DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
ROAD DEVELOPMENT AUTHORITY

DATA COLLECTION SURVEY ON PRIMARY BRIDGES ON NATIONAL ROADS AND MAINTENANCE SYSTEM OF BRIDGES

FINAL REPORT

FEBRUARY 2013

Japan International Cooperation Agency (JICA)

JAPAN BRIDGE & STRUCTURE INSTITUTE, INC. (JBSI)
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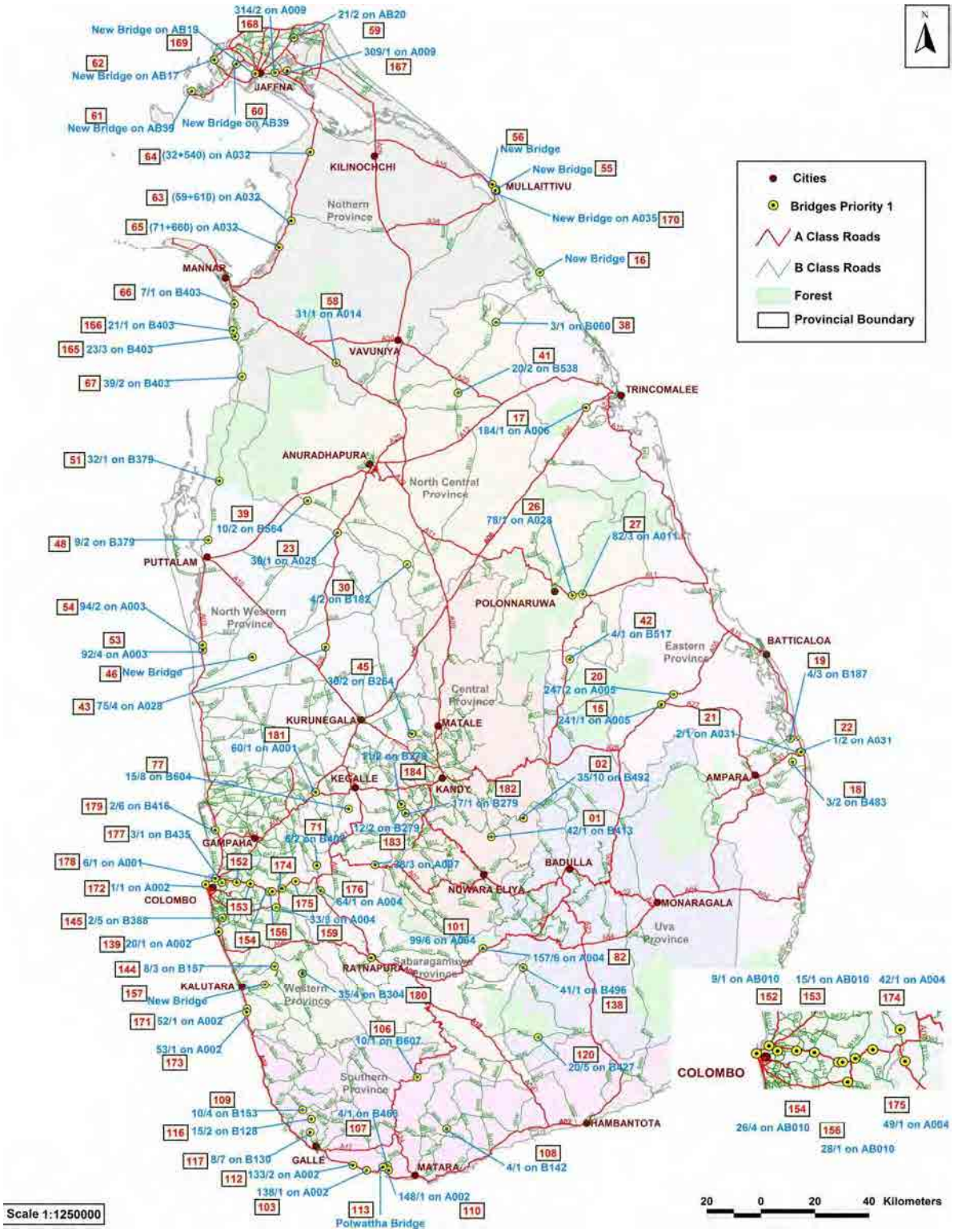
LANDTEC JAPAN, INC.



Source) RDA

Location of 184 Bridges

Commencement of Bridge Inspection in RDA

Combined OJT for bridge Inspection

UK Bridge Flyover

Reuse of old truss bridge

Digarolla bridge

Digarolla bridge

Meeting in RDA Planning Division

Meeting in MOPH

Photographs

CONTENT

APPENDIX

<ABBREVIATION WORD>

1) Name of Organizations

Abbreviation	Original Word
RDA	Road Development Authority
GOSL	The Government of Sri Lanka
JICA	Japan International Cooperation Agency
NEA	The National Environmental Act
CCA	The Coast Conservation Act
DCC	The Department of Coast Conservation
PPA	Project Proponent Agency
PPAs	Project Approving Agencies
CEA	The Central Environmental Authority
ESD	Environmental and Social Development Division
GND	The Grama Niladhari division
GRC	Composition of Grievance Redress Committee
GOJ	The Government of Japan
MOH	Ministry of Highway
ADB	Asian Development Bank
JBIC	Japan Bank for International Cooperation
WB	World Bank

2) Particular words of Sri Lanka

Abbreviation	Original Word
PD	provincial director
CE	chief engineer
EE	executive engineer
Class-A	national road of class AA or AB managed by RDA
Class-B	national road of class B managed by RDA
non-RDA	road managed by organization other than RDA

3) Words of Social and Environmental study

Abbreviation	Original Word
DS	divisional secretariat
EIA	environmental impact assessment
EMP	environmental management plan
ESA	environmental sensitive area
FFPO	zone of flora and fauna protection ordinance
IBAs	the important bird areas
IEE	initial environmental examination
PAPs	project-affected-persons
Peach	Household's land holding status – Area
PP	the project proponent
RAP	resettlement action plan

4) Others

Abbreviation	Original Word
PMU	Project Management Unit
NGO	Non-Government Organization
CBO	Community-Based Organization
ODA	Official Development Assistance
STEP	Special Terms for Economic Partnership
BIQ	basic information questionnaire
TOR	terms of reference
AADT	annual average daily traffic volume
LCC	life cycle cost
MHWL	mean high water line
PBMC	performance based Maintenance contracting
PCU	passenger car units
ROW	right of way

CHAPTER 1 GENERAL

1.1 Introduction

The Government of Sri Lanka (GoSL) manages 4,200 bridges around the whole of the country. Actual management has been done by Road Development Authority (RDA) as the responsible road administrative organization for GoSL. They have recognized that there are many old bridges which need to have rehabilitation/reconstruction and also enhancement of the load capacity in those locations where there has been significant increase in traffic volume due to the country's recent strong economic growth. GoSL requests the assistance of The Japan International Cooperation Agency (JICA) in order to improve this situation and also for JICA to send a study team (referred to as the Study Team) to investigate the above situation.

During the preliminary investigation, it has been realized that the average age of the bridges are higher than those of in Japan. This is one of many factors influencing this situation. It is necessary for the Study Team to consider the way of rehabilitation and reconstruction of these bridges and also to request GoSL to improve the present system of operation and maintenance for bridges.

1.2 Objective of Study and Scope of Work

JICA has supported RDA in strengthening the road network of the country, in which the bridges are critical component. Preceding this study, RDA required JICA to investigate 164 bridges along the main national road which require rehabilitation works.

The main objective of this study is to execute the investigation of bridges as the request of bridges as the request of RDA, and make advice after screened to rehabilitation or reconstruction these bridges, also including study the issues for reconstruction works.

In addition, it is necessary to propose the improvement plan for operation and maintenance system of bridges.

As the above the Survey was executed as the following principle.

A. To verify the prioritization criteria and long list of bridges requiring urgent rehabilitation and to justify the locations where new bridges to be constructed.

B. To study the condition and requirements for rehabilitation/construction of the prioritized bridges

C. To study the current procedures and status of bridge maintenance in RDA

D. To study most effective means for JICA assistance for bridge rehabilitation in Sri Lanka

1.3 Deviating Study Conditions from TOR (as of May 2012)

Initial TOR of the study was focused on bridges along Class-A roads. However, originally proposed bridges from RDA included Class-B and others.

Therefore, numbers of target bridges are increased.

Also RDA did not have sufficient information on most of the existing bridges. The Study team had to spend more than 1 month to collect all necessary information on bridges before site reconnaissance. Further reasons for urgency of reconstruction or repair of RDA requested bridges have not clearly described, it needed further study to make sure RDA's selection

1.4 Contents of Final Report

Reporting of site reconnaissance and some recommendations for implementation of the project.

Chapter 1 GENERAL

Background of the study, Objectives of the study and location map of selected bridges.

Chapter 2 RECONNAISSANCE SURVEY OF PROPOSED BRIDGES

Selection of survey target bridges. Reconnaissance of bridges.

Chapter 3 IDENTIFICATION OF THE BRIDGE FOR REHABILITATION AMONG THE RDA PROPOSED BRIDGES

Identification of bridges based on observations of the reconnaissance survey and the environmental study

Chapter 4 SRI LANKAN LAWS AND REGULATIONS OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Environmental and social survey of selected bridges

Chapter 5 PRIORITIZATION OF SELECTED 37 BRIDGES

Based on traffic condition and soundness of structure and so on evaluate prioritization of bridges.

Chapter 6 BRIDGE PLANNING

Present condition of bridges in the National Road Network in Sri Lanka and recommendation for new construction of bridges

Chapter 7 POSSIBILITY OF JAPANESE ADVANCED BRIDGE TECHNOLOGY AND KNOW–HOW FOR STEP LOAN

Recommending bridge project under STEP loan In the project Japanese consultant and contractor will show you advanced bride technology to Sri Lanka.

Chapter 8 COST ESTIMATION OF BRIDGE CONSTRUCTION

Cost estimation for bridge construction

Chapter 9 PROJECT IMPLEMENTATION

Construction lots, construction schedule, implementation organization

Chapter 10 MAINTENANCE MANAGEMENT OF BRIDGE

Present condition and problems of Maintenance Management of RDA, and Proposition to improvement the problems

Chapter 11 SUMMARY OF LOCAL SUBCONTRACT REPORTS

Summary of Geological Survey, Social environmental Survey, Hydrological Survey Traffic Counts

1.5 Comparison of Proposal and Achievement

Table 1.5-1 Comparison of Proposal and achievement

Items		Proposal (June 2012)		Achievement
2.1.4 Study Issues	Issue – 1 : Damage types and causes by bridge types P2-8 P2-10	Activity - 1	In order to cover whole Sri Lanka , 3 reconnaissance teams to be arranged to carry out work parallel and efficiently In order to cover follow-up request, additional reconnaissance was carried out two times by JICA Team.	Assigned 03 teams to get reconnaissance data within a short period from 2nd to 12nd August 2012 in north, east and south/west areas. Reconnaissance was done based on the negotiations with RDA, JICA and study team for the selected requested bridges from RDA. 7 nos bridges were inspected from 29th August 2012 to 30th August 2012. 4 nos bridges were inspected on 16th October 2012 and 4 nos bridges were inspected on 21st October 2012.
			In order to unify the observations in each team, OJT (on the job training) will be done beforehand	At 31st July 2012, RDA counterparts, local engineer and study teams attended to OJT. Each official was provided a uniform for easy recognition.
		Activity -2	In visual inspection, 4 grades of damages used in RDA evaluation standard to be adopted which will help to understand the condition of bridge easily	RDA evaluation standard of rating1-4 was used on inspecting damage bridges.
		Activity -3	Format of Bridge Improvement Study" held in 1996 is to be adopted for Bridge inspection.	Format of bridge inspection was prepared, based on the "Bridge Improvement Study" done in 1996 by RDA
			During site reconnaissance period, collect and report daily information to project office in Colombo and update the information	Cooperation among the counterpart engineers from RDA Head office and PD, CE offices in each district were obtained during the data collection
		Activity -4	Prior to site reconnaissance, confirmation for the inspection form is to be received from RDA	Inspection forms were explained to RDA and received approval

Items		Proposal (June 2012)		Achievement
2.1.4 Study Issues	Issue – 1 : Damage types and causes by bridge types P2-8 P2-10	Activity -5	JISI repair/ reinforce reconstruction system will be used to compile all the data.	To be done
	Issue -2 : Establishment of Bridge Maintenance system in RDA (P2-10 P2- 11)		No any special comments	To be done. In DFR will show the study summary
2.1.5 Basic Concept Technical		(1) Draft work schedule and selection of target bridges in each work stages (P2 -12)	RDA Bridge database	List was updated based on latest inspection results of bridges of more than 30 m in length on A, B class roads and submitted to RDA Planning Division
			Abstraction of 365 nos bridges, more than 30m bridge length, from RDA bridge database	Number of bridges which were requested by RDA was 184 nos out of which 84 nos were more than 30m in length.
			Prioritization of selected bridges are to be based on observations at site, urgency and necessity	Reconsidered the targeted 79 bridge sites. Priority rank was established as follows; Priority 1A : 37 (to be reconstruct) Priority 1B : 8 (to be reconstruct, remoe area) Priority 2 : 13 (to be repaired or reconstruct in future) Priority 3 : 21 (to be no urgency)
			Evaluation of environmental conditions Extraction of environmentally affected bridges	Under the priority 1: it is excluded which was affected due to environmental issues.
		(2) Speedy and efficient site reconnaissance		37 nos bridges were finalized. To make site reconnaissance survey efficient, 03 site reconnaissance groups were arranged. Hence, it was completed within the targeted time frame
		(3) Grouping of environmentally affected bridges on environmental conditions.		Interim Report 2
		(4) Visual explanation of inspection results		Final report

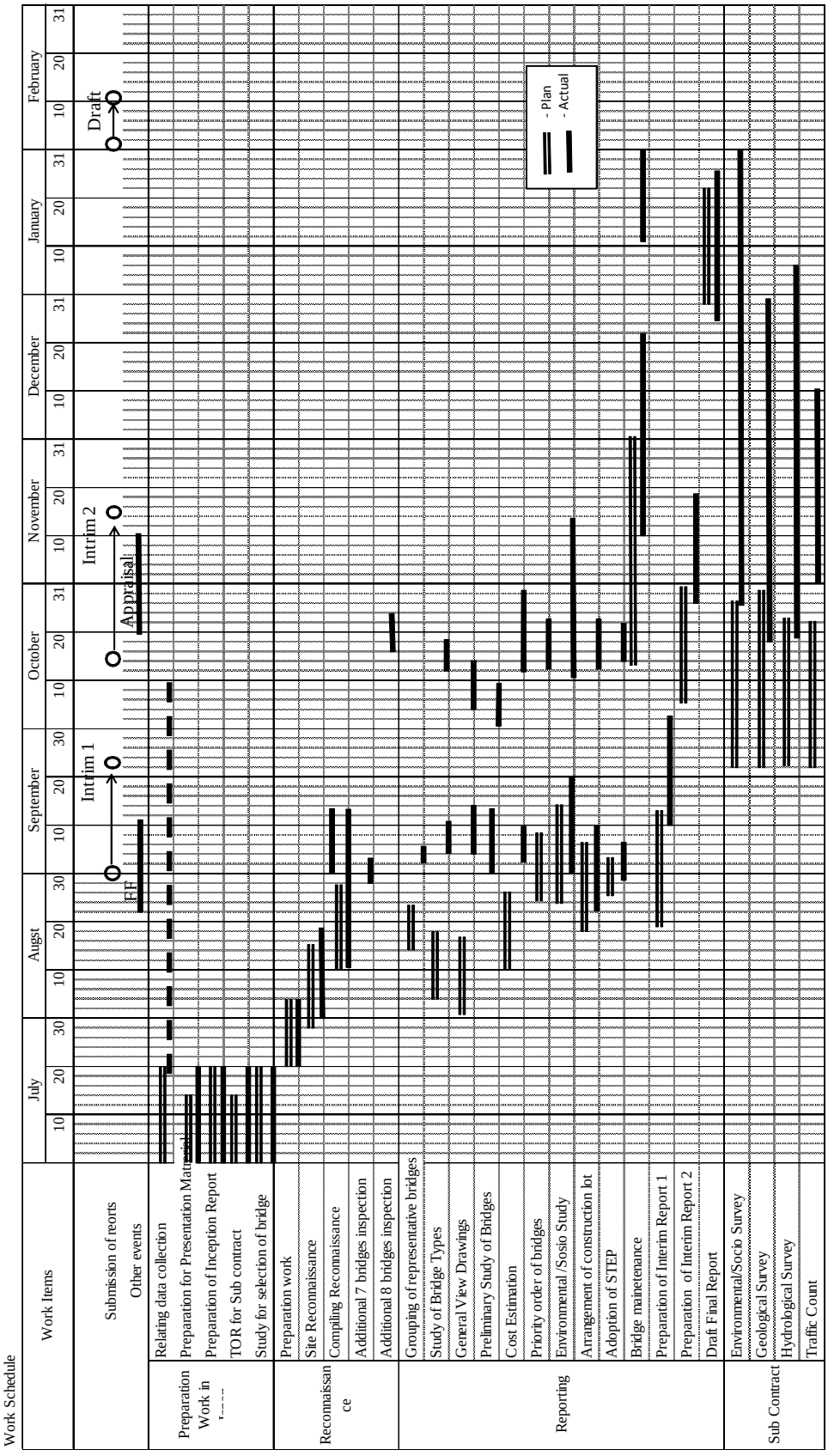
Items		Proposal (June 2012)	Achievement
2.1.6 Basic Concept Operation of study		(1) Close cooperation with JICA head office and JICA Sri Lanka office	Areas banned due to safety parameters, in Northern areas, were an adequate issue. Under the instructions of JICA Sri Lanka office it was completed without any trouble
		(2) Cooperation with RDA counter part	Data collection and study office was located closer to the RDA Head office. Hence, Regular communication with RDA planning division and other related divisions could be done. Study work is done under RDA's self- efficiency
		(3) Utilization of selection of good local firm to sublet local survey works	Selected firms are within the criteria
		(4) Safety measure	Especially safety measure in northern area in Sri Lanka. Under the instruction of JICA Sri Lanka office, site reconnaissance work was completed without any trouble.
2.2.1 Implemen-tation of study		General understanding of study issues and review of relating conditions	Required necessary information were obtained from Planning Division of RDA .
2.2.2 Steps of implemen-tation of study	Work in Japan (Preparation / Inception report)	Relating information	List of requested bridges were not fulfilled within the work period in Japan, final requested lists were received from RDA on 26th July 2012.
		Inception report	Submitted to JICA on 17th July 2012.
		Local subletting firms and TOR for work	Selection of Local firms are in progress
		Cooping Policy meeting held at JICA	The meeting with JICA head office was held on 17th July 2012.
		Selection of representative bridges	Target bridges more than 30m bridge length was decided at the meeting held on 31st July 2012, with RDA Planning Director, Mr. Bandara, Mr. Yusa from JICA and Mr. Takaura from Study team
		Explanation of Inception report to RDA	Inception report was approved by RDA on 26th July 2012.
		Site Survey	Site reconnaissance was done from 2nd to 12nd August 2012 by 03 teams
		Prioritization	Based on observation of site reconnaissance, priority bridges were finalized
		Site survey of 01st group bridges	Same as (2)

Items		Proposal (June 2012)	Achievement
2.2.2 Steps of implemen-tation of study	Work in Japan (Preparation / Inception report)	01st group bridges cost estimation	Draft cost estimation was done based on the existing design results available in RDA
		Confirmation of environmental conditions	Interim report 2
		Interim Report 1	Submitting in September
		02nd Group bridge sites reconnaissance	Interim report 2
		Submission of Interim report 2	Submitting in October
2.2.2 Methodolog y of the study	[3] 2nd Site Reconnaissanc e (Maintenance repair method)	Main issues are as follows Maintenance system of RDA Cooperation of Head office and PD,CE offices Local contractor's capacity of bridge construction Based on the result of survey proposed improvement plan and probability of assistance from JICA	
	[4] Draft Final Report	Based o n the result after 1st and 2nd site surveys、bridge construction and maintenance of bridges confirmation and explanation to RDA.	submitted in late february
	[5] Work in Japan	Official from Japan office cooperate with study team in Sri Lanka and supporting in compiling data and preparing of reports	Staff of 3 JV firms in Japan work cooperating manner with the study team in Sri Lanka.
	[6] Preparation and submission of Final Report		

Source) Study Team

1.6 Work Schedule (Comparing Actual Work with Planned One)

Table 1.6-1 Work Schedule (Comparing Actual work with Planed one)



Source)Study Team

1.7 Bridges Proposed by RDA

The Study Team received a list of 164 bridges proposed by RDA on 26th July 2012. Table 1.7-1 shows "164 nos Bridges Proposed for JICA by RDA at Start of Survey". The table consists of bridges not only on Class-A and Class-B roads but also on Class-AB roads and on a Non RDA road.

As mentioned 2.1, following bridges are added to the 164 nos of bridges.

1) Additional Bridges proposed by RDA provincial office during the survey: 6 nos
2) Additional Bridges proposed by RDA in August after the survey: 7 nos
3) Additional Bridges proposed by RDA in October: 8 nos

In addition to the 164 bridges the above 21 nos were requested. However one bridge (No.113) in 2) were already counted in the first 1564 bridges, therefore final nos of proposed bridges were 184 nos.

Table 1.7-2 shows 1) and 2)

Table 1.7-3 shows 3)

Table 1.7-1 164 nos Damaged Bridges List Made by RDA

Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of lanes	EE Division
1	B413	Tennekumbura - Rikiligaskada - Ragala	42/1	**38.50**	5.60	4.80	3	Padiyapelella Bridge	Arch	Weak & narrow	Central	Nuwara Eliya	2	
2	B492	Kandehandiya - Adikarigama - Randenigala - Loggal Oya	35/10	**35.00**	5.20	4.80				Weak & narrow	Central	Nuwara Eliya	2	
3	B122	Galagedara - Rambukkana	3/2	14.80	4.30	4.30	2	Kawdalla Palama	RCS	Narrow	Central	Kandy	2	
4	B122	Galagedara - Rambukkana	12/1	19.70	5.20	3.80	1	Rambukkana Oya Bridge	RSJ/BUC	Narrow	Central	Kandy	2	
5	B274	Matale- Illukkumbura-Pallegama	2/8	27.40	4.20	5.30	1	Kaludewala Palama		Weak	Central	Matale	2	
6	B274	Matale- Illukkumbura-Pallegama	9/8	26.00	4.70	4.30	3	Deliwala Palama		Weak & narrow	Central	Matale	2	
7	B274	Matale- Illukkumbura-Pallegama	13/3	10.40	6.10	5.80	1	Dikkumbara Palama		Good	Central	Matale	2	
8	B274	Matale- Illukkumbura-Pallegama	22/1	10.00	6.40	6.40	1	Bambaragala Palama		Good	Central	Matale	2	
9	B274	Matale- Illukkumbura-Pallegama	22/3	10.30	6.40	6.40	1	Bambaragala Palama		Narrow	Central	Matale	2	
10	B274	Matale- Illukkumbura-Pallegama	37/7	19.90	4.30	4.00	5			Narrow	Central	Matale	2	
11	B205	Katugastota - Madawala - Bambarella	28/3	19.70	4.50	4.20	2		Steel	Weak & Narrow	Central	kandy	2	
12	B205	Katugastota - Madawala - Bambarella	28/8	9.30	4.60	4.60	2		Steel	Weak & Narrow	Central	Kandy	2	
13	B377	Pujapitiya - Alawatugoda	3/4	15.50	4.00	3.50	2	Ovissa Bridge	Concrete	Weak & Narrow	Central	Kandy	2	
14	B317	Nawalapitiya - Dimbula	4/3	12.20	4.50	4.00	2		Steel	Weak	Central	Kandy	2	
15	AA005	Peradeniya - Badulla - Chenkaladi (PBC)	241/1	**149.00**	7.40	4.70	12	Mahapalama	ST-RSJ	Narrow	Eastern	Eastern	2	Ampara
16	**New Bridge**	Muativu Kokilai Pulmoodai Road	**New**	**200.00**				Kokilai bridge		**New Bridge Construction**	Eastern	Trincomalee	2	
17	AA006	Ambepussa - Kurunegala - Trincomalee (AKT)	184/1	**36.40**		5.80	3	Palampataru Bridge	ST-RSJ	Weak	Eastern	Trincomalee	4	Trincomalee
18	B483	Sammanthurai - Malkampiddi - Deegawapiya	3/2	**32.30**	4.90	4.10	3	Pallaaru Bridge		Weak & narrow	Eastern	Ampara	2	
19	B187	Kalmunai - Chavalakadai	4/3	**35.00**	5.30	4.80	4	Kiddanki Bridge - 1	Concrete	Weak & narrow	Eastern	Ampara	2	
20	AA005	Peradeniya - Badulla - Chenkaladi	243/3	**48.00**	4.70	4.50	5		ST-TR	Narrow	Eastern	Ampara	2	Batticaloa
21	AA031	Karaithivu-Ampara	2/1	**62.0**	5.2	5.2	1		Con	low elevation	Eastern	Ampara	2	
22	AA031	Karaithivu-Ampara	1/2	**82.0**	4.5	4.5	1		Con	Narrow	Eastern	Ampara	2	
23	AA028	Anuradhapura - Padeniya	30/1	**157.00**	8.70	7.40	5	Kala oya Bridge	Concrete	Narrow	North Central	Anuradhapura	4	Maho
24	AB044	Mahiyangana - Dimbulagala - Dalukkane	72/3	12.80	4.30	3.70	6		RCC	Weak & Narrow	North Central	Polonnaruwa	2	
25	AA011	Maradankadawela Habarana Tirikkondiadimadu	42/6	17.90	6.15	5.50	2	Batu Oya Bridge	RCC	Weak	North Central	Polonnaruwa	2	Habarana
26	AA011	Maradankadawela Habarana Tirikkondiadimadu	78/1	**35.50**	6.70	5.25	3	Kotaleeya Bridge	ST-RSJ	Weak	North Central	Polonnaruwa	2	Polonnaruwa
27	AA011	Maradankadawela Habarana Tirikkondiadimadu	82/3	**62.00**	6.80	5.00	5	500 Feet Bridge	ST-RSJ	Weak & Narrow	North Central	Polonnaruwa	2	Polonnaruwa
28	B556	Madatugama Pubbogama Andiyagala	6/1	10.00	7.35					Weak	North Central	Anuradhapura	2	
29	B556	Madatugama Pubbogama Andiyagala	13/2	21.20	5.00					Narrow	North Central	Anuradhapura	2	
30	B182	Kalawewa - Awukana	4/2	**35.00**	5.00	4.50	1	Causeway	Causeway	Narrow	North Central	Anuradhapura	2	
31	B282	Medawachchiya - Horowopotana	10/1	12.00	4.00	4.00	2		RCC	Weak & Narrow	North Central	Anuradhapura	2	
32	B282	Medawachchiya - Horowopotana	10/2	12.00	4.90	4.43	2		RCC	Weak & Narrow	North Central	Anuradhapura	2	
33	B282	Medawachchiya - Horowopotana	15/1	23.20	4.80	4.10	3		RCC	Weak & Narrow	North Central	Anuradhapura	2	
34	AA029	Vavuniya - Horowopotana	28/6	28.30	9.90	4.65	4	Vented Causeway	RCC	Good (Baily Bridge)	North Central	Anuradhapura	2	Medawachchiya
35	AA029	Vavuniya - Horowopotana	29/3	28.30	9.90					Good (Baily Bridge)	North Central	Anuradhapura	2	Medawachchiya
36	B282	Medawachchiya - Horowopotana	1/3	26.90	9.85	5.50		Causeway		Weak	North Central	Anuradhapura	2	
37	AA029	Vavuniya - Horowopotana	18/1	16.30	7.30	6.12		Causeway		Weak	North Central	Anuradhapura	2	Medawachchiya
38	B060	Bogahawewa - Pulmuddai	3/1	**50.00**	5.50	5.40	1		Causeway	Weak	North Central	Anuradhapura	2	
39	B564	Otappuwa Ihalawewa	10/2	**35.00**	12.00	7.60	1		Causeway	Weak	North Central	Anuradhapura	2	
40	B397	Sacred City Road, Nochchiyagama	1/2	24.40	4.10	3.65	8	Malwathu Oya Bridge	RCC	Narrow	North Central	Anuradhapura	2	
41	B538	Kahatagasdigiliya - Rathmalgahaweewa - Kivulekade	20/2	**41.00**	7.10					Weak	North Central	Anuradhapura	2	
42	B517	Dehiattakandiya - Aralaganwila	3/1	**40.50**	9.00	7.00	3		PSC Beams on Screed Concrete	Weak	North Central	Polonnaruwa	2	
43	AA028	Anuradhapura - Padeniya	75/4	**92.70**	8.00	4.35	3	Deduruoya bridge	ST-TR	Narrow	North Western	Kurunegala	4	Maho
44	B243	Kuliyapitiya - Hettipola	8/4	18.20	6.55	5.15	1	Buthgamuwa Palama	Corrugated Plates	Weak	North Western	Kurunegala	2	
45	B264	Mallawapitiya - Rambodagalla - Keppetigala	30/2	**37.55**	4.20	3.30	1	Meeliyadda Palama	ST-TR	Weak & narrow	North Western	Kurunegala	2	
46	**New Bridge**	Across Deduru Oya (Closed to Rasnayakepura-Kadigawa Road)	**New**	**100.00**				Kadigawa Bridge		**New Bridge Construction**	North Western	Kurunegala	2	

Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of lanes	EE Division
47	B326	Nikaweratiya - Moragollagama - Siyambalangamuwa	12/5	8.40	8.00	5.40	1	Koonwewa Bridge	RCC	Weak	North Western	Kurunegala	2	
48	B379	Puttalam - Marichchikadai	9/2	**30.00**	11.00	8.20	6	Mee Oya Bridge	RCC		North Western	Puttalam		
49	B379	Puttalam - Marichchikadai	16/1	20.00	11.00	8.20	2		RCC		North Western	Puttalam		
50	B379	Puttalam - Marichchikadai	30/2	25.00	11.00	8.20					North Western	Puttalam		
51	B379	Puttalam - Marichchikadai	32/1	**110.00**	11.00	8.20					North Western	Puttalam		
52	B379	Puttalam - Marichchikadai	33/2	25.00	11.00	8.20					North Western	Puttalam		
53	AA003	Peliyagoda - Puttalam	92/4	**42.80**	5.40	5.40	4		RSJ-RCC	Narrow	North Western	Puttalam	4	Chilaw
54	AA003	Peliyagoda - Puttalam	94/2	**42.80**	6.10	5.40	4	Ratambala Oya Bridge	RCS	Narrow	North Western	Puttalam	4	Puttalam
55	**New Bridge**	Construction of Selvapuram Bridge across Nantikadal Lagoon	**New**	**114.00**						**New Bridge Construction**	Northern	Mulative	2	
56	**New Bridge**	Construction of WaduwakkalBridge across Nantikadal Lagoon	**New**	**418.00**						**New Bridge Construction**	Northern	Mulative	2	
57	**New Bridge**	Construction of Chundikulam Bridge No. 3 (between main crossing and Kadaikadu)	**New**	16.50						**New Bridge Construction**	Northern	Mulative	2	
58	AA014	Medawachchiya - Mannar - Talaimannar	31/1	**34.20**	3.00	3.00	3			Weak & narrow	Northern	Vavuniya	2	Vavuniya
59	AB020	Jaffna - Point Pedro	21/2	**73.00**	10.53	7.35	2			Weak	Northern	Jaffna	2	
60	AB039	Valukkairaru-Pungudutivu-Kurikadduvan	**New**	**300.00**							Northern	Jaffna	2	
61	AB039	Valukkairaru-Pungudutivu-Kurikadduvan	**New**	**200.00**							Northern	Jaffna	2	
62	AB017	Jaffna-Manipai-Karainagar	**New**	**380.00**							Northern	Jaffna	2	
63	AA032	Navakkuli - Kerativu - Mannar	(59+610)	**35.00**	10.20	8.20	1	Pali aru Bridge with Causeway			Northern	Mannar		Mannar
64	AA032	Navakkuli - Kerativu - Mannar	(32+540)	**60.00**	10.20	8.20	2	Nachchikuda Causeway			Northern	Kilinochchi		Killinochchi
65	AA032	Navakkuli - Kerativu - Mannar	(71+660)	**40.00**	10.20	8.20		Kalliyadi Bridge			Northern	Mannar		Mannar
66	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	7/1	**30.00**	11.00	8.20		Aru-Kuli Causeway		Weak	Northern	Mannar		
67	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	39/2	**60.00**	11.00	8.20		Kal Aru Causeway			Northern	Mannar		
68	B390	Ratnapura - Palawela - Karawita (RPK)	4/5	24.70	5.20	4.20	1	Kotamulla Bridge	Square	Weak & narrow	Sabaragamuwa	Ratnapura	2	
69	AA007	Avissawella - Hatton - Nuwara Eliya	38/3	**65.00**	9.20	7.25	4	Kiulgala Bridge	PSC-PRE	Weak	Sabaragamuwa	Kegalle	2	Ruwanwella
70	AA021	Kegalle - Bulathkohupitiya - Karawanella	22/5	20.80	4.20	3.70	2	Alawathura Bridge	ST-RSJ	Weak & narrow	Sabaragamuwa	Kegalle	2	Kegalle
71	B408	Talduwa - Meewitigammana	5/2	**120.20**	7.30	5.25	6	Kelani	PSC-POS	Weak	Sabaragamuwa	Kegalle	2	
72	B093	Dehiowita - Deraniyagala - Noori	14/3	20.00	4.75	4.75	2		PSC-PRE	Weak & narrow	Sabaragamuwa	Kegalle	2	
73	AA021	Kegalle - Bulathkohupitiya - Karawanella	1/5	17.70	12.80	9.20	1	Welimannathota Bridge	PSC-PRE	Weak	Sabaragamuwa	Kegalle	2	Kegalle
74	B110	Eheliyagoda - Dehiowita	11/1	16.70	5.80	5.80	2	Batangala Bridge	ST-RSJ	Weak	Sabaragamuwa	Kegalle	2	
75	B457	Warakapola - Ruwanwella	19/4	12.30	5.60	5.30	1	Yakahatuwa Bridge	ST-RSJ	Weak	Sabaragamuwa	Kegalle	2	
76	B110	Eheliyagoda - Dehiowita	8/5	10.30	3.50	3.50	1	Panawala Palama	ST-RSJ	Weak & narrow	Sabaragamuwa	Kegalle	2	
77	B604	Paragammana Dikella Atugoda Wanduradeniya	15/8	**50.30**	4.90	3.75	4	Wanduradeniya	RCC	Weak & narrow	Sabaragamuwa	Kegalle	2	
78	B482	Yatiyantota - Poonagala - Meenagala	14/6	14.60	7.70	5.40	2	Poonagala Bridge	PSC-PRE	Weak	Sabaragamuwa	Kegalle	2	
79	B279	Mawanella - Hemmaththagama - Singhapitiya	12/2	21.90	4.20	4.20	4	Wagalla	RCC	Weak & narrow	Sabaragamuwa	Kegalle	2	
80	B278	Mawanella - Aranayake - Horawela	13/1	8.55	4.60	3.75	1	Welimanna	RSJ-RCC	Weak & narrow	Sabaragamuwa	Kegalle	2	
81	B482	Yatiyantota - Poonagala - Meenagala	17/1	9.50	5.80	5.80	2	Olu Ella Palama	ST-RSJ	Weak	Sabaragamuwa	Kegalle	2	
82	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	159/1	**33.80**	9.00	5.00	2	Belihuloya Bridge	RSJ/RCS	Narrow	Sabaragamuwa	Ratnapura	2	Pelmadulla
83	AA021	Kegalle - Bulathkohupitiya - Karawanella	11/4	**31.00**	3.50	3.50	4	Moronthota Bridge	RSJ/RCS	Narrow	Sabaragamuwa	Kegalle	2	Kegalle
84	AA021	Kegalle - Bulathkohupitiya - Karawanella	22/5	20.80	4.20	3.70	2	Alawathura Bridge	RSJ/RCS	Narrow	Sabaragamuwa	Kegalle	2	Kegalle
85	B528	Bodagma - Hambegamuwa - Kaltota	44/6	20.30	4.50	4.00	1	Walawe ganga bridge	RCS	Narrow	Sabaragamuwa	Ratnapura	2	
86	B127	Galigomuwa - Ruwanwella	11/6	10.20	4.40	4.30	1	Atala Bridge	RSJ/RCS	Narrow	Sabaragamuwa	Kegalle	2	
87	B127	Galigomuwa - Ruwanwella	16/1	16.65	5.20	4.30	1	Kotiyakumbura Bridge	ST-TR	Weak & Narrow	Sabaragamuwa	Kegalle	2	
88	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	62/1	10.70	9.60	6.60	1		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
89	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	64/1	28.60	8.70	7.30	2		WS-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
90	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	73/1	13.00	11.20	9.00	1		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
91	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	73/2	19.30	10.00	7.70	1		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
92	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	75/1	10.70	11.00	8.20	1		RRM-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura

Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of lanes	EE Division
93	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	75/2	12.40	10.40	8.20	1		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
94	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	75/3	13.50	11.30	8.10	1		RRM-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
95	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	75/4	11.80	10.60	8.00	1		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
96	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	80/3	20.20	8.20	6.70	1		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
97	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	86/5	22.50	9.80	7.20	1		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
98	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	88/2	23.90	9.40	7.40	1		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
99	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	91/3	27.40	9.00	7.30	2		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
100	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	94/3	21.70	12.40	7.40	2		Con-RCS	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
101	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	99/6	**42.00**	10.70	7.20	3		PSC-PRE	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
102	B248	Labuduwa-Waduraba-Sandarawa	9/1	12.05	4.80	4.30	1	Anda dola palama	WS-ST	Narrow	Southern	Galle	2	
103	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	138/1	**51.05**	12.38	10.37	3	Goiyapana Bridge	PSC-PRE	Weak	Southern	Galle	4	Galle
104	A017	Galle - Deniyaya - Madampe	48/12	9.95	6.11	5.01	1	Malpudanella	D/S	Weak	Southern	Matara	2	Deniyaya
105	B429	Udugama - Hiniduma	3/10	26.00	5.70	4.40	3	Nannikitha Palama	RCC	Weak & narrow	Southern	Galle	2	
106	B607	Bengamuwa - Molokgamuwa - Galdola	10/1	**31.50**	4.10	3.40	2			Weak & narrow	Southern	Matara	2	
107	B466	Weligama - Telijjawila	4/1	**46.57**	5.05	4.85	5	Denipitiya Bridge	ST-RSJ	Weak & narrow	Southern	Matara	2	
108	B142	Hakmana - Meella - Talahaganwaduwa	4/1	**30.49**	3.65	3.55	4	Denagama Bridge	ST-RSJ	Weak & narrow	Southern	Matara	2	
109	B153	Hikkaduwa - Baddegama - Nilhena Road	10/4	**50.00**	5.50	5.50	3	Halpatota Bridge		ST-RSJ	Southern	Galle	2	
110	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	148/1	**102.00**	7.90	5.46	11	Polwathumodara Bridge	RCS	Weak & narrow	Southern	Matara	4	Matara
111	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	129/1	16.00	14.40	11.79	3	Timbiriya Bridge	Arch/Co	Weak & narrow	Southern	Galle	4	Galle
112	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	133/2	**49.00**	10.09	9.59	3	Kathalu Bridge (Pol Oya Bridge)	PSC-PRE	Weak & narrow	Southern	Galle	4	Galle
113	**Non RDA**	Palana- Polwatta	**New**	**100.00**				Polwatta bridge		**New Bridge Construction**	Southern	Galle	2	
114	B055	Bentara - Uragaha - Elpitiya	1/2	9.00	3.85	3.10	2	Kurumitigoda Palama	PSC-PRE+RCS	Narrow	Southern	Galle	2	
115	B415	Thihagoda - Kamburupitiya - Mawarala - Kotapola	14/1	16.70	4.30	4.15	1	Horaboruwana Steel Bridge	ST-TR(H)	Weak	Southern	Matara	2	
116	B128	Galle-Baddegama	15/2	**32.80**	5.90	5.10	6	kahabiliya	Con	Narrow	Southern	Galle	2	
117	B130	Galle-Wackwella	8/7	**33.6**	6.3	5	2	Part of Gin ganga	Con	Narrow	Southern	Galle	2	
118	B097	Demodera - Spring Valley - Badulla	3/1	25.00	4.10	3.00	1		ST-TR	Weak & narrow	Uva	Badulla	2	
119	B097	Demodera - Spring Valley - Badulla	15/4	20.50	3.50	3.00	1	Kalu Palama	ST-TR	Weak & narrow	Uva	Badulla	2	
120	B427	Udawalawe - Tanamalwila	20/5	**39.10**	6.70					Weak	Uva	Monaragala	2	
121	A005	Peradeniya - Badulla - Chenkaladi (PBC)	169/3	20.00	5.70	5.00	1	Keenagoda Bridge		Weak & narrow	Uva	Badulla	2	Bibile
122	B097	Demodera - Spring Valley - Badulla	12/6	21.00	3.90	3.60	2	Sprinvalley Bridge		Weak & narrow	Uva	Badulla	2	
123	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	192/2	**44.40**	5.00	5.00	4	Nikapotha Ela	ST-TR(D)	Narrow	Uva	Badulla	2	Bandarawela
124	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	196/7	**30.90**	5.00	5.00	3	Lamastota Bridge	RSJ/RCS	Narrow	Uva	Badulla	2	Bandarawela
125	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	201/1	19.00	6.00	6.00	2	Koslanda Bridge	RSJ/RCS	Narrow	Uva	Badulla	2	Bandarawela
126	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	206/10	23.90	4.50	4.00	3	Diyaluma Bridge	Arch	Narrow	Uva	Badulla	2	Bandarawela
127	A005	Peradeniya - Badulla - Chenkaladi	145/3	26.30	4.00	4.00	1		Steel	Narrow	Uva	Badulla	2	Badulla
128	A005	Peradeniya - Badulla - Chenkaladi	149/3	10.30	5.60	4.85	1	Kavadi Bridge	Arch	Narrow	Uva	Badulla	2	Badulla
129	A005	Peradeniya - Badulla - Chenkaladi	159/5	10.40	4.60	4.60	1	Nombara 6 Bridge	RSJ/BUC	Narrow	Uva	Badulla	2	Badulla
130	A005	Peradeniya - Badulla - Chenkaladi	160/2	9.00	3.50	3.50	1	Udaoya Kandura Bridge	RSJ/BUC	Narrow	Uva	Badulla	2	Badulla
131	A005	Peradeniya - Badulla - Chenkaladi	173/2	27.20	5.00	5.00	3		Arch	Narrow	Uva	Monaragala	2	Bibile
132	A005	Peradeniya - Badulla - Chenkaladi	188/2	24.20	5.00	5.00	1		Arch	Narrow	Uva	Monaragala	2	Bibile
133	A005	Peradeniya - Badulla - Chenkaladi	194/1	15.30	3.40	3.20	2		RSJ/BUC	Narrow	Uva	Monaragala	2	Bibile
134	A005	Peradeniya - Badulla - Chenkaladi	202/4	22.00	5.90	5.00	2		Arch	Narrow	Uva	Monaragala	2	Ampara
135	B527	Bibile - Pitakumbura - Namal Oya - Inginiyagala	50/3	12.00	4.90	3.70	1		Causeway	Narrow	Uva	Monaragala	2	
136	B527	Bibile - Pitakumbura - Namal Oya - Inginiyagala	8/2	13.00	7.40	6.80	1		Causeway	Narrow	Uva	Monaragala	2	
137	B527	Bibile - Pitakumbura - Namal Oya - Inginiyagala	6/3	27.80	6.20	5.60	1		PSC-PRE+RCS	Narrow	Uva	Monaragala	2	
138	B496	Thanamalwila - Hambegamuwa (Thanamalwila - Bodagama)	41/1	**35.90**	4.50	3.60	7		PSC	Narrow	Uva	Monaragala		
139	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	20/1	**194.40**	8.50	5.60	7	Digarolla Bridge	ST-TR	Weak	Western	Kaluthara	2	Kaluthara

Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of lanes	EE Division
140	AB010	Colombo - Hanwella Low Level Road	2/1	19.00	6.15	6.15	5		RCC	Weak	Western	Colombo	4	Colombo
141	B157	Horana - Anguruwatota - Aluthgama	9/4	10.05	8.10	7.30	1	Galwala Palama	ST-RSJ	Weak	Western	Kaluthara	4	
142	B224	Kirimetiya - Yala	9/1	26.80	4.60	3.30	1		ST-TR(H)	Weak & narrow	Western	Kaluthara	4	
143	B322	Negombo - Giriulla	17/1	8.20	4.80	4.80	1	Godigamuwa Bridge	ST-RSJ	Weak & narrow	Western	Gampaha	2	
144	B157	Horana - Anguruwatota - Aluthgama	8/5	**34.40**	6.20	5.50	3		PSC-PRE	Weak	Western	Kaluthara	4	
145	B388	Ratmalana - Borupona	2/5	**84.00**	7.40	7.40	2		Steel	Weak	Western	Colombo	2	
146	B068	Ingiriya - Halwatura - Egaloya	5/4	18.45	4.00	3.80	4	Bothalegama Bridge	PSC-PRE	Weak & narrow	Western	Kaluthara	2	
147	AA002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	1/1	27.60	30.70	18.30	3	Beira Lake	RSJ-RCC	Weak	Western	Colombo	8	Colombo
148	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	38/1	18.10	7.00	6.90	2	Irrigation canal	RSJ/CHA	Narrow	Western	Colombo	4	Awissawella
149	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	41/1	13.00	8.20	6.80	1		RCS	Narrow	Western	Colombo	4	Awissawella
150	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	49/1	21.80	8.00	6.90	2	Irrigation CanalL	PSC-PRE	Narrow	Western	Colombo	4	Awissawella
151	B435	Urugodawatte - Ambatale	4/1	10.80	7.70	7.20	2		RCS	Weak	Western	Colombo	4	
152	AB010	Colombo- Hanwella- low level road	9/1	**33.30**	7.80	6.90	3	Ambathale Bridge	RCC	Narrow	Western	Colombo	4	Colombo
153	AB010	Colombo- Hanwella- low level road	15/1	**37.70**	7.70	6.70	4	Welehandiya Bridge	RCC	Narrow	Western	Colombo	4	Colombo
154	AB010	Colombo- Hanwella- low level road	24/1	**40.50**	6.10	5.55	5		RCC	Narrow	Western	Colombo	4	Awissawella
155	AB010	Colombo- Hanwella- low level road	26/4	**35.60**	6.00	5.50	4	Embulgama Bridge	RCC	Narrow	Western	Colombo	4	Awissawella
156	AB010	Colombo- Hanwella- low level road	28/1	**42.40**	8.30	6.80	4		RCC	Narrow	Western	Colombo	4	Awissawella
157	**New Bridge**	Galpatha-Yatawara-Kethhena-Rubber factory road	**New**	**110.00**	10.40					**New Bridge Construction**	Western	Kaluthara	2	
158	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	53/3	20.50	8.40	7.00	2	Pahanalanga bridge	RCC	Narrow	western	Colombo	4	Awissawella
159	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	33/3	**39.30**	10.20	7.40	3	Galagedara	PSC-PRE	Narrow	western	Colombo	4	
160	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	31/1	20.40	7.40	7.10	2		ST-RSJ	Narrow	western	Colombo	4	
161	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	42/1	27.20	11.40	8.40	2	Kalugalla Bridge	PSC-PRE	Narrow	western	Colombo	4	
162	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	47/1	23.90	10.50	7.40	1	Salawa Bridge	PSC-PRE	Narrow	western	Colombo	4	
163	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	49/1	27.60	8.10	7.40	2		PSC-PRE	Narrow	western	Colombo	4	
164	AA004	Colombo-Ratnapura-Wellawaya-Batticaloa	53/3	20.50	8.40	7.00	2	Pahanalanga bridge	RCC	Narrow	western	Colombo	4	

Source) RDA

Table 1.7-2 (6+7) nos Additional Damaged Bridges List by RDA in August

(No.113 is included in initial 63 bridges table)

Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of lanes	EE Division
165	B403	Talladi-Arippu-Marichchukkaddi	23/3	91.00	4.20	4.20	1	Aru-Kuli Causeway			Nothern	Mannar		
166	B403	Talladi-Arippu-Marichchukkaddi	21/1	70.00	4.20	4.20	1	Aru-Kuli Causeway			Nothern	Mannar		
167	AA009	Kandy-Jaffna	309/1	81.00	7.30	7.30	3	Kaithady	Bailey Bridge		Nothern	Jaffna		
168	AA009	Kandy-Jaffna	314/2	81.00	7.30	7.30	3	Navathuli	Bailey Bridge		Nothern	Jaffna		
169	AB019		-	27.00	7.30	7.30	1	Panney	Bailey Bridge		Nothern	Jaffna		
170	A035	Paratan-Mullaitivu	3/3	22.00	8.00	6	3		RCC	Narrow & Weak	Nothern	Mulative	2	Mulaitivu
171	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	52/1	24.30	12.70	9.80		Maggona Bridge	Concrete	Week	Western	Kaluthara	4	Kalutara
172	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	1/1	32	30	25	4	Baira Lake					6	Colombo
173	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	53/1	22.3	13.2	9.5				Weak			4	Kalutara
174	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	42/1	27.2	11.4	8.4	2		PSC-PRE	Narrow			Parallel 2	Avissawella
175	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	49/1	21.8	8	6.9			PSC-PRE	Narrow			Parallel 2	Avissawella
176	A004	Colombo-Ratnapura-Wellawaya-Batticaloa	64/1	24.1	9	9.3	2		PSC-PRE	Narrow			Parallel 2	Avissawella
113	Non RDA	Polwatta - Denipitiya		99	3.5	3.3	22	Polawatta Bridge	Concrete	Narrow & Weak	Southern	Matara	2	Matara

Notes:
- 6 Nos. Additional Bridges proposed by RDA Provincial Director's Office
- 6 Nos. Additional Bridges newly proposed by RDA
- 1 No. Additional Bridges reproposed by RDA

Source) RDA

Table 1.7-3 8 nos Additional Damaged Bridges List by RDA in October

Inventory No.	Road No	Bridge No	Road Name	Bridge's Name	O_L (m)	O_W (m)	C_W (m)	No of Span	Type of Bridge	Existing Condition	Narrow	Province	District	Division
177	B435	3/1	Urugodawatte - Ambatale	Wellampitiya Bridge	36.30	13.50	10.10	4	RCC	Fair		Western	Colombo	Colombo
178	AA001	6/1	Colombo - Kandy	Ingurukade Bridge	38.60	19.35	16.40	1	RCC	Fair		Western	Colombo	Colombo
179	B416	2/6	Thihariya - Warapalana		30.40	5.00	4.30	1	ST-TR	Good	Narrow	Western	Gampaha	Nittambuwa
180	B304	35/4	Nagoda - Kalawellawa - Bellapitiya	Aluthketiya Palama	42.10	5.80	4.60	4	PSC-PRE		Narrow	Western	Kaluthara	Agalawatta
181	AA001	60/1	Colombo - Kandy	Ambepussa Junction Bridge	28.80	14.40	9.70	4	RCC	Fair		Sabaragamuwa	Kegalle	Kegalle
182	B279	17/1	Mawanella - Hemmathagama - Gampala	Alakoladeniya Palama Bridge	31.90	3.70	3.20	3	ST-TR + RCC	Fair	Narrow	Sabaragamuwa	Kegalle	Kegalle
183	B279	12/2	Mawanella - Hemmathagama - Gampala	Wagolla Bridge	20.50	6.10	6.10	4	RCC	Fair	Narrow	Sabaragamuwa	Kegalle	Kegalle
184	B279	11/2	Mawanella - Hemmathagama - Gampala		18.80	6.10	4.30	1	ST(Bailey)	Good		Sabaragamuwa	Kegalle	Kegalle

Notes:
- 4 Nos. Additional Bridges around Colombo
- 4 Nos. Additional Bridges at Kegalle

Source) RDA

CHAPTER 2 RECONNAISSANCE SURVEY FOR PROPOSED BRIDGES

2.1 General

The Study Team received a list of 164 nos of bridges proposed by RDA on 26th July 2012 as mentioned in 1.2 above. JICA has agreed that bridges to be surveyed should be more than 30m long on Classes-A and -B Roads. From the 164 nos bridges list, the Study Team selected 66 nos bridges to be investigated. However, 3 nos within 66 nos bridges were cancelled because reconstruction of those bridges has been decided to be funded by other donors.

Table 2.1-1 shows the "63 Nos Bridges to Be Investigated by Study Team in Early August". 63 nos out of 164 nos bridges were selected for the reconnaissance survey by the Study Team.

During the reconnaissance survey, the study team were requested by the RDA Provincial Director's Office an additional survey for 6 nos bridges.

On 22nd August 2012, the joint meeting of the RDA and Study Team was carried out regarding results of reconnaissance surveys for 63 nos bridges. In the meeting, Eng. Mr. G. J. C. Gunatilake, Additional Secretary, Ministry of Ports & Highways, the chairman of the meeting, informed the Study Team that RDA intends to propose 7 nos additional bridges on A002, A004 and non RDA road.

Table 2.1-2 shows the "13 nos Additional Bridges to Be Investigated by Study Team in August". 13 nos bridges were additionally proposed by Provincial 86 bridges) and RDA head office(7 bridges).

The bridge of Inventory No. 113 was shown in Table 2.1-1 respectively which was not initially selected by the Study Team, again requested by RDA head office it was inclusive to target bridge.

On 29th and 30th August 2012, reconnaissance survey for 7 nos additional bridges was carried out by the Study Team. Advance additional 8 nos bridges were shown in Table 2.1-3 were surveyed. 4 nos of bridges from inventory No.177 to No.180 were selected to be suitable as their bridge length was more than 30m from the list which are located around Colombo and proposed by RDA. Other 4 nos bridges from No.181 to No.184 were surveyed by JICA Study Team voluntarily with reference to latest inspection data near Kegalle by RDA. Survey results were also submitted and confirmed with RDA. These additional survey results were expected to contribute to grouping of bridges for reconstruction planning.

Table 2.1-1 63 nos Bridges to Be Investigated by Study Team in Early August 1/3

Bridges: > 30m	JICA Study Team			To be cancelled	Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of Lanes	EE Division
	Team A	Team B	Team C																
1		1			1	B413	Tennekumbura - Rikiligaskada - Ragala	42/1	**38.50**	5.60	4.80	3	Padiy apelella Bridge	Arch	Weak & narrow	Central	Nuwara Eliy a	2	
2		2			2	B492	Kandehandiy a - Adikarigama - Randenigala - Loggal Oy a	35/10	**35.00**	5.20	4.80				Weak & narrow	Central	Nuwara Eliy a	2	
3		3			15	AA005	Peradeniy a - Badulla - Chenkaladi (PBC)	241/1	**149.00**	7.40	4.70	12	Mahapalama	ST-RSJ	Narrow	Eastern	Eastern	2	Ampara
4			1		16	**New Bridge**	Muativ u - Kokilai - Pulmoodai Road	**New**	**200.00**				Kokilai bridge		**New Bridge Construction**	Eastern	Trincomalee	2	
5			2		17	AA006	Ambepussa - Kurunegala - Trincomalee (AKT)	184/1	**36.40**		5.80	3	Palampataru Bridge	ST-RSJ	Weak	Eastern	Trincomalee	4	Trincomalee
6		4			18	B483	Sammanthurai - Malkampiddi - Deegawapiy a	3/2	**32.30**	4.90	4.10	3	Pallaaru Bridge		Weak & narrow	Eastern	Ampara	2	
7		5			19	B187	Kalmunai - Chavalakadai	4/3	**35.00**	5.30	4.80	4	Kiddanki Bridge - 1	Concrete	Weak & narrow	Eastern	Ampara	2	
8		6			20	AA005	Peradeniy a - Badulla - Chenkaladi	243/3	**48.00**	4.70	4.50	5		ST-TR	Narrow	Eastern	Ampara	2	Batticaloa
9		7			21	AA031	Karaithiv u - Ampara	2/1	**62.0**	5.2	5.2	1		Con	low elevation	Eastern	Ampara	2	
10		8			22	AA031	Karaithiv u - Ampara	1/2	**82.0**	4.5	4.5	1		Con	Narrow	Eastern	Ampara	2	
11			3		23	AA028	Anuradhapura - Padeniy a	30/1	**157.00**	8.70	7.40	5	Kala oy a Bridge	Concrete	Narrow	North Central	Anuradhapura	4	Maho
12		9			26	AA011	Maradankadawela - Habarana - Tirikkondiadimadu	78/1	**35.50**	6.70	5.25	3	Kotaleeya Bridge	ST-RSJ	Weak	North Central	Polonnaruwa	2	Polonnaruwa
13		10			27	AA011	Maradankadawela - Habarana - Tirikkondiadimadu	82/3	**62.00**	6.80	5.00	5	500 Feet Bridge	ST-RSJ	Weak & Narrow	North Central	Polonnaruwa	2	Polonnaruwa
14			4		30	B182	Kalawewa - Av ukana	4/2	**35.00**	5.00	4.50	1	Causeway	Causeway	Narrow	North Central	Anuradhapura	2	
15			5		38	B060	Bogahawewa - Pulmuddai	3/1	**50.00**	5.50	5.40	1		Causeway	Weak	North Central	Anuradhapura	2	
16			6		39	B564	Otappuwa Ihalawewa	10/2	**35.00**	12.00	7.60	1		Causeway	Weak	North Central	Anuradhapura	2	
17			7		41	B538	Kahatagasdigiliy a - Rathmalgahaweewa - Kiv ulekade	20/2	**41.00**	7.10					Weak	North Central	Anuradhapura	2	
18		11			42	B517	Dehiattakandiy a - Aralaganwila	3/1	**40.50**	9.00	7.00	3		PSC Beams on Screed	Weak	North Central	Polonnaruwa	2	
19			8		43	AA028	Anuradhapura - Padeniy a	75/4	**92.70**	8.00	4.35	3	Deduruoy a bridge	ST-TR	Narrow	North Western	Kurunegala	4	Maho
20		12			45	B264	Mallawapitiy a - Rambodagalla - Keppetigala	30/2	**37.55**	4.20	3.30	1	Meeliy adda Palama	ST-TR	Weak & narrow	North Western	Kurunegala	2	
21			9		46	**New Bridge**	Across Deduru Oya (Closed to Rasnay akepura-Kadigawa Road)	**New**	**100.00**				Kadigawa Bridge		**New Bridge Construction**	North Western	Kurunegala	2	
22			10		48	B379	Puttalam - Marichchikadai	9/2	**30.00**	11.00	8.20	6	Mee Oy a Bridge	RCC		North Western	Puttalam		
23			11		51	B379	Puttalam - Marichchikadai	32/1	**110.00**	11.00	8.20					North Western	Puttalam		

Source) Study Team

Table 2.1-1 63 nos Bridges to Be Investigated by Study Team in Early August 2/3

Bridges: > 30m	JICA Study Team			To be cancelled	Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of Lanes	EE Division
	Team A	Team B	Team C																
24	1				53	AA003	Peliyagoda - Puttalam	92/4	**42.80**	5.40	5.40	4		RSJ-RCC	Narrow	North Western	Puttalam	4	Chilaw
25	2				54	AA003	Peliyagoda - Puttalam	94/2	**42.80**	6.10	5.40	4	Ratambala Oya Bridge	RCS	Narrow	North Western	Puttalam	4	Puttalam
26			12		55	**New Bridge**	Construction of Sellvapuram Bridge across Nantikadal Lagoon	**New**	**114.00**						**New Bridge Construction**	Northern	Mulative	2	
27			13		56	**New Bridge**	Construction of WaduwakkalBridge across Nantikadal Lagoon	**New**	**418.00**						**New Bridge Construction**	Northern	Mulative	2	
28			14		58	AA014	Medawachchiya - Mannar - Talaimannar	31/1	**34.20**	3.00	3.00	3			Weak & narrow	Northern	Vavuniya	2	Vavuniya
29			15		59	AB020	Jaffna - Point Pedro	21/2	**73.00**	10.53	7.35	2			Weak	Northern	Jaffna	2	
30			16		60	AB039	Valukkairaru - Pungudutivu - Kurikadduvan	**New**	**300.00**							Northern	Jaffna	2	
31			17		61	AB039	Valukkairaru - Pungudutivu - Kurikadduvan	**New**	**200.00**							Northern	Jaffna	2	
32			18		62	AB017	Jaffna-Manipai-Karainagar	**New**	**380.00**							Northern	Jaffna	2	
33			19		63	AA032	Navakkuli - Kerativu - Mannar	(59+610)	**35.00**	10.20	8.20	1	Pali aru Bridge with Causeway			Northern	Mannar		Mannar
34			20		64	AA032	Navakkuli - Kerativu - Mannar	(32+540)	**60.00**	10.20	8.20	2	Nachchikuda Causeway			Northern	Kilinochchi		Killinochchi
35			21		65	AA032	Navakkuli - Kerativu - Mannar	(71+660)	**40.00**	10.20	8.20		Kalliyadi Bridge			Northern	Mannar		Mannar
36			22		66	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	7/1	**30.00**	11.00	8.20		Aru-Kuli Causeway		Weak	Northern	Mannar		
37			23		67	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	39/2	**60.00**	11.00	8.20		Kal Aru Causeway			Northern	Mannar		
38	3				69	AA007	Avissawella - Hatton - Nuwara Eliya	38/3	**65.00**	9.20	7.25	4	Kiulgala Bridge	PSC-PRE	Weak	Sabaragamuwa	Kegalle	2	Ruwanwella
39	4				71	B408	Talduwa - Meewitigammana	5/2	**120.20**	7.30	5.25	6	Kelani	PSC-POS	Weak	Sabaragamuwa	Kegalle	2	
40	5				77	B604	Paragammana - Dikella - Atugoda - Wanduradeniya	15/8	**50.30**	4.90	3.75	4	Wanduradeniya	RCC	Weak & narrow	Sabaragamuwa	Kegalle	2	
41		13			82	AA004	Colombo - Ratnapura - Wellaway a - Batticaloa	159/1	**33.80**	9.00	5.00	2	Belihuloya Bridge	RSJ/RCS	Narrow	Sabaragamuwa	Ratnapura	2	Pelmadulla
42				1	83	AA021	Kegalle - Bulathkohupitiya - Karawanella	11/4	**31.00**	3.50	3.50	4	Moronthota Bridge	RSJ/RCS	Narrow	Sabaragamuwa	Kegalle	2	Kegalle
43	6				101	AA004	Colombo - Ratnapura - Wellaway a - Batticaloa	99/6	**42.00**	10.70	7.20	3		PSC-PRE	Narrow	Sabaragamuwa	Ratnapura	4	Ratnapura
44	7				103	AA002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	138/1	**51.05**	12.38	10.37	3	Goiyapana Bridge	PSC-PRE	Weak	Southern	Galle	4	Galle
45	8				106	B607	Bengamuwa - Molokgamuwa - Galdola	10/1	**31.50**	4.10	3.40	2			Weak & narrow	Southern	Matara	2	
46	9				107	B466	Weligama - Telijjawila	4/1	**46.57**	5.05	4.85	5	Denipitiya Bridge	ST-RSJ	Weak & narrow	Southern	Matara	2	
47	10				108	B142	Hakmana - Meella - Talahaganwaduwa	4/1	**30.49**	3.65	3.55	4	Denagama Bridge	ST-RSJ	Weak & narrow	Southern	Matara	2	

Source) Study Team

Table 2.1-1 63 nos Bridges to Be Investigated by Study Team in Early August 3/3

Bridges: > 30m	JICA Study Team			To be cancelled	Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of Lanes	EE Division
	Team A	Team B	Team C																
48	11				109	B153	Hikkaduwa - Baddegama - Nilhena Road	10/4	**50.00**	5.50	5.50	3	Halpatota Bridge		ST-RSJ	Southern	Galle	2	
49	12				110	AA002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	148/1	**102.00**	7.90	5.46	11	Polwathumodara Bridge	RCS	Weak & narrow	Southern	Matara	4	Matara
50	13				112	AA002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	133/2	**49.00**	10.09	9.59	3	Kathalu Bridge (Pol Oya Bridge)	PSC-PRE	Weak & narrow	Southern	Galle	4	Galle
51	14				116	B128	Galle - Baddegama	15/2	**32.80**	5.90	5.10	6	kahabiliya	Con	Narrow	Southern	Galle	2	
52	15				117	B130	Galle-Wackwella	8/7	**33.6**	6.3	5	2	Part of Gin ganga	Con	Narrow	Southern	Galle	2	
53		14			120	B427	Udawalawe - Tanamalwila	20/5	**39.10**	6.70					Weak	Uva	Monaragala	2	
54				2	123	AA004	Colombo - Ratnapura - Wellaway a - Batticaloa	192/2	**44.40**	5.00	5.00	4	Nikapotha Ela	ST-TR(D)	Narrow	Uva	Badulla	2	Bandarawela
55				3	124	AA004	Colombo - Ratnapura - Wellaway a - Batticaloa	196/7	**30.90**	5.00	5.00	3	Lamastota Bridge	RSJ/RCS	Narrow	Uva	Badulla	2	Bandarawela
56		15			138	B496	Thanamalwila - Hambegamuwa (Thanamalwila - Bodagama)	41/1	**35.90**	4.50	3.60	7		PSC	Narrow	Uva	Monaragala		
57	16				139	AA002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	20/1	**194.40**	8.50	5.60	7	Digarolla Bridge	ST-TR	Weak	Western	Kaluthara	2	Kaluthara
58	17				144	B157	Horana - Anguruwatota - Aluthgama	8/5	**34.40**	6.20	5.50	3		PSC-PRE	Weak	Western	Kaluthara	4	
59	18				145	B388	Ratmalana - Borupona	2/5	**84.00**	7.40	7.40	2		Steel	Weak	Western	Colombo	2	
60	19				152	AB010	Colombo - Hanwella - low lev el road	9/1	**33.30**	7.80	6.90	3	Ambathale Bridge	RCC	Narrow	Western	Colombo	4	Colombo
61	20				153	AB010	Colombo - Hanwella - low lev el road	15/1	**37.70**	7.70	6.70	4	Welehandiya Bridge	RCC	Narrow	Western	Colombo	4	Colombo
62	21				154	AB010	Colombo - Hanwella - low lev el road	24/1	**40.50**	6.10	5.55	5		RCC	Narrow	Western	Colombo	4	Avissawella
63	22				155	AB010	Colombo - Hanwella - low lev el road	26/4	**35.60**	6.00	5.50	4	Embulgama Bridge	RCC	Narrow	Western	Colombo	4	Avissawella
64	23				156	AB010	Colombo - Hanwella - low lev el road	28/1	**42.40**	8.30	6.80	4		RCC	Narrow	Western	Colombo	4	Avissawella
65	24				157	**New Bridge**	Galpatha - Yatawara - Kethhena - Rubber factory road	**New**	**110.00**	10.40					**New Bridge Construction**	Western	Kaluthara	2	
66	25				159	AA004	Colombo - Ratnapura - Wellaway a - Batticaloa	33/3	**39.30**	10.20	7.40	3	Galagedara	PSC-PRE	Narrow	western	Colombo	4	

Notes:
- : 25 Nos. Bridges more than 30m long to be investigated by Team A.
- : 15 Nos. Bridges more than 30m long to be investigated by Team B.
- : 23 Nos. Bridges more than 30m long to be investigated by Team C.
- : 3 Nos. Bridges more than 30m long to be cancelled.

Source) Study Team

Table 2.1-2 13 nos Additional Bridges to Be Investigated by Study Team in August

Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of Lanes	EE Division
165	B403	Talladi - Arippu - Marichchukkaddi	23/3	91.00	4.20	4.20	1	Aru-Kuli Causeway			Nothern	Mannar		
166	B403	Talladi - Arippu - Marichchukkaddi	21/1	70.00	4.20	4.20	1	Aru-Kuli Causeway			Nothern	Mannar		
167	AA009	Kandy - Jaffna	309/1	81.00	7.30	7.30	3	Kaithady	Bailey Bridge		Nothern	Jaffna		
168	AA009	Kandy - Jaffna	314/2	81.00	7.30	7.30	3	Navathuli	Bailey Bridge		Nothern	Jaffna		
169	AB019		-	27.00	7.30	7.30	1	Panney	Bailey Bridge		Nothern	Jaffna		
170	A035	Paratan - Mullaitivu	3/3	22.00	8.00	6	3		RCC	Narrow & Weak	Nothern	Mulative	2	Mulaitivu
171	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	52/1	24.30	12.70	9.80		Maggona Bridge	Concrete	Week	Western	Kaluthara	4	Kalutara
172	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	1/1	32	30	25	4	Baira Lake					6	Colombo
173	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	53/1	22.3	13.2	9.5				Weak			4	Kalutara
174	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	42/1	27.2	11.4	8.4	2		PSC-PRE	Narrow			Parallel 2	Avissawella
175	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	49/1	21.8	8	6.9			PSC-PRE	Narrow			Parallel 2	Avissawella
176	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	64/1	24.1	9	9.3	2		PSC-PRE	Narrow			Parallel 2	Avissawella
113	Non RDA	Polwatta - Denipitiya		99	3.5	3.3	22	Polawatta Bridge	Concrete	Narrow & Weak	Southern	Matara	2	Matara

Notes: : 6 Nos. Additional Bridges proposed by RDA Provincial Director's Office and investigated by Team C

: 7 Nos. Additional Bridges newly proposed by RDA

Source) Study Team

Table 2.1-3 8 nos Advance Additional Bridges to be investigated by JICA Study Team in October

Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of Lanes	EE Division
177	B435	Urugodawatte - Ambatale	3/1	36.30	13.50	10.10	4	Wellampitiya Bridge	RCC	Fair	Western	Colombo		Colombo
178	AA001	Colombo - Kandy	6/1	38.60	19.35	16.40	1	Ingurukade Bridge	RCC	Fair	Western	Colombo		Colombo
179	B416	Thihariya - Warapalana	2/6	30.40	5.00	4.30	1		ST-TR	Good	Western	Gampaha		Nittambuwa
180	B304	Nagoda - Kalawellawa - Bellapitiya	35/4	42.10	5.80	4.60	4	Aluthketiya Palama	PSC-PRE		Western	Kaluthara		Agalawatta
*	B183	Kaleliya - Pallewela - Medagampitiya	3/3	18.30	5.30		2			Weak	Western	Gampaha		Nittambuwa
*	B183	Kaleliya - Pallewela - Medagampitiya	3/4	16.85	5.30	3.3	2		ST-RSJ	Weak	Western	Gampaha		Nittambuwa
*	B304	Nagoda - Kalawellawa - Bellapitiya	29/3	21.30	5.70	4.35	2		PSC-PRE		Western	Kaluthara		Agalawatta
*	B304	Nagoda - Kalawellawa - Bellapitiya	38/3	10.8	5.4	4.3	1		PSC-PRE		Western	Kaluthara		Agalawatta
*	B322	Negombo - Giriulla	17/1	8.2	4.8	4.8	1	Godigamuwa Bridge	ST-RSJ	Weak	Western	Gampaha		Gampaha
*	B322	Negombo - Giriulla	34/2	21	4.4	4.5	1	Tombunalle Palama		Good	Western	Gampaha		Gampaha

Inventory No.	Road No.	Road Name	Bridge No.	O_L (m)	O_W (m)	C_W (m)	No. of Span	Bridge Name	Type of Bridge	Existing Condition	Province	District	Proposed Nos. of Lanes	EE Division
181	AA001	Colombo - Kandy	60/1	28.80	14.40	9.70	4	Ambepussa Junction Bridge	RCC	Fair	Sabaragamuwa	Kegalle		Kegalle
182	B279	Mawanella - Hemmathagama - Gampala	17/1	31.90	3.70	3.20	3	Alakoladeniya Palama Bridge	ST-TR + RCC	Fair	Sabaragamuwa	Kegalle		Kegalle
183	B279	Mawanella - Hemmathagama - Gampala	12/2	20.50	6.10	6.10	4	Wagolla Bridge	RCC	Fair	Sabaragamuwa	Kegalle		Kegalle
184	B279	Mawanella - Hemmathagama - Gampala	11/2	18.80	6.10	4.30	1		ST(Bailey)	Good	Sabaragamuwa	Kegalle		Kegalle

Source) Study Team

2.2 Measures of Safety for Reconnaissance Survey for Northern Sri Lanka

Prior to the reconnaissance survey for Northern Sri Lanka, Study Team was given a briefing regarding measures of safety at Northern Sri Lanka by Mr. Hiroaki Adachi of JICA Colombo Office on 30th July 2012 at JICA Colombo Office using "Measures of Safety Regarding Passage to Northern Sri Lanka" prepared by JICA Office on 1st April 2012.

Mr. Adachi pointed out that Study Team needed to confirm the instructions regarding public peace, land mains, unexploded bombs and others.

Mr. Adachi instructed Study Team:

1) Submission of reconnaissance survey plan (schedule, survey route, names of team member, network of contact, accommodation)
2) To stay the accommodations appointed by JICA
3) To contact with Mr. Adachi and Ms. Kimura of JICA timely (times of arrival/ departure to/ from accommodations and lunch) by phone or SMS
4) Restriction of movement from 7 am to approximately 6 pm and prohibitions of going out in night time
5) To carry copies of passport

On 3rd August 2012, Study Team submitted a reconnaissance survey plan covering the above mentioned matters to JICA Office and the plan was approved.

Planning Division of RDA submitted a letter to the Ministry of Defense on 3rd August 2012 mentioning the purpose, schedule, route of reconnaissance survey and names of the members of the team.

2.3 Reconnaissance Survey

Table 2.3-1 shows the "Actual Progress of Reconnaissance Survey" that consists of the actual progress and team members of reconnaissance surveys for the above mentioned 84 nos bridges in total carried out by the Study Team.

Prior to the reconnaissance surveys to be carried out by the above mentioned 3 nos teams, an On-the-Job training on 2 nos bridges, basically to be investigated by Team A, was carried out to confirm the investigation method by all members of teams on 31st July 2012.

Reconnaissance survey of 63 bridges were carried out by following 3 study teams.

Team A : 25 bridge in western and southern region of Sri Lanka..

Team B : 15 bridges in eastern region of Sri Lanka

Team C :23 bridges in northern region of SriLanka

Thus total number of bridges to be surveyed was 61nos, initially 63 nos.

Reconnaissance of Additional 7 bridges were carried out from 29th Aug.to 30th Aug.2012.

Reconnaissance of Additional 8 bridges were carried out from 16th Oct.to Oct. 21th Aug.2012.

As a result total number of reconnaissance d bridges were 82 nos.

Table 2.3-1 Actual Progress of Reconnaissance Survey / Western and Southern Sri Lanka Carried out by TEAM A (Mr.Iwata and Mr.Nakishima)

DAY		ORIGIN	DESTINATION	VIA	INVENTORY NO.	ROAD NO.	ROAD NAME	BR. NO.	BR. LENGTH (m)	PROVINCE
OJT	31/7 (Tue)	Colombo	Colombo	AA002, B224	139	AA002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	20/1	197.20	Western
					144	B157	Horana - Anguruwatota - Aluthgama	8/5	34.00	Western
1	03/8 (Fri)	Colombo	Colombo	AB010	152	AB010	Colombo- Hanwella - low level road	9/1	33.50	Western
					153	AB010	Colombo- Hanwella - low level road	15/1	37.70	Western
					154	AB010	Colombo- Hanwella - low level road	24/1	40.50	Western
					156	AB010	Colombo- Hanwella - low level road	28/1	42.10	Western
2	05/8 (Sut)	Colombo	Colombo	AA007, AA021	69	AA007	Avissawella - Hatton - Nuwara Eliya	38/3	60.00	Western
					77	B604	Paragammana - Dikella - Atugoda - Wanduradeniya	15/8	42.40	Sabaragamuwa
3	06/8 (Man)	Colombo	Colombo	AA004,	71	B408	Talduwa - Meewitigammana	5/2	120.20	Sabaragamuwa
					145	B388	Ratmalana - Borupona	2/5	86.00	Western
					159	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	33/3	57.00	Western
					157	New Bridge	Galpatha - Yatawara - Kethhena - Rubber factory road	New	110.00	Western
4	07/8 (Tue)	Colombo	Colombo	AA003	53	AA003	Peliyagoda - Puttalam	92/4	42.50	North Western
					54	AA003	Peliyagoda - Puttalam	94/2	115.50	North Western
5	08/8 (Wed)	Colombo	Matara	E01, AA002	109	B153	Hikkaduwa - Baddegama - Nilhena Road	10/4	45.00	Southern
					116	B128	Galle - Baddegama	15/2	31.25	Southern
					117	B130	Galle - Wackwella	8/7	31.25	Southern
6	09/8 (Thu)	Matara	Matara	AA002	112	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	133/2	49.35	Southern
					103	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	138/1	36.35	Uva
					110	AA002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	148/1	100.10	Southern
					107	B466	Weligama - Telijjawila	4/1	46.30	Southern
7	10/8 (Fri)	Matara	Colombo	AA017, AA004	108	B142	Hakmana - Meella - Talahaganwaduwa	4/1	30.40	Southern
					106	B607	Bengamuwa - Molokgamuwa - Galdola	10/1	30.40	Southern
					101	AA004	Colombo - Ratnapura - Wellawaya - Batticaloa	99/6	24.60	Sabaragamuwa

Actual Progress of Reconnaissance Survey / Eastern Sri Lanka
Carried out by TEAM B (Mr.Sato)

DAY		ORIGIN	DESTINATION	VIA	INVENTORY NO.	ROAD NO.	ROAD NAME	BR. NO.	BR. LENGTH (m)	PROVINCE
1	02/8 (Thu)	Colombo	Kandy	A01	1	B413	Tennekumbura - Rikiligaskada - Ragala	42/1	38.50	Central
					2	B492	Kandehandiya - Adikarigama - Randenigala - Loggal Oya	35/10	35.00	Central
2	03/8 (Fri)	Kandy	Polonnaruwa	A10, Kurunegala, A6, Mahiyanganaya, Habarana, A11	45	B264	Mallawapitiya - Rambodagalla - Keppetigala	30/2	37.55	North Western
					26	AA011	Maradankadawela - Habarana - Tirikkondiadimadu	78/1	35.30	North Central
3	04/8 (Sat)	Polonnaruwa	Ampara	A11, AB44, B517, B502, A05, A27	27	AA011	Maradankadawela - Habarana - Tirikkondiadimadu	82/3	62.00	North Central
					42	B517	Dehiattakandiya - Aralaganwila	4/1	40.50	North Central
					15	AA005	Peradeniya - Badulla - Chenkaladi (PBC)	241/1	149.00	Eastern
					20	AA005	Peradeniya - Badulla - Chenkaladi	247/2	48.00	Eastern
4	05/8 (Sun)	Ampara	Ampara	A31	18	B483	Sammanthurai - Malkampiddi - Deegawapiya	3/2	32.30	Eastern
					21	AA31	Karaithivu - Ampara	2/1	62.00	Eastern
					22	AA31	Karaithivu - Ampara	1/2	82.00	Eastern
					19	B187	Kalmunai - Chavalakadai	4/3	48.00	Eastern
5	06/8 (Man)	Ampara	Wellawaya	A25, Siyambalanduwa, A4, A02	120	B427	Udawalawe - Tanamalwila	20/4	39.10	Uva
					138	B496	Thanamalwila - Hambegamuwa (Thanamalwila - Bodagama)	41/1	35.90	Uva
6	07/8 (Tue)	Wellawaya	Colombo	A04	82	AA004	Colombo - Ratnapura - Wellawaya - Batticaloa	157/6	33.80	Sabaragamuwa

Actual Progress of Reconnaissance Survey / Northern Sri Lanka
Including Additional 6 Bridges Carried out by TEAM C (Mr.Yokoyama)

DAY		ORIGIN	DESTINATION	VIA	INVENTORY NO.	ROAD NO.	ROAD NAME	BR. NO.	BR. LENGTH (m)	PROVINCE
1	06/8 (Man)	Colombo	Mannar	Puttalam, Anuradhapura	48	B379	Puttalam - Marichchikadai	9/2	40.00	North Western
					51	B379	Puttalam - Marichchikadai	32/1	60.00	North Western
					39	B564	Otappuwa - Ihalawewa	10/2	45.00	North Central
					58	AA014	Medawachchiya - Mannar - Talaimannar	31/1	31.50	Northern
2	07/8 (Tue)	Mannar	Jaffna	B403, AA032	66	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	7/1	90.00	Northern
					67	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	39/2	70.00	Northern
					165	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	23/3	91.00	Northern
					166	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	21/1	70.00	Northern
					65	AA032	Navakkuli - Kerativu - Mannar	(71+660)	45.00	Northern
					63	AA032	Navakkuli - Kerativu - Mannar	(59+610)	46.50	Northern
					64	AA032	Navakkuli - Kerativu - Mannar	(32+482)	60.00	Northern
3	08/8 (Wed)	Jaffna	Jaffna	AB020, AA009	59	AB020	Jaffna - Point Pedro	21/1	73.00	Northern
					167	AA009	Kandy - Jaffna	309/1	81.00	Northern
					168	AA009	Kandy - Jaffna	314/2	81.00	Northern
4	09/8 (Thu)	Jaffna	Jaffna	AB019	60	AB039	Valukkairaru - Pungudutivu - Kurikadduvan	New	1500.00	Northern
					62	AB017	Jaffna - Manipai - Karainagar	New	500.00	Northern
					61	AB039	Valukkairaru - Pungudutivu - Kurikadduvan	New	2000.00	Northern
					169	AB019	Jaffna - Pannai - Kayts	---	27.00	Northern
5	10/8 (Fri)	Jaffna	Vavuniya	AA009, AA039, Parathan, Mullaittivu, B297, B296, Puliyankulama	56	AA035	Construction of Waduwakkal Bridge across Nantikadal Lagoon	---	450.00	Northern
					55	---	Construction of Sellvapuram Bridge across Nantikadal Lagoon	---	118.00	Northern
					170	AA035	Parantan - Mullaitive Highway	(33/3)	22.00	Northern
					16	New Bridge	Muativu - Kokilai - Pulmoodai Road	New	1000.00	Eastern
6	11/8 (Sat)	Vavuniya	Anuradhapura	AA029, Trincomalee, AA006, AA012	38	B060	Bogahawewa - Pulmuddai	3/1	81.00	North Central
					41	B538	Kahatagasdigiliya - Rathmalgahaweewa - Kivulekade	20/1	42.00	North Central
					17	AA006	Ambepussa - Kurunegala - Trincomalee (AKT)	184/1	36.95	Eastern
7	12/8 (Sun)	Anuradhapura	Colombo	AA028, AA010, Kurunegala, AA010, AA006, AA012	30	B182	Kalawewa - Avukana	4/2	43.00	North Central
					23	AA028	Anuradhapura - Padeniya	30/1	156.60	North Central
					43	AA028	Anuradhapura - Padeniya	75/4	96.30	North Western
					46	New Bridge	Across Deduru Oya (Closed to Rasnayakepura - Kadigawa Road)	New	100.00	North Western

Actual Progress of Reconnaissance Survey / 7 nos. Additional Bridges in August
Carried out by Mr.Yokoyama

DAY		ORIGIN	DESTINATION	VIA	INVENTORY NO.	ROAD NO.	ROAD NAME	BR. NO.	BR. LENGTH (m)	PROVINCE
1	29/8 (Wed)	Colombo	Colombo	E01, AA002	113	Non RDA	Polwatta - Denipitiya	-	100	Southern
					173	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	53/1	22.20	Western
					171	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	52/1	24.30	Western
					172	A002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	1/1	36.60	Western
2	30/8 (Thu)	Colombo	Colombo	AA004	176	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	64/1	24.50	Western
					175	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	49/1	21.80	Western
					174	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	42/1	27.00	Western

Actual Progress of Reconnaissance Survey / 8 nos. Additional Bridges in October
Carried out by Mr.Yokoyama

DAY		ORIGIN	DESTINATION	VIA	INVENTORY NO.	ROAD NO.	ROAD NAME	BR. NO.	BR. LENGTH (m)	PROVINCE
1	16/10 (Wed)	Colombo	Colombo	Aroud Colombo	177	B435	Orugodawata - Ambatale	3/1	40.1	Western
					178	AA001	Colombo - Kandy	6/1	17.30	Western
		Gampaha	Yakkaala		179	B416	Thihariya - Warapalana	2/6	39.30	Western
		Kaluthana	Bulathsinhala		180	B304	Nagoda - Kalawaellawa - Bellapitiya	35/4	42.20	Western
2	21/10 (Thu)	Kegalle	Kegalle	Kegalle	181	A0014	Colombo - Kandy	60/1	30.20	Sabaragamuwa
					182	B279	Mawanella - Hemmathagama - Gampala	17/1	30.20	Sabaragamuwa
					183	B279	Mawanella - Hemmathagama - Gampala	12/2	20.40	Sabaragamuwa
					184	B279	Mawanella - Hemmathagama - Gampala	11/2	36.00	Sabaragamuwa

Source) Study Team

Based on the results of reconnaissance survey, the Study Team provided the out-line alignment design of each bridge and decided both bridge and approach lengths for the out-line cost estimation.

Table 2.3-2 shows the “Summary of Results of Investigations and Draft Recommendations of 63 nos Bridges”.

Table 2.3-3 shows the “Summary of Results of Investigations and Draft Recommendations of 13 nos Additional Bridges”.

Table 2.3-4 shows the “Summary of Results of Investigations and Draft Recommendations of 8 nos Advance Additional Bridges”.

Table 2.3-2 Summary of Results of Investigations and Draft Recommendations of 63 nos Bridges 1/3

Inventory No.	Road No.	Road Name	Bridge No.	Bridge Name	Existing Bridge							Proposed Nos. of Lanes	Recommendation				Province	District
					Length (m)	Width (m)		Soundness			Flood Records		Existing Bridge	New Bridge (m)	Approach (m)			
						Over All	Cb-to-Cb	Super-Structure	Sub-Structure	Loading Capacity					NS	FS		
1	B413	Tennekumbura - Rikiligaskada - Ragala	42/1	Padiyapelella	38.50	5.60	4.80	Good	Good	Sufficient		2	To be used	-	-	-	Central	Nuwara Eliya
2	B492	Kandehandiya - Adikarigama - Randenigala - Loggal Oya	35/10		35.00	5.20	4.80	Good	Good	Sufficient		2	To be removed	35	100	100	Central	Nuwara Eliya
15	AA005	Peradeniya - Badulla - Chenkaladi (PBC)	241/1	Mahapalama	155.75	5.20	4.20	Good	Critical	Sufficient		2	To be demolished	180	800	450	Eastern	Eastern
16	New Bridge	Muativu - Kokilai - Pulmoodai Road	New	Kokilai	1,000							2		1,150	500	500	Eastern	Trincomalee
17	AA006	Ambepussa - Kurunegala - Trincomalee (AKT)	184/1	Palampataru	36.95	6.60	6.35	Poor	Fair	Insufficient		4	To be demolished	60	200	200	Eastern	Trincomalee
18	B483	Sammanthurai - Malkampiddi - Deegawapiya	3/2	Pallaaru	23.15	4.90	4.17	Good	Critical	Insufficient	Insufficient Br opening	2	To be demolished	75	200	200	Eastern	Ampara
19	B187	Kalmunai - Chavalakadai	4/3	Kiddanki Bridge - 1	30.40	6.26	5.32	Fair	Fair	Insufficient	Insufficient Br opening	2	To be used	-	-	-	Eastern	Ampara
20	AA005	Peradeniya - Badulla - Chenkaladi	243/3														Eastern	Ampara
21	AA031	Karaithivu - Ampara	2/1		59.20	5.90	5.30	Good	Good	Insufficient	Submerged during floods	2	To be demolished	180	300	250	Eastern	Ampara
22	AA031	Karaithivu - Ampara	1/2		63.05	5.10	4.20	Good	Good	Insufficient		2	To be demolished	120	500	300	Eastern	Ampara
23	AA028	Anuradhapura - Padeniya	30/1	Kala oya	156.60	8.70	7.40	Good	Good	Sufficient		4	To be used	160	100	100	North Central	Anuradhapura
26	AA011	Maradankadawela - Habarana - Tirikkondiadimadu	78/1	Kotaleeya	34.80	6.70	5.42	Fair	Good	Sufficient	Submerged during floods	2	To be demolished	200	300	400	North Central	Polonnaruwa
27	AA011	Maradankadawela - Habarana - Tirikkondiadimadu	82/3	500 Feet Bridge	60.40	6.80	5.15	Fair	Good	Sufficient	Submerged during floods	2	To be demolished	150	300	200	North Central	Polonnaruwa
30	B182	Kalawewa - Avukana	4/2	Kalaoya Causeway	43.00	5.60	5.00	Fair	-	Insufficient	5m above causeway	2	-	-	-	-	North Central	Anuradhapura
38	B060	Bogahawewa - Pulmuddai	3/1	Alth halmillama	81.00	5.70	5.70	-	-	-		2	-	-	-	-	North Central	Anuradhapura
39	B564	Otappuwa Ihalawewa	10/2	Karabaya Causeway	45.00	12.00	7.60	-	-	Insufficient	Submerged 3 months	2	To be demolished	45	200	200	North Central	Anuradhapura
41	B538	Kahatagasdigiliya - Rathmalgahaweewa - Kivulekade	20/2		42.00	6.70	5.50	-	-	-		2	-	-	-	-	North Central	Anuradhapura
42	B517	Dehiattakandiya - Aralaganwila	3/1		40.40	9.00	6.95	Good	Poor	Sufficient		2	To be demolished	50	250	250	North Central	Polonnaruwa
43	AA028	Anuradhapura - Padeniya	75/4	Deduruoya	96.30	8.40	6.80	Fair	Good	Sufficient		4	To be used	100	200	400	North Western	Kurunegala
45	B264	Mallawapitiya - Rambodagalla - Keppetigala	30/2	Meeliyadda Palama	36.70	4.20	3.20	Fair	Good	Insufficient		2	To be demolished	70	150	100	North Western	Kurunegala
46	New Bridge	Across Deduru Oya (Closed to Rasnayakepura-Kadigawa Road)	New	Kadigawa	100							2	-	-	-	-	North Western	Kurunegala
48	B379	Puttalam - Marichchikadai	9/2	Mee Oya	40.00	6.60	4.00	Poor	Fair	Insufficient	Lower than soffit	2	To be demolished	40	200	300	North Western	Puttalam
51	B379	Puttalam - Marichchikadai	32/1		60.00	3.60	3.60	Fair	-	Insufficient	3m above causeway	2	To be used	120	400	500	North Western	Puttalam

Source) Study Team

Table 2.3-2 Summary of Results of Investigations and Draft Recommendations of 63 nos Bridges 2/3

Inventory No.	Road No.	Road Name	Bridge No.	Bridge Name	Existing Bridge							Proposed Nos. of Lanes	Recommendation				Province	District
					Length (m)	Width (m)		Soundness			Flood Records		Existing Bridge	New Bridge (m)	Approach (m)			
						Over All	Cb-to-Cb	Super-Structure	Sub-Structure	Loading Capacity					NS	FS		
53	AA003	Peliyagoda - Puttalam	92/4		42.50	6.10	5.50	Poor	Fair	Insufficient		4	To be demolished	55	100	100	North Western	Puttalam
54	AA003	Peliyagoda - Puttalam	94/2	Ratambala Oya	115.50	10.60	7.30	Good	Good	Sufficient		4	To be used	-	-	-	North Western	Puttalam
55	New Bridge	Construction of Sellvapuram Bridge across Nantikadal Lagoon	New	Sellvapuram Causeway	118.00	7.50	7.50	-	-	Insufficient		2	To be used	-	-	-	Northern	Mulative
56	New Bridge	Construction of WaduwakkalBridge across Nantikadal Lagoon	New	Waduwakkal Causeway	450	5.00	5.00	Poor	Poor	Insufficient	1m above causeway	2	To be demolished	80	200	400	Northern	Mulative
58	AA014	Medawachchiya - Mannar - Talaimannar	31/1	Kotaleeya	31.50	4.80	4.80	Poor	Good	Insufficient		2	To be demolished	50	100	300	Northern	Vavuniya
59	AB020	Jaffna - Point Pedro	21/2	Walley	73.00	9.10	7.30	Fair	Good	Sufficient		2	To be used	-	-	-	Northern	Jaffna
60	AB039	Valukkairaru - Pungudutivu - Kurikadduvan	New		1,500							2		1,000	600	1000	Northern	Jaffna
61	AB039	Valukkairaru - Pungudutivu - Kurikadduvan	New		2,000							2		-	-	-	Northern	Jaffna
62	AB017	Jaffna-Manipai-Karainagar	New		500							2		600	250	250	Northern	Jaffna
63	AA032	Navakkuli - Kerativu - Mannar	(59+610)	Pali aru Bridge with Causeway	46.50	7.40	7.40	Fair	-	Insufficient		2	To be demolished	60	200	200	Northern	Mannar
64	AA032	Navakkuli - Kerativu - Mannar	(32+540)	Nachchikuda Causeway	60.00	7.00	7.00	Poor	-	Insufficient	2m above causeway	2	To be demolished	100	200	200	Northern	Kilinochchi
65	AA032	Navakkuli - Kerativu - Mannar	(71+660)	Kalliyadi	45.00	7.40	7.40	Fair	-	Insufficient		2	To be demolished	80	200	400	Northern	Mannar
66	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	7/1	Aru - Kuli Causeway	90.00	5.00	5.00	Poor	-	Insufficient	1.5m above causeway	2	To be demolished	60	150	200	Northern	Mannar
67	B403	Thallady - Arippu - Marichchukaddy Southcoast Road	39/2	Kal Aru Causeway	70.00	6.10	6.10	Poor	-	Insufficient		2	To be demolished	100	200	200	Northern	Mannar
69	AA007	Avissawella - Hatton - Nuwara Eliya	38/3	Kiulgala	60.00	9.50	7.60	Good	Good	Sufficient		2	To be used	-	-	-	Sabaragamuwa	Kegalle
71	B408	Talduwa - Meewitigammana	5/2	Kelani	120.20	7.30	5.50	Good	Good	Sufficient		2	To be used FTB	-	-	-	Sabaragamuwa	Kegalle
77	B604	Paragammana - Dikella - Atugoda - Wanduradeniya	15/8	Wanduradeniya	42.40	4.90	3.90	Good	Good	Sufficient		2	To be used FTB	-	-	-	Sabaragamuwa	Kegalle
82	AA004	Colombo - Ratnapura - Wellawaya - Batticaloa	159/1	Belihuloya	34.50	6.30	5.20	Good	Critical	Insufficient		2	To be used FTB	350	100	100	Sabaragamuwa	Ratnapura
83	AA021	Kegalle - Bulathkohupitiya - Karawanella	11/4														Sabaragamuwa	Kegalle
101	AA004	Colombo - Ratnapura - Wellawaya - Batticaloa	99/6		24.60	11.20	7.50	Good	Good	Sufficient		4	To be used	50	70	50	Sabaragamuwa	Ratnapura
103	AA002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	138/1	Goiyapana	48.75	12.10	10.30	Critical	Fair	Sufficient		4	To be demolished	70	200	200	Southern	Galle
106	B607	Bengamuwa - Molokgamuwa - Galdola	10/1		30.40	4.00	3.40	Fair	Fair	Insufficient		2	To be used FTB	-	-	-	Southern	Matara
107	B466	Weligama - Telijjawila	4/1	Denipitiya	46.30	5.10	4.80	Fair	Fair	Insufficient		2	To be demolished	50	250	250	Southern	Matara
108	B142	Hakmana - Meella - Talahaganwaduwa	4/1	Denagama	30.40	3.50	3.30	Fair	Poor	Insufficient		2	To be demolished	60	300	100	Southern	Matara

Source) Study Team

Table 2.3-2 Summary of Results of Investigations and Draft Recommendations of 63 nos Bridges 3/3

Inventory No.	Road No.	Road Name	Bridge No.	Bridge Name	Existing Bridge							Proposed Nos. of Lanes	Recommendation				Province	District
					Length (m)	Width (m)		Soundness			Flood Records		Existing Bridge	New Bridge (m)	Approach (m)			
						Over All	Cb-to-Cb	Super-Structure	Sub-Structure	Loading Capacity					NS	FS		
109	B153	Hikkaduwa - Baddegama - Nilhena Road	10/4	Halpatota	45.00	5.50	5.50	Poor	Good	Insufficient		2	To be used FTB	140	150	300	Southern	Galle
110	AA002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	148/1	Polwathumodara	100.10	8.20	5.50	Fair	Fair	Insufficient		4	To be used FTB	150	250	150	Southern	Matara
112	AA002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	133/2	Kathalu Bridge (Pol Oya Bridge)	49.35	10.20	9.60	Critical	Fair	Sufficient		4	To be demolished	110	300	150	Southern	Galle
116	B128	Galle - Baddegama	15/2	Kahabiliya	31.25	5.90	5.30	Fair	Fair	Insufficient		2	To be demolished	50	100	100	Southern	Galle
117	B130	Galle-Wackwella	8/7	Part of Gin ganga	24.40	6.30	5.20	Fair	-	Insufficient		2	To be demolished	30	200	100	Southern	Galle
120	B427	Udawalawe - Tanamalwila	20/5	Maw Ara	38.83	6.70	4.80	Fair	Good	Insufficient		2	To be removed	50	200	100	Uv a	Monaragala
123	AA004	Colombo - Ratnapura - Wellaway a - Batticaloa	192/2														Uv a	Badulla
124	AA004	Colombo - Ratnapura - Wellaway a - Batticaloa	196/7														Uv a	Badulla
138	B496	Thanamalwila - Hambegamuwa (Thanamalwila - Bodagama)	41/1	Weli Oya	36.35	4.60	4.00	Fair	Fair	Insufficient		2	To be demolished	80	200	300	Uv a	Monaragala
139	AA002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	20/1	Digarolla	197.20	8.04	5.85	Critical	Fair	Insufficient		2	To be demolished	200	200	200	Western	Kaluthara
144	B157	Horana - Anguruwatota - Aluthgama	8/5		**34.40**	6.20	5.50	Fair	-	Insufficient		4	To be used FTB	40	200	200	Western	Kaluthara
145	B388	Ratmalana - Borupona	2/5		81.00	9.30	7.40	Fair	Good	Insufficient		2	To be used FTB	-	-	-	Western	Colombo
152	AB010	Colombo - Hanwella - low level road	9/1	Ambathale	33.50	9.80	6.90	Fair	-	Insufficient		4	To be used FTB	35	250	300	Western	Colombo
153	AB010	Colombo - Hanwella - low level road	15/1	Welehandiya	37.70	9.80	6.90	Poor	Fair	Insufficient		4	To be used FTB	40	200	150	Western	Colombo
154	AB010	Colombo - Hanwella - low level road	24/1		41.70	5.95	5.50	Poor	Fair	Insufficient		4	To be used FTB	45	300	200	Western	Colombo
155	AB010	Colombo - Hanwella - low level road	26/4									4					Western	Colombo
156	AB010	Colombo - Hanwella - low level road	28/1		42.40	8.30	6.80	Poor	Fair	Insufficient		4	To be used FTB	45	250	550	Western	Colombo
157	New Bridge	Galpatha - Yatawara - Kethhena - Rubber factory road	**New**		(110)	(10.4)						2	-	-	-	-	Western	Kaluthara
159	AA004	Colombo - Ratnapura - Wellaway a - Batticaloa	33/3	Galagedara	57.00	10.40	7.40	Good	Fair	Sufficient		4	To be used	60	300	300	western	Colombo

Notes: : 25 Nos. Bridges more than 30m long investigated by Team A.
: 15 Nos. Bridges more than 30m long investigated by Team B.
: 23 Nos. Bridges more than 30m long investigated by Team C.
: 3 Nos. Bridges more than 30m cancelled.

Notes: Cb-to-Cb : Curb-to-Curb
FTB : For the time being

Source) Study Team

Table 2.3-3 Summary of Results of Investigations and Draft Recommendations of 13 nos Bridges in August

Inventory No.	Road No.	Road Name	Bridge No.	Bridge Name	Existing Bridge							Proposed Nos. of Lanes	Recommendation				Province	District
					Length (m)	Width (m)		Soundness			Flood Records		Existing Bridge	New Bridge (m)	Approach (m)			
						Over All	Cb-to-Cb	Super-Structure	Sub-Structure	Loading Capacity					NS	FS		
165	B403	Thallady - Arippu - Marichchukaddy South Coast Road	23/3		91.00	4.20	4.20	Fair	-	Insufficient	0.5m above causeway	2	To be demolished	100	200	200	Nothern	Mannar
166	B403	Thallady - Arippu - Marichchukaddy South Coast Road	21/1	Arippu Causeway	70.00	4.20	4.20	Poor	-	Insufficient	1.5m above causeway	2	To be demolished	60	200	150	Nothern	Mannar
167	AA009	Kandy - Jaffna	309/1	Kaithady	81.00	9.10	7.30	Fair	Good	Sufficient		2	To be used	-	-	-	Nothern	Jaffna
168	AA009	Kandy - Jaffna	314/2	Navathuli	81.00	9.10	7.30	Fair	Good	Sufficient		2	To be removed	100	100	100	Nothern	Jaffna
169	AB019	Jaffna - Pannai - Kayts	-	Panney	27.00	9.10	7.30	Fair	Good	Sufficient		2	To be used	-	-	-	Nothern	Jaffna
170	A035	Paratan - Mullaitivu	3/3		22.00	8.00	6.00	Critical	Poor	Insufficient		2	To be demolished	30	200	600	Nothern	Mulative
171	A002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	52/1	Maggona	24.30	12.70	9.80	Critical	Fair	Insufficient		4	To be demolished	40	250	250	Western	Kaluthara
172	A002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	1/1	Baira Lake	36.60	30.00	18.47	Critical	Poor	Insufficient		6	To be demolished	45	100	100	Western	Colombo
173	A002	Colombo - Galle - Hambantota - Wellaway a (CGHW)	53/1	Maggona 2	22.20	13.70	9.70	Poor	Poor	Sufficient		4	To be demolished	60	150	200	Western	Kaluthara
174	A004	Colombo - Ratnapura - Wellaway a - Batticaloa	42/1	Wak Oya	27.00	11.10	9.00	Good	Good	Sufficient		Parallel 2	To be used	-	-	-	Western	Colombo
175	A004	Colombo - Ratnapura - Wellaway a - Batticaloa	49/1	Rubbur Kade	21.80	8.30	7.30	Fair	Fair	Sufficient		Parallel 2	To be used	-	-	-	Western	Colombo
176	A004	Colombo - Ratnapura - Wellaway a - Batticaloa	64/1		24.50	8.46	6.50	Good	Good	Sufficient		Parallel 2	To be used FTB	35	150	150	Western	Ratnapura
113	Non RDA	Polwatta - Denipitiya		Polawatta	100	3.70	2.80	Critical	Critical	Insufficient		2	To be demolished	110	150	150	Southern	Matara

Notes: : 6 Nos. Additional Bridges proposed by RDA Provincial Director's Office and investigated by Team C

: 7 Nos. Additional Bridges newly proposed by RDA

Notes: Cb-to-Cb : Curb-to-Curb

FTB : For the time being

Source) Study Team

Table 2.3-4 Summary of Results of Investigations and Draft Recommendations of 8 nos Additional Bridges in October

Inventory No.	Road No.	Road Name	Bridge No.	Bridge Name	Existing Bridge							Proposed Nos. of Lanes	Recommendation				Province	District
					Length (m)	Width (m)		Soundness			Flood Records		Existing Bridge	New Bridge (m)	Approach (m)			
						Over All	Cb-to-Cb	Super-Structure	Sub-Structure	Loading Capacity					NS	FS		
177	B435	Orugodawata - Ambatale	3/1	WAELAMPITIYA Bridge	40.10	13.50	10.30	Good	Fair	Insufficient		2	To be used	-	-	-	Western	Colombo
178	AA001	Colombo - Kandy	6/1	Doguru Kacle Bridge	17.30	24.60	17.00	Fair	Fair	Insufficient		4	To be used	-	-	-	Western	Colombo
179	B416	Thihariya - Warapalana	2/6	KALATUWAWA Bridge	39.30	5.30	4.20	Fair	Good	Insufficient		2	To be demolished	45	100	100	Western	Gampaha
180	B304	Nagoda - Kalawaellawa - Bellapitiya	35/4	ALUKATIYA Bridge	42.20	5.80	4.60	Good	Fair	Insufficient		2	To be demolished	80	100	100	Western	Kaluthana
181	AA001	Colombo - Kandy	60/1	Ambepussa Junction Bridge	30.20	14.00	11.00	Good	Fair	Insufficient		2	To be used	-	-	-	Sabaragamuwa	Kegalle
182	B279	Mawanella - Hemmathagama - Gampala	17/1	Alakoladeniya Palama Bridge	30.20	3.60	3.20	Fair	Good	Insufficient		2	Another Fund	-	-	-	Sabaragamuwa	Kegalle
183	B279	Mawanella - Hemmathagama - Gampala	12/2	Wagolla	20.40	4.00	4.00	Fair	Fair	Insufficient	2m above causeway	2	To be demolished	45	100	100	Sabaragamuwa	Kegalle
184	B279	Mawanella - Hemmathagama - Gampala	11/2	Polawatta	36	6.00	4.20	Fair	Good	Insufficient		2	To be removed	45	100	100	Sabaragamuwa	Kegalle

Source) Study Team

Table 2.3-5 13 nos Existing Bridges to Be Used

Inventory No.	Road No.	Road Name	Bridge No.	Bridge Name	Existing Bridge						Proposed Nos. of Lanes	Recommendation				Province	District
					Length (m)	Width (m)		Soundness			Flood Records		Existing Bridge	New Bridge (m)	Approach (m)			
						Over All	Cb-to-Cb	Super-Structure	Sub-Structure	Loading Capacity					NS	FS		
23	AA028	Anuradhapura - Padeniya	30/1	Kala oya	156.60	8.70	7.40	Good	Good	Sufficient		4	To be used	160	100	100	North Central	Anuradhapura
54	AA003	Peliyagoda - Puttalam	94/2	Ratambala Oya	115.50	10.60	7.30	Good	Good	Sufficient		4	To be used	-	-	-	North Western	Puttalam
59	AB020	Jaffna - Point Pedro	21/2	Walley	73.00	9.10	7.30	Fair	Good	Sufficient		2	To be used	-	-	-	Northern	Jaffna
69	AA007	Avissawella - Hatton - Nuwara Eliya	38/3	Kiulgala	60.00	9.50	7.60	Good	Good	Sufficient		2	To be used	-	-	-	Sabaragamuwa	Kegalle
101	AA004	Colombo - Ratnapura - Wellawaya - Batticaloa	99/6		24.60	11.20	7.50	Good	Good	Sufficient		4	To be used	50	70	50	Sabaragamuwa	Ratnapura
159	AA004	Colombo - Ratnapura - Wellawaya - Batticaloa	33/3	Galagedara	57.00	10.40	7.40	Good	Fair	Sufficient		4	To be used	60	300	300	western	Colombo
167	AA009	Kandy - Jaffna	309/1	Kaithady	81.00	9.10	7.30	Fair	Good	Sufficient		2	To be used	-	-	-	Nothern	Jaffna
169	AB019	Jaffna - Pannai - Kayts	-	Panney	27.00	9.10	7.30	Fair	Good	Sufficient		2	To be used	-	-	-	Nothern	Jaffna
174	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	42/1	Wak Oya	27.00	11.10	9.00	Good	Good	Sufficient		Parallel 2	To be used	-	-	-	Western	Colombo
175	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	49/1	Rubbur Kade	21.80	8.30	7.30	Fair	Fair	Sufficient		Parallel 2	To be used	-	-	-	Western	Colombo
177	B435	Orugodawata - Ambatale	3/1	WAELAMPITIYA Bridge	40.10	13.50	10.30	Good	Fair	Insufficient		2	To be used	-	-	-	Western	Colombo
178	AA001	Colombo - Kandy	6/1	Doguru Kacle Bridge	17.30	24.60	17.00	Fair	Fair	Insufficient		4	To be used	-	-	-	Western	Colombo
179	AA001	Colombo - Kandy	60/1	Ambepussa Junction Bridge	30.20	14.00	11.00	Good	Fair	Insufficient		2	To be used	-	-	-	Sabaragamuwa	Kegalle

Source) Study Team

Table 2.3-6 13 nos Existing Bridges to Be Used for The Time Being

Inventory No.	Road No.	Road Name	Bridge No.	Bridge Name	Existing Bridge						Flood Records	Proposed Nos. of Lanes	Recommendation				Province	District
					Length (m)	Width (m)		Soundness					Existing Bridge	New Bridge (m)	Approach (m)			
						Over All	Cb-to-Cb	Super-Structure	Sub-Structure	Loading Capacity					NS	FS		
71	B408	Talduwa - Meewitigammana	5/2	Kelani	120.20	7.30	5.50	Good	Good	Sufficient		2	To be used FTB	-	-	-	Sabaragamuwa	Kegalle
77	B604	Paragammana - Dikella - Atugoda - Wanduradeniya	15/8	Wanduradeniya	42.40	4.90	3.90	Good	Good	Sufficient		2	To be used FTB	-	-	-	Sabaragamuwa	Kegalle
82	AA004	Colombo - Ratnapura - Wellawaya - Batticaloa	159/1	Belihuloya	34.50	6.30	5.20	Good	Critical	Insufficient		2	To be used FTB	350	100	100	Sabaragamuwa	Ratnapura
106	B607	Bengamuwa - Molokgamuwa - Galdola	10/1		30.40	4.00	3.40	Fair	Fair	Insufficient		2	To be used FTB	-	-	-	Southern	Matara
109	B153	Hikkaduwa - Baddegama - Nilhena Road	10/4	Halpatota	45.00	5.50	5.50	Poor	Good	Insufficient		2	To be used FTB	140	150	300	Southern	Galle
110	AA002	Colombo - Galle - Hambantota - Wellawaya (CGHW)	148/1	Polwathumodara	100.10	8.20	5.50	Fair	Fair	Insufficient		4	To be used FTB	150	250	150	Southern	Matara
144	B157	Horana - Anguruwatota - Aluthgama	8/5		**34.40**	6.20	5.50	Fair	-	Insufficient		4	To be used FTB	40	200	200	Western	Kaluthara
145	B388	Ratmalana - Borupona	2/5		81.00	9.30	7.40	Fair	Good	Insufficient		2	To be used FTB	-	-	-	Western	Colombo
152	AB010	Colombo - Hanwella - low level road	9/1	Ambathale	33.50	9.80	6.90	Fair	-	Insufficient		4	To be used FTB	35	250	300	Western	Colombo
153	AB010	Colombo - Hanwella - low level road	15/1	Welehandiya	37.70	9.80	6.90	Poor	Fair	Insufficient		4	To be used FTB	40	200	150	Western	Colombo
154	AB010	Colombo - Hanwella - low level road	24/1		41.70	5.95	5.50	Poor	Fair	Insufficient		4	To be used FTB	45	300	200	Western	Colombo
156	AB010	Colombo - Hanwella - low level road	28/1		42.40	8.30	6.80	Poor	Fair	Insufficient		4	To be used FTB	45	250	550	Western	Colombo
176	A004	Colombo - Ratnapura - Wellawaya - Batticaloa	64/1		24.50	8.46	6.50	Good	Good	Sufficient		Parallel 2	To be used FTB	35	150	150	Western	Ratnapura

Source) Study Team

CHAPTER 3 IDENTIFICATION OF THE BRIDGE FOR REHABILITATION AMONG THE RDA PROPOSED BRIDGES

3.1 Number of Target Bridges to be Reconstructed

Among the 79 bridges (ref: Table 3.1-1) to be considered, target bridges were selected in consideration of necessity of reconstruction. And also urgency of reconstruction was studied.

Results of identification of target bridges are summarized as follows:

Table 3.1-1 Results of Identification of Target Bridges

Stage		Items	Number of Bridge					Total
			Original Request	Addition in Northern Area	Addition on A002 / A004	Addition in suburban Colombo	Addition in suburban Keggalla	
Stage-1	All Bridges	Managed by RDA (Class-A and Class-B Roads)	4,200	---	---	---	---	4,200 (1,000) (*1)
Stage-2	Bridges needed Replacement / New Construction	Serious Damage / High Priority	164 (*2)	6	7 (*2)	4	4	184 (*2)
Stage-3	Bridges needed Advanced Technical Capabilities from Japan	Over 30m Bridge Length	59	6	7	4	3	79
			(*3)	(*4)	(*5)	(*6)	(*7)	

Source) RDA

*1 Within 4,200 Bridges belong to RDA, 1,000 bridges are longer than 30m length.

*2 Within additional 7 Bridges, No113 is already included in 164 bridges, consequently total number of bridges are 184.

*3 Under construction : one(1), not existed : one(1), under other donor's project : five(5) Total seven(7) bridges are not included.

*4 Two(2) bridges with their length less than 30m are included, since they are expected to be more than 30m length after construction.

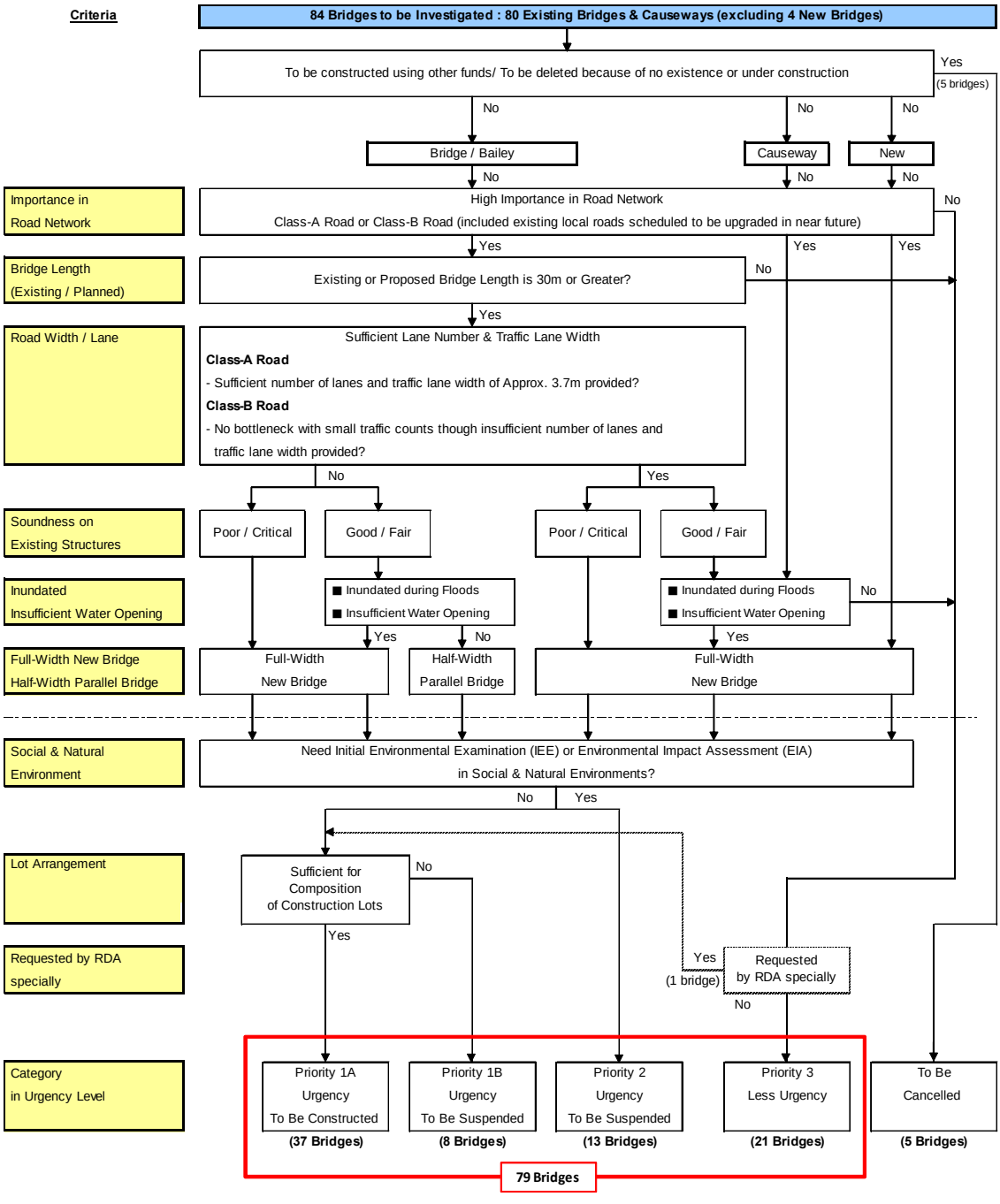
*5 Five(5) bridges with their length less than 30m are included, since they are expected to be more than 30m length after construction.

*6 One(1) bridge with its length less than 30m is included, since it is expected to be more than 30m length after construction.

*7 Exclude one (1) bridge under other donor's project.
One (1) bridge with its length less than 30m is included, since it is expected to be more than 30m length after construction.

3.2 Criteria for Recommended Bridges to be Reconstructed

Following Selection Procedure with Criteria (ref:Figure3.2-1)was applied for the determination of the necessity and the urgency of reconstruction. This criteria was prepared in collaboration with RAD and relevant environmental agencies to meet the needs of GoSL.



Note: Half-width parallel bridge should have minimum two (2) lanes.

Source) Study Team

Figure 3.2-1 Selection Procedure with Criteria

(1) Importance in The Road Network

Importance of bridges in the road network was evaluated based on road's functional classifications, high traffic volume and no alternative route.

Bridges on Class -A & -B roads were regarded as highly important, as they are on main arteries connecting major cities and towns for Class-A roads and on distributors between residential areas, industrial areas, towns, feeder roads of main arteries for Class-B roads. Existing bridges on local road, which will be upgraded to Class -A or -B the roads in the near future, were also considered highly important.

Presence of high traffic volume in the road implies, it's significant importance to social and economic activities in the area. When such road is closed for traffic, no alternative route for such road can be found in the region.

(2) Existing / Proposed Bridge Length

Existing or proposed small bridges with less than 30m in length can be improved by Sri Lankan contractor and such other donor agencies' supports as UK, USA, Spain, Saudi Arabia, China and Kuwait. Therefore, bridges with length 30m or greater were selected for target of the survey.

(3) Road Width / Number of Lanes

Existing narrow bridges will be the bottlenecks in the road network, and may give adverse effects to social and economic activities nationwide. This will be evaluated by curb-to-curb width and number of lanes compared to the requirements from Geometric Design Standards of Roads (RDA, 1998).

Both Class -A and -B roads are classified as national roads, and it is recommended the bridges meet the requirements of 3.7m wide traffic lane and required number of lanes, depending on the PCU basis traffic volume. However, the site survey results revealed that Class-B roads have lesser traffic volume than Class-A, and may impose less effect to traffic flow and so as to social economic activities.

JICA Study team accepted narrower curb to curb width and insufficient number of traffic lanes for bridges on Class B roads if less effect to traffic flow is observed due to low volume of traffic.

(4) Soundness on Existing Structures

Visual inspection was conducted on 84 nos bridges (including 2 nos of impracticable bridges and 3 nos under other donor's project.) with careful attention to damage on primary structural members, which may affect the overall structure. Structural conditions were evaluated with the following criteria:

Table 3.2-1 Evaluation on Structural Soundness

Evaluation	Condition
Good :	■ No defect / minor damage is found.
Fair :	■ It may have small loss of member section, deterioration, crack, scaling and scour. ■ No effect to overall structure is expected.
Poor :	■ Progress of loss of member section, deterioration, crack, scaling and scour is observed. ■ Serious damage such as loss of member section, deterioration, crack, scaling and scour, which may affect overall structure, is observed. ■ It needs urgent measures as repair or reinforcement works.
Critical :	■ Progress of serious damage on primary structural member is observed. ■ Imminent failure is expected. ■ It shall be closed to traffic immediately.

Source) Study Team

(5) Inundated or Insufficient Water Opening

Functionally obsolete bridges with no major problems for the structural integrity over the rivers / watercourses and in the lagoons were selected for urgent replacement.

Interview survey was conducted to RDA provincial office and the surrounding neighborhood if the surveyed bridges were inundated during floods. Such bridges shall be elevated to provide flood-free roads to an all-weather standard.

Where erosion of riverbank near the bridge or scouring around bridge piers is observed, bridge span / length shall be increased to provide sufficient water opening. The bridge is generally constructed at the narrow river segment in order to achieve the economical benefit for its short length. It will expedite the riverbank erosion and scouring, thereby resulting in bridge collapse.

Insufficient freeboard under the bridge deck soffit will also be a problem during floods. Collision of debris to bridge deck will damage the bridge structures if no sufficient freeboard is provided. Deterioration of bridge bearings / stoppers will also be expedited as they are subjected to immersion in water / seawater.

(6) Classification of Bridge Replacement / Reconstruction

Through the selection procedure, bridge replacement / reconstruction is categorized into two (2) types: full-width new bridge construction and half-width parallel bridge, due to the soundness of existing bridge structure and required curb-to-curb width / number of traffic lanes.

Where the existing bridge is structurally not sound and need replacement, “full-width” new bridge shall be constructed irrespective of current width / number of traffic lanes. Structurally sound bridge with insufficient width / number of traffic lanes will need “half-width” parallel bridge.

(7) Restrictions due to Environmental Considerations

Bridges are subjected to social and environmental act / ordinance / regulations for reconstruction, replacement and widening, and need Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) and/or Resettlement Action Plan (RAP). Taking such a long procedure is a problem to an early commencement of the works. Such bridges are intentionally excluded from the Project Scope.

3.3 Recommended Bridges Urgently to Be Improved

Targets Bridges have been classified in accordance with the selection procedure (ref:Figure.3.2-1) to each priority. The Bridge which require urgent reconstruction are belong to priority 1.

Definition of each priority is described below.

1) Priority – 1A : Bridges which need urgent replacement or new construction and well prepared for serious social/environmental impacts which are required for JICA guideline and related Sri Lankan Law and Regulation. 37 bridges

2) Priority – 1B : Bridges which need urgent reconstruction but to be suspended, because the bridges are located in remote area. 8 bridges

3) Priority - 2 :Bridges which need detailed environmental / resettlement assessments through discussions with relevant authorities, though urgent replacement / new construction are required. 13 bridges

4) Priority - 3 :No urgency in replacement or new construction. 21 bridges

Table 3.3-1 Selection Result for Reconstruction 1/4

Selection result for reconstruction

*lot no. 1 : Western & Southern area 2 : Central area 3 : Northern area

Group	No.	Province	District	Road No	Bridge No	Type of Bridge	Importance in Road Netwaork	Bridge Length of 30m or Greater	Sufficient Road Width /Lane	Soundness on Exisiting Structures	Submergence Shortage of water opening	New Bridge Parallel Bridge	Social & Environmental Remarks	Other Remarks	JICA Study Team Priorty	lot
Bridges Requested by RDA Originally	1	Central	Nuwara Eliya	B413	42/1	Bridge	Yes	Yes	No	Good / Fair	--	New Bridge	OK	China Fund	To Be Canceled	
	2	Central	Nuwara Eliya	B492	35/10	Bailey	Yes	Yes	No	Critical	--	New Bridge	Forest Reserve		2	
	15	Eastern	Ampara	AA005	241/1	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK	Insufficient for Composition of Lots	1B	
	16	Eastern	Trincomalee	New Bridge	New	New	Yes	--	--	--	--	New Bridge	Coastal/New Bridge		2	
	17	Eastern	Trincomalee	AA006	184/1	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK	Insufficient for Composition of Lots	1B	
	18	Eastern	Ampara	B483	3/2	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK	Insufficient for Composition of Lots	1B	
	19	Eastern	Ampara	B187	4/3	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	Public Water (Mee Oya)	UK Fund	To Be Canceled	
	20	Eastern	Ampara	AA005	247/2	--	--	--	--	--	--	--	--	Under Construction	To Be Canceled	
	21	Eastern	Ampara	AA031	2/1	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	OK	Insufficient for Composition of Lots	1B	
	22	Eastern	Ampara	AA031	1/2	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	OK	Insufficient for Composition of Lots	1B	
	23	North Central	Anuradhapura	AA028	30/1	Bridge	Yes	Yes	No	--	--	New Bridge	Forest Reserve		2	
	26	North Central	Polonnaruwa	AA011	78/1	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	Flood Plain		2	
	27	North Central	Polonnaruwa	AA011	82/3	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	Forest Reserve		2	
	30	North Central	Anuradhapura	B182	4/2	Causeway	No	--	--	--	--	--	OK		3	
	38	North Central	Anuradhapura	B060	3/1	Causeway	Yes	No	--	--	--	--	OK		3	
	39	North Central	Anuradhapura	B564	10/2	Causeway	Yes	--	--	--	Yes	New Bridge	OK	Insufficient for Composition of Lots	1B	
	41	North Central	Anuradhapura	B538	20/1	Causeway	Yes	No	--	--	--	--	OK		3	
	42	North Central	Polonnaruwa	B517	4/1	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK	Insufficient for Composition of Lots	1B	
	43	North Western	Kurunegala	AA028	75/4	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	2
	45	North Western	Kurunegala	B264	30/2	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	2
	46	North Western	Kurunegala	New Bridge	New	New	No	--	--	--	--	--	OK		3	
	48	North Western	Puttalam	B379	9/2	Bridge	Yes	Yes	No	--	--	New Bridge	Public Water (Mee Oya)		2	
	51	North Western	Puttalam	B379	32/1	Causeway	Yes	--	--	--	Yes	New Bridge	Forest Reserve		2	
	53	North Western	Puttalam	AA003	92/4	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	2
	54	North Western	Puttalam	AA003	94/4	Bridge	Yes	Yes	Yes	Good / Fair	--	--	OK		3	
	55	Northern	Mulative	Non RDA		Causeway	No	Yes	Yes	--	--	--	Coastal/Long Bridge		3	

Source) Study Team

*Coastal/Long Bridge: In the coastal areas, bridges with over 50 meters of newly-built-section are not permitted by CCD's environmental review

*Coastal/New Bridge : In the coastal areas, new bridges instead of existing Causeway are not permitted by CCD's environmental review

Table 3.3-1 Selection Result for Reconstruction 2/4

*lot no. 1 : Western & Southern area 2 : Central area 3 : Northern area

Group	No.	Province	District	Road No	Bridge No	Type of Bridge	Importance in Road Netwaork	Bridge Length of 30m or Greater	Sufficient Road Width /Lane	Soundness on Exisiting Structuress	Submergence Shortage of water opening	Full-Width New Bridge Half-Width Parallel Bridge	Social & Environmental Remarks	Reason to be screened out	JICA Study Team Priority	lot
Bridges Requested by RDA Originally	56	Northern	Mulative	AA035		Causeway	Yes	--	–	--	Yes	New Bridge	Coastal/Long Bridge		2	
	58	Northern	Vavuniya	AA014	31/1	Bridge	Yes	Yes	No	Critical	–	New Bridge	OK		1A	3
	59	Northern	Jaffna	AB020	21/1	Bailey	Yes	Yes	Yes	Good / Fair	–	--	OK		3	
	60	Northern	Jaffna	AB039		Causeway	Yes	--	–	--	Yes	New Bridge	Coastal/New Bridge		2	
	61	Northern	Jaffna	AB039	New	New	No	--	–	--	–	--	Coastal/New Bridge		3	
	62	Northern	Jaffna	AB017		Causeway	Yes	--	–	--	Yes	New Bridge	Coastal/New Bridge		2	
	63	Northern	Mannar	AA032	(59+610)	Causeway	Yes	--	–	--	Yes	New Bridge	OK		1A	3
	64	Northern	Kilinochchi	AA032	(32+482)	Causeway	Yes	--	–	--	Yes	New Bridge	OK		1A	3
	65	Northern	Mannar	AA032	(71+660)	Causeway	Yes	--	–	--	Yes	New Bridge	Coastal/Long Bridge		2	
	66	Northern	Mannar	B403	7/1	Causeway	Yes	--	–	--	Yes	New Bridge	OK		1A	3
	67	Northern	Mannar	B403	39/2	Causeway	Yes	--	–	--	Yes	New Bridge	OK		1A	3
	69	Sabaragamuwa	Kegalle	AA007	38/3	Bridge	Yes	Yes	Yes	Good / Fair	--	--	Soil Erosion		3	
	71	Sabaragamuwa	Kegalle	B408	5/2	Bridge	Yes	Yes	Yes	Good / Fair	--	--	OK		3	
	77	Sabaragamuwa	Kegalle	B604	15/8	Bridge	No	--	–	--	--	--	OK		3	
	82	Sabaragamuwa	Ratnapura	AA004	157/6	Bridge	Yes	Yes	No	Poor / Critical	--	New Bridge	OK		1A	1
	101	Sabaragamuwa	Ratnapura	AA004	99/6	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	Resettlement more than 20		2	
	103	Southern	Galle	AA002	138/1	Bridge	Yes	Yes	Yes	Critical	--	New Bridge	OK		1A	1
	106	Southern	Matara	B607	10/1	Bridge	No	--	–	--	--	--	OK		3	
	107	Southern	Matara	B466	4/1	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	1
	108	Southern	Matara	B142	4/1	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	1
	109	Southern	Galle	B153	10/4	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	1
	110	Southern	Matara	AA002	148/1	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	1
	112	Southern	Galle	AA002	133/2	Bridge	Yes	Yes		Critical	--	New Bridge	OK		1A	1
	116	Southern	Galle	B128	15/2	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	OK		1A	1

Source) Study Team

*Coastal/Long Bridge: In the coastal areas, bridges with over 50 meters of newly-built-section are not permitted by CCD's environmental review

*Coastal/New Bridge : In the coastal areas, new bridges instead of existing Causeway are not permitted by CCD's environmental review

Table 3.3-1 Selection Result for Reconstruction 3/4

*lot no. 1 : Western & Southern area 2 : Central area 3 : Northern area

Group	No.	Province	District	Road No	Bridge No	Type of Bridge	Importance in Road Network	Bridge Length of 30m or Greater	Sufficient Road Width /Lane	Soundness on Exisiting Structuress	Submergence Shortage of water opening	Full-Width New Bridge Half-Width Parallel Bridge	Social & Environmental Remarks	Reason to be screened out	JICA Study Team Priorty	lot
Bridges Requested by RDA Originally	117	Southern	Galle	B130	8/7	Bridge	Yes	Yes	No	Good / Fair	--	New Bridge	OK		1A	1
	120	Uva	Monaragala	B427	20/4	Bridge	Yes	Yes	Yes	Good / Fair	--	New Bridge	National Park		2	
	138	Uva	Monaragala	B496	41/1	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	OK		1A	1
	139	Western	Kaluthara	AA002	20/1	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	1
	144	Western	Kaluthara	B157	8/3	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	OK		1A	1
	145	Western	Colombo	B388	2/5	Bridge	Yes	Yes	Yes	Good / Fair	--	--	OK		3	
	152	Western	Colombo	AB010	9/1	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	1
	153	Western	Colombo	AB010	15/1	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	1
	154	Western	Colombo	AB010	26/4	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	1
	155	Western	Colombo	AB010	--	--	'--	--	--	--	--	--	--	Not Existed	To Be Canceled	
	156	Western	Colombo	AB010	28/1	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	1
	157	Western	Kaluthara	New Bridge	New	New	No	--	--	--	--	--	OK		3	
	159	western	Colombo	AA004	33/3	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	1
Additional Bridges NewlyRequested by RDA(August)	165	Northern	Mannar	B403	23/3	Causeway	Yes	--	--	--	Yes	New Bridge	OK		1A	3
	166	Northern	Mannar	B403	21/1	Causeway	Yes	--	--	--	Yes	New Bridge	OK		1A	3
	167	Northern	Jaffna	AA009	309/1	Bailey	Yes	Yes	Yes	Good / Fair	--	--	Drop		3	
	168	Northern	Jaffna	AA009	314/2	Bailey	Yes	Yes	Yes	Good / Fair	--	--	Drop	Requested by RDA	1A	3
	169	Northern	Jaffna	AB019		Bailey	Yes	Yes	Yes	Good / Fair	--	--	Drop		3	
	170	Northern	Mulative	AA035	33/3	Bridge	Yes	Yes	No	Critical	Yes	New Bridge	OK	Insufficient for Composition of Lots	1B	
	171	Western	Kaluthara	A002	52/1	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	1
	172	Western	Colombo	A002	1/1	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	1
	173	Western	Kalutara	A002	53/1	Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	1
	174	Western	Avissawella	A004	42/1	Bridge	Yes	Yes	Yes	Good / Fair	--	--	OK		3	
	175	Western	Avissawella	A004	49/1	Bridge	Yes	Yes	Yes	Good / Fair	--	--	OK		3	
	176	Sabaragamuwa	Avissawella	A004	64/1	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	1
	113	Southern	Matara	Non RDA		Bridge	Yes	Yes	No	Critical	--	New Bridge	OK		1A	1

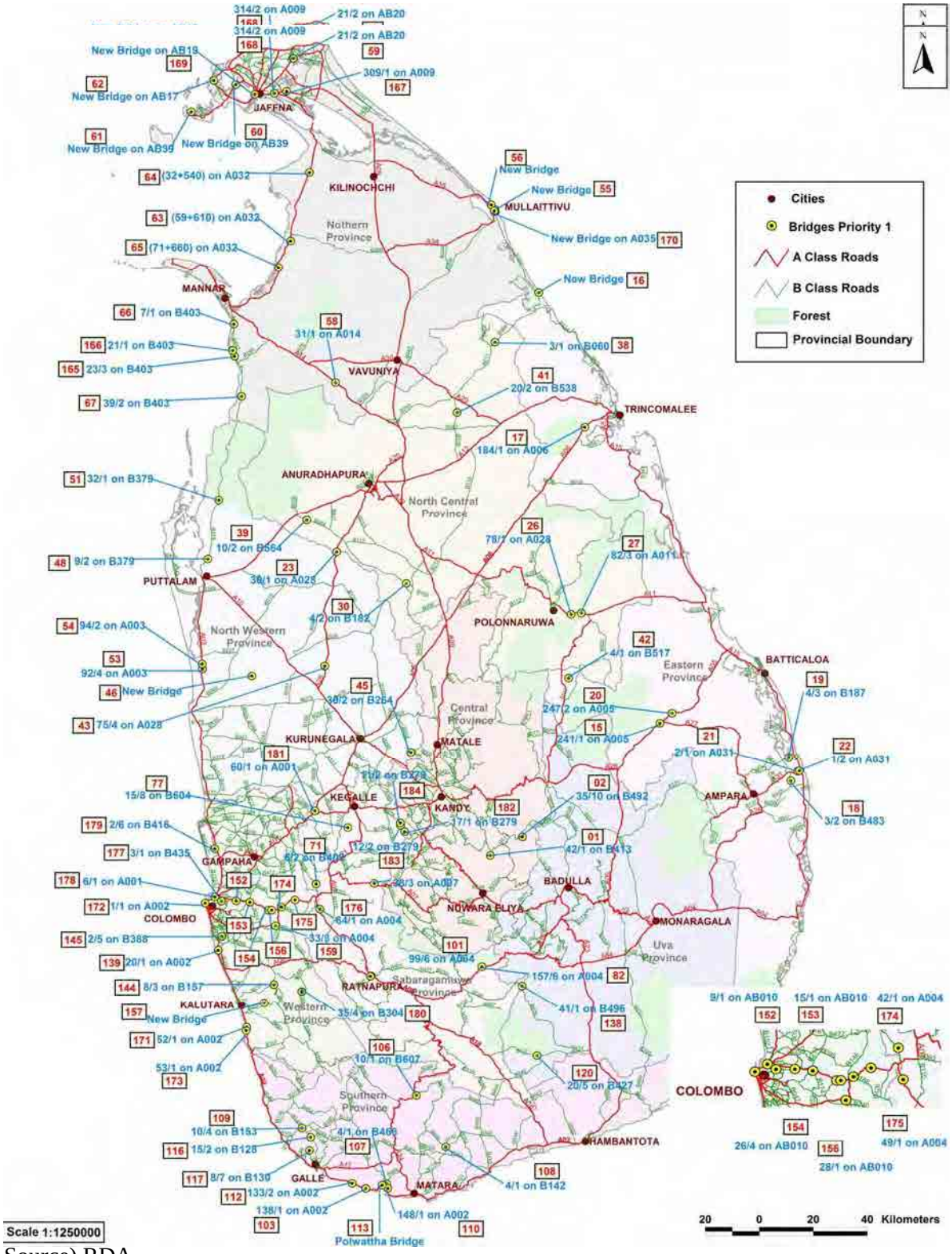
Source) Study Team

Table 3.3-1 Selection Result for Reconstruction 4/4

*lot no. 1 : Western & Southern area 2 : Central area 3 : Northern area

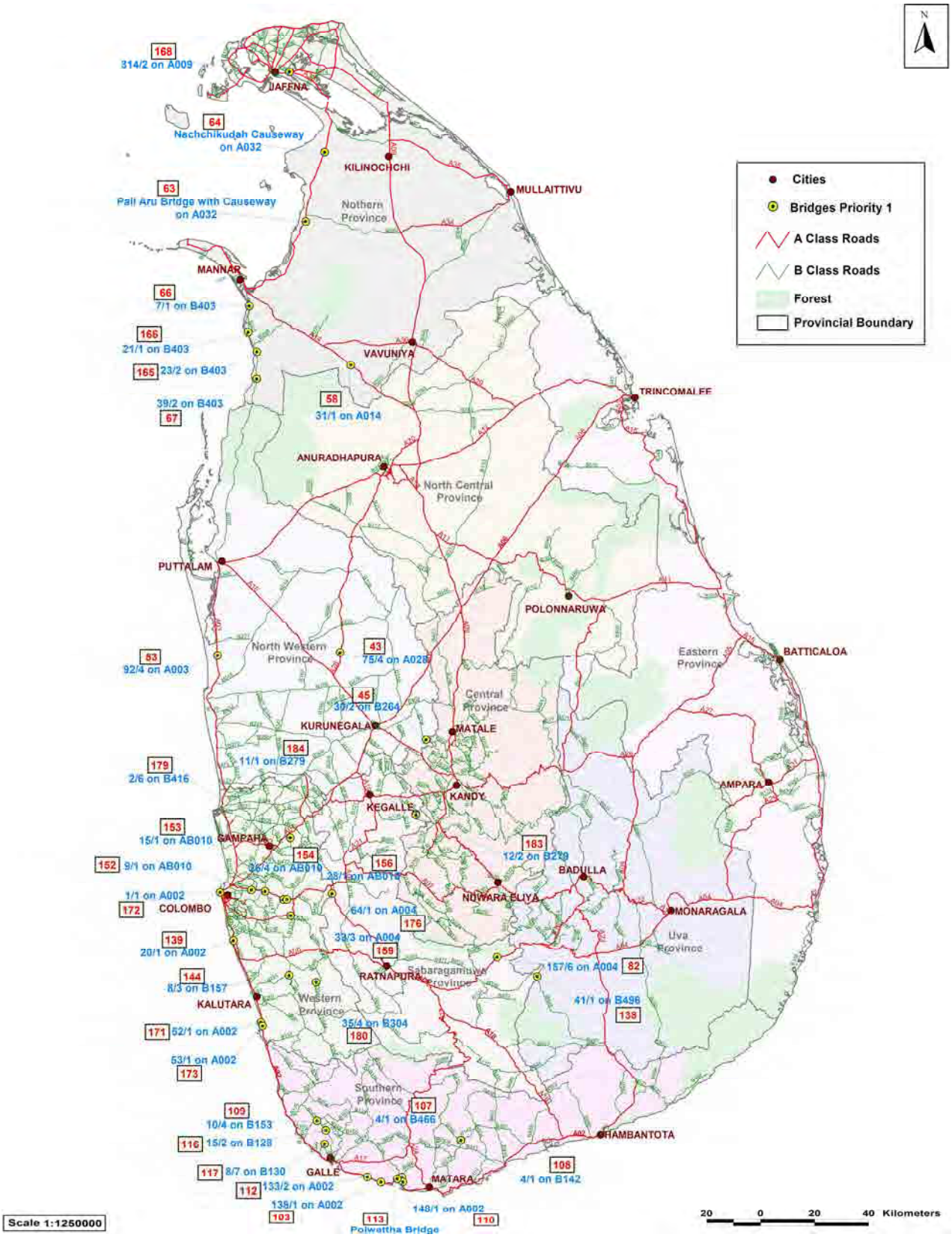
Group	No.	Province	District	Road No	Bridge No	Type of Bridge	Importance in Road Netwaork	Bridge Length of 30m or Greater	Sufficient Road Width /Lane	Soundness on Exisiting Structuress	Submergence Shortage of water opening	Full-Width New Bridge Half-Width Parallel Bridge	Social & Environmental Remarks	Reason to be screened out	JICA Study Team Priorty	lot
Additional Bridges Newly Requested by RDA (October)	177	Western	Colombo	B435	3/1	Bridge	Yes	Yes	Yes	Good / Fair	--	--	OK		3	
	178	Western	Colombo	AA001	6/1	Bridge	Yes	Yes	Yes	Good / Fair	Yes	--	OK		3	
	179	Western	Gampaha	B416	2/6	Bridge	Yes	Yes	No	Good / Fair	--	Parallel Bridge	OK		1A	2
	180	Western	Kaluthana	B304	35/4	Bridge	Yes	Yes	No	Good / Fair	--	New Bridge	OK		1A	1
	181	Sabaragamuwa	Kegalle	AA001	60/1	Bridge	Yes	Yes	Yes	Good / Fair	--	--	OK		3	
	182	Sabaragamuwa	Kegalle	B279	17/1	Bridge	Yes	Yes	No	Good / Fair	--	--	OK	Kuwait Fund	To Be Canceled	
	183	Sabaragamuwa	Kegalle	B279	12/2	Bridge	Yes	Yes	No	Good / Fair	Yes	New Bridge	OK		1A	2
	184	Sabaragamuwa	Kegalle	B279	11/2	Bridge	Yes	Yes	No	Good / Fair	--	New Bridge	OK		1A	2

Source) Study Team



Source) RDA

Figure 3.3-1 Location of 184 Bridges



Source) Study Team

Figure 3.3-2 Selected 37 Bridges

CHAPTER 4 SRI LANKAN LAWS AND REGULATIONS OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

4.1 Environmental Considerations

4.1.1 Sri Lankan Environmental Regulations and Procedure

4.1.1.1 Governing Laws on Environment

Generally the following laws are thought to have relevance to the planning and implementation of the proposed project of rehabilitation/reconstruction of bridges nationwide in Sri Lanka

National Environmental Act No.47 of 1980, Amendment No.56 of 1988, and other Amendments

The Soil Conservation Act, No. 25 of 1951 Amended in 24 of 1996

Water Resources Board Act No. 29 of 1964, Amendment No.42 of 1999

Fauna and Flora Protection Act (2009)

Flood Protection Ordinance No. 04 of 1924

Land Acquisition Act No.09 of 1950

Coast Conservation Act no 57 of 1981

4.1.1.2 Particulars of NEA and CCA Applied to the Bridge Project

This subsection intends to see particulars of the governing laws, namely, the National Environmental Act (NEA) and the Coast Conservation Act (CCA), as they have direct implications on the environmental clearance mandated for the proposed project of rehabilitation/reconstruction of bridges nationwide in Sri Lanka. The Coastal zone is defined in the Coast Conservation Act no 57 of 1981 "as the area lying within a limit of 300 m landward from mean high water line (MHWL). In the case of rivers, streams, lagoons or any other body of water connected to the sea, either permanently or periodically, the landward boundary extends to a limit of 2 km measured perpendicular to the straight baseline drawn between the natural entrance points thereof and includes waters of such rivers, streams and lagoons or any other body of water so connected to the sea. ."

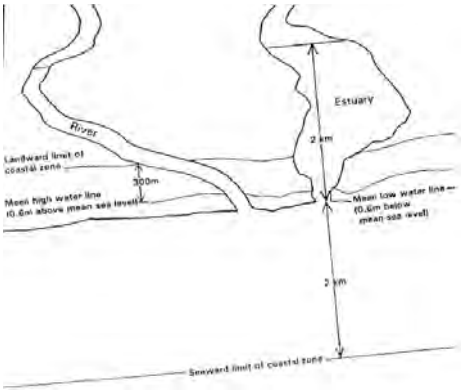


Figure 4.1-1 The Definition of the Coastal Zone of Sri Lanka

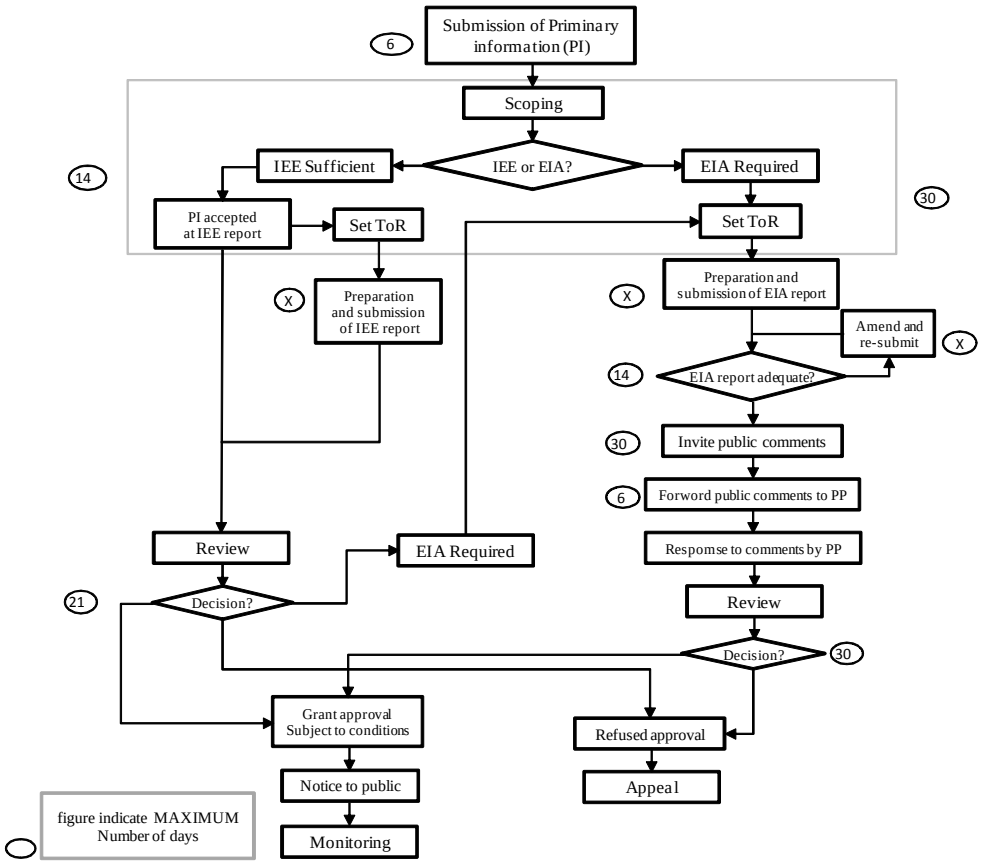
Source) The coastal zone, Coast Conservation Act No. 57, 1981

On the other hand, "rehabilitation and reconstruction of local, provincial, and *national roads and bridges* are NOT prescribed under NEA", though they shall undergo CEA/PAA's review whenever respective Authorities deem it necessary.

4.1.1.3 Procedure to Obtain Environmental Clearances

RDA is the Project Proponent Agency (PPA) in the above NEA context, as RDA proposes the above Project.

Road Development Authority (RDA), the Executing Agency of the Bridges rehabilitation / reconstruction project (the Project hereunder) under JICA assistance, shall proceed to obtain environmental clearance of proposed bridge rehabilitation/reconstruction projects, as shown in Figure 4.1-2 procedure in Obtaining Environmental Clearance.
The project proposal shall be reviewed, by respective PAAs (DCC and CEA), and shall be determined whether the project is going to have potentially significant impacts, or to have impacts of no significance. In the former case, the right-hand side procedure of the Figure 4.1-2, i.e., the "EIA Report" shall be followed, while, in the latter case, the left-hand side procedure, i.e., the "IEE Report" shall be followed.



Source) Central Environmental Authority

Figure 4.1-2 Procedure in Obtaining Environmental Clearance.

(1) IEE Report Procedure

a) If the PAA considers that the BIQ submitted by RDA, the project proponent, is adequate to consider to be an lEE Report, RDA shall proceed to submit the "IEE Report" to respective PAA.

b) If not, PAA will set the TOR for PPA to prepare IEE Report.

c) Upon receipt of the Draft IEE Report, the PAA shall check the adequacy of the IEE report and amendments will be suggested accordingly. After attending to any suggested amendments, PPA will submit the final IEE report.

d) Upon receipt of the final IEE report, It will be reviewed by a Technical Committee and the PAA will (i) grant approval for implementation of the proposed project subjected to specified conditions: or (ii) refuse approval for the implementation of the proposed project and state reasons for doing so.

(2) EIA Report Procedure

a) In respect of any prescribed project for which carrying out EIA and preparation of EIA report is required, the PAA shall grant its approval only with the concurrence of the CEA.

b) PAA will call a scoping meeting with relevant stakeholders and TOR will be set to prepare the EIA report. PAA will submit the TOR to PPA for preparation of the EIA report.

c) Upon receipt of the 1st Draft of the EIA report, the PAA shall determine whether all the matters to be addressed in the TOR are properly addressed in the Draft EIA report, and if the report is determined to be inadequate, the PAA shall require RDA, the project proponent to make necessary amendments and resubmit the report.

d) Upon receipt of the corrected 1st Draft of the EIA report, the PAA shall submit a copy to the CEA and by prompt notice published in the Gazette and in one national newspaper, PAA shall invite the public to make written comments, if any, to the PAA within 30 days from the date of the first appearance of the notice.

e) The PAA, upon completion of the period of public inspection or public hearing, if held, shall forward to RDA, the project proponent, comments received for review and response, within 6 days. RDA, the project proponent, shall respond to such comments in writing to the PAA.

f) Upon receipt of such responses as referred to in regulation referred to above, it will be reviewed by a Technical Committee and the PAA shall with the concurrence of the CEA, within 30 days either: (i) grant approval for the implementation of the proposed project subjected to specified conditions; or (ii) refuse approval for the implementation of the proposed project with reasons for doing so.

4.1.1.4 Special Care to Be Paid to Environmentally Sensitive Areas

It is anticipated that rehabilitation/reconstruction work of some of the candidate bridges shall be done in environmentally sensitive/protected areas, due to their existing location, whether they may be in the National Parks, Sanctuaries, Forest Reserves, or the Coastal Zone.

Part III, Gazette Extraordinary No.722/22, June 24, 1993 declares that any project, whether it may be located inland or in the coastal zone, part or whole of which project circumference fall into the "*Environmental Sensitive Area*" (ESA), are mandated to undergo a full EIA process. Although a large number of recurrent and non-recurrent activities under road and rail development are presently not covered by the NEA, they may, however, be subjected to an environmental review, if the PAA and/or the CEA deem it necessary. That is when the project's boundary is located wholly or partly within the area specified as "Environmentally Sensitive Areas" More specifically, the proposed project's boundary needs to be checked against potential interference with the following zonal boundaries, some of which demand keeping a certain distance away from the boundary of the protected areas, such as;

a) 100 m from the boundaries of or within any area declared under the National Heritage Wilderness Act no 4 of 1988

b) 100 m from the boundaries of or within any area declared under the Forest Ordinance (chapter 451).

c) Coastal zone as defined in the Coast Conservation Act No 57 of 1981

d) Any erodible area declared under the Soil Conservation Act (Chapter 450)

e) Any flood area declared under the Flood Protection Ordinance (Chapter 449)

f) Any flood protection area declared under the Sri Lanka Land Reclamation and Development Corporation Act 15 of 1968 as amended by Act No 52 of 1982

g) 60 meters from the bank of a public stream as defined in the Crowns Lands Ordinance (Chapter 454) and having width of more than 25 meters at any point of its course

h) Any reservation beyond the full supply level of a reservoir

i) Any archaeological reserve, ancient or protected monument as defined or declared under the Antiquities Ordinance (Chapter 188)

J) Any area declared under the Botanic Gardens Ordinance (Chapter 446)

k) Within 100 meters from the boundaries of or within any area declared as a Sanctuary under the Fauna and Flora Protection Ordinance (Chapter 469)

l) 100 meters from the high flood level contour of or within a public lake as defined in the Crown Lands Ordinance (Chapter 454) including those declared under section 71 of the said Ordinance, and

m) Within a distance of one mile of the boundary of a National Reserve declared under the Fauna and Flora Protection Ordinance

During RDA's own internal environmental screening process, candidate bridge (existing) proposals for rehabilitation/reconstruction are subjected to the above examination to see their potential interference with the above designated environmentally sensitive areas. If they infringe the protected areas, they are mandated to go through further consideration on potential impacts, which usually entail a full EIA process.

4.2 Land Acquisition and Resettlement

4.2.1 Laws and Policy on Land Acquisition and Resettlement

The section shows the contents and relevant articles of laws applicable to the land acquisition, resettlement and compensation schemes mandated under the policies and principles of the Government of Sri Lanka (GOSL). Special attention was paid to The National Involuntary Resettlement Policy, 2001 (NIRP) and the Land Acquisition Act (LAA).

4.2.1.1. The National Involuntary Resettlement Policy (2001)

NIRP assign responsibility of implementing body to formulate a Resettlement Plan addressing key resettlement issues such as (i) exploring alternative project options which avoid or minimize impacts on people; (ii) compensate those who do not have title to land; (iii) consulting displaced persons and host community on resettlement options, (iv) providing for successful social and economic integration of the displaced persons with their hosts; and; and (v) full social and economic rehabilitation of the displaced persons.

The government of Sri Lanka adopted it (by cabinet approval) as a National Policy on 24th May 2001.

Objectives of the NIRP are; a) Avoid, minimize and mitigate negative impacts of involuntary resettlement by facilitating the reestablishment of the DPs (*displaced persons*) on a productive and self-sustaining basis. b) Ensure that DPs are fully and promptly compensated and satisfactorily resettled. The livelihoods of all displaced persons should be re-established and their standard of living improved; and, c) Ensure that no impoverishment of people shall result as a consequence of compulsory land acquisition for development purposes by the state.

NIRP stipulates that a comprehensive RAP (*Resettlement Action Plan*) be prepared where 20 or more families are displaced. In case where less than 20 families are displaced, the NIRP still requires a RP with lesser level of detail. NIRP applies to all projects irrespective of source of funding.

4.2.1.2 Land Acquisition Act

The Land Acquisition Act (LAA), 1950 makes provisions for acquisition of the Lands and Servitudes for public purposes and provides for matters connected with or incidental to such provision. It provides the payment of compensation at market rates for lands, structures and crops. The Land Acquisition Act amended by Act 28 of 1964 is the premiere and oldest Land Acquisition Act in force today. It has several amendments and the latest being the version of 1986 and the Revised Regulations, 2008 gazetted as No. 1585/ 7 on Tuesday, 20th of January 2009.

LAA procedural steps are illustrated in the Table 4.2– 1 below.

Table 4.2-1 LAA Procedural Steps

Procedural Step No.	Activity	Agency In Charge
1	Preparation and Submission of Land Acquisition Proposal	PMU, Project Executing Agency
2	Issuance of Order to Survey (LAA Section 02)	Ministry of Land and Land Development
3	Preparation and Posting of Notices (LAA Section 02), declaring “Cut off” date.	Divisional Secretary
4	Preparation of Advance Tracing	Survey Department
5	Issuance of Order to Acquire the Land (LAA Section 04)	Ministry of Land and Land Development
6	Section 04 Posting and Publication of Notices (LAA Section 04)	Divisional Secretary, Government Press
7	Objection Inquiries	Project Executing Agency
8	Gazette Notification (LAA Section 05)	Divisional Secretary, Department of Government Printing
9	Preparation of Preliminary Plan	Survey Department
10	Gazette Notification (LAA Section 07)	Divisional Secretary, Department of Government Printing
11	Inquiries (LAA Section 09)	Divisional Secretary
12	Decision (Section 10-1)	Divisional Secretary
13	Valuation	Valuation Department
14	Award (LAA Section 17)	Divisional Secretary
15	Payment of Compensation	Divisional Secretary
16	Order (LAA Section 38 a)	Ministry of Land and Land Development Department of Government Printing
17	Proviso (LAA Section 38 a)9	Ministry of Land and Land Development, Department of Government Printing
18	Taking Over the Vacant Possession	Divisional Secretary, Project Executing Agency
19	Registration of Land	Divisional Secretary, Project Executing Agency

Source) Study Team

Each step of the above LAA procedures is detailed as follows;

- Preparation of acquisition proposal by PMU, the requesting agency and submission to the Ministry of Land and Land Development (MLLD) through the Secretary of the Ministry the Ministry of Ports and Highways.

• Once approval of the proposal is granted by MLD, notices are posted by the relevant divisional secretary/secretaries (as designated Acquiring Officer/s) in accordance with the Section 2 of LAA. The act of posting is meant to declare the "cut-off date", beyond which date claims on land are deemed invalid.

Subsequently, advanced tracing by the Dept. of Survey is prepared on the requisitions issued by relevant divisional secretaries (Section 2 of LAA).

• If sec 38 (a) is not invoked, divisional secretary to proceed with Section 4 of the LAA to call objections from the interested parties in the land. Even after inquiring of the objections called under section 4, if the relevant land is required to be acquired ,the requirement will be conveyed by the line ministry (in case of roads, Ministry of Ports and Highways) to the Ministry of Land and Land Development.

• Minister of Land then issues and order under Section 5 confirming the acquisition of the relevant land which will be followed up through a gazette notification in all three languages. In the same order Ministry of Land and Land Development directs the divisional secretary to take action to prepare the preliminary plans (PPs).

• Based on the Minister's order under Section 5, DS issue a requisition to the Superintendent of Surveys of the district to prepare and submit the plan.

• On receipt of PP the DS will published in Government gazette notification in all three national languages (Sinhala, Tamil and English) that he/she intends to conduct inquiries under section 9 of LAA and request people to submit their claims for ownership of land before the date mentioned by him in the gazette notification. In addition to the gazette notification a paper notice will be published by the DS in all three languages for information of the stake holders.

• Then inquiries will be conducted to determine the ownership and DS will issue an order declaring ownership under Section 10 (i) of LAA.

• Acquiring officer either makes the decision on the claims or refers the claims to the district courts or primary courts if he is unable to determine the ownership.

• Acquiring officer (Divisional Secretary of the area) holds an inquiry into the market value of the land, the claims for compensation and the legality of claimants (advised by valuation officers) and award of compensation under section 17 of LAA.

• Then the possession will be taken over under Section 38 or in an urgent situation in made section 38 (a) even though the LAA permits to takeover possession before paying compensation any land acquired by the state. At present, possession of land is taken over ONLY by paying compensation in full. This is a very positive outcome of the NIRP and SPS, 2009 of ADB. After taking over the possession DS will take action to vest the properties acquired under the name of relevant beneficiary/ies (RDA for road development) under section 44 (¡) of LAA and register the title with the registrar of the land of relevant district.

- Following the decision (either by the acquiring officer or the courts) the acquiring officer makes an award after determining the persons who are entitled to compensation, the total amount of compensation deemed to be allowed for the acquisition and the apportionment of the compensation among the persons with interest and;

- In the event of disputes over the determination of compensation, it may be appealed to either the compensation review Board or Court of appeal within 21 days of the receipt of the notification of the award. If there are no appeals, the compensation will be paid.

4.2.2 JICA Policy of Resettlement

All other JICA policy are shown in the Appendix of 4.2.2.

4.2.3 Gap Analysis between JICA Guidelines and GOSL Laws and Policy

GOSL laws on land acquisition (LAA) and the National Policy on Involuntary Resettlement (NIRP) are compared against the JICA Guidelines (JICA GL) to see the institutional gap. The comparative table is shown in the Appendix of 4.2.3.

4.2.4 Income and Livelihood Restoration

Present income restoration/rehabilitation procedures and systems available to work with affected peoples (APs) under the guidance and supervision of PMU are as follows.

(1) Proposed invigorative activities for income generation

a) Development of vocational, managerial and entrepreneurial skills
b) Training in Human Resources Development
c) Training in occupational skills development
d) Members of target groups open savings accounts and promote banking practices
e) Feedback information to the PMU to facilitate the implementation process.

(2) Organization to implement Income Restoration Plan

PMU will act as a facilitator and a coordinator for the APs to obtain the services and inputs available from the respective state and private institutions in the area of entrepreneur development. NGOs and CBOs will play a key role in planning and implementation of income restoration programme, as it is necessarily a community level programme. PMU provides logistic support and initial funds required to implement the programme. The Resettlement Officer of PMU will be the focal person with regard to income restoration.

(3) Categories of APs Entitled to Income Restoration Benefits

Farmers losing agricultural lands
Farmers with less than one acre of residual agricultural land
APs losing reasonable income from homestead gardens.
APs losing businesses.
Very poor who need institutional support to improve their income.
APs categorized as vulnerable

(4) Potential Income Restoration Programmes

RDA has conceived resettlement as a development opportunity aiming at full rehabilitation of APs. There is no difference between title holders and non-title holders for income generation programme. Everyone will be afforded with an opportunity to improve their living standards as planned. Provisions are included in the Entitlement Matrix to assist the farmers, agricultural holders, tenants, business units and others who lose their income as a result of this project.

As project involves only primary improvements to existing bridges, majority of effects will be from the strip acquisition of their property frontages. This nature of acquisition is very severe only in highly urbanized areas where residential and commercial areas are very close, with little or no room to move back for relocation on the same plot. However, majority of bridge locations in this project is not in this nature. As discuss earlier, these sites are less affected areas in terms of land and number of APs. However, people residing close to public roads are aware that one day their land would be required for improvements for the road and this is true in the case of main roads. This is not an unexpected occurrence for them. In this situation, APs are compelled to lose their existing homes and or businesses. Sri Lankan experience is that they prefer to stay close to the roads and remain on lands with reduced standards in order to remain on land enjoying direct road frontages. APs will be given the option under these conditions to remain on the existing plot if the road widening allows and will not be forced to relocate. All APs whose livelihoods are displaced under the project will be provided with livelihood restoration measures which will include the following.

- A livelihood restoration allowance to assist as seed money to re-establish a business
- Allowance and interventions for poor and vulnerable families
- Vocational or skilled training
- Project related employment

When identifying potential income generating opportunities for needy people, greater emphasis will be paid to raw materials, availability of required infrastructure and market potentials.

(5) Training in Skills Development

One person from each fully displaced household will be selected for the development of skills. Adult children of the households losing dwellings and commercial premises will be given priority in the selection of trainees. RDA's STDP (Southern Transport Development Prpject) experience confirms the importance of skill development training in income generation support.

(6) Training in Entrepreneur Development

Entrepreneur development will be provided to selected individuals who are capable of benefiting from such training after an initial screening purpose. This is an advance step from income generation interventions focus on low income earners. The basic requirements would be willingness to commence a business or an industry and ability to raise capital. PMU will act as a facilitator to raise the capital and develop business plans of the interested APs.

4.2.5 Proposed Project Entitlement Matrix

The eligibility policy, as spelled out in the LAA, and NIRP (National Involuntary Resettlement Policy) and those by the World Bank, and JICA, is to provide a comprehensive coverage for lost assets and restoration and/or enhancement of livelihoods for all categories of affected people, whether affected directly, indirectly, permanently or temporarily, with or without titles, and tenants/lessees. For all lost lands and assets compensation will be at replacement cost.

Here, the project Entitle Matrix is proposed for the "Primary Bridges on National Roads" Project to be financed by JICA, taking into account of NIRP and procedures and "JICA Guidelines for Environmental and Social Considerations". The right-most column used to indicate "Responsible Organizations" is not shown here, however, they are PMU, RDA and Divisional Secretary of jurisdictional power over the territory of respective bridge location. The matrix is shown in the Appendix as Table 4.2.5 – 1 Proposed Entitlement Matrix.

4.2.6 Institutional Set Up for Grievance Redress Mechanism

(1) Proposed Grievance Redress Mechanism (GRM)

The project locations are distributed over 21 DS (Divisional Secretary) divisions of 13 Districts in six Provinces. The proposed GRM is so organized as to cater to the needs of APs ("Affected Persons") geographically distributed, who wish to resolve their project related grievances through amicable settlements.

For mobilizing GRM dedicated to the project "PRIMARY BRIDGES ON NATIONAL ROADS", operating budget of GRM at GND (*Grama NIladhari Divisions*) and Regional Level are to be borne by PMU Project Office. National level budget is to be expended by MP&H.

(2) PMU's Role in Mobilizing and Coordinating Proposed Grievance Redress Mechanism (GRM)

PMU is responsible for raising APs' awareness on GRC. PMU mobilizes its own cadre of Resettlement Officers tasked to facilitate relocation and resettlement with respect to project implementation, and make them attend to GRM related work at field level. Eventually with the commencement of LA (land acquisition) process, the Resettlement Officers are to have a full list of APs showing disabilities, legal and illegal status of land ownership and other individual attributes, which are obtained through Census and Assets Inventory Survey conducted by PMU at the initial stage of project implementation. The PMU professional staff will hold meetings with APs with the participation of heads of respective GNDs (Grama NIladhari Divisions) throughout the LA process, and in the preparation of Resettlement Action Plans. In the LA process, heads of GNDs too will have a list of APs officially, and have to meet with APs several times during LA process. PMU field staff can circulate information flyers, leaflets in these meetings on GRC and other matters, and also can post to APs through mail also. GND heads have field offices, one or two in the division, and project related documents can be deposited there also. In addition, village level NGOs, mostly very active village level funeral welfare societies also can be used for project related information dissemination.

(3) Mediating grievances lodged by APs through holding GRC at GND level

PMU's responsibility is providing a fair and equal opportunities for APs who have grievances caused by the project to bring their cases for mediating body lying outside the formal legal institutions. The Director of PMU has discretion to have a routine GRC meeting, for example, once per month, even no cases coming to GRC. If cases are there GRC has to respond to it immediately.

(4) Composition of Grievance Redress Committee (GRC) - DS level

21 DSDs (district secretariat divisions) have only bridge within their divisions, and 8 DSDs have two bridges within their divisions. Therefore, this level GRC works operationally at location level, most likely as a committee at GND (*Grama NIladhari Division*) level. This committee is most important in solving grievances of APs who live closely to the bridge site. The affected people can lodge complaints at respective Grama Niladhari Office, Divisional Secretariat office, at the Construction Site or at the Executive Engineer office, RDA. At this level, GRC is expected to resolve complains

within three weeks' time. In this stage it is expected to get the advantage of the construction management setup (which involves the employer and the contractor) to resolve construction related issue at site (avoid/ minimize any delays in rectifying the problem). DS level GRC consist of following members;

Table 4.2-6 Proposed GRC Set Up at Divisional Level

Divisional Secretary of the area	Chairman
A representative of PMU	Secretary
Grama Niladhari *[When a bridge has two GNDs (Grama NIladhari Divisions) on either side of the bridge, the two Grama NIladhari can attend on depending on the dispute]*	Member
A representative of the Supervision Consultant	Member
A representative of the Contractor	Member
A representative of a social organization (NGO/CBO) of the area	Member
A community member/religious leader	Member
A representative from the agency who is a party of the dispute	Representative of Complaint

Source) Study Team

GRC meetings will be held at the PMU's site office or at DS office, to which APs who have lodged complaints will be invited. The APs will be informed about the GRC, seven days prior to its meeting. However, GRC meetings could be held in the public if required.

CHAPTER 5 PRIORITIZATION OF SELECTED 37 BRIDGES

5.1 Purposes of Prioritization

Some of 37 nos bridges, selected in accordance with the criteria, are seriously deteriorated on primary members, thereby resulting in overall instability of the structure, and are the bottlenecks in road network due to narrow carriageway widths. Though such bridges need urgent measures as repair or replacement, it is difficult to take necessary measures at the same time due to insufficient management capacity and budgetary restriction.

Therefore, prioritization is needed for efficient operation and maintenance management.

5.2 Criteria for Prioritisation

Most important criteria for prioritization are “soundness of the bridge” and “influence on traffic condition”.

In this Study, Study Team selected the following criteria for prioritization from the present conditions of bridges and information from RDA.

“Score” given in Table 5.2-1 is the maximum one for each criterion, and higher total score obtained implies higher priority compared to other bridges.

Table 5.2-1 Criteria and Scores Given for Prioritization

Criterion		Score	
Importance of Bridge	Type of Road	10	25
	Traffic Volume	15	
Bridge Condition	Soundness	20	30
	Inundation / Insufficient Water Opening	10	
Carriageway Width		45	45
		Total	100

Source) Study Team

Descriptions on each criterion and scores are given below.

5.2.1 Importance of Bridge

"Importance of Bridge" is the criterion to rate degree of importance in the area based on the road information. It is consisted of "Type of Road" and "Traffic Volume".

(1) Type of Road

In this Study, Study Team inspected the existing bridges basically on "Class-A (AA/AB)" and "Class-B" national roads managed by RDA. Bridges on lower road classifications were also inspected as such bridges will be on Class A and B roads in the future.

The higher the road class is, the higher the given point is.

Table 5.2-2 Point Given for "Type of Road"

Type of Road	score
AA	10
AB	10
B	5
Others	0

(2) Traffic Volume

It evaluates the difficulty to ensure sufficient detour by the number of traffic on AADT (Annual Average Daily Traffic) basis given by RDA. Bridges on roads with heavy traffic volume are of high importance in road network, since alternative route to accommodate such heavy traffic is difficult to ensure whenever the roads are closed to traffic due to damage or collapse of the bridges. The higher the AADT is, the higher the given point is.

Table 5.2-3 Point Given for "Traffic Volume"

Traffic Volume	score
over 5000	15
1000 - 5000	10
less than 1000	5

5.2.2 Bridge Condition

"Bridge Condition" is one of the important criteria to rate the existing bridges. It comprises "Soundness" and "Submergence".

(1) Soundness

It evaluates the soundness of the bridges based on the inspection results. Soundness is classified into four (4) categories: critical, poor, fair and good. In addition, for its importance in overall structural stability, such primary members as superstructure / substructure and other secondary members shall have different weighting respectively. Of primary members, superstructure shall have higher weighting than substructure due to its immediate impact to road users and safety.

Table 5.2-4 Point & Weighting Given for "Soundness"

Damage Rank	weight
Rate4 : Critical	1.00
Rate3 : Poor	0.50
Rate2 : Fair	0.25
Rate1 : Good	0.00
0 : No Member	0.00

Bridge Member	weight
super	0.55
sub / bearing	0.40
secondary member	0.05

	score
Total of Soundness	45

DAMAGE RANK
Damage Rank shows following condition of bridge member.
Rate1 : Good condition
Rate2 : Fair condition with minor natures: Periodical maintenance is required.
No urgent repair is needed.
Rate3 : Significant damages: Damaged portion(s) are to be repaired immediately.
Rate4 : Critical damages: Urgent improvement,
reconstruction or restriction of heavy vehicles is required.

* Sample Calculation

Damage Rate: [super = 4][sub/bearing = 3][secondary member = 4]

Weight of "super" = 1.00 x 0.55 = 0.55

Weight of sub/bearing = 0.50 x 0.40 = 0.20

Weight of secondary member = 1.00 x 0.05 = 0.05

Total of weight = 0.80

Maximum score of "Soundness" x Total of weight = 45 x 0.80 = 36.0 (score of soundness)

(2) Submergence & Insufficient Water Opening

It evaluates the effect of economical losses due to closure of road by inundation during floods and rate of danger of scour / erosion / collision of debris and subsequent bridge collapse. Water level and rate of riverbank erosion obtained from interview survey at each bridge site are the valuable information for rating.

SUBM: Water levels recorded during past flood times were higher than bridge deck surface, thereby resulting in closure of the bridge to traffic.

SHORT: Shortage of water opening during floods can be confirmed from the erosion situation of riverbanks around the bridge or insufficient freeboard under the bridge deck soffit. Freeboard shall be at least 1.0m from the design high water level to the bridge deck soffit in order to prevent damage to bridge deck due to collision of debris and water load.

Table 5.2-5 Point Given for "Submergence / Insufficient Water Opening"

Submergence / Insufficient Water Opening	score
SUBM	**15**
SHORT	**10**
--	**0**

5.2.3 Carriageway Width

It evaluates the effect of bottleneck to the road network due to narrow carriageway width. It causes traffic congestion during the peak hours in the morning and evening, and will give unfavourable impacts to social environments and safety. Special attention is recently being paid by RDA.

The following criteria were developed for carriageway width.

Table 5.2-6 Point Given for "Carriageway

Carriageway Width	score
Carriageway width less than 5.0m	**15**
At least 5.0m wide carriageway provided	**10**
Required number of lane and lane width of 3.7m satisfied	**0**

5.2.4 Summary of Prioritization Results

Prioritisation made in accordance with the above is summarized in Table 5.2-7.

Table 5.2-7 Summary of Prioritization Results

No.	BRIDGE NAME	ROUTE	No.	BRIDGE No. [km]	COMPETENT OFFICE: PROVINCIAL DIRECTOR OFFICE	COMPETENT OFFICE: CHIEF ENGINEER OFFICE	BRIDGE LOCATION: LATITUDE	BRIDGE LOCATION: LONGITUDE	TYPE OF BRIDGE PC or STEEL etc	NUMBER OF SPANS	BRIDGE LENGTH [m]	SERVICEABILITY OF BRIDGE: OVERALL WIDTH [m]	CARRIAGEWAY WIDTH [m]	NUMBER OF LANE	LANE WIDTH *1)
116	Kahabiliya	B	128	15/2	Southern	Galle	6.138556	80.197194	Concrete	6	31.3	5.90	5.30	2	Narrow
109	Halpatota	B	153	10/4	Southern	Galle	6.169889	80.167944	Steel	3	45.0	5.50	5.50	2	Narrow
153	Welehandiya	AB	010	15/1	Western	Colombo	6.933511	79.992547	Concrete	4	37.7	9.80	6.90	2	Narrow
156		AB	010	28/1	Western	Colombo	6.907256	80.065769	Concrete	4	42.1	7.50	6.75	2	Narrow
113	Polawatta	-	-	-	Southern	Matara	5.977072	80.435769	Concrete	22	100.0	3.70	2.80	2	Very Narrow
139	Digarolla	AA	002	20/1	Western	Kaluthara	6.771733	79.886764	Steel	7	197.2	8.04	5.85	2	Narrow
152	Ambathale	AB	010	9/1	Western	Colombo	6.937694	79.946453	Concrete	3	33.5	9.80	6.90	2	Narrow
184	Wagolla	B	279	11/2	Sabaragamuwa	Kegalle	7.201047	80.496489	Bailey	1	36.0	6.00	4.20	2	Very Narrow
172	Baira Lake	AA	002	1/1	Western	Colombo	6.930204	79.842589	Steel	4	36.6	30.00	18.47	4	OK
64	Nachchikuda Causeway	AA	032	(32+482)	Northern	Kilinochchi	9.397714	80.188683	Causeway	1	60.0	7.00	7.00	2	Narrow
183	Waglla	B	279	12/2	Sabaragamuwa	Kegalle	7.192900	80.497336	Concrete	4	20.4	4.00	4.00	2	Very Narrow
103	Goiyapana	AA	002	138/1	Southern	Galle	5.965750	80.381528	Concrete	3	48.8	12.10	10.30	2	OK
112	Kathalu	AA	002	133/3	Southern	Galle	5.982972	80.335806	Concrete	3	49.4	10.20	9.60	2	OK
168	Navathli	AA	009	314/2	Northern	Jaffna	9.663978	80.069681	Bailey	3	81.0	9.10	7.30	2	Narrow
171	Maggona	AA	002	52/1	Western	Kaluthara	6.510383	79.982197	Concrete	3	24.3	12.70	9.80	2	OK
53		AA	003	92/4	N-Western	Puttalam	7.720778	79.831806	Concrete	4	42.5	6.10	5.50	2	Narrow
154		AB	010	26/4	Western	Colombo	6.906914	80.054514	Concrete	5	41.7	5.95	5.50	2	Narrow
166	Arippu Causeway	B	403	21/1	Northern	Mannar	8.795511	79.931297	Causeway	1	70.0	4.20	4.20	2	Very Narrow
144		B	157	8/3	Western	Kaluthara	6.655781	80.073519	Concrete	3	34.0	6.20	5.50	2	Narrow
108	Denagama	B	142	4/1	Southern	Matara	6.106667	80.648694	Steel	4	30.4	3.50	3.30	2	Very Narrow
138	Weli Oya	B	496	41/1	Uva	Monaragala	6.651681	80.904014	Concrete	7	36.4	4.60	4.00	2	Very Narrow
58	Kotaleeya	AA	014	31/1	Northern	Vavuniya	8.688069	80.277272	Steel	3	31.5	4.80	4.80	2	Very Narrow
66	Aru-Kuli Causeway	B	403	7/1	Northern	Mannar	8.884522	79.935089	Causeway	1	90.0	5.00	5.00	2	Narrow
67	Kal Aru Causeway	B	403	39/2	Northern	Mannar	8.641531	79.961411	Causeway	1	70.0	6.10	6.10	2	Narrow
107	Denipitiya	B	466	4/1	Southern	Matara	5.982111	80.451417	Steel	5	46.3	5.10	4.80	2	Very Narrow
173	Maggona2	AA	002	53/1	Western	Kaluthara	6.499006	79.980697	Concrete	1	22.0	13.70	9.70	2	OK
179	Karatuwawa	B	416	2/6	Western	Gampaha	7.112914	79.874772	Steel	2	39.2	5.30	4.20	2	Very Narrow
110	Polwathumodara	AA	002	148/1	Southern	Galle	5.966222	80.454778	Concrete	11	100.1	8.20	5.50	2	Narrow
165		B	403	23/3	Northern	Mannar	8.775778	79.937906	Causeway	1	91.0	4.20	4.20	2	Very Narrow
117	Part of Gin ganga	B	130	8/7	Southern	Galle	6.093917	80.193000	Concrete	2	24.4	6.30	5.20	2	Narrow
43	Kurunegala	AA	028	75/4	N-Western	Kurunegala	7.731253	80.242686	Steel	3	96.3	8.40	6.80	2	Narrow
159	Galagedara	AA	004	33/3	Western	Colombo	6.854016	80.078722	Concrete	3	57.0	10.40	7.40	2	OK
63	Pali aru Bridge with Causeway	AA	032	(59+610)	Northern	Mannar	9.166728	80.125253	Causeway	1	46.5	7.40	7.40	2	OK
180	Alukatiya	B	304	35/4	Western	Kalutana	6.632458	80.166431	Concrete	4	42.2	5.80	4.60	2	Very Narrow
45	Meeliyadda Palama	B	264	30/2	Central	Nuwara Eliya	7.440300	80.531753	Steel	1	36.7	4.20	3.30	2	Very Narrow
82	Belihuloya	AA	004	157/6	Sabaragamuwa	Ratnapura	6.716956	80.769756	Steel	2	34.5	6.30	5.20	2	Narrow
176		AA	004	64/1	Western	Ratanapura	6.910161	80.226981	Concrete	2	24.5	8.46	6.50	2	Narrow

No.	SUBMERGENCE *2)	TRAFFIC DATA: ROUTE No.	AADT TRAFFIC VOLUME	DAMAGE RANK *3): Slab	Girder	Substructure	Bearing	Secondary member	IMPORTANCE OF BRIDGE: TYPE OF ROAD	TRACK TRAFFIC VOLUME	SUB TOTAL	BRIDGE CONDITION: SUBMERGENCE	SOUNDCNESS	SUB TOTAL	CARRIAGEWAY WIDTH	OVERALL SCORE *4)
116	SUBM	B128	7073		3	4		3	5	15	**20**	15	32	**47**	**10**	**77**
109	SHORT	B153	5112	4	4	2		4	5	15	**20**	10	32	**42**	**10**	**72**
153	SHORT	AB10	20780		3	3		2	10	15	**25**	10	22	**32**	**10**	**67**
156	SUBM	AB10	17670		2	3		2	10	15	**25**	15	16	**31**	**10**	**66**
113	--	--	999		4	4		4	0	5	**5**	0	45	**45**	**15**	**65**
139	--	AA2	16917		4	2		2	10	15	**25**	0	30	**30**	**10**	**65**
152	SHORT	AB10	20780		3	2		2	10	15	**25**	10	17	**27**	**10**	**62**
184	--	B279	2751		4	2		2	5	10	**15**	0	30	**30**	**15**	**60**
172	--	AA2	80000		4	3		2	10	15	**25**	0	34	**34**	**0**	**59**
64	SUBM	AA32	1366	3		0		0	10	10	**20**	15	12	**27**	**10**	**57**
183	SUBM	B279	2751		2	2		2	5	10	**15**	15	11	**26**	**15**	**56**
103	--	AA2	12205		4	2		3	10	15	**25**	0	30	**30**	**0**	**55**
112	--	AA2	13892		4	2		2	10	15	**25**	0	30	**30**	**0**	**55**
168	--	AA9	921		4	2		2	10	5	**15**	0	30	**30**	**10**	**55**
171	--	AA2	25350		4	2		2	10	15	**25**	0	30	**30**	**0**	**55**
53	--	AA3	8537		3	2		2	10	15	**25**	0	17	**17**	**10**	**52**
154	--	AB10	17670		3	2		2	10	15	**25**	0	17	**17**	**10**	**52**
166	SUBM	B403	921	3		0		0	5	5	**10**	15	12	**27**	**15**	**52**
144	SHORT	B157	5978		2	2		2	5	15	**20**	10	11	**21**	**10**	**51**
108	--	B142	3839	4	1	4		4	5	10	**15**	0	20	**20**	**15**	**50**
138	SUBM	B496	3112	2	1	2		2	5	10	**15**	15	5	**20**	**15**	**50**
58	--	AA14	2157		3	1		2	10	10	**20**	0	13	**13**	**15**	**48**
66	SUBM	B403	921	3		0		0	5	5	**10**	15	12	**27**	**10**	**47**
67	SUBM	B403	921	3		0		0	5	5	**10**	15	12	**27**	**10**	**47**
107	--	B466	5018	2	3	2		3	5	15	**20**	0	12	**12**	**15**	**47**
173	--	AA2	24775		3	3		2	10	15	**25**	0	22	**22**	**0**	**47**
179	--	B416	2206		3	2		2	5	10	**15**	0	17	**17**	**15**	**47**
110	--	AA2	12205	2	2	2		2	10	15	**25**	0	11	**11**	**10**	**46**
165	SUBM	B403	921	2		0		0	5	5	**10**	15	6	**21**	**15**	**46**
117	--	B130	7718		2	2		4	5	15	**20**	0	13	**13**	**10**	**43**
43	--	AA28	5561		2	1		2	10	15	**25**	0	7	**7**	**10**	**42**
159	--	AA4	21892		3	2		2	10	15	**25**	0	17	**17**	**0**	**42**
63	SUBM	AA32	1366	2		0		0	10	10	**20**	15	6	**21**	**0**	**41**
180	--	B304	3572		2	2		2	5	10	**15**	0	11	**11**	**15**	**41**
45	--	B264	3913	2		1	2	1	5	10	**15**	0	6	**6**	**15**	**36**
82	--	AA4	7712	1	1	4	1	1	10	15	**25**	0	0	**0**	**10**	**35**
176	--	AA4	21119		1	1		1	10	15	**25**	0	0	**0**	**10**	**35**

No.	LOT No.*5)	DISTANCE FROM BASE TOWN	BRIDGE TYPE OF NEW BRIDGE*6)	COST ESTIMATION (million JPY)	RANKING OF URGENCY
116	1		Steel I	182	1
109	1		Pos. I	197	2
153	1		Steel I	145	3
156	1		Steel I	164	4
113	1		Pos. I	219	5
139	1		Extra dosed	1,327	6
152	1		Steel I	147	7
184	2		Steel I	146	8
172	1		Pre. I	275	9
64	3		Steel I	376	10
183	2		Steel I	146	11
103	1		Pos. I	293	12
112	1		Pos. I	309	13
168	3	remote	Pos. I	314	14
171	1		Pos. I	184	15
53	2		Steel I	290	16
154	1		Steel I	156	17
166	3		Pre. I	221	18
144	1		Steel I	146	19
108	1		Steel I	225	20
138	1	remote	Pre. I	88	21
58	3		Steel I	156	22
66	3		Pre. I	228	23
67	3		Pre. I	271	24
107	1		Pre. I	121	25
173	1		Pos. I	178	26
179	2		Steel I	162	27
110	1		Pos. I	269	28
165	3		Pre. I	351	29
117	1		Pos. I	105	30
43	2		Steel I	244	31
159	1		Steel I	240	32
63	3		Pre. I	204	33
180	1		Steel I	184	34
45	2		Steel I	179	35
82	1	remote	Steel I	355	36
176	1		Steel I	154	37

NOTE

1) Carriageway Width
Very narrow : Carriageway width < 5.0m
Narrow : Width per a lane < 3.7m
OK : Width per a lane >= 3.7m
*Very narrow is considered width to go past two buses .

2) Submergence / Flow area
When the bridge get fooded,
SUBM : : The bridge submerges
SHORT : Shortage of flow area, girder or slab gets stream.

3) DAMAGE RANK
Damage Rank shows following condition of bridge member.
Rate1 : Good condition
Rate2 : Fair condition with minor natures: Periodical maintenance is required.
No urgent repair is needed.
Rate3 : Significant damages: Damaged portion(s) are to be repaired immediately.
Rate4 : Critical damages: Urgent improvement,
reconstruction or restriction of heavy vehicles is required.

4) OVERALL SCORE
Overall score is calculated by following method.
sub total (importance) + sub total (usability) + soundness

The bridges get high Overall score shall be coped in an emergency.

5) LOT No.
Area of eacn LOTs
LOT1 : Western and Southern area
LOT2 : Central area
LOT3 : Northern area

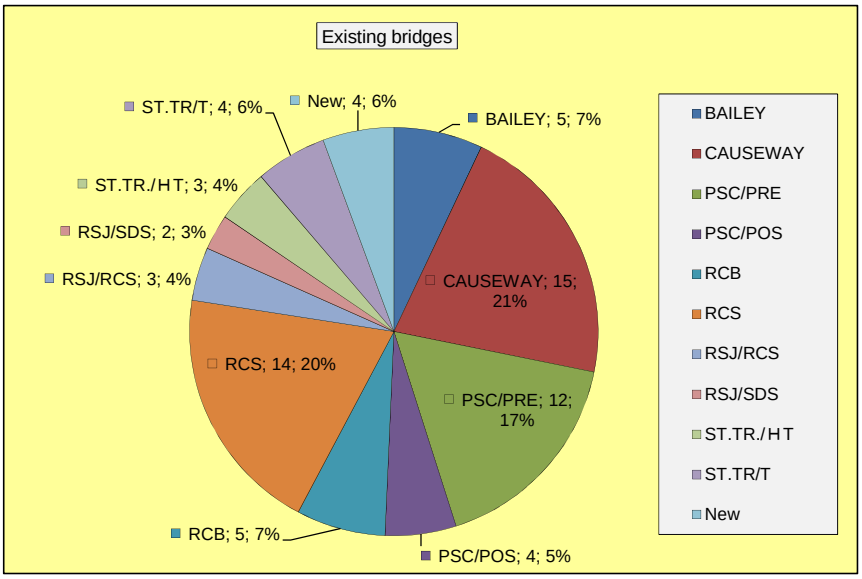
6) BRIDGE TYPE OF NEW BRIDGE
Type of superstructure
Pre. I : Pre-tension concrete I girder bridge
Pos I : Post-tension concrete I girder bridge
Steel I : Steel rationalized I girde bridge (with prestressed concrete slab)
Extra dosed : Extra dosed concrete bridge

Source) Study Team

CHAPTER 6 BRIDGE PLANNING

6.1 Present Conditions of 82 nos Road Bridges Investigated by Study Team

There are several types of bridges presently available in Sri Lanka, namely reinforced concrete (RC), pre-stressed concrete (PC) and steel structures. Types of 82 nos bridges investigated are classified as in Figure 6.1-1, and details are tabulated with symbols in Table 6.1-1.



Share of Bridge Type

1) RC Bridge : 27 %
2) PC Bridge : 22 %
3) Causeway : 21 %
4) Steel Bridge : 17 %
5) Bailey : 7 %
6) New Bridge : 6 %

Source) RDA

Figure 6.1-1 Types of Existing Bridges

Current conditions of existing bridges are briefly summarized as follows:

- Concrete bridge decks are in sound condition except those in the coastal area.
- Serious damage is observed on steel members due to less maintenance works.
- A lot of causeways present in the northern area are closed for traffic during floods due to inundation

Table 6.1-1 Bridge Types Presently Available

Symbol	Bridge Type
BAILEY	Bailey
CAUSEWAY	Causeway
PSC/PRE	Pre-tensioned Beam
PSC/POS	PC Post-tensioned Beam
RCB	RC Beam ST
RCS	RC Slab
RSJ/RCS	Rolled Steel Joist with RC Slab
RSJ/SDS	Rolled Steel Joist with Steel Deck Plate
ST.TR./HT	Steel Half-Through Truss
ST.TR/T	Steel Through Truss
New	New

Source) Study Team

Bailey bridges are grobally considered as a temporary facility; however such bridges are still being erected in Sri Lanka with the loans from UK, France and China as permanent ones. Bailey bridge is originally developed for military purpose, and good at quick construction. Hence deck is not RC slab but steel plate, drivability (causing accident due to slippery) and short life of deck due to vibration are problem. Panel point is only pin insertion, all the structure is hanging down.
Actually, bailey bridges on A9 road are damaged due to heavy traffic,
repair is needed for the bridges as soon as possible.

6.2 Bridge Design Requirements

6.2.1 Introduction

For the purpose of cost estimate for formulation of bridge reconstruction projects financed by Japanese ODA loan, bridge planning was conducted for surveyed bridges. Fundamental requirements were identified and basic geometric and cross section designs are described based on the design standards presently practiced in Sri Lanka, and horizontal alignment, bridge length, span arrangement and bridge type selection were subsequently introduced for implementation.

6.2.2 Bridge Profile Design

Bridge profile will be designed in accordance with Geometric Design Standards of Roads (RDA, 1998) in general. Special attention shall be given to the followings:

1) Minimum Gradient on Bridge

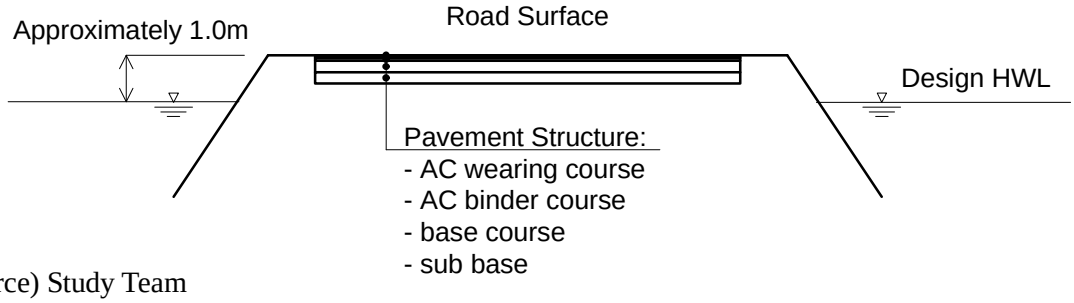
At least minimum gradient shall be used to facilitate the drainage efficiency. Some longitudinal gradient is preferred for satisfactory drainage depending on the terrain type.

In Sri Lanka, flat gradient is allowed on the bridge wherever no such specific conditions as navigation clearance and vertical clearance for crossing road is given, so that the sufficient sight distance can be ensured.

With the drainage efficiency considered, however, all the recommended bridges have minimum longitudinal gradient of 0.3% in urban areas and 0.5% in rural areas as same as Japanese practice.

2) Road Profile in Flood Areas

The Class-A and Class-B roads are the trunk roads which play important roles in the socio-economic activities in Sri Lanka. Since bridges requested by RDA are all on Class -A and -B roads, such bridges shall be flood-free to all-weather conditions. In order to prevent inundation during floods and reduction in roadbed strength thereby leading to an uneven road surface, it is proposed that road surface be approximately 1.0m above the design water level so that pavement structure cannot be immersed.



Source) Study Team

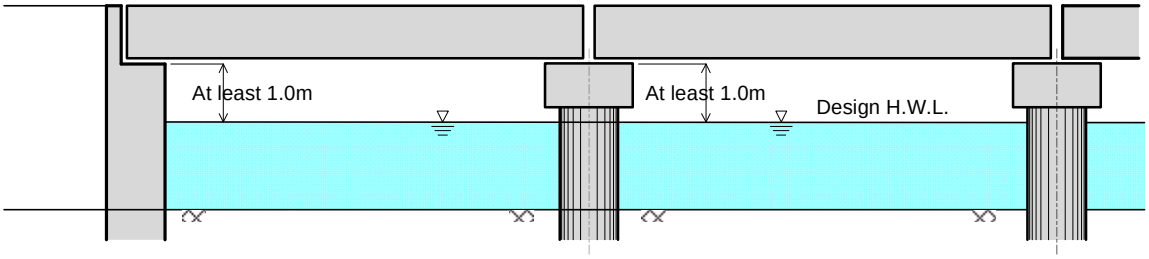
Figure 6.2-1 Road Profile in Flood Areas

3) Bridge Profile over Water

During flood times, it is expected that debris blockage at water openings and damage the bridge structures in across rivers, streams or other water bodies. Bridge accessories such as bearings and stoppers might be under water and will also be deteriorated.

Blockage of water opening might come to the increase in water level upstream, thereby leading to the inundation of crop / paddy fields, residential area and social facilities in the upstream.

In order to alleviate such damage and adverse effects, it is proposed that the bridge profile be determined so that bridge bearing seats are at least 1.0m above the design high water level (HWL).



Source) Study Team

Figure 6.2-2 Freeboard under Bridge Deck Soffit

6.2.3 Cross Section Elements

Cross section of a road is basically comprised of carriageway, shoulder, drainage, center median, reservation for services and right of way (ROW). Road surface shall have crossfall to prevent stagnation of surface water.

In addition, road cross section may have the embankment fill slope or cut slope where roads run on a fill area or a cut area. Requirements on each element are discussed below in accordance with Geometric Design Standards of Roads (RDA, 1998) and Bridge Design Manual (RDA, 1997).

(1) Carriageway

The carriageway is used for vehicles to run, and classified as single-lane, two-lane, four-lane or multi-lane. "Traffic Lane" is defined for the use of single line of traffic operation, and its desirable width is 3.7m with side clearance as the design vehicle width vary from 2.1m to 2.6m. Such side clearance will give improvement in operating speed and safety. Considering maximum width of design vehicle in Sri Lanka is 2.5m, as same as in Japan, it is recommended to be 3.2m for carriageway and 0.5m for shoulder, following Japanese highway design standards,

The absolute minimum traffic lane width is 3.1m for embankment / cut road section, and is 3.4m for bridge / structure section. However, for Class -A road, it was confirmed through discussion with RDA that traffic lane width be 3.7m.

(2) Shoulder

The shoulder provides vehicles with reasonable spaces to stand or to allow emergency maneuvering.

For fill / cut road sections, shoulder width is 3.0m for desirable one; 2.4m for minimum width; and 1.8m for absolute minimum width depending on site conditions.

For bridge / structure section, no shoulder is given in Sri Lanka.

Study Team, however, proposed that shoulder should be provided on bridge / structure with at least 0.5m in width in order to prevent blockage due to damaged vehicles, from the international practices.

(3) Drains

Drains are provided for efficient disposal of surface water. The width of drains varies from 0.6m to 1.2m depending on the requirements. Drains' cross section may be rectangular or trapezoidal. Earth drains should have maximum side slope of 1 : 4 (1 horizontal to 4 vertical).

(4) Centre Median

For four-lanes or multi-lane road, centre medians shall be provided at the centre of carriageway in order to avoid the hazardous condition arising from opposing traffic. The minimum width of a centre median is 1.2m.

(5) Fill / Cut Slopes

The embankment fill slope is 2 horizontal to 1 vertical, and cut slope is 1 horizontal to 4 vertical in general. Slopes flatter than this will improve safety; however it may be uneconomical.

(6) Crossfall

The crossfall is provided for smooth drainage of water from road surface, and is given to both carriageway and shoulder. Crossfall should vary with surface materials. The recommended crossfall on carriageway / shoulder for straight embankment fill / cut road sections are presented in Table 6.2-1. In this Study, from the practices in Sri Lanka, 2.0% and 4.0% of crossfall are proposed respectively for carriageway and shoulder.

Table 6.2-1 Recommended Crossfall on Straight Road Section

Crossfall on Carriageway		Crossfall on Shoulder	
Surface Material	Recommended	Surface Material	Recommended
Portland Cement	2.0 %	Bitumen or Other All Weather Surface	3.0 to 4.0 %
Asphalt Concrete	2.0 %		
Surface Seal	3.0 %	Gravel	4.0 to 5.0 %
Unseals Gravel	4.0 %		

Source) Study Team

For bridge / structure sections, the minimum crossfall shall be 60 horizontal to 1 vertical (1.67%). It is noted that steeper crossfall will lead to the increases in dead load and cost.

In consideration of the above recommended values and practices in Sri Lanka namely having heavy rainy condition and accuracy of workshop, it is proposed 2.5% crossfall be used on bridge and road structure.

6.2.4 Typical Cross Section

In Sri Lanka, typical road cross section is classified into 6 categories: R0, R1, R2, R3, R4 and R5, depending on the ranges of traffic volume (ADT) in terms of PCU/day and road functional class types of A, B, C and D. Dimensions of typical road cross section are given as follows:

(1) Embankment Fill / Cut Section

Dimensions of cross section elements: berm, drain, shoulder, carriageway, median and R.O.W. are summarized in Table 6.2-2 for embankment fill / cut road sections. Minimum values are used depending on the site conditions.

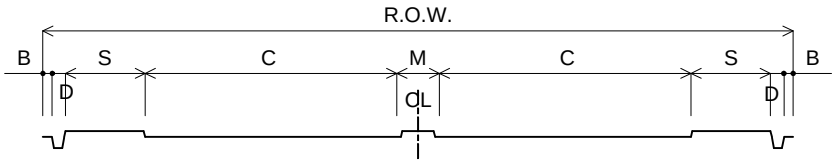
(2) Bridge / Structure Section

The median may be provided wherever it is provided on approach roads. Pedestrian (walkway, parapet and railing) will be provided if the site conditions require. Walkway width is 1.2 m as a minimum and should be increased to satisfy the requirement.

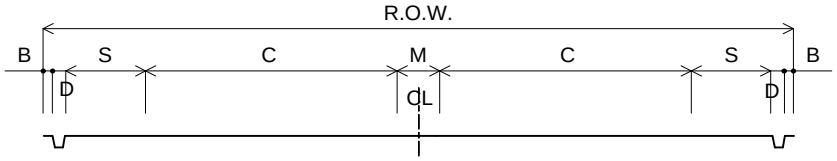
Dimensions on each cross element are summarized in Table 6.2-3.

Table 6.2-2 Typical Cross Section for Embankment Fill / Cut Road Section

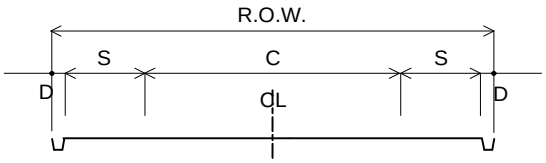
Typical Cross Section Type	R0	R1	R2	R3	R4	R5
ADT (PCU/day)	72,000 – 108,000	40,000 – 72,000	25,000 – 40,000	18,000 – 25,000	300 – 18,000	< 300
Road Class	A	A	A, B	A, B	B, C	C, D
Berm (B) (meter)	-	1.0 (min. 0.0)	0.6 (min. 0.0)	-	1.2	-
Drain (D) (meter)	0.9	1.5 (min. 0.9)	0.9	0.9	0.9	0.9
Shoulder (S) (meter)	3.0	3.0 (min. 2.4)	3.0 (min. 2.4)	3.0	2.4	2.4
Carriageway (C) (meter)	10.5	7.4	7.4 (min. 7.0)	3.7	3.1	3.5
Median (M) (meter)	1.2	1.2	1.2	0.0	0.0	-
R.O.W. (meter)	30.0	27.0	25.0	15.2	15.2	10.1



Type R0, R1



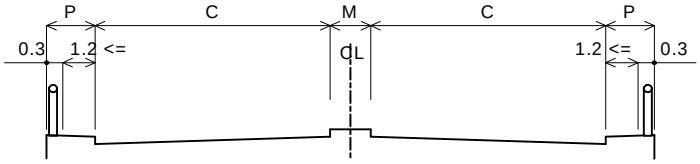
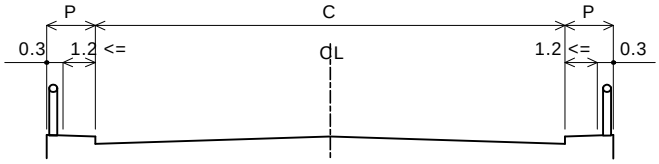
Type R2, R3, R4



Type R5

Source) Study Team

Table 6.2-3 Typical Cross Section for Bridge / Structure Section

Typical Cross Section Type	R1	R2	R3, R4	R5
ADT (PCU/day)	40,000 – 72,000	25,000 – 40,000	300 – 25,000	< 300
Carriageway (C) (meter)	7.4	7.0	3.7	3.7
Median (M) (meter)	Depends on approach road			
Pedestrian (P) (meter)	Depends on site conditions. 0.3 (parapet) + 1.2 (minimum) = 1.5 (minimum)			
 R1, R2, R3, R4  R5				

Source) Study Team

6.2.5 Bridges / Roads Cross Sections

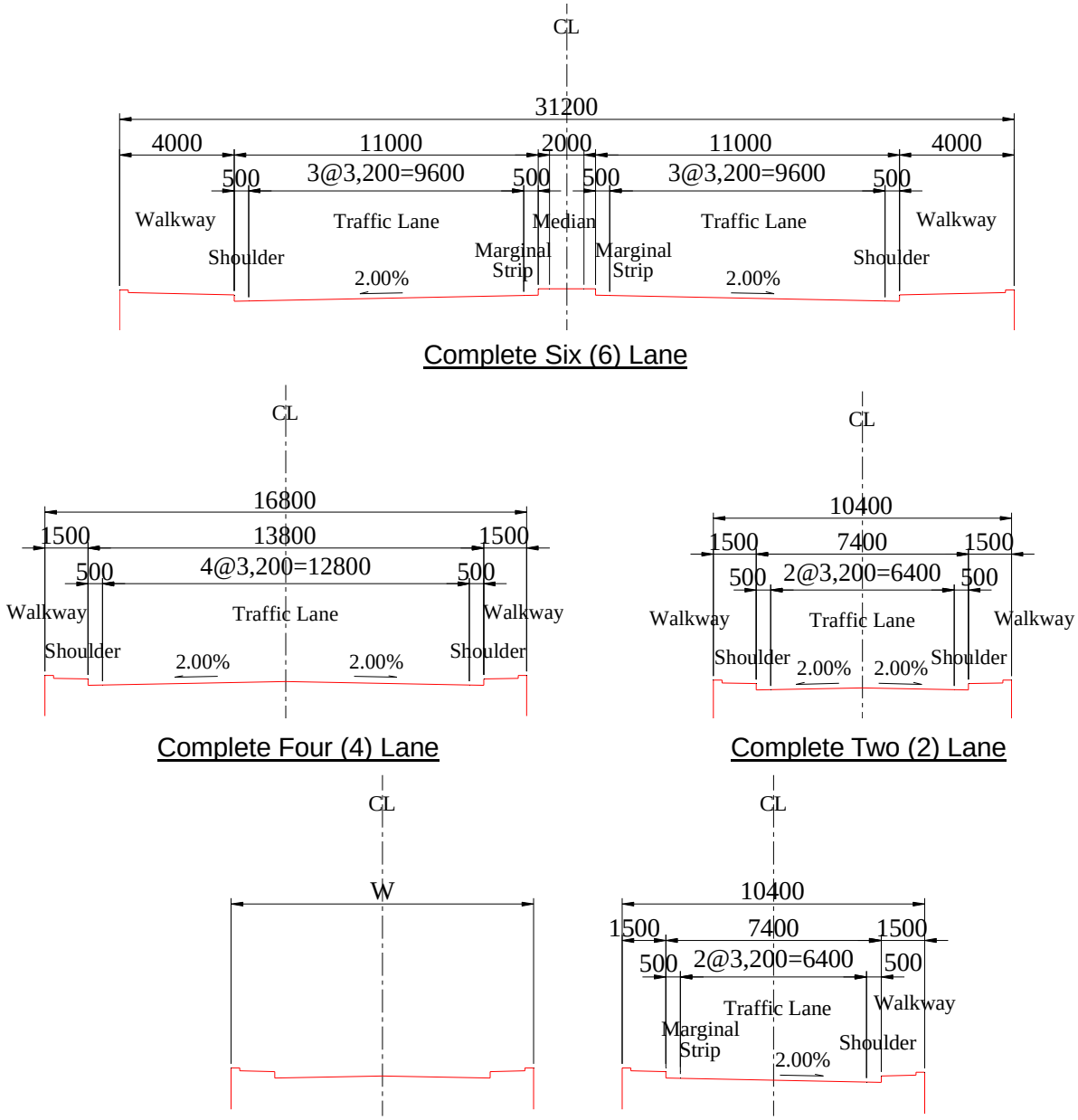
According to the above stated details, project road / bridge cross section will be determined in consideration of annual average daily traffic (AADT) on a PCU basis for carriageway and demands from the surrounding environments for walkway. Yet, no PCU basis traffic data is available and it has not been discussed with RDA on the cross section elements. As to carriageway, provision of shoulder on the bridge section needs clear understanding of RDA officials on its necessity from overseas practices and experiences. Those decisions could be taken in consultation with RDA officials.

In such circumstances, RDA presented Study Team four (4) types of standard bridge cross sections from the requests of provincial / regional agencies: new complete six (6) traffic lanes, new complete four (4) traffic lanes, new complete two (2) traffic lanes and additional parallel two (2) traffic lanes next to the existing one. They have a 3.7m or 3.5m wide traffic lane without shoulder at the outermost lane and marginal strip at median side. It is not recommended for smooth traffic management due to blockage of traffic flow by damaged vehicles on the bridge. Considering maximum width of design vehicle in Sri Lanka is 2.5m, as same as in Japan, it is recommended to be 3.2m for carriageway and 0.5m for shoulder, following Japanese highway design standards. Discussing the traffic lane width, in

consideration of maximum overall vehicle width of 2.5m[1], some margins for vehicle maneuvering at both sides and current traffic flows in Sri Lanka, 3.2m wide traffic lane is judged suitable. With this, 0.5m wide shoulder can be provided at the outermost lane.

Where raised median is provided, it is recommended 0.5m wide marginal strip be provided at both sides to prevent vehicles from bumping into it.

The recommended bridge cross sections by Study Team, based on the RDA requests, are as follows:



Source) Study Team

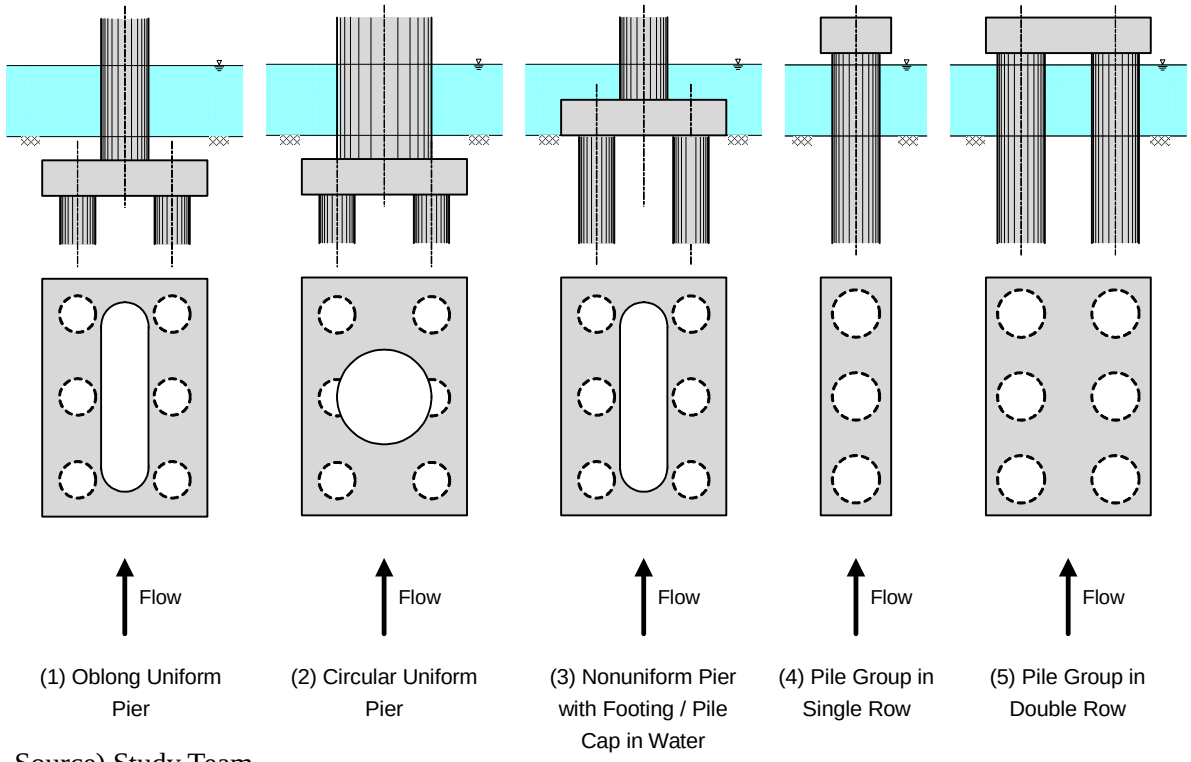
Figure 6.2-3 Recommended Bridge Cross Section

1 Motor Traffic Act (Chapter 3) on October 08, 2004.

6.2.6 Bridge Piers in Water

(1) Bridge Pier Shape and Local Scour

Bridge piers are constructed in a variety of different types and shapes. Some of more common types of piers are illustrated in Figure 6.2-4.



Source) Study Team

Figure 6.2-4 Common Type of Pier in Water

Bridge piers in water are affected by general scour and local scour effects. Local scour effect depends on the flow obstruction imposed by pier itself; shape factor and alignment factor to the flow direction. Detail discussions on both shape and alignment factors are given in "Bridge Scour" published by Water Resources Publications, LLC in 2000. The summary is introduced as follows:

1) Shape Factors

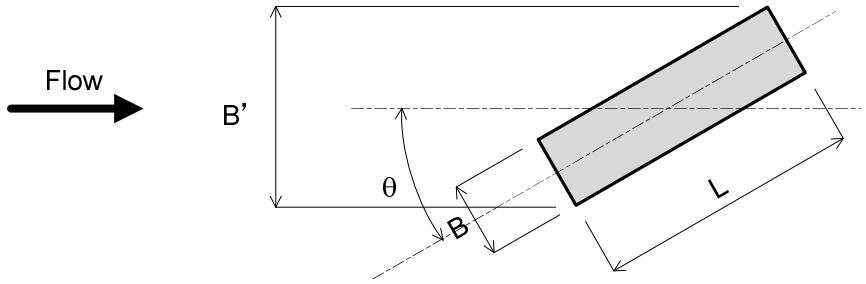
It is well known that wider bridge elements in water lead to deeper local scour. Structure elements, when introduced to a water flow, result in significant changes to the flow patterns.

Shape factors are only important if the stable unidirectional water flow can be ensured. Uniform piers are preferred to non-uniform piers since wider base element intercepts the water flow leading to deeper scour depth. Oblong pier is also preferable in comparison with circular pier due to its narrower element to the flow direction. However, in case of unstable water flow, circular uniform pier is recommended.

Pile groups exposed to water flow induces blockage of debris in flood times. It may cause damage to the bridge structure itself due to increased water load and collision force. In addition, the pile spacing (measured center-to-center) is one of the factors in increasing scour depth. The smaller pile spacing is, the greater scour depth is. Single row pile group is subjected to less local scour compared to double or multi row pile group.

2) Alignment Factor

The depth of local scour for all shapes of pier, except circular, is strongly dependent on the alignment to the flow, θ. As the angle increases, as shown in Figure 6.2-5, the scour depth increases because the effective frontal width of the pier (B') is increased.



Source) Study Team

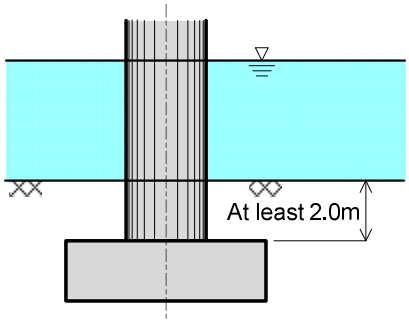
Figure 6.2-5 Alignment to the Water Flow, θ

(2) Recommendation

It is strongly recommended, from the above discussion, that pile cap be embedded into riverbed / seabed with the soil cover of at least 2.0m and pier wall be of oblong shape. Sufficient soil cover on top of pile cap shall be provided not to expedite local scour.

Japanese river structure standard gives 2m soil cover on footing in river. Falling down of bridge due to scoring of foundation in river is in many cases in Japan, 2m cover is not fully safe.

It will achieve the increased operation period of bridge structures.



Source) Study Team

Figure 6.2-6 Soil Cover on Pile Cap / Footing in Riverbed

6.3 Possibility of Use of Steel Structures

6.3.1 General

As discussed in the previous section, common bridges in Sri Lanka are of reinforced concrete (RC) and prestressed concrete (PC), as all the materials except prestressing tendons are available in domestic market. Prestressing tendons are usually imported from India and Singapore so that prestressing beams, which are one of the typical bridge types in Sri Lanka, are produced for longer span bridges in the domestic factories all over Sri Lanka.

Structural steels are not available in domestic market and need to be imported from overseas, if they are used. They need marine transport, fabrication in Sri Lanka or overseas, corrosion protection surface coating, erection and periodical painting. Being surveyed in this Study, Colombo Dockyard has experiences in fabricating steel girders for aqueduct bridges with corrosion protection surface coating against high corrosive environments. It might have an experience to work for steel girder bridges in fabrication and corrosion protection surface coating.

Hereby studied are bridge deck / foundation types: PC box type and steel girder type for bridge deck, and cast-in-situ concrete piles (bored piles) and steel pipe sheet piles for bridge foundations.

The studies were conducted with the assumption that 3-span bridge with 120m long in total (3 x 40.0m = 120.0m) is constructed to cross the river with the bridge foundation bearing stratum of approximately 25m below the riverbed.

Table 6.3-1 Alternative Studies

Study	Alternative Descriptions	
Study – 1	Alternative – 1	■ Bridge Deck : PC Box Girder ■ Bridge Foundation : Bored Piles
	Alternative – 2	■ Bridge Deck : Steel Girder with PC Slab ■ Bridge Foundation : Bored Piles
Study – 2	Alternative – 1	■ Bridge Deck : PC Box Girder ■ Bridge Foundation : Bored Piles
	Alternative – 2	■ Bridge Deck : PC Box Girder ■ Bridge Foundation : Steel Pipe Piles

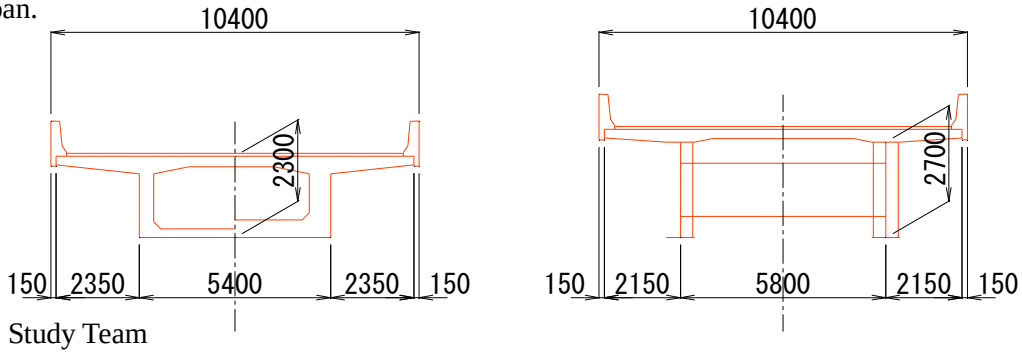
Source) Study Team

For steel structures, use of atmospheric corrosion resistant steel was studied compared to ordinary carbon manganese steel for its economical benefit on a life cycle cost basis. Though periodical inspection is required, no periodical surface coating is needed on atmospheric corrosion resistant steel

6.3.2 Study – 1 : Study on Bridge Deck Types

It is well known that steel bridges might be economically preferable for a longer span of 40m or greater to prestressed concrete bridges, depending on the site conditions. It needs to be studied to ensure economical benefit in bridge construction.

Both PC box girder and steel girder have uniform depth of 2.3m and 2.7m respectively. Figure 6.3-1 shows the detail of each bridge deck type. Deck slab is of prestressed concrete for both types with longer span.

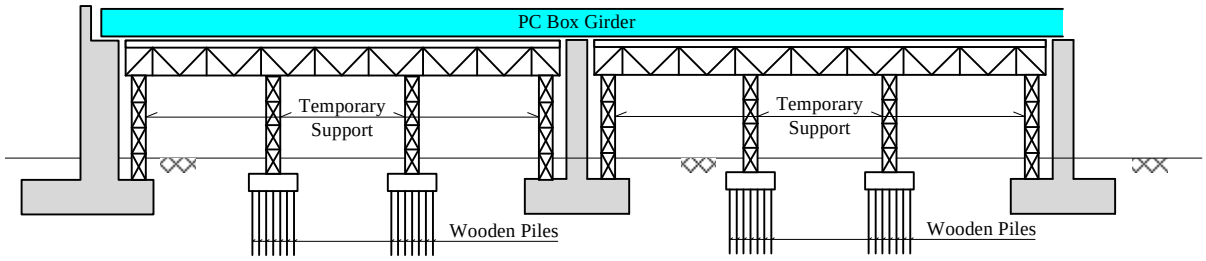


Source) Study Team

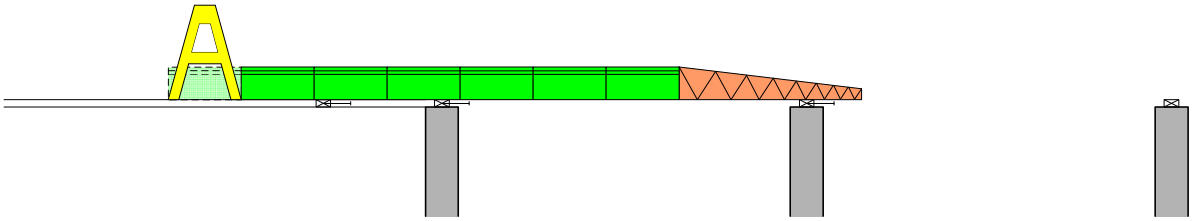
PC Box Girder Steel Girder

Figure 6.3-1 Bridge Deck Cross Section used in Alternative Study

Practically, prestressed concrete bridges were constructed as typical bridge deck type in Sri Lanka. Though PC box girder bridges are not so much constructed, local technicians and labours have a lot of experiences in prestressing works. Construction methods are of all-staging, incremental launching, and erection girder with precast segments. For short bridges, “erection girder with precast segments” is not economical due to high initial investment cost. Two (2) construction methods of all-staging and incremental launching are possible options for the study.



All-Staging



Incremental Launching

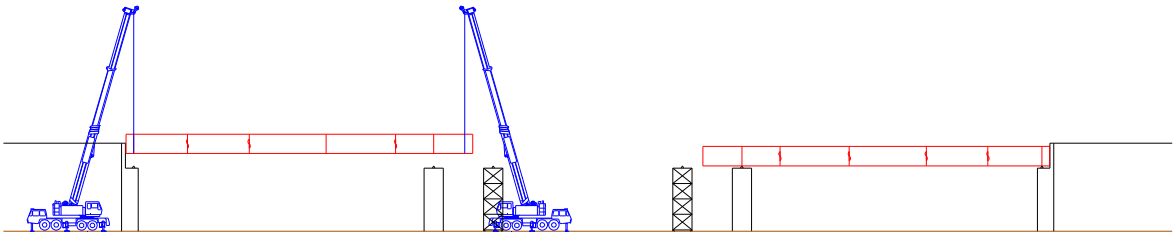
Source) Study Team

Figure 6.3-2 Construction Methods for PC Box Girder Bridge

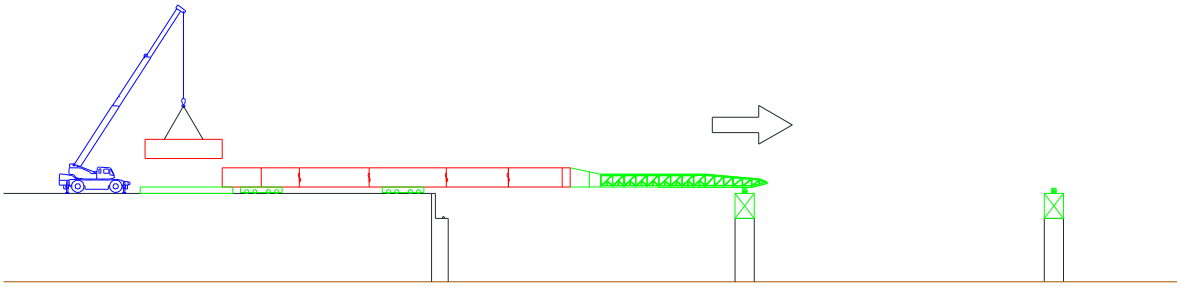
All-staging needs temporary supports for all spans. When it is used in water, adverse effect to water quality is expected due to works in water. It is difficult to use this option in deep water.

Incremental launching is an advanced technology in Sri Lanka, and needs skilled technicians and labourers. This option can be used at any circumstances in deep water, soft soil condition and over the crossing roads / railroads. However, the cost is high due to the requirement of larger quantities of prestressing tendons because tendons must be arranged for repetitive positive / negative flexure moment during launching.

Steel girders are fabricated at site or in the factory, transported to the site, and erected by crawler / wheel cranes with some temporary supports or incremental launching method. Stable working platform is also necessary for erection works. With respect to the fabrication, it needs advanced technology in consideration of camber, longitudinal grade and crossfall. Careful attention must be paid to the transportation not to damage girders and anti-corrosion painting. Fabricating with high tension bolts at site needs accurate tension control.



Erection with Cranes



Incremental Launching

Source) Study Team

Figure 6.3-3 Construction Methods for Steel Girder Bridge

Discussing the maintenance works and costs, prestressed concrete bridges need less works and costs than steel girder bridges if they are properly constructed in arrangement of rebar / prestressing tendons, concrete cover, concrete casting and prestressing works. Steel girders, with ordinary steel material ,need periodical painting for every 40 to 60 years, even though they are painted with high resistance corrosion coating.

Cost estimate and construction time schedule were made with the following assumptions:

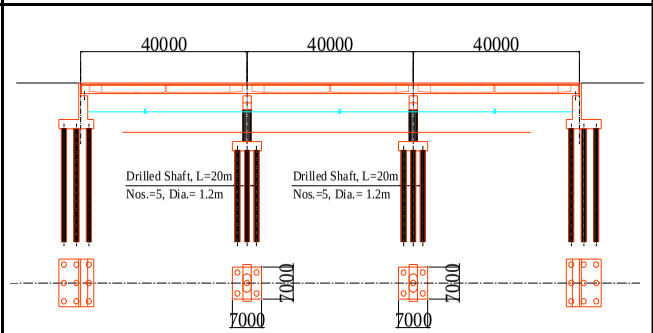
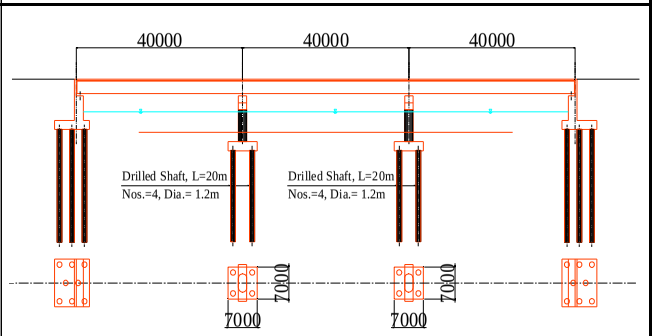
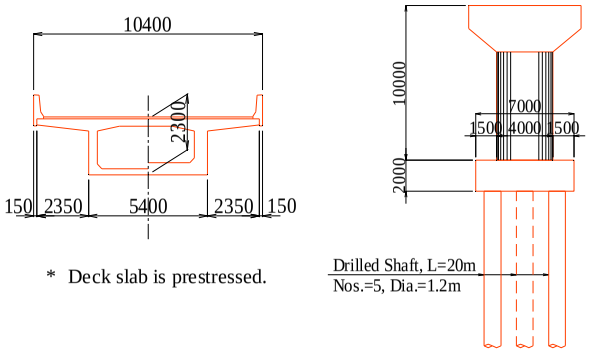
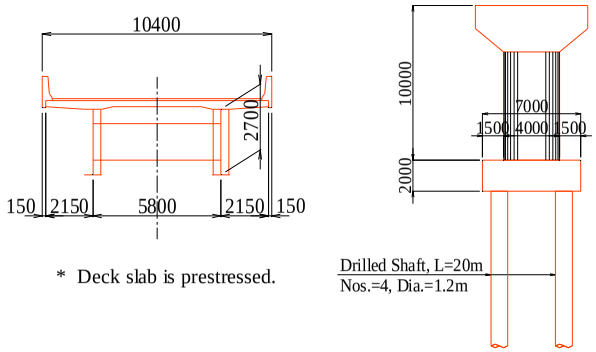
Table 6.3-2 Assumptions on Cost Estimate & Construction Time Schedule (Bridge Deck Type Study)

Alternative	PC Box Girder	Steel Girder with PC Deck Slab
Procurement of Materials	■ Prestressing tendons, bridge bearings, expansion joints from overseas. ■ Others in domestic market.	■ Structural steel, bridge bearings, expansion joints from overseas. ■ Atmospheric Corrosion Resistant Steel from overseas. ■ Others in domestic market.
Construction Method	■ Incremental launching for PC box girder. ■ Bored piles / substructure construction with temporary cofferdam, bridge and platform.	■ Incremental launching for steel girder. ■ Fabrication of steel girder / stabilizing treatment for corrosion resistance surface coating in Colombo Dockyard. ■ Bored piles / substructure construction with temporary cofferdam, bridge and platform.
Work Group	■ 2 work groups are mobilised for foundation / substructure construction (one for A1 & P1, the other for P2 & A2).	■ 2 work groups are mobilised for foundation / substructure construction (one for A1 & P1, the other for P2 & A2).
Work Duration	■ PC box girder incremental launching refers to practices for Manampitiya Bridge. ■ Others refer to the practices in Sri Lanka. ■ Non-operation rate considered.	■ Steel girder incremental launching refers to practices in Japan. ■ Others refer to the practices in Sri Lanka. ■ Non-operation rate considered.
Cost	■ Cost estimate based on project experiences in Sri Lanka with price escalation.	■ Cost estimate based on project experiences in Sri Lanka with price escalation.

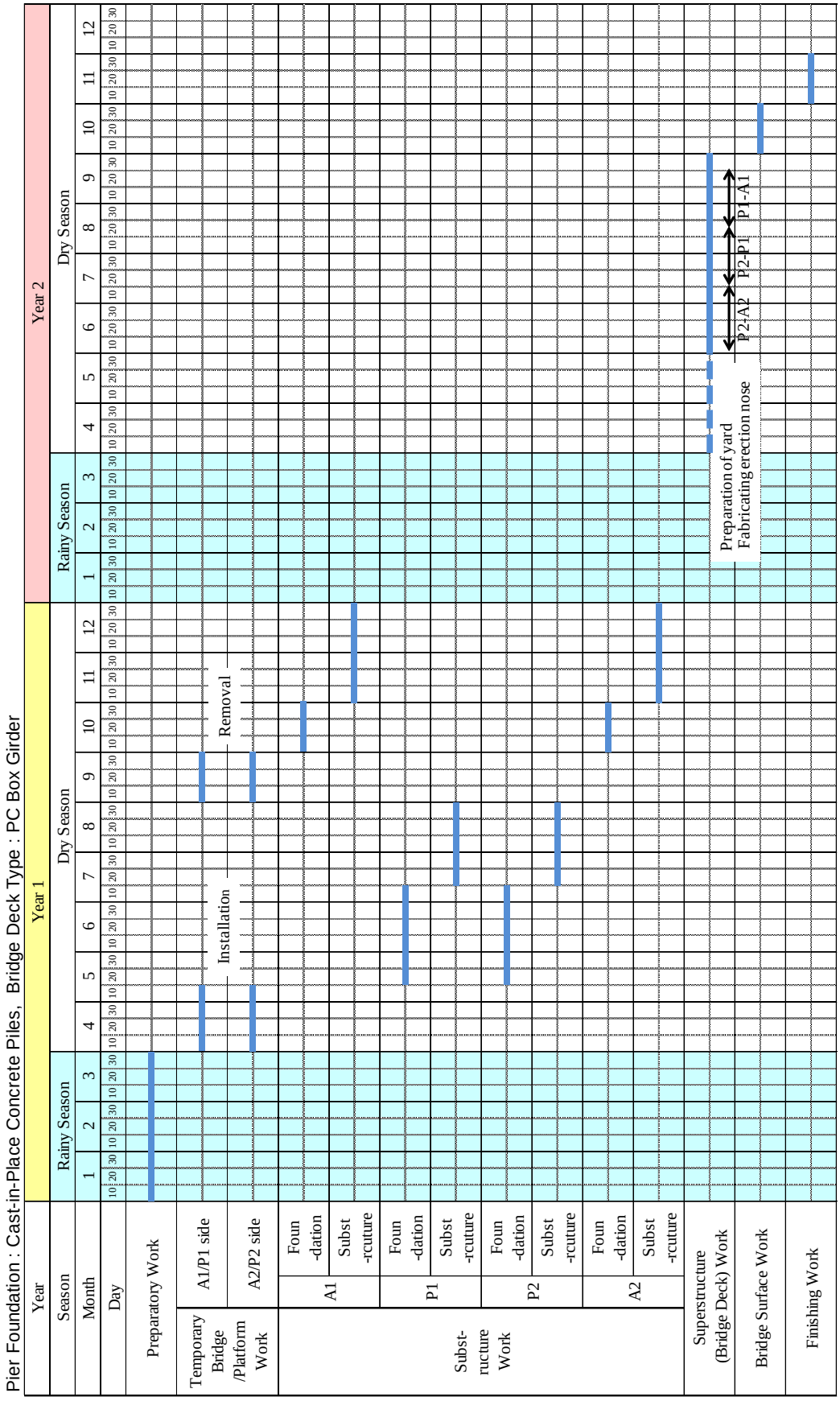
Source) Study Team

The above discussion is summarized in Table 6.3-3 with the construction time schedules in Figure 6.3-4 and 6.3-5.

Table 6.3-3 Comparison on Bridge Deck Types

Bridge Deck Type	PC Box Girder	Steel Girder
Profile		
Detail of Bridge Deck Cross Section & Pier Dimensions	 * Deck slab is prestressed.	 * Deck slab is prestressed.
Advantage	■ Need only locally available materials except PC tendons. ■ No experienced technicians / labours (practices in Sri Lanka). ■ Less maintenance works.	■ Shorter site work period. ■ Less capacity of heavy equipment for erection.
Disadvantage	■ Need temporary support in water when all staging method is used. ■ Need advanced technology when incremental launching method used. ■ Longer site work period.	■ Need imported materials (structural steel). ■ Need experienced technicians and labours for fobrication /erection / coating. ■ Need anti-corrosion coating. ■ Need periodical maintenance works.
Construction Period	23.0 months	20.7 months
Cost	1.04 (435 million JPY)	1.00 (418 million JPY)
Recommendation	△	○

Source) Study Team

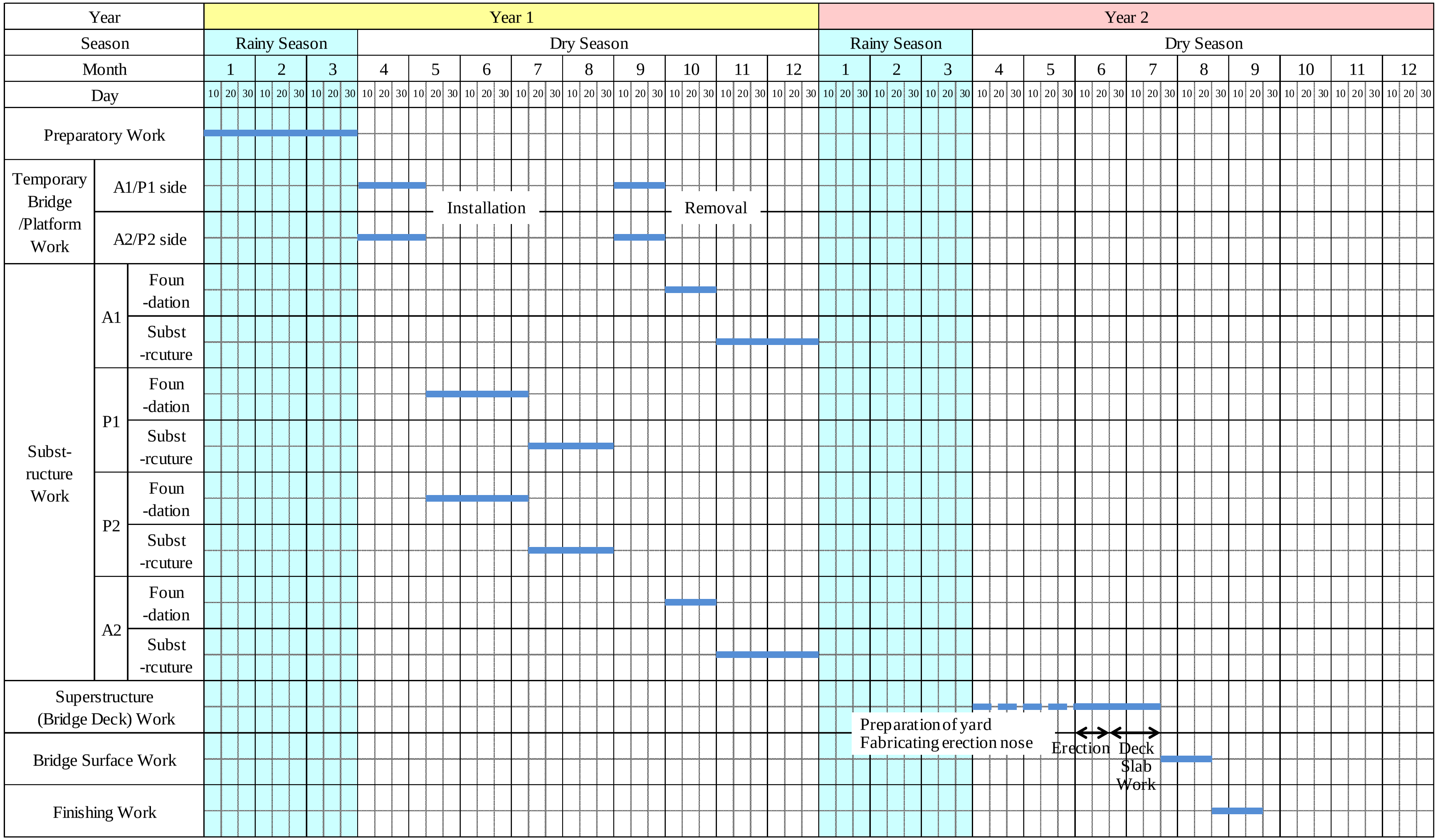


Note: * Method of Girder Erection : Incremental Launching
* Two work groups are mobilised for foundation & substrcuture construction.
* No site work for bridge deck is scheduled in the second year rainy season.

Source) Study Team

Figure 6.3-4 Construction Time Schedule (PC Box Girder)

Pier Foundation : Cast-in-Place Concrete Piles, Bridge Deck Type : Steel Girder



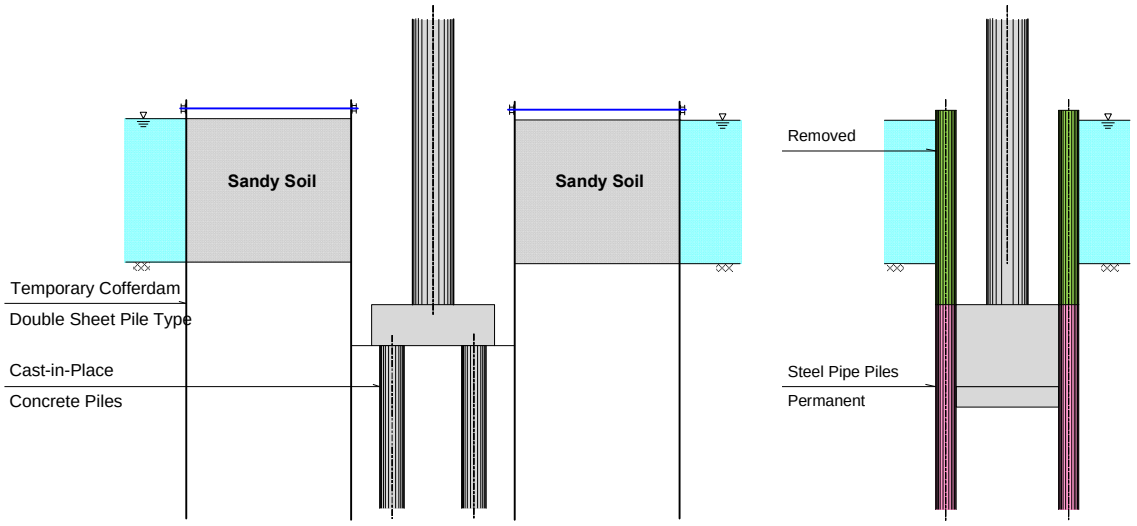
Note:
- * Method of Girder Erection : Incremental Launching
- * Two work groups are mobilised for foundation & substrcuture construction.
- * No site work for bridge deck is scheduled in the second year rainy season.

Source) Study Team

Figure 6.3-5 Construction Time Schedule (Steel Girder)

6.3.3 Study – 2 : Study on Bridge Foundations

With regard to the bridge foundation, steel pipe sheet piles foundation is preferred to the cast-in-place concrete piles when they are used in deep water; practically 5 m or greater.



(a) Cast-in-Place Concrete Pile (b) Steel Pipe Piles

Figure 6.3-6 Foundation Types in Deep Water

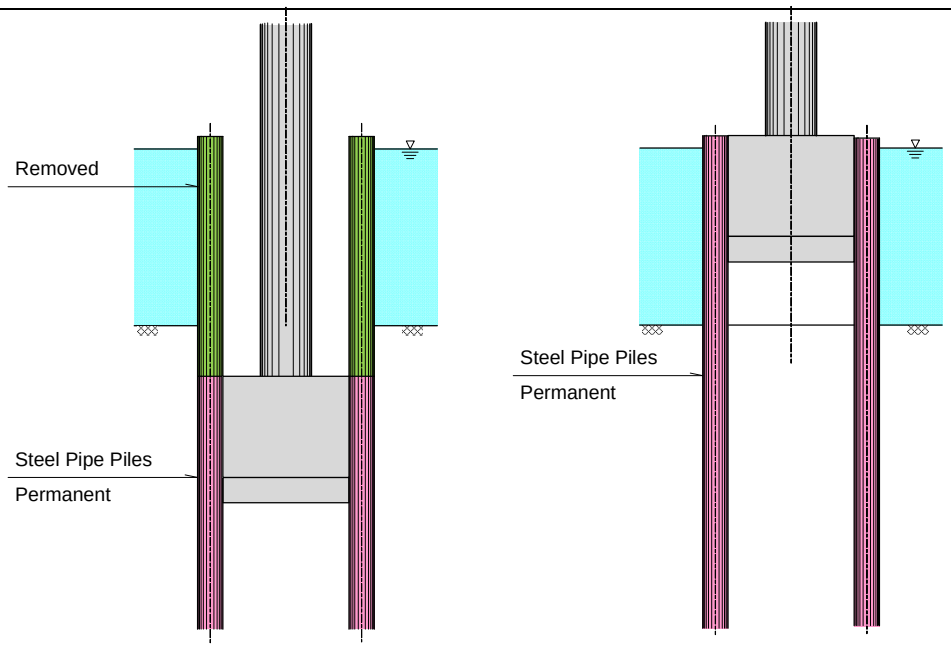
When the cast-in-place concrete piles are constructed in deep water, a large scale of cofferdam, such as double sheet pile type, is required to construct foundation piles, pile caps and pier columns. It is necessary to pay special attention to the obstruction to water flow during construction. In addition, cast-in-place concrete piles need steel casing in water so that drilling; installation of reinforcing bars and concrete casting can be carried out in dry condition.

Filling soil in double sheet pile must be of good quality sandy soil in order to provide sufficient stiffness of cofferdam and to alleviate earth pressure to steel pipe sheet piles. Such good quality soil must be obtained from the authorized sources by the relevant environmental agencies. It must also be given the special attention not to pollute the water when the soils are filled in or removed from the water.

Discussing the steel pipe sheet piles, they can be used as both temporary cofferdam and permanent bridge foundation piles, thereby resulting in economical benefit.

Steel pipe sheet piles foundation is used in a variety of types, of which two options are shown in Figure 6.3-7. Option-1 is to minimize obstruction to water flow in order not to expedite local scour even though it needs removal of steel pipe sheet piles after the construction of concrete slab / pier columns is completed. Option-2 has high work performance in bridge construction compared to Option-1 as no removal of steel pipe piles is required; however, it is inferior in expediting local scour to Option-1 due to wider element.

Being considered the proposed bridge span of approximately 30 - 40m constructed in water, Option-1 is considered as alternative option in the studies.



(a) Option-1 (b) Option-2

Source) Study Team

Figure 6.3-7 Use of Steel Pipe Piles Foundations

Pile driving causes noise and vibration, and may give adverse effect to surrounding neighborhood and aquatic life, if any. When driving into hard rock or boulder layers, special technology shall be introduced: i) concurrent use of water jet and vibratory hammer, and ii) penetration with gyration force and special bits on pile tip.

Steel pipe sheet piles need welding at site due to the limited maximum length for land transportation. Experienced welders shall work in order to achieve sufficient strength equal to or greater than that of steel pipe sheet pile itself.

Cost estimate and construction time schedule were made with the following assumptions:

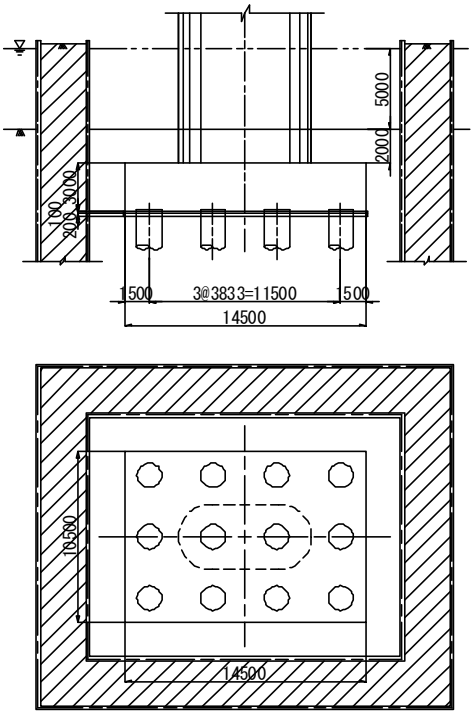
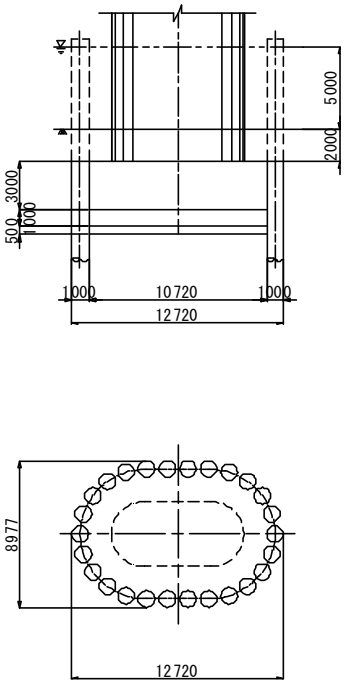
Table 6.3-4 Assumptions on Cost Estimate & Construction Time Schedule (Foundation Type Study)

Alternative	Cast-in-Place Concrete Piles	Steel Pipe Sheet Piles
Procurement of Materials	■ All materials in domestic market.	■ Structural steel from overseas. ■ High corrosion resistance surface coating from overseas.
Construction Method	■ Reverse circulation drilling method.	■ Driving by vibration hammer. ■ If necessary, water jet is concurrently used for hard layer.
Work Group	■ 2 work groups are mobilized for foundation / substructure construction (one for A1 & P1, the other for P2 & A2).	■ 2 work groups are mobilized for foundation / substructure construction (one for A1 & P1, the other for P2 & A2).
Work Duration	■ It refers to the practices in Sri Lanka. ■ Non-operation rate considered.	■ Steel pipe sheet pile construction refers to practices in Japan. ■ Others refer to the practices in Sri Lanka. ■ Non-operation rate considered.
Cost	■ Cost estimate based on project experiences in Sri Lanka with price escalation.	■ Cost estimate based on project experiences in Japan and Sri Lanka with price escalation.

Source) Study Team

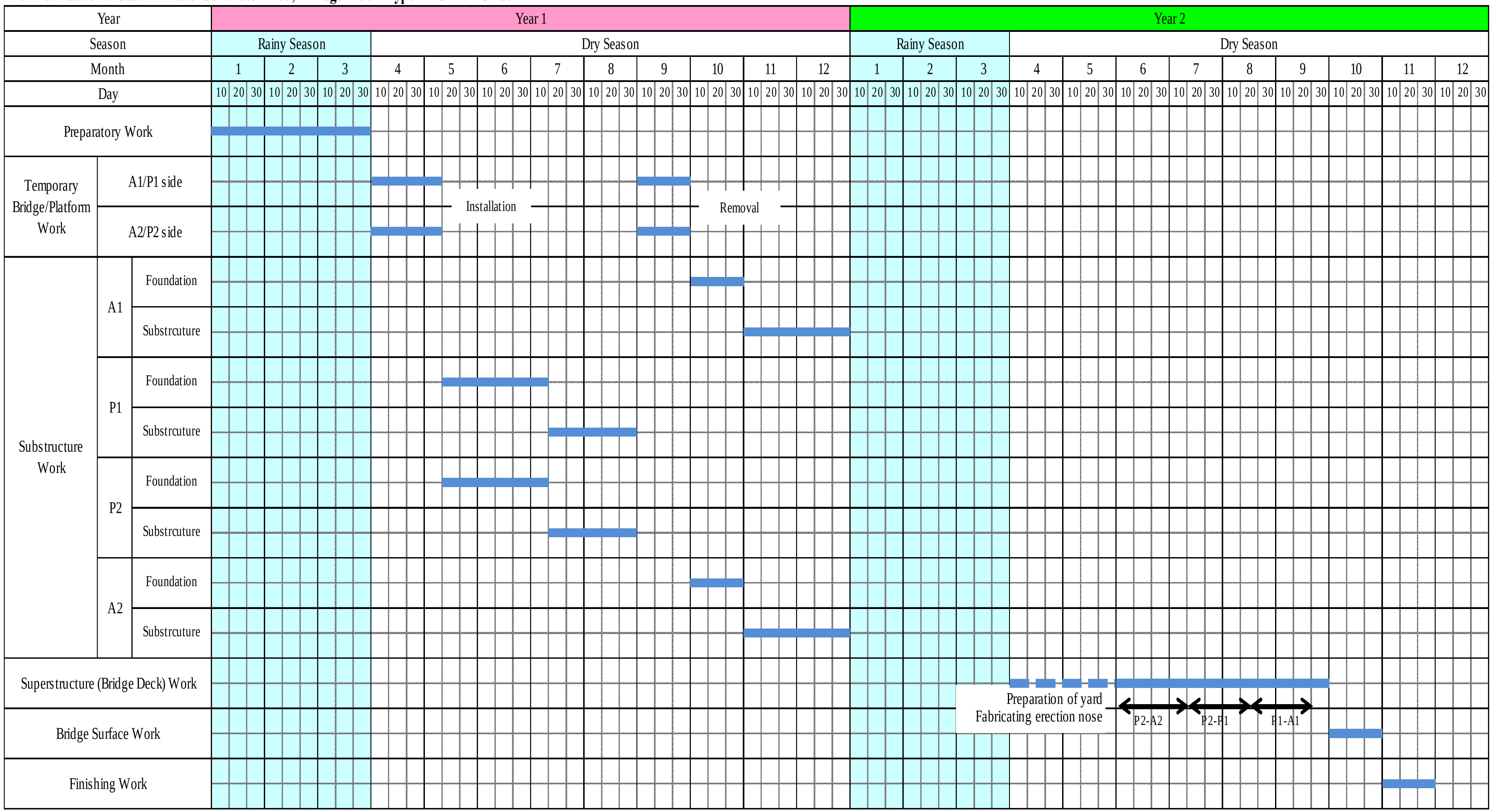
Table 6.3-5 summarizes the above discussions with the construction time schedules in Figures 6.3-8 and 6.3-9.

Table 6.3-5 Comparison on Bridge Foundation Types

<table>
<tr><th></th><th>Cast-in-Place Concreet Piles (Bored Piles)</th><th>Steel Pipe Sheet Piles</th></tr>
<tr><td>Profile
&
Plan</td><td> 
</td><td> 
</td></tr>
<tr><td>Direct Cost</td><td>
<table>
<tr><th>Item</th><th>Cost
(million JPY)</th></tr>
<tr><td>Cofferdam</td><td>47.3</td></tr>
<tr><td>Bored piles</td><td>14.6</td></tr>
<tr><td>Footing</td><td>17.1</td></tr>
<tr><td>Total</td><td>79.1</td></tr>
<tr><td>Ratio</td><td>(1.06)</td></tr>
</table>
</td><td>
<table>
<tr><th>Item</th><th>Cost
(million JPY)</th></tr>
<tr><td>Material cost</td><td>40.7</td></tr>
<tr><td>Steel Pipe Pile</td><td>33.5</td></tr>
<tr><td></td><td>0.0</td></tr>
<tr><td>Total</td><td>74.2</td></tr>
<tr><td>Ratio</td><td>(1.00)</td></tr>
</table>
</td></tr>
<tr><td>Construction Period with Pier</td><td>10 Months</td><td>7 Months</td></tr>
<tr><td>Advantages / Disadvantages</td><td>・ A large scale cofferdam, such as double sheep pile type, is required for construction in deep water of 5 m or greater.
・ Obstruction to water flow is in problem during construction due to large scale cofferdam.</td><td>・ steel pipe sheet piles can be used for both temporary cofferdam and permanent pile foundations (practices up to 15m deep water).
・ Less obstruction to water flow due to smaller plan dimension.</td></tr>
<tr><td>Evaluation</td><td>Less Recommended</td><td>Most Recommended</td></tr>
</table>

Source) Study Team

Pier Foundation : Cast-in-Place Concrete Piles, Bridge Deck Type : PC Box Girder

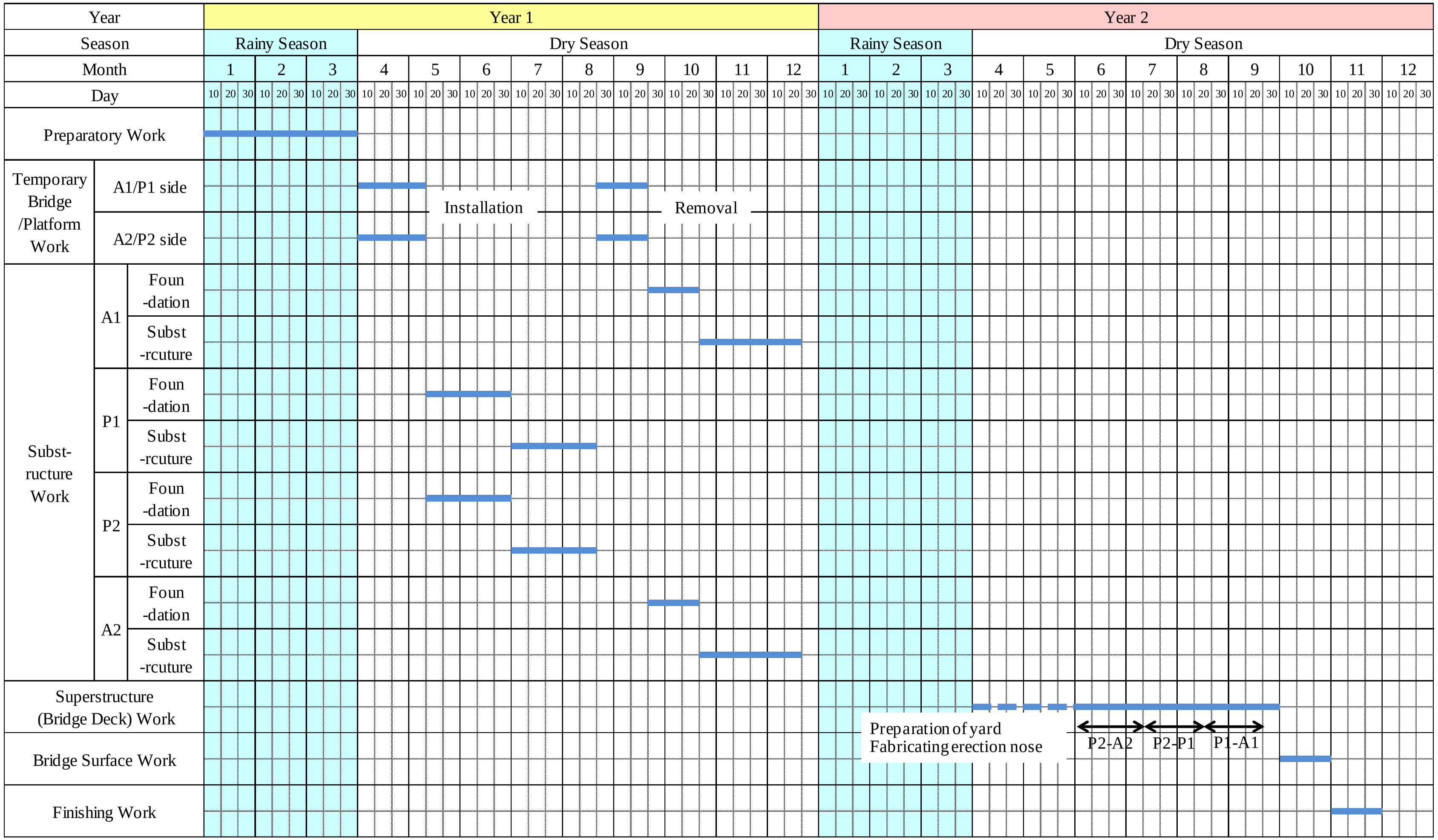


Note:
* Method of Girder Erection : Incremental Launching
* Two work groups are mobilised for foundation & substrcuture construction.
* No site work for bridge deck is scheduled in the second year rainy season.

Source) Study Team

Figure 6.3-8 Construction Time Schedule (Cast-in-Place Concrete Pile)

Pier Foundation : Steel Pipe Sheet Piles, Bridge Deck Type : PC Box Girder



Note:
* Method of Girder Erection : Incremental Launching
* Two work groups are mobilised for foundation & substrcuture construction.
* No site work for bridge deck is scheduled in the second year rainy season.

Source) Study Team

Figure 6.3-9 Construction Time Schedule (Steel Pipe Sheet Piles)

6.3.4 Use of Atmospheric Corrosion Resistant Steel

Hereby studied is the use of atmospheric corrosion resistant steel in place of ordinary carbon manganese steel with two (2) types of surface coatings.

Ordinary steel structure needs periodical surface coating at 10-15 year intervals for ordinary surface coating and at 45-60 year intervals for heavy-duty surface coating in order to ensure the durability and load carrying capacity for its design life.

Ordinary surface coating is frequently used for steel structures located at such ordinary environment as rural and mountainous areas and at such severe environment as urban area. Periodical surface coating, together with inspection and cleaning, is required, even though its initial cost is low.

Heavy-duty surface coating has high resistance to corrosion, and is frequently used at coastal area (severest environment). Though initial cost is higher than that of ordinary surface coating, maintenance cost including inspection and cleaning is lower for its longer service life.

On the other hand, atmospheric corrosion resistant steel does not need periodical surface coating for its design life with its stable rust on surface, even though such maintenance activities as inspection and cleaning are required. Without periodical surface coating, maintenance cost is low. However, so as to ensure development of stable rust, atmospheric corrosion resistant steel structures shall not be used in marine environment, de-icing salt and continuous wet / damp environments, and shall be used in such a well ventilated circumstance as in a mountainous area. Cost estimate was made in consideration of practices in Japan as well as procurement cost of steel material from overseas and marine transport. Life cycle costs (LCC), including periodical surface coating, inspection and cleaning, were also estimated for the purpose of LCC comparison during 100-year period.

The above discussion is summarized in Table 6.3-6.

(1) The area within 2km apart from sea shore,atmospheric corrosion resistance steel is not recommended. The area is affected strong wind and salty sea water. More precisely speaking adoption of atmonspheric corrosion resistant steel will be decided after air-born salt test.

(2) In conclusion, in consideration of suitable environments for use of atmospheric corrosion resistant steel and LCC, it is proposed that Steel I-Girder bridge constructed approximately 2 km *) far from coastal line be made of atmospheric corrosion resistant steel material.

*) Japanese highway bridge design specification allow to omit air –born salt test for the bridges located more than 2km apart from sea shore. (Even the bridge location is within 2km apart from sea shore, amount of air-born salt is less than standard value, atmospheric corrosion resistance steel is applicable.

Compare Sri Lanka and Japanese Pacific ocean sea shore, wind velocity of Sri Lanka is ‘Same as average wind velocity or less of that of Pacific Ocean side in Japan’ and Sea wind toward West side of Sri Lanka in only few months including January, other months of year wind speed is less. Considering those facts, evaluation for adoption of atmospheric corrosion resistance steel is 2km apart from sea shore at this study stage.

However it is necessary to measure air –born salt in particular locations in Sri Lanka.

Judging from Japanese actual result, it is possible to evaluate the adoption of atmospheric corrosion resistance steel according to whether 2.0km from sea side, so far no actual data in Sri Lanka, it is good to measure air –born salt this time.

Table 6.3-6 Comparison between Ordinary Steel with Surface Coating and Atmospheric Corrosion Resistant Steel for New Constructed Bridge

	Ordinary Steel with Ordinary Surface Coating	Ordinary Steel with Heavy-Duty Surface Coating	Atmospheric Corrosion Resistant Steel
Outlines	Ordinary surface coating, which requires simple surface preparation and coating, is frequently used for steel structures located at mountainous area (ordinary environment) and urban area (severe environment). Maintenance cost for periodical surface coating is high due to short service life, though its initial cost is low.	Heavy-duty surface coating has high resistance to corrosion, and is frequently used at coastal area (severest environment). Due to its hardness, surface coating is not subject to defect / damage during transportation. Though initial cost is higher than that of ordinary surface coating, maintenance cost is lower for its longer service life.	Atmospheric corrosion resistant steel produces a stable, much less porous rust layer under conditions of alternate wetting and drying, which impedes further access of moisture and oxygen, thereby resulting in reduction of corrosion rate. Rust stain can be reduced with rust stabilization treatment. No surface coating is required in future.
Service Life*	15 years (10 years)	60 years (45 years)	Over 100 years
Aesthetic View	A variety of color is used depending on the surrounding environment. It is superior in aesthetic view.	A variety of color is used depending on the surrounding environment. It is superior in aesthetic view.	As surface color is limited to reddish brown, it is inferior in aesthetic view.
Practice	A lot of practices.	A lot of practices.	Less practices compared to other options. However, practices are increasing.
Economy (Inspection, Coating included)	Initial Cost 111 Mil. Yen (Fabrication 53 Mil. Yen) (Coating 11 Mil. Yen) Maintenance Cost 240 Mil. Yen Total Cost 351 Mil. Yen (1.66)	Initial Cost 125 Mil. Yen (Fabrication 53 Mil. Yen) (Coating 25 Mil. Yen) Maintenance Cost 129 Mil. Yen Total Cost 254 Mil. Yen (1.20)	Initial Cost 123 Mil. Yen (Fabrication 59 Mil. Yen) (Coating 17 Mil. Yen) Maintenance Cost 88 Mil. Yen Total Cost 211 Mil. Yen (1.00)
Evaluation	Not Recommended	Less Recommended	Most Recommended

* Service life: under normal environment (under severe environment)

Source) Study Team

6.3.5 Conclusions

Use of steel structures for selected bridges was studied in terms of construction cost, life cycle cost, construction time schedule and effects to social / natural environments for both bridge deck and foundation.

It was confirmed that, for both bridge deck and foundation, cost of steel structures are lower compared to Prestressed Concrete (PC) bridge deck and cast-in-place concrete piles respectively.
In addition, construction duration at site is shorter in steel girder / steel pipe sheet pile than that in prestressed concrete bridge deck and cast-in-place concrete pile. It will alleviate the economic loss arisen from traffic congestion and such adverse effects to surrounding residents and road users as air pollution and dust. Considering the selected bridges located at national roads, the above-mentioned adverse impacts shall be avoided.

Study Team discussed with RDA the adoption of atmospheric corrosion resistant steel girders for a span of 40 m or greater bridge, focusing on life cycle cost. All the cost necessary for maintenance activities are burden on RDA. So as to alleviate such burden, atmospheric corrosion resistant steel girder is of favorable option for RDA. RDA judged Steel I-Girder, made of atmospheric corrosion resistant steel, will consequently be used for a span of 40m or greater bridge.

With respect to bridge foundation, it was discussed on Digarolla Bridge constructed in approximately 5m deep river. It was evident that steel pipe sheet piles foundation is superior to cast-in-place concrete piles in both construction cost and construction time period. It also has a lot of benefits in smaller obstruction to river flow during construction and less adverse effects to water quality and aquatic life because of no huge double sheet pile cofferdam.

As a result, it has decided to use steel pipe sheet pile foundation Digarolla Bridge as a bridge foundation.

The above will be discussed again at detail design stage with topographic survey, soil investigations and hydrological analysis results.

6.4 Bridge Planning

6.4.1 Bridge Deck Type

Almost all bridges selected for the Project are across the rivers / watercourses, which do not require navigation clearance under the bridge decks due to no passage of large-size vessels. A long span and high vertical clearance are therefore not needed.

The depths of rivers / watercourses are less than 5 m at most of the bridge sites except for Digarolla Bridge, and subsurface ground is in comparatively favorable conditions. With such situations, substructure / bridge foundation cost is expected not high. It is therefore said that economical benefit for a bridge depends on the bridge deck cost.

As discussed in 6.1 and previous practices in Sri Lanka, bridge deck types used are summarized in Table 6.4-1 by span.

Table 6.4-1 Bridge Deck Type by Span

Bridge Deck Type	Span, in meter					
	0	10	20	30	40	50
Pre-tensioned Beam	■	■				
Post-tensioned I-Girder			■	■	■	
Steel I-Girder					■	■

Source) Study Team

Pre-tensioned Prestressed Concrete Slab Beam is the slab beam system, used for spans ranging from 9m to 19m. Compression force is given to the concrete beam with prestressing tendons. Tendons are arranged at designated locations with reinforcement steels and forms, and tensioned before the concrete is cast. After the concrete is hardened, tendons are cut to give the compression force to the beam. Beams are closely installed each others, and slab concrete is cast on the beams. Beams and slab concrete resist the dead / live loads together.

Post-tensioned Prestressed Concrete Girder Bridge is the multi-girder system bridge, used for spans ranging from 20m to 40m. Compression force is given to the concrete girder with prestressing tendons after the concrete is hardened. Several girders are installed at 2.0m to 2.5m intervals and connected with end and intermediate cross beams so that such floor system can resist dead / live loads.

Two- or Three- Steel Plate I-Girder Bridge is newly developed steel girder system. In order to achieve economical benefit with reduction in total steel weight, number of steel plate girder is two or three for a 2-lane or 4-lane bridge respectively, even though each girder has a little bit heavier weight than usual multi-girder steel bridge system. Concrete deck slab is cast on girders and prestressed for its longer span after the concrete is hardened.

It is noted, however, at coastal areas within 2 km from the coastal line, prestressed concrete bridge deck shall be used, since steel bridges are subjected to salt damage due to sea wave and salt splash.

6.4.2 Alignment Change

Study Team proposed alternative alignment after reviewed the existing selected bridges which are necessary to alter the existing alignment is necessary.

After the review, wherever existing alignments are judged not suitable for smooth movement of vehicles at design speed and safety as national roads, Study Team proposed new alignments for such bridge sites and discussed with RDA for confirmation.

Wherever cost of temporary bridge used for the traffic management during construction is high due to its high piers and abutments or in deep water, new alignments will be proposed for such bridge sites, even with appropriate existing alignments. With the use of existing bridges, economical benefit is achieved from shorter construction period and no temporary bridge. Existing bridges will be demolished if adverse effect to the obstruction of river flow is suspected.

In some bridges even though the existing bridge is in sound condition, the number of traffic lanes are not enough. In such cases, an additional bridge will be constructed at a distance from the existing one in order to minimize adverse effects to existing bridge structures in terms of increase in scour and instability during a new bridge construction due to excavation, pile driving / construction.

Proposed new alignments shall have less impact to existing facilities, land acquisition and resettlement, social and natural environments. In addition, drastic change in existing alignment shall be avoided in this Study due to necessity of further time-consuming discussions with relevant authorities.

After discussing with RDA, the following bridges will be changed in horizontal alignment.

Table 6.4-2 List of Bridges with Alignment Change

Inventory No	Route No.	Bridge Number	Bridge Name	Remarks
43	AA 028	75/4	Kurunegala	Parallel bridge
45	B 264	30/2	Meeliyadda Palama	Improvement of existing alignment.
58	AA 014	31/1	Kotaleeya	Cost of temporary bridge is high.
63	AA 032	59+610	Pali aru Bridge with Causeway	Improvement of existing alignment.
66	B 403	7/1	Aru-Kuli Causeway	Improvement of existing alignment.
82	AA 004	157/6	Belihuloya	Improvement of existing alignment.
107	B 466	4/1	Denipitiya	Improvement of existing alignment.
108	B 142	4/1	Denagama	Improvement of existing alignment.
109	B 153	10/4	Halpatota	Improvement of existing alignment.
110	AA 002	148/1	Polwathumodara	Parallel bridge
113	-	-	Polawatta	Improvement of existing alignment.
138	B 496	41/1	Weli Oya	Improvement of existing alignment.
144	B 157	8/3	-	Parallel bridge
152	AB 010	9/1	Ambathale	Parallel bridge

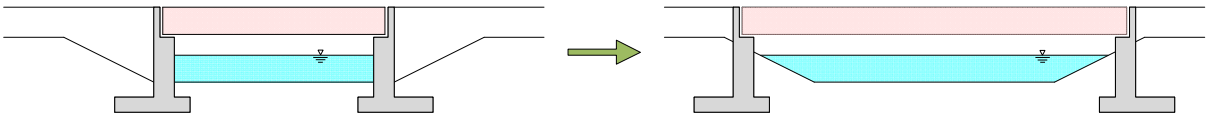
Inventory No	Route No.	Bridge Number	Bridge Name	Remarks
153	AB 010	15/1	Welehandiya	Parallel bridge
154	AB 010	26/4	-	Parallel bridge
156	AB 010	28/1	-	Parallel bridge
159	AA 004	33/3	Galagedara	Parallel bridge
166	B 403	21/1	Arippu Causeway	Improvement of existing alignment.
171	AA 002	52/1	Maggona	Improvement of existing alignment.
173	AA 002	53/1	Maggona 2	Improvement of existing alignment.
176	AA 004	64/1	-	Parallel bridge
180	B 304	35/4	Alukatiya	Improvement of existing alignment.
183	B 279	12/2	Wagolla	Improvement of existing alignment.
184	B 279	11/2	Wagolla	Improvement of existing alignment.

Source) Study Team

6.4.3 Bridge Length

Bridge abutments for a bridge across the river / watercourse shall be constructed in consideration of riverbank / channel bank and adverse effects to riverbank / channel bank and a bridge itself due to erosion, water load and scour. In Sri Lanka, abutments are generally constructed in the water so that a bridge length can be shorter for low construction cost; however such abutments will obstruct water flow during floods, thereby resulting in erosion of riverbank / channel bank and serious scour at bridge piers / abutments.

In this Study, it is proposed that abutments be set back so that sufficient water opening and prevention of damage to riverbank / channel bank can be ensured during floods.



Practiced Abutment Location in Sri Lanka Proposed Abutment Location

Source) Study Team

Figure 6.4-1 Proposed Abutment Location

In the causeway or flooding area, bridge length shall be determined based on the hydrological analysis using the previous records of water level, discharge and interview survey result to residents. In Sri Lanka, design high water level and discharge with 100-year return period shall be considered.

In general, road embankment obstructs water flow during floods and causes water level difference between upstream and downstream, thereby resulting in breach of embankment and/or serious scour at a bridge (at a water opening). As a result, a flood-free to an all-weather standard road network can

not be ensured. Since all the selected bridges in this Study are on national roads, closure to traffic due to breach of embankment and/or collapse of a bridge shall be prevented.

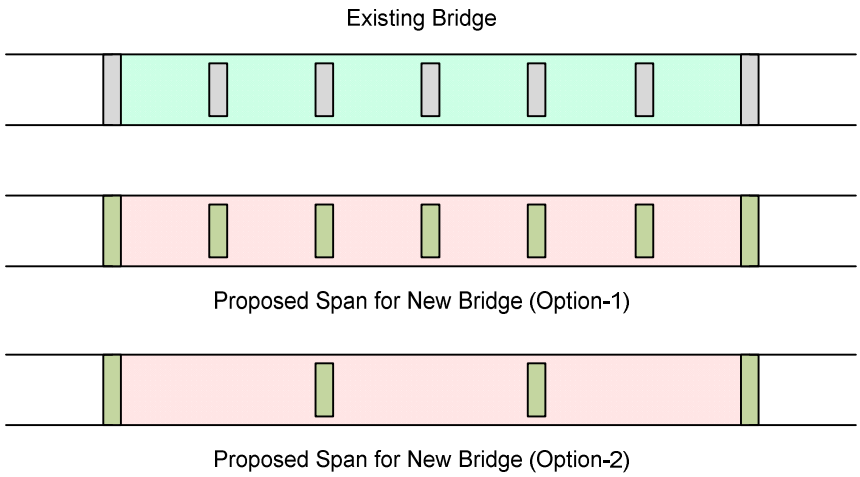
A longer bridge length (wider water opening) is recommended, since a water level difference is decreased, and damage to road embankment and extent of scour at a bridge are alleviated.

Though detail analysis is implemented at detailed design stage, appropriate bridge length was determined according to the previous experiences of Study Team for each bridge located in causeway and flooding area.

6.4.4 Span Arrangement

In general, span arrangement is studied together with bridge deck type so as to achieve low construction cost. Previous practices indicate economical bridge deck type by span is as in Table 6.4-1. In addition, wherever erosion and scour are in question at times of flooding, hydrological effect is one of the important factors to determine the span arrangement. Where a span is small, extent of obstruction to water flow and changes in flow patterns are significant. It will expedite local scour at piers and subsequent collapse of a bridge. Such effects shall be analyzed in the hydrological study.

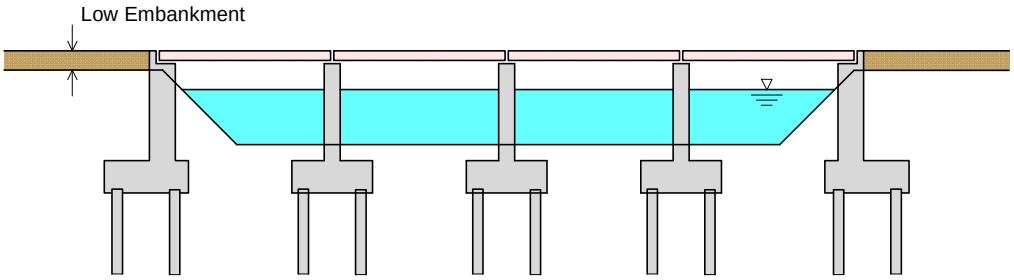
Where a parallel bridge is constructed adjacent to the existing one, new bridge piers shall be in line with the existing ones to the water flow direction in order to alleviate scouring at existing piers and obstruction to water flow, thereby contributing to the prevention of bridge collapse. Wherever scour at existing piers and/or erosion at existing abutments are observed, a recommended span shall be twice or three times the current span so as to alleviate such effects.



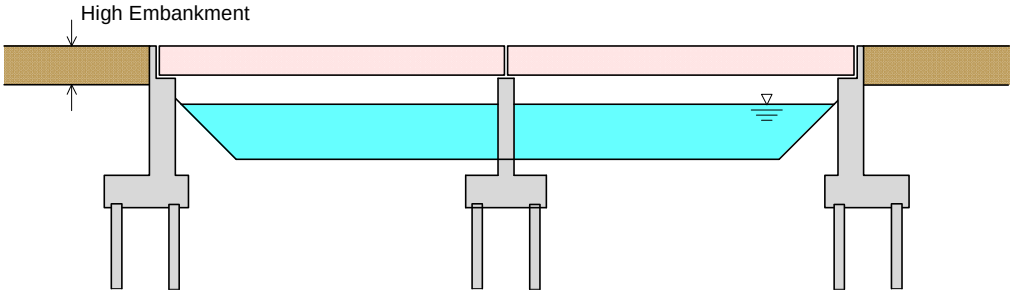
Source) Study Team

Figure 6.4-2 Span Arrangement at Parallel Bridge

Attention shall also be given to the approaches at both sides of a bridge. Bridge deck with approximately 2 – 3 m depth for a longer span may need high embankment at approaches either with ordinary slopes or retaining walls, as shown in Figure 6.4-3. Where residential areas exist at approaches, a large number of land acquisition and resettlement are needed, or high retaining walls will give feeling of oppression to the residents and obstruct sunshine when used. In such cases, if erosion and/or scour are not in problem, small depth of bridge deck shall be used with a shorter span.



Small Depth Bridge Deck for a Short Span

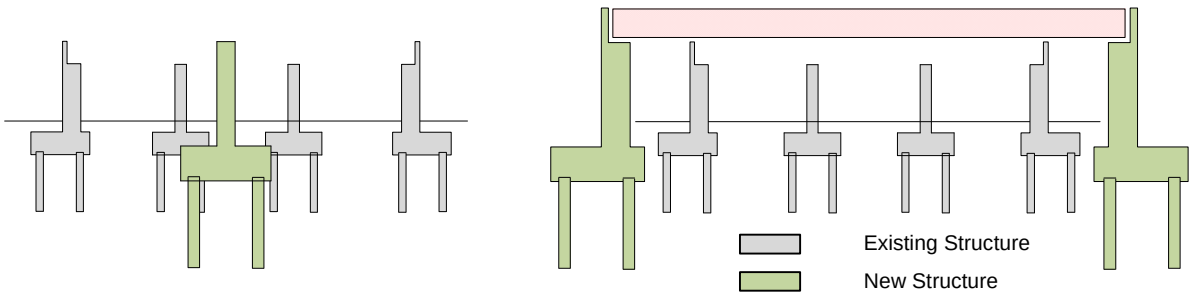


Source) Study Team Large Depth Bridge Deck for a Long Span

Figure 6.4-3 Effect of Approach Embankment with Bridge Deck Depth

As is discussed in 6.4.2, where existing alignment is as good as enough for smooth movement of vehicles and safety, a new bridge will be constructed at the same place. After demolishing the existing structures, piles, if necessary, and pile caps / footings of a new bridge will be constructed.

However, where it is expected that existing structures obstruct a new bridge construction, a bridge shall have one (1) span with the abutments set back from the existing ones as in Figure 6.4-4.



Obstruction of Existing Structure Proposed Span Arrangement

Source) Study Team

Figure 6.4-4 Proposed Span for a Bridge Constructed at Existing Structure

6.4.5 Digarolla Bridge

Digarolla Bridge on National Road A 002 has heavy traffic, especially in peak hours in the morning and in the evening, and have caused accidents that pedestrians fell down from the bridge to the river due to its narrow carriageway and walkway.

There are a lot of residents and business shops along both sides of approaches, and it needs a large scale of land acquisition and resettlement for reconstruction of the bridge.

Digarolla Bridge is constructed in approximately 5m deep river, and the construction cost of its foundations is expected quite high. As is discussed in 6.3.3, bridge foundation type should be of steel pipe sheet pile irrespective of necessity of imported steel materials. It is superior in lower construction cost, shorter construction time period, lesser effects to obstruction to river flow and water quality, to the other types of ordinary bridge foundation such as cast-in-place concrete piles.

For reasons of shorter construction time period and lower construction cost for a bridge, it is recommended that number of piers in deep river be as small as possible.

In order to minimize the land acquisition and resettlement on highly populated approaches, approach road length shall be as short as possible. High embankment requires large area of lands due to its slopes or high retaining walls. Where high retaining wall is constructed, feeling of oppression to residents and/or obstruction of sunshine will be of serious concern. Both of these problems will be solved with smaller depth of bridge deck.

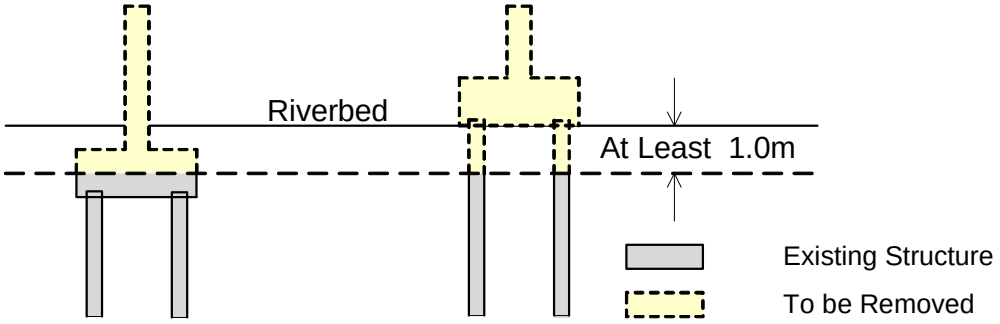
In consideration of the above discussion, Study Team proposed extra-dosed PC box girder bridge for Digarolla Bridge.

6.4.6 Demolition of Existing Structures

Where a new bridge is constructed at the same location of existing one or where it is expected that existing structures obstruct water flow or are seriously damaged resulting in losses of human lives or collapse of structures, such structures shall be demolished.

Demolition of existing structures may disturb the existing ground resulting in reduction of ground strength or come to water pollution. In order to prevent such adverse effects, demolition shall be minimized to the extent obstruction to water flow is solved.

Study Team proposed that existing structures be demolished at least 1.0m from the riverbed / seabed, as in Figure 6.4-5.



Source) Study Team

Figure 6.4-5 Demolition of Existing Structure

6.4.7 Summary of Bridge Length and Span Arrangement for Selected Bridges

Hereby summarized in Table 6.4-3 are the necessity of alignment change, bridge length and span arrangement together with the reasons of such bridge planning.

Table 6.4-3 Summary of Alignment, Bridge Length and Span Arrangement (Lot 1: Southwest Area) 1/4

Inventory No.	Route No.	Bridge Number	Proposed Bridge Details	Descriptions (Alignment, Bridge Length, Span Arrangement)	
82	AA 004	157/6	Bridge Name: Belihuloya	Alignment	The alignment is changed for improvement (downstream).
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at point of intersection with existing road along the new alignment.
			Span : 3 x 50m = 150m	Span Arrangement	For the bridge across the meandering river, in order to prevent scour expedition at both existing and new bridge piers, span shall be longer.
103	AA 002	138/1	Bridge Name: Goiyapana	Alignment	No alignment change.
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are set back from existing ones without obstruction for construction.
			Span : 3 x 30m = 90m	Span Arrangement	Pier are arranged not to be affected by existing piers / foundations.
107	B 466	4/1	Bridge Name: Denipitiya	Alignment	The alignment is changed for improvement.
			Bridge Type: Pre Beam	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 3 x 16.7m = 50m	Span Arrangement	Span arrangement is determined for economical reasons. New span is greater than existing one.
108	B 142	4/1	Bridge Name: Denagama	Alignment	The alignment is changed for improvement.
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water.
			Span : 2 x 40m = 80m	Span Arrangement	For narrow and bent access road, transportation of precast beam is difficult. Casting yard for post-tensioned girder fabrication needs large scale of deforestation. Steel girder will be the optimum solution. Span arrangement is determined for steel girder bridge.
109	B 153	10/4	Bridge Name: Halpatota	Alignment	The alignment is changed for improvement (upstream).
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 3 x 30m = 90m	Span Arrangement	Span arrangement is determined so that new piers are in line with existing ones remained in comparatively straight river.
110	AA 002	148/1	Bridge Name: Polwathumodara	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (downstream).
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 4 x 30m = 120m	Span Arrangement	Span arrangement is determined for economical reasons (number of piers is reduced) and so that new piers are in line with existing ones remained in comparatively straight river..

Source) Study Team

Summary of Alignment, Bridge Length and Span Arrangement (Lot 1: Southwest Area) 2/4

Inventory No.	Route No.	Bridge Number	Proposed Bridge Details	Descriptions (Alignment, Bridge Length, Span Arrangement)	
112	AA 002	133/3	Bridge Name: Kathalu (Pol Oya)	Alignment	No alignment change.
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are set back from existing ones so that obstruction to construction is avoided.
			Span : 3 x 30m = 90m	Span Arrangement	Pier are arranged not to be affected by existing piers / foundations.
113	-	-	Bridge Name: Polawatta	Alignment	The alignment is changed for improvement.
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 4 x 27.5m = 110m	Span Arrangement	Span arrangement is determined for economical reasons.
116	B 128	15/2	Bridge Name: Kahabiliya	Alignment	No alignment change.
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are set back from existing ones so that obstruction to construction is avoided.
			Span : 1 x 50m = 50m	Span Arrangement	No pier is constructed due to obstruction by existing piers.
117	B 130	8/7	Bridge Name: Part of Gin Ganga	Alignment	No alignment change.
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are set back from existing ones so that obstruction to construction is avoided.
			Span : 1 x 30m = 30m	Span Arrangement	No pier is constructed due to obstruction by existing piers.
138	B 496	41/1	Bridge Name: Weli Oya	Alignment	The alignment is changed for improvement.
			Bridge Type: Pre Beam	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 3 x 16.7m = 50m	Span Arrangement	Span arrangement is determined for economical reasons and in consideration of effects to approaches in deforestation due to increase in elevation with deeper bridge deck.
139	AA 002	20/1	Bridge Name: Digarolla	Alignment	No alignment change.
			Bridge Type: Extradosed PC Box	Bridge Length	Abutments are set back from existing ones so that obstruction to construction is avoided.
			Span : 3 x 66.7m = 200m	Span Arrangement	Number of piers shall be reduced in consideration of high pier construction cost in deep water. Span arrangement is determined for Extradosed Bridge. Detail discussion is given in 6.4.5.

Source) Study Team

Summary of Alignment, Bridge Length and Span Arrangement (Lot 1: Southwest Area) 3/4

Inventory No.	Route No.	Bridge Number	Proposed Bridge Details	Descriptions (Alignment, Bridge Length, Span Arrangement)	
144	B 157	8/3	Bridge Name: -	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (downstream).
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 40m = 40m	Span Arrangement	To prevent adverse effects to existing slender / week piers due to obstruction to water flow in meandering river, no pier is proposed.
152	AB 010	9/1	Bridge Name: Ambathale	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (upstream).
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 40m = 40m	Span Arrangement	To prevent increasing scour effect to existing piers in meandering river, no pier is proposed.
153	AB 010	15/1	Bridge Name: Welehandiya	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (downstream).
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 40m = 40m	Span Arrangement	To prevent adverse effects to existing slender / week piers due to obstruction to water flow in meandering river, no pier is proposed.
154	AB 010	26/4	Bridge Name:-	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (upstream).
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 45m = 45m	Span Arrangement	To prevent increasing scour effect to existing piers in meandering river, no pier is proposed.
156	AB 010	28/1	Bridge Name:-	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (downstream).
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 45m = 45m	Span Arrangement	To prevent adverse effects to existing slender / week piers due to obstruction to water flow in meandering river, no pier is proposed.
159	AA 004	33/3	Bridge Name: Galagedara	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (downstream).
			Bridge Type: Steel I-Girder	Bridge Length	In consideration of current scour conditions at piers, water opening (bridge length) is increased. Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 2 x 40m = 80m	Span Arrangement	For the bridge across the meandering river, so as to prevent scour expedition at both existing / new bridge piers, a span is increased to approximately twice the existing one.

Source) Study Team

Summary of Alignment, Bridge Length and Span Arrangement (Lot 1: Southwest Area) 4/4

Inventory No.	Route No.	Bridge Number	Proposed Bridge Details	Descriptions (Alignment, Bridge Length, Span Arrangement)	
171	AA 002	52/1	Bridge Name: Maggona	Alignment	The alignment is changed for improvement.
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 2 x 20m = 40m	Span Arrangement	Number of piers shall be reduced in consideration of high pier construction cost in the seashore. In order to minimise adverse effect to residents and land acquisition at both sides of approaches, bridge deck depth shall be small.
172	AA 002	1/1	Bridge Name: Baira Lake	Alignment	No alignment change.
			Bridge Type: Pre Beam	Bridge Length	Abutments are set back from existing ones so that obstruction to construction is avoided.
			Span : 5 x 9m = 45m	Span Arrangement	Pier are arranged not to be affected by existing piers / foundations.
173	AA 002	53/1	Bridge Name: Maggona 2	Alignment	The alignment is changed for improvement.
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 2 x 20m = 40m	Span Arrangement	Span arrangement is determined for economical reasons and new span is almost equal to or increased.
176	AA 004	64/1	Bridge Name: -	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (upstream).
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 45m = 45m	Span Arrangement	To prevent adverse effects to existing slender / week piers due to obstruction to water flow in meandering river, no pier is proposed.
180	B 304	35/4	Bridge Name: Alukatiya	Alignment	The alignment is changed for improvement.
			Bridge Type: Steel I-Girder	Bridge Length	Bridge length is determined in consideration of ease of approach embankment construction in valley geography.
			Span : 2 x 40m = 80m	Span Arrangement	For reasons of increase in construction cost due to high piers, number of piers shall be as small as possible, thereby resulting in longer span.

Source) Study Team

Table 6.4-4 Summary of Alignment, Bridge Length and Span Arrangement (Lot 2: Central Area)

Inventory No.	Route No.	Bridge Number	Proposed Bridge Details	Descriptions (Alignment, Bridge Length, Span Arrangement)	
43	AA 028	75/4	Bridge Name: Kurunegala	Alignment	New alignment is proposed for additional 2 lanes adjacent to existing one (upstream).
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods. In addition, new abutments shall not be ahead to the river side compared to existing ones.
			Span : 2 x 50m = 100m	Span Arrangement	
45	B 264	30/2	Bridge Name: Meeliyadda Palama	Alignment	The alignment is changed for improvement.
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 50m = 50m	Span Arrangement	For narrow and bent access road, transportation of precast beam is difficult. Casting yard for post-tensioned girder fabrication needs large scale of deforestation. Steel girder will be the optimum solution. Span arrangement is determined for steel girder bridge.
53	AA 003	92/4	Bridge Name: -	Alignment	No alignment change.
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are set back from existing ones so that obstruction to construction is avoided.
			Span : 1 x 50m = 50m	Span Arrangement	No pier is constructed due to obstruction by existing piers.
179	B 416	2/6	Bridge Name: Karatuwawa	Alignment	No alignment change.
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are set back from existing ones so that obstruction to construction is avoided.
			Span : 1 x 45m = 45m	Span Arrangement	No pier is constructed due to obstruction by existing piers.
183	B 279	12/2	Bridge Name: Waglla	Alignment	The alignment is changed for improvement.
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 45m = 45m	Span Arrangement	For narrow and bent access road, transportation of precast beam is difficult. Casting yard for post-tensioned girder fabrication needs large scale of deforestation. Steel girder will be the optimum solution. Span arrangement is determined for steel girder bridge.
184	B 279	11/2	Bridge Name: Wagolla	Alignment	The alignment is changed for improvement.
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at point of intersection with existing road along the new alignment.
			Span : 1 x 45m = 45m	Span Arrangement	For narrow and bent access road, transportation of precast beam is difficult. Casting yard for post-tensioned girder fabrication needs large scale of deforestation. Steel girder will be the optimum solution. Span arrangement is determined for steel girder bridge.

Source) Study Team

Table 6.4-5 Summary of Alignment, Bridge Length and Span Arrangement (Lot 3: Northern Area) 1/2

Inventory No.	Route No.	Bridge Number	Proposed Bridge Details	Descriptions (Alignment, Bridge Length, Span Arrangement)	
58	AA 014	31/1	Bridge Name: Kotaleeya	Alignment	The alignment is changed due to high temporary bridge cost with high piers.
			Bridge Type: Steel I-Girder	Bridge Length	Abutments are at riverbanks not to obstruct water flow even during floods.
			Span : 1 x 50m = 50m	Span Arrangement	No pier is constructed for reason of high construction cost due to high pier.
63	AA 032	59+610	Bridge Name: Pali Aru Bridge with Causeway	Alignment	The alignment is changed for improvement.
			Bridge Type: Pre Beam	Bridge Length	Bridge length was determined from the experiences of JICA Study Team, though it shall be determined by hydrological analysis at detailed design stage.
			Span : 4 x 15m = 60m	Span Arrangement	In consideration of high construction cost due to long approach roads with strong slope protection, bridge deck depth shall be small, resulting in shorter approaches and low cost.
64	AA 032	32+482	Bridge Name: Nachchikuda Causeway	Alignment	No alignment change.
			Bridge Type: Steel I-Girder	Bridge Length	Bridge length was determined from the experiences of JICA Study Team, though it shall be determined by hydrological analysis.
			Span : 2 x 50m = 100m	Span Arrangement	
66	B 403	7/1	Bridge Name: Aru-Kuli Causeway	Alignment	The alignment is changed for improvement.
			Bridge Type: Pre Beam	Bridge Length	Bridge length was determined from the experiences of JICA Study Team, though it shall be determined by hydrological analysis at detailed design stage.
			Span : 4 x 15m = 60m	Span Arrangement	In consideration of high construction cost due to long approach roads with strong slope protection, bridge deck depth shall be small, resulting in shorter approaches and low cost.

Source) Study Team

Summary of Alignment, Bridge Length and Span Arrangement (Lot 3: Northern Area) 2/2

Inventory No.	Route No.	Bridge Number	Proposed Bridge Details	Descriptions (Alignment, Bridge Length, Span Arrangement)	
67	B 403	39/2	Bridge Name: Lal Aru Causeway	Alignment	No alignment change.
			Bridge Type: Pre Beam	Bridge Length	Bridge length was determined from the experiences of JICA Study Team, though it shall be determined by hydrological analysis at detailed design stage.
			Span : 6 x 16.7m = 100m	Span Arrangement	In consideration of high construction cost due to long approach roads with strong slope protection, bridge deck depth shall be small, resulting in shorter approaches and low cost.
165	B 403	32/1	Bridge Name: -	Alignment	No alignment change.
			Bridge Type: Pre Beam	Bridge Length	Bridge length was determined from the experiences of JICA Study Team, though it shall be determined by hydrological analysis at detailed design stage.
			Span : 6 x 16.7m = 100m	Span Arrangement	In consideration of high construction cost due to long approach roads with strong slope protection, bridge deck depth shall be small, resulting in shorter approaches and low cost.
166	B 403	21/1	Bridge Name: Arippu Causeway	Alignment	The alignment is changed for improvement.
			Bridge Type: Pre Beam	Bridge Length	Bridge length was determined from the experiences of JICA Study Team, though it shall be determined by hydrological analysis at detailed design stage.
			Span : 4 x 15m = 60m	Span Arrangement	In consideration of high construction cost due to long approach roads with strong slope protection, bridge deck depth shall be small, resulting in shorter approaches and low cost.
168	AA 009	314/2	Bridge Name: Navathli	Alignment	No alignment change.
			Bridge Type: Pos I-Girder	Bridge Length	Abutments are set back from existing ones so that obstruction to construction is avoided.
			Span : 4 x 25m = 100m	Span Arrangement	Pier are arranged not to be affected by existing piers / foundations and for economic reasons.

Source) Study Team

CHAPTER 7 POSSIBILITY OF JAPANESE ADVANCED BRIDGE TECHNOLOGY AND KNOW-HOW FOR STEP LOAN

7.1 General

Infrastructure development is indispensable for sustainable economic growth of developing countries. Under the recognition that providing assistance to infrastructure can contribute to the economic growth of recipient countries, the Government of Japan (GOJ) introduced a new ODA loan scheme called Special Terms for Economic Partnership (STEP) in July 2002. STEP is expected to raise the visibility of Japanese ODA among citizens in both recipient countries and Japan through best use of advanced technologies and know-how of Japanese firms.

In order the recipient countries to apply STEP loan, not less than 30% of total amount of contract(s) (excluding consulting services) financed by STEP must be accounted for by (a) goods from Japan and services provided by Japanese firm(s), or goods from Japan only.

The latest terms and conditions, effective on 20th October 2006, stipulate that the procurement of goods from a Japanese manufacturer in a recipient country or a Japanese manufacturer in a developing country other than a recipient country can be regarded as goods from Japan, if the following conditions are met.

- A manufacturer invested in by one or more Japanese firms in a recipient country

  a) Not less than ten percent (10%) of shares of manufacturer are held by a Japanese firm.

  b) The proportion of the shares held by the Japanese firm mentioned in a) above (or the firm having the largest share among Japanese firms if more than one Japanese firm meets the conditions stated in a) above) is same as or greater than that of shares held by any firm of a third country or region.

- A manufacturer invested in by one or more Japanese firms and located in one of the developing countries and territories listed in the List of Recipients of ODA approved by the Development Assistance Committee of the OECD.

  a) Not less than one-third of the shares of the manufacture are held by a Japanese firm.

  b) The proportion of the shares held by the Japanese firm mentioned in a) above is same as or greater than that of shares held by any firm of a country or region other than Japan and the country or the territory where the manufacturer is located.

This chapter will describe the advanced bridge technologies and know-how in Japan so that such technologies can be introduced to Sri Lanka to meet the procurement requirements of STEP Loan.

In consideration of bridge conditions survey results for the Project, possible advanced technologies and know-how for bridge reconstruction / replacement works are expected as follows:

- Steel pipe sheet pile foundations;
- Epoxy coated reinforcement steel for concrete structures exposed to chloride damage;
- Atmospheric Corrosion Resistant Steel with stabilization treatment girder bridge for short work period at site with minimum maintenance work and cost;
- Import of prestressing steels, bridge bearings and expansion joints.

7.2 Steel Pipe Sheet Pile Foundations

The Project will need the replacement of existing damaged, deteriorated or less functional bridges at the same locations or in parallel with the existing ones. Parallel bridges can be used where effects to surrounding neighbors, railroads / highways and social facilities are within permissible levels. Environmental effects in both social and natural aspects shall be subjected to the authorization from the relevant authorities in Sri Lanka.

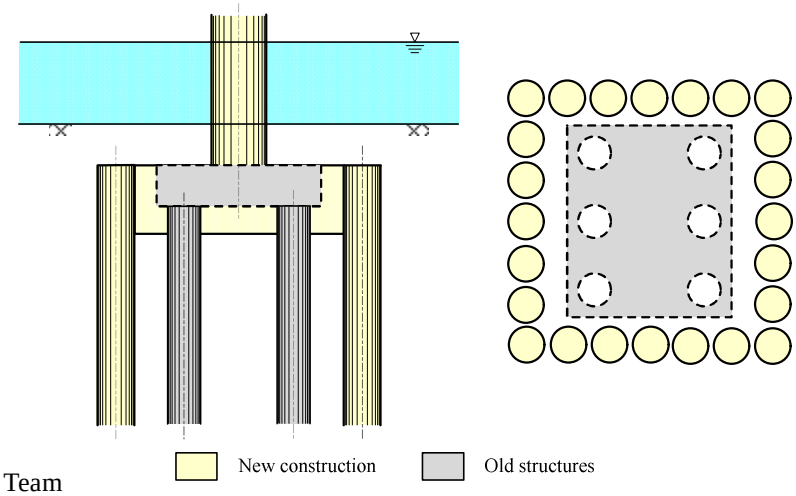
Parallel bridges do not need any temporary roads / bridges during construction. Existing bridges can be used with the careful attentions not to give serious damage by speed limit, load limit and/or daily monitoring on damage / deterioration progresses.

When difficulties are encountered in constructing parallel bridges or existing alignment should not be changed for its smoothness, new bridges are to be constructed at the same locations after the existing ones are demolished. Though pier column / wall and pile caps can be demolished without any difficulties, demolition or removal of existing piles will need great effort and longer period of time, and will come to the disturbance in existing ground conditions and water pollution as well as delay of the Project completion.

In order to prevent such adverse effects, steel pipe sheet piles can be driven around the existing piles, and subsequently pile cap and pier column / wall are constructed. Steel pipe piles are connected with each other to form a closed configuration such as circle, rectangle, ellipse or others, as in Figure 9.1-1, in order to achieve high horizontal rigidity and vertical bearing capacity. Work procedure is described in Figure 9.1-2.

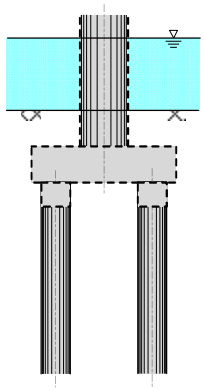
Another effective optional use of steel pipe sheet piles is in deep water conditions. Use of such conventional bridge foundations as drilled shaft and spread footing in deep water need a large dimension of temporary cofferdam: double sheet pile type (Figure 1-3). It needs a large amount of good quality sandy soil. During construction, it obstructs water flow due to its large dimensions.

Good quality soil must be obtained from the authorized sources by the relevant environmental agencies. It must also be given the special attention not to pollute the water when the soils are filled in or removed from water.

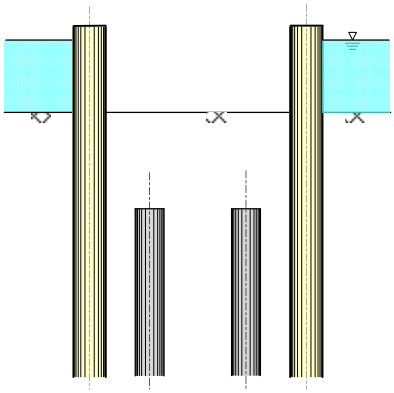


Source) Study Team

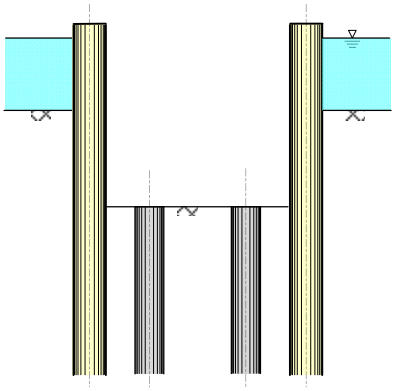
Figure 7.2-1 Use of Steel Pipe Sheet Piles around Existing Structures



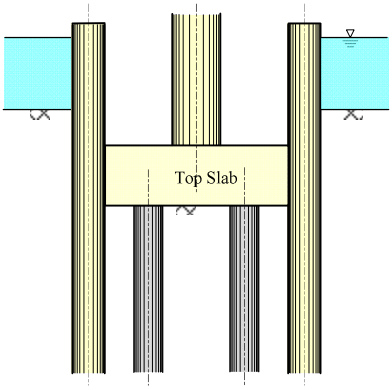
Step-1: Demolish existing structures



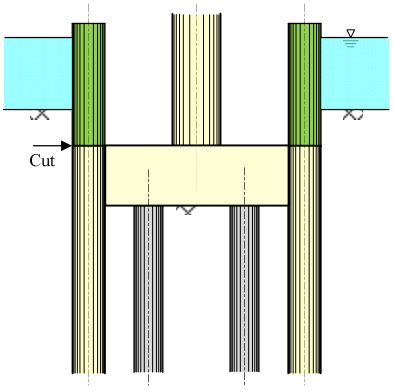
Step-2: Drive steel pipe sheet piles



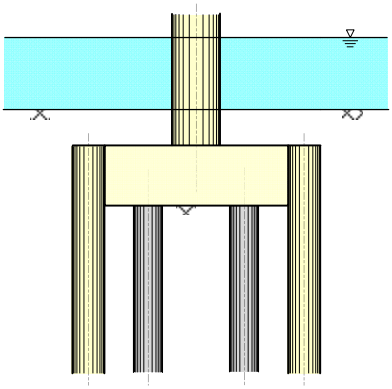
Step-3: Excavation



Step-4: Construct top slab, pier column



Step-5: Cut steel pipe sheet piles

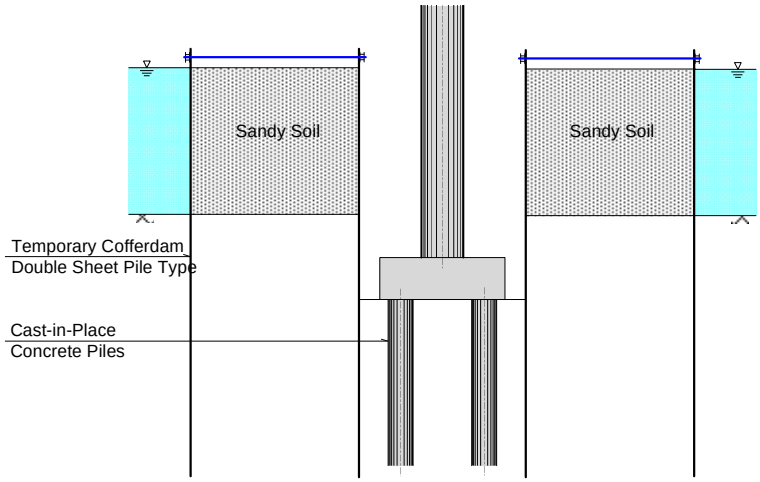


Step-6: Backfilling

Source) Study Team

Figure 7.2-2 Work Procedure for Steel Pipe Sheet Piles around Existing Structures

When bridge planning is made, bridge span shall be determined in consideration of obstruction to water flow during construction.



Source) Study Team

Figure 7.2-3 Double Sheet Pile Cofferdam

Steel pipe sheet piles need high level of welding techniques by experienced welders to ensure high quality of connections at site. Corrosion protection surface coating will be made in Colombo Dockyard.

7.3 Use of Epoxy Coated Reinforcement Steel

Project bridges are located along the coastal areas and in the causeway, thereby subjecting to chloride damage.

In general, reinforcement steel in concrete is in a high level of alkalinity with such alkali aqueous solutions as sodium hydroxide and potassium hydroxide, and protected by passive state film. Once chloride ions penetrate into concrete, they can locally destroy the passive state film (de-passivity) and promote active steel dissolution. With the corrosion progresses, reinforcement steel is covered by rust in the initial stage. As the rust is porous, it cannot prevent the penetration of water and oxygen, thereby resulting in expediting the corrosion progress. Rust is as much as approximately 2.5 times its original steel volume, and its expansion pressure causes crack, scaling and spalling in concrete.

In order to minimize such deterioration progress by chloride damage, two (2) options are generally used: 1) increase in concrete cover and 2) use of epoxy-coated reinforcement steel.

It is recommended epoxy-coated reinforcement steel be used in bridge construction, as prevention of chloride damage by increasing in concrete cover depends largely on the workmanship.

Reinforcement steel is available in local market in Sri Lanka, and anti-corrosion surface coating with epoxy may be implemented in Colombo Dockyard.

7.4 Use of Atmospheric Corrosion Resistant Steel Girder

In Sri Lanka, steel bridges were constructed in the period of colonial era and in recent years by such donor countries as United Kingdom, France and Saudi Arabia. Steel bridges have advantages in shorter construction period at site, thereby contributing to less traffic congestion and environmentally-friendly surrounding circumstances for residents. However, due to insufficient maintenance activities as fastening loose bolts and periodical corrosion protection surface painting, such bridge are not in good conditions.

Ordinary carbon manganese steels have a tendency to rust, the rate of which depends on the access of oxygen, moisture and atmospheric contaminants to the surface. As the corrosion progresses, the rust layer forms a barrier to the ingress of oxygen, moisture and atmospheric contaminants, and the rate of rusting slows down.

The rust layers formed on ordinary structural steels detach from the surface after the critical time, and the corrosion cycle commences again.

Atmospheric Corrosion Resistant Steel, made of high strength low alloy, has the same rusting process with ordinary steels; however it produces a stable, much less porous rust layer adhering to the base steel due to the specific alloying elements. Such stable rust called “patina” develops under conditions of alternate wetting and drying to produce a protective layer which impedes further access of moisture and oxygen, thereby resulting in reduction of corrosion rate.

Atmospheric Corrosion Resistant Steels can be used effectively in most locations. However, there are certain environments which can lead to durable problems: marine environment, de-icing salt, continuous wet / damp conditions, atmospheric pollution.

In marine environment, Atmospheric Corrosion Resistant Steel is exposed to high concentration of chloride ions, originating from sea water spray, salt frog or coastal airborne salts. Hygroscopic

nature of salt adversely affects the "patina" as it maintains a continuous damp environment on steel surface. In general, Atmospheric Corrosion Resistant Steel should not be used for bridges within 2 km of coastal waters.

As with in marine environment, de-icing salt and continuous wet / damp environments impede development of stable "patina" on steel surface.

In addition, where high concentrations of corrosive chemicals or industrial fumes, especially sulfur dioxide (SO_2), are present, Atmospheric Corrosion Resistant Steel should not be used.

Consequently, it is strongly recommended that Atmospheric Corrosion Resistant Steel bridges be used in such a well ventilated circumstance as in a mountainous area and where access is difficult or dangerous, if it is economically feasible.

It is noted that Atmospheric Corrosion Resistant Steel bridges need routine inspection, monitoring and occasional maintenance to ensure satisfactory performance as with ordinary steel bridges. Visual inspection shall be conducted by experienced inspectors at least every 2 years. The surface conditions of "patina" shall be monitored if corrosion is progressing at an acceptable rate or not. In addition, the unfavorable signs such as leaking expansion joints, accumulation of dirt / debris, moisture retention due to overgrown vegetation, faulty drainage system, and excessive corrosion products at bolted joints are found, appropriate measures shall be taken.

7.5 Import of Prestressing Steel, Bridge Bearing and Expansion Joint

As the result of site surveys, it is confirmed that prestressing steels, bridge bearings and expansion joints for a longer span bridge are not available in local market and need to be imported.

As almost Project bridges are expected to be prestressed concrete type; either pre-tensioned beams or post-tensioned beams, a large amount of prestressing steels are to be imported. Presently, local PC beam factories import prestressing steels from India and Singapore and so on.

Sources of prestressing materials should be examined if such materials can be procured from a manufacturer invested by one of more Japanese firms and located in developing countries and territories stated above. They are, of course, those which have economical benefits compared to the present sources.

Locally available bridge bearings are of elastomeric rubber sheet, used mainly for pre-tensioned PC beams.

A bridge bearing is a superstructure element that provides an interface between the superstructure and the substructure. Primary functions of a bridge bearing are:

- To transmit loads from the superstructure to the substructure;
- To allow rotation caused by dead load and live load deflection;
- To permit horizontal movement of the superstructure due to thermal expansion and contraction, creep and shrinkage in concrete.

In order to achieve the above functions for a longer span bridge, steel laminated elastomeric bearings or steel pot bearings are needed.

Used for existing bridge expansion joints are "plug seal" type, which is sealed with elastomeric materials such as polymer-modified asphalt binders after steel plate or other material is centered over the joint, bridging the opening, for its entire length. This "plug seal" type expansion joints are generally used for small movement of 50mm or less due to its advantages of ease of installation and repair, good riding quality and low cost of installation and repair. However, problems are observed on some installations, including softening in hot weather, debonding of joint pavement interface and damage due to excessive movement.

Damage on Existing Expansion Joint

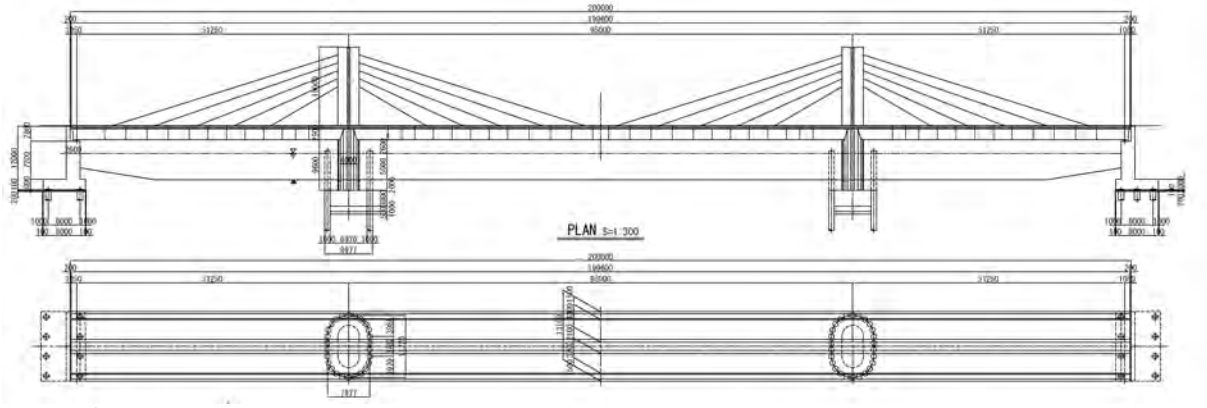
A function of a bridge deck expansion joint is to accommodate motions that occur in the superstructure. These motions are from live loads, thermal changes, and the physical properties of materials such as creep and shrinkage. In order to accommodate such movement, openings are provided to permit the deck to move or rotate freely within limitations. However, as a result, a discontinuity is created impairing the ride quality of roadway in the surface of the deck. The joint opening can also act as a path through which such damaging materials as water and soils are deposited on supporting elements beneath the deck. A variety of devices are herefore incorporated in the design to protect the joint edges, to bridge the opening in the deck, and to seal the opening.

Possible expansion joints used for the Project bridges are compression seal, strip seal, cushion seal joints for small movement and finder joint with trough and modular joint sealing systems for large movement.

Detail studies will be carried out to find out the appropriate sources of the above bridge bearings and expansion joints to meet the procurement requirements of STEP loan.

7.6 Extra-Dosed Bridge

Extra-dosed bridge is modification of a cable stayed bridge. The main tower is lower than that of cable stayed bridge. This Bridge design would be introduced to the Digarolla Bridge on the National Road A2. The length of It will be the symbol of progress and modernization of Sri Lanka with its newly introduced advanced technology.



Source) Study Team

Figure 7.6-1 Extra-Dosed Bridge (Digarolla Bridge)

7.7 Waterproofing Membrane

Presence of water on bridge surface will expedite the deterioration of bridge deck slab. In order to minimize such deterioration, waterproofing membrane is applied between bridge deck slab and pavement. Waterproofing membrane newly introduced to Sri Lanka will improve the durability of bridge structures, thereby contributing to less maintenance cost.

CHAPTER 8 COST ESTIMATION OF BRIDGE

8.1 Calculation for Cost Estimation of Bridge

8.1.1 Outline of cost estimation

Rough estimation for the reconstruction (including a construction to side) cost for Priority1bridges are summarized at table 8.2-1. Priority 1 bridges are selected according to the ”Priority 1 Bridges Selection” of Study Team, also those bridges are accepted in RDA as priority 1 list.

8.1.2 Target items of cost estimation of bridges

Target items to calculate cost estimation are as follows:

1) Reconstructed bridge (superstructure / substructure / foundation) based on the investigation
2) Approach road for the reconstructed bridge
3) Temporary bridge instead of the reconstructed bridge during construction
4) Jetty to construct continuous and long bridge on the river
5) Removing existing bridge or causeway
6) One standing dispute board for all LOTs

8.1.3 Method of cost estimation

Methods to calculate cost estimation is as follows:

1) Bridge construction cost is estimated based on each general drawings and bill of quantity (BOQ).
2) Unit rates using in this rough estimation are referred with experience in Sri Lanka and other information.
3) Considering effect on cost occurred by scale of the construction of each LOTs.

8.1.4 Calculation of Foreign / Local / RDA portion

The calculation of Foreign / Local / RDA portion are as follows:

1) Procurement items out of Sri Lanka shall be sorted as foreign portion.
2) Procurement items in Sri Lanka shall be sorted as local portion.
3) All of steel girder (atmospheric corrosion resistant steel) shall be sorted as foreign portion
4) Cost for removal of the old bridge shall be distributed according to the following criteria;

   When the new bridge is planned to be constructed on the same location & at the same alignment as that of the existing bridge, removal cost of the old bridge shall be included in the cost estimation and sorted as foreign portion (Because removal work is needed before reconstruction for effective construction planning).

   If the new bridge is planned to be constructed to a side of the existing bridge (alignment is shifted): Removal cost shall be excluded from the cost estimation and sorted as RDA portion. (Because removal of the old bridge is not needed before construction of the new bridge and construction work can be commenced at any time. RDA shall remove the existing bridge at their cost at any time)

8.1.5 Other detail information

Other information to calculate cost estimation is as follows,

1) Foundation is regarded as “Cast-in-place concrete pile foundation”, “Spread foundation” or

   “Steel sheet-pile foundation (No.139 Digarolla Bridge)”.
2) At 4 bridges on AA002 in the coast (No.103/112/171/172),

   waterproofing and Epoxy reinforcing steel bar are adopted to improve durability of the bridge.
3) Approach road (Bank) shall be sorted as earthwork type or causeway type

   by construction location.
4) Jetty shall be built if the new bridge is continuous and depth of river is over 2.0m.
5) Cost of dispute Board shall be distributed to 3 LOTs depending on the scale of each of them.

8.2 Result of Calculation for Cost Estimation of Bridge

Result of Calculation for total cost estimation of bridges is shown hereinafter.

Table 8.2-1 Result of Calculation for Total Cost Estimation of Bridges

		Information								
		Bridge						Proposed numbers of lanes	Width of Bridge (m)	waterprofing & epoxy
No.	lot	Bridge Type	Situation of New Bridge	Erection Method	Bridge length (m)	Proposed span	Max span (m)			
103	1 : southern	Pos. I girder	Recon S-site	TC	90	3 x 30.0	30.0	4	16.8	★
107	1 : southern	Pre. Beam girder	Recon O-site	TC	50	3 x 16.7	17.0	2	10.4	
108	1 : southern	Steel I girder	Recon O-site	TC/B	80	2 x 40.0	40.0	2	10.4	
109	1 : southern	Pos. I girder	Recon O-site	Launching	90	3 x 30.0	30.0	2	10.4	
110	1 : southern	Pos. I girder	Parallel	EG	120	4 x 30.0	30.0	2	10.4	
112	1 : southern	Pos. I girder	Recon S-site	EG	90	3 x 30.0	30.0	4	16.8	★
113	1 : southern	Pos. I girder	Recon O-site	EG	110	4 x 27.5	28.0	2	10.4	
116	1 : southern	Steel I girder	Recon S-site	TC/B	50	1 x 50.0	50.0	2	10.4	
117	1 : southern	Pos. I girder	Recon S-site	EG	30	1 x 30.0	30.0	2	10.4	
138	1 : southern	Pre. Beam girder	Recon O-site	TC/B	50	3 x 16.7	16.7	2	10.4	
82	1 : western	Steel I girder	Recon O-site	Launching	150	3 x 50.0	50.0	2	10.4	
139	1 : western	Extra dosed	Recon S-site	Cantilever	200	3 x 66.7	95.0	2	13.1	
144	1 : western	Steel I girder	Recon O-site	TC/B	40	1 x 40.0	40.0	2	10.4	
152	1 : western	Steel I girder	Parallel	TC/B	40	1 x 40.0	40.0	2	10.4	
153	1 : western	Steel I girder	Parallel	TC/B	40	1 x 40.0	40.0	2	10.4	
154	1 : western	Steel I girder	Parallel	TC/B	45	1 x 45.0	45.0	2	10.4	
156	1 : western	Steel I girder	Parallel	TC/B	45	1 x 45.0	45.0	2	10.4	
159	1 : western	Steel I girder	Parallel	EG	80	2 x 40.0	40.0	2	10.4	
171	1 : western	Pos. I girder	Recon O-site	EG	40	2 x 20.0	20.0	4	16.8	★
172	1 : western	Pre. Beam girder	Recon S-site	TC	45	3 x 15.0	15.0	6	31.2	★
173	1 : western	Pos. I girder	Recon O-site	EG	40	2 x 20.0	20.0	4	16.8	
176	1 : western	Steel I girder	Parallel	TC/B	45	1 x 45.0	45.0	2	10.4	
180	1 : western	Steel I girder	Recon O-site	Launching	80	2 x 40.0	40.0	2	10.4	
43	2 : central	Steel I girder	Parallel	Launching	100	2 x 50.0	50.0	2	10.4	
45	2 : central	Steel I girder	Recon O-site	TC/B	50	1 x 50.0	50.0	2	10.4	
53	2 : central	Steel I girder	Recon S-site	TC/B	50	1 x 50.0	50.0	4	16.8	
179	2 : central	Steel I girder	Recon S-site	TC/B	45	1 x 45.0	45.0	2	10.4	
183	2 : central	Steel I girder	Recon O-site	TC/B	45	1 x 45.0	45.0	2	10.4	
184	2 : central	Steel I girder	Recon O-site	TC/B	45	1 x 45.0	45.0	2	10.4	
58	3 : north	Steel I girder	Recon O-site	TC/B	50	1 x 50.0	50.0	2	10.4	
63	3 : north	Pre. Beam girder	New Bridge O-site	TC	60	4 x 15.0	15.0	2	10.4	
64	3 : north	Steel I girder	New Bridge S-site	Launching	100	2 x 50.0	50.0	2	10.4	
66	3 : north	Pre. Beam girder	New Bridge O-site	TC	60	4 x 15.0	15.0	2	10.4	
67	3 : north	Pre. Beam girder	New Bridge S-site	TC	100	6 x 16.7	17.0	2	10.4	
165	3 : north	Pre. Beam girder	New Bridge S-site	TC	100	6 x 16.7	17.0	2	10.4	
166	3 : north	Pre. Beam girder	New Bridge O-site	TC	60	4 x 15.0	15.0	2	10.4	
168	3 : north	Pos. I girder	Recon S-site	Launching	100	4 x 25.0	25.0	2	10.4	
Total					2,615					

Dispute Board (million JPY)			Total (million JPY)		STEP	
S&W	38 MM	62	5,726		30.9%	
Central	38 MM	13	1,179	8,985	37.9%	29.6 %
North	38 MM	23	2,079		22.0%	

Source) Study Team

CHAPTER 9 PROJECT IMPLEMENTATION

9.1 Arrangement of Construction Lots

For construction of proposed bridges, number of construction lots should be decided taking into consideration the size of divided area and number of bridges of each lot. One contractor or one Joint Venture contractors have responsible to complete one lot.

Number of bridges in one construction lot will be depended on the site conditions. In the case that locations of bridges is spreading each other, 5 to 10 nos bridges are controllable. Approximately 20 nos bridges will be controllable, if the bridges are in a group or groups,

After comparison study of 3 lots and 4 lots, 3 lots plan was finally selected as mentioned below.

Table 9.1-1 shows the relating items to be considered to decide the construction lots.

Table 9.1-1 Relating Items to Construction Lots

Distance from core office/ base camp to each bridge site	To maintain proper relation between core office/ base camp to each bridge site, the location of core office/ base camp is to be decided taking into the following conditions: 1) One day travel to bridge sites: less than 150km 2) Maximum travel time: 4 hours
Location of quarries and borrow pits	During the study period the locations with borrow pits and quarry are to be surveyed. Especially for northern region, the locations of quarries and borrow pits are spreading.
Location of concrete batching plant	Since many bridge sites are located near the major city, procurement of concrete will be possible from batching plants near by. Separate batching plants are to be recruited for the bridge sites located in remote areas.

Source) Study Team

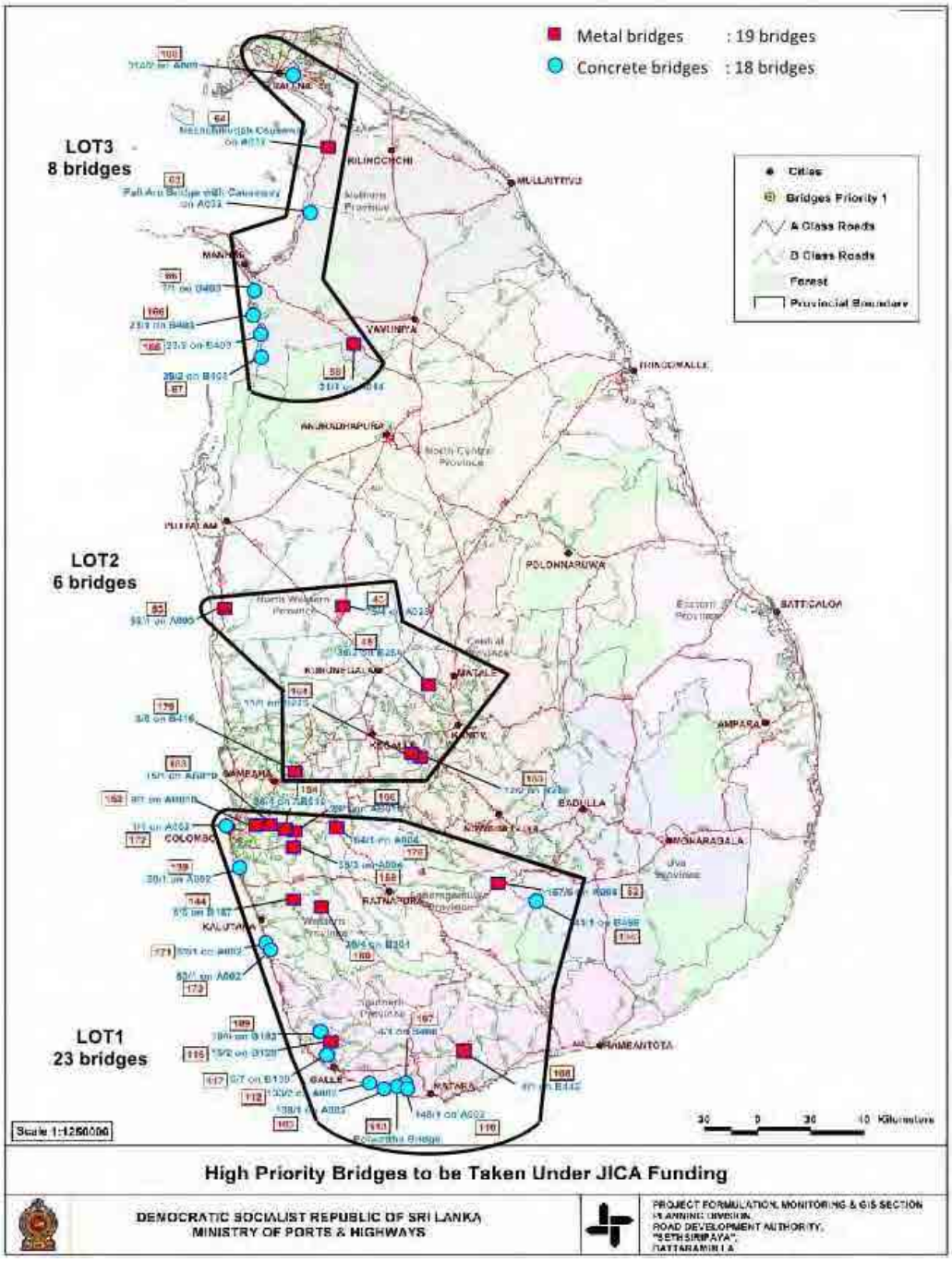
9.1.1 Lot Arrangement

The features of the 3 lots plan are as follows:

Largest lot: 100km x 100km

Smallest lot: 75km x 65km

Number of bridges: 6 - 23 nos



Source) Study Team Figure 9.1-1 Lot Arrangement

Table 9.1-2 Outline of Project lots

	Location (Major City)	Number of Bridges.	Bridge Inventory Number	Size of Area: NS (km) x EW(km) Travel Time	Construction Costs (Million JPY)	Reference
Lot 1	Western (Colombo, Galle)	23	82,103,107,108,109,110,112, 113,116,117,138,139,144,152, 153,154,156,159,171,172,173, 176,180	100 x 100 (3h)	5,700	
Lot 2	Eastern (Batticaloa)	6	43,45,53,179,183,184	75 x 65 (2h)	1,160	
Lot 3	North (Jaffna, Mannar)	8	58,63,64,66,67,165,166,168	110 x 35 (3h)	2,100	

Source) Study Team

9.2 Work Schedule of Bridge Construction Project

The construction of proposed bridges will be progressed by the following steps:

a) JICA Study
b) Selection of Consultant
c) Detailed Design
d) Selection of Contractors
e) Land Acquisitions/ Compensations
f) Construction/ Construction Supervision

The details of each step are as follows:

a) JICA Study (8 months)

Selection of Proposed Bridges, Proposed Bridge Types, Cost Estimates
Environmental Study, Social/ Resettlement Study

b) Selection of Consultant (Approximately 11 months)

c) Detailed Design Stage (Approximately 12 months)

Topographical Survey, Geotechnical Survey, Hydrological Study,
Confirmation of Design Conditions, Alignment and Approach Road Design
Detailed Design of Structures, Cost Estimates,
Preparation of Pre-qualification (PQ) Documents, Preparation of Bid Documents, Preparation of Right-of-Way Maps

d) Selection of Contractors/ Pre-Construction Stage (Approximately 18 months)

PQ, Evaluation of PQ Document, Bid , Bid Evaluation, Selection of Contractors

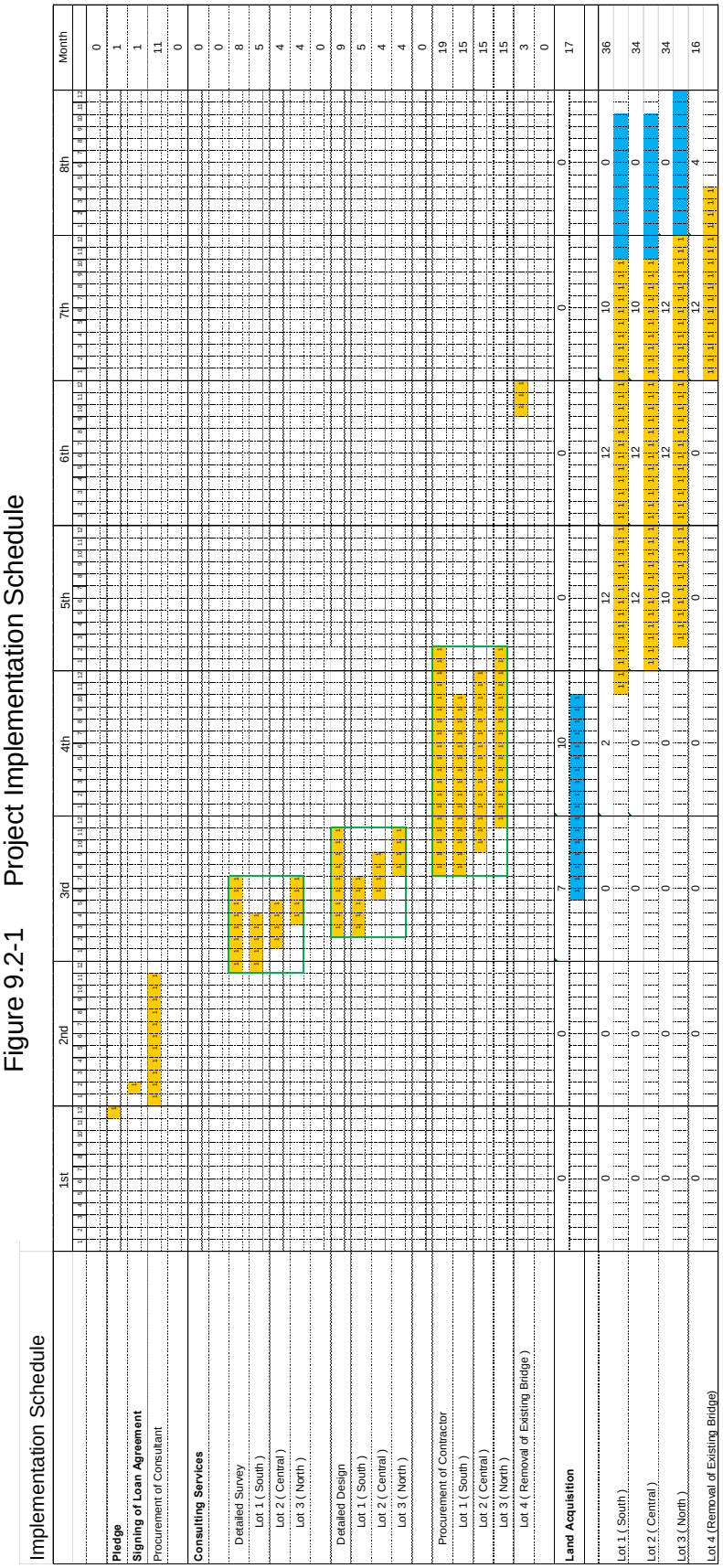
To accelerate the progress, PQ and Evaluation of PQ Document are expected to be commenced within the Detailed Design Stage.

e) Land Acquisitions/ Compensations (Approximately 12 months)

To accelerate the progress, Land Acquisitions/ Compensations are expected to be commenced where the Right-of-Way Maps are completed within the Detailed Design Stage.

f) Construction/ Construction Supervision Stage (Approximately 36 months)

Figure 9.2-1 Project Implementation Schedule



Source) Study Team

9.3 Implementation Organization of Consultant

The Consultant will arrange the Core Team Office in Colombo for Detailed Design through Construction Supervision Stages and 3 nos Sub Offices for 3 lots for Construction Supervision Stages.

a) Detailed Design Stage

Professional (A) Staff

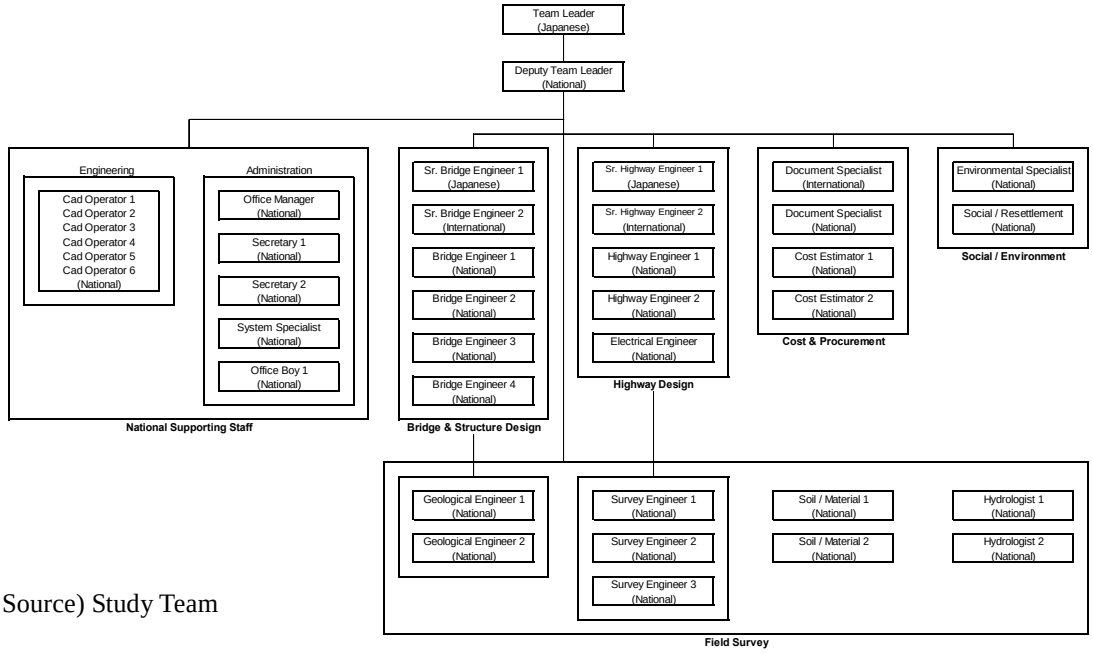
Team Leader, Senior Bridge Engineer (2),
Senior Highway Engineer, Document Specialist

Professional (B) Staff

Deputy Team Leader, Bridge Engineer (3), Highway Engineer (3),
Electric Engineer, Survey Engineer (3), Geotechnical Engineer (2),
Soil and Material Engineer (2), Hydrologist (2), Cost Estimator (2),
Environmental Specialist/ Social Resettlement, Safety Engineer

Professional (C) Staff

Office General Manager/ Secretory, System Specialist,
CAD Operator (8), Office Boy



Source) Study Team

Figure 9.3-1 Consultant's Organizations in Detailed Design Stage

b) Pre-Construction Stage

Professional (A) Staff

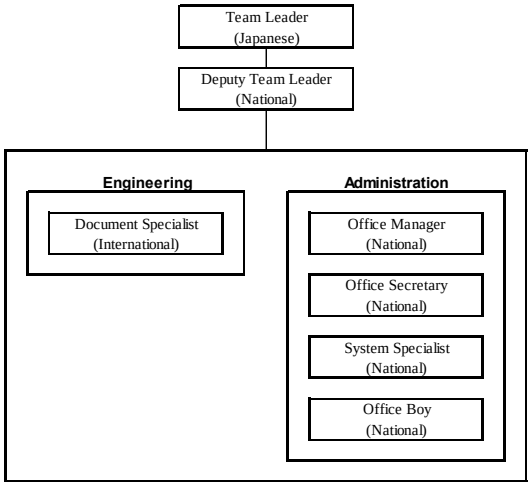
Team Leader, Document Specialist

Professional (B) Staff

Deputy Team Leader

Professional (C) Staff

Office General Manager/ Secretory, System Specialist,
Office Boy



Source) Study Team

Figure 9.3-2 Consultant's Organizations in Pre-Construction Stage

c) Construction Supervision Stage

Professional (A) Staff

Team Leader, Document Specialist,
Resident Engineer (2),

Professional (B) Staff

Resident Engineer

Bridge Engineer (3), Highway Engineer (3),
Safety Engineer

Professional (C) Staff

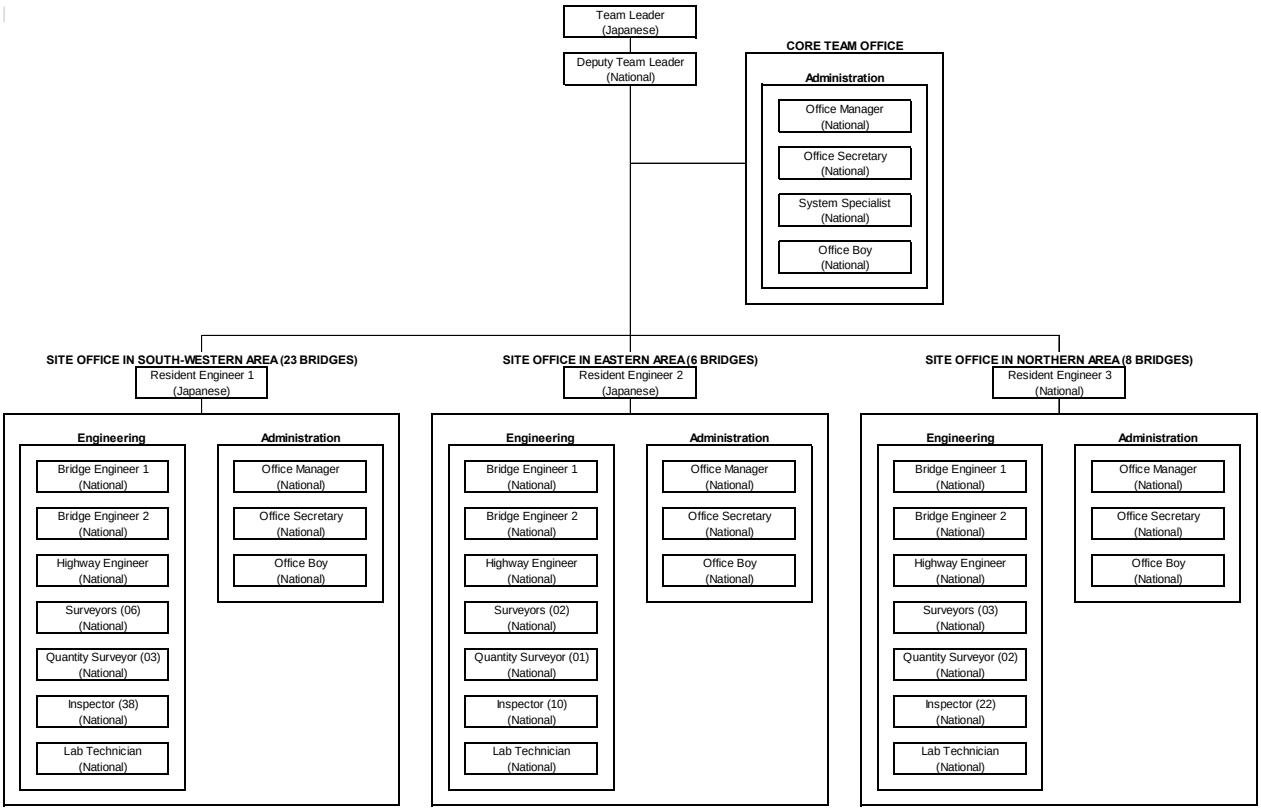
Core Team Office:

Office General Manager/ Secretory, System Specialist,
Office Boy

Sub Team Office (3):

Office Manager/ Secretory, Office Boy,

Surveyor (10), Quantity Surveyor (4), Inspector (32),
Laboratory Technician (3)



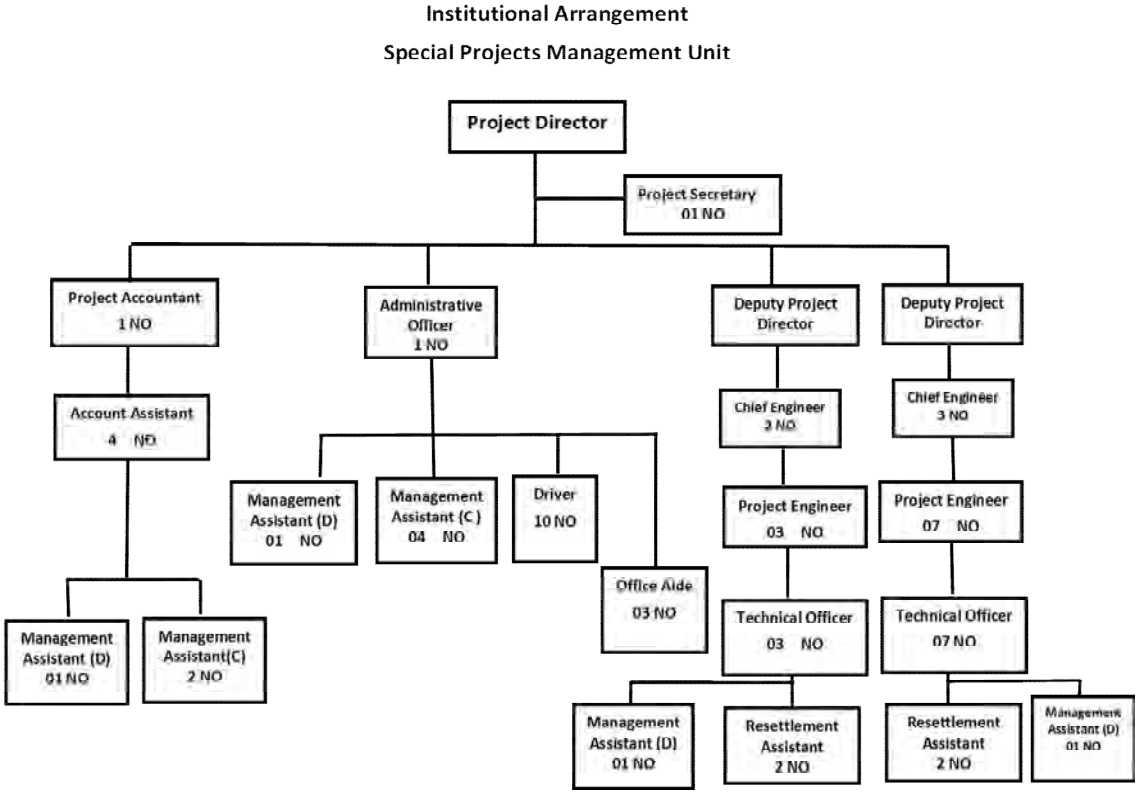
Source) Study Team

Figure 9.3-3 Consultant's Organizations in Construction Supervision Stage

9.4 PMU of RDA

Project management unit of RDA has important role for implementation of the project.

Consultant team will carry out design work and construction supervision. At the same time RDA organize PMU. PMU and consultant are closely cooperating work together. Especially approval and authorization matters relating regulation in Sri Lanka, PMU will show good correspondence



Source) RDA

Figure 9.4-1 Institutional Arrangement of PMU

9.5 Recommendation and Issues to Be Studied

Main objectives of this project is reconstruction of deteriorated bridges on national Roads in Sri Lanka, including, construction of new bridge with rearrangement of alignment, constructing of a new bridge parallel to the existing bridge to maintain traffic volume, constructing of a new bridge at existing causeway section to avoid traffic due to submersion of rainy season

These construction activities sometimes affect to natural condition or surrounding people, commercial facilities. To minimize those contrary impacts, it needs to complete the development project both in detail design stage and construction stage as early as possible.

Following issues are observed in the other similar projects in Sri Lanka, and the Consultant will aggregate the issues and submit proposals through this study.

(1) Approval and authorization including environmental issues.

Selected bridge/road sections are less effective to natural conditions and detailed environmental impact review is not necessary.

Though environmental destruction activity and recovery action is recognized, submitting the detailed design, application along with the necessary documents with the drawing for the approval of the relevant authorities after the compromising the actual size of the bridge

Following are the relevant authorities and application, it explain flow of application to approval and time required to get approval based on the past examples

Table 9.5-1 Major Approval an Authorization Issues

	Relevant authorities	Application procedure	Time required
Water Line	W B	Construction plan, Quotation, Subcontract	6 months
Electric wire	CEB	Construction plan, Quotation, Subcontract	6 months
Construction in river	Irrigation department	Construction plan, Flood analysis, Approval from Irrigation department	6 months
Borrow pit, Quarry	Local government, GSMB,CEA	Approval from local government, GSMB, CEA	9 months

Source) Study Team

At collection of construction material including river sand, gravel and soil within bidding period / construction period, contractor will apply location of borrow pits or other and RDA discuss with stake holders and get approval. At the same time polluted gas or contamination of water relating to the collection of material is also targeted to be approved from relevant authorities.

For these approval and authorization is mainly applied by RDA as implementation agency. Other past projects showed lack of capacity of project implementing and necessary budget which made the delay in work.

Before commencing of work it is necessary to confirm the flow of approval, authorization procedure, and necessary budget and should strongly apply to the relevant authorities.

(2) Land acquisition

Land acquisition and relocation relating to construction work will be done according to JICA guideline.

Bridge rehabilitation plan is carried out to minimize the land acquisition and relocations. If not compensation for affected asset or support for recover of standard of living and not to remain discontent and grumbling.

If recommended assessments are not competitive, land acquisition and relocation program will be delayed and result the delay in construction work.

Land acquisition will be carried out mainly by RDA, executive agency monitoring from Japanese side whether personnel in charge of relocation consent to affected people about to adequate payment of compensation, to support of recovery of standard of living

Land acquisition will be completed before the commencement of construction work.

Consultant will make effort to minimize the affected areas for land acquisition and relocation in bridge section which alignment will be changed and at the same time

(3) Shifting of utility lines

Need time when shifting of water drainage, drainage line, electricity line, when it is large size or lack of side space.

Delegating of responsibility between Japanese party and RDA is important and early recognition of such location and effective consultation between Japanese party and RDA.

(4) Detailed design

Contents of detailed design is conforms of selection of bridge location, detailed design of the bridge, prequalification and preparation of bidding document.

Soon after commencement of design work, carry out basic topographical survey and preparation of topographical map to show location of bridge construction site

Consultant prepares some different alignment plans and select best alternative not only economical but also convenience of construction, and to minimizing of social natural environmental conditions.

Finally the location will be decided on approval of executive agency RDA.

After confirmation of final alignment at each bridge site, prepare plan for land acquisition and submit to executive agency, and the land acquiring to be completed within the targeted time period.

Carrying out of detailed topographical survey, geotechnical survey and hydrological survey within the targeted time is necessary to planning of the bridge and road. Otherwise commencing of constructions will get delayed.

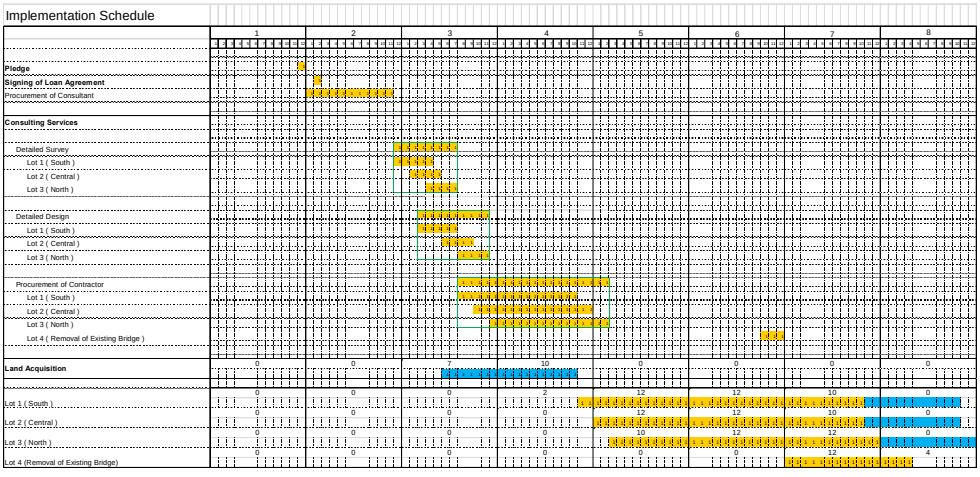
In this stage final plan will be confirmed after getting approval of executive agency. Continuously detailed design of bridge and road will be carried out.

In order to promote the implementation of three lots shall commence work in stages. When finished land acquisition in 01st lot prepare documents of pre-qualification and commence work accordingly.

Those series of works are based on good communication between executive agency and consultant.

Consultant should try to prepare documents accurately and speedily, at the same time executive agency try to complete design approval process.

Table 9.5-2 Construction schedule of each lots



Source) Study Team

(5) Quality control of construction work

Quality control of construction work in Sri Lanka is not enough so far.

Besides in this project bridge site are broadly scattered in whole island.

Acceleration of work consultant work together with RDA is a matter of course, following improvements are necessary.

*Compare to broad construction area number of working personnel are not enough. By using small number of staff and carryout effective site supervision utilize TV conference and so on.

*Improvement of communication between site and site office are necessary especially emergency case.

Issues on quality control or accidents lateral communication and information sharing between construction sites are very important.

*When information shearing is not enough about troubles, similar troubles will happen.

Information shearing from other construction section as a reference is important.

(6) Safety Measure

In Japanese ODA project in Sri Lanka happened to occur fatal accidents due to not enough safety measures.

Because of inadequate blasting work and scattering pieces of stone hit a girl living near by and killed.

No sign boards or fence are installed near excavated hole, a boy sipped and drowned after

fell into the submerged hole.

In Japanese ODA carrying out projects in other countries electrocution had happened because of working in rain or thunder. Dewatering from excavation hole of pile cap and no security staff and no installation of fence causes some children living near by drawn to death

These accidents leads not only delay of site work of ODA, but also threaten the existence of Japanese ODA project itself. Carryout through safety control and try not to occur such accidents again.

In consultant supervision stage of this project Consultant provides Safety manager at sites.

Combined safety patrol together with Client, Consultant Engineer, Contractor will be held regularly.

As a whole project each parties have to try their best to conduct safety management such as, project staff in the client RDA will be given safety training, contractor have to prepare safety plan and giving regular safety education to staff, periodic review of safety plan and Voluntary safety control.