

**Appendix 2-16**  
**Evaluation Report on Workshop of Machinery based**  
**Asphalt Pavement Work in Large Area**

**Japan International Cooperation Agency  
(JICA)**

**Lao People's Democratic Republic**

**The Project for Improvement of  
Road Management Capability in Lao PDR**

**Evaluation Report  
on  
Workshop  
of  
Machinery based Asphalt Pavement  
Work in Large Area**

**April 2013**

**International Development Center of Japan Inc. (IDCJ)  
& Oriental Consultants Co., Ltd. (OC)**

## Table of Contents

1.	Introduction .....	1
1.1	Background of the Project .....	1
1.2	Project Goal, Purpose and Output .....	2
1.3	Outline of Workshop.....	3
2.	Detail of Workshop.....	4
2.1	Timetable .....	4
2.2	Personnel of Trainers .....	5
2.3	Personnel of Participants .....	5
2.4	Contents of Workshop .....	6
3.	Evaluation of Workshop .....	9
3.1	Satisfaction and Understanding .....	9
3.2	Interested Topic to Learn More .....	10
3.3	Benefit of Workshop.....	10
3.4	Comments of the Participants.....	11

### Appendices

A: Textbook (Laotian)

B: Form of Evaluation Sheet (Laotian)

## **Figures**

1.3.1	Spot Replacement of Damaged Pavement.....	4
2.4.1	Photos in Session-1.....	7
2.4.2	Photos in Session-2.....	8
3.1.1	Evaluation Result of Satisfaction & Understanding.....	9
3.1.2	Evaluation Result of Understanding Level on Each Session .....	10
3.3.1	Benefit of the Training.....	11

## **Tables**

1.3.1	Work Quantity of PP2 (Repaired Area).....	3
2.1.1	Timetable of Workshop .....	5
2.2.1	List of Trainers .....	5
2.3.1	List of Participants.....	6
3.2.1	Interested Topics to Learn More.....	10

## **1. Introduction**

### **1.1 Background of the Project**

Laos is a land-locked country and its transport infrastructure and system heavily relies on road transport to carry both goods and passengers to/from neighboring countries. The road transport in Lao is reported to carry 80% of total domestic cargos and 85% of total passengers transported in entire Laos.

Due to financial constraints, the Lao Government has encouraged to pave the national roads by DBST for the last decades (Accordingly, 90% of the paved national roads are paved by DBST). Having said so, the national roads are currently being paved by Asphalt Concrete (AC), including that at NR-9 and NR-18B. Pavement of the national roads is being deteriorated rapidly, due to a lack of local planning/technical/financial capability in terms of road management and maintenance. And which contributes to hindering provision of safe and reliable transport system and hence development of regional economic activities.

The identified issues related with road maintenance can be summarized below.

- Due to a lack of manpower, technical capability and finance, road maintenance works, including inspection, evaluation and work execution, are not properly implemented.
- Besides, almost all road maintenance works are contracted out to the private contractors and the only maintenance work, for which the public agency in Laos is responsible, is every-one-month routine monitoring.
- Due to a lack of manpower, technical capability and finance, road management planning works are not properly implemented, and which results in delay of budget planning.
- The actual road maintenance budget in Laos only meet one-third of the planed budget necessary for the road maintenance works. In this regards, the rehabilitation works at NR-9 results in replacement of deteriorated asphalt concrete pavement to less expensive DBST.

In the last decade, the World Bank, together with other multi-lateral and bilateral donors, has made great efforts for capacity development of the road maintenance and management in Laos, through providing technical and financial supports. In 2010, the

World Bank completed Road Maintenance Program Phase II and channels its supports to wider sector approach project, entitled Road Sector Project and less supports will be made towards road maintenance per se. Under recognition that road maintenance in Laos still requires a continuous support, the Lao Government officially requested Japanese Government for a technical cooperation program, entitled, the Project for Improvement of Road Management Capability, to develop planning and technical capability of road maintenance works in Laos.

## 1.2 Project Goal, Purpose and Output

The Project Design Matrix (PDM), which demonstrates the goal, purpose, output and activities of the Project, has been discussed and agreed, involving key stakeholders of the MPWT. The following table summarizes the PDM of the Project.

Project Design Matrix (PDM)
<p><u>Overall Goal</u></p> <p>1. Roads and bridges in Laos will be properly maintained, which contributes to economic growth and accessibility to public infrastructure are improved.</p>
<p><u>Project Purpose</u></p> <p>Capacity of road maintenance management is improved.</p>
<p><u>Output</u></p> <p>1. Maintenance management is enhanced.            2. Technical manuals for road/bridge maintenance are prepared.            3. <u>Capacity of engineers is enhanced.</u></p>
<p><u>Activities</u></p> <p>1-1 Update/improvement of RMS and PRoMMS            1-2 Improve relationship between RMS and PRoMMS and road maintenance budget plan.            2-1 Prepare road/bridge repair manual.            2-2 Prepare road/bridge maintenance patrol guideline            2-3 Review and revise condition manual, inventory manual            2-4 Formulate a plan for technical manuals development and scheme for improvement and sustainability            2-5 Develop technical manuals and revise existing manuals in collaboration with the central office and provincial offices.            2-6 Issue technical manuals to pilot provinces to be utilized at project sites.            2-7 Monitor utilization of technical manuals and evaluate usefulness and relevance.            3-1 Conduct on-the-job training needs analysis for each technical personnel.            3-2 Formulate training plan and follow-up scheme for the central office and provincial offices.            3-3 Develop training program on inspection/repair and quality control.            3-4 Conduct dry run of training modules with the central office and provincial offices.            3-5 <u>Conduct the pilot project on repair work/maintenance work for supervising and quality control of asphalt concrete pavement in Savannakhet Province.</u>            3-6 Conduct on-the-job training in Vientiane Province and Savannakhet Province.            3-7 Conduct on-the-job training for utilization of RMS and PRoMMS.            3-8 Evaluate on-the-job training of different modules.            3-9 Improve training modules and training programs.            3-10 Monitor and evaluate training follow-up scheme.</p>

### 1.3 Outline of Workshop

#### (1) Pilot Project Phase-2

Currently, the Project has been implementing “Pilot Project for Rehabilitation of National Road No.9 in Lao P.D.R (PP2)” related with the output and its subsidiary activity as shown below.

- ✓ Output-3 : Capacity of engineers is enhanced.
- ✓ Activity 3-2 : the pilot project on repair work/maintenance work for supervising and quality control of asphalt concrete pavement

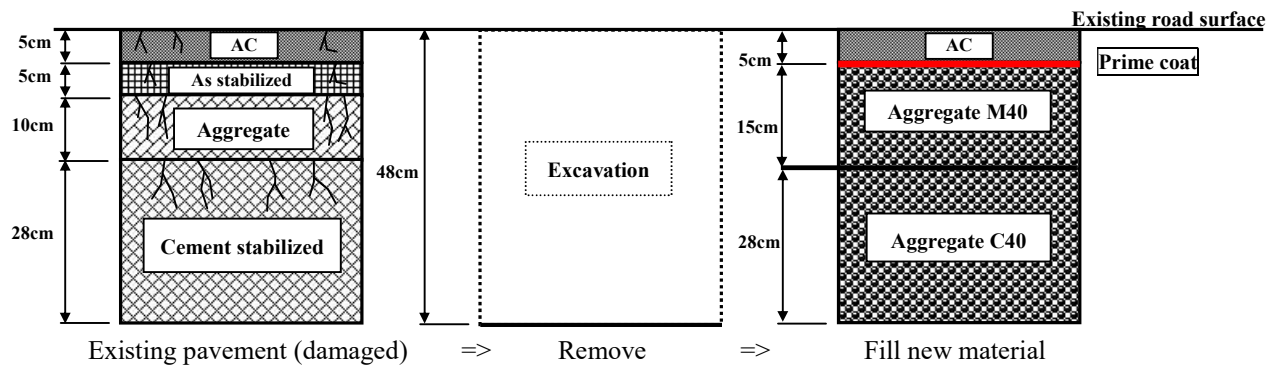
Component of PP2 is spot replacement work of damaged asphalt concrete pavement. Brief information of PP2 is as shown below.

- ✓ Work supervision : DPWT Savannakhet was in charge of the supervision work in collaboration with the assistance of the CaRoL
- ✓ Work execution : Local contractor currently assigned for repair work on National Road No.9 (NR9)
- ✓ Material supply : Local contractor currently operating plants for asphalt and crush stone along NR9
- ✓ Work quantity : Total repaired area is approx. 2,500m<sup>2</sup> in 17 locations. The work breakdown is as shown in Table 1.3.1.

**Table 1.3.1 Work Quantity of PP2 (Repaired Area)**

No.	Start				End			Area (m <sup>2</sup> )
1	39	+	940	to	39	+	970	135.00
2	40	+	580	to	40	+	588	32.00
3	40	+	600	to	40	+	624	225.60
4	40	+	650	to	40	+	675	235.00
6	41	+	160	to	41	+	188	131.60
5	41	+	155	to	41	+	189	159.80
7	41	+	930	to	41	+	947	76.50
8	41	+	950	to	41	+	960	47.00
9	42	+	400	to	42	+	414	65.80
10	42	+	700	to	42	+	708	37.60
11	43	+	600	to	43	+	622	103.40
12	43	+	650	to	43	+	662	56.40
13	43	+	670	to	43	+	688	72.00
14	43	+	700	to	43	+	760	282.00
15	44	+	990	to	45	+	14	225.60
16	45	+	80	to	45	+	116	432.00
17	45	+	116	to	45	+	147	182.59
<b>Total</b>								<b>2,499.89</b>

- ✓ Work procedure : Spot replacement work consists of 2 actions namely “removal of existing pavement” and “installation of new pavement structure”.  
The work procedure is as shown in Figure 1.3.1.



**Figure 1.3.1 Spot Replacement of Damaged Pavement**

## (2) Workshop

The work of PP2 contains installation of hot asphalt mixture as a wearing course. The contractor executed the installation work by applying the labor based method in narrow area. On the other hand, the work requires machinery based method in large area. However, the contractor didn't own sufficient knowledge and experience for the appropriate work execution. Therefore, the CaRoL conducted the workshop to complement the above insufficiencies. Brief information of the workshop is as shown below.

- ✓ Purpose : (i) Introduction and learning of operation method machinery for paving work of hot asphalt mixture for the contractors.  
(ii) Introduction and learning of critical points to assure the work quality in the supervision work for DPWT staffs.
- ✓ Date : 07/Apr (Sun)
- ✓ Venue : Km 45 from Savannakhet, B. Nonvilay on NR9 known as the beginning point of Pilot Project Phase-1

## 2. Detail of Workshop

### 2.1 Timetable

The workshop was conducted in accordance with Table 2.1.1.



**Table 2.1.1 Timetable of Workshop**

<b>Time.</b>	<b>Agenda</b>	<b>Contributor</b>
10:00 -	Purpose of workshop	JICA Expert Team (CaRoL)
10:10 -	Introduction of participants	DPWT Savannakhet
10:15 - 10:30	<b>Session-1 : Introduction of training program</b> - Operation skill of paver - Operation skill of roller - Manual skill for rake works - Q & A	CaRoL Expert Road No.8 State Enterprise
10:30 - 11:45	<b>Session-2 : Demonstration of works</b> 1) Paving works by Paver (Finisher) 2) Compaction by Road roller & Tire roller 3) Spreading AC by lake 4) Q & A with discussion	CaRoL Expert Road No.8 State Enterprise
11:45 - 12:00	- Briefing of capacity assessment method/ - Supervision ability check sheet	JICA Expert Team (CaRoL)
12:00 - 12:10	Closing address and remarks	DPWT Savannakhet

## 2.2 Personnel of Trainers

The lecture was undertaken by the experts of the CaRoL as shown in Table 2.2.1.

**Table 2.2.1 List of Trainers**

<b>No.</b>	<b>Name</b>	<b>Organization</b>	<b>Position</b>	<b>Remarks</b>
1	Mr. Masataka FUJIKUMA	CaRoL	Construction management	Supervisor
2	Mr. SYOUDOM Khamfanh	CaRoL	Supervision engineer	Chief lecturer
3	Dr. Kongkeo PHAMAVANH	CaRoL	Bridge maintenance	Lecturer
4	Mr. Hiroaki KOBAYASHI	CaRoL	Road maintenance	Advisor

## 2.3 Personnel of Participants

The participants were invited from DPWT/OPWT-Savannakhet and local contractors related with road maintenance and construction as shown in Table 2.3.1.

**Table 2.3.1 List of Participants (Bounthom)**

No.	Name	Organization
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## 2.4 Contents of Workshop

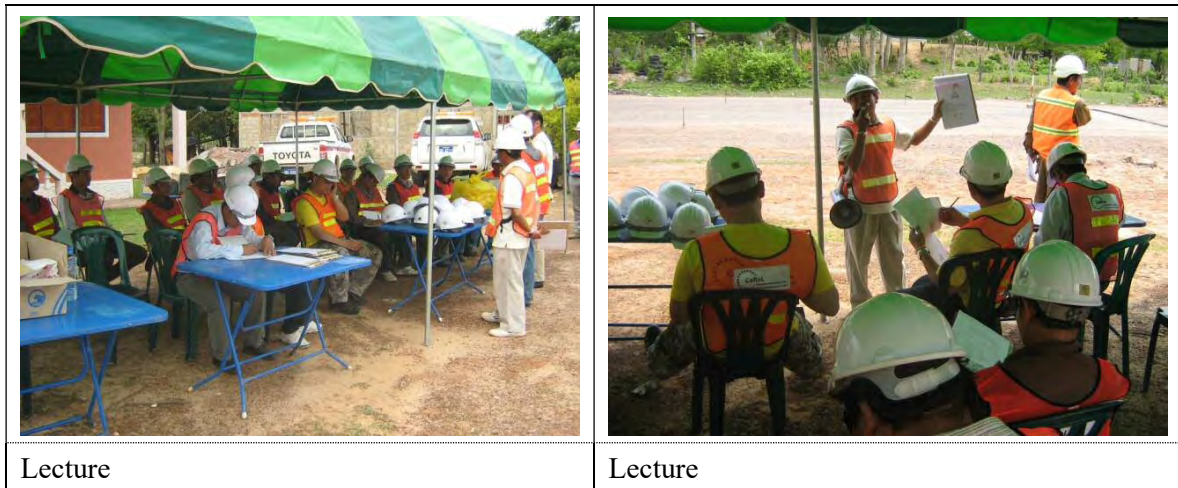
The workshop was composed of Session-1 and 2 as stated in the following sections.

### (1) Session-1

The Lecturer explained the operation method of the machinery and the work procedure of paving work prior to the demonstration. Note the machines used for the paving work

are paver, road (steel wheel) roller, tyred roller and vibratory roller respectively. The work procedures are summarized as follows. The textbook (Laotian) is attached in **Appendix-A**. Photos at the lecturing are as shown in Figure 2.4.1.

- (i) Sweep the surface
- (ii) Mark the carriageway
- (iii) Apply the tack coat
- (iv) Set up the guide system for the paver
- (v) Prepare the equipment
- (vi) Placing the mix
- (vii) Compaction
- (viii) Compaction on joint area



**Figure 2.4.1 Photos in Session-1**

## (2) Session-2

Demonstration of the paving work was conducted in the Session-2. The operators of the machines and the skilled workers performed the works on each step. Those photos are as shown in Figure 2.4.2.



**Figure 2.4.2 Photos in Session-2**

### 3. Evaluation of Workshop

Evaluation of the workshop (i.e. Session-1: lecture and Session-2: demonstration) was carried out immediately after Session-2. The CaRoL analyzed and examined the evaluation sheets filled and submitted by the participants for the evaluation. Form of the evaluation sheet (Laotian) is attached in [Appendix-B](#). Further, evaluation result is described in the following sections.

#### 3.1 Satisfaction and Understanding

##### (1) Comprehensive Evaluation

Evaluation result of satisfaction and understanding of the workshop is indicated in Figure 3.1.1. 90% of the participants answered “Satisfied” or “Very satisfied” as well as the all participants answered “Understandable” or “Very understandable” according to the figure. Considering above, the contents of the workshops were prepared on the satisfactory level to match with the interest and technical capacity of the participants comprehensively.

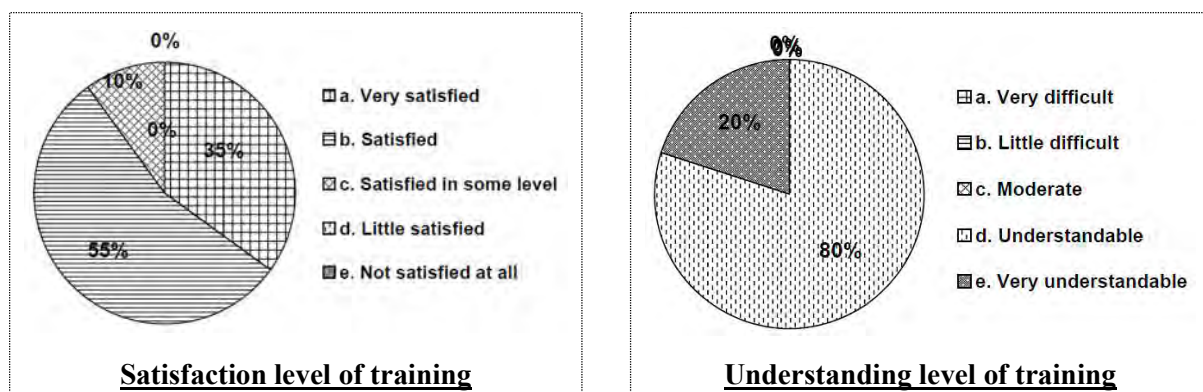
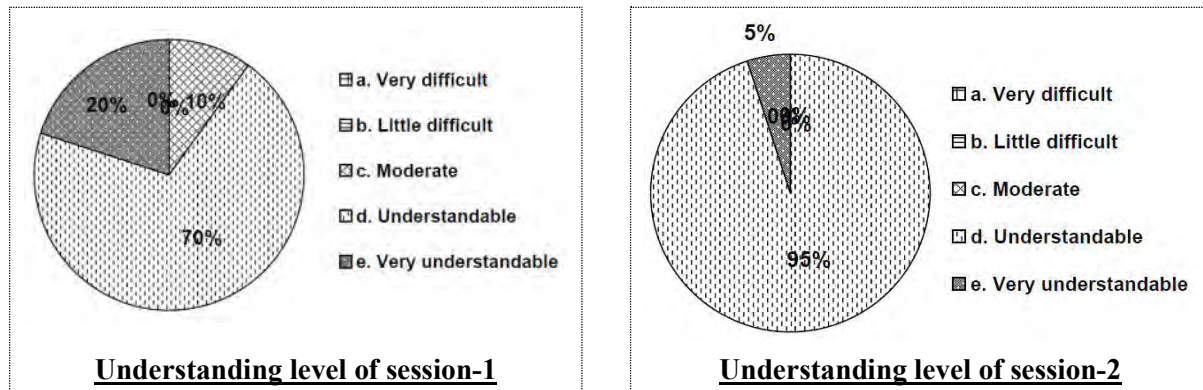


Figure 3.1.1 Evaluation Result of Satisfaction & Understanding

##### (2) Evaluation of Understanding on Each Session

Understanding level on each session is indicated in Figure 3.1.2. 90% of the participants answered “Understandable” or “Very understandable” in regard to the Session-1 as well as the all participants answered “Understandable” or “Very understandable” in regard to the Session-2. Considering this, the both contents were prepared on the satisfactory level to match with the technical capacity of the participants.



**Figure 3.1.2 Evaluation Result of Understanding Level on Each Session**

### 3.2 Interested Topics to Learn More

The result of question and answer regarding the interested topics to learn more is shown in Table 3.2.1. The participants tend to learn the topics regarding the operation skill of paver and supervision method of paving work in the both sessions. The feedback will be utilized in case of the preparing of the prospective workshop/training program.

**Table 3.2.1 Interested Topics to Learn More**

Session	Which topic you want to learn more?	No.
1 (Lecture)	a. Operation skill of paver	13
	b. Operation skill of roller	0
	c. Work skill for rake man	1
	d. Skill of supervision method of whole work procedure	9
	e. Others (Type and characteristic of asphalt mixture)	1
2 (Demonstration)	a. Operation of paver	11
	b. Operation of road roller	2
	c. Operation of tyred roller	0
	d. Raking work	1
	e. Supervision work	9
	f. Others	0

### 3.3 Benefit of Workshop

Benefit of the training is evaluated in accordance with the questions stated below.

- (i) "Did you get information on what you expected?"
- (ii) "Can you apply what you learned to your work?"

The result is indicated in Figure 3.3.1. 55% of the participants answered “A lot” or “Enough” for question-(i) as well as 55% of the participants answered “Apply a lot” or “Apply some” for question-(ii). Considering above, the contents should be improved to match with the interest and the demand of the participants for the prospective occasions.

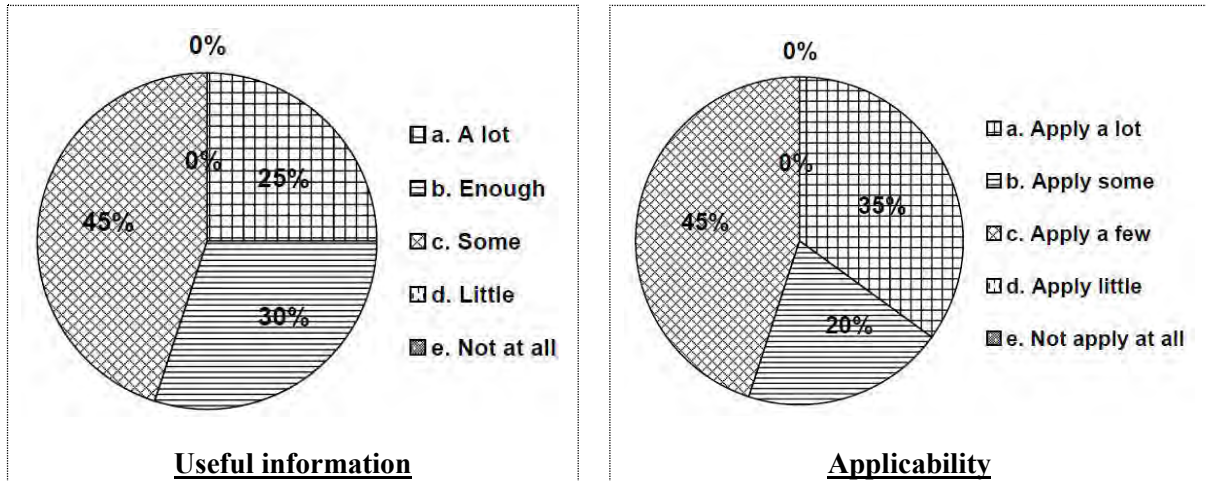


Figure 3.3.1 Benefit of the Training

### 3.4 Comments of the Participants

The participants commented their impression of the workshop and the suggestions for the further improvement. Summary of the comments are listed as follow.

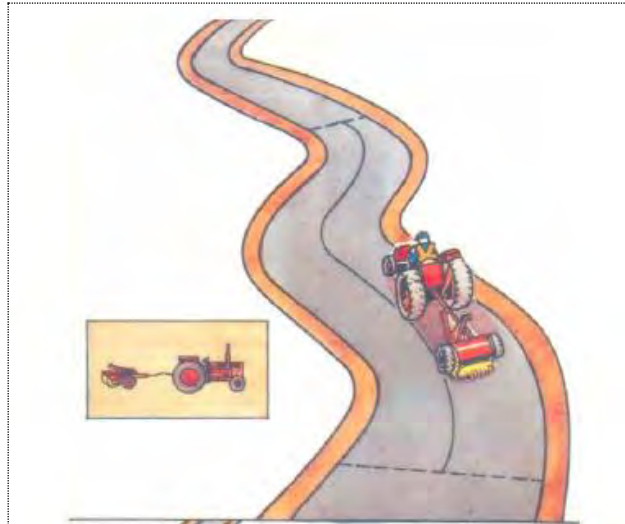
- ✓ The content is very interesting and useful but the time is too short.
- ✓ Continuous implementation in future is necessary.
- ✓ Clear and detail explanation is necessary.
- ✓ Strengthening of Session-2 is necessary.

The CaRoL will utilize the above comments for the further improvement.

ໂດຍທົ່ວໄປແລ້ວການປຸງຢາງເທື່ອໜຶ່ງ ແມ່ນຈະກວມເອົາເນື້ອທີ່ເຄິ່ງນຶ່ງຂອງຖະໜົນ (ເຄິ່ງເລນ) ແລະມີ 8 ຂັ້ນຕອນດັ່ງຕໍ່ໄປນີ້:

1. ປັດໜ້າຖະໜົນເພື່ອທຳຄວາມສະອາດ

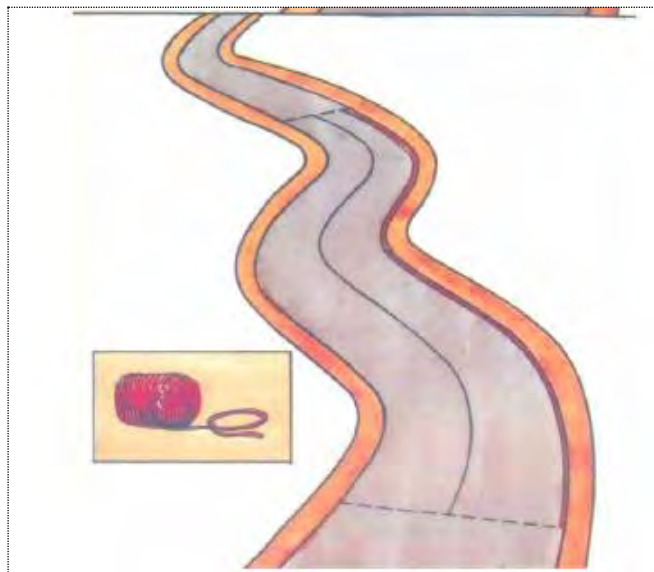
ປັດໜ້າຖະໜົນເພື່ອທຳຄວາມສະອາດຜິວທາງກ່ອນຈະສິດຢາງແທັກໂຄດ (Tack coat)



ປັດໜ້າຜິວທາງດ້ວຍເຄື່ອງກວດ (Mechanical Broom)

2. ໝາຍເຂດຂອບທາງ

ໝາຍເຂດຂອງຂອບທາງດ້ວຍເຊືອກຕີລາຍ, ຢູ່ເຂດທີ່ຈະປຸງຢາງເພື່ອປ້ອງກັນການສິດແທັກໂຄດ (Tack coat) ບໍ່ໃຫ້ອອກນອກເຂດ



ໝາຍເຂດຂອງທາງດ້ວຍເຊືອກຕີລາຍ



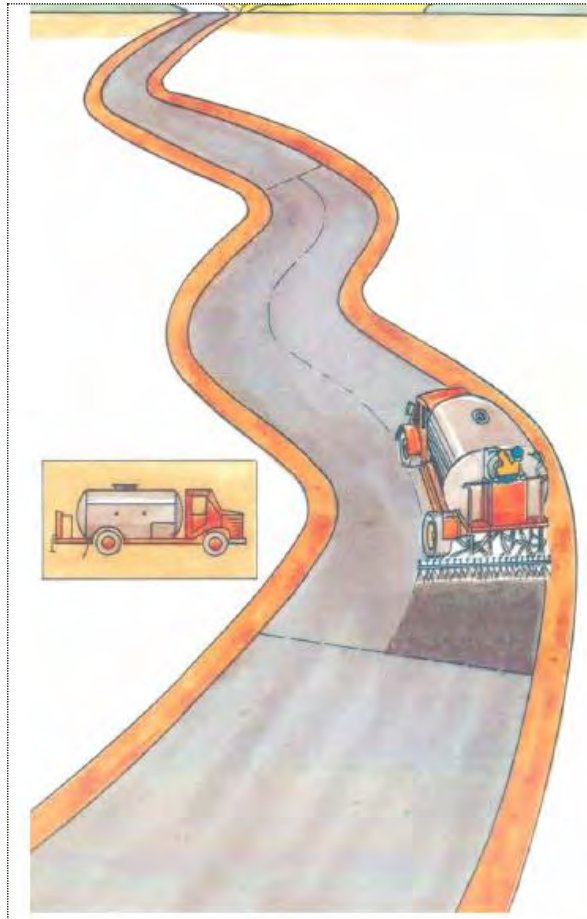
### 3. ສີດຢາງແທັກໂຄດ (Tack coat)

ຕ້ອງກວດເບິ່ງວ່າໜ້າທາງແຫ້ງດີຫຼືບໍ່, ຖ້າແຫ້ງດີກໍສີດແທັກໂຄດ (Tack coat) ດ້ວຍລົດສີດຢາງຢູ່ເຂດທີ່ຈະປູຢາງ.

ຕ້ອງສີດຢາງຕາມປະລິມານທີ່ກຳນົດໄວ້ແລະບອກໂຊເພີ່ລົດໃຫ້ຮັກສາຄວາມໄວແລະສັງເກດປະລິມານການສີດ.

ບໍ່ຄວນປູຢາງທັບທັນທີຫຼັງຈາກສີດແທັກໂຄດ (Tack coat) ເພາະມັນຈະກົດຂອງການລະເຫີຍອາຍຂອງສານລະລາຍທີ່ປະສົມຢູ່ນຳແທັກໂຄດ (Tack coat)

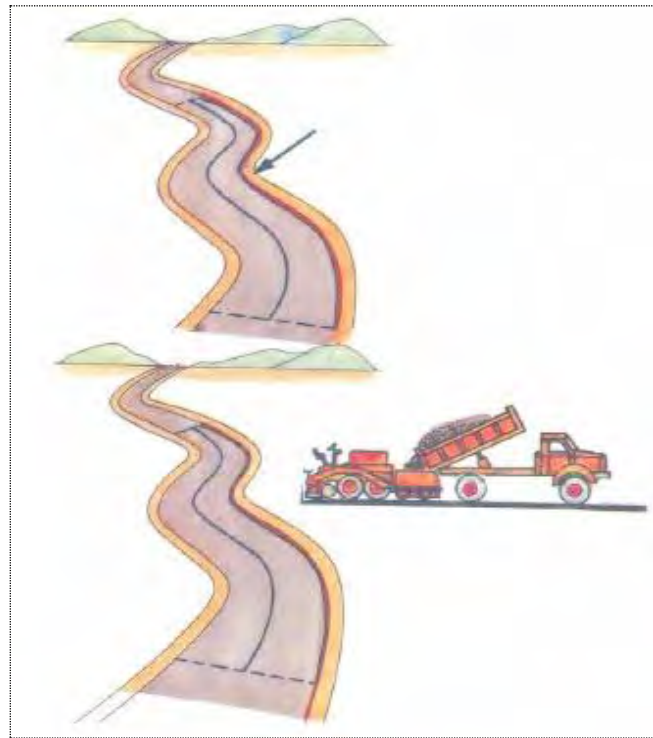
ຫ້າມບໍ່ໃຫ້ມີການສັນຈອນໃດໆຫຼັງຈາກສີດແທັກໂຄດ (Tack coat)



ການສີດຢາງແທັກໂຄດ (Tack coat)

### 4. ຕັ້ງລະບົບເຊັ່ນເຊີ້ນຳລ່ອງຂອງເຄື່ອງປູຢາງ Paver

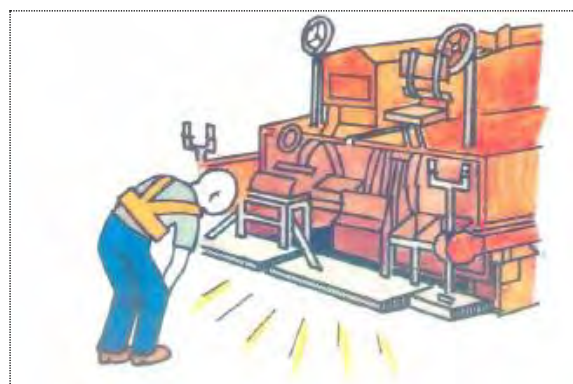
ຕັ້ງລະບົບເຊັ່ນເຊີ້ນຳລ່ອງຂອງເຄື່ອງປູຢາງ Paver ເພື່ອໃຫ້ໄດ້ຄວາມໜາທີ່ ຕ້ອງການ ແລະ ຄົງທີ່, ເຄື່ອງປູຢາງ Paver ຈະປູຕາມເສັ້ນລວດທີ່ຕັ້ງໄວ້ຂອບທາງ



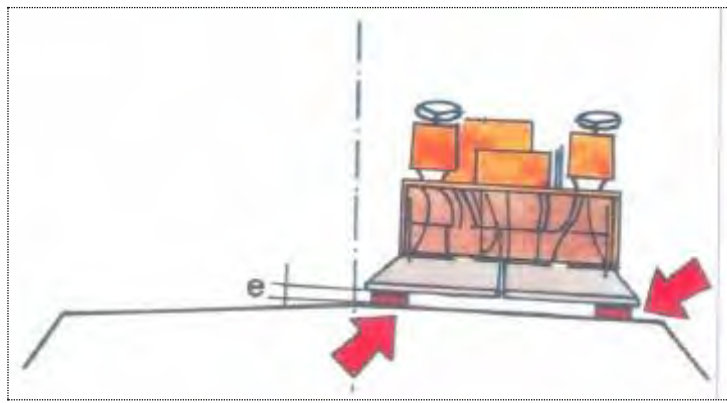
ລະບົບນໍ້າລ່ອງສໍາລັບ Paver (ສາຍລວດ)

5. ກະກຽມອຸປະກອນ

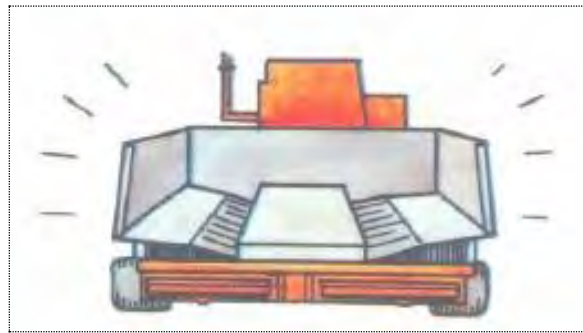
ປັບຄວາມກວ້າງຂອງເຄື່ອງປຸຢາງ Paver ໃຫ້ໄດ້ເຄິ່ງໜຶ່ງຂອງຖະໜົນ ກວດເບິ່ງຄວາມສະອາດຂອງແຜ່ນລິດ (Sereed plate) ເພື່ອຮັບປະກັນບໍ່ໃຫ້ມີຈຸດຕໍາມິ (Defect) ຂອງໜ້າຢາງ ຫຼັງຈາກປຸແລ້ວ. ຕ້ອງເຮັດໃຫ້ແຜ່ນລິດຮ້ອນກ່ອນຈະເລີ່ມປຸຢາງເພື່ອບໍ່ໃຫ້ຢາງອາດສະຟານຕິດກັບແຜ່ນລິດ, ໃຊ້ໄມ້ຫຼືທ່ອນເຫຼັກທີ່ມີຄວາມໜາເທົ່າກັບ "e" ວາງຮອງແຜ່ນລິດເພື່ອປັບລະດັບ, ກວດເບິ່ງຮອບເບີ້ (hopper) ຂອງເຄື່ອງປຸຢາງ (Paver) ໃຫ້ມີຄວາມສະອາດ, ແຫ້ງ ແລະ ປາສະຈາກວັດສະດຸເຢັນອື່ນໆ



ກວດເບິ່ງແຜ່ນລິດ



ປັບລະດັບຂອງແຜ່ນລົດ

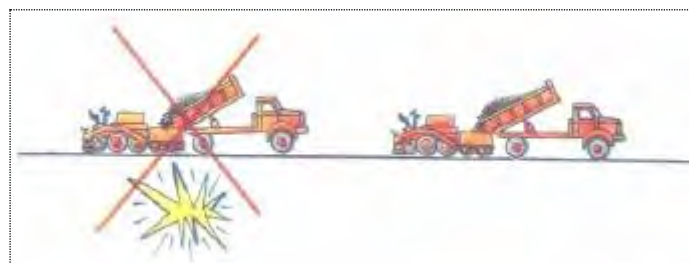


ຮ່ອນເບີ້ (ສະອາດແລະເປົ່າວ່າງ)

### 6. ການປຸງຢາງອາດສະຟານ

ໃນກໍລະນີຝົນຕົກຕ້ອງຢຸດເຮັດວຽກ

ໃນເວລາລົດດ້າມ (ຂົນຢາງ) ຖອຍຫຼັງຫາເຄື່ອງປຸງຢາງ (Paver) (i) ຈະຕ້ອງໄດ້ລະມັດລະວັງບໍ່ໃຫ້ຕໍາກັບເຄື່ອງປຸງຢາງ, (ii) ຄວນລະວັງບໍ່ໃຫ້ວັດສະດຸຢາງເຮ່ຍອອກຈາກຮ່ອນເບີ້ (Hopper) ໃນເວລາເທຢາງອອກຈາກລົດດ້າມ, (iii) ປ່ຽນເກຍລົດດ້າມໃຫ້ຢູ່ເກຍວ່າງເພື່ອໃຫ້ເຄື່ອງປຸງຢາງ (paver) ສາມາດດັນລົດດ້າມໄດ້ຈົນກວ່າຢາງຈະໝົດ, (iv) ຕ້ອງກະກຽມຈໍານວນລົດດ້າມ (ຂົນຢາງ) ໃຫ້ມີຈໍານວນພຽງພໍ ແລະ ໃຫ້ມີລົດຈອດຖ້ຳຢູ່ສະເໝີເພື່ອໃຫ້ເຄື່ອງປຸງຢາງ (paver) ເຮັດວຽກຕໍ່ເນື່ອງກັນ  
ເມື່ອນໍາໃຊ້ຢາງແທັກໂຄດ (Tack coat) ຊະນິດອີມູຊັນ (emulsion) ຕ້ອງລໍຖ້າໃຫ້ຢາງແທັກໂຄດເຊັດໂຕເສຍກ່ອນ (ຢາງແທັກໂຄດເລີ່ມໜຽວ ຫຼື ແຫ້ງ)



(i) ລະມັດລະວັງບໍ່ໃຫ້ຕໍາ



(ii) ລະມັດລະວັງບໍ່ໃຫ້ຢາງອາດສະຟານລົ້ນອອກ



(iii) ປັບເກຍລົດດ້າມໃຫ້ຢູ່ເກຍວ່າງ



(iv) ໃຫ້ລົດດ້າມຄັນຕໍ່ໄປຈອດຖ້າສະເໝີ

ຕາຕະລາງຂ້າງລຸ່ມນີ້ແມ່ນສະແດງລະດັບອຸນນະພູມຂອງຢາງອາດສະຟານ (ຢູ່ໃນຮ່ອບເບີ້) ໃນເວລາຢູ່ຢາງ

**ອຸນນະພູມຕໍ່າສຸດຂອງຢາງອາດສະຟານ**

ຊະນິດຂອງຢາງໝາກຕອຍ	ອຸນຫະພູມຕໍ່າສຸດ (ອີງສາ C)
ຢາງ Bitumen 80/100	125
ຢາງ Bitumen 60/	130
ຢາງ Bitumen 40/50	135

ກວດເບິ່ງຄວາມໜາຂອງຢາງທີ່ຍັງບໍ່ໄດ້ບົດອັດສະເໝີຖ້າຈຳເປັນໃຫ້ປັບແຜ່ນລົດ (Sereed plate) ເພື່ອໃຫ້ໄດ້ຄວາມໜາທີ່ຕ້ອງການ

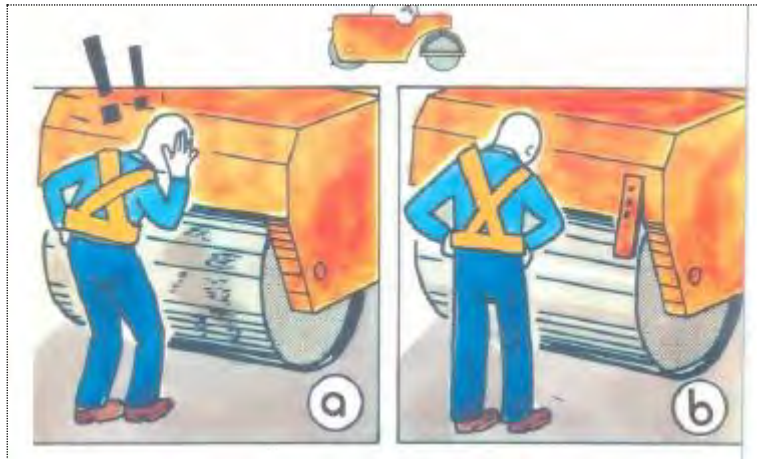
**7. ການບົດອັດ**

**(1) ການບົດອັດເທື່ອທຳອິດ**

ການບົດອັດເທື່ອໜຶ່ງແມ່ນບົດອັດດ້ວຍລົດໂລມາກາດ້າມ (Macadam roller), ການໃຊ້ລົດໂລຊະນິດນີ້ແມ່ນຕ້ອງໄດ້ເອົາໃຈໃສ່ດັ່ງຕໍ່ໄປນີ້:

- ກວດເຊັກຄວາມສະອາດຂອງຕີນລົດໂລເພື່ອປ້ອງກັນບໍ່ໃຫ້ຜົວໜ້າອາດສະຟານເປັນຮອຍ
- ກວດເຊັກລະບົບສີດນໍ້າຂອງລົດໂລ ແລະ ປະລິມານນໍ້າ ໃຫ້ພຽງພໍກ່ອນຈະເລີ່ມວຽກ

ລົດໂລມາກາດ້າມ (Macadam roller)



ກວດເບິ່ງຄວາມສະອາດ ແລະ ລະບົບສີດນໍ້າ

ການບົດອັດທີ່ດີ ຈະຕ້ອງ

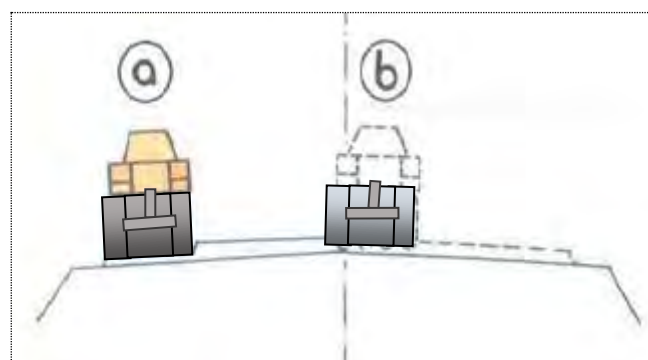
- ຈະຕ້ອງໃຫ້ລົດໂລມາກາດ້າມ Macadam ບົດອັດຢ່າງໃຫ້ໄກ້ກັບເຄື່ອງຈັກປູຢາງ Paver ທີ່ສຸດ ໃຫ້ຫັນລໍ້ທີ່ຄັບເຄື່ອນໄປຫາແລະເຂົ້າໄກ້ກັບເຄື່ອງຈັກປູຢາງ



ເຂົ້າໄກ້ກັບເຄື່ອງປູຢາງ Paver

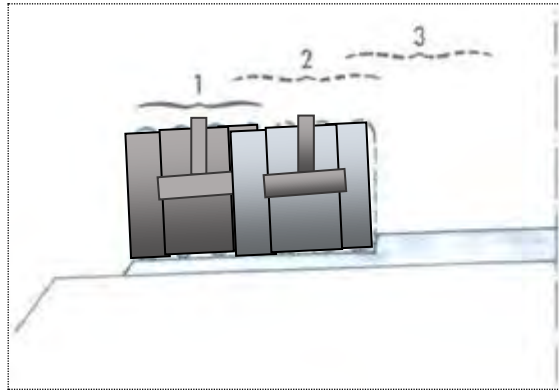
ບົດອັດໃຫ້ຂະໜານກັນ

- ສໍາລັບເຄິ່ງເລນທໍາອິດຕ້ອງເລີ່ມບົດອັດຈາກຂອບທາງ (a),
- ສໍາລັບເຄິ່ງເລນທີ່ສອງຕ້ອງເລີ່ມບົດອັດຈາກກາງທາງ (b).



Parallel Passing

ການບົດອັດແຕ່ລະຄັ້ງ ຕ້ອງໃຫ້ລໍລິດໂລສ່ວນໜຶ່ງບົດຊ້ຳຮອຍເກົ່າ



ການບົດອັດຊ້ຳຮອຍເກົ່າ

ໃຫ້ລົດຄວາມໄວຂອງລົດໂລລົງຊ້າໆເພື່ອໃຫ້ການກັບລົດມີຄວາມນິ້ມນວນແລະປ້ອງກັນການກະຕຸກຂອງລົດ



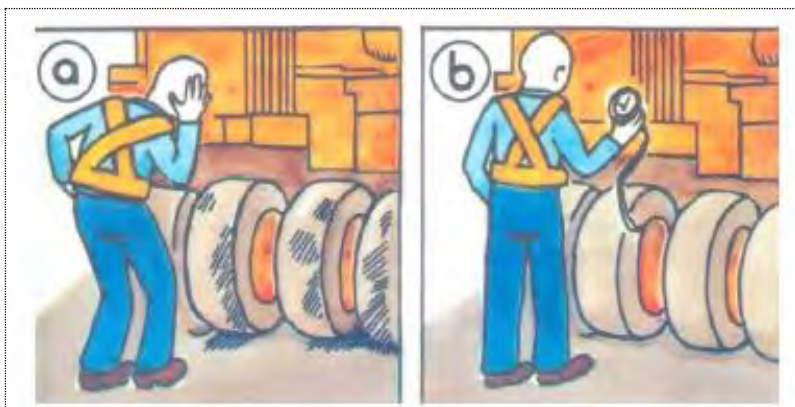
ລົດຄວາມໄວຊ້າໆ

(2) ການບົດອັດຂັ້ນຕອນທີ່ສອງ

ການບົດຂັ້ນຕອນທີ່ສອງແມ່ນໃຊ້ລົດໂລຕຶນຢາງ ຕ້ອງກວດເບິ່ງຈຸດສໍາຄັນດັ່ງຕໍ່ໄປນີ້:

- ກວດເບິ່ງຄວາມສະອາດຂອງລໍລິດເພື່ອປ້ອງກັນບໍ່ໃຫ້ຢາງອາດສະພານຕິດລໍລິດ(a).
- ກວດເບິ່ງຄວາມດັນຂອງລົມຢາງໃຫ້ຢູ່ປະມານ 6Kg/cm<sup>2</sup> ເມື່ອຢາງອຸ່ນ (b).

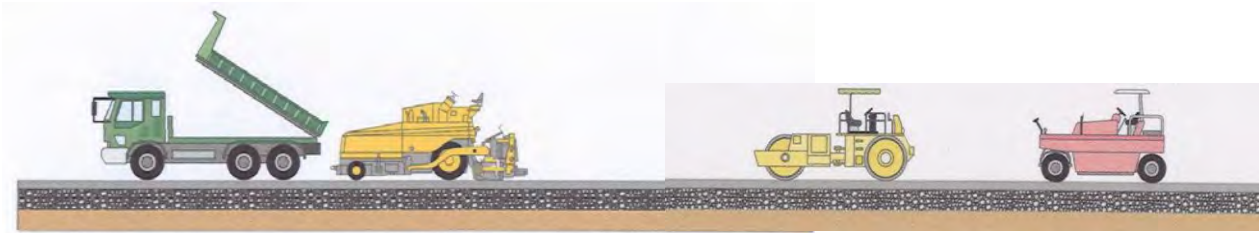
ລົດໂລຕຶນຢາງ



ກວດຄວາມສະອາດ ແລະ ຄວາມດັນຂອງຢາງລົດ

ເພື່ອໃຫ້ມີການບົດອັດທີ່ດີ

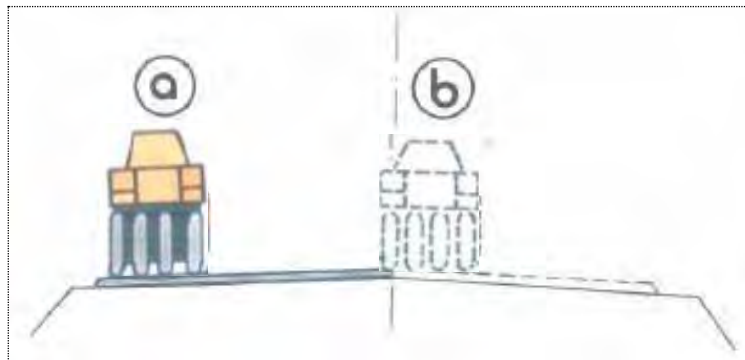
- ກວດເຊັກຄວາມສະອາດຂອງລໍ້ລົດ ເພື່ອປ້ອງກັນບໍ່ໃຫ້ເກີດຮອຍຢູ່ໜ້າທາງ (a),
- ກວດເຊັກປະລິມານນໍ້າ ແລະ ຄວາມປົກກະຕິຂອງລະບົບສີດນໍ້າ
- ໃຫ້ລົດໂລຕິນຢາງບົດອັດໄປໃກ້ໆກັບລົດໂລມາກາດ້າມ



ບົດອັດໄປໃກ້ໆກັບລົດໂລມາກາດ້າມ

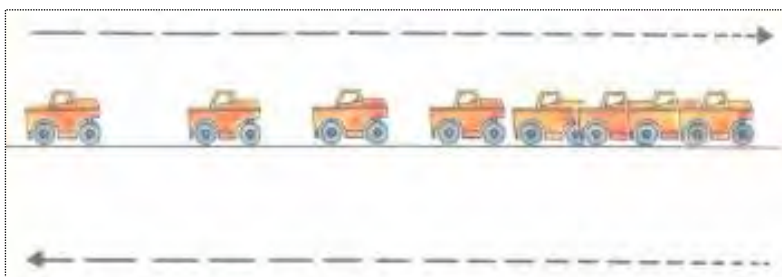
- ໃຫ້ບົດອັດຂະໜານກັນ

- ສໍາລັບເຄິ່ງເລນທໍາອິດຕ້ອງເລີ່ມບົດອັດຈາກຂອບທາງ (a),
- ສໍາລັບເຄິ່ງເລນທີ່ສອງຕ້ອງເລີ່ມບົດອັດຈາກກາງທາງ (b).



ບົດອັດຂະໜານກັນ

ໃຫ້ລົດຄວາມໄວຂອງລົດລົງຊ້າໆເພື່ອໃຫ້ການກັບລົດມີຄວາມນື້ມນວນແລະປ້ອງກັນການກະຕຸກຂອງລົດ



ລົດຄວາມໄວຊ້າໆ

ການບົດອັດຕ້ອງໃຫ້ສໍາເລັດ ກ່ອນທີ່ວັດສະດຸຈະເຢັນ

### 8. ຈຸດຕໍ່ (Jointing)

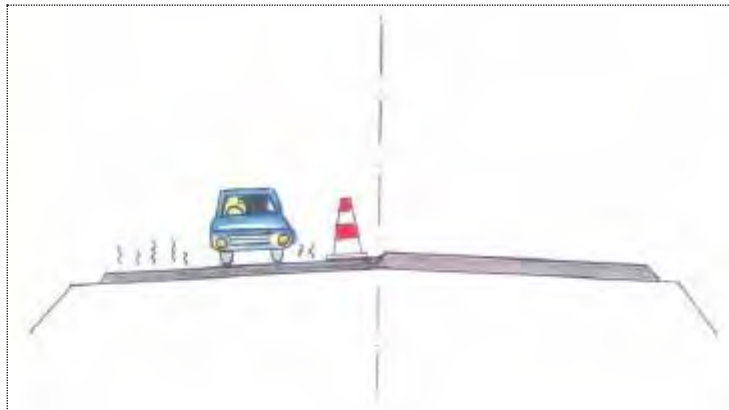
ຈະຕ້ອງເອົາໃຈໃສ່ ໃນການເຮັດຈຸດຕໍ່, ຈຸດຕໍ່ຈະສົ່ງຜົນກະທົບດັ່ງຕໍ່ໄປນີ້:

- ການປ້ອງກັນການຊຶມຂອງຜິວຢາງ
- ຄວາມທົນທານຂອງຊັ້ນຢາງອາດສະຟານ
- ຄວາມພຽງຂອງຜິວໜ້າທາງ

#### (1) ຈຸດຕໍ່ຕາມລວງຍາວ

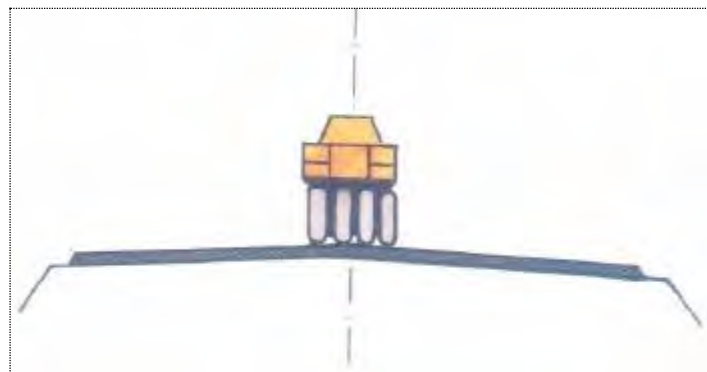
ວິທີທີ່ຖືກຕ້ອງຈະກ່າວດັ່ງຕໍ່ໄປນີ້:

- ປຸຢາງເຄິ່ງເລນທີ່ເຫຼືອໃນຂະນະທີ່ຢາງຢູ່ເລນທໍາອິດຍັງຮ້ອນຢູ່



ປຸຢາງເຄິ່ງເລນທີ່ເຫຼືອໃນຂະນະທີ່ຢາງຢູ່ເລນທໍາອິດຍັງຮ້ອນຢູ່

- ກວດຫຼືປັດຢາງອາດສະຟານທີ່ເຮ່ຍຢູ່ເລນທໍາອິດເນື່ອງຈາກການປຸຢາງຢູ່ເລນທີ່ສອງແລະປັບໃຫ້ເປັນເສັ້ນຊື່
- ບົດອັດຈຸດຕໍ່ຕາມລວງຍາວໂດຍກວມເອົາທັງສອງເລນ



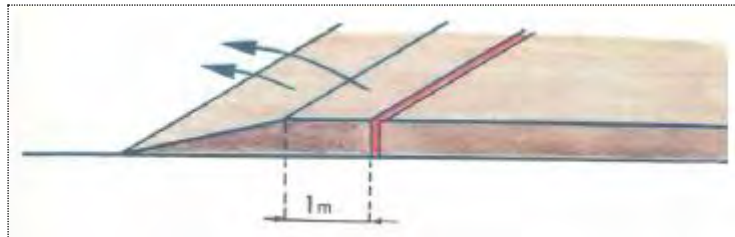
ບົດອັດຮອຍຕໍ່



(2) ຈຸດຕໍ່ທາງຂວາງ

ວິທີການທີ່ຖືກຕ້ອງແມ່ນດັ່ງຕໍ່ໄປນີ້

- ຕັດແລະລອກສິ້ນຢາງເກົ່າອອກປະມານ 1 ແມັດ



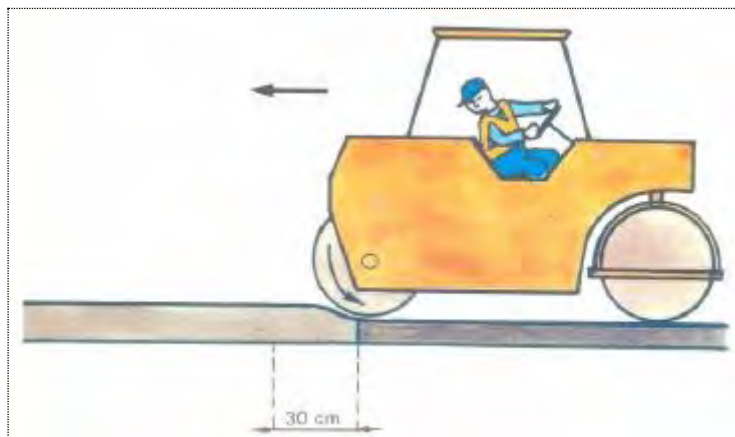
ລອກເອົາຢາງເກົ່າຢູ່ສິ້ນຢາງອອກຫຼັງຈາກຕັດ

- ກ່ອນຈະເລີ່ມປຸຢາງແມ່ນໃຫ້ໃຊ້ໄມ້ ຫຼືທ່ອນເຫຼັກທີ່ມີຄວາມໜາເທົ່າກັບການຢຸບໂຕຂອງຢາງອາດສະຟານ ຫຼັງຈາກບິດອັດ ຮອງລະຫວ່າງ ແຜ່ນລົດກັບໜ້າທາງເດີມ



ການວາງໄມ້ຮອງແຜ່ນລົດກ່ອນຈະເລີ່ມປຸຢາງ

- ຖອຍຫຼັງລົດໄລເຂົ້າບິດອັດຊ້າໆປະມານເທື່ອລະ 30-40 cm



ບິດອັດຈຸດຕໍ່

ແບບສອບຖາມ ການປະເມີນ ການຝຶກອົບຮົມ ໂຄງການຕົວແບບ ໄລຍະ 2  
(ວັນທີ 7 ເມສາ, 2013)

ຊື່: \_\_\_\_\_ ພາກສ່ວນ/ບ່ອນສັງກັດ: \_\_\_\_\_

1) ການປະເມີນໂດຍລວມ

(i) ການຝຶກອົບຮົມນີ້ແມ່ນ ໄດ້ຜົນຫຼາຍບໍ່? ໃຫ້ເລືອກຄຳຕອບລຸ່ມນີ້.

- a. ໄດ້ຜົນຫຼາຍ      b. ໄດ້ຜົນ      c. ໄດ້ຜົນລະດັບໜຶ່ງ      d. ໄດ້ຜົນໜ້ອຍໜຶ່ງ      e. ບໍ່ໄດ້ຜົນ

(ii) ລະດັບຄວາມເຂົ້າໃຈ ຕໍ່ການຝຶກອົບຮົມຄັ້ງນີ້ເປັນແນວໃດ?

- a. ຍາກຫຼາຍ      b. ຍາກໜ້ອຍໜຶ່ງ      c. ປານກາງ      d. ເຂົ້າໃຈໄດ້      e. ເຂົ້າໃຈໄດ້ດີຫຼາຍ

2) ກ່ຽວກັບເນື້ອໃນ ການຝຶກອົບຮົມ

(i)-1 ລະດັບຄວາມເຂົ້າໃຈ ຂອງພາກທີ 1 ເປັນແນວໃດ (ການແນະນຳເນື້ອໃນການຝຶກອົບຮົມ)?

- a. ຍາກຫຼາຍ      b. ຍາກໜ້ອຍໜຶ່ງ      c. ປານກາງ      d. ເຂົ້າໃຈໄດ້      e. ເຂົ້າໃຈໄດ້ດີຫຼາຍ

(ii)-1 ຫົວຂໍ້ໃດ ໃນພາກທີ 1 ທີ່ ຢາກຮຽນຕື່ມ? (ສາມາດເລືອກໄດ້ຫຼາຍຄຳຕອບ)

- a. ການນຳໃຊ້ເຄື່ອງ      b. ການຢຽບດ້ວຍ      c. ການກະຈາຍຢາງ      d. ການຕິດຕາມ ກວດກາ      e. ອື່ນໆ  
ປຸຢາງ      ລົດໂລ      ຂອງຄົນງານ      ການຈັດຕັ້ງປະຕິບັດ      (ລະບຸ )  
ໂດຍລວມ

(ii)-1 ລະດັບຄວາມເຂົ້າໃຈ ຕໍ່ພາກທີ 2 (ການຝຶກພາກສະໜາມຂອງວຽກການປູຢາງ)?

- a. ຍາກຫຼາຍ      b. ຍາກໜ້ອຍໜຶ່ງ      c. ປານກາງ      d. ເຂົ້າໃຈໄດ້      e. ເຂົ້າໃຈໄດ້ດີຫຼາຍ

(ii)-2 ຫົວຂໍ້ໃດ ໃນພາກທີ 2 ທີ່ ຢາກຮຽນຕື່ມ? (ສາມາດເລືອກໄດ້ຫຼາຍຄຳຕອບ)

- a. ການນຳໃຊ້      b. ການຢຽບດ້ວຍ      c. ການຢຽບດ້ວຍລໍ      d. ການກະຈາຍຢາງ      e. ການຕິດຕາມ ກວດກາ  
ເຄື່ອງປູຢາງ      ລົດໂລ      ຂອງຄົນງານ  
f. ອື່ນໆ  
(ລະບຸ )

3) ຜົນຮັບຂອງການຝຶກອົບຮົມ

(i) ໄດ້ຮັບຂໍ້ມູນຂ່າວສານຕາມທີ່ໄດ້ຄາດຫວັງບໍ່?

- a. ຫຼາຍ      b. ພຽງພໍ      c. ໄດ້ຮັບ      d. ໜ້ອຍໜຶ່ງ      e. ບໍ່ໄດ້

(ii) ສາມາດນຳໃຊ້ສິ່ງທີ່ໄດ້ຈາກການຝຶກອົບຮົມນີ້ ເຂົ້າໃນໜ້າວຽກຕົນເອງບໍ່?

- a. ໃຊ້ໄດ້ຫຼາຍ      b. ໃຊ້ໄດ້ສ່ວນໜຶ່ງ      c. ໃຊ້ໄດ້      d. ໃຊ້ໄດ້ໜ້ອຍ      e. ບໍ່ໄດ້

ຄຳເຫັນທີ່ຍາກໃຫ້ມີການປັບປຸງໃນ ການຝຶກອົບຮົມຄັ້ງໜ້າ?

ຄຳເຫັນຕໍ່ ການຝຶກອົບຮົມຄັ້ງນີ້.

ຂອບໃຈ!!

Japan International Cooperation Agency  
(JICA)

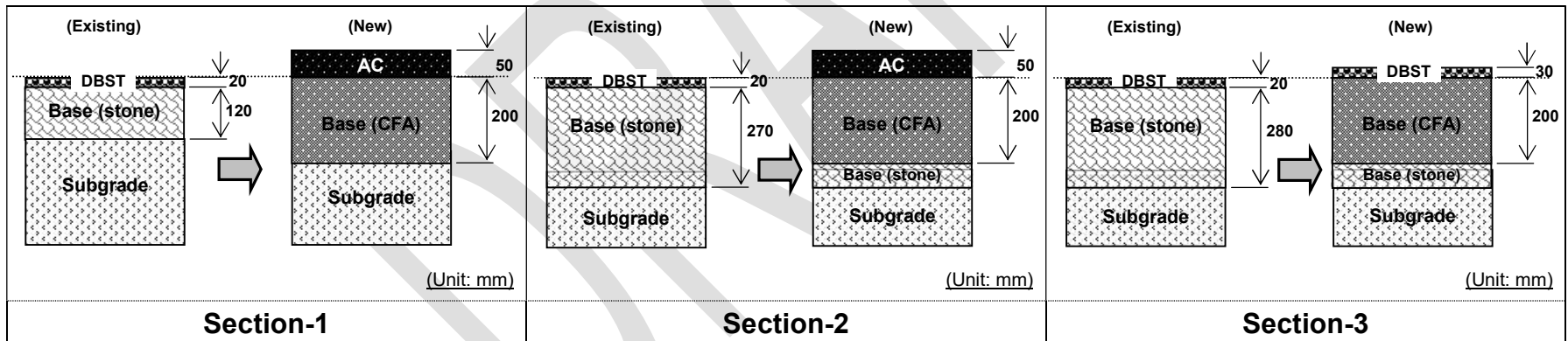
Lao People's Democratic Republic

**The Project for Improvement of  
Road Management Capability in Lao PDR  
(Phase-2)**

**Evaluation Report  
on  
Technical Workshop  
of  
Recycling of Existing Pavement by  
Cement Foamed Asphalt (CFA) Method**

**March 2016**

**International Development Center of Japan (IDCJ)  
Oriental Consultants Global (OCG)  
& World Kaihatsu Kogyo (WKK)**



## PROJECT LOCATION MAP & PAVEMENT STRUCTURE BY SECTION

## Table of Contents

### PROJECT LOCATION MAP & PAVEMENT STRUCTURE BY SECTION

1.	Outline of the Project.....	1
2.	Implementation of Technical Workshop.....	3
2.1	Purpose .....	3
2.2	Summary.....	3
2.3	Contents of the Workshop .....	4
2.3.1	C1: What is CFA? (by Mr. Laythong, MPWT) .....	4
2.3.2	C2: Approach of Material Mix Design (by Mr. Fujinaga, WKK) .....	9
2.3.3	C3: Work Progress in the Project (by Mr. Malaikham, MPWT).....	12
2.3.4	Fieldwork Session .....	12
3.	Evaluation of Workshop .....	13
3.1	Background of the Participants .....	13
3.1.1	Work Experience .....	13
3.1.2	Workshop/Training Experience .....	14
3.2	Satisfaction and Understanding Level.....	14
3.2.1	Comprehensive Evaluation.....	14
3.2.2	Understanding Level by Section.....	15
3.2	Interested Topic to Learn More .....	18
3.3	Benefit of Workshop.....	18
3.4	Comments of the Participants.....	19

### Appendices

A: Presentation Handout (Laotian)

B: Participant List

C: Comments to the Workshop

## **Figures**

2.3.1	Equipment Formation .....	4
2.3.2	Material Solidification Process.....	4
2.3.3	Comparison Images of CFA and Conventional Work .....	5
2.3.4	Pavement Structure of Conventional Work & CFA Work (R13-N).....	6
2.3.5	Comparison of Pavement Serviceability in Life Cycle .....	6
2.3.6	Initial Cost Comparison (R9 Project) .....	7
2.3.7	Sample Roadmap of the Promotion of the CFA Work.....	8
2.3.8	Laboratory Equipment .....	9
2.3.9	Workflow of Material Mix Design Work .....	9-10
2.3.10	Relation between Expansion Ratio and Water.....	10
2.3.11	Relations between Cement Content and Other Elements.....	11
2.3.12	Work progress Chart (as of 27/Mar).....	12
2.3.13	Photos of Fieldwork Session .....	12
3.1.1	Work Experience of the Participants .....	13
3.1.2	Workshop/Training Experience of the Participants .....	14
3.1.3	Evaluation Result of Satisfaction & Understanding Level.....	15
3.1.4	Evaluation of Understanding Level in Session C1 .....	15
3.1.5	Evaluation of Understanding Level in Session C2.....	16
3.1.6	Evaluation of Understanding Level in Session C3.....	17
3.1.7	Evaluation of Understanding Level in Fieldwork .....	18
3.3.1	Benefit of the Workshop .....	19

## **Tables**

2.3.1	Cost Comparison in 30 Years .....	7
3.1.1	Possible Cause(s) and Approach for Improvement in C1 Session .....	16
3.2.1	Interested Topics to Learn More.....	18

## 1. Outline of Pilot Project

Currently, JICA Expert Team (the Team) and Ministry of Public Works and Transport (MPWT) have been jointly implementing Pilot Project (PP) by applying in-situ pavement recycling work called as Cement Foamed Asphalt (CFA) method. The CFA method is newly introduced in Lao PDR and indicates significant benefits in economical and environmental aspects as shown below.

- High durability comparing with stone material
- Early traffic opening due to no need of curing work
- Short construction period by skipping a few work processes comparing with conventional method
- Cost reduction in entire pavement life cycle comparing with conventional method
- Reduce CO<sub>2</sub> emission by saving fuel consumption and exhaust gas

Brief information of the PP is as described below.

Project location	Km70 on Road No.13-North, Phonhong Village, Vientiane Province
Project length	- Section-1: AC/CFA=400m - Section-2: AC/CFA=1,200m - Section-3: DBST/CFA=400m - <b>Total: 2,000m</b>
Project period (CFA & wearing course)	18/Mar – 08/Apr, 2016
Work items	- In-situ recycled base course by CFA method - Wearing course by hot mix asphalt - (Side drainage)
Client	DOR/MPWT
Site management	DPWT/Vientiane Province
Contractor	Panyathilath Construction Co., Ltd.
Inputs by Japanese side	- Construction supervision: Mr. Ueda & Mr. Iwatsuki (OCG) - Quality control of CFA work: Mr. Fujinaga (WKK) - Operation & maintenance of stabilizer: Mr. Harada (WKK) - Stabilizer (WKK)

Working photos



Place cement on existing road surface



Crushing & mixing by stabilizer



Initial compaction by tire roller



Forming road surface by grader



Finishing compaction by steel wheel roller



Spraying water on road surface



## 2. Implementation of Technical Workshop

### 2.1 Purpose

The Team and MPWT invited the participants from both sectors namely public and private to demonstrate mechanism and benefits of the CFA work in the workshop.

### 2.2 Summary

- ✧ Date : 29/Mar/2016 (Tue)
- ✧ Venue : DPWT-Vientiane Province
- ✧ Participants : Total 85 persons (see [Appendix-B: Participant list](#) in detail)
- ✧ Presenters :

Theme	Presenter	Organization
C1: What is CFA?	Mr. Laythong	MPWT
C2: Approach of material mix design	Mr. Fujinaga	WKK
C3: Work progress in the project	Mr. Malaikham	MPWT

- ✧ Timetable :

Time	Topics
0830 – 0900	Registration
0900 – 0920	Opening remarks (MPWT), Welcome remarks (JICA)
(i) Classroom	
0920 – 0950	C1: What is CFA? (Mr. Laythong, MPWT) - Demonstration video - Mechanism - Benefits of CFA - Future prospect of CFA
0950 – 1010	Q & A
1010 – 1030	Tea break
(ii) Fieldwork	
1030 – 1050	Move to site
1050 – 1140	Demonstration of CFA work
1140 – 1200	Move to restaurant
1200 – 1300	Lunch time
1300 – 1320	Move to DPWT
(iii) Classroom	
1330 – 1400	C2: Approach of material mix design (Mr. Fujinaga, WKK)
1400 – 1420	Q & A
1420 – 1450	C3: Work progress in the project (Mr. Malaikham, MPWT)
1450 – 1510	Q & A
1510 – 1530	Filling questionnaires
1530 – 1540	Closing remarks (DPWT)
1540	End

## 2.3 Contents of the Workshop

### 2.3.1 C1: What is CFA? (by Mr. Laythong, MPWT)

#### (1) General

The presenter explained work procedure and method, and material solidification process by applying the video and the slides (see Fig.2.3.1 and Fig.2.3.2).

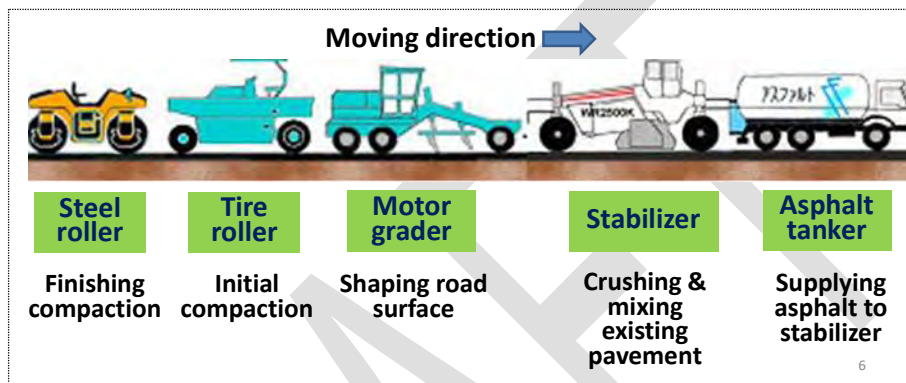


Fig.2.3.1: Equipment Formation

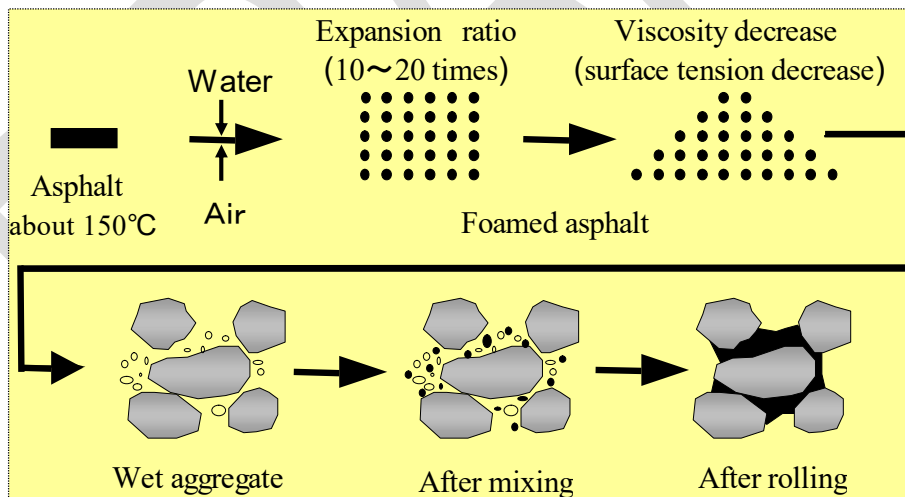


Fig.2.3.2: Material Solidification Process

#### (2) Benefits of CFA

Subsequently, the presenter explained the benefits of the CFA work compared to the conventional works in the following aspects.

**(i) Excellent Durability**

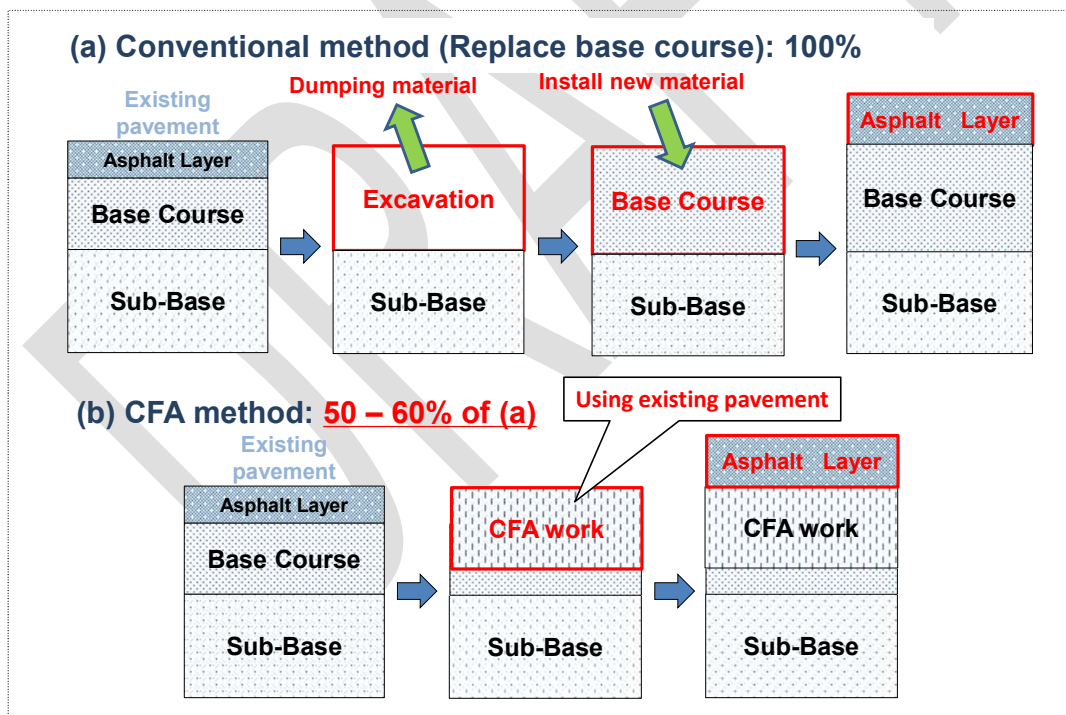
The CFA work strengthens bearing capacity by cement and flexibility by asphalt. Accordingly, AASHTO material coefficient (base course) of the CFA indicates significantly higher value (**0.30**) than crush stone (0.14).

**(ii) Early Traffic Opening**

Early traffic opening is capable because that the CFA work does not require curing period after the work completion.

**(iii) Short Construction Period**

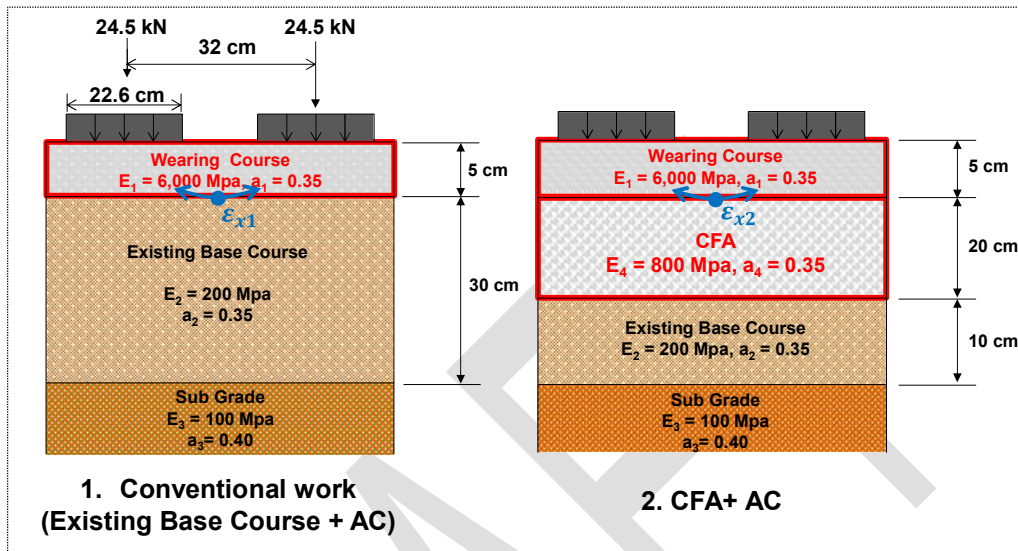
Minimization of construction period is capable due to skipping a few work processes compared to the conventional works. Comparison images are as shown in Fig.2.3.3.



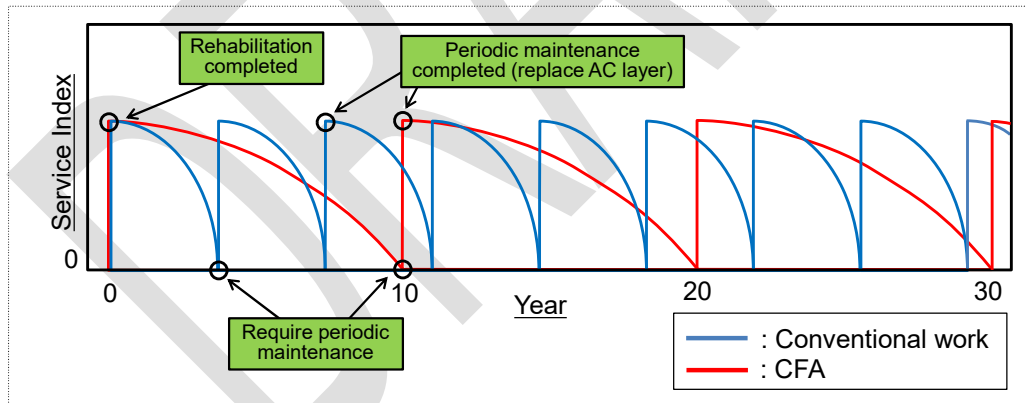
**Fig.2.3.3: Comparison Images of CFA and Conventional Work**

(iv) **Cost Reduction**

The CFA work indicates superior economy in accordance with Life Cycle Cost (LCC) comparison between the CFA work and the conventional work as illustrated in Fig.2.3.4, Fig.2.3.5 and Tab.2.3.1.



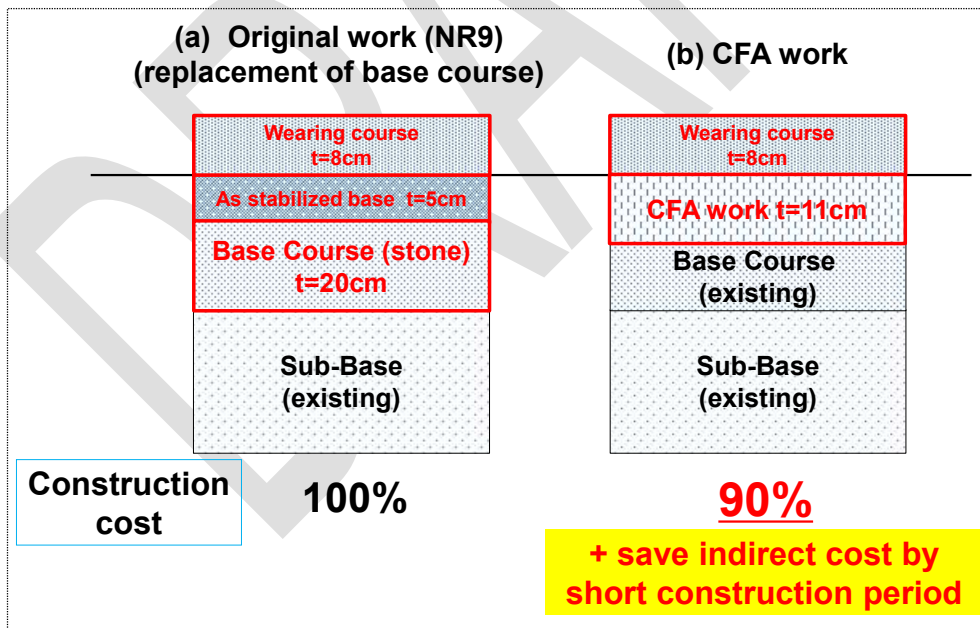
**Fig.2.3.4: Pavement Structure of Conventional Work & CFA Work (R13-N)**



**Tab.2.3.1: Cost Comparison in 30 Years**

Year	1. Conventional	2. CFA	
0	1.00	2.11	WC (5cm)+CFA (11cm)
3.6	1.00	0	WC (5cm)
7.2	1.00	0	
10	0	1.00	WC (5cm)
10.8	1.00	0	
14.4	1.00	0	
18.0	1.00	0	
20	0	1.00	
21.7	1.00	0	
25.3	1.00	0	
28.9	1.00	0	
30	0	1.00	
<b>Total</b>	<b>9.00</b> <b>(100%)</b>	<b>5.11</b> <b>(57%)</b>	

Furthermore, the CFA work is predominant in accordance with cost comparison at initial cost (i.e. construction cost) as shown in Fig.2.3.6 by assuming both works own same strengths.



Note: Both structures own same strength.

**Fig.2.3.6: Initial Cost Comparison (R9 Project)**

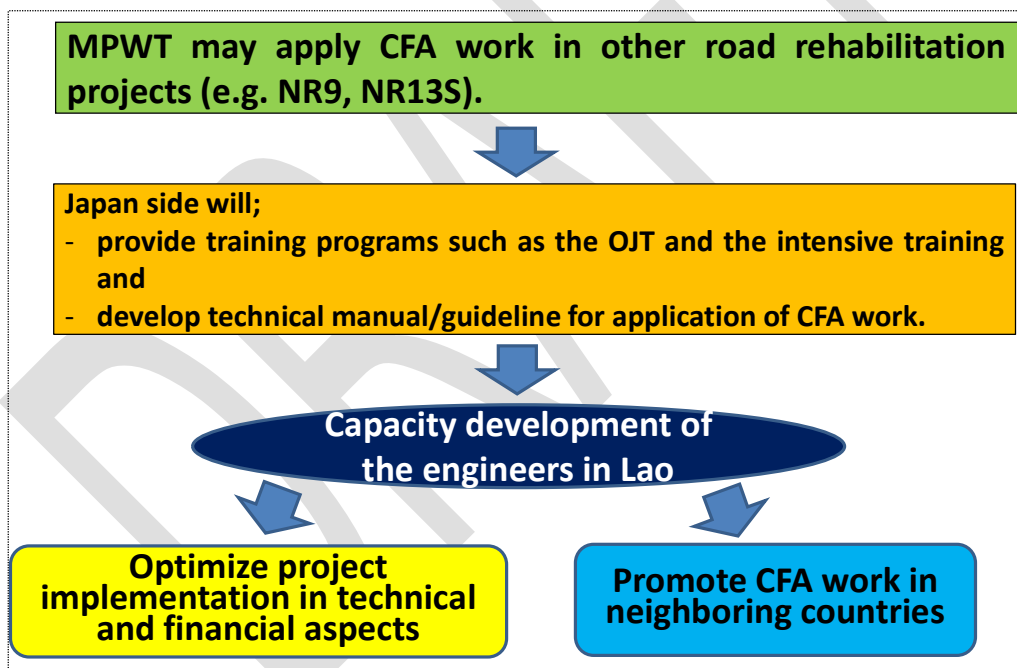
**(v) Reduce CO<sub>2</sub> Emission**

Reduction of the emission will be capable due to characteristics of the CFA work as shown below.

- ✧ CFA (cold mixing) does **NOT** require energy for **heating aggregate**.
- ✧ Skipping work sequence saves **fuel consumption** and **exhaust gas** of the equipment.

**(3) Future Prospect**

So far, the CFA work had not been introduced in neighboring countries of Lao PDR. Lao may promote the CFA work through accumulating the work experiences in domestic road network. Sample roadmap of the promotion is illustrated in Fig.2.3.7.

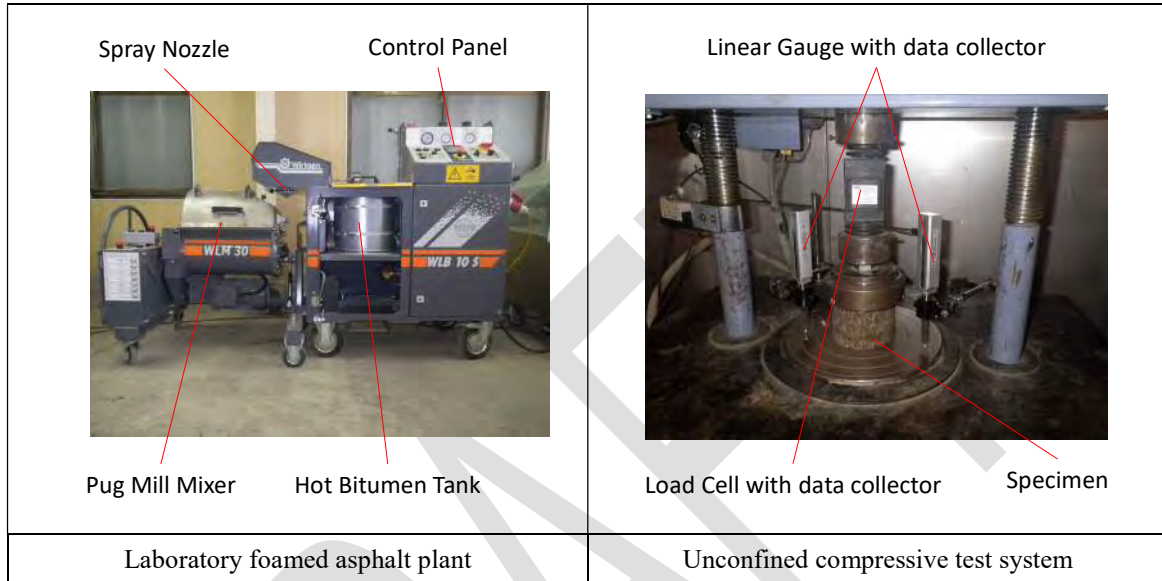


**Fig.2.3.7: Sample Roadmap of the Promotion of the CFA Work**

**2.3.2 C2: Approach of Material Mix Design (by Mr. Fujinaga, WKK)**

**(1) Laboratory Equipment**

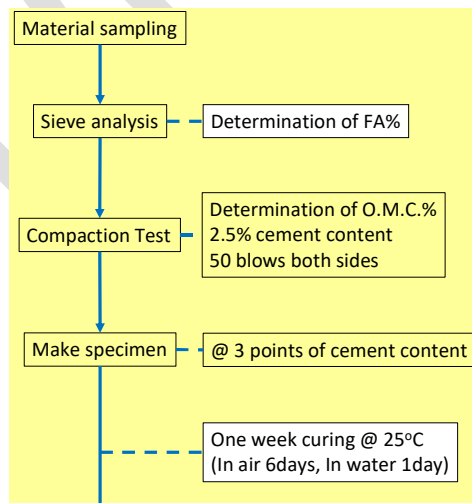
The presenter introduced laboratory equipment to be applied in the mix design of CFA material as shown in Fig.2.3.8.



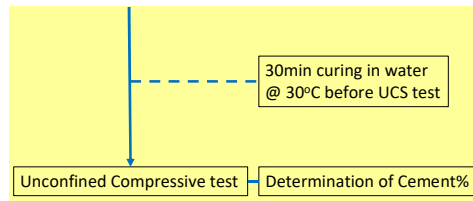
**Fig.2.3.8: Laboratory Equipment**

**(2) Workflow**

The presenter explained work sequences for the design work by applying workflow as shown in Fig.2.3.9.



**Fig.2.3.9: Workflow of Material Mix Design Work (1 of 2)**



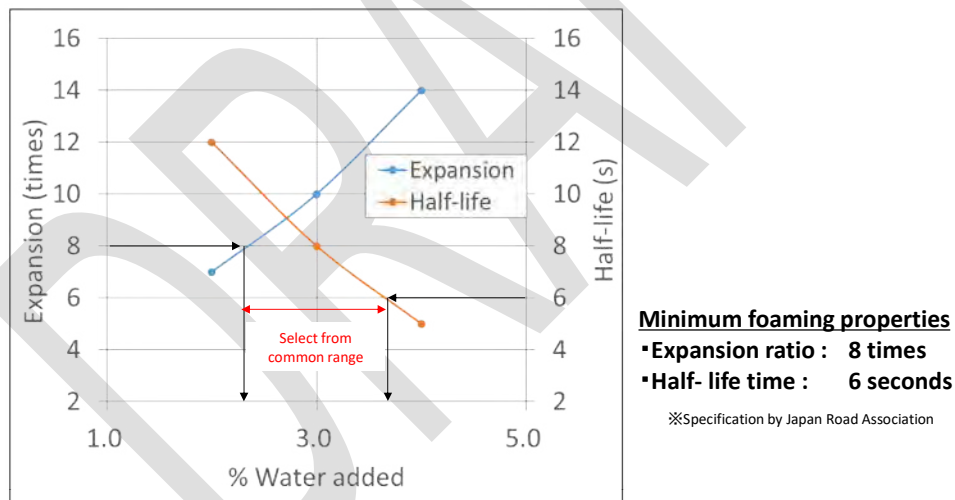
**Fig.2.3.9: Workflow of Material Mix Design Work (2 of 2)**

**(3) Determination of Material Mix Portion**

The presenter explained methodology of determination of material mix proportion such as asphalt, water and cement as follows.

**(i) Water**

Water contents will be determined in accordance with relation between expansion ratio of the foam and water content to be added (%) as shown in Fig.2.3.10.



**Fig.2.3.10: Relation between Expansion Ratio and Water**

**(ii) Asphalt**

The content (%) will be determined by following formula.



$$p = 0.03 \times a + 0.05 \times b + 0.2 \times c$$

Where

p : Mass % of FA (%)

a : Mass % of remaining on 2.36mm sieve (%)

b : Mass % of passing 2.36mm sieve and remaining on 0.075mm sieve (%)

c : Mass % of passing 0.075mm sieve (%)

Example

$$p = 0.03 \times (100 - 35.5) + 0.05 \times (35.5 - 2.0) + 0.2 \times 2.0$$

$$p = 4.0$$

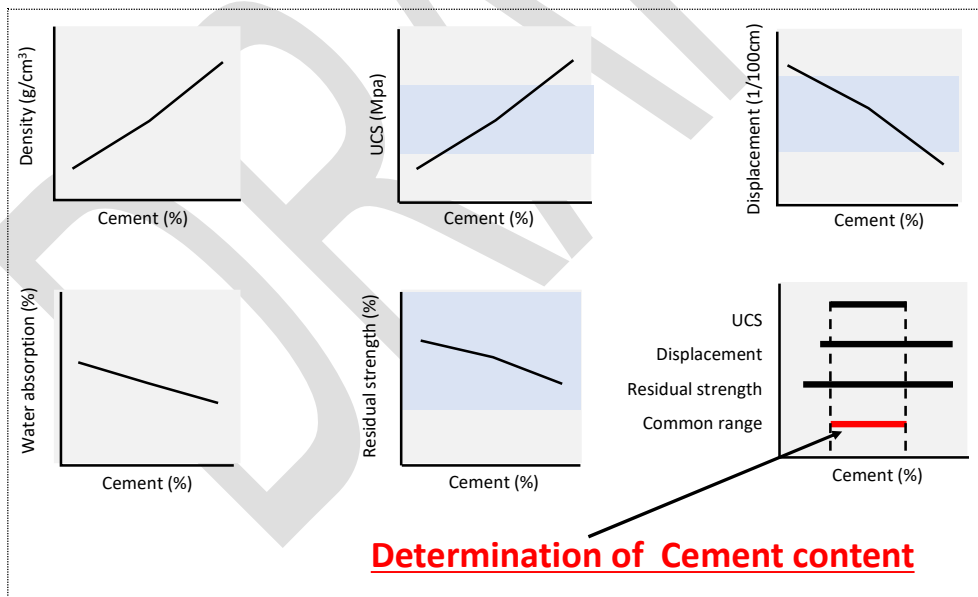
**Limit of bitumen content**

• Lower 3.5%

• Upper 5.5%

**(iii) Cement**

The content (%) will be determined in accordance with relations with various elements and cement content (%) as shown in Fig.2.3.11.



**Fig.2.3.11: Relations between Cement Content and Other Elements**

### 2.3.3 C3: Work Progress in the Project (by Mr. Malaikham, MPWT)

The presenter explained current site condition and work progress by applying working photos (see page 2) and the progress chart as shown in Fig.2.3.12.

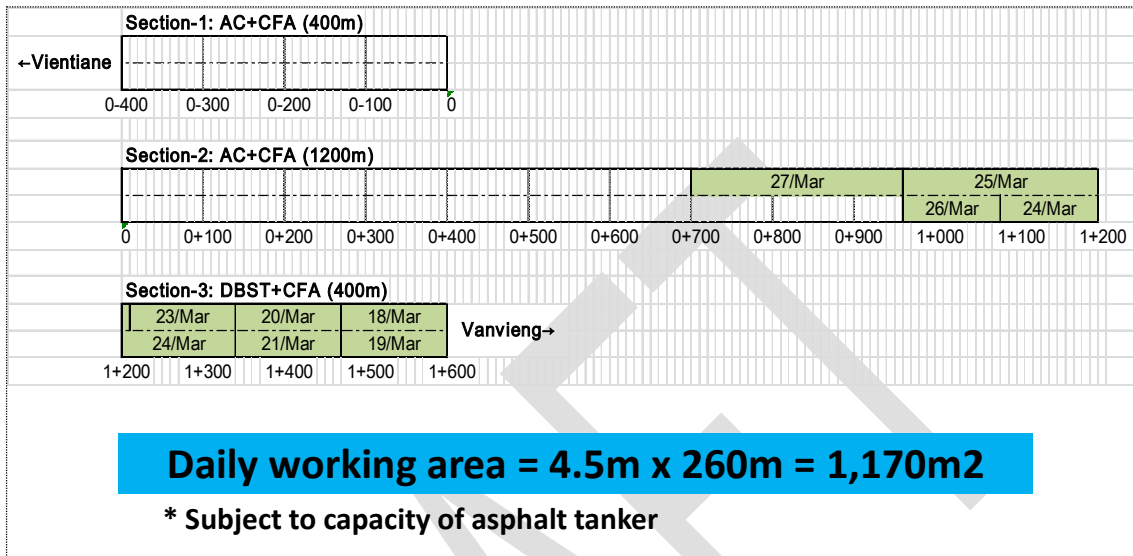


Fig.2.3.12: Work progress Chart (as of 27/Mar)

### 2.3.4 Fieldwork Session

The participants moved to the construction site after ending the session C1 to observe the working view (i.e. in-situ recycling of existing pavement by CFA method) as shown Fig.2.3.13.



Fig.2.3.13: Photos of Fieldwork Session

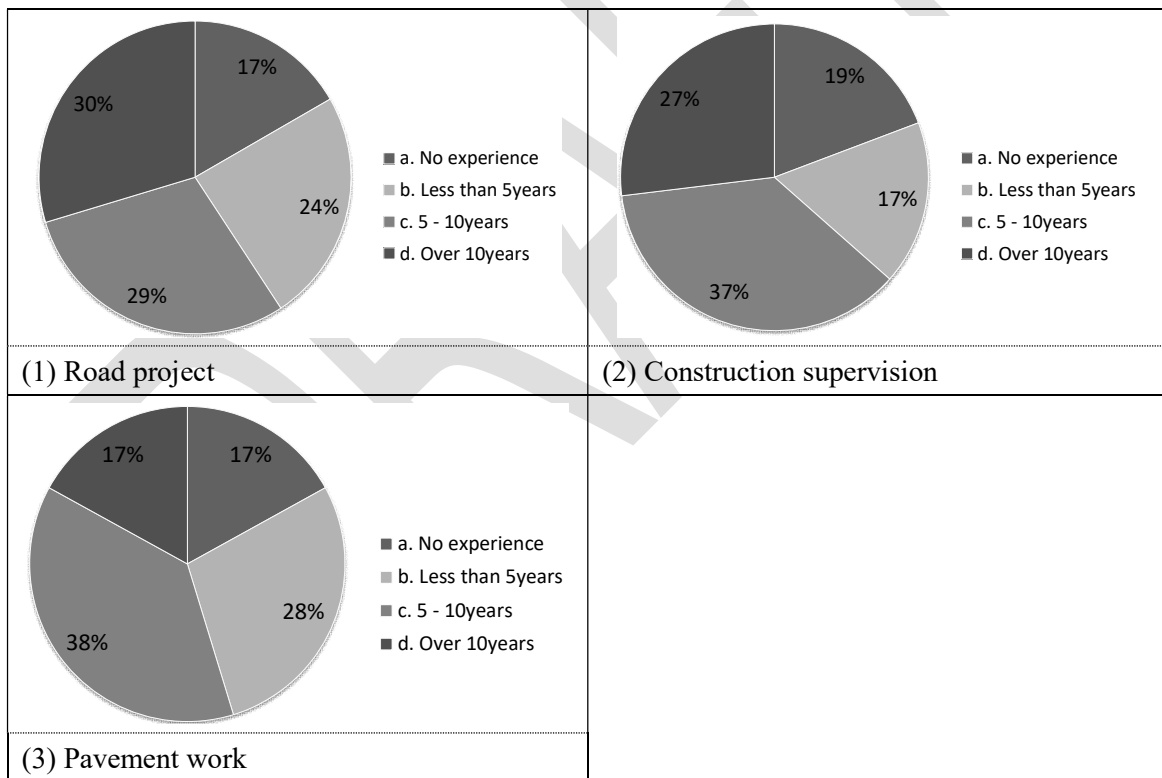
### 3. Evaluation of Workshop

The Team distributed and collected questionnaire sheets to the participants for evaluation of satisfaction and understanding level. Numbers of the collected sheets were 55. Result of the evaluation is described as follows.

#### 3.1 Background of the Participants

##### 3.1.1 Work Experience

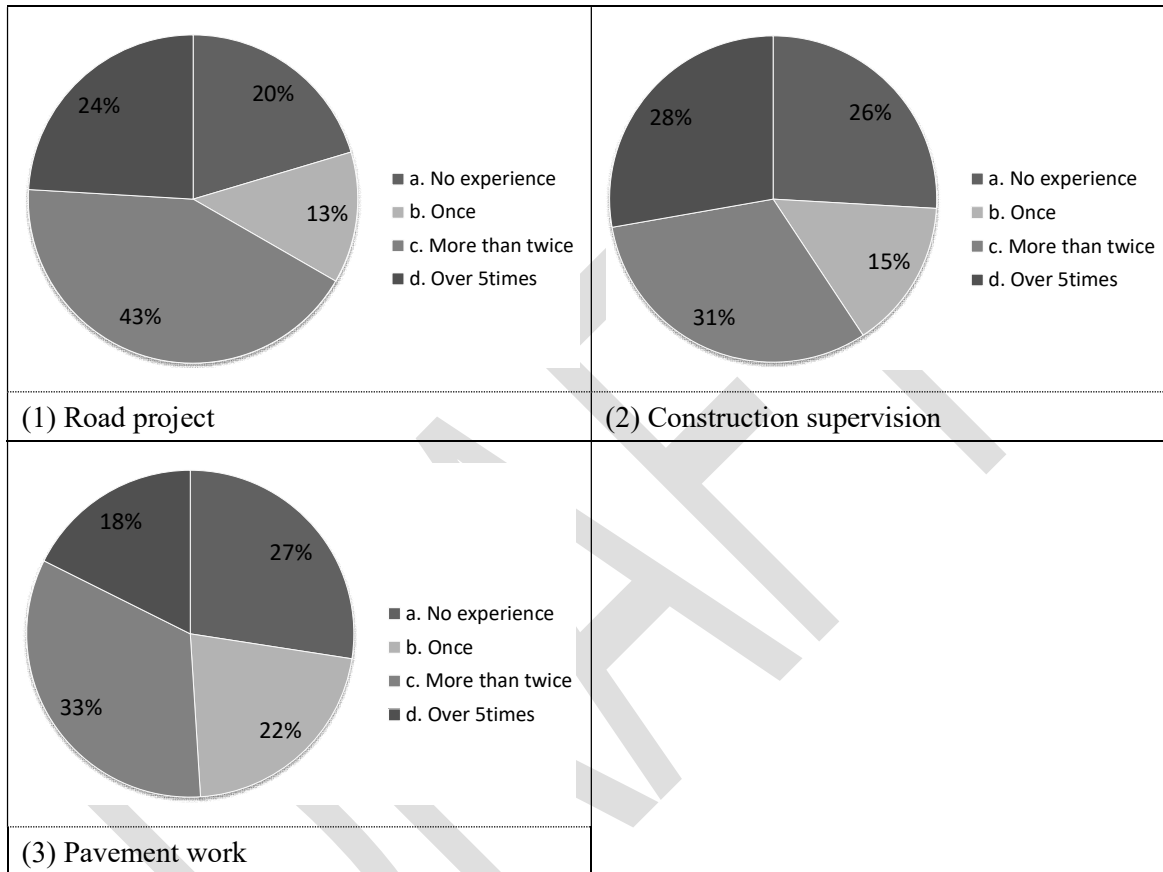
Figure 3.1.1 indicates previous work experience of the participants related to topics of the workshop. It seems that majority of the participants (54 – 59%) have the certain experience (more than 5 years) related to the topics.



**Fig.3.1.1: Work Experience of the Participants**

### 3.1.2 Workshop/Training Experience

Figure 3.1.2 indicates previous workshop and/or training experience of the participants related to topics of the workshop. It seems that majority of the participants (51 – 67%) have the certain experience (more than twice) related to the topics.

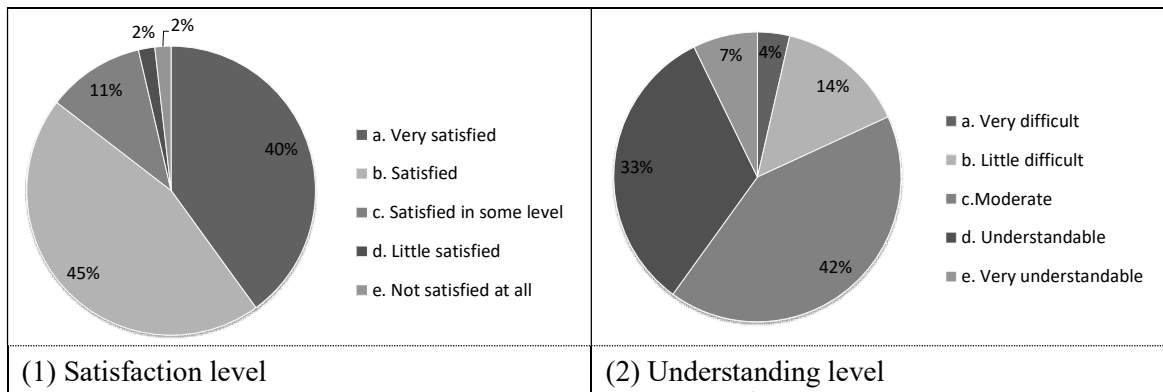


**Fig.3.1.2: Workshop/Training Experience of the Participants**

## 3.2 Satisfaction and Understanding Level

### 3.2.1 Comprehensive Evaluation

Evaluation result of satisfaction and understanding of the workshop is indicated in Fig.3.1.3. 85% of the participants answered “satisfied” or “very satisfied”. On the other hand, only 40% of the participants answered “understandable” and “very understandable”. Contents of the presentations shall be prepared to comply with capabilities of the participants.

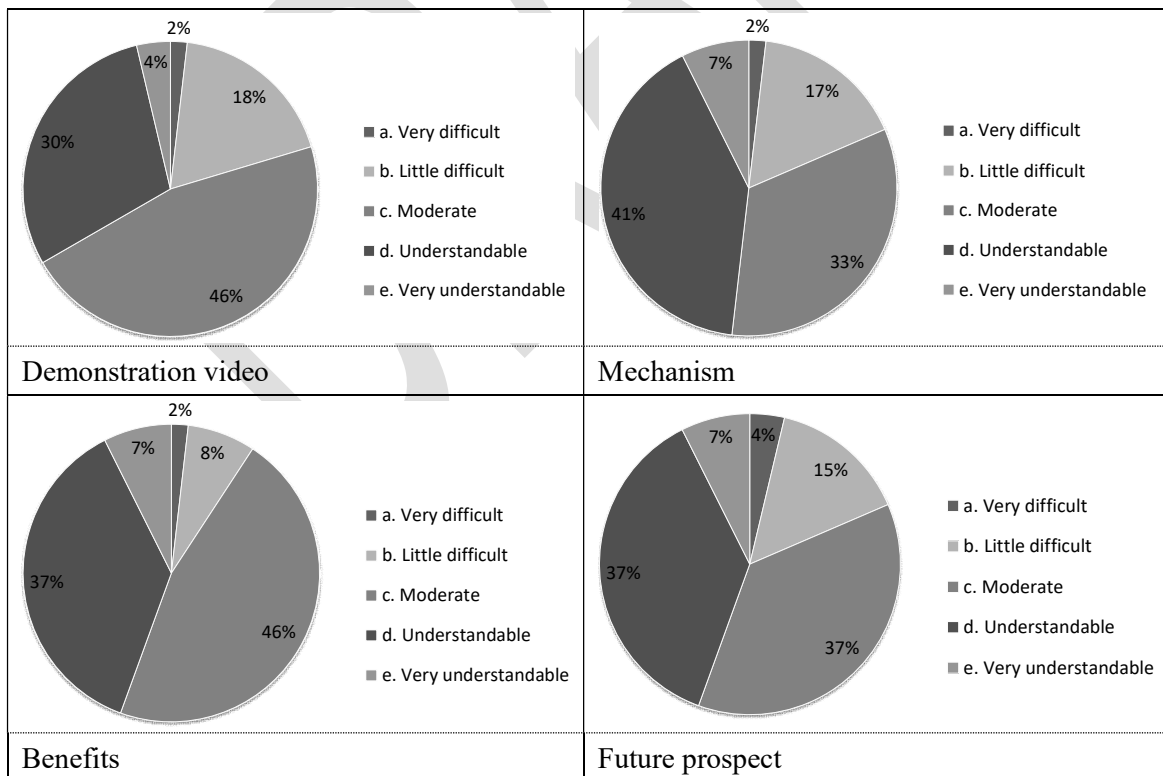


**Fig.3.1.3: Evaluation Result of Satisfaction & Understanding Level**

### 3.2.2 Understanding Level by Session

#### (1) C1: What is CFA?

Evaluation result of understanding level is indicated in Fig.3.1.4. Less than 50% (34 – 48%) of the participants answered “understandable” or “very understandable” in this session. Possible cause and approach for improvement are summarized in Tab.3.1.1.



**Fig.3.1.4: Evaluation of Understanding Level in Session C1**

**Tab.3.1.1: Possible Cause(s) and Approach for Improvement in C1 Session**

Topics	Possible cause(s)	Approach for improvement
Demonstration video *(34%)	- Explanation voice in English.	- Explanation voice in Laotian.
Mechanism *(48%)	- Explained limited information due to time constraint.	- Use sufficient time and slides for explanation.
Benefits *(44%)	- Topic tended to management level in central government.	- Reconsider topics to suit participants.
Future prospect *(44%)	- Topic tended to management level in central government. - Used only one slide.	- Reconsider topics to suit participants. - Use many slides for detailed explanation.

\*: % in ( ) is for “satisfied” and “very satisfied”.

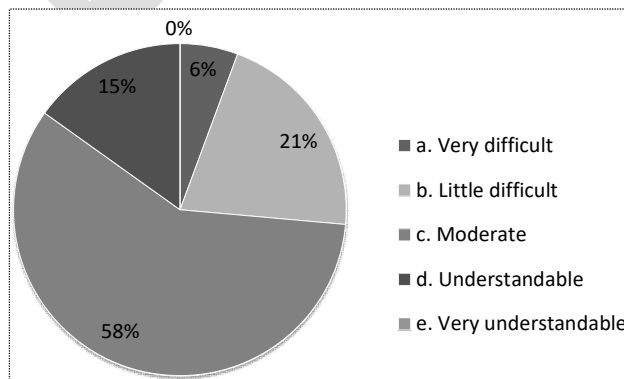
**(2) C2: Approach of Material Mix Design**

Evaluation result of understanding level is indicated in Fig.3.1.5. Only 15% answered “understandable” and no one answered “very understandable”. On the other hand, 27% answered “very difficult” or “difficult”. This result was made due to the following reasons.

- ✧ Content of the presentation was too advanced for the participants. The work approach was not familiar for the participants in particular.
- ✧ Presentation was made in 2 steps namely from Japanese to Laotian. It might the presentation slightly hard to understand.

The approaches for improvement are as follows.

- ✧ Reconsider the contents to suit technical capacity of the participants. Speed and volume of the presentation also should be reconsidered.
- ✧ Presentation in Laotian.



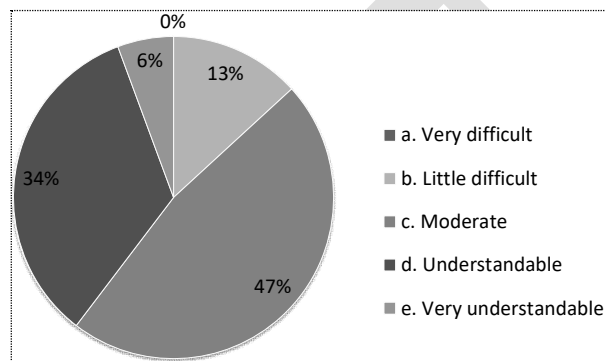
**Fig.3.1.5: Evaluation of Understanding Level in Session C2**

### (3) C3: Work Progress in the Project

Evaluation result of understanding level is indicated in Fig.3.1.6. Only 40% answered “understandable” or “very understandable”. This result was made due to;

- ✧ using only a few slides was insufficient to deepen understanding level of the participants.

Therefore, the presenter should consider composition of the slides to deepen the understanding gradually and certainly.



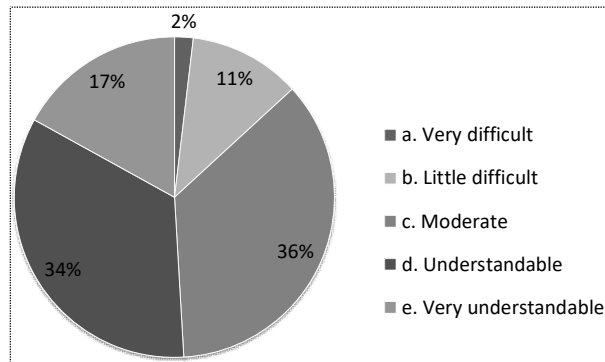
**Fig.3.1.6: Evaluation of Understanding Level in Session C3**

### (4) Fieldwork: Demonstration of CFA Work

Evaluation result of understanding level is indicated in Fig.3.1.7. Majority of the participants (51%) answered “understandable” or “very understandable” indeed. However, it is also said that the result was not fully satisfactory one.

Accordingly, following approaches for the improvement are suggested for opportunities in future.

- ✧ Increase the guide persons to comply with numbers of the participants.
- ✧ The guide shall use handy loudspeaker in the field.



**Fig.3.1.7: Evaluation of Understanding Level in Fieldwork**

### 3.2 Interested Topics to Learn More

The result of question and answer regarding the interested topics to learn more is shown in Table 3.2.1. The participants tend to learn theory and methodology in case of applying and developing CFA work by their own capacities. The feedback will be utilized for the prospective workshop/training program.

**Tab.3.2.1: Interested Topics to Learn More**

Session	Which topic you want to learn more?	No.
C1: What is CFA?	- Mechanism	34
	- Benefits of CFA	12
	- Future prospect of CFA	23
C2:	Approach of material mix design	38
C3:	Work progress in the project	8
Fieldwork	Demonstration of CFA work	9

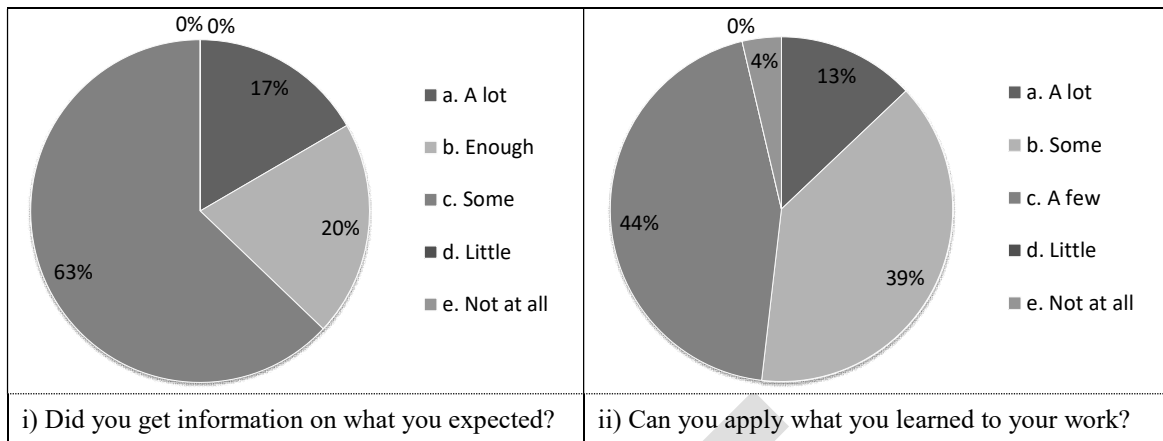
### 3.3 Benefit of Workshop

Benefit of the workshop is evaluated in accordance with the questions stated below.

- (i) “Did you get information on what you expected?”
- (ii) “Can you apply what you learned to your work?”

The result is indicated in Figure 3.3.1. Only 37% of the participants answered “a lot” or “enough” for question-(i) as well as 52% answered “apply a lot” or “apply some” for question-(ii). Considering above, the contents should be improved to match with the interest and the demand of the participants for the prospective opportunity.





**Fig.3.3.1: Benefit of the Workshop**

### 3.4 Comments of the Participants

Almost of the participants commented their impression of the workshop and the suggestions for the further improvement. The Team will utilize such feedback for the prospective opportunity. All comments are compiled in Appendix-C.



**SGS**

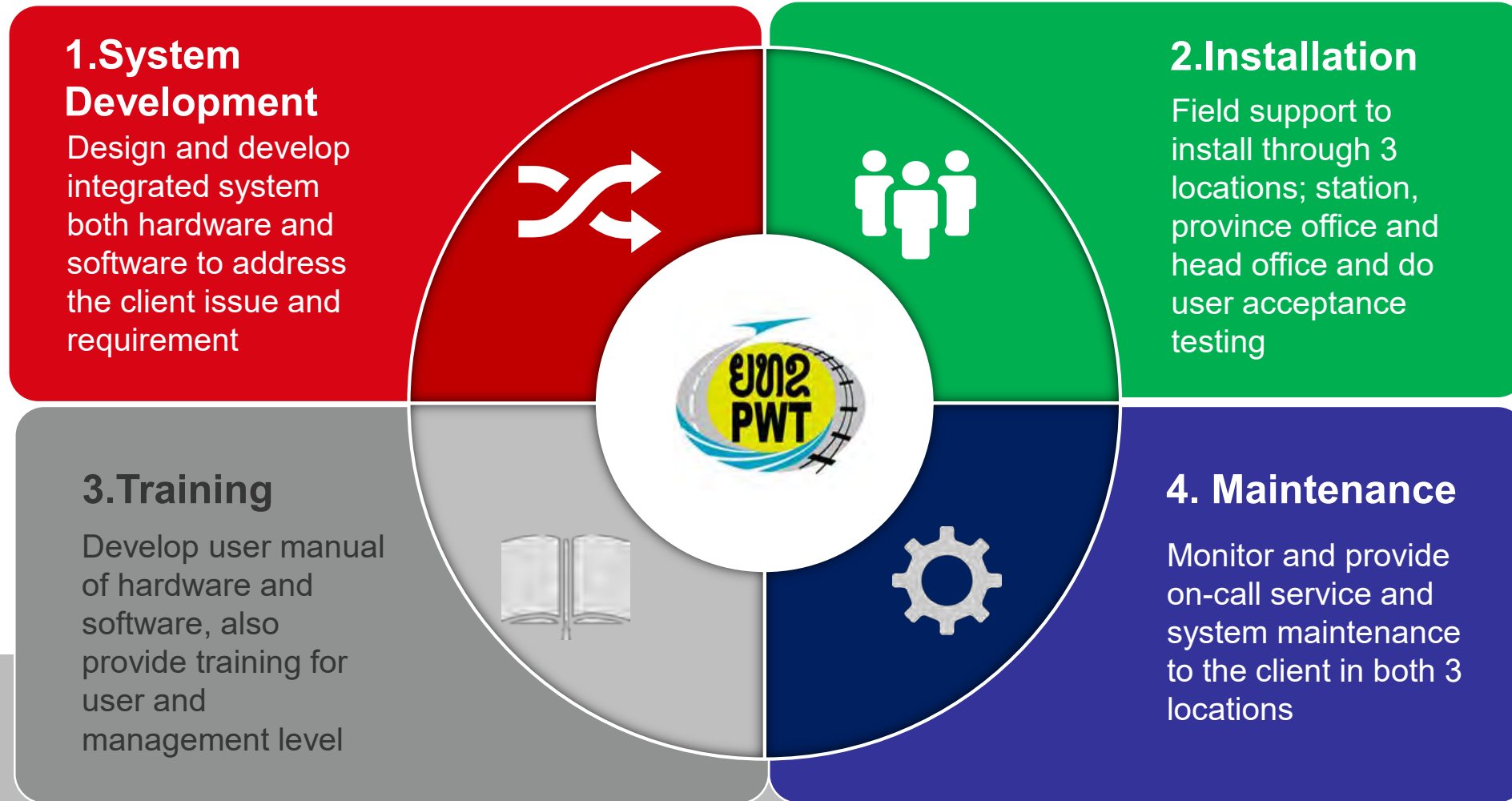


# Training Weighing System & Data Management System

26<sup>th</sup> – 27<sup>th</sup> March 2018

WHEN YOU NEED TO BE SURE

**SGS**

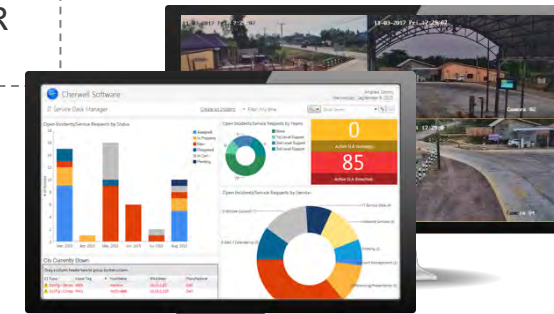


- AUTOMATIC TRUCK SCANNER
- AUTOMATIC PLATE READER



Truck type and plate number will be directly input in the system

- COMPUTER SERVER



- DATA MANAGEMENT SYSTEM

- COMPUTER



- PRINTER



- CCTV
- FIXED CAMERA



- WEIGHING SYSTEM



ประเภทรถ	3 เพล่า	10 ล้อ
น้ำหนักเพล่า 1	5,000	กิโลกรัม
น้ำหนักเพล่า 2	10,000	กิโลกรัม
น้ำหนักเพล่า 3	10,000	กิโลกรัม
น้ำหนัก รวม	25,000	กิโลกรัม

- REMOTE DISPLAY

โหลดเซลล์  
LOAD CELL

โหลดเซลล์  
LOAD CELL

กล่องรวมสัญญาณ  
JUNCTION BOX

โหลดเซลล์  
LOAD CELL

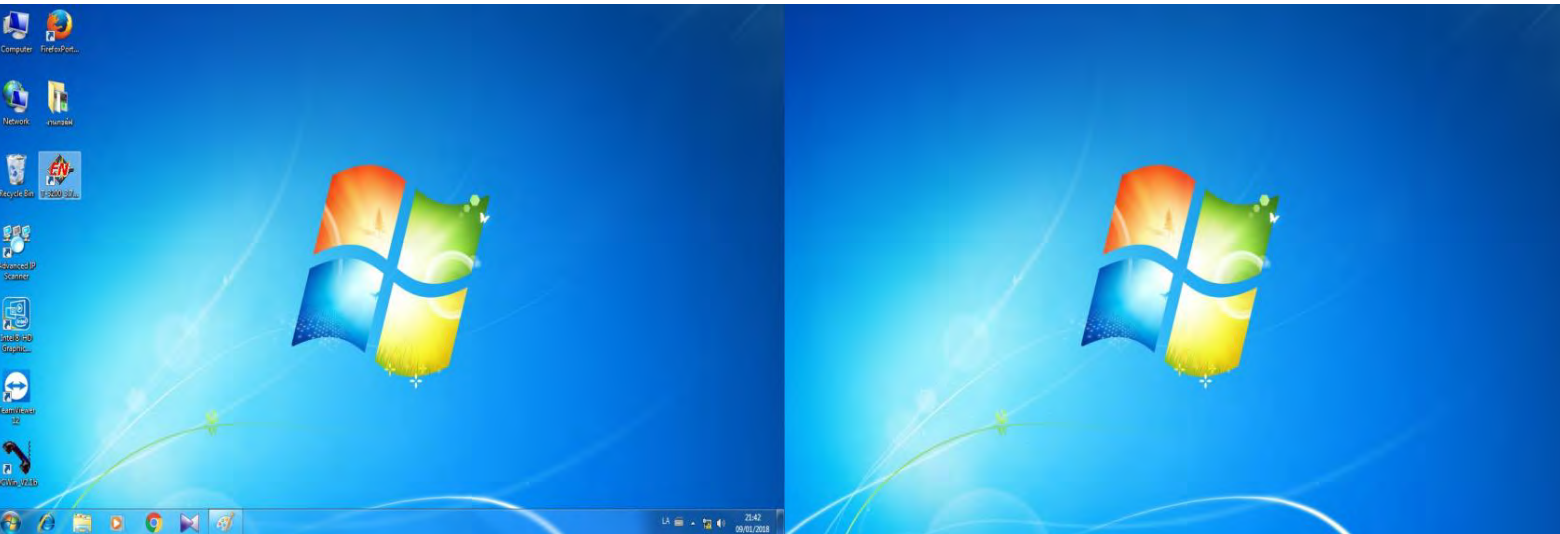
โหลดเซลล์  
LOAD CELL



# TRAINNING Weighing System

WHEN YOU NEED TO BE SURE

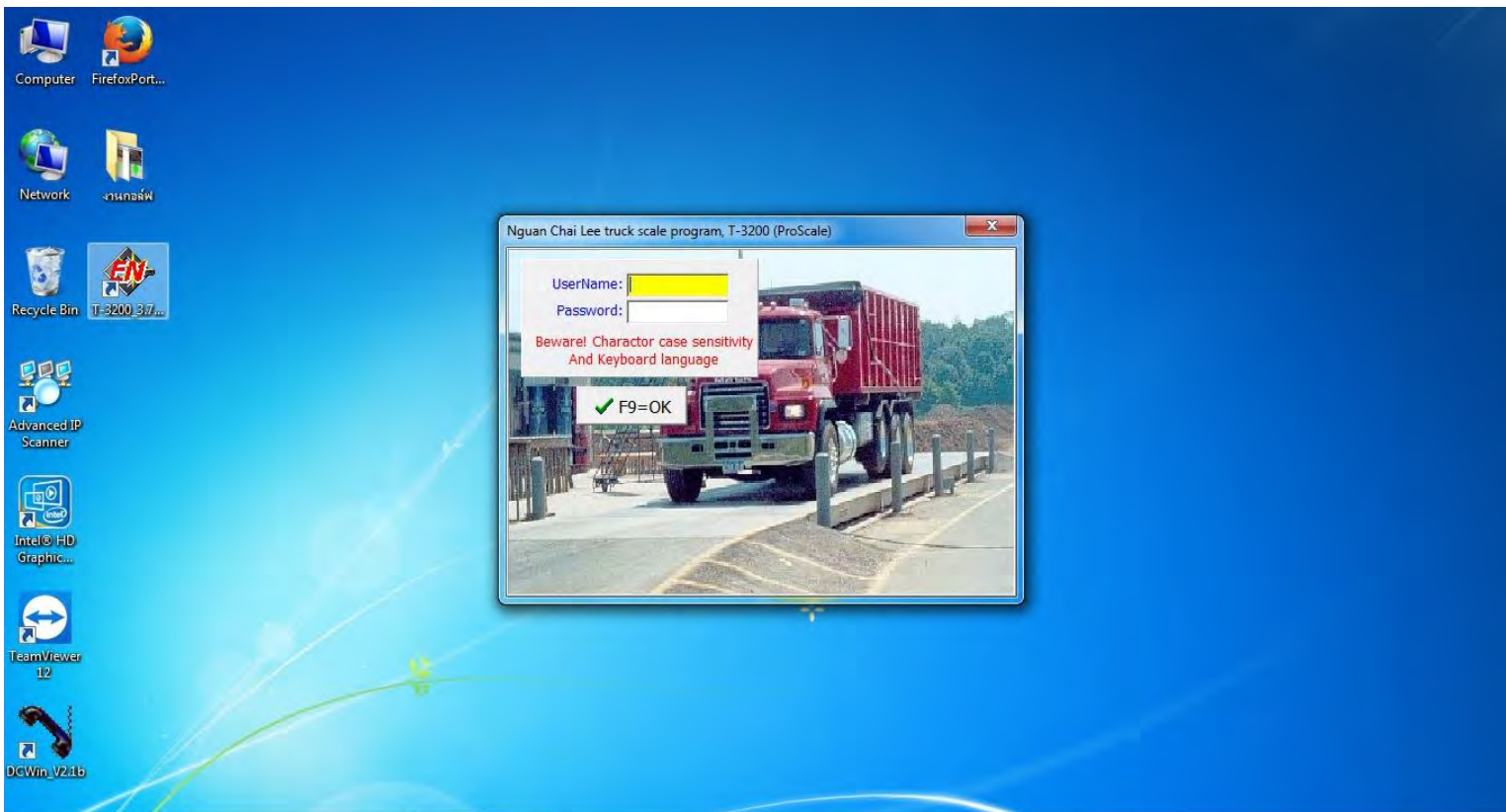




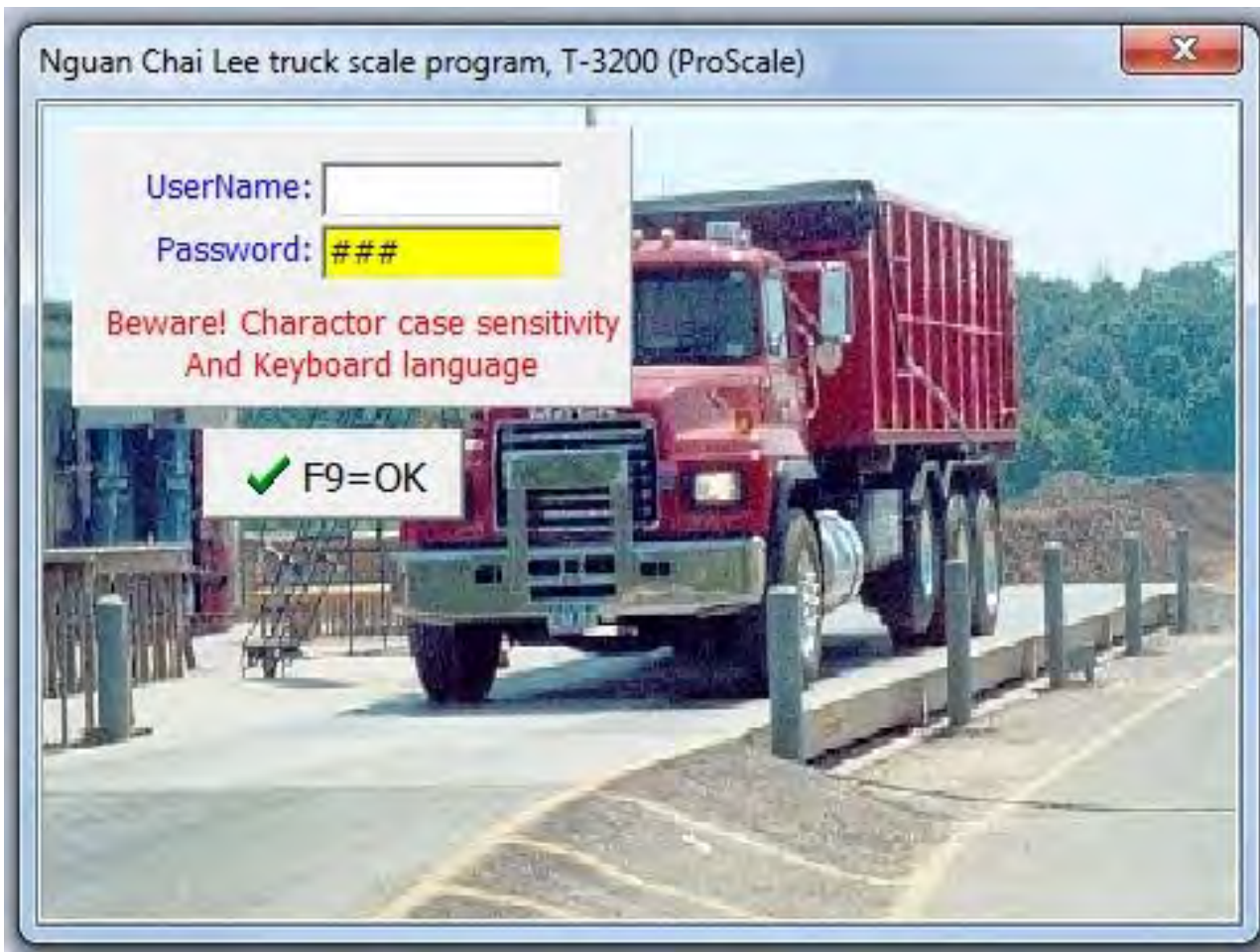
### วิธีการใช้งานโปรแกรมชั่งน้ำหนัก

T-3200 ด้านข้างทางหลวง ( HighWays Scale )

เปิดระบบเครื่องคอมพิวเตอร์ รอจนหน้าจอแสดง  
Windows Desktop ทั้งจอหลักและจอที่สองที่อยู่  
ด้านนอก ( Remote Display )



ดับเบิลคลิก ที่ Icon โปรแกรม  
ข้างหน้ารูปภาพ EN สีแดงบนกรอบ  
สีเขียว เพื่อเข้าใช้งานข้างหน้าหนัก

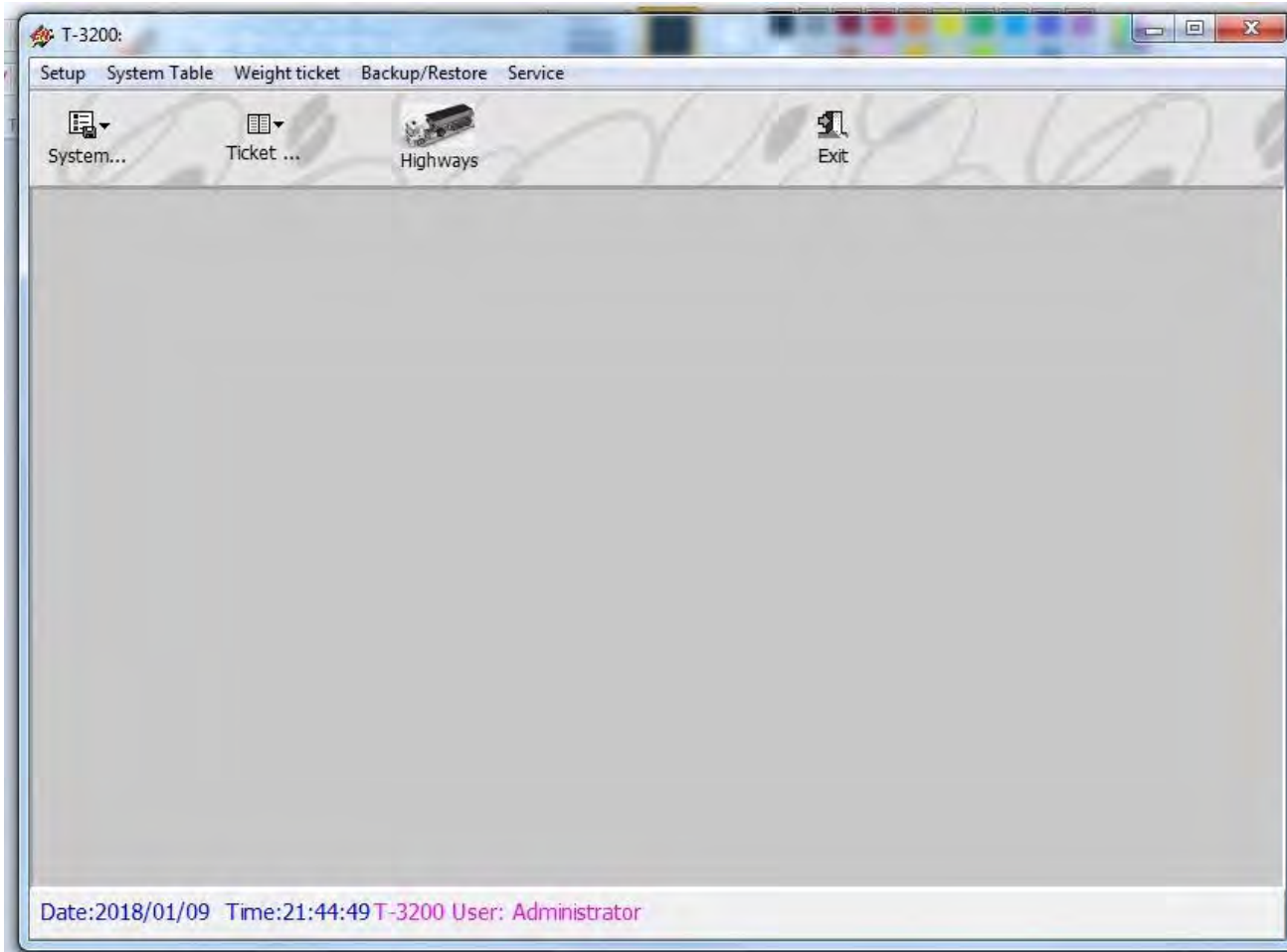


ป้อนรหัสผ่าน sgs

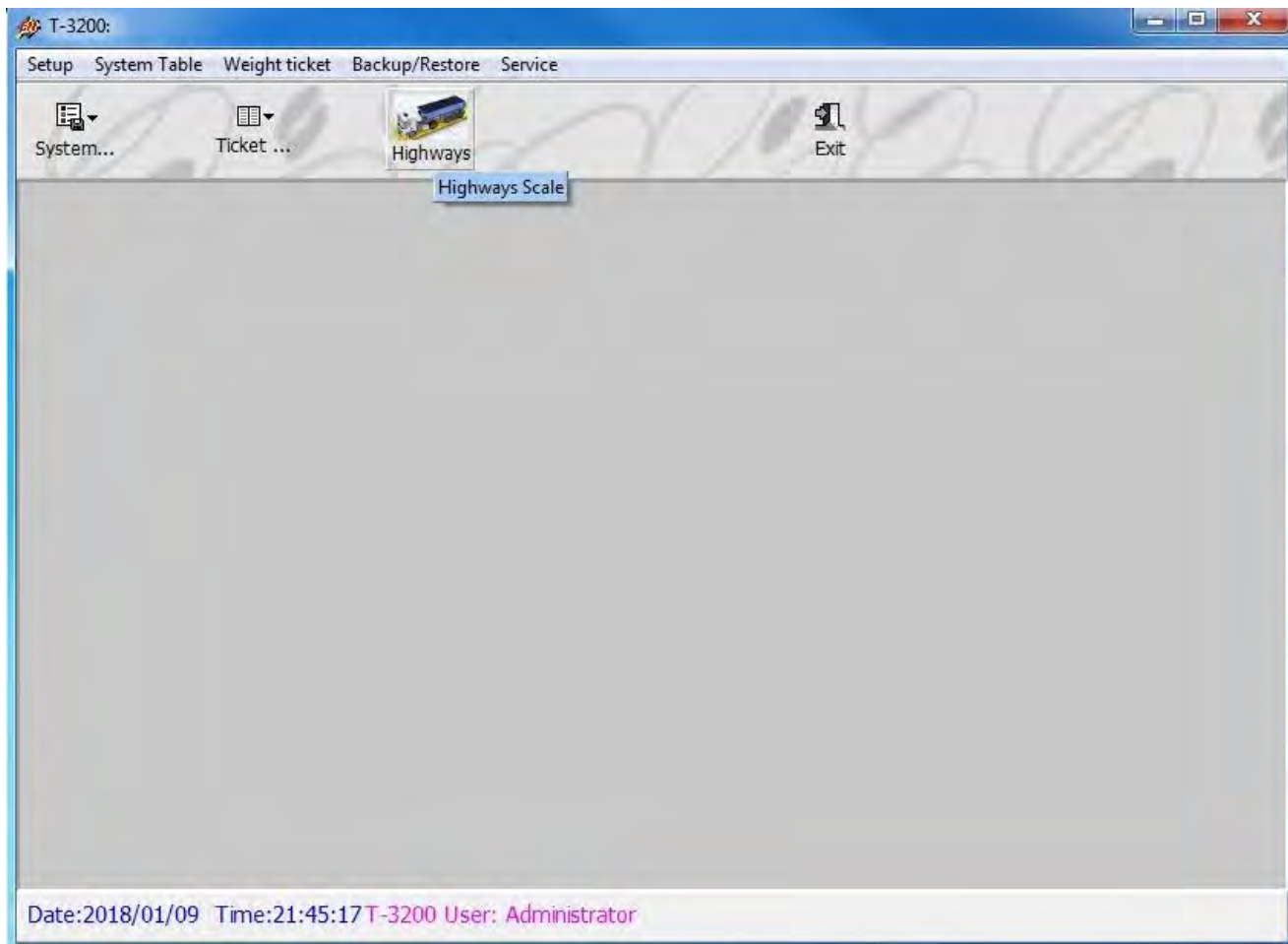
( ตัวพิมพ์เล็กเท่านั้น )

UserName ไม่มี และกดปุ่ม OK





เข้าหน้าจอหลักโปรแกรมชั่งน้ำหนัก  
T-3200 แล้วเลือกไปที่ Highways



นำเมาส์ไปเลือกรูปภาพ  
แล้ว ดับเบิ้ลคลิก



The screenshot shows the 'Highways Ticket' software interface. Five red boxes with numbers 1 through 5 highlight specific areas:

- 1:** Ticket information fields including date (2018/01/28), time (15:35:13), and ticket number (00000752).
- 2:** A grid of 18 truck icons representing different axle configurations, such as 1-2A/4W, 2-2A/6W, up to 18-4A/16W.
- 3:** Scale weight input fields, including 'น้ำหนักรวม(กรก)' (Total weight) and 'น้ำหนักห่อ(กรก)' (Weight of package), with a 'Scale Weight' field showing '0'.
- 4:** The 'ระยะทาง(กม)' (Distance in km) field, currently set to '1.00'.
- 5:** The 'AVC Table' which lists transaction details for 10 lanes (Lane 1 to Lane 10), including ObjectID, Lane number, Transaction Date/Time, AVC Class, and License Plate.

At the bottom, there is a toolbar with function keys: F1:Insert, F2:Edit, F3:Delete, F4:Cancel, F9:Save, F10:Save+Prt, Exit, and Remote Monitor. The system tray shows the date and time as 15:35 on 28/01/2018.

1. ข้อมูล ระบุวันที่, เวลา, เลขที่บัตรชั่ง และป้ายทะเบียนรถบรรทุก
2. ประเภทรถบรรทุก 18 รายการ
3. น้ำหนักรวมทั้งหมด, น้ำหนักส่วนหัว และน้ำหนักส่วนพ่วง ช่องน้ำหนักเป็น ศูนย์ทั้งหมด พร้อมทำการชั่งน้ำหนัก
4. ระยะทาง (กิโลเมตร) เจ้าหน้าที่จะเป็น คนกรอกข้อมูลเอง
5. สร้างน้ำหนักแต่ละเพลา, น้ำหนักที่อนุญาต กำหนด, ส่วนต่างของน้ำหนักที่เกินกำหนด แต่ละเพลา และค่าปรับ



**SPEED LIMIT**

**\* โดยมีข้อยกเว้น รถบรรทุกต้อง  
จอดนิ่งและน้ำหนักไม่มีการ  
เปลี่ยนแปลง \***



# TRAINING Weighing System

ວັນທີ 2018/01/13    ເວລາ 16:31:03    ເລກທີ 00000622  
 ລາຍລະບຽບລົດ ບກ0143    ບະຫວັດຜ່ານມາ  
 ບະເລດລົດ 4: 3Axl/10W/back pair    ໄລຍະທາງ(ກມ) 1.00  
 ລົດຜ່ວງ 17: 3Axl/12W/Trailer

	ນ້ຳໜັກຕົວຊີ້	ນ້ຳໜັກຄອບຄຸມ	ນ້ຳໜັກຜ່ານເກັບ(ກກ)	ຕຳປັບໄໝ	ຊຸບຕຳປັບໄໝ
ເລົ່າ1	5,260	5,000	260	0	0
ເລົ່າ2	11,670	10,000	1,670	0	0
ເລົ່າ3	11,670	10,000	1,670	0	0
ເລົ່າ4	10,940	11,000	0	0	0
ເລົ່າ5	9,395	10,000	0	0	0
ເລົ່າ6	9,385	10,000	0	0	0
ເລົ່າ7	0	0	0	0	0
ເລົ່າ8	0	0	0	0	0
ເລົ່າ9	0	0	0	0	0
ເລົ່າ10	0	0	0	0	0
<b>ລວມ</b>	<b>58,320</b>	<b>56,000</b>	<b>3,600</b>	<b>12,000</b>	<b>50,000</b>
ນ້ຳໜັກຜ່ານ(ກກ)		2,320	ລວມຕຳປັບ		62,000

ນ້ຳໜັກລວມ(ກກ) 58,320    ນ້ຳໜັກກຮົ່ວ(ກກ) 28,600  
 ນ້ຳໜັກຜ່ວງ(ກກ) 29,720  
**58320**  
 Scale Weight

Administrator  
 Column to default    ກວດສອບຜ່ານຜູ້ງ    ສ່ຳເລົ່າ 1  
 Column+Mod.+Save    2018/01/13    ຕັ້ງກ່ອນຜົມ  
 Highways scale record     Auto-AVC record moving stopped    **AVC Table (double click - get record, mouse in - refresh)**

TckNo	TruckNo	RefSeq
00000620	ບກ0102	
* 00000622		
00000621	ບກ0143	

HEADER    TRAILER

ObjectID	Lane_Num...	Transaction_DateTi...	AVC_Class	License_Plate
1545	1	2018/1/13 16:04:00	1	ສຄ6116
1544	1	2018/1/13 15:34:46	1	ກພ1819
1543	1	2018/1/13 15:29:29	1	ໂຄລ4425
1542	1	2018/1/13 14:36:19	1	ສຄ6116

\*\*Press F4 for other Date selection\*\*    Mod-RePrt-Del

ເມື່ອຣຄບຣທຸກເຂົ້າແທ້ໝາຍ ຮະບົບ  
 AVC ຈະສົ່ງຂໍ້ມູນ ປະເພດຣຄ  
 ແລະປ້າຍທະເບີນອັດໂນມັດ



# TRAINING Weighing System

Highways Ticket  
Highways weighbridge | Ticket Designer & Browser | AVC Setup

วันที่ 2018/01/28 เวลา 15:35:13 เลขที่ 00000752  
 เลขทะเบียนรถ 15801280752-1  
 ประเภทรถ 0 no header  
 ไซลิ่ง (กรัม) 1.00  
 วัสดุ 0: no Trailer  
 Auto saving mode

น้ำหนักตัวถัง	น้ำหนักบรรทุก	น้ำหนักเต็ม (รวม)	ค่าปรับ	คูณค่าปรับ
น้ำหนัก1	0	0	0	0
น้ำหนัก2	0	0	0	0
น้ำหนัก3	0	0	0	0
น้ำหนัก4	0	0	0	0
น้ำหนัก5	0	0	0	0
น้ำหนัก6	0	0	0	0
น้ำหนัก7	0	0	0	0
น้ำหนัก8	0	0	0	0
น้ำหนัก9	0	0	0	0
น้ำหนัก10	0	0	0	0
รวม	0	0	0	0
น้ำหนักเต็ม (รวม)	0	รวมค่าปรับ	0	0

น้ำหนักรวม (รวม) 0    น้ำหนักหัวรถ (รวม) 0  
 น้ำหนักท้ายรถ (รวม) 0

Scale Weight 0

File name: f1801280752-1.bmp

Highways scale record

TckNo	TruckNo	RefSeq
* 00000752		
00000748	๑๑๑0140	
00000749	๑๑๑0140	
00000750	๑๑๑0140	

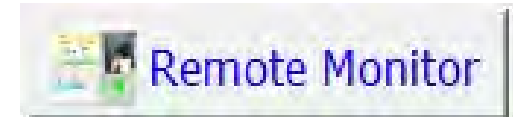
AVC Table (double click = get record, mouse in = refresh)

ObjectID	Lane_Num...	Transaction_DateTi...	AVC_Class	License_Plate
2210	1	2018/1/28 15:02:17	1	๑๑0140
2209	1	2018/1/28 15:01:50	1	๑๑๑1111
2208	1	2018/1/28 14:16:12	1	๑๑๑0140
2207	1	2018/1/28 14:14:01	1	1๑๑-4425

Highways Ticket | B-Open | Use Grid->F4

15:35 28/01/2018

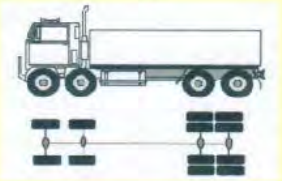
จอแสดงน้ำหนักตัวที่สอง  
 ที่อยู่ด้านนอกห้องควบคุม  
 ต้องกดปุ่ม



Remote monitoring

Camera image | Camera setup

ປະເພດລົດ 4 ເຜົາ 12 ລໍ້  
 ນໍ້າໜັກອະນຸຍາດ 29,500 ກິໂລກຣາມ



	ນໍ້າໜັກຕົວຊີງ	ນໍ້າໜັກອະນຸຍາດໜັກເຜົາເກີນ(ກກ)	ອາປວໃໝ່	<input checked="" type="checkbox"/> ມູນອາປວໃໝ່
ເຜົາ1	0	4,750	0	0
ເຜົາ2	0	4,750	0	0
ເຜົາ3	0	10,000	0	0
ເຜົາ4	0	10,000	0	0
<b>ລວມ</b>	<b>0</b>	<b>29,500</b>	<b>0</b>	<b>0</b>
<b>ນໍ້າໜັກເກີນ(ກກ)</b>		<b>0</b>	<b>ລວມອາປວ</b>	<b>0</b>

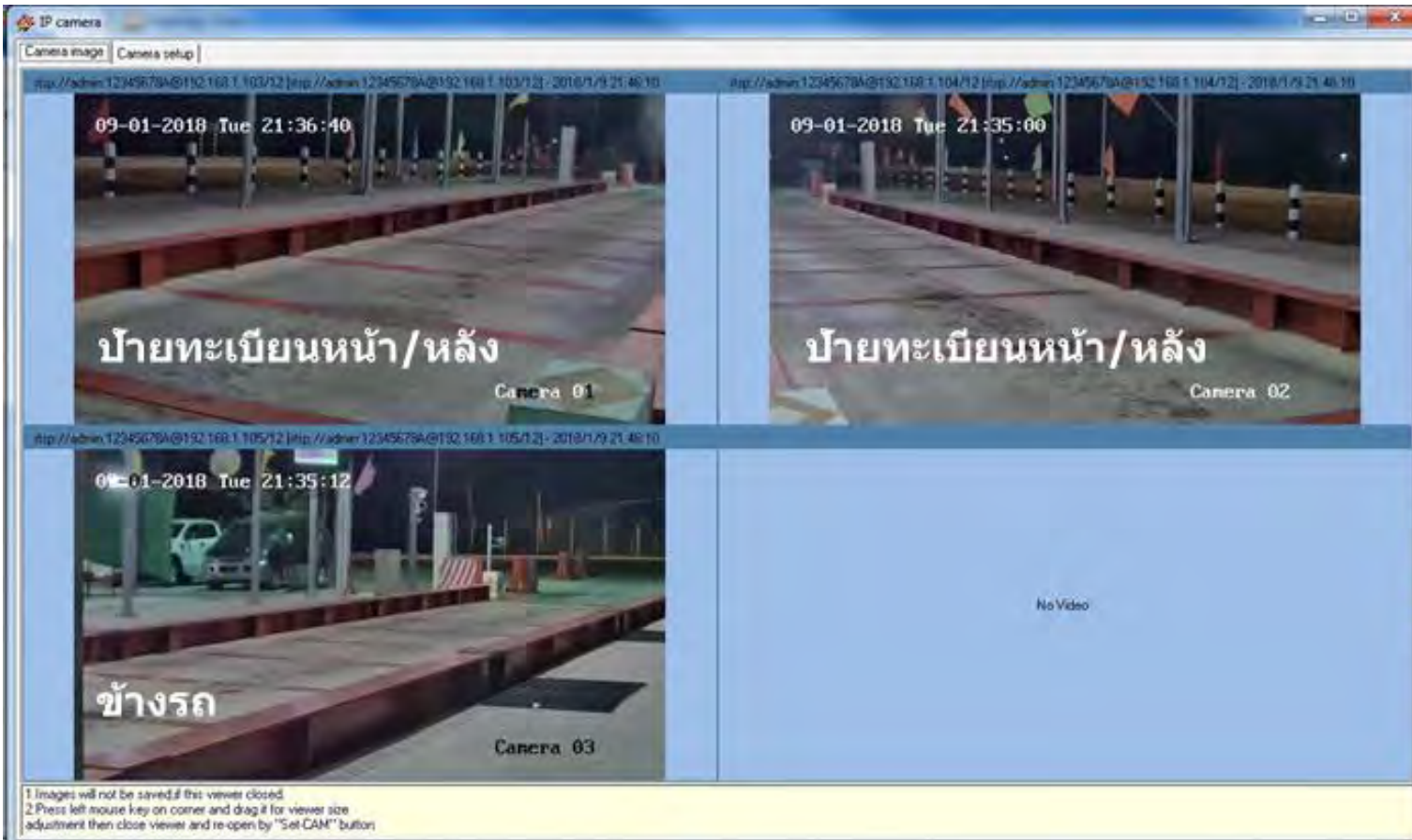
09-01-2018 Tue 21:34:38

Camera 02



ຜ່ານ

จอแสดงน้ำหนักตัวที่สอง  
 ( Remote Display)



จอภาพจากกล้องทั้งสามจะ  
แสดงซ้อนอยู่ด้านหลังจอซึ่ง  
น้ำหนักจอภาพนี้จะแสดงภาพ  
ป้ายทะเบียนหน้า/หลัง และ  
ด้านข้างของรถบรรทุก



Highways Ticket | Highways weighbridge | Ticket Designer & Browser | AVC Setup

วันที่ 2018/01/28 เวลา 15:35:13 เลขที่ 00000752

ประเภทขบวนรถ 0: no header ไลขะทาง(กรม) 1.00

ชนิดขบวนรถ 0: no Trailer  Auto saving mode

น้ำหนักถ่วง	น้ำหนักบรรทุก	น้ำหนักบรรทุก(รวม)	ค่าปรับ	รวมค่าปรับ
ถ่วง1	0	0	0	0
ถ่วง2	0	0	0	0
ถ่วง3	0	0	0	0
ถ่วง4	0	0	0	0
ถ่วง5	0	0	0	0
ถ่วง6	0	0	0	0
ถ่วง7	0	0	0	0
ถ่วง8	0	0	0	0
ถ่วง9	0	0	0	0
ถ่วง10	0	0	0	0
รวม	0	0	0	0
น้ำหนักบรรทุก(รวม)	0	รวมค่าปรับ	0	0

น้ำหนักรวม(รวม) 0 น้ำหนักหัว(รวม) 0 น้ำหนักท้าย(รวม) 0

Scale Weight 0

AVC Table (double click = get record, mouse in = refresh)

ObjectID	Lane_Num...	Transaction_DateTi...	AVC_Class	License_Plate
2210	1	2018/1/28 15:02:17	1	๐๓0140
2209	1	2018/1/28 15:01:50	1	๓๓๑1111
2208	1	2018/1/28 14:16:12	1	๓๓๑0140
2207	1	2018/1/28 14:14:01	1	1๓๓-4425

1

Highways scale record

TckNo	TruckNo	RefSeq
* 00000752		
00000748	๓๓๑0140	
00000749	๓๓๑0140	
00000750	๐๓0140	

HEADER TRAILER

F1:Insert F2:Edit F3:Delete F4:Cancel F9:Save F10:Save+Prt Exit Remote Monitor

Small Insert Ticket B-Open Use Grid->F4

15:35 28/01/2018

เมื่อมีรถบรรทุก ทุกคันที่เข้าด่านซึ่ง  
ตรงตาราง **AVC Table**  
จะปรากฏข้อมูลของรถบรรทุก  
และระบบชั่งน้ำหนักจะนำข้อมูลนี้เข้า  
ระบบชั่งน้ำหนัก เองโดยอัตโนมัติ



# TRAINING Weighing System

วันที่ 2018/01/13 เวลา 16:31:03 เลขที่ 0000622  
 เลขทะเบียนรถ บก0143 ประเภทยานพาหนะ  
 ประเภทรถ 4: 3Axl/10W/back pair ไซตทาง(กรัม) 1.00  
 ชนิดรถ 17: 3Axl/12W/Trailer

น้ำหนักจุด	น้ำหนักอนุภาค	น้ำหนักเต็ม(กก)	ตาปัด	ตาปัดใหม่
น้ำหนัก1	5,260	5,000	260	0
น้ำหนัก2	11,670	10,000	1,670	0
น้ำหนัก3	11,670	10,000	1,670	0
น้ำหนัก4	10,940	11,000	0	0
น้ำหนัก5	9,395	10,000	0	0
น้ำหนัก6	9,385	10,000	0	0
น้ำหนัก7	0	0	0	0
น้ำหนัก8	0	0	0	0
น้ำหนัก9	0	0	0	0
น้ำหนัก10	0	0	0	0
รวม	58,320	56,000	3,600	12,000
น้ำหนักเต็ม(กก)		2,320	รวมตาปัด	62,000

น้ำหนักรวม(กก) 58,320 น้ำหนักหัว(กก) 28,600  
 น้ำหนักพ่วง(กก) 29,720  
**58320**  
 Scale Weight

Administrator  
 Column to default 2018/01/13  
 Column+Mod.+Save

Highways scale record  
 TckNo TruckNo RefSeq  
 0000620 บก0102  
 \* 0000622  
 0000621 บก0143

Auto-AVC record moving stopped  
 AVC Table (double click = get record, mouse in = refresh)

ObjectID	Lane_Num...	Transaction_DateTi...	AVC_Class	License_Plate
1545	1	2018/1/13 16:04:00	1	๓๑6116
1544	1	2018/1/13 15:34:46	1	๓๑๑819
1543	1	2018/1/13 15:29:29	1	1๓๑4425
1542	1	2018/1/13 14:36:19	1	๓๑6116

Diagrams: HEADER, TRAILER

เมื่อรถบรรทุกทำการชั่งน้ำหนัก  
 เสร็จถ้ารถบรรทุกคันไหนที่มี  
 น้ำหนักรวมเกินอนุญาตกำหนด  
 รถบรรทุกคันนั้นจะถูกดำเนินการ  
 คิดค่าปรับ

กรมขนส่ง  
Department of Transport  
สถานีตรวจน้ำหนักถ่วง  
Donghen Weigh Station

### ใบตัดถ่วงน้ำหนัก Weight Report



เลขที่ใบตัดถ่วงน้ำหนัก  
Vehicle No : บก2282

วันที่  
Date : 2018/01/09

เวลา  
Time : 21:07:5

เลขที่  
No : 00000584

น้ำหนักตัวรถ(กก)  
Rigid weight : 29,580

น้ำหนักพ่วง(กก)  
Trailer weight (kg) : 27,260

ระยะทาง(กม)  
Distance (km) : 1

น้ำหนักรวม(กก)  
Total Weight (kg) : 56,840

แกน Axial	น้ำหนักตัวรถ(กก) Actual Weight	น้ำหนักตามเกณฑ์(กก) Load Limit (kg)	น้ำหนักเกิน(กก) Over Axial limit (kg)	ค่าปรับค่าทาง(บาท) Maintenance Fee(LAK)	ค่าปรับในน้ำหนักเกิน Over weight
แกน Axial 1	7,110	5,000	2,110		
แกน Axial 2	11,235	10,000	1,235		
แกน Axial 3	11,235	10,000	1,235		
แกน Axial 4	14,050	11,000	3,050		
แกน Axial 5	10,790	10,000	790		
แกน Axial 6	2,420	10,000			
แกน Axial 7					
แกน Axial 8					
แกน Axial 9					
แกน Axial 10					
<b>รวม Total</b>	<b>56,840</b>	<b>56,000</b>	<b>840</b>	<b>7,000</b>	<b>50,000</b>
รวมน้ำหนักตัว Total O/w	840				



จุดด้านหน้า/ด้านซ้าย

จุดด้านซ้าย/ด้านหน้า

จุดด้านขวา

ประเภทหัวรถ  
Header Type



ชนิดพ่วง  
Trailer Type

ชื่อหัวหน้าสถานี  
Head officer of weigh station

เจ้าหน้าที่ประจำสถานี :  
Authorities of weigh Station

## ตัวอย่างใบชั่งน้ำหนัก (Weight Report)



ກົມຂົນສົ່ງ  
Department of Transport  
ສະຖານີສັດຂົ່ງນໍ້າໜັກຄັງເທີນ  
DonqHen Weigh Station

ວັນທີ : 2018/01/09  
Date :

ລະຫັດບຽນລົດ : ບກ2282  
Vehicle No :

ຄ່າຄຸ້ມຄອງທາງ (ກີບ) : 7,000  
Maintenance Charge(LAK) :

ຄ່າປັບໃໝນໍ້າໜັກເກີນ(ກີບ) : 50,000  
Over weight Fine (LAK) :

ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ  
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນາຖາວອນ  
ໃບຮັບເງິນປັບໃໝ  
Fine Fee

ເວລາ : 21:07:52  
Time

ເລກທີ : 00000584  
No

ລວມຄ່າປັບ (ກີບ) : 57,000  
Total Fine (LAK) :

ເຈົ້າໜ້າທີ່ປະຈໍາຕາມ :  
Authorities of weigh Station

ຫົວໜ້າສຳນັກ  
Head officer of weigh station

ຜູ້ຄິດໄລ່  
Calculator

### ຕົວຢ່າງໃບຮັບຄ່າປັບ

ເມື່ອຣຄບຣທຸກຄັນນີ້ລົງໄປຈາກເຄື່ອງ  
ຂັງແລ້ວ ຄື ຈບ ຂັ້ນຕອນການຂັງ  
ນໍ້າໜັກຣຄບຣທຸກ

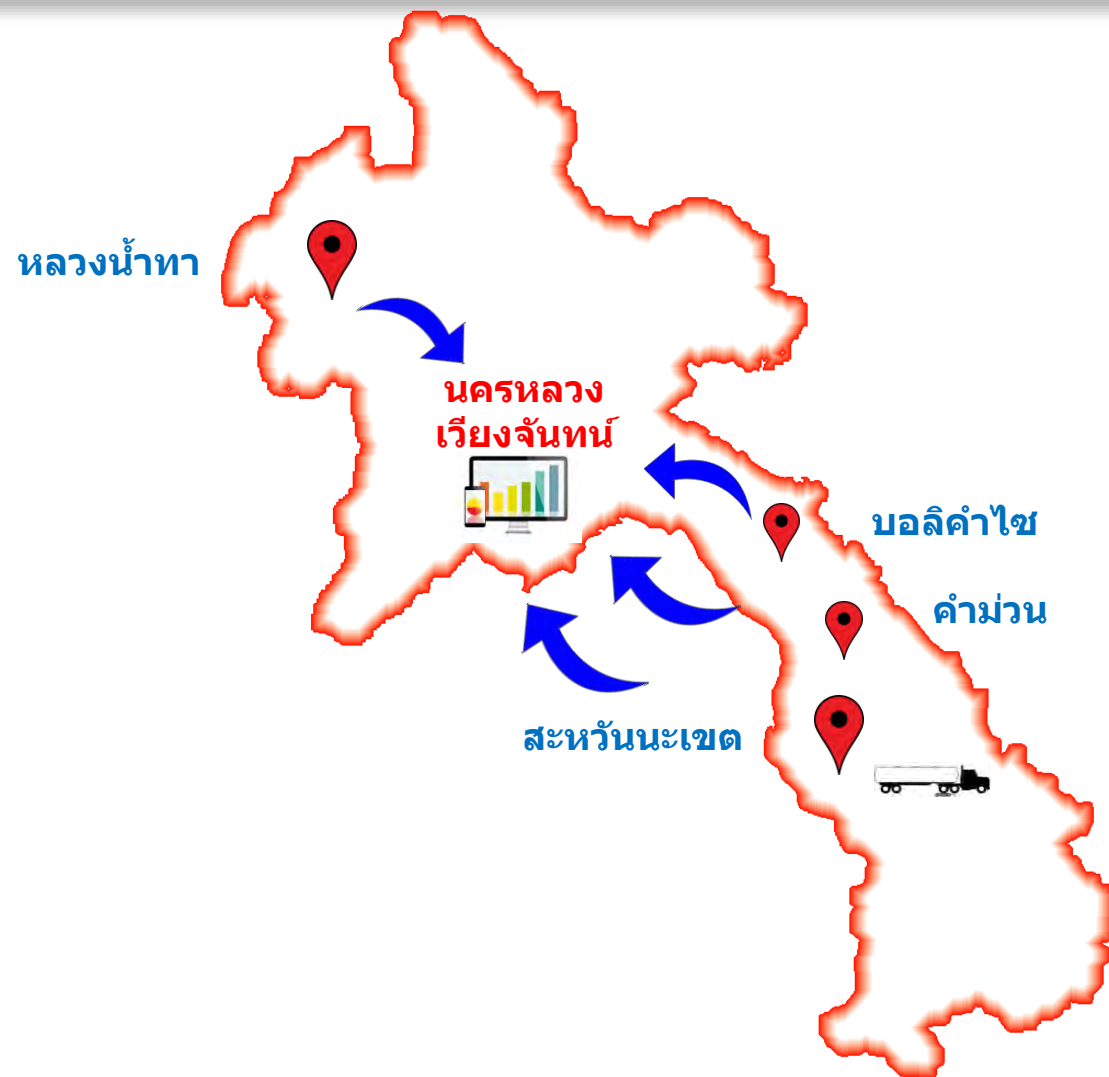


# Data Management System

# TRAINNING

WHEN YOU NEED TO BE SURE





# หัวข้อการใช้งานระบบ



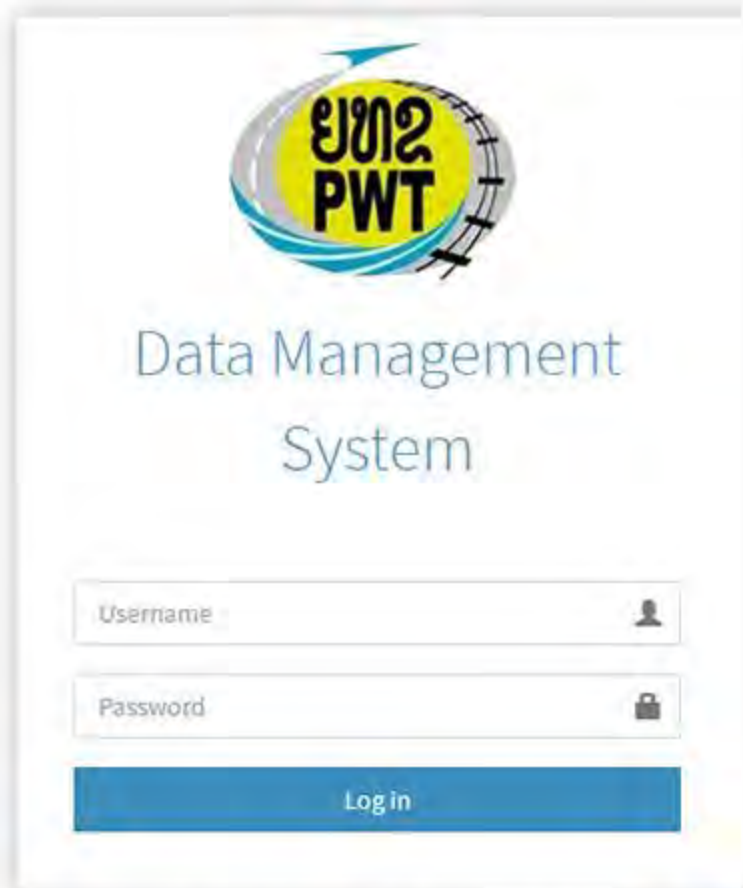
Data Management  
System

- เข้าสู่ระบบ (Login)
- ผู้ดูแลระบบ (Admins)
- ภาพรวมข้อมูล (Dashboard)
- ใบสั่ง (Ticket)
- รายงาน (Report)

URL ที่ใช้ในการเข้าระบบข้างหน้าหน้า

สถานที่	URL
จังหวัด (สะพานนะเขต)	192.168.1.4:8080
ส่วนกลาง (เวียงจันทน์)	192.168.1.2:8080





ยท๒  
PWT

Data Management  
System

Username

Password

Login

ระบุ Username และ Password เพื่อเข้าสู่ระบบ

เข้าสู่ระบบ (Login)

ระบบ Username และ Password ที่ผู้ดูแล  
ระบบสร้างให้เพื่อเข้าสู่ระบบ



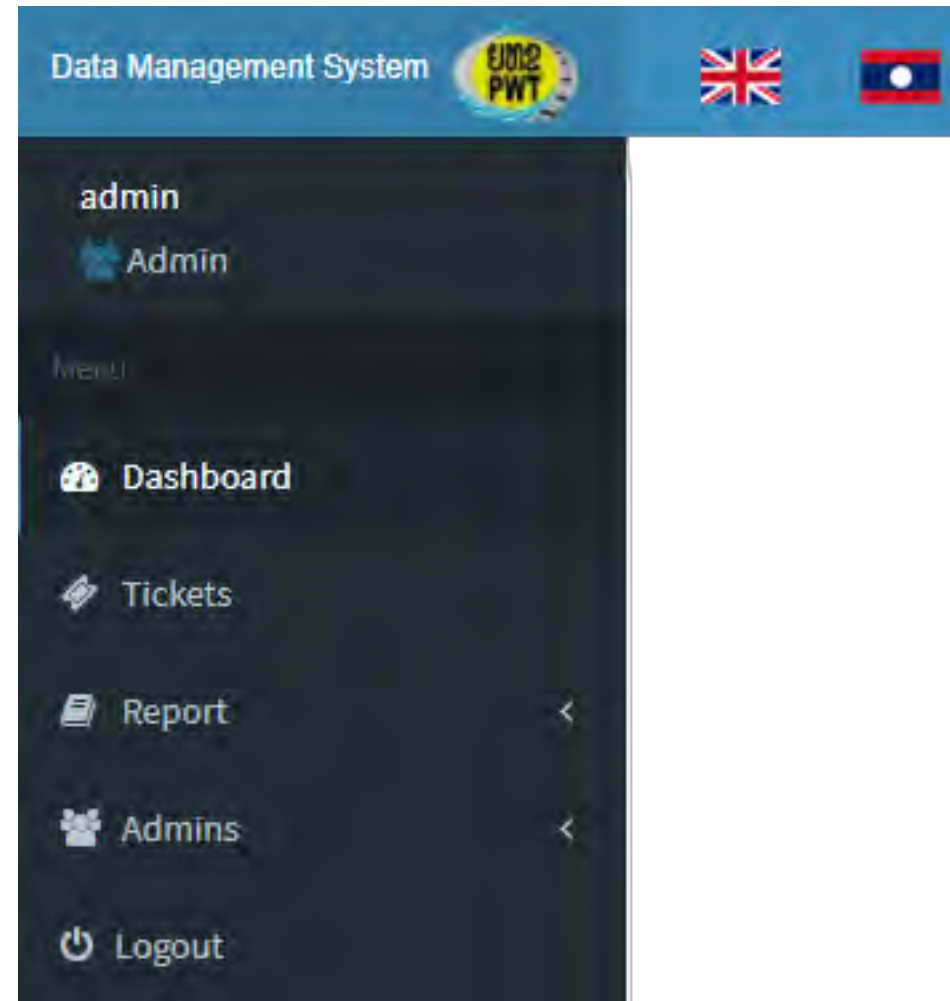
Weight System

เปลี่ยนภาษา (ENG, LAO)

ชื่อและกลุ่มผู้ใช้งานปัจจุบัน

เมนูแสดงตามสิทธิ์ที่กำหนด

ออกจากระบบ



## ผู้ดูแลระบบ (Admins)



Data Management  
System

1. **จัดการข้อมูลผู้ใช้ (User Management)**
2. **ตั้งค่าสิทธิการใช้งานระบบ (Permission Setting)**
3. **จัดการกลุ่มผู้ใช้ (Role Management)**

User Management

Username	First name	Last name	Province	Last Login	Role	Edit	Delete
admin	Systemedit	Admiedit	SAVANNAKHET	2018-01-29	Admin		
management	Management	System	SAVANNAKHET		Management		
staff	Staff	System	CENTRAL	2017-11-01	Staff		

[Add User](#)

## จัดการข้อมูลผู้ใช้ (User Management)

1. แสดงรายละเอียดผู้ใช้
2. ปุ่มเพิ่มผู้ใช้
3. แก้ไขข้อมูลผู้ใช้
4. ลบผู้ใช้

Add User ×

Username:

Password:

Retype password:

First name:

Last name:

Province: SAVANNAKHET ▼

Role: Admin ▼

**1** Save **2** cancel

## การเพิ่มผู้ใช้

1. บันทึกข้อมูล
2. ยกเลิก

Edit user ×

**Username:**

**Password:**

**Retype password:**

**First name:**

**Last name:**

**Province:**

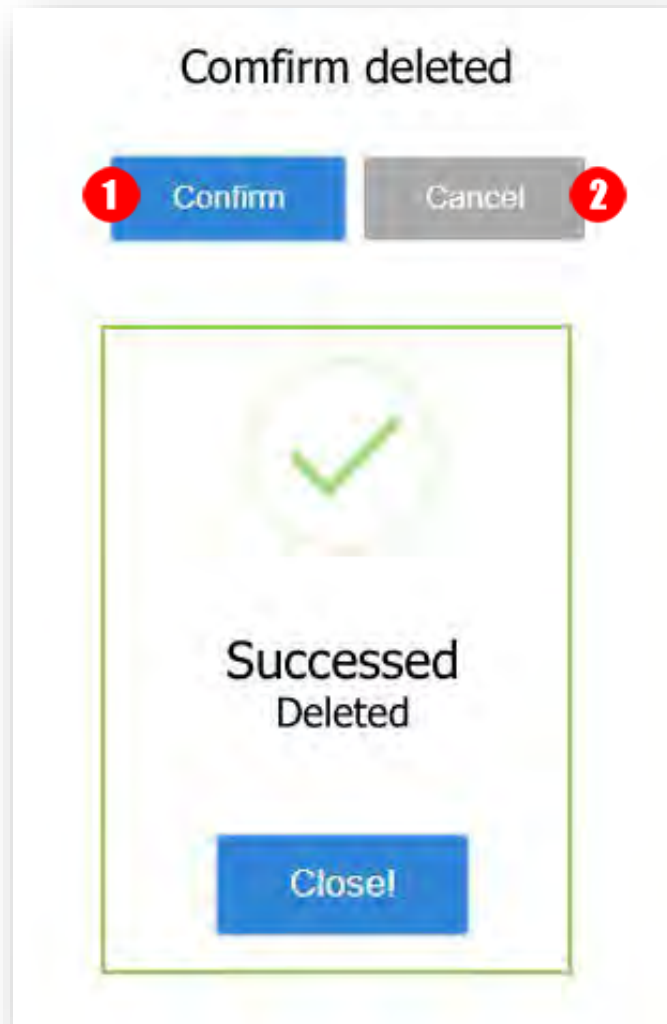
**Role:**

**1** Save **2** cancel

## การแก้ไขข้อมูล

1. บันทึกข้อมูล

2. ยกเลิก



## การลบผู้ใช้

1. บันทึกข้อมูล
2. ยกเลิก



Permission Settings

	1	2	3
	Admin	Management	Staff
Access Admin Management	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access Dashboard	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Access Report	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Access Ticket	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

4 Save

### ตั้งค่าสิทธิการใช้งานระบบ (Permission Setting)

1. กลุ่มผู้ใช้ Admin
2. กลุ่มผู้ใช้ Management
3. กลุ่มผู้ใช้ Staff
4. ปุ่มบันทึก

## จัดการกลุ่มผู้ใช้ (Role Management)

Role Management			
Role Id	Role Name	Edit	Delete
1	Admin	<a href="#">Click</a>	<a href="#">Click</a>
2	Management	<a href="#">Click</a>	<a href="#">Click</a>
3	Staff	<a href="#">Click</a>	<a href="#">Click</a>

**Edit role** ✕

**Role Name:**

**Confirm delete**

## ภาพรวมข้อมูล (Dashboard)



Data Management  
System

### Dashboard

Province

SAVANNAKHET ▾  
**All province**  
 SAVANNAKHET  
 VIENTIAN  
 SALAVAN

Station:

All station ▾  
**All station**  
 DONGHEN  
 STATION 2  
 STATION 3

Date From

02/02/2018 12:21 | 📅

To

02/02/2018 12:21 | 📅

February 2018

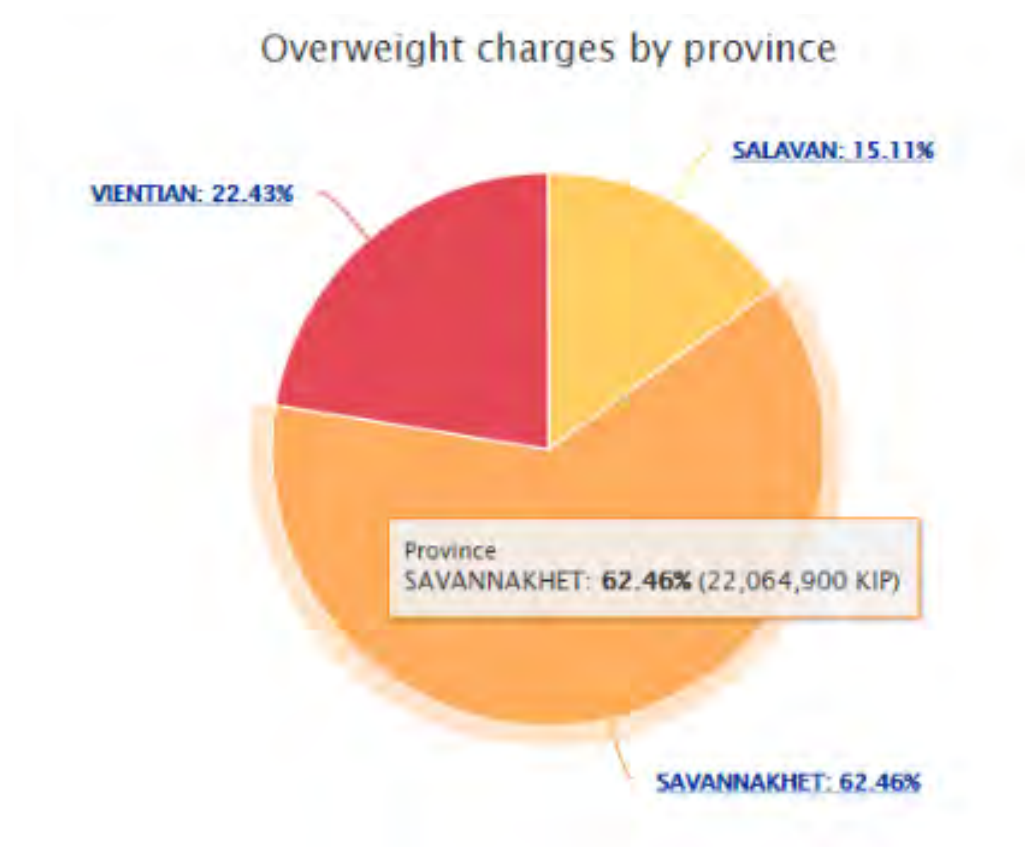
Su	Mo	Tu	We	Th	Fr	Sa
28	29	30	31	1	<b>2</b>	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	1	2	3
4	5	6	7	8	9	10

February 2018

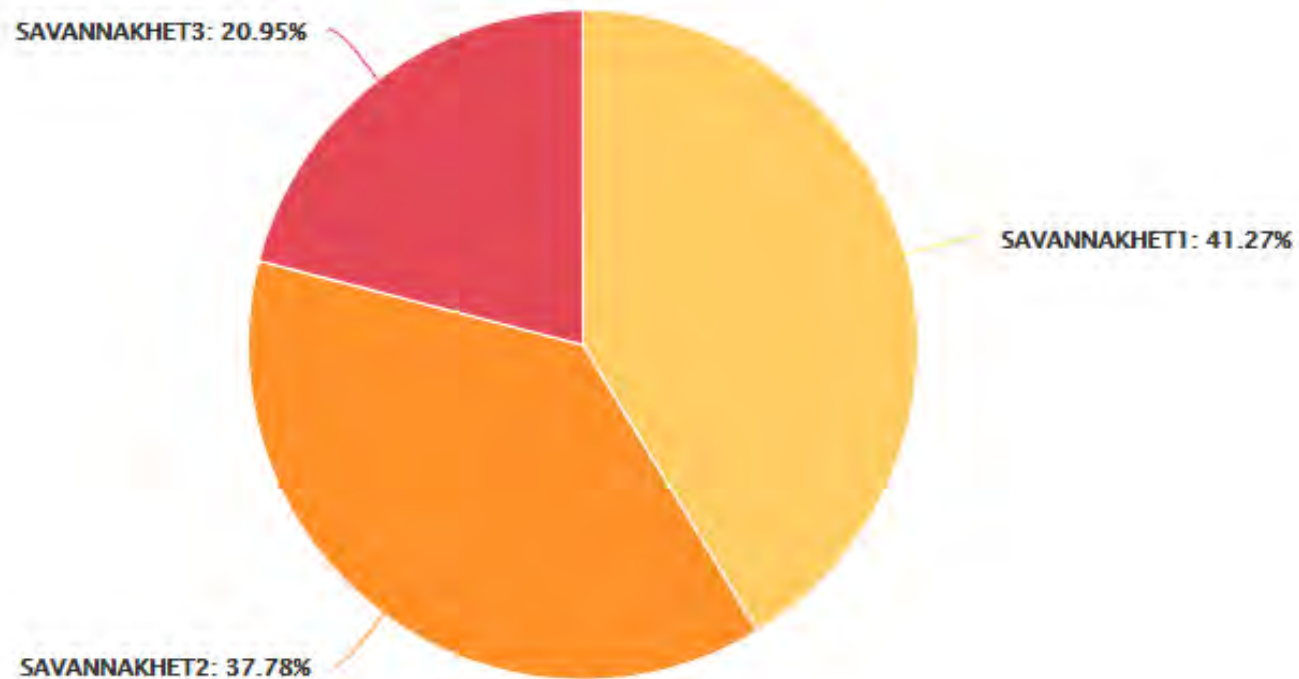
Su	Mo	Tu	We	Th	Fr	Sa
28	29	30	31	1	<b>2</b>	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	1	2	3
4	5	6	7	8	9	10

เลือกจังหวัด สถานี ช่วงวันและเวลาที่ขั่ง เพื่อแสดงภาพรวมข้อมูล  
 ในรูปแบบกราฟวงกลม กราฟแท่ง

# 1. กราฟภาพรวมข้อมูลค่าปรับแยกตามจังหวัด

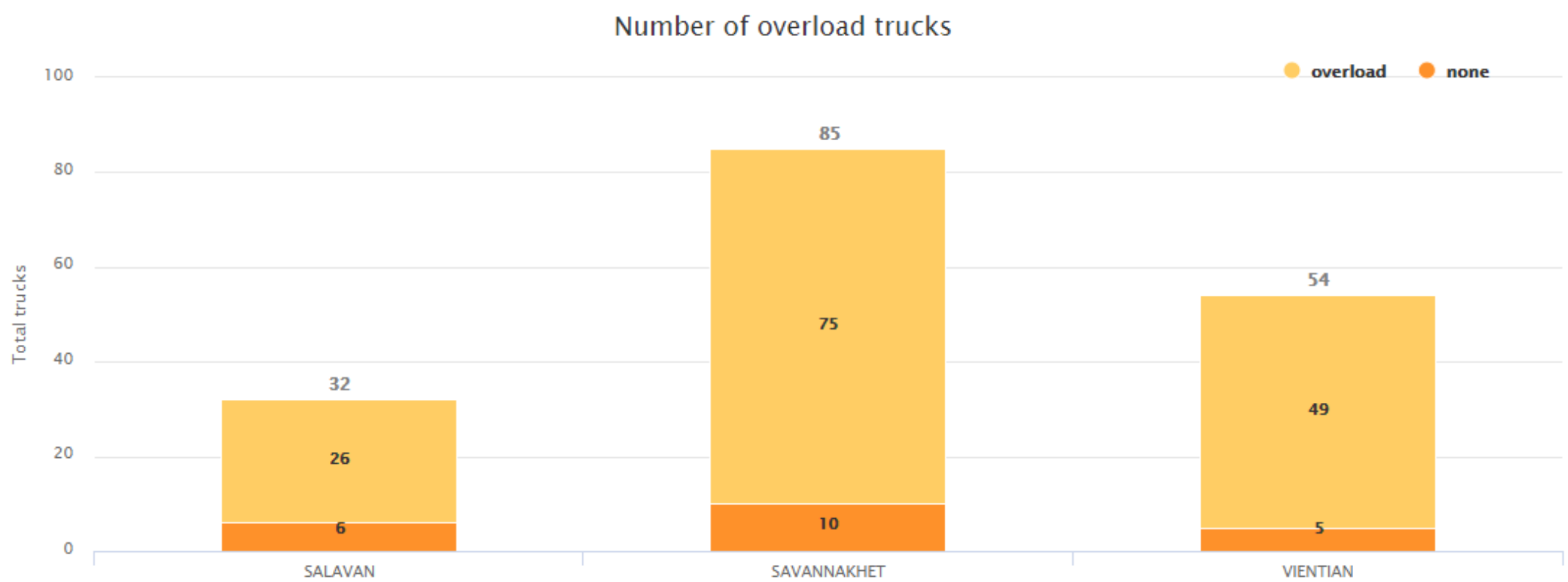


เมื่อคลิกที่จังหวัดจะแยกรายละเอียดตามสถานี

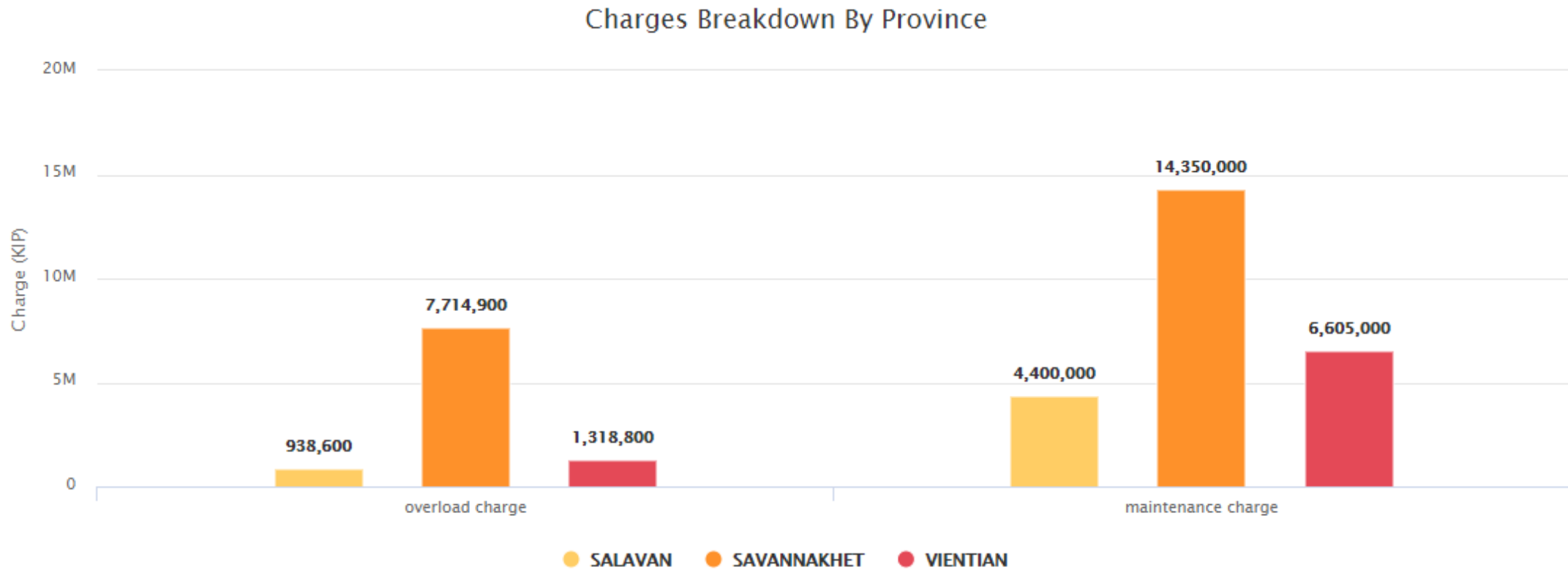


◀ Back to Province

## 2. เปรียบเทียบจำนวนรถที่ผ่านเกณฑ์และรถที่น้ำหนักเกิน

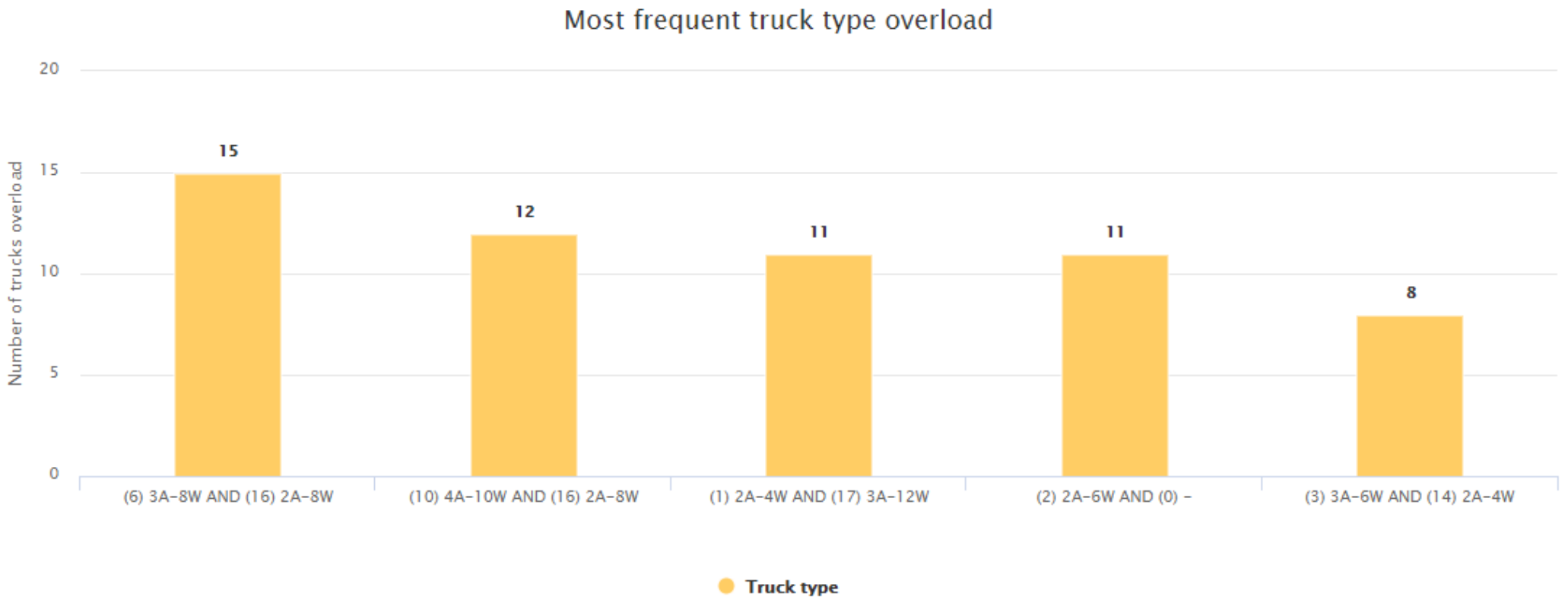


### 3. เปรียบเทียบประเภทค่าปรับของแต่ละจังหวัด

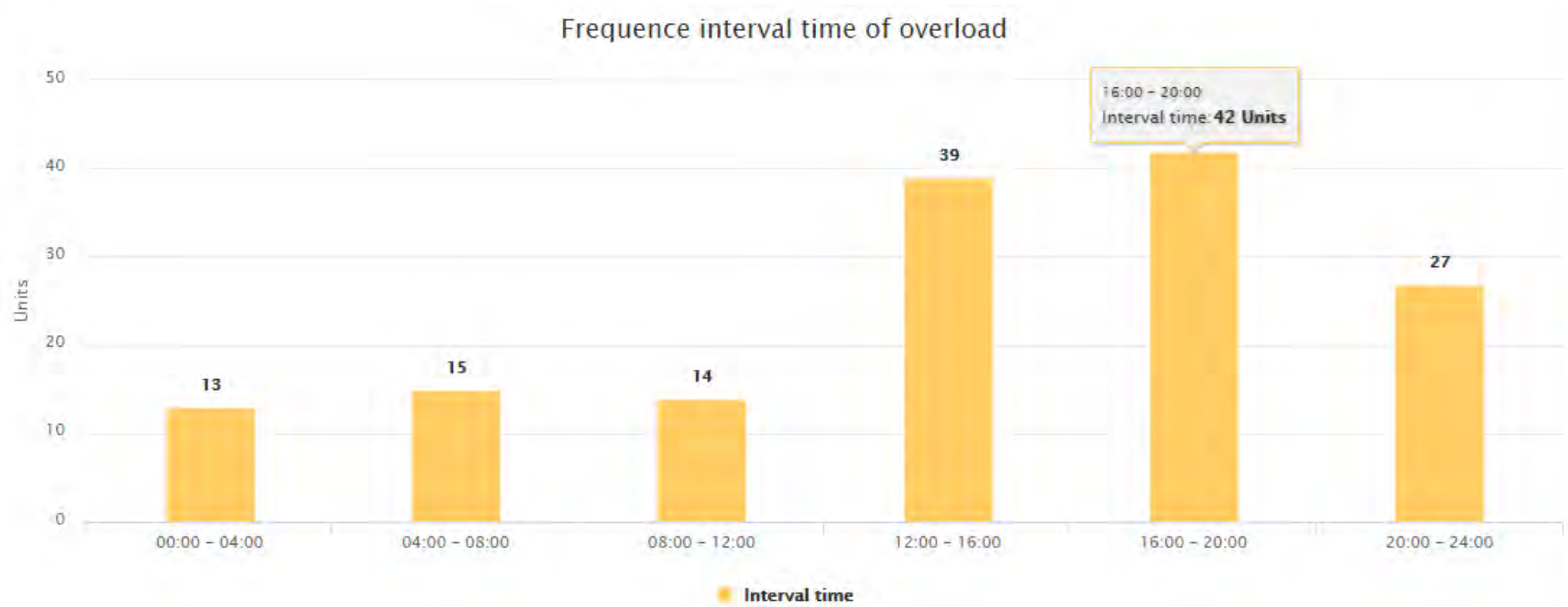




## 4. ประเภทรถที่น้ำหนักเกินบ่อยที่สุด



## 5. จำนวนรถที่น้ำหนักเกินจำแนกตามช่วงเวลา



## ใบขั้ง (Ticket)



Data Management  
System

1. เลขใบขั้ง (Ticket No.)
2. ป้ายทะเบียนรถ (Plate No.)
3. จั้งหวัด (Province)
4. สถานี (Station)
5. ช่วงวันที่ขั้ง (Date from - to)

admin  
System Admin

Menu

- Dashboard
- Tickets
- Report
- Admins
- Logout

### Tickets

Ticket No.:

Plate No.:

Province:

Date From:

Station:

To:

### ตัวกรองการค้นหาได้แก่

1. เลขใบขั้ง
2. ป้ายทะเบียนรถ
3. จังหวัด
4. สถานี
5. ช่วงวันที่ขั้ง
6. ปุ่มค้นหา

### ข้อมูลใบสั่งจากผลการค้นหา

admin  
System Admin

Menu

- Dashboard
- Tickets
- Report
- Admins
- Logout

#### Tickets

Ticket No.:

Province:

Station:

Plate No.:

Date From:

To:

Ticket No.	Plate No.	Province	Station	Date	Time	Weight(kg.)	Weight Limit(kg.)	Weight Overload (kg.)	Distance	Total Charge(KIP)	Link	Pdf
00000613	บค0070	Savannakhet	SAVANNAKHET1	12/01/2018	12:27:39	42,170.00	49,600.00	8,970.00	1.00	0.00	<a href="#">View</a>	
00000823	ภค0235	Savannakhet	SAVANNAKHET1	29/01/2018	11:00:32	47,460.00	56,000.00	2,180.00	1.00	0.00	<a href="#">View</a>	
00000807	ภค2563	Savannakhet	SAVANNAKHET1	29/01/2018	09:28:35	13,730.00	15,000.00	0.00	1.00	0.00	<a href="#">View</a>	
00000822	ภค7739	Savannakhet	SAVANNAKHET1	29/01/2018	10:58:39	2,990.00	9,500.00	490.00	1.00	0.00	<a href="#">View</a>	
00000826	ภค8035	Savannakhet	SAVANNAKHET1	29/01/2018	11:08:17	4,610.00	15,000.00	0.00	1.00	0.00	<a href="#">View</a>	
00000828	ภค8035	Savannakhet	SAVANNAKHET1	29/01/2018	11:25:46	28,930.00	15,000.00	21,410.00	1.00	360,000.00	<a href="#">View</a>	
00000833	ภค2734	Savannakhet	SAVANNAKHET1	29/01/2018	11:35:50	8,630.00	15,000.00	0.00	1.00	0.00	<a href="#">View</a>	
00000572	ภค7719	Savannakhet	SAVANNAKHET1	08/01/2018	16:01:20	60,570.00	9,500.00	51,060.00	1.00	360,000.00	<a href="#">View</a>	
00000820	ภค9991	Savannakhet	SAVANNAKHET1	29/01/2018	10:52:18	50,250.00	35,000.00	15,250.00	1.00	360,000.00	<a href="#">View</a>	
00000866	ภค7278	Savannakhet	SAVANNAKHET1	30/01/2018	07:13:17	2,210.00	9,500.00	0.00	1.00	0.00	<a href="#">View</a>	

Showing 51 to 60 of 340 entries

Previous 1 ... 5 6 7 ... 34 Next

### แสดงรายงานข้อมูลใบชั่งที่ค้นหาในรูปแบบ PDF

exportPDF 22 / 41

Statistics of Overloading report

From: All      to: All      Province: All Province      Station: All Station

Ticket No.	Plate No.	Truck type	Province	Station	Date	Time	Weight (kg.)	Weight Limit(kg.)	Weight Overload(kg.)	Distance(km.)	Maintenance Charge	Overload Charge	Total Charge
00000466	1269	RIGID TRUCK 3 Shaft 10 Wheel and TRAILER 3 Shaft 12 Wheel	Savannakhet	SAVANNAKHET 1	15/12/2017	17:02:05	52,520.00	56,000.00	4,870	1.00	0	0	0.00
00000467	5093	RIGID TRUCK 3 Shaft 10 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	17:15:59	32,660.00	25,000.00	17,660	1.00	68,250	50,000	118,250.00
00000468	2770	RIGID TRUCK 4 Shaft 12 Wheel and TRAILER 3 Shaft 12 Wheel	Savannakhet	SAVANNAKHET 1	15/12/2017	17:34:36	59,060.00	60,500.00	26,360	1.00	0	0	0.00
00000469	0782	RIGID TRUCK 3 Shaft 10 Wheel and TRAILER 3 Shaft 12 Wheel	Savannakhet	SAVANNAKHET 1	15/12/2017	17:36:58	53,310.00	56,000.00	17,310	1.00	0	0	0.00
00000470	1104	RIGID TRUCK 3 Shaft 10 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	17:39:31	22,780.00	25,000.00	3,200	1.00	0	0	0.00
00000471	0882	RIGID TRUCK 2 Shaft 6 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	17:41:33	7,410.00	15,000.00	0	1.00	0	0	0.00
00000472	7184	RIGID TRUCK 4 Shaft 12 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	17:44:49	35,530.00	29,500.00	16,030	1.00	48,800	50,000	98,800.00
00000473	0290	RIGID TRUCK 3 Shaft 10 Wheel and TRAILER 3 Shaft 12 Wheel	Savannakhet	SAVANNAKHET 1	15/12/2017	17:48:57	81,090.00	56,000.00	45,090	1.00	310,000	50,000	360,000.00
00000474	0657	SEMI TRAILER TRUCK 5 Shaft 18 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:08:02	50,790.00	45,000.00	19,420	1.00	36,750	50,000	86,750.00
00000475	1819	SEMI TRAILER TRUCK 6 Shaft 22 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:12:16	53,550.00	49,600.00	12,430	1.00	19,400	50,000	69,400.00
00000476	1059	SEMI TRAILER TRUCK 6 Shaft 22 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:16:45	44,630.00	49,600.00	590	1.00	0	0	0.00
00000477	1064	SEMI TRAILER TRUCK 6 Shaft 22 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:19:23	45,500.00	49,600.00	1,410	1.00	0	0	0.00
00000478	1056	SEMI TRAILER TRUCK 6 Shaft 22 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:20:40	44,900.00	49,600.00	7,910	1.00	0	0	0.00
00000479	2808	SEMI TRAILER TRUCK 5 Shaft 18 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:21:53	41,580.00	45,000.00	2,420	1.00	0	0	0.00
00000480	1374	SEMI TRAILER TRUCK 5 Shaft 18 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:23:22	43,250.00	45,000.00	930	1.00	0	0	0.00
00000481	1061	SEMI TRAILER TRUCK 5 Shaft 18 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:24:59	44,390.00	45,000.00	1,690	1.00	0	0	0.00
00000482	2296	SEMI TRAILER TRUCK 5 Shaft 18 Wheel and NO TRAILER	Savannakhet	SAVANNAKHET 1	15/12/2017	18:26:14	42,090.00	45,000.00	4,010	1.00	0	0	0.00

### รายละเอียดใบสั่ง URL



**Weighing Report**

**Ticket No.:** 00000413  
**Plate No.:** 43C030.60  
**Province:** Savannakhet  
**Station::** SAVANNAKHET1  
**Number of Axial:** 6  
**Number of Wheels:** 22  
**Date/Time in:** 2017/12/14 16:33:18  
**Distance:** 1  
**Note:**




	Weight(kg.)	Weight Limit(kg.)	Weight Overload (kg.)	
Shaft1	4,840.00	5,000.00	0.00	
Shaft2	12,650.00	10,000.00	2,650.00	
Shaft3	5,900.00	10,000.00	0.00	
Shaft4	6,380.00	8,200.00	0.00	
Shaft5	9,970.00	8,200.00	1,770.00	
Shaft6	4,680.00	8,200.00	0.00	
Shaft7	0.00	0.00	0.00	
Shaft8	0.00	0.00	0.00	
Shaft9	0.00	0.00	0.00	
Shaft10	0.00	0.00	0.00	
<b>Total</b>	<b>44,420.00</b>	<b>49,600.00</b>	<b>4,420.00</b>	<b>Charge (KIP)</b> 0.00

### แสดงรายละเอียดใบชั่งในรูปแบบ PDF

00000430
1 / 2

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⬇️
🖨️

#### Weighing Report

Tikcet No.:	00000430		
Plat No.:	43C0312.17		
Province:	Savannakhet	Station:	SAVANNAKHET1
Number of Axial:	6	Number of Wheels:	22
Date/Time In:	2017/12/14 17:11:44	Distance:	1.0 Km.
Truck Type:	13: SEMI TRAILER TRUCK 6 Shaft 22 Wheel 0: NO TRAILER		
Note:			

⏏️
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P.1 - 00000430



## รายงาน (Report)



Data Management  
System

1. รายงานตามสถานี (Report by station)
2. รายงานตามช่วงเวลา (Report by time period)
3. รายงานตามประเภทรถ (Report by truck type)

Reports

Province **1**  
SAVANNAKHET

Station: **2**  
All station

Report Type: **4**  
Summary By Station

Date From **3**

To

Search **5**

### ตัวกรองการค้นหาได้แก่

1. จังหวัด
2. สถานี
3. ช่วงวันที่ตั้ง
4. ประเภทรายงาน
5. ปุ่มค้นหา

### รายงานตามสถานี (Report by station)

Reports

Province: SAVANNAKHET

Station: All station

Report Type: Summary By Station

Date From: [ ] To: [ ]

Search

Station	No. of Trucks	0-20% Over Weight	21-40% Over Weight	>40% Over Weight	Total Over Weight	% Over Weight	Maintenance Charge(KIP)	Over-Limit Charge(KIP)	Total Charge(KIP)
SAVANNAKHET1	77	37	6	31	74	96.10%	11,367,400.00	32,655,000.00	44,022,400.00
SAVANNAKHET2	77	37	6	31	74	96.10%	11,367,400.00	32,655,000.00	44,022,400.00
<b>Gross total</b>	<b>154</b>	<b>74</b>	<b>12</b>	<b>62</b>	<b>148</b>	<b>96.10%</b>	<b>22,734,800.00</b>	<b>65,310,000.00</b>	<b>88,044,800.00</b>

Showing 1 to 2 of 2 entries

Previous 1 Next

### รายงานตามสถานี (Report by station) ข้อมูลที่ค้นหาในรูปแบบ PDF

exportPDF 1 / 1

Statistics of Overloading truck by Station

From: All      to: All      Province: SAVANNAKHET      Station: All Station

Station	No. of Trucks	0-20% Over Limit	21-40% Over Limit	>40% Over Limit	Total Over Limit	% Over Limit	Maintenance Charge	Over-Limit Charge	Total Charge (Kip)
SAVANNAKHET1	77	37	6	31	74	96.10	11,367,400.00	32,655,000.00	44,022,400.00
SAVANNAKHET2	77	37	6	31	74	96.10	11,367,400.00	32,655,000.00	44,022,400.00

รายงานข้อมูลตามช่วงเวลา (Report by time period)

Time Period	No. of Trucks	0-20% Over Weight	21-40% Over Weight	>40% Over Weight	Total Over Weight	% Over Weight	Maintenance Charge(KIP)	Over-Limit Charge(KIP)	Total Charge(KIP)
04:00 - 08:00	12	8	0	4	12	100.00%	363,400.00	2,000,000.00	2,363,400.00
08:00 - 12:00	14	10	0	4	14	100.00%	1,005,400.00	3,410,000.00	4,415,400.00
00:00 - 04:00	26	2	0	24	26	100.00%	7,762,400.00	5,700,000.00	13,462,400.00

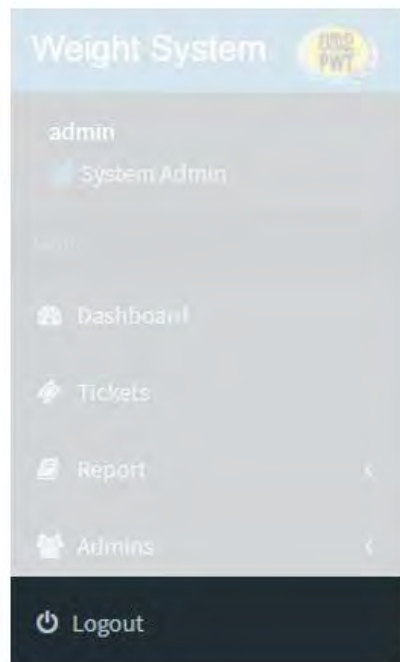
### รายงานตามประเภทรถ (Report by truck type)

Truck Type	No. of Trucks	0-20% Over Weight	21-40% Over Weight	>40% Over Weight	Total Over Weight	% Over Weight	Maintenance Charge(KIP)	Over-Limit Charge(KIP)	Total Charge(KIP)
SEMI TRAILER TRUCK 4 Shaft 14 Wheel (10-4) + NO TRAILER	2	0	0	2	2	100.00%	66,000.00	300,000.00	366,000.00
SEMI TRAILER TRUCK 6 Shaft 22 Wheel + NO TRAILER	2	2	0	0	2	100.00%	9,000.00	100,000.00	109,000.00
RIGID TRUCK 2 Shaft 4 Wheel	2	0	0	2	2	100.00%	100,000.00	600,000.00	700,000.00

## ออกจากระบบ (Logout)



Data Management  
System



กดปุ่ม Logout ที่แถบเมนูด้านซ้าย  
เพื่อออกจากระบบ

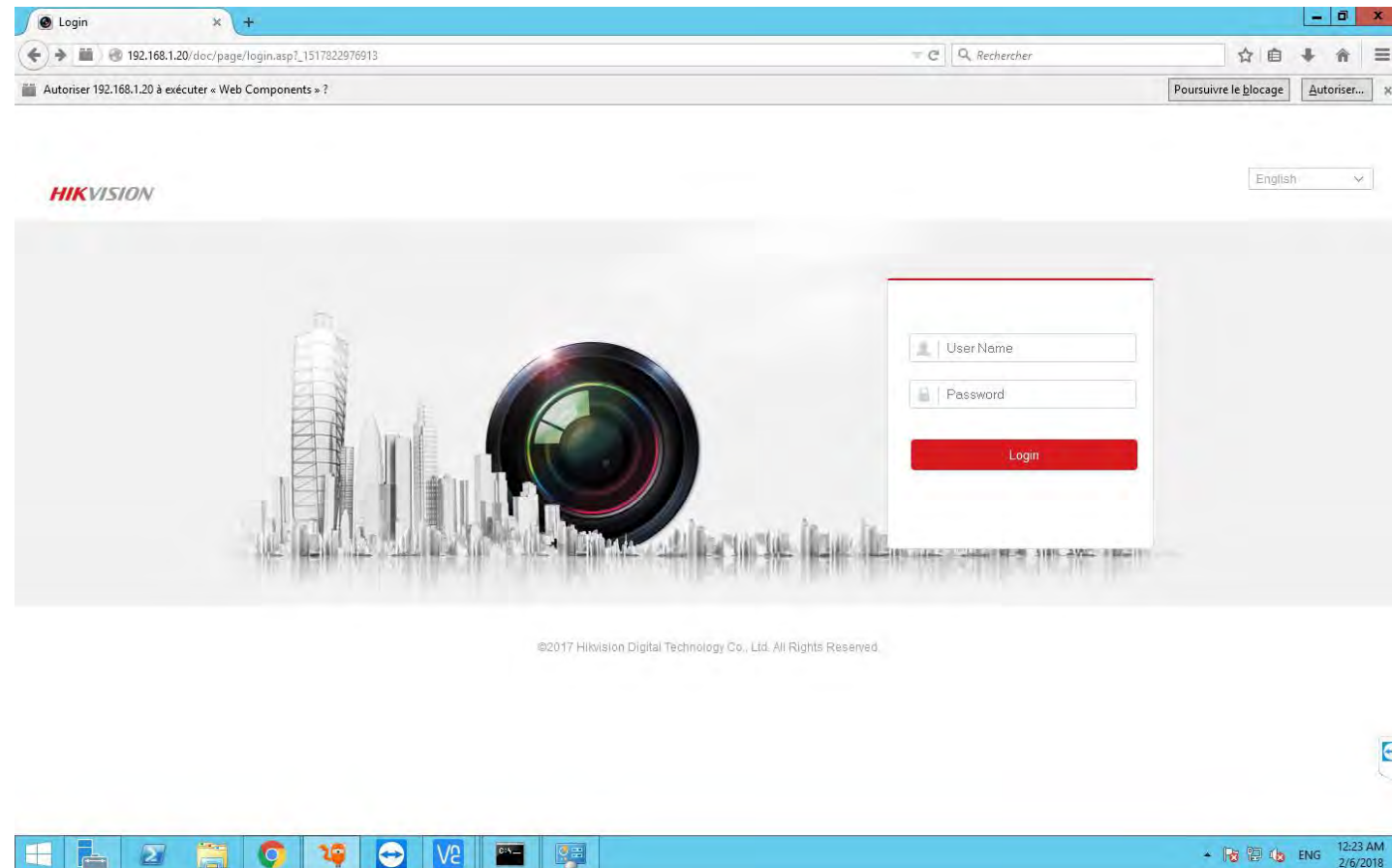


### CCTV & Surveillance

The screenshot displays a web browser window with the URL `192.168.1.20/doc/page/preview.asp`. The interface is for a Hikvision NVR, featuring a top navigation bar with 'Live View', 'Playback', 'Picture', and 'Configuration' tabs. The 'Live View' tab is active, showing a 2x2 grid of camera feeds. The top-left feed (Camera 01) shows a road with construction barriers. The top-right feed (Camera 02) shows a paved area with orange traffic cones. The bottom-left feed (Camera 03) shows a road with a red and white striped barrier. The bottom-right feed (Camera 04) shows a truck at a checkpoint. On the left, a 'Network Video Recorder' sidebar lists 'Camera 01' through 'Camera 04', with 'Camera 04' selected. On the right, a 'PTZ' control panel includes directional arrows, zoom, pan, and tilt buttons, a zoom slider set to 4, and a list of presets from Preset1 to Preset9. The bottom status bar shows the time as 15:46 on 28/01/2018 and the language set to EN. The copyright notice at the bottom reads '©2017 Hikvision Digital Technology Co., Ltd. All Rights Reserved.'

URL การเข้าดูกล้องวงจรปิด

URL : **192.168.1.20**



Q & A



DEPARTMENT OF TRANSPORT  
MINISTRY OF PUBLIC WORKS AND TRANSPORTS  
LAO PEOPLE'S DEMOCRATIC REPUBLIC

BID DOCUMENTS  
**FOR**  
THE PROJECT FOR UPGRADING OF WEIGH STATION  
IN  
DONG HENG, NR9, SAVANNAKHET PROVINCE  
(2016/17 PILOT PROJECT UNDER JICA CAROL PROJECT)



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**Part 1:**

Invitation for Bids

Section 1: Instructions to Bidders

Section 2: Bid Forms

Section 3: Contract Forms

**Part 2: Conditions of Contract**

**Part 3: Bill of Quantities**

**Part 4: Specifications**

**Part 5: Conceptual Drawings**

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NOVEMBER 2016



Japan International Cooperation Agency

***Part 1:***  
***Invitation for Bids***



Japan International Cooperation Agency

## INVITATION FOR BIDS

Date: (month) (date), 2016

Bid No. XXXX

To: \_\_\_\_\_  
\_\_\_\_\_

Subject: Invitation for Bids of the Project for Upgrading of Weigh Station in Dong Heng, NR9, Savannakhet Province (2016/17 Pilot Project under JICA CaRoL Project)

Dear Sirs,

In response to the request from the Government of Lao People's Democratic Republic (hereinafter referred to "GOL"), the Project for Improvement of Road Management Capacity of Lao PDR (hereinafter referred to as "the Project") has been conducted with financial assistance from the Government of Japan (hereinafter referred to "GOJ"). In order to ensure a smooth implementation of the project, Japan International Cooperation Agency (hereinafter referred to as "JICA" or "the Employer") has dispatched an expert team comprising the members from International Development Center of Japan and Oriental Consultants Co., Ltd., Japan (hereinafter referred to as "JICA Expert Team" or "the Consultant"). The aim of project is to improve the road maintenance and management capabilities of road sector in the GOL. In this regards, JICA intends to use a part of the fund to proceed with implementation of the Project for Upgrading of Weigh Station in Dong Heng, NR9, Savannakhet Province (2016/17 Pilot Project under JICA CaRoL Project) (hereinafter referred to as "the PP") within the framework of the Project. The PP will be conducted for an effort to cope with enhancement of control of overloaded vehicle as well as to understand the current technical availability and capacity of the GOL.

On behalf of the Department of Transport, (hereinafter referred to as "DOT" or "the Owner") under the Ministry of Public Works and Transports (hereinafter referred to as "MPWT"), as the executing agency of GOL, JICA now invites the eligible Bidders for the submission of sealed Bid for the provision of Works.

The eligible Bidders may obtain the Bid Documents for the Works at the following address from (month) (date), 2016, from 10:00 to 12:00 hour and from 14:00 to 16:00 hour upon free payment:

Japan International Cooperation Agency (JICA)  
Laos Office

2nd Floor, Sacombank Building, 044 Haengboun Rd, Ban Haisok, Chanthabouly  
District , Vientiane Capital, PO Box 3933, Lao PDR  
Tel/Fax: +856-21-241100/241101  
URL: <http://www/jica.go.jp>

Bid opening is scheduled to be held on (month) (date), 2016 at 15:00 hour.  
For further details please contact us at the above-mentioned address.

**Japan International Cooperation Agency**

---

Mr. Yusuke Murakami  
Chief Representative  
JICA Laos Office

***Part 1 - Section 1:  
Instructions to Bidders***



**BID DOCUMENTS  
FOR  
THE PROJECT FOR UPGRADING OF WEIGH STATION  
IN  
DONG HENG, NR9, SAVANNAKHET PROVINCE  
(2016/17 PILOT PROJECT UNDER JICA CAROL PROJECT)**

**PART 1  
SECTION 1 INSTRUCTIONS TO BIDDERS**

**CONTENTS**

Chapter 1	Introduction .....	1
1.	Purpose of Bid .....	1
2.	Qualification of Bidders .....	1
3.	Implementation System .....	2
4.	Scope of Work .....	2
5.	Misprocurement .....	2
6.	Completion date of the Works .....	2
7.	Acquaintance with Local Conditions .....	3
Chapter 2	Bid Documents .....	4
1.	Composition of Bid Documents .....	4
2.	Responsibility of Bidders .....	4
3.	Clarification of Bid Documents .....	4
4.	Addenda to Bid Documents .....	5
Chapter 3	Preparation and Submission of Bids .....	6
1.	Preparation of Bids .....	6
2.	Bid Prices .....	6
3.	Term of Validity of Bids .....	6
4.	Submission of Bids .....	7
5.	Interpretation of Bids .....	7
Chapter 4	Opening of Bids .....	8
1.	General .....	8
2.	Bid Opening Procedures .....	8
Chapter 5	Evaluation of Bids and Award of Contract .....	9
1.	Evaluation of Bids .....	9

2.	Clarification or Alteration of Bids .....	9
3.	Process to be Confidential .....	9
4.	Contact with the Employer .....	10
5.	Letter of Acceptance .....	10
6.	Signing of Contract.....	10
7.	Performance Security .....	11
8.	Notification of the Result of Bid .....	11
Chapter 6	Common Conditions.....	12
1.	Quality Assurance .....	12
2.	Safety Procedure .....	12

## CHAPTER 1 INTRODUCTION

### 1. PURPOSE OF BID

- (1) The Project for Upgrading of Weigh Station in Dong Heng, NR9, Savannakhet Province (2016/17 Pilot Project under JICA CaRoL Project) (hereinafter referred to as “the PP) shall be undertaken under the Project for Improvement of Road Management Capacity in Lao PDR (hereinafter referred to as “the Project”) which has been extended by Japan International Cooperation Agency (hereinafter referred to as “JICA”) as a technical cooperation to the Government of the Lao People’s Democratic Republic (hereinafter referred to as “the GOL”).
- (2) The PP shall comprise procurement of one set of weigh bridge and reinstallation of the weigh station on NR9 in Savannakhet Province. On behalf of the Department of Transport (DOT) under the Ministry of Public Works and Transport (hereinafter referred to as “the Owner”), the Japan International Cooperation Agency (hereinafter referred to as “the Employer”) invites the eligible Bidders, as defined in Clause 2 hereof, to Bid for the Works.
- (3) The PP is to be carried out throughout the monitoring and control of works conducted by Department of Transport (hereinafter referred to as “the Owner’s Representative”) and supervised by JICA Expert Team (hereinafter referred to as “the Engineer”).

This Bid is to be limited to the PP specified for the site as follows (hereinafter referred to as “the Works”):

- Weigh Station on NR9, Dong Heng, Savannakhet Province (64km from Savannakhet City Center)

### 2. QUALIFICATION OF BIDDERS

- (1) The Invitation for bid is restricted to open to the eligible bidders who were officially selected by the Owner.
- (2) All eligible bidders shall satisfy the following qualification requirements:
  - a) Bidders shall demonstrate the following work experience (Form T2):
    - i) having successfully completed at least three (3) road projects in the last five (5) years regardless of whether acting as prime contractor or subcontractor;
    - ii) having experience of at least one (1) road construction or rehabilitation project using reinforcing concrete pavement in Lao PDR.
  - b) Bidders shall demonstrate the following key staffs (prime/alternate) for the project (Form T6):
    - i) Project Manager
    - ii) Civil Engineer/ Concrete Structure Engineer
    - iii) Quality Control Engineer
    - iv) Mechanic and Equipment Operator

- v) Skilled Foreman and Screed Man

### **3. IMPLEMENTATION SYSTEM**

- (1) The Employer will assume the responsibility for implementing the Works, with the Department of Transport supported by JICA Expert Team.
- (2) The Works shall be carried out based on the conceptual design provided by the Engineer (JICA Expert Team). The successful Bidder shall provide the appropriate construction drawing, method statements and other technical documents, at his full responsibility, the specified facilities in accordance with the conceptual design provided in the Bid Documents.

### **4. SCOPE OF WORK**

The Works covered by this Bid consists of the reinstallation of the weigh station on NR9 as summarized below and detailed in the Bid Documents:

Summary of the PP:

- Site location: Km64 on NR-9
- Total work area: Approximately 3,400 sq.m
- Main work components:
  - \* Transport as set of new weigh bridge to the site
  - \* Assemble and install the bridge on the place specified by the Engineer
  - \* Set up monitoring device (i.e. sensor and CCTV) and wiring work in the station
  - \* Set up recording device in the station
  - \* Set up communication network between the station and central office via internet
  - \* Remove existing pavement in the station
  - \* Install reinforced concrete pavement on the approach road section
  - \* Stone masonry work beside the approach road

### **5. MISPROCUREMENT**

JICA requires that, under this contract, Bidders and contractor observe the highest standard of ethics during the procurement and execution of such contract. In this regard, JICA shall not verify the contract if it determines that the contractor has engaged in corrupt or fraudulent practices in competing for the contract in question. JICA shall recognize a contractor as ineligible, for a period determined by JICA, to be awarded a contract if, at any time, it determines that the contractor has engaged in corrupt or fraudulent practices in competing for, or in executing any other contracts funded by the Japanese ODA.

### **6. COMPLETION DATE OF THE WORKS**

The Works shall be completed within a period of 210 days from the Commencement Date, unless the validity period stipulated in Contract is extended by mutual agreement between the authorities concerned of the GOL and the JICA, and the delivery terms under the Contract between the GOL and the Contractor is so amended.

## **7. ACQUAINTANCE WITH LOCAL CONDITIONS**

- (1) The sites of the Works are shown on the Conceptual Drawings in Part 5 of the Bid Documents and the actual site conditions shall be confirmed by the Bidder.
- (2) On-site orientation will not be held at the work sites. Bidders are advised to visit and examine the work sites and their surroundings to obtain for themselves, and on their own responsibility and expenses, all information that may be necessary for preparing the Bid, if any.
- (3) To the extent practicable (taking into account cost and time), Bidders shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances that may influence or affect the Bid or to have inspected and examined the work sites and their surroundings, the above data and other available information, and to have been satisfied before submitting the Bid as to all relevant matters, including but not limited to:
  - a) the form and nature of the sites, including sub-surface conditions;
  - b) the hydrological and climatic conditions;
  - c) the availability and quality of materials to be furnished;
  - d) the extent and nature of the Works and goods necessary for the execution and completion of the Works and remedying of any defects thereof;
  - e) the laws, procedures and labor practices of Lao People's Democratic Republic; and
  - f) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.
- (4) No claim whatsoever shall be made as a result of ignorance of local conditions on the part of the Bidders and such ignorance shall be the responsibility of the Bidders.

## **CHAPTER 2      BID DOCUMENTS**

### **1.      COMPOSITION OF BID DOCUMENTS**

The Bid Documents are those stated below, and should be read in conjunction with any Addenda issued in accordance with Clause 4 hereof:

Part 1:      Invitation for Bids

Section 1: Instructions to Bidders

Section 2: Bid Forms

- Form T1: Form of Bid and Appendix to Bid
- Form T2: General Information on Bidder
- Form T3: Financial Statement
- Form T4: List of Proposed Major Construction Plant and Equipment
- Form T5: Construction Schedule
- Form T6: Organization Chart and Manning Schedule
- Form T7: Quality Control Plan
- Form T8: Safety Plan

Section 3: Contract Forms

- Form C1: Contract Agreement
- Form C2: Performance Security
- Form C3: Advance Payment Security

Part 2:      Conditions of Contract

Part 3:      Bill of Quantities

Part 4:      Specifications

Part 5:      Conceptual Drawings

### **2.      RESPONSIBILITY OF BIDDERS**

- (1) Bidders shall examine carefully the Bid Documents to understand fully the content of the Works including the amounts and any difficulties or restrictions that may affect the execution and completion of the Works.
- (2) Bidders shall be liable for any failure or negligence to obtain reliable and necessary information for successful execution or completion of the Works.

### **3.      CLARIFICATION OF BID DOCUMENTS**

- (1) Any inquiries on the Bid Documents or any doubts as to their interpretation shall be written in English and sent to the Employer by facsimile on or before 17:00 hour on (month) (date), 2016
- (2) The Employer shall respond in writing to the inquiries and/or expressed doubts on interpretation. The responses will be sent by facsimile to all prospective Bidders who obtained the Bid Documents on or before 17:00 hour, (month) (date), 2016
- (3) All prospective Bidders shall acknowledge receipt of the response by facsimile to the Employer.

- (4) The responses will constitute a part of the Bid Documents provided in Clause 1 hereof.

**4. ADDENDA TO BID DOCUMENTS**

- (1) The Employer may, for any reason, whether at his own initiative or in response to a clarification requested by prospective Bidders, modify the Bid Documents.
- (2) The Employer will notify all prospective Bidders in English and by facsimile of any addenda indicating such modification on or before (month) (date), 2016, i.e., at least three (3) calendar days before the Bid opening date.
- (3) The prospective Bidders shall acknowledge receipt of the addenda stated above by facsimile to the Employer.
- (4) The addenda will constitute a part of the Bid Documents provided in Clause 1 hereof.

## **CHAPTER 3 PREPARATION AND SUBMISSION OF BIDS**

### **1. PREPARATION OF BIDS**

- (1) Bids shall be prepared and submitted by filling out the forms and documents provided in Section 2: Bid Forms and the Bill of Quantities provided in Part 3. Each of the forms shall be completely filled in indelible ink, typewritten or prepared as a computer printout. No interlinings, erasures (or crossing out), addition, or alteration may be allowed. If the documents submitted by the Bidder do not meet the requirements mentioned above, the Bidder may be disqualified.
- (2) Bidder shall submit his Bid comprising the documents specified below:
  - 1) Power of Attorney duly signed by the legal representative of the Bidder for the signatory of the Bid;
  - 2) Certificate of Signature of the issuer of the above Power of Attorney, authenticated by notary office in Lao PDR;
  - 3) The Bid Forms T1 to T8 mentioned in Chapter 2 Clause 1, duly filled in as instructed therein; and
  - 4) Any other information which Bidders consider useful to prove their technical capabilities to undertake the Works.
  - 6) Priced Bill of Quantities with breakdown of 1 prices thereof, as specified in Part 3; and
  - 7) Any other data or explanations relating to the Bid price, which Bidders consider useful for price evaluation.
- (3) All entries in the Bid including attachments shall be written in English. All units in the Bid shall be in the metric system unless otherwise specified in the Specifications or Conceptual Drawings.
- (4) Incomplete, vague or conditional Bids will not be considered.

### **2. BID PRICES**

- (1) All prices shall be quoted in United States Dollars without exception. The Bid price shall be stated on each Bill of Quantities.
- (2) Bid prices shall be firm and final, and not be subject to adjustments due to price fluctuations.
- (3) Customs duties, internal taxes including VAT and other fiscal levies which may be imposed in the Lao PDR with respect to the purchase of materials and equipment for and under the Contract shall be treated in accordance with Sub-Clause 16.1 and 16.2 in Part 2 Conditions of Contract.

### **3. TERM OF VALIDITY OF BIDS**

The Bids shall remain valid and irrevocable for a period of 30 days from the date of Bid opening.



**4. SUBMISSION OF BIDS**

- (1) Bidder shall prepare one (1) original and one (1) copy of his Bid. The Bid shall be submitted in one (1) envelope, each properly sealed, duly marked as “ORIGINAL” or “COPY”, and bearing the name of the Bidder and the name of the Project.
- (2) Bids shall be submitted to the address specified in Chapter 4 hereof, not later than the closing time for submission of Bids specified in the same.
- (3) Each Bid shall be submitted by the Bidder in person. Bids submitted through other means such as cable, facsimile, e-mail or mail will not be accepted.
- (4) Any Bids received after the closing time will be returned unopened.
- (5) Alternative Bids are not allowed.
- (6) Bidders are neither allowed to modify nor to withdraw their Bid after the closing time.

**5. INTERPRETATION OF BIDS**

- (1) Should there be any discrepancy between the “ORIGINAL” and the “COPY”, the “ORIGINAL” shall prevail. If there is a difference between the figures entered in words and those in numerals in the Bid, the figures entered in words shall prevail.
- (2) Should there be any discrepancy between the unit rate and the amount entered for any item of the Bill of Quantities, the unit rate shall prevail.

## CHAPTER 4      OPENING OF BIDS

### 1.      GENERAL

- (1) All Bids will be opened immediately after the closing time, in the presence of the Employer and the Bidders, at the following time and date and place:

**Time & Date :**      **15:00 hour, (month) (date), 2016**

**Place:**              **Japan International Cooperation Agency (JICA)**  
**Laos Office**  
2nd Floor, Sacombank Building, 044 Haengboun Rd, Ban  
Haisok, Chanthabouly District , Vientiane Capital, PO Box 3933,  
Lao PDR  
Tel/Fax: +856-21-241100/241101  
URL: <http://www/jica.go.jp>

- (2) At least one (1) authorized representative with Power of Attorney from each Bidder who submitted a Bid, shall attend the Bid opening.

### 2.      BID OPENING PROCEDURES

- (1) All participants to the Bid opening shall register their signatures in an Attendant List prepared by the Employer before the Bid opening.
- (2) The Employer will open the Bid envelope and examine preliminarily its contents to confirm whether the Bid meets the initial requirements for Bid submission as stipulated in Chapter 3 Clauses 1 and 4, and whether the documents submitted are valid. Any Bid founds to be in one of the following conditions will be rejected and returned to the Bidder:
- a) the Bid is not submitted in the specified number of copies (1 original and 1 copy);
  - b) the Power of Attorney for the signatory of the Bid is not submitted, or is not accompanied by a Certificate of Signature of the issuer; and
  - c) any of the Forms T1 to T8 is not provided in the Bid, or is not duly filled in as instructed.
- (3) The Bid price of only Bidders who passed the above preliminary examination will then be opened and read aloud then recorded.
- (4) The Bidder who submits the lowest Bid price will be designated as the prioritized negotiator for the contract award, subject to the result of detailed evaluation of his Bid from both technical and financial viewpoints.

## **CHAPTER 5      EVALUATION OF BIDS AND AWARD OF CONTRACT**

### **1.      EVALUATION OF BIDS**

- (1) The Employer will conduct a detailed evaluation of the Bid of the prioritized negotiator to ascertain its conformity to the procedural and technical requirements of the Bid Documents, and the correctness of the Bid price.

The evaluation will consist of:

- i) examining the completeness and responsiveness of the Bid to the Bid requirements regarding the documents to be submitted, the financial status and the work experience of the Bidder;
  - ii) assessing the adequacy and appropriateness of the Bidder's proposals regarding the work schedule, construction plant and equipment, key personnel, site organization, and quality and safety control plans; and
  - iii) checking whether the computation of Bid price is accurate and the pricing is reasonable and balanced.
- (2) If the Bid of the prioritized negotiator is evaluated as incomplete or not sufficiently responsive, or as not substantially conforming to the Specifications, or containing inadmissible reservations or otherwise as not substantially responsive to the Bid Documents, it will be rejected. In this case, the Employer will invite the next lowest price Bidder to enter into contract negotiation, and this procedure will be followed until the Employer reaches agreement with a Bidder.
- (3) In the event that the evaluated Bid price of the prioritized negotiator or of the next lowest price Bidder(s), as the case may be, exceeds the Employer's estimated ceiling amount, the two parties will negotiate a price reduction to such ceiling amount. If no agreement can be reached in this procedure, re-Bidding may be considered by the Employer.

### **2.      CLARIFICATION OR ALTERATION OF BIDS**

In the examination, evaluation and comparison of Bids, the Employer may, at his discretion, ask any Bidder for a clarification of his Bid. All responses to the requests for clarification shall be in writing, and no change in the total price or the substance of the Bid shall be offered or permitted.

### **3.      PROCESS TO BE CONFIDENTIAL**

Information relating to the examination, clarification, and evaluation of Bids, and recommendations for the award of the contract shall not be disclosed to Bidders or any other persons who are not officially concerned with such process until the notification of award defined in Chapter 5 Clause 5.

**4. CONTACT WITH THE EMPLOYER**

- (1) Except for the purpose of clarification of the Bid as provided for in Clause 2 hereof, no Bidder shall contact the Employer on any matter related to the Bid, from the time of the Bid opening to the time of Contract awarding.
- (2) Any attempt by a Bidder to influence the Employer's processing or awarding of Bids may result in the disqualification of the Bidder.

**5. LETTER OF ACCEPTANCE**

- (1) The Bidder whose offer substantially conforms to the Specifications and other conditions of the Bid Documents, and who offers the lowest evaluated price will be designated as the successful Bidder.
- (2) After completion of Bid evaluation, the Employer will issue the Letter of Acceptance to the successful Bidder within the period of validity of Bids stated in Chapter 3 Clause 3 by facsimile or registered letter.

**6. SIGNING OF CONTRACT**

- (1) At the same time that the Employer notifies the successful Bidder that his Bid has been accepted, the Employer will send the Bidder the Contract Agreement provided in the Bid Documents, incorporating all arrangements between the parties.
- (2) The following documents shall be considered as an integral part of the Contract:
  - 1) Contract Agreement
  - 2) Letter of Acceptance
  - 3) Bid of the successful Bidder
  - 4) Addenda
  - 5) Conditions of Contract
  - 6) Specifications
  - 7) Conceptual Drawings
  - 8) Priced Bill of Quantities
  - 9) Instructions to Bidders and such other documents intended to form the Contract

The documents of the Contract are to be taken as mutually explanatory of one another. If an ambiguity or discrepancy is found in the documents, the interpretation shall be done in accordance with the above-mentioned sequence of priority.

The successful Bidder shall submit a breakdown of the Bill of Quantities to the Employer within fourteen (14) days after the date of the Letter of Acceptance. The breakdown of the Bill of Quantities does not constitute a part of the Contract, but as a reference for the following purposes:

- 1) confirmation of the work amount for an interim payment; and
- 2) confirmation of the adjusted contract price in case of early termination.

**7. PERFORMANCE SECURITY**

The successful Bidder, having received the Letter of Acceptance, shall furnish a performance security amounting to ten percent (10%) of the total contract price within fourteen (14) days following the date of award. The Employer shall have the custody of the performance security.

**8. NOTIFICATION OF THE RESULT OF BID**

Upon receiving the performance security from the successful Bidder, the Employer shall promptly notify the other Bidders in writing that their Bids have been unsuccessful.

## **CHAPTER 6      COMMON CONDITIONS**

### **1.      QUALITY ASSURANCE (FORM T7)**

- (1) The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Bid Documents.
- (2) Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

### **2.      SAFETY PROCEDURE (FORM T8)**

The Contractor shall:

- (1) comply with all applicable safety regulations in Lao PDR;
- (2) take care for the safety of all persons entitled to be on the Site;
- (3) use reasonable efforts to keep the Site and the Works clear of unnecessary obstructions so as to avoid danger to persons entitled to be on the Site;
- (4) provide fencing, lighting, guarding and watching of the Works until completion and taking-over; and
- (5) provide any temporary works (including roadways, footways, guards and fences) that may, as a result of the execution of the Works, be necessary for the use by or protection of the public and of owners and occupants of adjacent land.

***Part 1 - Section 2:  
Bid Forms***

**BID DOCUMENTS  
FOR  
PILOT PROJECT FOR REHABILITATION OF  
NATIONAL ROAD NO.9  
(BAN NONVILAY, SAVANNAKHET PROVINCE)**

**PART 1  
SECTION 2 BID FORMS**

**CONTENTS**

<b>Form T1:</b>	<b>Form of Bid and Appendix to Bid</b>
<b>Form T2:</b>	<b>General Information on Bidder</b>
<b>Form T3:</b>	<b>Financial Statement</b>
<b>Form T4:</b>	<b>List of Proposed Major Construction Plant and Equipment</b>
<b>Form T5:</b>	<b>Construction Schedule</b>
<b>Form T6:</b>	<b>Organization Chart and Manning Schedule</b>
<b>Form T7:</b>	<b>Quality Control Plan</b>
<b>Form T8:</b>	<b>Safety Plan</b>



**FORM T1**  
**FORM OF BID**

NAME OF CONTRACT:

**The Project for Upgrading of Weigh Station in Dong Heng, NR9, Savannakhet Province (2016/17 Pilot Project under JICA CaRoL Project)**

**Bid Ref. No.**

TO: JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
2nd Floor, Sacombank Building, 044 Haengboun Rd, Ban Haisok, Chanthabouly District, Vientiane Capital, PO Box 3933, Lao PDR  
Tel/Fax: +856-21-241100/241101  
URL: <http://www/jica.go.jp>

We have examined the Conditions of Contract, Specifications, Drawings, Bill of Quantities, Addenda No. .... and the matters set out in the Appendix hereto relating to the execution of the above-named Works. We offer to design, execute and complete the Works and remedy any defects therein, fit for purpose in conformity with the said documents and this Bid, for the sum of:

United State Dollars \_\_\_\_\_  
\_\_\_\_\_  
(USD \_\_\_\_\_)

or such other sum as may be determined in accordance with the Conditions of Contract. The above sum is in accordance with the priced Bill of Quantities submitted herewith and forming part of this Bid.

We agree to abide by this Bid until \_\_\_\_\_ (30 days) and it shall remain binding upon us and may be accepted at any time before that date. We acknowledge that the Appendix forms part of this Form of Bid.

If this Bid is accepted, we will provide the specified Performance Security, commence the Works as soon as is reasonably practicable after the Commencement Date, and complete the Works in accordance with the above-named documents within the Time for Completion mentioned in the Appendix to Bid.

Unless and until a formal Agreement is prepared and executed, this Form of Bid, together with your written acceptance thereof, shall constitute a binding contract between us.

We understand that you are not bound to accept the lowest or any Bid you may receive.

Date \_\_\_\_\_

Signature \_\_\_\_\_  
Name: \_\_\_\_\_ in the capacity of \_\_\_\_\_  
duly authorized to sign Bids for and on behalf of \_\_\_\_\_  
Address \_\_\_\_\_

### **Appendix to Bid**

*[Note: with the exception of the items for which the Employer's requirements have been inserted, the following information must be completed and submitted with the Bid]*

	<u>COC</u> <u>Sub-Clause</u>	
Engineer's name and address	1.1. e) & 4.2	JICA Expert Team Department of Railway Building, Khamsavath Village, Saysettha District, Vientiane Capital, PO Box 3933, Lao PDR Tel: +856-21-465 018 Fax:+856-21-465 018
Time for Completion of the Works	1.1. k)	210 days
Governing Law	1.4	The law in force of Lao PDR
Language for communications and reports	1.5	English
Employer's Representative	2.1	Mr. Yusuke Murakami Chief Representative, Lao Office Japan International Cooperation Agency
Owner's Representative	3.1	Mr. Sayasane Bouaphet Acting Director General Department of Transport MPWT
Provision of Site	3.4	On the Commencement Date
Contractor's Representative	5.2	(name)
Amount of Performance Security	6.1	Ten (10) % of the Contract Price, in United States Dollars
Time for submission of Work Program	7.2	14 days after Commencement Date, in the form and details prescribed by the Engineer

- |  |      |   |
|--|------|---|
| Period for notification of defects             | 9.1  | One (1) year from the date of issue of the Taking-Over certificate.                                 |
| Insurance arrangements                         | 14.2 |   |
| - Insurance coverage:                          |      | All insurances shall be effected in conformity with the insurance regulations applicable in Lao PDR |
| - Minimum amount of third party insurance:     |      | <b>USD100,000</b> per occurrence, with number of occurrences unlimited                              |
| - Period for submission of insurance evidence: |      | 28 days after Commencement Date   |
| - Period for submission of insurance policies: |      | 56 days after commencement Date   |

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

**FORM T2**  
**GENERAL INFORMATION ON BIDDER**

1. Name (legal name)

\_\_\_\_\_

2. Address of the Head Office

\_\_\_\_\_

3. Specific Construction Business License Granted by the Government of Lao PDR

License No.: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Date of Issue: : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. Name of Company's Representative

\_\_\_\_\_

5. Date of Establishment of the Company

(month and year) \_\_\_\_\_

6. Full Paid-in Capital

\_\_\_\_\_

7. Numbers of Employees

- |  |       |
|--|-------|
| (1) Project Manger                                     | _____ |
| (2) Civil Engineer/ Pavement Engineer                  | _____ |
| (3) Operator of Asphalt Concrete Finisher/ Road Roller | _____ |
| (4) Mechanical and Electrical Engineer                 | _____ |
| (5) Skilled Foreman and workers                        | _____ |
| (6) Administrator                                      | _____ |

Total \_\_\_\_\_

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

7. Particular experience for road works completed in last five (5) years

No.	Project Name (1)	Completion Period (month) (2)	Total Contract Value (Thousand USD) (3)	Remarks (4)

Notes: (1) Indicate the project name and project category, i.e. road improvement, road rehabilitation, road repair, DBST (SBST), asphalt concrete pavement and reinforced concrete pavement, etc. with satisfying the criteria;

i) having **successfully completed at least three (3) road projects in the last five (5) years** regardless of whether acting as prime contractor or subcontractor;

ii) having experience of **at least one (1) road construction or rehabilitation project using reinforced concrete** in Lao PDR.

(2) Indicate the number of months and in parentheses the period from (month, year) to (month, year)

(3) Indicate the final total amount in million USD (excluding escalated amount), and in parentheses the total value of share of the Bidder in case of participation as a partner of a joint venture or as a subcontractor.

If the original amount is in foreign currency, indicate the exchange rate used in conversion.

(4) Indicate the status of participation: sole contractor, partner of joint venture, or subcontractor and share percentage

Attach to this Form copies of completion certificates issued by Employers or Engineers for the listed projects.

Notes:

(1) In the case the Bidder proposes to use subcontractor(s), a separate Form is to be completed for each of the subcontractors

(2) Professional certificates or licenses relating to the Bidder's activities, issued by competent authorities, shall be attached to this Form. These shall be submitted also for each of the subcontractors, if any.

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

**FORM T3**  
**FINANCIAL STATEMENT**

Unit: thousand USD

Description	Fiscal Year		
	2013	2014	2015
1. Gross sales			
2. Gross profit			
3. Operating profit			
4. Ordinary profit			
5. Net profit before tax			
6. Current assets			
7. Fixed assets			
8. Current liabilities			
9. Shareholders' equity			
10. Total of liabilities and shareholders' equity			

**Notes:**

Gross profit = Gross sales - Cost of sales  
Operation profit = Gross profit - Selling and Administration cost  
Ordinary profit = Operating profit + non-operating income - non-operating expense  
Net profit before tax = Ordinary profit + extraordinary income - extraordinary loss

*Attach to this Form the audited balance sheets and profit and loss statements for the last three fiscal years.*

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

**FORM T4**  
**LIST OF PROPOSED CONSTRUCTION PLANT AND EQUIPMENT**

No.	Description (Type, Model, Make)	Estimated Power Rating	Capacity (ton or m <sup>3</sup> )	Quantity	Year of Manufacture	New or Used	Owned or Leased	CIF Value

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

## **FORM T5**

### **CONSTRUCTION SCHEDULE**

Bidders shall provide in this Form a Construction Schedule both in Gantt and PERT/CPM charts clearly indicating how all of the Works are to be sequenced and scheduled in order to meet the Time for Completion specified in the Appendix to Bid. Sufficient time should be allowed for completion and testing activities.

The division of works into logical categories, the start and completion dates of each activity and the inter-relationship between different activities should be clearly indicated in the Schedule. Any unfavourable conditions such as rainy days should also be taken into account in the work programme.

The Form shall be accompanied by separate notes and calculations, if necessary, in support of the durations allowed for the principal activities.

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_



## **FORM T6**

### **ORGANIZATION CHART AND MANNING SCHEDULE**

Bidders shall provide in this Form an Organization Charts and a Manning Schedule proposed for execution of the Works. The documents shall be as specified below:

(1) Organization Chart

The chart shall indicate the management and staff structure, with responsible back-up personnel/departments at the head office, as well as the proposed site organization showing the proposed structure, inter-relation between the head office and the site office, staff members and positions necessary to adequately manage and control the work execution at the Site.

(2) Manning Schedule

The schedule shall be provided in bar chart format, covering the contract period in months horizontally and listing the Key Personnel (site management, key staff and operator) vertically. The chart shall indicate the proposed months of assignment of each staff in the key positions at least;

- i) Project Manager
- ii) Civil Engineer/ Concrete Structure Engineer
- iii) Quality Control Engineer
- iv) Mechanic and Equipment Operator
- v) Skilled Foreman and Screed Man

For each key position, a prime candidate and an alternate candidate shall be named.

The attached Summary of Candidate form shall be provided for each staff.

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

## Candidate Summary

Name of Applicant
-------------------

Position		Candidate Prime /Alternate
<i>Candidate information</i>	1. Name of candidate	2. Date of birth
	3. Professional qualifications	
<i>Present employment</i>	4. Name of employer	
	Address of employer	
	Telephone	Contact (manager / personnel officer)
	Fax	E-mail
	Job title of candidate	Years with present employer

Summarize professional experience over the last 10 years, in reverse chronological order. Indicate particular technical and managerial experience relevant to the Project

From	To	Company / Project / Position / Relevant technical and management experience

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

**FORM T7**  
**QUALITY CONTROL PLAN**

Bidders shall provide in this Form a Quality Control Plan describing in sufficient detail the process and means of compliance with the quality control requirements in the Specifications, to ensure that the specified levels of quality for the materials, equipment and workmanship are achieved.

The plan shall be accompanied by a quality control chart showing the lines of authority of the personnel in charge with their qualifications.

Bidders shall indicate the testing laboratory and equipment they intend to use for the Works and provide information and documentation to substantiate the experience and expertise of such laboratory.

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

## **FORM T8**

### **SAFETY PLAN**

Bidders shall provide in this Form a Safety Plan clearly describing how they intend to meet personnel safety, construction safety and traffic safety requirements in the Specifications.

The plan shall contain sufficient information to demonstrate clearly the proposed method of achieving the safety control objectives and activities during the execution of the Works, and the duties and authority of the personnel in charge of safety control and their qualifications.

The following shall be clearly described in the Plan:

- (i) proposed first aid facilities;
- (ii) emergency vehicles to be made available;
- (iii) medical and first aid personnel to be assigned to the Works;
- (iv) the hospital and/or facility proposed for emergency treatment, and
- (v) all safety and traffic control staff, equipment, devices and materials to be given in Drawings

Date: \_\_\_\_\_

Name of Bidder: \_\_\_\_\_

Signature: \_\_\_\_\_

Name of Signatory: \_\_\_\_\_

Title of Signatory: \_\_\_\_\_

***Part 1 - Section 3:  
Contract Forms***

**BID DOCUMENTS  
FOR  
PILOT PROJECT FOR REHABILITATION OF  
NATIONAL ROADS NO.9  
(BAN NONVILAY, SAVANNAKHET PROVINCE)**

**PART 1  
SECTION 3 CONTRACT FORMS**

**CONTENTS**

- Form C1: Contract Agreement**
- Form C2: Performance Security**
- Form C3: Advance Payment Security**

**FORM C1**  
**CONTRACT AGREEMENT**

This Agreement made the \_\_\_\_\_ day of \_\_\_\_\_ 2016 between Japan International Cooperation Agency (JICA) with its registered office at 2nd Floor, Sacombank Building, 044 Haengboun Rd, Ban Haisok, Chanthabouly District, Vientiane Capital, PO Box 3933, Lao PDR with Tel/Fax: +856-21-241100/241101 (hereinafter called "the Employer") of the one part, and \_\_\_\_\_ of \_\_\_\_\_ with its registered office at \_\_\_\_\_

(hereinafter called "the Contractor") of the other part,

**Whereas** the Government of Japan has extended the Project for Improvement of Road Management Capacity of Lao PDR (hereinafter referred to as "the Project"), as a part of the Project, the Pilot Project for efforts to cope with enhancement of control of overloaded vehicle in Lao PDR,; and

**Whereas** the Employer, on behalf of the Department of Roads, (hereinafter referred to as "DOR" or "the Owner") under the Ministry of Public Works and Transports (hereinafter referred to as "MPWT"), as the executing agency of GOL, desires that the Works of Pilot Project (hereinafter referred to as "the Works") under the Project be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of the Works and the remedying of any defects therein,

**The Employer and the Contractor agree** as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement:
  - (a) The Letter of Acceptance dated \_\_\_\_\_
  - (b) The Form of Bid dated \_\_\_\_\_ and the Appendix to Bid
  - (c) The Addenda No. \_\_\_\_\_
  - (d) The Conditions of Contract
  - (e) The Specifications
  - (f) The Conceptual Drawings
  - (g) The Priced Bill of Quantities, and
  - (h) The Instructions to Bidders and such other documents intended to form the Contract
3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer execute and complete the Works and remedy any defects therein in conformity with the provisions of the Contract.
4. The Employer, on behalf of the Owner, hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price at the times and in the manner prescribed by the Contract.

**In Witness Whereof** the parties hereto have caused this Agreement to be executed the day and year first before written.

SIGNED by \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

for and on behalf of the Employer

SIGNED by \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

for and on behalf of the Contractor

in the presence of:

Witness:

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Address: \_\_\_\_\_

in the presence of:

Witness:

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Address: \_\_\_\_\_



**FORM C2**  
**PERFORMANCE SECURITY**  
**(BANK GUARANTEE)**

To: Mr. Yusuke Murakami  
Japan International Cooperation Agency (JICA) Laos Office  
2nd Floor, Sacombank Building, 044 Haengboun Rd, Ban Haisok, Chanthabouly District ,  
Vientiane Capital, PO Box 3933, Lao PDR  
Tel/Fax: +856-21-241100/241101  
URL: <http://www/jica.go.jp>

Re.: Contract No. .... dated ....., 2016  
The Project for Upgrading of Weigh Station in Dong Heng, NR9, Savannakhet Province  
(2016/17 Pilot Project under JICA CaRoL Project)

**Whereas** ..... (*name and address of Contractor*)  
(hereinafter called “the Contractor”) has undertaken, in pursuance of the Contract Agreement  
No..... dated ..... (hereinafter called “the Contract”) to execute the works of  
reinstallation of the weigh station on NR9;

**Whereas** it has been stipulated by you in the said Contract that the Contractor shall furnish you  
with a Bank Guarantee for the sum specified therein as security for compliance with his obligation  
in accordance with the Contract;

**And Whereas** we have agreed to give the Contractor such a Bank Guarantee;

**Now Therefore** we hereby affirm that we are the Guarantor and responsible to you, on behalf of  
the Contractor, up to a total amount of United State Dollars ..... (*amount in*  
*words, equivalent to 10% of Contract Price*) (USD ..... ) (*amount in figures*), and we  
undertake to pay you, upon your first written demand and without cavil or argument, any sum or  
sums within the limit of ..... (*amount of Guarantee in words*  
*and, in parentheses, in figures*) as aforesaid without your needing to prove or to show grounds or  
reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before  
presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or  
of the Works to be performed hereunder or of any of the Contract Documents made between you  
and the Contractor shall in any way release us from any liability under this guarantee, and we  
hereby waive notice of any such change, addition or modification.

This security shall be released immediately after issue of the Taking-Over Certificate in response to

the successful completion of the completion inspection of the Work to be conducted by the Engineer with the approval of the Owner.

Name of Bank or Financial Institution:

\_\_\_\_\_

Signature and Seal : \_\_\_\_\_

Name of Signatory : \_\_\_\_\_

Position of Signatory : \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

**FORM C3**  
**ADVANCE PAYMENT SECURITY**  
**(BANK GUARANTEE)**

To: Mr. Yusuke Murakami  
Japan International Cooperation Agency (JICA) Laos Office  
2nd Floor, Sacombank Building, 044 Haengboun Rd, Ban Haisok, Chanthabouly District ,  
Vientiane Capital, PO Box 3933, Lao PDR  
Tel/Fax: +856-21-241100/241101  
URL: <http://www/jica.go.jp>

Re.: Contract No. \_\_\_\_\_ dated \_\_\_\_\_, 2016  
The Project for Upgrading of Weigh Station in Dong Heng, NR9, Savannakhet Province  
(2016/17 Pilot Project under JICA CaRoL Project)

Gentlemen:

In accordance with the provisions of the Conditions of Contract Sub-Clause 11.5: Advance Payment of the above referred Contract for the reinstallation of the weigh station on NR9 (hereinafter called “the Contract”),

\_\_\_\_\_ (name and address of Contractor) (hereinafter called “the Contractor”) shall deposit with the Japan International Cooperation Agency (hereinafter called “the Employer”), a bank guarantee to guarantee his proper and faithful performance under the said Sub-Clause of the Contract in the amount of:

United States Dollar \_\_\_\_\_  
(guarantee amount in words) (USD \_\_\_\_\_)  
(amount in figures).

We, the \_\_\_\_\_ (name of the bank or financial institution), as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to the Employer on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding United States Dollars \_\_\_\_\_ (guarantee amount in words) (USD \_\_\_\_\_) (amount in figures).

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents made between the Employer and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This security shall be released immediately after the completion inspection of the Work to be conducted by the Engineer.

Name of Bank or Financial Institution:

\_\_\_\_\_

Signature and Seal : \_\_\_\_\_

Name of Signatory : \_\_\_\_\_

Position of Signatory : \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

***Part 2:  
Conditions of Contract***

**BID DOCUMENTS**  
**FOR**  
**THE PROJECT FOR UPGRADING OF WEIGH STATION**  
**IN**  
**DONG HENG, NR9, SAVANNAKHET PROVINCE**  
**(2016/17 PILOT PROJECT UNDER JICA CAROL PROJECT)**

**PART 2**  
**CONDITIONS OF CONTRACT**

**CONTENTS**

	Page
1. General Provisions .....	1
1.1 Definitions .....	1
1.2 Interpretation .....	3
1.3 Priority of Documents.....	3
1.4 Governing Law .....	3
1.5 Communications .....	3
1.6 Statutory Obligations .....	3
1.7 Measurement System.....	3
2. The Employer .....	3
2.1 Employer’s Representative .....	3
2.2 Employer’s Instruction .....	4
2.3 Employer’s Approvals .....	4
2.4 Delegation.....	4
3. The Owner .....	4
3.1 Owner’s Representative .....	4
3.2 Owner’s Instructions .....	4
3.3 Owner’s Approvals .....	4
3.4 Provision of Site .....	4
3.5 Customs Clearance, Tax Exemption, Permits and Licenses .....	5
3.6 Owner’s Liabilities .....	5
4. The Engineer.....	6
4.1 Engineer’s Duties and Authority.....	6
4.2 Delegation by the Engineer .....	6
4.3 Engineer’s Instructions.....	6
5. The Contractor .....	7
5.1 General Obligations .....	7
5.2 Contractor’s Representative.....	7
5.3 Subcontracting .....	7

5.4	Shop Drawing .....	7
5.5	Responsibility for Temporary and Miscellaneous Works.....	8
6.	Bank Security .....	8
6.1	Performance Security.....	8
6.2	Bank Security during the Defect Liability Period .....	8
7.	Time for Completion .....	8
7.1	Execution of the Works .....	8
7.2	Work Program.....	8
7.3	Extension of Time .....	8
8.	Taking-Over.....	9
8.1	Completion.....	9
8.2	Taking-Over Certificate .....	9
9.	Remedying Defects.....	9
9.1	Remedying Defects.....	9
9.2	Uncovering and Testing .....	9
10.	Variations and Claims.....	10
10.1	Right to Vary.....	10
10.2	Valuation of Variations.....	10
10.3	Early Warning .....	10
10.4	Variation and Claim Procedure.....	10
11.	Contract Price and Payment .....	10
11.1	Contract Price .....	10
11.2	Terms of Payment.....	10
11.3	Changes in the Bill of Quantities or Activity Schedule .....	11
11.4	Payments for Variation.....	11
11.5	Materials for the Permanent Works.....	12
11.6	Payment Schedule .....	13
11.7	Provisional Sums .....	15
11.8	Deduction of Payment due to the Contractor's Fault.....	15
12.	Default .....	15
12.1	Default by Contractor .....	15
12.2	Default by Employer .....	16
12.3	Insolvency .....	16
12.4	Payment upon Termination .....	16
13.	Risk and Responsibility .....	17
13.1	Contractor's Care of the Works .....	17
13.2	Force Majeure .....	17
13.3	Indemnification.....	17
14.	Insurance.....	18

14.1	Extent of Cover.....	18
14.2	Arrangements.....	18
14.3	Failure to Insure.....	18
15.	Resolution of Disputes.....	18
15.1	Resolution of Disputes.....	18
16.	Other Conditions.....	19
16.1	Local Taxation.....	19
16.2	Custom and Duties on Contractor's Equipment and Materials.....	19
16.3	Price Adjustment.....	19
16.4	Warranty Period of the Equipment.....	20



## PART 2

### CONDITIONS OF CONTRACT

#### 1. General Provisions

##### 1.1 Definitions

In the Contract as defined below, the words and expressions defined shall have the following meanings assigned to them, except where the context requires otherwise:

- a) "Contract" means the Contract Agreement and the other documents listed in Chapter 5 Sub-Clause 6.(2), Section 1 of Part 1.
- b) "Specifications" means the general and particular specifications provided in Part 4 and any variation thereto.
- c) "Conceptual Drawings" means the Employer's Bid drawings provided in Part 5, and any variation to such drawings.
- d) "Employer" means the Japan International Cooperation Agency (hereinafter referred to as "JICA") and the legal successors in title to this person, but not, except with the consent of the Contractor, any assignee.
- e) "Engineer" means the "JICA Expert Team" or the person appointed by the JICA Expert Team to act as the Engineer for the purposes of the Contract and named in the Appendix to Bid, or other person appointed from time to time by the Employer and notified to the Contractor.
- f) "Contractor" means the person named in the Contract Agreement and the legal successors in title to this person, but not, except with the consent of the Employer, any assignee.
- g) "Owner" means the Department of Transport (DOT) under the Ministry of Public Works and Transport, the Government of Lao People's Democratic Republic.
- h) "Party" means either the Employer, the Engineer or the Contractor, according to the context.
- i) "Commencement Date" means the date 7 days after the date the Agreement comes into effect or any other date agreed between the Parties.
- j) "day" means a calendar day.
- k) "Time for Completion" means the time for completing the Works as stated in the Appendix to Bid, or as extended under Sub-Clause 7.3, calculated from the Commencement Date.
- l) "Defects Notification Period" means the period for notifying defects in the Works or a section, as the case may be, under Sub-Clause 9.1, as stated in the Appendix to

Bid.

- m) "Cost" means all expenditure properly incurred or to be incurred by the Contractor, whether on or off the Site, including overheads and similar charges, but does not include profit.
- n) "Provisional Sum" means a sum, if any, which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of materials or services under the Contract.
- o) "Contractor's Equipment" means all apparatus, machinery, vehicles, facilities and other things required for the execution of the Works but does not include Materials or Plant.
- p) "Country" means the Lao People's Democratic Republic.
- q) "Owner's Liabilities" means those matters listed in Sub-Clause 3.6.
- r) "Force Majeure" means an exceptional event or circumstance: (i) which is beyond a Party's control; (ii) which such Party could not reasonably have provided against before entering into the Contract; (iii) which, having arisen, such Party could not reasonably have avoided or overcome; and (iv) which is not attributable to the other Party.

Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below, so long all of the above-mentioned four conditions have been satisfied:

- i) war and hostilities (whether war be declared or not), invasion, act of foreign enemies, within the Country;
  - ii) rebellion, terrorism, revolution, insurrection, military or usurped power, or civil war;
  - iii) riot, commotion, disorder, strike or lockout by persons other than the Contractor's personnel and other employees;
  - iv) munitions of war, explosive materials, ionizing radiation or contamination by radioactivity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radioactivity; and
  - v) natural catastrophes such as earthquake, hurricane, typhoon or volcanic activity.
- s) "Materials" means things of all kinds other than Plant intended to form or forming part of the permanent work and to be supplied under the Contract.
  - t) "Plant" means the machinery and apparatus intended to form or forming part of the permanent work.
  - u) "Site" means the places provided by the Owner where the Works are to be executed, and any other places specified in the Contract as forming part of the Site.
  - v) "Variation" means a change to the Scope of Work which is instructed by the

Employer under Sub-Clause 10.1.

- w) "Works" means all the work and service including design to be performed by the Contractor including temporary work and any Variation.

## **1.2 Interpretation**

Words importing persons or parties shall include firms and organizations. Words importing singular or one gender shall include plural or the other gender where the context requires.

## **1.3 Priority of Documents**

The documents forming the Contract are to be taken as mutually explanatory of one another. If an ambiguity or discrepancy is found in the documents, the Employer shall issue any necessary instructions to the Contractor, and the priority of the documents shall be in accordance with the order as listed in Chapter 5 Sub-Clause 6.(2), Section 1 of Part 1.

## **1.4 Governing Law**

The governing law is the law in force in Lao PDR as stated in the Appendix to Bid.

## **1.5 Communications**

Wherever provision is made for the giving or issue of any notice, instruction, or other communication by any person, unless otherwise specified such communication shall be written in the language stated in the Appendix to Bid and shall not be unreasonably withheld or delayed. All specifications, reports and other documents shall also be presented in the language stated in the Appendix to Bid.

## **1.6 Statutory Obligations**

The Contractor shall comply with the laws of the countries where activities are performed. The Contractor shall give all notices and pay all fees and other charges in respect of the Works.

## **1.7 Measurement System**

The metric system shall be employed in all documents made under this Contract.

# **2. The Employer**

## **2.1 Employer's Representative**

The Employer shall appoint a representative as named in the Appendix to Bid and notified to the Contractor, who shall have authority to act for and in the name of the Employer.

## **2.2 Employer's Instructions**

The Employer shall give instructions from time to time to the Contractor, either directly or through the Engineer, on important matters relating to the Contract and the Works, including the suspension of all or part thereof. The Contractor shall strictly comply with all such instructions.

## **2.3 Employer's Approvals**

Any approval or consent or absence of comment by the Employer or the Employer's Representative shall in no case relieve the Contractor's from any of his obligations under the Contract.

## **2.4 Delegation**

The Employer shall delegate a part of his duties and responsibilities to the Owner within the extents limited to the control of works, except the control of payment and financial terms of Contract, upon notifying the Contractor in writing, and that may cancel any delegation anytime after notifying the Contractor.

# **3. The Owner**

## **3.1 Owner's Representative**

The Owner shall appoint a representative as named in the Appendix to Bid and notified to the Contractor, who shall have authority to act for and in the name of the Owner.

## **3.2 Owner's Instructions**

The Owner shall give instructions from time to time to the Contractor, either directly or through the Engineer, on important matters relating to the Contract and the Works, including the suspension of all or part thereof. The Contractor shall strictly comply with all such instructions.

## **3.3 Owner's Approvals**

Any approval or consent or absence of comment by the Owner or the Owner's Representative shall in no case relieve the Contractor's from any of his obligations under the Contract.

## **3.4 Provision of Site**

The Owner shall make necessary arrangement to provide the Site and right of access thereto to the Contractor by the time stated in the Appendix to Bid.

### **3.5 Customs Clearance, Tax Exemption, Permits and Licenses**

The Owner shall make necessary arrangement to assist the Contractor in getting:

- a) facility for prompt unloading, customs clearance and inland transport of equipment and materials imported for the purposes of the Works; and
- b) facility for obtaining permits, licenses or approvals which are required for the performance of duties of the Contractor for the Works.

### **3.6 Owner's Liabilities**

The Owner's Liabilities under the Contract mean:

- a) war and hostilities (whether war be declared or not), invasion, act of foreign enemies, within the Country
- b) rebellion, terrorism, revolution, insurrection, military or usurped power, or civil war, within the Country;
- c) riot, commotion or disorder by persons other than the Contractor's personnel and other employees, affecting the Site and/or the Works;
- d) ionizing radiations or contamination by radioactivity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive, or other hazardous properties of any explosive nuclear assembly or nuclear component of such an assembly, except to the extent to which the Contractor may be responsible for the use of any radioactive material;
- e) pressure waves caused by aircraft or other aerial devices traveling at sonic or supersonic speeds;
- f) use or occupation by the Employer or the Owner of any part of the Works, except as may be specified in the Contract;
- g) design of any part of the Works by the Employer's personnel or by others for whom the Employer is responsible; and
- h) any operation of the forces of nature affecting the Site and/or the Works, which was unforeseeable or against which an experienced contractor could not reasonably have been expected to take precautions.
- i) Force Majeure cases defined in Sub-Clause 13.2;
- j) a suspension under Sub-Clause 2.2 unless it is attributable to the Contractor's failure,
- k) any failure of the Employer or the Owner;
- l) physical obstructions or physical conditions other than climatic conditions, encountered on the Site during the performance of the Works, which obstructions or conditions were not reasonably foreseeable by an experienced contractor and which the Contractor immediately notified to the Engineer and the Employer;

- m) any delay or disruption caused by any Variation;
- n) any change to the law of the Contract after the date of the Contractor's bid as stated in the Contract Agreement;
- o) losses arising out of the Employer's or the Owner's right to have the permanent work executed on, over, under, in or through any land, and to occupy this land for the permanent work; and
- p) damage which is an unavoidable result of the Contractor's obligations to execute the Works and to remedy any defects.

## **4. The Engineer**

### **4.1 Engineer's Duties and Authority**

The Engineer appointed by the Employer shall carry out the duties assigned to him in the Contract. He may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract.

However, the Engineer shall have no authority in taking any of the following actions without prior written approval of the Employer:

- a) approving subletting of any part of the Works under Sub-Clause 5.3 hereof;
- b) certifying any additional cost to the Contract Price under Clause 11;
- c) determining an extension of time under Sub-Clause 7.3 hereof;
- d) issuing a variation under Clause 10, except in an emergency situation, as reasonably determined by the Engineer and approved by the Employer; or
- e) fixing rates or prices under Sub-Clause 10.2.

Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Engineer, including absence of disapproval, shall not relieve the Contractor from any responsibility he has under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances.

### **4.2 Delegation by the Engineer**

The Engineer shall be represented by the Project Manager who shall be authorized to act on behalf of the Engineer in performing all the issues related to the duties and authority as defined in Sub-Clause 4.1 and can be replaced by the Engineer at any time during the Project without interference of the Contractor.

The Engineer, directly or represented by his Project Manager, may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. Such assignment, delegation or revocation shall be informed in writing to the Contractor and shall not take effect until the acknowledgement by both Parties.

### **4.3 Engineer's Instructions**

The Engineer may issue to the Contractor at any time instructions which may be necessary for the execution of the Works and the remedying of any defects therein, all in accordance with the Contract.

The instructions shall be given in writing. The Contractor shall comply with the instructions given by the Engineer or his delegated assistant, on any matter related to the Contract.

## **5. The Contractor**

### **5.1 General Obligations**

The Contractor shall carry out the Works properly and in accordance with the Contract. The Contractor shall provide all labor, materials, plant, equipments and other provisions necessary to the required Works under the Contract. All Materials and Plant on Site shall be deemed to be the property of the Owner.

### **5.2 Contractor's Representative**

One of the Contractor's personnel shall have authority to act for him. The authorized person shall be as stated in the Appendix to Bid or as otherwise notified by the Contractor to the Employer. The Contractor's Representative may delegate any powers, functions and authority to any competent person, and may at any time revoke the delegation. Any delegation or revocation shall not take effect until the Employer has received prior notice signed by the Contractor's Representative, naming the person and specifying the powers, functions and authority being delegated or revoked.

### **5.3 Subcontracting**

The Contractor shall not sublet the whole of the Works. The Contractor shall make sure that any subcontractor used by him has sufficient technical capability required for execution of the sublet work. The Contractor shall bear full responsibility towards the Employer for any work executed by his subcontractor(s) as if it has been executed by himself. The Contractor shall not subcontract any part of the Works without the consent of the Engineer.

### **5.4 Shop Drawing**

The Contractor shall produce the shop drawing based on the standard drawings and design conditions specified in the Specifications provided in Part 4, and shown on the Conceptual Drawings in Part 5. The Contractor shall promptly submit to the Engineer all the drawings prepared by him. Within 7 days of receipt the Engineer shall notify any comments or, if the shop drawings submitted is not in accordance with the Contract, shall reject it stating the reasons. The Contractor shall not commence any part

of works until the Engineer approves the shop drawing. If the shop drawing has been rejected by the Engineer, the drawings shall be promptly amended and re-submitted. The Contractor shall re-submit all shop drawings commented on taking these comments into account as necessary.

## **5.5 Responsibility for Temporary and Miscellaneous Works**

The Contractor shall remain responsible for all of his plan and design for temporary works and miscellaneous works under this Clause, which shall be fit for the intended purpose defined in the Contract, and he shall also remain responsible for any infringement of any patent or copyright in respect of them.

## **6. Bank Security**

### **6.1 Performance Security**

The Contractor shall deliver to the Employer within 14 days of the Commencement Date a performance security in the amount stated in the Appendix to Bid and in the Form C2 provided in Section 3 of Part 1, or any form acceptable to the Employer.

### **6.2 Bank Security during the Defect Liability Period**

The Contractor shall deliver to the Employer within 14 days from issuing date of the Taking-Over Certificate a bank security which covers five (5) % of the Contract amount to be kept during the defect liability period stated in the Appendix to Bid. The Contractor shall be required to have the approval of the Owner for the bank and the form to be applied prior to the deliver.

## **7. Time for Completion**

### **7.1 Execution of the Works**

The Contractor shall commence the Works on the Commencement Date and shall proceed expeditiously and without delay in accordance with the Work Program mentioned in Sub-Clause 7.2 hereof, and shall complete the Works within the Time for Completion. The work completion shall be entitled at the date of issue of the Taking-Over Certificate by the Engineer.

### **7.2 Work Program**

Within the time stated in the Appendix to Bid, the Contractor shall submit to the Engineer a program for the Works in the form stated in the Appendix to Bid.

### **7.3 Extension of Time**

Subject to Sub-Clause 10.3, the Contractor shall be entitled to an extension to the Time for Completion if he is or will be delayed by any of the Owner's Liabilities.



On receipt of an application from the Contractor, the Employer shall consider all supporting details provided by the Contractor and shall extend the Time for Completion as appropriate.

## **8. Taking-Over**

### **8.1 Completion**

The Contractor may notify the Employer and the Owner, with copy to the Engineer, when he considers that the whole of the Works has been completed.

### **8.2 Taking-Over Certificate**

The Owner shall issue the Taking-Over Certificate to the Contractor when he considers that the Contractor has completed the whole of the Works stating the date accordingly.

The Owner shall take over the Works upon the issue of this certificate. The Contractor shall promptly complete any outstanding work and, subject to Clause 9, clear the Site.

## **9. Remedying Defects**

### **9.1 Remedying Defects**

The Engineer may at any time prior to the expiry of the Defects Notification Period stated in the Appendix to Bid, notify the Contractor of any defects or outstanding work. The Contractor shall remedy at no cost to the Employer any defects due to the Contractor's works, materials, plant, equipment or workmanship not being in accordance with the Contract.

The cost of remedying defects attributable to any other cause shall be valued as a Variation. Failure to remedy any defects or complete outstanding work within a reasonable time of the Employer's notice shall entitle the Employer to carry out all necessary work at the Contractor's cost.

The bank guarantee stipulated in Sub-Clause 6.2 shall be released after confirmation of the all remedy works instructed by the Engineer and/or the Owner.

### **9.2 Uncovering and Testing**

The Engineer may give instruction as to the uncovering and/or testing of any work. Unless as a result of any uncovering and/or testing it is established that the Contractor's design, Materials, Plant or workmanship are not in accordance with the Contract, the Contractor shall be paid for such uncovering and/or testing as a Variation in accordance with Sub-Clause 10.2.

## **10. Variations and Claims**

### **10.1 Right to Vary**

The Employer may have the right to instruct Variations.

### **10.2 Valuation of Variations**

Variations shall be valued as follows:

- a) at the rates in the Bill of Quantities; or
- b) where appropriate, at the existing rates agreed between the Parties;
- c) in the absence of appropriate rates, the rates in the Schedule of Rate be used as the basis for valuation; or failing which,
- d) at appropriate new rates, as may be agreed or which the Employer considers appropriate.

### **10.3 Early Warning**

A Party shall notify the others as soon as he is aware of any circumstance which may delay or disrupt the Works, or which may give rise to a claim or additional payment. The Contractor shall take all reasonable steps to minimize these effects.

The Contractor's entitlement to extension of the Time for Completion or additional payment shall be limited to the time and payment which would have been due if he had given prompt due notice and had taken all reasonable steps.

### **10.4 Variation and Claim Procedure**

The Contractor shall submit to the Employer the itemized Variation with the value thereof within 14 days after the Engineer's instruction or the event arisen to the claim. The Engineer shall examine and assesses the value of Variation submitted by the Contractor. The Employer shall have right to determine the value of Variation, unless agreed with the Contractor.

## **11. Contract Price and Payment**

### **11.1 Contract Price**

The Employer shall pay the Contractor the Contract Price agreed by and between the Parties as mentioned in the Contract in accordance with the terms and conditions set forth under this Clause.

### **11.2 Terms of Payment**

- a) The Bill of Quantities shall contain items for the construction, installation, testing, and commissioning work to be done by the Contractor.

- b) The Bill of Quantities is used to calculate the Contract Price. The Contractor is paid for the quantity of the works done at the rate in the Bill of Quantities for each item.

### **11.3 Changes in the Bill of Quantities or Activity Schedule**

- a) If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25 percent, provided the change exceeds five percent (5%) of the Initial Contract Price, the Engineer shall adjust the rate to allow for the change.
- b) The Engineer shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 15 percent, except with the prior approval of the Employer.
- c) If requested by the Engineer, the Contractor shall provide the Engineer with a detailed cost breakdown of any rate in the Bill of Quantities.

### **11.4 Payments for Variations**

- a) The Contractor shall provide the Engineer with a quotation for carrying out the Variation when requested to do so by the Engineer. The Engineer shall assess the quotation, which shall be given within seven days of the request or within any longer period stated by the Engineer and before the Variation is ordered.
- b) If the work in the Variation corresponds with an item description in the Bill of Quantities and if, in the opinion of the Engineer, the quantity of work above the limit stated in Sub-Clause 11.3 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work.
- c) If the Contractor's quotation is unreasonable, the Engineer may order the Variation and make a change to the Contract Price, which shall be based on the Engineer's own forecast of the effects of the Variation on the Contractor's costs.
- d) If the Engineer decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a compensation event.

- e) The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.

### **11.5 Materials for the Permanent Works**

With respect to materials brought by the Contractor to the Site for incorporation in the Permanent Works, the Contractor shall (i) receive a credit in the month in which these materials are brought to the Site and (ii) be charged a debit in the month in which they are incorporated in the Permanent Works, both such credit and debit to be determined by the Engineer in accordance with the following provisions:

- a) no credit shall be given unless the following conditions shall have been met to the Engineer's satisfaction:
  - 1) the materials are in accordance with the specifications for the Works;
  - 2) the materials have been delivered to the Site and are properly stored and protected against loss, damage or deterioration;
  - 3) the Contractor's records of the requirements, orders, receipts and use of materials are kept in a form approved by the Engineer, and such records are available for inspection by the Engineer;
  - 4) the Contractor has submitted a statement of his cost of acquiring and delivering the materials to the Site, together with such documents as may be required for the purpose of evidencing such cost; and
- b) the amount to be credited to the Contractor shall be the equivalent of seventy five (75) percent of the Contractor's reasonable cost of the materials delivered to the Site, as determined by the Engineer after review of the documents listed in paragraph(a) 4) above, as determined by the Engineer.

For road aggregates, such interim payments may be made on the estimated quantities of crushed aggregates produced for aggregate base, reinforced concrete pavement satisfactorily stockpiled on site, the quantities of such loose aggregate shall be converted into equivalent compacted materials or tones, as the case may be, and paid for at a rate of sixty (60) percent of the unit prices for the Bill of Quantities into which it is intended the aggregates shall be incorporated.

- c) the amount to be debited to the Contractor for any materials incorporated into the Permanent Works shall be equivalent to the credit previously granted to the Contractor for such materials pursuant to Sub-Clause (b) above, as determined by

the Engineer; and

- d) the currencies in which the respective amounts shall be credited or debited as set forth above shall be determined by the Engineer, provided (i) that in the case of a credit, the currency shall be in contract currency indicated in the Bill of Quantities for the relevant item of material; and (ii) that in the case of a debit, the currency shall be those in which the credit for the respective item of materials had been given.

## 11.6 Payment Schedule

Payment will be made in accordance with the following table stipulating the payment conditions.

**Payment Schedule**

Payment	Work progress to be achieved	Payment disbursement	Requirement
Advance	0%	40%	The Contractor shall submit the invoice with the following attachments within twenty eight (28) days from the date of signing of the Contract. 1) Copy of the signed contract 2) Performance security specified in Sub-Clause 6.1
1st interim	50%	25%	The Contractor shall submit the invoice with the following attachments. 1) Payment certificate issued by the Engineer to prove the achievement of the target work progress
2nd interim	80%	15%	The Contractor shall submit the invoice with the following attachments. 1) Payment certificate issued by the Engineer to prove the achievement of the target work progress
Final	100%	20%	The Contractor shall submit the invoice with the following attachments. 1) Certificate of the completion inspection issued by the Engineer 2) Release certificate of the advance payment security issued by the bank in charged. 3) Bank security (5% of the contract amount) to be kept during the defect liability period

### (1) Advance Payment

- a) The Contractor is to use the advance payment only to pay for Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been used in

this way by supplying copies of invoices or other documents to the Engineer.

## **(2) Payment Certificates**

- a) The Contractor shall submit to the Engineer statements of the estimated value of the works executed less the cumulative amount certified previously. Such statements shall be submitted monthly.
- b) The Engineer shall check the Contractor's statement and certify the amount to be paid to the Contractor.
- c) The value of work executed shall be determined by the Engineer.
- d) The value of works executed shall comprise the value of the quantities of the items in the Bill of Quantities completed for Admeasurements Contracts.
- e) Any credit or debit for the month in question in respect of "Materials for the Permanent Works", in the relevant amounts, and under the conditions set forth in Sub-Clause 11.4 shall be included in deductibles.
- f) Any amounts to be deducted as repayment of the Advance under the provisions of Sub-Clause 11.6 shall be included in deductibles; and
- g) The Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

## **(3) Payments**

- a) Payments shall be adjusted for deductions for advance payments and retention. The Employer shall pay the Contractor the amounts certified by the Engineer within 30 days of the date of each certificate.
- b) Unless otherwise stated, all payments and deductions will be paid or charged in the proportions of currencies comprising the Contract Price.
- c) Items of the Works for which no rate or price has been entered in will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

#### **(4) Final Payment**

Not later than 84 days after the issue of the Taking-Over Certificate in respect of the whole of the Works, the Contractor shall submit to the Engineer three (3) copies of final statements with supporting documents showing in detail, in the form approved by the Engineer,

- a) the final value of all work done in accordance with the Contract up to the date stated in such Taking-Over Certificate;
- b) any further sums which the Contractor considers to be due; and
- c) an estimate of amounts which the Contractor considers will become due to him under the Contract.

The Engineer shall certify payment in accordance with Sub-Clause 11.6 (2).

#### **11.7 Provisional Sums**

Provisional Sums shall only be used, in whole or part, in accordance with the Employer's instruction. The payment to the Contractor shall include such amount for the work, supplies or services to which the Provisional Sum relates as the Employer shall have instructed.

The Contractor shall, when required by the Employer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.

#### **11.8 Deduction of Payment due to the Contractor's Fault.**

If the Contractor fails to complete the Works until the date stipulated in the Contract, a sum of money equal to 0.1 percent of the Contract amount shall be deducted from Final Payment every day. The deduction period shall be continued until the date of issue of the Taking-Over Certificate by the Engineer. The deduction amount shall be no more than 10% of the Contract amount. Note the period shall not be counted in case the delay occurred due to the event entitled as Force Majeure stipulated in Sub-Clause 13.2.

### **12. Default**

#### **12.1 Default by the Contractor**

If the Contractor abandons the Works, refuses or fails to comply with a valid instruction of the Employer or the Engineer, or fails to proceed expeditiously and without delay, or is, despite a written complaint, in breach of the Contract, the Employer may give notice referring to this Sub-Clause and stating the default.

If the Contractor has not taken all practicable steps to remedy the default within 14

days after the Contractor's receipt of the Employer's notice, the Employer may by a second notice given within a further 21 days, terminate the Contract. The Contractor shall then demobilize from the Site leaving behind Materials and Plant and any Contractor's Equipment which the Employer instructs in the second notice is to be used until the completion of the Works.

## **12.2 Default by the Employer**

If the Employer fails to pay in accordance with the Contract, or is, despite a written complaint, in breach of the Contract, the Contractor may give notice referring to this Sub-Clause and stating the default. If the default is not remedied within 7 days after the Employer's receipt of this notice, the Contractor may suspend the execution of all or parts of the Works.

If the default is not remedied within 28 days after the Employer's receipt of the Contractor's notice, the Contractor may by a second notice given within a further 21 days, terminate the Contract. The Contractor shall then demobilize from the Site.

## **12.3 Insolvency**

If a Party is declared insolvent under any applicable law, the other Party may by notice terminate the Contract immediately. The Contractor shall then demobilize from the Site leaving behind, in the case of the Contractor's insolvency, any Contractor's Equipment which the Employer instructs in the notice to be used until the completion of the Works.

## **12.4 Payment upon Termination**

After termination, the Contractor shall be entitled to payment of the unpaid balance of the value of the Works executed and of the Materials and Plant reasonably delivered to the Site, adjusted by the following:

- a) any sums to which the Contractor is entitled under Sub-Clause 10.4,
- b) any sums to which the Employer is entitled,
- c) if the Employer has terminated under Sub-Clause 12.1 or 12.3, the Employer shall be entitled to a sum equivalent to 20% of the value of those parts of the Works not executed at the date of the termination,
- d) if the Contractor has terminated under Sub-Clause 12.2 or 12.3, the Contractor shall be entitled to the Cost of his suspension and demobilization together with a sum equivalent to 10 % of the value of those parts of the Works not executed at the date of termination.

The net balance due shall be paid or repaid within 28 days of the notice of termination.



## **13. Risk and Responsibility**

### **13.1 Contractor's Care of the Works**

The Contractor shall take full responsibility for the care of the Works from the Commencement Date until the issue of the Taking-Over Certificate under Sub-Clause 8.2. Responsibility shall then pass to the Owner. If any loss or damage happens to the Works due to the Contractor's fault during the above period, the Contractor shall rectify such loss or damage so that the Works conform to the Contract.

Unless the loss or damage happens as a result of an Owner's Liability, the Contractor shall indemnify the Owner, the Owner's contractors, agents and employees against all loss or damage happening to the Works and against all claims or expenses arising out of the Works caused by a breach of the Contract, by negligence or by other default of the Contractor, his agents or employees.

### **13.2 Force Majeure**

If a Party is or will be prevented from performing any of its obligations by Force Majeure, the Party affected shall notify the other Party immediately. If necessary, the Contractor shall suspend the execution of the Works and, to the extent agreed with the Employer, demobilize the Contractor's Equipment.

If the event continues for a period of 60 days, either Party may then give notice of termination, which shall take effect 21 days after the giving of the notice.

After termination, the Contractor shall be entitled to payment of the unpaid balance of the value of the Works executed and of the Materials and Plant reasonably delivered to the Site, adjusted by the following:

- a) any sums to which the Contractor is entitled under Sub-Clause 10.4,
- b) the Cost of his suspension and demobilization, and
- c) any sums to which the Employer is entitled.

The net balance due shall be paid or repaid within 28 days of the notice of termination.

### **13.3 Indemnification**

The Contractor shall indemnify and hold the Employer and the Owner harmless from any and all liability, claims, losses, causes of action, suits or judgments for property damage, bodily injury or death caused by the fault or negligence of the Contractor or caused by any defect in the Works.

The Contractor shall indemnify and hold the Employer and the Owner harmless from any and all claims or disputes which may arise alleging infringement of patents, trademarks, utility models, designs, copyrights, trade secrets or any other intellectual

property right in connection with the Works.

## **14. Insurance**

### **14.1 Extent of Cover**

The Contractor shall, prior to commencing the Works, effect and thereafter maintain insurances in the joint names of the Parties:

- a) for loss and damage to the Works including materials, plant and equipment;
- b) for liability of Parties for loss, damage, death or injury to third parties or their property arising out of the Contractor's performance of the Contract, including the Contractor's liability for damage to the Owner's property other than the Works; and
- c) for liability of Parties and of any of Owner's / Employer's /Engineer's staff for death or injury to the Contractor's personnel except to the extent that liability arises from the negligence of the Owner's /Employer's /Engineer's, and any of Owner's / Employer's /Engineer's staff or their employees.

### **14.2 Arrangements**

All insurances shall conform with the requirements specified in the Appendix to Bid. The policies shall be issued by insurers and in terms approved by the Employer. The Contractor shall provide the Employer with evidence that any required policy is in force and that the premiums have been paid, and the relevant insurance policies, within the time specified in the Appendix to Bid.

All payments received from insurers relating to loss or damage to the Works shall be held jointly by the Parties and used for the repair of the loss or damage or as compensation for loss or damage that is not to be repaired.

### **14.3 Failure to Insure**

If the Contractor fails to effect or keep in force any of the insurances referred to in the previous Sub-Clause, or fails to provide satisfactory evidence, policies or receipts, the Employer may, without prejudice to any other right or remedy, effect insurance for the cover relevant to such default and pay the premiums due and recover the same as a deduction from any other monies due to the Contractor.

## **15. Resolution of Disputes**

### **15.1 Resolution of Disputes**

If any dispute arises out of this Contract, both Parties shall use their best efforts to settle such dispute amicably. If a mutually agreed settlement cannot be reached, such dispute shall be settled by arbitration in Tokyo in accordance with the Commercial

Arbitration Rules of the Japan Commercial Arbitration Association.

The award of arbitration shall be final and binding upon the Parties hereto and the Parties shall comply in good faith with the award of the Japan Commercial Arbitration Association.

The fees of all proceedings of arbitration, the cost of arbitrators and other associated costs and expenses including reasonable attorney's fee shall be paid by the Party adjudged liable.

## **16. Other Conditions**

### **16.1 Local Taxation**

The prices bid by the Contractor shall include all local taxes including business taxes, income and other taxes that may be levied in accordance to the laws and regulations in being as of the date 14 days prior to the closing date for submission of bids in Lao PDR on the Contractor's Equipment, Plant, materials and supplies (permanent, temporary and consumable) acquired for the purpose of the Contract and on the services performed under the Contract. Nothing in the Contract shall relieve the Contractor from his responsibility to pay any tax that may be levied in Lao PDR on profits made by him in respect of the Contract. The Contractor shall be deemed to be familiar with the tax laws in Lao PDR.

Unless otherwise agreed by and between the Governments of Lao PDR and Japan, with regard to the Value Added Tax (VAT), the Contractor might not be deemed to claim reimbursement of VAT amount paid by him in accordance with tax laws in Lao PDR.

### **16.2 Custom and Duties on Contractor's Equipment and Materials**

Notwithstanding the provision of Sub-Clause 16.1, all duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 14 days prior to the deadline for submission of bids, shall, unless modified by the Government of Lao PDR, be deemed to include into the rates and prices and the total bid price submitted by the Contractor. The Contractor shall be deemed to be familiar with the tax laws of Lao PDR. The Contractor shall obtain necessary information regarding payable duties, other commissions and levies imposed at custom clearance for imported equipment and materials in Lao PDR, and confirm the requirements thereof at his own responsibility when preparing his bid.

### **16.3 Price Adjustment**

The rates and prices as accepted in the Contract are fixed and shall not be subject to adjustment due to price fluctuations, except in the case of changes to national laws and regulations resulting in an increase or decrease in cost during the period of

execution of the Contract, in which case the rates and prices may be adjusted in accordance with the mutual agreement between the Parties.

#### **16.4 Warranty Period of the Equipment**

The Contractor shall ensure one (1) year warranty period of a whole component of the equipment called as Weigh Scale and System from commencement date of the operation work. The Contractor shall remedy the failure with free of charge during the period. Note the warranty will not be applied in case that the equipment falls into malfunction caused of inappropriate operation manner of the Owner. The Contractor shall submit the guarantee stating the above condition issued by the manufacturer of the equipment until the Contract signing.

***Part 3:***  
***Bill of Quantities***

**BID DOCUMENTS  
FOR  
THE PROJECT FOR UPGRADING OF WEIGH STATION  
IN  
DONG HENG, NR9, SAVANNAKHET PROVINCE  
(2016/17 PILOT PROJECT UNDER JICA CAROL PROJECT)**

**PART 3  
BILL OF QUANTITIES**

**CONTENTS**

Preamble.....	PR-1
Summary of Bill of Quantities.....	BOQ-1
Bill No. 1.....	BOQ-2
Bill No. 2.....	BOQ-3
Bill No. 3.....	BOQ-4
Bill No. 4.....	BOQ-5

## **PART 3**

### **BILL OF QUANTITIES**

#### **PREAMBLE**

- 1 The Bill of Quantities shall be read in conjunction with the Bid Documents, namely Part 2: Conditions of Contract, Part 4: Specifications, Part 1 – Section 1: Instructions to Bidder, Part 5: Conceptual Drawings and other pertinent data. Bidders shall be deemed to have fully acquainted himself with the detailed description of the Works to be done, the way in which they shall carry out the Works and the requirements and standards of the Works.
- 2 The Bill of Quantities provided hereafter is intended only for indicating the basic bill items to be quoted by bidders in their bid. Bidders shall fill in the unit, quantity, rate and amount in the respective columns of the Bill of Quantities, and may at their discretion add thereto or omit therefrom any bill items which they deem necessary to compose their bid price.
- 3 The quantities given in the Bill of Quantities are estimates and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Engineer and valued at the rates and prices bid in the priced Bill of Quantities.
- 4 A rate or price shall be entered in United State Dollars (US\$) in black ink against each item in the Bill of Quantities, whether quantities of each item are stated or not. The cost of Items against which the Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.
- 5 The rates and prices bid in the priced Bill of Quantities shall, except insofar as it is otherwise provided under the Contract, include all constructional plant, labour, supervision, materials, erection, maintenance, insurance, profit, together with all general risks, liabilities and obligations set out or implied in the Contract.
- 6 The costs of premiums for all contractual insurances required under Part 2 Clause 15 of the Bid Documents shall be included in the rates and amounts of the bill items in the priced Bill of Quantities. No separate payment will be made by the Employer to the Contractor for the cost of insurance for any bill item.
- 7 The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.
- 8 General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the contract documents shall be made before entering unit rates or prices against each item in the Bill of Quantities.
- 9 The method of measurement of completed work for payment shall be in accordance with the Specifications, except as supplemented, modified or revised in the amendment contained in the document.

- 10 The unit rates and amounts entered in the Bill of Quantities shall be exclusive of all customs duties, internal taxes including VAT and other fiscal levies which may be imposed with respect to the purchase of products and services for and under the Contract.
- 11 In the case of arithmetic errors in computation or summation of the prices, correction will be made in the following manner:
- (a) where there is a discrepancy between amounts in figures and in words, the amount in words will govern; and
  - (b) where there is a discrepancy between the unit rate and the total amount derived from the multiplication of the unit rate and the quantity, the unit rate as quoted will govern.
- 12 The Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part only at the discretion and direction of the Employer, and payment for such Provisional Sums shall be in accordance with Part 2 Clause 8 of the Bid Documents.
- 13 The following abbreviations shall be used in the Bill of Quantities:

cu.m or m <sup>3</sup>	: Cubic meter
sq.m or m <sup>2</sup>	: Square meter
sq.mm or mm <sup>2</sup>	: Square millimeter
m	: Linear meter
no(s) or nr(s)	: Number(s)
km	: Kilometer
l	: Liter
kg	: Kilogram
ton	: Metric ton = 1,000 kg
dia. or Ø	: Diameter
%	: Percent
LS	: Lump Sum
PS	: Provisional Sum
m/d	: Man-day
hr	: Hour
¥	: Japanese Yen



**PART 3**  
**BILL OF QUANTITIES**

**SUMMARY OF BILL OF QUANTITIES**

<b>Bill</b>	<b>Description</b>	<b>Amount (USD)</b>
Bill No. 1	General	
Bill No. 2	Civil Works	
Bill No. 3	Weigh Scale and System	
Bill No. 4	Ancillary Works	
<b>Grand Total</b>		

## BILL OF QUANTITIES

### BILL NO. 1

Item	Description	Unit	Rate (USD)	Quantity	Amount (USD)
<b>100</b>	<b>General</b>				
	Mobilization & Demobilization of Plant & Equipment	Ls		1	
	Site Preparation	Ls		1	
	Assemble/ Dismantle of Plant	Ls		1	
	Site operation & Maintenance	Ls		1	
	Traffic Safety Control	Ls		1	
	Office/ Accommodation	Ls		1	
	Project Sign Board	Ls		1	
	Insurance, Bond and Securities	Ls		1	
	Bidders shall quote herein other items of work, equipment, materials and labor required to fulfill the obligations specified in Sections 101 to 113 of Part 4 Specification of Bid Documents				
<b>Bill No. 1 Total</b>					

## BILL OF QUANTITIES

### BILL NO. 2

Item	Description	Unit	Rate (USD)	Quantity	Amount (USD)
<b>200</b>	<b>Civil Works</b>				
201	Remove Existing Concrete Pavement (A=3,400m <sup>2</sup> , T=25cm)	m <sup>3</sup>		850.0	
202	Ground Excavation (A=2,558m <sup>2</sup> , T=25cm)	m <sup>3</sup>		639.5	
203	Subgrade Compaction (Compaction degree = 98%)	m <sup>2</sup>		3,052	
204	Base Course (A=2,558m <sup>2</sup> , T=25cm)	m <sup>3</sup>		639.5	
205	Reinforced Concrete Pavement (A=2,558m <sup>2</sup> , T=25cm)	m <sup>3</sup>		639.5	
206	Stone Masonry	m <sup>2</sup>		494.0	
<b>Bill No. 2 Total</b>					

## BILL OF QUANTITIES

### BILL NO. 3

Item	Description	Unit	Rate (USD)	Quantity	Amount (USD)
<b>300</b>	<b>Weigh Scale and System</b>				
301.01	<b>Weigh Scale and System</b>  1 Electronic and Digital Weigh Scale: 1 unit - Capacity: 150 tons - Smallest division: 20 kilograms. - Platform size: 3.5 x 22.0 m 2 Digital weight indicator: 1 LS 3 Digital weigh scale software: 1 LS 4 Load cell: 8 unit 5 Platform (steel main girders): 1 unit 6 Remote display: 1 unit 7 Fixed camera: 2 units 8 CCTV sets: 1LS 9 Uninterrupted Power Supply: 1 LS 10 Isolate Transformer I/P 220v: 1 LS 11 Automatic Vehicle Classification: 1 LS 12 Automatic License Plate Recognition System : 1 LS 13 Data management system: 1 LS	Set		1	
<b>Bill No. 3 Total</b>					

## BILL OF QUANTITIES

### BILL NO. 4

<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Rate (USD)</b>	<b>Quantity</b>	<b>Amount (USD)</b>
<b>400</b>	<b>Ancillary Works</b>				
401	Road Marking (Yellow, W=15cm)	m		643.0	
402	Guide Post (Black & White, H=1.5m)	No		86.0	
403	Street Lighting (H=9.0m)	No		6.0	
404	Sign Board (2.0m * 3.0m)	No		6.0	
405	Field Fence (H=2.0m)	m		210	
406	Remove Existing Roof	No		1.0	
407	New Roof on the Scale (22.0m * 10.0m)	No		1.0	
408	Repaint Existing Office	m <sup>2</sup>		463.0	
<b>Bill No. 4 Total</b>					

***Part 4:  
Specifications***

**BID DOCUMENTS**  
**FOR**  
**THE PROJECT FOR UPGRADING OF WEIGH STATION**  
**IN**  
**DONG HENG, NR9, SAVANNAKHET PROVINCE**  
**(2016/17 PILOT PROJECT UNDER JICA CAROL PROJECT)**

**PART 4**  
**SPECIFICATIONS**

**CONTENTS**

	<b>Page</b>
<b>Introduction</b> .....	<b>1</b>
1. Description .....	1
2. Reference Standards .....	1
3. Construction Program .....	1
4. Measurement Sheet for Payment .....	2
<b>100 GENERAL</b> .....	<b>3</b>
Section 101 Arrangement for Traffic during Construction .....	3
Section 102 Contractor's Establishment on Site .....	3
102.1 Office, Equipment, Testing Facilities, etc. ....	3
102.2 Legal Relations and Responsibility to the Public .....	3
Section 103 Information Furnished by the Employer .....	3
Section 104 Workmanship and Quality Control .....	4
Section 105 Work Executed by the Employer or Other Contractors .....	5
Section 106 Relocation of Utilities .....	5
Section 107 Maintenance of Existing Roads .....	6
Section 108 Remedial Work .....	6
Section 109 Water Supply Arrangements .....	6
Section 110 Facilities for the Engineer and His Staff .....	7
110.1 Description .....	7
110.2 Land for Facilities .....	7
110.3 Sole Use of Facilities .....	8
110.4 Utilities .....	8
110.5 Rented Premises .....	8
110.6 Offices and Furnishings .....	8
110.7 Laboratory and Equipment .....	9
110.8 Maintenance of Engineer's Facilities .....	9
Section 111 Setting Out and Cross Section Survey and Drawings .....	9
Section 112 Project Signboards .....	10
Section 113 Provision of Insurance, Bonds and Securities .....	10
<b>200 CIVIL WORKS</b> .....	<b>11</b>
Section 201 Removal of Existing Concrete Pavement .....	11

201.1 Description .....	11
201.2 Construction Requirements .....	11
201.3 Method of Measurement .....	11
201.4 Basis of Payment .....	11
Section 202 Ground Excavation .....	11
202.1 Description .....	11
202.2 Materials .....	11
202.3 Construction Requirements .....	12
202.4 Method of Measurement .....	13
202.5 Basis of Payment .....	13
Section 203 Subgrade Compaction .....	13
203.1 Description .....	13
203.2 Materials .....	14
203.3 Construction Requirements .....	15
203.4 Method of Measurement .....	16
203.5 Basis of Payment .....	16
Section 204 Base Course .....	17
204.1 Description .....	17
204.2 Materials .....	17
204.3 Construction Requirements .....	18
204.4 Method of Measurement .....	21
204.5 Basis of Payment .....	21
Section 205 Reinforced Concrete Pavement .....	22
205.1 Description .....	22
205.2 Materials .....	22
205.3 Equipment and Tools .....	24
205.4 Construction Methods .....	25
205.5 Tolerance in Pavement Thickness .....	38
205.6 Method of Measurement .....	38
205.7 Basis of Payment .....	38
Section 206 Stone Masonry .....	39
206.1 Description .....	39
206.2 Materials .....	39
206.3 Construction Requirements .....	39
206.4 Method of Measurement .....	39
206.5 Basis of Payment .....	39
<b>300 WEIGH SCALE AND SYSTEM .....</b>	<b>41</b>
Section 301 Weigh Scale and System .....	41
301.1 Description .....	41
301.2 Equipment .....	41
301.3 Training and Support .....	45
301.4 Method of Measurement .....	45
301.5 Basis of Payment .....	45
<b>400 ANCILLARY WORKS .....</b>	<b>46</b>



Section 401 Road Markings .....	46
401.1 Description .....	46
401.2 Materials .....	46
401.3 Construction Requirements .....	46
401.4 Method of Measurement .....	46
401.5 Basis of Payment .....	47
Section 402 Guide Post .....	47
402.1 Description .....	47
402.2 Materials .....	47
402.3 Manufacturing Requirements .....	48
402.4 Construction Requirements .....	50
402.5 Method of Measurement .....	50
402.6 Basis of Payment .....	50
Section 403 Street Lighting .....	51
403.1 Description .....	51
403.2 Electricity Supply .....	51
403.3 Materials and Equipment .....	51
403.4 Method of Measurement .....	52
403.5 Basis of Payment .....	52
Section 404 Sign Board .....	53
404.1 Description .....	53
404.2 Materials .....	53
404.3 Construction Requirements .....	54
404.4 Method of Measurement .....	55
404.5 Basis of Payment .....	55
Section 405 Field Fence .....	56
405.1 Description .....	56
405.2 Materials .....	56
405.3 Construction Requirements .....	59
405.4 Method of Measurement .....	62
405.5 Basis of Payment .....	62
Section 406 Remove Existing Roof .....	62
406.1 Description .....	62
406.2 Construction Requirements .....	62
406.3 Method of Measurement .....	62
406.4 Basis of Payment .....	63
Section 407 New Roof on the Scale .....	63
407.1 Description .....	63
407.2 Material .....	63
407.3 Construction Requirements .....	63
407.4 Method of Measurement .....	63
407.5 Basis of Payment .....	63
Section 408 Repaint Existing Office .....	64
408.1 Description .....	64
408.2 Material .....	64
408.3 Construction Requirements .....	64

408.4 Method of Measurement .....	64
408.5 Basis of Payment .....	64
<b>500 COMMON WORKS .....</b>	<b>66</b>
Section 501 Falsework and Formwork .....	66
501.1 Description .....	66
501.2 Materials .....	66
501.3 Construction Requirements .....	67
501.4 Measurement and payment .....	71
Section 502 Steel Reinforcement .....	71
502.1 Description .....	71
502.2 Materials .....	71
502.3 Construction Requirements .....	72
502.4 Measurement and payment .....	75
Section 503 Structural Concrete .....	75
503.1 Description .....	75
503.2 Grades and Use of Concrete .....	75
503.3 Materials .....	76
503.4 Construction Mix Design .....	80
503.5 Batching and Mixing Concrete .....	82
503.6 Protection of Concrete .....	86
503.7 Handling and Placing Concrete .....	87
503.8 Construction Joints .....	91
503.9 Finishing Plastic Concrete .....	92
503.10 Curing Concrete .....	94
503.11 Finishing Formed Concrete Surfaces .....	97
503.12 Precast Concrete Members .....	99
503.13 Mortar and Grout .....	100
503.14 Early Loading .....	100
503.15 Testing .....	101
503.15 Measurement and Payment .....	103
Section 504 Demolition Work .....	103
504.1 Description .....	103
504.2 Demolition Requirements .....	103
504.3 Measurement and Payment .....	104

APPENDIX 1 OFFICES FOR THE ENGINEER

APPENDIX 2 LABORATORY AND EQUIPMENT TO BE FURNISHED

APPENDIX 3 PROJECT SIGNBOARDS

## **SPECIFICATIONS**

### **Introduction**

#### **1. Description**

These specifications are prepared for the Project for Upgrading of Weigh Station in Dong Heng, NR9, Savannakhet Province (2016/17 Pilot Project under JICA CaRoL Project) (hereinafter referred to as “the PP) as a major components of the Project for Improvement of Road Management Capacity in Lao PRR.

#### **2. Reference Standards**

The Works shall be carried out in accordance with the relevant quality standards, test procedures or Codes of Practice, collectively referred to as Reference Standards, listed in the relevant part of the Specification. The Contractor shall familiarize himself fully with the requirements of such standards. If no standard is indicated or if the Contractor deems it necessary, he may propose to the Engineer the use of any alternative authoritative and internationally recognized Reference Standard which shall be no less exacting, in the opinion of the Engineer, than the corresponding standard quoted in these Specifications. The Contractor shall demonstrate to the Engineer that the alternative standard is suitable and equivalent to the specified standard, and provide proof of previous successful application of such standard. The Engineer will decide and advise the Contractor whether or not to accept such alternative standard as a Reference Standard.

#### **3. Construction Program**

The program shall be prepared in the formats acceptable to the Engineer and include at least the following details:

Time Bar-chart Program	Showing all main activities and relevant sub-activities
Organization Chart	Showing the site organization including all key staff and necessary divisions for the construction works.
Method Statement	Showing all details in this Specification.
Quality Control Plan	Showing all quality control matters to comply the technical specifications, drawings and other requirements.
Safety Plan	Showing all safety matters as stated in this Specification.

#### **4. Measurement Sheet for Payment**

The quantities shown in the Bill of Quantities attached to the Bid Documents are tentative; the actual quantities might be re-measured by the Engineer, or by the Contractor under the Engineer's instructions and supervision, at any time during the construction period based on the drawing.

The Contractor shall measure the area and/or volumes for all of the Works prior to and/or after completion, and shall submit the calculation sheets with sketch drawings to the Engineer for the letter's approval for payment.

## **100 GENERAL**

### **Section 101 Arrangement for Traffic during Construction**

The Contractor shall provide and maintain for the period of construction, traffic control and safety devices including traffic signs, traffic signals, barricades, traffic cones, lighting devices, etc., at all locations where work is in progress.

Material and equipment temporarily stored on, or adjacent to, the existing roadway shall be so placed, and the work at all times shall be so conducted as to cause minimum disruption to the traveling public. Warning signs and barrels will be required to separate the Contractor's material and equipment from the public.

The Contractor will not be permitted to have excavations open on both sides of the road at a particular chainage such that there is a step adjacent to public traffic which may create a danger to traffic – that is, the excavation and backfilling with base shall be flush with the existing road level on one side before excavation can proceed on the other side of road.

### **Section 102 Contractor's Establishment on Site**

#### **102.1 Office, Equipment, Testing Facilities, etc.**

It is the Contractor's responsibility to acquire land for the setting of all his offices, accommodation, stores, testing facilities, equipment yards and workshops and for all temporary works, and shall reinstate such land on completion of the Contract to the satisfaction of the Owner. The Contractor shall obtain approval of the Engineer for the setting of offices, accommodation, stores, testing facilities, equipment yards and workshops before such land is acquired and he shall indemnify the Employer against all claims and charges in respect of the occupation, use and reinstatement of the land.

The Contractor is solely responsible for the satisfactory accommodation of all his employees and for complying with all regulations and requirements in this respect.

#### **102.2 Legal Relations and Responsibility to the Public**

The Contractor shall take all necessary steps to comply with the Conditions of Contract, particularly in respect of the insurances and indemnities required, and he shall comply with all regulations of statutory authorities.

### **Section 103 Information Furnished by the Employer**

Certain information contained in the Contract documents or provided separately prior to Bid by the Employer is offered in good faith but there is no guarantee by the Employer that any or all of the information supplied is correct or representative of the actual conditions.

The Employer accepts no liability for the correctness or otherwise of the information supplied or for the resulting damages, whether direct or consequential, should it prove during the course of the Contract that the information supplied is either not correct or not representative. Any reliance which the Contractor places on this information shall be at his own risk and the Contractor shall be deemed to have checked the correctness of the information prior to submission of this Bid.

## **Section 104      Workmanship and Quality Control**

The Contractor is responsible for producing work which conforms in quality and accuracy in detail to the requirements of the Contract and he shall, at his own expense, institute a quality control system and provide experienced engineers, foremen, surveyors, material technicians, other technicians and other technical staff, together with all transport, instruments and equipment, to ensure adequate supervision and quality control of the Works at all times.

The cost of supervision and quality control, including testing, carried out by the Contractor shall be deemed to be included in the price bided.

The Contractor's attention is drawn to the provision of the various sections of the Specifications regarding the minimum frequency of testing that will be required for quality control. The Contractor shall, at his own initiative, increase this frequency where necessary to ensure adequate control.

On completion of every part of the Works and submission, the Contractor shall submit the results of all relevant tests and survey checks that he has carried out, indicating compliance with the Specifications, to the Engineer for his examination.

The Contractor shall furnish the manufacturer's test certificates to the Engineer. When required by the Engineer to carry out some essential tests at the manufacturer's plants or at laboratories other than the site laboratory, the cost of samples, sampling, testing and furnishing of test certificates shall be borne by the Contractor.

The method of sampling and testing of materials shall be as required under the relevant sections stipulated in these Specifications or as approved by the Engineer.

The Contractor shall demonstrate the adequacy of the equipment for each operation to establish its capability to achieve the requirements of the Specifications to the satisfaction of the Engineer before commencement of the Works.

All equipment provided shall be of proven efficiency and purpose for the required operation and shall be operated by skilled operators and maintained at all times to perform its proper function in a manner acceptable to the Engineer.

No equipment or personnel will be removed from Site without consent of the Engineer.

## **Section 105      Work Executed by the Employer or Other Contractors**

The Employer reserves the right to execute, on the Site, works not included in the Contract and to employ for this purpose either his own employees or other contractors.

The Contractor shall ensure that neither his own operations nor the actions of his employees interfere with the operations of the Employer or his contractors on such works and the same obligations shall be imposed on the Employer or contractors in respect of work being executed under the Contract.

The Contractor shall provide unhindered access to all parts of the Site to the Employer and authorized representatives of the Employer and of public bodies and corporations and to contractors employed by the Employer and he shall make available to such authorized persons the use of all temporary access track in or about the Site.

## **Section 106      Relocation of Utilities**

Any work involved in moving and reinstating existing utility facilities that may be affected by the construction of the Works shall be undertaken by the appropriate authority.

The Contractor may be ordered to carry out certain works for and on behalf of various statutory service authorities and he shall also provide, with the prior approval of the Engineer, such assistance to the various bodies as may be authorized by the Engineer.

No removal or alteration to any public utility shall be carried out unless ordered by the Engineer.

The Contractor shall take all reasonable precautions to protect, and shall provide temporary support to, existing utility facilities during the construction and during the relocation of such facilities.

Whenever utility facilities are encountered that interfere with the extension of the works and require moving or relocation, the Contractor shall advise the Engineer who will determine the extent of the works involved.

Any pipe, cable, conduit or other known utilities of any nature whatsoever, which have been damaged as a result of the Contractor's operations, shall be repaired and reinstated forthwith by the Contractor or by the authority concerned, all at the expense of the Contractor and to the satisfaction of the Engineer.

The Employer will not be held liable or responsible for any delay in completion of the Works under the Contract which may occur due to any damage occurring to such utilities in consequence of the Contractor's operations.

## **Section 107      Maintenance of Existing Roads**

The Contractor shall take all reasonable steps to minimize nuisance during the construction of the Works.

All existing highways and roads used by vehicles of the Contractor or any of his subcontractors or suppliers of materials or plant, and similarly any new roads which are part of the Works and which are being used by traffic, shall be kept clean and clear of all dust/mud/extraneous materials dropped by the said vehicles or their tires. Similarly, all dust/mud/extraneous materials from the Works spreading on these highways shall be immediately cleared by the Contractor.

Clearance shall be executed immediately by manual sweeping and removal of debris, or, if directed by the Engineer, by mechanical sweeping and cleaning equipment, and all dust, mud and other debris shall be removed entirely from the road surface. Additionally, if so directed by the Engineer, the road surface shall be hosed or watered using suitable equipment.

Any structural damage caused to the existing roads by the Contractor's constructional plant or equipment shall be made good at the Contractor's expense.

## **Section 108      Remedial Work**

When upon examination by the Engineer any part of the Works or any plant fails to conform to the requirements of the Specifications, or is at any stage before final acceptance damaged so that it no longer conforms to such requirements, the Engineer will instruct its complete removal and replacement, at the Contractor's expense, with satisfactory work, plant or material. In special cases the Engineer may instruct the Contractor to apply remedial measures in order to make good any such defects or damage. The actual remedial measures taken shall be entirely at the Contractor's own cost but subject to the Engineer's approval regarding the details thereof.

In particular, remedial measures shall ensure that the final products is in full compliance with the Specifications, shall not endanger any other part of the Works and shall be carefully controlled and submitted to the Engineer for examination when completed or at any intermediate stage as may be required.

## **Section 109      Water Supply Arrangements**

The Contractor shall make his own arrangement for the procurement, transportation, storage, distribution and application of water needed for construction and other purposes except where otherwise specified.

Only clean water from undesirable concentrations of deleterious salts and other materials shall be used.



Mechanically driven and operated water bowsers with effective spray equipment shall be provided at all times to ensure that compaction can proceed without any hold up on account of watering.

## **Section 110 Facilities for the Engineer and His Staff**

### **110.1 Description**

The Contractor shall provide offices for the Engineer and his staff as described in Appendix 1 hereto.

The facilities shall include the provision of land, site grading, access roads, parking facilities for vehicles, construction of buildings and all other necessary appurtenance such as drainage systems, fences, utilities, area development, etc.

The Contractor shall supply furniture, fittings, equipment, labor and material as detailed in the Appendices in order to provide fully functioning and usable facilities and to provide the Engineer's staff with the necessary resources for the administration and supervision of the Works.

After providing the facilities, the Contractor shall maintain them for the required duration of the Contract. Such maintenance shall include but shall not be limited to the following:

- Keeping buildings in good repair and decorative order, and free from pests, insects, etc.
- Maintaining the grounds around buildings
- Providing power, drainage, telephone services, fax and internet facilities
- Supplying toilet and cleaning equipment and materials
- Servicing and repairing all fittings and equipment installed (eg: air-conditioners, fans, etc)
- Providing adequate security for offices

Upon completion of the Works and when instructed by the Engineer the Contractor shall remove the facilities to the satisfaction of the Engineer.

### **110.2 Land for Facilities**

The Contractor shall construct the facilities on the land provided by the Owner or otherwise purchased or leased by the Contractor.

Where the Contractor leases land for construction of the facilities, the Contractor shall ensure the terms of the land lease allow the use of the premises for as long as they are required and shall take into account possible extension and use of the facilities after the issue of the Defects Liability Certificate. The terms of the lease shall incorporate provisions whereby the Contractor may assign his interests to the Owner.

110.3 Sole Use of Facilities

The facilities shall be for the sole use of the Engineer and his staff during the period of the Contract and as further required to carry out final inspection, etc., but shall revert to the Contractor when no longer required, unless otherwise stated or requested.

110.4 Utilities

The Contractor shall arrange, where possible, for the connection of water mains, drainage and sewerage and electricity to all facilities. In circumstances where location of facilities makes such connection impracticable, the Contractor shall provide and operate generators to supply adequate power and shall provide pumps to supply water from wells or storage tanks.

Telephone services including at least one direct line shall be provided as indicated in Appendix-1.

110.5 Rented Premises

Rented offices as an alternative to constructing buildings may be considered by the Engineer in locations where it is agreed upon near the site. Rents payable shall be at normal market rates and shall be subject to the approval of the Engineer. The total cost using the alternative of rented offices shall be such that there is no extra cost to the Employer compared with the expected construction cost.

110.6 Offices and Furnishings

The offices to be provided are described in Appendix-1. The offices including fittings, furnishings and equipment, shall be completed within two weeks from the commencement date of the Works. Where the Engineer approves, the Contractor may rent suitable premises in accordance with the Specifications. The offices shall remain the property of the Contractor upon completion of the Works.

Any rented offices provided shall be available and ready for use within one week of the above date.

The Contractor shall provide temporary office space for the period from one week from the commencement date until completion of the permanent offices. In the event of the Contractor failing to provide such temporary or permanent office facilities, the Engineer will provide suitable offices for his use. Costs incurred shall be paid by the Contractor.

The fittings, furnishings and equipment to be provided in the offices are described in Appendix-1, and shall remain the property of the Contractor upon completion of the Works.

110.7 Laboratory and Equipment

The laboratory to be provided is described in Appendix-2. The operational laboratory facility, complete with equipment, shall be ready for use within two weeks from the date of the Engineer's Notice to Commence the Works.

At the end of its use, the laboratory and equipment shall become the property of the Contractor.

110.8 Maintenance of Engineer's Facilities

The Contractor shall maintain in good decorative and working order all the buildings and the contents thereof supplied under the Contract. The Contractor shall be responsible for supplying all power, water and telephone services to all the facilities, and shall bear all costs for these services unless otherwise stated.

The maintenance of the Engineer's offices shall include daily cleaning to the satisfaction of the Engineer's Representative and provision of toilet materials.

The Contractor shall maintain all grounds and gardens that surround the buildings to the satisfaction of the Engineer.

The Contractor shall maintain in good condition, service regularly and repair or replace as required all items of furniture, fittings and equipment supplied and installed in the offices.

The Contractor shall provide adequate security to guard and secure the facilities on a 24 hours per day basis.

The Contractor shall be responsible for the cost of all local telephone charges but shall not be responsible for the cost of any overseas calls made from telephones provided in the offices.

**Section 111      Setting Out and Cross Section Survey and Drawings**

The Contractor shall check the condition of all permanent Ground Markers and shall satisfy himself that they have not been damaged or disturbed and are true in regard to position and level. Where markers have been destroyed, damaged or displaced the Contractor shall reinstate a new marker based in the markers which remain. A new marker shall not be used unless its true position and level have been established and the new values verified by the Engineer.

Where a marker is likely to be disturbed during construction operations the Contractor shall establish suitable reference markers at locations where they will not be disturbed during construction. No marker shall be covered, disturbed or destroyed before accurate reference markers have been established and the details of the position and level of such markers have

been submitted to the Engineer and approved by him. The Contractor's reference markers shall be of least the same quality and durability as those of the existing markers.

The Contractor shall submit to the Engineer the method of setting out he proposes to employ. To ensure beyond doubt that the complex elements of the road or structure are truly and correctly located the Contractor shall check all setting out by a different approved method. The Engineer may at any time request the Contractor to submit proof that his setting out has been satisfactorily checked.

Accurate control of line and level shall be provided by the Contractor at all stages of construction. In respect of the road itself control shall be at 20m intervals, or such closer intervals as may be directed, on horizontal and vertical curves..

The Contractor shall make all provisions necessary for the Engineer to check and measure the setting out of the Works and shall be in attendance to agree measurements and levels before construction works commence.

## **Section 112      Project Signboards**

The Contractor shall erect signboards in accordance with Appendix-4: Project Signboards at the locations determined by the Engineer.

At the end of the Contract all such signboards shall be removed and ground reinstated to the approval of the Engineer.

## **Section 113      Provision of Insurance, Bonds and Securities**

The Contractor shall provide all necessary insurances, bonds, guarantees and securities as required in Part 2: Conditions of Contract.

## 200 CIVIL WORKS

### **Section 201      Removal of Existing Concrete Pavement**

#### 201.1    Description

The work consists of removal of existing concrete pavement at locations to be reconstructed.

#### 201.2    Construction Requirements

Where reinforced concrete pavement is to be re-constructed as shown in the drawing, the existing concrete pavement shall be removed as specified on the drawings or as directed by the Engineer. Removal edge of existing pavement shall be trimmed to a vertical face.

#### 201.3    Method of Measurement

The quantities shall be measured on cubic meters and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

#### 201.4    Basis of Payment

The accepted quantities shall be paid for at the Contract unit price for each of the Pay Items listed in the Bill of Quantities, which price and payment shall be full compensation for removing and disposing of obstruction, including all materials, labor, equipment, tools and incidentals necessary to complete the work prescribed in this item. The price shall also include backfilling, hauling of salvaged materials, storage or disposal.

Payment shall be made under:

Bill Item No	Description	Unit
201	Removal of Existing Concrete Pavement	m <sup>3</sup>

### **Section 202      Ground Excavation**

#### 202.1    Description

Ground Excavation shall comprise excavation and disposal of all materials of whatever character encountered within the working area that is not classified as rock excavation or which is not otherwise classified.

#### 202.2    Materials

Suitable material shall comprise all material which is acceptable in accordance with the

Specifications for use in the Works and which is capable of being compacted in the manner required by the Specifications to form a stable embankment or fill having side slopes as indicated on the Drawings.

Unsuitable material shall comprise all material which, in the opinion of the Engineer, is not suitable for embankment and/or backfill, such as deep topsoil not removed by clearing and grubbing, highly organic clays and silts and peat.

Materials which are soft or unstable merely because they are too wet or dry shall not be classified as unsuitable, unless otherwise instructed by the Engineer.

### 202.3 Construction Requirements

Excavation operations shall be conducted without disturbing the material outside the staked construction limits.

Prior to the start of excavation operations, all necessary clearing, grubbing and top soil removal in that area shall be completed.

All excavated material shall be used, as far as is reasonably practical, in the formation of the embankment and/or subgrade and at such other places as directed by the Engineer, unless it is declared unsuitable.

No excavated suitable material shall be wasted without permission of the Engineer, and when such material is permitted to be wasted, it shall be so placed in locations approved by the Engineer that it will present a neat appearance and not be an injury to abutting property or to the general environment.

Stockpiles of suitable material for reuse shall be neatly and compactly constructed in an approved manner.

In steeply side-sloping terrain, unless otherwise specifically approved by the Engineer in writing, surplus material excavated from the upper side slope shall not be allowed to be deposited over the lower side slope, and special care shall be taken to preserve vegetation on the lower side slope for the purpose of erosion protection. No material shall be disposed of close to culvert or bridge locations or adjacent to any water course or irrigation facility or at locations where any private properties or crops etc. on the lower side slope, could be damaged.

During the construction work, the formation shall be maintained in such a condition that it will be well-drained at all times. Care shall be taken to ensure that side berms are not created at the edges of the excavation trapping water within the excavation. Side ditches emptying from cut to embankment areas shall be so constructed to prevent damage to embankment area by erosion.

In order that the subgrade and/or base course shall not be subject to wetting, during or after

construction, the Contractor shall at all times provide adequate drainage by scheduling ditch work or outlet construction so as to prevent such wetting. The Contractor shall clean and trim all such ditches from time to time and or when instructed by the Engineer, so that there may be a free water flow throughout the execution of the Works.

Damage to the Works attributable to wetting through failure to provide such adequate drainage shall immediately be made good by the Contractor at his own expense.

Excavation shall proceed in such sequence and manner and shall be so coordinated with other phases of construction that suitable conditions for the maximum drainage discharge will be provided at all times.

Excavation shall be discontinued when climatic conditions prevent the placing and compacting of the excavated material in accordance with the Specifications.

The subgrade shall be prepared in accordance with the requirements of Section 205 of the Specifications.

202.4 Method of Measurement

The quantities shall be measured on cubic meters and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

202.5 Basis of Payment

The accepted quantities shall be paid for at the Contract unit price for each of the Pay Items listed in the Bill of Quantities, which price and payment shall be full compensation for removing and disposing of obstruction, including all materials, labor, equipment, tools and incidentals necessary to complete the work prescribed in this item. The price shall also include backfilling, hauling of salvaged materials, storage or disposal.

Payment shall be made under:

Bill Item No	Description	Unit
202	Ground Excavation	m <sup>3</sup>

**Section 203 Subgrade Compaction**

203.1 Description

This work shall consist of the compaction of subgrade surface by rolling or tamping or any combination of these methods in accordance with the requirements of the Drawings and the Specification, or as instructed by the Engineer.

203.2 Materials

(A) Moisture-Density Tests

Moisture-density tests and preliminary studies will be made of each type of soil to be used in the construction of the Works to determine the maximum dry density (MDD), the optimum moisture content (OMC) and the moisture range required for satisfactory compaction. The field density and actual moisture content of the compacted subgrade shall be determined by field tests.

The MDD, as determined by the moisture-density test, shall be the density to which the field density is referred to for comparison.

The OMC shall be the moisture content corresponding to the MDD on the moisture-density curve.

The moisture range shall be the limits of the moisture content for each type of soil within which the required density can be attained.

The field density shall be the density of the compacted subgrade determined by the field density test.

The moisture content shall be the actual moisture content of the soil in the compacted subgrade at the time of compaction.

(B) Sampling and Testing

Sampling and testing shall be performed in accordance with the following AASHTO test methods:

Test	Description
AASHTO T 99	Moisture-Density Relationship (2.5 kg rammer)
AASHTO T 180	Moisture-Density Relationship (4.54 kg rammer)
AASHTO T 191	In-place Density, Sand-Cone Replacement
AASHTO T 205	In-place Density, Rubber-Balloon
AASHTO T 265	Moisture Content

(C) Compaction Trials

The precise manner in which the subgrade is to be compacted shall be the subject of field compaction trials to establish the type, sequence and numbers of passes of the Contractor's compaction equipment necessary to obtain the degree of compaction specified, the OMC associated with such equipment, and the loose thickness of layers which can be effectively compacted.

The Contractor shall perform compaction trials prior to the commencement of compaction



work, and put forward in writing to the Engineer for his approval a detailed work method statement including a list of equipment he proposes to use.

The soil and compaction equipment used in the trials shall be approved by the Engineer.

The field compaction trials shall proceed until such time as the Engineer and the Contractor are agreed on the procedure necessary to obtain the specified degree of compaction. The agreed procedure, embracing the type, sequence and nominal number of passes of the equipment required to compact a layer of given thickness, and the limits within which the moisture content of the soil shall lie at the time of compaction, shall be recorded and shall thereafter form the basis of the field control of the compaction equipment on that material.

A field compaction trial shall be carried out on each type of material, including material exposed in cuts, and for each standard of compaction, as determined by the Engineer. The Engineer may stop the work or order further field compaction trials if the required degree of compaction is not being obtained consistently in the Works.

### 203.3 Construction Requirements

#### (A) General

Compacting operations shall include adequate blading with motor graders to ensure uniformity of the surface being compacted. The number of graders and rollers in use shall be sufficient to blade and compact adequately all material within the site.

#### (B) Compaction Equipment

All compaction equipment shall be approved by the Engineer, and proven satisfactory performance shall be the basis for such approval.

The weight of rollers shall be increased as necessary to obtain the degree of compaction required by the Specifications.

#### (C) Work Quality Control

If the soil encountered in earth cuts at the subgrade level is found by test to be unstable, or that its 4 day soaked CBR when compacted to 98% MDD in accordance with AASHTO T 180 Method D, is less than 6, the soil shall be declared as unsuitable and shall be removed to the depth instructed by the Engineer, and the unsuitable material replaced with suitable stable material as instructed by the Engineer.

Whenever the work area is placed adjacent to structures or at locations where it is not practicable to use a roller, the material shall be tamped by the use of mechanical rammers or hand tampers acceptable to the Engineer.

The layer shall be compacted to a density equal to or greater than that obtained under the

rolling procedure for the type of compaction designated.

The moisture content of the soil at the time of compaction shall be uniform and shall be such that the soil can be compacted to the requirements of this Section of the Specifications.

Work on compaction of the materials shall only be carried out when the material has moisture content within the limits agreed in the compaction trials.

Moisture content shall be increased or decreased as necessary to obtain the required density and stability.

(D) Compaction Requirements

The material located within 300 mm below subgrade level shall be compacted to a characteristic value of 98% of the MDD as determined according to AASHTO T 180 Method D.

In-place field density measurements shall be determined using AASHTO T 191 or AASHTO T 205 if approved by the Engineer.

(E) Maintenance of during Construction

The Contractor shall protect finished subgrade surface from weather and erosion and keep them free of rubbish and debris and repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances. Where completed areas are disturbed by subsequent construction operations or adverse weather, the Contractor shall scarify the surface, reshape and compact to the required density in accordance with the Specifications prior to further construction.

203.4 Method of Measurement

The quantities shall be measured on square meters and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

203.5 Basis of Payment

The accepted quantities shall be paid for at the Contract unit price for each of the Pay Items listed in the Bill of Quantities, which price and payment shall be full compensation for removing and disposing of obstruction, including all materials, labor, equipment, tools and incidentals necessary to complete the work prescribed in this item. The price shall also include backfilling, hauling of salvaged materials, storage or disposal.

Payment shall be made under:

Bill Item No	Description	Unit
203	Subgrade Compaction	m <sup>2</sup>

**Section 204 Base Course**

204.1 Description

This work shall consist of furnishing and placing one or more layers of crushed aggregate base course, bound by means of controlled moisture content, on a prepared sub-base and in conformity with the lines, grades, thickness and typical cross sections shown on the Drawings or established by the Engineer.

204.2 Materials

(A) General

The coarse and fine aggregates for base shall consist of crushed rock, clean, tough, durable, sharp-angled fragments free of any excess of thin or elongated pieces, and reasonably free of soft, disintegrated or decomposed stone, dirt or other deleterious matter.

The aggregate shall be obtained by crushing material, which if so instructed by the Engineer, has first been screened in such a manner that not less than 90% of the material to be crushed is retained on a 6.3mm sieve. The amount of crushing shall be regulated so that at least 80% by weight of the pieces retained on a 4.75 mm sieve have at least two mechanically fractured faces.

(B) Grading Requirements

Material for base course shall be crushed rock and the combined aggregate shall have the following grading:

AASHTO Sieve (mm)	Percent Passing (by weight)	
	Type A	Type B
50.0	100	–
37.5	90 – 100	100
25.0	75 – 95	85 – 100
19.0	60 – 90	70 – 90
9.5	40 – 75	50 – 85
2.0	20 – 45	25 – 45
0.425	10 – 26	10 – 25
0.075	4 – 12	5 – 15

(C) Other Requirements

The combined material passing the 19 mm sieve shall have a California Bearing Ratio (4 days soaked) by test AASHTO T193, of at least 80 percent (at the maximum dry density).

Aggregate retained on the 2.0 mm sieve shall have a percentage wear, by Los Angeles test AASHTO T96, of not more than 40%.

Coarse aggregate flakiness and elongation indices, determined by BS 812, shall not be greater than 35%. Soundness loss shall not be greater than 12% as determined by AASHTO T 104.

The fraction passing the 0.425 mm sieve shall have a liquid limit not greater than 20 and plasticity index not greater than 6 nor less than 2 and the Plasticity Product (PI x percentage passing the 0.425 mm sieve) shall not exceed 90.

The aggregate shall have a 10% Fines Value (wet) of not less than 130 kN and the Wet Dry Variation of the 10% Fines Value shall not exceed 40%.

(D) Acceptance of Production Materials

The aggregate will be accepted immediately following mixing based on periodic random samples taken from the mixing plant output. Acceptance of the material by the Engineer does not constitute acceptance of the base, only that the material is approved for use in the base.

204.3 Construction Requirements

(A) General

The surface on which base is to be placed shall be well compacted, smooth, hard and uniform, with all irregularities having been bladed out and rolled down, and approved by the Engineer prior to the placing of base material.

Immediately prior to placing base, the complete surface of the sub-base shall be proof rolled. Proof rolling shall comprise 2 passes of a 6 wheeled truck with the rear 4 wheel single axle loaded as approved by the Engineer. Compliance of proof rolling shall be when an area withstands test rolling without visible deformation or springing. The Contractor shall at his own expense carry out any additional compaction and testing necessary to achieve the requirements specified herein for proof rolling.

(B) Placing

When the thickness of base exceeds 150mm, the base shall be compacted in two equal layers. The compacted thickness of any layer shall not be less than 75mm, nor exceed 150mm.

(C) Combining Aggregates and Water

Aggregates for base shall be combined into a uniform mixture and water added in a central mixing plant in a manner approved by the Engineer.

When binder is to be added, it shall be combined in the central mixing plant.

The amount of water added to the aggregate shall be that required to obtain the specified density, giving a mixture which is completely ready for compaction after spreading. In no case will the wetting of aggregates in stockpiles or trucks be permitted.

(D) Spreading

Immediately after mixing, the base mix material shall be delivered to the construction site as a uniform mixture and shall be placed on the subgrade in a uniform layer or layers.

The material shall be so handled as to avoid segregation. All segregated material shall be removed and replaced with well-graded material. No “skin-patching” shall be permitted.

Unless otherwise approved by the Engineer spreading shall be done by an approved self-propelled paving machine or spreader box which distributes the material to the required width and uniform depth without delay. If the paving machine or spreader causes segregation or leaves ridges or other objectionable marks on the surface which cannot be eliminated easily or prevented by adjustment of the paving machine or spreader operation, the use of such a paving machine or spreader shall be discontinued and replacement equipment provided.

No hauling or placing of material will be permitted when, in the opinion of the Engineer, the weather or road conditions are such that hauling operations will cause cutting or rutting of the surface or contamination of the base material.

(E) Compaction

Immediately after placing, the base material shall be compacted to a characteristic value of relative dry density of not less than 98% of maximum dry density as determined by AASHTO T 180 Method D. In-place density shall be determined by AASHTO T 191 or, if approved by the Engineer, AASHTO T 205. The use of AASHTO T 224 to correct for oversize particles may be required.

Rolling shall be carried out until the entire thickness of each layer is thoroughly and uniformly compacted to the density specified. Rolling shall be accompanied by sufficient blading in a manner approved by the Engineer, to ensure a smooth surface, free from ruts or ridges and having the proper section. When additional water is required it shall be added in a manner approved by the Engineer. The Contractor shall ensure that the required compaction is obtained throughout each layer and for the full finished width of the base. Filling outside the finished base width will be necessary in order to achieve the required compaction for the full finished base width.

The Contractor shall plan the work and handle the various operations so that the least amount of water will be lost by evaporation from non-compacted surfaces.

If the material is laid and compacted in two layers, the Contractor shall plan and coordinate the work in such a manner that the previously placed and compacted layer shall be allowed ample time for drying and development of sufficient stability before vehicles hauling materials for the succeeding layer, or other heavy equipment, are permitted on the base.

Each layer of base shall be completely compacted, and approved by the Engineer, prior to the delivery of material for a succeeding layer.

Prior to placing the succeeding layer of material, the top of the under-layer shall be made sufficiently moist to ensure bond between the layers.

Samples shall be taken from the compacted layers for testing to ensure that the compacted material complies with the requirements of Section 206.2 herein.

If after the base is compacted, any areas fail to meet the specified density and grading requirements, or are outside the specified tolerances, such areas shall be loosened and after having had additional materials added or excess material removed, as the case may be, shall be reconstructed as described herein.

Edges and edge slopes shall be bladed or otherwise dressed to conform to the lines and dimensions shown on the Drawings and present straight, neat and workmanlike lines and slopes as free of loose materials as practicable.

Where there has been 4 hours or more between laying adjoining layers, the joints (transverse and longitudinal) shall be cut back to a full height vertical face. The material arising from this cut back may be spread in a thin layer under the layer being laid.

Pins supporting wire guidance of the paver shall be spaced at a maximum of 5 meters.

(F) **Compaction Trials**

Prior to the commencement of his base course operations, the Contractor shall construct trial lengths as instructed by the Engineer. The material used in the trials shall be that approved for use as base and the equipment used shall be that which the Contractor intends to use for the work proper.

The objective of these trials shall be to determine the adequacy of the Contractor's equipment, the loose depth necessary to result in the specified compacted layer depth, the field moisture content, and the relationship between the nominal number of compaction passes and the resulting density of the material.

The Contractor may proceed with base course work only after the methods and procedures established in the trials have been approved by the Engineer.

Each trial length will be 100 meters long and trials shall be repeated as necessary until compaction procedures acceptable to the Engineer are achieved. The trial lengths will be

incorporated in the Works provided the requirements of this Section are met, and no additional payment will be made for them.

(G) Tolerances

The thickness of the layer at any point shall not vary by more than -15 mm from that specified.

The variation of the surface of finished base from any two points of contact with a 3 meter long straight-edge shall in no case exceed 15 mm when placed on or parallel to the centerline or 10 mm when placed perpendicular to the centerline of the roadway.

Finished base shall not be lower than the required elevation by more than 15 mm, nor exceed it by more than 15 mm.

All humps and depressions and thickness deficiencies exceeding the specified tolerances shall be corrected by removing the defective work or by adding new material as instructed by the Engineer. Adding new material to areas of thickness deficiency, or segregated areas in the form of skin patching will not be permitted.

(H) Maintenance of Base

Following construction, the compacted base shall be maintained by the Contractor at his own expense. The Contractor shall blade, broom and otherwise maintaining the base, keeping it free from ravelling, and other defects until such time as the prime coat is applied. Water shall be applied at such times as is necessary or as instructed by the Engineer.

The Contractor shall ensure that proper drainage of the pavement and shoulder area is maintained at all times.

The surface of the base shall be approved by the Consultant before the prime coat is applied. The surface shall be hard, dense, tight mosaic, free from dust and caked fines.

204.4 Method of Measurement

The quantities shall be measured on cubic meters and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

204.5 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
204	Installation of Base Course	m <sup>3</sup>

## **Section 205 Reinforced Concrete Pavement**

### 205.1 Description

This work shall consist of constructing a Portland cement concrete pavement with or without reinforcement accepted sub-grade or base in accordance with this Specification and in conformity with the lines, levels, grades, dimensions and cross-sections shown on the Drawings. Portland cement concrete pavement shall consist of a mixture of Portland cement, fine aggregate, coarse aggregate and water, with or without admixtures.

### 205.2 Materials

#### (A) Portland Cement Concrete

Applicable concrete shall conform to the bending strength more than 4.5N/mm<sup>2</sup> shall be decided upon the trial mix test at the site.

#### (B) Reinforcement Steel

Pavements which are reinforced shall contain steel-wire fabric or bar-mat reinforcement, as shown in the Drawings and dowels, tie bars and other details as necessary.

Wire-fabric and bar-mat reinforcement shall extend to within 5 centimeters of each side of the slab. The sheets shall be furnished in such lengths that, with at least the minimum lap between sheets, the reinforcement extends to within 5 centimeters of transverse expansion or construction joints.

Steel-wire fabric reinforcement shall conform to the requirements of AASHTO M 55. It shall be furnished in flat sheets.

Bar-mats shall conform to the requirement of AASHTO M 54. The bars shall conform to the requirements of TIS 20, grade SR 24. Members shall be of the size and spacing shown on the Drawings.

Dowel and tie bars shall conform to the requirements of AASHTO M 31 and M 42. Dowels bars shall be SR 24 and tie bars shall be SD30, all in accordance with TIS 20 and TIS 24. Dowels bars shall be plain round bars. They shall be free from burring or other deformation restricting slippage in the concrete. Before delivery to the site of construction, one-half of the length of each dowel bar shall be painted with one coat of lead paint or asphaltic



material. Tie bars shall be deformed bars. Rail steel shall not be used for tie bars which are to be bent and restraightened during construction.

(C) Sleeves

The sleeves for dowel bars shall be of metal or approved synthetic material. These shall be designed to cover not less than 5 centimeters nor more than 7.5 centimeters of the dowel, with closed ends, and with suitable stops to hold the end of the sleeve a distance equal to the thickness of joint filler or at least 2.5 centimeters from the end of the dowel bar.

Sleeves shall be of such design that they do not deflect or collapse during construction, and the arrangement of sleeves shall be in accordance with Section 205.4, (I) in the Specification.

(D) Base Materials

Requirement of base course material shall be in accordance with Section 204.2 in the Specifications.

(E) Subgrade Paper

The Subgrade paper shall conform to the requirements of AASHTO M 74 or other approved by the Engineer.

(F) Plastic Membrane

Plastic Sheeting used as a separation membrane under the pavement shall be dispensed from rolls immediately ahead of the paving machinery; joints in the sheeting should provide a lap of at least 20 cm. The width of roll shall be at least 1.20 m and the thickness of the plastic should be 0.07 mm with a tolerance not greater than seven percent.

(G) Jointing Materials

The expansion joint fillers shall conform to the requirements of AASHTO M 153 or M 213 as shown in the Drawings. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise authorized by the Engineer. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened closely together securely and accurately to shape by stapling or other positive fastening satisfactory to the Engineer.

Joint priming compound shall be Expandite No.3 or other approved compound.

Joint sealing material shall be Expandite Plastic hot poured rubber-bitumen sealing compound Grade 99 or other approved compound.

### 205.3 Equipment and Tools

#### (A) General

Equipment and tools necessary for handling materials and performing the work, and satisfactory to the Engineer as to design, capacity, and mechanical condition, shall be at the site of the work before work is started.

If any equipment is not maintained in full working order or if the equipment as used by the Contractor proves inadequate to obtain the results prescribed, such equipment shall be improved or other satisfactory equipment substituted or added at the discretion of the Engineer.

#### (B) Finishing Equipment

The finishing machine shall be of the screening and troweling type equipped with two independently operated screeds, designed and operated to strike off the concrete. It shall be fully and accurately adjustable for loss of crown or other disarrangement due to wear.

Vibrators for full width vibration of concrete paving slabs may be either the surface pan type or the internal type. They may be attached to the spreader finisher. They shall not come in contact with the joint, load transfer devices, sub-grade or side forms. The frequency of the surface vibrators shall not be less than 3,500 impulses per minute and for the internal type not less than 500 impulses per minute.

#### (C) Joint Cutting Saw

The mechanical saw for cutting joints shall be adequately powered to cut rapidly with a water cooled diamond edge saw blade or an abrasive wheel to the depth required. When sawing of joints is carried out the Contractor shall keep a stand-by power saw on the project.

#### (D) Forms

Straight side forms shall be metal forms having a thickness of at least half a centimeter and have a depth equal to the prescribed edge thickness of the pavement slab.

Curved forms shall be of the radius called for on the Drawings and acceptable flexible forms shall be installed with that radius.

Built up forms with horizontal joints shall not be used. Forms shall be free from kinks, bends or warps. Forms shall not deflect more than 6 millimeters when tested as a simple beam with a span of three meters under a load equal to that which the finisher or other construction equipment will exert on them. The base width of forms shall at least equal the effective height. The top of the form shall not vary from a three meter straight edge by more than 3 millimeters at any point and the side by more than 6 millimeters at any point.

The forms shall contain provision for locking together tightly the ends of abutting form sections and for secure setting.

(E) Curing Materials

The burlap used for curing shall be made from jute or hemp and at the time of using shall be in good condition, free from dirt, clay or any other substances which interfere with its absorbing quality. It shall not contain any substance which would have a deleterious effect on the concrete. Burlap shall be of such quality that it will absorb water readily when dipped or sprayed and shall weigh not less than 240 grams per square meter when completely dry.

Sand shall be clean, sharp and free from any clay balls or any other deleterious matter.

Liquid membrane forming compounds shall conform to the requirements of AASHTO M 148 type 2.

205.4 Construction Methods

(A) Preparation

Before forms are set and paving operations are begun, the roadbed within the proposed pavement lines shall have been graded and compacted to proper line and surface elevation, any base course, or other preliminary work including compaction shall have been completed, all structures shall have been brought to proper grade and alignment, and the roadbed shall have been trimmed approximately to correct elevation for a width extending at least 60 centimeters beyond each edge of the proposed concrete pavement. Generally sufficient roadbed shall have been trimmed and approved to permit forms to be set for at least 2 days' concreting ahead of the point where concrete is being placed.

(B) Setting Forms

(i) Base Support

The roadbed under the forms shall be compacted and cut to grade so that the forms, when set, shall be uniformly and adequately supported for their entire length and at the specified elevations. Roadbed found to be below established grade at the form line shall be filled to grade in lifts of one centimeter or less for 45 centimeters on each side of the base of the forms and thoroughly rerolled or tamped. Imperfections and variations above grade shall be corrected by tamping or by cutting to the degree required.

(ii) Advance Setting

Forms shall have been set, checked and approved by the Engineer for at least half the length of pavement to be concreted in a particular day before concreting shall commence on that day. Unless prior approval has been obtained from the Engineer for concreting short

sections, the length of formwork set, checked and approved by the Engineer shall not be less than 150 meters at the time of commencement of concreting on any one day.

(iii) Staking Forms

Forms shall be staked into place with three or more pins for each 3 meter section, one pin being placed near each the end of the section. Form sections shall be tightly locked, free from play or movement in any direction. The forms shall not deviate from true line by more than six millimeters at any point. Forms shall be cleaned and oiled prior to the placing of concrete.

(iv) Grade and Alignment

The alignment and grade elevations of the forms shall be checked and the necessary corrections made by the Contractor immediately before and after placing the concrete. When any form has been disturbed or any roadbed has become unstable, the form shall be reset and rechecked.

(C) Condition of Roadbed

The roadbed shall be checked for conformity with the crown and elevation shown on the drawing by means of a toothed template riding on the side forms. If necessary material shall be removed or added, as required, it shall be confirmed all portions of the roadbed at the correct elevation. It shall then be compacted thoroughly and again checked with the template. Concrete shall not be placed on any portion of the roadbed which has not been checked and approved by the Engineer.

If the roadbed is disturbed after acceptance it shall be reshaped and compacted without additional compensation.

The finished roadbed shall be in a smooth, compacted condition when the concrete is placed, and shall be moist, but under no circumstances will concrete be placed on a muddy or unclean surface. If the roadbed is dry at the time the concrete is to be placed, it shall be sprinkled. The method of sprinkling shall be such that it does not form pools of water. If required by the Engineer the roadbed shall have been moistened at a time dependent on weather conditions prior to the placing of the concrete.

(D) Limitations of Mixing

No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

Concrete shall be mixed only in the amount required for current use.

The Contractor shall be responsible for producing concrete of the required consistency. Should it prove impracticable to finish centrally mixed concrete properly before it has

become too stiff, the Engineer may require that the concrete be mixed at the site of the work.

(E) Placing Concrete

Concrete shall be placed only on a roadbed that has been prepared as specified in Section 205.4 (C) in the Specification. No concrete shall be placed around structures until they have been brought to the required grade and alignment, nor until expansion joint material has been placed around them.

Unless truck mixers, truck agitators, and other approved hauling equipment are equipped with means for discharge of concrete without segregation of the materials, the concrete shall be unloaded into a bucket, which shall be lifted over the roadbed and the concrete deposited there from in such a way as to prevent segregation or pre-compaction of the materials.

Concrete to be reinforced shall be placed in two layers, the bottom layer being stuck off at the level for the reinforcement or as designated on the Drawings.

The concrete shall be distributed so as to require as little re-handling as possible and so that when the layer is consolidated and finished the thickness required will be provided, with the surface at no point below the required elevation.

Unless otherwise instructed by the Engineer, spreading shall be accomplished by the use of a mechanical concrete spreader of a type and design approved by the Engineer. Hand spreading at joints shall be done with shovels, not with rakes. Workmen with earth or other foreign material on their boots or shoes shall not walk in the freshly mixed concrete.

Placing shall be continuous between transverse joints, except in case of emergency.

The concrete shall be thoroughly consolidated against and along the faces of all forms by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the roadbed, or a side form. In no case shall the vibrator be operated longer than 30 seconds in any one location.

Where concrete is to be placed adjoining a previously constructed concrete slab, the Contractor shall carry out any work the Engineer deems necessary to provide a good joint including drilling and grouting load transfer bars into the existing slab.

Should any concrete materials fall on or be worked into the surface of a completed slab they shall be removed immediately by approved methods to the full satisfaction of the Engineer.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket on to a joint assembly.

Except at construction joints, concrete shall be shoveled against both sides of the joint simultaneously, maintaining equal pressure on both sides. It shall be deposited to a height of approximately 5 centimeters more than the depth of the joint, and shall be vibrated so that all honeycomb and voids are prevented. The vibrator shall be inserted in the concrete and worked along the full length and both sides of the joint.

The reinforcement shall be placed on the bottom layer and the second and upper layer of concrete shall be placed before initial set of the bottom layer has occurred. Displacement of the reinforcement during subsequent concreting shall be prevented.

(F) Initial Strike – Off and Placement of Reinforcement

The bottom layer of concrete shall be struck off for the full width true to crown at the required distance below the finished surface elevation, for placement of reinforcement or for placement of a top layer of the required thickness.

The striking – off shall be accomplished by use of the finishing machine, unless some other approved device is provided therefore or unless the use of hand methods is specifically authorized by the Engineer at specific locations such as changes in width, or in case of emergencies.

Wire – fabric or bar – mat reinforcement shall be laid on the surface of the bottom layer of concrete. Equal clearance shall be provided on each side of the slab, successive sheets shall be lapped as called for on the Drawings, and the reinforcement shall extend to within 5 centimeters of transverse expansion and contraction joints, but shall not extend across the joints. It shall be continuous without interruption at emergency construction joints. At laps, the sheets shall be wired or slipped together firmly at intervals of not more than 1 meter.

The reinforcement, when placed, shall be free from dirt or other foreign matter, and shall not be so rusted as to impair bond of the steel with the concrete.

Cross bars or bar mats shall be overlapped at least 10 centimeters.

(G) Joints

Joints shall be of the designs shown on the Drawings and shall be constructed where called for on the Drawings or instructed by the Engineer. Before any joint materials are set in place, the roadbed at those locations shall have been approved by the Engineer.

A strip of the preformed expansion joint filler shall be placed around each structure which extends into or through the pavement before concrete is placed.

The material for a transverse expansion joint shall be assembled off the roadbed, and placed into position as a unit.

Each assembly shall consist of an installing bar or approved substitute, preformed joint

filler of the required dimensions, a protective metal cap of at least 2.5 millimeter thick and material having flanges not less than 3.75 centimeters deep, dowel bars of the required size and length assembled at the required locations, dowel bar sleeves, and an approved auxiliary spacing and supporting element for the dowel bars, located at or near the ends of the bars.

The installing bar shall be steel plate cut to the required depth and crown of the slab and having a length 1 centimeter less than the required length of the joint. It shall be slotted from the bottom as necessary to permit removal. Suitable means shall be provided on the bar for facilitating its removal.

The protective metal cap may be either a separate component or a part of the installing bar.

The installing bars and protective caps shall be cleaned and oiled before use.

One end of each dowel bar shall be thoroughly coated with a brush coat of asphalt MC-250, graphite lubricant, or equivalent other material adequate in the opinion of the Engineer to prevent the concrete from bonding to that portion of the dowel. A dowel sleeve shall be placed on the coated end of each dowel.

The supporting element shall be of such design and construction as to hold dowels in correct alignment, both vertically and horizontally, subject to a tolerance of not more than 1 millimeter in 10 centimeters.

When assembled, the top of the installing bar shall be about 5 millimeters above the top of the preformed filler, the filler shall be vertical when the dowel bars are level, the face of the filler shall be in a plane at right angles to the center line of the road, subject to a tolerance of not more than 5 millimeters in the width of a traffic lane, and the dowels shall be parallel and at right angles to the face of the filler.

The joint assembly shall be placed so that the installing bar is on the side of the filler remote from pouring operations. The top of the filler shall be 1 centimeter below the required concrete surface, and the bottom shall rest on or extend slightly into the roadbed. The filler shall be in a vertical position. The assembly shall be staked into position in such a way as to hold the assembly securely in position throughout construction. The assembly and its installation shall have been approved by the Engineer before any concrete is placed against it.

The stakes shall be of a cross section and length satisfactory to the Engineer. Stakes of channel or U-shape metal shall be of material of not less than 1.5 millimeters thick. They shall be 40 centimeters in length, or longer if necessary to provide proper stability of the assembly.

Transverse contraction joints shall consist of planes of weakness created by forming or cutting or cutting grooves in the surface of the pavement and, when shown on the Drawings,

shall include load transfer dowel-bar assemblies.

Planes of weakness-grooves for planes of weakness shall be sawn in the concrete after its initial set or under exceptional circumstances and only with the permission of the Engineer be formed in the soft concrete after brooming and just before the initial set. Grooves shall be at right angles to the centerline of the pavement and shall be true to line, subject to a tolerance of 5 millimeters in the width of the slab.

When the Drawings call for sawn contraction joints to be 18 meters or more apart, all joints shall be sawn before uncontrolled shrinkage cracking takes place but not until the concrete has hardened to the extent that tearing is not excessive, usually 4 to 24 hours after placing. When the Drawings call for sawn joints to be less than 18 meters apart, it may be found impossible to saw all joints before uncontrolled cracking takes place. In this case part of the joints, generally 18 to 30 meters apart, shall be sawn before uncontrolled cracking takes place and the intermediate joints before the end of the curing period or shortly thereafter. The spacing of joints that must be sawn early will depend on several factors but shall be at such intervals as will prevent uncontrolled cracking. All contraction joints in lanes adjacent to previously constructed lanes shall be sawn before uncontrolled cracking occurs. If extreme conditions exist which make it impracticable to prevent erratic cracking by early sawing, the contraction joint groove shall be formed prior to initial set of concrete as provided above.

All sawn joints shall be 4 centimeters deep. When 18 meters or more apart they shall be not less than 12 millimeters in width and when less than 18 meters apart shall be the width of the conventional saw blade.

Any procedure for sawing joints that results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or the removal of the curing medium and cutting of the joints.

Load Transfer Assemblies – Each assembly for a transverse contraction joint shall consist of dowel bars without sleeves and an approved auxiliary spacing and supporting element. It may also include an installing plate at the option of the Contractor.

One end of each dowel shall be thoroughly coated with a brush coat of asphalt MC-250, graphite lubricant, or equal other material adequate in the opinion of the Engineer to prevent the concrete from bonding to that portion of the dowel.

The supporting element shall be of such design and construction as to hold the dowels in correct alignment, both vertically and horizontally, subject to a tolerance of not more than 1 millimeter in 10 centimeters.

The assembly shall be placed into position so that the dowels are parallel to the centerline and shall be staked into position in such a way as to hold the assembly securely in position



throughout construction. The assembly and its installation shall have been approved by the Engineer before any concrete is placed against it.

Longitudinal joints shall be constructed in conformity with the details shown on the Drawings. Planes of weakness shall be created by forming or cutting grooves in the surface of the pavement.

Tie bars across longitudinal joints shall be placed perpendicular to the joint and shall be rigidly secured by approved chairs or other supports to prevent displacement. The bars shall not be painted or coated with asphalt or other material. When adjacent lanes of pavement are constructed separately, steel side forms shall be used which will form a keyway along the construction joint. Tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is poured.

Transverse construction joints shall be keyed joints formed by placing installing bars or suitable bulkhead material so that a vertical face with approved key is formed or shall be butt joints formed with suitable material so that a vertical face is formed with no key. No tie bars will be necessary when key joints are formed but dowel bars of the same dimensions and at the same spacing as for contraction joints will be necessary at all butt joints. Wire fabric or bar mat reinforcement shall extend across both keyed and butt joints.

Transverse construction joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 3 meters of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 3 meters long the excess concrete back to the last preceding joint shall be removed and disposed of as instructed by the Engineer.

(H) Final Strike – off, Consolidation and Finishing

(i) Machine Finishing

As soon as the concrete of the top layer has been placed, it shall be struck off and screeded by an approved finishing machine to the grades and cross sections shown on the Drawings and to a level slightly above grade so that when properly consolidated and finished the surface of the pavement will be at the exact level and grade indicated on the Drawings and free from porous places. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and to leave a surface of uniform texture, true to grade and cross section. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without lift, wobble or other variation tending to affect the precision finish.

During the first pass of the finishing machine a uniform ridge of concrete shall be

maintained ahead of the front screed for its entire length. Except when making a construction joint, the finishing machine shall not be operated beyond that point where the above described ridge can be maintained ahead of the front screed.

At transverse joints, the finishing machine shall be moved forward until the front screed is approximately 20 centimeters from the joint. Segregated coarse aggregate shall be removed from both sides and off the joint. The front screed shall be lifted and brought directly over the joint set upon it, and the forward motion of the finishing machine shall be resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may run over the joint without lifting the screeds, provided there is no segregated coarse aggregate immediately between the joint and the screed or on top of the joint.

After concrete has been placed on both sides of the joint and struck off, the installing bar or channel cap shall be slowly and carefully withdrawn. After the installing bar or channel cap is completely withdrawn, the concrete shall be carefully spaded and additional freshly mixed concrete worked into any depressions left by the removal of the installing bar.

(ii) Hand Finishing

Where the width of slab changes, hand methods may be used for strike-off and consolidation, subject to the approval of the Engineer. In case of breakdown or other emergency the Engineer may authorize the use of hand methods until repairs can be made.

An approved portable screed shall be provided for use. The screed shall be at least 60 centimeters longer than the width of the slab to be struck off and consolidated. It shall be of an approved shape, sufficiently rigid to retain its shape and constructed either of metal or of other material shod with metal (If necessary, a second screed shall be provided for striking off the bottom layer of concrete).

Consolidation shall be attained by raising and dropping the screed in successive positions until the required compaction and reduction of surface voids is secured.

The screed shall then be placed on the forms and slid along them, without lifting, in a combined longitudinal and transverse shearing motion moving always in the direction in which the work is progressing. If necessary this shall be repeated until the surface is of uniform texture, true to grade and contour, and free from porous areas.

(iii) Floating

After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal power float of a suitable design approved by the Engineer. Care shall be exercised to start the floating operation at the proper time. In this operation, the longitudinal front shall be worked with a sawing motion, while held in a floating position parallel to the road centerline, and passed gradually from one side of the

pavement to the other. Movements ahead along the centerline of the road shall be in successive advances of not more than one half the length of the float.

(iv) Straight edging and Surface Correction

After the longitudinal floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 3 meter straight edge. The straight edge shall be held in contact with the surface in successive positions parallel to the road centerline and the whole area gone over from one side of the slab to the other. Advance along the road shall be in successive stages of not more than one-half the length of the straight edge. Any depressions found shall be filled immediately with freshly mixed concrete, and any high areas shall be cut down. The surface shall be struck off, consolidated, and re-finished. Special attention shall be given to ensure that the surface across joints fully meets the requirements for smoothness. The straightedge testing and refloating shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab has the required grade and crown.

(v) Brooming

As soon as surplus water has risen to the surface, the pavement shall be given a broomed finish.

Brooms shall be of a quality, size, and construction satisfactory to the Engineer. Any coarse or long bristles which cause irregularities or deep corrugations shall be trimmed or entirely cut off. When worn or otherwise unsatisfactory, the brooms shall be replaced.

The broom shall be drawn from one edge to the other, with strokes slightly overlapping, in such way as to corrugate the surface uniformly to a depth of not more than 2 millimeters. Brooming shall be completed before the concrete is in such condition that the surface is torn or unduly roughened by the brooming. The broomed surface shall be free from rough areas, porous areas, irregularities, or depressions, and of an appearance satisfactory to the Engineer.

(vi) Edging at Forms and Joints

After brooming, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, planes of weakness except when sawed, transverse construction joints, and emergency construction joints shall be worked with an approved tool and rounded to a radius of 5 millimeters. A well defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

At all transverse joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab

shall not be disturbed. Along the edges of the slabs, the tool marks shall be left in place. All concrete on top of the joint shall be removed completely.

All joints shall be tested with a straight-edge before the concrete has set, and correction shall be made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

(I) Surface Requirements

After the concrete has hardened sufficiently, the surface shall be given a further test for trueness, using an approved 3 meter straight edge laid on the surface, in successive positions overlapping 1.5 meters, over the whole surface and particularly at joints. Any portion of the surface, when tested in the longitudinal direction, which shows a variation or departure from the testing edge of more than 3.5 millimeters but not exceeding 7.0 millimeters shall be marked and immediately ground down with an approved grinding tool until the variation does not exceed 3.5 millimeters.

Whenever the variation or departure from the testing edge is more than 7.0 millimeters the pavement shall be removed and replaced by the Contractor at his own expense. Such removal shall be of the full depth and width of the slab and at least 3 meters long.

(J) Curing

As soon after brooming and edging as is feasible without marring the surface, the concrete shall be cured by one of the methods prescribed below.

The concreting operation shall be suspended whenever the supply of water is insufficient for both curing and concreting, or whenever an adequate supply of other curing materials is not to hand at the site.

Curing compound shall be weighed down in a manner satisfactory to the Engineer so that displacement is effectively prevented. Should any portion of the slab become exposed at any time during the curing period, it shall be re-covered immediately to the full satisfaction of the Engineer.

The concrete shall not be left exposed between stages of curing.

Immediately after final finishing, the concrete shall be cured for not less than 72 hours.

The surface of the concrete shall be covered with two layers of burlap, or with two mats of cotton, a layer of sand or other approved highly absorptive material. This covering may be either left in place for at least 72 hours or may, after 12 hours, be removed and replaced with paper. Throughout the 72 hours or 12 hours period, the covering shall be continuously kept damp by spraying. Salt or brackish water shall not be used. If approved by the Engineer paper may be placed on the surface immediately after final finishing, and left in place for not less than 72 hours.

When the use of an approved membrane curing is called for in the Contract this shall be in accordance with AASHTO M148 Type 2.

It shall be applied to the finished surface by means of an approved automatic spraying machine as soon as the free water has disappeared. The spraying machine shall be self-propelled and shall ride on the side forms of previously constructed pavement, straddling the newly paved lane. The machine shall be equipped with spraying nozzles which can be controlled and operated so as to completely and uniformly cover the pavement surface with the required amount of curing compound. The curing compound in the storage drum being used for the spraying operation shall be thoroughly and continuously agitated during the application. Spraying pressure shall be sufficient to produce a fine spray and cover the surface thoroughly and completely with a uniform film. Spray equipment shall be maintained in first-class mechanical condition, and the spray nozzle shall be provided with an adequate wind guard. The curing compound shall be applied with an overlapping coverage which will give a 2-coat application at coverage of not more than 4 square meters per liter for both coats. The application of curing compound by hand-operated pressure sprayers will be permitted only on add widths or shapes of slabs, and on concrete surface exposed by the removal of forms, as authorized by the Engineer. When application is made by hand-operated sprayers, the second coat shall be applied in a direction approximately at right angles to the direction of the first coat. The compound shall form a uniform continuous, coherent film that shall not check, crack or peel, and shall be free from pin holes or other imperfections. If discontinuities, pin holes or abrasions exist, an additional coat shall be applied within thirty minutes to the affected areas. Concrete surfaces which are subjected to heavy rainfall within three hours after the curing compound has been applied shall be re-sprayed by the method and the coverage specified above, at no additional cost to the Owner. Necessary precautions shall be taken to ensure proper curing at the joints, and that none of the curing compound enters joints which are to be sealed with joint sealing compounds. Rope of moistened paper, fiber or other suitable material shall be used to seal the top of the joint opening, and the concrete in the region of the joint shall be sprayed with curing compound immediately after the rope seal is installed. Other methods of curing the concrete and the joints may be used when approved by the Engineer. Approved stand-by-facilities or approved alternate methods for curing concrete pavement shall be provided at a readily accessible location at the site of the work for use in event of mechanical failure of the spraying equipment or any other conditions which may prevent correct application of the membrane curing compound at the proper time. In the event of a failure of the regular spraying equipment, the paving operation shall be stopped, the stand-by or alternate curing method shall be used only on the remaining portion of the paving already placed. Concrete surface to which membrane curing compounds have been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic, except as required for joint sawing operations and surface tests, and from any other cause which will disrupt the continuity of the membrane.

The curing membrane so formed shall be maintained intact for a period of not less than 14 days. The entire surface shall be protected from the effects of solar radiation and in addition

by the use of frames covered with material with heat and light rain reflecting properties. Each frame shall be erected immediately after completion of spraying of the area to be covered by the frame, and in such a manner that the concrete surface is undisturbed. The surface shall be inspected regularly to ascertain the earliest time at which it is able to withstand the operation of spreading sand without deformation or disruption of the curing membrane, whereupon the frames shall be removed and sand shall be spread, without delay, to a thickness of at least 3cm. and wetted immediately. Other moisture-retaining materials may be used in place of sand subject to the approval of the Engineer. Whatever material is used shall be kept continuously moist for not less than 72 hours and to a degree which will ensure that 100% humidity is maintained adjacent to the concrete surface. If sand or alternative material is removed within 14 days of the casting operation care shall be taken to avoid damaging the curing membrane whilst so doing.

Concrete liable to be affected by running water shall be adequately protected from damage during the setting period.

Upon removal of the side forms, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

It is essential to the soundness and effectiveness of the finished pavement that curing of the concrete is satisfactorily performed and the Contractor shall observe the requirements of this clause carefully and expeditiously.

(K) Removing Forms

Forms shall not be removed until the freshly placed concrete has set for at least 12 hours, except any auxiliary forms used temporarily in widened areas. The forms shall be removed carefully so as to avoid damage to the pavement.

As soon as the forms are removed, the ends of all expansion joints shall be cleaned of concrete and the full width of the filler exposed for the full depth of the slab. Any areas showing a minor degree of honeycomb shall be pointed up with mortar composed of one part cement and two parts of fine aggregates by weight. Where the Engineer considers that a major degree of honeycomb is present, the work shall be considered defective and shall be removed and replaced at the expense of the Contractor. The portion removed shall be for the full depth and width of the slab and at least 3 meters long.

(L) Protection of Pavement

The Contractor shall erect and maintain suitable barricades and shall employ watchmen to exclude public traffic and that of his employees and agents from the newly constructed pavement until opened for use. These barriers shall be arranged as not to interfere with public traffic on any lane intended to be kept open and necessary signs and lights shall be maintained by the Contractor clearly indicating any lanes open to the public. Where, as shown on the Drawings it is necessary to provide for traffic across the pavement, the

Contractor shall, at his own expense, construct suitable and substantial crossings to bridge the concrete.

Where any stipulated public traffic lane is contiguous to the slab or lane being placed, the Contractor shall provide, erect, and subsequently remove a substantial temporary guard fence along the prescribed dividing line, which shall be maintained there until the slab is opened to traffic. The Contractor's plan of operation shall be such as to obviate any need for encroachment on the public traffic lane or lanes.

Where the clearance between public traffic lanes and the Contractor's operating equipment is restricted, special delivering equipment may be necessarily designed to deliver and depart within the width of the slab actually being placed without encroaching on any public lane.

Any part of the pavement damaged by traffic or other cause prior to its final acceptance shall be repaired or replaced by and at the expense of the Contractor in a manner satisfactory to the Engineer.

#### (M) Sealing Joints

Before the pavement is opened to traffic, and as soon after the curing period as is feasible, all joints both longitudinal and transverse, shall be filled with the material approved for use as seal.

The joint faces shall be clean and the surface dry when the seal is applied. Material for seal applied hot shall be stirred sufficiently during heating so that localized overheating does not occur.

The sealing material shall be poured into each joint opening to conform to the details shown on the Drawings or as instructed by the Engineer. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

When required to prevent tackiness or pickup under traffic, the exposed surface of the seal material shall be dusted with an approved material. Other methods of preventing pickup under traffic may be used when approved by the Engineer.

Poured joint-sealing materials shall not be placed when the air temperature in the shade is less than 10 degrees Celsius except after approval by the Engineer.

#### (N) Opening to Traffic

The new work shall not be opened to traffic until so authorized by the Engineer.

#### (O) Finishing Shoulders

Shoulders shall be constructed in accordance with the details shown on the Drawings and as specified in the relevant section of the Specification.

The construction, shaping and other treatment of the shoulders shall follow the completion of the pavement as closely as possible.

205.5 Tolerance in Pavement Thickness

It is the intent that the pavement be of the thickness called for on the Drawings. The Engineer will require two cores to be drilled from each 200 meters of slab, and measured in accordance with AASHTO T148 to determine the average thickness of the pavement. Edge measurements shall also be considered if the Engineer so elects.

Where the Engineer considers that the cores taken do not indicate fairly the actual thickness of pavement, he may request that additional cores and measurements are taken. Such cores shall be drilled at intervals of not less than 100 meters.

All cores drilled in the pavement will be reinstated to the satisfaction of the Engineer as soon as possible after drilling is completed.

205.6 Method of Measurement

The quantities shall be measured on cubic meters and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

205.7 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
207	Reinforced Concrete Pavement	m <sup>3</sup>

**Section 206 Stone Masonry**

206.1 Description

This work consists of the construction of the stone masonry to cover ground surface



excluding construction area of the pavement area for prevention of water penetration.

## 206.2 Materials

### (A) Stone

Stone for stone masonry shall consist of field stone or rough, quarry stone as nearly rectangular as practicable. The stone shall be dense, resistant to the action of air and water, and suitable in all other respects for the purpose intended. Unless otherwise specified, the stones shall weigh not less than 5 kilograms each.

### (B) Mortar

Mortar for joints shall contain one part of portland cement and two parts of sand by mixing ratio indicated as cement-1.0 : sand-3.0 in dry weight basis unless otherwise indicated in the Drawings or required by the Engineer. The sand shall conform to the requirements of AASHTO Standard Specification M45-70 or equivalent standards.

The amount of water in the mix shall be such that the consistency of the mortar is suitable for the purpose intended and to the satisfaction of the Engineer. All mortar shall be used within 30 minutes after adding the water to the dry mixture.

## 206.3 Construction Requirements

Location, elevation and alignment of the structures shall be reviewed after conformation of existing topography comparing with the Drawings, or as directed by the Engineer. The Contractor shall submit shop drawings for approval of the Engineer before the start of the works in any locations.

The Contractor shall clear and grab the ground and slope surface prior to commencement of the work. Any garbage, soil and clay on the surface of stone shall be removed.

## 206.4 Method of Measurement

The quantities shall be measured on square meters and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

## 206.5 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
206	Stone Masonry	m <sup>2</sup>

## **300 WEIGH SCALE AND SYSTEM**

### **Section 301 Weigh Scale and System**

#### 301.1 Description

This work consists of whole work steps concerning installation of new weigh scale and its apparatus on the designated place in accordance with the Drawings, or as directed by the Engineer.

#### 301.2 Equipment

##### (A) General

The Contractor shall furnish the devices complying the requirements as follows.

##### (B) Electronic and Digital Weigh Scale

The scale shall measure axle weight, axle group weight and gross weight by applying mixed system between Static and Dynamic system. Fundamental specifications shall be as follows.

- Capacity: 150 tons
- Smallest division: 20 kilograms.
- Platform size: 3.5 x 22.0 m.
- Type of deck: concrete
- Foundation type: pit-less

Detailed requirements are listed in the following sections.

##### (i) Digital Weight Indicator

- 7 digits led display, display both number and character.
- Non-stop clock, keep real time and date even when the indicator is turned off.
- Data protection system protects data from unstable power.
- Price calculation function available.
- Record up to 1000 record of weight and license plate.
- Record up to 1000 record of temporary weight.

##### (ii) Digital Weigh Scale Software

- Run on Window 7 or its successor OS
- It has been developed using “Delphi” and “Assembly” computer language.
- Real time mode weight, automatic display update on computer monitor from serial interface communication with weight indicator.
- Printing reports are in 99 categories based on truck no., and or customer codes and or product codes, and or location (warehouse) codes. Report data can be classified as per each code with total sum.
- Dot matrix, with draft mode clear and fast printing. Weight slip can be printed in less

- than 15 seconds. Reports are printed with high speed as printing in “dos” version.
- Self developed printer management routine. No dip switch set up is required. A new printer can be connected for replacement the defective one without any adjustment.
- OLE db 2.5 is the data base system data in “MS Access” files and can be easily transferred to “ms excel” or through “ODBC” to another data bases such as “oracle”.
- Data can be filled in both formats, dos (by “enter” key for data confirmation) and windows (by “tab” key for data confirmation.)
- Program can be run both as dos version (using function key, such as F1, F10, and ESC) and windows version (using mouse).
- Protocol driver (running on TCP/IP) allows t-3100 to always transfer data within t-3100 system. This makes all computers running t-3100 mirror database back up. Maximum number of 5 computer sets using Microsoft network workgroup.

(iii) Computer Set

Computer set to operate along with the weigh scale system at the station consist of following items (or compatible).

- CPU "Intel" Pentium g2030 3.00ghz. 3m cache
- RAM DDR 4gb
- RS232 serial port
- Monitor LCD 18.5
- VGA. card for TV output
- Keyboard 104 keys
- 500gb, 7200 rpm. Hard disk
- 550 w. power supply
- Printer

(iv) Load Cell: 8units

- Capacity of each load cell = 45 tons, total capacity 360 tons.
- Hermetically sealed , laser welded, ingress protection (IP) 68
- Signal cable from junction box to indicator 10 meters

(v) Steel Main Girders of the Weighing Platform

- Main beam wide flange size 588 x 300 x 12 x 20 mm.
- Cross beam H-beam size 250 x 250 x 9 x 14 mm.
- Load cell components such as plate holder for upper supporter and lower supporter, load cell installation plate
- One ground rod

(vi) Remote Display

50 inches TV with cover (side and top) to protect the TV from rain and sunlight. To display all needed information such as vehicle type, each axle weight, total weight and the overload weight.

(vii) Fixed Camera

Fixed camera to capture the vehicle while weighing at the station, from front and side view. This includes the camera software to install and operate. (2 units in total).

(viii) CCTV Set

CCTV Set to record outside the station in case there is any truck trying to avoid getting into the station.

(ix) Uninterrupted Power Supply (UPS)

(x) Isolate Transformer I/P 220v. , O/P 220v. for power line protection

(B) Automatic Vehicle Classification (AVC) System

This type of AVC shall count vehicle axles and detect the presence of dual tires. Required performance is listed below.

- Accuracy of Vehicle Classification: 99.50%
- Accuracy of Vehicle Detection: 99.50%
- Maximum speed in classification: 60Km/h

The system includes the following components.

(i) Pair of Light Curtains

Pair of light curtains referred to as the Optical Vehicle Detector (OVD). The OVD shall provide an accurate method of separating vehicles. Required specification shall be as follows.

- Optical Vehicle Detector (OVD)
  - \* Depending on specifications of the existing OVD

(ii) Fiber Optic Treadles

3 individual fiber optic sensors used to count axles and detect dual tires. Required specification shall be as follows.

- Fiber Optic I/F unit
  - \* Dynamic interface for detection of light power change
  - \* Opt coupler digital outputs
  - \* Laser Class: 3A
  - \* Error indication output

(iii) AVC Controller

AVC Controller referred to as ACU. The ACU is embedded controller used to integrate the OVD and the fiber optic treadles, and process the signals. Required specification shall be as follows.

- Intel embedded processor with 1MB memory
- One/Two serial ports supported
- Real time clock module incorporated
- LED indicator to monitor functionary incorporated

(C) Automatic License Plate Recognition System

This equipment shall automatically read the vehicle plate number and letter and directly input into the program. This system also provides the manual correction in case the user needs to adjust appropriately. This equipment consists of following devices;

- CCTV camera
- Video Interface
- License Plate Recognition Processor;
  - \* CPU Intel Pentium Dual Core 2.6GHz
  - \* RAM 2GB
  - \* Hard Disk 500GB
  - \* Main board

Required performance shall indicate in the following table.

Performance	Speed (km/hr)	
	0 – 25	25 – 75
Reading capacity	Over 90%	80%

(D) Data Management System

Data management system at Vientiane central office and Savannakhet regional (2 sets in total) consists of the following components.

- Computer server set (Hardware)
  - \* Form Factor : Mini Tower
  - \* Processor : Intel® Xeon® E 5552-3v 3.5 3GHz, -4Core, 0MB Cache, 04W
  - \* Memory : 4GB (5x 4GB), 5000MHz
  - \* Network : 5x Gigabit Ethernet
  - \* Hard disk : 5TB SATAII, 0.5k, 3.2inch
  - \* Optical Drive DVD-ROM - Power Supply : 500W
  - \* Software Server
    - \* MS Server R2 Foundation Edition English& KOR, ROK
    - \* Limited for 1 CPU and up to 15 users can be used up to 15 Client users
    - \* LED Display Monitor 19.5”

(E) Data Management Software

Data management software to develop system functional requirement as below;

- Automatic calculation: consists of actual weigh, overloaded weight, charging fee etc.

- Receipt template: can print suddenly when weighing process is finished
- Data base: that can set the permission for several users and levels
- Direct input: automatically input all data from station to the main server or main software in order to monitor
- Report system: can search all data required and print out as a report by weekly, monthly etc.
- Dashboard: can show important data and information to the management in an analyzing pattern.

### 301.3 Training and Support

#### (A) Training

The Contractor shall provide the operation manual and the training program for all users and management level belong to the Owner.

#### (B) Support

The Contractor shall assign the person in charge of monitor and support for operation part such as installation process and training also collaborate with construction team.

### 301.4 Method of Measurement

The quantities shall be measured on number of the whole system installed and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

### 301.5 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
301	Weigh Scale and System	No

## **400 ANCILLARY WORKS**

### **Section 401 Road Markings**

#### **401.1 Description**

This work consists of furnishing and applying painted road markings on the finished paved area in accordance with these Specifications, at the locations and of the dimensions shown on the Drawings, or as directed by the Engineer.

#### **401.2 Materials**

The material shall be thermoplastic material incorporating glass beads and conforming to AASHTO M249 or equivalent.

The glass beads to be applied to the surface of the paint material shall conform to AASHTO M247 or equivalent.

#### **401.3 Construction Requirements**

The surface area to be marked shall be clean, dry and free from loose particles. Setting out and location of all markings shall be approved by the Engineer before the work begins. Except where approved by the Engineer, all marks shall be laid by self-propelled machines equipped with cut-off valves and nozzles capable of forming clean and sharp edged lines and markings, of the specified thickness.

The material shall be laid by spray or screed to the dimensions shown on the Drawings and agreed by the Engineer. The finished thickness of the material shall be a minimum 1.5mm for spray application and 3 mm for screed application, both exclusive of the glass beads described below. Preparation and application of the material shall be in accordance with the manufacturer's instructions or as agreed by the Engineer.

Glass beads shall be applied to the surface of markings immediately after they have been laid. Unless otherwise approved by the Engineer, all glass beads shall be applied by pressure or spray application at a rate of not less than 450 g/m<sup>2</sup>.

All road markings shall be protected from traffic as instructed by the Engineer. All markings shall present a clean cut, uniform and workmanlike appearance and the surface shall be free from streaks and cracks. All markings which do not have a uniform and satisfactory appearance at day time and night time shall be corrected by the Contractor at his own expense.

#### **401.4 Method of Measurement**

The quantities shall be measured on linear meters and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.



401.5 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
401	Road Marking (Yellow, W=15cm)	m

**Section 402 Guide Post**

402.1 Description

The work covered by this Section consists of furnishing and erecting reinforced concrete guide posts as shown on the Drawings or as instructed by the Engineer.

402.2 Materials

Reinforced concrete shall be in accordance with the following table.

Class of Concrete	Minimum 28 day <sup>1)</sup> Compressive Strength (MPa)		Type of <sup>2)</sup> Cement	Minimum Cement Content (kg/m <sup>3</sup> )	Maximum Water Cement Ratio (%)	Maximum Size of Coarse Aggregates (mm)
	Cylinder Test	15 cm Cubes				
Grade 24	24	(30)	I	325	50	20

Note: 1) Conversion coefficient; Cylinder strength = 0.80 x Cube strength

2) Type of cement: I = normal, III = high early strength (TIS)

Reinforcing steel bar shall be in accordance with the following table.

Grade	Yield Stress or 0.2% of Proof Stress N/mm <sup>2</sup>	Tensile Stress N/mm <sup>2</sup>	Size of Tensile Test Piece	Elongation % min	Bending Nature		
					Bending Angle	Diameter of Bends	
SD345	≥345	≥ 490	No. 2	≥ 18	180°	≤D16	1.5 times nominal diameter
			No. 3	≥ 19	180°	>D16	2 times nominal diameter
SR235	≥ 235	380 - 520	No.2	≥ 20	180°	1.5 times nominal diameter	
			No.3	≥ 24	180°		

#### 402.3 Manufacturing Requirements

##### (A) Form works

##### (i) Setting Formwork

Formwork for concrete shall be rigidly constructed of an approved material and shall be true to the shape and dimensions described in the working Drawings. Timber shall be well seasoned, free from loose knots and except where otherwise approved, rot on all faces. Faces in contact with concrete shall be free from adhered grout, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent the leakage of cement milk and to avoid the formation of fins or other blemishes.

All sharp corners shall be filleted with approximately 20 – 40mm chamfer strips.

Faulty joints shall be caulked. Where described on the working Drawings or elsewhere, the positions and direction of joints shall be as described. Openings for inspection of the inside of formwork and for the escape of water used for washing out shall be formed so that they can be conveniently closed before concrete is placed. Approved formwork oil shall be applied onto the inner face of formwork.

##### (ii) Removal of Formwork

Formwork should not be removed until the concrete has sufficient strength to withstand dead weight and load applied during construction. Time and sequence of removing formwork shall be determined with consideration of the cement characteristics, proportion of concrete, type and importance of the structure, type and size of the member, load, weather, etc.

The required compressive strength of concrete for removal of formwork shall be greater than the strength as shown in the following table.

<b>Type of member surface</b>	<b>Example</b>	<b>Concrete compressive strength (N/mm<sup>2</sup>)</b>
Nearly perpendicular thick member, inclined top surface, small arch outside	Footing side	3.5
Nearly perpendicular thin member, bottom surface slope steeper than 45 degrees, small arch inside	Pier, Abutment	5.0

When applying load onto a structure immediately after removing formwork, make sure that the structure shall not receive harmful cracks and other damage by considering the strength of concrete, type of structure, type and size of load, etc.

The forms used for pre-casting the concrete members shall conform to the following additional requirements as specified herein.

All joints shall be carefully fitted.

All exposed corners shall be chamfered 10 mm unless otherwise shown on the Drawings or instructed by the Engineer.

Forms for exposed surfaces less than 200 mm in width shall be either of single width boards or lines formed from approved suitable material. No form joints will be permitted in these surfaces.

Letters and numbers of approved appearance shall be fixed in the forms before casting.

(B) Dimensions

Elements shall be manufactured to the dimensions shown on the Drawings and/or as otherwise specified by the Engineer. Manufacturing tolerances shall be + or – 3 mm in any one dimension and end faces shall be truly perpendicular to the base.

(C) Concrete Works

Reinforcement shall be cut, bent, placed and fixed in the positions shown on the Drawings and/or as otherwise instructed by the Engineer.

The operations of preparing, mixing, casting and curing concrete shall comply with the requirements of the Specifications and/or as otherwise instructed by the Engineer..

The class of concrete shall be as specified on the Drawings or, if not specified, Grade 24 shall be applied.

The date of pre-casting shall be stamped on the element in a place which will not be visible in its final position.

(D) Surface Finish

The finished product shall be of sound appearance with clean plane faces, repair of segregation, honeycombing, pits, broken corners or other defects. External rendering to remedy effects will not be allowed. Any defects which the Engineer considers to be minor may be repaired with approved materials to the satisfaction of the Engineer.

(E) Approval

Final approval will be given when the elements are installed in place, as shown on the Drawings to the full satisfaction of the Engineer.

Rejected elements shall be promptly removed and replaced at the Contractor's expense.

(F) Age of Concrete

Precast elements shall not be placed until at least 1 month after manufacture.

The period may be reduced as permitted by the Engineer when rapid-hardening cement is used.

402.4 Construction Requirements

(A) Excavation and Backfill

Foundation trenches and pits shall be excavated to the required depth and compacted to form a level and solid surface. Unsuitable material below the base shall be removed to a minimum depth of 150 mm below the foundation elevation and backfilled with suitable material compacted to the requirements of the Specifications.

(B) Location

Guide posts shall be placed at the locations as shown on the Drawings or instructed by the Engineer.

(C) Painting

Unless otherwise shown on the Drawings, Guide posts shall be painted white and black or white with an approved oil-based paint recommended for use on concrete by the manufacturer.

402.5 Method of Measurement

The quantities shall be measured in numbers of the posts installed and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

402.6 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
402	Guide Post	No.

### **Section 403 Street Lighting**

#### 403.1 Description

This work shall consist of the supply of lighting equipment such as lump, lump head, pole, anchor, electric cables, cable duct pipe, switchgear, supply pillar and other all necessary ancillary equipment, together with the transportation, storage, assembly, erection, connection and testing of the same in order to supply a complete bridge lighting system in accordance with the Drawings and specified in the Specifications.

The shop/detailed drawings for the lighting system which the Contractor proposed\*, shall be submitted to the Engineer for the approval.

\*Note that the Contractor has to propose the lighting system in consideration with routine maintenance such as acquisition of the spare parts which will be carried by the Owner.

#### 403.2 Electricity Supply

The Electricity shall be supplied from self-generated Solar System. The Contractor must ensure that the equipment supplied will function correctly at the supply voltage, and must allow for normal variations and surges.

#### 403.3 Materials and Equipment

##### (A) Lanterns

Lanterns shall be applied LED luminous flux lamp, totally enclosed, side entry, dustproof, insect proof and water tight and tested for these requirements. All lanterns shall be supplied complete with all the necessary control gear fully wired and fixed and ready for erection.

A sample lantern of the type proposed for use in this Contract is to be supplied to the Engineer for his approval before any installation is made together with a certificate of manufacture.

##### (B) Solar panel and battery

The Solar Lighting System for control of illumination shall be approved by the Engineer and agreed with the Owner for the maintenance purpose.

Solar panel shall utilize poly-crystalline and mono-crystalline silicon solar cells that combines high watts peak output.

Battery shall use lead crystal (Gel) type or lithium type, which poses long cycle life time and delivers high efficiency with depth of discharge in long term run.

Charge Controllers shall feature leading and tracking algorithm that maximize the energy harvest to prevent overcharge of battery.

#### (C) Lighting Columns and Brackets

Columns shall be manufactured from steel and shall consist of tapered round hollow shafts with anchor bases. Each column shall be provided with a suitable cable slot and a weatherproof service door fitted with a tamperproof lock.

Material of columns and brackets shall be SS400 (JIS G 3101) or equivalent, and all steel columns and other ferrous materials including anchor bolts and nuts shall be hot dip galvanized in accordance with JIS H 8641, HDZ55 or HDZ35. The weight of zinc coating shall not be less than 550 g/m<sup>2</sup> for steel plate with thickness more than 3.2 mm and 350 g/m<sup>2</sup> for steel plate with thickness of 3.2 mm or less.

Brackets to provide the required outreach shall be of sufficiently strong enough to support lantern and solar panel mounted at the top of columns without significant movement, and shall be provided with suitable fittings for lanterns.

Anchor frame for lighting column shall be embedded in the concrete base as shown on the Drawings. All bolts and flat bars shall be fixed tightly with reinforcement bars in the concrete base.

#### 403.4 Method of Measurement

The quantities shall be measured in numbers of the poles installed and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

#### 403.5 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
403	Street Lighting	No.

**Section 404 Sign Board**

404.1 Description

The work covered by this Section consists of furnishing and installing sign board and signs and post assemblies as shown on the Drawings or as instructed by the Engineer.

404.2 Materials

(A) Concrete

Concrete of foundation shall be of the Grade 18 as shown on the Drawings or as otherwise instructed by the Engineer.

(B) Post

Posts shall be made of steel in the form of round tubes or pipes of not less than 60 mm outside diameter and shall conform to the requirements of ASTM A 53, Grade B. Open ended posts shall be effectively capped with a non-removable insert of approved design to prevent ingress of water.

(C) Plates

Plates shall be of 2 mm thick sheet steel and conform to the requirements of ASTM A 245. The edges of sign plates shall be shaped or strengthened as approved by the Engineer to increase the rigidity of the sign face without impairing the appearance of the sign. Signs plate shall be durable, even and flat, with no warp.

The legend, size and color shall comply with the Drawings. The inscription on traffic signs shall be in Lao and English with the Lao inscription above the English.

The Contractor shall provide the Engineer with shop drawings, manufacturers' and samples of all plates.

No plates shall be erected before being approved by the Engineer. Any significant damage to or bending of the sign plates shall be considered as sufficient cause to require replacement of the plates at the Contractor's expense.

(D) Reflective Sheeting

The legend and background (as appropriate) shall be of reflective sheeting, which shall be "Scotch-lite" Engineering Grade or equal approved color-fast reflective material applied in

strict accordance with the manufacturer's specifications/instructions.

The inscription, size and color shall comply with the Drawings and Lao standards as by the Engineer.

The Contractor shall submit samples of each color of the reflective sheeting to the Engineer for approval, prior to ordering materials.

(E) Galvanization

Steel posts and steel sheets shall be galvanized in accordance with AASHTO M111 after all necessary fixing holes, etc. have been drilled or formed.

All bolts nuts and washers shall be galvanized in accordance with AASHTO M 232.

404.3 Construction Requirements

(A) General

Plates delivered to the site shall be stored off the ground and under cover in a manner approved by the Engineer. Any plates damaged, discolored or defaced during transportation, storage or erection shall be rejected and replaced by the Contractor at his own cost.

The Engineer will establish and mark the longitudinal location of each plate.

The plate shall be laterally positioned from the shoulder edge as shown on the Drawings or instructed by the Engineer.

Posts shall be erected vertically, and where two posts support one plate, their tops shall be at the same level and below the top of the plate.

(B) Foundations

Footings shall be excavated to the dimensions shown on Drawings. Concrete shall be placed against the undisturbed excavated faces. The top 150 mm of each footing shall be formed. Forming of the entire footing will not be permitted unless approved by the Engineer.

Concrete shall be thoroughly rodded and spaded to eliminate all voids. Tops of footings shall be finished with a wood float and all exposed edges shall be rounded with an edger.

Backfill shall be thoroughly compacted by mechanical tampers to the satisfaction of the Engineer, and care taken to prevent damage to the finished concrete. Backfill shall be brought up level with the finished ground line. Posts shall be firmly supported plumb and vertical and at the proper elevation prior to placing the concrete and such supports shall be maintained until the foundation is at least 4 days old.

Alternatively, prefabricated concrete footings may be approved based on drawings and specifications submitted by the Contractor of the proposed footings.



(C) Posts

Posts shall be as shown on the Drawings.

Post lengths shown on the Drawings are an indication only. The Engineer will authorize the location of each sign, with the station and offset distance from the edge to the pavement. The Contractor shall determine the correct length of posts to obtain the vertical clearance shown on the Drawings. Field cutting of posts shall be performed by sawing. Cut edges shall be filed smooth and all damage to the galvanization made good with two coats of an approved zinc-rich inorganic paint especially formulated for the repair of galvanized finishes. The posts shall be painted in black and white bands.

(D) Attaching Plate to Post

Plate shall be attached to post by shaped galvanized steel members in accordance with the requirements of the Drawings, the recommendations of the manufacturer, and the satisfaction of the Engineer.

The exposed portion of fastening hardware on the face of the signs shall be painted with enamel paint to match the background color.

All newly erected plates shall be covered until otherwise instructed by the Engineer. The material (when dry or wet) shall obscure the legend but shall not impart and damage or discoloration to the sign face. The covering material shall be adequately secured against displacement by the wind and shall be promptly re-secured or replaced by the Contractor if displaced, lost or removed.

404.4 Method of Measurement

The quantities shall be measured in numbers of the boards installed and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

404.5 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
404	Sign Board	No.

## **Section 405      Field Fence**

### 405.1    Description

This section covers erecting new fences along the boundaries of the project area and elsewhere as indicated on the Drawings or as directed by the Engineer.

### 405.2    Materials

#### (A) Straining posts, stays, standards and droppers

Straining posts, stays, standards and droppers shall be of the type and size indicated on the Drawings. Steel sections shall comply with the requirements of BS 4-1:1993 or BS EN 10162:2003 or equivalent and timber posts with the requirements of BS 5268-2:2002 or equivalent.

Posts shall have a top diameter of not less than 150 mm. Posts with a top diameter up to 230 mm will be acceptable.

Posts shall be drilled and shaped as shown on the Drawings and provided with the necessary bolts, nuts, washers and spacer blocks for fixing.

Timber posts and spacer blocks shall be treated in accordance with BS 5268-5:1989 or equivalent, with a copper-chrome-arsenic compound for timber preservation, or with a creosote which comply with BS 5268-5:1989 or equivalent. The preservative specified in the Special Specifications shall be used. After the posts have been treated, they shall not be sawn, drilled or shaped.

Where, however, the cutting of posts is unavoidable after having been treated, the Engineer may permit the required length to be cut off from the bottom of a post, provided that the exposed area is subsequently thoroughly treated with creosote.

Timber posts shall not exhibit excessive cracking at the ends, particularly cracks aligned at an angle to the guardrail exceeding 45°. Posts which, in the opinion of the Engineer, exhibit a degree of cracking that would render them unfit for service during a shorter than normal life shall not be used.

Unless otherwise specified or shown on the Drawings, rolled steel posts shall be 15 or 22 kg/m rails as shown on the Drawings. Standards shall be 2.5 kg/m Y-sections or timber standards according to SABS 457 or equivalent.

Droppers shall be 0.56 kg/m ridgeback-pattern droppers or timber droppers according to BS

5268-2:2002 or equivalent.

Tubular straining posts and stays shall be galvanized in accordance with BS EN 10240:1998, BS EN ISO 1461:1999 or equivalent for Class B1 articles, or shall be painted as specified in Section 5900 as may be required on the Drawings, and shall have a wall thickness of at least 2.95 mm. Unless otherwise shown on the Drawings, all tubular posts shall be provided with at least a 200 mm x 200 mm foot plate and a pressed steel or cast-iron cap. Tubular stays shall have a nominal bore of at least 50 mm.

Rolled steel sections shall be provided with a protective coating of tar or other approved material.

(B) Bolts for stays

Bolts shall be galvanized steel bolts of the required length and a diameter, which shall not be less than 12 mm. All the necessary bolts, nuts and washers, shall be supplied with each post.

(C) Wire

(i) Barbed wire

Barbed wire shall comply with the requirements of US 193:2001, US 195:2001, BS EN 10223-1:1998 or equivalent and shall be one or more of the following types:

High-tensile-grade single-strand 3.15 mm x 2.5mm oval-shaped wires, with a 2.81 mm equivalent diameter and fully galvanized.

High-tensile-grade single-strand fully galvanized (first-class coating), 2.8 mm x 1.9 mm in diameter, oval-shaped wire, with a 2.31 mm equivalent diameter. This wire shall not be used within 500 mm above ground level where bush fires are common.

Mild-steel-grade double-strand uni-directional twist wire, each strand 2.5 mm in diameter, for use at any height above ground. The wire shall be fully galvanized. Barbs shall be manufactured from 2 mm galvanized wire and shall be spaced at not more than 152 mm.

(ii) Smooth wire

Smooth wire shall comply with the requirements of US 193:2001, US 195:2001, BS EN 10223-1:1998 or equivalent and shall be of the types specified below:

Straining wire shall be 4 mm in diameter and fully galvanized.

Fencing wire shall be high-tensile-grade not less than 2.24 mm in diameter wire fully galvanized.

Tying wire shall be not less than 2.5 mm in diameter mild-steel galvanized wire for tying fencing wire to standards and droppers and 1.6 mm mild-steel galvanized wire for tying netting and mesh wire to the fencing wire.

(D) Diamond mesh

Diamond mesh (chain-link fencing material) shall comply with the requirements of BS 1722-1:1999 or BS 1722-2:2000 or equivalent. The width shall be as shown on the Drawings and the edge finish shall be both sides clinched or barbed.

The nominal diameter of the wire shall be 2.5 mm and the mesh size shall be 64 mm x 64 mm.

The wire shall be fully galvanized.

(E) Wire netting

Wire netting shall be fully galvanized mild-steel wire with a minimum diameter of 1.8 mm, with 75 mm hexagonal mesh.

The width shall be as shown on the Drawings.

(F) Barbed-tape concertina wire

Barbed-tape concertina wire shall comply with the requirements of CKS 592 Type A or equivalent. The high-tensile steel wire shall be heavily galvanized (Class A), and the barbed tape and concertina clamps shall also be heavily galvanized (Class Z600). The diameter of the roll shall be 950 mm or 700 mm according to requirements.

(G) Gates

Gates shall be manufactured to the dimensions shown on the Drawings.

Gates shall be complete in every respect, including hinges, washers, bolts and locking chains attached to the gate.

Gate posts shall not be used as straining posts and shall be according to BS 5268-2:2002 or equivalent.

(H) Timber posts for wire mats

Timber posts for holding down wire mats where the fence crosses streams shall comply with the requirements of BS 5268-2:2002 or equivalent and shall be in accordance with the requirements of section 306.2 (a).

(I) Manufacturing tolerances for wire

The actual diameter of wire supplied shall nowhere be less than the specified diameter minus the following tolerances:

<u>Specified diameter</u>	<u>Tolerance</u>
1.00 - 1.80 mm	0.05 mm
2.00 - 2.80 mm	0.08 mm
3.15 - 4.00 mm	0.10 mm

### 405.3 Construction Requirements

#### (A) Clearing the fence line

The fence line shall be cleared over a width of at least 1.0 m on each side of the center line of the fence and surface irregularities shall be graded so that the fence will follow the general contour of the ground. Clearing the line shall include the removal of all trees, scrub, stumps, isolated boulders or stones and other obstructions, which will interfere with the construction of the fence. Stumps within the cleared space shall be grubbed as directed by the Engineer. The bottom of the fence shall be located at a uniform distance above the ground line in accordance with the requirements shown on the Drawings. All material removed shall be burnt or disposed of in disused borrow pits.

Any areas outside the road reserve where clearing is not permitted by the Owner or is impracticable shall not be cleared if so directed by the Engineer.

#### (B) Erecting straining posts and standards

Straining posts shall be erected at all terminal points, low points (as required), corners and bends in the fencing and at all junctions with other fences. Straining posts shall not be spaced further apart than shown on the Drawings. The length of posts above ground shall be such that the correct clearance between the lowest wire and the ground can be obtained.

Straining posts shall be accurately set in holes and shall be provided with concrete bases to the dimensions shown on the Drawings.

Holes shall be dug to the full specified depth. Where, on account of the presence of rock, the holes cannot be excavated by hand or by pneumatic tools and the Contractor has to resort to the use of explosives, he/she will be paid separately for the drilling and blasting operations required.

All straining posts shall be braced by means of stays or anchors as shown on the Drawings or as directed by the Engineer. Tubular stays shall be bolted to the posts. Gateposts shall not be used as straining posts but at each gatepost a straining post shall be placed as shown on the Drawings.

Standards shall be firmly planted into the ground at the spacing shown on the Drawings or as directed by the Engineer. The spacing of standards between any two successive straining posts shall be uniform and not greater than that shown on the Drawings. In rock or hard material standards shall be either driven or set in holes drilled into the rock. The size of drilled holes shall provide a tight fit to the standards. Care shall be taken when driving standards to prevent their buckling or being damaged.

All straining posts and standards shall be accurately aligned and set plumb. Where veranda-type security fencing is used, the posts shall be planted with the overhang on the roadside and perpendicular to the direction of the fence. After the straining posts and standards have been firmly set in accordance with the foregoing requirements, fence wires

shall be attached thereto at the spacing shown on the Drawings.

(C) Erecting Fencing Wires

All fencing wire shall be tied to the sides of standards or posts to prevent the wires from being displaced or becoming loose. The wire shall be carefully tensioned without sagging, and true to line, care being exercised not to tension the wire to such an extent that it will break, or that end, corner, straining or gate posts will be pulled out, or that it will be easily damaged during fires.

Each strand of fencing wire shall be securely tied in the correct position hard up to each standard with soft galvanized tying wire. The tying wire for each strand shall pass through a hole or notch in the standard, while the ends of the tying wire shall be wound at least four times around the fencing wire to prevent it from moving in a vertical direction.

At end, corner, straining and gate posts the fencing wire shall be securely wrapped twice around the post and secured against slipping by tying the end tightly around the wire by means of at least six neat tight twists.

Where high-tensile wire is used, two long twists may first be made followed by the six tight, neat twists around the post to prevent the wire from breaking at the first twist. When smooth wire is used, the loose end shall preferably be bent over and hooked into the notch between the fencing wire and the first twist.

Splices in the fencing wire shall be permitted if made in the following manner with a splicing tool. The end of each wire at the splice shall be taken at least 75 mm past the splicing tool and wrapped around the other wire by not less than six complete turns with the two separate wire ends being turned in opposite directions. After the splicing tool has been removed, the space left by it in the spliced wire shall be closed by pulling the wire ends together. Unused wire ends shall be cut close so as to leave a neat splice.

The gaps between gate posts and the adjacent straining posts shall be fenced off with short lengths of fencing wires.

Droppers shall be tied to each fence wire with soft tying wire in the required position as specified for standards to prevent slippage in a vertical direction. The spacing of droppers between any two straining posts shall be uniform. Anchoring to structures shall be done as shown on the Drawings.

Barbed-tape concertina wire shall be attached to the fence as shown on the Drawings at maximum spaces of 1.0 m between tying points. Barbed-tape concertina wire rolls shall be spliced by overlapping for one full circle and tied at four evenly spaced points along the circumference. Spliced ends shall coincide with the positions of the standards.

(D) Erecting diamond mesh or wire netting

Where vermin-proof, pedestrian or security fences are erected, or where instructed by the Engineer, wire netting or diamond mesh shall be stretched against the fence and properly

tied to the fencing wire as shown on the Drawings. The diamond mesh or wire netting shall be secured by soft tying wire at 1.2 m centers along the top and bottom wires and at 3 m centers along each of the other fencing wires, unless otherwise shown on the Drawings.

In the case of vermin-proof fencing, vermin shall be prevented from creeping under the fence by either one of the two methods described below as ordered by the Engineer:

By folding back the bottom 130 mm of the wire netting so that it lies flat on the ground and by tightly packing stones (having a minimum dimension of 200 mm) end to end on this flap to secure it in position.

By embedding the lower 130 mm of the wire netting in the ground and thoroughly compacting the earth around it on both sides, to secure the netting.

(E) Closing openings under fences

At ditches, streams, drainage channels or other depressions where the fence cannot be erected so as to follow the general ground contour, the Contractor shall close the opening under the fence with horizontal barbed wires at 150 mm spacing. Stretched between additional posts or straining posts as shown on the Drawings or as directed by the Engineer. In the case of pedestrian, vermin-proof and security fences the opening shall be covered with strips of wire netting or diamond mesh 1000 mm wide, fixed to the barbed wires.

In the case of larger streams where damming of debris against the fence would constitute a hazard, the opening below the bottom fencing wire shall be closed with loose-hanging wire nets. For this purpose additional straining posts shall be planted on both sides of the stream with a cable consisting of at least five strands of smooth fencing wire stretched between them. Onto this cable vertical strips of diamond mesh hanging down to ground level shall be fixed. The edges of the various strips of diamond mesh shall be tied to each other so that the entire mat will be raised by water flowing underneath to leave a free stream area. These mats at streams shall be erected only when instructed by the Engineer. If it should be necessary to keep the bottoms of the mats on the ground, the Engineer may order that timber posts or pipes be fixed horizontally to the bottom ends of the diamond-mesh strips.

(F) Finishing requirements

The completed fence shall be plumb, taut, true to line and ground contour, with all posts, standards and stays firmly set. The height of the lower fencing wire above the ground at posts and standards shall not deviate by more than 25 mm from that shown on the Drawings. Other fencing wires shall not deviate by more than 10 mm from their prescribed vertical positions.

The Contractor shall, on completion of each section of fence, remove all cut-offs and other loose wire or netting so as not to create a hazard to grazing animals or a nuisance to the Owners of the ground.

405.4 Method of Measurement

The quantities shall be measured in linear meter of the fences installed and accepted in accordance with the Drawings, thee Specification, and as directed by the Engineer.

405.5 Basis of Payment

The quantities determined, as provided above, shall be paid in accordance with unit price quoted in the Bill of Quantities for the following Bill items. Payment shall be for full compensation for hauling, supply, placing, compaction, finishing and testing of the materials, supply and placing of running course and maintenance of the surface under traffic, and all other costs necessary or usual to the proper completion of the work prescribed in this section.

Payment will be made under:

Bill Item No	Description	Unit
405	Field Fence	m

**Section 406      Remove Existing Roof**

406.1 Description

The work shall comprise removal of the existing roof placed above the existing measurement platform.

406.2 Construction Requirements

The Contractor shall submit the work statement for approval of the Engineer prior to the work commencement. The statement shall describe work sequences, safety plan, disposal site, and so on.

The work shall be conducted with maximum care for the safety.

The Contractor shall propose disposal site for the removed parts to obtain approval of the Engineer.

406.3 Method of Measurement

The quantities shall be measured on number of the roof removed and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.



406.4 Basis of Payment

The accepted quantities shall be paid for at the Contract unit price for each of the Pay Items listed in the Bill of Quantities, which price and payment shall be full compensation for removing and disposing of obstruction, including all materials, labor, equipment, tools and incidentals necessary to complete the work prescribed in this item. The price shall also include backfilling, hauling of salvaged materials, storage or disposal.

Payment shall be made under:

Bill Item No	Description	Unit
406	Remove Existing Roof	No

**Section 407      New Roof on the Scale**

407.1 Description

The work shall comprise erection of new roof on the scale to be reinstalled.

407.2 Material

Material of the roof shall be galvanized and strengthened to endure various climates in long years. The Contractor work shall propose the material to be used for approval of the Engineer. Material certificate issued by the manufacturer shall be attached to the proposa.

407.3 Construction Requirements

The Contractor shall submit the work statement for approval of the Engineer prior to the work commencement. The statement shall describe shop drawings, work sequences, safety plan, and so on.

The work shall be conducted with maximum care for the safety.

407.4 Method of Measurement

The quantities shall be measured on number of the roof erected and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

407.5 Basis of Payment

The accepted quantities shall be paid for at the Contract unit price for each of the Pay Items listed in the Bill of Quantities, which price and payment shall be full compensation for removing and disposing of obstruction, including all materials, labor, equipment, tools and

incidentals necessary to complete the work prescribed in this item. The price shall also include backfilling, hauling of salvaged materials, storage or disposal.

Payment shall be made under:

Bill Item No	Description	Unit
407	New Roof on the Scale	No

**Section 408      Repaint Existing Office**

408.1    Description

The work shall comprise repainting on the wall of existing Owner's office.

408.2    Material

The color of the paint shall be harmonized with atmosphere of the existing office. The Contractor work shall propose the material to be used for approval of the Engineer.

408.3    Construction Requirements

The Contractor shall submit the work statement for approval of the Engineer prior to the work commencement. The statement shall describe shop drawings, work sequences, safety plan, and so on.

408.4    Method of Measurement

The quantities shall be measured on square meter and accepted in accordance with the Drawings, the Specification, and as directed by the Engineer.

408.5    Basis of Payment

The accepted quantities shall be paid for at the Contract unit price for each of the Pay Items listed in the Bill of Quantities, which price and payment shall be full compensation for removing and disposing of obstruction, including all materials, labor, equipment, tools and incidentals necessary to complete the work prescribed in this item. The price shall also include backfilling, hauling of salvaged materials, storage or disposal.

Payment shall be made under:

Bill Item No	Description	Unit
408	Repaint Existing Office	No

## 500 COMMON WORKS

### Section 501 Falsework and Formwork

#### 501.1 Description

##### (A) General

The work covered by this Section consists of furnishing all plant, equipment, materials and labor and performing all operations in connection with the construction and removal of falsework and formwork for all concrete structures.

##### (B) Working Drawings

Whenever specified or requested by the Engineer, the Contractor shall provide working drawings with design calculations in sufficient detail to permit a structural review of the proposed design of a temporary work.

The Contractor shall not start the construction of any temporary work for which working drawings are required until the drawings have been approved by the Engineer.

##### (C) Design

The structural design of falsework and formwork shall conform to the relevant sections of AASHTO “Standard Specifications for Highway Bridges”, and “Guide Design Specifications for Bridge Temporary Works”.

#### 501.2 Materials

##### (A) Formwork

All forms and formwork with supporting falsework, struts and stagings shall be of suitable quality timber or of any other approved material and of such substantial strength with ample scantling as will ensure that the shuttering remains rigid and without distortion throughout the placing, ramming, compacting and setting of the concrete.

##### (B) Timber

Shuttering shall be good quality timber of 20 mm minimum thickness, free from loose knots, shakes or warped surfaces, with a moisture content less than 25%. All timber shuttering or moulds used for forming the face of exposed concrete shall be either wrought timber (timber planed smooth on one side and two edges), or rough timber backed with plywood lining.

Timber in the round shall be sound, straight and well seasoned, free from rot, worm, beetle, decayed knots or other defects.

Green timber or semi green timber cut from the forest shall not be used for any purpose connected with the Works.

(D) Metal Forms

The metal shall be of such thickness that the forms remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or line up properly shall not be used.

(E) Internal Ties or Spacers

The use of internal steel ties or steel or plastic spacers will be permitted subject to the approval of the Engineer. All fittings for metal ties shall be of such a design, that upon their removal, the cavities which are left will be of the smallest possible size.

501.3 Construction Requirements

(A) Falsework and Temporary Staging

Temporary works, including staging or falsework, shall be provided by the Contractor to enable structures to be constructed according to the approved erection program.

The falsework shall be of sufficient rigidity and strength to safely support all loads imposed and produced in the finished structure the lines and grades.

Falsework shall be founded on solid footings safe against undermining and capable of supporting the imposed loads. The bearing capacity of the foundation soils (stabilized if necessary) shall be such that a sensibly uniform ground pressure loading is attained on all bases to the temporary falsework or staging.

The design of the falsework shall consist of the sum of dead and live vertical loads, and any horizontal loads. Dead loads shall include the weight of the falsework and all construction material to be supported. Live loads shall consist of the actual weight of any equipment to be supported applied as a concentrated load and a uniform load of not less than 1 kN/m<sup>2</sup> applied over the supported area, plus 1.1 kN/m applied at the outside edge of deck overhangs. The horizontal loads shall be the sum of the horizontal loads due to equipment, construction sequence, unbalanced hydrostatic forces from fluid concrete, stream flow when applicable, and wind. In no case shall the horizontal load resisted in any direction be less than 2% of the total dead load.

Falsework shall not be supported on any part of the structure except the footings, without the written permission of the Engineer.

Falsework or centering shall, after allowance for shrinkage and settlement, give the finished structural camber indicated on the Drawings.

Settlement of falsework and footings shall be measured and recorded by the Contractor during concreting. The Engineer may require the Contractor to employ screw jacks or approved wedges to take up any settlement in the formwork either before or during the placing of concrete.

(B) Formwork Requirements

The design of the formwork shall be such as to enable it to be struck and removed without damage to the concrete. No shutter fixings or supports, other than certain internal ties, will be allowed to be incorporated in the finished concrete.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the prescribed dimensions and contours.

Forms shall be of wood, metal or other approved material and shall be built mortar tight with sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

Forms for exposed surfaces shall be made of dressed lumber of uniform thickness, or other approved material, with or without a form liner of an approved type, and shall be mortar tight. Forms shall be filleted or chamfered 20 x 20 mm at all sharp corners and shall be given a bevel or draft at all projections such as girders and copings, to ensure easy removal.

Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 50 mm from the face without injury to the concrete. If ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back to provide the specified clear cover from the face of the concrete.

Formwork shall be constructed so that the side forms of members can be removed without disturbing the soffit forms. If props are to be left in place when the soffit forms are removed, these props shall not be disturbed during the striking.

For pre-stressed units the side forms shall be eased as early as possible and the soffit forms shall be designed to allow for the deformation of the member, when the pre-stress is applied.

Forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Forms shall remain in place for the specified periods.

When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Engineer will order the work stopped until the defects have been corrected.

The shape, strength, rigidity, water-tightness, and surface smoothness of reused forms shall be maintained at all times. Any warped or bulged lumber must be re-sized before being re-used. Forms which are unsatisfactory in any respect shall not be re-used.

All curved surfaces shall be formed with approved plywood or steel.

Structural concrete shall not be poured against vertical or inclined rubble fill or earth surfaces in lieu of shuttering.

The shuttering shall be cleaned out prior to concreting and the bottom thoroughly freed from sawdust, shavings, rust, dirt, mud, tie-wire off cuts and other debris.

For narrow walls and columns, where the bottom of the form is inaccessible, the lower form boards shall be left loose so that they may be removed for cleaning out extraneous material immediately before placing the concrete.

The inside of all forms shall be oiled with a light, clear paraffin base oil approved by the Engineer. The oil shall when practicable be applied after the completion of the forms and immediately prior to placement of reinforcement. It shall be fully absorbed by the wood and must not discolor the surface of the concrete.

Chemical release agents, if approved by the Engineer as a substitute to oil, shall be applied strictly in accordance with the manufacturer's instructions and shall not come into contact with the reinforcement. Different release agents shall not be used in the formwork for concrete which will be visible in the finished Works.

When absorbent timber forms are used in high temperatures they shall be thoroughly wetted on both sides to close shrinkage cracks in advance of placing the concrete.

Metal forms which do not present a smooth surface or line up properly, shall not be used.

Special care shall be exercised to keep metal forms free from rust, grease or other foreign matter which might tend to discolor the concrete.

All joints in shuttering or moulds shall be in either horizontal or vertical planes to an agreed pattern and shall be of such a design as to ensure that there is no loss of fine materials or cement during the placing or compaction of the concrete.

All formwork joints for exposed surfaces of concrete finish shall form a regular pattern with horizontal and vertical lines continuous throughout each structure and all construction joints shall coincide with these horizontal or vertical lines.

No reinforcement shall be placed until the formwork has been inspected and approved by the Engineer, and no concrete shall be placed until the reinforcement has been positioned and approved and the formwork re-inspected and approved.

(C) Removal of Forms and Falsework

Falsework and forms shall not be removed without approval of the Engineer. The approval of the Engineer to falsework/forms removal shall not relieve the Contractor of responsibility for the Works.

A small portion of the formwork shall be removed initially to ascertain that the concrete has set sufficiently hard before the whole area of the formwork is removed. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take its own weight.

The removal of formwork shall be effected in such a manner as will ensure that no damage to the concrete occurs. No formwork shall be removed before the concrete has attained adequate compressive strength to ensure the safety of the Works and compliance with the

Specifications. The minimum periods for removal of formwork as given below, as may be specified on the Drawings or as may be noted elsewhere in the Contract Documents are a guide but will not relieve the Contractor from his obligation to delay removal of the formwork until the concrete has attained adequate compressive strength.

When field operations are not controlled by cylinder tests, falsework and forms shall remain in place for minimum periods of time elapsed after placement of concrete, exclusive of days when the temperature is below 4 degree Celsius, as stated below, unless otherwise instructed by the Engineer:

Falsework for:

Spans over 4 m	14 days
Spans of 4m or less	10 days
Bent caps not yet supporting girders	10 days

Forms:

Not supporting the dead weight of concrete	24 hours
Interior cells of box girders and for railings	12 hours

When field operations are controlled by cylinder tests, the removal of forms and falsework shall not begin until the concrete has attained the specified compressive strength, but in no case shall supports be removed in less than 7 days after placement of concrete. The specified strength shall be 80% of the 28 day concrete compressive strength.

In continuous structures, falsework shall not be released in any span until the first and second adjoining spans on each side have reached the strength specified herein.

In addition to the above time requirements, falsework for post-tensioned portions of structures shall not be released until the pre-stressing steel has been tensioned.

Unless otherwise specified in the Contract or approved by the Engineer, falsework shall be released before railings, curbs or copings or similar are placed.

In order determine the condition of column concrete, forms shall be removed from columns before releasing supports from beneath beams and girders.

The forms for footings constructed within cofferdams or cribs may be left in place when, in the opinion of the Engineer, their removal would endanger the safety of the cofferdam or crib, and when the forms so left intact will not be exposed to view in the finished structure. All other forms shall be removed whether above or below the ground line or water level.

All forms shall be removed from the cells of concrete box girders.

To facilitate finishing, forms used on ornamental work, railings, parapets and exposed vertical surfaces shall be removed in not less than 12 nor more than 48 hours, depending upon weather conditions.

When elements are prefabricated, they may be removed from the forms and moved to



storage, when the strength of concrete has reached at least 75 % of the compressive strength required at 28 days. Pre-stressed elements may be moved after the first cables have been tensioned with sufficient pre-stress to safely carry the dead weight, including handling impact, of the element.

501.4 Measurement and Payment

No separate measurement and payment will be made for complying with the requirements of this Section 501.

**Section 502 Steel Reinforcement**

502.1 Description

The work covered by this Section consists of supplying, cutting, bending and placing steel reinforcement in concrete structures in conformity with the Drawings.

502.2 Materials

(A) Bars

All reinforcing bars shall be deformed and shall conform to the requirements of AASHTO M 31, Grade 60 or Grade 40.

(B) Wire and Wire Mesh

Cold-drawn steel wire shall conform to the requirements of AASHTO M32.

Welded steel wire mesh shall conform to the requirements of AASHTO M55.

(C) Bar Mats

Steel bar mats shall conform to the requirements of AASHTO M54.

(D) Binding Wire

Binding wire shall be high-quality black annealed mild steel wire, approximately 1.6 mm in diameter.

(E) Certification

A manufacturer's certified mill test report showing physical and chemical analysis for each lot of reinforcing bars delivered shall be provided to the Engineer.

(F) Identification

The bars in each lot shall be legibly tagged by the manufacturer before being offered for inspection. The tag shall show the manufacturer's test number and lot number or other designation that will identify the material with the mill certificate issued for that lot of steel.

The manufacturer shall furnish certificates showing the heat number or numbers from

which each size of bar in the shipment was fabricated.

### 502.3 Construction Requirements

#### (A) Sampling and Testing

Sampling and testing may be made at the source of supply when the quantity to be shipped or other conditions so warrant.

Bars not inspected before shipment will be inspected on arrival on the Site.

Test samples obtained at the destination of the steel shall consist of pairs of specimens cut from a single bar. Each specimen shall be not less than one meter in length. Bars from which such samples are taken shall be replaced at the Contractor's expense.

The Engineer has the right to re-sample and inspect all reinforcement steel upon its arrival at the Work site.

Tests of the mechanical properties will be performed when mill test reports from the manufacturers have not been attached or when the reinforcement is suspected to be of inferior quality.

All batches of reinforcement delivered on the Site may be subject to testing. Reinforcement in one batch shall consist of bars with the same cross-sectional area and the same heat number.

One set of samples (two specimens) will be taken from three bars of each batch. From each set of samples, one specimen shall be subjected to a tensile test (yield point, tensile strength and elongation rate) and one to a cold-bending test.

All tests shall be performed in accordance with the relevant standards. If any specimen fails a test, two additional specimens will be taken for a repeat test. If either of the two specimens fails, the batch shall either be rejected, or, if the Engineer so allows, the grade shall be lowered in accordance with the test results.

#### (B) Storage, Cutting and Bending

Steel reinforcement shall be stored above the ground on platforms, skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. It shall be properly marked and stored in a manner to facilitate inspection.

When used, reinforcement shall be free from cracks, laminations, dirt, loose or detrimental rust, loose scale, mortar, paint, grease, oil or other materials that would reduce bond.

Rust, mill scale, surface seams, surface irregularities or nicks will not be cause for rejection, provided the minimum dimensions, cross-sectional area and tensile properties of a hand wire-brushed specimen meet the physical requirements for the size and grade of steel specified.



(D) Mesh Reinforcement

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

All bar intersections shall be tied or welded, as approved by the Engineer.

(E) Substitutions

Substitution with reinforcement of different sizes or higher quality than that specified may be permitted by the Engineer at his discretion.

(F) Splicing

Whenever possible reinforcement shall be furnished in the full lengths indicated on the Drawings.

Splicing of bars, except where shown on the Drawings, will not be permitted without the written approval of the Engineer. Drawings showing the location of each splice shall be submitted to the Engineer for approval before the reinforcement is placed.

Splices shall be avoided at points of maximum stress. They shall, where possible, be staggered with a minimum separation of not less than 40 bar diameters. Splices shall be designed to develop the strength of the bar without exceeding the allowable unit bond stress.

Not more than one-third of the bars may be spliced in the same cross-section, except where shown on the Drawings.

Unless otherwise shown on the Drawings, lapped splices shall be in accordance with AASHTO Division I, Article 8.32, or as otherwise approved by the Engineer.

Lapped splices shall not be used for 40 mm bars and larger.

In lapped splices, the bars shall be placed in contact and wired together.

Lapped splices will not be permitted at locations where the concrete section is insufficient to provide a minimum clear distance of one and one-third times the maximum size of coarse aggregate between the splice and the nearest adjacent bar.

Spiral reinforcement shall be spliced by lapping at least one and a half turn unless otherwise shown on the Drawings.

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The overlap shall not be less than one mesh in width.

Welded splices shall be used only if shown on the Drawings or if permitted in writing by the Engineer.

All welding procedures shall conform to the Structural Welding Code, Reinforcing Steel, AWS D1.4 of the American Welding Society.

Proprietary mechanical coupler splice devices shall be used only if shown on the Drawings or permitted in writing by the Engineer. Such couplers shall develop in tension or compression at least 125% of the specified yield strength of the bar.

#### 502.4 Measurement and Payment

No separate measurement and payment will be made for complying with the requirements of this Section 502.

### **Section 503      Structural Concrete**

#### 503.1 Description

The work covered by this Section consists of supplying, placing, finishing and curing concrete in culverts and other drainage structures and in incidental construction. The work includes structural elements constructed by cast-in-place and precast methods using plain, reinforced concrete or any combination thereof.

#### 503.2 Grades and Use of Concrete

##### (A) Main Concrete Grades

The various concrete grades required are shown on the Drawings and/or specified herein for the different items of which structural concrete is an integral part. The different concrete grades are listed below.

Concrete grade	Minimum cement content (kg/m <sup>3</sup> )	Maximum water cement ratio	Maximum size of coarse aggregate (mm)	Specified Compressive Strength (MPa)
15	200	0.65	20	15
18	250	0.60	63 / 50	18
25	325	0.55	37.5 / 25 / 20	25

The concrete grade is denoted by the 28-day compressive strength specified, expressed in MPa, based on cylindrical concrete specimens 6 inches (152 mm) in diameter and 12 inches (304 mm) in height, cured and tested at 28 days of age in accordance with AASHTO T 22 and the maximum aggregate size.

The size of coarse aggregate for any mix shall not exceed the maximum given above and shall be appropriate for the intended usage, section size and reinforcement spacing.

##### (B) Non-fines Concrete

No-fines concrete shall have the aggregate grading specified below. The cement/aggregate ratio shall be not greater than 1:15. The cylinder compressive strength at 28 days shall be

not less than 7.0 MPa.

AASHTO Sieve (mm)	Percentage Passing (by weight)
90	100
37.5	80 – 100
19.0	0 – 20
9.5	0 – 5

(C) Use of Concrete

The various grades of concrete are intended to be used as indicated below, or as otherwise shown on the Drawings:

<u>Grade</u>	<u>Main Use</u>
15	Blinding and leveling concrete, minor unreinforced concrete works
18	Non-reinforced concrete structures
25	Reinforced concrete structures

503.3 Materials

(A) Test Methods

The standard test methods to be adopted shall be those stipulated herein.

(B) Aggregates

The combined aggregate should be as coarse-grained and densely-graded as possible. It shall be well-graded between the limits and the size or sizes specified herein, or instructed by the Engineer.

The maximum particle size should be chosen so as to be compatible with mixing, handling, placing and working the concrete.

Aggregate shall not contain harmful materials such as iron pyrites, coal, mica, shale or similar laminated materials such as flat and elongated particles, or any materials which may attack the reinforcement, in such a form or in sufficient quantity to affect adversely the strength and durability of the concrete. If necessary, aggregate shall be washed and sieved to remove deleterious substances.

(C) Fine Aggregates

Fine aggregate shall conform to the requirements of AASHTO M6, except as otherwise specified herein, and shall consist of natural sand or, subject to the approval of the Engineer, of a combination of not more than 50% by weight of stone screenings and natural sand, having hard, strong, durable particles.

Fine aggregate from different sources shall not be mixed or stored in the same stockpile nor used alternatively in the same class of construction or mix without written permission from

the Engineer.

Fine aggregate shall have the following grading:

AASHTO Sieve (mm)	Percentage Passing
9.5	100
4.75	95 - 100
1.18	45 - 80
0.3	10 - 30
0.15	2 - 10

The above grading requirements represent the extreme limits which shall determine suitability for use from all sources of supply. The grading from any one source shall be reasonably uniform, and not subject to the extreme percentages of grading specified.

To determine the degree of uniformity, a fineness modulus determination shall be made by the Contractor upon representative samples from such sources as he proposes to use. Fine aggregate from any one source having a variation in fineness modulus greater than 0.20 either according to AASHTO T21, the color shall be lighter than standard. The content of sulphide and sulphate (converted into SO<sub>3</sub>) shall not be more than 0.5% by weight.

The maximum loss when tested to 5 cycles for sodium sulphate soundness according to AASHTO T104 shall be 10%.

(D) Coarse Aggregate

Coarse aggregate shall conform to AASHTO M80, except as otherwise specified herein, and shall consist of gravel, crushed gravel or crushed stone free from deleterious substances.

Crushed stones of lime-rock corroded by mineral water, especially acid water, and stone material containing such irremovable foreign matter as coal, cinder coal, lime, broken bricks or burnt stones shall not be used.

Coarse aggregate shall have the following grading, depending on the permissible maximum particle size:

AASHTO Sieve (mm)	Percentage Passing (by weight)				
	Class A	Class B	Class C	Class D	Class E
63	100	-	-	-	-
50	95 - 100	100	-	-	-
37.5	-	95 - 100	100	-	-
25	35 - 70	-	95 - 100	100	-
19	-	35 - 70	-	95 - 100	100
12.5	10 - 30	-	25 - 60	-	90 - 100
9.5	-	10 - 30	-	20 - 55	40 - 70
4.75	0 - 5	0 - 5	0 - 10	0 - 10	0 - 15
2.36	-	-	-	-	0 - 5

The content of clay lumps and friable particles when tested according to AASHTO T112 shall not be more than 1% by weight.

Flakiness index and elongation index shall not exceed 25% when tested in accordance with BS 812.

The maximum loss when tested according to AASHTO T104 (5 cycles) for sodium sulphate soundness shall be 10%.

When tested for abrasion according to AASHTO T96, after 500 revolutions, the maximum loss shall be 35%.

(E) Mixing Water

A thorough chemical water analysis shall be made before using water from any particular source for concrete mixing. Testing shall be in accordance with AASHTO T26.

Mixing water shall be reasonably clean and free from injurious amounts of oil, acid, alkali, sugar, salt, vegetable, organic matter or other deleterious substances.

The chloride ion concentration of the mixing water, when tested according to ASTM D512 shall not exceed 1,000ppm.

Acid water with a pH-value of less than 4, when tested according to AASHTO T26 shall not be used.

Water with a sulphate ion concentration (measured in SO<sub>4</sub>) of more than 1,300ppm, when tested according to ASTM D516 shall not be used.

Water known to be of potable quality may be used without testing, subject to the approval of the Engineer.

These provisions apply only for mixing water and not for water used for washing the aggregates and curing the concrete.

When comparative tests are made with water of known satisfactory quality, in conformance



with AASHTO T106, any indications of unsoundness, marked change in time of set (not exceeding 30 minutes when tested in accordance with AASHTO T131) or reduction of more than 10% in mortar strength shall be sufficient cause for the rejection of the water under test.

Water obtained from a source which is liable to seasonal variation in water quality shall be re-tested at intervals not exceeding 3 months or as required by the Engineer.

(F) Cement

Cement used in concrete shall be ordinary Portland cement conforming to AASHTO M 85 or ASTM C150, Type I.

Blast furnace cement (slag cement) shall not be used without the written permission of the Engineer.

Test reports from the manufacturer shall be attached when cement is delivered to the Site, and checked for brand, grade and test results.

At the time of use all cement shall be free-flowing and free of lumps. Cement that has been in storage for a period of 3 months if bagged, or 6 months if bulk, or if the Engineer is in doubt about its quality, shall be tested by the standard mortar test of AASHTO T106 to determine its suitability for use and such cement shall not be used without approval by the Engineer.

All cement shall have a compressive strength of standard cement mortar samples at 28 days of not less than 25.0 MPa, tested in accordance with AASHTO T131.

When factory tests or field tests subsequent to the original approval tests, show that the cement does not comply with the Specifications, the entire consignment from which the sample was taken will be rejected and the Contractor shall immediately remove the rejected material from the Site and replace it with cement which meets the required specifications.

(G) Admixtures and Additives

The consent of the Engineer shall be obtained in writing prior to the use of admixtures or cement containing additives.

Chemical admixtures shall conform to AASHTO M194. Unless otherwise specified, only Type A (water-reducing), Type B (retarding) and Type D (water reducing-retarding) shall be used.

Water-reducing admixture shall be added to concrete for precast pre-stressed girders to improve the workability if instructed by the Engineer.

The Contractor shall submit the manufacturer's certified formula for the proposed admixture with sufficient evidence that the proposed admixture has given satisfactory results on other similar work. Permission to use the admixture may be withdrawn at any time when unsatisfactory results are obtained.

The amount of admixture to be used shall be in accordance with the manufacturer's specification and it shall be verified by testing to the approval of the Engineer.

The Contractor shall introduce the admixture in the mix in a water solution and the water so included shall be calculated as effective mix water.

Concrete with a retarding admixture must reach initial set at least 1 hour later, but not more than 3 hours later than the reference concrete and must reach final set not more than 3 hours later than the reference concrete, when tested in accordance with AASHTO T197.

#### 503.4 Construction Mix Design

##### (A) General Requirements

The mix shall be proportioned so as to secure a workable, finishable, durable, watertight and wear resistant concrete of the required strength.

Mixes for the grades of concrete required for the Works shall be designed by the Contractor, and shall be subject to approval by the Engineer.

Durable concrete of suitably low permeability shall be obtained by the use of strong dense aggregates, a sufficiently low water/cement ratio, complete compaction and proper curing methods to ensure sufficient hydration of the cement.

The mix shall be designed to allow it to be properly placed, and the difficulty in mixing and/or transportation shall not be considered in the mix acceptability.

Concrete as dry as it is practical to place with the available equipment shall be used.

The quantity of mixing water once approved shall not be varied without the prior written approval of the Engineer.

##### (B) Strength Requirements

In calculating the water/cement ratio of the mix, the weight of water shall be the total free water in the mix which includes the mixing water, the water in any admixture solution and any water in the aggregates.

The consistency of fresh concrete shall be monitored by testing the slump in accordance with AASHTO T119. The quantity of water used shall not exceed that required to produce a concrete with sufficient workability to be placed and compacted in the particular location as required, and to produce concrete of the following consistencies or as otherwise approved by the Engineer.

Type of Work	Nominal slump (mm)	Maximum slump (mm)
Formed elements		
Sections over 300mm	60	100
Sections under 300mm	80	120
Slabs with crossfall	60	80
Cast-in-place piles and drilled shafts, not vibrated	125 -200	230
Precast piles	80	120
Concrete placed underwater	125 -200	230

The cement content in any mix shall not exceed 500 kg/m<sup>3</sup> if not otherwise specified or directed.

Unless otherwise approved by the Engineer, the mix designs shall be on the basis of continuously graded aggregates.

(C) Trial Mixes

At least 42 days before the commencement of concreting the Contractor shall, have trial mixes designed and prepared in the laboratory for the approval of the Engineer. The concrete from each mix shall be tested in accordance with Section 503.15, (E) herein and shall satisfy the strength requirements specified.

The Contractor shall furnish single-use cylinder moulds conforming to AASHTO M205, or when approved by the Engineer, reusable vertical moulds made from heavy gauge metal.

A minimum of ten test cylinders taken from a trial batch of the proposed mix shall be made with the materials approved for use by the Engineer, with five tested at 7 days and five at 28 days. Testing shall be witnessed by the Engineer.

The average strength of the cylinders tested at 7 days shall not be less than 70% of the specified 28 days strengths.

The average strength of the cylinders tested at 28 days shall be at least 20% greater than the specified 28 days strength.

The Engineer will review the Contractor's trial mixes and cylinder strengths at 7 and 28 days. The Engineer will then determine which of the trial mixes shall be used. If none of the mixes for a given grade meets the Specifications or is acceptable to the Engineer, the Contractor shall prepare additional trial mixes.

No structural concrete shall be placed in the Works until the relevant trial mix has been approved by the Engineer.

When a trial mix has been approved, no variations shall be made in the proportions, the source of the cement and aggregates, or in the type, size and grading of the latter without the consent of the Engineer.

Should any variations be made which, in the opinion of the Engineer, could influence the strength or characteristics of the concrete, concreting operations shall cease and further trials undertaken by the Contractor. Concreting shall not recommence until a new mix has been approved by the Engineer.

When the Contractor intends to purchase factory-made precast concrete units, the Engineer may dispense with trial mixes and laboratory tests provided that evidence is given which satisfies him that the factory regularly produces concrete which complies with the Specifications. The evidence shall include details of mix proportions, water/cement ratios, workability and strengths obtained at 28 days.

#### 503.5 Batching and Mixing Concrete

##### (A) Delivery and Storage of Materials

The batching site shall be of adequate size to permit the stockpiling of sufficient base materials, having proper and uniform moisture content to ensure continuous and uniform operation.

Aggregates shall be stockpiled in such quantities that sufficient material approved by the Engineer is available to complete any continuous pour necessary for structures.

All aggregates shall be stockpiled for at least 12 hours before use in order to promote a uniform moisture content and to provide uniform conditions for proportioning plant control. Segregation shall be avoided.

Aggregate for concrete shall not be contaminated by other materials during transport and during storage on Site, and shall be stockpiled, preferably on a concrete slab, in such a manner that will preclude the intrusion of foreign material. If aggregates are stored on the ground, the bottom 200 mm minimum thickness layer of aggregates shall not be disturbed or used without re-cleaning, and an approved system of permanent gauges shall be installed to indicate that minimum thickness.

Coarse aggregate, unless otherwise permitted by the Engineer, shall be delivered to the Site in separate sizes.

Aggregates of different sizes shall be stored in different hoppers, or different stockpiles which shall be separated from each other.

Stockpiles of coarse aggregate shall be built in horizontal layers not exceeding one meter in depth to avoid segregation. Should the coarse aggregate become segregated it shall be re-mixed to conform to the grading requirements.

Fine aggregate from different sources of supply shall not be mixed or stored in the same stockpiles nor used alternatively in the same class of construction or mix without written permission from the Engineer.

Cement shall be protected from moisture during transport and storage. Bulk transport vehicles and bins or silos for cement shall not contain any residues of a different type, or of

a lower strength class or of any other materials.

Cement shall be delivered and stored in quantities sufficient to ensure that there is no suspension or interruption of the work at any time. Each consignment shall be kept separate and distinct in accordance with its mark, grade and date of production.

Cement in sacks shall be stored in a suitable weatherproof structure which shall be as airtight as practicable. Floors shall be wooden and elevated above the ground a sufficient distance to prevent the absorption of moisture. Sacks shall be stacked close together to reduce circulation of air but shall not be stacked against outside walls. The manner of storage shall permit easy access for inspection and identification of each consignment.

Bulk cement shall be transferred to elevated airtight and weatherproof bins.

In cases where only a small amount of concrete work is required, cement storage in the open may be permitted by the Engineer, in which case a raised platform and ample waterproof covering shall be provided.

(B) Mixing Concrete

All weighing and water-dispensing plant shall be maintained in good order. Their accuracy shall be checked against accurate weights and volumes when required by the Engineer. They shall be accurate to within 0.5% throughout the range of use.

The weight of each size of aggregate indicated by the mechanisms employed shall be within a tolerance of +/- 2% of the respective weight per batch agreed by the Engineer. Quantities of water, cement, and water-reducing admixture shall be within a tolerance of +/- 1% respectively.

The weight of the fine and coarse aggregates shall be adjusted to allow for the free water contained in them. The water to be added to the mix shall be reduced by the quantity of free water contained in the fine and coarse aggregates, which shall be determined by the Contractor by the method of AASHTO T255 immediately before mixing begins.

Concrete shall be mixed only in the quantities required for immediate use. Concrete shall not be used which has developed initial set. Re-tempering concrete by adding water or by other means will not be permitted. Concrete that is not within the specified slump limits at the time of placement shall not be used and shall be disposed of as instructed by the Engineer.

Concrete may be mixed at the site of the work, in a central-mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of Section 503.5, (C) herein.

Mixing of concrete shall be performed until a well-distributed mixture of the various constituent materials appears with consistent color.

When mixed at the job site or in a central-mixing plant, the mixing time shall not be less than 1.5 minutes nor more than 3 minutes. Five seconds shall be added to the specified mixing time if timing starts the instant the skip reaches its maximum raised position. Mixing time ends when the discharge chute opens. Different limiting mixing times may be allowed or directed by the Engineer, based on field trials or the experience of production.

The mixer shall be operated at the drum speed shown on the manufacturer's rating plate on the mixer.

The timing device on stationary mixers shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the Contractor will be permitted to continue operations while it is being repaired, provided he furnishes an approved timepiece equipped with minute and seconds hands. If the timing device is not placed in good working order within 24 hours, further use of the mixer will be prohibited until repairs are made.

Any concrete which, in the opinion of the Engineer, is mixed more or less than the specified time shall be discarded and disposed of by the Contractor at his expense.

The volume of concrete mixed per batch should not exceed the mixer's nominal capacity, as shown on the manufacturer's rating plate on the mixer. The mixer shall have a rated capacity sufficient to mix a batch of concrete containing at least one full bag of cement.

The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

Unless otherwise agreed by the Engineer, immediately before any session of batching concrete, a preliminary part batch shall be mixed having the masses of fine aggregate, cement and water in correct proportion and no coarse aggregate. The purpose of this is to avoid loss of mortar from the first batch of concrete as specified. The preliminary batch shall be passed through all delivery equipment but not placed in the forms except with the specific approval of the Engineer.

The entire contents of the mixer shall be removed from the drum before materials for the next batch are placed therein. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before any fresh concrete is mixed. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, water-tight, and so constructed that the concrete can be mixed to ensure a uniform distribution of materials throughout the mass.

All solid materials for the concrete shall be accurately measured and charged into the drum at the proportioning plant.

Except as subsequently provided, the truck mixer shall be equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in which case a tank is not required.

Truck mixers may be required to be provided with a means by which the mixing time can be readily verified by the Engineer.

The maximum size of batch in truck mixer shall not exceed the minimum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer.

Truck mixing shall unless otherwise directed be continued for not less than 100 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.

Mixing shall begin within 30 minutes after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water or surface wet aggregate and when the temperature is above 32 degrees Celsius, this limit shall be reduced to 15 minutes. The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the judgment of the Engineer, the aggregate is sufficiently free from moisture, so that there will be no harmful effects on the cement.

When a truck mixer is used for transportation of centrally-mixed concrete, the mixing time specified in Section 503.7 herein may be reduced to 30 seconds and mixing completed in a truck mixer. The mixing in the truck mixer shall be as specified for truck mixing.

During hot weather, the Contractor shall ensure that the constituent materials of the concrete are sufficiently cool to prevent the concrete from stiffening in the interval between its discharge from the mixer and compaction in its final position.

Manual mixing shall be only permitted with the prior approval of the Engineer for concrete in small amounts. Mixing concrete by hand shall be performed on a steel plate. Cement and fine aggregates shall be mixed uniformly in advance and then mixed with coarse aggregate and water. The mixing shall continue until a well-distributed mixture of the constituent materials with uniform color is obtained.

(C) Ready-Mixed Concrete

Ready-mixed concrete batched off the Site may be used only with the approval of the Engineer and shall comply with all relevant requirements of the Specifications for structural concrete.

(D) Transporting Mixed Concrete

Mixed concrete may only be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturers of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement

and consolidation in place.

Track agitators shall be loaded not to exceed the manufacture's guaranteed capacity. They shall maintain the mixed concrete as a thoroughly mixed uniform mass during hauling.

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point.

The rate of discharge of mixed concrete from truck mixers or agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within one hour, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 30 degrees Celsius, or above, a time less than one hour will be required as directed by the Engineer.

#### 503.6 Protection of Concrete

##### (A) General

Precautions shall be taken to protect concrete structures from damage due to weather or other environmental conditions during placing and curing operations.

The temperature of the concrete mixture immediately before placement shall be between +10 degrees Celsius and +32 degrees Celsius.

##### (B) Hot Weather Concreting

Hot weather concreting shall conform to the requirements of "Recommended Practice for Hot Weather Concreting" (American Concrete Institute 305-R77).

Unless otherwise directed, when the air temperature in the shade is expected to reach + 32 degrees Celsius or more, the Contractor shall schedule his operations to place and finish the concrete during the hours when the air shade temperature is below + 32 degrees Celsius. This shall preferably be in the latter part of the day after the maximum temperature has been reached and outside normal working hours.

The temperature of concrete at the time of placement shall be maintained within the specified temperature range by any combination of: shading the materials storage areas or production equipment; cooling the aggregates by sprinkling with water; cooling the aggregates or water by refrigeration or replacing the mix water with ice that is flaked or crushed.

The time available for handling and placing concrete during periods of high temperature may be considerably reduced and the Contractor shall take appropriate measures and precautions at his own cost. Concrete shall be protected during transportation by use of



damp hessian or similar.

No additional water shall be added at the time of mixing without the approval of the Engineer, as this may lead to additional shrinkage of the concrete. On no account shall water be added during transportation or placing of the concrete.

#### 503.7 Handling and Placing Concrete

##### (A) General

The methods of transporting and placing concrete shall be to the approval of the Engineer. Concrete shall be so transported and placed that there is no contamination, segregation or loss of the constituent materials.

The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The method of delivery and handling shall be such as will facilitate placing with a minimum of re-handling and without damage to the structure or the concrete.

The Engineer may delay or suspend the mixing and placing of concrete at any job site for which he considers the Contractor's delivery and compaction equipment inadequate, until such time as the Contractor provides additional approved delivery and compaction equipment.

The formwork and reinforcement shall be clean and free from standing water immediately before the placing of the concrete and all sawdust, construction debris and other extraneous matter shall have been removed.

Concrete shall not be placed in any part of the structure until the Engineer's approval has been obtained.

The pouring operation shall be performed continuously. Should an intermission occur, it shall immediately be reported to the Engineer.

Concrete shall be compacted in its final position within 30 minutes of discharge from the mixer unless, with the approval of the Engineer, it is placed in a purpose-made agitator, operating continuously, in which case it shall be compacted in its final position within 2 hours of the introduction of cement to the mix and within 30 minutes of discharge from the agitator. These limiting times may be adjusted by the Engineer to take into account factors such as temperature and mix design, including admixtures.

##### (B) Handling Concrete

A leak-proof, non-absorbent vessel shall be used for transporting concrete. It should be cleaned frequently from the remains of adhering concrete.

A cover shall be provided for the vessel in order to prevent sunshine, rain or cold weather affecting the quality of the concrete.

(C) Placing Concrete

Concrete shall be placed so as to avoid displacement of the reinforcement, and shall be placed as nearly as possible to its final position.

The use of long troughs, chutes and pipes for conveying concrete to the forms shall be permitted only on written authorization of the Engineer. The Engineer shall reject the use of equipment for concrete transportation that will allow segregation, loss of fine materials or which in any other way will have an adverse effect on the concrete quality.

Open troughs and chutes shall be metal lined; where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement to avoid segregation.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure.

Where Site conditions make it unavoidable that concrete has to be dropped more than 1.5 meters, the concrete shall be dropped through a tube fitted with a hopper head, or through other approved devices to avoid segregation.

As far as practicable, the pipes shall be kept full of concrete during placing and their lower end shall be kept buried in newly placed concrete

Except where otherwise agreed by the Engineer, concrete shall be deposited in horizontal layers to a compacted depth not exceeding 450 mm where internal vibrators are used, and 300 mm in all other cases. Each layer shall be placed and consolidated before the preceding batch has taken its initial set to prevent injury to the green concrete and to avoid surfaces of separation between the batches.

After the initial set of the concrete, the forms shall not be jarred and no force shall be applied to projecting reinforcing bars.

When concreting the bottom layer of footings, precautions shall be taken to prevent the concrete from absorbing moisture from the foundation or being permeated. Drainage measures shall be provided in the foundation trench. No standing water on the bottom of the trench shall be allowed prior to the concreting. A 100 mm thick layer of blinding concrete shall generally be used unless otherwise permitted by the Engineer, such as in the case of a foundation of clean, hard, impermeable rock.

Pumping will not be permitted from the inside of the foundation forms while concrete is being placed. If necessary to prevent flooding, a seal of concrete shall be placed through a closed chute or tremie and allowed to set.

Where there is dense top reinforcement, some straight bars may be displaced temporarily to facilitate the concrete placement. The bars shall be repositioned before placing the top layer.

Concrete for columns, substructure and culvert walls, and other similar vertical members shall be placed and allowed to set and settle for a period of time before concrete for integral horizontal members, such as caps, slabs or footings is placed. These shall be not less than 12 hours for vertical members over 4.5 meters in height and not less than 30 minutes for members over 1.5 meters but not over 4.5 meters in height.

Concrete for T-beam or deck girder spans whose depth is less than 1.2 meters may be placed in one continuous operation or in two separate operations; first, to the top of girder stems, and second, to completion. For T-beam or deck girder spans whose depth is greater than 1.2 meters, concrete shall be placed in two operations, with the deck slab concrete placed at least five days after concrete placement in the stems.

Embedded items (bolts and anchor bars) shall be inspected regularly during the casting operation and any displacements shall be rectified. Care shall be taken to ensure the concrete fills up properly under horizontal plates, e.g. expansion joint plates.

(D) Placing Concrete under Water

Concrete shall be deposited in water only with the permission of the Engineer.

No concrete shall be placed in running water. Forms which are not reasonably watertight shall not be used for holding concrete deposited under water.

The minimum cement content of the grade of concrete being deposited in water shall be increased by at least 10% without financial compensation.

When depositing in water is allowed, the concrete shall be carefully placed in the space in which it is to remain in a compact mass, by means of a tremie, bottom-dumping bucket, concrete pump or other approved method.

A tremie shall consist of a tube having a diameter of not less than 250 mm constructed in sections having flanged couplings fitted with gaskets with a hopper at the top. The tremie shall be supported so as to permit free movement of the discharge and over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of work so as to prevent water entering the tube and shall be completely submerged in concrete at all times; the tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by lightly raising the discharge end, but always keeping it in the placed concrete. The flow shall be continuous until the work is completed.

When the concrete is placed with a bottom-dump bucket, the top of the bucket shall be open. The bottom doors shall open freely downward and outward when tripped. The buckets shall be completely filled and slowly lowered to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited and when discharged shall be withdrawn slowly until well above the concrete.

The concrete shall not be disturbed after being deposited.

(E) Pumping Concrete

Placement of concrete by pumping will be permitted only if authorized by the Engineer in writing after approval of a modified mix design and preliminary trials as specified.

Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be suitable in kind and adequate in capacity for the work, and shall be so arranged that no vibrations result that might damage freshly placed concrete. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

After the operation, the entire equipment shall be thoroughly cleaned.

(F) Compaction of Concrete

All concrete, except concrete placed under water, during and immediately after depositing, shall be thoroughly compacted to produce a dense homogeneous mass. Unless otherwise permitted by the Engineer it shall be compacted with the assistance of mechanical vibration subject to the following provisions.

The vibration shall be internal except that external vibrators may be used for thin sections when forms have been specifically designed for external vibration.

Vibrators shall be of a type and design approved by the Engineer. They shall be capable of transmitting vibrations to the concrete at frequencies of not less than 4,500 impulses per minute. The intensity of vibration shall be such as visibly to affect a mass of concrete of 50 mm slump over a radius of at least 450 mm.

A sufficient number of vibrators in serviceable condition shall be present at the site of concreting operations so that spare equipment is always available in the event of breakdown. Concrete placing shall not commence until approval is given by the Engineer to the number of vibrators in serviceable condition available at the place of concreting.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn slowly to avoid creating voids.

Vibrators shall be inserted vertically into the concrete and to a sufficient depth to ensure that the newly-poured concrete is worked into the previous layer. The penetration of the vibrator into the previous layer should be approximately 50 mm.

Application of vibrators shall be at points uniformly spaced and not further apart than twice the radius over which the vibration is visibly effective.

The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be

continued at any one point to the extent that localized areas of grout are formed.

Where immersion type vibrators are used, contact with reinforcement, formwork and all inserts shall be avoided, so far as is practicable.

Vibration shall not be applied directly to or by way of the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration.

Vibrators shall not be used to make concrete flow in the forms and shall not be used to transport concrete in the forms. Where necessary, concrete shall be redistributed in the forms by spading.

Vibration shall be supplemented by such rodding as is necessary to ensure smooth surfaces and dense concrete, along surfaces and in corners and locations difficult or impossible to reach with the vibrators.

Concrete shall not be subjected to vibration between 2 and 24 hours after compaction, unless otherwise permitted by the Engineer.

#### 503.8 Construction Joints

##### (A) General

Joints in concrete work due to stopping work shall be avoided to the degree possible. If not detailed on the Drawings, or in an emergency, construction joint locations shall only be formed with the prior approval of the Engineer. Joints shall not be allowed within 500 mm of the top of any face.

Shear keys or inclined reinforcement shall be used where necessary to transmit shear and bond the two sections together. When shear keys or inclined reinforcement are not provided, the concrete shall be roughened as directed.

##### (B) Construction Requirements

The upper surface of lifts of concrete walls and columns shall be horizontal unless otherwise described on the Drawings.

Immediately following the discontinuance of placing concrete, all accumulations of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. Care shall be exercised during the cleaning of the reinforcing steel, not to injure or break the concrete-steel bond at and near the surface of the concrete.

Where a construction joint contains a formed surface, that surface shall be roughened to expose the aggregate without damaging the aggregate and the arises of the joint. The roughened surface shall then be washed with clean water under pressure to remove loose particles.

Where sections of the work are carried out in lifts, the reinforcement projecting above the lift being cast shall be adequately supported so as to prevent movement of the bars during the casting and setting of the concrete.

Whenever possible laitance and all loose material shall be removed while the concrete is still green and no further roughening will then be required. When this is not possible, it shall be removed by mechanical means when the concrete has been in position for more than 24 hours. Extreme care shall be taken to avoid the mechanical devices hitting the reinforcement as this may result in the loss of bond between the reinforcement and the concrete. The roughened surface shall then be washed with clean water under pressure.

To compensate for loss of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall first be thoroughly painted with a thick coat of 1:2 cement/sand mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set. Where this is not possible, other approved means shall be adopted.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints that are exposed to view shall be carefully finished true to line and elevation.

Suitable keys may be formed by the use of timber blocks approximately 50 mm deep by 100 mm wide in cross section and having a length of 100 mm less than the width of the member. The key blocks shall be spaced along the member as required, but the spacing shall be not greater than 300 mm centre to centre. The blocks shall be bevelled and oiled in such manner as to ensure their ready removal, and they shall be removed as soon as the concrete has set sufficiently to retain its shape.

Immediately following the discontinuation of placing concrete, all accumulations of mortar splashed on the reinforcing steel and the surface of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete setting, extreme care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete, while cleaning the reinforcing steel.

#### 503.9 Finishing Plastic Concrete

##### (A) General

After the concrete has been compacted and prior to the application of curing, all surfaces of concrete which are not placed against forms shall be struck-off to the given grade, superelevation or crown specified on the Drawings and the surface finished by floating with wooden floats.

Exposed surfaces, if instructed by the Engineer, shall be finished with a wood float. When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, it shall be steel-trowelled under firm pressure to produce a dense, smooth, uniform surface free from trowel marks.

(B) Roadway Surface Finish

Concrete surfaces for use by traffic shall be finished to a skid-resistant surface.

During finishing operations the Contractor shall provide suitable and adequate work bridges for performance of the work.

(C) Striking Off and Floating

After the concrete is placed and compacted, finished pavements shall be finished using approved power driven finishing machines.

All surfaces shall be struck-off by equipment supported by and travelling on rails or headers. Rails or headers shall be adjustable for elevation and shall be set to allow for anticipated settlement, camber, and deflection of falsework, as necessary to obtain a finished surface true to the required grade and cross section.

Before the delivery of concrete is begun, the finishing machine or, if used, the hand-operated strike-off tool shall be operated over the entire area to be finished to check for excessive rail deflections, for proper slab thickness and cover on reinforcing steel.

A slight excess of concrete shall be kept in front of the cutting edge of the screed at all times. This excess concrete shall be carried all the way to the edge of the pour or form and shall not be worked into the slab, but shall be wasted.

After strike-off, the surface shall be finished with a float, roller or approved device as necessary to remove any local irregularities and to leave sufficient mortar at the surface of the concrete for later texturing.

During finishing operations, excess water, laitance, or foreign materials brought to the surface shall not be re-worked into the slab, but shall be removed immediately upon appearance.

After finishing, the entire surface shall be checked by the Contractor with a 3 meter long metal straightedge operated parallel to the centerline of the bridge and shall show no deviation in excess of 3 from the testing edge. Deviations in excess of these requirements shall be corrected before the concrete sets.

(D) Texturing

The surface shall be given a skid-resistant texture by either burlap or carpet dragging, brooming, tining, or by a combination of this methods. This operation shall be done after floating.

If the surface is to be drag finish, the surface shall be finished by dragging a seamless strip of damp burlap over the full width of the surface. The burlap drag shall consist of sufficient layers of burlap and have sufficient length in contact with the concrete to slightly groove the surface.

If the surface texture is to be broom finish, the surface shall be broomed when the surface has hardened sufficiently. The strokes shall be square across the slab, from edge to edge, with adjacent strokes slightly overlapped, and shall be made by drawing the broom without tearing the concrete, but so as to produce regular corrugations not over 3 mm in depth. The surface as thus finished shall be free from porous spots, irregularities, depressions, and small pockets.

If the surface is to be tined, the tining shall be in transverse direction using a wire broom, comb or finned float having a single row of tines or fins. The tining grooves shall be between 2 mm and 5 mm deep, spaced 12 mm to 40 mm on centers.

(E) Surface Testing and Correction

After the concrete has hardened, the finished roadway surfaces will be inspected by the Engineer. The surface shall be tested with a 3 meter long straight-edge. Areas showing high spots of more than 3 mm but not exceeding 12 mm in 3 meters between any two contact points shall be marked. The Contractor shall correct such irregularities by the use of concrete planing or grooving equipment which produces a textured surface in equal roughness to the surrounding unground concrete.

Where the departure from correct cross section exceeds 12 mm the Engineer may instruct the Contractor to remove and re-do the work at the Contractor's own cost.

The Contractor shall request the Engineer's approval of all finished surfaces.

503.10 Curing Concrete

(A) General

In all cases the method of curing shall be approved by the Engineer before concreting of any element commences and concreting shall not be commenced until all curing materials are available at the site of the concreting operations and have been approved by the Engineer.

Immediately after the free water has left the surface and finishing operations are completed. Curing by other than steam method shall continue for 7 days thereafter, or as instructed by the Engineer. The concrete shall be protected against harmful effects of weather, including rain, rapid temperature change and from drying out.

The methods of curing and their duration shall be such that the concrete will have satisfactory durability and strength and the member will suffer a minimum of distortion, be free from excessive efflorescence and will not leak due to shrinkage cracking in the structure. If necessary the concrete shall be insulated so that it is maintained at a suitable temperature, or so that the rates of evaporation of moisture from the surfaces are kept to appropriate values. Different curing or drying treatments will be appropriate to different members and products. Where necessary special care should be taken to ensure that similar components are cured as far as practicable under the same conditions.



The top surfaces of concrete pavement shall be cured by the water curing method. The water cure shall be applied progressively immediately on completion of a section of surface finishing. Sections shall be agreed with the Engineer. Curing of concrete shall commence no later than 4 hours after placement.

The liquid membrane curing method shall not be used on surfaces where a rubbed finish is required or on surfaces of construction joints. It may however be used on concrete surfaces which are to be buried under ground and surfaces where only an ordinary surface finish is to be applied and on which a uniform color is not required and which will not be visible from public view.

When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surface being cured by the curing compound method or by the forms-in-place method until the Engineer determines that a cooling effect is no longer required.

Formed structure members, prior to removal of forms, shall be kept continually wet regardless of the method of curing.

Where structural members are of considerable depth or bulk or have an unusually high proportion of cement or are precast units subjected to special or accelerated curing methods, special methods of curing shall be implemented and shall be approved by the Engineer.

(B) Water Curing

Water curing shall consist of maintaining formwork in place and closely covering the unformed concrete surface with a material such as straw, hessian, sand or with an absorbent material which is kept continually damp. The type of covering provided shall be that which in the opinion of the Engineer is best suited to the conditions.

On formed surfaces, if the forms are removed before the end of the curing period, curing shall be continued as for on the unformed surfaces.

When sand, burlap, or other approved fabric materials are used, they shall not cause any undesirable finish such as a rough surface and discoloring of parts which will be exposed to view.

(C) Liquid Membrane Curing

The curing membrane shall be in accordance with the requirements specified for curing membrane material AASHTO M148, Type 2.

The curing membrane shall be applied in 2 applications in conformance with the manufacturer's instructions and to the satisfaction of the Engineer.

The first coat shall be applied immediately after removal of the forms and the Engineer's acceptance of the finish and after the disappearance of free water on unformed surfaces.

If the concrete is dry or becomes dry, it shall be thoroughly wetted with water and the

curing compound applied just as the surface film of water disappears. In such case the Engineer shall be informed of the situation to allow a decision to be taken as to the acceptability of the concrete that has been allowed to dry prior to the application of curing.

The second application shall be applied immediately after the first application has set.

During curing operations, any unsprayed surfaces shall be kept wet with water. The curing membrane will not be allowed on areas against which more concrete is to be placed.

Curing membrane shall be protected against marring for the entire specified curing period. Any coating marred or otherwise disturbed shall be made good immediately.

(D) Waterproof Membrane Curing

The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which a curing membrane of waterproof paper or plastic sheeting shall be placed.

The curing membrane shall remain in place for a period of not less than 7 days.

Waterproof paper and plastic sheeting shall conform to the AASHTO M171.

The waterproof paper or plastic sheeting shall be formed into sheets of such width as to cover completely the entire concrete surface.

All joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 100 mm.

The sheet shall be securely weighed down by placing a bank of earth on the edges of the sheets or by other means approved by the Engineer.

Should any portion of the sheets be broken or damaged after being placed the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

Sections of membrane which have lost their waterproof qualities or have been damaged to such an extent as in the opinion of the Engineer to render them unfit for curing the concrete shall not be used.

(E) Forms-in-Place Method

Formed surfaces of concrete may be cured by retaining the form-in-place. The forms shall remain in place for a minimum period of 7 days after the concrete has been placed. Wooden forms shall be kept continually wet by watering during the curing period.

(F) Steam Curing

After placement of the concrete, members to be steam cured shall be held for a minimum 4-hour pre-steaming period.

To prevent moisture loss on exposed surfaces during the pre-steaming period, members

shall be covered immediately after casting or the exposed surface shall be kept continually wet by fog spray or wet blankets.

Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good condition and secured in such a manner to prevent the loss of steam and moisture.

Steam at jets shall be low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders or forms.

During application of the steam, the temperature rise within the enclosure shall not exceed 20 degrees Celsius per hour. The curing temperature throughout enclosure shall not exceed 65 degrees Celsius and shall be maintained at a constant level for a sufficient time to develop the required compressive strength.

Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature of the cylinders will be the same as that of the concrete.

Temperature recording devices that will provide an accurate continuous permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per 50 m of continuous bed length will be required for checking temperature.

Curing of pre-cast concrete will be considered completed after the termination of the steam curing cycle.

#### 503.11 Finishing Formed Concrete Surfaces

##### (A) General

Surface finishing shall be classified as follows:

Class 1: Ordinary Finish

Class 2: Rubbed Finish

All concrete shall be given Class 1, Ordinary Finish and additionally any further finish as specified or as instructed by the Engineer.

Unless otherwise specified, the following surfaces shall be given a Class 2, Rubbed finish:

- The exposed faces of wingwalls and retaining walls
- The outside faces of concrete pavement.

Wingwalls shall be finished from the top to 50 cm below the finished slope lines on the outside face and shall be finished on top and for a depth of 20 cm below the top on the back sides.

If on the removal of the forms there is any honeycombing or other significant defect apparent in the concrete, the Engineer shall be informed immediately. No making good or

other treatment shall be carried out except with the prior approval of the Engineer.

Where so approved by the Engineer, in areas with honeycombing and/or exposed reinforcement or other such defects, the defective concrete and individual projecting stones shall be chiselled away to the full depth of the defects. The concrete surface shall be cleaned with wire brushes and/or water under high pressure, filled with fine aggregate concrete (one grade higher than the defective concrete), compacted and cured.

Methods proposed for making good defects shall be approved by the Engineer.

If, in the opinion of the Engineer, defects are of such extent or character as to materially affect the strength of the structure or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the part of the structure affected.

(B) Ordinary Surface Finish

Immediately after the removal of forms, fins and irregular projections shall be removed from the surfaces, except those which are not to be exposed. On all surfaces, the cavities produced by form ties, minor blemishes, broken corners or edges and other minor defects shall be thoroughly cleaned, and after thorough saturation with water shall be carefully pointed and made good with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall be not more than 1 hour old.

Any mortar or concrete patching or pointing to make good significant holes or depressions, honeycombing, etc., shall only be carried out when allowed by the Engineer and shall use methods/materials as approved by the Engineer.

Exposed surfaces not protected by forms shall be struck off with a straight-edge and finished with a wood float to a true and even surface. The use of additional mortar to provide a grout finish will not be permitted.

The mortar patches shall be cured as specified in Section 503.10 herein.

The resulting surfaces shall be true and uniform. Repaired surfaces of which, in the opinion of the Engineer, the appearance is not satisfactory, shall be rubbed as specified for rubbed finish.

(C) Rubbed Finish

After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished.

Rubbing shall be continued until marks, projections and irregularities have been removed, voids have been filled and a uniform surface has been obtained. After other work which

could affect the surface has been completed, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of smooth texture and uniform color.

After the final rubbing is finished and the surface has dried, it shall be rubbed with burlap to remove loose powder.

#### 503.12 Precast Concrete Members

##### (A) General

Precast concrete members shall be constructed and placed in the work in conformity with the details shown on the Drawings, specified or shown on the approved working drawings.

Whenever specified or requested by the Engineer, the Contractor shall provide working drawings for precast members. Such drawings shall include all details not shown on the Drawings for the construction.

The method of manufacture shall be approved by the Engineer before work is started. No changes shall subsequently be made without the consent of the Engineer.

The Contractor shall inform the Engineer in advance of the date of commencement of manufacture for each type of precast member.

##### (B) Materials and Manufacture

The materials and manufacturing processes used for precast concrete members shall conform to the requirements of the relevant Sections of the Specifications.

The foundation for the precasting moulds shall be solid, cast on unyielding beds or pallets and, if necessary, improved and drained to obtain sufficient bearing capacity to avoid settlements and subsequent deformation of the members.

The side forms may be removed as soon as their removal will not cause distortion of the concrete surface, and provided that curing is not interrupted. Members shall not be lifted from their casting beds until their strength is sufficient to prevent damage.

When precast members are designed to be abutted together in the finished work, each member shall be match-cast with its adjacent segments to ensure proper fit. The segments must be precisely aligned to achieve final structure geometry, and during alignment, adjustments to compensate for deflections shall be made.

Unless otherwise specified, precast members shall be cured by the water method or steam method.

##### (C) Storage and Handling

Members shall be firmly supported at such bearing positions as will ensure that the stresses induced in them are always less than the permissible design stresses. Members shall be lifted or supported only at the points specified on the Drawings and shall be handled and

placed without impact.

Care shall be taken during storage, hoisting, and handling of the precast units to prevent cracking or damage. Units damaged by improper storing or handling shall be replaced by the Contractor at his own cost.

(D) Tolerances

The following tolerances shall apply:

Length	+/- 12 mm
Width and depth	+/- 6 mm
Bow in the vertical plane	+/- 15 mm
Bow in the horizontal plane	+/- 12 mm
Difference between longest and shortest dimensions in any plane	6 mm
Twist (measured by the deviation of any corner from the plane containing the other three corners)	6 mm
Flatness (the maximum deviation from a 1.5 m straight edge placed in any position on a nominally plane surface)	6 mm
Cover to reinforcement	0/+5 mm
Dowel holes (in any direction)	3 mm

503.13 Mortar and Grout

This work consists of making and placing of mortar and grout for use in concrete structures.

Materials for mortar and grout shall conform to the requirements of Section 503.3 herein. The grading of sand for use in mortar or grout when the width and depth of void to be filled is less than 40 mm shall be modified so that all material passes the 2.36 mm sieve.

Unless otherwise specified or instructed by the Engineer, the proportion of cement to sand for mortar shall be 1 to 2 and for grout shall be 1 to 1, by loose volume.

Sufficient water shall be used to permit placing and packing. Mixing shall be by hand methods or with rotating paddle-type mixing machines and shall be continued until all ingredients are thoroughly mixed. Once mixed, mortar or grout shall not be re-tempered by the addition of water and shall be placed within one hour.

No load shall be allowed on mortar until after 72 hours, unless otherwise permitted by the Engineer.

Mortar and grout shall be cured by an approved method.

503.14 Early Loading

(A) General

The Contractor shall ensure that no loads are applied until the concrete has attained

sufficient strength and when applicable, so that it will not cause damage to newly constructed work. Any damage caused by such overloading shall be made good by the Contractor at his own cost to the satisfaction of the Engineer.

(B) Earth Loads

When the placement of backfill will cause flexural stresses in the concrete, the placement shall not begin until the concrete has reached at least 80% of its specified strength.

(C) Construction Loads

Light equipment and materials may be carried on the slabs only after the concrete has been in place at least 24 hours, providing curing is not interfered with and the texture is not damaged.

Construction vehicles weighing between 500 and 1,500 kg., and comparable material loads, will be allowed on the slab only after the last concrete placed has attained a compressive strength of at least 17 MPa.

Loads imposed on existing, new or partially completed portions of structures due to construction operations shall not exceed the load-carrying capacity of the structure as determined by the Load Factor Design methods of AASHTO using Load Group IB. The concrete compressive strength ( $f_c'$ ) to be used shall be the smaller of the actual compressive strength at the time of loading or the specified compressive strength of concrete.

(D) Opening to Traffic

Traffic shall not be permitted on concrete slab until 21 days after the last placement of concrete and until such concrete has attained its specified strength, and the written permission of the Engineer shall be obtained prior to opening.

503.15 Testing

(A) General

A strength test shall consist of the average strength of three compressive strength test cylinders fabricated from material taken from a single randomly selected batch of concrete, except that, if any cylinder should show evidence of improper sampling or testing, the said cylinder shall be discarded and the strength test shall consist of the strength of the remaining cylinders.

From any batch, 3 samples shall be taken, and 2 test cylinders shall be made from each of the 3 samples. Three test cylinders shall be tested at 7 days and the other three test cylinders tested at 28 days. The six test cylinders shall constitute a set of test specimens.

The average value of the compressive strengths of the three test specimens will be taken as the compressive strength of the set.

(B) Field Cured Specimens

For determining the adequacy of curing and protection, and for determining when loads or stresses can be applied to concrete structures, test cylinders shall be cured at the structure site under conditions that are not more favorable than the most unfavorable conditions for the structure which they represent as described in Section 9.4 of AASHTO T23.

(C) For Acceptance of Concrete

For determining compliance with a specified 28-day compressive strength, test cylinders shall be cured under controlled conditions as described in Section 9.3 of AASHTO T23 and tested at 28 days.

(D) Sampling

At least one set of test specimens shall be taken once every day on which concreting work is in progress.

Test specimens shall be made from each separate concrete grade and mix ratio, and shall be typical for the portion of concrete they represent.

For mass concrete structures, at least one set of test specimens shall be made from each 100 cubic meters of concrete.

For reinforced concrete, at least one set of test specimens shall be made each 50 cubic meters of concrete.

For small scattered work, such as minor culverts and incidental structures, at least one set of test specimens shall be taken from each grade of concrete in the structure.

Where an identical mix is being placed in different parts of the same work, sampling may be limited to one set of test specimens with the prior approval of the Engineer.

(E) Strength Requirements

No individual 28-day test cylinder from any set of test specimens shall be less than the specified 28-day compressive strength by more than 3 MPa, and the average value of the 28-day compressive strengths of any set of test specimens shall be not less than the specified 28-day compressive strength.

A series of test specimen sets shall comprise sets of test specimens from each structural member of an integral structure, or sets of test specimens from one or more prefabricated members having similar mixes.

(F) Test Results and Additional Tests

Should the compressive strength value obtained from the tests fail to comply with the specified requirements, the Engineer may require core samples to be taken and tested in accordance with the standard methods of AASHTO T24. The Contractor shall, at his own expense, furnish all equipment required for such sampling and testing.



Direct loading tests may also be ordered for examination of the load capacity of the structure or member.

No member shall be used until a satisfactory test result has been obtained or the specified requirement is achieved by means of strengthening methods, and approval has been given by the Engineer.

503.15 Measurement and Payment

No separate measurement and payment will be made for complying with the requirements of this Section 503.

**Section 504 Demolition Work**

504.1 Description

Demolition work shall consist of the removal, wholly or in part, and satisfactory disposal of all buildings, fences, culverts, abandoned pipes or utilities, and any other obstructions which are not designated or permitted by the Engineer to remain, except for the obstructions specifically designated to be removed and disposed of under other items in the Specifications.

Demolition work shall include the salvaging of designated materials and the backfilling and compaction of the resulting cavities.

The Contractor shall perform all demolition work required within and adjacent to the roadway, as shown elsewhere in the Contract or as instructed by the Engineer.

The breaking out of concrete on structures in order to carry out a patch repair is not deemed to be demolition work.

504.2 Demolition Requirements

Where a structure to be demolished lies wholly or in part within the limits for a new structure, it shall be removed to the extent necessary to accommodate the construction of the new structure and to ensure unimpeded use of the new structure.

All designated salvable material shall be carefully dismantled and removed, without unnecessary damage, in sections or pieces which may be readily transported, match marked as necessary, transported to and offloaded and stored at the Owners facilities designated by the Engineer, which facilities will be within 50 kilometers of the Site. All salvable materials shall at all times remain the property of the Owner.

All existing metal and concrete pipe culverts are designated as salvable material.

Unless waived in writing by the Engineer, all material removed which is suitable for rip-rap and not needed immediately on the Works shall be stockpiled within the limits of work for future use. Where such material is surplus to the requirements of the Contract it shall be

disposed of as designated by the Engineer.

Material not considered as salvable or not considered as suitable for incorporation into the Works shall be removed and disposed of in disposal location approved by the Engineer.

Gravel, bituminous material, or other surfacing materials designated as salvable shall be stockpiled at locations approved by the Engineer and protected from contamination by dirt or foreign material by the Contractor until utilized in the Works or approved by the Engineer to be disposed of.

504.3 Measurement and Payment

No separate measurement and payment will be made for complying with the requirements of this Section 504.

## **APPENDIX 1**

### **OFFICES FOR THE ENGINEER**

#### **A1.1 Offices for the Engineer**

The offices for the Engineer shall be fixed structures and the floor area shall be subdivided, with permanent walls and doors to suit the particular type of facilities as instructed by the Engineer. The area of the Engineer's office shall not be less than 100m<sup>2</sup> and the minimum headroom or ceiling height shall not be less than 2.5 meters for the main office.

The buildings shall be constructed with hollow concrete blocks or bricks, with all internal surfaces plastered with cement/lime mortar to a smooth finish and painted white or any other color approved by the Engineer. The floors shall be made of concrete and covered with tiles or similar covering to the approval of the Engineer. All windows shall be glazed and provided with security grills and blinds and mosquito netting.

Each room shall be fitted with two 40-watt fluorescent light fittings, ceiling fans with regulators, and two electric 5A outlets with ground connection. The kitchens shall have at least two 5A and 15A electric outlets.

One toilet room shall be equipped with a water closet (pedestal type). The other toilet shall be equipped with two urinal stalls, two water closets (floor type). Both toilets shall be fitted with wash basins, mirrors and wall hooks for clothing, soap dishes, electric extractor fans, etc.

Before connecting construction works, the Contractor shall prepare for the Engineer's approval, working drawings of the offices, including the site layouts, front and side elevations, floor plan with dimensions, details of construction with finishes and all other data as required for the completion of the office facilities in accordance with these Specifications.

Electrical power shall be provided either from the main supply or a generator with adequate ground connection, installed and operated by the Contractor. Power shall be available on a 24-hour basis.

Where public sewerage disposal systems are not available, septic tanks of the size and materials approved by the Engineer, equipped with proper inlet and outlet baffles and sealed access latch shall be constructed. The Contractor shall submit full details of the proposed system for approval of the Engineer.

The Contractor shall provide two external telephone lines with necessary extensions for use in the various offices.

The Contractor shall provide and maintain the offices and the facilities therein until contract completion in a location which is not necessarily close to the Contract Works and approved by the Engineer

The minimum ground floor requirements of the main office should be as shown in the table below:

## **A1.2 Furniture and Office Equipment for the Engineer’s Staff**

The furniture and equipment to be supplied and installed in the offices shall be new, and of acceptable quality. The furniture may be steel, aluminum, wood or combination of these. The Contractor should forward details of the items he intends to supply and obtain prior approval from the Engineer.

The Contractor shall provide, install and maintain the furniture and equipment until the contract completion to the satisfaction of the Engineer. Contractor is required to provide transportations from the Engineer and his staff’s accommodation on site.

### Furniture and Equipment for the Main Office

Description	Number
<b>Office</b>	
Junior executive desk 0.75 m x 1.5 m with 2 drawers each side	4
Junior executive chair	4
Chairs, moulded plastic	4
Steel bookcase, 4 shelves, 1.0 m wide x 1.5 m high	2
Filing cabinet, steel, 2- drawer	2
Cupboard, steel, lockable, 1.8 m high x 0.9 m wide x 0.45 m deep	2
Layout table, 1.0 m x 2.0 m	1
White board 1.0 m wide x 0.75 m high	1
Telephone line, international direct dial	2
Fax machine for A4 plain paper	1
Computer network system (LAN network connection for 6 computers)	1
Computer	3
DELL compatible Intel Core i7 or equivalent of at least 2.0 GHz, 4.0GB Ram, 500GB Hard Drive, Floppy disk drive, 52 x DVD ROM and DVD-R, mouse, 101 keyboards, 17” color monitor complete with LAN and internet connection.	
Uninterrupted Power Supply, 600VA, with at least 20 minutes standby time	1
Laser jet printer, A4 size, black and white (12 pages per minutes minimum capacity)	1
Ink jet printer, A3 size, full color, 5760x1440 dpi, USB 2.0 connection	1
Air conditioner 10000 BTU	2
<b>Conference Room</b>	
Conference table	1
Chairs, moulded plastic	5
White board 1.0 m wide x 0.75 m high	1
Air conditioner 24000 BTU	1
<b>Drivers Room</b>	
Table 1.25 m x .75 m wide	1
Chairs, moulded plastic	5
Bookcase, 4 shelves, 1.0 m wide x 1.5 m high	1
Ceiling fan with regulator	1

## **APPENDIX 2**

### **LABORATORY AND EQUIPMENT TO BE FURNISHED**

#### **A2.1 General**

The Contractor shall provide and maintain for the duration of the Contract a laboratory complete with all utility service, equipment, apparatus and fittings, for on-site testing of materials.

The laboratory, fittings and equipment as approved by the Engineer shall be operated by the Contractor in accordance with the Contract or as directed by the Engineer.

The Contractor shall provide all technicians, laborers, etc. in the numbers deemed necessary by the Engineer to operate the laboratory as required by the Contract. Personnel once assigned to the laboratory shall not be removed without written approval of the Engineer.

Laboratory equipment and apparatus shall be furnished before the start of any work requiring their use.

Materials, equipment and instruments in the laboratory and those used for field testing are to be maintained by the Contractor and kept ready in good operating condition at all times.

The materials testing laboratory shall be for the exclusive use of the Engineer and shall be located adjacent to the Engineer's office and shall have a minimum floor area of 75m<sup>2</sup>.

Adequate storage of water and pressure supply shall be maintained for normal testing together with two sinks including taps.

The floor of the building shall be rigid and adequate to support operating test equipment without vibration and undue noise.

The laboratory shall have a minimum of two fans, two ceiling fans with regulators and three opening windows with blinds.

At the completion of the contract the laboratory and all furniture, equipment, apparatus and fittings for it provided by the Contractor shall revert to the Contractor.

#### **A2.2 Laboratory Equipment**

The Contractor shall provide all testing equipment, devices, apparatus, tools and consumables required to enable the Engineer to carry out most of the tests to ascertain the quality of the works executed by the Contractor under the Contract. A list of such equipment, devices, apparatus, tools and consumables shall be submitted by the Contractor to the Engineer for his prior approval.

Sample List of Equipment and Apparatus at Laboratory are shown below for reference.

**SAMPLE LIST OF EQUIPMENT AND APPARATUS AT LABORATORY**

Test/ Equipment	Quantity
<b>1. Sieve Analysis and Washing Test</b>	
Set of Sieves (AASHTO M-092)	
50 mm	1 each
37.5 mm	1 each
25 mm	1 each
19.5 mm	1 each
12.5 mm	1 each
9.5 mm	1 each
4.75 mm	1 each
2.36 mm	1 each
2.00 mm	1 each
1.70 mm	1 each
1.18 mm	1 each
0.6 mm	1 each
0.425 mm	1 each
0.30 mm	1 each
0.15 mm	1 each
0.075 mm	1 each
Washing Sieve No. 200	1 each
Cover	1 each
Pan	1 each
Sieve Brush/ Hard Bristle Brass	2 each
Paint Brush	6 each
<b>2. Atterberg Limit Test</b>	
Set of Liquid Limit Device with Grooving Tool	1 set
Plastic Limit Glass Plate	1 set
Triple Beam Balance, 311 g cap w/ 0.01 g sensitivity	1 set
Moisture Cans with cap (3 oz.)	12 each
Porcelain Evaporating Dish	2 each
100 mL cap Graduated Cylinder	1 each
Spatula (4")	2 each
<b>3. Compaction Test</b>	
Compaction Mold (dia.=101.6 mm; h = 116.43 mm; V = 0.000943 m <sup>3</sup> )	1 set
Compaction Mold (dia.=152.4 mm; h = 116.43 mm; V = 0.002124 m <sup>3</sup> )	1 set

Rammer (2.5 kg x 305 mm drop)	1 each
Rammer (4.54 kg x 457 mm drop)	1 each
Moisture Cans (6 oz.)	12 each
Spatula 12"	1 each
<b>4. Field Density Test</b>	
Sand Cone Apparatus	2 set
Density Guide Plate	2 each
Steel Chisel	2 each
Sand Scoop	2 each
Large Spoon	2 each
Density Pick	2 each
Hammer	2 each
Replacement Jag	1 set
<b>5. Moisture Content</b>	
LP Gas Stove, 2 burner with Tank	1 set
Laboratory Oven (small)	1 each
Speedy Moisture Tester	1 set
Carbide	1 pack
Pan	2 each
Weighing Scale (500 g)	1 each
<b>6. Organic Impurities</b>	
Graduated Glass Bottles with Stoppers, 350 mL	1 each
Color Standard Chart	1 each
Sodium Hydroxide Solution	1 bag
<b>7. Specific Gravity and Absorption</b>	
Pycnometer (500 mL)	1 each
Wire Basket, No.6 or No.8 mesh, 5kg cap	1 each
Conical (frustum) mold 40mm top dia; 90mm bottom dia; h=75mm	1 each
Tamper- Metal, 340g , flat circular tamping face = 25mm dia.	1 each
Specific Gravity Bench	1 set
<b>8. Abrasion Test</b>	
Los Angeles Abrasion Machine with 12 standard chargers	1 set
Pan, galvanized 500x500x70mm	1 each
<b>9. Soundness Test</b>	
Sodium Sulfate Reagent	1 bag
4mm Sieve	1 each
8mm Sieve	1 each

16mm Sieve	1 each
<b>10. Marshall Testing</b>	
Marshall Stability Machine +Accessories	1 unit
Stability mould ASTM/CNR	1 each
Flow Meter (mm)	1 each
Water Bath With Digital Temperature Control Heater	1 each
Padestal and Mold Holder + Accessories	1 each
Marshall Compaction Hammer	1 each
Marshall Mould	18 each
Extruder (Mold Remover jack)	1 each
Filter Paper Dia 4"	2 Packet
Digital Thermometer Heavy Duty (-5 to 250C)	2 each
Stainless Steel Bowl 2kg Capacity	12 each
Vacuum Pump	1 each
Vacuum Desicator for Gmm	1 each
Extractor (Extraction Machine 3000 g Capacity)	1 each
Filter Paper (100 pieces)	2 Packet
<b>11. Miscellaneous Tools, Equipment, Accessories</b>	
Coring Machine with Core bit (4" diameter)	1 each
Platform Scale, 2610 g capacity	1 each
Heavy Duty Solution Scale, 20 kg capacity	1 each
Graduated Cylinder, 100 mL	1 each
Graduated Cylinder, 500 mL	1 each
Graduated Cylinder, 1000 mL	1 each
Mixing Pan	3 each
Asphalt Thermometer (Armored)	2 each
Sample Splitter (for aggregate)	1 each
Stop Watch	2 each
12" steel straight edge	2 each
Bowl, 200 mm dia. Aluminum	2 each
Square Pan (500mm x500mm)	1 each
Square Pan (800mm x 800mm)	1 each
Square Pan (1 m x 1m)	1 each
Plastic Pale (20 liters)	3 each





***Part 5:  
Conceptual Drawings***

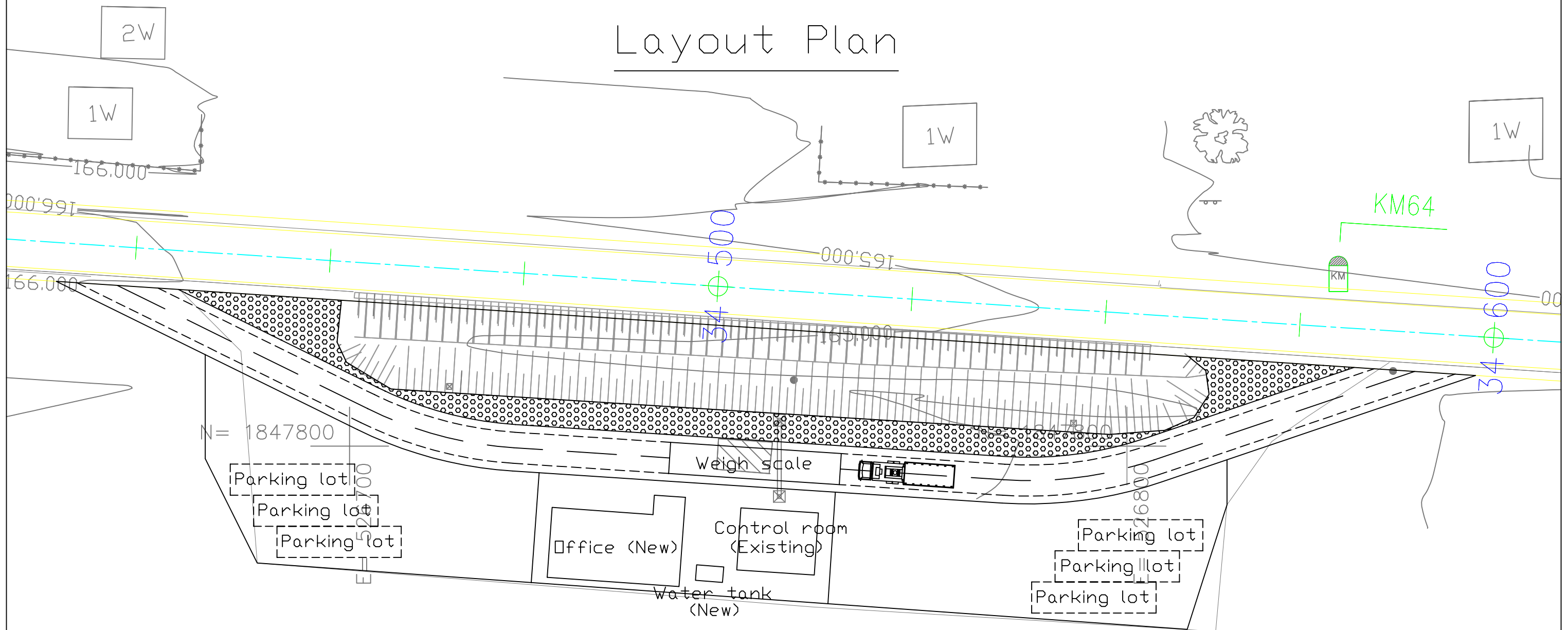
E= 5267

E= 5268

# Conceptual Drawing-1

Scale = 1 : 500

## Layout Plan



Existing staion area (concrete pavement): 3,400m<sup>2</sup>

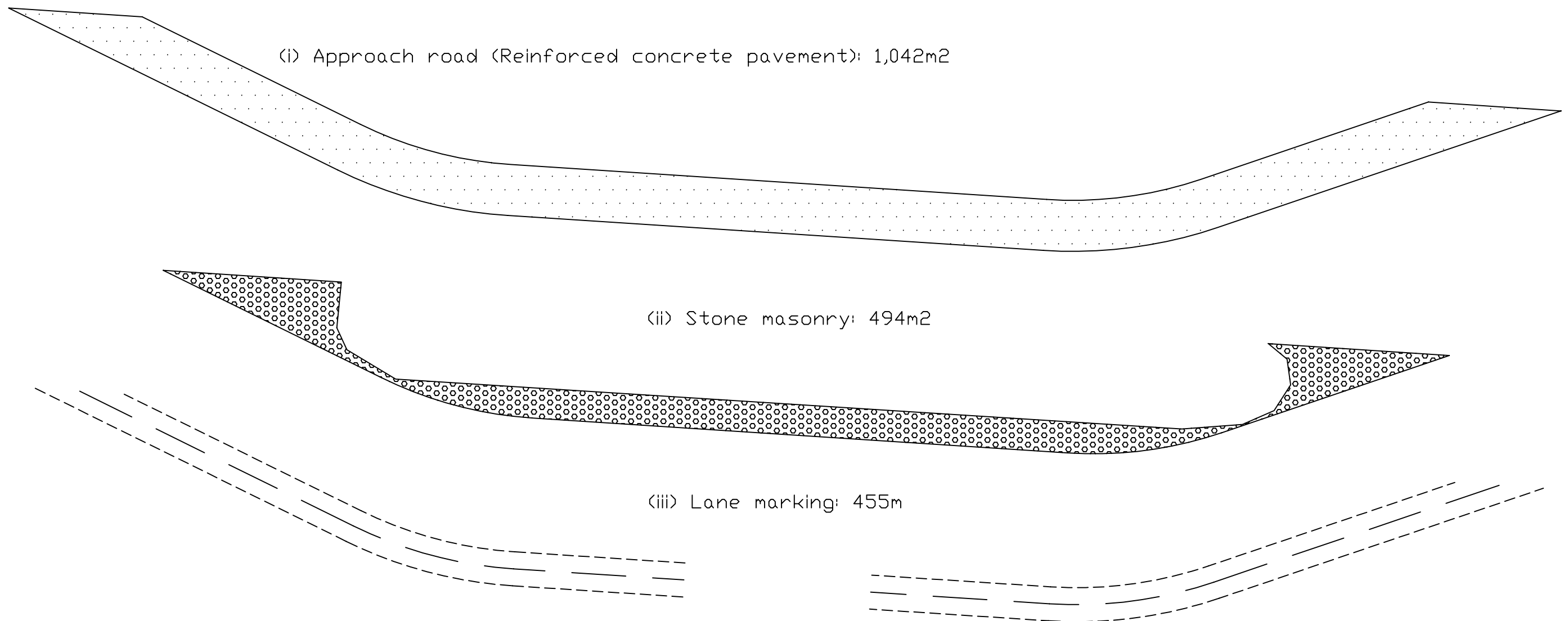
### NOTE

The Contractor shall develop shop drawings in accordance with the conceptual drawings and instruction of the Engineer prior to the work commencement.

# Conceptual Drawing-2

Scale = 1 : 500

## Civil Works Portion (1 of 2)



### NOTE

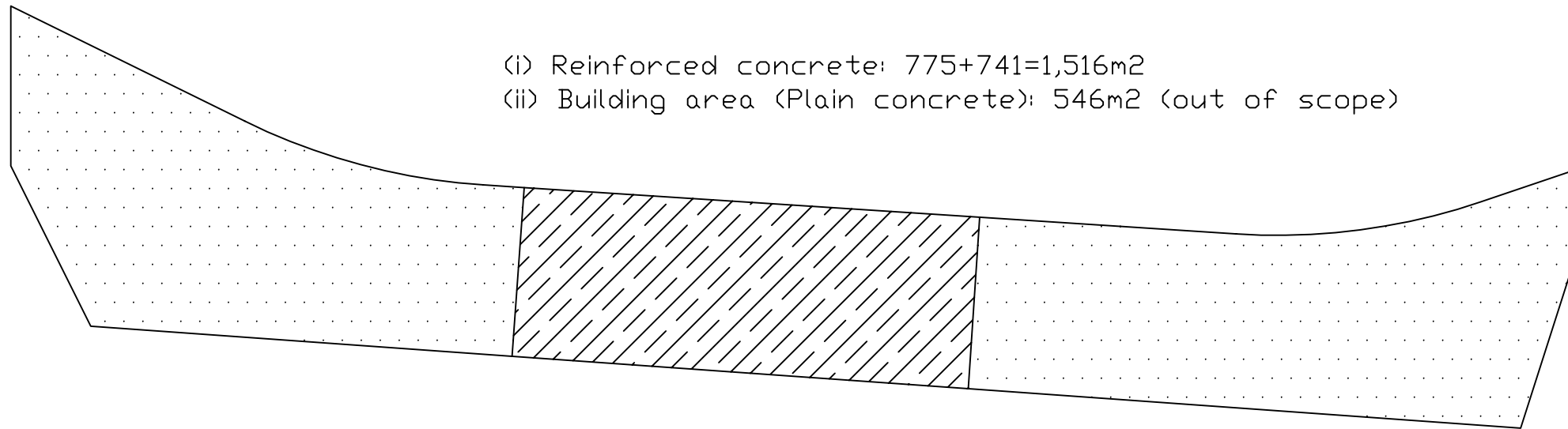
The Contractor shall develop shop drawings in accordance with the conceptual drawings and instruction of the Engineer prior to the work commencement.

# Conceptual Drawing-3

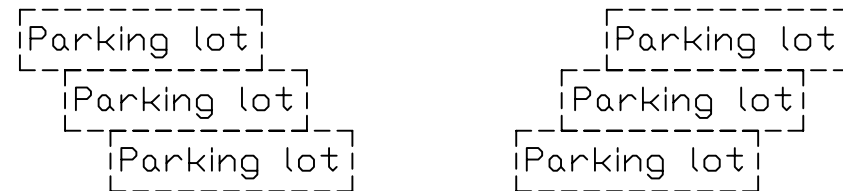
Scale = 1 : 500

## Civil Works Portion (2 of 2)

- (i) Reinforced concrete:  $775+741=1,516\text{m}^2$
- (ii) Building area (Plain concrete):  $546\text{m}^2$  (out of scope)



- (iii) Painting of parking lot: 188m



### NOTE

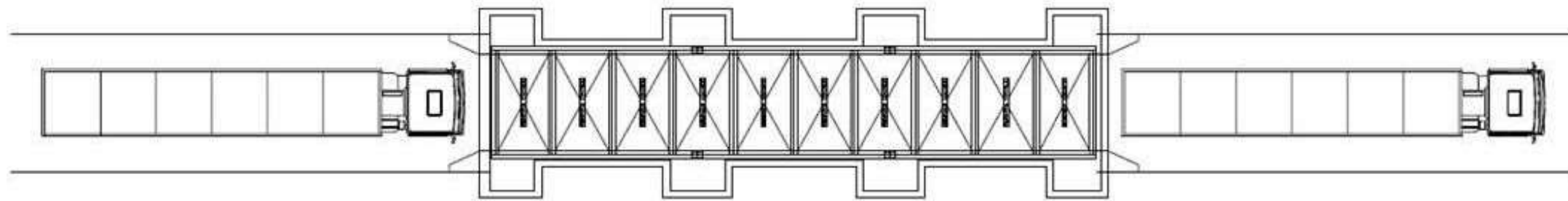
The Contractor shall develop shop drawings in accordance with the conceptual drawings and instruction of the Engineer prior to the work commencement.

# Conceptual Drawing-4

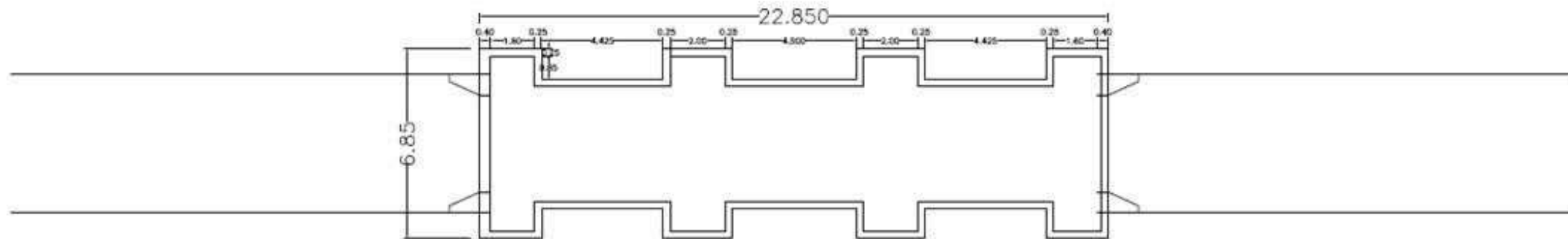
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## Weigh Scale (1 of 2)

Plan-1 (Platform)



Plan-2 (Frame)



### NOTE

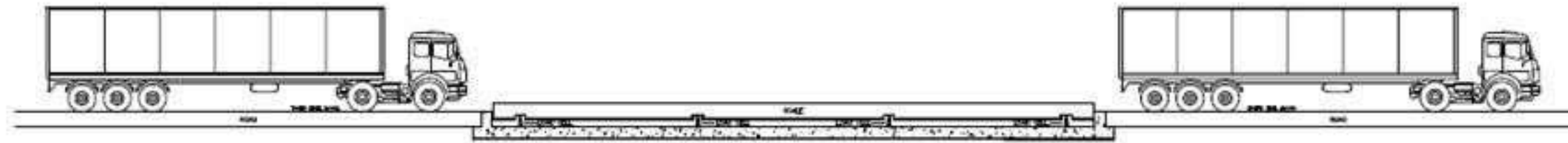
The Contractor shall develop shop drawings in accordance with the conceptual drawings and instruction of the Engineer prior to the work commencement.

# Conceptual Drawing-5

## Weigh Scale (2 of 2)

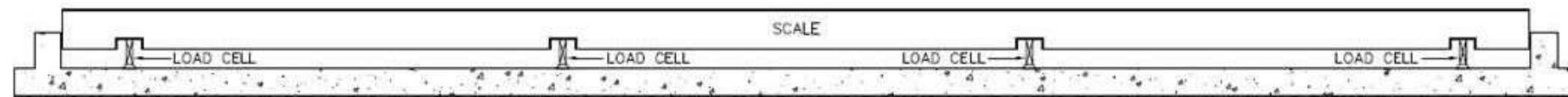
### Profile-1 (Platform)

Scale = 1 : 200



### Plan-2 (Zoomed View of Platform)

Scale = 1 : 100



#### NOTE

The Contractor shall develop shop drawings in accordance with the conceptual drawings and instruction of the Engineer prior to the work commencement.

*Appendix:  
Project Information*