacts associated with the project are properly addressed at any stage, either by preventing the impacts or by mitigating them to reduce the effect to an acceptable level by adopting the most suitable technical and economic option. Where possible and applicable, the EMP makes provision for in-kind compensation for lost or damaged environmental resources to private and public assets. Based on field inventories and observations, the EMP takes special care for the protection of environmentally sensitive areas and habitats, and proposes environmental enhancement activities.

(2) Objectives of the Environmental Management Plan

1) Outlining recommended mitigation measures required for managing potential impacts;
2) Develop a monitoring system and identifying related parameters that will be required for confirming the effective implementation of the mitigation measures;
3) Defining roles and responsibilities of the project proponent for the implementation of EMP and identifying areas.

The Environmental Management Plan (EMP) is shown in Appendix 5-3, and the Environmental Monitoring Plan is shown in Appendix 5-4.

(3) Mitigation Measures

The EMP provides a framework for the implementation of the recommended mitigation measures, is aimed at achieving the quality of the existing environmental condition and preferable mitigation to reduce risk and prevent adverse impacts caused by the construction activities. Most of the recommended mitigation measures have been conducted by the Contractor properly. The Environmental Mitigation Measures are shown in Appendix 5-2.

(4) Roles and Responsibilities

As project proponents, RDA will be responsible for implementing the EMP. The RDA will be responsible for the overall environmental performance during the proposed activity. The Environment Specialist (ES) under the PMU/ESD will have functional responsibilities for Environmental matters during the project implementation. The ES will hold prime responsibility for ensuring that the environmental performance of the project is in accordance with governing legislation. The ES will ensure that the provisions of the EMP are translated into the Contractor's requirements and that these requirements are implemented to

the full extent. The ES will also monitor the performance of the Contractors related to environmental issues.

The Contractor will be responsible for implementation of, or adherence to, all provisions of the EMP and with any environmental and other codes of conduct required by RDA/ESD. All these activities are monitored by the Supervising Consultant and reported to RDA.

2-2 Basic Design of Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Concept

The basic concept for the Project is as follows:

1) The objective bridges are 5 bridges which were recommended in the Preliminary Study implemented in September 2008. The Japanese side will construct these 5 bridges including temporary detours if the location of a new bridge is in the same place as the existing bridge.

2) The Sri Lankan side shall bear expenses for securing land for the objective bridges, compensating for facilities to be resettled, leasing temporary yards, clearing land mines and UXOs, acquiring certificates for the clearing, removing the existing bridge left after completion of a new bridge and maintaining those new bridges.

3) The lengths of new bridges are decided based on the "Technical Memorandum, March 25, 2009", securing each cross-sectional area of water flow to be not less than that of the existing bridge. Regarding bridge No.2, the bridge length is to be extended to compensate for the area that blocks water flow at the time of flood by the new approach road.

4) Approach road pavements are DBST (Double Bituminous Surface Treatment), a kind of temporary low-cost pavement, because these sections of national road No.5 and No.15 are to be improved in the near future by ADB fund and French fund respectively.

5) The Study Team reviewed the existing design of Panichchankerni causeway and bridge No. 5, which was carried out by the Feasibility Study in May 2006 and the Detailed Design in May 2007, and concluded that the piles for the "pile-bend foundation" shall be cast-in-place concrete rather than precast concrete piles considering stability of the foundation.

6) The navigation clearance for bridge No.5 is 2.5m according to the letter of RDA (No. RDA/ES/JBEP) dated on April 3, 2009.

7) The function of existing pipe culverts at Panichchankerni causeway is to mitigate high water velocity under the existing bridge, which is only 37 m long, in order to prevent damages by scouring and effects on fishing operation. The pipe culverts will not be necessary when the new bridge is completed because it will have 127 m width of water flow (for a bridge length of 133 m, which is 3 times more than the existing bridge length), and this will be more effective than the multiple pipe culverts at reducing water velocity under the bridge.

8) The main fishing method around the Panichchankerni causeway is “fixed net traps” to catch prawns and crabs. These net traps are set upstream of the causeway and close to the shore. This location is selected because of the low velocity of water flow. The fishermen are not expecting pipe culvert effects as far as this main fishing method is concerned. Therefore the appropriate area for “fixed net traps” will be widened when the new bridge is completed reducing the water velocity. The widened area for net traps will compensate for the effects of elimination of pipe culverts; however, the effects shall be confirmed through monitoring after completion of the new bridge.

2-2-1-2 Policies Based on Natural Conditions

(1) Meteorological conditions

In Eastern Province, the rainy season (from October to February) and the dry season (from March to September) are clearly divided. The heaviest rain can fall in December, and low elevation and swamp areas are covered by water caused by river floods and/or increasing water level of lagoons. Therefore, consideration of the effects of the rainy season and increasing river water level is essential to make a realistic construction plan in this area.

However, bearing in mind the lack of river flow and water level data in this area, the high water level at the objective bridge sites must be set by hearing from local people. If the existing bridge is often covered by flood water, the elevation of the new bridge and approach road will have to be higher than the flood level because the objective bridges are on national trunk roads in Sri Lanka, and the road section wills be improved (level might be raised) by foreign funds the in near future.

(2) Hydrological conditions

The result of hydrological analysis must be considered for designing bridge locations, bridge length and structure type of bridges. The design high water level for the 5 objective bridges will be set not only from the result of hearing on flood levels at the sites, but also from the results of hydrological analysis for a 50-year return period high water level. At the same time, considering the risk such as debris flow based on the condition of boulders in the river bed and the topography of the site, the appropriateness of setting piers in the middle of the river will be evaluated.

If any plans exist for dams upstream of the site, this condition also will be considered in setting the design high water level.

2-2-1-3 Policies Regarding Socio-economical Conditions

It is expected that there will be no large-scale resettlement or land acquisition because almost

no houses are located around the objective bridges.

The detours for bridge No.1, No.2 and No.5 must be carefully prepared to maintain safe traffic conditions on national trunk road, with existing bridges removed and utilized by local people daily. Regarding bridge No.5, design and construction method for minimizing water pollution during construction is important to avoid the effect of the project on the ecological environment and fishing operation.

2-2-1-4 Policies Regarding Situation of Construction and Procurement

Most of the materials and equipment for this project can be procured in Sri Lanka. It is especially easy to procure domestic cement and crushed stone in Eastern Province. Consequently, concrete is the preferred type of new bridge.

There are three suppliers (5 factories) for pre-cast PC beam, subject to RDA standards, in Sri Lanka. In Eastern Province, there is also one factory in Mahiyangana. The Study Team surveyed the PC-girder factory in Mahiyangana during the field study. The Team also confirmed the quality of the products is acceptable for use in the Project. However, an inspection of the manufacturing by the Engineer will be crucial. Therefore, PC-girder for the Project will be procured from Mahiyangana.

2-2-1-5 Policies Regarding Application of Local Enterprise

Recently, local contractors have increased their experience in bridge and road work in Eastern Province through projects funded by Japan or other countries after racial conflicts and the tsunami disaster. Although these local contractors have experiences for medium to small bridges and DBST pavement, it is still difficult for there to perform as a prime contractor for large bridges (more than 100 m), such as bridge No.5 of Panichchankerni. In this study, it is assumed that the local contractors will work as one of the subcontractors of a Japanese prime contractor or work as the supplier of equipment or labourers. To increase work opportunities for Tamil people, simple designs for auxiliary road structures, such as drainage trenches, are proposed by the study team.

2-2-1-6 Policies Regarding Maintenance Capabilities of the Administering Agency

The Road Development Agency (RDA) is responsible and capable for maintenance of national road and has equipment, a workshop and a branch office in each province. The budget for Road maintenance work of the RDA was 3.4 billion Rupees in 2008, and around 100 million Rupees were allocated as road and maintenance budget in Eastern Province.

The expected maintenance cost for the objective five bridges will be very small because they will all be made of concrete. Consequently there will be few problems regarding operation and maintenance of the Project. However, the Sri Lankan side must bear removal costs for bridge

No.3 and bridge No.4, immediately after the completion of these bridges. If the removal works is not completed before the rainy season, there is concern that the remaining structures will affect the function of the new bridges by blocking water by the existing embankment of the old bridge. Therefore the Study Team suggests RDA to secure budget for these removal works, and the team will monitor the work to be done by RDA.

2-2-1-7 Policies Regarding the Grade of Facilities and Equipment

The following manual and specifications will be applied according to "Technical Memorandum, March 25, 2009" between the Study Team and RDA, attached as Appendix 7.

- RDA Bridge Design Manual 1997
- RDA Geometric Design Standards of Road: 1998
- British Standard BS5400

The bridge shall have 2 lane width and the design speed of these sections of national highway No.5 (the section includes Bridge No.1, No,2, NO.3 and No.4) and No.15 (the section includes Bridge NO.5) will be 70 km/hr according to the "Memorandum" stated above.

2-2-1-8 Policies Regarding Erection/Procurement Methods and Schedule

(1) Policies for Bridge Erection Works

The bridge sites of PC girders basically allow setting of crawler cranes on the riverbeds in the dry season. Even in rainy season, bridge sites No.1, No.2 and No.4 are not under the flood water for long periods. It is assumed to be possible that crawler crane can get into the river bed by taking chance of low water level. Regarding bridge No.5, a temporary jetty must be prepared to carry out piling works and PC girder erection works. After PC girders' erection, concreting for the slab will be done using a bucket rather than concrete pump because the performance of concrete pump in Sri Lanka is unreliable.

(2) Policies for Procurement

For the main materials for the Project, steel products (re-bar, steel pipe and shaped steel for temporary works, etc.) and bridge auxiliary materials (rubber bearing, expansion joint etc.) are usually imported from India and so on. However, common materials can be purchased from markets in Colombo. Because the Study Team could collect quotations from the local markets for imported materials, there is no necessity to consider overseas transportation costs or procurement duration for imported materials.

(3) Policies for Schedule

The substructure for the objective bridges must be built within the dry season (from March to September) to avoid flood waters. The contract for construction work may take place in rainy season, however, fabrication of precast PC girders can be started even in the rainy season. Consequently, short length bridge, such as bridge No.1 and bridge No.3 will be completed within the first dry season. On the other hand, the construction period of bridge No. 2, bridge No.4 and bridge No.5 will continue until the second dry season. The longest construction period, from contract agreement to completion of construction, will be 21 months (1.75 years) for bridge No.5.

2-2-2 Basic Plan

2-2-2-1 Summary of Design

The summary of the design for the Project is shown in Table 2-2-2-1.

Table 2-2-2-1 Design Summary of the Project

Facility	Contents
1.Bridge	
(1) Bridge length/ Span arrangement	(Bridge No.1) 13.0m+13.0m=26.0m (Bridge No.2) Bridge: 17.0m@5span=85.0m, Box culvert: 7.0m (Bridge No.3) 16.0m (Bridge No.4) 18.0m+18.0m=36.0m (Bridge No.5) 19.0m@5span=133.0m Causeway: Left bank 82 m Right bank 85 m
(2) Bridge width	All bridge: 1.5m(sidewalk)+3.7m@2(carriage way)+1.5m(sidewalk)=10.4m (Separate sidewalk: Mount up type)
(3) longitudinal and transverse gradient	longitudinal gradient (Bridge No.1) 2.0%, -2.0% (Bridge No.2) 2.0%, -4.0% (Bridge No.3) 0.75%, -1.50% (Bridge No.4) 1.5%, -0.5% (Bridge No.5) 1.294%, 0%, -1.285% transverse gradient All bridge: 2.0%
(4) Design high water level	(Bridge No.1) 43.9m, (Bridge No.2) 42.6m, (Bridge No.3) 39.6m, (Bridge No.4) 2.2m (Bridge No.5) 1.9m
(5) Design Load	
・Live load	HA load and HB load are applied subject to BS5400
・Seismic Load	No need to be applied

・Other Load	Wind load, Earth Pressure, Water Pressure, Buoyancy
(6) Superstructure	
・Structural type	All bridge: Pre-tension PC simple beam
・Erection Method	Crane method
(7) Substructure	(Bridge No.1) Abutment: Inverse L type, Pier: T type (Bridge No.2) Abutment: Inverse L type, Pier: T type (Bridge No.3) Abutment: Inverse L type (Bridge No.4) Abutment: Inverse L type, Pier: T type (Bridge No.5) Abutment: Inverse L type, Pier: Pile bent method
(8) Foundation (Supporting layer)	(Bridge No.1) Direct foundation (Weathered rock) (Bridge No.2) Bridge section : Direct Foundation (Weathered rock), Box culvert: Direct foundation (Sandy soil) (Bridge No.3) Direct foundation (Sandy soil) (Bridge No.4) Pile foundation (Weathered rock) (Bridge No.5) Pile bent method (Weathered rock)
(9) Auxiliary facilities	Newel Post、Drainage system
(10) Others	Water supply pipe, electric line, telephone line shall be considered for future load are to be applied as auxiliary facilities of loads
2.Approach road	
(1) length	(Bridge No.1) Left bank: 60 m Right bank: 54 m (Bridge No.2) Left bank: 115 m Right bank: 120 m (Bridge No.3) Left bank: 89 m Right bank: 75 m (Bridge No.4) Left bank: 124 m Right bank: 60 m (Bridge No.5) Left bank: 90 m Right bank: 100 m
(2) Basic condition	Road class：Class A (R3), Topography：Plain, Design Speed：70km/h
(3) Road cross section	A005 1.25m (Shoulder)＋+3.0m@2(Carriage way)+1.25m (Shoulder)=8.5m A015 1.0m(Shoulder)+3.1m@2(Carriage way)+1.0m(Shoulder)=8.2m
(4) Geometric Alignment	Geometric Alignment for design speed of 70km/h Minimum curve radius：R=185m, Maximum Gradient：4.0%
(5) Pavement structure	Carriage way：Wearing layer：DBST, Sub-grade 20cm, Base course 15cm、 Shoulder：Crushed stone 15cm （Temporary pavement adopted because road improvement of these sections is expected in near future）
(6) Drainage Facilities	None

2-2-2-2 Design Road Width

(1) Bridge and Causeway

Standard bridge width is shown in Figure 2-2-2-1 and standard causeway width is shown in Figure 2-2-2-2. Concrete pavement will be applied for bridge No.5 and causeway.

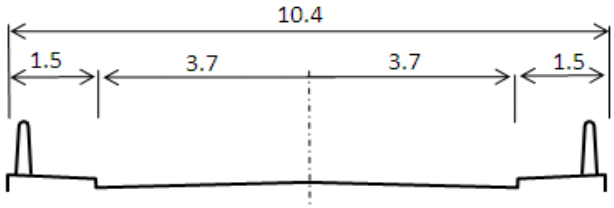


Figure 2-2-2-1 Road Width at Bridge Section

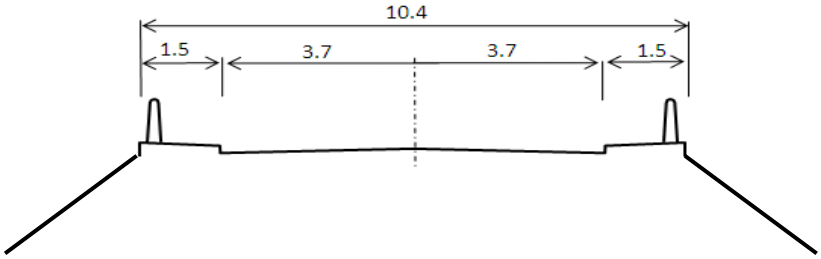


Figure 2-2-2-2 Road Width at Causeway Section

(2) Approach Road

The standard approach road width on national highway No.5 is shown in Figure 2-2-2-3, and the standard approach width on national highway No.15 is shown in Figure 2-2-2-4. The road width for national highway No.15 is subject to RDA standard, while the road width for national highway No.5 is according to the design for road improvement works funded by ADB.

Low cost pavement (DBST) will be applied for the approach roads because there are no existing asphalt plants around the sites, and these approach roads will be improved by foreign funds (ADB fund for national highway No.5 and French fund for national highway No.15) in the near future.

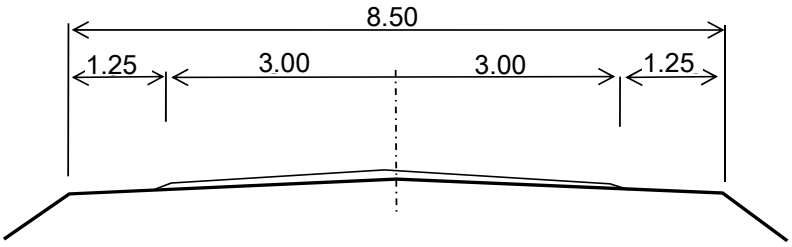


Figure 2-2-2-3 Road Width on National Highway No. 5 (ADB Section)

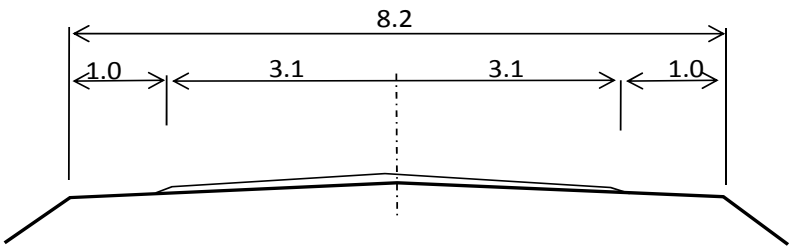


Figure 2-2-2-4 Road Width on National Highway No. 15 (RDA Standard)

2-2-2-3 Design Conditions for Bridges

(1) Design Standard

"Bridge Design Manual" shall be applied for the design, supplemented by the Japanese "Specifications for Highway Bridges (Japan Road Association)" for matters not stated in the former standard.

(2) Design Method

Allowable stress method shall be applied at the basic design stage by the Japanese side.

(3) Design Load

1) Dead Load

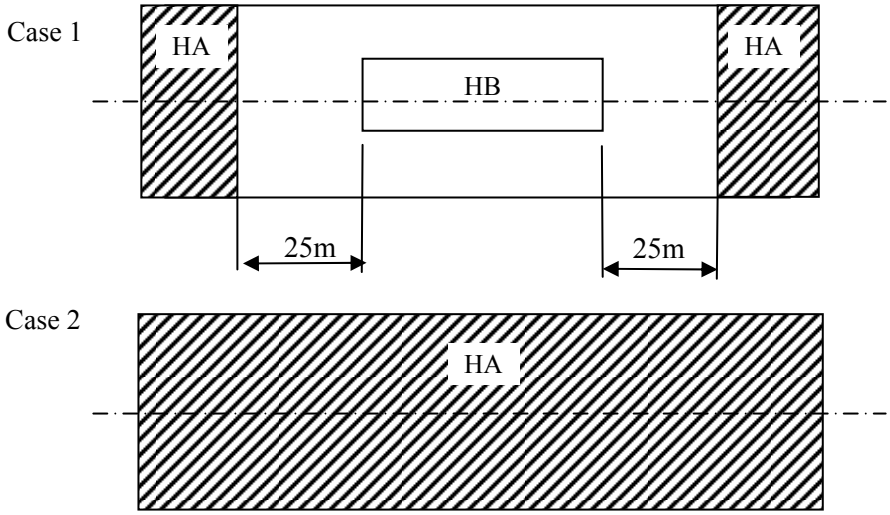
Dead Load is the weight of a bridge itself with attached utility lines. Table 2-2-2-2 shows the unit weight of bridge materials for the calculation of design dead load.

Table 2-2-2-2 Unit Weight for Bridge Materials

Material	Unit Weight (kN/m^3)	Material	Unit Weight (kN/m^3)
Steel	77.0	Plain concrete	23.0
Cast-iron	71.0	Cement mortar	21.0
Aluminum	27.5	Asphalt Concrete	22.5
Reinforced Concrete	24.5	Wood	8.0
Pre-stressed Concrete	24.5		

2) Live Load

Correspondingly, applying BS standard, the design live load shall be either case 1 or case 2 in the next figure, whichever is the larger one, in Sri Lanka.



HA：Vehicle Distribution Load

HB：Vehicle Axial Load

Figure 2-2-2-5 Design Live Load on National Highway in Sri Lanka

3) Other Load

Following Loads also shall be considered in the bridge design.

- Impact Load (include break load)
- Pre-stressed Load
- Creep of Concrete
- Contraction of Concrete
- Earth Pressure
- Water pressure and Impact of Floating Object
- Buoyancy or Lifting Pressure

(4) Design Strength

Design strength of concrete, re-bar and steel materials are as follows.

Table 2-2-2-3 Design Strength of Concrete

Description	Design Strength (N/mm^2)
PC Girder (Pre-tension)	30 or more
Slab Concrete	30 or more
Abutment, Pier	21 or more
Concrete Pile（Cast-in-place)	30 or more
Lean Concrete	18 or more

Table 2-2-2-4 Design Yield Strength of Steel

Description	Yield Strength (N/mm^2)
Round bar	$\sigma_{py} > 235$
Deformed bar (SD295)	$295 < \sigma_{py} < 390$
Deformed bar (SD345)	$345 < \sigma_{py} < 440$

Table 2-2-2-5 Design Tensile Strength of Steel

Description	Tensile Strength (N/mm^2)	Remarks
SS400,SM400	410 or more	Ordinary steel
SM490,SM490Y	500 or more	Ordinary steel
SM520	530 or more	Ordinary steel

2-2-2-4 Bridge Design

(1) Design High Water Level

Although the flow volume and water level of the main rivers are periodically surveyed in Sri Lanka, there are usually no data or no managed data for small rivers, such as the rivers related to the objective bridges of this project, because of long term conflicts in the country. Therefore the high water level was confirmed based on hearing at all sites except bridge No.5, where hydrological analysis was implemented for the latest feasibility study in 2005. For bridge No.5, the Study Team reviewed the analysis and decided to use the result of the analysis. The navigation clearance for bridge No.5 is 2.5 m, according to the letter from RDA dated April 3, 2009 (refer Appendices 5).

The design water levels for the objective bridges are in following table.

Table 2-2-2-6 Design Water Level

	Maximum Flood Level	Basis	Design Water Level
No.1	20cm below existing girder	Hearing	43.9m
No.2	60cm above the surface of bridge 241/4	Hearing	42.6m
No.3	1 m below existing girder	Hearing	39.6m
No.4	30cm below existing girder	Hearing	2.2m
No.5		Result of F/S	1.9m

(2) Bridge Location

Based on the site survey, the proper alignment for each bridge was compared and studied. The comparison was made mainly for two alternatives, the existing location or a new alignment, and the following subjects were discussed.

- Effect on the environment of the surrounding area of the bridge
- Effect on the river
- Riding quality (before and after completion)
- Construction efficiency
- Construction period
- Risk of delay
- Construction Cost

The comparison tables are attached in Appendix 6, and the result is shown in Table 2-2-2-7.

Table 2-2-2-7 Result of Route Selection

Bridge No.1	Same alignment as the existing bridge
Bridge No.2	Close alignment with the existing bridge
Bridge No.3	Different alignment（Southern route）
Bridge No.4	Different alignment（Northern route）
Bridge No.5	Same alignment as the existing bridge

(3) Bridge Length

Regarding bridge No.1, No.2 and No.4, the bridge lengths are designed to secure the same cross-sectional flow area of the existing bridge. The length of bridge No.3 is decided so that the longitudinal alignment of bridge No.3 secures design high water level and the length can keep at least the existing bridge length. The length of bridge No.5 is decided to secure the water flow width of 127 m which was the result of hydrological analysis implemented at the feasibility study and approved by the Sri Lankan side.

The following policies shall be taken so that the improved bridges will not produce adverse effects, especially when flood occurs.

Policy-1 : Bridge Length（cross section flow area） after the improvement shall be longer than that of the existing bridge.

Policy- 2 : The bridge span after improvement shall be longer than the shortest span at the existing bridge.

The candidate types of bridges will be as follows:

Table 2-2-2-8 Span arrangement considering cross section flow area

	Existing Bridge		Bridge Type after Improvement (candidate)
	Span	Bridge Length	
Bridge No.1	10m	20m	RDA standard PC Girder or RC Girder is suggested as the bridge span will be more than 10m. It is more desirable to adopt RDA standard PC Girder in order to complete the construction during the dry season, as it will be a 2-span bridge.
Bridge No.2-1	6m	6m	Box Culvert is suggested since the existing span is 6m. The impact from blockage caused by Culvert would be eased by the neighboring new bridge since its cross section flow area is large.
	3m	3m	Box Culvert is recommended considering the existing span being around 3m. Since the nearest bridge is very close, it is desirable that they will be united into one bridge.
Bridge No.2-2	9.6m	48m	RDA standard PC Girder or RC Girder is suggested as the bridge span will be more than 9.6m. It is more desirable to adopt RDA standard PC Girder in order to complete the construction during dry season, as it will have 2-spans or more.
Bridge No.3	16m	16m	RDA standard PC Girder is desirable as the bridge span will be more than 16m.
Bridge No.4	4m	36m	Bridge span shall be 4m or more. However, as Box Culvert will be 7~9 continuous one and blockage in case of flood is concern, RDA Standard PC Girder shall be adopted, taking 9 or more spans. It is more desirable to adopt RDA standard PC Girder in order to complete the construction during dry season, as it will be a 2-span bridge.
Bridge NO.5	12.33m	37m	RDA standard PC Girder or RC Girder is suggested as the bridge span will be more than 12.33m. It is more desirable to adopt RDA standard PC Girder, as the construction point is above water of lagoon.

Based on these policies, length and each span are described on Table 2-2-2-9..

Table 2-2-2-9 Length of Objective Bridges

Bridge No.	Location	Length	Span	Remarks
No.1	240/4	26 m	13m	A2 abutment was moved according to the topography
No.2-1	241/2 241/3	7m	7m	241/2 and 241/3 were combined as the same culvert
No.2-2	241/4	85 m	17m	The bridge must be extended because of interruption of flood water flow by approach road of Batticaloa side
No.3	247/2	16 m	16m	Same as the existing bridge length
No.4	247/2	36 m	18m	Same as the existing bridge length
No.5	59/1	133 m	19m	Securing 127m of water flow width

(4) Bridge Type

a) Superstructure Type

Regarding superstructures, pre-tensioned PC girders or even RC girders can be applied for the span less than 20 m. For the objective bridges, pre-tensioned PC girders, which are fabricated in factories, are selected considering better quality and durability as shown in the next table.

Table 2-2-2-10 Superstructure Type

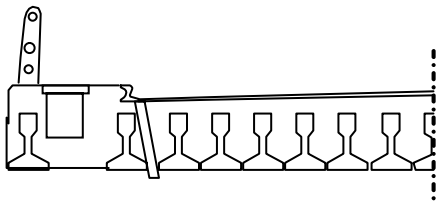
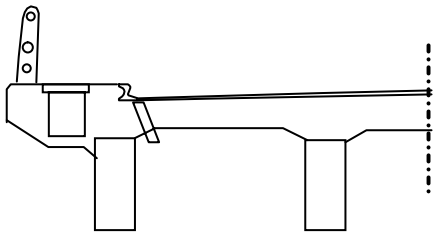
	Pretension PC Girder	RC Girder
Cross section		
Quality Management	Factory made under quality control ○	Cast -in-place quality may vary △
Durability	Controlled crack by PC ○	Non crack control △
Economic	Ready-made and low cost ○	Construction at different conditions △
Evaluation	○	△

Figure 2-2-2-6 shows the standard cross section of pre-tensioned PC girder bridge generally adopted by RDA.

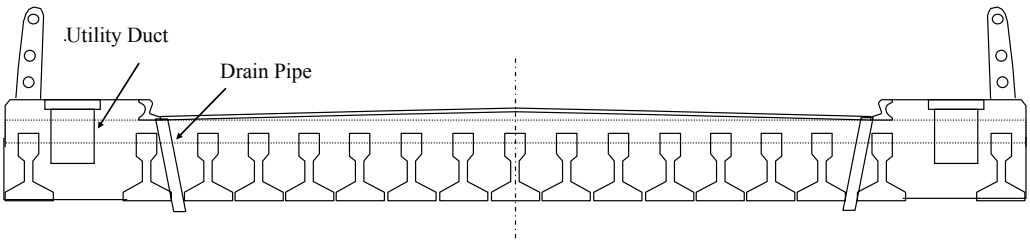


Figure 2-2-2-6 Standard Cross Section of Pretension PC Girder Bridge

b) Substructure Type

Substructure type shall be inverse T type for abutments and T type for piers which are the most economical structure considering the condition of this project (except for piers of bridge No.5, whose substructure is pile bent type).

c) Foundation Type

The direct foundation will be applied if the depth of bearing strata is less than 5m, while pile foundation will be applied if it is more than 5 m).

(5) Summary of Bridge Plan

The following Table 2-2-2-11 shows the summary of bridge plan.

Table 2-2-2-11 Summary of Bridge Plan

	Bridge No.1	No.2-1 Culvert	Bridge No.2-2	Bridge No.3	Bridge No.4	Bridge No.5
Road Class	RDA Standard: Class A					
Design Speed	70 km/h					
Bridge Length (m)	26.0	7.0	85.0	16.0	36.0	133.0
Superstructure	pre-tensioned PC Girder	Culvert	Pre-tensioned PC Girder			
Substructure						
Abutment (Inverse T Type)	A1, A,2	—	A1, A,2	A1, A,2	A1, A,2	A1, A,2
Pier (P Type)	—	—	P1～P4	—	P1	P1～P6
Foundation	Direct Foundation				Precast Pile 400 mm x 400 mm	Cast-in-place Pile (φ1200 mm)

2-2-3 Basic Design Drawings

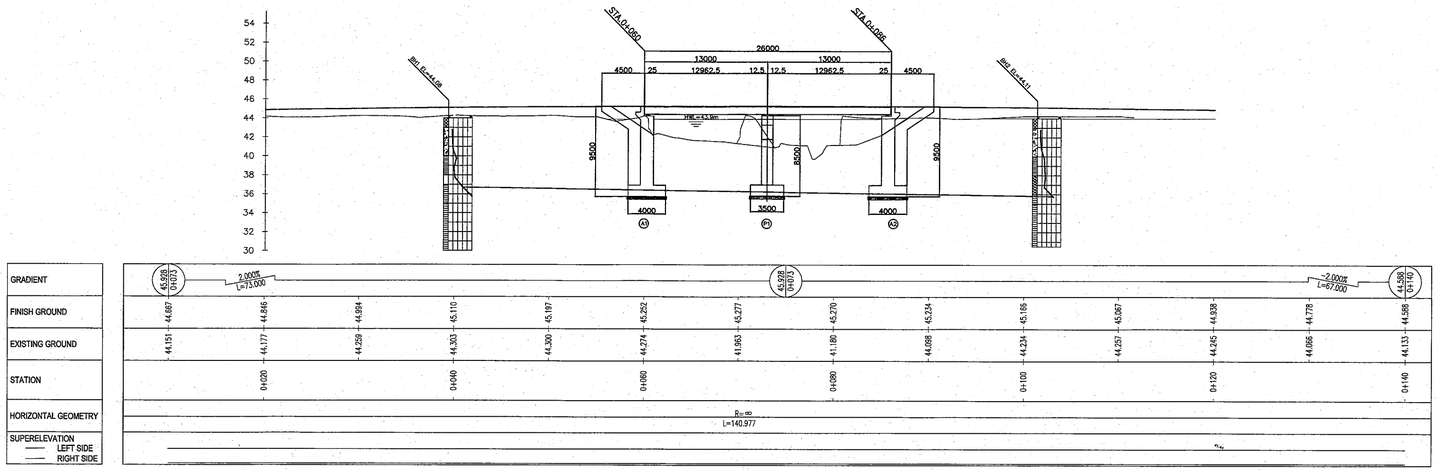
The basic design drawings for the 5 objective bridges are shown from the next page.

Table 2-2-3-1 5 Objective Bridges

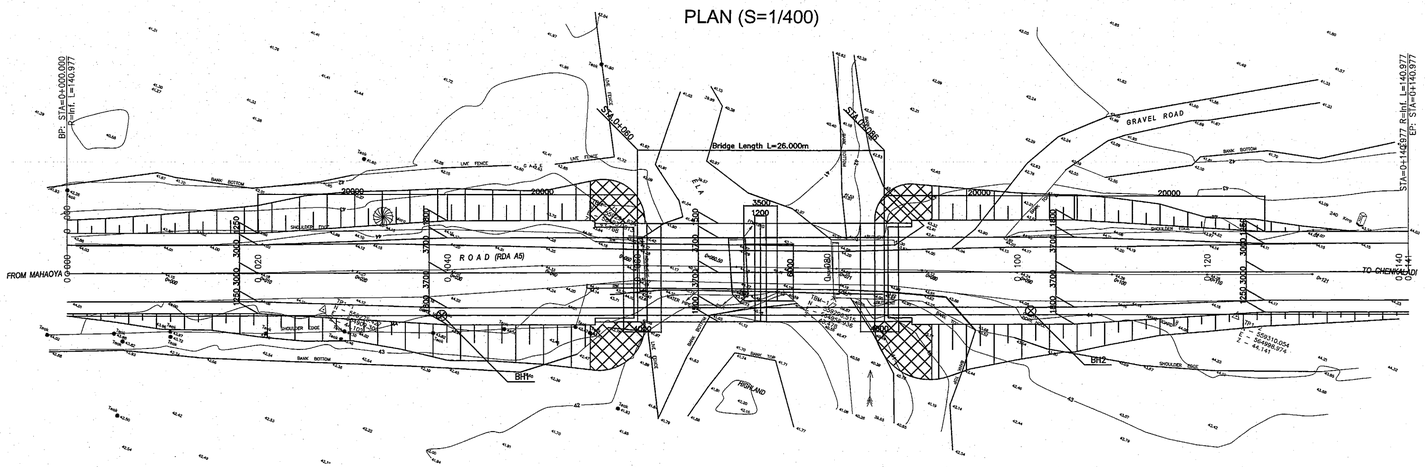
Bridge No.1	240/4 KMP on A005
Bridge No.2	241/2 KMP on A005
	241/3 KMP on A005
	241/4 KMP on A005
Bridge No.3	247/2 KMP on A005
Bridge No.4	283/7 KMP on A005
Bridge No.5	59/1 KMP on A015

GENERAL VIEW OF THE BRIDGE No.1 (240/4)

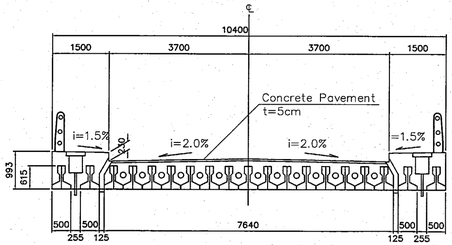
PROFILE (S=1/400)



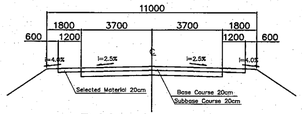
PLAN (S=1/400)



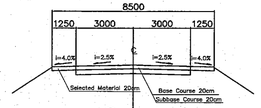
CROSS SECTION FOR GIRDER (S=1/100)



CROSS SECTION FOR ROAD (S=1/100)

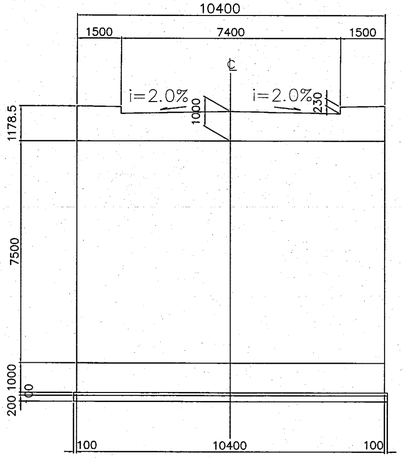


Bridge Approach

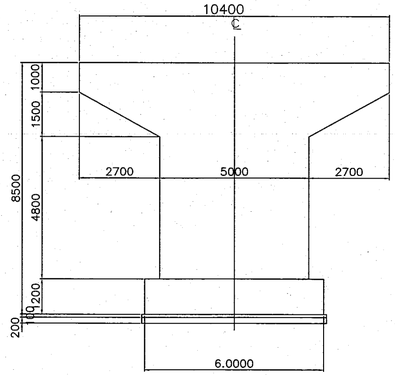


Genral

FRONT VIEW OF ABUTMENT (S=1/100)



FRONT VIEW OF P1 (S=1/100)



No	DATE	

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF HIGHWAYS
Road Development Authority

JICA JAPAN INTERNATIONAL COOPERATION AGENCY
ORIENTAL CONSULTANTS CO., LTD.
in association with
JAPAN BRIDGE & STRUCTURE INSTITUTE, INC.

THE PROJECT FOR THE RECONSTRUCTION OF FIVE BRIDGES IN EASTERN PROVINCE

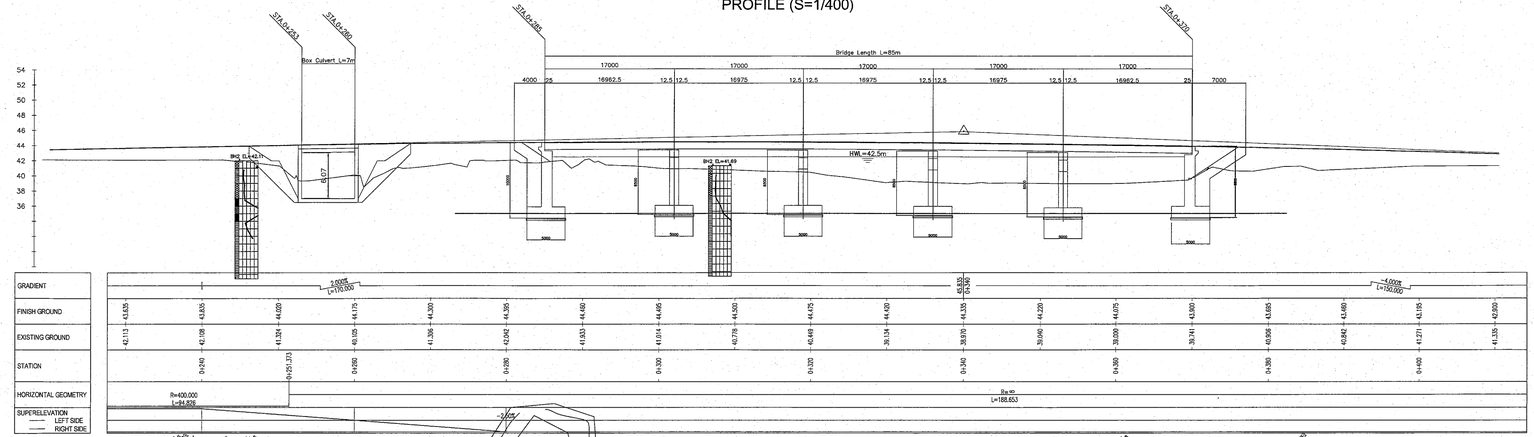
DRAWING TITLE: GENERAL VIEW OF THE BRIDGE No.1 (240/4)

SCALE: AS SHOWN

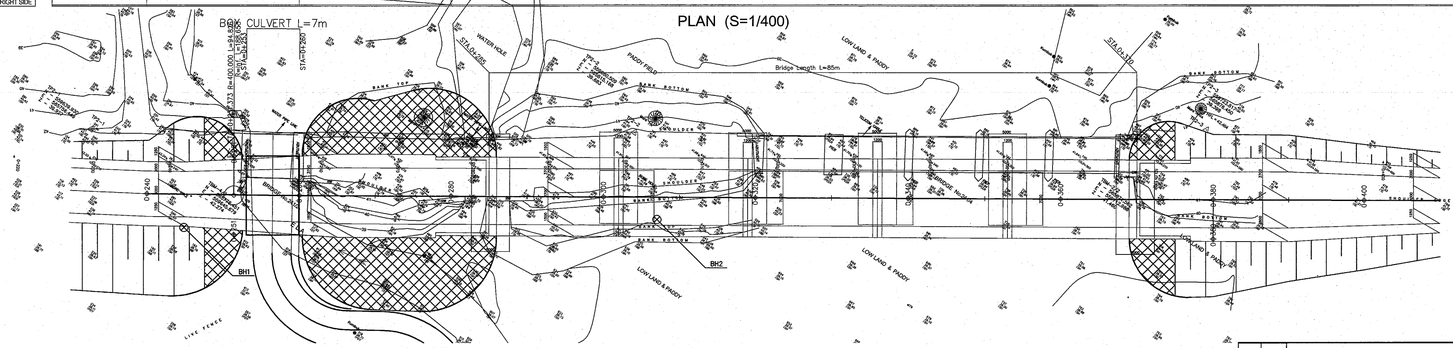
DRAWING No.: D-01

GENERAL VIEW OF THE BRIDGE No.2 (241/2,3,4)

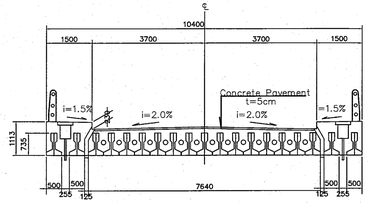
PROFILE (S=1/400)



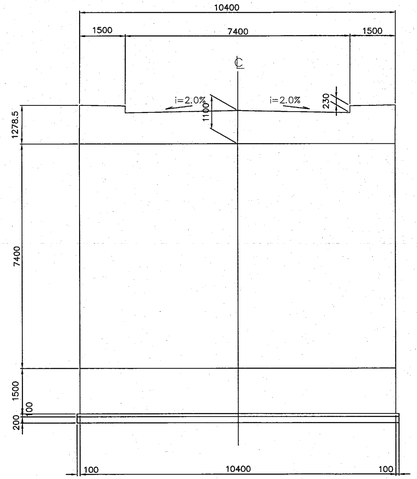
PLAN (S=1/400)



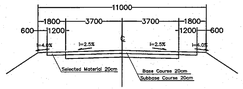
CROSS SECTION FOR GIRDER (S=1/100)



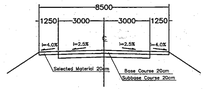
FRONT VIEW OF ABUTMENTS (S=1/100)



CROSS SECTION FOR ROAD (S=1/100)

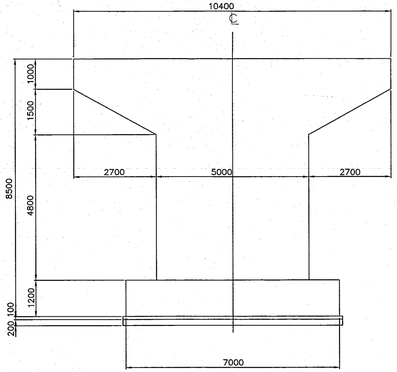


Genral



Bridge Approach

FRONT VIEW OF PIERS (S=1/100)



No	DATE	

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF HIGHWAYS
Road Development Authority

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
in association with
JAPAN BRIDGE & STRUCTURE INSTITUTE, INC.

THE PROJECT FOR THE RECONSTRUCTION OF FIVE BRIDGES IN EASTERN PROVINCE

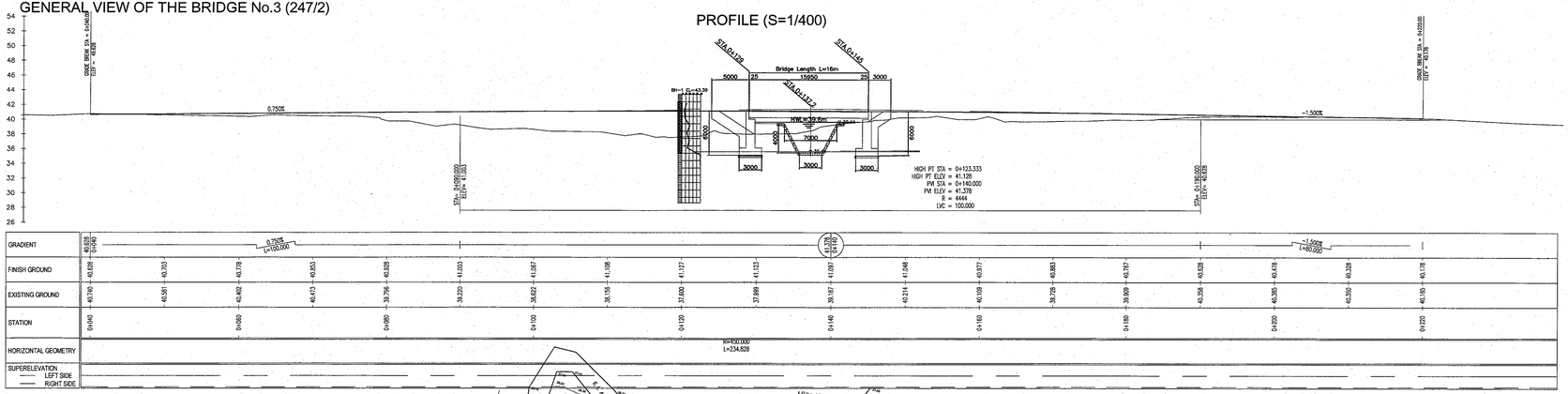
DRAWING TITLE: GENERAL VIEW OF THE BRIDGE No.2 (241/2,3,4)

SCALE: AS SHOWN

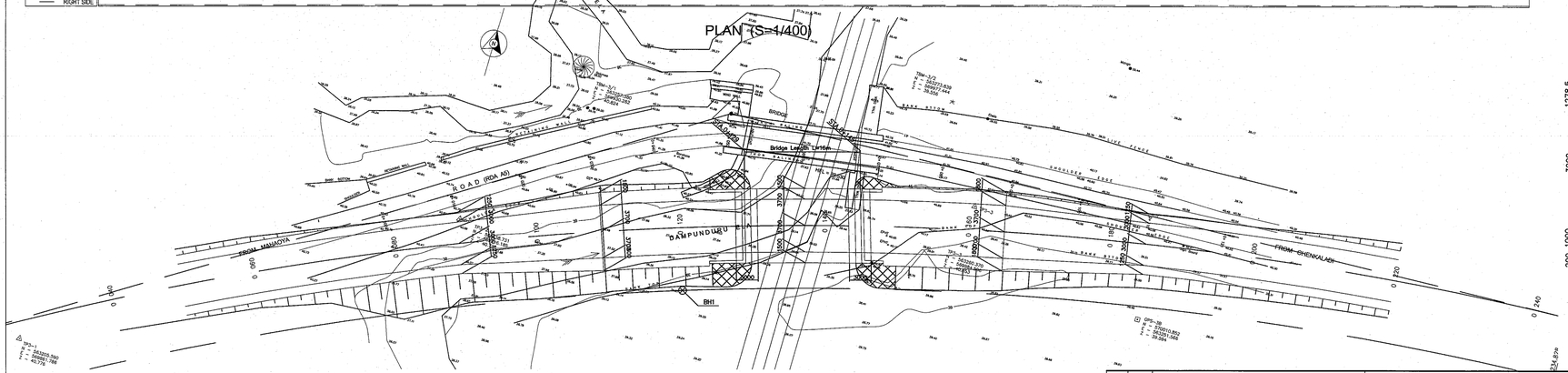
DRAWING No.: D-01

GENERAL VIEW OF THE BRIDGE No.3 (247/2)

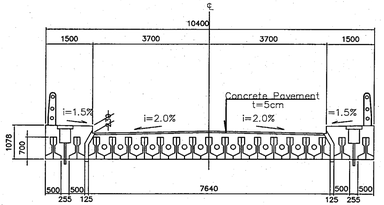
PROFILE (S=1/400)



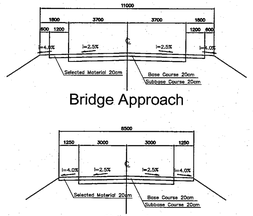
PLAN (S=1/400)



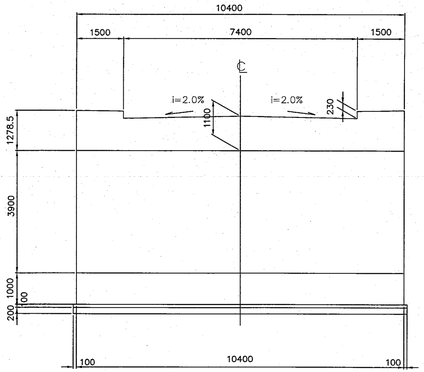
CROSS SECTION FOR GIRDER (S=1/100)



CROSS SECTION FOR ROAD (S=1/100)



FRONT VIEW OF ABUTMENTS (S=1/100)



No	DATE	

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF HIGHWAYS
Road Development Authority

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
in association with
JAPAN BRIDGE & STRUCTURE INSTITUTE, INC.

THE PROJECT FOR THE RECONSTRUCTION OF FIVE BRIDGES IN EASTERN PROVINCE

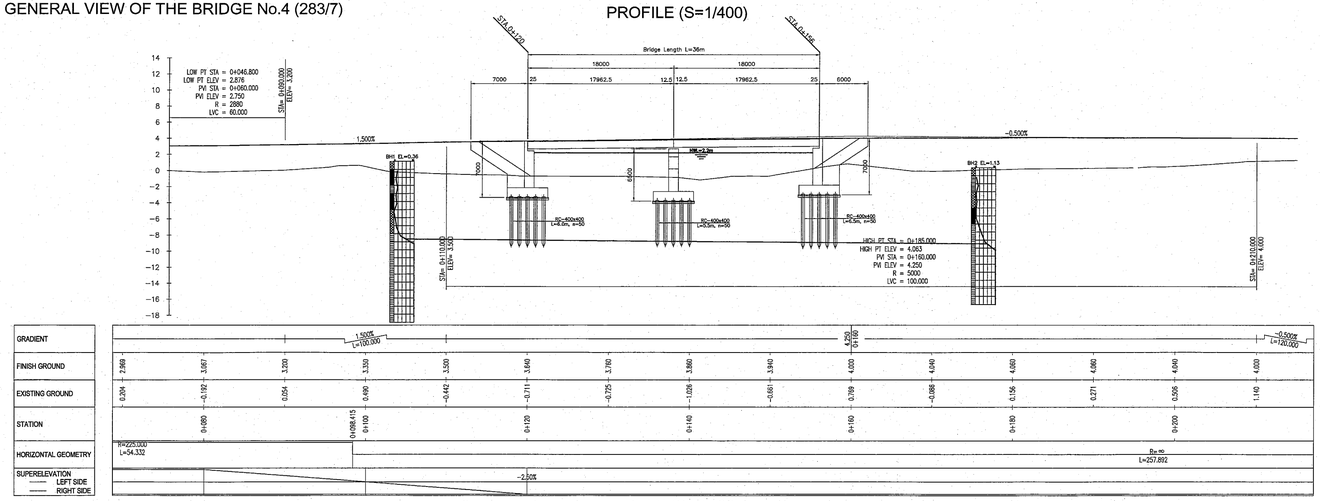
DRAWING TITLE: GENERAL VIEW OF THE BRIDGE No.3 (247/2)

SCALE: AS SHOWN

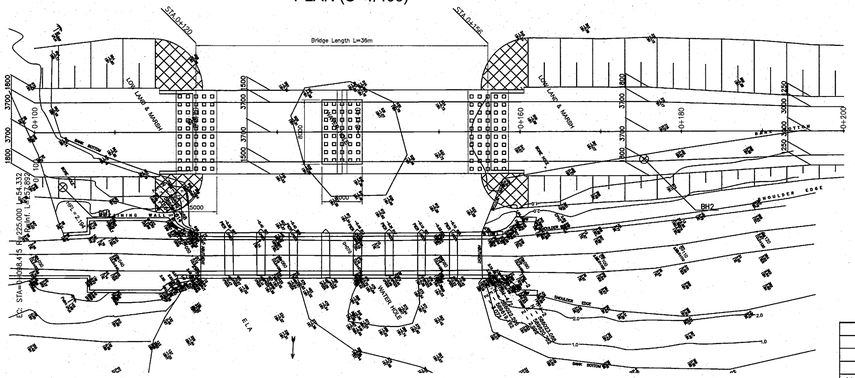
DRAWING No.: D-01

GENERAL VIEW OF THE BRIDGE No.4 (283/7)

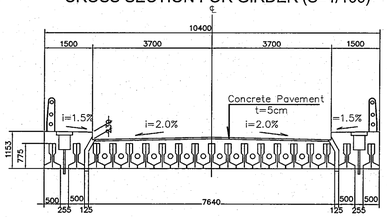
PROFILE (S=1/400)



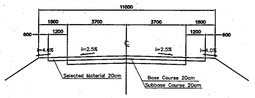
PLAN (S=1/400)



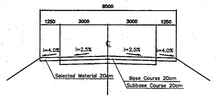
CROSS SECTION FOR GIRDER (S=1/100)



CROSS SECTION FOR ROAD (S=1/100)

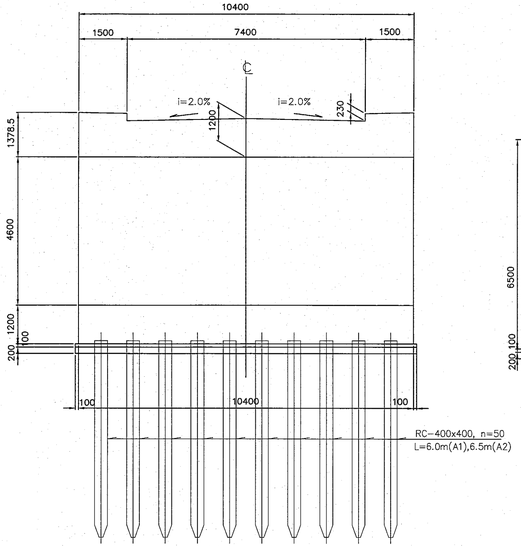


Genral

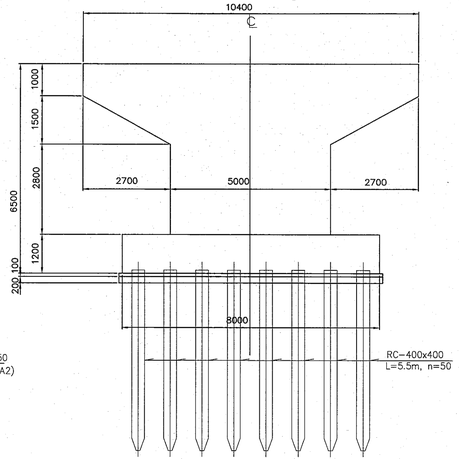


Bridge Approach

FRONT VIEW OF ABUTMENT (S=1/100)



FRONT VIEW OF P1 (S=1/100)



No	DATE	

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF HIGHWAYS
Road Development Authority

JICA JAPAN INTERNATIONAL COOPERATION AGENCY
ORIENTAL CONSULTANTS CO., LTD.
in association with
JAPAN BRIDGE & STRUCTURE INSTITUTE, INC.

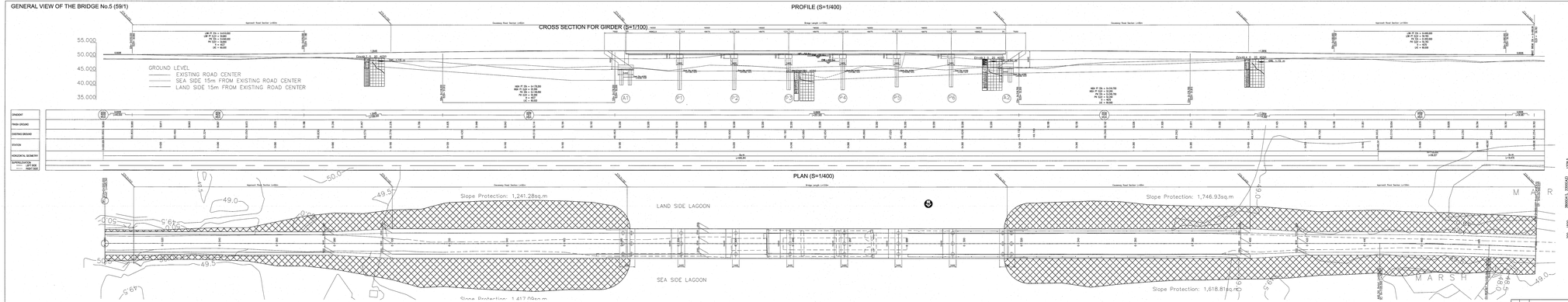
THE PROJECT FOR THE RECONSTRUCTION OF FIVE BRIDGES IN EASTERN PROVINCE

DRAWING TITLE: GENERAL VIEW OF THE BRIDGE No.4 (283/7)

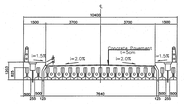
SCALE: AS SHOWN

DRAWING No.: D-01

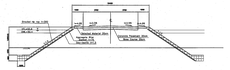
GENERAL VIEW OF THE BRIDGE No.5 (59/1)



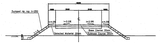
FRONT VIEW OF P1 (S=1/100)



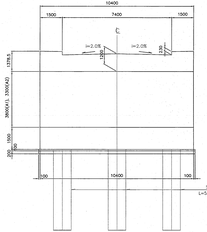
TYPICAL CROSS SECTION FOR CAUSEWAY (S=1/100)



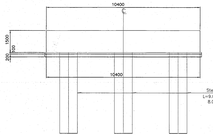
TYPICAL CROSS SECTION FOR APPROACH ROAD (S=1/100)



FRONT VIEW OF ABUTMENT (S=1/100)



FRONT VIEW OF PIER (S=1/100)



No.	DATE	

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF HIGHWAYS
Road Development Authority

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
in association with
JAPAN BRIDGE & STRUCTURE INSTITUTE, INC.

THE PROJECT FOR THE RECONSTRUCTION OF FIVE BRIDGES IN EASTERN PROVINCE

DRAWING TITLE: GENERAL VIEW OF THE BRIDGE No.5 (59/1)

SCALE: AS SHOWN

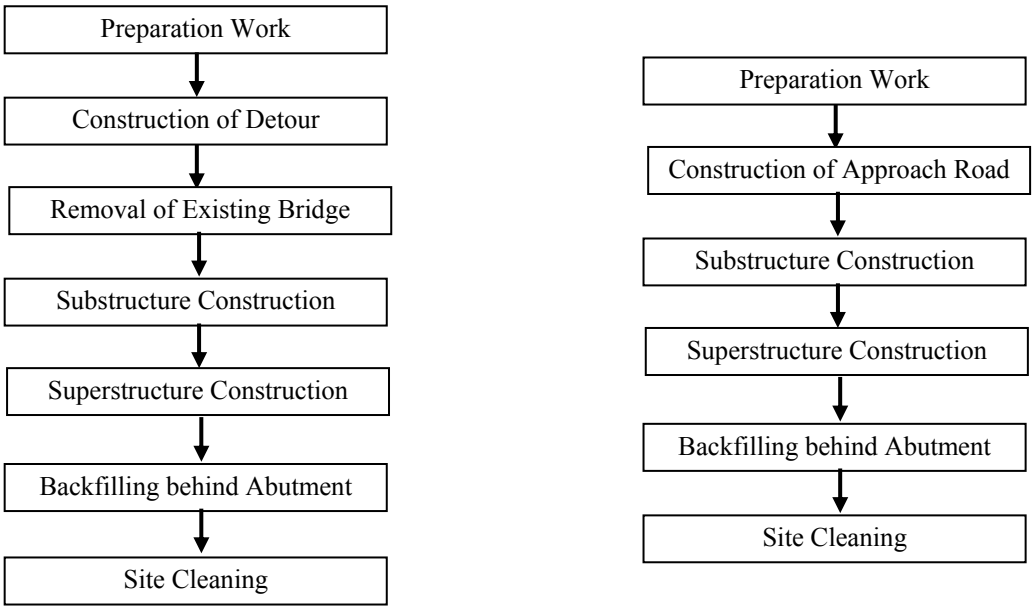
DRAWING No.: D-01

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) Direct Work

The construction sequence for the objective bridges are shown in Figure 2-2-4-1. These five bridges are divided into two different sequences; one for when the bridge is constructed at the same location (almost the same alignment) as the existing bridge and the other for when it is constructed at a new location (along side the existing bridge).



Case 1: Same Location (Bridge No.1, No.2, No.5) Case 2: New Location (Bridge No.3, No.4)

Figure 2-2-4-1 Construction Sequence

Earth work and substructure work shall be done in the dry season; during the 7 months from March to September. As for superstructure work, it is assumed that erection work could be done even in the rainy season.

In case 1, Construction of detour and removal of existing bridge must be done before construction of a new bridge. Sufficient equipment will be required especially in the early stage of these works.

a) Detour (for Bridge No.1, No.2, No.5)

Current traffic must be guided to the detour before commencement of construction work.

If the construction work can be completed during the first dry season, such as bridge No.1, the detour level need not to be higher than high water level, and only a 1.0 m pipe will be enough for stream drainage. If the construction work can not be completed during the first dry season,

such as bridge No.1 and No.2, the detour must be higher than high water level and durable against flood water.

b) Removal of Existing Bridge (for Bridge No.1, No.2, No.5)

Concrete structures will be removed by breakers, and steel girders will be cut by oxyacetylene torch. These waste materials shall be collected and disposed separately.

The first removal work is breaking and disposing of the concrete slab deck, then removing the girders one by one. Substructures made of concrete or stone masonry shall be broken in the same way. The main equipment for this work is giant breaker (600 kg to 800 kg) and 0.8 m^3 class back hoe.

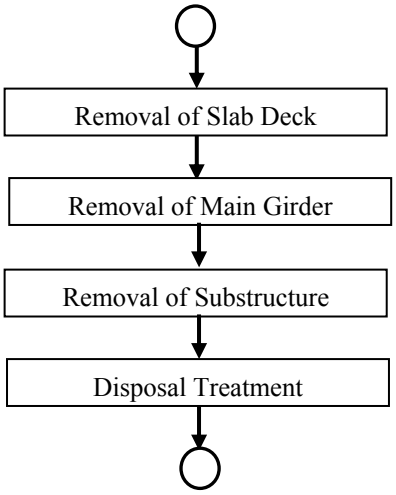


Figure 2-2-4-2 Removal Work of Existing Bridges

The disposal materials, especially broken concrete, will be reused for the embankment slopes; however, it is difficult to use them as sub-grade materials because of difficulty of compaction with different sized lumps.

c) Jetty for Temporary Road

In order to carry out pile foundation work and girder erection work for bridge No.5, a temporary jetty is required to access the site.

Shaped steel H-350 beam will be required for the piles of the jetty. They will be driven by a 60 kW vibration hammer. The pile lengths are less than 13 m, and driving work can be implemented at the same time as the earth work for the approach road and causeway.

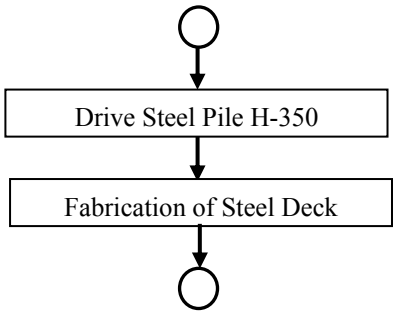


Figure 2-2-4-3 Construction of Temporary Jetty

The width of the jetty is to be 6 m. In order to implement piling works and pile cap works, steel deck stages are also necessary around the piers.

d) Substructure Work

Direct Foundation

For direct foundation of the objective bridges (bridge No.1, No.2 and No.3), all the excavation depths are less than 5 m. Therefore there is no need to use any special methods for excavation and concreting. Excavation will be done by back hoe, and concrete bucket or chute method will be used for concreting substructures. The use of a mobile concrete pump is not applicable for this project because the availability and maintenance conditions of the equipment are not at satisfactory level in Sri Lanka.

Pile Foundation

Precast concrete piles will be used for the foundation of bridge No.4. A diesel hammer of 5 ton will be used for driving the piles.

The substructure of bridge No.5 piers are to be pile bent type with cast-in-place concrete piles. The upper part, around 4 m, of these piles will be in water, so permanent casings will be required for casting concrete as shown in Figure 2-2-4-4.

The number of piles is shown in Table 2-2-4-1.

Table 2-2-4-1 Number of Piles

	Number of Piles	Pile type and length
Bridge No.4	140	Precast Concrete Pile 400mm x 400mm L=5.5 - 6.5m
Bridge No.5	30	Cast-in-place concrete pile φ1200 L=5.0 - 11.0m

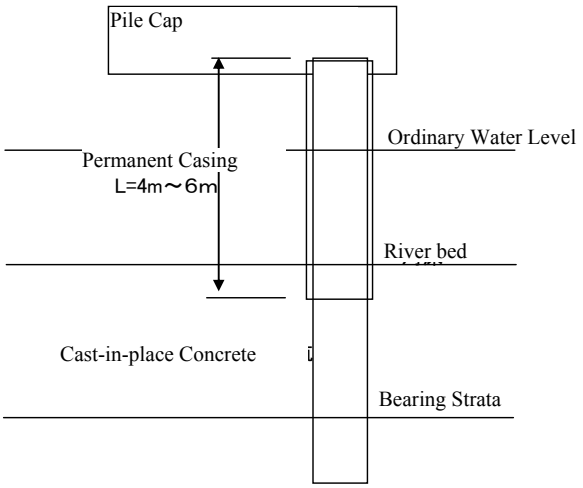


Figure 2-2-4-4 Pile Foundation for Bridge No.5

e) Superstructure Work

Pretensioned PC girder will be used for the superstructure of the objective bridges. To fabricate all the PC girders for this project, it will take more than 1 year, so orders to manufacturers will need to be placed considering the erection timing at each site.

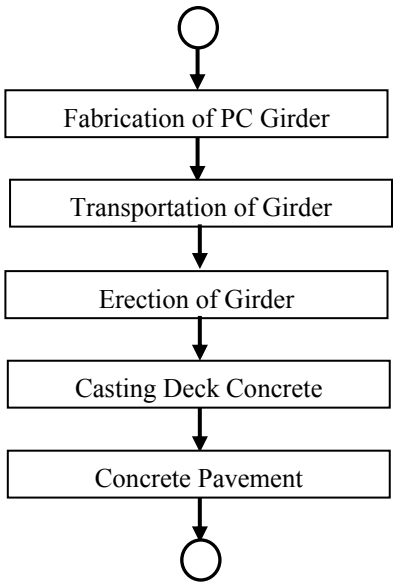


Figure 2-2-4-5 Construction Sequence for Superstructure Work

The PC girders shall be unloaded as close as possible to the bridge site so that no additional transportation is required. Because the weight of one PC girder is up to 9 tons, a crawler crane with 50 ton capacity shall be prepared for girder erection work. The 50 ton crane can reach 12 m when lifting the girder, so it is possible to set the girder directly at the required place without moving it horizontally.

(2) Indirect Work

a) Temporary Yard

It is assumed that the main camp site (45 m x 75 m) for the contractor is located near Chenkaladi at the junction of national road No.5 and No.15. This location is about 40 to 60 km from bridge No.1 and bridge No.5. Sub-camps (20 m x 50 m) shall be established at each site for a site office and temporary stock pile. Two sets of concrete plants shall be established, one is for the bridges on national road no.5, and the other shall be close to bridge No.5.

b) Main Camp

As stated above, a main camp will be located about the mid-way between bridge No.1 and No.5, where bridge No.4 is located. The following facilities will be set up in the camp. Aggregate stockpile yards will be located in the main camp and adjacent to the other concrete plant which is located around bridge No.5.

- Main Office, labor loading, testing Laboratory, Warehouse
- Form Fabrication Yard, Re-bar fabrication yard
- Concrete batching Plant, Aggregate Stock Yard

c) Sub-camp

A sub-camp shall be located near each bridge to stock precast PC girders and house a workshop, re-bar fabrication yard and watchmen's posts.

d) Security measures

Construction caution boards, sign boards and fences surrounding the construction yard shall be prepared for security purposes.

The fences surrounding the construction yard will be barbed-wire to prevent intruders and animals from breaking into the yard.

e) Procurement of Main Materials

All the main materials including expansion joints and rubber bearings can be procured within Sri Lanka, although some are originally imported from other countries, as shown in Table 2-2-4-2. The location of borrow pits, quarries and sand pits are shown in Figure 2-2-4-6. The route for PC girder transportation is shown in Figure 2-2-4-7.

Table 2-2-4-2 Procurement Countries

Materials	Local	Foreign	Remarks
Cement	○		
Concrete Admixture	○		Imported
Reinforcement Bar	○		Imported
Structural Steel	○		Imported
Bitumen	○		Imported
Crusher Stone, Sand	○		
Wood for Formwork	○		
Scaffolding	○		
Precast Concrete	○		
Expansion Joint	○		Imported
Bearing	○		Imported

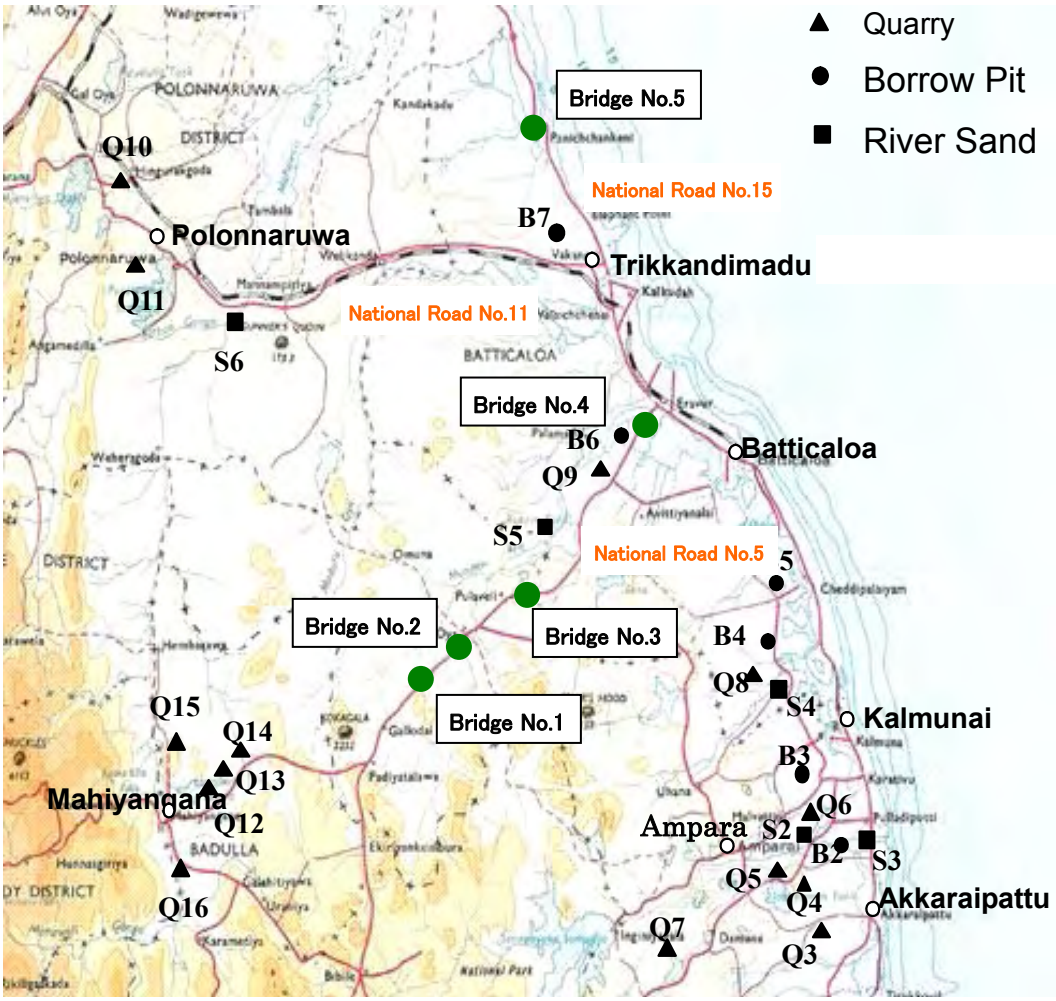


Figure 2-2-4-6 Locations of borrow Pits, Quarries and Sand Pits

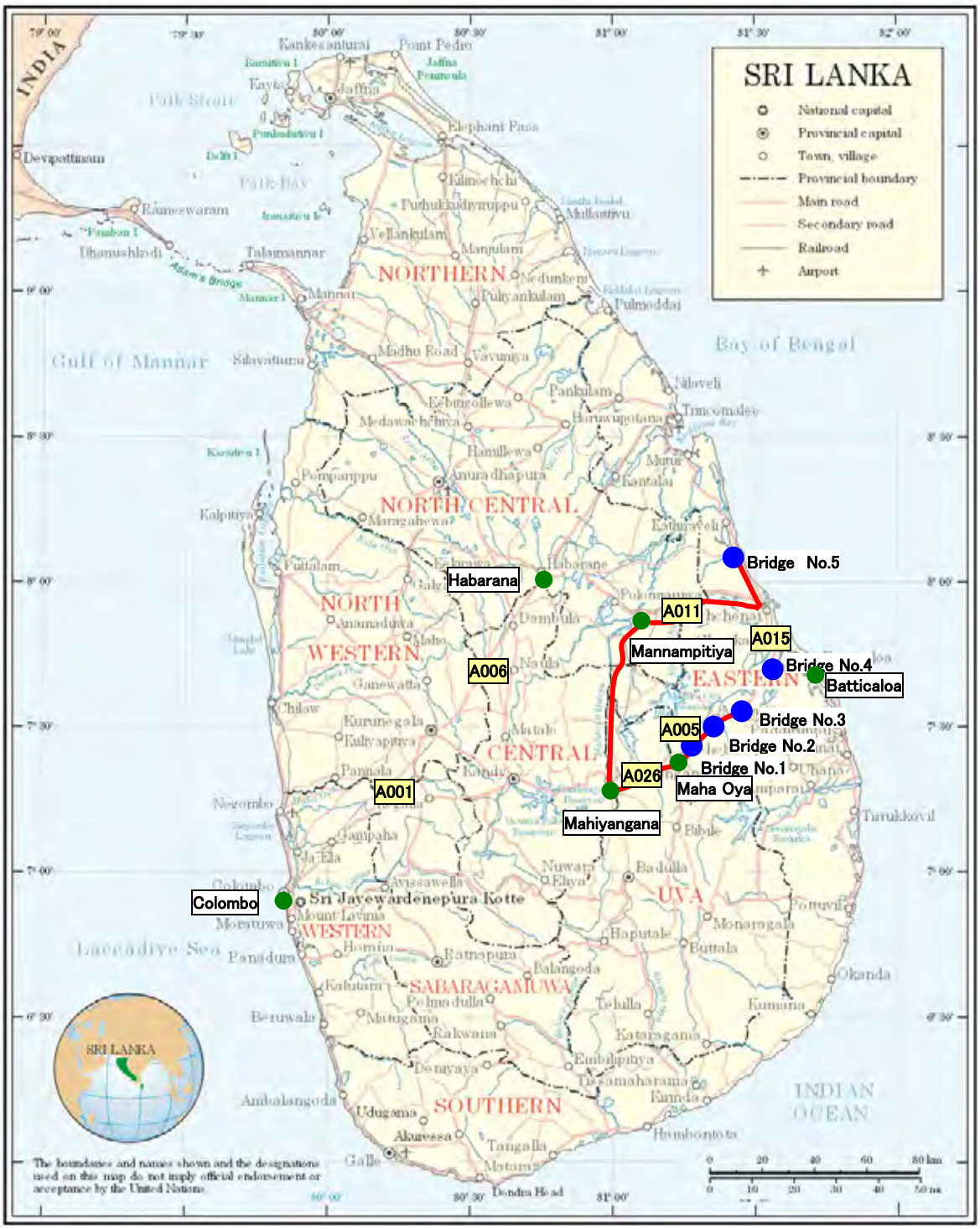


Figure 2-2-4-7 Transportation Routes for PC Girders

(3) Equipment for the Project

a) Procurement Conditions of Equipment in Sri Lanka

Large contracting firms, such as MAGA, ICC, and SANKEN, retain almost all equipment required for the construction works because they have been working on the urgent

rehabilitation projects since the Indian Ocean Tsunami in 2004. New technologies for construction equipment have also been introduced during this time; therefore most of the equipment can be procured locally from agents that were originally equipment import firms. Presently, most of the rehabilitation projects have been completed. Consequently, operation rates for heavy equipment have been coming down recently.

In Eastern Province, heavy equipment is not available from Batticaloa or any other cities because the main offices of large contracting firms are located in Colombo. They have not established branches in this area where the conflict between government and LTTE had continued until a few years ago. Therefore all heavy equipment for the Project will be procured from Colombo.

The Japanese contractor will, as far as possible, not procure any equipment by importing from a third county and will try to procure the heavy equipment from domestic firms.

(4) Transport and Packing Plan

As stated above, all the equipment and materials are to be procured from the domestic market. There is no need to consider transportation and packing costs for overseas transportation (only inland transportation).

2-2-4-2 Implementation Conditions

(1) Safety Conditions during Construction

Regarding ongoing road improvement projects in Eastern Province, 24hr security guards are required for consultant's office and contractor's offices and plants. It is reported that there are still a few LTTE members remaining in the jungle who occasionally attack security agents and residents of Eastern province, though the main body of LTTE was already overwhelmed by the government in May 2009. Therefore the current security system must be maintained for a while until the safe situation is confirmed.

(2) Conditions of Checkpoints

In March 2009, cargo trucks must go in for a security check which requires unloading of cargo, at the border of Ampara and Batticaloa, or Polonnaruwa and Batticaloa. A major consideration for the procurement plan is that it will be almost impossible for cargo trucks to go through these checkpoints with bare sand or aggregate. After the conflict with LTTE ceased, these security check system might be changed drastically, so monitoring of these conditions is required for making proper implementation plan at the time of the detailed design.

2-2-4-3 Scope of Works

For the implementation of the project under the grant aid of the Government of Japan, the share of works to be undertaken by the Government of Japan and the Government of Sri Lanka as described hereafter.

(1) The share to be borne by the Government of Japan

① Transportation of equipment and material from Japan or Third Country to Site
② Transportation from the landing port in Sri Lanka or the procurement place to Site
③ Construction of Bridge, Causeway, Revetment and Approach Road to be paved by DBST (Referred to Section 2-2-3 Basic Design Drawings (1)～(5) (p.2-33～p.2-37)
④ Construction and removal of construction yard and road, detour, and camp yard
⑤ Procurement of the materials, equipment and labourers required for the construction works
⑥ Field management costs for the above construction works
⑦ The consultant services, which are necessary to implement the works

(2) The share to be borne by the Government of Sri Lanka

① Land acquisitions and compensation for the construction sites, land lease for temporary yards, and resettlement of public facilities inside of the construction yards
② Clearing and grand preparation grabbing before construction and erecting the fence
③ Notice of A/P to Japanese Bank and payment of any commission
④ The exemption from tax on the materials and equipment imported for the project and the expeditious proceeding of custom procedures
⑤ Expediency to the Japanese to procure equipment and materials and to transport it to Sri Lanka
⑥ The exemption of custom fees for the Japanese and the third national parties entering Sri Lanka to work on the project, and exemption of financial obligations
⑦ To establish the necessary facilities such as electricity, water, and so on to each site
⑧ To provide free of charge the materials from the Bailey bridge (80 m long) that was procured by Japan's Grant Aid in 2006 to the Contractor to be utilized for the detour at bridge No.5. Transport the materials for the Bailey bridge between the store yard and the bridge No.5 project site, before and after the construction period.
⑨ Removal of existing two bridges (bridge No.3 and No.4) after completion of construction work covered by Japanese Grant Aid
⑩ Proper treatment and maintenance of the bridges constructed by this Grant Aid program
⑪ Pay necessary cost outside the cost supplied by this Grant Aid program for construction of the objective bridges

2-2-4-4 Consultant Supervision

(1) Basic Policy of Detailed Design

The basic policy of the detailed design is as follows:

- Field studies during the detailed design will be conducted for reconfirmation of the site, supplementary studies related to the construction/estimation and additional survey based upon the basic design. Final discussion shall be held with the Government of Sri Lanka on confirmation items related to the detailed design.
- After completion of the detailed design, the context of the detailed design shall be explained to the Sri Lankan side, and discussion will be held.

(2) Basic Policy of Consultant Supervision

The Basic Policy of the Consultant Supervision will be as follows:

- Consultant office shall be located in the same area as the contractor's office.
- In Colombo, the Consultant would not have a liaison office and would visit the RDA on a monthly basis to submit the monthly report by business trip from Batticaloa.
- In the second dry season (assumed to be March 2011 to September 2011), the substructure works for each of the five bridges will start almost at the same time. Therefore one bridge substructure engineer will be necessary during this season.
- It is necessary to establish a backup system for this project in Japan.

(3) Consultant Supervision

The supervisors dispatched to the sites will perform the following construction supervision works with the leading local engineer to be employed in Sri Lanka:

- Approval of the Construction Plan, Schedule and Construction Drawings

  Supervisors will inspect and approve the construction plan, schedule and shop drawings submitted by the contractor, in conformity with the contract document, contract drawings, specifications and others.

- Schedule Control

  Supervisors will receive the progress reports from the contractor, and give adequate and essential instructions necessary for the completion of the project.

- Quality control

  Supervisor will examine and approve the quality of construction materials and construction methods, in conformity with the contract drawings and specifications.

- Inspection of Completed construction Works

  Through the inspection of the final sections, figures in plan and others, supervisors will confirm the completed construction works to the control criteria and certify the quantities.

- Issuing of Certification

  Supervisors will issue the certificates for the payment of the contractor, such as the completion of the construction and the expiration of warranty term etc.

- Submittal of Reports

  Supervisor will inspect the monthly reports and final pictures prepared by the contractor and submit them to the Sri Lankan authorities, JICA and others. Furthermore, the supervisors will prepare the final report after the completion of the construction and submit to JICA.

(4) Procurement

The routes for transportation of pre-tensioned PC girders fabricated in Colombo are shown in Figure 2-2-4-7. It is reported from the same kind of projects that around 10% of the pre-tensioned girders are damaged during transportation and rejected at site. To avoid this situation and to keep proper quality, the Contractor shall prepare a transportation plan especially for pretension PC girders in advance and the Consultant shall approve it.

2-2-4-5 Quality Control Plan

Table 2-2-4-3 shows the quality control plan for this project.

Table 2-2-4-3 Quality Control Plan

Type of Work	Control Item	Inspection, Testing and etc.	Frequency of Inspection/Testing
1) Earthwork, Asphalt Pavement (DBST), Subgrade, Base Course, Underground Structures	Material Control	CBR Test, Geotechnical Test (Specific gravity, Grain size, Moisture content, Liquid & Plastic limit, Density), Aggregate Test (Specific gravity, Grain size, Strength, Coefficient of water absorption), Bituminous material (Quality certificate, Componential analysis result)	Before implementation
	Routine Control	Soil Compaction Test, Bituminous material (Stability, Flow value, Void ratio, Marshall test, Temperature)	At implementation and mixing
2) Concrete Structure, Concrete Pavement	Batching Plant calibration	Weighing equipment, Mixing efficiency	Before implementation and once a month
	Material Control	Cement, Admixture (Quality certificate, Result of componential analysis), Aggregate test (Specific gravity, Grain size, Strength, Coefficient of water absorption, Alkali-aggregate reaction	Before implementation, the timing of changing material
	Concrete Trial Mix	Slump, Air content, Temperature, Sample Strength	Before implementation
	Daily Management	Fresh concrete (Air content, Slump, Temperature)	Witness inspection at placement
		Inspection (Consolidation, Curing method, Removal of laitance)	Witness inspection at placement
		Concrete Sample (Sample compressive strength test, Preparation of the concrete control chart)	Once a day, 7 and 28 days after placement
3) Reinforcing Bar, Prestressed Concrete Steel	Material Control	Quality certificate (Mill sheet), Tension strength test	Before placement
	Routine Management	Inspection (Coverage, Arrangement, lap length), Control of prestressed concrete steel	At placement

2-2-4-6 Implementation Schedule

The implementation schedule of each bridge is shown in Figure 2-2-4-8. The basic concept is to complete substructure works for each bridge by the end of the first dry season.

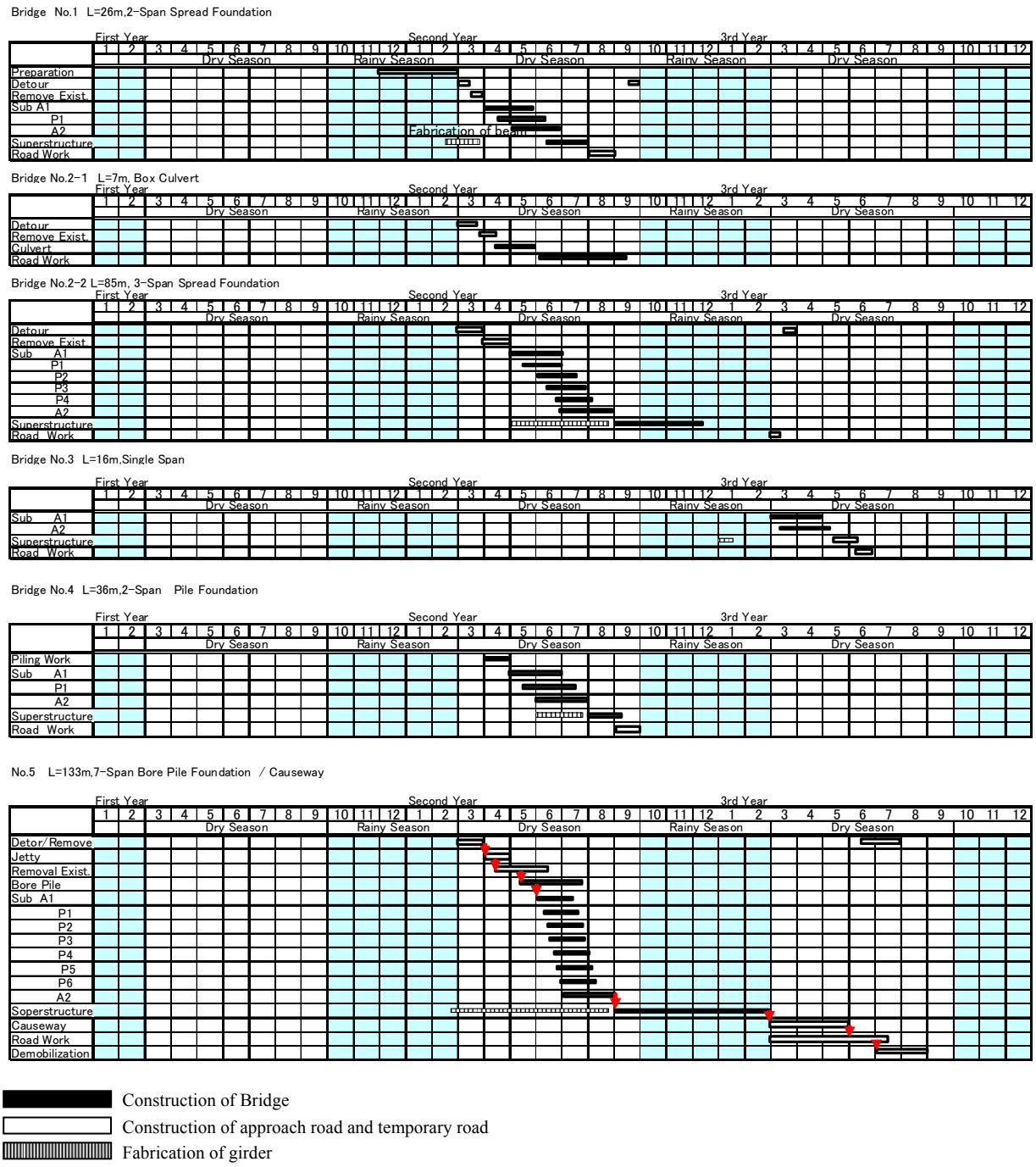


Figure 2-2-4-8 Implementation Schedule for the Objective Bridges

2-3 Obligation of the Recipient Country

The obligations of the Sri Lankan side for the Project are listed below.

(1) General

① To set Banking Arrangement (B/A),

② To advise commission of Authorization to Payment (A/P) and make payment of the commission

(2) Implementation Matters

① To secure land for the project sites, to lease temporary yards, to compensate for resettlement, and to remove/relocate obstructive utilities,

② To clear land mines and UXOs at temporary yards as well as the bridge sites for the project and to acquire certificates of clearance,

③ To secure all the expenses and prompt execution of customs clearance at the port of disembarkation for unloading products purchased under the Grant Aid,

④ To accord Japanese nationals whose services may be required in connection with supply of the products and the services under the verified contracts,

⑤ To exempt Japanese nationals and the third party nationals entering Sri Lanka to work on the project from customs duties, internal taxes and other fiscal levies which may nomally be imposed in the recipient country with respect to the supply of the products and services under the verified contracts,

⑥ To provide electricity, water supply, drainage and other incidental facilities to the vicinities of the sites,

⑦ To provide free of charge the materials for the Bailey bridge (80 m long) that was procured by Japan's Grant Aid in 2006 to the Contractor in order for them to be utilized for the detour at bridge No.5. Transport the materials for the Bailey bridge between the store yard and the bridge No.5 project site, before and after the construction period.

⑧ To remove existing bridges at bridge No.3 and No.4 immediately after completion of construction work covered by Japanese Grant Aid,

⑨ To maintain and use properly and effectively the facilities constructed under the Grant

Aid,

⑩ To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities,

(3) Others

① To secure the budget for land acquisition, temporary yard leasing, compensation for resettlement, and tax exemption covered by the recipient country,

② To contract with a Japanese consulting firm for detailed design (D/D) and construction supervision,

③ To contract with a Japanese construction firm,

④ To complete reconstruction or reinforcement works for the bottleneck bridges laying on the way to each site, including Kayankerni bridge, before commencement of the Project.

2-4 Project Operation Plan

2-4-1 Operation and Maintenance System

Large-scale repair works will not be necessary until 20 to 30 years after completion of the bridges by the following operation and maintenance method mentioned in Table 2-4-2-1 unless the main structural members will be deformed and damaged by a vehicle collision. However, replacement of expansion joints and rubber bearings will be necessary in the future (about 15 years later for expansion joints and 30 years later for rubber bearings), depending on the amount of damage, caused by the increasing traffic volume. Moreover, since the national roads No.5 and No.15 will be improved by the other funds in the near future, the pavements for the approach roads for all 5 bridges are planned as Double Bituminous Surface Treatment (DBST) which is less durable than the conventional asphalt concrete pavement. Therefore, the Sri Lankan side has to pay paticular attention to maintenance of the approach road pavement, such as timely fixing of potholes, in order to keep those road sections in fair conditions until the completion of improvement works by the other fund.

No additional organization will be required for maintenance works concerning this project because RDA, who is responsible and capable of all national roads maintenance works, will also maintain for these new bridges.

2-4-2 Operation and Maintenance Method

1) Periodical Inspection and Maintenance

Although the main objective of this project is the construction of 5 bridges, the approach roads are also taken as the objectives of the operation and maintenance. A standard schedule of periodical inspection and maintenance for the bridges is shown in Table 2-4-2-1.

It is important to keep records (date of inspection, location of inspection, result of inspection and name of inspector) of periodical checking in the road register and grasp the condition of damage in order to establish the repair schedule and its scale. Therefore, the periodical checking system must be established at an early stage.

2) Maintenance of Asphalt Pavement

Following repairing works for DBST pavement will be required timely, as well as minor maintenance works (patching, smoothing).

Table 2-4-2-1 Schedule of Periodical Inspection and Maintenance

Facility		Maintenance and Repairing Works	Inspection Frequency
Bridges	Drainage pipe	Cleaning of sediments	Every 3 months
	Expansion joint	Repair of damaged members	Every 3 months
	Handrail	Repairing damages by traffic accidents	Every 3 months
	Bearings	Removal of earth deposit	Every half year
	RC slab and Curb	Repair of crack and stripping	Every year
	Asphalt pavement	Repair of crack and potholes	Every year
	Main structure, Floor system, Lateral bracing	Repair of damaged members	Every year
	Substructure	Repair of crack and stripping	Every year
	Revetment	Repair of scour	Every year
Roads	Road surface	Patching and smoothing	Every month
	Shoulder and Slope	Surface treatment, vegetation, additional embankment	Every month
	Sid drainage	Removal of earth deposit	Every month
	Marking	Repainting	Every month
	Guard rail	Repainting and replacement	Every half year
	Retaining wall	Repair of crack and stripping	Every year

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Cost Borne by Japanese Side

The Project will be implemented in accordance with Japan's Grant Aid scheme and the Project cost will be determined before concluding the Exchange of Note for the Project.

(2) Cost Borne by Sri Lankan Side

Based on the share of works as described in 2-2-4-3, the cost borne by Sri Lankan side is as follows.

① Preparation of land for construction site	:	0.0 million Rs. (	0.0 million Yen)
② Preparation of land for camp & yard	:	0.0 million Rs. (	0.0 million Yen)
③ Material lend of Bailey bridge	:	0.0 million Rs. (	0.0 million Yen)
④ Transportation of Bailey bridge for No.5	:	1.8 million Rs. (	1.6 million Yen)
⑤ Removal & relocation of public utilities	:	15.3 million Rs. (	13.1 million Yen)
(i) Telecom line (buried) D=150mm	:	1.9 million Rs. (	1.6 million Yen)
(ii) Electric pole (30kV)	:	13.4 million Rs (	11.5 million Yen)
⑥ Removal of existing two bridges	:	14.5 million Rs. (	12.4 million Yen)
(i) Bridge No.3	:	2.0 million Rs. (	1.7 million Yen)
(ii) Bridge No.4	:	12.5 million Rs. (	10.7 million Yen)
⑦ Import tax refund	:	43.6 million Rs. (	37.8 million Yen)
⑧ VAT refund	:	162.0 million Rs. (	138.0 million Yen)
⑨ Bank charge	:	1.5 million Rs. (	1.3 million Yen)
TOTAL (①+②+③+④+⑤+⑥+⑦)	:	238.7 million Rs. (	203.6 million Yen)

Note: Land for ① & ② will be provided without any cost because of utilization of state land.
③ will be also provided without any cost because of utilization of materials granted by Recovery, Rehabilitation and Development Project for Tsunami Affected Trunk Roads on the East Coast.

(3) Condition of Cost Estimate

1) Date of Estimate : April, 2009

2) Exchange rate : 1US$ = 95.94 yen
1Rs. = 0.8539 yen

3) Implementation period : 10 months for detail design and tendering, 21 months for construction of five bridges as shown in Table 2-2-4-8.

4) Others : This project will be implemented in accordance with Japan's Grant Aid system.

2-5-2 Operation and Maintenance Cost

(1) Periodical Inspection and Maintenance

The periodical inspection, minor repairing/maintenance will be carried out under direct management of RDA. The normal cost for operation and maintenance per year is estimated as shown below and the total cost for operation and maintenance accounts for 0.01 % of the investment for maintenance in 2008 (5.8 billion Rs.) so that implementation of enough maintenance can be carried out.

Personal expenses (1 engineer: 2 days)	: 80,000 Rs. ×2/30×12 months	= 64,000 Rs.
Personal expenses (2 workers: 2 days)	: 1,654 Rs.×4 ×12 months	= 79,392 Rs.
Miscellaneous materials cost	: Lump-sum (labor cost×150%)	=215,088 Rs.
Vehicle hire charge	: 6,100 Rs.×2/30 ×12 months	=146,400 Rs.
TOTAL		504,880 Rs. (≒505,000 Rs.)

Table 2-5-2-1 Approximate Cost for Operation and Maintenance

Maintenance and Repairing Works	Inspection Frequency per Year	Facility	Approximate Cost (Rs.)
Cleaning of sediments	4 times	Drainage pipe	20,000
Repair of damaged members	4 times	Expansion joint	20,000
Repairing damages by traffic accidents	4 times	Handrail	20,000
Removal of earth deposit	Twice	Bearings	20,000
Repair of crack and stripping	Once	RC slab and Curb	50,000
Repair of crack and potholes	Once	Asphalt pavement	50,000
Repair of damaged members	Once	Main structure, Floor system, Lateral bracing	50,000
Repair of crack and stripping	Once	Substructure	50,000
Repair of scour	Once	Revetment	50,000
Patching and smoothing	12 times	Road surface	30,000
Surface treatment, vegetation, additional embankment	12 times	Shoulder and Slope	30,000
Removal of earth deposit	12 times	Sid drainage	30,000
Repainting	12 times	Marking	30,000
Repainting and replacement	Twice	Guard rail	30,000
Repair of crack and stripping	Once	Retaining wall	25,000
The normal cost for operation and maintenance per year			505,000

(2) Maintenance of Asphalt Pavement

In Eastern Province, generally a mobile asphalt plant is required for each road improvement project because there is no permanent asphalt plant in the province. At the same time, the approach road lengths of the objective bridges are only several hundred meters or less, a

low-cost pavement called DBST is applicable because the pavement does not require any asphalt plant. The cost of yearly maintenance work for each bridge is shown in Table 2-5-2-1, with the assumption that the total maintenance cost every ten years is about the same as the pavement over-lay works by a local contractor every ten years.

Table 2-5-2-2 Maintenance Cost of Asphalt Pavement

Bridge Name	Road Overlay Area (m^2)	Maintenance Cost (×1,000Rs.)
Bridge No.1	1,313.2	123
Bridge No.2	3,606.4	338
Bridge No.3	2,784.2	261
Bridge No.4	2,489.2	273
Bridge No.5 and Panich-chankerny Causeway	3,567.2	391
TOTAL	13,760.2	1,386

2-6 Other Relevant Issues

There will be basically little problem to implement the Project because the Sri Lankan side has adequate knowledge of Japanese Grant Aid System and issues to be solved in the system, such as land acquisition, resettlement and relocation of public utilities etc, through experience in similar types of bridge project, including “Manampitia Bridge” and “Manner Bridge”. In addition, the security problem is expected to be resolved since the rebel LTTE, has been overwhelmed by the Government forces.

However, there is a remaining issue of mines and UXOs which have not been cleared completely in Eastern Province. Although clearance of these was done around the bridges for the preparatory study, additional clearance actions for plant areas, stock piles and contractor’s office, are required before tendering of the Project by the Sri Lankan side.

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project Effect

The target of the project is to improve traffic access in the Eastern Province, which has been seriously damaged by the over 20-year-long civil war and the tsunami in 2004, by the reconstruction of 5 bridges, including 4 bridges on National Road A5 (A005), and Panichchankerni Causeway and Bridge on National Road A15 (A015).

The implementation of the project will effectively contribute to the National Road Master Plan (NRMP) in Sri Lanka that intends to improve trunk road network by widening the traffic lanes (NRMP also intends to widen A005 and A015 to 2-lane roads). Furthermore, the project will contribute to the road infrastructure essentials of life sustainability of the Tamil and Muslim minority ethnic groups living in Eastern Province, which is less developed than the other provinces. Direct beneficiaries of the project are the inhabitants of Ampara & Batticaloa District, estimated at 1,138,000, while indirect beneficiaries are all the inhabitants of Eastern Province including Trincomalee District, estimated at 1,493,000.

The following benefits are expected from the implementation of the project:

(1) Direct Benefits

i) Increasing traffic volume

Current Situation & status	The widths of all of the existing bridges are so narrow that only one vehicle can go through it. After improvement of National Road A005 and A015 widening of one-lane existing road for two-lane take place, these bridges will be bottle-necks for traffic flow. Furthermore, Bridges No.3 and 5 are built by temporary Bailey bridge and they cannot allow the load of three-axle trucks or trailers.
Measure the Project	The project bridges will have two-lane carriageway according to the road improvement project.
Benefit & Degree of Improvement	The traffic volume is expected to increase after widening of carriageways on bridges by this project and roads by other funds. Regarding bridges No.3 and No.5, the allowable types of vehicle will also increase because the existing bailey bridges forbid heavy vehicles with more than three axles.

ii) Improvement of durability

Current Situation & Issues	All the five project bridges have been seriously damaged. It was observed that aging and corrosion of girders, damages of piers and abutments, collapse of bank protection and broken bridge railings.
Measure in the Project	All of the five bridges will be rebuilt as permanent bridges.
Benefit & Degree of	Durability of bridges will be improved by replacing the existing damaged bridges. Consequently, the risk of traffic shutdown as a result of bridge collapse will be

Improvement	avoided and periodical maintenance cost for bridges will be reduced.

iii) Securing a pedestrian safety

Current Situation & Issues	The widths of the project bridges are narrow and all the five project bridges do not have pedestrian lane. When a heavy vehicle is to go through the bridges, it is very dangerous for pedestrian to walk through the bridges at the same time
Measure the Project	Sidewalks will be installed on both sides of the bridges.
Benefit & Degree of Improvement	Traffic on the bridges will be secured with wider carriage ways and pedestrian lanes mounted on each side of the new bridges.

(2) Indirect Benefits

i) Reduction in economic gap

Current Situation & Issues	The Eastern Province has suffered from civil war and tsunami. Therefore, the province has been left behind in economic development. The economic gap among the provinces is considerably large.
Measure the Project	The project bridge will connect Colombo and Eastern Province at river crossing points that are major bottle-necks for economic growth.
Benefit & Degree of Improvement	The economic gap between Colombo (Central Province) and Eastern Province (between Sinhalese and Tamils) will be reduced by activation of the economy of the Eastern Province.

ii) Ensuring a balanced development of national territory

Current Situation & Issues	The civil war with LTTE was just terminated and a balanced development of the national territory is desired for peacekeeping.
Measure the Project	The project bridge will advance infrastructural development as the dividend of peace, with the road improvement project funded by other donors.
Benefit & Degree of Improvement	The unsettling situation of Eastern Province will be improved by tightening economic relations between the eastern and western areas through road improvement.

3-2 Recommendations

In order to realize the effect of the Project promptly and sustainably, the Sri Lankan side shall contend with the following matters.

(1) The Sri Lankan side shall detect, locate and clear all unexploded ordnances (UXO) and land mines from the temporary yards, as well as from the bridge sites. The Sri Lankan side shall also acquire official certificates of completion of UXO clearance for all sites, and shall submit them to JICA before construction tendering for the Project.

(2) The Sri Lankan side shall complete necessary reconstruction or reinforcement works for the bottleneck bridges and roads located on the way to each bridge site, including Kayankerni bridge on national road No.15 (A015) by the end of April, 2010.

(3) The Sri Lankan side shall pay attention to the maintenance of bridges as well as to the maintenance of the approach road pavement (DBST). Concrete bridges are not "maintenance free" and require daily inspection of pipe drainage, expansion joints and bearings. Timely inspection and repair of revetment and scouring are also important especially during the rainy season. No additional organization will be required for these maintenance works since RDA, who is responsible and capable for all national roads maintenance works, will maintain these new bridges accordingly.