Chapter 7. Output 3: Road and Bridge Repair Capacity of RID is Enhanced

7.1. To Review and Establish Road Repair Manual

7.1.1 Definition of Road Maintenance

The goal of maintenance is to preserve the asset, not to upgrade it. The maintenance work must be done regularly. Road maintenance comprises "activities to keep pavement, shoulders, slopes, drainage facilities and all other structures and property within the road margins as near as possible to their as-constructed or renewed condition". It includes minor repairs and improvements to eliminate the cause of defects and to avoid excessive repetition of maintenance efforts. For management and operational convenience, **Road Maintenance** is categorized as **Routine, Periodic,** and **Emergency.**

1. **Routine Maintenance,** which comprises small-scale works conducted regularly, aims "to ensure the daily passability and safety of existing roads in the short-run and to prevent premature deterioration of the roads". Frequency of activities varies but is generally once or more a week or a month. Typical activities include roadside verge clearing and grass cutting, cleaning of silted ditches and culverts, patching, and pothole repair. For gravel roads it may include re-grading every six months.

2. **Periodic Maintenance,** which covers activities on a section of road at regular and relatively long intervals, aims "to preserve the structural integrity of the road". These operations tend to be large scale, requiring specialized equipment and skilled personnel. They cost more than routine maintenance works and require specific identification and planning for implementation and often even design. Activities can be classified as preventive, resurfacing, overlay, and pavement reconstruction. Resealing and overlay works are generally undertaken in response to measured deterioration in road conditions. For a paved, road repaving is needed about every eight years; for a gravel road re-graveling is needed about every three years.

3. **Emergency Maintenance** is undertaken for repairs that cannot be foreseen but require immediate attention, such as collapsed culverts or landslides that block a road.

   In general, maintenance does not include reconstruction, improvement and rehabilitation works on any road sections, but Cambodia includes these works in periodic maintenance.

7.1.2 Issues on Current Road Repair Work

Table 7-1 summarizes three major issues on current road maintenance observed by JICA Experts Team: 1) maintenance system/management, 2) inspection, and 3) repair work. In order to overcome these issues, manual improvement is the most effective way.

Table 7-1 Road Maintenance Issues Observed

Major Item	Description
Maintenance System/Management	· Need for annual road maintenance cycle for efficient road maintenance management · **Insufficient road repair manual** · Need for identification of vulnerable road sections and implementation of preventive maintenance. (Road sections with high groundwater level are likely to be vulnerable). · Need for a more detailed and convincing repair work rationale for budget request · Need for a common road inventory database at MPWT in partnership with DPWTs.
Inspection	· Time consuming (currently, visual inspection only) · There is need of a more universal and accurate evaluation criterion for identification of repair work · There is need to balance the number of inspectors in the DPWTs · There is need for frequent inspections, especially during the rainy season in order to identify defects and prevent deterioration
Repair Work	· Partially vulnerable pavement repair due to insufficient material composition was observed · Financial loss due to poor timing of works was observed. To correct this, training especially of young engineers on time management is recommended. · The basic knowledge on pavement design, geo-technology and civil engineering is expected to support proper decision making (e.g. excessive use of laterite for base course) · The quality of pavement repair is good in some DPWTs. The techniques of these DPWT's should be adopted by others. · It is worthy to note that off-carriageway maintenance activities such as drainage, grass cutting, culvert cleaning etc., should be conducted frequently. · **Overloaded vehicles** are often observed which leads to pavement damage. Control measures for Overloading must be enforced.

Photo 7-1 Observation of Road Maintenance Works by DPWT in Kampot Province (NR3 PK138~140km Problem Area)

Photo 7-2 Observation of Road Maintenance Works by DPWT in Kampot Province (NR3 PK138～140 km Problem Area)

7.1.3 Required Revision of Existing Road Repair Manual

As described in Chapter 4, MPWT prepared five (5) guidelines for road maintenance work under force accounts;

1) Guideline for Regular Inspection
2) Guideline for Supervision of Routine Maintenance
3) Guideline for Supervision of Periodic Maintenance
4) Guideline for Road Defects Repair
5) Technical specification for road maintenance

Out of the published guidelines, *Guideline for Road Defects Repair* and *Technical Specification for Road Maintenance* are the documents concerning road repairs.

The following points were identified as key considerations for revision during the discussions with RID.

Revision Point 1: Inclusion of all work items practically used
Revision Point 2: Improvement of consistency of the contents
Revision Point 3: Improvement of the guideline format

7.1.4 Proposed Revision of Road Repair Manual

(1) Purpose of New Guideline

The purpose of this guideline is to present standard practical methods for paved and unpaved road repair to the Provincial Department of Public Works (DPWT) of Cambodia. Through past experiences, various methods and materials had been adopted by DPWT which led to diverse results. These ultimately had effects on the lifetime of the road, quality of the ride for commuters and cost of repair.

This guideline should provide road engineers with an easy and clear instruction on how to repair various job codes. The pocket edition allows engineers to consult on-site should a need for a quick reference arise.

The guideline has been published both in English and Khmer to make it easy for DPWTs site engineers who may not be familiar with English.

(2) Outline of the Guideline

The new edition of the **Guideline for Road Defects Repair** contains the points proposed above:

Revision Point 1: Inclusion of all work items practically used
Revision Point 2: Improvement of consistency of contents

In consideration of the revision points, the revision of the road repair manual was proposed in this project as shown in Table 7-2.

Table 7-2 Proposal for the Revision of the Road Repair Manual

Revision Guideline	Revision Descriptions
Guideline for Repairing Road Defects (Road Defects Repair)	To be revised by RID in this project. - To include methods/procedures of repair work in practice (Table 7-3)
Technical Specification for Road Maintenance	The *Technical specification for road maintenance* ws added as an appendix in the *Guideline for Repairing Road Defects*

Table 7-3 Work items to be included in the revised manual

No.	Job Code	Activity	Unit
1	1100	Pothole repair- Asphalt Concrete (AC) by Plant hot Mix	M^2
2	1101	Pothole repair- Asphalt Concrete (AC) by Site Mix	M^2
3	1131	Crack filling 1 layer 12 mm aggregate with CRS- 2	M^2
4	1132	Crack filling 2 layers 19 mm then 12 mm aggregate with CRS-2	M_2
5	1140	Repaired paved shoulders	M^2
6	1150	Shape correction(Ruts/Settlement)	M^2
DBST/AC Road surface repair			
7	1161	Pothole repair- mixed stone based- DBST	M^2
8	1162	Pothole repair-cement mixed based-DBST	M^2
9	1163	Pothole repair-mixed gravel CRS-2 & cement based - DBST	M^2
10	1164	Pothole repair-Excel Patch	M^2
Temporary road restore			
11	1160-3	Temporary road restore to facilitate traffic- laterite	M^2
12	1160-3C	Temporary road restore to facilitate traffic- mixed gravels	M^2
Concrete Pavement			
13	1180	Reinforced concrete road–thickness 200 mm	M^2
Shoulder maintenance			
14	1200	Grading shoulders	Km
15	1201	Adding laterite to road shoulder (road)	M^3
Laterite Road			
16	1250	Grading laterite	M^2
17	1260	Heavy grading laterite Road	M^2
Channel maintenance			
18	2100	Channel cleaning by labour	M
19	2110	Channel cleaning by machine	M
20	2150	Excavate channels by machine	M
Hazards			
21	4800	Clearing rock falling	M^3
Culvert maintenance			
22	3100	Cleaning culvert transversal	Place
23	3110	Cleaning culvert longitudinal	M
24	3130	Repair culvert transversal	Place
25	3141	Repair pipe culvert longitudinal	M
26	3142	Repair box culvert longitudinal (concrete)	M
27	3150	Install pipe culvert	M
Bridge Maintenance			
28	3200	Minor Bridge Repair (Cleaning, Painting and etc.)	Person/Hour
Road furniture and repair maintenance			
29	4150	Vegetation control (Shrub, Plant and Tree)	Km
30	4200	Sand bag work-slope protection	Bag
31	4400	Grass planting on the slope	M^2
32	4500	Adding soil to the slope	M^3
33	4610	Access road (public to national road) by AC	M^2

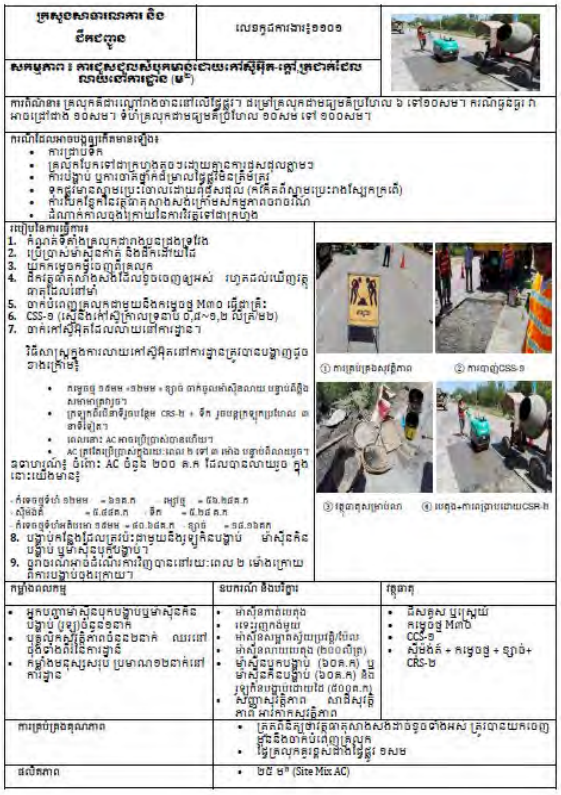
No.	Job Code	Activity	Unit
34	4620	Access road (public to national road) by DBST	M^2
35	4630	Access road (public to national road) by macadam	M^2
36	4700	Dragon hole filling	M^3
37	5100	Traffic lanes painting (Thermoplastic)	M
38	5200	Clean and paint traffic sign	Nos
39	5230	Traffic sign repair	Nos
40	5250	New Traffic sign installation	Nos
41	6100	Cleaning and painting safety poles	Nos
42	6150	Safety poles installation	Nos
43	7100	Cleaning & painting kilometres post	Nos
44	7130	Repairing kilometres post	Nos
45	7150	Kilometre post installation	Nos
46	7200	Replacing safety guardrail (steel)	M

Revision Point 3: Improvement of the guideline format

The existing guideline required improvement of the format to make it easier both for users and for editors.

"Job sheet form "was applied as template.

- Consistency of CODE number (1 CODE 1 Sheet)
- Easy to read (sheet form) and Khmer version
- Easy to update (adding sheet for new item)



Ministry of Public Works and Transports	Job Code: 1101
Activity: Pothole repair- Asphalt Concrete (AC) by Site Mix (m^2)	

Description: Pothole are bowl shaped holes in the pavement surface. Average potholes depth is around 6 – 10 cm, the more severe case is bigger than 10 cm. Average pothole size is around 10cm ~ 100cm.

Possible Cause:
- Infiltration of water
- The bowl has broken into small piece of the lumps without prompt repairs.
- Incorrect compaction or grading of road surface
- Road crack left unrepaired (Develop from Alligator Cracks)
- Break away of material under the action of traffic.
- Final stage in the development of a depression.

Work method:
1. Mark out the pothole area in a rectangular shape
2. Used cutter machine and manual excavation
3. Remove debris from potholes
4. Excavate to remove all bad materials until firm material is found
5. Backfilling the hole with M30 aggregate as base material
6. CSS-1 (Equivalent prime coat 0.8 ~ 1.2 L /m^2)
7. Apply Asphalt Concrete (AC) by Site Mix.
   Site Mixed AC Method is shown as follows
   - 19 mm + 12 mm aggregate + sand are input in the mixer after weighing its ratio
   - Mixed for a few minutes then add CRS-2 + water and continue mixing for about 3 minutes
   - The AC is then ready to used
   - AC must be used within 2-3 hours after mixing

For example, in the case of 200 Kg AC mixed, we have:
- Aggregate 12 mm = 61 Kg, - Stone Powder = 56.28 Kg
- Cement = 5.44 Kg, - Water = 5.28 Kg
- Aggregate Max 19 mm = 40.68 Kg, - Sand = 18.16 Kg
- Emulsificated Asphalt [CRS-2] = 13.12 Kg

8. Compact the patch area with vibrating roller, vibrating plate or a rammer.
9. Traffic can resume 2 hours after final compaction

Manpower	Tool and Equipment	Material
• 1 operator of hand roller compactor or vibrating plate compactor (rammer) • 2 safety officers at both end of work site • Approximately total of 12 men on the site	• Concrete cutting machine • Wheel barrow • Mechanical broom/shovels • Concrete Mixer (200 Lits.) • Tamping rammer (60Kg) or vibrating plate (60Kg) and Hand Roller Compacter (500Kg) • Safety sign, cones, vest	• Marking chalk or spray • M30 aggregates • CSS-1 • Cement + Aggregate + Sand + CRS-2
Quality Control	• Check all loose material are being removed before filling pothole • Surface of pothole should be slightly higher than the road by 1cm	
Productivity	• 25 m^2 (Site Mix AC)	

Table 7-4 Sample of Job Sheet

Ministry of Public Works and Transports	**Job Code: 1101**	
Activity: Pothole repair- Asphat Concrete (AC) by Site Mix (m^2)		

Description: Pothole are bowl shaped holes in the pavement surface. Average potholes depth is around 6 – 10 cm, the more severe case is bigger than 10 cm. Average pothole size is around 10cm ~ 100cm.

Possible Cause:

- Infiltration of water
- The bowl has broken into small piece of the lumps without prompt repairs.
- Incorrect compaction or grading of road surface
- Road crack left unrepaired (Develop from Alligator Cracks)
- Break away of material under the action of traffic.
- Final stage in the development of a depression.

Work method:

1. Mark out the pothole area in a rectangular shape
2. Used cutter machine and manual excavation
3. Remove debris from potholes
4. Excavate to remove all bad materials until firm material is found
5. Backfilling the hole with M30 aggregate as base material
6. CSS-1 (Equivalent prime coat 0.8 ~ 1.2 L /m^2)
7. Apply Asphalt Concrete (AC) by Site Mix.
   Site Mixed AC Method is shown as follows
   - 19 mm + 12 mm aggregate + sand are input in the mixer after weighing its ratio
   - Mixed for a few minutes then add CRS-2 + water and continue mixing for about 3 minutes
   - The AC is then ready to used
   - AC must be used within 2-3 hours after mixing

For example, in the case of 200 Kg AC mixed, we have:
- Aggregate 12 mm = 61 Kg, - Stone Powder = 56.28 Kg
- Cement = 5.44 Kg, - Water = 5.28 Kg
- Aggregate Max 19 mm = 40.68 Kg, - Sand = 18.16 Kg
- Emulsificated Asphalt (CRS-2) = 13.12 Kg

8. Compact the patch area with vibrating roller, vibrating plate or a rammer.
9. Traffic can resume 2 hours after final compaction


① Safety Control


② CSS-1 spraying


③ Material for Mixing


④ Concrete+CSR-2 Compaction

Manpower	Tool and Equipment	Material
• 1 operator of hand roller compactor or vibrating plate compactor (rammer) • 2 safety officers at both end of work site • Approximately total of 12 men on the site	• Concrete cutting machine • Wheel barrow • Mechanical broom/shovels • Concrete Mixer (200 Lits.) • Tamping rammer (60Kg) or vibrating plate (60Kg) and Hand Roller Compacter (500Kg) • Safety sign, cones, vest	• Marking chalk or spray • M30 aggregates • CSS-1 • Cement + Aggregate + Sand + CRS-2
Quality Control	• Check all loose material are being removed before filling pothole • Surface of pothole should be slightly higher than the road by 1cm	
Productivity	• 25 m^2 (Site Mix AC)	

7.1.5 Sensitization on the revised guideline

Presentation of Best Practices of DPWTs
Target Convention in November, 2016

① There are some quality control gaps regarding maintenance among DPWTs.
② The role of the guideline is to provide information on how to conduct road repair for maintenance.
③ It is necessary to improve the poor quality of maintenance by observing the good samples to realize best practices within the DPWTs. As the saying goes: *Seeing is believing*.

(1) Deployment schedule of the Guideline Ver. 1 to all DPWTs (Plan)

① Delivery Period: June-August, 2016
② Feedback Period: June-September, 2016
③ Presentation of Best Practice of Maintenance: November, 2016
④ Publication of the Hand book (English & Khmer) as Ver. 1: December, 2016

Milestones:

30th September: Correction to be finished by RID officials
31st October: Final check by H.E. of MPWT will be finished.
30th November: Printing of the Guideline is finished (English & Khmer) Ver. 1
1-15 December: Delivery to DPWTs

(2) Sensitization of DPWTs on the Guideline (Actual)

The JICA project team had discussions on the revision of the Guideline (Guidelines for Repairing Road Defects) with 25 DPWTs. The meetings were held in 5 provinces. The proceedings report on the discussions were reflected by MPWT in the draft Guideline for Repairing Road Defects. The Guidelines was finalized through the review process by MPWT.

Table 7-5 Road Repair Guideline Sensitization Seminar

No.	Province and another organization	No. of DPWTs	Venue	Date
1	Koh Kong, Kampong Speu, Phnom Penh, Kandal, Takeo, Kampot, Kep, Preah Sihanouk, HEC, RMC, SPIED	11	Phnom Phen	Dec 14th
2	Steung Treng, Ratanakiri, Kratie, Mondulkiri	4	Kratie	Dec 16th
3	Kampong Chhnang, Pursat, Pailin, Battambang	4	Pursat	Dec 19th
4	Oddar Meanchey, Banteay Meanchey, Siem Reap, Preah Vihear	4	Siem Reap	Dec 20th
5	Kampong Thom, Kampong Cham, Tboung Khmum, Prey Veng, Svay Rieng	5	Kampong Cham	Dec 21st

Figure 7-1 **Sample Guideline and Sensitization Seminar**

7.2. To Review and Establish Bridge Repair Manual

7.2.1 Issues on Current Bridge Repair Work

Table 7-6 summarizes major issues of existing bridge repair work observed by the Expert Team.

Table 7-6 Major Issues on Current Bridge Repair Work

Major Item	Description
Maintenance System/Management	· There is need for an annual bridge maintenance cycle standard procedure · **There is no official Bridge Repair Manual** · There is need for vulnerable bridge identification · There is need for implementation of preventive maintenance to the bridges in good condition. · **There is need for standardization of bridge repair works including coding.** · There is need for a common bridge inventory/inspection database at MPWT and DPWTs. · **There is need for administrative system to promote bridge maintenance experts.**
Inspection	· **A standardization of the Inspection System ought to be created** · There is need for universal and accurate evaluation criterion for identification of repair works · **There is need for the increase of the number of experts and inspectors at RID and DPWTs** · Need for regular inspection
Repair Work	· **Bridge repair guideline should be published** · There is need for inspection of works · Lack of repair equipment in the provinces

Table 7-7 briefly summarizes major issues on current condition of the bridge repair manual/guideline and bridge database as confirmed by RID.

Table 7-7 Current condition of Bridge Repair Manual/Guideline

Name	Issues to be considered
Bridge repair manual on framework	There is neither a framework on bridge repair within the ministry, nor a technical standard.
Bridge repair manual on defect repair	No technical standard or manual has been prepared within the ministry.

7.2.2 Proposed Bridge Repair Manual

The purpose of the 'Bridge Repair Manual' is to introduce standard maintenance methods and procedures against defects commonly found in bridges under MPWT and DPWT. The target audience of the manual is the DPWT staff who conduct actual bridge repair. The terminologies in the manual shall not be too technical but easy to understand even for non-engineers.

The manual is prepared jointly with MPWT staff and JICA Expert Team (Photo 7-3). Through the studies, the major points to be considered for the contents of the manual are summarized in Table 7-8. The manual in English has been completed. The contents of the manual are shown in Table 7-9 and Table 7-10. The Khmer version was prepared with effort from RID.

Photo 7-3 Developing of the Bridge Repair Manual

Table 7-8 Issues to be considered for manual making

Name	Issues to be considered
Bridge repair manual on frame work	· There is need to establish a framework for bridge maintenance cycle. · Standardization of bridge maintenance procedures should be done · Coding of required jobs for budget allocation · Visualization of the current condition of the bridge is recommended.
Bridge repair manual on defect repair	· It is necessary to identify typical defects and bridge structure in Cambodia and standardize the repair method and manual · Consider contracting private companies to carry out specific repair works

Table 7-9 Contents of Bridge Repair Manual

Contents	Key Concepts
CHAPTER 1 Introduction	・The importance of maintenance ・Concept of Preventive Maintenance ・Glossary
CHAPTER 2 Organization for bridge repair	・Bridge repair Schedule ・Jurisdiction of Bridge repair
CHAPTER 3. Safety and maintenance work	・For keeping safety repair work ・Confirmation before repair work ・Confirmation during repair work ・Routine maintenance
CHAPTER4 Maintenance room and Basic knowledge of concrete	・Maintenance Room ・Knowledge of Concrete Material ・Damages due to construction failures (Concrete) ・Concrete Work ・Concrete quality verification test
CHAPTER 5 Repair of concrete structure	・Planning of Concrete structure repair ・Introduction to Concrete structure repair
CHAPTER 6 Repair of steel structure	・Planning of Steel structure repair ・Introduction to Steel structure repair
CHAPTER 7 Repair of foundation or other structure	・Introduction of foundation or other structure repair

Table 7-10 Bridge structure repair items included in the Manual

No.	Contents
Concrete Structure	
C-1	Concrete crack
C-2	Carbon Fiber Cloth (CFC) Reinforcement Method
C-3	Corrosion of reinforcement in concrete pier column
C-4	Damages on concrete pier plinth
C-5	Cavity in the lower flange
C-6	Water leakage from the lower flange
C-7	Cracking damage on slab
C-8	Fracture damage
C-9	Corrosion of man Re-bars in concrete railing
C-10	Vehicle Collision Damage on Concrete Railing
C-11	Longitudinal Crack in the Lower Flange of PC Girder
C-12	Concrete Pier Damaged by Alkali-Aggregate Reaction
Steel Structure	
S-1	Corrosion on steel girder due to water leakage
S-2	Cracks the jammed part connecting cross beam and vertical stiffener of I-girder
S-3	M-Cracks on connected part of gusset or lateral bracing around support of steel I-girder
S-4	Crack at haunch girder
S-5	Steel pier corrosion
Foundation or other structure	
J-1	Damage on Expansion joint
J-2	Bridge scour

7.2.3 To Hold 'Bridge Repair Manual' workshop

MPWT officials and the JICA project team held a workshop on 'Bridge Repair Manual' in order to deepen the understanding of the newly-introduced bridge repair knowledge.
The workshops were held in 5 provinces. The target organizations were not only the 25 DPWTs but also the EMB, HEC, RMC, SPIED and PWRC. The lectures were selected from the Bridge Repair Manual ME trainers (cf. Table 7-11)
The 'Bridge Repair Manual' was finalized through the review process in MPWT.

Table 7-11 To Hold 'Bridge Repair Manual' workshop for

No.	Province and another organization	No. of DPWTs	Venue	Date
1	Koh Kong, Preah Sihanouk Ville, Kampong Speu, Phnom Penh, Kandal, Takeo, Kompot, Kep, EMB, HEC, RMC, SPIED, PWRC	8 (13)	Phom Phen	June 9, 2017
2	Pursat, Battambang, Pailin Kampong Chhnang	4	Pursat	June 12, 2017
3	Kratie, Rattanak Kiri, Stung Treng Mondul Kiri	4	Kratie	June 13, 2017
4	Kampong Cham, Kampong Thom Tboung Khmum, Prey Veng, Svay Rieng	5	Kampong Cham	June 14, 2017
5	Siem Reap, Oddar Meanchey Banteay Meanchey, Preah Vihear	4	Siem Reap	June 15, 2017

Photo 7-4 Sample of 'Bridge Repair Manual' workshop

7.3. To Hold Training Workshops on Road and Bridge Repairs

Workshops on road/bridge repair were held in order to deepen the understanding of the newly-introduced inspection systems and procedures in this project. All the workshops and the seminars held are described in Chapter 5.4. Workshops on road and bridge repairs were held in 2016 and 2017 as shown in Table 7-12 below.

The manuals produced by the project are to be used for the ME (Maintenance Expert Program)

Table 7-12 List of Workshops

Topic		Contents	Target	Time
PDCA Cycle for Maintenance		Road/bridge maintenance cycle	RID	2015
Inspection	Training	- Road/bridge inspection technologies - Systematic database management	RID	2015
	Review	Application of road/bridge inspection technologies at site	RID, DPWT	
Repair	Training	Road/bridge repair technologies	RID	2016
	Review	Application of road/bridge repair technologies at site	RID, DPWT	
Inspection/Repair Seminar (1)		- Life cycle cost - PDCA cycle for road/bridge maintenance - Strategy for asset management	RID, Related organization	To be decided
Inspection/Repair Seminar (2)		- High technologies for road/bridge inspection - PDCA cycle for road/bridge maintenance - Systematic bridge database management	DPWT, Students	
Project Review Seminar		- Evaluation of the project - Strategy for asset management - Future maintenance plan	RID, DPWT	

7.4. Summary of Pilot Projects

The implementation of the bridge and road repair pilot project for the month of July 2016 are summarized in Table 7-13 and Table 7-14 below.

Table 7-13 Implementation of BRIDGE repair pilot projects

	Target DPWT	**Methodology**	**Number of bridges**
1st Pilot Project	Kandal and Phnom Penh	Crack Sealing	2 in Phnom Penh 3 in Kandal
2nd Pilot Project	PreahSihanouk	CFC Reinforcement	1 in PreahSihanouk (NR. 4)

Table 7-14 Implementation of Road repair pilot projects

	Target DPWT	**Methodology**	**Road Number**
1st Pilot Project	Kandal and Phnom Penh	EXCEL PATCH (imported)	NR.4, 6, 8
2nd Pilot Project	Preah Sihanouk Takeo	EXCEL PATCH (locally produced)	In town

Table 7-15 1st Pilot Project (Bridge and Road)

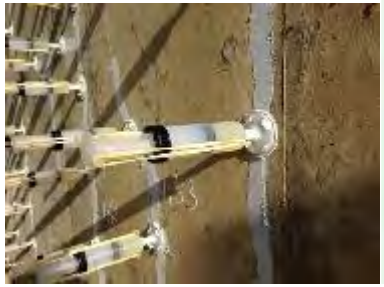
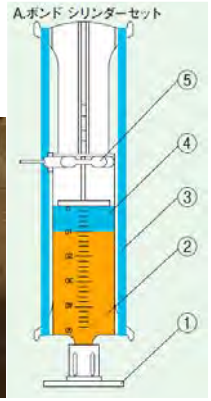
	Bridge Repair	Road Repair
Outline	Injection of concrete bond to the cracks on concrete bridges [Emergence Repair/ Preventive Maintenance]	Pothole patching using cold mix asphalt [Emergence Repair/ Preventive Maintenance]
	  Stopper Ring Rubber Bond Base	 
Objective	Injection of concrete bond is the most typical and easy repair method for concrete bridges. The materials and tools can be imported from Japan. This method can be applied to any concrete bridge with relatively small scale cracks.	This is to apply for the pothole patching for emergence purpose. Due to very short required time for the work, this method is good for heavy congested roads or intersections to minimize negative impact to traffic flow. Typical work as preventive maintenance of the Asphalt Concrete maintenance.
Period	January to February 2016	January to February 2016
Work Methods Tools and equipment	・Epoxy resin 15 sets ・Concrete crack seal 100 sets ・Injection tools 1000 nos	・Ready mix cold asphalt (Excel patch) 100 bags (1 bag 15 kg) ・Compress washer 4 nos
Remarks	Kandal 2 bidges Phnom Penh 2 bridges	The road with heavy traffic is recommended.

Table 7-16 2nd Pilot Project (Bridge and Road)

	Bridge Repair	Road Repair
Outline	CFC Reinforcement method	Pothole patching using cold mix asphalt Using locally produced Excel Patch
		
Objective	Repair and reinforcement of bridge slab and column	Verification of better use of local made products - Work organization of target DPWT for pothole patching - Technical specification (recommendation for better use) - Verification of cost effectiveness
Period	January to February 2017	January to February 2017
Work Methods Tools and equipment	*Carbon fiber sheet*	Excel patch 200 bags
Remarks	*No traffic regulation needed *Incremental weight is very small *Easier construction procedure	Excel patch is the product of IKEE company.

7.5. To Identify Bridges for the Pilot Repair Works based on the Inspection Results at the Target DPWTs

7.5.1 1st Pilot Project

(1) Target DPWT

Kandal DPWT
Phnom Penh DPWT

(2) Pilot Project Plan for Bridge Repair

1) Concept of the Pilot Project

The progress of concrete corrosion is shown in Table 7-17.

Figure 7-2 shows a concept of preventive maintenance. If the current condition and the progress of deterioration can be monitored and identified in the early stages, recovery can be made through minor repairs. Constant and timely repair works are essential in order to reduce the burden of future maintenance thus minimizing the life cycle cost.

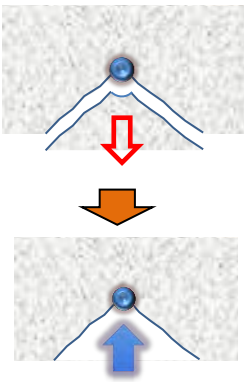
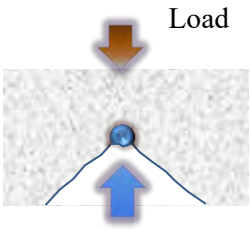
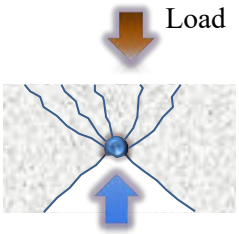
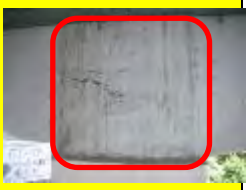
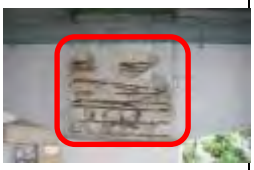
As part of preventive maintenance, a decision was made during the first bridge repair Pilot Project to introduce resin injection method for concrete crack repairing.

The resin injection method has the following advantages:

- Inexpensive
- Advanced repair technology and equipment is not required
- No electricity needed

The cost of resin injection method for concrete crack repair is relatively inexpensive compared to other methods. In cases whereby concrete cracks are not caused by external loading, savings from the repair budget can be made in the long run by adopting this simple and reasonable method while the degree of cracks remains small.

Table 7-17 Progress of concrete corrosion

	Step 1	Step 2	Step 3	Step 4
				
				
	Invasion of rusting factor, such as water, oxygen and salt, into inner areas through the cracks	By expanding pressure, surface concrete becomes detached. Exposure of rebar to rusting factors and rusting is accelerated	The whole structure becomes weaker and weaker	Continued loading of a weakened structure causes further damage.
Counter measures	Injection of epoxy resin into cracks	Covering the exposed rebar with mortar	Reinforcement	Replacement
Repair cost	Low ⟷			High

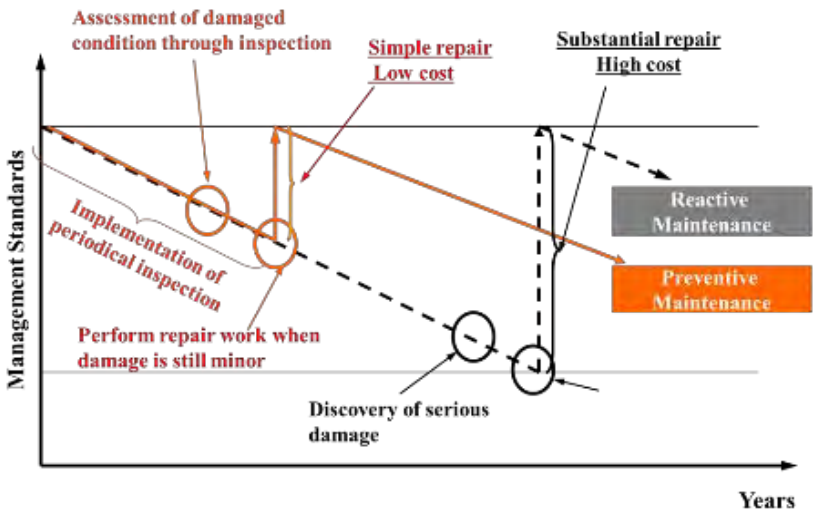


Figure 7-2 Concept of Preventive Maintenance

2) Location of the Pilot Project

The Target DPWT were Phnom Penh and Kandal Provinces. This was agreed in the JCC meeting on 10 July 2015. The proposed location is as shown in Table 7-18 and Table 7-19.

Table 7-18 Target bridge of 1st Pilot Project (Phnom Penh Province)

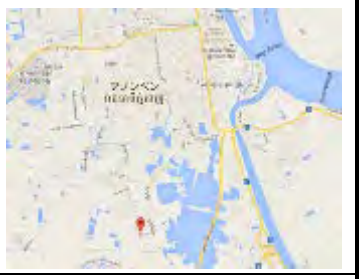
	No. 1	No. 2
Bridge Name	Teuk tla	Prek jrey
Road Name	National Road 3	Street217
Latitude	11.445274	11.489382
Longitude	104.804388	104.894555
Map		
Photo		
Notes	—	

Table 7-19 Target bridge of 1st Pilot Project (Kandal Province)

	No. 1	No. 3	No. 4
Bridge Name	Prek kong ly	Prek Ta park	Prek phe
Road Name	National Road 110	National Road 110	National Road 110
Latitude	11.155862	11.286843	11.296495
Longitude	105.084235	105.042463	105.050630
Map			
Photo			
Notes	—	—	—

7.5.2 2nd Pilot Project

(1) Target DPWT

Preah Sihanouk DPWT

(2) Pilot Project Plan for Bridge Repair

1) Concept of the Pilot Project

For selection of the 2nd pilot project method, an analysis of the inspection results on the causes of bridge damage in Cambodia was done. Listed below are the main causes of serious bridge damages in Cambodia;

Case 1: Insufficient strength capacity due to non-conforming work or design deficiency (Photo 7-5)
Case 2: Overloading (Photo 7-6)

Photo 7-5 Insufficient strength capacity

Photo 7-6 Overloading

The basic policies for countermeasures are highlighted below:

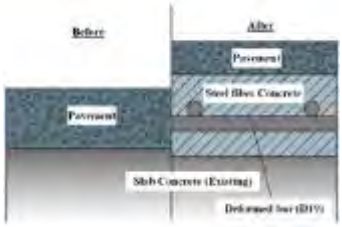
Case 1: Structural reinforcement of the bridge members to increase strength capacity
Case 2: Strengthening law enforcement on overloading of vehicles and structural reinforcement of the bridge members to increase strength capacity

As a feasible solution to the two main causes of bridge damages, structural reinforcement of bridge members shall be performed in the 2nd pilot project. The structural reinforcement methods are shown in Table 7-20

The repair methods often applied for slab reinforcements are concrete overlaying, steel plate bonding and CFC (Carbon Fiber Cloth) bonding. In case of concrete overlaying and steel plate bonding methods, dead load is greatly increased by reinforcement. Therefore, it is necessary to re-examine the capacity of existing girders, piers, and bearings. And according to the calculation, there is a case that requires redesigning for bearing replacement and pier reinforcement. (In case of re-designing, structural calculation reports and design drawing of existing bridge should be prepared.)

The 2nd Pilot Project of bridge repair was decided to introduce reinforcement method by CFRP.

Table 7-20 The selection of Reinforcement Method at 2nd Pilot Project

	Concrete overlaying	Steel plate bonding	CFC bonding
Repair Method	Increasing the thickness of concrete slab from the surface  	Bonding steel plate from slab bottom with adhesive and anchor bolts  	Bonding Carbon Fiber Cloth from slab bottom with adhesive  
Merits	● Scaffolding not needed	● No traffic regulation needed ● Many applications for busy bridges in Japan	● No traffic regulation needed ● Incremental weight is very small ● Easier construction procedure
Demerits	● Big incremental weight ● Heavy equipment needed ● Chipping of existing concrete is necessary for firm fixing ● Road closure is needed during construction	● Big incremental weight ● Scaffolding is needed ● Anchor's holding capacity is not guaranteed if the existing concrete is poor	● Scaffolding is needed ● Risk of energization
Judgment	**Medium**	**Not good**	**Good**

The advantages of CFC method are:

- Excellent material properties.
- Lightweight
- High strength, high elasticity（Tensile strength: 3,400 N/mm^2, 10 times more compared with iron）
- High durability against ultraviolet ray
- Excellent workability

2) Location of the 2nd Pilot Project

The MPWT and JICA Experts Team agreed that the target bridge for the 2nd pilot project should satisfy the following conditions:

- The target bridge for the 2nd pilot project is 1 bridge
- The 2nd pilot project should be carried out in a different province from the 1st pilot project.
- The 2nd pilot project should be carried out on a 1-digit national road.

Based on the conditions above, the proposed bridge for the 2nd pilot project is shown in Table 7-21.

Table 7-21 Target Bridge for the 2nd Pilot Project

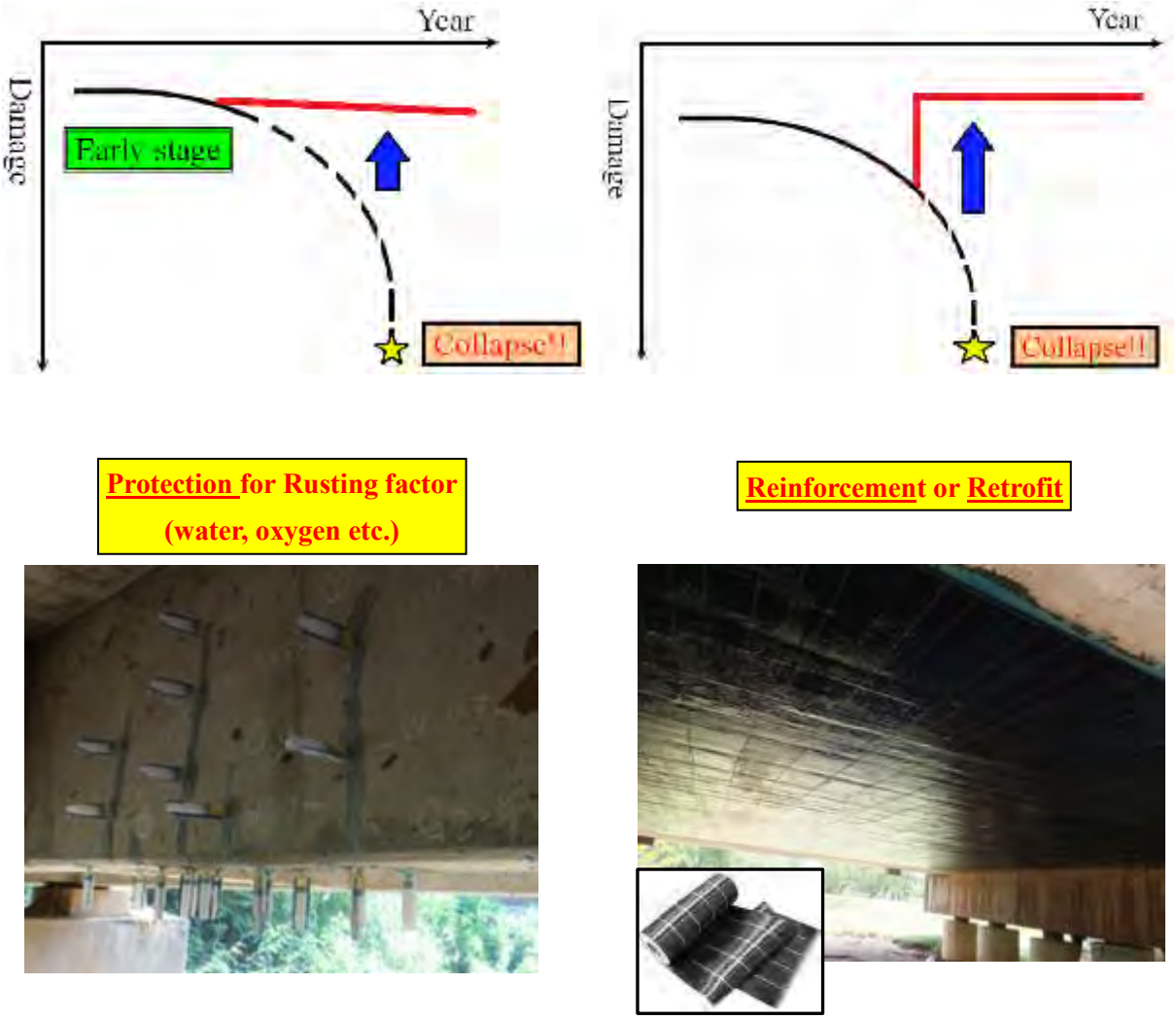
	Target Bridge
Bridge Name	O Trav
Road Name	National Road 4
Province	Preah Sihanouk
Latitude	10.667072
Longitude	103.794133
Map	
Photo	
Notes	It is a possibility of fatigue crack by overloading from the following reasons. – These cracks occur in transverse direction. – Cracking on adjacent precast slab are continuous – There is a huge vibration of the slab when overloaded vehicles pass. – There are many cracks near the axle.

7.5.3 Differences in purpose between '1st pilot project' and '2nd pilot project' (Bridge repair)

'Crack Sealing method' (1st pilot project) protects the rusting factor of rebar (e.g. water, oxygen) while CFC method (2nd pilot project) reinforces concrete.

'Crack Sealing method' is inexpensive, but is only a preventive measure. The bridge function cannot be completely recovered. It is advisable to apply 'Crack Sealing method' at an early stage of damage.

The repair purpose image is shown in Figure 7-3.



(a) Crack Sealing (1st Pilot project) **(b) CFC Reinforcement (2nd pilot project)**

Figure 7-3 Bridge Repair Image (Bridge Repair Pilot project)

7.6. To Identify Roads for the Pilot Repair Works based on the Inspection Results at the Target DPWTs

7.6.1 Target DPWTs for Pilot Project

Kandal DPWT
Phnom Penh DPWT
(Agreed in the 1st JCC meeting of 10 July 2015)

7.6.2 Pilot Project Plan for Road Repair

(1) Method to be applied in the Pilot Project

Refer to Chapter 7.4.2

(2) Candidate Location for the Pilot Project

1-digit road sections managed by Phnom Penh DPWT and Kandal DPWT were chosen as targets for the pilot projects (pilot repair works) in the first project year. Candidate road sections are summarized in Table 7-22 .

Table 7-22 List of Target Road Sections for Pilot Projects during the First Project Year

Road Name	Approximate Target Length (km)		
	Phnom Penh	Kandal	Total
RN1	5 km	55 km	60 km
RN2	2 km	18 km	20 km
RN3	12 km	13 km	25 km
RN5	11 km	24 km	35 km
RN6	7 km	28 km	35 km
RN8	-	20 km	20 km
Total	37km	158 km	195 km

The candidate locations for the pilot project are:

1) Selected section from national road in Table 7-22 and Table 7-23.
2) Selected section of city roads within the DPWT (heavy traffic roads)

Table 7-23 Candidate Roads for Pilot Project

DPWT	Name of Bridge	Remark
Kandal	NR.21	
	NR.2	
	City Roads	
Phnom Penh	NR.2	
	Mao Tse Toung Road	
	Round About at Wat Phnom	

Figure 7-4 Candidate Road Sections for Pilot Projects

7.7. To establish repair plan for the identified BRIDGES at the target DPWTs

7.7.1 Repair plan for the 1st pilot project

In order to confirm the extent of damage and construction methods, MPWT, DPWT and JICA Expert Team conducted field surveys in the months of December 2015 and January 2016 before the project implementation (see Photo 7-7). The results of the survey are shown in Figure 7-6 to Figure 7-14.

The MPWT, DPWT, and JICA Expert Team held a meeting on safety measures and scaffolding installation methods (see Photo 7-8).

Photo 7-7 Field Survey for 1st Pilot Project

Photo 7-8 Meeting on Safety and Scaffolding Installation

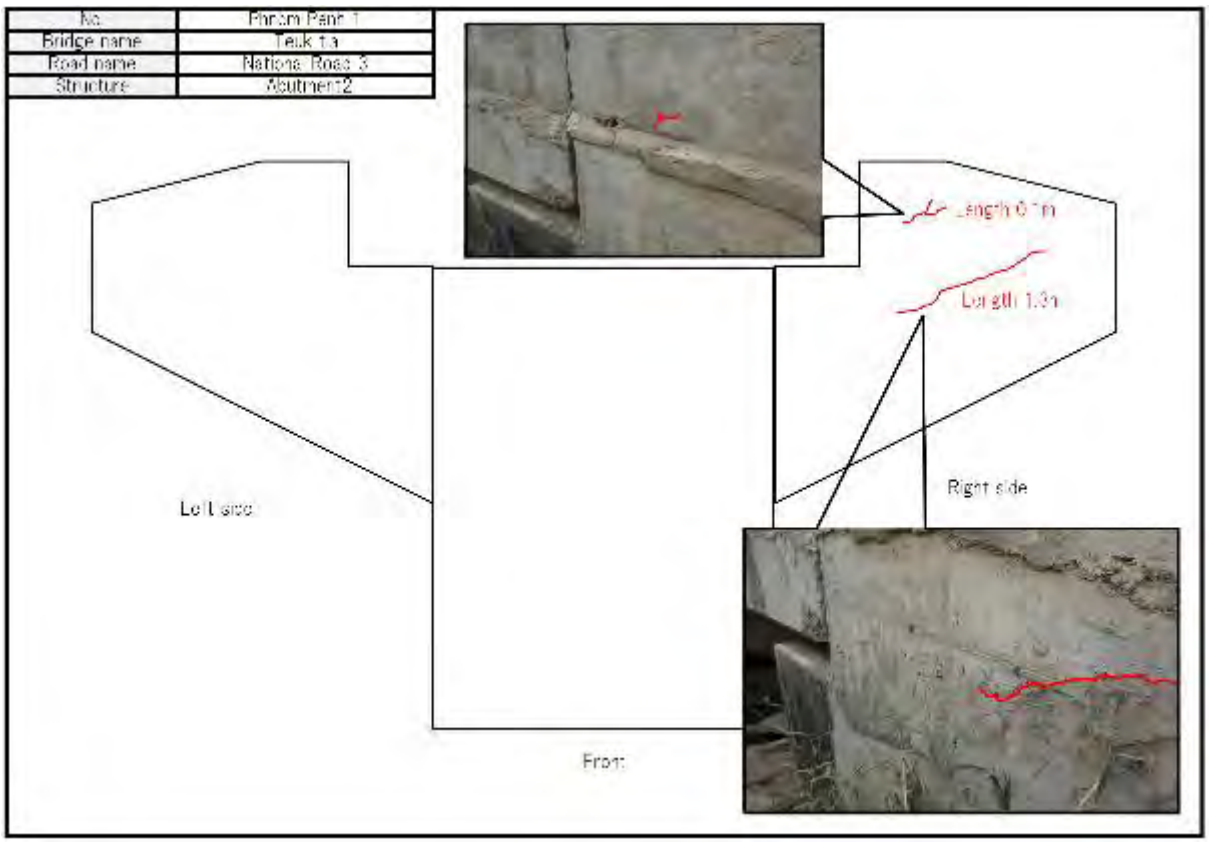


Figure 7-5 Inspection Sheet (Teuk tla: Phnom Penh. Bridge No. 1)

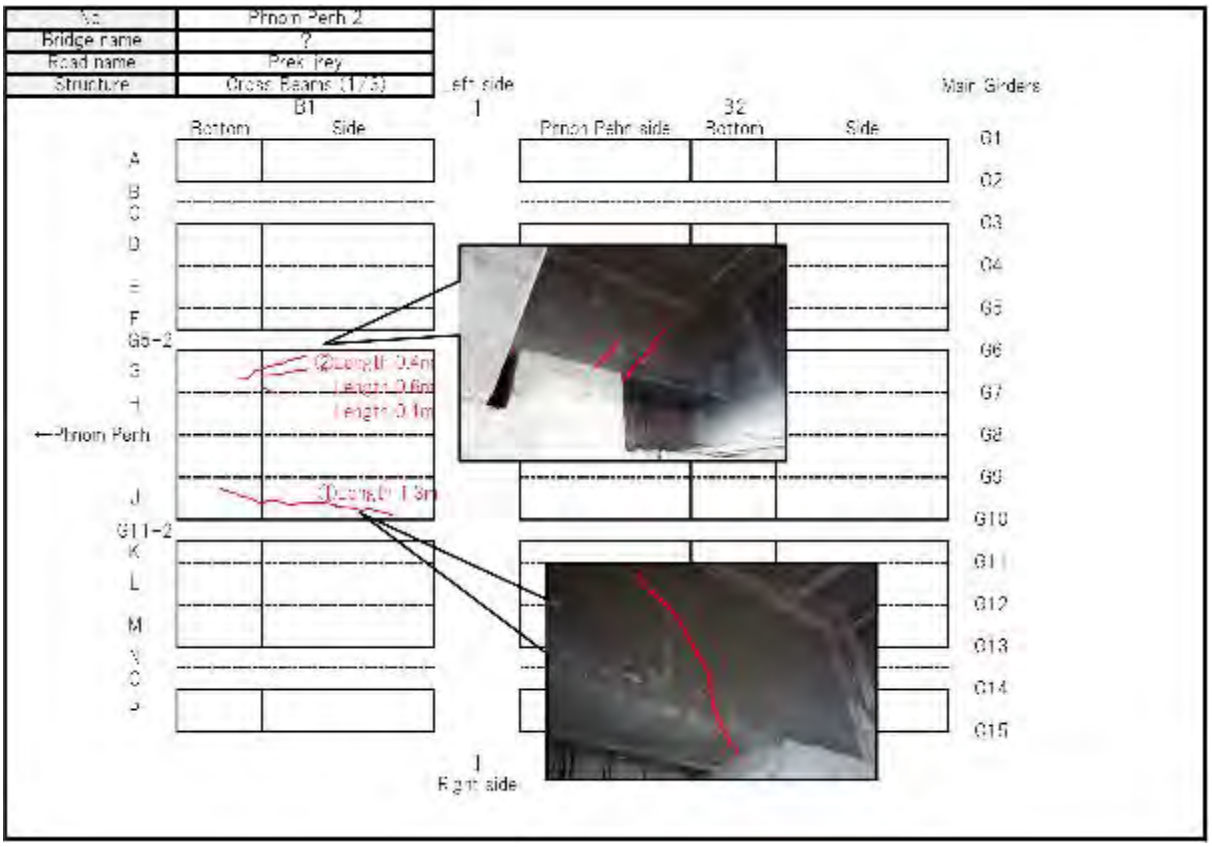


Figure 7-6 Inspection Sheet (Prek jrey: Phnom Penh. Bridge No. 2)

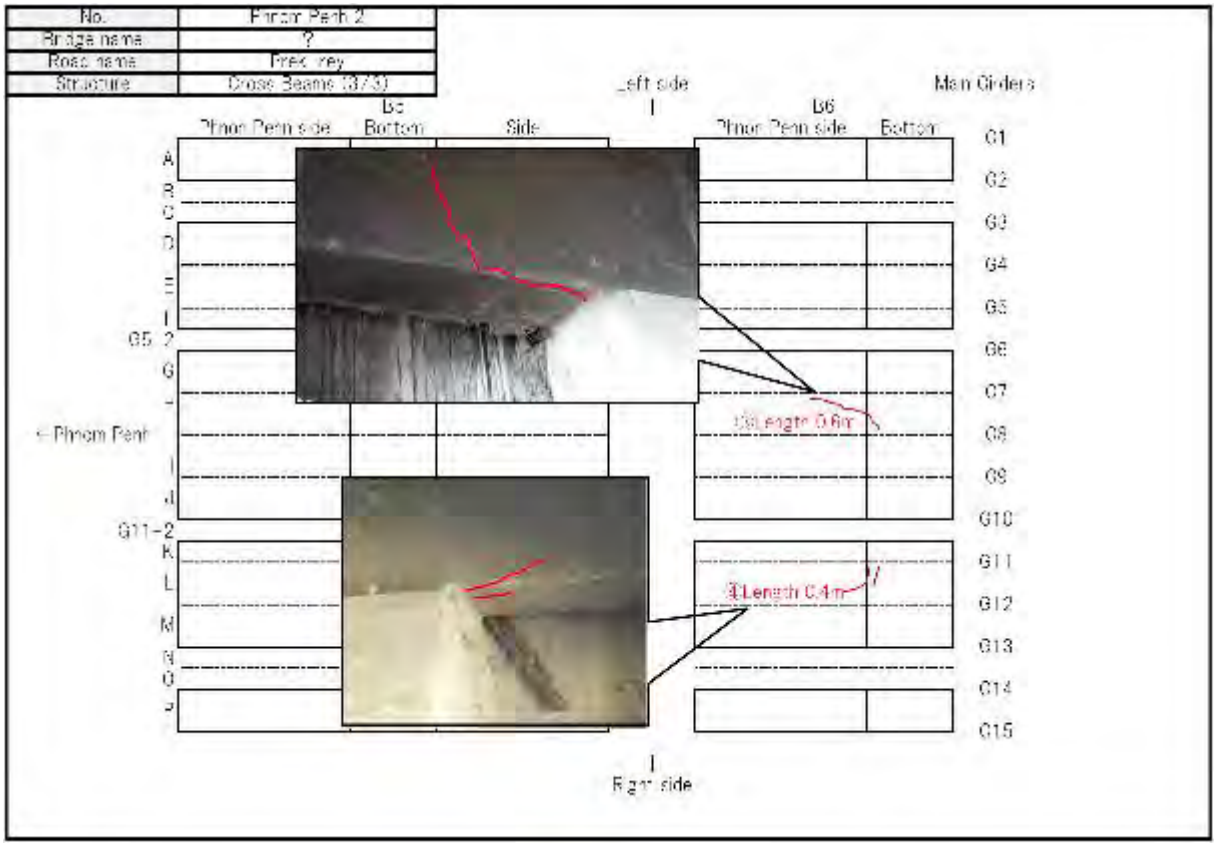


Figure 7-7 Inspection Sheet (Prek jrey: Phnom Penh. Bridge No. 2)

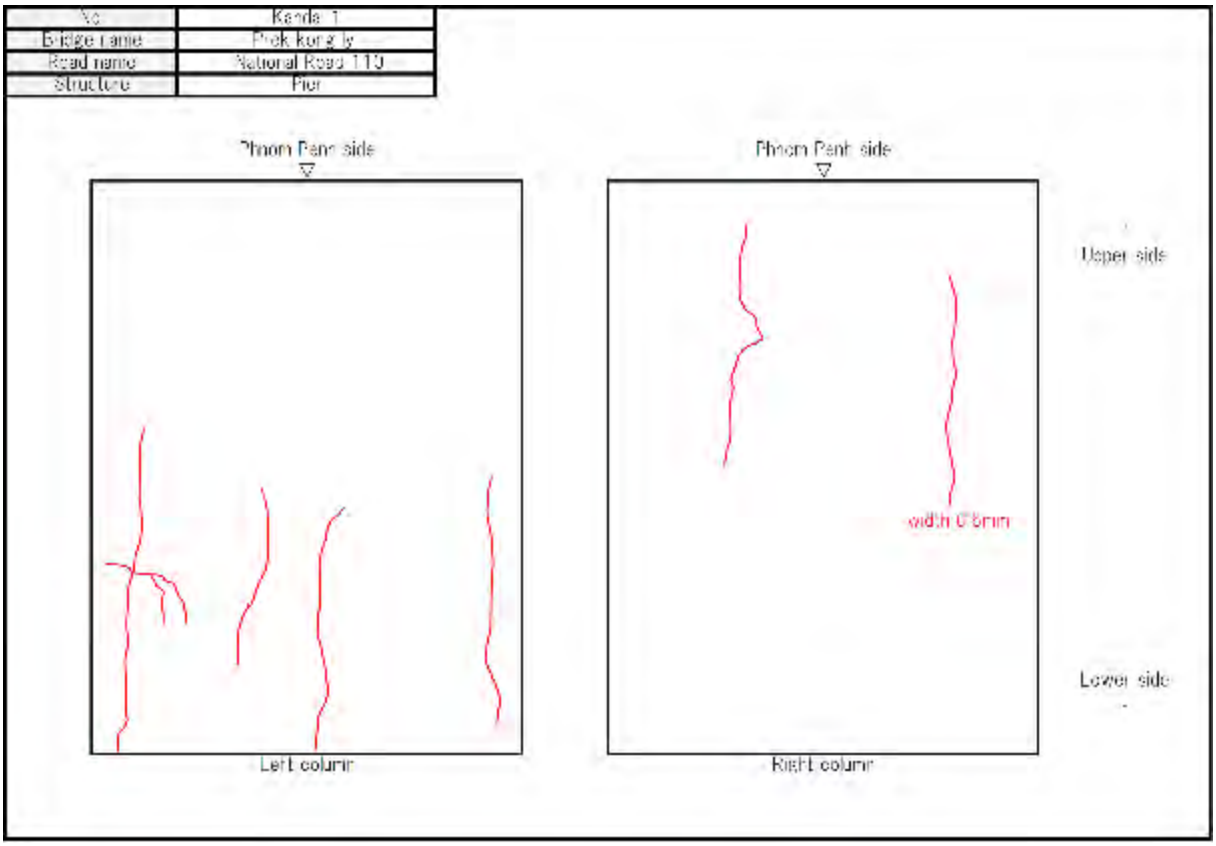


Figure 7-8 Inspection Sheet (Prek kong ly: Kandal. Bridge No. 1)

Figure 7-9 Inspection Sheet (Prek Ta prak: Kandal. Bridge No. 3)

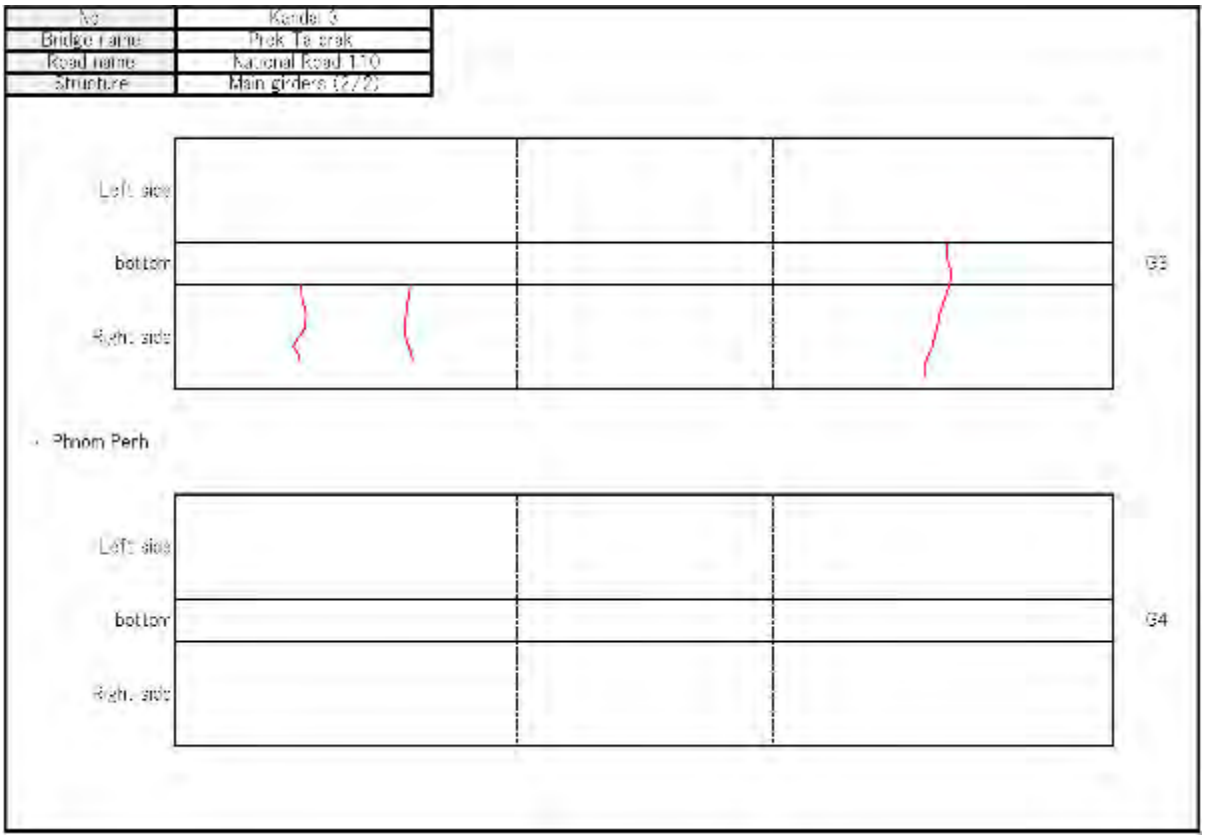


Figure 7-10 Inspection Sheet (Prek Ta prak: Kandal. Bridge No. 3)

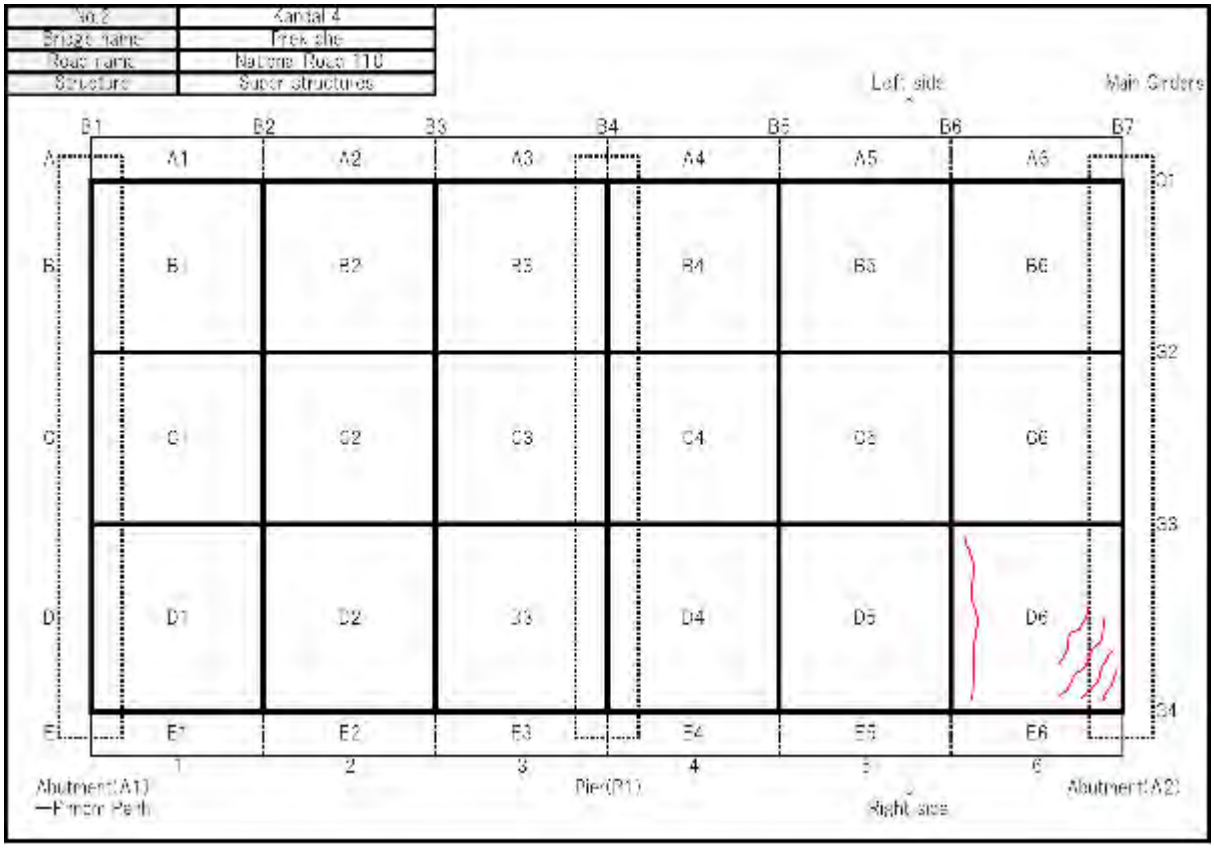


Figure 7-11 Inspection Sheet (Prek phe: Kandal. Bridge No. 4)

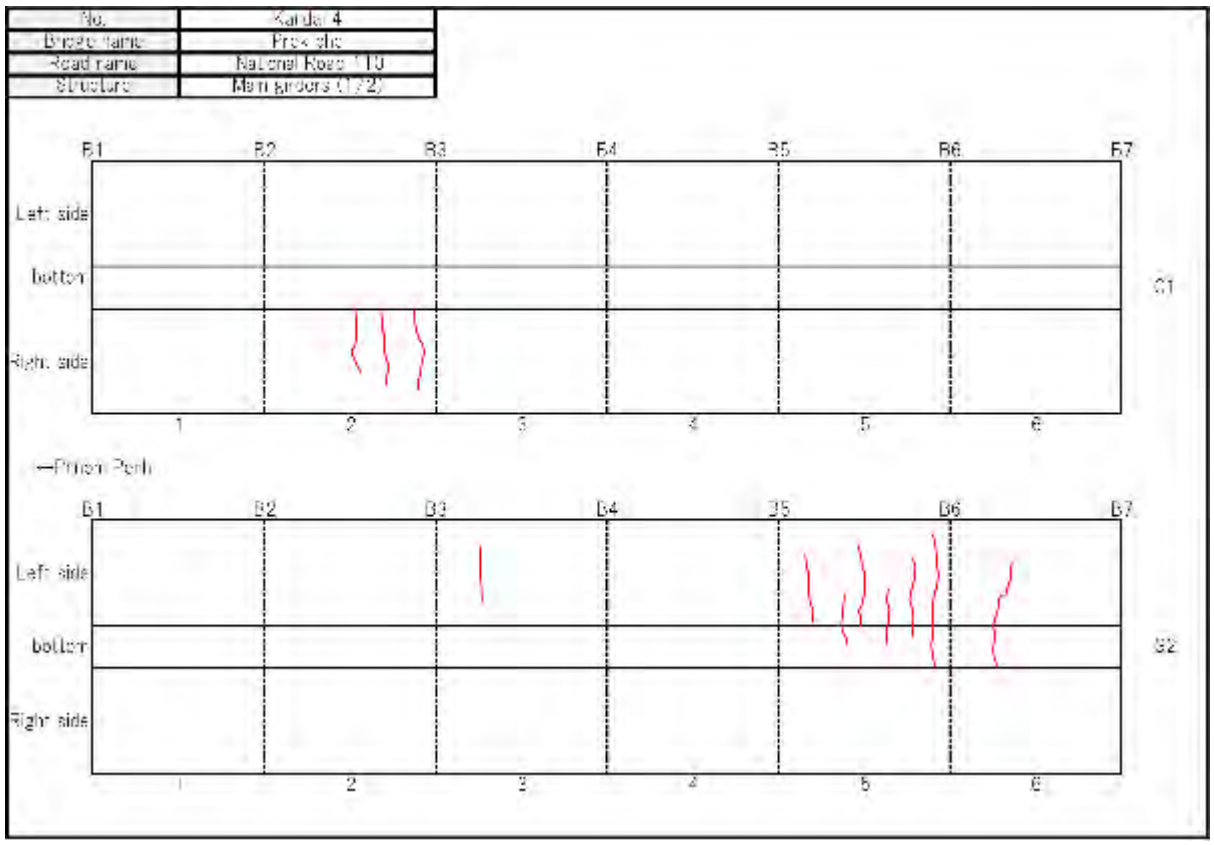


Figure 7-12 Inspection Sheet (Prek phe: Kandal. Bridge No. 4)

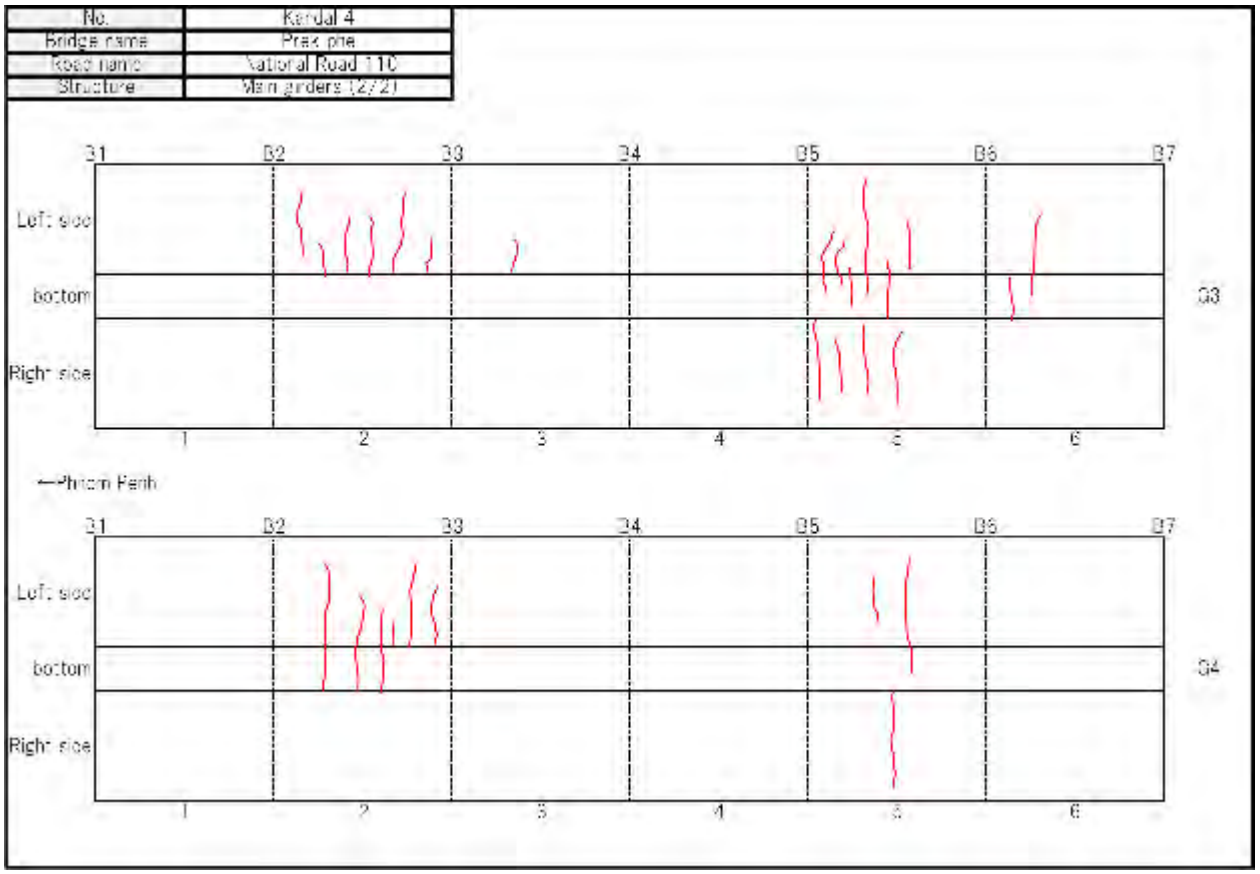


Figure 7-13 Inspection Sheet (Prek phe: Kandal. Bridge No. 4)

Table 7-24 Inspection Result

Phnom Penh Province bridge	
No. 1: Teuk tla	*There is a big crack on the abutment. * It is not necessary to prepare scaffolding.
No. 2: Prek jrey	*There are two big cracks on the end cross girder. * It is necessary to prepare scaffolding.
Kandal Province bridge	
No. 1: Prek kong ly	*On the column, there is a crack in the vertical direction * Scaffolding and ladder are necessary for inspection and repair.
No. 3: Prek Ta prak	*There are several cracks on the girders * Scaffolding and ladder are necessary for inspection and repair.
No. 4: Prek phe	*There are several cracks on the girders * Scaffolding and ladder are necessary for inspection and repair.

7.7.2 Repair plan for the Second (2nd) pilot project

The Target bridge inspection result is shown from Figure 7-14. The bridge has many cracks on the slab (transversally). There is a possibility of fatigue crack in these cracks.

The slab is well now by hammering test, but the soundness cannot be maintained in the future.

Table 7-25 Dimension of Target Bridge (2nd Pilot Project)

Bridge length	16.8m	Width	10m
Pire	7 cylindrical columns	Span	2span
Bridge type	Continuous slab bridge	Constructed year	1996

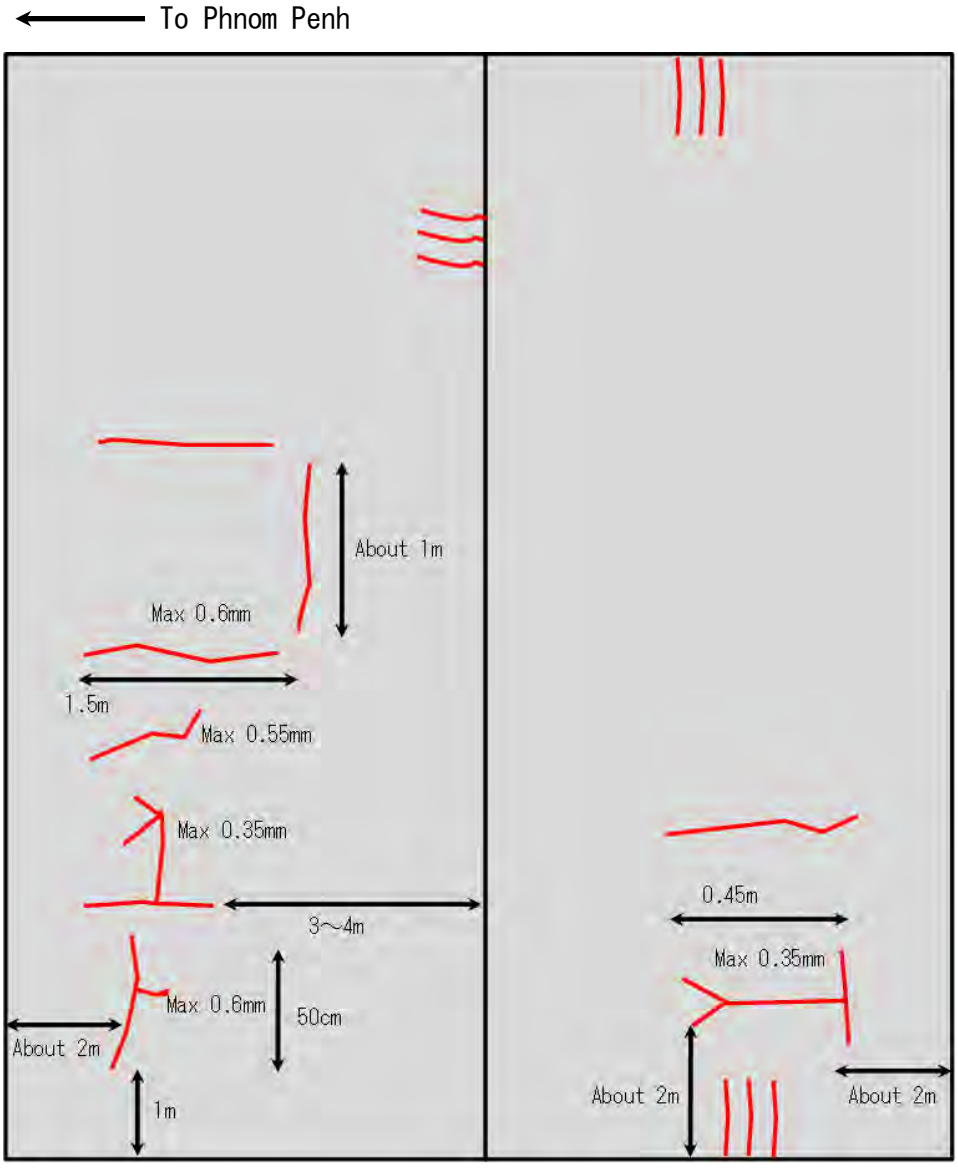


Figure 7-14 Inspection Sheet (O Trav: Preah Sihanouk)

In order to confirm the extent of damage and construction methods, MPWT, DPWT and JICA Expert Team conducted field surveys in the months of September and November 2016, (see Photo 7-9) before the project implementation.

The MPWT, DPWT, and JICA Experts Team had a meeting on safety measures and scaffolding installation method (see Photo 7-10).

Photo 7-9 Field survey for the 2nd pilot project

Photo 7-10 Meeting on Safety and scaffolding installation

7.8. To establish repair plan for the identified ROADS at the target DPWTs

7.8.1 Repair plan for the 1st pilot project

(1) Background of Excel Application for Road Repair

Approximately 80% of the expenditure on road maintenance is related to pavement repair. For that reason, MPWT demands a reduction on the cost of pavement repair. In this Project, as one of the solutions for expediting road repair, a fast pothole repair before it grows larger through the application of cold asphalt mixture product (hereafter called Excel) as a cost reduction measure is proposed. The product is a ready mixed cold asphalt with specific bituminous and gravel composition which is hardened by compaction of the passing vehicles only.

(2) Objective of the 1st Pilot Project for Road Repair Works

To Test and verify practical use (application) of Excel and conditions.

(3) The 1st Pilot Project Implementation Plan

1) The Conditions for Verification of Excel Effectiveness

A. Size of the Pothole to be applied and required treatment
Type-1: A small pothole less than 50 cm x 50 cm
Type-2: Alligator crack (after cutting of the damaged pothole)
Type-3: Resurfacing (around 5 m x 5 m with repair of base course)

B. Repair works under wet condition
Note: Excel effectiveness should be verified for the conditions above during the pilot project.

2) Target Roads for the 1st Pilot Project

— Target road: NR.8 (Kandal) and NR.6 (Phnom Penh)
— Pavement type: AC, DBST
— Specific locations: 3 locations in Kandal DPWT, 1 location in PP DPWT

3) Material

— Imported Material 100 bags
— Locally Manufactured Material 100 bags

4) MPWT Implementation Structure

— Excel manufacturing: IKEE (info)
— Cost: Production cost and construction cost: IKEE (info)
— Construction: DPWT pavement repair team

(4) Method Statement and Quality Control

See next page for the Job Sheet. A flow chart for selection of the repair method is shown in Figure 7-15.

Ministry of Public Works and Transports	**Job Code: 1164**	

Activity: Pothole repair – Excel Patch (m^2)

Description:
Urgent patching Application to pothole (maximum diameter 1.0 m, depth 50 mm ~ 100 m)

Possible Cause:

- Poor quality DBST surfacing mix
- Incorrect compaction of the mix during construction
- Infiltration of water
- Break away of material under the action of traffic
- Final stage in the development of depression

Work method:

1. Sweep the pothole.
   Clear and remove sands and soil from edge of the pothole by brushing
2. If pothole more than 5 cm depth, coarse material should be fill prior EXCEL patch
3. Loosen EXCEL
   Before open the bag, loosen EXCEL in the bag.
4. EXCEL in the pothole.
   Put Excel into the pothole. 40% surplus is recommended for even compaction. (see Figure) (1-2cm)
5. Level surface.
   Level surface of the Excel patching with trowel and shovel
6. Spread Sand on an EXCEL.
   Spread sand even on the surface of Excel
7. Compaction by foot or car tires/ vibrating plate compactor, compacting steel plate="elephant leg"
   Compact surface by foot or tire of vehicle
8. Spread sand onto the EXCEL to reduce friction of EXCEL and car tires


1. sweep the pothole

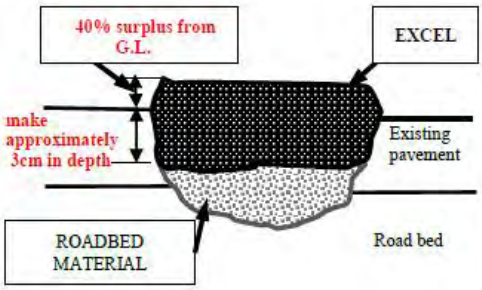

2. loosen an EXCEL


3. insert an EXCEL in the pothole


4. smooth a surface


5. sprinkle sand


6. compaction by foot



Manpower	Tool and Equipment	Material
• 1-2 unskilled worker	• Square Shovel, Broom, Water (+1 pickup for mobilization. • Pickaxe	• EXCEL, base course material, sand (for spread)
Quality Control	• To confirm the Excel surface after compaction is smooth and higher than existing road surface. (no water allowed stay)	
Productivity	• 10 minutes per location/ team	

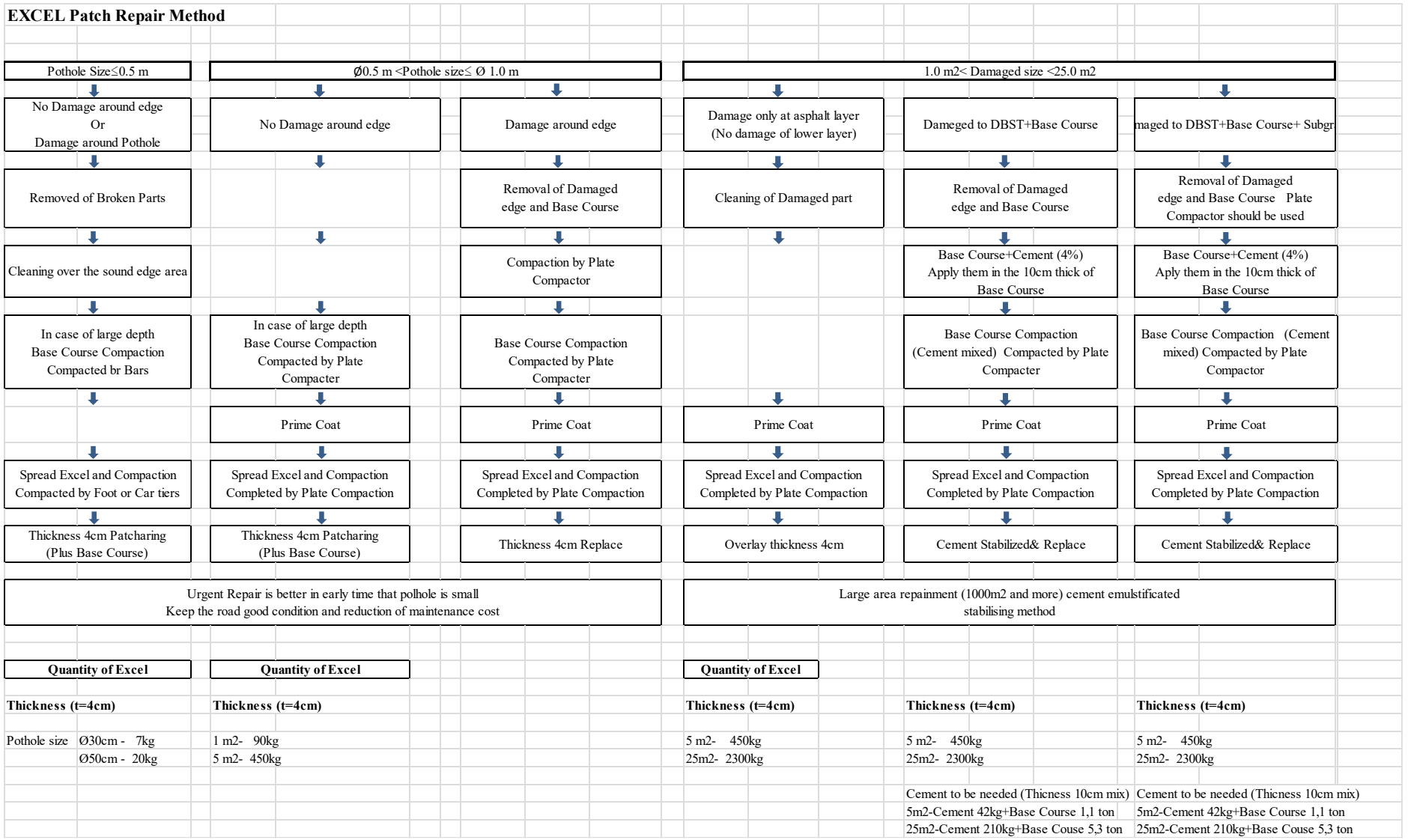


Figure 7-15 Flow chart for selection of the repair method by Excel

(5) Location for the 1st pilot project

The pilot project was conducted at NR.4, 6 and 8 at the locations shown in Table 7-26.

Table 7-26 Locations of the 1st Pilot Project of Road Repair

Road	Station	Size	Method
NR.8	27+150	1 x 2.5 m, d = 3 cm, 8 bags	With machine
	27+250	0.8 x 4.5 m, d = 5 cm, 15 bags	With machine
	31+200	0.5 x10 m, d = 3 cm, 20 bags	With machine
NR.6	3+200	0.5 x 0.6 m 0.4 x 0.8 m 0.12 x0.12 m	Labour only
NR.4	23+500	1.8 x 4.5 m, 28 bags	With machine

7.8.2 Repair plan for the 2nd pilot project

The 2nd pilot project also employs locally produced excel patch for asphalt concrete patching. The supplier, IKEE Cambodia, installed a plant at RID laboratory and produced products using locally available materials. The project monitored the use of the material. The project was also employed to the NR.5 widening project to repair potholes in the existing roads.

7.9. To Repair the Identified Bridges at the Target DPWTs

7.9.1 1st Pilot Project for bridge repair

(1) Outline of resin injection method for concrete crack repair

Concrete cracks are filled with epoxy resin injection (Photo 7-11). The material is shown in Photo 7-12.

The repair work is carried out in three days (Figure 7-16).

Photo 7-11 Concrete Crack Repair Method

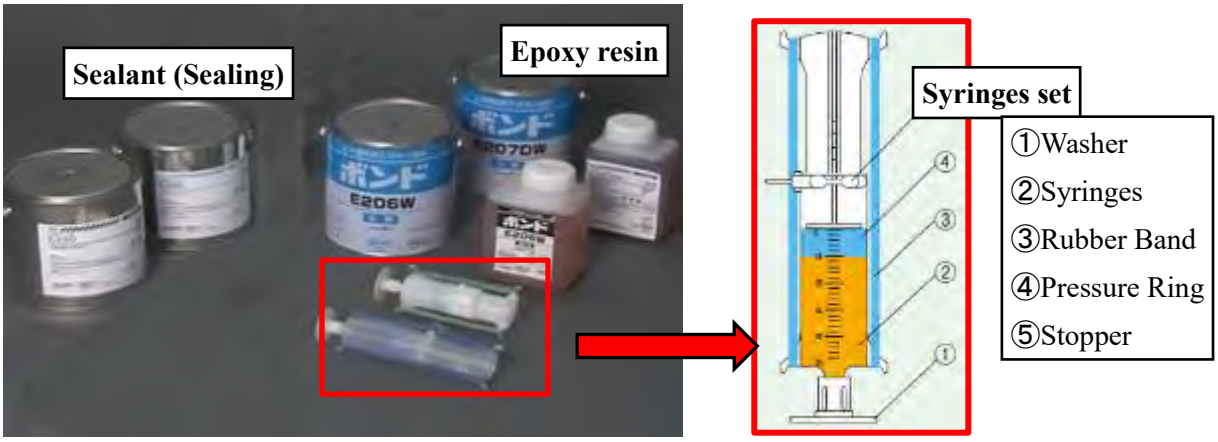


Photo 7-12 Concrete Crack Repair Material

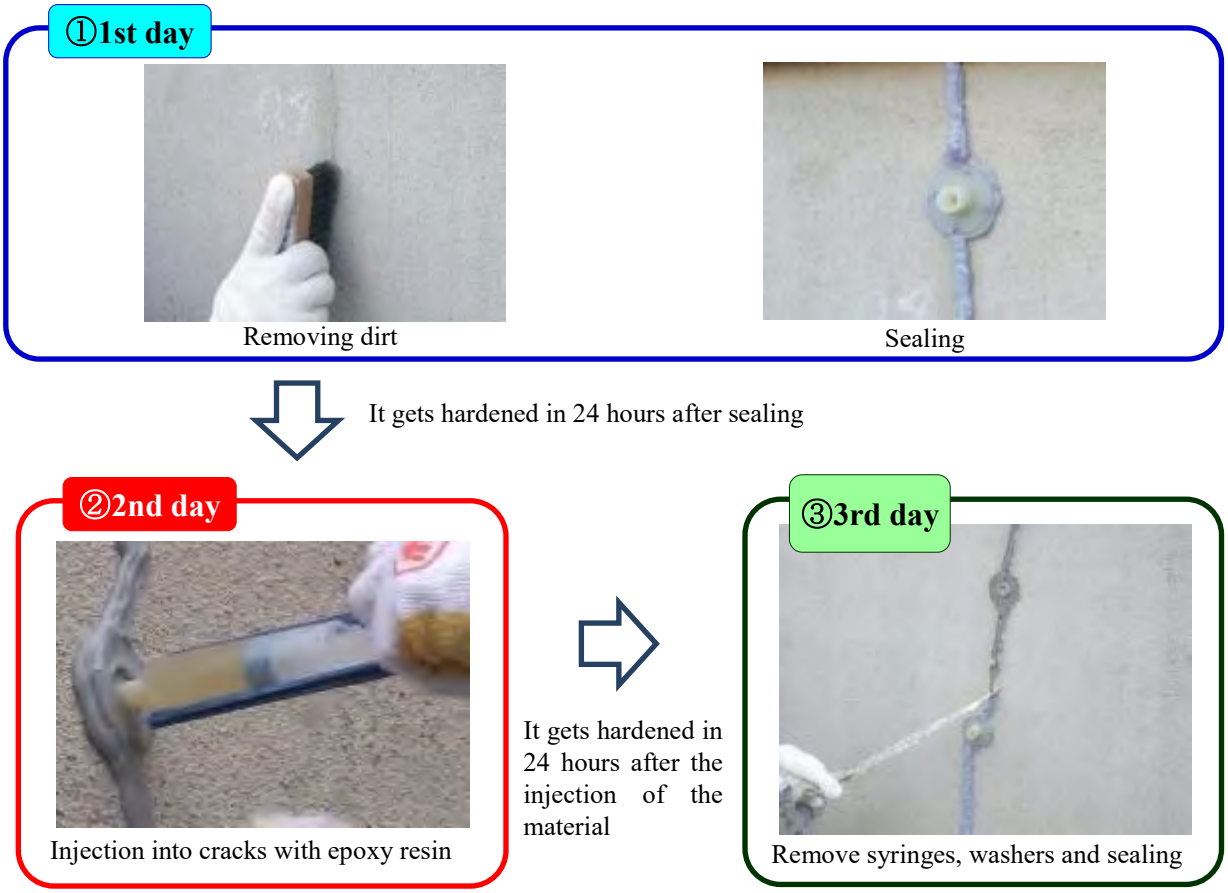


Figure 7-16 Outline of Crack Repair Method by Epoxy Resin

(2) Implementation of 1st pilot project

The 1st Pilot Project schedule for bridge repair is shown in Table 7-27.

Table 7-27 1st Pilot Project Schedule

January 2016						
Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
25	26	27	28	29	30	31
① 1st day	(①)	② 2nd day Open site tour in No.2 bridge	(②) Phnom Penh	③ 3rd day		
February 2016						
1	2	3	4	5	6	7
① 1st day	(①)	② 2nd day	(②) Kandal	③ 3rd day		
8	9	10	11	12	13	14
① 1st day	(①)	② 2nd day Open site tour in No.2 bridge	(②) Kandal	③ 3rd day		

The MPWT staff mastered this repair technology during the pilot project. The MPWT staff can then train the DPWT staff in the future. During the 1st pilot project, the MPWT staffs and JICA Expert Team trained the DPWT staff not only on repair technique but also safety at work, e.g. site cleaning (see Photo 7-13), safety meeting (see Photo 7-14) A site tour of the pilot project was conducted to share this technical repair information. The outline of 1st bridge repair pilot project is shown in Table 7-28 and Photo 7-15. The site tour was attended by more than 35 people.

An agreement has been reached to be able to purchase the repair material in Cambodia. The MPWT staff will then support the DPWT staff on repairs. This will enable each DPWT to perform the repairs using this method in the future.

Photo 7-13 Site Cleaning

Photo 7-14 On-Site Safety Meeting

Table 7-28 1st Pilot Project Site Tour

Site Tour in Phnom Penh	
Date	January 27, 2016
Time	2:00 PM – 3:30 PM
Location	Prek jrey Bridge, Street 217 (bridge No. 2)
Site Tour in Kandal	
Date	February 3, 2016
Time	2:00 PM – 3:30 PM
Location	Prek phe Bridge, National Road 110 (bridge No. 4)
Date	February 10, 2016
Time	2:00 PM – 3:30 PM
Location	Prek Ta prak Bridge, National Road 110 (bridge No. 3)


Photo 7-15 1st Pilot Project Site Tour

Table 7-29 Status of 1st Pilot Project

1st day	
1 Site meeting	 
2 Site cleaning	 
3 Installation of scaffolding	 
4 Preparation of repair material	 
5 Crack measurement	 

Table 7-30 Status of 1st Pilot Project

1st day	
6 Surface cleaning	 
7 Making of repair material (Sealing)	 
8 Sealing Work	 
9 End (1st day)	 

Table 7-31 Status of 1st Pilot Project

2nd day	
1 Site meeting	—
2 Site cleaning	 
3 Installation of scaffolding	—
4 Preparation of repair material	—
5 Making of repair material (Resin)	 
6 Making of repair material (Resin)	 
7 Fixing the cylinder to the washer	 
8 End (2nd day)	 

Table 7-32 Status of 1st Pilot Project

3rd day	
1 Site meeting	—
2 Site cleaning	—
3 Removal of the cylinder	 
4 Removal of the washer	 
5 Completion	 

7.9.2 2nd Pilot Project for bridge repair

(1) Outline of resin CFC (Carbon Fiber Cloth) method

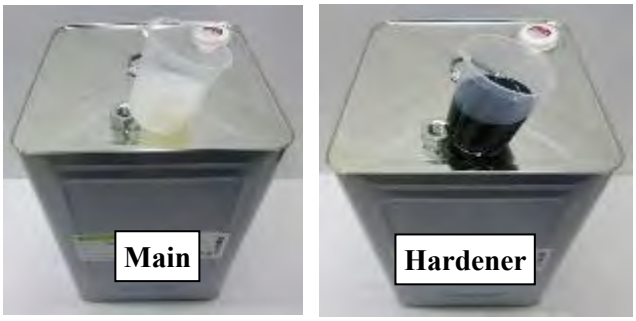
This method involves the reinforcement of the concrete structure by CFC (Photo 7-16). Due to the light weight of the CFC, this method does not require heavy equipment and can be done by hand. The CFC can be cut by scissors as desired. The CDC therefore can be adjusted freely and flexibly on the concrete surface.

The standard usage weight per unit area of CFC is show in Table 7-33. The execution of the little resin weight causes the deterioration of the reinforcement.

Photo 7-16 CFC Method

(a) Primer material

(b) Smoothing agent material



(c) Impregnating resin material

(d) CFC

Photo 7-17 CFC Material

Table 7-33 Standard Usage Weight of CFC (per unit area)

Type of resin	Areal weight of CFC (g/m^2)	Standard usage weight per unit area (kg/m^2)		
		Under applying	Over applying	Total
Primer	-	-	-	0.20
Smoothing Agent	-	-	-	1.00
Impregnating resin	400	0.50～0.60	0.50～0.40	1.00
CFC	-	1	-	-

* It depends on the type of CFC.

Required tools for CFC reinforcement are shown in Table 7-34**.**

Table 7-34 Required Tools for CFC Reinforcement

Process	Tool	Photo
Protection tool	Gloves	 
	Protective glasses	 
	Helmet	 

Table 7-35 Required Tools for CFC Reinforcement

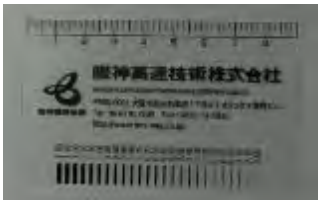
Process	Tool	Photo
Protection tool	Mask	 
	Raincoat	 
Sectional repair Surface preparation	Chalk	 
	Wire brush	 
	Blower	 
	Crack gauge, Steel Tape	 

Table 7-36 Required Tools for CFC Reinforcement

Process	Tool	Photo
Sectional repair Surface preparation	Thermo -hygrometer	 
	Disk grinder	 
	Pail	 
	Pan balance	 
	Stopwatch	 
	permanent marker	 

Table 7-37 Required Tools for CFC Reinforcement

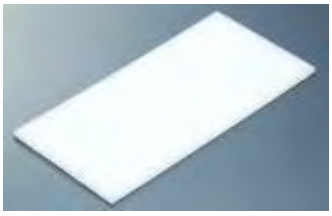
Process	Tool	Photo
Sectional repair Surface preparation	Spatula	 
	Board (Plastic type)	 
	Jug	
	Polishing sheet	 
	Trowel	 
	Box cutter, and Scissors	 

Table 7-38 Required Tools for CFC Reinforcement

Process	Tool	Photo
	Agitator (Low speed type)	 
	Application roller (Handle)	 
	Application roller (Roller)	 
	Brush	 
	Paddle Roller	 

Table 7-39 Required Tools for CFC Reinforcement

Process	Tool	Photo
For tool cleaning and for site cleaning	Picnic sheet (Plastic type)	 
	Paper towel	 
	Thinner	 
	Garbage bag	 
	Tongs	 

(2) Work procedure

The purpose of this method is reinforcement of the bridge. It is therefore necessary to perform repair works before implementing this method.

It is also necessary before the site works, to measure the repair and reinforcement parts and to include them in the work plan.

The CFC workflow is shown in Figure 7-17.

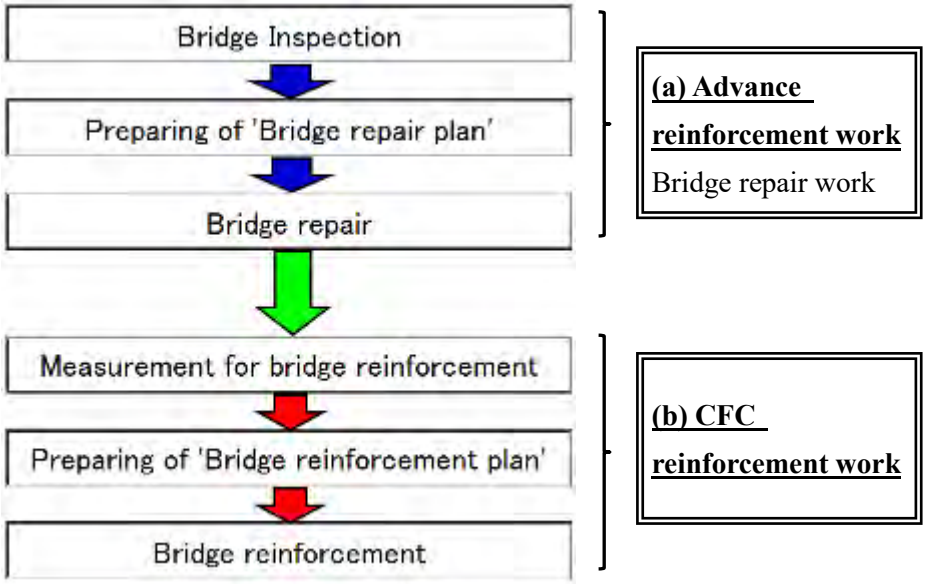


Figure 7-17 CFC Workflow

(a) Advance reinforcement work

1) Bridge inspection

Inspection and recording should be done in order to prepare a work plan.

The bridge inspection should be done first. If a crack wider than 0.3 mm on the bridge is notices, it must be repaired.

In addition, by hammering inspection, the detached sections should be checked and removed. The reinforcing range should be measured and record it on the expansion plan.

2) Sectional repair

The omission of hollows and cracks causes bad bonding. Therefore, if there is lacking parts and the hollows in concrete must be repaired by resin mortar. Any crack wider than 0.3 mm must be repaired by epoxy resin (Figure 7-19).

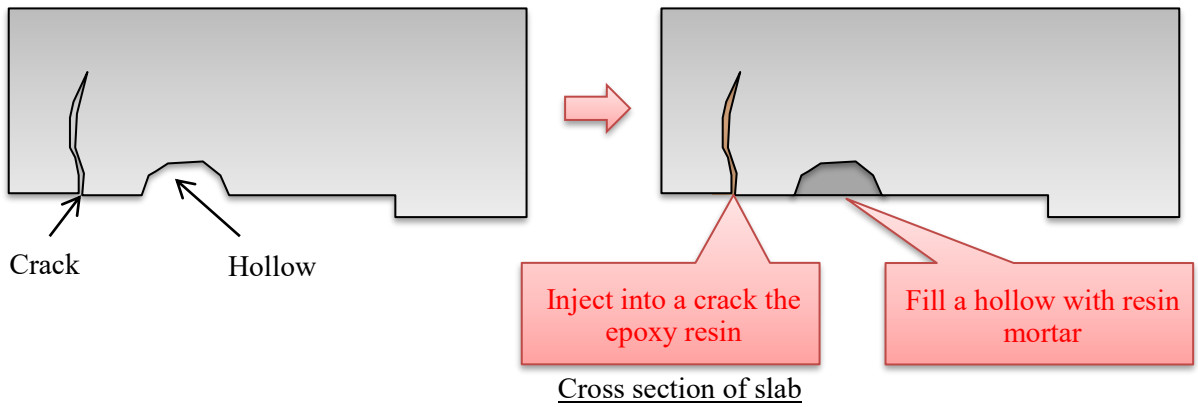


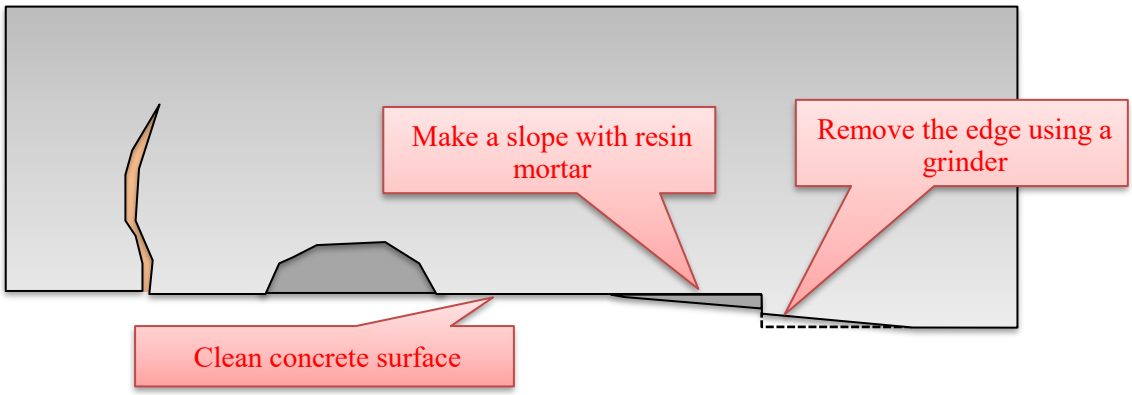
Figure 7-18 Crack and Hollow Repair

Figure 7-19 Crack Repair (Reference: 1st Pilot Project)

3) Surface Preparation (Figure 7-20)

Surface difference in level or edge of the corner causes bad bonding and breakage of the carbon fiber. Therefore, the surface difference is flattened by a disk grinder (Photo 7-18 (a)) for a surface less than 1 mm in difference level or put resin mortar (for a difference larger than 30 mm in radius).

The mortar, oil and dust should be removed to expose the sound concrete by a disk grinder or a wire brush and by polishing scrubbing (Photo 7-18 (b)).



Cross section of slab

Figure 7-20 Surface Preparation

(a) To flatten by disk grinder **(b) To remove dust by polishing scrubbing**

Photo 7-18 Surface Preparation

(b) CFC reinforcement work

This full repair work is carried out in four days (Figure 7-21).

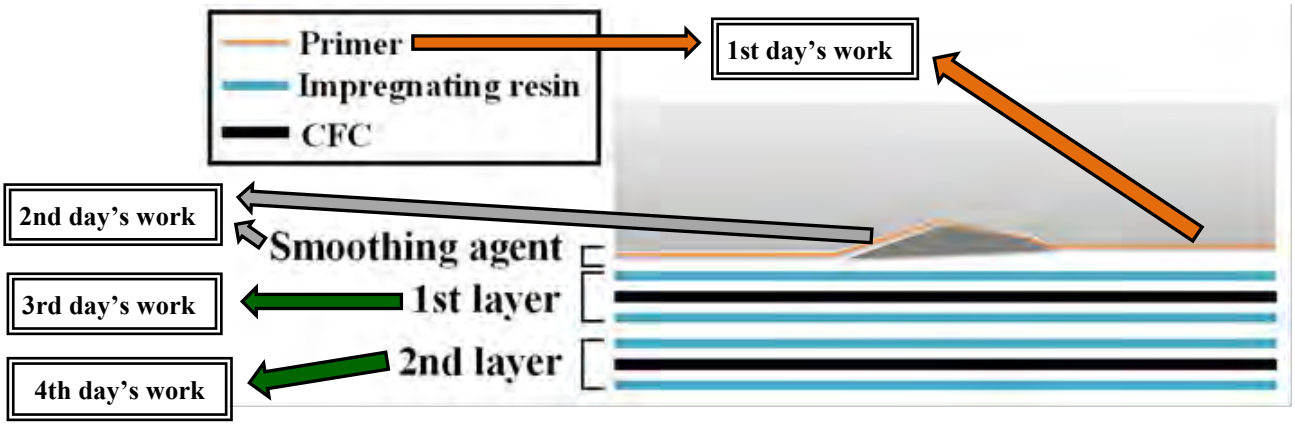


Figure 7-21 Surface Preparation

(3) Implementation of 2nd pilot project

The 2nd Pilot Project schedule for bridge repair is shown in Table 7-40.
The MPWT staff mastered this repair technology during the pilot project. The MPWT staff can then train the DPWT officials in the future.

Table 7-40 1st Pilot Project Schedule

January 2017						
16 Monday	17 Tuesday	18 Wednesday	19 Thursday	20 Friday	21 Saturday	22 Sunday
		13:30～ Meeting in DPWT				
23 Monday	24 Tuesday	25 Wednesday	26 Thursday	27 Friday	28 Saturday	29 Sunday
9:00～ CFC work 1st day	9:00～ CFC work 2nd day	9:00～ CFC work 3rd day	9:00～ CFC work 4th day			
January		February 2017				
30 Monday	31 Tuesday	1 Wednesday	2 Thursday	3 Friday	4 Sutarday	5 Sunday
CFC work	CFC work	CFC work	CFC work	CFC work		
6 Monday	7 Tuesday	8 Wednesday	9 Thursday	10 Friday	11 Saturday	12 Sunday
CFC work	CFC work	CFC work	CFC work	CFC work		

By DPWT, MPWT and JICA

By DPWT

During 2nd pilot project, the MPWT officials and JICA Expert Team trained the DPWT officials not only on repair technique but also on safety at work, (e.g. site cleaning (see Photo 7-19), safety meeting (see Photo 7-20))

An agreement has been negotiated to be able to purchase the repair material in Cambodia. The MPWT officials will then support the DPWT officials on repairs. This will enable each DPWT to perform the repairs using this method in the future.


Photo 7-19 Site Cleaning


Photo 7-20 Site safety Meeting

Using the measurement result, CFC reinforcement work plan was prepared before site work.

The CFC layout plan is shown in Figure 7-22.

The material use plan is shown in Figure 7-23.

The CFC resin mixing plan is shown in Figure 7-24.

Layout of CFC (1st week work)

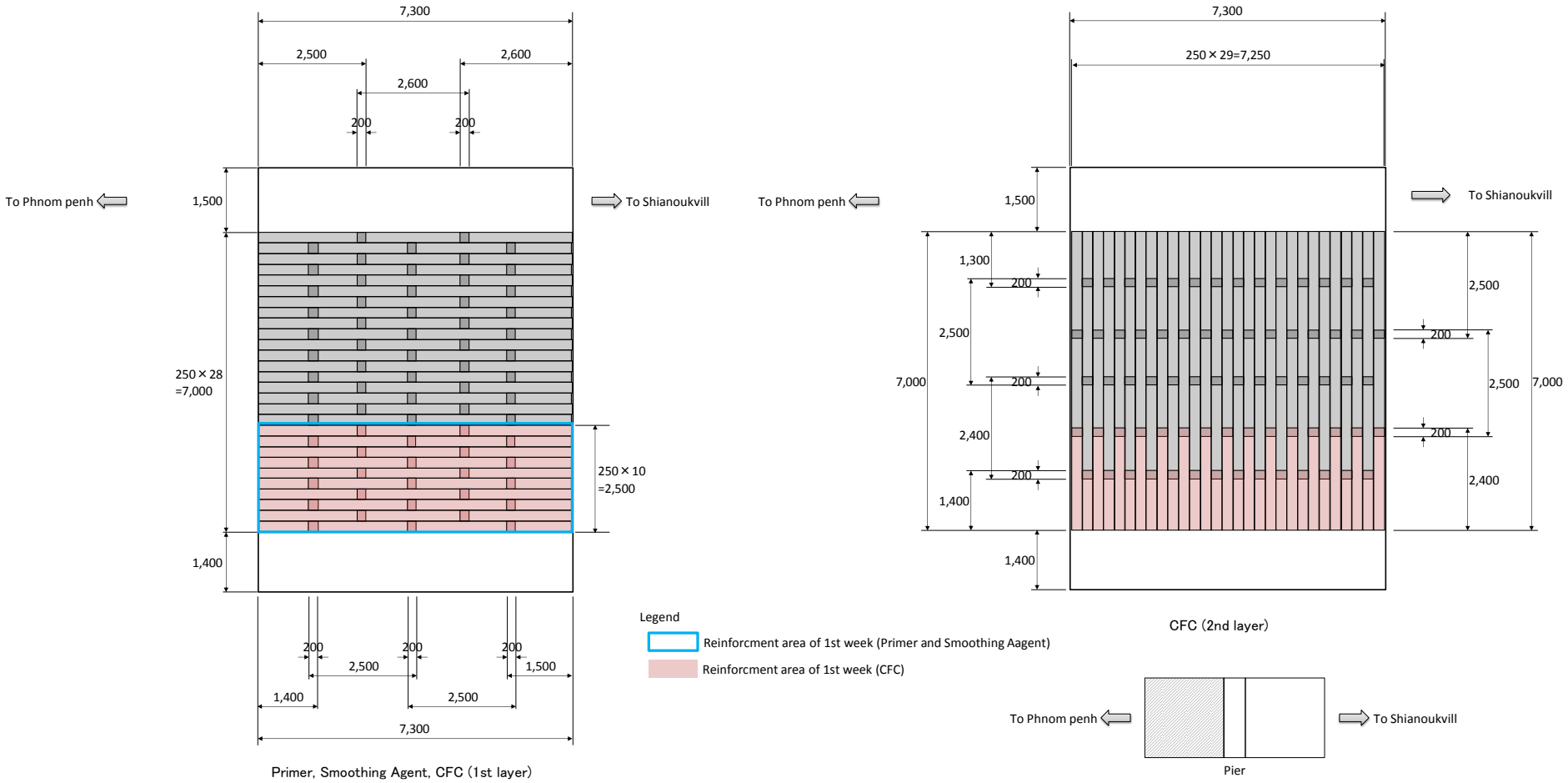


Figure 7-22 CFC Layout (1st week work)

●Material use plan

	Procedure	Area										Ability/day	Quantity of Material
Phnom Penh side Total	Primer	7.3m	×	7.0m					=	51.1m2		0.2kg/m2	Main 7.5kg Hardener 3.7kg (Including Loss 10%)
	Smoothing Agent	7.3m	×	7.0m					=	51.1m2		1.0kg/m2	Main 37.5kg Hardener 18.7kg (Including Loss 10%)
	CFC(1st layer)	7.3m	×	7.0m					=	51.1m2		Resin (1.0kg/m2)	Main 37.5kg Hardener 18.7kg (Including Loss 10%)
												CFC 54.6	1.4m × 14 + 1.5m × 14 + 2.5m × 42 + 2.6m × 28
	CFC(2nd layer)	7.3m	×	7.0m					=	51.1m2		Resin (1.0kg/m2)	Main 37.5kg Hardener 18.7kg (Including Loss 10%)
												CFC 54.35	1.3m × 14 + 1.4m × 14 + 2.4m × 29 + 2.5m × 44
1st week	Primer	7.3m	×	2.5m					=	18.3m2	46m2/day	0.2kg/m2	Main 2.7kg Hardener 1.3kg (Including Loss 10%)
	Smoothing Agent	7.3m	×	2.5m					=	18.3m2	24m2/day	1.0kg/m2	Main 13.4kg Hardener 6.7kg (Including Loss 10%)
	CFC(1st layer)	7.3m	×	2.5m					=	18.3m2	20m2/day	Resin (1.0kg/m2)	Main 13.4kg Hardener 6.7kg (Including Loss 10%)
												CFC 19.5m2	1.4m × 5 + 1.5m × 5 + 2.5m × 15 + 2.6m × 10
	CFC(2nd layer)	(2.4m	×	15	+	1.4m	×	14)	×	0.25m	=	13.9m2	20m2/day	Resin (1.0kg/m2)	Main 10.2kg Hardener 5.1kg (Including Loss 10%)
												CFC 13.9m2	1.4m × 14 + 2.4m × 15
2nd week	Primer	7.3m	×	2.5m					=	18.3m2	46m2/day	0.2kg/m2	Main 2.7kg Hardener 1.3kg (Including Loss 10%)
	Smoothing Agent	7.3m	×	2.5m					=	18.3m2	24m2/day	1.0kg/m2	Main 13.4kg Hardener 6.7kg (Including Loss 10%)
	CFC(1st layer)	7.3m	×	2.5m					=	18.3m2	20m2/day	Resin (1.0kg/m2)	Main 13.4kg Hardener 6.7kg (Including Loss 10%)
												CFC 19.5m2	1.4m × 5 + 1.5m × 5 + 2.5m × 15 + 2.6m × 10
	CFC(2nd layer)	(2.5m	×	15	+	2.4m	×	14)	×	0.25m	=	17.8m2	20m2/day	Resin (1.0kg/m2)	Main 13.0kg Hardener 6.5kg (Including Loss 10%)
												CFC 17.8m2	2.4m × 14 + 2.5m × 15
3rd week	Primer	7.3m	×	2.0m					=	14.6m2	46m2/day	0.2kg/m2	Main 2.1kg Hardener 1.1kg (Including Loss 10%)
	Smoothing Agent	7.3m	×	2.0m					=	14.6m2	24m2/day	1.0kg/m2	Main 10.7kg Hardener 5.4kg (Including Loss 10%)
	CFC(1st layer)	7.3m	×	2.0m					=	14.6m2	20m2/day	Resin (1.0kg/m2)	Main 10.7kg Hardener 5.4kg (Including Loss 10%)
												CFC 15.6m2	1.4m × 4 + 1.5m × 4 + 2.5m × 12 + 2.6m × 8
	CFC(2nd layer)	(3.6m	×	14	+	2.5m	×	15)	×	0.25m	=	22.0m2	20m2/day	Resin (1.0kg/m2)	Main 16.1kg Hardener 8.1kg (Including Loss 10%)
												CFC 22.7m2	1.3m × 14 + 2.5m × 29

CFC Cutting plan

				Remainder	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14	No.15	No.16
1st week	1st layer	1.3m		0																
		1.4m	5	0		5														
		1.5m	5	0	4	1														
		2.4m		0																
		2.5m	15	0	7	8														
		2.6m	10	0	10															
	2nd layer	1.3m		0																
		1.4m	14	0		3	11													
		1.5m		0																
		2.4m	15	0		7	8													
		2.5m		0																
		2.6m		0																
2nd week	1st layer	1.3m		0																
		1.4m	5	0			5													
		1.5m	5	0				1	4											
		2.4m		0																
		2.5m	15	0				12	3											
		2.6m	10	0			3	7												
	2nd layer	1.3m		0																
		1.4m		0																
		1.5m		0																
		2.4m	14	0					14											
		2.5m	15	0					1	14										
		2.6m		0																
3rd week	1st layer	1.3m		0																
		1.4m	4	0							4									
		1.5m	4	0						1	3									
		2.4m		0																
		2.5m	12	0							12									
		2.6m	8	0						5	3									
	2nd layer	1.3m	14	0							1	13								
		1.4m		0																
		1.5m		0																
		2.4m		0																
		2.5m	29	0								13	16							
		2.6m		0																
		Remainder of CFC			0.5m	0.5m	0.6m	0.3m	0.4m	0.5m	0.8m	0.6m	10.0m	50.0m	50.0m	50.0m	50.0m	50.0m	50.0m	50.0m

Figure 7-23 Material use plan (1st - 3rd week work)

●Resin mix plan (1st week)

Loss 5%

Primer

Total Width 7.3m

Width 2.2m	Width 1.7m	Width 1.7m	Width 1.7m
Area 5.5m2	Area 4.3m2	Area 4.3m2	Area 4.3m2
Quantity of Material	Quantity of Material	Quantity of Material	Quantity of Material
Total 1.2kg	Total 0.9kg	Total 0.9kg	Total 0.9kg
Main 0.8kg	Main 0.6kg	Main 0.6kg	Main 0.6kg
Hardener 0.4kg	Hardener 0.3kg	Hardener 0.3kg	Hardener 0.3kg

Hight 2.5m

Standard usage weight 0.2kg/m2
Including Loss 5%

Smoothing Agent

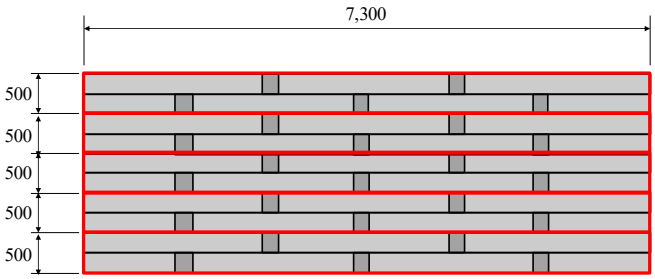
Total Width 7.3m

Width 2.2m	Width 1.7m	Width 1.7m	Width 1.7m
Area 5.5m2	Area 4.3m2	Area 4.3m2	Area 4.3m2
Quantity of Material	Quantity of Material	Quantity of Material	Quantity of Material
Total 5.8kg	Total 4.5kg	Total 4.5kg	Total 4.5kg
Main 4.0kg	Main 3.0kg	Main 3.0kg	Main 3.0kg
Hardener 2.0kg	Hardener 1.5kg	Hardener 1.5kg	Hardener 1.5kg

Hight 2.5m

Standard usage weight 1.0kg/m2
Including Loss 5%

Impregnating Resin (1st Layer)

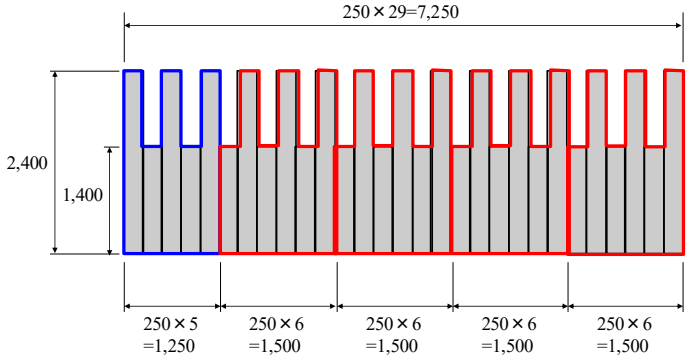


Standard usage weight 1.0kg/m2
Under Application 0.6kg/m2
Over Application 0.4kg/m2
Loss 5%

Each cycle (Total 5 cycle)
Area
7.3m × 0.5m = 3.7m2

Quantity of Material
Under Application
Total 2.3kg
Main 1.6kg
Hardener 0.8kg
Over Application
Total 1.5kg
Main 1.2kg
Hardener 0.6kg

Impregnating Resin (2nd Layer)



Standard usage weight 1.0kg/m2
Under Application 0.6kg/m2
Over Application 0.4kg/m2
Loss 5%

1st - 4th Cycle
Area
(1.4m + 2.4m)
× 3
× 0.25m = 2.9m2

Quantity of Material
Under Application
Total 1.8kg
Main 1.2kg
Hardener 0.6kg
Over Application
Total 1.2kg
Main 0.8kg
Hardener 0.4kg

5th Cycle
Area
(1.4m × 2 +
2.4m × 3)
× 0.25m = 2.5m2

Quantity of Material
Under Application
Total 1.6kg
Main 1.2kg
Hardener 0.6kg
Over Application
Total 1.1kg
Main 0.8kg
Hardener 0.4kg

Figure 7-24 Resin Mixing Plan (1st week work)

Table 7-41 Status of 2nd Pilot Project of BRIDGE Repair (1st day 1/2)

1st day's work (Primer work)	
1 Site meeting	 
2 Site cleaning	 
3 Confirmation of temperature and surface humidity	 
4 Measurement of constructed range	 
5 Surface cleaning	 

Table 7-42 Status of 2nd Pilot Project of BRIDGE Repair (1st day 2/2)

6 Preparation of primer material	 
7 Making of primer	 
8 Applying primer	 
9 End (1st day)	 

Table 7-43 Status of 2nd Pilot Project of BRIDGE Repair (2nd day 1/2)

2nd day's work (Smoothing agent work)	
1 Site meeting	 
2 Site cleaning	 
3 Confirmation of temperature and surface humidity	 
4 Confirmation of primer surface flatness	 
5 Preparation of smoothing agent material	 

Table 7-44 Status of 2nd Pilot Project of BRIDGE Repair (2nd day 2/2)

6 Making of smoothing agent	 
7 Applying smoothing agent	 
8 End (2nd day)	 

Table 7-45 Status of 2nd Pilot Project of BRIDGE Repair (3rd day 1/3)

3rd day's work (1st CFC layer work)	
1 Site meeting	 
2 Site cleaning	 
3 Confirmation of temperature and surface humidity	 
4 Confirmation of smoothing agent surface flatness	   

Table 7-46 Status of 2nd Pilot Project of BRIDGE Repair (3rd day 2/3)

5 Measurement of CFC construction range	 
6 Cutting CFC	 
7 Preparation of impregnating resin material	 
8 Making of impregnating resin material	 
9 Applying 1st impregnating resin	 

Table 7-47 Status of 2nd Pilot Project of BRIDGE Repair (3rd day 3/3)

10 Setting CFC	 
11 Pushing out air bubbles by paddle roller	 
12 Applying 1st impregnating resin (once again)	 
13 Applying 2nd impregnating resin (After 20 min of '12' work)	 
14 End	 

Table 7-48 Status of 2nd Pilot Project of BRIDGE Repair (4th day 1/4)

4th day's work (2nd CFC layer work)	
1 Site meeting	 
2 Site cleaning	 
3 Confirmation of temperature and surface humidity	 
4 Confirmation of pushing out air bubbles	 

Table 7-49 Status of 2nd Pilot Project of BRIDGE Repair (4th day 2/4)

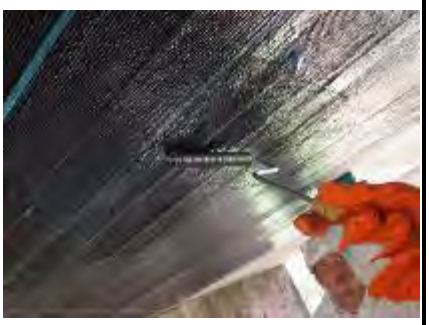
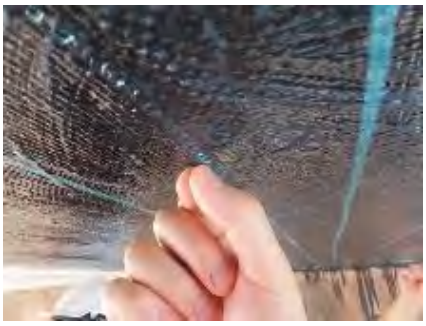
5 Repairing after completely cured impregnating resin (If necessary from 4 work)	   
6 Confirmation of impregnating resin surface flatness	 
7 Measurement of CFC construction range	 
8 Cutting CFC	 

Table 7-50 Status of 2nd Pilot Project of BRIDGE Repair (4th day 3/4)

9 Preparation of impregnating resin material	
10 Making of impregnating resin material	 
11 Applying 1st impregnating resin	 
12 Setting CFC	 
13 Pushing out air bubbles	 

Table 7-51 Status of 2nd Pilot Project of BRIDGE Repair (4th day 4/4)

14 Applying 1st impregnating resin (once again)	 
15 Applying 2nd impregnating resin (After 20 min of '14' work)	 
16 End	 

7.9.3 Repair of Kizuna Bridge

The crack sealing method was employed on the repair of Kizuna bridge which was damaged by traffic accident on 4 March 2016.

(1) Outline of the accident

Date of the accident: 4 March 2016
Road: National Road 7 at Kizuna Bridge

Figure 7-25 Location of the accident

(2) Counterpart members

H.E. Chankosal, H.E. Pen Bran, Phalla, Chamnang, Phibal, Kimsochet
Kompong Cham DPWT, Ko DPWT etc.,

(3) Damage to the bridge

・Railing pole x 3 nos, ・Railing, ・Slab

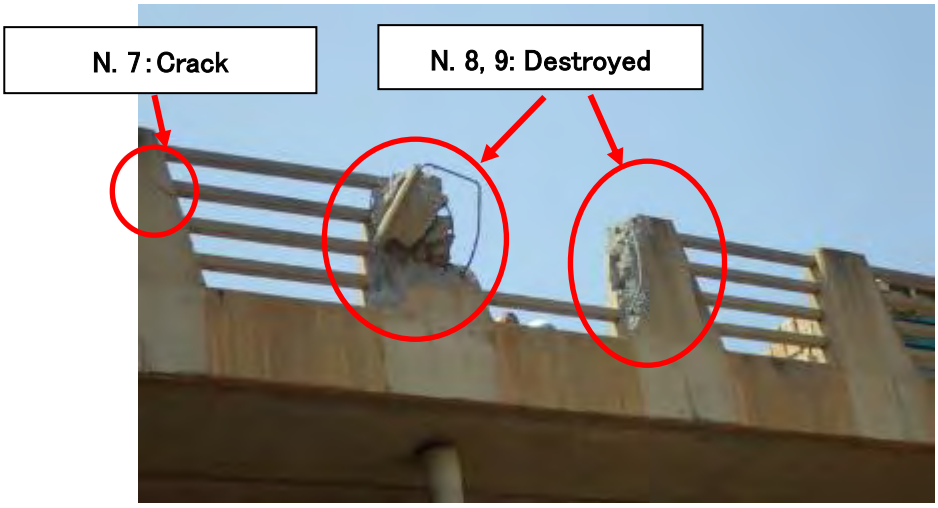




Photo 7-21 Site Photos

(4) Repair Method

After discussion with the MPWT and DPWT, the following decision was made on the method to use for the repair of the damaged part of the bridge:

- Removal of the damaged pole
- Re-casting of concrete after re-arrangement of reinforcement
- Sealing crack of the slab using crack sealing method

(5) Repair and Demonstration of Crack Sealing Method

The bridge was repaired by DPWT Kompong Cham. Crack sealing method was demonstrated by RID engineers inviting neighboring DPWTs.





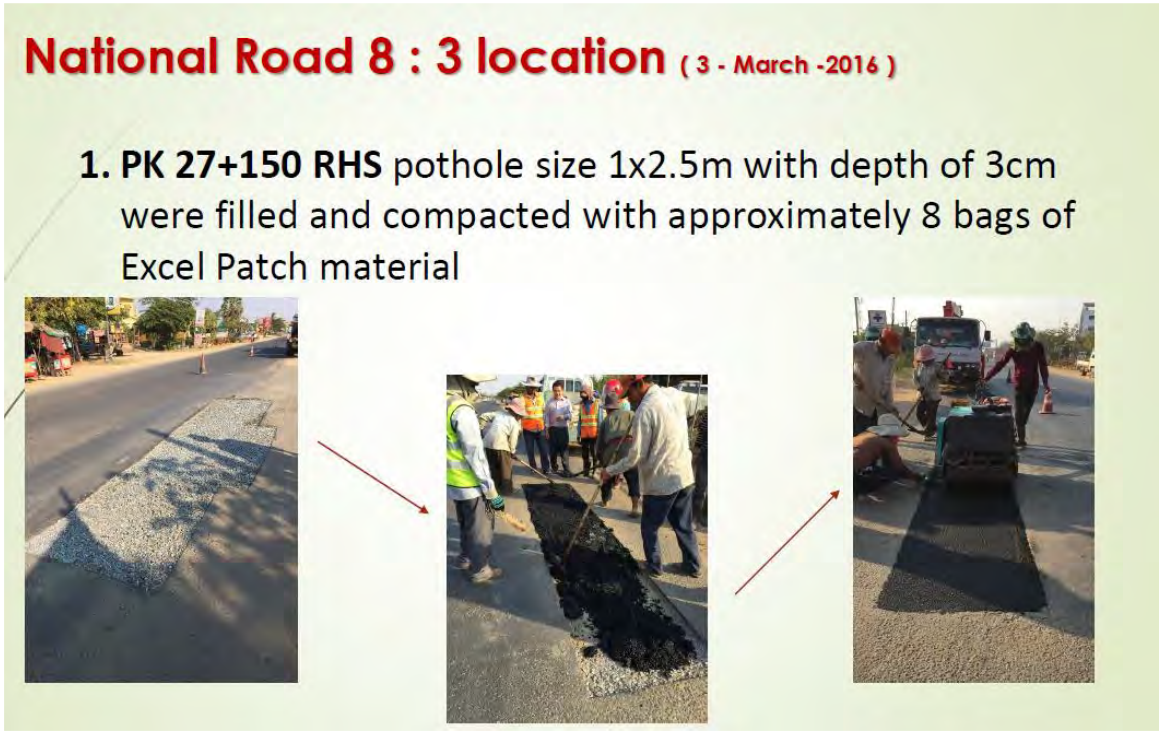

Photo 7-22 Repair of the Damage at Kizuna Bridge and Demonstration of Crack Sealing Method

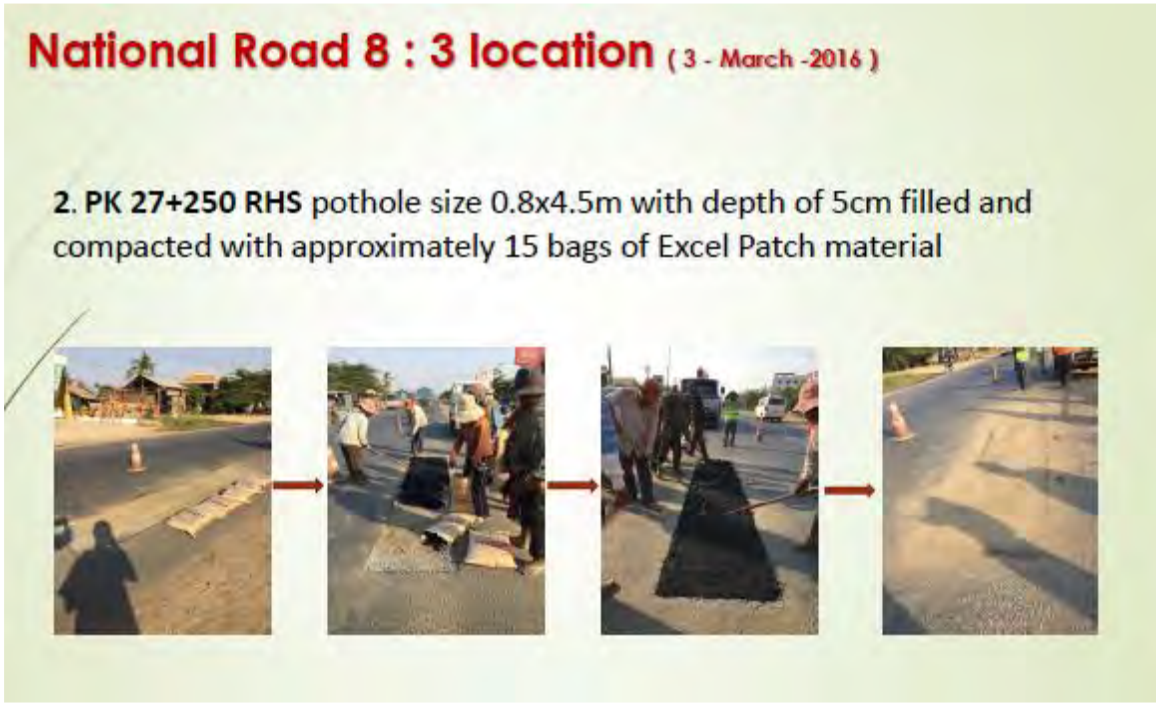
7.10. To Repair the Identified ROADS at the Target DPWTs

7.10.1 1st Pilot Project to Repair Road

The implementation of the pilot project and monitoring report was summarized in the presentation.

(1) NR.8





National Road 8 : 3 location (3 - March -2016)

3 . PK 31+200 RHS pothole size 0.5x10m with depth of 3cm were filled and compacted with 20 bags of Excel Patch material

Inspection The Result NR 8 (07-March-2016 after 1 week repair)

PK 27+150 RHS & PK 27+250 RHS : No settlement were found

Inspection The Result NR 8 (07-March-2016 after 1 week repair)

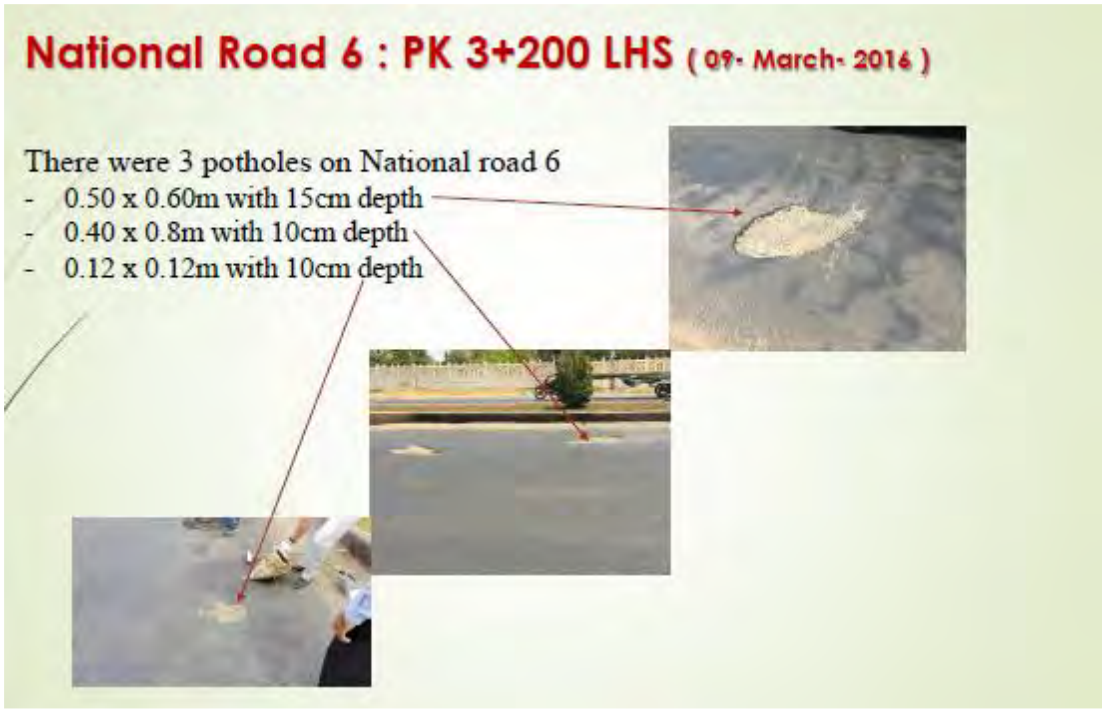
PK 31+200 RHS : Soft Excel Patch material were dragged from the starting point and piled up to the end of repaired area, causing about 5 cm bump to the road surface

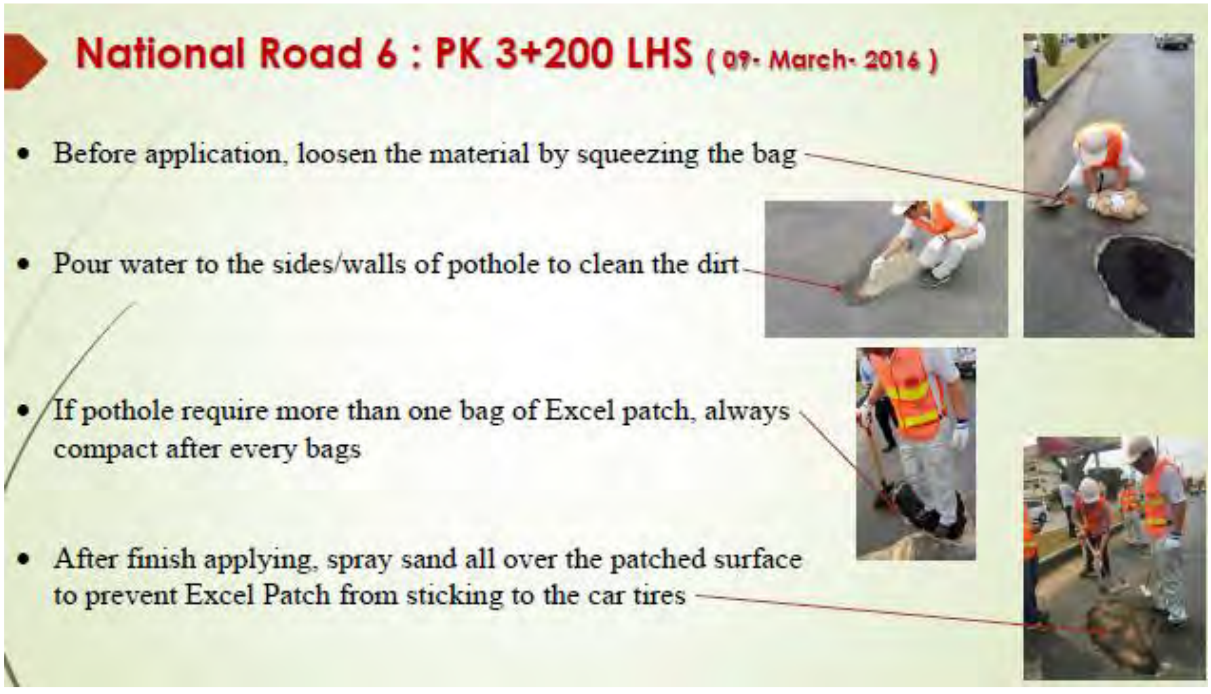
Assumption made by Jica was: after repaired, there were traffic check point located around there for a few days, these caused many heavy vehicles to stop on the repaired surface which eventually lead to dragging of EP and cause the road bump.

18 Bump were cut and scraped off by pick axle to be re-use (09-March-2016)

Excel patch usually take around 2 weeks to 4 weeks to completely harden, this vary depending on the thickness of the excel that were applied

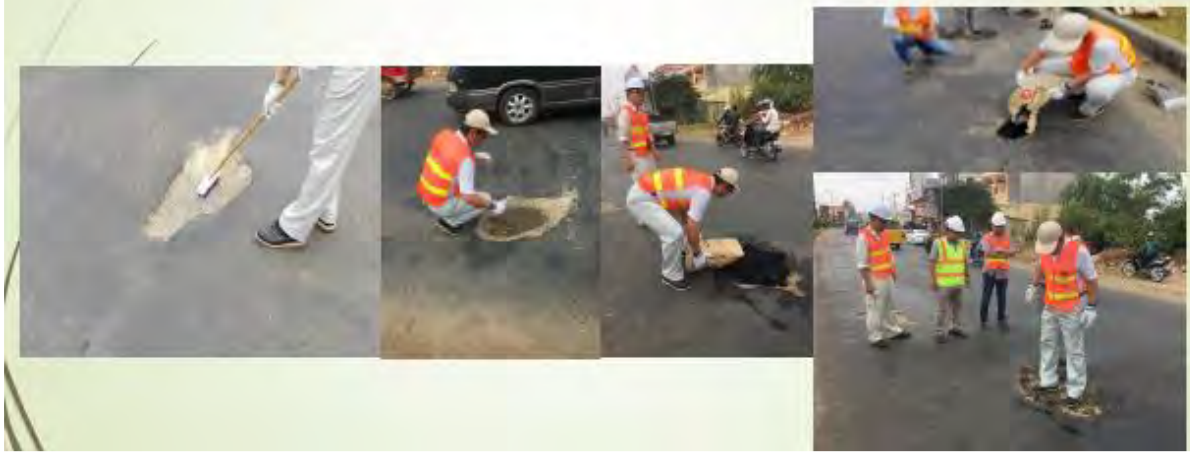
(2) NR.6


National Road 6 : PK 3+200 LHS (09- March- 2016)
There were 3 potholes on National road 6
- 0.50 x 0.60m with 15cm depth
- 0.40 x 0.8m with 10cm depth
- 0.12 x 0.12m with 10cm depth


National Road 6 : PK 3+200 LHS (09- March- 2016)
• Before application, loosen the material by squeezing the bag
• Pour water to the sides/walls of pothole to clean the dirt
• If pothole require more than one bag of Excel patch, always compact after every bags
• After finish applying, spray sand all over the patched surface to prevent Excel Patch from sticking to the car tires

2 National Road 6 : PK 3+200 LHS (09- March- 2016)

- 4.5 bags of Excel patch were used for the 3 potholes



National Road 6 : PK 3+200 LHS (09- March- 2016)

- After allowing drying time of 5-10 minutes, road were resumed to traffic and a few trucks run over the pothole caused a bit of settlement (1-1.5cm)

(3) NR.4

National Road 4 : PK23+500 LHS (11- March- 2016)

Pothole size: **1.8 x 4.5m depth of 5 cm**

- Pothole was already cut by Kandal Dpwt
- In this last pilot project, Jica requested to use different approach by putting on prime coat before applying the excel patch

National Road 4 : PK23+500 LHS (11- March- 2016)

- All excel bags were soften before apply
- Number of bags: **28 bags** of excel patch were used
- Duration: **45 minutes (Start at 10am)**
- Safety practices and measures were implemented by the team
- Road resume to traffic immediately

National Road 4 : PK23+500 LHS (11- March- 2016)




Inspection The Result NR 4 (23-March-2016 after 12 days repair)

The EXCEL Patch is still fixed and No settlement were found


7.11. To Evaluate the Repair Works

7.11.1 Bridge 1st Pilot Project

Follow-up inspection results of the 1st pilot project are shown from Table 7-52 to Table 7-61.

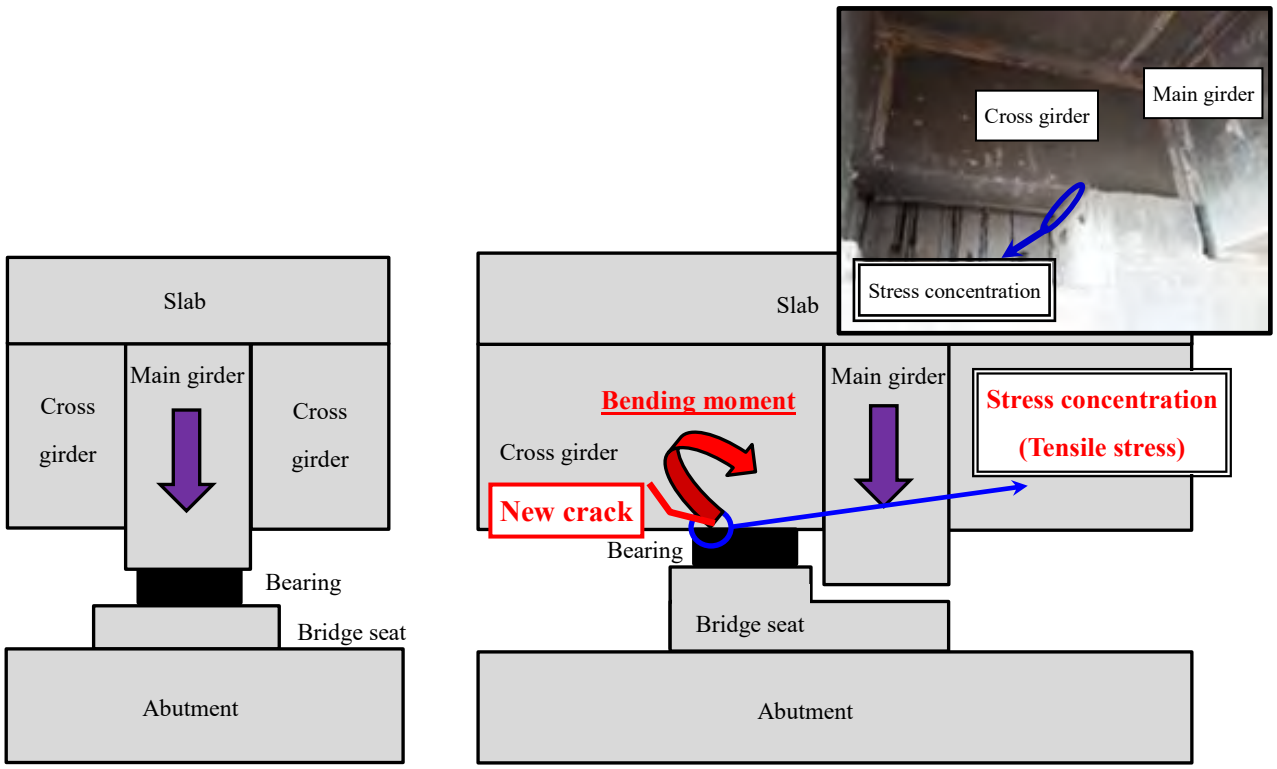
The repair works were still of good quality except for one crack (in May 2016). This crack was found on Prek jrey bridge (Phnom Penh, No. 2, Crack No. 3, No. 4; Table 7-18).

The cause is not 'non-conforming repair work', but is due to:

— The bridge's unique structure: stress concentration occurs around the bearing (Table 7-18).

— Overloading of vehicles

Since the crack is caused due to structural deficiency, there is a possibility that new cracks might occur on other repaired parts in the future.



(a) General bridges **(b) Prek jrey bridge (Phnom Penh, No. 2)**

Figure 7-26 Cause of the New Crack

Table 7-52 Follow-up Inspection of 1st Pilot Project (Phnom Penh, No. 1)

	Crack No. 1	Crack No. 2		
The damage situation (11/2015)			N/A	N/A
The repair situation (02/2016)			N/A	N/A
Immediately after repair (02/2016)			N/A	N/A

Table 7-53 Follow-up Inspection of 1st Pilot Project (Phnom Penh, No. 1)

	Crack No. 1	Crack No. 2		
Follow-up inspection (3 months after) (05/2016)	・It is still of good quality ・(By hammering Test) ・There is no rust, lifting, or any new crack 	・It is still of good quality ・(By hammering Test) ・There is no rust, lifting, or any new crack 	N/A	N/A
Follow-up inspection (7 months after) (09/2016)	・It is still of good quality ・(By hammering Test) ・There is no rust, lifting, or any new crack 	・It is still of good quality ・(By hammering Test) ・There is no rust, lifting, or any new crack 	N/A	N/A

Table 7-54 Follow-up Inspection of 1st Pilot Project (Phnom Penh, No. 2)

	Crack No. 1	Crack No. 2	Crack No. 3	Crack No. 4
The damage situation (11/2015)				
The repair situation (02/2016)				
Immediately after repair (02/2016)				

Table 7-55 Follow-up Inspection of 1st Pilot Project (Phnom Penh, No. 2)

	Crack No. 1	Crack No. 2	Crack No. 3	Crack No. 4
Follow-up inspection (3 months after) (05/2016)	・It is still of good quality ・(By hammering Test) ・There is no rust, lifting, or new crack 	・It is still of good quality ・(By hammering Test) ・There is no rust, lifting, or new crack 	・A new crack occurs due to overloading of vehicles. 	・It is still of good quality ・(By hammering Test) ・There is no rust, lifting or new crack 
Follow-up inspection (7 months after) (09/2016)	・It is still ofgood quality ・(By hammering Test) ・There is no rust, lifting, and new crack 	・It is still of good quality ・(By hammering Test) ・There is no rust, lifting, and new crack 	・Cracks are progressing due to overloading of vehicles. 	・A new crack occurs due to overloading of vehicles. 

Table 7-56 Follow-up Inspection of 1st Pilot Project (Kandal, No. 1)

	Crack
The damage situation (11/2015)	
The repair situation (02/2016)	
Immediately after repair (02/2016)	

Table 7-57 Follow-up Inspection of 1st Pilot Project (Kandal, No. 1)

	Crack
Follow-up inspection (3 months after) (05/2016)	・It is still in good quality (by hammering Test) ・There is no rust, lifting or new crack 
Follow-up inspection (7 months after) (09/2016)	・It is still of good quality. ・There is no rust, lifting or new crack 

Table 7-58 Follow-up Inspection of 1st Pilot Project (Kandal, No. 3)

	Crack
The damage situation (11/2015)	
The repair situation (02/2016)	
Immediately after repair (02/2016)	N/A

Table 7-59 Follow-up Inspection of 1st Pilot Project (Kandal, No. 3)

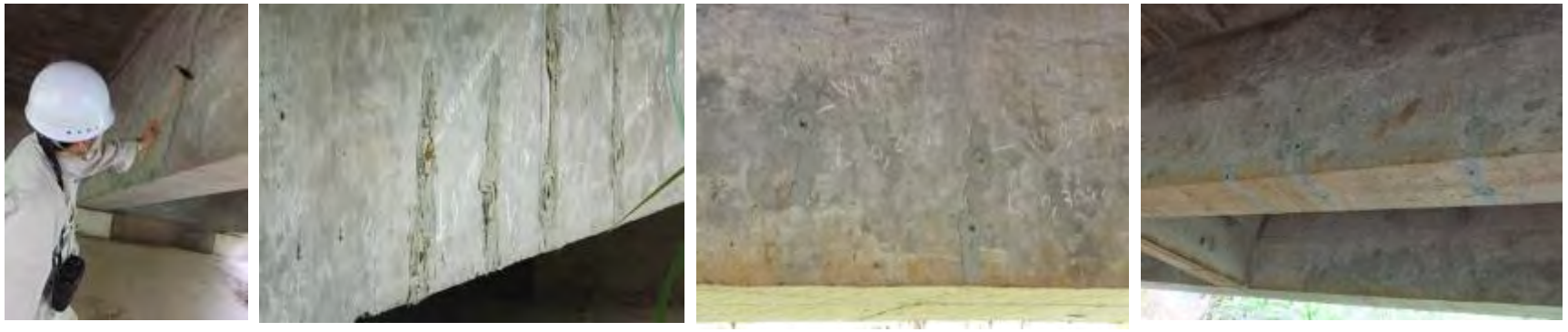
	Crack
Follow-up inspection (3 months after) (05/2016)	・It is still of good quality (By hammering Test) ・There is no rust, lifting, or new crack 
Follow-up inspection (7 months after) (09/2016)	・It is still of good quality (By hammering Test) ・There is no rust, lifting, or new crack 

Table 7-60 Follow-up Inspection of 1st Pilot Project (Kandal, No. 4)

	Crack
The damage situation (11/2015)	   
The repair situation (02/2016)	   
Immediately after repair (02/2016)	 

Table 7-61 Follow-up Inspection of 1st Pilot Project (Kandal, No. 4)

	Crack
Follow-up inspection (3 months after) (05/2016)	・It is still of good quality (By hammering Test) ・There is no rust, lifting, or new crack   
Follow-up inspection (7 months after) (09/2016)	・It is still of good quality (By hammering Test) ・There is no rust, lifting, or new crack   

7.11.2 Bridge 2nd Pilot Project

Follow-up inspection of the 2nd pilot project is shown from Table 7-62.
It is still of good quality.

Table 7-62 Follow-up Inspection of 2nd Pilot Project

	Situation
The damage situation (06/2016)	 
The repair situation (Crack repair method by Epoxy Resin) (12/2016)	 
The repair situation (CFC reinforcement work) (01/2017)	 
Follow-up inspection (5 months after) (06/2017)	・It is still of good quality (Floating and peeling of CFC was not confirmed)  

7.12. To Revise the Road and Bridge Repair Manual Incorporating Lessons Learned from the above Activities by Organizing Review Workshop

7.12.1 ME Training on Bridge Repair Manual

Workshops on bridge repair manual were held in order to deepen the understanding of the newly-introduced repair method and knowledge of safety repair work in this project. All the workshops and the seminars held were described in Chapter 5.4.

The Bridge Repair Manual (Draft 1) was launched in 2016. A Maintenance Expert (ME) system has also been introduced for the improvement of bridge maintenance management capacities of MPWT/DPWT officials. Table 7-63 below shows the details of the training program.

Table 7-63 Maintenance Expert Training Program for Bridge Repair

Lecture Activities	Reference of Manual
1 Introduction	Chapter 1
2 Organization for Bridge Repair	Chapter 2
3 For Keeping Safety (Work Safety)	Chapter 3
4 Routine maintenance	Chapter 3
5 Maintenance Room	Chapter 4
6 Basic Knowledge of Concrete	Chapter 4
7 Concrete structure Repair	Chapter 5
8 Steel structure Repair	Chapter 6

The bridge repair training program was implemented on 16 September, 2016 by 5 RID officials:

1) Mr. Nin Menakak; 2) Mr. Eam Sovisoth; 3) Mr. Long Davuth; 4) Mr. Dvong Chhomratanak; 5) Mr. Chhouk Sochea and one official from RID: Nuth Sovanneth on 10 June, 2017 successfully passed the test.

Photo 7-23 Bridge Maintenance Expert Training

7.12.2 ME Training on Road Repair Guideline

Workshops on bridge repair manual were held in order to deepen the newly-introduced repair method and knowledge on repair work safety in this project.

Guideline for Repairing of Road Defects (Draft 1) was launched in 2016. A Maintenance Expert (ME) system has been introduced for the improvement of bridge maintenance management capacities of MPWT/DPWT officials. Table 7-64 below shows details of the training program.

Table 7-64 Maintenance Expert Training Program for Road Repair

Contents	Key Concepts
CHAPTER 1 Introduction and Outline of the Guideline	•Importance of Maintenance
	•Effect of Road Roughness on Vehicle Operation Cost
	•Purpose of Guideline for Repair of Road Defect
CHAPTER 2 Presentation of Job Codes Examination	•Explanation of major job codes
	•Writing test

The bridge repair training program was implemented on 16 June, 2016 and three (3) RID officials: 1) Mr. You Dara; 2) Mr. Sithy Panhavuth; and 3) Mr. Hay Chandara successfully passed the test.

7.12.3 Holding Workshops for Bridge Repair

The workshop for 'Bridge Repair Manual' and 'Bridge Repair pilot projects' was held in order to deepen the understanding of the newly-introduced repair method and knowledge of repair work safety in this project (see Table 7-65).

The workshops were held in 5 provinces. The target organizations are not only the 25 DPWTs but also the EMB, HEC, RMC, SPIED and PWRC. The lectures were selected from the ME trainers on Bridge Repair (Refer to 7.12.1)

The 'Bridge Repair Method of the pilot project' was finalized through the review process by the MPWT.

Table 7-65 The workshop for BRIDGE repair pilot project

No.	Province and another organization	No. of DPWTs	Venue	Date
1	Koh Kong, Preah Sihanouk Ville, Kampong Speu, Phnom Penh, Kandal, Takeo, Kompot, Kep, EMB, HEC, RMC, SPIED, PWRC	8 (13)	Phom Phen	June 9, 2017
2	Pursat, Battambang, Pailin Kampong Chhnang	4	Pursat	June 12, 2017
3	Kratie, Rattanak Kiri, Stung Treng Mondul Kiri	4	Kratie	June 13, 2017
4	Kampong Cham, Kampong Thom Tboung Khmum, Prey Veng, Svay Rieng	5	Kampong Cham	June 14, 2017
5	Siem Reap, Oddar Meanchey Banteay Meanchey, Preah Vihear	4	Siem Reap	June 15, 2017

Chapter 8. Output 4: Road and Bridge Maintenance Cycle is Introduced to Other DPWTs and Related Agencies

8.1. To organize seminars for other DPWTs – trainings on road and bridge inspection

(1) Kickoff Seminar

The kickoff seminar was held on 22 May 2015 with participants invited from MPWT, 5 DPWT, MEF, WB, ADB, JICA, EOJ.

(2) SIP Seminar

The SIP* seminar with focus on concrete bridge maintenance was held between 1-2 March, 2016.

The seminar was co-hosted by MPWT, ITC (Institute of Technology of Cambodia), JICA, and JCI (Japan Concrete Institute). A larger percentage of bridges (more than 75%) in Cambodia are made by concrete. There is a demand in Cambodia for technology on maintenance and repair of concrete bridges. Concrete bridge maintenance was the topic for the first day of the seminar, whereas the second day the participants covered the introduction to bridge inspection by use of equipment from Japan. More than 300 people attended the seminar which yielded a productive and active exchange of opinions and ideas.

*SIP stands for Cross-ministerial Strategic Innovation Promotion Program, which is steered by the Cabinet Office, Government of Japan.

Venue (Conference hall at ITC)

Demonstration of bridge inspection tools in Japan

Question and Answer

8.2. To organize seminars for other DPWTs – trainings on road and bridge repair

The seminars and trainings involving the DPWTs is summarized in Table 8-1 below.

Table 8-1 List of Seminars involved DPWTs

No	Date	Title	Organization	Participants
1	22 May 2015	Kick off Seminar	MPWT, 5 DPWT, MWF, WB, ADB, JICA, EOJ	49
2	May 2015 to May 2016	2000 bridge inspection	RID, All DPWTs	300
3	14 December 2016	Road Repair Guideline Workshop(1)	Kandal, Takeo,Kampong Speu,Kampot, Kep, Preah Sihanouk, Koh Kong	24
4	16 December 2016	Road Repair Guideline Workshop(2)	Kratie, Stund Treng,Mondolkiri, Ratanakiri	14
5	19 December 2016	Road Repair Guideline Workshop(3)	Battambang, Pursat,Kompong Chhnang, Palin	13
6	20 December 2016	Road Repair Guideline Workshop(4)	Banteay Meanchey, Siem Reap, Preah Vihear, Oddar Meanchey	17
7	21 December 2016	Road Repair Guideline Workshop(5)	Kompong Cham, Prey Veng, Svay Rieng, Tbaug Khmum, Kampong Thom	13
8	19 May 2017	Bridge Inspection Workshop in Siem Reap	Siem Reap	4
9	22 May 2017	Bridge Inspection Workshop in Pursat	Pursat	4
10	23 May 2017	Bridge Inspection Workshop in Sihanouk Ville	Sihanouk Ville	5
11	From 9 June to 15 June 2017	Bridge Repair ME Training	ALL DPWTs	83
12	2 August to 4 August 2017	Bridge ME (Inspection) 1st batch	RID, HEC,RMC, SPIED Phnom Penh, Kandal, Takeo, Kampong Spueu, Prey Veng, Svay Rieng, Kampong Cham	20
13	8 August to 10 August 2017	Bridge ME (Inspection) 2nd batch	Kratie, Stueng Traeng, Mondol Kiri, Rotanak Kiri, Tboung Khmum	18
14	11 October to 13 October 2017	Bridge ME (Inspection) 3rd batch	Pursat, Kampong Chhnang, Pailin, Battambong	18
15	18 October to 20 October 2017	Bridge ME (Inspection) 4th batch	Siem Reap, Banteay Meanchey, Otdar Meanchey,Preah Vihear, Kompong Thom	25
16	13 December to 15 December 2017	Bridge ME (Inspection) 5th batch	Preah Sihanouk, Kampot, Kaoh Kong, Kep	
17	20 December 2017	Final Seminar (Bridge Inspection)	ALL DPWTs	96

8.3. To organize the project final seminar

(1) Purposes of the Final Seminar

1) To share the current bridge condition resulting from the TCP project
2) To conclude the project outcomes and exchange opinions towards overall goals

(2) Seminar Date

December 20, 2017 (Wednesday)

(3) Venue

Sunway Hotel

(4) Invited participants

JCC members (10)
RID (15)
Representatives from DPWTs (50) 2 person / DPWT
Representatives from Institute de Technologie du Cambodia (3)
Nominated Professor for keynote lecture from Japan (2)
JICA Cambodia (2)
Other JICA Projects (3)
EOJ (1)
JICA Project Team (7)
ADB Project (2)
Approximate total 100 (Actual 96)

(5) Program

See next page.

Date: 20 December 2017

Venue: Sunway Hotel

PART 1: FINAL BRIDGE INSPECTION SEMINAR

Topics	Schedule	Presenter
Opening Remark	9:00～9:10AM	Mr. Chhim Phhala Director RID
Report of Bridge Inspection Workshop	9:40～10:00AM	Eam Sovisoth Master Trainer(RID)
Keynote Lecture 1 *What's required of a bridge maintenance engineer in Cambodia.*	10:00～10:30AM	Prof. Vong Seng (Institute of Technology in Cambodia)
Coffee Break	10:30～10:50AM	
Keynote Lecture 2 *CFRP Repair and Reinforcing Technology for Infrastructure*	10:50～11:20AM	Mr. Takahiro Matsui （Toray）
Summary of Cambodian Bridge Inspection Results *Reporting summary of 2,000 bridge survey and 173 bridge inspection, Representative defect, critical defect, serious defect*	11:20-11:40AM	Nin Menakak Master Trainer (RID)
Report from DPWTs *Report on bridge inspection by 2 DPWTs*	11:40-12:00AM	Pursat DPWT Preah Vihear DPWT Sihanouk Ville DPWT

With consecutive interpretation English/Khmer

Lunch Break

PART 2: FINAL PROJECT SEMINAR

No	Topics	Schedule	Presenter
	Announcement	13:00	
1	**Keynote Lecture 1:** Fascination of High Quality Steel Bridges	13:00-13:20PM	Dr. Susumu INOKUCHI Yokogawa Bridge Holdings Corp.
2	**Keynote Lecture 2:** Current Status of Infrastructure in Japan and Utilization of Database for Maintenance	13:20 -14:00PM	Dr. Kohei NAGAI Tokyo University
	Coffee Break	14:00 -14:30PM	
3	**Official Opening Remark**	14:30-14:40PM	H.E. TAUCH Chankosal State Secretary
4	**Project Results**	14:40-15:40PM	Mr. You Dara Deputy Director RID
5	**Keynote Lecture 3 :** Road and Bridge Maintenance Policy in Cambodia	15:40-16:00PM	Mr. Chim Phhala Director RID
6	**Recommendation/Discussion**	16:00-16:20PM	Open
7	**Closing Remark**	16:20-16:30PM	JICA Representative

With consecutive interpretation English/Khmer

8.4. Maintenance Expert Program (non-numbered activity)

This output is to expand road and bridge maintenance cycle widely to DPWT and other related agencies. In order to ensure such expansion, first of all, sustainability of the training on road and bridge inspection should be enforced. For that reason, ME (Maintenance Expert) training was proposed. Training plan and training materials were developed. The Master Trainers were trained by the JICA experts team.

8.4.1 Background

- According to 2,000 Bridge Inspection results, 5% of the bridges are considered as SD Bridge (Seriously Damaged Bridges). Most of SD Bridges are either wooden and Bailey or very poor old RC bridges. The bridges still maintain important links especially in the localities. Apart from the SD bridges, the bridges are relatively in fair or good condition. However, regular inspections are important in order to identify damages at an early stage to reduce maintenance cost in long run.
- Bridge maintenance works including inspection are still very low because of the limited number of experts in the ministry. Another contributing factor is the lack of a standard methodology (guideline). It is very important to increase the number of bridge maintenance experts.
- The Bridge Maintenance Expert Program is a training and certification mechanism. By setting such a program within the ministry, it is expected to create a better understanding of the MPWT's efforts towards bridge maintenance to the Ministry of Finance as well as to the public.
- In the near future, maintenance of mega-bridges is to be a critical social issue in Cambodia. This program may be expanded to such bridges in case they require a specific technological approach.

8.4.2 Role of Maintenance Expert (ME)

The roles of the ME are:

a Planning Support: Bridge inspection, preparation of maintenance plan, Database management
b Emergency Support: Providing technical support during emergencies
c Local Support: Providing technical support to DPWTs.

8.4.3 Technical Support by the Project

The manuals and the training plan used in the Project will be templates for the ME Program.

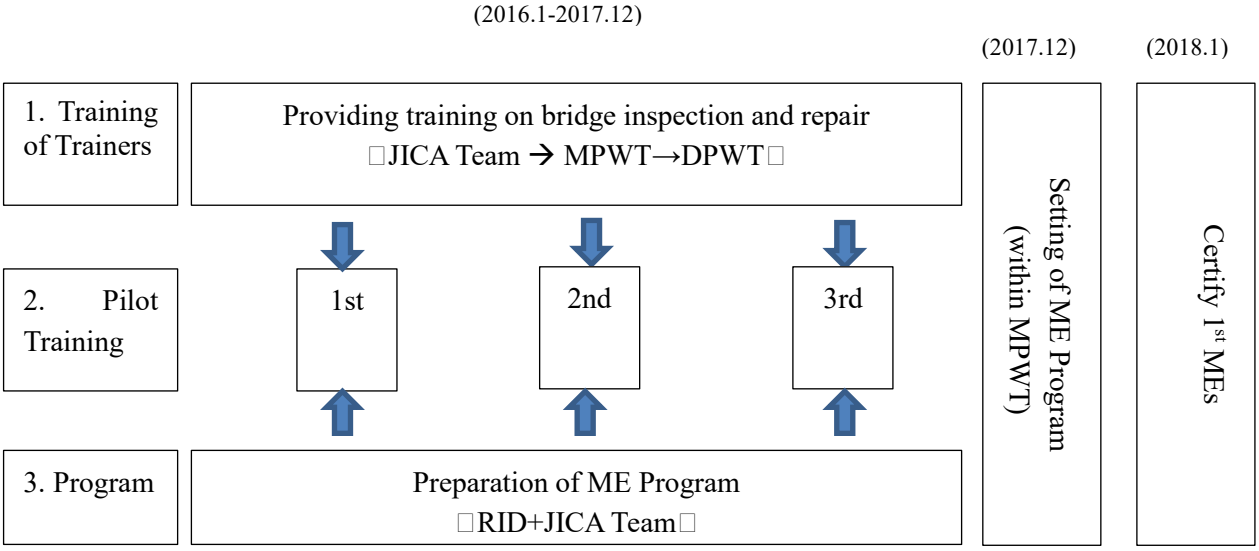


Figure 8-1 Maintenance Expert Program Development Scheme

8.4.4 ME's structure

The ME team is headed by the RID director. The MEs national government level and local government level coordinate to conduct inspection works.

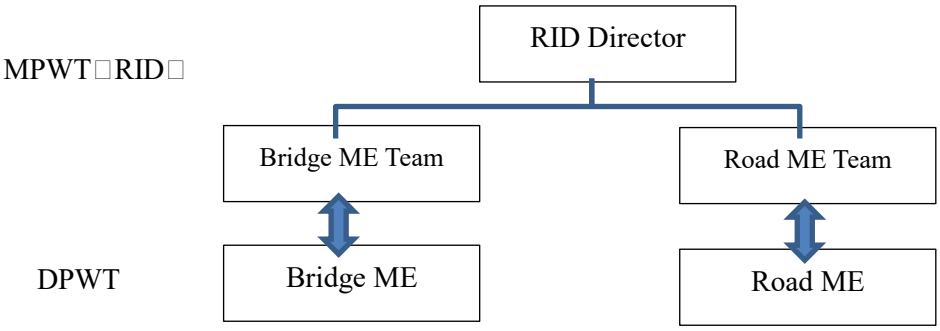


Figure 8-2 ME Structure

8.4.5 Training Method

The first training targets are the Master Trainers from the RID. The RID ME team will subsequently train the staff from the DPWT level.

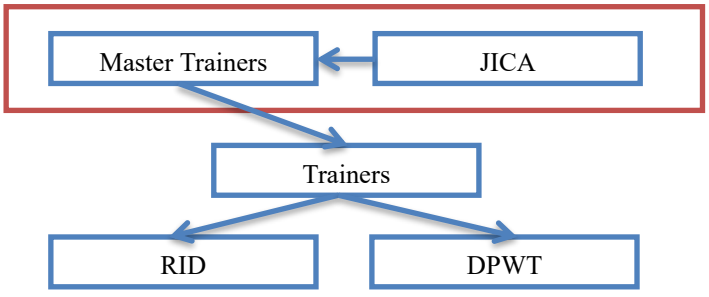


Figure 8-3 ME Training Procedure

8.4.6 Training Material

The Training Material developed for ME is used for training. A PPT presentation has been prepared into one book explaining the contents to the lecturers.

Table 8-2 Maintenance Experts Category and Training Material

ME	Bridge ME		Road ME		
Code	BI (Bridge Inspection)	BR (Bridge Repair)	RI (Road Inspection)	RR (Road Repair)	
Subject of ME	Bridge Inspection	Bridge Repair	Road Inspection	Road Repair	
Competences	Bridge inspection Bridge database	Standard bridge repair	DRIMS Visual inspection	Standard road repair	
Manual and Guideline to be used for training	Bridge Inspection Manual	Bridge Repair Manual	Guidelines for Routine Maintenance Using IRI	Guidelines for Repairing Road Defects	

8.4.7 Achievement of ME Training

The achievements of ME training is shown in Table 8-3 below.

Table 8-3 Achievements of ME Training

No	Date	Title	Organization	Participants
1	From 6 to 8 June 10 June, 2016	Road Maintenance Master Trainer Expert Training (DRIMS and Inspection)	RID	2
2	From 13 to 15 June 2016	Bridge Maintenance Master Trainer Expert Training (Inspection)	RID	4
3	16 June 2016	Road Maintenance Master Trainer Expert Training（Repair）	RID	3
4	16 September 2016	Bridge Maintenance Master Trainer Expert Training （Repair）	RID	5
5	From 17 Oct to 19 Oct. 2016	2nd Bridge Maintenance Master Trainer Expert Training	RID, Takeo DPWT	13
6	From 9 June to 15 June 2017	Bridge Repair ME Training	RID MT ALL DPWT	83
7	26 June 2017	Road Maintenance ME (Repair)	RID MT DPWT	11
8	2 August to 4 August 2017	Bridge ME (Inspection) 1st batch	RID MT, HEC,RMC, SPIED Phnom Penh, Kandal, Takeo, Kampong Spueu, Prey Veng, Svay Rieng, Kampong Cham	20
9	8 August to 10 August 2017	Bridge ME (Inspection) 2nd batch	RID MT Kratie, Stueng Traeng, Mondol Kiri, Rotanak Kiri, Tboung Khmum	18
10	11 October to 13 October 2017	Bridge ME (Inspection) 3rd batch	RID MT Pursat, Kampong Chhnang, Pailin, Battambong	18
11	18 October to 20 October 2017	Bridge ME (Inspection) 4th batch	RID MT Siem Reap, Banteay Meanchey, Otdar Meanchey,Preah Vihear, Kompong Thom	25

No	Date	Title	Organization	Participants
12	13 December to 15 December 2017	Bridge ME (Inspection) 5th batch	RID MT Preah Sihanouk, Kampot, Kaoh Kong, Kep	
13	20 December 2017	Final Seminar (Bridge Inspection)	RID MT and ALL DPWTs	96

8.5. Framework for Ministry and Academic Corporation

A ccorporative framework between the MPWT and the academia is proposed in order to provide a continuous utilization of the bridge maintenance database.

The project team shall provide support on inspection techniques and system development to build a basic framework. Academic institutions such as TIC (Technical Institute of Cambodia) can partner with MPWT to conduct research and improve the system.

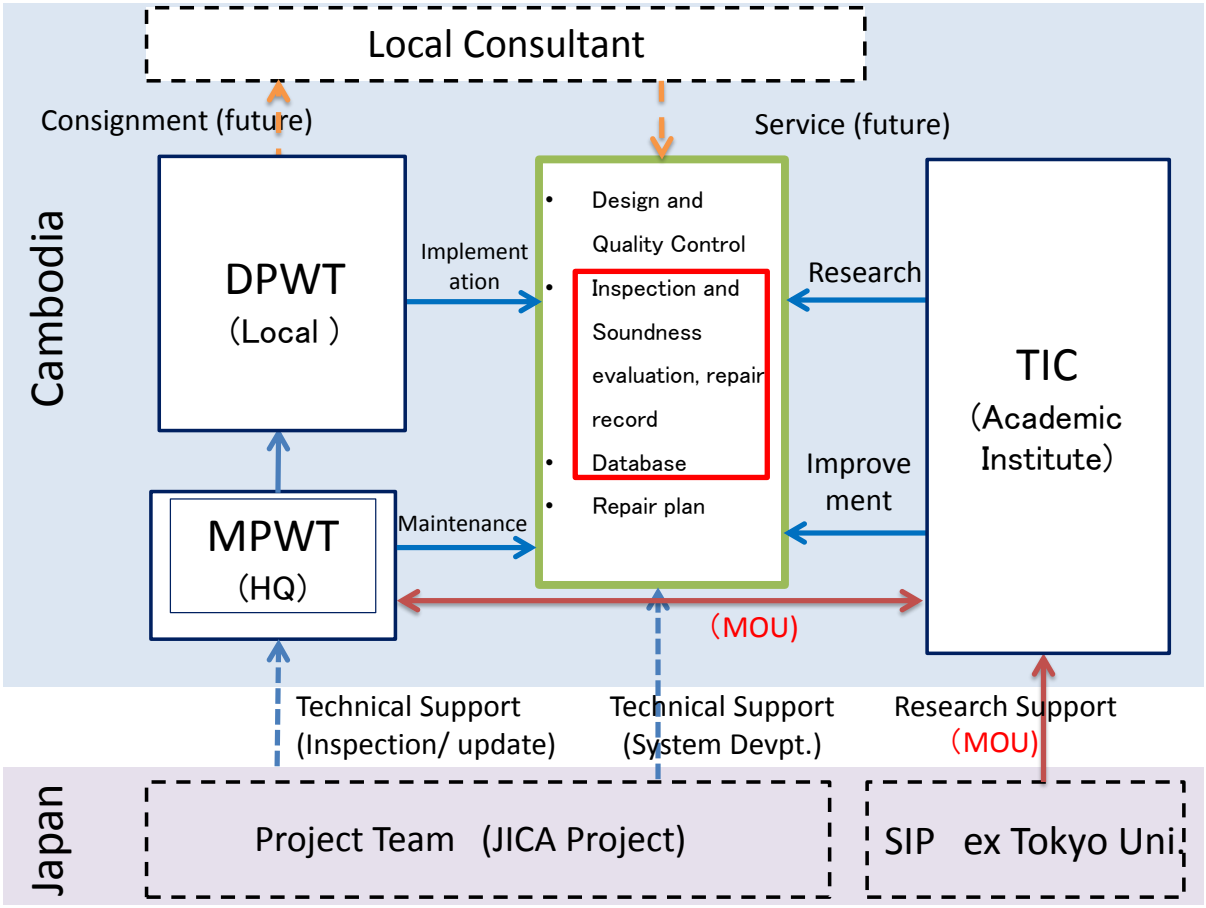


Figure 8-4 Inter-Ministerial and Academic Entity Framework

8.6. Document Management System (Electronic Library to support maintenance works)

8.6.1 Background

In order to support implementation of the maintenance cycle for roads and bridges, RID has installed two (2) databases (roads and bridges) to use as electrical (electronic) library to store document related to design, construction and maintenance in a single portal site. It is advisable that RID examine past maintenance work reports for planning. However, documents such as design reports, inspection reports, design drawing, As-built drawings, etc., of roads and bridges projects have not been shared appropriately within the ministry after the handover from the Project Management Unit (PMU), in-charge of the construction project. In order to improve document management, during the reorganization of the MPWT in 2016, RID was given the responsibility to collect the roads and bridges maintenance documents. However, the documents are not sufficiently managed as of May 2017.

On the other hand, the library database at the Public Works and Transport Technical Department (PWTTD) through JICA's technical cooperation implemented around 2010 has been developed and available within the PWTTD network. However, PWTTD has not conducted periodic updates of the databases and linked to other departments. This has been caused by the reorganization at MPWT, the movement of library space, the expansion of the scale of construction projects and the complicated management system at MPWT.

This activity has been conducted in order to improve supervision efficiency of maintenance works by upgrading the database system, clarification of roles of each related department at MPWT and RID to be able to collect relevant documents and update documents in the library.

8.6.2 Current Condition of Document Management at the MPWT

(1) Responsibility in document management

The Office of Planning and Road Technique at the RID is in charge of document management given by Prakas. Table 8-4 below details the responsibilities.

Table 8-4 Responsibilities

Collect Document and Information	Responsible offices at RID	Related Departments
1. Roads Database (Inventory Data, Inspection Results, Maintenance Records)	Planning and Road Technique Office	
2. Bridges Database (Inventory Data, Inspection Results, Maintenance Records)	Planning and Road Technique Office	
3. Completion Documents of Past Projects by National Budget (As-built drawing, Final report, Maintenance Report)	Planning and Road Technique Office	PWTTD (Library), DPWT
4. Completion Documents of Past Projects by Donor Fund (As-built drawing, Final report, Maintenance Report)	Planning and Road Technique Office	PWTTD(Library), PMU
5. Standard Drawing	Road Construction and Repair Office	PWTTD(Library)
6. Improvement Project Plan by National Budget, Donor Fund)	Planning and Road Technique Office	Other Department, DPWT, PMU
7. Improvement Project Plan by Donor Fund	Planning and Road Technique Office	PMU
8. Traffic Data	Road Inventory and Ferry Terminals Office	Other Department
9. Inventory List of Construction Machinery	Planning and Road Technique Office	PWTTD, DPWT

(2) Existing system

The JICA Technical Cooperation Project "The Strengthening of Construction Quality Control" supported the initiative to improve document management for Public Works Research Center (currently Public Works and Transport Technical Department: PWTTD). A document library and a library management database were prepared in this project.

In this database, related document from year 2000 to 2010 were collected and encoded among them 1,000 files such PDF and JPEG are related to road and bridges.

(3) Required improvements

The following improvements were required in order for RID to be able to use for their work.

1) Network link with PWTTD
2) Upgrade of software to adopt Khmer font and latest windows
3) Improve operability
4) Update of document

8.6.3 Development of Document Management System

With reference to the PWTTD's library database, documents should be managed and collected by RID. Table 8-5 below details the RID officials in charge. In order to collect these documents, the General Department of Technique, has sent out request letters for cooperation to other department under it.

Based on the following procedure (see Figure 8-5: Flowchart of Document Collection), RID officers will collect the documents of completed projects in electronic data or hard copy through the cooperation from other departments (the hard copy should be converted to electronic data, either PDF or JPEG Formats) and returned to the department in charge). Documents concerning construction drawings, budget disbursement were collected and stored in the database.

Table 8-5 Type of Documents

Project Document	Study Report, Detail Design, Tender/Contract Documents, Completion Report, Drawing (Tendering), Drawing (As built), Others
Specifications, Standards	National Specifications, Standards and so on
Guidelines	Guidelines, Internal Regulation and so on
Technical Documents	Construction Technical Documents and so on
Others (Administration Documents)	Law, Regulations, Policy Paper and so on

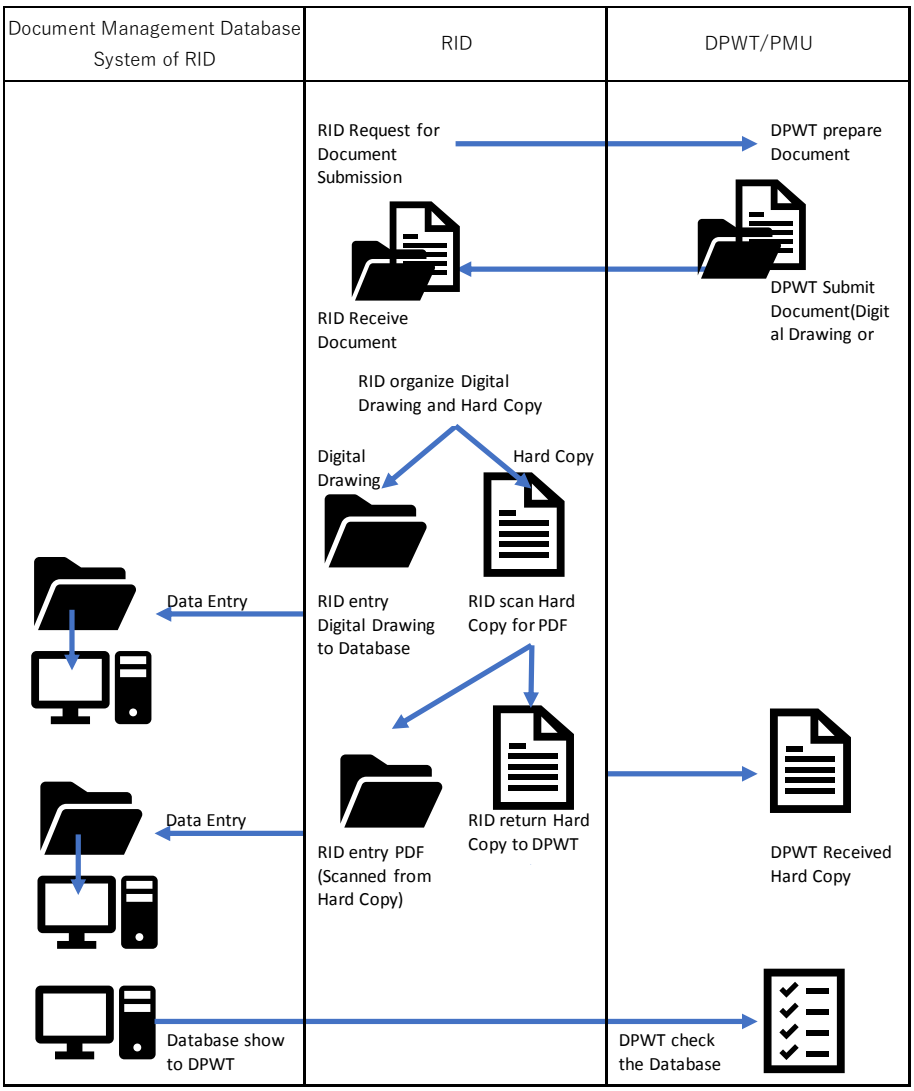


Figure 8-5 Flowchart of Document Collection

8.6.4 Database Development

Reference to the library database managed by PWTTD, the RID officers are in charge of document management as discussed and agreed with other departments. The officers shall conduct the database development using highly versatile OSS (Open Source Software, MySQL, PHP).

Since RID has a plan to replace the data server in the year 2018, the database was developed taking into consideration compatibility with both old and new servers. Documents that were obtained through the above collection procedure helped with the preparation of the guideline for document management database. The database simplifies the search for As-built Drawings bridges and roads. This document management database is currently used by the RID. However, the upgrade of the database is expected so that DPWT can have access in the future.

The database administration setting has four (4) levels: 1) Database Administration; 2) Data Management; 3) Data Entry; and, 4) User. Table 8-6 below shows the detailed descriptions. DB Administrators and Data Managers require practical training in order to understand the framework and database instructions. The RID director should appoint a trained official with sufficient level

of understanding as the administrator. In addition, manuals have been prepared for each administrator. This will enable the Database Administrator to offer to other database users.

Table 8-6 Administration Setting

Level	User/Administration Authority	Requirement
Database Administrator (Database System Administration Manual)	・Modify Database Specification ・User Registration ・Modify Administration Authority of All Users ・Analyze Database Log (Log in and out) ・Including the authorities of Data Management	・Instruction from IT Developer ・Understand the whole database Framework ・Understand Explosion of the database to the Public
Data Management (Data Management Manual)	・Modify Data Entry Format ・Categorize the Documents ・Delete Document Data from the Database ・Including Data Entry authorization	・Instruction from Database administrator ・Understand Basic database framework ・Understand Document Categories
Data Entry (Data Entry Manual)	・Entry New Document Data ・Modify Document Data ・Including the function of User	・Instruction from Database Administrator or Data Manager ・Understanding of database function ・Understanding of Data Entry Flow
User (Catalog Search Manual)	・Browse Document Data ・Download Document Data	・Follow User Manual

8.6.5 Recommendations

1) Large bridges projects are normally managed by the PMU. It is important to establish a mechanism whereby departments in charge of construction projects shall submit necessary documents to RID after handover.

2) It is necessary to give a clear official mandate to selected officers from RID in charge of library management.

3) It is necessary to consider the inclusion this database to the new database system planned by MPWT in the future.

8.7. Non-numbered activity (3rd Country Training from the Philippines)

(1) Visitors Entity's Information

The Project for Improvement of Quality Management for Road and Bridge Construction and Maintenance Phase III, in the Republic of the Philippines

Department of Public Works and Highway (DPWT)

(2) Purposes of Technical Exchange

- Exchange opinion by engineers from both countries and share issues on improvement
- Visiting of the roads and bridges repair pilot project site in Cambodia

(3) Period of the Training

December 11th, 2017 (Mon) to December 15th, 2017 (Fri) *5 days

(4) Receiving entity's Information

The Project for Strengthening Capacity for Maintenance of Roads and Bridges

Ministry of Public Works and Transport (MPWT)

Road Infrastructure Department

(5) Language

English

(6) Training Schedule

Table 8-7

Table 8-7 Training Schedule (General)

No.	Date		Time	Schedule	Person	Location
1	11 Dec	Mon	11h00AM	Courtesy Call to MPWT	Mr. Chim Phalla	MPWT
			PM	Site visit Tsubasa Bridge （RID、Sovisoth, So Chia, DaVuth） （IKEE Excel Plant）	Mr. Wang Mr. Ohtake	Tsubasa br.
2	12 Dec	Tue	9h00-11h00AM	Site visit Chroy Changwar Bridge （RID、Sovisoth, So Chia, DaVuth）	Mr. Ogawa, Mr. Nakajima Mr. Ohtake Mr. Wang	Phnom Penh
			PM	Move from PHN to Preah Shihanouk Site visit to the CFC Pilot Project	Dr. Tsukamoto Dr. Tamagawa (JICA)	Kandal
3	13 Dec	Wed		Bridge Maintenance Workshop (ME Training) **See Next Page for detailed Program (Attachment A)**	Dr. Tsukamoto Dr. Tamagawa (JICA) Chhouk Sochea Eam Sovisoth (RID) Dr. Sathaya Dr. Narith (ITC)	Preah Shihanouk DPWT
4	14 Dec	Thu	AM	Bridge Maintenance Workshop **See Next Page for detailed Program (Attachment A)**		Preah Shihanouk DPWT
			PM	Move from Preah Shianouk to PHN		
5	15 Dec	Fri	AM9h00	JICA Courtesy Call	Mr. Tanaka Kotaro	
			AM10h00-12h00	Joint Workshop(Special lecture on introduction of bridge maintenance in the Philippines) Project Achievement presentation by Mr. You Dara	RID EXMID	
			PM	Move to Airport Phnom Penh 1550- Siem Reap 1645		

* The Participants will make a presentation at Technical Exchange Programs.

Attachment A Bridge Inspection Seminar Program

Day	Training Topics	Remarks	Instructor
Day 1 (Lecture) 13 Dec	Opening Remark (5 min)	9:00～9:05AM	Director (Preah Shihanouk DPWT)
	Outline of Bridge ME (5 min)	9:05～9:15AM	Nin Menakak (RID)
	Keynote Lecture 1 (2 Hours)	9:15～11:15AM	Dr. Sathaya
	Why and How should bridges require maintenance	Lecture	Dr. Narith (ITC)
	Chapter 1(in Bridge Maintenance Manual):- Introduction (45 Min)	11:15AM-12PM	Chhouk Sochea (RID)
	At the end of this topic the participants should be able to: 1. Explain the Purpose of Bridge Maintenance 2. Explain the Process of Bridge Maintenance 3. Explain the Glossary about parts of a Bridge	Lecture	(Supporting JICA Expert)
	Special Lecture 1 from JICA Philippines Project		**DPWH Philippines**
	1. Outline in DPWH-Philippines	**2:00 – 2:20PM**	**Eng. Medmier G. Malig**
	2. Status of Road and Bridge maintenance in DPWH	**2:20 – 2:40PM**	**Eng. Nerie Bueno**
	3. Outline of TCP-III "Improvement of Quality Management for Highway and Bridge Construction and Maintenance"	**2:40 – 3:00PM**	**Eng. Aristarco M. Doroy**
	4. BMS and Bridge Engineering Inspection using NDT	**3:00 – 3:30PM**	**Eng. Justino Jaime T. Surot, Jr**
	5. Bridge Repair	**3:30 – 4:00PM**	**Eng. Adelina P. Gomez**
	Chapter 2 (in Bridge Maintenance Manual): - Organization for Bridge Maintenance (1H)	4PM-5PM	Eam Sovisoth (RID)
	At the end of this topic the participants should be able to: 1. Explain Jurisdiction of Bridge Maintenance 2. Explain Schedule of Bridge Maintenance	Lecture	(Supporting JICA Expert)
Day 2 (Lecture) 14 Dec	Keynote Lecture 2 (1 Hour)	9AM～10AM	JICA Expert
	Introduction of Japanese Bridge Inspection	Lecture	Dr. Tsukamoto Dr. Tamagawa
	Special Lecture 2 from JICA Philippines Project		**DPWH Philippines**
	6. Special Bridge in the Philippines	**10:00-10:30AM**	**Eng. Recy L Calma**
	7. Special Bridge Inspection by Drone	**10:30-11:00AM**	**Eng. Ronalyn P. Ubiña**
	8. Special Bridge Repair on Steel Truss bridge (1st Mactan Br)	**11:00-11:30AM**	**Eng. Rosario C. Calves**
	9. Special Bridge Repair on Cable stayed bridge (Diosdado Makapagal Br)	**11:30-12:00PM**	**Eng. Ruel M. Nazareno**
	Return to Phnom Penh		

Chapter 9. Overloading and countermeasure at Tsubasa Bridge

Abstract

An investigation on overloading issue and countermeasure at Tsubasa Bridge was attached to "Project for Strengthening Capacity for Maintenance of Roads and Bridges, JICA" in August 2015.

The purposes were:

Data Collection and Concept Building (Section 9.1)
1) To investigate the current overloading situation in Cambodia
2) To introduce foreign example of countermeasures against overloading
3) To propose practical countermeasures against overloading at Tsubasa Bridge
4) To summarize proposal specifications for next stage (step)

Preliminary Study on Permanent Solution at Tsubasa Bridge (Section 9.2)

Pilot Project for Tsubasa Bridge (Section 9.3)

Institutional Framework for Overloading Truck Control (Section 9.4)

Budgetary Framework for Overloading Truck Control (Section 9.5)

9.1. Data Collection and Concept Building on Overloading Control at Tsubasa Bridge

9.1.1 Investigate current overloading situation in Cambodia

The contents of this section are included in the "Current situation of overloading enforcement in Cambodia" (cf. 9.1) as follows:

(1) Administration

An ad hoc team constituted under the leadership of His Excellency Mr. Pen Boran is charged with the responsibility to look into the overloading issue and implement any pertinent process. There are 11 fixed overloading stations. Ten (10) are active. Seven (7) are ADB funded while two (2) are JICA funded. The RGC installed 2 new fixed stations. One ADB funded station is dormant temporarily because of the road expansion work. At each station there is a group of MPWT personnel, local DPWT personnel, police and a military team that deals with law enforcement. The operation is implemented twenty four-seven (24/7) 365 days.

The process of enforcement is listed in Figure 9-1, though all the HSWIM (High Speed Weigh in Motion, Fast WIM) are not active.

(2) The Current traffic at Tsubasa Bridge

Tsubasa Bridge was opened to the public in April, 2015. After the bridge opening bridge, the traffic number investigation was conducted by JICA. The details are given in Table 9-1 below. The current traffic is light. The heavy traffic ratio shows 22%-33%, which is rather high. There are two existing weigh-stations between Phnom Penh and the Bridge, one is out-bound the other in-bound. Though records of enforcement were requested, it seemed there were none. According to the (hearing) information on site, the average inspected vehicles per day for out-bound station are 17, while the average overloaded vehicles are less than 1 as shown in Table 9-1.

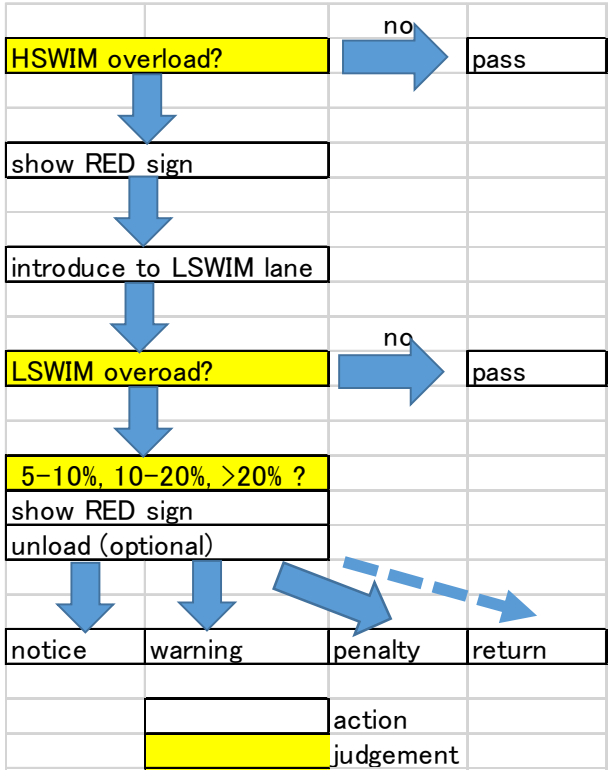


Figure 9-1 Overloading Enforcement Procedure

Table 9-1 Current Traffic and Overloaded Vehicles at Tsubasa Bridge

Location	Motor Cycle (MC)	Light Vehicle (LV)	Heavy Vehicle (HV)	other	total	LV+HV	HV/(LH+HV)
2	5,794	3,516	1,044	108	10,462	4,560	22.9%
3	7,898	3,341	1,630	70	12,939	4,971	32.8%

Hearing at the overloading enforcement station, NR1

suspicious overloaded vehicles	17	veh /day
overloaded vehicles	<1	veh /day

(3) Current method of overloading enforcement

On 23 September and 1 October, site inspection on current overloading enforcement was conducted with the assistance of MPWT engineers. The followings observations at the overloading enforcement station at NR5 were made.

- Enforcement at 10 stations by 24 hours every day for 365 days
- At every fixed station equipped with HSWIM, all failed and in a dormant state.
- Overloading station at NR5 was funded by ADB. The are 11 enforcement personnel, from the following organizations: 4 from the police and military, 3 from MPWT, and 4 from the Municipal province DPWT. The DPWT became a member of the enforcement team after decentralization four (4) years ago.
- 2 persons rotate from MUI to check the length, width and height of large vehicles
- PMU3 deals with the management of the weighing system.
- It takes 5 minutes to inspect a vehicle.
- HSWIM, LSWIM, speedometer, automatic traffic counter are provided. All except for the LSWIM have failed.
- The vehicle must drive at 5 km/h over the axial weight meter.
- HSWIM was installed in 2010 and failed sometime in 2012. The product was made by KTS, a Korean company.
- The cause of the fault and repair forecast was not clear. The documentation regarding the malfunction does not exist.
- About 100 vehicles are checked, and 50% exceed axial load limit just by visual observation.

(4) Overloading statistics in Cambodia

There are 10 overload stations in Cambodia. The annual report depicting the trend for each station is not known except for the annual statistics shown in “Current situation of overloading enforcement in Cambodia”. As per the table, the overloading ratio of inspected vehicles was 0.49%, as of 2014, which is a surprising figure. Enforcement is practiced but no statistics available.

The MPWT does not publish an official report on overloading status. The table was provided by MPWT as the only statistic summary of the overloading enforcement in 2014. The credibility cannot be confirmed since there are no other data shown.

In the year 2008, it was revealed that detailed investigations were conducted under the JICA expert Mr. Harada, and several reports handed to MPWT. Some of the observations are active to-date and the excerpts are summarized as appendix A.

(5) Overload enforcement investigations

The MRD and ADB were interviewed.

1) MRD (Ministry of Rural Development)

- The MRD held a national convention of rural roads against overloading vehicles on September 16, 2015 at a Phnom Penh Hotel. Two major truck associations, CAMRA and CAMTA, attended the conference, and played one of the key note speakers. The Traffic police also attended the convention.
- The commencement of law enforcement on illegal modification of truck cart is not confirmed.

- A Pilot project for overload enforcement by making use of a portable scale is being implemented at two provinces. The scale is loaded on pick-up truck with traffic control cones, load indicator.
- 8,000 leaflets about "stop the overloading campaign" have been printed and shall be distributed to stakeholders, including truck drivers and truck associations. Signboards of similar design will be posted along the road side.
- Citizens are encouraged to call the road administrator whenever they encounter a suspiciously overloaded truck through a "Hotline" number. There has been no report so far.

2) ADB

- According to our investigation, 80% of the overloaded vehicles were detected by the portable scale. It is to say that only 20% were detected through the fixed station.
- The portable weighing scale is so effective and have been stocked by MPWT.
- The ADB does not recognize malfunction of Fast WIM in Cambodia.
- ADB advocates for total automatic weigh station, but no agreement has been reached.
- Malfunction of the Fast WIM may be caused by internal management.
- There is a strong protest from the transportation industries which resists overloading strategy in Cambodia.
- The automatic weigh station and e-tag trial excerpts from ADB report are shown in appendix B.

9.1.2 Overloading enforcement in foreign countries

The contents of this section are included in "Enforcement examples" (cf. 9.2). Any industrial country faces challenges dealing with overloading issue. The examples below were presented to the MPWT officials in charge of weigh bridge stations and the project counterparts during the Workshop held on 11 December 2015.

- Japan
- National highway
- Expressway
- Europe
- South Africa
- Kenya
- Vietnam
- Port facilities
- U.S.A.

Through site visits of current domestic enforcement stations and analysis of foreign examples, the following observations can be made:

1. Status report of enforcement

Enforcement status report does not exist. The total overloading statistics is available per month, but no data for each enforcement station is available. No background data was obtained. There is no

clarity on the trend. The overloading station should be responsible for the vehicle numbers inspected and penalized, and they should be recorded and reported to MPWT. The traffic volume is not known. Due to the malfunction of the HSWIM, the traffic number was not counted. An alternative for taking the count must be invented.

2. *Accident report*
   On September 28, it was reported that a local Bailey bridge had collapsed due to an overloaded vehicle. Such incidences should be recorded in a format and stored for reference.
3. *Facility failure*
   There are 8 funded fixed stations in Cambodia, comprising of HSWIM and LSWIM. All of the HSWIMs have been dysfunctional since October, 2015. An analysis report does not exist. It is impossible to know when they were broken and where. Several officers lacked knowledge on the history of the equipment. The repair works have not been finished. It should be compulsory for the local station to submit a written accident report whenever such facility failures happen.
4. *Penalty record*
   Local overloading station records the vehicle identification and its penalties. These records should be collected and analyzed. The repeated violators should be identified.
5. *Private participation*
   Overloading enforcement is implemented by government sections. But it is efficient and effective to introduce private company to participate the task. Submission of periodical report will become secured.
6. *Training*
   Training for overloading enforcement should be implemented.
7. *Observation at Tsubasa Bridge*
   Because the Bridge is located on loose and dense soil layers, high attention was paid during construction. It is anticipated that the subsidence continues after the construction. So, it is advisable that the subsidence is measured periodically. It is observed that nearby road side private embankment can be seen. Lateral movement should be observed as well.
8. *Maintenance and control office*
   It is reported that there traffic accidents or inappropriate handling caused pavement damage. Considering the size and importance of the Bridge, it is advisable that a site office is established and periodical inspection is conducted on the road surface and soffit of the structure. Any anomaly should be reported to MPWT.
9. *Penalty*
   A penalty should be paid in cash at the site. It is advisable that the penalties are paid through financial institution in the future.
10. *Penalty classification*
    Penalties are currently classified in 3 steps: 5 to 10%, 10% to 20%, and more than 20%. The classification should be shifted one stage higher, such as 10% to 30%, 30% to 50%, and more than 50%. If a 5% criteria is introduced, the scale accuracy must be more than perfect, otherwise it may unnecessarily expensive. An excess of 5% overloading would not cause significant damage if the bridge is sustained and in normal condition.
11. *Heavy vehicle permit*
    In article 26 of “Law on Road”, heavy vehicle permit is described but not activated. An investigation should be conducted to determine its suitability.
12. *Penalty only to drivers?*
    It seems that the overloading penalty is applied only to drivers. But driver’s liability is limited. It

is a common rule that the penalties are applied to traffic companies or consigners as well. The most effective method should be considered.

13. *Portable scales*
    Enforcement through the portable scale is the universal norm, because of its manual application. It is expected a day will come when the difficulty against the portable scale is cleared, and they are activated again in Cambodia.
14. *Overloading seminars*
    Overloading seminars must be conducted periodically to related personnel.
15. *Roundtable meeting*
    Roundtable meetings are recommended to be held between MPRT, local DPWT, police, and the truck association as it is implemented by MRD.
16. *Pamphlet, road side banner, internet etc.*
    Pamphlet against overloading should be made and distributed to the pertinent offices or drivers. The road side banner should be activated to promote the overloading movement. Public media or internet should be encouraged to bring to the attention of the citizens the overloading matter.
17. *Master plan*
    Overloading measurement master plan has been in existence. Action should be taken for its implementation. The master plan ought to be activated by making use of strategic road map.

9.1.3 Countermeasures against overloading issue at Tsubasa Bridge

The following contents have also been included in the "Overload enforcement at Tsubasa Bridge" (refer to 9.4)

(1) Current situation

Since Tsubasa Bridge was opened to the public in April, 2015, there was an urgent need from MPWT to start overloading enforcement at the site. Currently, there is no enforcement going on at the site. "Free pass" is the norm. There are three fixed overloading stations on NR1, but they do not cover the Bridge effectively because they are located far away from the site.

The Bridge consists of cable stayed bridge, approach span bridge, and embankment. The embankment height is kept above +10 m above surrounding ground level. It is said the annual fluctuation of water level changes from 0 – 8 m from the ground level. Inhabitant area is located about 10 m level.

The ground level around the Bridge is 0 to several meters which is mostly private property and used generally for agricultural purposes.

(2) Three options of enforcement at Tsubasa Bridge

Three options for the overloading enforcement were proposed as highlighted below. An in-depth description is reported on 1121 (refer to 9.8).

On 20 November, (insert year), the MPWT restricted any modification near the Monument zone for aesthetic reasons. After several revisions 6 enforcement plans were proposed (see Section 9.2). They are divided as west or east, or pilot project, permanent (1), permanent (2) and listed in Table 9-2. Permanent (1) is the juncture between pilot project and permanent (2).

Each plan is classed by options between "within roadway" or "establish embankment". The third option of HSWIM in existing road way is added to make Table 9-3. A comparative for option is

done.

Finally, a set of options is shown in Table 9-4. There are 8 sets altogether with three sets being practical. Set 1 introduces every option recommended by the team. Set 2 eliminates embankment and keeps enforcement by permanent (1). Set 3 is to eliminate HSWIM further and to enforce overloading by WIM scale at the existing roadway.

Table 9-2 Case Numbering

	West entrance	East entrance	Note
Pilot project	West (1)	East (3) East (4)	Enforcement within existing roadway
Permanent (1)	West (1)	East (3)	Enforcement within existing roadway
Permanent (2)	West (2)	East (5) East (6)	Establish embankment

Table 9-3 Comparison of 3 Options

	Establish embankment	Enforcement within existing roadway	HSWIM at existing roadway
Cost	Poor	very good	fair
Function	very good	good	poor
Construction time	Poor	very good	very good
Operation	very good	poor	poor
Local measures	Poor	poor	good

Table 9-4 Set of options

	Establish embankment	Enforcement within existing roadway	HSWIM at existing roadway
Set 1	○	○	○
Set 2		○	○
Set 3		○	

(3) Soft countermeasures

Overloading enforcement on the road is one of the countermeasures against overloading vehicles. There are other several countermeasure strategies such as sensitization, familiarization, education, TV broad casting, road banners, and government brochures and so on. Round table discussion with stakeholders such as truck associations, consigners, and police may be one means. Nowadays, decree against overloading through HP is effective.

The MRD has initiated roundtable forum with road users, including two major truck associations in Cambodia.

A report on the survey on trucks on national route 5, indicates that cart modifications seems to be

the norm in Cambodia. As economic activities increase in this country, this trend is expected to continue if nothing is done. It is believed that it is not easy to recognize the effect of the control of the modification once started.

(4) Cost estimation

The project cost is arrived at by considering the unit cost as used in the existing construction project as illustrated in 9.20. As for unit cost for special product, such as Low WIM or Fast WIM, quotations are collected.

The estimated cost for each scheme is shown in the Table below.

Table 9-5 Cost calculation, Overhead, Tax included, ¥, 2015

Case	Cost
West (1)	1,570,000
West (2)	52,100,000
East (3)	1,380,000
East (4)	1,570,000
East (5)	34,260,000
East (6)	94,820,000

Extra table

Item	Cost	No.
LSWIM	16,140,000	2
HSWIM	21,830,000	2
p WIM	7,450,000	3
container house	2,530,000	2

9.1.4 Proposals

The following proposals were made for the enhancement of overloading vehicle control:

(Data collection)

1. Daily overloading vehicle data should be forwarded to MPWT, and monthly and annual report should be made and reported to the Secretary.
2. Enforcement report at each site is recommended.
3. Traffic number investigation should be conducted periodically at designated points.
4. Structural accident report should be made in prescribed format.
5. Notice, warning, penalty data should be collected and analyzed. Repeat violators should be penalized.

(Maintenance and management)

6. Facility (equipment) failure should be reported immediately and the cause of the failure recorded. Immediate repairs must be made.
7. Private companies should be incorporated into the maintenance works.
8. Periodic facility maintenance training for operators should be conducted.
9. Tsubasa Bridge is located on loose, thick and unstable soil layers. Consecutive survey investigation is required.
10. It is advisable that a site control office is established and periodic road surface observation is made as well as under the bridge.

(Enforcement)

11. Portable scale should be considered again as a viable tool for enforcement.
12. Penalties should not be limited to drivers. The transportation company and consigners should owe due liability.
13. Penalty money should be collected through financial institutions such as a commercial bank.
14. The classification may be shifted one stage higher; from current the “5 to 10%, 10% to 20%, and

more than 20%" to say "10% to 30%, 30% to 50%, and more than 50%".

15. Overloading seminar should be organized at MPWT or at any other venue outside of MPWT.
16. Round table discussion should be held between police, transport companies, consigners and road administrator.

(Familiarization)

17. Pamphlets against overloading should be published and distributed.
18. Roadside signs or banners against overloading should be constructed.
19. Familiarization and sensitization on overloading issues should be addressed by making use of possible communication tools including internet, TV or newspapers by MPWT.

(Plan and action program)

20. An overloading master plan must be stated and implemented quantitatively.
21. A strategic program against cart modification should be made and the action program implemented accordingly.

9.1.5 Next step

(1) Stage-wise Implementation

An implementation plan is proposed as shown in Table 9-6.

The Cost estimation of each set is shown in Table 9-7.

Table 9-6 Draft Implementation Schedule

		2016	2017	2018	2019	2020	2021
Set (3) Pilot Project	Design						
	Construction						
	Implementation						
Set (2) Permanent(2)	Design						
	Construction						
	Implementation						
Set (1) Permanent (1)	Design						
	Construction						
	Implementation						

(2) Pilot Project

A pilot project is proposed to be conducted in order to verify the effectiveness of the proposed options and to identify issues for implementation of the plan.

Table 9-8 below shows two options for the pilot project. Option 1 is to utilize portable weighing scales (pilot of set (1)). Option 2 is to utilize portable weighing scale and HSWIM (pilot of set (2)).

Table 9-7 Set Cost Estimation

Set	WEST				EAST				**Total**			
	Category	Item	Quantity	Cost (Yen)	Category	Item	Quantity	Cost (Yen)	Category	Item	Quantity	Cost (Yen)
Set 1	Construction	West (2)	l.s.	52,100,000	Construction	East (5)	l.s.	34,260,000	Construction	East (5)	l.s.	86,360,000
(Permanent)												0
	Equipment	LSWIM	1	8,070,000	Equipment	LSWIM	1	8,070,000	Equipment	LSWIM	2	16,140,000
		HSWIM	1	10,915,000		HSWIM	1	10,915,000		HSWIM	2	21,830,000
		Container House	1	1,265,000		Container House	1	1,265,000		Container House	2	2,530,000
	Total			72,350,000	Total			54,510,000	Total			**126,860,000**
Set 1	Construction	West (2)	l.s.	52,100,000	Construction				Construction			
(Permanent)						East (6) *roadside station	l.s.	94,820,000		East (6) *roadside sta	l.s.	94,820,000
* use part of	Equipment	LSWIM	1	8,070,000	Equipment	LSWIM	1	8,070,000	Equipment	LSWIM	2	16,140,000
Roadside Station		HSWIM	1	10,915,000		HSWIM	1	10,915,000		HSWIM	2	21,830,000
		Container House	1	1,265,000		Container House	1	1,265,000		Container House	2	2,530,000
	Total			72,350,000	Total			115,070,000	Total			**135,320,000**
Set 2	Construction	West (1)	l.s.	1,570,000	Construction	East (3)	l.s.	1,380,000	Construction	East (3)	l.s.	2,950,000
(Semi Permanent)												0
	Equipment	Portable WIM	1	2,483,333	Equipment	Portable WIM	2	4,966,667	Equipment	Portable WIM	3	7,450,000
		HSWIM	1	10,915,000		HSWIM	1	10,915,000		HSWIM	2	21,830,000
		Container House	1	1,265,000		Container House	1	1,265,000		Container House	2	2,530,000
	Total			16,233,333	Total			18,526,667	Total			**34,760,000**
Set 2	Construction	West (1)	l.s.	1,570,000	Construction	East (3)	l.s.	1,380,000	Construction	East (3)	l.s.	2,950,000
(Semi Permanent)												0
* use of existing portabl	Equipment	Portable WIM	0	0	Equipment	Portable WIM	0	0	Equipment	Portable WIM	0	0
scale		HSWIM	1	10,915,000		HSWIM	1	10,915,000		HSWIM	2	21,830,000
		Container House	1	1,265,000		Container House	1	1,265,000		Container House	2	2,530,000
	Total			13,750,000	Total			13,560,000	Total			**27,310,000**
Set 3	Construction	West (1)	l.s.	1,570,000	Construction	East (3)	l.s.	1,380,000	Construction	East (3)	l.s.	2,950,000
(Pilot Project)						East (4)	l.s.	1,570,000		East (4)	l.s.	1,570,000
	Equipment	Portable WIM	1	2,483,333	Equipment	Portable WIM	2	4,966,667	Equipment	Portable WIM	3	7,450,000
												0
		Container House	1	1,265,000		Container House	1	1,265,000		Container House	2	2,530,000
	Total			5,318,333	Total			9,181,667	Total			**14,500,000**

Table 9-8 Draft Options for Pilot Project on Overloading Control at Tsubasa Bridge

Options	Option 1 (Pilot control using portable scale)	Option 2 (Pilot project using portable scale and High Speed Weigh in Motion)
Outline	(1) Detection and control of overloading by portable scale (2) Conduct within existing road area by temporary change of lane marking	(1) Automatic detection and record of overloading vehicle by HSWIM (2) Detail verification and control by portable scale (3) Conduct within existing road area by temporary change of lane marking
		
Period	June to August in 2016	June to August in 2016 (data collection shall continue)
Operation	[Japan side] Portable scale Technical advise [Cambodia side] All operations: traffic control, measurement, vehicle control	[Japan side] High Speed Weigh in Motion Technical advice [Cambodia side] Portable scale (including temporary borrowing from other stations) All operations: traffic control, measurement, vehicle control Maintenance of HSWIM and data collection
Material and equipment	(1) Portable scale (2) Temporary office (3) Material for temporary lane marking	(1) HSWIM (2 locations) including installation (2) Temporary office (3) Material for temporary lane marking
Expected Cost	Approximately 15,000,000 Yen	Approximately USD 28,000,000
Advantage	Immediate manual control of overloading Small cost of operation	Immediate control of overloading manually HSWIM can link to future facility Continuous road and loading data collection even after Pilot the Project (The data will be used for condition analysis.)
Disadvantage	Only temporary effect No link with future plan	Large cost of operation
Remarks		Requires installation of a sensor cable on the surface of asphalt concrete pavement within the section under the Defect Liability Period.

9.1.6 Conclusions

CTI and Hanshin Expressway Co. team have implemented an overloading enforcement investigation. Six plans were proposed and expressed by six drawings respectively. Added by Fast WIM, they are grouped in three options. The team expects that the three options will all be implemented at the Tsubasa Bridge to provide a solution to the overloading issue. The team also expects the impact of the implementation shall influence the overall overloading challenges in Cambodia.

Appendix A:

From Harada report

1) Overload Ratio

- Among heavy-type vehicles, the overload ratio varies depending on the road, from more than 10% to less than 3%.

2) Some difficulties in overloading control

- Truck or trailer with modified bodies, for example the addition of a special axle.
- Truck or trailer transferring cargo to avoid inspection, for example, the truck may transfer cargo to another smaller truck before passing the inspection point.
- Truck or trailer does not stop for inspection, for example, vehicles with military number plates.
- Lack of overloading personnel and overloading control equipment
- Intervention by powerful and/or rich people.
- Complaints from vehicle owners or drivers.

3) Recommendations

- MPWT should determine a clear functioning of overload related equipment, i.e. the permanent weight stations, weigh in motion and portable weigh scale.
- MPWT should plan to install weight stations at the borders.
- MPWT should plan to install weighing equipment on locations where the existing equipment cannot control.
- Weigh in motion should also be installed on national and provincial roads as needed in order to collect traffic data.
- The installation of equipment should be reviewed from time to time to ensure the roads are well protected.
- Adequate equipment such as portable weight scale, patrol car, etc., should be provided against overloaded vehicles without passing through the weigh-stations or overload checkpoints.
- MPWT should consider sufficient budget for equipment maintenance and repair.
- Weigh in motion data should be analyzed monthly and reported in order to understand the latest situation of overload traffic.
- MPWT should carry out public campaigns against overloading in order to create awareness and get public participation by all sectors in the society.

Appendix B:

Excerpts from ADB report

1) The key components of the proposed automated weigh station

- A weigh station complex will be located on each side of the carriageway.
- A virtual gantry/violation detector will be placed on the main carriageway with a virtual height restriction of 2.5 m.
- Advance warning signs advising all vehicle over 2.5 m in height and 2.80 m in width to enter the weigh station.
- Heavy vehicles and buses enter the weigh station on their right.
- The vehicles then pass over a High Speed WIM where all vehicles are weighed and photographed.
- Buses and heavy vehicles are then directed by a green arrow signal to the main carriageway provided their total weight and individual axle weights as measured by the High Speed WIM if below those specified.
- The other heavy vehicles are directed to the Low Speed WIM where they are weighed, photographed and their total weight and individual axle weights and the fine are calculated.
- The driver of an overloaded vehicle will then be advised electronically at an electronic payment machine of the amount of fine payable and pay the required fine in cash and then will be directed by a green arrow, closed barrier and a loud speaker message from the 24-hour Surveillance Center to unload the excess load in the unloading area.
- Once the vehicle has partially unloaded it passes over a second WIM where it is again weighed and photographed. If its load is then conforming, it is given a green light and the barrier is opened to allow it to return to the carriageway. If not, it is advised by loudspeaker to unload further until the load conforms.
- Prosecutions, monitoring and supervision is all undertaken remotely from the 24-hour Surveillance Center.

2) proposed e-tag trial

- It is proposed that a trial of electronic tags be implemented in cooperation with CAMTA.
- The concept is that each truck and driver operating out of Poipet would be issued with an electronic tag. As the truck approaches the low-speed WIM the tags would be read by an RFID tag reader and the details would be date and time stamped and added to the weight records together. This information would then be transmitted to the 24-hour Surveillance Center.

9.2. Preliminary Study on Permanent Facility for overloading control at Tsubasa Bridge

9.2.1 Introduction

This is a propositions report for solution for the overloading control at Tsubasa Bridge.

The summary result of the study is shown in Table 9-9.

Table 9-9 Summary of the study result

No	Solutions	Options		Remark
		West entrance	East entrance	
1	Temporary Solution (Pilot Project)	West (1)	East (4)	These options are proposed for the pilot project.
2	Permanent Solution	West (2) West (3) *	East(4-2*) East(5) East (6)* East (7)	*West (3) and East(4-2) or East (6) are recommended

9.2.2 Current situation

Since the Tsubasa Bridge was opened to the public in April, 2015, there was an urgent need from MPWT to start overloading enforcement at the site. Currently, there is no enforcement at the site. “Free pass” is the norm. There are three fixed overloading stations in NR1, but they do not cover the Bridge effectively, because they are located far away from the site.

The Bridge consists of cable stayed bridge, approach span bridge and an embankment. The embankment height is kept above +10 m above the surrounding ground level. It is said the annual fluctuation of water level changes from 0 – 8m from ground level. Inhabitant area is located about 10 m level.

The ground level around the Bridge is 0 to several meters. The border of ROW is 30 m from the center line of the road and surrounding property is private and generally used as agricultural purpose.

9.2.3 Alternative Study for Facilities

(1) Alternatives of enforcement at Tsubasa Bridge

Two plans were proposed for overloading enforcement as detailed below. The first plan is the temporary measure for the urgent enforcement and the second plan is the permanent enforcement for the bridge. After several revisions, seven (7) options were studied.

They are divided as west or east, or temporary plan, permanent plan as listed in Table 9-10. The temporary plan is to be assisted under pilot project. Alternative comparative studies for both sides are described herein after.

The temporary measure is proposed to be implement as a pilot project for emergency action to enhance overloading control at Tsubasa Bridge.

Table 9-10 Case numbering

No	Solutions	Options		Note	Remark
		West entrance	East entrance		
1	Temporary solution (Pilot Project)	West (1)	East (4)	Enforcement within existing roadway	Proposed for pilot project
2	Permanent solution	West (2) West (3)	East(4-2) East(5) East (6) East (7)	Construct weighbridge station besides road	

9.2.4 West side

(1) Temporary Solution

In the west side, below are the proposed temporary solutions:

1. (From Phnom Penh by NR.1)
   Use of existing weigh bridge station at Kampong Phnom (west side of the road) to weigh the trucks.
2. (From south by NR.14)
   Step 1: Guide the suspected vehicle to the existing weigh bridge station at Kampong Phnom. The weight of the vehicle shall be checked there.
   This is the most practical and fast temporary solution. However, this allows the suspected vehicle take NR.1 up to the weigh bridge station.
   Step 2: Install temporary office (container house) of 40 ft at NR.14 for a 24-hour operation and identify overloaded vehicle at the site. (Option West 1). Estimated cost is 24,150 USD.

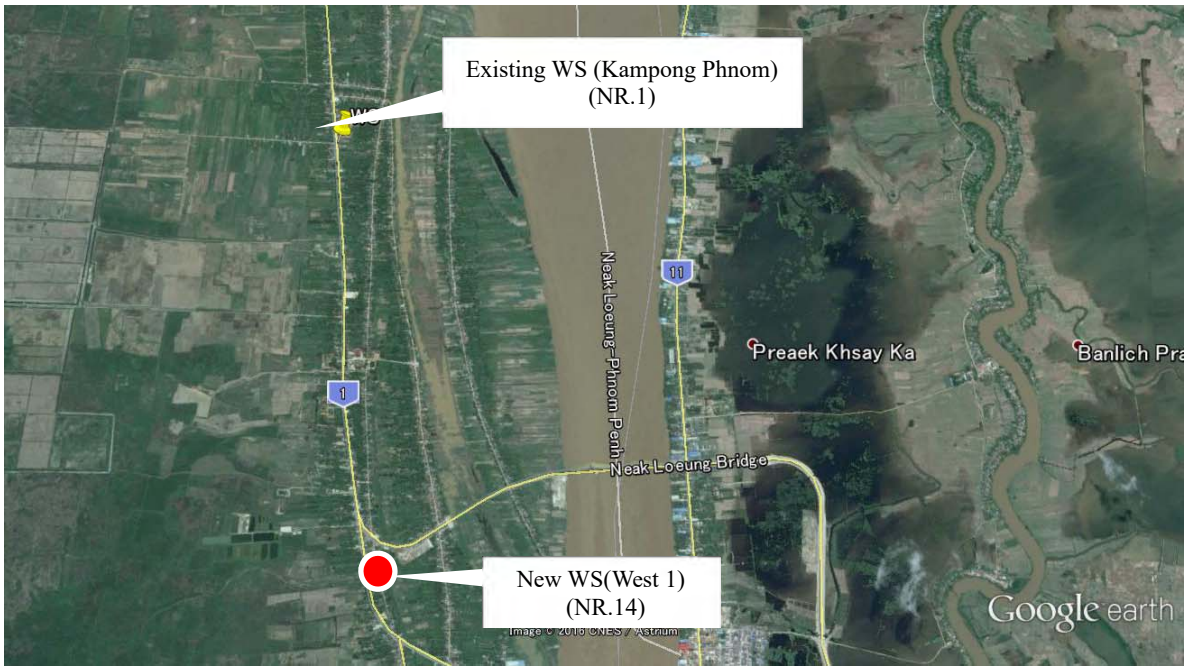


Figure 9-2 Temporary Solution for the West side

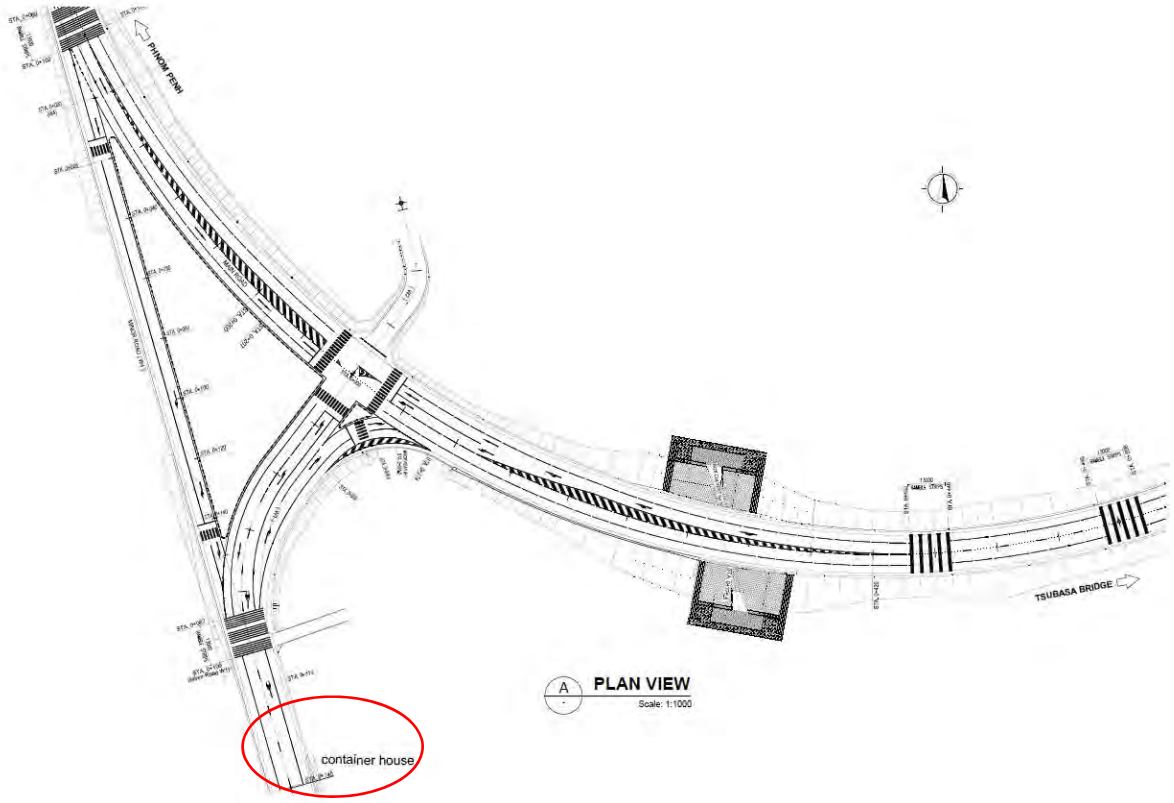


Figure 9-3 Temporary Alternative (West 1)

(2) Permanent Solution

Tow (2) options are compared and option 2 (West 2) is recommended due to the following reason.

1. Ease of construction (better soil condition)
2. Less cost
3. Land availability

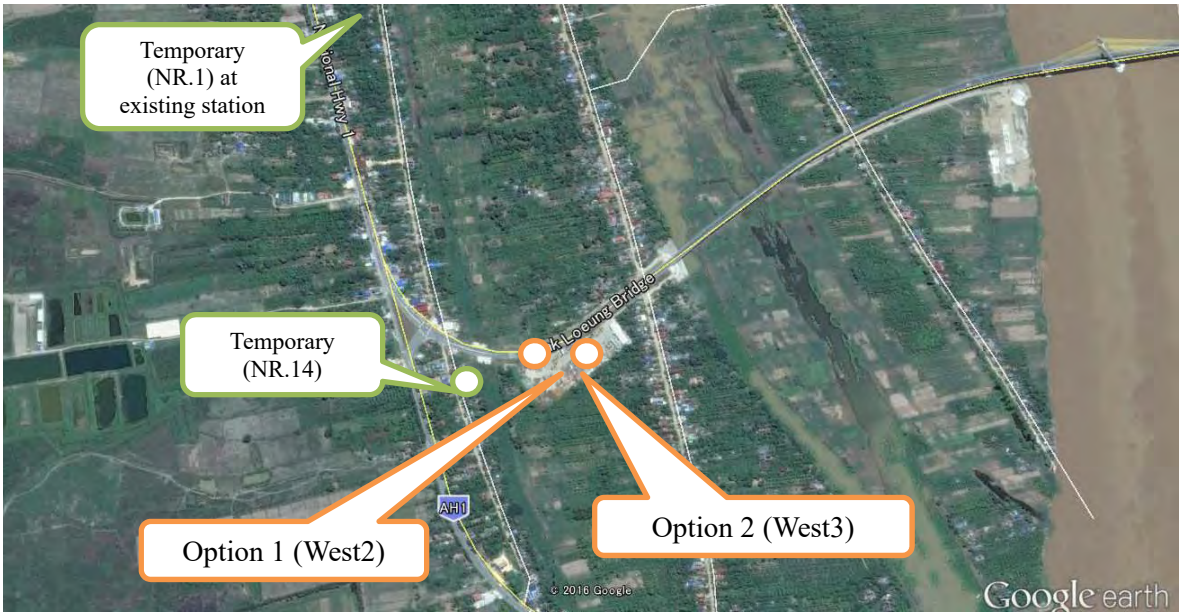
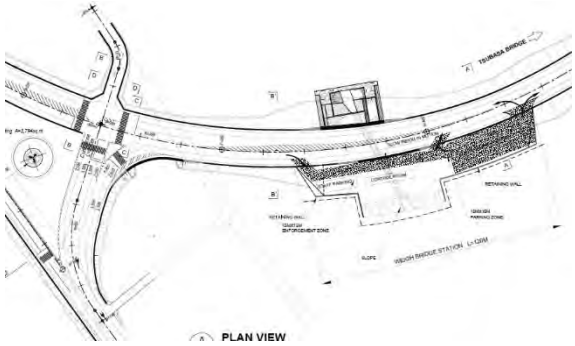
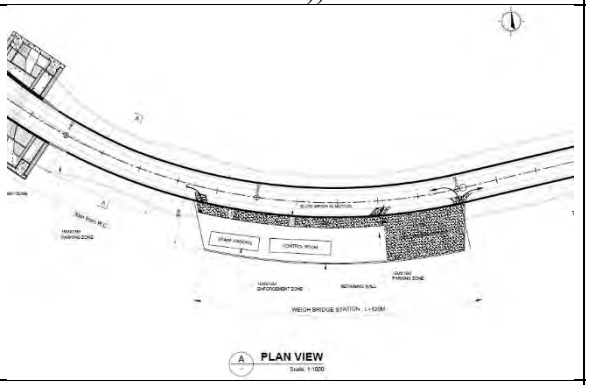


Figure 9-4 Location of the Options (West side)

Table 9-11 Alternative Comparison for West side

Options	Option 1 (West 2) (Construct at 0+370 (Box Culvert))	Option 2 (West 3) (Construct at 0+500(Current Contractor's Yard))
Plan		
Outline	(1) Expand existing box culvert (2) Construction of retaining wall (2) Construct embankment with soil stabilization (3) Construct weigh bridge and unloading parking	(1) Construct retaining wall (2) Construct embankment (within ROW (30 m from centerline)) (3) Construct weigh bridge and unloading parking
Expected Cost	1,168,000 USD	1,033,000 USD
Advantage	Close to the intersection	Better soil condition
Dis-advantage	Land restriction Unstable soil condition at existing culvert Difficulty of stabilization of foundation (more risk on cost increase) Long construction period required	
Evaluation	**Fair**	**Good**

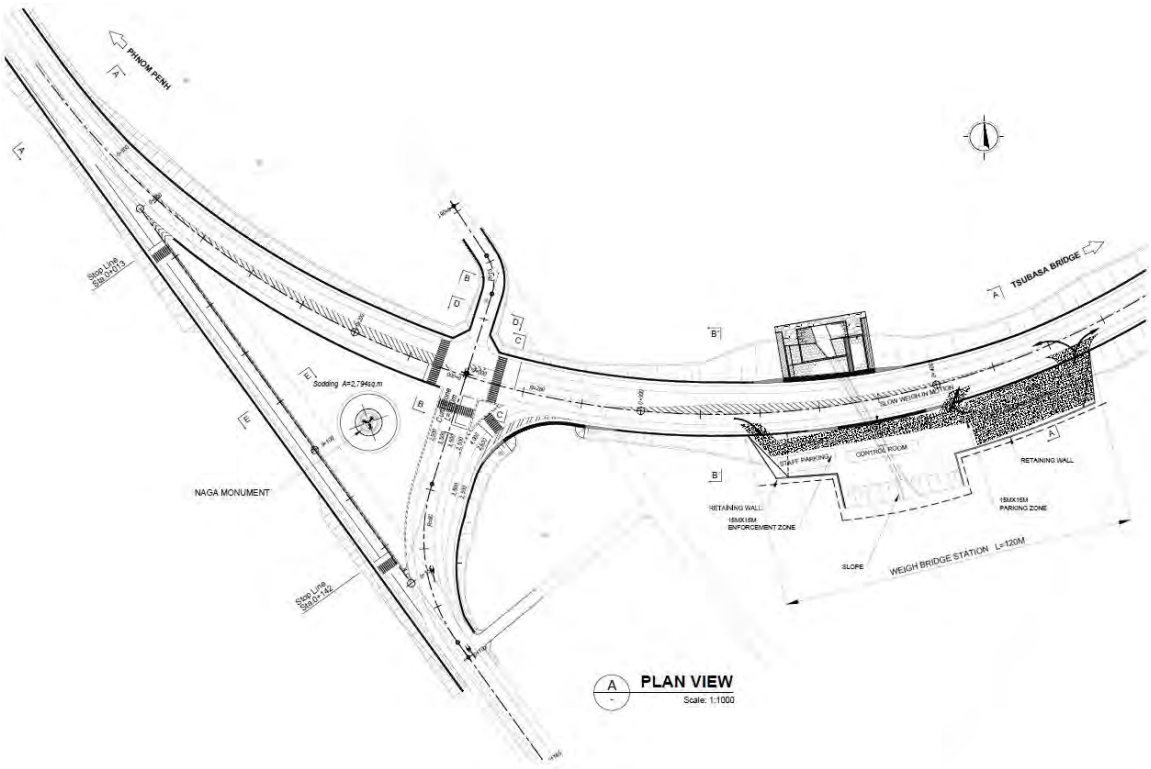


Figure 9-5 Option 1 (West 2) West side (general)

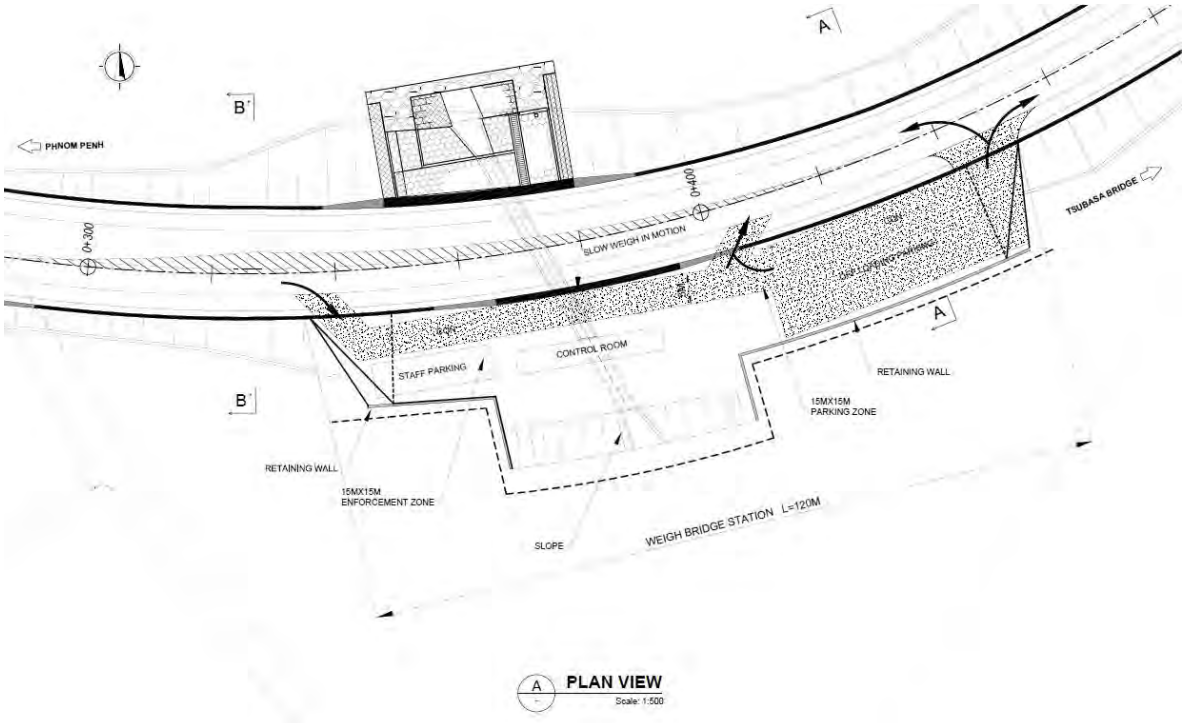


Figure 9-6 Option 1 (West 2) West side (detail)

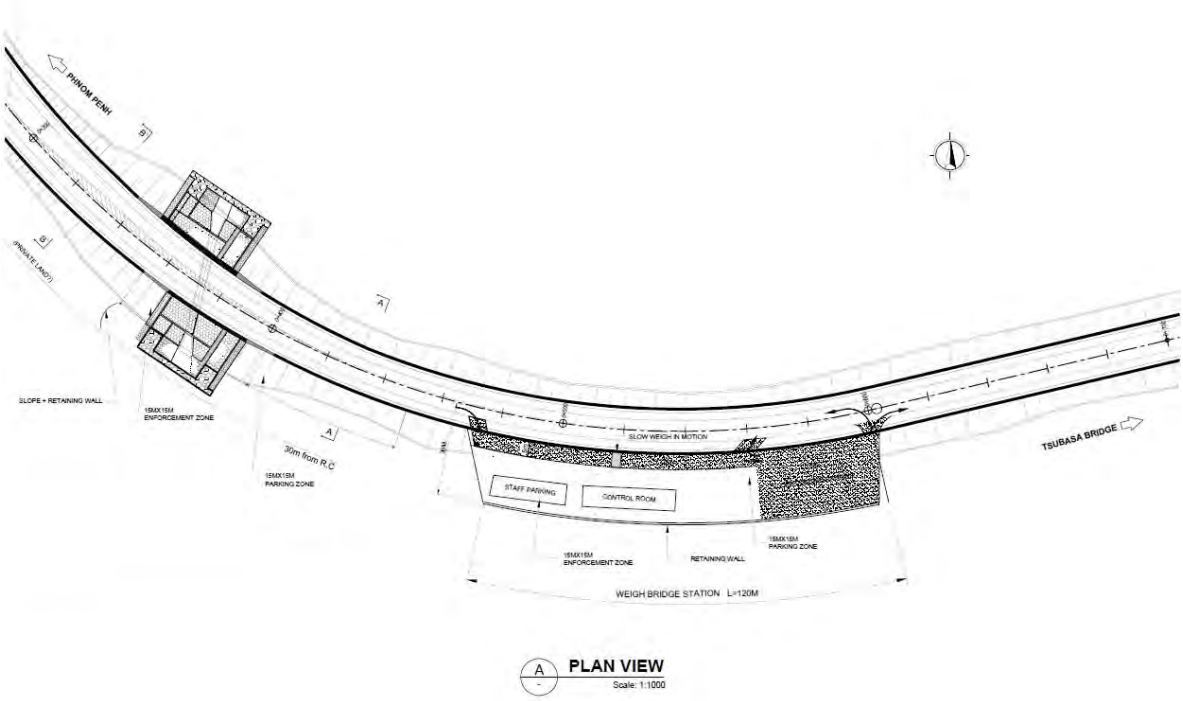


Figure 9-7 Option 2 (West 3) West side (general)

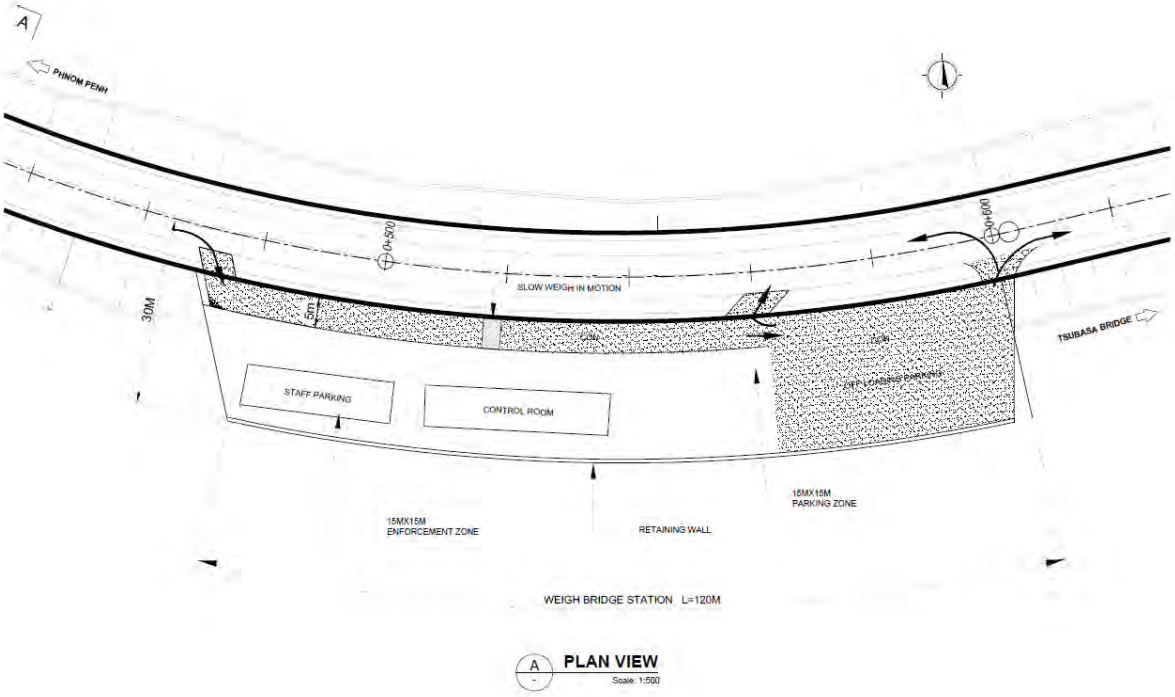


Figure 9-8 Option 2 (West 3) West side (detail)

9.2.5 East side

(1) Temporary Solution

Temporary solution is proposed to use the section between existing rumble strip at western part of the intersection to old ferry port (Figure 9-9)

The plan is to use the road shoulder to stop vehicles to scale axle loads. In order to protect surface of shoulder, it is proposed to overlay one layer to the exiting surface. A portable scale shall be used for this solution.

The new surface shall be constructed level as possible to assure accuracy of the measurement. One temporary office of 40 ft is proposed to be installed at the embankment slope with support beam to support 24-hour operation. The estimated cost is USD 40,500.

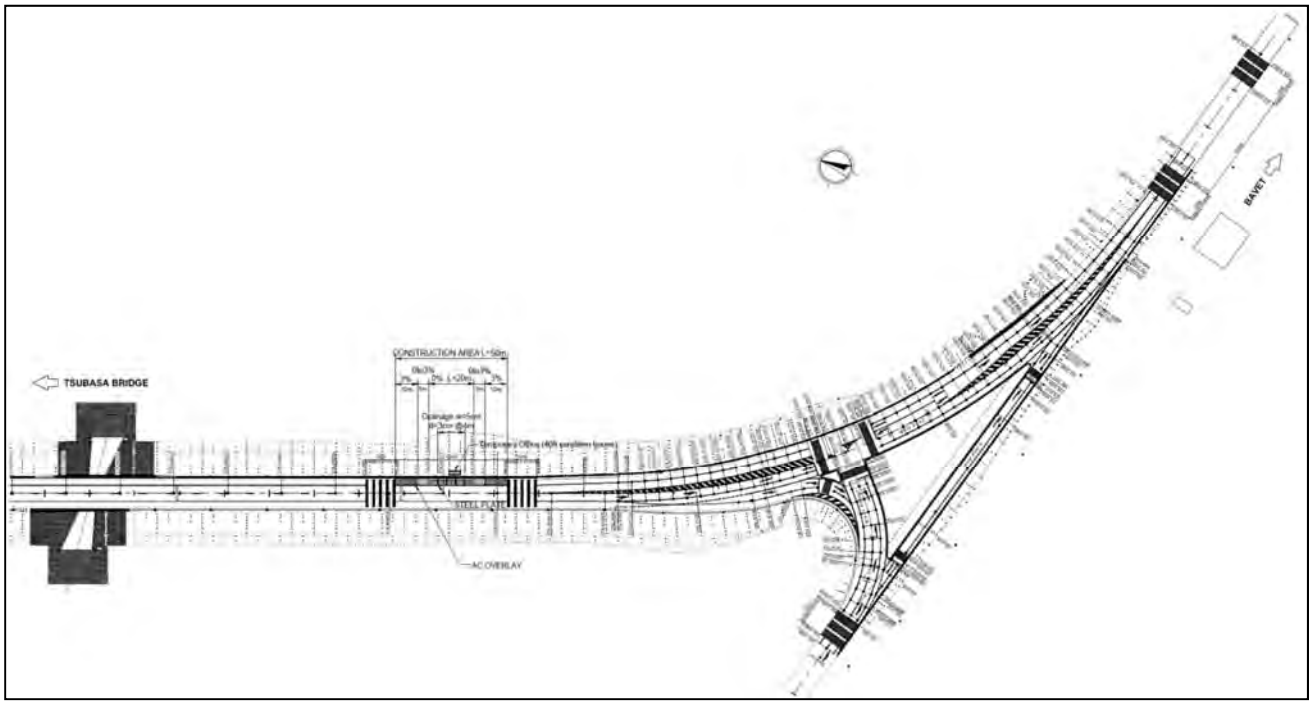


Figure 9-9 Location for Temporary Solution at East side

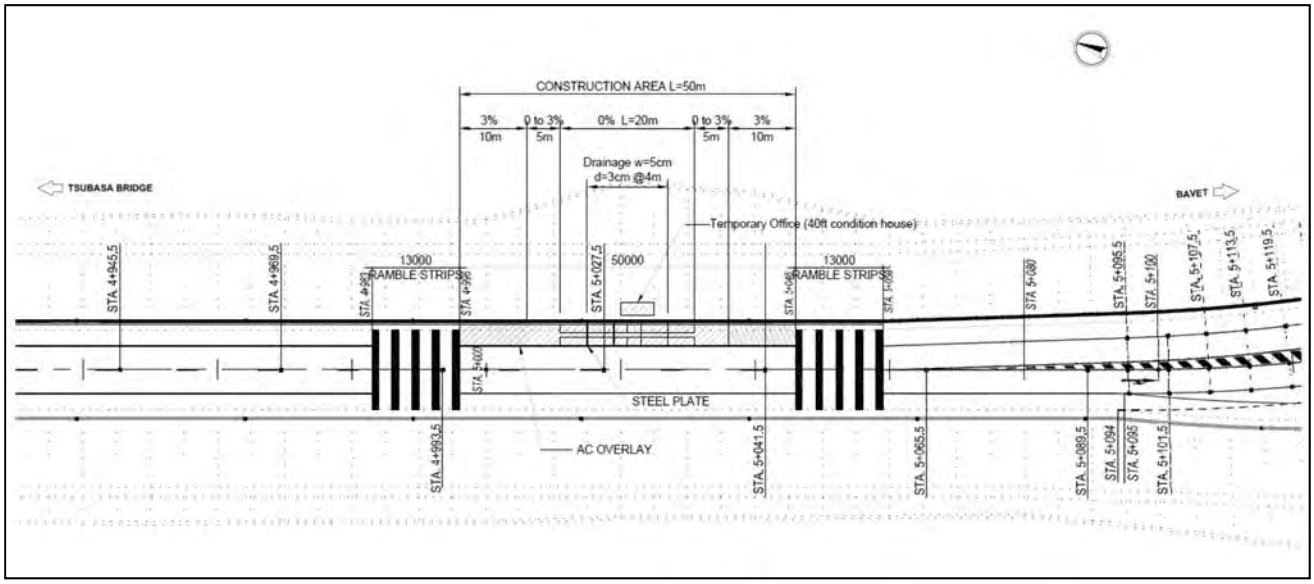


Figure 9-10 Detailed Plan for Temporary Solution

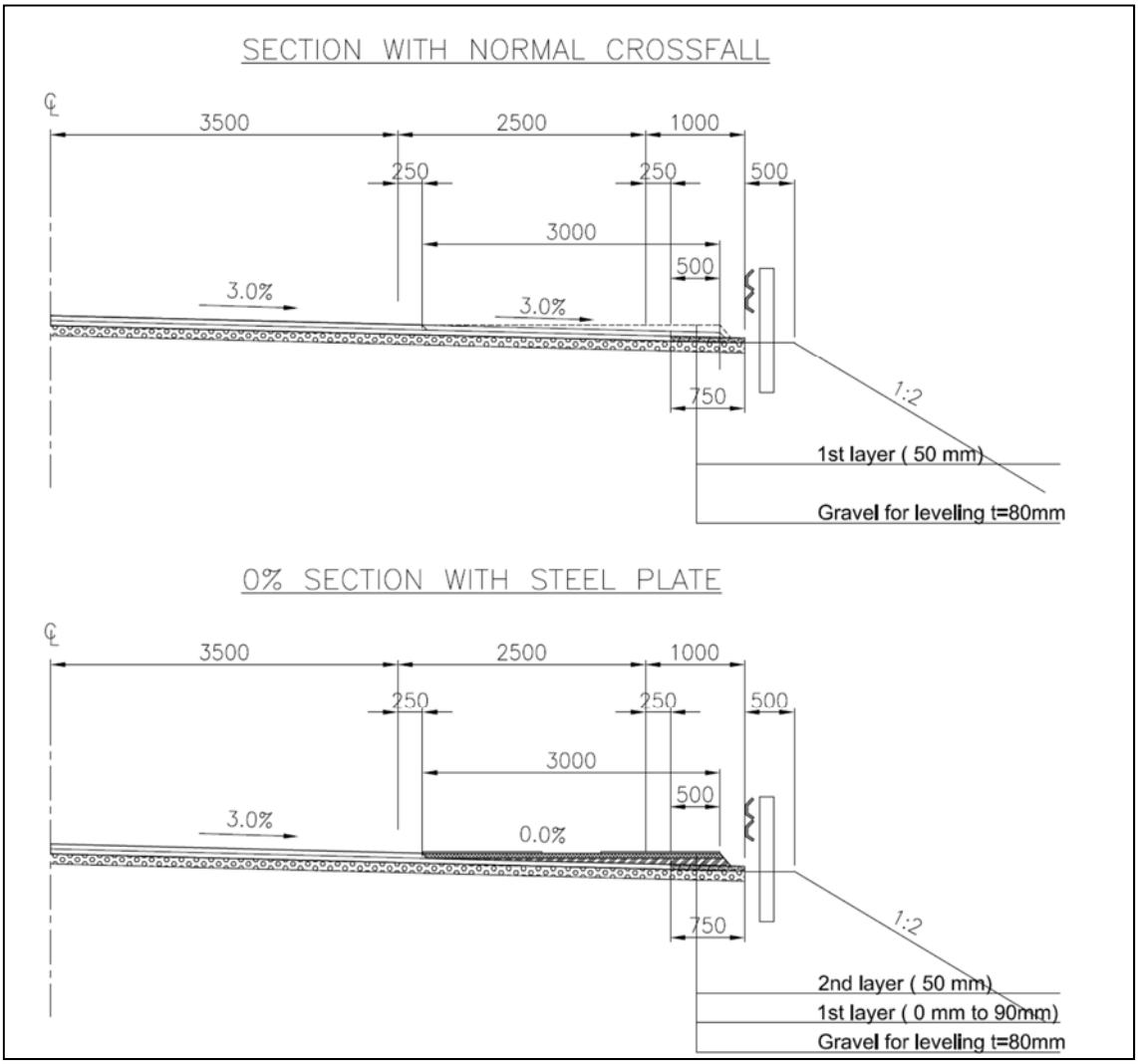


Figure 9-11 Typical Cross Section of the Temporary Solution

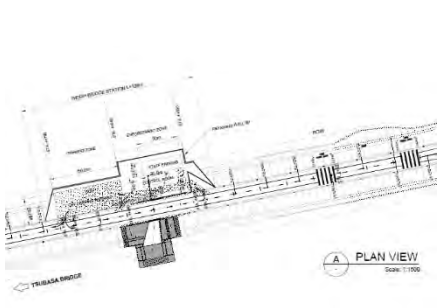
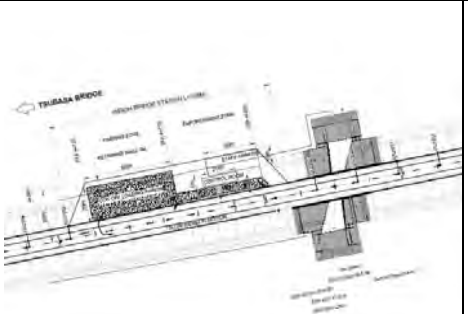
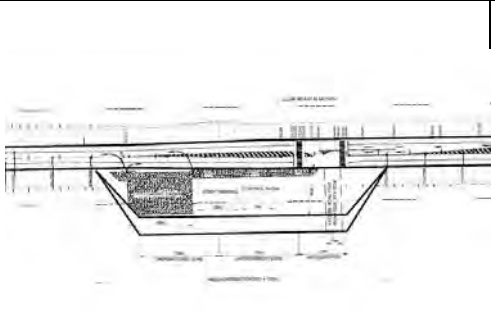
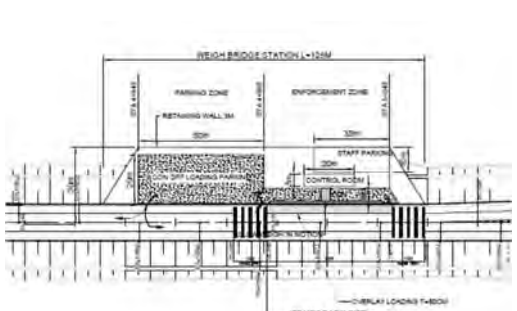
(2) Permanent Solution

Three (3) options are compared and option 2 (East 6) is recommended due to the following reasons:

1. The option 2 (East 6) is easier for operation since it is close to the existing intersection.
2. Ease of construction (better soil condition)
3. Option 3 (East 7) is favorable because land is already available, even though the weigh bridge station will be in the opposite side of the traffic direction.

Figure 9-12 Location of the options

Table 9-12 Alternative Comparison for East side

Options	Option 1(East 5) (Construct at 4+850 (Box Culvert))	Option 2 (East 6) (Construct at 4+770 (West of box culvert))	Option 3 (East 7) (Construction at 3+780 (land for roadside station))	Option 4(East 4-2) (Construct at 5+020) Improvement of current operation office
Plan				
Outline	(1) Expand existing box culvert (2) Construction of retaining wall (3) Construct embankment with soil stabilization (4) Construct weigh bridge and unloading parking	(1) Construct retaining wall (2) Construct embankment (within ROW: 30 m from centerline) with soil stabilization (3) Construct weigh bridge and unloading parking	(1) Construct embankment (within land for roadside station) with soil stabilization (2) Construct weigh bridge and unloading parking	(1) Construct retaining wall (2) Construct embankment (within ROW (30m from centerline)) with soil stabilization (3) Construct weigh bridge and unloading parking
Expected Cost	1,154,000 USD	USD 1,039,000	USD 1,884,000	USD 1,039,000 (estimated same as East 6)
Advantage	Close to intersection	Better soil condition	No land restriction	Better soil condition Close to intersection
Dis-advantage	Limitation of land Soil condition is very poor (water way) Unstable soil condition at existing culvert Difficulty of stabilization of foundation (more risk on cost increase) Long construction period required	Limitation of land Soil condition is poor	Soil condition is very poor (close to Mekong river) W.S. is located in opposite direction	Limitation of land Soil condition is poor
Evaluation	**Poor**	**Good**	**Fair**	**Good**

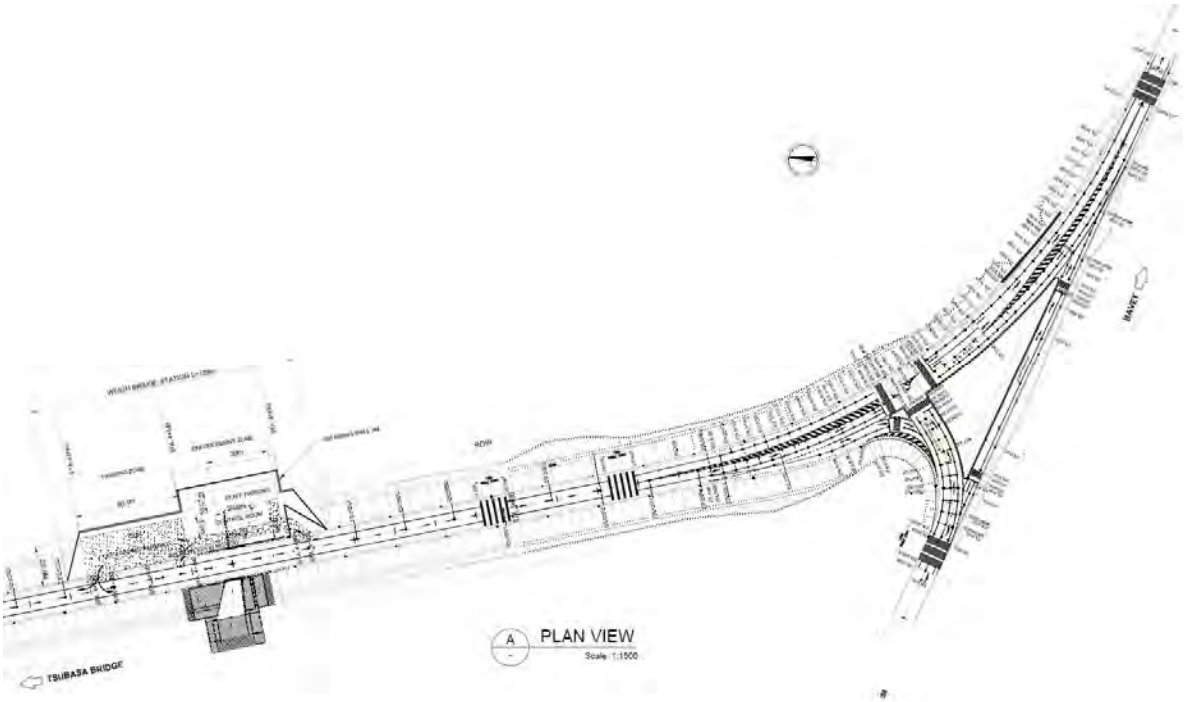


Figure 9-13 Option 1: (East 5) East side (general)

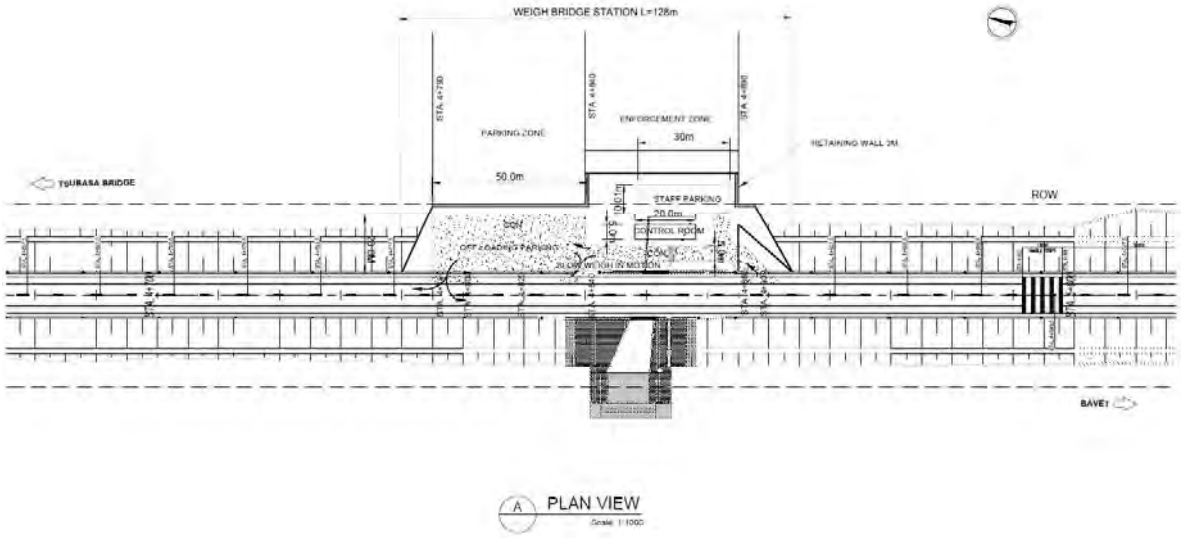


Figure 9-14 Option 1: (East 5) East side (detail)

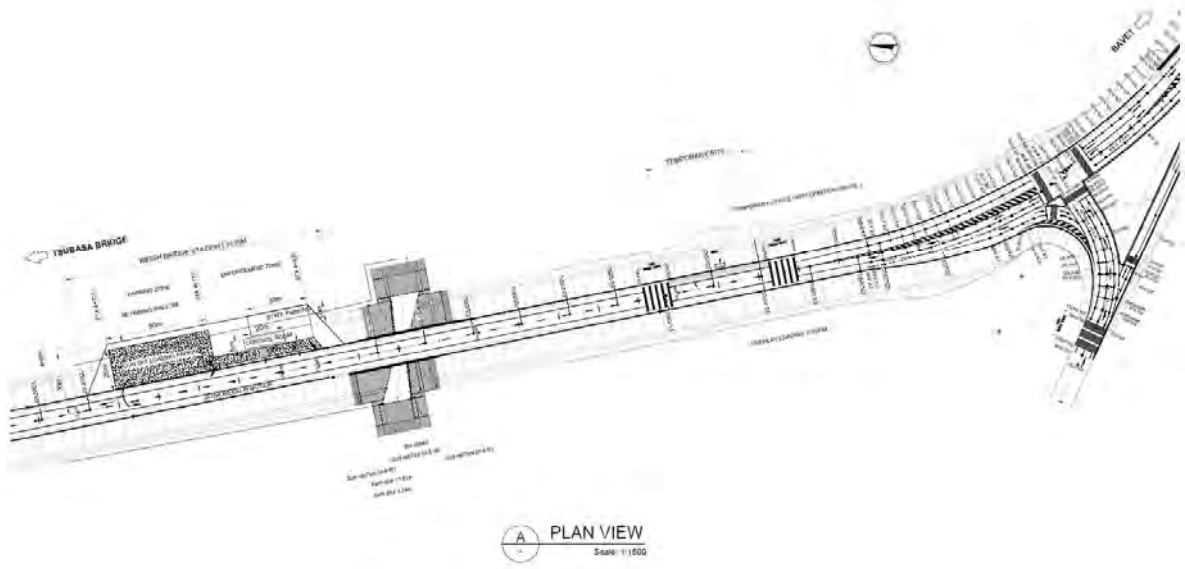


Figure 9-15 Option 2:(East 6) East side (general)

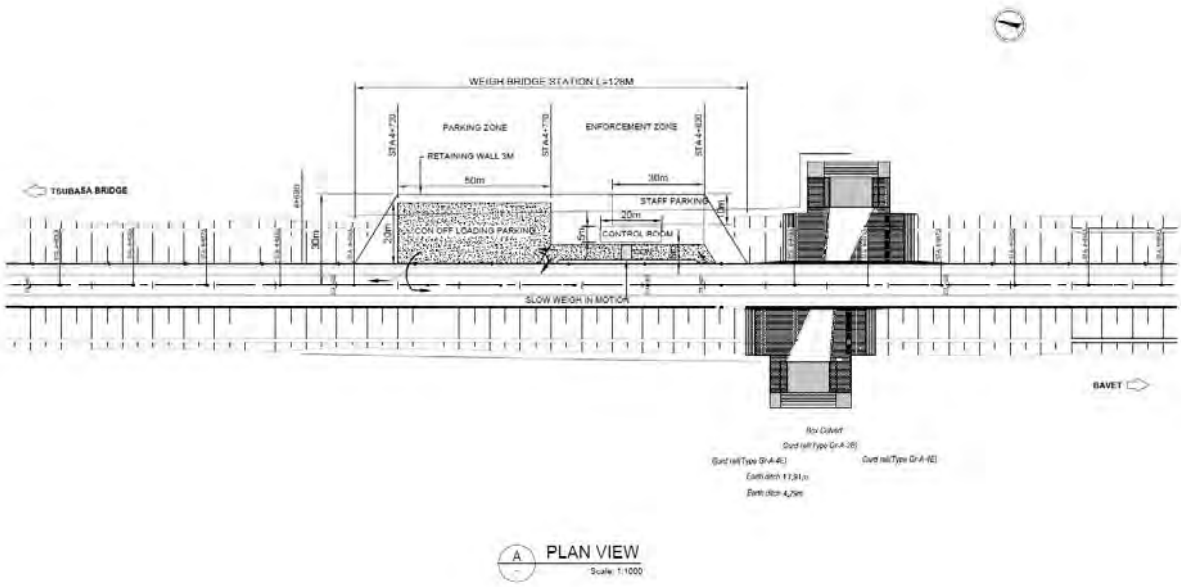


Figure 9-16 Option 2: (East 6) East side (detail)

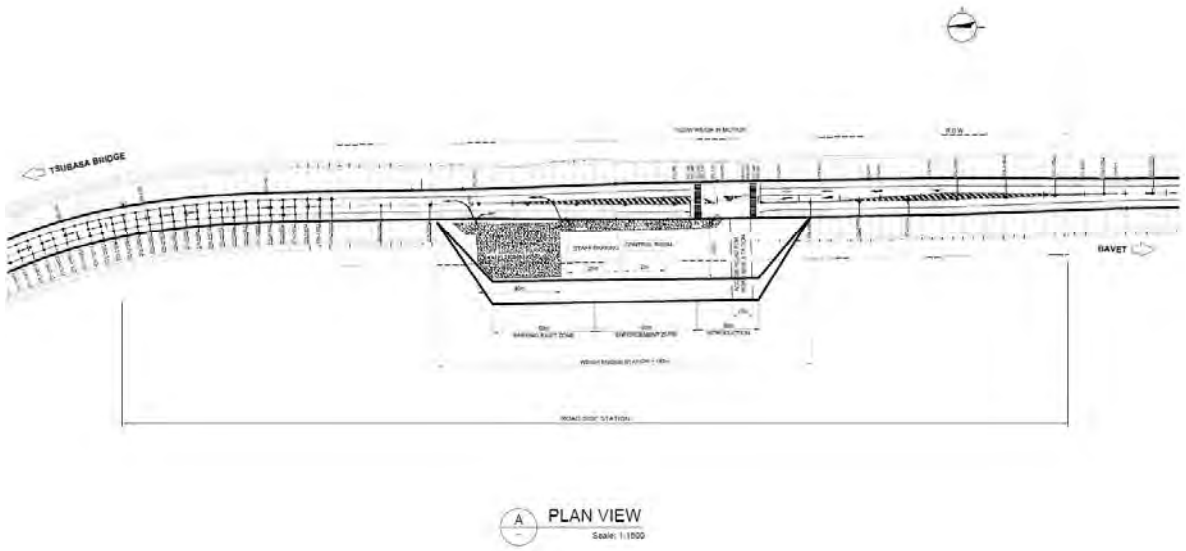


Figure 9-17 Option 3: (East 7) East side (general)

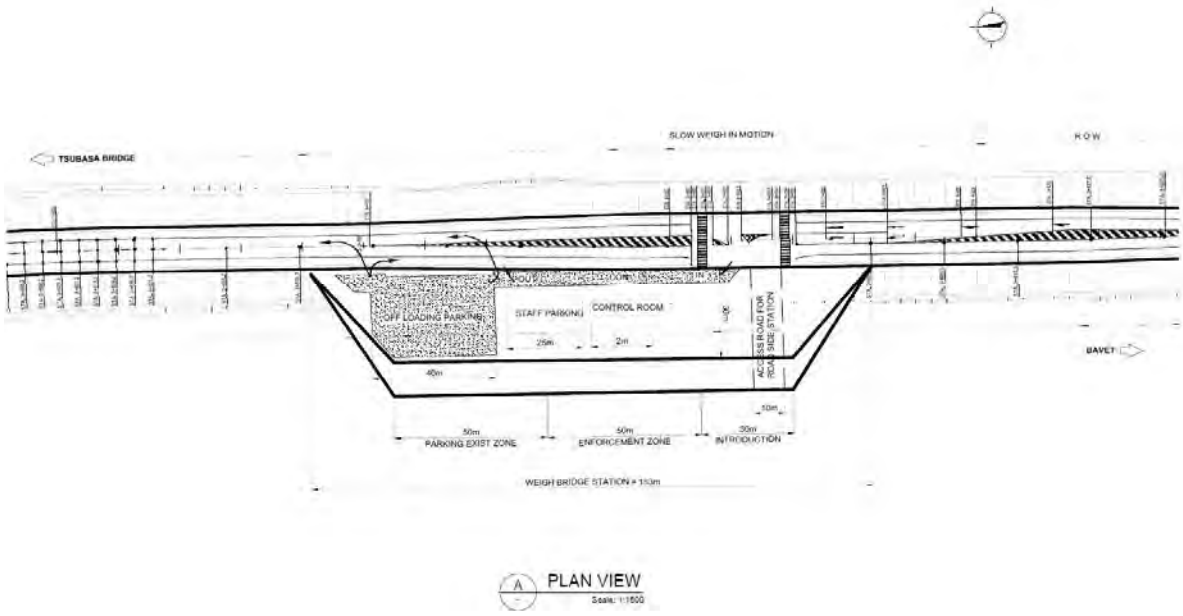


Figure 9-18 Option 3: East side (detail)

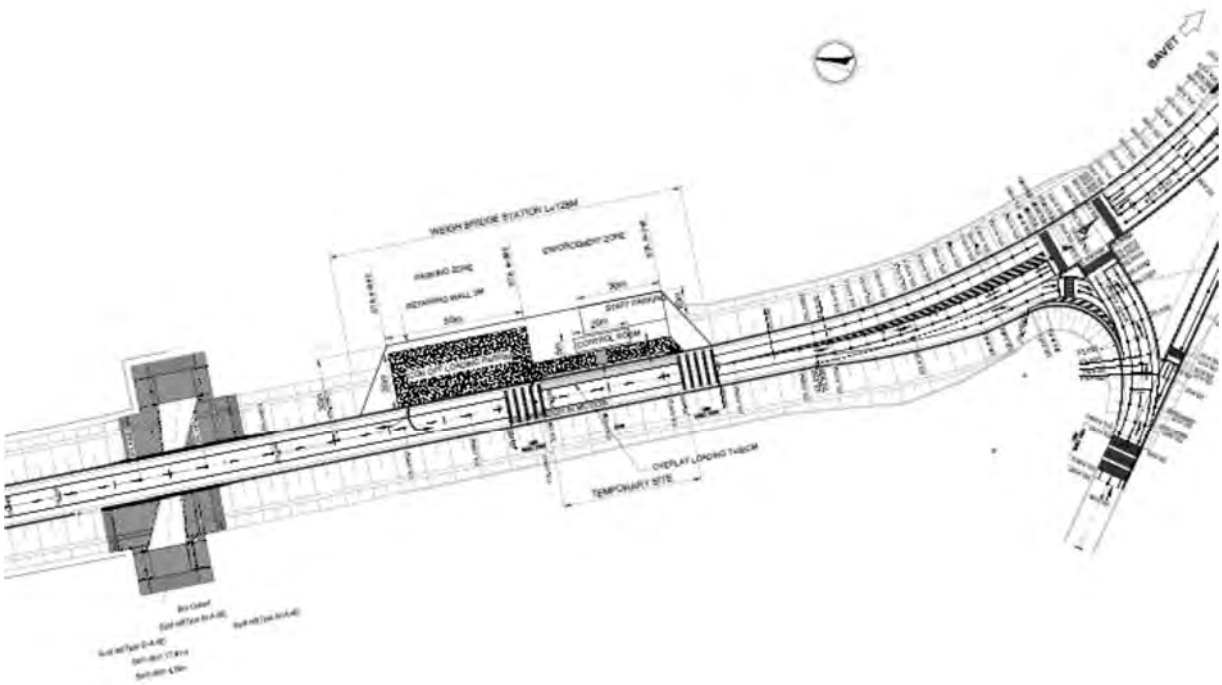


Figure 9-19 Option 4: (East 4-2) East side (general)

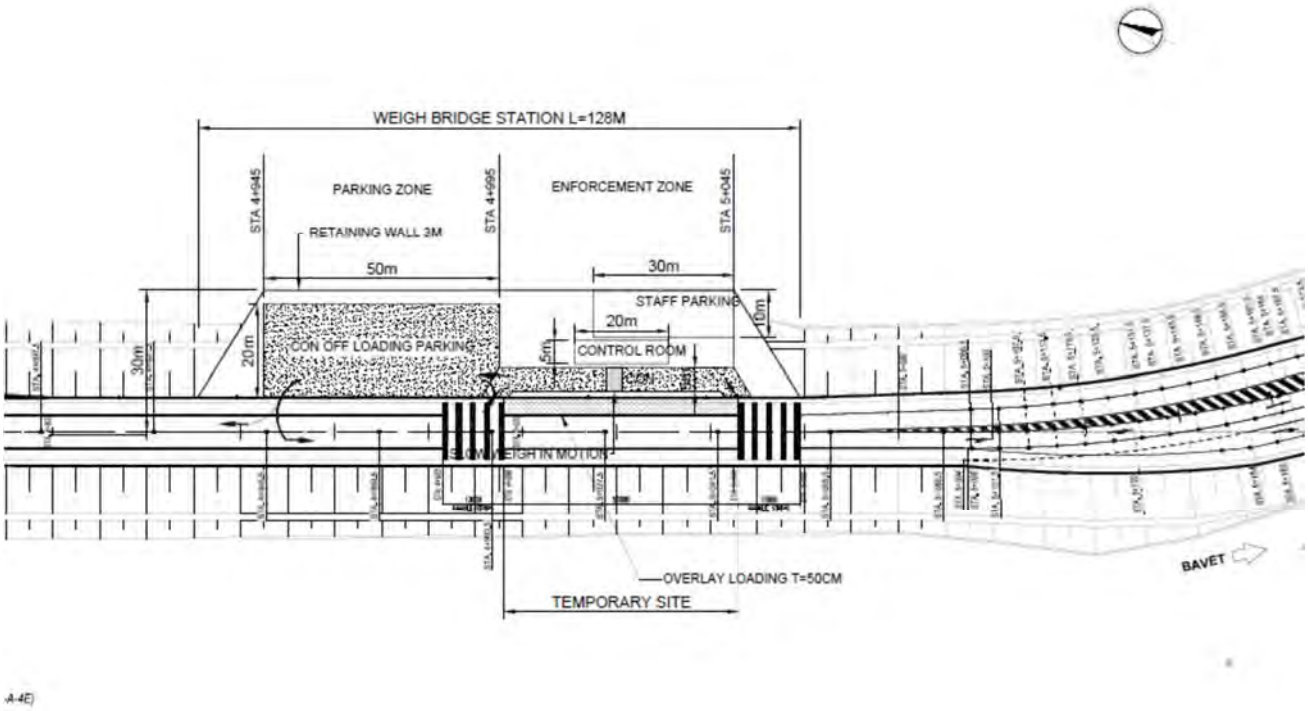


Figure 9-20 Option 4-2 (detail)

9.2.6 Measurement facility and others

The permanent weigh bridge station shall be equipped with HSWIM (High Speed Weigh in Motion) and LSWIM (Low Speed Weigh in Motion). The required number of equipment for each facility and their images are shown below.

Table 9-13 List of measurement facility and others

Facility	Number/location	Cost (in USD)	Remarks
LSWIM	1	80,000	Figure 9-21
HSWIM	1	110,000	Figure 9-22
Control Office	1	50,000	500 USD/m^2, 100 m^2
Total	1	210,000	

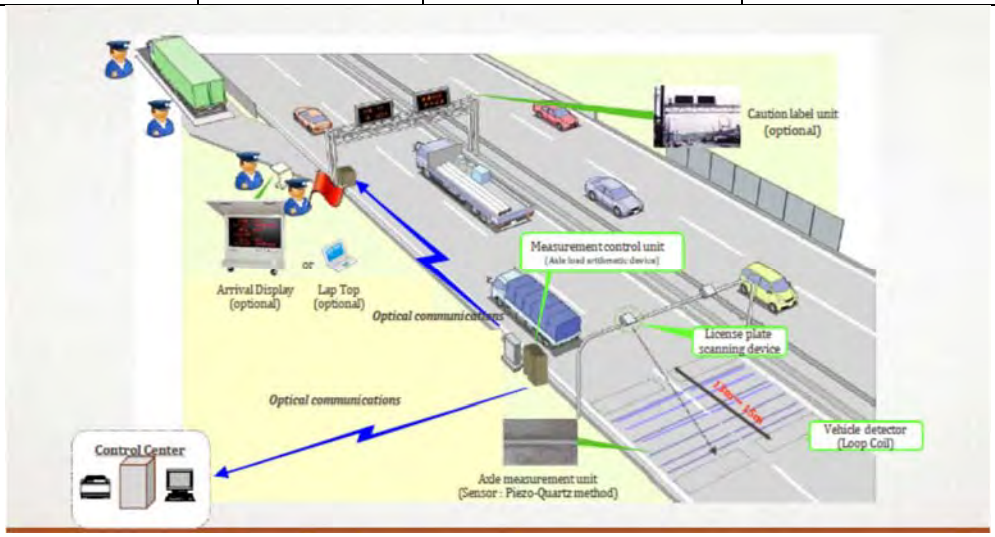


Figure 9-21 Image of HSWIM

Figure 9-22 Existing LSWIM

9.2.7 Soft countermeasures

Overloading enforcement on the road is one of the countermeasures against overloading vehicles. There are other several countermeasure strategies such as sensitization, familiarization, education, advertisements on TV, roadside banners, and government brochures and so on. Round table discussions with stakeholders such as truck associations, consigners, and the police may be one means. Nowadays, decree against overloading through HP is effective.

The MRD has initiated roundtable forums with road users, including two major truck associations in Cambodia.

A report on the survey on trucks on national route 5, indicates that cart modifications seems to be the norm in Cambodia. As economic activities increase in this country, this trend is expected to continue if nothing is done. It is believed that it is not easy to recognize the effect of the control of the modification once started.

The strategies mentioned above should be implemented through the initiative of MPWT always. Physical equipment such as weigh station and tools such as portable scales have not been fully allocated to Tsubasa Bridge. This is the key reason why the study result recommends a temporary solution as pilot project while preparation for a more permanent solution is made.

The consideration for the establishment of a maintenance control unit for the bridge is also recommended. This shall enable a 24-hour overloading control and supervision of the bridge.

9.2.8 Cost estimation

For the project cost, unit cost is used by making the existing construction project.

Quotations are collected for unit cost for special product, such as Low WIM or Fast WIM.

The estimated cost for the proposed alternatives are summarized in Table 9-14 and Table 9-15.

Table 9-14 Estimated Cost for Alternatives in the West sides

Cost estimation by Alternative

WEST 1 Temporary

Item	Unit Price	Unit	Quantity	Unit	Cost	Note
Building (main)	500	USD/m2	0	m2	0	
Container House	7,000	USD/nos	1	nos	7,000	
Concrete Pavement 25cm	50	USD/m2	0	m2	0	
Embankment	35	USD/m2	0	m2	0	
Slope treatment	10	USD/m2	0	m2	0	
Retaining wall	2,000	USD/m	0	m	0	
Duct elong	400	USD/m2	0	m2	0	
Soil improment	50	USD/m2	0	m2	0	
Portable Scale	14,000	USD/set	1	set	14,000	
LSWIM	80,000	USD/set	0	set	0	
HSWIM		USD/set	0	set	0	
Total					21,000	
Contengency					3,150	15%
Estimated Cost					24,150	

WEST 2 Permanent Alternative 1

Item	Unit Price	Unit	Quantity	Unit	Cost	Note
Building (main)	500	USD/m2	100	m2	50,000	
Container House	7,000	USD/nos	0	nos	0	
Concrete Pavement 25cm	50	USD/m2	1,400	m2	70,000	
Embankment	35	USD/m2	5,000	m2	175,000	
Slope treatment	10	USD/m2	500	m2	5,000	
Retaining wall	2,000	USD/m	120	m	240,000	
Duct elong	400	USD/m3	90	m3	36,000	
Soil improment	50	USD/m2	3,000	m2	150,000	
Reconstruction of drainage	100,000	ls	1	ls	100,000	
Portable Scale	14,000	USD/set		set	0	
LSWIM	80,000	USD/set	1	set	80,000	
HSWIM	110,000	USD/set	1	set	110,000	
Total					1,016,000	
Contengency					152,400	15%
Estimated Cost					1,168,400	

WEST 3 Permanent Alternative 2

Item	Unit Price	Unit	Quantity	Unit	Cost	Note
Building (main)	500	USD/m2	100	m2	50,000	
Container House	7,000	USD/nos	0	nos	0	
Concrete Pavement 25cm	50	USD/m2	1,400	m2	70,000	
Embankment	35	USD/m2	4,500	m2	157,500	
Slope treatment	10	USD/m2	500	m2	5,000	
Retaining wall	2,000	USD/m	120	m	240,000	
Duct elong	400	USD/m3	90	m3	36,000	
Soil improment	50	USD/m2	3,000	m2	150,000	
Reconstruction of drainage	100,000	ls	0	ls	0	
Portable Scale	14,000	USD/set		set	0	
LSWIM	80,000	USD/set	1	set	80,000	
HSWIM	110,000	USD/set	1	set	110,000	
Total					898,500	
Contengency					134,775	15%
Estimated Cost					1,033,275	

Table 9-15 Estimated Cost for Alternatives in East side

Cost estimation by Alternative

EAST 4 Temporary

Item	Unit Price	Unit	Quantity	Unit	Cost	Note
Building (main)	500	USD/m2	0	m2	0	
Container House	7,000	USD/nos	1	nos	7,000	
Overlay	50	USD/m2	150	m2	7,500	
Embankment	35	USD/m2	0	m2	0	
Slope treatment	10	USD/m2	0	m2	0	
Retaining wall	2,000	USD/m	0	m	0	
Duct elong	400	USD/m2	0	m2	0	
Soil improment	50	USD/m2	0	m2	0	
Portable Scale	14,000	USD/set	1	set	14,000	
LSWIM	80,000	USD/set	0	set	0	
Others		USD/set	0	set	6,700	light, generator
Total					35,200	
Contengency					5,280	15%
Estimated Cost					40,480	

EAST 5 Permanent Alternative 1

Item	Unit Price	Unit	Quantity	Unit	Cost	Note
Building (main)	500	USD/m2	100	m2	50,000	
Container House	7,000	USD/nos	0	nos	0	
Concrete Pavement 25cm	50	USD/m2	1,400	m2	70,000	
Embankment	35	USD/m2	5,500	m2	192,500	
Slope treatment	10	USD/m2	500	m2	5,000	
Retaining wall	2,000	USD/m	120	m	240,000	
Duct elong	400	USD/m3	90	m3	36,000	
Soil improment	50	USD/m2	2,400	m2	120,000	
Reconstruction of drainage	100,000	ls	1	ls	100,000	
Portable Scale	14,000	USD/set		set	0	
LSWIM	80,000	USD/set	1	set	80,000	
HSWIM	110,000	USD/set	1	set	110,000	
Total					1,003,500	
Contengency					150,525	15%
Estimated Cost					1,154,025	

EAST 6 Permanent Alternative 2

Item	Unit Price	Unit	Quantity	Unit	Cost	Note
Building (main)	500	USD/m2	100	m2	50,000	
Container House	7,000	USD/nos	0	nos	0	
Concrete Pavement 25cm	50	USD/m2	1,400	m2	70,000	
Embankment	35	USD/m2	5,500	m2	192,500	
Slope treatment	10	USD/m2	500	m2	5,000	
Retaining wall	2,000	USD/m	120	m	240,000	
Duct elong	400	USD/m3	90	m3	36,000	
Soil improment	50	USD/m2	2,400	m2	120,000	
Reconstruction of drainage	100,000	ls	0	ls	0	
Portable Scale	14,000	USD/set		set	0	
LSWIM	80,000	USD/set	1	set	80,000	
HSWIM	110,000	USD/set	1	set	110,000	
Total					903,500	
Contengency					135,525	15%
Estimated Cost					1,039,025	

EAST 7 Permanent Alternative 3

Item	Unit Price	Unit	Quantity	Unit	Cost	Note
Building (main)	500	USD/m2	100	m2	50,000	
Container House	7,000	USD/nos	0	nos	0	
Concrete Pavement 25cm	50	USD/m2	1,400	m2	70,000	
Embankment	35	USD/m2	23,400	m2	819,000	
Slope treatment	10	USD/m2	2,340	m2	23,400	
Retaining wall	2,000	USD/m	0	m	0	
Duct elong	400	USD/m3	90	m3	36,000	
Soil improment	50	USD/m2	9,000	m2	450,000	
Reconstruction of drainage	100,000	ls	0	ls	0	
Portable Scale	14,000	USD/set		set	0	
LSWIM	80,000	USD/set	1	set	80,000	
HSWIM	110,000	USD/set	1	set	110,000	
Total					1,638,400	
Contengency					245,760	15%
Estimated Cost					1,884,160	

Appendix: Draft Plan for the Pilot Project

Attachment 1: Pilot Project Plan

Table 1: Summary of the Pilot Project

No	Item	Contents	Implementation	Remark
1	Overloading Control	[Facility improvement] 1-1. Procurement of portable axle load scales 1-2. Improvement temporary yard	(1) Portable scale (2 sets and spare parts) (2) Leveling of surface (3) Temporary office	Portable scale 2 sets (including spare parts) One 40 ft container house AC Surface Leveling (east side)
		[Technical improvement] 1-3. Enhancement of data collection and management 1-4. Enhancement of site control/ inspection of Tsubasa bridge	Data collection, record, report Regular daily inspection of the bridge and recording	
2	Traffic Data collection	2-1. Traffic Count	3 times (beginning, middle and end of the pilot project)	
3	Verification of operation	Verification of effectiveness of operation	(1) Equipment (2) Number of staff (3) Work management	

Table 2: Contents of technical assistance

Item		Cambodian sides	Japanese sides
1-3 Enhancement on data collection and management	Data collection, reporting	Daily report on basic data (ex. Total number of trucks, overloaded trucks, commodity, origin, destination, company etc.,) Report line	Providing advice on improvement of the form Data collection methodology
	Regular daily inspection of the bridge/ recording	Conduct daily inspection of the bridge (pavement, safety facility)	Methodology on visual inspection Forms Reporting line
1-4. Enhancement of site control/ inspection of Tsubasa bridge	3 times (beginning, middle and end of the pilot project)	Data analysis	24-hours traffic survey

Attachment 2: Undertaking of Japanese and Cambodian side in the implementation stage

Table 3: Undertakings

<table>
<tr><th>Cambodian side</th><th>Japanese sides</th></tr>
<tr><td>
1. Operation
(1) Operation staff and their salary and allowances
List of the staff required
<table>
<tr><th></th><th>West</th><th>East</th></tr>
<tr><td>MPWT Officer</td><td>10</td><td>7</td></tr>
<tr><td>Traffic Police</td><td>2</td><td>2</td></tr>
<tr><td>Military Police</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>14</td><td>11</td></tr>
</table>
(2) Operation Cost
Electric supply & expense, etc. for both east and west side for the 24-hours operation .
Office supply for operation, etc.

2. Land preparation
- Land for the installation of container house on the west side should be secured

3. Temporary weigh bridge station facility
- The foundation for the container house should be constructed for both sides with sufficient strength for a 40 feet container house.

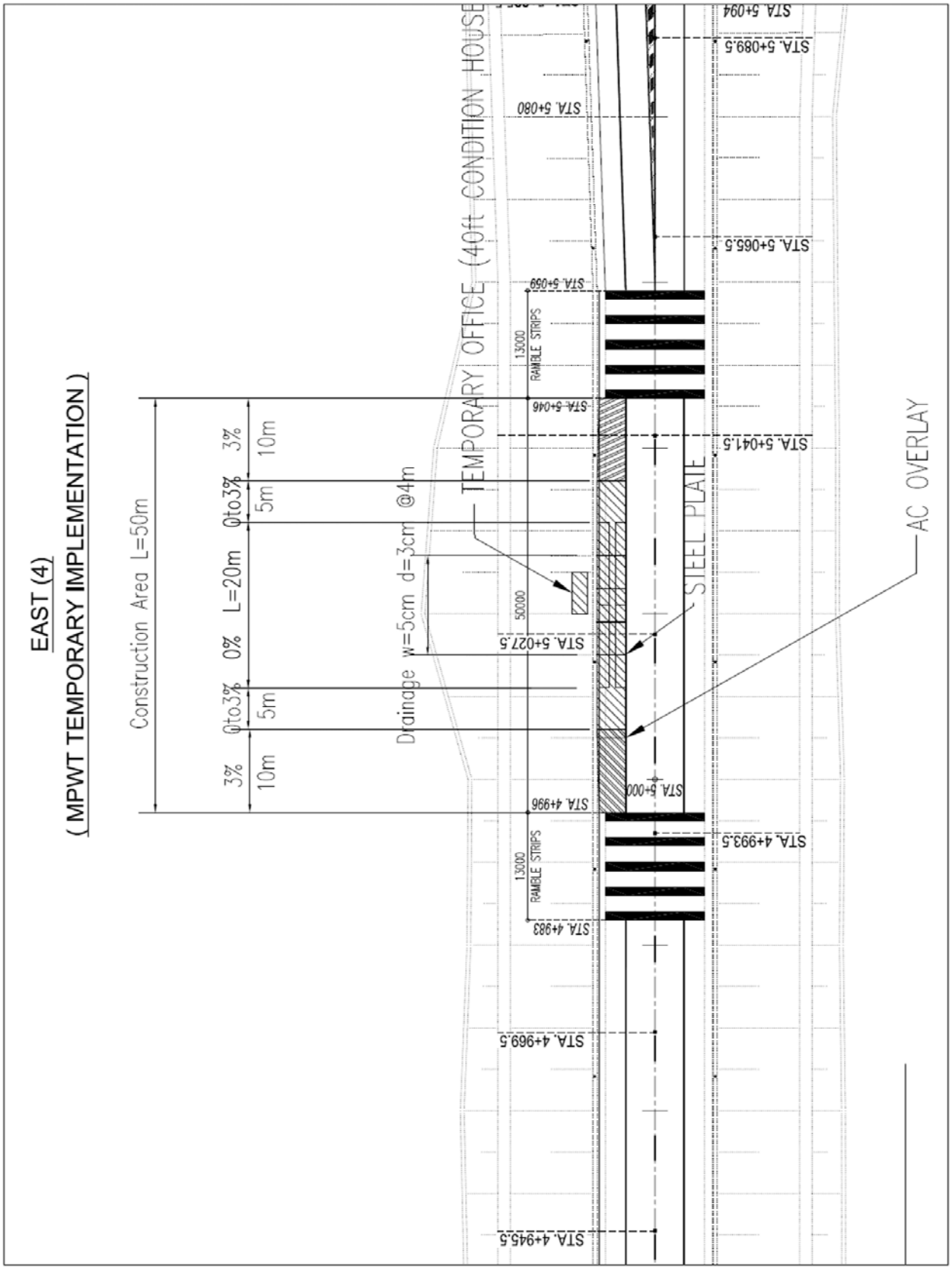
4. Maintenance of procured equipment and facilities
</td><td>
1. Experts
(1) Japanese Expert
- Overloading Operation and monitoring: 2.5 MM
- Procurement of equipment and materials/ installation: 1.0 MM
(2) Local Assistant
- Operation and monitoring assistant: 3.5 MM
(3) Traffic Survey
- 12 persons/day x 3 days 36.0 Mday
(4) Vehicle
1) Overloading control
- Overloading operation and monitoring: 2.5 MM
- Procurement of equipment/ installation: 1.0 MM
2) Traffic Count
- Mobilization of surveyors: 3 days (0.1MM)
Total 3.6 MM
2. Equipment
(1) Scale
- Portable axle load scale: 2 sets including spares
(2) Container House
- 40 ft container house: 1 set (one for west at NR.14)
(3) Surface leveling construction
- Asphalt Concrete 50 m x 3.0 m = 150 m^2
(**Attachment 4**)
</td></tr>
</table>

Attachment 3: List of equipment to be procured

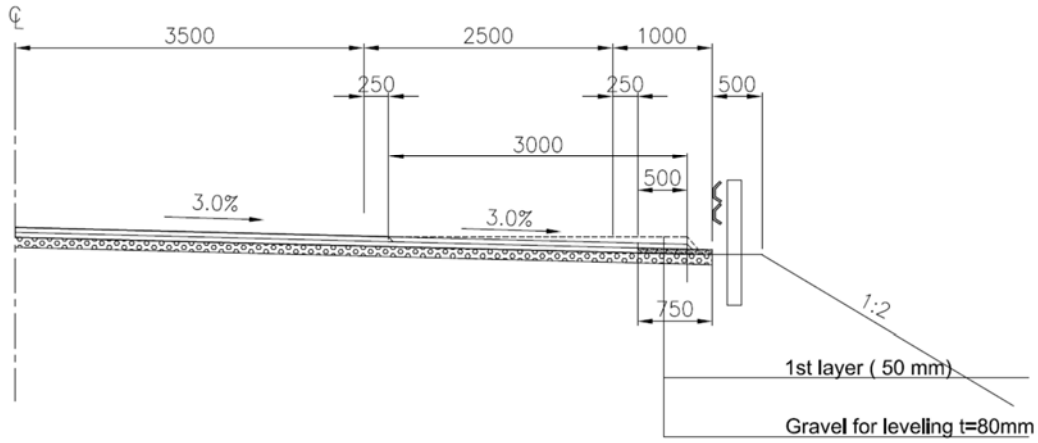
Table 4: List of equipment to be procured

No	Name of the product	Quantity	Unit	Specification	Remark
1	Portable weigh scale	2	set	Capacity 15 ton/plate	Including spare parts
2	Container house	1	nos	40 ft	West at NR.14 (use part of space for project activity during pilot project)

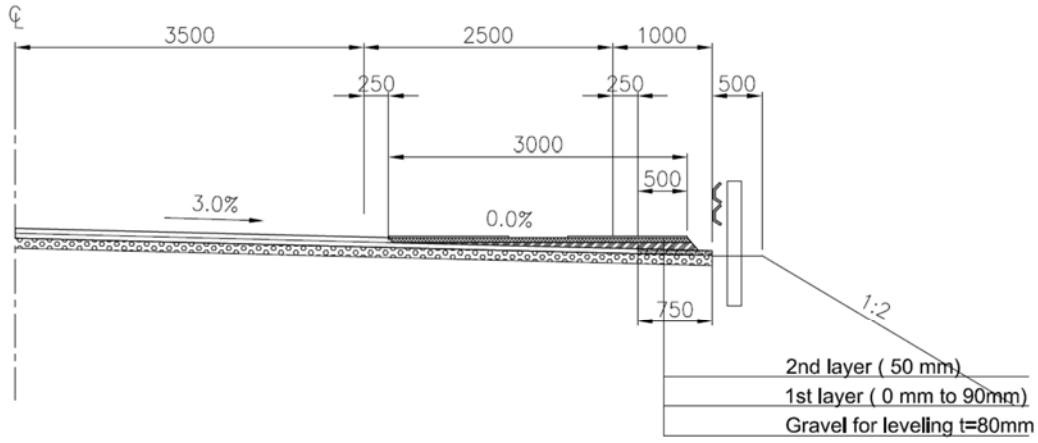
Attachment 4: Overlaying Plan in East Sides

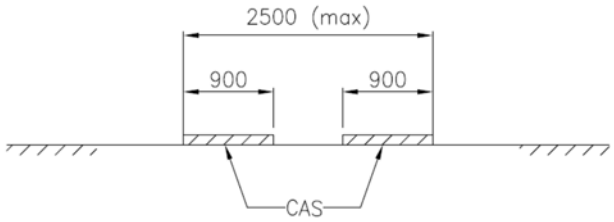


SECTION WITH NORMAL CROSSFALL



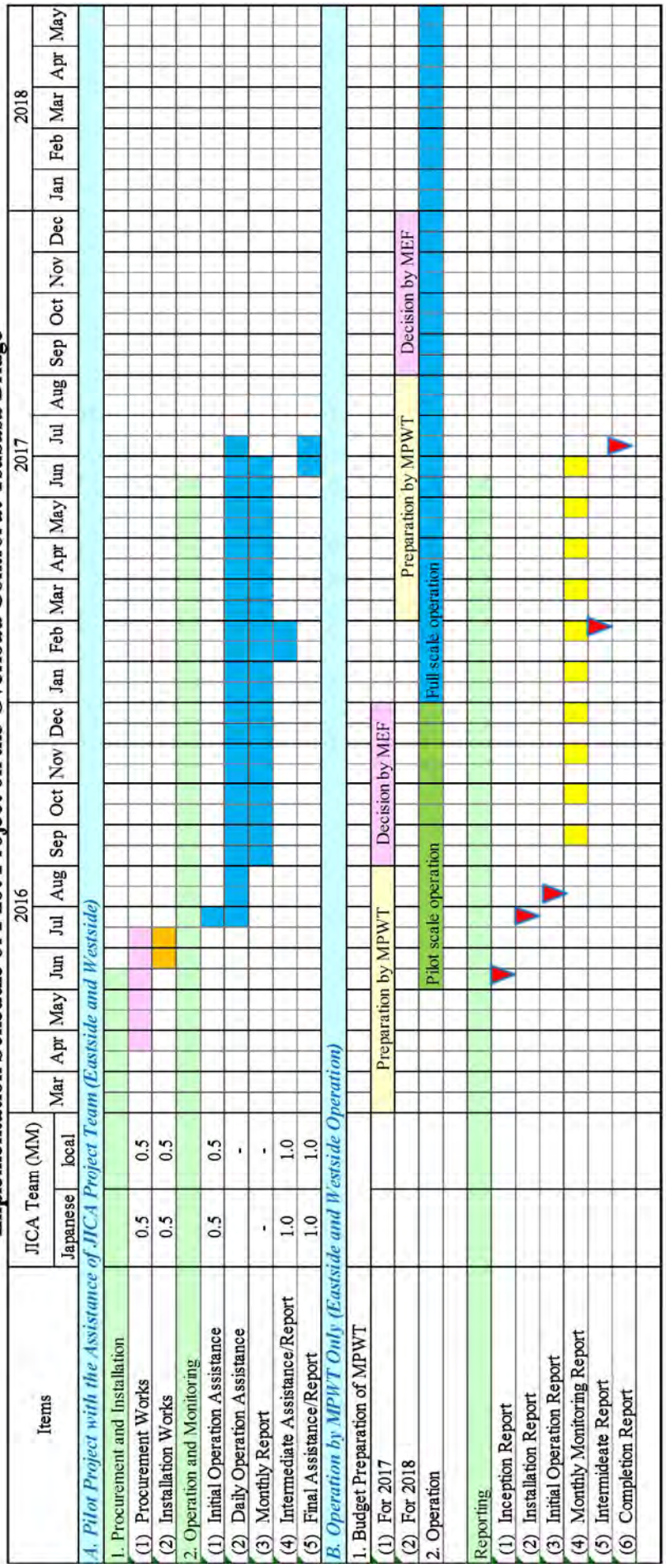
0% SECTION WITH STEEL PLATE





LOCATION OF CAS

Attachment 5: Implementation Schedule



Example of permanent solution (Draft)

A. Data collection	1. Daily overloading vehicle data should be forwarded to MPWT, and monthly and annual report should be made and reported to the Secretary.
	2. Enforcement report at each site is recommended.
	3. Investigation of traffic volume should be conducted periodically at designated points.
	4. Structural accident report should be made in prescribed format.
	5. Notice, warning, penalty data should be collected and analyzed. Repeated violators should be penalized.
B. Maintenance and management	6. Equipment failure should be reported and the cause of the failure recorded. Immediate repair must be done.
	7. Private companies should be incorporated into the maintenance works/services.
	8. Facility/Equipment operators should be trained periodically on maintenance.
	9. Tsubasa Bridge is located on loose, thick and unstable soil layers. Consecutive survey investigation is required.
	10. It is advisable that a site control office is established and periodical observation is done for road surface as well as under the bridge.
C. Enforcement	11. Portable scale should be considered again as a viable tool for enforcement.
	12. Penalties should not be limited to drivers. The transport companies and consigners should owe due liability.
	13. The penalty fee should be collected through a financial institution such as commercial bank.
	14. The classification may be shifted one step higher from the current “5 to 10%, 10% to 20%, and more than 20%” to such as “10% to 30%, 30% to 50%, and more than 50%”.
	15. Overloading seminars should be organized at MPWT or at an outside venue.
	16. Roundtable discussions should be held between the police, transportation companies, consigners and road administrators.
D. Familiarization	17. Pamphlet against overloading issue should be published and distributed.
	18. Roadside signs or banners against overloading should be constructed.
	19. Familiarization and sensitization on overloading issues should be addressed by making use of possible communication tools, including internet, TV or newspapers by MPWT.
E. Plan and action program	20. An overloading master plan should be stated and implemented quantitatively.
	21. A strategic program against cart modification should be made, and an action program implemented accordingly.

9.3. Pilot project for Tsubasa Bridge

9.3.1 Objective

Overloading is the main cause of pavement and bridge deterioration in Cambodia. Urgent countermeasures should be compulsory in order to provide lasting pavement and bridges for a secure sustainable economic and social development in Cambodia. The Pilot project for the countermeasure was planned at Tsubasa bridge.

(1) Status and improvement plans

The enforcement of overloading at Tsubasa Bridge started from February 2016 as two of the 25 enforcement locations. The output is reported monthly. The enforcement data is stored at the local enforcement site, and not utilized as "proactive measures" against incessant violators.

In the previous report, it was stated that it would be advisable to take following steps.

Table 9-16: Plans and Goals

Improvement plans	Goals at the end of Pilot Project
1) Daily overloading vehicle data should be forwarded to MPWT, and a monthly and annual report should be made and reported to the Secretary.	Daily enforcement data are documented and reported to MPWT from the operation offices. Monthly and annual reports are published.
2) Enforcement report at each site is recommended.	Monthly report is published.
3) Investigation of the traffic number should be conducted periodically at designated points.	Traffic survey is implemented at least three times.
4) Structural accident report should be made in a prescribed format.	Accident report is submitted to MPWT from the operation offices.
5) Notice, warning, penalty data should be collected and analyzed. Repeated violators should be penalized.	An enhanced monthly report is done.
6) Facility / Equipment failure should be reported and the cause of the failure recorded. Immediate repair must be conducted.	Failure report should be submitted to MPWT from the operation offices.
7) Private companies should be incorporated in maintenance work.	Investigation meeting should be held with the participation from the private sectors.
8) Facility/Equipment operators should be trained periodically on maintenance.	Training seminar for overloading enforcement is held periodically.
9) Tsubasa Bridge is located on loose, thick and unstable soil layers. Consecutive survey investigation is required.	Investigation on maintenance of massive structure on loose soil is implemented with continuous survey after the construction.
10) It is recommended that a site control office is established and periodic observation is done for the road surface as well as under the bridge.	Investigation on site control office is made. Proposition of action plan.

(2) Submission of Reports

Table 9-17 Submission of Report

No	Report	Submission
1	Inception Report	23 September 2016 to Mr. Vuthan
2	Installment Report	10 October 2016 to HE. Seng. Chhuon
3	Initial Operation Report	18 October 2016 to Mr. Sinaveth
4	Traffic Count Survey Report	17 October 2016 to Mr. Vuthan
5	Monthly Report (July, August, September, October, November 2016)	Every end of month to Mr. Vuthan

9.3.2 Overloading enforcement cooperation

(1) Facility cooperation

2 sets of portable scale will be procured. Introductory assembly of explanation will be held at the start of the use of the scale by the supplier (corresponding to 8). Leveling of asphalt surface is executed by asphalt concrete. A temporary office is installed at enforcement site.

(2) Engineering cooperation

Engineering assistance will be provided with respect to data collection, data recording and transportation, document reporting (1, 2, 5). Daily inspection or patrolling of the bridge is assisted together with recording and reporting to MPWT (6, 10). A joint workshop is held since MPWT is expected to perform the daily road patrolling at Tsubasa Bridge after the pilot project.

9.3.3 Traffic survey

A 24-hour traffic survey to be executed thrice during the program (3). A Joint workshop is held since MPWT is expected to perform traffic survey after the pilot project.

9.3.4 Administrative enhancement

For overloading enforcement to become sustainable, effectiveness of the operation should be reviewed. A site control office will be studied, where daily inspection and patrolling will be executed (4, 6, 7, and 10).

9.3.5 Miscellaneous activity

Private sector involvement will be considered during enforcement (7). Ground settlement measurement will be discussed with MPWT (9).

Table 9-18 TCP schedule

June 2016 to July 2017

Implementation Schedule of Pilot Project on the Overload Control at Tsubasa Bridge

Items	JICA Team (MM)		2016										2017												2018				
	Japanese	local	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
A. Pilot Project with the Assistance of JICA Project Team (Eastside and Westside)																													
1. Procurement and Installation																													
(1) Procurement Works	0.5	0.5																											
(2) Installation Works	0.5	0.5																											
2. Operation and Monitoring																													
(1) Initial Operation Assistance	0.5	0.5																											
(2) Daily Operation		-																											
(3) Monthly Report	-	-																											
(4) Intermediate Assistance/Report	1.0	1.0																											
(5) Final Assistance/Report	1.0	1.0																											
(6) Operation																													
B. Operation by MPWT Only (Eastside and Westside Operation)																													
1. Budget Preparation of MPWT																													
(1) For 2017			Preparation by MPWT						Decision by MEF																				
(2) For 2018															Preparation by MPWT						Decision by MEF							
2. Operation						Pilot scale operation							Full scale operation																
Reporting																													
(1) Inception Report																													
(2) Installation Report																													
(3) Initial Operation Report																													
(4) Monthly Monitoring Report																													
(5) Intermideate Report																													
(6) Completion Report																													

Note: Fund for 9 overload control program was approved among 20 candidates
Annual fund for operating one (1) overload control office for the Year-2016 was evaluated at 219,534,000 riel (USD55,000): USD110,000 for two (2) sites.

Workshop or board meeting of presentation will be held in October 2016, April 2017 and September 2017.

9.3.6 TCP members on overloading control at Tsubasa Bridge

Tentative TCP members for discussion are as highlighted in Table 9-19.

Table 9-19 Tentative TCP members

Chao Sopheak Phibal	Chief of Planning&Technical Bureau			MPWT
You Dara	Deputy Chief of Bureau Road Inventory&Maintenance			MPWT
Takashi NAKAJIMA	Deputy Team Leader /Road Maintenance Planner			CTI Engineering International Co., Ltd.
Fumio HAKAMADA	Road Maintenance Engineer (3)			Hanshin Expressway Co., Ltd.
Kiry Nyvirak	Office Assistant Staff			assistant of TCP
Seng. Chhuon	MPWT			
Ek. Roath	MPWT			
Min Ravy	MPWT			
Duch Bunthan	MPWT			
Im Vuthan	MPWT			
Nhem Sokkern	DPWT			chief of enforcement at east
Gnek Som On	Comin Khmere			member of private involvement
Hum Borasy	AAP			member of private involvement

9.3.7 Installations

(1) Objective

During the project, the following shall be installed:

1. Pavement at east station
2. Two Container houses at east and west stations
3. Two sets of portable scales at east and west stations

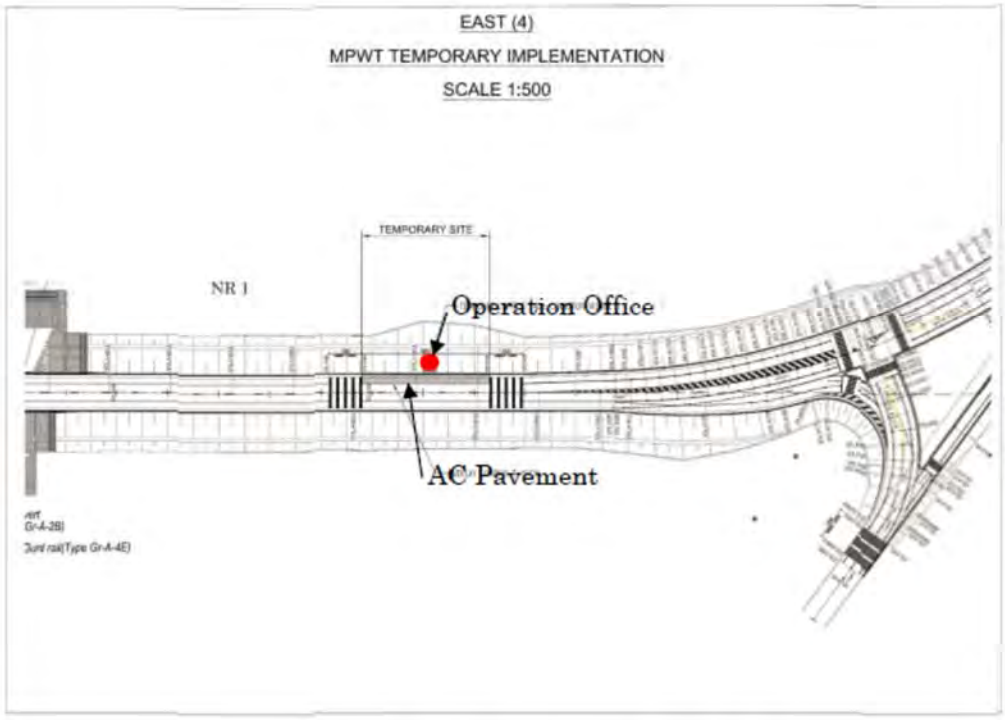
(2) General view and pavement at east section

In this pilot project, three enforcement stations are selected as shown in Figure 9-23. As one of the west stations, existing fixed station was used. Mobile scales are used at the other two stations.

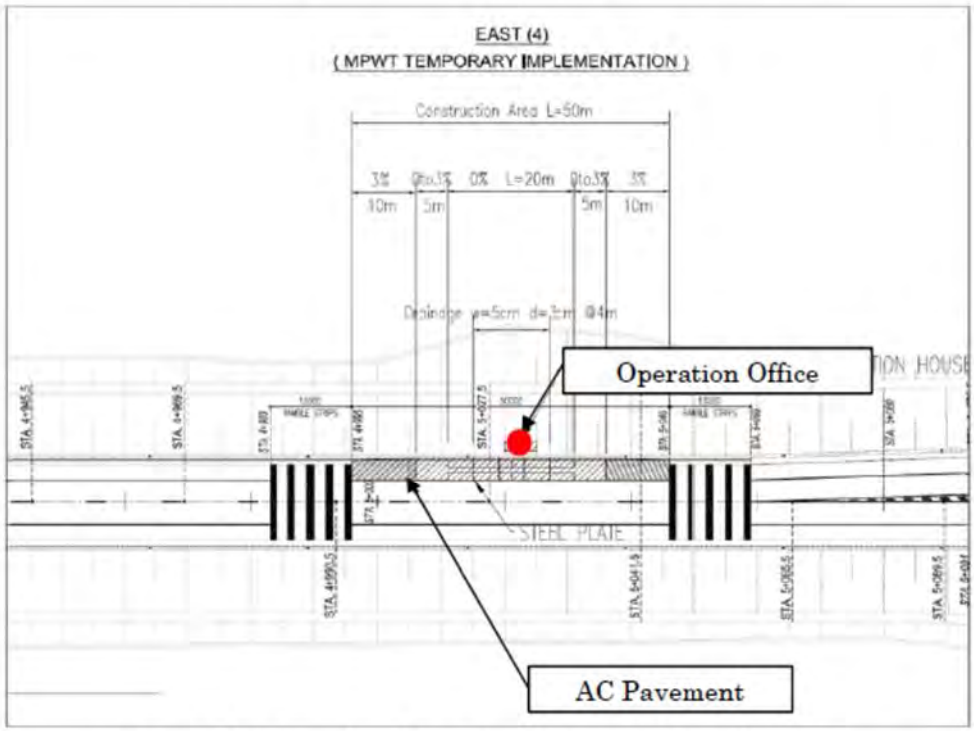
Weigh Station Name	Type of weighing scale
Kampong Phnom	Permanent
West Neak Loeung	Portable
East Neak Loeung	Portable

Figure 9-23 Location Map

Mobile station at the east is located along NR 1 as shown in Figure 9-24 with a container house.



Location of East Neak Loeung Weigh Station



Plan of AC Overlay, East Neak Loeung Weigh Station

Figure 9-24 Operation Office at East（NR.1）

Operation House of East Neak Loeung Weigh Station

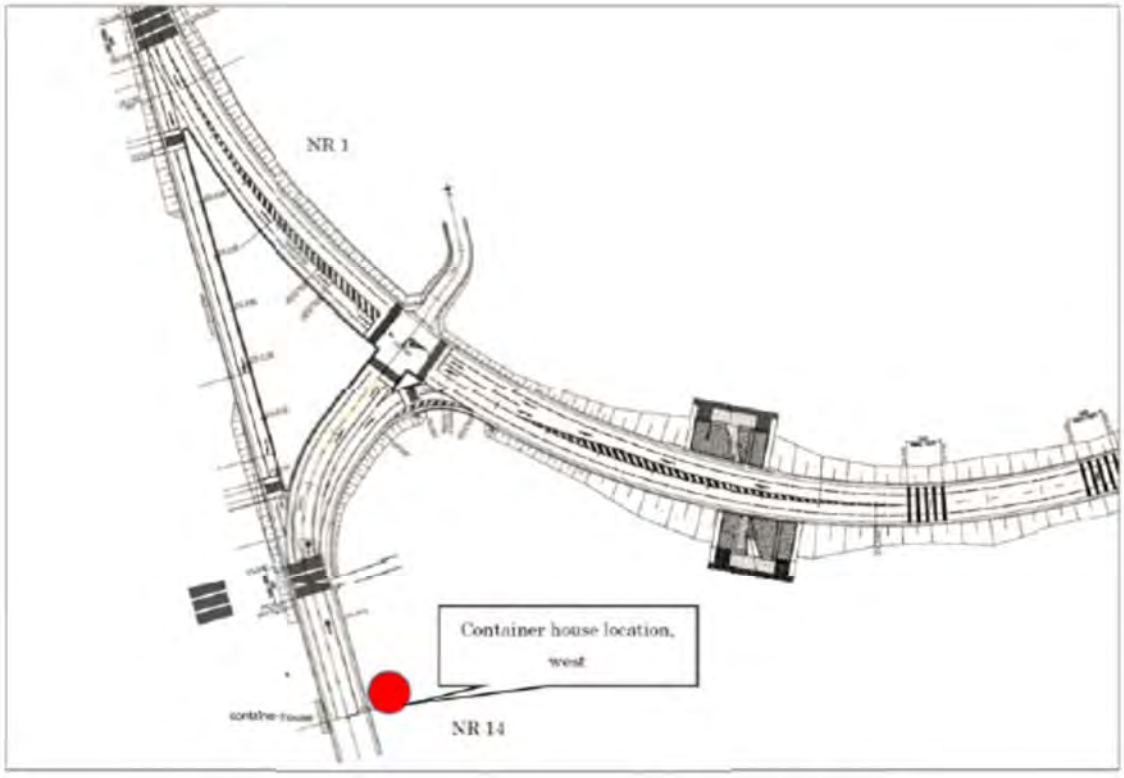
Not enough space and imbalance
ground elevation for load measurement

AC Overlay

AC Overlay, East Neak Loeung Weigh Station

Figure 9-25 East Station

The portable scale and container house are located in the west as well as shown in Figure 9-26.



Plan of West Neak Loeung Weigh Station

Operation Office of West Neak Loeung Weigh Station

Figure 9-26 West Station

Figure 9-27 Supplemented Surface Layer

(3) 2(Two) Container houses at east and west stations

Figure 9-28 shows the inside of the container house.

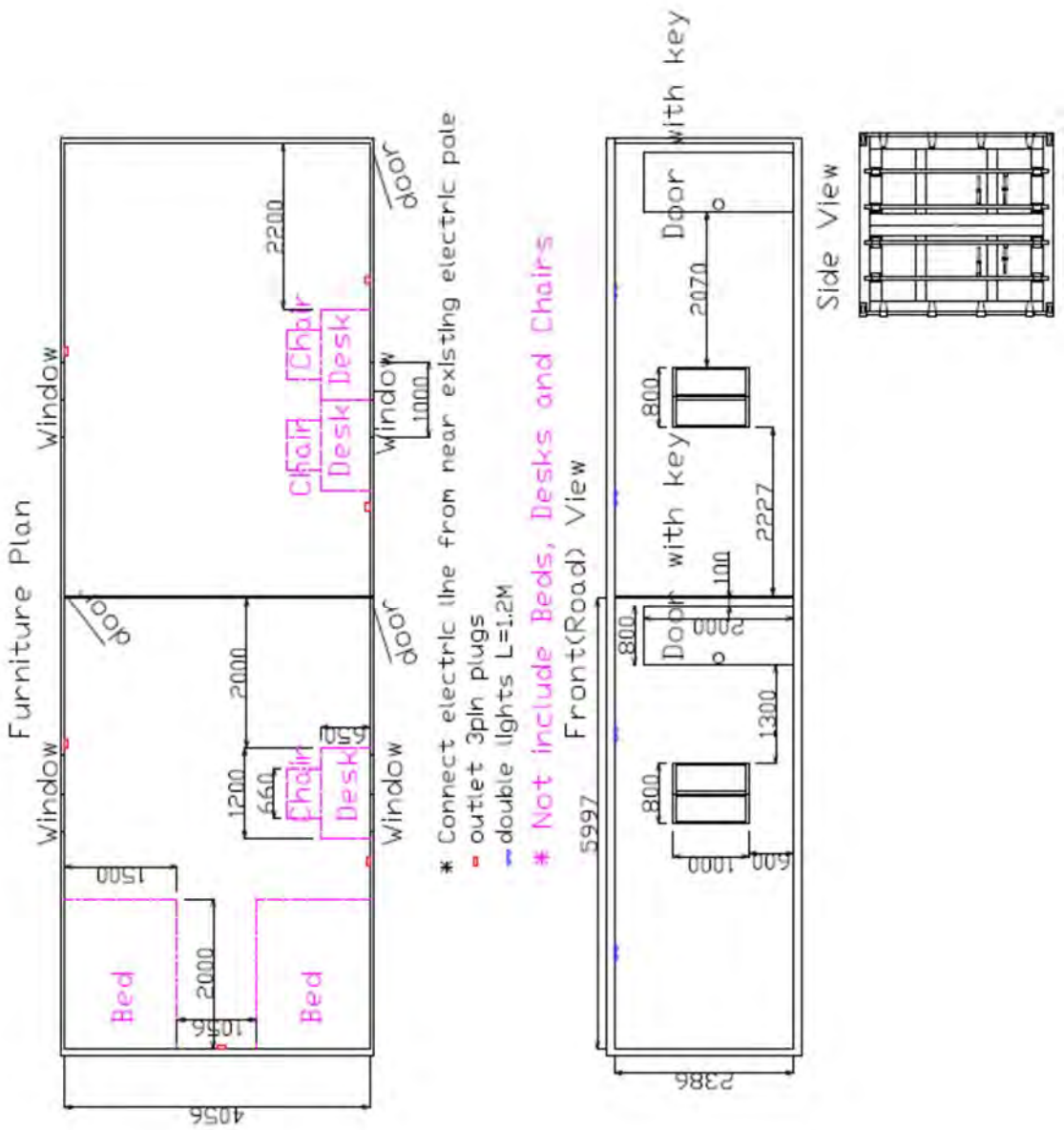


Figure 9-28 Container House

Container house west

Container house east

Figure 9-29 Container Houses

(4) 2 (Two) sets of portable scales at east and west stations

Portable scale PTS-II was selected as mobile scale at the pilot project.

Figure 9-30 Overweight Scale at Site

9.3.8 Operation

(1) Data management of overload enforcement

Data management is one of the targets of the Pilot Project. The management of overloading, input-output must be decided in order to proceed as highlighted below.

Figure 9-30 shows the current national monthly report. It shows the number of inspected vehicles, overloaded vehicles, warning and penalty for all the 25 enforcement stations. No. 19 corresponds to Tsubasa (Nak Leung) East.

The data details cannot be traced. It means an analysis could not be performed. This is one of the reasons why the Pilot Project was initiated.

An example of the outputs is shown in **Figure 9-31 National Monthly Report**Figure 9-31. On a visit to the enforcement station, it is evident that the data on penalized vehicles are recorded as shown in Figure 9-32 and Figure 9-33, but it is not easy to digitize them. Instead, the MPWT plans to start a new recording (data collection) system, (see Figure 9-34). The situation is expected to improve.

It is important to note that, just as No. 19, other stations too do not have records. Each station has a different format. Some stations do not have daily records. Most of the records are manually written or printed version. There are no available digitized data. Data on money collected from penalty imposed on the drivers was also not available.

During the period of the pilot project, data processing starting from input data to output data will be performed. Input and output forms will be discussed and improved. The process shall be performed first by JICA. It will then be adopted by the Cambodia side, including the private sector.

Overloading inspection report table in August

No	Station	DPWT	Inspected	Overloading Vehicle				No Documen	Warning	Penalty	Total Penalty (Riel)
				0<5%	5%-10%	10%-20%	>20%				
1	Bavet	Svay Rieng	1,476	29	0	0	4	7	36	4	8,850,000
2	Kampong Phnon	Kandal	545	4	1	1	0	6	10	2	2,480,000
3	Prek Eang	Phnom Penh	619	58	0	1	3	9	67	4	7,370,000
4	Long Vek	Kampong Chhna	1,739	204	0	5	0	15	219	5	5,550,000
5	Klang Meong	Pursat	3,283	1,055	0	0	0	164	1,219	0	0
6	Kon Domrey	Banteay Meanch	4,390	563	6	1	0	22	585	7	3,800,000
7	Puek	Siem Reab	664	63	0	2	0	12	75	2	2,000,000
8	Tnol Torteng	Tbong Khmum	1,357	134	0	2	1	8	142	3	4,350,000
9	Prey Pnov	Prey Veng	1,161	223	0	0	2	12	235	2	5,550,000
10	Kampong Tuel	Kandal	3,470	682	0	0	1	205	887	1	2,790,000
11	Tnol Keng	Kampong Cham	663	25	2	6	3	12	37	11	21,886,000
12	Reachea Nukoul	Steung Treng	177	13	0	0	2	8	21	2	11,560,000
13	Brasat	Kampong Thom	593	19	0	1	0	14	33	1	1,400,000
14	Kel Chey	Kampong Cham	309	13	0	8	4	23	36	12	25,700,000
15	Tropang Krohom	Ratanak Kiri	77	8	0	0	0	2	10	0	0
16	Manchey	Kratie	62	11	0	1	0	2	13	1	2,400,000
17	Klang Sambat	Takeo	650	28	0	1	0	12	40	1	1,300,000
18	Tropang Tlong	Kampong Speu	1,520	124	0	1	0	18	142	1	1,200,000
19	Nak Leung	Prey Veng	363	12	0	0	0	2	14	0	0
20	Aeng Snuel	Kandal	12,048	66	0	3	4	7	73	7	23,205,000
21	Kandal Chom	Kampong Speu	21,515	5,156	0	3	1	20	5,176	4	5,916,000
22	Steung Chral	Preah Sihanouk	11,934	310	0	8	1	10	320	9	13,280,000
23	O Chomna	Preah Sihanouk	8,677	913	0	5	0	52	965	5	5,488,000
24	Veal Renh	Kampot	3,453	249	0	0	0	7	256	0	0
25	Removable	MPWT	5	0	0	2	3	5	0	5	20,623,000
TOTAL			80,750	9,962	9	51	29	654	10,611	89	176,698,000

***Noted** **No. 2** Kampong Phnom-West weigh station
No. 19 Neak Leung-East weigh station

Figure 9-31 National Monthly Report

Figure 9-32 Daily Enforcement Report

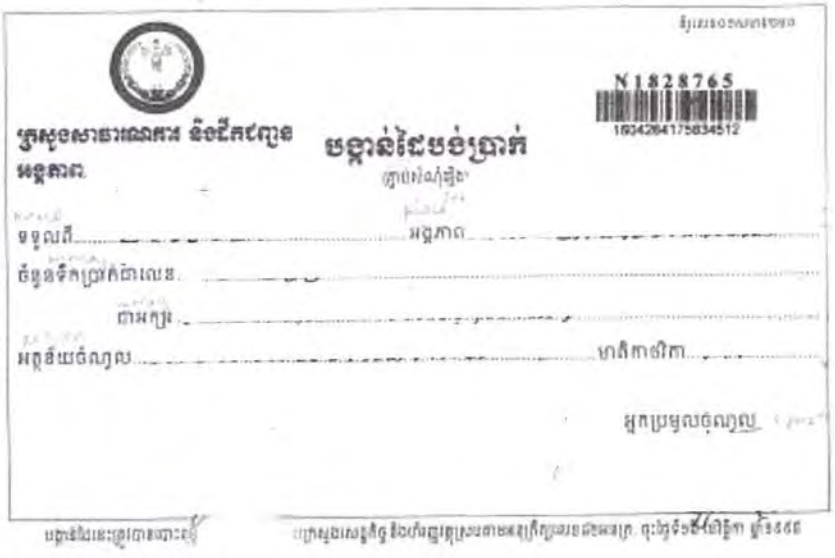
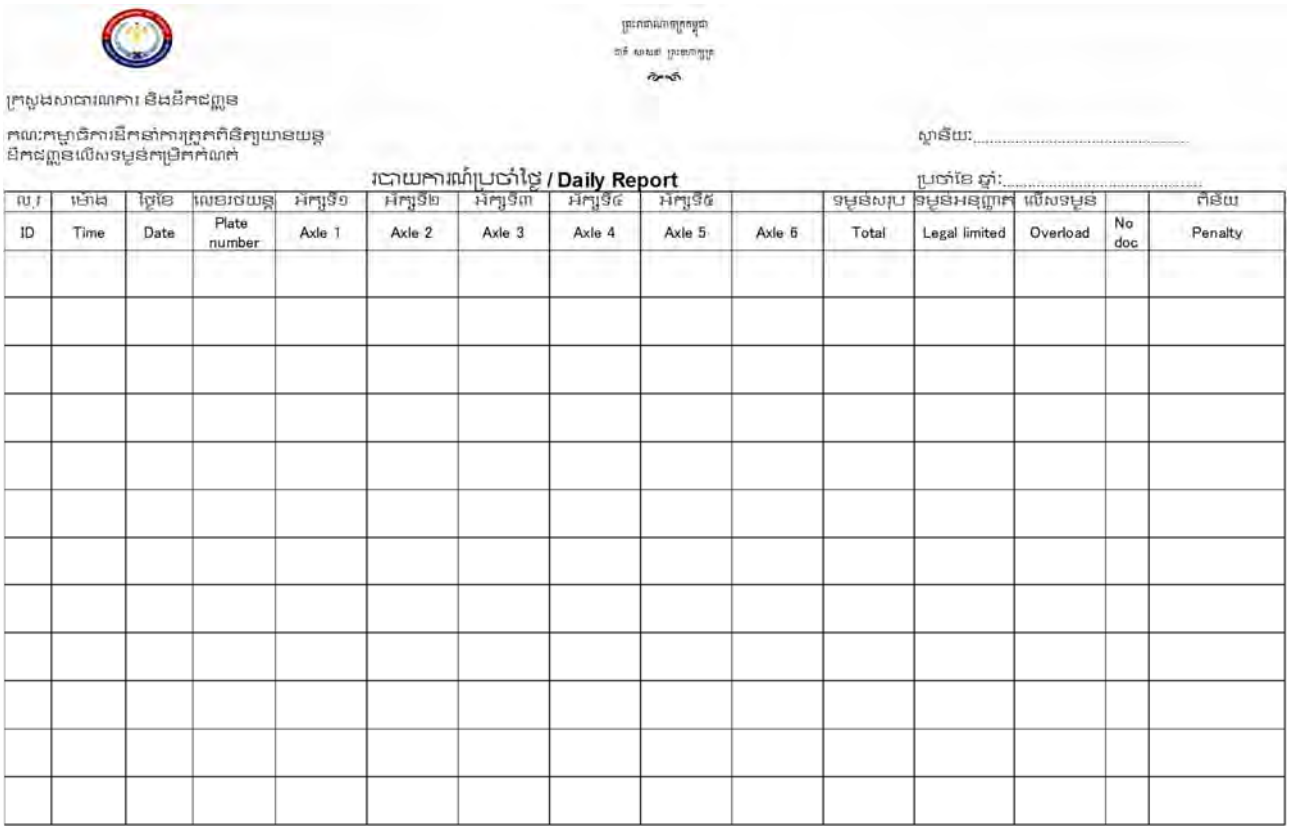


Figure 9-33 Penalty Record



ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងសាធារណការ និងដឹកជញ្ជូន

គណៈកម្មាធិការដឹកនាំការត្រួតពិនិត្យយានយន្ត
ដឹកជញ្ជូនលើសទម្ងន់កម្រិតកំណត់

ស្ថានីយ:.....

របាយការណ៍ប្រចាំថ្ងៃ / Daily Report

ប្រចាំខែ ឆ្នាំ:.....

លរ	ម៉ោង	ថ្ងៃខែ	លេខផ្លាកយន្ត	អ័ក្សទី១	អ័ក្សទី២	អ័ក្សទី៣	អ័ក្សទី៤	អ័ក្សទី៥		ទម្ងន់សរុប	ទម្ងន់អនុញ្ញាត	លើសទម្ងន់		ពិន័យ
ID	Time	Date	Plate number	Axle 1	Axle 2	Axle 3	Axle 4	Axle 5	Axle 6	Total	Legal limited	Overload	No doc	Penalty

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងសាធារណការ និងដឹកជញ្ជូន

គណៈកម្មាធិការដឹកនាំការត្រួតពិនិត្យយានយន្ត
ដឹកជញ្ជូនលើសទម្ងន់កម្រិតកំណត់

របាយការណ៍លើសទម្ងន់ប្រចាំថ្ងៃ

ស្ថានីយ:.....

Daily Overload Report

ប្រចាំខែ ឆ្នាំ:.....

លរ	ម៉ោង	ថ្ងៃខែ	ប្រភេទយានយន្ត	ទំនិញ	ចេញពី	ដល់ទៅ	ក្រុមហ៊ុន/ឯកជន	អ្នកទទួលទំនិញ	អ្នកបើកបរ	មន្ត្រីស្ថានីយ
ID	Time	Date	Vehicle type	Cargo	Origin	Destination	Transportation company	Owner/ Consigner	Driver	Weighing officer

Figure 9-34 Proposed New Format

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងសាធារណការ និងដឹកជញ្ជូន

គណៈកម្មាធិការដឹកនាំការត្រួតពិនិត្យយានយន្ត
ដឹកជញ្ជូនលើសទម្ងន់កម្រិតកំណត់

ស្ថានីយ: ....

ប្រចាំខែ ឆ្នាំ 2016

របាយការណ៍ប្រចាំថ្ងៃ / Daily Report

ល.រ	ម៉ោង	ថ្ងៃខែ	លេខរថយន្ត	អ័ក្សទី១	អ័ក្សទី២	អ័ក្សទី៣	អ័ក្សទី៤	អ័ក្សទី៥	អ័ក្សទី៦	ទម្ងន់សរុប	ទម្ងន់កំណត់	លើសទម្ងន់	គ្មានឯកសារ	ពិន័យ
ID	Time	Date	Plate number	Axle 1	Axle 2	Axle 3	Axle 4	Axle 5	Axle 6	Total	Weigh Limit	Overload	No Doc	Penalty
1	00H10	26.10	----	5200	6600	8000	9000	12400		41200	40000	1200		
2	00H30	"	----	4200	6400	7800	9200	12200		39800	40000			
3	01H10	"	----	4000	6400	7200	9000	11900		39400	40000			
4	01H49	"	----	4600	5600	7200	8400	11600		37400	40000			
5	02H14	"	----	4800	6200	7600	10800	11600		41000	40000	1000		
6	02H20	"	----	4200	6400	7800	9600	12000		40000	40000			
7	03H13	"	----	5200	6400	7600	8600	11400		39200	40000			
8	03H22	"		4400	5600	7400	9600	10800		37800	40000			
9	04H20	"	----	4400	5800	7000	10800	11600		40000	40000			
10	20H55	"	----	4800	5400	7200	9600	12000		39000	40000			
11	21H30	"	----	4000	6800	8800	10400			30000	30000			
12	22H10	"	----	5600	6800	7300	[illegible]			29400	30000.			

Figure 9-35 Actual Sample Form used in the Pilot Project (Daily Report)

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងសាធារណការ និងដឹកជញ្ជូន
គណៈកម្មាធិការដឹកនាំការត្រួតពិនិត្យយានយន្ត
ដឹកជញ្ជូនលើសទម្ងន់កម្រិតកំណត់

របាយការណ៍លើសទម្ងន់ប្រចាំថ្ងៃ
Daily Overload Report

ស្ថានីយ៍អ្នកលឿង
ប្រចាំខែ តុលា ឆ្នាំ 2016

លរ	ម៉ោង	ថ្ងៃខែ	ភាគរយលើស	ប្រភេទយានយន្ត	ទំនិញ	ចេញពី	ឆ្ពោះទៅ	ក្រុមហ៊ុន/ឯកជន	អ្នកទទួលទំនិញ	អ្នកបើកបរ	មន្ត្រីស្ថានីយ៍
ID	Time	Date	%Overload	Vehicle Type	Cargo	Origin	Destination	Transporation Company	Owner / Consigner	Driver	Weighing Office
1	00:10	26.10.16	[illegible] 5%	[illegible]	[illegible]	[illegible]	[illegible]			—	[illegible]
2	02:16	"	"	"	[illegible]	"	"			—	"
3	22:15	28.10.16	"	R 5	[illegible]	"	"			—	[illegible]
4	23:24	"	"	[illegible]	"	"	"				"
5	22:15	29.10.16	"	"	"	"	"				[illegible]
6	23:20	"	"	"	[illegible]	"	"			—	"
7	23:36	"	"	"	"	"	"				"
8	23:55	"	"	R 5	[illegible]	"	"			—	"
9	00:48	30.10.16	"	[illegible]	"	"	"			—	[illegible]
10	02:11	31.10.16	"	"	"	"	"			—	[illegible]
11	10:55	02.11.16	10%	R 11	[illegible]	"	"			—	[illegible]
12	22:07	"	[illegible] 5%	[illegible]	[illegible]	"	"			—	[illegible]

Figure 9-36 Actual Sample Form used in the Pilot Project (Overload Report)

(2) Data collection

1) Pilot project for Overload enforcement

Essential process of data management is data collection. A systematic data collection to preserve bridges and pavement is shown in Figure 9-37. During JICA's tenure, data support will be made by JICA. At the end of their tenure, it is intended for the private sector to be in charge.

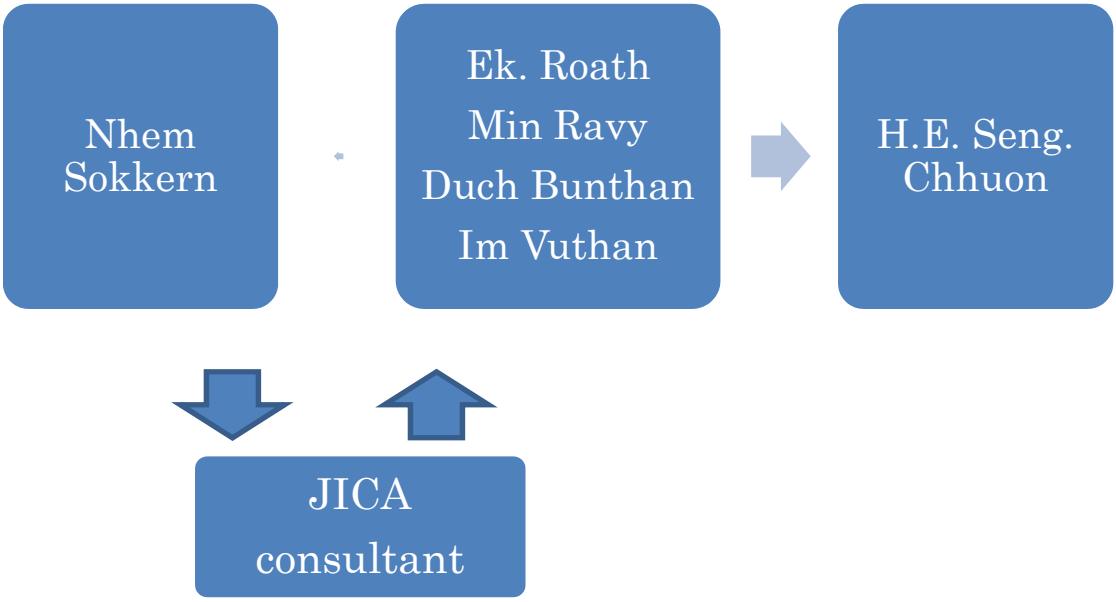


Figure 9-37 Proposed New Format

Figure 9-38 Report Flow

As for the routine report, first, data collection is done, and then follows the analysis and reporting.

Tsubasa Bridge Patrol

It is recommended that Tsubasa Bridge be patrolled periodically for daily observations including observation of overloaded vehicles. The patrol items should cover pavement, guardrail, traffic, or underside bridge encroachment. Figure 9-39 shows a report diagram.

For daily reports, the report items should cover pavement, miscellaneous, bridge, ROW under bridge. An observation note should be prepared. Figure 9-40 below the shows a future image of road patrolling.

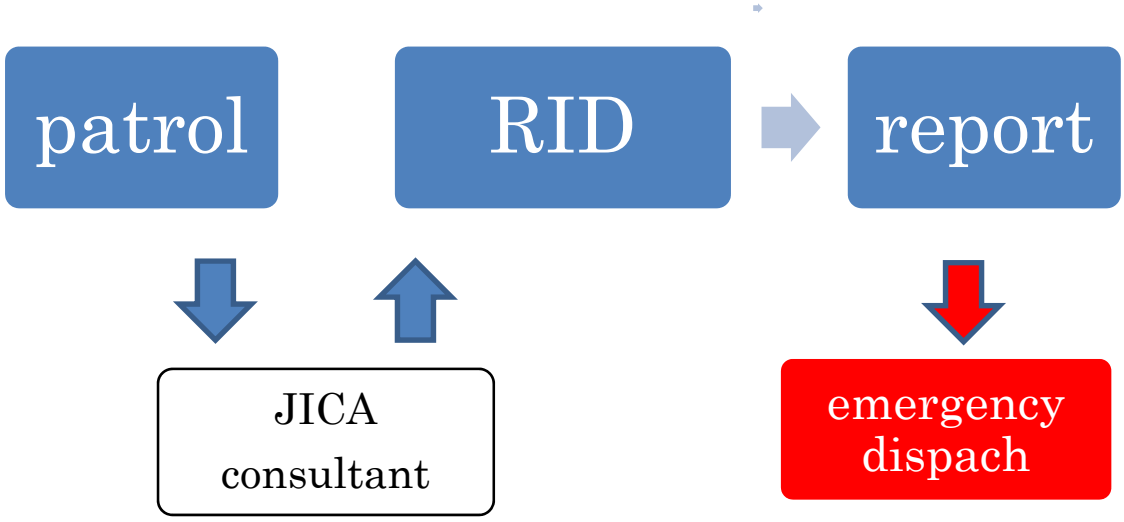


Figure 9-39 Proposed patrol structure at Tsubasa Bridge.

Figure 9-40 Road Patrolling

9.3.9 Traffic survey

(1) Objective

Traffic survey gives fundamental design of road management. Cambodia develops daily. Therefore, frequent traffic survey is recommended to account for traffic demand for roads. Traffic survey at Tsubasa Bridge was conducted on October 10, for 24 hours near the east side (Vietnam side) operation office. The result of the survey will be used for fundamental investigation of overloading enforcement measures at the bridge.

(2) Method

The Traffic survey was conducted by 4 inspectors in two (2) shifts of 3 hours each. The traffic was classified into 3, and each direction. The observation was made from the roadside, or from vehicles. The weather was cloudy, with heavy rain in the morning. The traffic was counted by 6 traffic counters, and each number was recorded every 15 minutes.

(3) Survey results

1) 15 minutes measurement

Traffic numbers during the survey for each direction are shown in Figure 9-41 and Figure 9-42. Motorcycles are dominant during the day and heavy vehicles during night time. Passenger vehicles are in between. There is no significant change between west bound and east bound traffic as shown in Figure 9-41 and Figure 9-42. As is evident in Figure 9-43 below, west bound vehicles reached its 2nd peak at midnight.

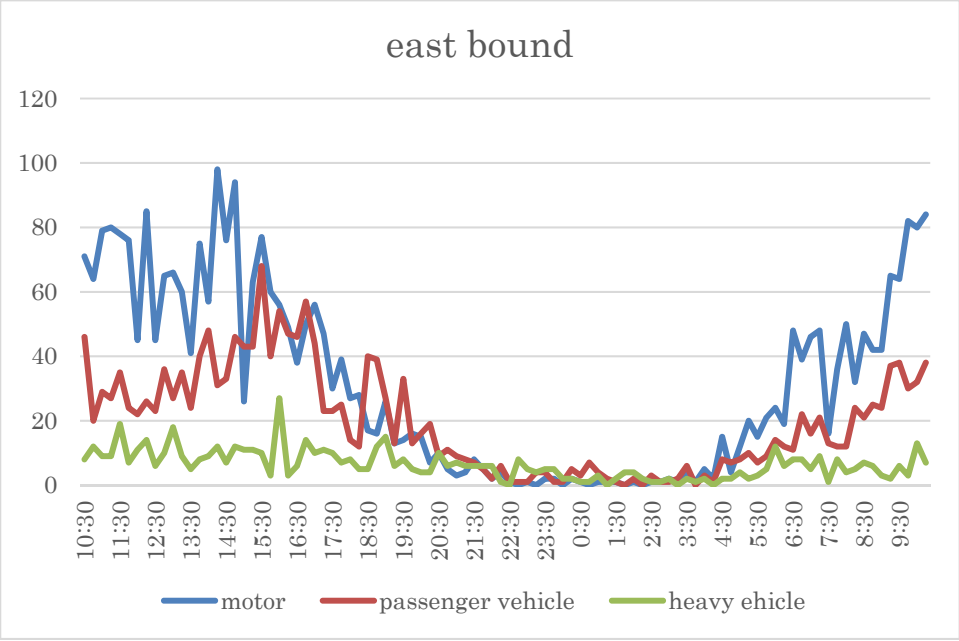


Figure 9-41 Traffic Numbers - East bound.

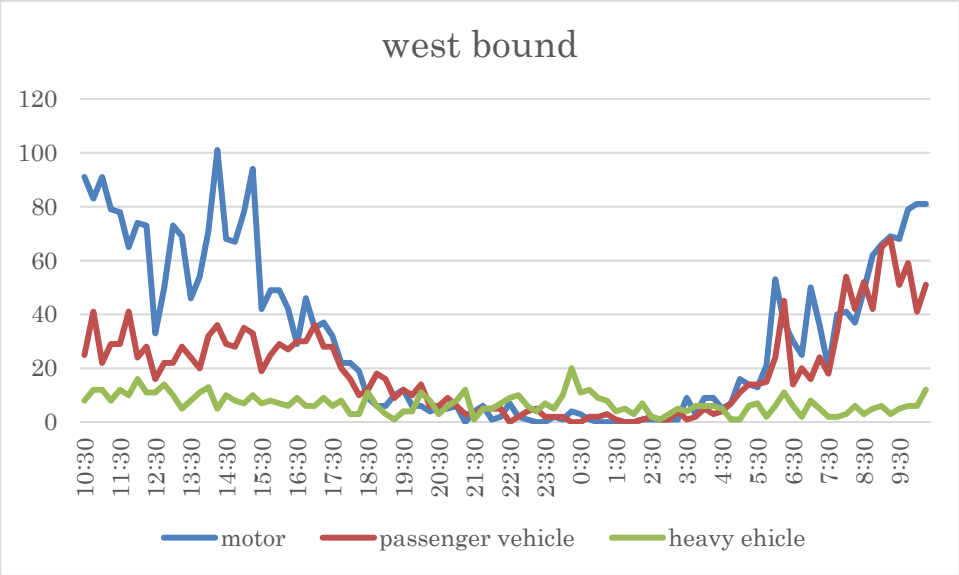


Figure 9-42 Traffic Numbers - West bound.

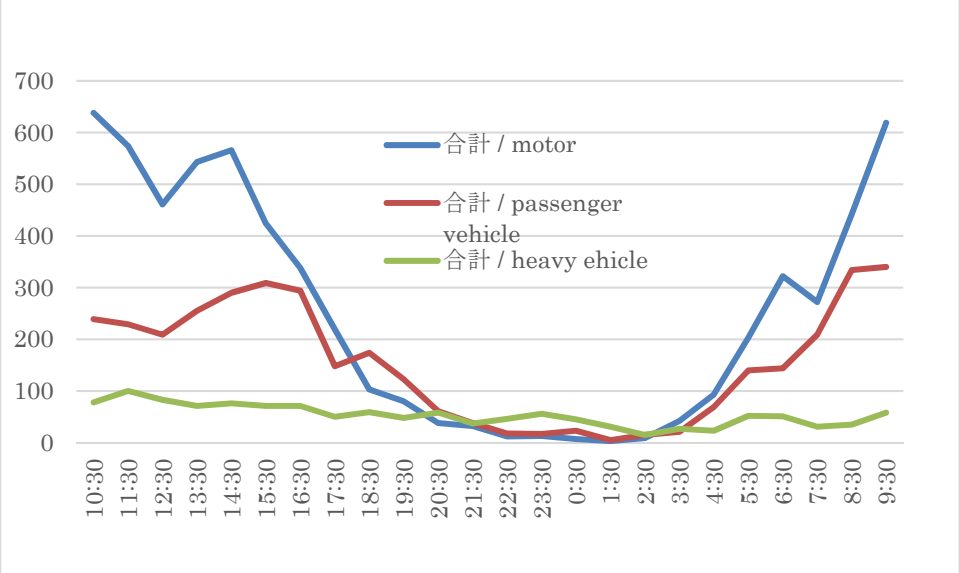


Figure 9-43 Traffic Numbers - Both Directions by the Hour.

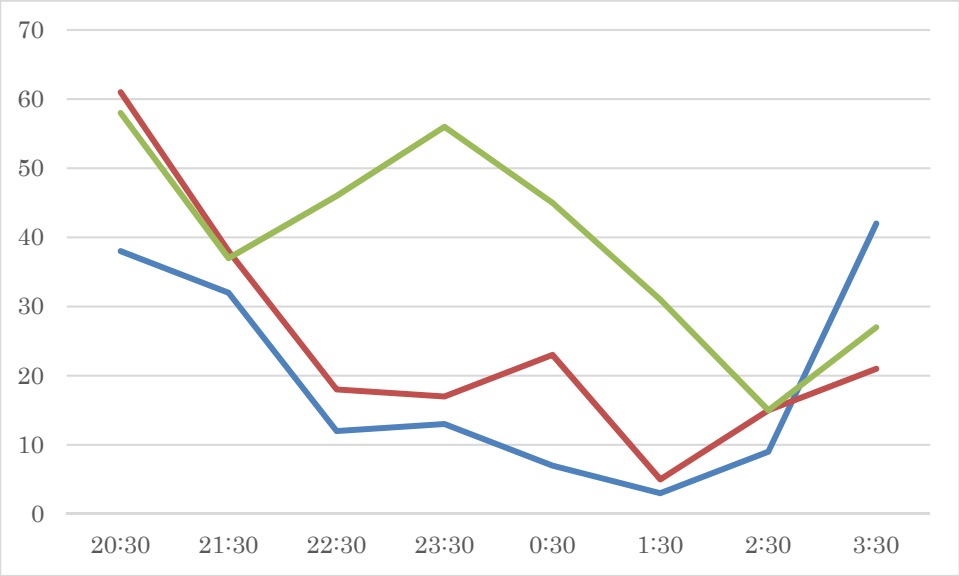


Figure 9-44 Traffic Numbers between 20:30 – 4:30.

Figure 9-44 reveals that from 21:30 – 2:30 there is a larger count of heavy vehicles than other type of vehicles.

2) Heavy traffic rate

The heavy traffic rate is shown in Table 9-20 below. In comparison to the practice in Japan, shown in Table 9-21 below, these figures are quite normal.

Table 9-20 Heavy Vehicle Rate

	Motor	Passenger vehicle (P)	Heavy vehicle(H)	
East bound	3,047	1,873	616	
West bound	3,006	1,831	656	
Total traffic	6,053	3,704	1,272	
Heavy vehicle rate			25.6%	=H/(P+H)

vehicles for 24 hours

Table 9-21 Standard Heavy Vehicle Rates in Japan

Heavy vehicle rates in Japan

	Urban	Rural
National expressway	27.0%	28.5%
Urban expressway	22.8%	---
National road	16.0%	19.4%
Prefecture road	12.6%	13.5%

JICA performed traffic survey in May 26, 2015, one month after the opening of Tsubasa Bridge on both ends of the bridge as shown in Table 9-22. The result coincides well with that of this time.

Table 9-22 Survey Results May 26, 2015

	Motorcycle	Passenger vehicle(P)	Heavy vehicle(H)	Heavy vehicle rate
West point	5,794	3,516	1,044	22.9%
East point	7,898	3,341	1,630	32.8%

(4) Observation

The difference between day and night is conspicuous. In the night there was a zone when only heavy vehicles dominated the road. Overload enforcement is implemented. There was one case whereby an overloaded truck was forced back east bound.

(5) Conclusion

Traffic survey was performed on 11-12 October, 2016 on the East end of Tsubasa Bridge. The daily traffic volume recorded was 4,976 vehicles. Heavy truck rate was 25.6%. The traffic volume is similar to one year ago.

It is recommended that traffic survey be implemented by MPWT.

9.3.10 Midterm review as of May 2017

(1) Monthly report

Every monthly report has been submitted since July 2016 to April 2017. The overloading stations were expanded from one to 3 stations around Tsubasa bridge. There are 10 monthly reports that have been submitted to-date with comments by the JICA experts.

The data input was reviewed by MPWT and a format decided. The format was fixed and the unified input form was applied in three stations.

Table 9-23 Input Format (1)

id	date	plate number	axle 1	axle 2	axle 3	axle 4	axle 5	axle 6	total	legal limit	eccess load	penalty	no document
1	9/153A1597		4,000	6,000	7,200	8,600	11,400		37,200	40,000			
2	9/153A1384		4,200	6,600	7,800	9,200	12,000		39,800	40,000			
3	9/153D5338		4,000	6,400	7,400	9,000	12,400		39,200	40,000			
4	9/153A0521		6,200	5,600	5,600	9,200	7,400	6,000	40,000	40,000			
5	9/153A0702		4,000	6,200	7,200	9,200	14,000		40,600	40,000	600		
6	9/153D6907		5,800	8,400	7,200	7,000	12,400		40,800	40,000	800		
7	9/153A2204		5,000	8,000	9,200	10,600			32,800	30,000	2800	100,000	
8	9/153B8398		5,400	7,000	7,600	8,400	9,800		38,200	40,000			
9	9/153A0439		3,800	4,600	7,600	9,000	9,600		34,600	35,000			
10	9/153D6561		6,000	6,800	9,000	8,600			30,400	30,000	400		
11	9/153X1111												1

Table 9-24 Input Format (2)

overload sheet2

id	time	vehicle type	Cargo	Origin	Destination	transportation company	Owner/Consigner	Driver	Weighing officer
7	3:30		machine	Vietnum	Phnom Penh	AA	BB	CC	DD

From July (2016 or 2017), the data was copied and generated manually by the JICA team. From March MPWT prepared the data using MS Excel format, and began to send by email. This has made the process faster and more accurate.

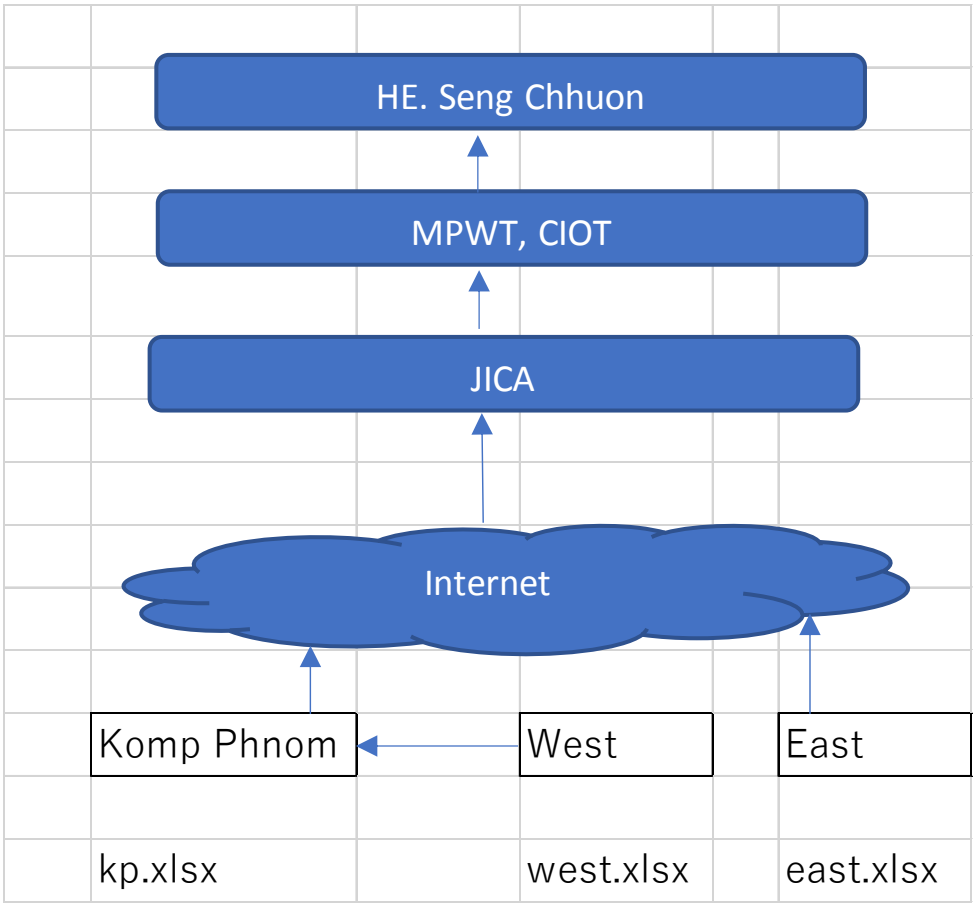


Figure 9-45 Report Diagram.

Disparity between the law and practice has been revealed. First, the 3 ton rule is applied instead of the 5% rule stated in the Road Law for tentative enforcement stations by JICA. A penalty is applied when the inspected vehicle exceeded by 3 tons, instead of 5%. Second, no axle load enforcement is implemented. It is not only unfavorable that practice is different from the law, but also causes practical damage to structures if the axle overload is overlooked.

The repeated loader problem is a concern. It was noted that overloading is limited to prescribed vehicles.

National overload location map should be incorporated in Google map. It would assist in management of overload stations in Cambodia.

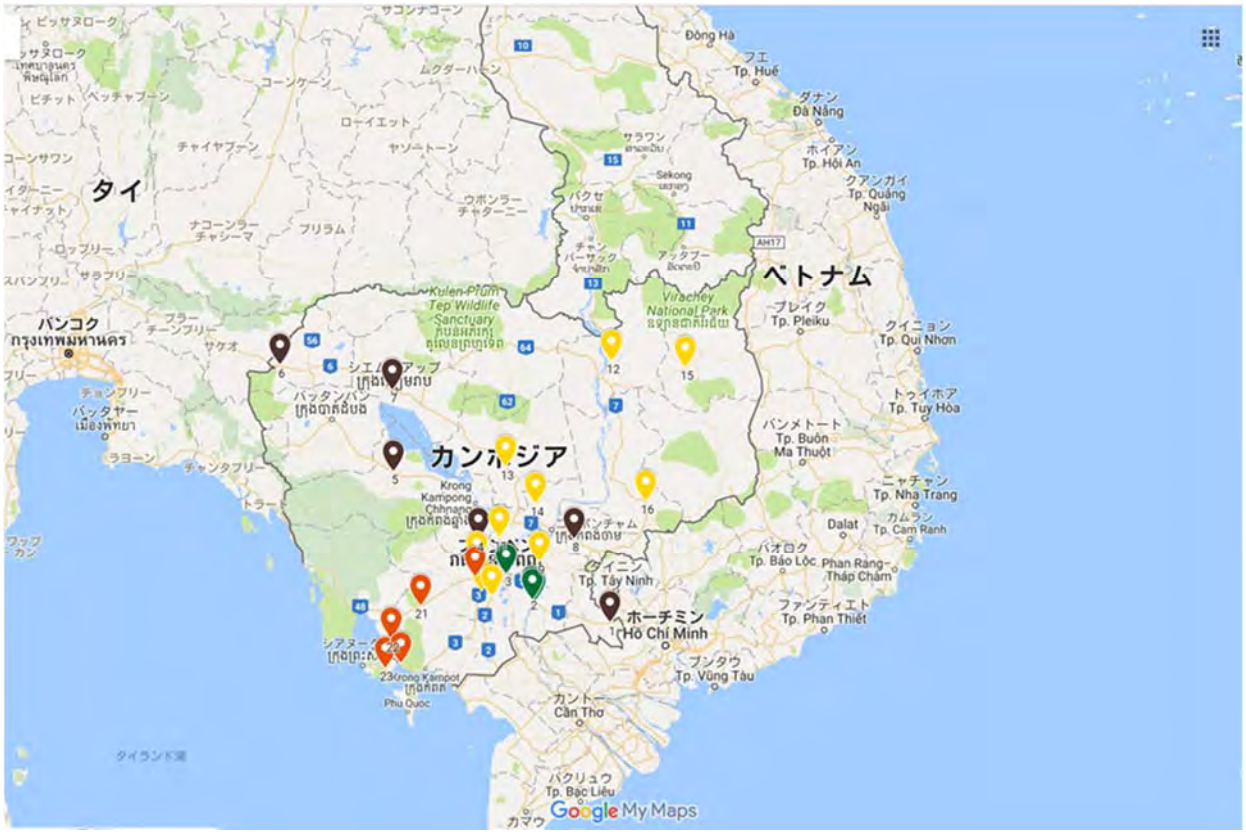


Figure 9-46 Locations of Enforcement Stations on Google Map.

(2) Traffic survey

Traffic survey was implemented on April 4, 2017. Although it had been planned to be conducted by both the MPWT and JICA teams, it was executed by the JICA team only. Compared to the previous survey conducted on October 10, 2016, significant increase of passenger vehicles was observed.

Table 9-25 Survey results Comparison

October 10, 2016 Survey Results

	Motorcycle	Passenger vehicle (P)	Heavy vehicle (H)	Vehicle total	Heavy vehicle rate
East bound	3,047	1,873	616	2,489	24.7%
West bound	3,006	1,831	656	2,487	26.4%
Total	6,053	3,704	1,272	4,976	25.6%

April 4, 2017 Survey results

	Motor	Passenger vehicle (P)	Heavy vehicle (H)	Vehicle total	Heavy vehicle rate
East bound	4,465	3,468	698	4,166	16.8%
West bound	4,646	2,885	750	3,635	20.6%
Total	9,111	6,353	1,448	7,801	18.6%

(3) Midterm conclusion

Overload enforcement is not an easy task. There is little corporation from Cambodian authorities. There are three issues that need to be addressed by the MPWT:

1. The three-ton rule being applied for 2 JICA stations instead of the 5% rule.
2. Axle load enforcement is not applied at all in Cambodia.
3. Overloading vehicles are limited to small group of vehicles.

In addition to the above, it is agreed:

4 Cambodian authorities confirmed that enforcement and data collection at Tsubasa bridge shall continue after September 2017.

5 Cambodia authorities committed to replace and continue analysis work submitted by JICA from September 2017.

No progress has been made on road patrolling and embankment management. This is because the Cambodian authorities were too busy to allocate engineers or share time for discussion. However, the concept and purpose were explained and recognized by the authorities.

Corporation by Cambodian authorities is very limited, but efforts will be made in the second half to achieve the continuous work by MPWT. It is recommended that inter-relational discussions be made with previous overload enforcement investigators.

9.3.11 Final report

(1) Submission of reports

Total report submitted during the pilot project can be summarized as below.

Table 9-26 List of reports

No	Date	Report	Submission
1	2016/9/29	Inception report	Mr. Vuthan, MPWT
2	2016/9	Monthly report, July 2016	Mr. Vuthan, MPWT
3	2016/9	Monthly report, August 2016	Mr. Vuthan, MPWT
4	2016/9	Monthly report, September 2016	Mr. Vuthan, MPWT
5	2016/9/30	Installment report	Mr. Vuthan, MPWT
6	2016/10/14	Initial operation report	Mr. Vuthan, MPWT
7	2016/10/15	Traffic survey (1)	Mr. Vuthan, MPWT
8	2016/10	Monthly report, October 2016	Mr. Vuthan, MPWT
9	2016/11	Monthly report, November 2016	Mr. Vuthan, MPWT
10	2016/12	Monthly report, December 2016	Mr. Vuthan, MPWT
11	2017/1	Monthly report, January 2017	Mr. Vuthan, MPWT
12	2017/3	Monthly report, February 2017	Mr. Vuthan, MPWT
13	2017/3	Monthly report, March 2017	Mr. Vuthan, MPWT
14	2017/4/5	Traffic survey (2)	Mr. Vuthan, MPWT
15	2017/4/11	Midterm report	HE. Chhuon, MPWT
16	2017/4	Monthly report, April 2017	Mr. Vuthan, MPWT
17	2017/5	Monthly report, May 2017	Mr. Vuthan, MPWT
18	2017/6	Monthly report, June 2017	Mr. Vuthan, MPWT
19	2017/7	Monthly report, July 2017	Mr. Vuthan, MPWT
20	2017/8	Monthly report, August 2017	Mr. Vuthan, MPWT
21	2017/9	Monthly report, September 2017	Mr. Vuthan, MPWT
22	2017/10/4	Traffic survey (3)	Mr. Vuthan, MPWT
23	2017/10/10	Final report	HE. Chhuon, MPWT

(2) Status and improvement plans

Table 9-27 Evaluation of the Plan

no	Improvement plans	Goals at the end of Pilot Project	evaluation
1	Daily overloading vehicle data should be forwarded to MPWT, and monthly and annual report should be made and reported to the Secretary.	Daily enforcement data are documented and reported to MPWT from the operation offices. Monthly and annual reports are published.	From July 2016 to September 2017, daily data were collected and monthly reports were submitted to MPWT. The 1 st page of the monthly report becomes an annual report.
2	Enforcement report at each site is recommended.	Monthly report is published.	Monthly report for 3 relevant stations were published.
3	Traffic number investigation should be made periodically at designated points.	Traffic survey is implemented for three times.	Traffic survey was implemented for 3 times.
4	Structural accident report should be made in prescribed format.	Accident report is summited to MPWT from the operation offices.	There were not significant structural accident during the term.
5	Notice, warning, penalty data should be collected and analyzed. Repeated violators should be penalized.	Monthly report is made by an enhanced format.	Every monthly report contains warning and penalty information.
6	Failure of facility should be reported and the cause of the failure must be recorded. Immediate repair must be made.	Failure report summited to MPWT from the operation offices.	There were not significant facility failure during the term.
7	Private company should be incorporated in maintenance work.	Investigation meeting is held with participation from private sectors.	On October 5, guidance seminar of monthly reporting for private companies were implemented.
8	Training on maintenance manual for facility operation should be performed periodically.	Training seminar for overloading enforcement is held periodically.	Manual for facility operation was prepared.
9	Tsubasa Bridge is located on loose, thick and unstable soil layers. Consecutive survey investigation is required.	Investigation on maintenance of massive structure on loose soil is implemented with continuous survey after the construction.	The engineering concern was explained to Mr.Sang Sinaveth.
10	It is recommended that site control office is established and periodical observation is made for road surface as well as under the bridge.	Investigation on site control office is made. Proposition of action plan.	It was proposed to Mr.You Dara.

(3) Monthly Report

The Monthly report was published every month. On the 26th of every month the last data, and excel data were emailed through internet. The Manager of each station sent data to Hakamada. Internet connectivity not being available at the West station, the manager of Kompong station was asked to send the west data on his behalf. The West and Kompong stations are closely located to each other.

Errors such as “date” input, sum of axle loads, plate numbers (vehicle registration numbers), and redundant space were checked and corrected.

Data collection was another big problem. Except for East station, there were many instances where data did not arrive as expected. The manager would state they were too busy. Request for data transfer must be repeated at the end of every month. The East station manager was excellent. Data from the East station arrives exactly every month.

There are two input types: Sheet 1 and Sheet 2. Sheet 1 deals with conventional axle load, date, or penalty figure. Sheet 2 contains cargo data. East and Kompong Phnom can provide Sheet 2 data.

The Monthly reports were submitted from July 2016 to September 2017. During the second semester, April 2017- September 2017, the main target was set to achieve the sustainability of the analysis and reporting system. Most of the analysis was performed by Hakamada. It is essential that data collection, analysis and reporting continue after the JICA tenure. A sustainable business model had to be established after the departure of JICA.

(4) Private sector involvements

First, in April 2017, there was a proposal by MPWT for their engineer to perform the task. Assistance was to be offered via email. However there was no progress by MPWT. Invitation of consultants or private sector stakeholders to perform the excel operation on behalf of the MPWT engineer was proposed, but MPWT strongly opposed to seek consultant assistance. At the end of the pilot project, permission to involve consultants was granted and cooperation with consultants was initiated.

On October 5, invitation to several consultants and independent engineers was made to study the monthly reporting modestly. Some declined, some accepted. Introduction of Excel operations were conducted and thereafter performed. Each engineer was notified beforehand to come with a laptop so as to be able to perform the Excel operations. The MPWT officials were also invited but no one attended. The participants were:

1. **Phanna RATH**, Position: GIS Operator, Es International Consultants Co., Ltd, Mobile: +855 70975008, E-mail: rathphanna.lmla@gmail.com
2. **Bun Sereyvuth**, TCP staff, 0984-433-42, bunsereyvuth94@gmail.com
3. **Pet Meng Hout**, AAP group, 086 886 609, hsg.hak127@gmail.com,
4. **Heng Sophonnrith**, AAP group, 092 858 464, hengsophonnrith@yahoo.com

It is not compulsory to use private engineers, but it would be beneficial to MPWT to have as many options as possible to implement the overload enforcement program. Private sector involvement is one of the options.

During the pilot project, it was established that it requires about 15 minutes to report one enforcement station. No new program is needed. It would be inexpensive and would save time for MPWT engineers.

(5) Traffic survey

Traffic survey was implemented in order to understand traffic behavior and trend at the site. Though it had been intended to be conducted in partnership with MPWT, it was executed by JICA only. It was difficult to convince the Cambodian authorities on the importance of the traffic survey. Due to budget limitation, the survey items were minimal and it was conducted only domestically.

Since the opening of Tsubasa bridge, traffic survey has been conducted four (4) times, 24 hours each time. The first was conducted one month after the opening ceremony. The other three are investigations by the pilot project. Every time the number fluctuates significantly. This may be as a result of Cambodian characteristics.

On average, the heavy vehicle rate is about 27%, which is identical to intercity traffic in Japan. The average daily heavy vehicle traffic is about 6,000, and it is increasing.

Table 9-28 Four Times Traffic Survey

	survey results May 26, 2015				
	motor cycle	passenger vehicle(P)	heavy vehicle(H)	vehicle total	heavy vehicle rate
west point	5,794	3,516	1,044	4,560	22.9%
east point	7,898	3,341	1,630	4,971	32.8%
	survey results October 10, 2016				
	motor cycle	passenger vehicle(P)	heavy vehicle(H)	vehicle total	heavy vehicle rate
west bound	3,006	1,831	656	2,487	26.4%
east bound	3,047	1,873	616	2,489	24.7%
total	6,053	3,704	1,272	4,976	25.6%
	survey results April,4 , 2017				
	motor	passenger vehicle (P)	heavy vehicle(H)	vehicle total	heavy vehicle rate
west bound	4,646	2,885	750	3,635	20.6%
east bound	4,465	3,468	698	4,166	16.8%
total	9,111	6,353	1,448	7,801	18.6%
	survey results October 2, 2017				
	motor	passenger vehicle (P)	heavy vehicle(H)	vehicle total	heavy vehicle rate
west bound	3,459	2,005	796	2,801	28.4%
east bound	3,420	2,263	800	3,063	26.1%
total	6,879	4,268	1,596	5,864	27.2%

(6) Status of Overloading at Tsubasa Bridge

The number of overloading at Tsubasa Bridge is summarized in Figure 9-47. In this figure, the month of May 2017 seems to have an irregular record to be ignored. After commencement of the pilot project and provision of the portable scale, number of inspection of vehicle has been stable around 272/month. The number of warning (less than 5% excess) has been increased and on the other hand, number of serious overloading (more than 5% excess) has been decreased. This shows that the number of serious offenders were decreasing during the pilot project.

Figure 9-48 shows monitoring result of accumulated numbers by an offender. This shows that same vehicles repeatedly offend sometimes more than 15 times per month. It is recommended to capture such repeating offenders and give penalty in accordance with the current regulation[1].

It is also to notes that the application of penalty against offenders more than 5% seems low.

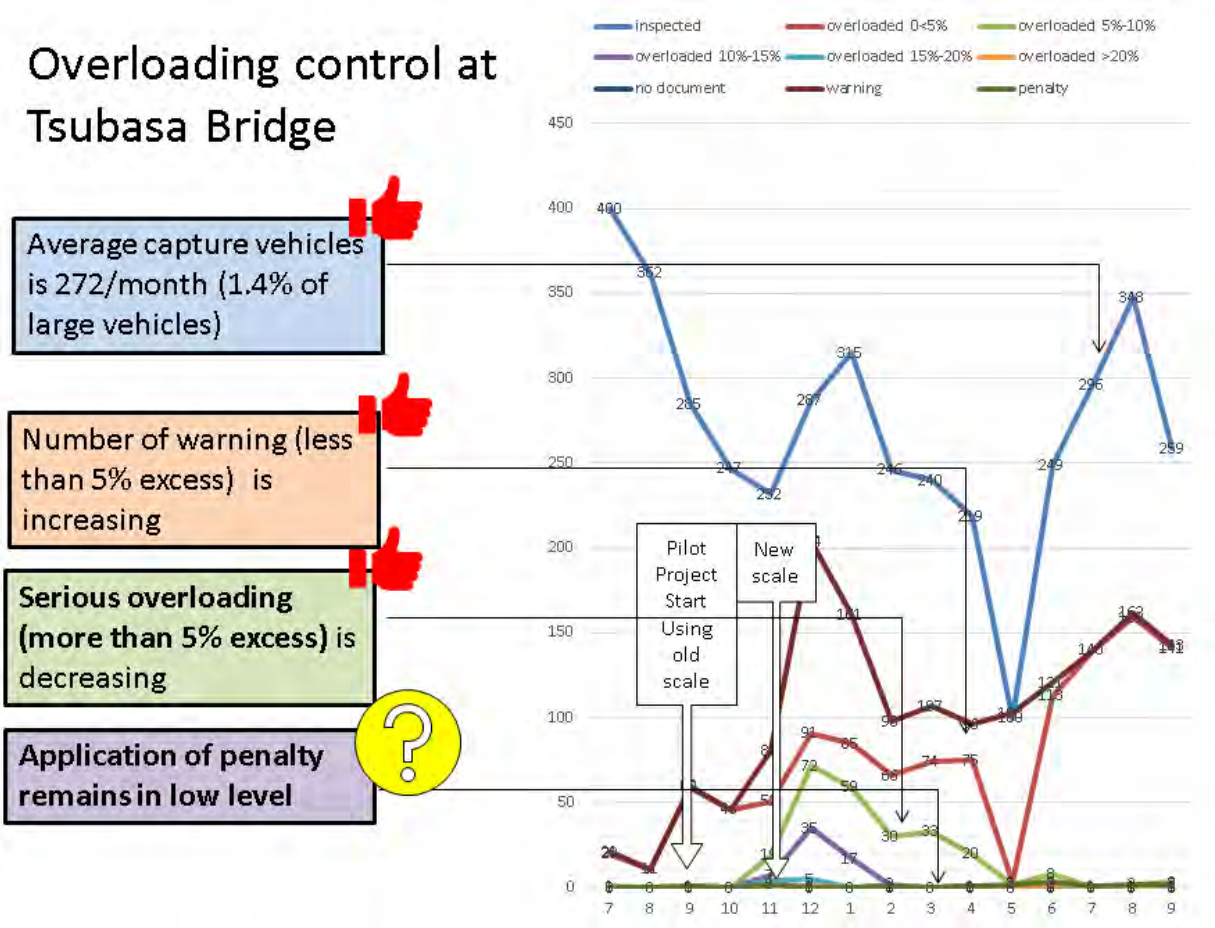


Figure 9-47 Number of Overloading at Tsubasa Bridge during Pilot Project

[1] For the repeated offenders, Article 60 of Law on Road, 2014 stipulates that " in case this violation it continued, a double transactional fine shall be imposed and stopped the transportation business for 1 (one) year. The owner of the vehicles shall be responsible for the cost of loading and reloading goods and renting cost of the place to keep the goods and the vehicles.

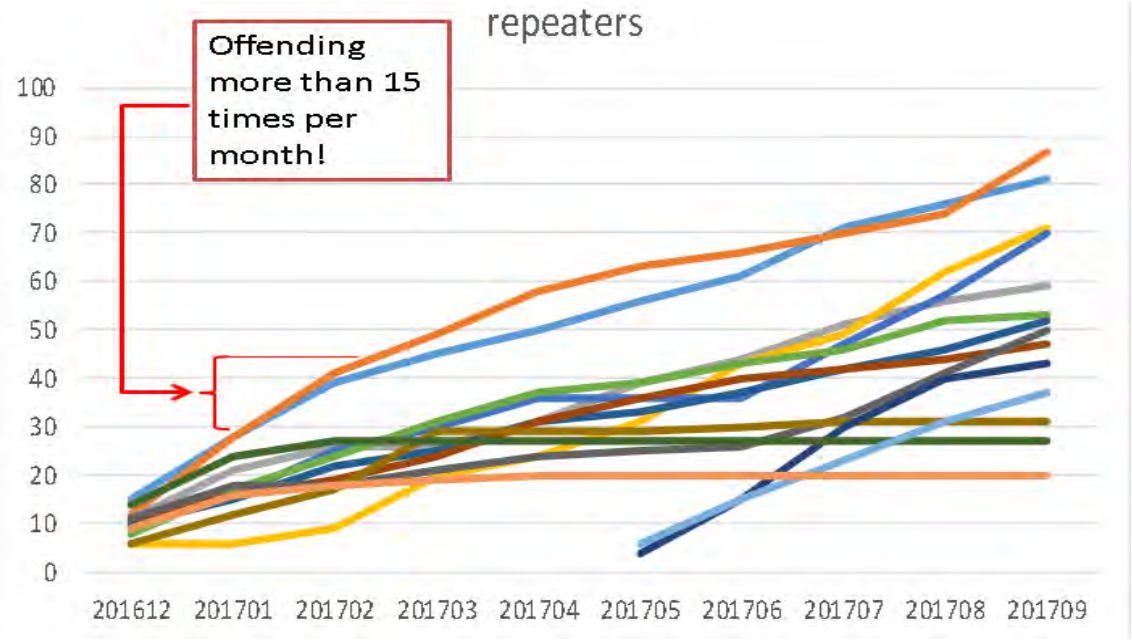


Figure 9-48 Repeating Offenders

(7) Review by previous investigators

So far, JICA TCP has been providing report to MPWT. Each time they have requested for feedback, but no response had been available from MPWT. Being a new concept of approaching overloading enforcement from data management perspective, the JICA TCP sought opinions from the previous relevant investigators. Most of the previous investigators have left Cambodia for their next assignment, but there are some suggestions from their previous experience.

There was a benign neglect by MPWT officials to hold discussion with previous engineers. Or MPWT was not enthusiastic about the discussions. However, at the end of the pilot program, there was consent from MPWT side. A mail was delivered immediately to the engineers below on September 29.

robalmac@gmail.com ：Mr. Robin Macdonald, Chief engineer for overload enforcement project at rural road, MRD

k.a.lundqvist@gmail.com ：Mr. Lundqvist, Chief engineer for overload enforcement project at rural road, MRD

andre_drockur@gmx.net ：Dr. Drockur, Chief engineer of Second Road Asset Management Project

(8) Mobile team (practice of MRD)

Monthly report had been collected for several months, however, since March 2017, it became impossible to collect the report. Even though it is paper based, it requires a lot of administrative procedure to take. In the August report, in addition to 25 existing overloading enforcement stations, there is a “mobile” station. The capturing result was report as 100%. In this case, if 5 vehicles are inspected all the 5 are identified to be overloaded. It is known that an experienced officer at the station can tell if a vehicle is overloaded just from appearance before even scaling the vehicle.

Figure 9-49 Mobile Scale Vehicle at MRD

Table 9-29 Monthly Report of MPWT as of August, 2016

Overloading inspection report table in August

No	Station	DPWT	Inspected	Overloading Vehicle				No Documen	Warning	Penalty	Total Penalty (Riel)
				0<5%	5%-10%	10%-20%	>20%				
1	Bavet	Svay Rieng	1,476	29	0	0	4	7	36	4	8,850,000
2	Kampong Phnon	Kandal	545	4	1	1	0	6	10	2	2,480,000
3	Prek Eang	Phnom Penh	619	58	0	1	3	9	67	4	7,370,000
4	Long Vek	Kampong Chhna	1,739	204	0	5	0	15	219	5	5,550,000
5	Klang Meong	Pursat	3,283	1,055	0	0	0	164	1,219	0	0
6	Kon Domrey	Banteay Meanch	4,390	563	6	1	0	22	585	7	3,800,000
7	Puek	Siem Reab	664	63	0	2	0	12	75	2	2,000,000
8	Tnol Torteng	Tbong Khmum	1,357	134	0	2	1	8	142	3	4,350,000
9	Prey Pnov	Prey Veng	1,161	223	0	0	2	12	235	2	5,550,000
10	Kampong Tuel	Kandal	3,470	682	0	0	1	205	887	1	2,790,000
11	Tnol Keng	Kampong Cham	663	25	2	6	3	12	37	11	21,886,000
12	Reachea Nukoul	Steung Treng	177	13	0	0	2	8	21	2	11,560,000
13	Brasat	Kampong Thom	593	19	0	1	0	14	33	1	1,400,000
14	Kel Chey	Kampong Cham	309	13	0	8	4	23	36	12	25,700,000
15	Tropang Krohom	Ratanak Kiri	77	8	0	0	0	2	10	0	0
16	Manchey	Kratie	62	11	0	1	0	2	13	1	2,400,000
17	Klang Sambat	Takeo	650	28	0	1	0	12	40	1	1,300,000
18	Tropang Tlong	Kampong Speu	1,520	124	0	1	0	18	142	1	1,200,000
19	Nak Leung	Prey Veng	363	12	0	0	0	2	14	0	0
20	Aeng Snuel	Kandal	12,048	66	0	3	4	7	73	7	23,205,000
21	Kandal Chom	Kampong Speu	21,515	5,156	0	3	1	20	5,176	4	5,916,000
22	Steung Chral	Preah Sihanouk	11,934	310	0	8	1	10	320	9	13,280,000
23	O Chomna	Preah Sihanouk	8,677	913	0	5	0	52	965	5	5,488,000
24	Veal Renh	Kampot	3,453	249	0	0	0	7	256	0	0
25	Removable	MPWT	5	0	0	2	3	5	0	5	20,623,000
TOTAL			80,750	9,962	9	51	29	654	10,611	89	176,698,000

***Noted** **No. 2** Kampong Phnom-West weigh station
No. 19 Neak Leung-East weigh station

(9) High Capture by mobile station

A “mobile” station is similar to a mobile vehicle as seen in Figure 9-49 at MRD offices. The donor team presented two mobile vehicles to MRD office.

In addition to the high capture rate, the collected penalty is one of the top 5 of all stations. Where hundreds of vehicles are daily enforced, if 5 inspections are conducted and penalties collected out of the 5 inspections, it then becomes top 5. It can be deduced that mobile enforcement is very effective.

The fact that a mobile station can identify highly overloaded vehicle would be presumed to be due to the experience of the officer being able to make a correct guess just from appearance.

The Government order 2015 of mobile scales had a severe negative impact, especially among site officers. But it is a fact that a portable station can effectively detect an overloaded vehicle. It would be far more effective and efficient than portable station with fixed location, or fixed scale with fixed location.

(10) Sustainability of budget plan

To have a monthly reporting capacity is essential for the sustainability of overload enforcement in Cambodia. A budget plan assurance is very important. JICA TCP repeatedly requested for a budget plan for all the enforcement stations. MPWT did not declare the budget plan. It is impossible to understand, given that budget plans in the public sector are never confidential. Though JICA TCP member, request for the budget plan will be continued.

(11) Accuracies

When data collection was started by East and West stations, there were several complaints from MPWT. The complaint was that the introduced scale exhibits incorrect value compared to the conventional scale. MPWT stated that it was not practical when trucks stated overloaded at east or west station if checked at Kong Phnom station would read (a different) the correct result.

JICA executed the calibration test by introducing measured heavy vehicle, and checked inaccuracy of scales at the East and West stations. Since the same vehicle passed the station in a row, the accuracy of the scale was assured. Further, the vehicle carried standard weights, whose weight was precisely measured at the laboratory; the scale's accuracy was checked independently.

The calibration report was submitted to MPWT on 9 December, 2016. The introduced scales exhibited accuracy within allowance. The scale of the conventional fixed station also exhibited accuracy within limits, but had an error margin on the safe side.

(12) Dissemination of output

Overloading is the major cause to structural damage to bridges, thereby causing traffic accidents or disturbing smooth traffic flow. In order to control overloading, cooperation between drivers, transport companies and cosigners is essential. Damaged bridges have to be repaired using taxpayers money. So, in order to deal with the comprehensive measures against overloading, comprehensive understanding and cooperation among stakeholders is essential. In this case, sharing of information on the current overloading situation/state is important. The data collected in this project will be useful material in this regard.

(13) Conclusion

- Overload enforcement through data approach is effective.
- Overload enforcement at the Tsubasa bridge should be continued.
- Continuous acquisition and analysis of data is recommended.

- 3 overloading issues should be addressed. 1) 3 ton rule and 5% rule does not coexist. 2) Axle overload enforcement should be considered. 3) Proactive measures against repeat offenders is essential.
- Dissemination of results should be considered.

9.4. Institutional Framework for Overloading Truck Control

9.4.1 Existing Institutional Framework

(1) Objectives of Committee for Inspection of Overloading Trucks

The inspection of overloading trucks is managed by the Ministry of Public Transport. Under the MPWT, the Committee for Inspection of Overloading Trucks is established and the provision of the Committee is regulated as Sub-Degree No. 141. The objectives of the Sub-Degree No 141 are as follows:

- ✓ To set up measures to prevent any loading over the weight limits,
- ✓ To oversee the management of weighbridge stations positioned to weigh any overloaded vehicles along the roads under the management of the MPWT
- ✓ To prevent the road infrastructure from being ruined by the traveling overloaded vehicles so that the road durability could be maintained to meet the road construction techniques
- ✓ To lunch corresponding actions for timely cracking down and preventing any overloaded transport

(2) Overall Organizational Structure

The Committee for Inspection of Overloaded Trucks shall be composed of the following members:

- ✓ Minister of Public Works and Transports
- ✓ Secretary of State for Interior Ministry
- ✓ Secretary of State for Ministry of Economic and Finance
- ✓ National Police General Commissioner
- ✓ Commander of National Military Police
- ✓ Chairman of Permanent Coordination Committee

Under the Committee for Inspection of Overloaded Trucks, the Permanent Coordination Committee has responsibility for the actual weigh station management in corporation with the related agencies. The overall organization structure related to the overloaded trucks control is shown below.

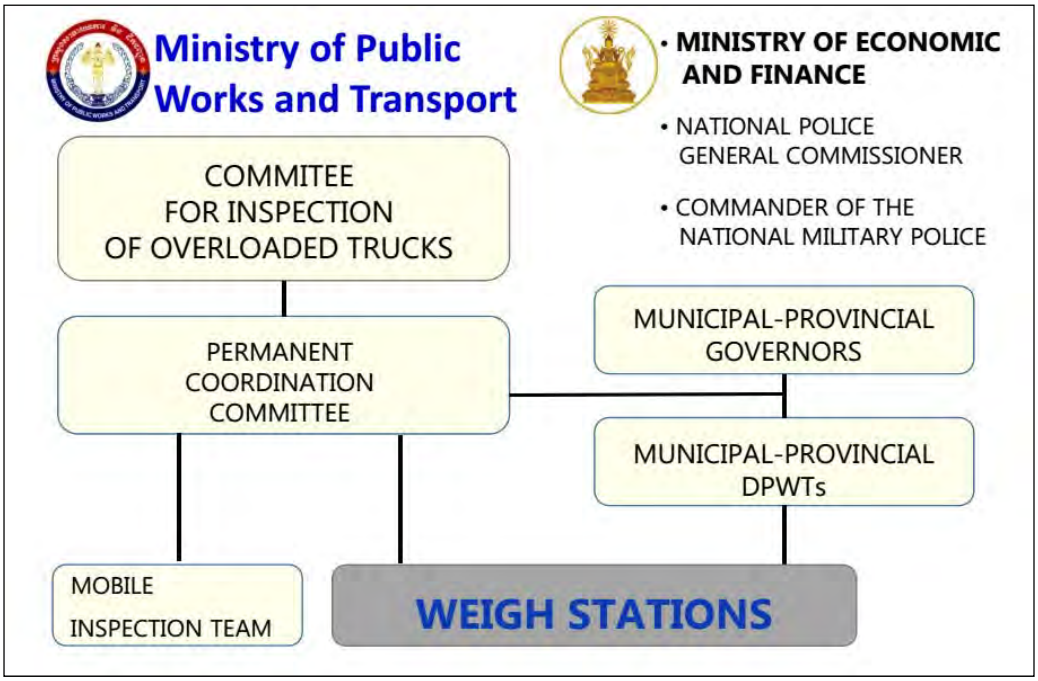


Figure 9-50 Organization Structure for Overloaded Trucks Control

(3) Staff Organization

The Permanent Coordination Committee has the following staff members:

- ✓ Chief of Secretariat
- ✓ Vice Chief of Secretariat (2 members)
- ✓ Accounting Manager
- ✓ Financial Manager
- ✓ Technical Manager
- ✓ Inspector (three members)

The staff of each weigh station is dispatched from related Agencies. The general staff is constituted by 11 members as follows:

- ✓ 3 members from the Provincial Government
- ✓ 3 members from the Provincial DPWT
- ✓ 2 members from the National Police
- ✓ 2 members from the National Military Police
- ✓ 1 member from the Municipal Government

(4) Operation Staff at Tsubasa Weigh Station

The East and West weigh-stations at Tsubasa bridge were implemented using the portable scale type under the JICA pilot project. The operation staff at the East weigh station consists of eight members dispatched from the related agencies, 1 staff member from the Provincial Government, 3 staff members from Provincial the DPWT, 4 staff members from the National Police. The staff at the West weigh station has 4 members who were originally from Kompong Phnom Station, because the traffic volume is very small. **The current staffing assignment is less than JICA's proposal, but since the traffic volume is small, it is fully operated. When the traffic volume increases, the Committee shall add more staff members as per JICA's proposal.**

Table 9-30 Staffing comparison between JICA proposal and actual assignment

	Current Station in general	Tsubasa Bridge Station JICA Proposal		Tsubasa Bridge Station Actual Assignment as of 2017	
		East	West	East	West
Government Officer	7	10	7	4	2
National Police	2	2	2	4	1
Military Police	2	2	2	-	1
Total	11	14	11	8	4

9.5. Budgetary Framework for Overloading Truck Control

(1) Budget Plan and Source

The budget for overloading truck control consists of personnel expenses and maintenance cost. The personnel budget has a separate line by the dispatching agency respectively, and the maintenance expenditure is to be provided by MEF upon request by the Permanent Committee. The budget revenue is sourced from national budget and financing under national and international cooperation from international organizations and development partners. The committee requests the maintenance expenditure with approximately 5 % increase rate every year.

Table 9-31 Budget Plan 2018 for Overloading Truck Control

Category	Budget 2018
Fix Station	5,987,800,000 riel (1.50 million US$)
Mobile Station	863,637,000 riel (0.22 million US$)
3 Pickup Trucks	495,000,000 riel (0.12 million US$)
Total	7,346,437,000 riel (1.84 million US$)

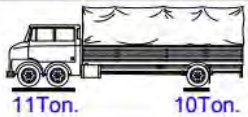
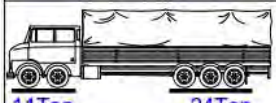
(2) Maintenance Budget for Tsubasa Bridge Weigh Station

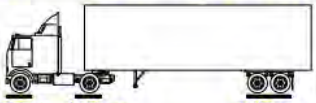
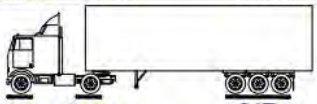
The equipment of the Tsubasa Bridge Weigh Station is a portable type, and **there is concern that maintenance cost at Tsubasa Stations will be higher than other permanent type facilities**. In that case, **the additional budgetary measures are required by using RID road and bridge maintenance budget**.

(3) Limited Weight of axle and gross weight

Allowable maximum weight limit for full trailer trucks and semitrailer trucks are regulated by Article 26 of Road Law as shown below.

Table 9-32 Allowable Maximum Weight Limit

Axle Weight Limits	Total weight Limits	Classification
 6Ton. 10Ton.	16Ton.	Class 1
 11Ton. 10Ton.	21Ton.	Class 2
 6Ton. 19Ton.	25Ton.	Class 3
 11Ton. 19Ton.	30Ton.	Class 4
 11Ton. 24Ton.	35Ton.	Class 5

Axle Weight Limits	Total weight Limits	Classification
 6Ton. 10Ton. 10Ton. 10Ton.	35Ton.	Class 11
 6Ton. 19Ton. 10Ton. 10Ton.	40Ton.	Class 12
 6Ton. 10Ton. 19Ton.	35Ton.	Class 13
 6Ton. 19Ton. 19Ton.	40Ton.	Class 14
 6Ton. 10Ton. 24Ton.	40Ton.	Class 15

(4) Overloading Penalty and its Allocation

The overloading penalty is described in a "Leaflet for Spreading the Law and Other regulation with Overloaded Trucks". For the loading maximum overloaded of axles and maximum gross weight of truck must be penalties to be imposed with the Traffic Laws as mentioned below.

Table 9-33 Penalties on Overloaded Trucks

Categories: / Sanction	≤ 5 %	> 5 % - 10 %	> 10 % - 20 %	> 20 %
a. Unload the goods and detain the vehicles for:	Shall be subject to Obtain a Warming Letter.	10 days	1 month	1 year
and impose a Transactional Fine of:		100,000 KHR /t ($25)	200,000 KHR /t ($50)	300,000 KHR /t ($75)
b. Take away the driving license and suspended for :		10 days	6 month	2 years

The monetary penalty allocation is regulated under Sub-Degree No. 141. 60% of the monetary penalties shall be paid into the national budget and the remaining 40% (Weigh Station 25%, Committee 15%) shall be rewarded to the officials for their task performance.

(5) Achievement Monetary Penalty in 2016

The monetary penalties in 2016 are summarized below. The total number of overloaded trucks is 11,841 vehicles, the amount is about 770,000$. The 60% of monetary penalties is delivered to the national revenue. In the future, **this amount should be used for specialized purpose like the operation and maintenance of overloading trucks control as earmarked revenue sources.**

Table 9-34 Monetary Penalties in 2016

Month	No. of Trucks Inspectd	No.of Trucks Not Overload	Overload Under 5%	Overload			Total Overload	Penalty(USD)
				5%-10%	10%-20%	>20%		
Jan	54,749	44,710	9,845	103	66	25	194	$ 17,738
Feb	96,335	84,267	11,971	49	27	21	97	$ 28,018
Mar	116,034	107,219	8,680	69	43	23	135	$ 41,076
Apr	82,525	72,743	9,691	52	23	16	91	$ 19,899
May	75,209	64,720	10,265	106	65	53	224	$ 82,859
Jun	82,359	72,934	9,160	36	96	133	265	$ 121,927
Jul	83,111	74,321	8,600	10	81	99	190	$ 114,847
Aug	80,750	70,699	9,962	9	51	29	89	$ 44,175
Sep	79,569	69,144	10,288	11	48	78	137	$ 106,407
Oct	65,538	56,274	9,175	11	47	31	89	$ 38,949
Nov	62,079	50,889	11,046	11	80	53	144	$ 62,868
Dec	64,707	51,823	12,698	12	98	76	186	$ 91,761
Total	**942,965**	**819,743**	**121,381**	**479**	**725**	**637**	**1,841**	**$ 770,522**

9.6. Sustainability for Overloading Truck Control

9.6.1 Location of Weigh Station along National Road

The weigh-stations are spread along the national road, the 28 weigh-stations in total are operating as of August 2017. Four stations will be installed by World Bank project in the near future. Two (2) stations along the NR3 and 2 stations along the NR7 (detail locations are under study). Under the JICA NR5 project, 3 stations will be installed at Kompong Chhnang, Battambang, Poipet.

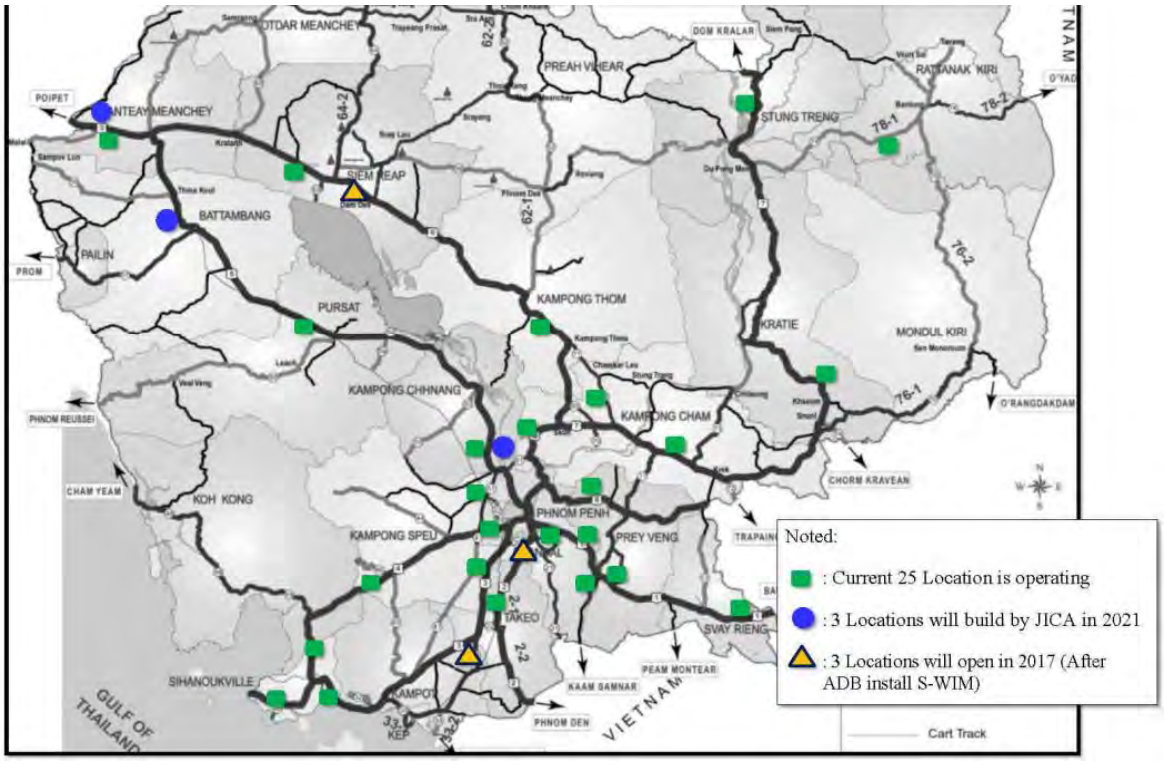


Figure 9-51 Current and Future Location of Weigh-stations (excluding on-going WB projects)

9.6.2 Upgrading to Permanent Weigh-Station at Tsubasa Station

It is necessary to move from the portable equipment type to the permanent equipment type in the future. The budget should be allocated from international organizations fund or the JICA follow-up Project. While studying the JICA Pilot Project for Tsubasa bridge weigh-station, the permanent weigh-station plans were studied as follows.

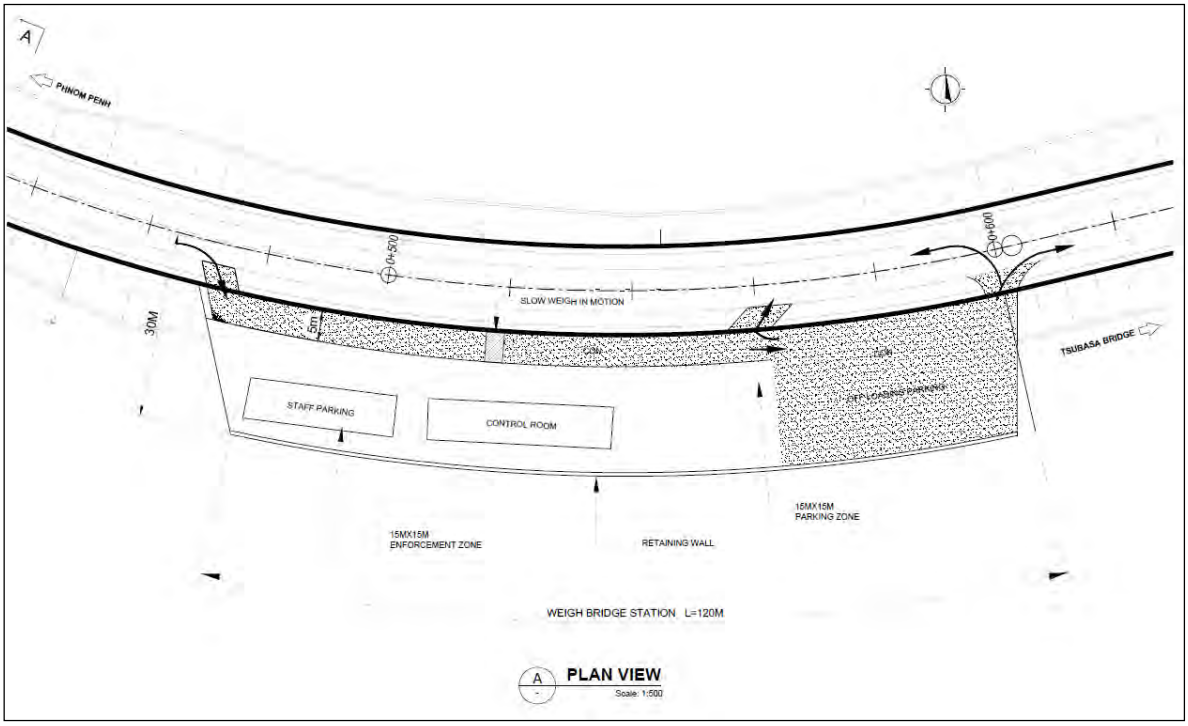


Figure 9-52 Option 2 (West 3) West side (detail plan)

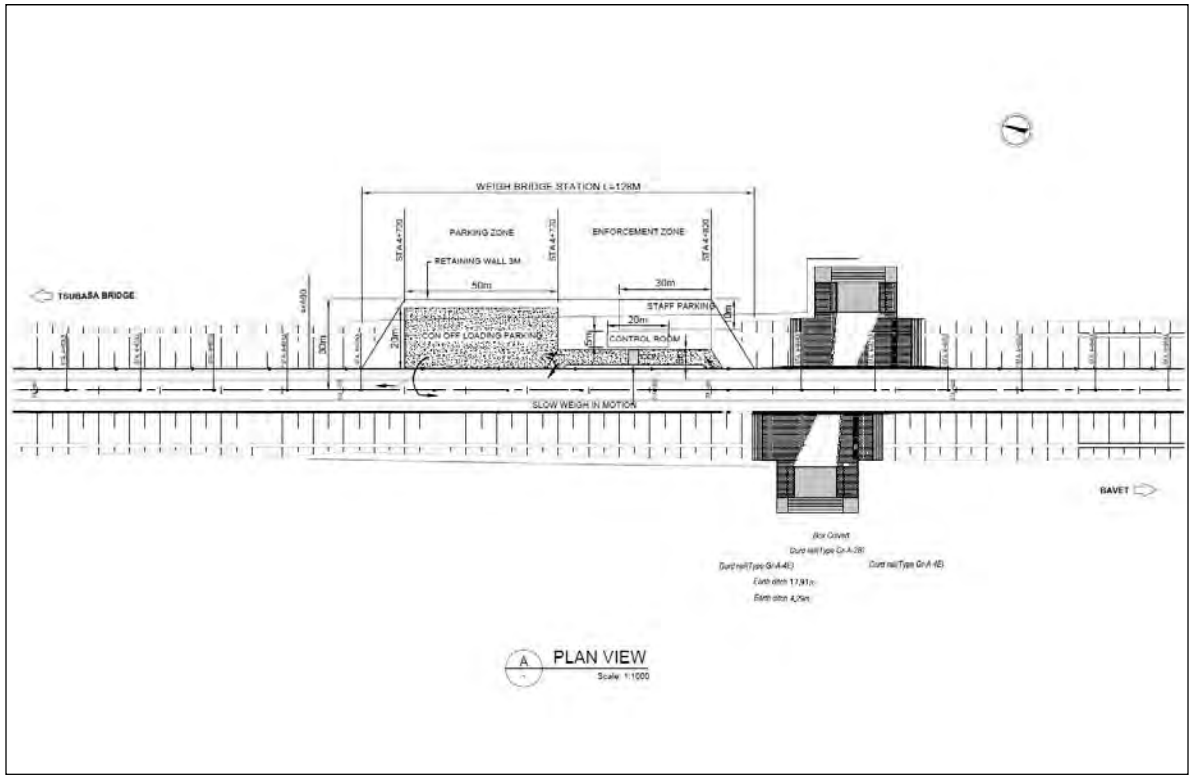


Figure 9-53 Option 2 (East 6) East side (detail plan)

The permanent weigh station shall be equipped with HSWIM (High Speed Weigh in Motion) and LSWIM (Low Speed Weigh in Motion). Required number of the facility and draft project cost are shown below. The construction cost is dependent on the site condition, here assuming 300,000 – 50,000 $.

Table 9-35 Permanent Weigh-Station Equipment and Cost at Tsubasa Bridge

Items		No. /location	Cost (in USD)	Remark
Construction		LS	300,000 – 500,000	(1) Construct retaining wall (2) Construct embankment (within ROW [30 m from centerline]) (3) Construct weighbridge and unloading parking
Facility	LSWIM	1	80,000	
	HSWIM	1	110,000	
	Control Office	1	50,000	500 USD/m^2, 100 m^2
Total		1	510,000 - 710,000	

9.6.3 Monitoring Inspection Activities by Surveillance Camera

In the ADB project, surveillance cameras were installed at 25 weigh-stations except at Tsubasa bridge in order to confirm the status of the truck inspection and staff activity. At the Permanent Committee office within the MPWT building, the situation at the 25 weigh-stations can be monitored. It is also important to introduce surveillance camera system and monitor inspection activities also at the Tsubasa bridge. **It is desirable to implement surveillance camera system at Tsubasa bridge weigh-stations under ADB project or JICA follow-up project.**

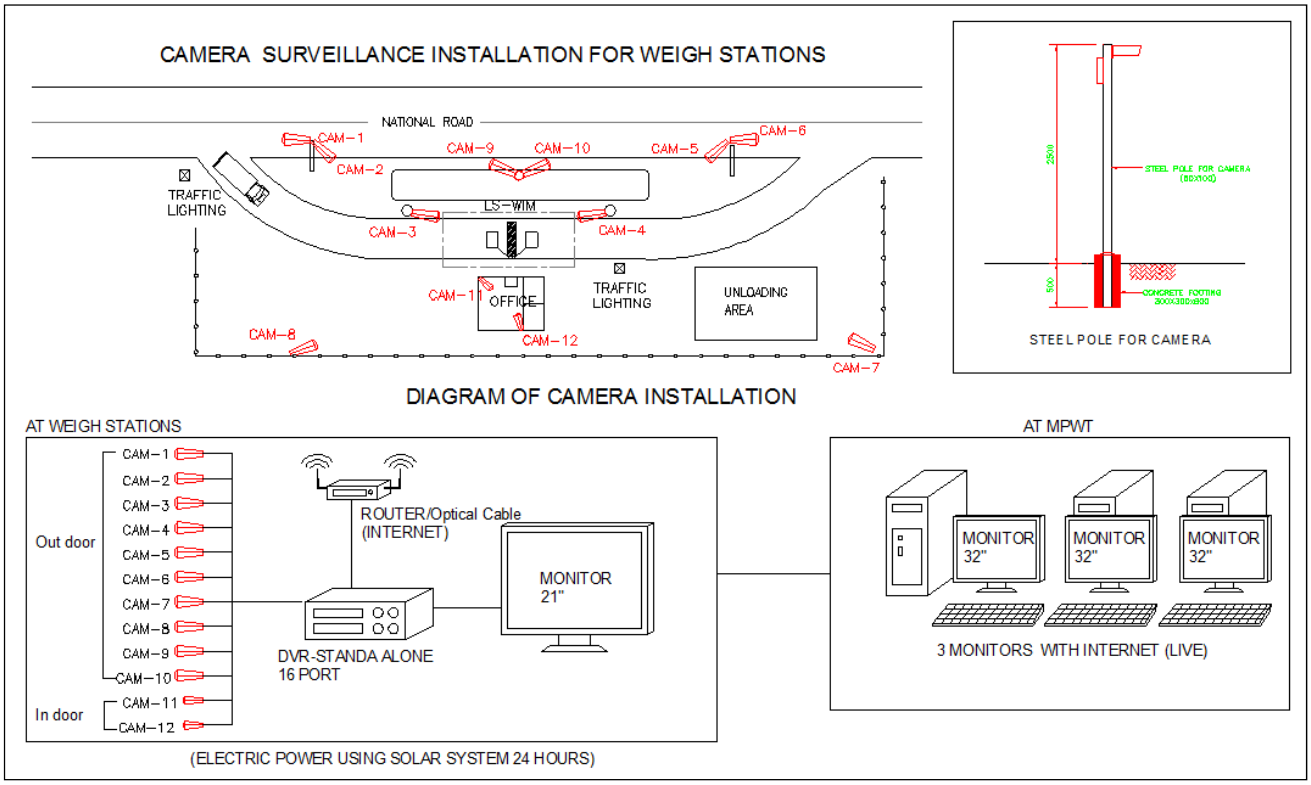


Figure 9-54 Surveillance Camera System

Figure 9-55 Picture of Surveillance Camera System

Table 9-36 Detail Specification of Surveillance Camera System under the ADB project

Item	Description	Specification required
1	In door Security Camera	- Full HD indoor camera - 1080P resolution and updated Franklin Europa DE189 Germany module system board - 3.6 MM Full HD built-in lens - Infrared Radiation 30 meters - ORIENT Digital Image (ODI) perspective that generates Excellent Quality both day and night (Used to watch general view in very clear video)
2	Outdoor Security Camera (To watch car plate number)	- Full HD Outdoor Camera - 1080P resolution with Franklin Europa DE827 Germany module system board - Zoom HD Auto image focus Lens - ORIENT Digital Image (ODI) perspective with extra 4 LEDs that generates Excellent Quality both day and night - Special functioning on Vehicle Plate Number collection - Water Resistance with ISO IP66 system (Used to capture Vehicle Plate Number)
3	Power Converter	Hi-Security Power Converter 30A shelter box
4	Digital Video Recorder with full function, 16-Channel, reveal time.	- Full HD 16 Channel Recording Server - Operating System Linux DR718 - Real time video with Franklin Electric Europa, Germany accordance system - PAL/NTSC selection, Standard Lithium CR2032 battery - 16 composite video 1 Vpp, 75 ohm - Live and Playback simultaneously - Full functions of HDMI, VGA, Network backup, USB, enrich of various Smart Phone OS - User friendly software for Multi-Camera Monitoring System - Built-in 3000 Gigabytes Hard Drive
5	LED TV 21" Wide Screen	LED TV 32" + Wall Bracket
6	UPS	High Quality UPS to support overall CCTV system backup
7	Accessories & Labor	Full Accessories + strong Camera Poles + Professional Service Installation
8	Solar Panel	Mono-crystalline Solar Module with CE TUV Certificates 120W with VoC 21.6V, LSC 9.16A 3.2 mm high transmission front cover
9	Solar Battery	Deep Cycle Solar battery 200AH VRLA dry, Valve regulated lead acid dry with AGM dry
10	Solar Power Controller	MPPT Solar Charge controller with LCD display to working condition DSP Processors architecture ensure high speed and performance

Table 9-37 Detail Specification of Surveillance Camera System under the ADB project

Item	Description	Specification required
11	Solar Inverter	Solar grid tie power inverter DC/AC sine wave inverter 3000W
12	Accessories + Labor	Accessories + Labor
13	Glass 6mm patient wall install with Aluminum frame	Glass 6mm patient wall install with aluminum frame
14	Aluminum door of 2200x800mm size with glass of 6mm thick.	Glass 6mm door install with Aluminum frame
15	Internet Connecting	High speed with FTTH Optical system
16	CPU to control all Camera at MPWT	High Capacity CPU to Control all Cameras at the Head Quarter
17	LED TV 32" Wide Screen	LED TV 32" + Wall Bracket
18	UPS	High Quality UPS
19	Service Configuration	Service Configuration
20	Internet Connecting	High speed with FTTH Optical system

Table 9-38 Detail Project Cost of Surveillance Camera System under the ADB project

Item N°	Description of Goods	Unit Quantity per location	Number of Destination	Total Quantity	Physical unit	Delivery Final Destination	Delivery Period	Unit Price, inclusive of any taxes and duties payable (US$)	Total price inclusive of any taxes and duties payable (US$)
	At Weigh Stations								
1	In door Security Camera	2.00	26.00	52.00	No.	Appendix B	33 days	90.00	4,680.00
2	Out door Security Camera (To watch car plate number)	8.00	26.00	105.00	No.	Appendix B	33 days	120.00	24,960.00
3	Power Converter	1.00	26.00	26.00	No.	Appendix B	33 days	50.00	1,300.00
4	Digital Video Recorder with full function, 16-Channel, reveal time.	1.00	26.00	26.00	No.	Appendix B	33 days	490.00	12,740.00
5	LED TV 21" Wide Screen	1.00	11.00	11.00	No.	Appendix C	33 days	225.00	2,475.00
6	UPS	1.00	26.00	26.00	No.	Appendix B	33 days	70.00	1,820.00
7	Accessories & Labor	1.00	26.00	26.00	No.	Appendix B	33 days	900.00	23,400.00
8	Solar Panel	4.00	26.00	104.00	No.	Appendix B	33 days	190.00	19,760.00
9	Solar Battery	2.00	26.00	52.00	No.	Appendix B	33 days	250.00	13,000.00
10	Solar Power Controller	1.00	26.00	26.00	No.	Appendix B	33 days	80.00	2,080.00
11	Solar Inverter	1.00	26.00	26.00	No.	Appendix B	33 days	80.00	2,080.00
12	Assessories+Labor	1.00	26.00	26.00	No.	Appendix B	33 days	200.00	5,200.00
13	Glass 6mm patient wall install with Aluminum frame	10.00	26.00	260.00	sq.m	Appendix B	33 days	35.00	9,100.00
14	Aluminum door of 2200x800mm size with glass of 6mm thick.	1.00	26.00	26.00	set	Appendix B	33 days	150.00	3,900.00
15	Internet Connecting	1.00	26.00	26.00	set	Appendix B	33 days	230.00	5,980.00
	At Head Office Center (MPWT)								
16	CPU to control all Camera at MPWT	3.00	1.00	3.00	No.	Phnom Penh	33 days	1,200.00	3,600.00
17	LED TV 32" Wide Screen	3.00	1.00	3.00	No.	Phnom Penh	33 days	225.00	675.00
18	UPS	3.00	1.00	3.00	No.	Phnom Penh	33 days	70.00	210.00

9.6.4 Capacity Development of Overloading Truck Management

ADB has started the new project, "Institutional Capacity Building in the Road Sector" in 2017. This project covers the capacity building about axle overload control. The outline of the ADB project is shown below.

Table 9-39 Summary of ADB Capacity Development Project

Project Name	Kingdom of Cambodia: Institutional Capacity Building in the Road Sector (Financed by the Japan Fund for Poverty Reduction)
Executing Agency	Ministry of Public Works and Transport
Executing Period	From 15 May 2017 to 15 May 2019.
Key Activities	Output 1: Institutional and regulatory frameworks strengthened. Output 2: Strategic framework for engaging the private sector in road maintenance established. **Output 3: Axle overload control operations strengthened.** 3.1 Review the current process controlling overloading to determine gaps 3.2 Develop a long-term strategy (up to 2025) to combat overloading 3.3 Prepare a road map for implementing the strategy 3.4 Review and recommend ways to strengthen the business process of the NAOCC (national axle overloading control committee) secretariat 3.5 Review the current internal calibration procedure of weigh scales used in weigh-stations to determine gaps 3.6 Strengthen the internal calibration procedure of weigh scales 3.7 Draft a technical note on the experience in controlling overloading 3.8 Organize a consultation meeting with stakeholders to share and discuss the draft technical note

Related to this project, the ADB seminar was held on 27th October 2017, the seminar agenda was as shown on the next page.

SEMINAR PROGRAM

ADB CD TA 9300 – CAM: Institutional Capacity Building in the road sector

Venue: Raffles Hotel Le Royal

Date: Friday October 27, 2017

Time	Theme	Responsiblity
8:00 – 8:15	Participant registration	
8:15 – 8:20	Welcoming remarks ADB country director	H.E Mr. Samiuela Tukuafu Country Director, ADB CARM
8:20 – 8:25	Remarks by Embassy of Japan	Japanese Embassy Representative
8:25 – 8:35	Keynote remarks and opening by MPWT Secretary of State	H.E Mr. Pheng Sovicheano Secretary of State, MPWT
8:35 – 8:45	CAM 9300 TA Objectives and implementation of the project	Mr. David Shelley Team Leader Vicroads
8:45 – 9:10	Legal and Finance Work-stream	Cambell Duncan / Phan Sin, Legal Experts
9:10 – 9:15	Question - Answer (Q & A)	
9:15 – 9:40	Institutional Work-stream	Michele Burns / Ke Wattana, HRD Experts
9:40 – 9:45	Question - Answer (Q & A)	
9:45 – 10:00	Coffee/Tea Break (Participants Photo Opportunity)	
10:00 – 10:30	Road Maintenance and Axial Load Work-streams	David Shelley, Team Leader Sea Sochivoan, D.T.L
10:30 – 10:40	Question - Answer (Q & A)	
10:40 – 11:20	Presentation by ADB Consultant on Weight Station Observation Report and Way forward	Dr. Robert Smith International Weight Station EP
11:20 – 11:45	Question - Answer (Q & A)	
11:45 – 12:00	Concluding remarks by MPWT Secretary of State	H.E Mr. Pheng Sovicheano Secretary of State, MPWT
12:00 – 14:30	Lunch provided	

Chapter 10. Procurement of Material and Equipment

Table 10-1 shows the list of the equipment while **Table 10-2** shows the list of construction materials for the pilot project procured by the Project

Table 10-1 Equipment List

Item	No. of Items	Year/Month	Storage Site	Status
(1) Road Inspection				
DRIMS (Dynamic Response Intelligent Monitoring System)	2	2015 April, 2016 October	JICA team office, MPWT	use for road condition evaluation
DRIMS-relevant accessary	2	2016 September	RID office*1	use for road condition evaluation
Movie recorder (road monitor)	2	2016 September	RID office	use for road condition evaluation
(2)Bridge Inspection				
Binocular	5	2015 August	RID office	use for bridge inspection
Inspection hammer	10	2015 October	RID office	use for bridge inspection
Waist pouch for inspection equipment	10	2015 October	RID office	use for bridge inspection
Flashlight	10	2015 October	RID office	use for bridge inspection
Inspection camera	1	2016 September	JICA team office	use for bridge inspection
Oxygen meter	1	2016 September	JICA team office	use for bridge inspection
Safety belt	5	2016 September	RID office	use for bridge inspection
Ladder	1	2016 September	RID office	use for bridge inspection
Head beam light	2	2016 September	RID office	use for bridge inspection
Head light	5	2016 September	RID office	use for bridge inspection
Transceiver	1	2016 September	RID office	use for bridge inspection
Shovel	2	2016 September	RID office	use for bridge inspection
Grass Cutter	1	2016 September	RID office	use for bridge inspection
Color cone	5	2016 September	RID office	use for bridge inspection
Vehicle stopper	1	2016 September	RID office	use for bridge inspection
(3) Bridge Database				
iPad	10	2016 September	RID office	use for bridge inspection
Laptop computer	2	2016 September	RID office	use for bridge database management
MacBook Pro（laptop PC）	1	2015 October	RID office	use for bridge database management
DELL Inspiron 15 5000series（laptop PC）	1	2015 October	RID office	use for bridge database management
FileMaker Sever (software)	1	2015 October	RID office	use for bridge database management
FileMaker Pro (software)	1	2015 October	RID office	use for bridge database management
(4) Overloading Control				
Portable type weighing scale	2	2016 September	Tsubasa Bridge	Use for measurement
Container house	1	2016 September	Tsubasa Bridge	Use for measurement
Load cell (spare parts)	1	2016 December	Secretariat of Permanent Coordination Committee for Inspection of Overloaded Trucks (SPCC)	Use for measurement

Table 10-2 List of Construction Materials for Pilot Projects

Item	No. of Items	Year/Month	Storage Site	Status
(1) Bridge Pilot Project				
BOND E206 (BASE)	15	2016 January	RID lab*2	Used for pilot projects
BOND E 206 (HARDENER)	15	2016 January	RID lab	Used for pilot projects
BOND E390 (BASE)	15	2016 January	RID lab	Used for pilot projects
BOND E 390 (HARDENER)	15	2016 January	RID lab	Used for pilot projects
CYLINDER FOR BOND	12 (box)	2016 January	RID lab	Used for pilot projects
WEIGHTING MACHINE	1	2016 January	RID lab	Used for pilot projects
WIRE BRUSH	6	2016 January	RID lab	Used for pilot projects
SPATURA FOR MIXING	3	2016 January	RID lab	Used for pilot projects
CHALK	1 (box)	2016 January	RID lab	Used for pilot projects
BUCKET	6	2016 January	RID lab	Used for pilot projects
STOP WATCH	3	2016 January	RID lab	Used for pilot projects
SPATURA FOR PAINT	3	2016 January	RID lab	Used for pilot projects
MEASURE CUP	6	2016 January	RID lab	Used for pilot projects
SANDPAPER	6	2016 January	RID lab	Used for pilot projects
BLOWER	3	2016 January	RID lab	Used for pilot projects
LEATHER SKIVING CUTTER	6	2016 January	RID lab	Used for pilot projects
Bridge repair materials for the pilot project	1 set	2016 November	Sihanouk DPWT	Used for pilot projects
Carbon fiber sheets	1 set	2016 November	Sihanouk DPWT	Used for pilot projects
Bridge repair materials for the pilot project	1 set	2016 November	JICA team office	Used for pilot projects
Carbon fiber sheets	1 set	2016 November	JICA team office	Used for pilot projects
(2) Road Pilot Project				
Permanent Cold Patch Asphalt (1)	100	2016 January	RID lab	Used for pilot projects
Permanent Cold Patch Asphalt (2)	200	2017	RID lab	Used for pilot projects

*1: MPWT main office building, 3rd floor

*2: Bridge unit warehouse in RID laboratory

(Form12)

CERTIFICATE OF HANDOVER

PROJECT TITLE: The Project for Strengthening Capacity for Maintenance of Roads and Bridges

This is to certify that the equipment in the attached list for above-mentioned project has been handed over properly as of November 2, 2016 to Secretariat of Permanent Coordination Committee for Inspection of Overloaded Trucks (SPCC). SPCC will use and maintain the equipment properly in accordance with the purpose of the project activities.

(Signature)
Mr. Yuzo Mizota
Team Leader
JICA Expert Team

(Signature)
H.E. Seng Chhuon
Under Secretary of State
and Chief of Secretariat.
MPWT

November 2, 2016
RID, MPWT

(Form12)

(Attachment)

List of Equipment

No.	Name of Item	Qty	Place of Installment	Date of Handover
1	Portable weigh station with dummy plate	2	Both side (West and East) at Tsubasa bridge	November 2, 2016
2	Container house	1	West side at Tsubasa bridge	November 2, 2016

Photo

Portable weigh station

Container house

(Form12)

CERTIFICATE OF HANDOVER

PROJECT TITLE: The Project for Strengthening Capacity for Maintenance of Roads and Bridges

This is to certify that the equipment in the attached list for above-mentioned project has been handed over properly as of October 26, 2016 to Road Infrastructure Department (RID), Ministry of Public Works and Transport (MPWT). RID will use and maintain the equipment properly in accordance with the purpose of the project activities.

(Signature)
Mr. Yuzo Mizota
Team Leader
JICA Expert Team

(Signature)
Mr. Heng Rathpiseth
Director
Road Infrastructure Dept.
MPWT

October 26, 2016
RID, MPWT

(Form12)

(Attachment)

List of Equipment

No.	Name of Item	Qty	Place of Installment	Date of Handover
1	iPad mini	10	RID, MPWT	October 26, 2016
2	Laptop computer	2	RID, MPWT	October 26, 2016
3	Safety belt	5	RID, MPWT	October 26, 2016
4	Ladder	2	RID, MPWT	October 26, 2016
5	High power light	2	RID, MPWT	October 26, 2016
6	Head ramp	5	RID, MPWT	October 26, 2016
7	Transceiver	1 set	RID, MPWT	October 26, 2016
8	Shovel	2	RID, MPWT	October 26, 2016
9	Grass cutter	1	RID, MPWT	October 26, 2016
10	DRIMS accessary	2	RID, MPWT	October 26, 2016
11	Road cone	5	RID, MPWT	October 26, 2016
12	Stopper	1	RID, MPWT	October 26, 2016

Photo

1: iPad mini	2: Laptop computer
	
3: Safety belt	4: Ladder
	

(Form12)

5: High power light	6: Head ramp
	
7: Transceiver	8: Shovel
	
9: Grass cutter	10: DRIMS accessary
	
11: Road cone	12: Stopper
	

(Form12)

CERTIFICATE OF HANDOVER

PROJECT TITLE: The Project for Strengthening Capacity for Maintenance of Roads and Bridges

This is to certify that the equipment in the attached list for above-mentioned project has been handed over properly as of June 12, 2017 to Road Infrastructure Department (RID), Ministry of Public Works and Transport (MPWT). RID will use and maintain the equipment properly in accordance with the purpose of the project activities.

(Signature)
Mr. Yuzo Mizota
Team Leader
JICA Expert Team

(Signature)
Mr. Heng Rathpiseth
Director
Road Infrastructure Dept.
MPWT

June 12, 2017
RID, MPWT

(Form12)

(Attachment)

List of Equipment

No.	Name of Item	Qty	Place of Installment	Date of Handover
1	Inspection camera	1	RID, MPWT	May 22, 2017
2	Oxygen meter	1	RID, MPWT	May 22, 2017
3	DRIMS	2	RID, MPWT	May 22, 2017

Photo

<table>
<tr><td colspan="2">  </td></tr>
<tr><td colspan="2">No.1 Inspection Camera</td></tr>
<tr><td>  </td><td> 
</td></tr>
<tr><td>No.2 Oxygen meter</td><td>No.2 DRIMS (2 sets)</td></tr>
</table>

Chapter 11. Training in Japan

11.1. Outline of the Training in Japan (1st in 2015)

(1) Name of Training Course

THE PROJECT FOR STRENGTHENING CAPACITY DEVELOPMENT FOR MAINTENANCE MANAGEMENT OF ROADS AND BRIDGE IN THE KINGDOM OF CAMBODIA

(2) Training Period

From 13 October 2015 to 24 October 2015

(3) List of Participants

7 trainees

Table 11-1 Name of Trainees and Position

Organization	Name	Position
Ministry of Public Works and Transport	Mr. NAY Chamnang	Director of Road Infrastructure Department
	Mr. LIM Sambo	Director of Kampot Provincial Department
	Mr. KIM Ponna	Director of Siem Reap Provincial Department
	Mr. MAM Touch	Director of Kep Provincial Department
	Mr. CHOU Kolla	Director of Kompong Thom Provincial Department
	Mr. CHAO Sopheak Phibal	Deputy Director of Road Infrastructure Department
Ministry of Economy and Finance	Mr. MEN Vivoit Vithiea	Chief of Investment Bureau

□Mr. NAY Chamnang participated from 13 October 2015 to 18 October 2015

(4) Schedule

The schedule of the training is shown in Table 11-4.

Table 11-2 Training Schedule

Date	Time	Training Program	Place
14 Oct (Wed)	10:00 ～ 11:30	Briefing	JICA Kansai
	11:00 ～ 13:30	Lunch	
	13:30 ～ 16:00	Program Orientation	
15 Oct (Thu)	10:00 ～ 12:15	Expressway in Japan	Hanshin Expressway Company
	12:15 ～ 13:00	Lunch	
	13:00 ～ 15:00	Bridge inspection	
	15:00 ～ 17:00	Bridge maintenance	
16 Oct (Fri)	10:00 ～ 12:00	Large Scale Repair Work	Hanshin Expressway Company
	12:00 ～ 14:00	Lunch	
	14:00 ～ 16:30	Site Visit to Large Scale Repair Work	
17 Oct (Sat)	9:30 ～ 12:00	Site visit toAkashi Bridge	Akashi Bridge World
18 Oct (Sun)		Holiday	
19 Oct (Mon)	10:00 ～ 12:00	Maintenance Expert System	Gifu University
20 Oct (Tue)	10:00 ～ 12:00	Discussion on Action plan	JICATokyo
	12:00 ～ 13:30	Lunch	
	13:30 ～ 16:00	Bridge Asset Management	CTIE
21 Oct (Wed)	9:50 ～ 11:30	Bridge study tour along Sumida River	Sumida River
	13:30 ～ 16:30	Tokyo Metropolitan Expressway	Tokyo Metropolitan Expressway Company
22 Oct (Thu)	10:00 ～ 12:00	Bridge Maintenance by local government	Machida City
	12:00 ～ 14:00	Lunch	
	14:00 ～ 16:00	Preparation for evaluation	JICATokyo
23 Oct (Fri)	9:30 ～ 12:00	Evaluation Meeting	JICATokyo
	14:00 ～ 16:00	Discussion on Action plan	Hotel

(5) Photo of activities

Briefing on 14 October	Hanshin Expressway Company on 15 October
	
Site visit at Hanshin Expressway on 16 Oct	Bridge Asset Management on 20 October
	
Tokyo Metropolitan Expressway on 21 oct	Machida City on 22 october
	
Action plan discussion on 22 Oct	Evaluation Meeting on 23 Oct
	

11.2. Outline of the Training in Japan (2nd in 2016)

(1) Name of Training Course

THE PROJECT FOR STRENGTHENING CAPACITY DEVELOPMENT FOR MAINTENANCE MANAGEMENT OF ROADS AND BRIDGES IN THE KINGDOM OF CAMBODIA

(2) Training Period

From 30 October 2016 to 12 November 2016

(3) List of Participants

7 trainees

Table 11-3 Name of Trainees and Position

Organization	Name	Position
Ministry of Public Works and Transport	Mr. SRENG Sros	Director, Department of Public Works and Transport of Kratie Province
	Mr. HAY Chandara	Deputy Chief Office, Road Infrastructure
	Mr. SITTHY Panhavuth	Deputy Chief Office, Road Infrastructure
	Mr. NIN Menakak	Deputy Chief of Planning and Technical Office, Road Infrastructure
	Mr. LONG Davuth	Officer, Road Infrastructure
Ministry of Economy and Finance	Mr. VONGSEY Vicheth	Deputy Director, Department of Investment
	Mr. PHAT Kong	Deputy Chief Office, Department of Investment

(4) Schedule

The schedule of the training is shown in Table 11-4.

Table 11-4 Training Schedule

Date	Time			Training Program	Place
31 Oct (Mon)	10:00	～	12:30	Briefing	JICA Kansai
	12:30	～	14:00	Lunch	
	14:30	～	16:30	An Example of Human Resource Development for Bridge Engineering in Japan	CTI Engineering
1 Nov (Tue)	10:00	～	12:00	Torayca Carbon Fiber for Rehabilitation and Retrofitting	TORAY Industries
	12:00	～	13:00	Lunch	
	13:00	～	18:30	Transport (from Osaka to Matsuyama)	
2 Nov (Wed)	10:00	～	12:00	Production of Cold Mix Asphalt (EXCEL) and Routine Maintenance Project	IKEE Group
	12:00	～	13:30	Lunch	
	13:45	～	16:15	Production of Cold Mix Asphalt (EXCEL) and Routine Maintenance Project	
3 Nov (Thu)		～		Transport (from Matsuyama to Osaka)	
4 Nov (Fri)	9:45	～	12:30	Intensive Maintenance Works with All Lane Closures in Hanshin Expressway (Lecture)	Hanshin Expressway
	12:30	～	13:30	Lunch	
	13:30	～	17:00	Intensive Maintenance Works with All Lane Closures in Hanshin Expressway (Study Tour)	
5 Nov (Sat)		～		Cultural Exchange	
6 Nov (Sun)		～		Holiday	
7 Nov (Mon)	10:00	～	13:00	Maintenance Framework of Hanshin Expressway	Hanshin Expressway Engineering
	13:00	～	14:00	Lunch	
	14:00	～	17:00	Non-destructive Testing	
8 Nov (Tue)	6:30	～	14:10	Transport (from Osaka to Niigata) , Lunch	
	14:00	～	16:30	Bridge Maintenance Activities of Niigata City	Niigata city
9 Nov (Wed)	10:00	～	12:00	Overload Vehicle Control Methods and Portable Truck Scale (PTS) Overview	Tanaka Scale
	12:00	～	13:00	Lunch	
	13:00	～	15:30	Introduction of Relational Database	Nagaoka College
	15:30	～	18:00	Transport (from Nagaoka to Tokyo)	
10 Nov (Thu)	9:30	～	12:30	Infrastructure Monitoring Using Sensors on Vehicles	Tokyo University
	12:30	～	14:00	Lunch, Transport to CTII	
	14:00	～	16:00	Preparation for evaluation meeting	CTII
11 Nov (Fri)	10:00	～	13:00	Evaluation meeting	JICA Tokyo

(5) Photo of activities

Briefing on 31 October	CTI Engineering on 31 October
	
TORAY Industries on 1 November	IKEE Group on 2 November
	
Hanshin Expressway on 4 November	Site visit at Hanshin Expressway on 4 November
	
Hanshin Expressway Engineering on 7 November	Niigata city on 8 November
	

Tanaka Scale on 9 November	Nagaoka College on 9 November
	
Tokyo University on 10 November	Evaluation meeting on 11 November
	

11.3. Outline of the Training in Japan (3rd in 2017)

(1) Name of Training Course

THE PROJECT FOR STRENGTHENING CAPACITY DEVELOPMENT FOR MAINTENANCE MANAGEMENT OF ROADS AND BRIDGES IN THE KINGDOM OF CAMBODIA

(2) Training Period

From 4 November to 18 November 2017

(3) List of Participants

7 trainees

Table 11-5 Name of Trainees and Position

Organization	Name	Position
MPWT (Ministry of Public Works and Transport)	Mr. SIM San Vapiseth	Vice Chief Office, Road Infrastructure
	Mr. NGIM Nouba	Deputy Chief Office, Road Infrastructure
	Ms. CHAY Chakriya	Office, Road Infrastructure
	Mr. MOM Ratha	Vice Chief Office, Road Infrastructure
	Mr. CHHOUK Sochea	Office, Road Infrastructure
MEF (Ministry of Economy and Finance)	Mr. CHAN Pulrith	Deputy Chief Office, Department of Investment
	Ms. NONG Chandany	Deputy Chief Office, Department of Investment

(4) Schedule

The Japan training schedule is shown in **Table 11-6**.

Table 11-6 The Japan Training Schedule

			AM	PM	Stay
Day 1	4-Nov	Sat		Dep Phnom Penh	Air
Day 2	5-Nov	Sun	Fukuoka (via Bangkok)	JICA Kyushu (or Hotel)	Fukuoka
Day 3	6-Nov	Mon	Briefing (JICA Kyushu)	Kitakyushu City (Bridge Maintenance)	Fukuoka
Day 4	7-Nov	Tue	Construction site visit (PC bridge) Fuji PS	Factory visit (PC)	Fukuoka
Day 5	8-Nov	Wed	Tsutawaru Doboku (Kyushu Association for Bridge and Structural Engineering) (Training and Dissemination of bridge maintenance by NPO)		Fukuoka
Day 6	9-Nov	Thu	Move Fukuoka to Osaka	Hanshin Expressway Company (Site visit)	Osaka
Day 7	10-Nov	Fri	Hanshin Expressway Company (bridge maintenance training)	Hanshin Expressway Company (bridge maintenance training)	Osaka
Day 8	11-Nov	Sat	Japanese culture program		Osaka
Day 9	12-Nov	Sun	Holiday		Osaka
Day 10	13-Nov	Mon	Move Osaka to Tokyo	JICA Tokyo (or Hotel), training review meeting, Documentation, CTII	Tokyo
Day 11	14-Nov	Tue	Tokyo University (Concrete fatigue failure)	Site visit (Sumida river bridges)	Tokyo
Day 12	15-Nov	Wed	Move Tokyo to Chiba	Chiba City (Chiba Navigation, road maintenance by community participatory method)	Tokyo
Day 13	16-Nov	Thu	Tokyo University (DRIMS)	Lap-up and preparation for evaluation meeting	Tokyo
Day 14	17-Nov	Fri	Evaluation meeting	Tokyo visit	Tokyo
Day 15	18-Nov	Sat	Dep Narita to Phnom Penh		

(5) Photo of activities

7 Nov Site visit of concrete bridge construction

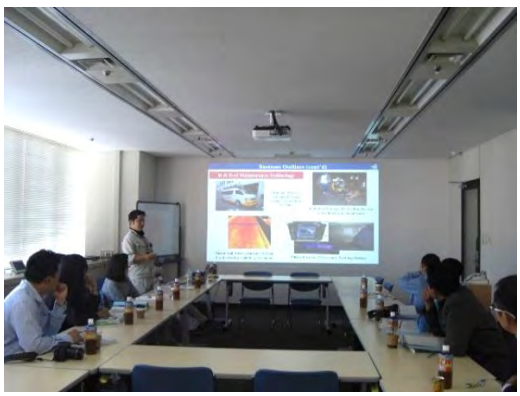
7 Nov Site visit of the factory of fablication of PC girder

8 Nov Lecture at Tsutawaru Doboku

9 Nov Lecture at Kita Kyushu

9 Nov Site visit of Wakato bridge

10 Nov visit to Seisemic disaster memorial museam



10 Nov Lecture at Hanshin Expressway Company

10 Nov OJT using bridge inspection car

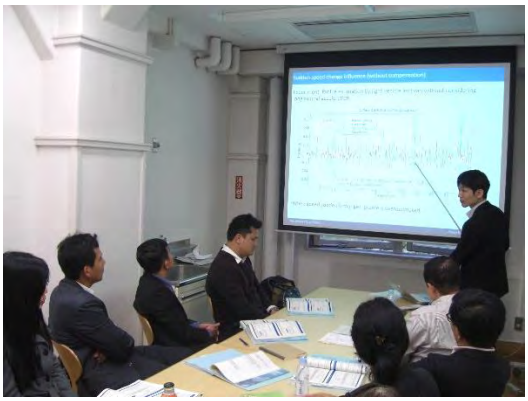
13 Nov traning review meeting

13 Nov Lecture of CTII

15 Nov Lecture at Chiba Prefecture

15 Nov OJT using smart phone (Chiba Nav)

14 Nov Lecture at Tokyo University



16 Nov Lecture at Tokyo University

17 Nov Evaluation meeting