



Cost Estimation Manual for Performance Based Road Maintenance Contract

Ministry of Transport, Infrastructure,
Housing, Urban Development and Public Works
(MoTIHUD & PW)

Volume 1: Manual for Cost Estimation Administrators

Edition 2 - 2019



JAPAN INTERNATIONAL COOPERATION AGENCY
Strengthening of Capacity on Road Maintenance Management
through Contracting (Phase 3)



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COST ESTIMATION MANUAL
FOR PERFORMANCE BASED
ROAD MAINTENANCE CONTRACT

Volume I: Manual for Cost Estimation Administrators

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Artwork by John Agutu

Email: agutujo@yahoo.com

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- National Construction Authority – NCA
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- Kenya Wildlife Services – KWS
- Kenya National Highways Authority – KeNHA
- Kenya Rural Roads Authority – KeRRA
- Kenya Urban Roads Authority – KURA
- Kenya Institute of Highways and Building Technology – KIHBT
- Materials Testing and Research Department

The Manual would not have come to fruition without the dedication of the Cost Estimation (COSTES) Sub-Working Group Committee members, mandated by the National Working Group and the Joint Coordinating Committee to carry out this task.

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Foreword

Performance Based Contracting (PBC) is a contract concept for road maintenance in which necessary road maintenance services and works are performed to bring a road to required service levels, based on measured 'outputs' and not on measured 'inputs'. This concept commenced in 2010 on a pilot basis. However, the method of estimating cost of works under performance-based contracts was not clear. A suggestion was made to formulate a scientific and accurate way of cost estimation for PBC road maintenance contracts. In this regard, JICA under the Project for Strengthening of Capacity on Road Maintenance Management through Contracting (Phase 2), embarked on this task of developing the cost estimation system.

The concept of performance-based contracting in road maintenance and management has been adopted in Kenya and the government is in the process of rolling out performance-based contracting for the 10,000 km road programme (Low Volume Seal Roads) and other road projects to ensure proper maintenance of roads and reduce maintenance cost in the long run. There is need therefore to continually revise the cost estimation system to conform to changing needs in road maintenance.

The Cost Estimation Manual for Performance Based Road Maintenance Contract Volume 1, 2 & 3, Edition 2.0, was revised to include six on-carriageway works namely; Grading and Re-gravelling on unpaved road, Pothole Patching, Crack Sealing, Road Marking, Repair on Concrete Structures and Guardrail Repair/Replacement. The revision was done based on surveys conducted on ongoing performance-based contracts and wide stakeholder consultations.

To supplement the Cost Estimation Manuals, the Cost Survey Guidenotes for PBC has been prepared to provide the survey techniques for collection of data necessary for regular updates of the manual. The guidenotes focus exclusively on PBC Maintenance services and Instructed works. It illustrates how quantity and productivity survey of work items should be conducted and analysed.

I wish to acknowledge with appreciation the National Working Group and Sub-Working Group members who provided their valuable advice through a series of meetings during the period of validating the guidenotes. I am particularly grateful to the JICA team for their technical assistance in achieving this milestone and for their overall assistance in capacity building for road maintenance and management. Special gratitude goes to all road agencies and other government agencies: KRB, KeNHA, KURA, KeRRA, KWS, KIHBT, NCA and PPRA for their valuable support in the development of these guidenotes.



Eng. J. M. Kung'u
Chief Engineer (Roads)
Ministry of Transport, Infrastructure, Housing,
Urban Development and Public Works

Abbreviations and Acronyms

APRP	—	Annual Public Roads Programme
CEU	—	Cost Estimation Unit
ARICS	—	Annual Road Inventory and Condition Survey
IMP	—	Initial Mobilization Period
P/R	—	Productivity Rate
RA	—	Road Agency
RMP	—	Routine Maintenance Period
SRUQ	—	Standard Resource Usage per (Unit) Quantity

Glossary of Terms

Actual Quantity	Refers to the actual quantity of work and service for each service criteria executed by the contractor to achieve the specified service level.
Simple Quantity	Refers to the targeted quantity of work and services for each service criteria to be executed by the contractor as per the contract drawings.
General Maintenance	Refers to all works and services (mainly off-carriageway) required to be performed by the contractor under the Performance Based contract.
Initial Mobilization Period	This is the period during the initial stages of the contract when the contractor makes interventions to bring the road to maintainable conditions.
Routine Maintenance Period	This is the period after the expiry of the initial mobilization period when the contractor undertakes routine maintenance activities. The activities are performed to maintain the performance standards of the road and to achieve specified service levels.

Related Manuals and Guidenotes

1. Cost Estimation Manual for Performance Based Road Maintenance Contract Volume 1 (Administrators)
2. Cost Estimation Manual for Performance Based Road Maintenance Contract Volume 2 (Government Cost Estimators)
3. Cost Estimation Manual for Performance Based Road Maintenance Contract Volume 3 (Contractor Cost Estimators)
4. Cost Survey Guidenotes for Performance Based Maintenance Road Contracts
5. Cost Estimation Manual for Road Maintenance Works
6. Performance Based Road Maintenance Contract (PBC Guideline)

1 Introduction

1.1 Background and Objectives

Performance Based Contract (PBC) is a type of a road maintenance contract, which has increasingly become a very common contract method for road maintenance. The main payment method in PBC projects is based on a km-lump sum utilizing set service levels to be achieved by contractors. PBC is a term contract which covers both the wet seasons when frequent works are required, and the dry seasons when lesser works may just be sufficient.

In spite of the widespread use of PBC in road maintenance, no standard cost estimation method had been developed. This created a situation that no scientific based judgment could be made when the Engineer's cost estimate was different from the actual tender price. Therefore, the need for the development of a standard cost estimation method was vital for sustainable application of PBC in road maintenance. Utilizing a standard cost estimation method is one of the basic fundamentals of project management and will enable staff in various road agencies to have proper understanding of the tender price.

Therefore, a Cost Estimation Manual for Road Maintenance under Performance Based Contracts (hereinafter referred to as "the Manual") was developed to provide a scientific cost estimation method for PBC road maintenance using cost breakdown sheets and standardized estimation procedures. The Manual included not only how to estimate costs but also provided information on survey methods required for revisions and updates of various parameters such as the Standard Resource Usage per (Unit) Quantity (SRUQ) especially focused on Labor Based works on off-carriageway works and important cost items such as unit rates.

The Manual was then revised in February 2016 (hereinafter referred to "the Manual Edition 1.1"). The Manual Edition 1.1 was in line with Cost Estimation System for PBC 2015 (hereinafter referred to as "COSTES for PBC 2015"), which is a computer tool used for actual cost estimation exercises.

Positive responses from engineers and managers from various road agencies in charge of planning and implementing PBC road maintenance projects then tabled requests for improvement and a team of inspiring road agency engineers and managers together with an expert team organized by Japan International Cooperation Agency took charge in this task beginning December 2016.

Without losing the original intention, the Manual Edition 1.1 has been updated to this Manual (hereinafter referred to as "the Manual Edition 2.0) which is in line with the Cost Estimation System for PBC 2018 (hereinafter referred to as "COSTES for PBC 2018"). In addition, a separate volume titled "the Cost Survey Guidenotes for Performance Based Road Maintenance Contracts" has been developed to explain how the surveys were done during the improvement period.

1.2 Changes from Edition 1.1, February 2016

The following changes are made under the Manual Edition 2.0 from the Manual Edition 1.1.

I. Addition of six (6) on-carriageway works under PBC.

As the present situation in Kenya calls for extending the sphere of PBC Works onto the carriageway section, six on-carriageway works were selected. These items are:

- i. Grading and Regravelling on Unpaved Road,
- ii. Patching,
- iii. Crack Sealing,
- iv. Road Marking,

- v. Repair on Concrete Structures, and
- vi. Guardrail Repair/ Replacement.

These six (6) on-carriageway works were selected mainly based on the driving safety aspect in Kenya and are sub-classified into work items as shown in **Table 5-2**.

2. Update and revision of several elements of estimating the cost of the 6 major Labour Based works.
Based on analysis of extensive surveys conducted on the current practice carried out by PBC contractors, updates and revisions were made on the following elements of estimating the cost of the 6 major labour based works under PBC:
 - i. The Standard Resource per unit Quantities (SRUQs) and Productivity Rates (PRs)
 - ii. KM Standardized Quantities, Simple Quantities and Actual Quantities, and
 - iii. The typical labour organization from 90:3:1 (labourers: supervisors: foreman) to 30:3:1 (labourers: foremen: supervisor) as outlined under Section 5.3.5. The term “foreman” is renamed as “supervisor” and the term “supervisor” as “foreman”.
3. Determination of parameters on deterioration of Road Marking (Appendix 5)

1.3 Structure of Cost Estimation Manual

Three volumes of the Cost Estimation Manuals have been prepared according to the purpose and intended users shown in **Table 1-1**.

Table 1-1 Structure of Cost Estimation Manuals

Volume	Name of Manual	User	Objectives
1	Manual for Cost Estimation Administrators	KRB	Cost and Affiliated Surveys Provision of Estimation Parameters Update and Maintenance of Database and Manual How to Revise Vol. 2 and 3
2	Manual for Government Cost Estimators	Road Agencies	Estimation of Project Cost for Budget Allocation Estimation of Project Cost for Tender
3	Manual for Contractors' Reference & Use	Contractors	Estimation of Project Cost

1.4 PBC Works and Instructed Works

All current PBC projects in Kenya are composed of works and services related to Maintenance Services (hereafter referred to as the PBC Works) and Instructed Works. Contractors have full responsibilities for works and services required to bring up the road condition to the specified service levels. Contractors need to assess the existing road condition and quantify the volume of the works and services required to achieve specified service levels.

PBC Works mainly consists of:

- 1) Selected 6 On-Carriageway Works and services comprised of Grading and Regravelling, Pothole Repair, Crack Sealing, Road Marking, Repair on Concrete Structures and Guardrail Repair;
- 2) 6 Major Labour-based works and services comprised of repair and maintenance of drainage, maintenance of vegetation and maintenance of road cleanliness;
- 3) Other PBC Works and services such as repair of structures, repair on road furniture and maintenance on profile, width and embankment and slopes, not specifically mentioned under 1) and 2);

- 4) Provision and operation of a Self Control Unit for self-management of road maintenance;
- 5) Necessary haulage cost for transporting labor, materials and equipment from/to the site.

Table 1-2 PBC Works and Instructed Works

Work Type	PBC Works	Instructed Works
Payment Method	Based on KM-Monthly Lump Sum	Based on Bill of Quantities
Initiator	Contractor	Client

Based on the nature of various requirements, Instructed Works are a combination of the following works and services as indicated in **Table 1-3**.

Table 1-3 Details of Instructed Works

Instructed Works	Bill of Quantities	Payment
Rehabilitation Works To bring the road up to the pre-defined standards at the start of the PBC project. e.g. filling potholes, laying gravel wearing course, repairing carriageway edges, reinstating road camber, road furniture maintenance and repair, and repairing culverts as may be required	Prepared by the client	Unit rate payment determined by the contractor
Improvement Works To add new characteristics to the road in response to new traffic, safety or other conditions	Prepared by the client	Unit rate payment determined by the contractor
Emergency Works To reinstate the road after damage has occurred as a result of natural occurrences with unexpected consequences under the condition defined in the contract	Prepared by the client	Unit rate payment determined by the contractor

This Manual has been prepared principally to estimate the cost of PBC Works for which no standard procedure for cost estimation was addressed in the previously issued “*Cost Estimation Manual for Road Maintenance Works 2011*”, popularly referred to as the CEM 2011.

This Manual, the Manual Edition 2.0, covers both typical on carriageway and off-carriageway works and tries to correctly estimate the cost of both works under PBC based on surveys conducted on on-going PBC projects. The Manual Edition 2.0, therefore reflects the result of surveys conducted from PBC projects undertaken in 2014 to 2018 and recommends methods and procedures of standard estimation.

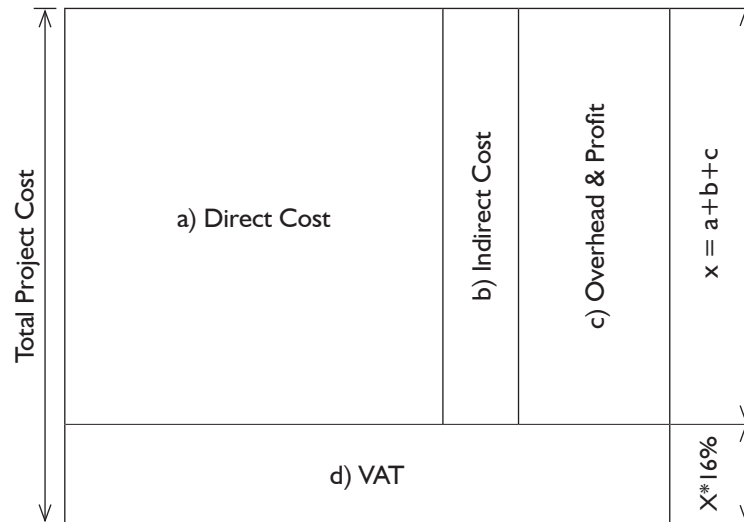
It is important to appreciate that some future projects may be different from those projects surveyed for the purpose of determining various values incorporated into this Manual Edition 2.0. For example, in projects surveyed, there were no physical repairs of scour checks and no physical maintenance and repair of structures and road furniture, excluding small exceptions.

In such cases, the CEM 2017 should be used to correctly modify the cost estimation by incorporating the additional costs for such physical repairs. Similarly, if a road agency is required to estimate the cost of Instructed Works in addition to the PBC Works, the CEM 2017 should be used after correctly assessing quantities of the Instructed Works required.

1.5 Cost Structure for Estimation

The cost structure for estimation is shown in **Figure I-1** and the components of PBC cost estimation are shown in **Table I-4**. The Total Project Cost consists of four (4) cost components namely; a) Direct Cost, b) Indirect Cost, c) Overhead & Profit and d) VAT. The total estimated cost is computed as the summation of all four cost components. The project cost is the summation of three cost components excluding VAT.

Note) Using the Framework of the CEM 2011



Note: Using the Framework of the CEM 2011

Figure 1-1 Principal Structure of PBC Cost Estimation

Table 1-4 Contents of Cost Estimation Components

Component	Cost Elements		Cost Estimation
Direct Cost	On Carriageway Maintenance Costs	Maintenance costs for the PBC Works such as repair and maintenance of carriageway and shoulders, repair and maintenance of concrete structures and repair of guardrail	Selected 6 On Carriageway Works represent the cost.
	Off Carriageway Maintenance costs	Maintenance costs for the PBC Works such as maintenance of drainage, vegetation and road cleanliness	Major 6 Labor Based Works represent the cost.
	Other PBC Works	Maintenance costs for the PBC Works such as repair of structures, repair of road furniture, repair of road profile and width and repair of embankment and slopes.	Required costs are to be computed by judgment of the cost estimator
	Provision of Self Control Unit	Provision of Self Control Unit for self-management of road maintenance.	The cost for Patrol and Self Inspection represents the cost.
	Miscellaneous Costs and Others	Miscellaneous expenses and other costs which are required for proper on-site control and provision of safety gears and devices for workers.	Miscellaneous expenses and other costs are added on top over 1) Selected 6 On Carriageway Works, 2) Major 6 Labor Based Works and 3) Other PBC Works.
	Haulage Cost	Haulage cost for transporting labour, materials and equipment from/to the site	The haulage cost is computed separately as the Haulage Cost for 6 Major Labour Based Works.
Indirect Cost	• Site Establishment • Site Management Cost • Site Staff Allowances • Site Staff Social Charges • General Safety Measures • Human Resource Management Cost		Cost computation for these items is taken as 30% percent of the sum of the Direct Cost.
Overhead & Profit	• Head Office Management Cost • Head Office Staff Salaries and Allowances • Cooperate Social Charge • Research and Development • Advertisement and Publicity • Depreciation Costs for Fixed Asset • Profit Margin		Cost computation for these items is taken as 10% percent of the sum of the Direct Cost and the Indirect Cost.

The structure of a typical project is shown in **Figure I-2** for cost estimation purpose under COSTES for PBC 2018. The Direct Cost in this case consists of PBC Works, Instructed Works and Haulage Cost.

Item	Cost
Total Project Cost (VAT(16% Inclusive))	13 = 11+12
Project Cost	11 = 8+9+10
Direct Cost	8 = 6+7
PBC Works	6 = 1+2+3+4+5
Selected 6 On-Carriageway Works	1
6 Major Labor Based Works	2
Other PBC Works	3
Patrol and Self Inspection	4
Haulage Cost for 6 Major Labor Based Works	5
Instructed Works	7
Indirect Cost	9
Overhead & Profit	10
VAT(16%)	12

Figure 1-2 Cost Estimation Structure under COSTES for PBC 2018

1.6 Definition of SRUQ and P/R

Standard Resource Usage per (Unit) Quantity (SRUQ) and Productivity Rate (P/R) are important concepts required for cost estimation. SRUQ is the volume of work input i.e. labour, materials and machines required to complete a unit work output. For labour input, it is the ratio of the number of person-days divided by the volume of work completed. For machines/ equipment, it is the ratio of the number of machine-days divided by the volume of work completed. For materials, it is the ratio of the quantity of materials used by the volume of work completed. The Selected 6 on carriageway works use labour SRUQ, machine SRUQ and material SRUQ in costing while the 6 major labour based works only use the Labour SRUQ.

Productivity Rate (P/R) is the inverse of SRUQ and it refers to the quantity of work output that can be completed by a unit input.

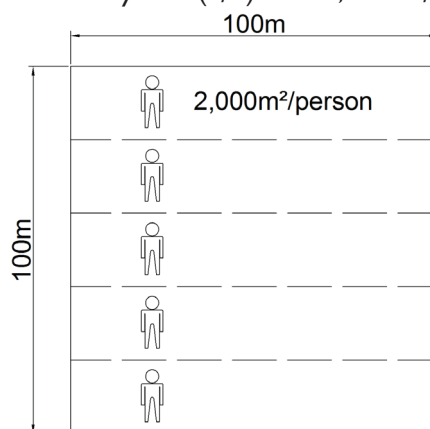
An example of SRUQ and Productivity Rate is illustrated in **Figure 1-3**.

Example: Grass cutting of labor based works

Grass cutting of 10,000m² is completed in 5 person-days. That is 5 persons each completing 2,000m² on a given day.

$$\text{SRUQ} = 5 \text{ person-days} / 10,000 \text{ m}^2 = 0.0005 \text{ person-days/m}^2$$

$$\text{Productivity Rate (P/R)} = 2,000 \text{ m}^2 / \text{person-day}$$



$$\text{SRUQ} = 5 \text{ man day} / 10,000 \text{ m}^2$$

$$\text{P/R} = 2,000 \text{ m}^2 / \text{man day}$$

Figure 1-3 SRUQ and P/R

2 Importance of Cost Estimation

The importance of cost estimation for PBC projects cannot be over-emphasized as the government is stepping forward in increasing PBC contracts as a key contract method for road maintenance. In addition, each road agency must be accountable to the government as well as the public and road users for effective utilization of the available road maintenance fund.

It is therefore necessary for each road agency to justify the anticipated project cost by performing cost estimation based on a standardized method and that the estimated costs are adequate to meet the specified service levels using conventional PBC techniques available in Kenya.

Each road agency must acknowledge that in meeting some of the service levels required under the PBC project, especially the “Other PBC Works”, quantification of maintenance and repair during the project requires professional and engineering judgment. In addition to the development of cost estimator’s competence in operation of COSTES for PBC 2018, a group of engineering professionals must be designated to support the cost estimator in quantification of work inputs required for maintaining service levels.

3 Role of Cost Estimation Administrator

The roles of a cost estimation administrator are as follows:

- 1) Conducting surveys on costs, establishing standard costs and updating of costs annually;
- 2) Conducting surveys on productivity, establishing productivity indices and updating of productivity indices; and,
- 3) Management and updating of the Cost Estimation Manual.

4 PDCA Cycle for Cost Estimation

Scientific cost estimation is based on using data collected from actual road maintenance projects. The Manual should therefore be revised periodically so that the data used is always up to date. Hence, the PDCA (Plan-Do-Check-Action) cycle is introduced to express this periodic updating process. This process is to improve the quality of the Manual by accumulation of basic data.

Table 4-1 gives the Plan, Do, Check, Action (PDCA) cycle for cost estimation related activities.

Table 4-1 PDCA Cycle for Cost Estimation Related Activities

Item		Contents			Recommended	Action
Manual Revision	C (Check)	Cost Survey	Unit Rates Survey Indirect Cost and Overhead & Profit Surveys	(Coordination and referral with KNBS index, etc.)	Every 2 Years	KRB/ CEU
			Productivity Survey	SRUQ (by work item) SRUQ (by Road Agency)	Every 2 Years	
	A (Action)	Manual Update (See 2.2)			Every 2 Years	
Manual Utilization	P (Plan)	Planning the budget for next year projects			Every Year	Road Agencies
	D (Do)	Cost Estimation for the project			Every Year	

Note) SRUQ: Standard Resource Usage per (Unit) Quantity

COST ESTIMATION CYCLE																																																
	1 ST FY												2 ND FY												3 RD FY																							
	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
MARKET SURVEY																																																
PRODUCTIVITY SURVEY																																																
DATA ANALYSIS																																																
DATA SETS																																																
BUDGETING																																																
CONTRACT PREPARATION (ENGINEER'S ESTIMATE)																																																

APRP PREPARATION CYCLE																																																		
	1 ST FY												2 ND FY												3 RD FY																									
	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6		
KRB RELEASES CEILINGS																																																		
RA COMPLETE ARICS AND COMPILE PRG																																																		
SUBMIT DRAFT PROGRAMME TO KRB FOR ADVISE																																																		
SUBMIT DRAFT PROGRAMME TO KRB FOR APPROVAL																																																		
KRB COMPLIES APRP																																																		
BOARD APPROVES																																																		
SUBMISSION TO CS MOTIHUD																																																		

Figure 4-1 Cost Estimation PDCA Cycle Schedule

5 Cost Estimation of PBC Works

Cost estimation is performed in two stages.

First Stage

The first stage involves cost estimation of the PBC Works.

For the PBC Works, before cost estimation is carried out, the cost estimator needs to identify work inputs required for maintaining the required service levels under the contract. After identification, both the volume of works and the frequency of works required during the entire contract needs to be calculated and by applying appropriate unit rates for works and summation thereof, the cost of the PBC Works can be derived. These exercises are completely different from the one applied on a new road construction project in which the cost estimator requires to take off the volume of works from design drawings and do not require to consider the frequency of works. For on-carriageway maintenance, this identification will require surveys to be carried out on the current and past conditions of degradation on the carriageway so that the volume of works may be calculated based on such timeline differences as the engineering substantiation method.

As many of you may wonder, such exercises for the PBC Works require performing various complicated tasks of deriving at numerical values as appropriate for the project each unique. On the other hand, the cost estimator is required to undertake these exercises efficiently as possible. This Manual was compiled with due consideration of such and proposes on simplification of cost estimation by 1) identifying the principal work inputs required, then calculate the volume of works and the frequency based on a standardized method with engineering substantiation and to derive the principal cost, and 2) identifying non-principal work inputs which has low cost sensitivity and provide a fixed percentage rate over the principal cost as calculated under 1).

Based on the above understanding, the contents of the PBC Works maybe split into five (5) categories as indicated in **Table 5-1** based on cost elements involved as illustrated in **Table 1-4**. The details of Selected 6 On Carriageway Works and 6 Major Labor Based Works and are indicated in **Table 5-2** and **Table 5-3** respectively.

Table 5-4 lists such five categories of the PBC Works together with the corresponding service scope.

Table 5-1 PBC Works

No	Categories	Description	Cost Element
1	Selected 6 On-Carriageway Works (Table 5-2)	Essentially on carriageway works and involves use of machines, materials and labour.	Labor, materials, machineries and equipment. Vehicle and fuel costs are included in Haulage Cost
2	6 Major Labor Based Works (Table 5-3)	Essentially labor based off-carriageway works.	Labor cost only. Vehicle and fuel costs are included in Haulage Cost.
3	Other PBC Works	Essentially on carriageway works and involves use of machines, materials and labour.	Labour, materials, machineries and equipment. Vehicle and fuel costs are included in Haulage Cost
4	Patrol and Self-Inspection (Self Control Unit)	For patrolling under Road Usability and for self-inspection	Labor, vehicles and fuel costs.
5	Haulage Cost	For transporting labor, materials and equipment from/to the site	Labor, trucks and fuel costs.

Table 5-2 Selected 6 On-Carriageway Works

No	On-Carriageway Works	Work Items		Code (as per CEM 2017)	Work Category (as per CEM 2017)
1	Grading and regravelling	M001-1	Light Grading	10.50.003	Grading
		M001-2	Regravelling	10.60.001	Gravelling
2	Patching	M002-1	Pothole Patching – Hot mix	16.50.001	Pavement Repairing
		M002-2	Pothole Patching – Cold Mix	16.50.004	
		M002-3	Pothole Patching – Cold Mix (made on site)	—	—
3	Crack sealing	M003-1	Crack Sealing	16.50.004	Pavement Repairing
4	Road marking	M004-1	Road Marking on smooth pavement	20.70.011	Road Marking
		M004-2	Road Marking on Surface Dressed pavement	—	
5	Repair on concrete structures	M005-1	Culvert Installation – 600mm with surround	08.60.025	Pipe Culvert Installation
		M005-2	Headwall construction for 600mm pipe culvert	08.60.019a	Headwall Construction
6	Guardrail repair/ replacement	M006-1	Straightening of Beams	—	—
		M006-2	Straightening of Beams and Realignment of posts	—	—
		M006-3	Guardrail replacement with new beam and realignment of posts	—	—

Table 5-3: 6 Major Labor Based Works

No	Work Items
1	Grass Cutting
2	Cross culvert de-silting
3	Catch basin de-silting
4	Lined side ditch de-silting
5	Unlined side ditch de-silting
6	Carriageway cleaning

Table 5-4 The PBC Works and Corresponding Service Scope

Category	Service Scope	Selected 6 On-carriageway Works	6 Major Labour Based Works	Other PBC Works	Patrol and Self Inspection	Haulage Cost
Road Usability	A) Passability		○ (Cleanliness)		○	□
Road User Comfort	B) Smooth and Safe Traffic (Pavement, Shoulder, Median, Footpath and Footbridge)	○ (pavement)		○	Δ	
	C) Visibility		○		Δ	□
	D) Traffic Information (Signage, Road Works Advance Warning Signs and Road Marking)	○ (road marking)		○	Δ	
Road Durability	E) Drainage Capability		○		Δ	□
	F) Vegetation Control		○		Δ	□
	G) Maintenance of other Structures (Concrete Structures, Blocked Culverts, Steel Structures, Bridge Expansion Joints, Guardrail/Pedestrian Rail and Riverbeds)	○ (concrete structures and guardrail)	○	○	Δ	□
	H) Slope Stability			○	Δ	

○: Main Works

Δ: Secondary works

□: Common works

Second Stage

The second stage requires estimating the cost of the Indirect Cost and the Overhead & Profit.

6 Cost and Other Affiliated Surveys

This section covers cost surveys and other affiliated surveys, such as the productivity survey and the road facilities survey which are required for updating the Manual by the cost estimation administrator. For detailed survey method refer to “Cost Survey Guidenotes For Performance Road Maintenance Contracts”.

- 1) Unit Rates
- 2) Productivity Survey
 - i. Selected 6 On-Carriageway Works
 - ii. 6 Major Labour Based Works
- 3) Self Control Unit
- 4) Pre-surveyed Quantities for selected 6 On-Carriageway Works
- 5) Other PBC Works
- 6) Percentages Based Indirect Cost, and the Overhead & Profit
- 7) Road Facilities (Survey for Assessing Associated Facilities Required for Maintenance)

Table 6-1 List of Cost Surveys

No	Cost Surveys	Purposes
1	Unit Rates	For determining standard unit rates
2	Productivity survey 6 Major Labour Based Works Selected 6 On-Carriageway works	For determining productivity parameters. P/Rs
3	Patrol and Self Inspection (Self Control Unit)	For determining productivity parameters
4	Pre-surveyed Quantities for selected 6 On-Carriageway Works	Estimation of quantities expected during the contract period for selected on-carriageway works under PBC
4	Other PBC Works	For determining standard work information For determining standard work quantities For determining productivity parameters
5	Indirect Cost, Overhead & Profit Percentages	For determining standard indirect cost percentages For determining standard overhead & profit percentages
6	Road Facilities (Survey for Assessing Associated Facilities Required for Maintenance)	For assessing quantities of associated facilities required for maintenance

6.1 Unit Rates

The unit rates survey is conducted by the cost estimation administrator so that each road agency may use standard unit rates for the cost estimation purpose.

Unit rates for material, labour and machineries used for cost estimation by road agencies are basically derived from official price information provided by several government offices. They are open to public and are based on nation-wide market surveys. Hence, they can be assumed to be the average rates in Kenya. They include:

- Material Rates: Material Price List from Kenya National Bureau of Statistics (KNBS).
- Fuel Rates: Pump Price List from Energy Regulatory Commission, the Ministry of Energy.
- Labour Rates: The Regulation of Wages (General) (Amendment) Order, The Labour Institution Act, the Ministry of Labour.
- Machinery Rates: Equipment Hire Rate List from Mechanical and Transport Department, the Ministry of Transport and Infrastructure.

All labour, material and machinery rates should be surveyed by regions; big cities (example: Nairobi, Mombasa and Kisumu) and all others.

Rates may be updated in an ad-hoc basis when substantial change takes place during the fiscal year (e.g. in case of high inflation or embargo).

When some of material and machinery rates are not covered in official documents, average market rates acquired from surveys by the cost estimation administrator or provisional rates by referring to similar items may be used. However, those rates should be revised immediately the official rates become available.

For cost estimation using the Manual, collection of the unit rates indicated in **Table 6-2** is required. These unit rates apply for 6 Major Labour Based Works, selected 6 On-Carriageway works and Self Control Unit (Patrol and self-inspection), but these are not applicable to the Other PBC Works.

Table 6-2 Unit Rates for Cost Estimation

No	Category	Item	Unit	Remarks
1	Labor	Unskilled Labor	Ksh/day	
		Foreman	Ksh/month	
		Supervisor	Ksh/month	
		SCU Leader	KSH/month	
		SCU Inspector	KSH/month	
		Driver (Pick up)	KSH/month	
		Driver (Truck)	KSH/month	
2	Vehicle Cost (Dry rate)	Truck (2 ton)	KSH/month	
		Pick up (Double Cabin)	KSH/month	
3	Machinery Cost (Dry Rate)	Motor Grader	Ksh/hour	
		Vibratory Steel wheel roller	Ksh/hour	
		Pedestrian Roller	Ksh/hour	
		Pneumatic Roller	Ksh/hour	
		Asphalt Cutter	Ksh/hour	
		Bitumen Sprayer	Ksh/hour	
		Road Marking Machine	Ksh/hour	
		Melting Pod	Ksh/hour	
		Air Compressor	Ksh/hour	
		Concrete Mixer	Ksh/hour	
		Asphalt Finisher	Ksh/hour	
		Pick up (Double Cabin)	KSH/month	
4	Material Cost	Gravel (murram)	Ksh/m3	
		Premix AC	Ksh/m3	
		Bitumen Emulsion	ksh/litre	
		Thermoplastic Paint	Ksh/kg	
		Glass Beads	Ksh/kg	
		Fine Aggregates	Ksh/m3	
		Graded Aggregates	Ksh/m3	
5	Fuel Cost	Diesel	Ksh/litre	
		Petrol	Ksh/litre	

6.1.1 Labour Cost

The unit rate for labourers will be determined based on the current regulation issued by the Ministry of Labour on minimum wages. The minimum wage will be used. The unit rates for Labour Costs (excluding Labourers) indicated in **Table 6-2** will be determined by conducting Workers' Wage Survey to check prevailing rates for each position. Adequate data will be collected and the average value will be used as the unit rates for each worker category. In case drastic regional disparity exists, adjustment will be made to compensate for such disparity in certain regions.

6.1.2 Vehicle Cost

The unit rate (dry hire rate) for vehicles will be determined based on availability in the market. Adequate data will be collected and the average value used as the unit rate. This survey may be supplemented by conducting a survey on firms who own a fleet of vehicles on purchase basis and who apply a yearly depreciation cost as the vehicle cost. In this case also, adequate data will be collected and the average value used as the unit rate.

6.1.3 Machinery Cost

The unit rates for machinery will be determined based on availability in the market. Data will be collected then compared with the machinery rates from the Mechanical and Transport Division, Ministry of Transport and Infrastructure. The economical rate of the two is used as the unit rate. These rates applicable for the selected 6 on-carriageway works.

6.1.4 Material Cost

Six (6) Major Labour Based Works do not have material costs. However, the selected 6 On-Carriageway works and the other PBC Works require unit rates survey to determine various materials required for works.

Owing to variation in rates according to the location of the project, the result of the material cost survey must be compiled according to regions. Adequate data will be collected and the average value used as the unit rate.

6.1.5 Fuel Cost

The unit rate for fuel will be determined based on use of the latest Pump Price List issued by the Energy Regulatory Commission.

6.2 Productivity Survey

Productivity survey is a scientific based work study to assess resources, equipment and processes necessary in execution of road maintenance works under Performance Based Contracting (PBC). Productivity survey is conducted by the cost estimation administrator so that each Road Agency may use productivity parameters for the cost estimation purpose.

In order to obtain precise cost estimation, it is important to understand the precise volume of work inputs such as labour, materials and equipment resources for a volume of work output necessary to achieve the specific service level. It is also important to understand the work frequency so that a volume of work output is computed for achieving the specific service level.

For such, Standard Resource Usage per (unit) Quantity (SRUQ) is computed for each work by obtaining the actual productivity rate (P/R) on site by collecting multiple samples and performing a statistical analysis on the entire samples. The P/R is the inverse of the SRUQ.

This survey is divided into two categories based on the nature of work item being surveyed, that is:

- i. **Survey on selected 6 On-Carriageway Works.** These work items' executions not only require labour but also machinery and materials for example, Pothole Repair.
- ii. **Survey on 6 major Labour Based Works.** These work items' executions only require labour for example, Grass Cutting.

Two types of forms are used in Productivity survey, namely:

1. Form PRI – Productivity Survey Sketch Sheet (see **Figure 6-1**)
2. Form PR2 – Productivity Survey Sheet (see **Figure 6-2**)

[Form.PRI] SKETCH SHEET (Quantity Survey)	Date: _____ Inspected by: _____
Road Name: _____	Region/ Location: _____
Section No.: _____	Station: _____ + _____ ~ _____ + _____
<Top View>	<Typical Section>
L R Start ⇒	

Figure 6-1 Form PRI: Productivity Survey Sketch Sheet Records 1) Typical Cross sections 2) Work Team Info 3) Work Items and 4) Others by hand during the survey on site.

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6.2.1 Survey on the selected 6 On-Carriageway Works

6.2.1.1 Survey Procedure

The procedure for surveying on-carriageway works is as follows:

1. The start point of each activity is marked with spray paint and noted and the start time of the activity is recorded.
2. Two types of forms are used; One for sketching the road plan and cross-section and the other for survey recording. Both samples of completed forms are attached as Forms PR1 and PR2 in Figure 6-1 whereas completed filled in forms are shown in Chapter 6.2.1.4.

On-Carriageway work items are divided to activities based on how the execution of the work item is done. For example, Road marking is classified into 4 activities, that is; cleaning, pre-marking, priming and marking. Each of these activities will be filled in a separate form PR2 as shown in chapter 6.2.1.4.

3. The number of workers assigned for each work output is recorded at the beginning of the survey. Also, the number of workers who have been re-assigned to work on a different work output should be recorded.
4. The number, type and specifications of machinery and equipment used should be noted.
5. The safety measures employed should be noted. These include the use of safety cones, safety wear for labourers and construction site warnings and cautions for road users. Safety measures required should also be employed by the cost surveyors.
6. The end point is then marked and measurement done on completion of each activity. Dimensions to be measured are the lengths, widths and depths. Measurement can be conducted using a tape measure (preferably 50m long) or a measuring wheel.
7. Pictures are taken for each activity and grouped into respective roads. Pictures will be taken before, during and after completion of every activity. Pictures are also taken to show how the survey was carried out. Please refer to Chapter 6.2.1.3

6.2.1.2 Data Transfer

Calculations to obtain the areas, volumes, total number of workers and hours worked are performed at the site during the survey using Forms PR1 and PR2 above. Please refer to Chapter 6.2.1.4 for completed/ filled in forms.

Such transfer of data and analytical calculations are explained in Chapter 7.

6.2.1.3 Photos of Productivity Survey



Grading



Watering



Compaction



Measurement of Graded Area



Pothole cutting



Removal of Cut Asphalt



Measurement of Pothole



Spraying of Tack Coat



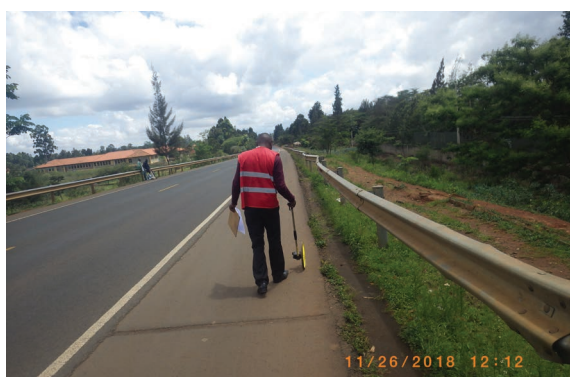
Straightening of guardrail



Damaged guardrail removal



Fixing of straightened beam



Measurement of fixed guardrail



Cleaning of Road Surface



Premarking



Priming



Road Marking

6.2.1.4 Sample Forms

THE PROJECT FOR STRENGTHENING OF CAPACITY ON ROAD MAINTENANCE MANAGEMENT THROUGH CONTRACTING IN THE REPUBLIC OF KENYA

[Form PR1] SKETCH SHEET (Productivity Survey)

No. _____

Date: 2017/11/15Inspected by: TEAM A

Road Name : <u>NGONG ROAD</u>	Region/ Location : <u>NAIROBI</u>
Section No. : _____	Work Item: <u>ROAD MARKING</u>

(Sta. + ~ Sta. +)

<Top View>

WL - continuous white line
 Vg-F
 Continuous white line
 LINED DRAIN

Start ⇒

<Typical Section>

Cross Section A-A

Work Item	Road Marking - Marking		Sheet No:	1		Date: 27/11/2017	
Road Name:	Ngong Road		Road Agency:	KURA			
Region/ Location:	Nairobi		Contractor Name:	WKK			
Work Frequency:	First time (thru' interview, times per month)		Weather:	Sunny/Cloudy			
Work Volume:	Actual Qty: 542.50 (Unit) m ²		Work Time	Start: 1:35 PM		End: 2:00 PM	
Work Procedure	Cleaning Road surface using Air Compressor 1) ☐ 2) ☐ 3) ☐ 4) ☐ 5) ☐ 6) ☐						
Work Measurement	Actual Qty	L: 155 m	w: 3.5 m	h:	d:	%	Qty: 542.50 m ² (Unit)
	Simple Qty	L: 155 m	W: 3.5 m	H:	D:	%	Qty: 542.50 m ² (Unit)
Work Difficulty Level	Work Difficulty Level Work spec. (in case of grass cutting, height of grass %....In case of Lane Marking, width, thickness.....)						

Manpower Composition	Type	Spec.	No. of	Start Time	End Time	Working Hour	Remarks
Supervisors	Skilled		2	1:35 PM	2:00 PM	1.6667	SRUQ
							= 0.000439 per-d/m ²
Operator (Air comp.)	Skilled		1				P/R
Labour	Unskilled		1				= 2278.5 m ² / per -d
Material							
Fuel (Truck)	Diesel		17.5 hrs				
Fuel (Air compressor)	Diesel		1.5 hrs				
Machinery/ Equipment							
Air Compressor	PD5126s-16		1	1:35 PM	2:00 PM	0.4167	SRUQ
							= 0.0001097 No-day / m ²
							P/R
							= 9113.3 m ² / No-day
Safety Measures							
Safety jackets			1				
Boots			1 pair				
Helmets			4				
Safety cones			14				
Barriers			13				

Notes:

Work Item	Road Marking - Premarking		Sheet No:	2		Date: 27/11/2017	
Road Name:	Ngong Road		Road Agency:	KURA			
Region/ Location:	Nairobi		Contractor Name:	WKK			
Work Frequency:	First time (thru' interview, times per month)		Weather:	Sunny/Cloudy			
Work Volume:	Actual Qty: 310 (Unit) m		Work Time	Start: 2:05 PM		End: 2:27 PM	
Work Procedure	Premark area to be road marked using chalk Time 1) — 2) — 3) — 4) — 5) — 6) —						
Work Measurement	Actual Qty	L: 310 m	w:	h:	d:	%	Qty: 310 m (Unit)
	Simple Qty	L: 310 m	W:	H:	D:	%	Qty: 310 m (Unit)
Work Difficulty Level	Work Difficulty Level Work spec. (in case of grass cutting, height of grass %....In case of Lane Marking, width, thickness.....)						
Manpower Composition	Type	Spec.	No. of	Start Time	End Time	Working Hour	Remarks
Supervisors	Skilled		2	2:05 PM	2:27 PM	18.333	SRUQ
Labour			3				= 0.000845 per-d/m
							P/R
							1183.64 m/per-d
Material							
Chalk	White		1				
Machinery/ Equipment							
Safety Measures							
Safety jackets			5				
Boots			1 pair				
Helmets			5				
Safety cones			9				
Notes:							

Work Item	Road Marking - Priming		Sheet No:	3		Date: 27/11/2017	
Road Name:	Ngong Road		Road Agency:	KURA			
Region/ Location:	Nairobi		Contractor Name:	WKK			
Work Frequency:	First time (thru' interview, times per month)		Weather:	Sunny/Cloudy			
Work Volume:	Actual Qty: 31	(Unit) m ²	Work Time	Start: 2:17 PM	End: 2:34 PM		
Work Procedure	Time 1) <i>Paint primer on road surface using brush</i> 2) <i>---</i> 3) <i>---</i> 4) <i>---</i> 5) <i>---</i> 6) <i>---</i>						
Work Measurement	Actual Qty	l: 310 m	w: 0.15 m	h:	d:	%	Qty: 46.50 m ² (Unit)
	Simple Qty	L: -	W: -	H:	D:	%	Qty: - (Unit)
Work Difficulty Level	Work Difficulty Level Work spec. (in case of grass cutting, height of grass %....In case of Lane Marking, width, thickness.....)						
Manpower Composition	Type	Spec.	No. of	Start Time	End Time	Working Hour	Remarks
Supervisors	Skilled		2	2:17 PM	2:34 PM	0.8500	SRUQ
Labour	Unskilled		1				= 0.00261 per-d/m ²
							P/R
							= 382.94 m ² / per -d
Material							
Primer	Crown		0.5 hrs				SRUQ
							= 0.01075 Ltrs / m ²
							P/R
							= 93.0 m ² / Ltr
Machinery/ Equipment							
Safety Measures							
Safety jackets			3				
Boots			2 pairs				
Helmets			3				
Safety cones			14				
Barriers			13				
Notes:							

Work Item	Road Marking - Marking		Sheet No:	4		Date: 27/11/2017	
Road Name:	Ngong Road		Road Agency:	KURA			
Region/ Location:	Nairobi		Contractor Name:	WKK			
Work Frequency:	First time (thru' interview, times per month)		Weather:	Sunny/Cloudy			
Work Volume:	Actual Qty: 31	(Unit) m ²	Work Time	Start: 2:35 PM	End: 3:20 PM		
Work Procedure	Marking (White thermoplastic paint) 1) -- 2) -- 3) -- 4) -- 5) -- 6) --						
Work Measurement	Actual Qty	L: 310 m	w: 0.1 m	h:	d:	%	Qty: 31 m ² (Unit)
	Simple Qty	L: 310 m	W: 0.15 m	H:	D:	%	Qty: 46.5 m ² (Unit)
Work Difficulty Level	Work Difficulty Level Work spec. (in case of grass cutting, height of grass %....In case of Lane Marking, width, thickness.....)						
Manpower Composition	Type	Spec.	No. of	Start Time	End Time	Working Hour	Remarks
Supervisors	Skilled		2	2:35 PM	3:20 PM	3	SRUQ
Labour	Unskilled		1				= 0.01382 per-d/m ²
Operator	Skilled		1				P/R
							= 72.333 m ² / per -d
Material							
Thermoplastic paint	White		93 Kgs				SRUQ = 3 Kgs / m ²
							P/R = 0.333 m ²
Gas			13 Kgs				
Fuel			4.29 ltrs				
Machinery/ Equipment							
Road marking machine	PD5126s-16		1	2:35 PM	3:20 PM	0.75 No-hr	SRUQ
							= 0.0003456 No-day / m ²
							P/R
							= 289.33 m ² / No-day
Boiler			1				
Safety Measures							
Safety jackets			4				
Boots			3 pairs				
Helmets			4				
Safety cones			14				
Barriers			13				
Notes:							

6.2.2 Survey on 6 Major Labour Based Works

These are the Productivity Survey (SRUQ Survey) and the Work Frequency Survey.

6.2.2.1 Survey Procedure

This is the survey to understand how much of work output is produced and completed for a given manpower.

Examples:

Work Output:	Grass Cutting	P/R: xx m ² / person day.
	Cross Culvert De-silting	P/R: yy m/person day.
	Carriageway Cleaning	P/R: zz m ² /person day.

The procedure for conducting the survey is as follows;

1. The plan and cross-section of the road being maintained will be drawn. All pertinent features including access drives, drainages, carriageways, vegetation zones and so on will be included.
2. The start point of each activity is marked with spray paint and recorded on the drawing with the start time recorded.
3. Two types of forms are used; One for sketching the road plan and cross-section and the other for survey recording. Both samples of completed forms are attached as Forms 1 and 2 in **Figure 6-1** and **Figure 6-2** whereas completed filled in forms are shown in Chapter 6.2.2.4.
4. Measurement is done on completed sections for each activity at an interval of 1 hour. Dimensions to be measured are the lengths, widths and depths. Measurement is conducted using a tape measure (preferably 50m long). The end point for each completed activity in one hour is marked after the measurement.
5. The number of workers assigned for each work output is recorded at the beginning of the survey. Also, the number of workers who have been re-assigned to work on a different work output should be recorded.
6. Difficulty of work produced is classified into “Heavy”, “Normal” and “Light” based on the visual inspection performed by surveyors and will be recorded in “Remarks”. These remarks will be referred to when calculating three different levels of SRUQs. For details of each site work condition to Work Difficulty Levels, please refer to **Table 6-3**.

Table 6-3 Work Difficulty Levels

Work Difficulty Level	Site Work Condition	Remarks
Heavy (productivity: low)	Very heavy work normally observed in the initial mobilization period.	Used for initial mobilization period
Normal (productivity: normal)	Moderate work volume mainly observed in the wet season	Used for the wet season
Light (productivity: high)	Light work volume mainly observed in the dry season	Used for the dry season

7. Safety will be observed throughout the survey. Surveyors will always wear reflective safety jackets and helmets to enhance safety. Surveyors are also required to be cautious of the traffic to avoid accidents.
8. Pictures are taken for each activity and grouped into respective roads. Pictures will be taken before, during and after completion of every activity. Pictures are also taken to show how the survey was carried out. Please refer to Chapter 6.2.2.3.

9. Work frequency survey is conducted to understand the number of frequencies required to maintain the work output to achieve the prescribed service levels. This survey is performed based on interviews with contractors and also by continual monitoring of SRUQ survey above.

Example: Work Frequency: xx times /month, or yy times/day.

6.2.2.2 Data Transfer

Calculations to obtain the areas, volumes, total number of workers and hours worked are performed at the site during the survey using Forms PR1 and PR2. Please refer to Chapter 6.2.2.4 for completed/filled in forms.

Such transfer of data and analytical services are explained in Chapter 7.

6.2.2.3 Photos of Productivity Survey

	
Slashing of grass	Measurement of slashing of grass
	
De-silting of drainage	Measurement on de-silted drain
	
De-siltation of carriageway	Measurement on de-silted carriageway.



De-siltation of drainage and cleaning of carriageway



Measurement of completed section

6.2.2.4 Sample Forms

THE PROJECT FOR STRENGTHENING OF CAPACITY ON ROAD MAINTENANCE MANAGEMENT THROUGH CONTRACTING IN THE REPUBLIC OF KENYA

[Form.PRI] SKETCH SHEET (Productivity Survey) No. _____ Date: 2017/10/02, Inspected by: TEAM A.

Road Name :	11/11/11 SUPER HIGHWAY			Region/ Location :	KIAMBURU (RURU)		
Section No. :	(Sta. + ~ Sta. +)	Work Item :	GRASS CUTTING				
<Top View>							
<Typical Section>							

6.2.3 Miscellaneous Cost Survey

Miscellaneous cost is a cost required to: 1) obtain necessary tools and equipment for carrying out the work; 2) acquire safety equipment and gears; and 3) acquire tools and equipment for inspection. An example is indicated in **Table 6-4** below.

The Manual recommends the value of 5% on top of the total labour cost. However, this can be improved by conducting the Miscellaneous Cost Survey to determine the standard percentage based on each road agency, region and contract.

Table 6-4 Example of Miscellaneous Cost

Item	Unit	Quantity	Rate	Amount	Remarks
Safety Jacket	Pcs	100	300	30,000	100pcs/year
Helmet	Pcs	100	1,000	100,000	100pcs/year
Safety Boots	Pcs	100	2,500	250,000	100pcs/year
Safety Cones	Pcs	20	250	5,000	60pcs/3years45
Grass Slasher	Pcs	200	700	140,000	200pcs/year
Wheel barrow	Pcs	40	3,000	120,000	40pcs/year
Shovel	Pcs	20	500	10,000	20pcs/year
Hoe	Pcs	20	800	16,000	20pcs/year
Fork foe	Pcs	10	1,000	10,000	20pcs/2years
Pick-axe	Pcs	2	800	1,600	6pcs/3yeas
Rake	Pcs	20	300	6,000	20pcs/year
Broom	Pcs	600	150	90,000	50pcs/month
Machete	Pcs	5	600	3,000	5pcs/year
Tape Measure	Pcs	2	200	400	2pcs/year
Total				782,000	(a)
%				5.0%	(a)/(b)%
Labourer	Man days	30,000	450	13,500,000	100*25days*12 months
Foreman	Man months	40	40,000	1,600,000	3.33*12 months
Supervisor	Man months	13.3	50,000	665,000	1.11*12 months
Workers Total				15,765,000	(b)

6.3 Patrol and Self-Inspection (Self-Control Unit) Survey

In order to obtain precise cost estimation, it is important to understand the precise volume of work inputs such as labour, materials and equipment resources for a given volume of work output under Self-Control Unit. It is also important to understand the work frequency so that a given volume of work output is performed to achieve the prescribed service level.

A survey is required to determine how the Self Control Unit is utilized in on-going projects. The scope of such a survey is indicated in **Table 6-5**.

The team formation illustrated in the PBC Guideline is indicated in **Figure 6-3**. Similarly, in **Table 6-6**, the required set up for patrolling and self-inspection is indicated.

The additional survey is required to either maintain or modify such team, vehicles and equipment formations for more precise cost estimation as standard formation of the Self-Control Unit may be different for projects under KeNHA, KURA, KeRRA and KWS.

Table 6-5 Patrol and Self-Inspection (Self Control Unit) Survey

Activities	Survey Items	Remarks
Patrol	Team Formation, Vehicles and Equipment Frequency	According to road agencies and types of roads
Self-Inspection	Team formation, Vehicles and Equipment Frequency	Same as above
Documentation	Details of Work Inputs Required	In case of a project with extraordinary inputs required, an extra cost may be required other than the cost included under the Indirect Cost

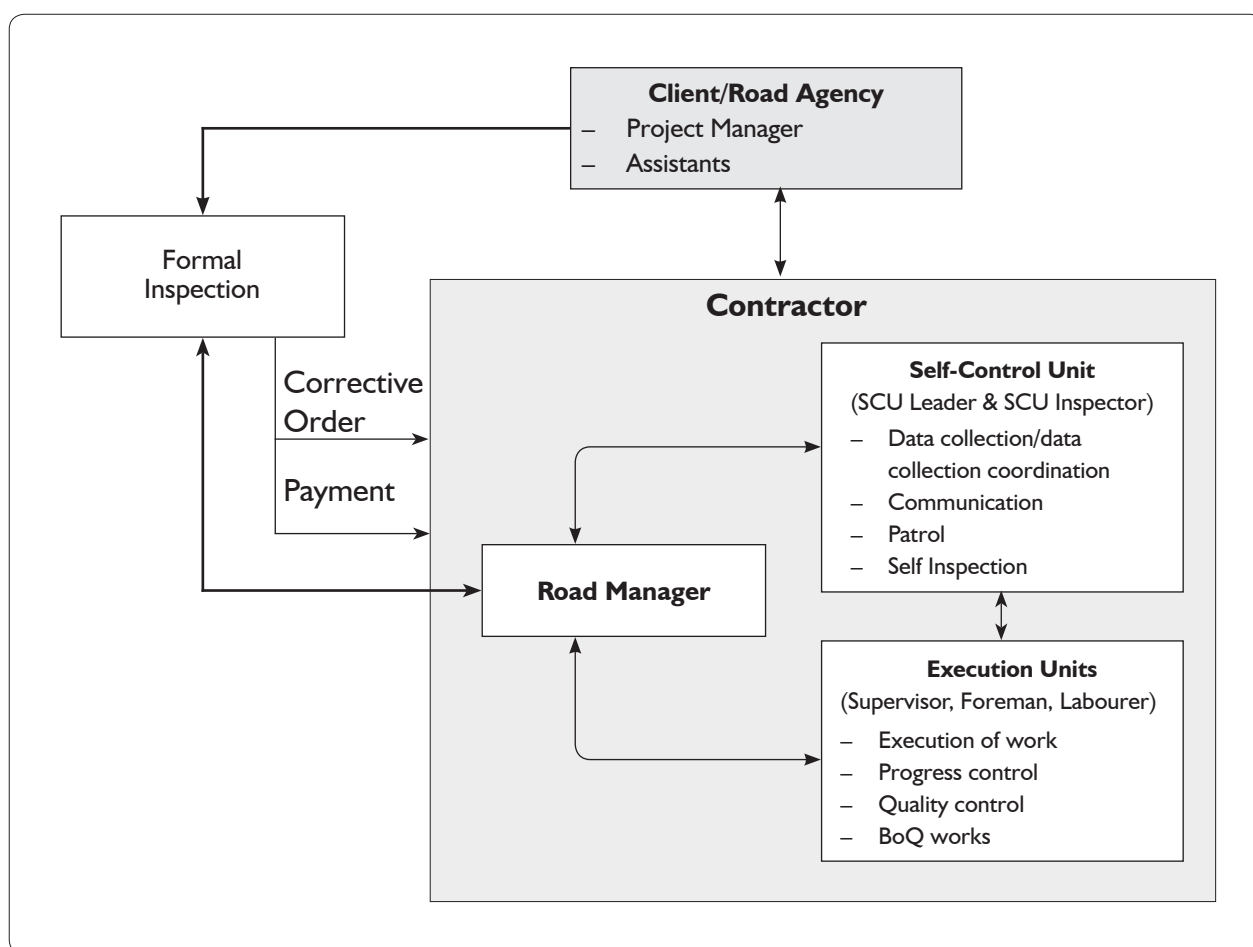
**Figure 6-3 Example of Self-Control Unit Structure**

Table 6-6 Staffing Structure of Self-Control Unit

				Number of staff (Depends on the road type and complexity)		
	Position	Task	Requirements	Up to 10km ^{*1}	Up to 50km ^{*2}	Over 50km ^{*3}
1	SCU leader	Coordination of data collection, Report, communication	Trained in PBC, Experience more than 5 years in road construction and maintenance	1	1	1
2	SCU Inspector	Data collection patrol	Experience more than 3 years in road construction and maintenance	0	1	2

*1 Up to 10km: SCU leader conducts both patrol and self-inspection (1 vehicle required)

*2 Up to 50km (standard) : SCU leader conducts patrol and self-inspection with one inspector (1 vehicle required)

*3 Over 50km: SCU leader and an assistant conduct patrol and self-inspection. An inspector conducts patrol in other roads under contract at same time (2 vehicles required).

6.4 Pre-surveyed Quantities for selected 6 On-Carriageway Works

Pre-surveyed Quantity is defined, especially for the Selected 6 On-Carriageway Works, the Other PBC Works and the Instructed Works, as an estimated input of works and services required for standard level cost estimation using quantities of works and services as obtained by surveys conducted either at the planning stage or during the tender stage. Surveys are conducted firstly by assessing the degradation of road facilities and then estimating the volume of works and services.

3 types of the pre-surveyed quantity method are proposed considering the nature of on-carriageway works and the level of information already available as shown on **Table 6-7** and are listed in **Table 6-8**.

Table 6-7 Types of Pre-surveyed Quantity

Type	Description
Type 1	Pre-surveyed quantity based on visual inspection of the current state and make practical judgment.
Type 2	Pre-surveyed quantity generated from past PBC project data
Type 3	Pre-surveyed quantity generated from visual inspection and engineering correlation with past PBC project data.

Table 6-8 Types of Pre-surveyed Quantity of Selected 6 On-Carriageway Works

No	Item	Type of pre-surveyed quantity	Details of Data Available
1	Grading and regravelling on unpaved road	Type 1	Not Available, regravelling after each rainy season
2	Patching	Type 3	Obtained by survey
3	Crack sealing	Type 1	Research Paper
4	Road Marking	Type 3	Obtained by survey
5	Repair on Concrete Structures	Type 1	Not Available
6	Guardrail Repair/ Replacement	Type 2	Obtained by survey

The details of the survey for the presurveyed quantities for On-carriageway works is outlined in the cost survey Guidenotes for Performance Based Contracts Part 2.

6.5 Survey on Other PBC Works

This section covers the survey on the “Other PBC Works” which are also required to be undertaken under a PBC project. The Other PBC Works are works and services which are required to be carried out during the duration of a PBC project for the cost of which is not computed under either Selected 6 On-Carriageway Works or 6 Major Labor Based Works. Components of the Other Major PBC Works are indicated in **Table 6-9** with information required for cost estimation.

Table 6-9 Components of Other PBC Works

Items	Check Items for Cost Estimation
Repair of Carriageway	Simple Quantity, Period of Maintenance, Age of Road, Number of Lanes, Thickness of Asphalt Pavement, Damage Inventory, Pre-surveyed Quantity
Repair of Shoulder	Simple Quantity, Period of Maintenance, Age of Road, Thickness of Asphalt Pavement, Damage Inventory, Pre-surveyed Quantity
Repair of Structures	Simple Quantity, Period of Maintenance, Damage Inventory, Pre-surveyed Quantity
Repair of Road Furniture	Simple Quantity, Period of Maintenance, Damage Inventory, Pre-surveyed Quantity
Repair of Profile and Road Width	Simple Quantity, Period of Maintenance, Damage Inventory, Pre-surveyed Quantity
Repair of Embankment and Slopes	Simple Quantity, Period of Maintenance, Damage Inventory, Pre-surveyed Quantity

The Manual proposes three ways of cost estimation for Other PBC Works and surveys to obtain data/information to enable such cost estimation to be conducted. It is important to understand the precise volume of work inputs such as labour, materials and equipment resources for a volume of work output to achieve the specific service levels as well as the volume of work output itself are important. However, we must acknowledge that it is understandably difficult to determine the volume of the work output for each work on its own. Therefore, collection of damage inventory and computation of damage probabilities through this survey becomes important as well.

6.5.1 Damage Inventory Survey

By understanding the past maintenance record of damages and compiling them into the damage inventory, the probability of each repair such as pothole repair, rutting repair, shoulder repair and road furniture repair can be placed in a database to be provided by the cost estimation administrator.

This probability of each repair is termed as the damage probability and the probable quantity may be computed by multiplying the simple quantity and the damage probability of repairs necessary under Other PBC Works by the cost estimator from information in the database.

For compiling the damage inventory, the following survey needs to be established so as to provide adequate information required for cost estimation purposes. The damage inventory survey is conducted in the following order:

- I. Selection of Roads for Obtaining Damage Inventory

The selected road should possess typical features of roads in Kenya which is being maintained under PBC. The road agency in charge and the cost estimation administrator will need to agree that the selected road will be used for the damage inventory throughout the duration of the PBC project.

2. Cooperation with PBC Contractor

The PBC contractor responsible for maintaining the road will be informed that the selected road will be used as a model project for collection of the damage inventory for Other PBC Works. The contractor will be informed of usefulness which the study will serve for the road agency.

3. Damage Inventory Survey

Based on the progress on site, the contractor will inform the representative of the road agency on the volume of Other PBC Works which the contractor periodically carries out. The representative will then pass the information to the cost estimation administrator. Inventories of repairs carried out on damages will be recorded by the cost estimation administrator in a standardized form indicating the magnitude of damage and ensuing details of repair recorded with the anticipated cost incurred by the contractor. This is the input required for the damage inventory.

4. Compilation of Database

Upon completion of the PBC project, all information collected in the damage inventory under the project can be compiled into a database by computing the number of damages recorded per project, per year and per km/year. Computing the amounts required for repair recorded per project, per year and per km/year for each work under Other PBC Works will also be made. This database will become the damage probability database. In case, the model project is in multiple numbers, the database will be more useful in future.

6.5.2 Percentage Survey

The percentage survey is a survey following the result of Damage Inventory Survey.

This is the survey using the database established under Damage Inventory Survey to quantify the cost required for repair of damages as a percentage of the direct cost of the PBC project.

This survey may be carried out without using the result of Damage Inventory Survey by collection of data through interviewing contractors undertaking PBC projects for which the Other PBC Works are a part of the scope.

6.5.3 How Other PBC Works Survey is Used in Cost Estimation

For the Six (6) Major Labour Based Works and Self- Control Unit, quantification of work outputs is comparatively simple as such works are of repetitive nature and one can be able to adopt standard work frequencies to obtain work outputs.

For quantifying work outputs for the selected 6 On-Carriageway works and “Other PBC Works”, a concept of presurveyed quantities is introduced instead of computing work outputs using work frequencies.

The presurveyed quantity for the selected 6 On-Carriageway works and Other PBC Works can be computed using the following formula:

$$\text{Presurveyed Quantity} = \text{Simple Quantity} \times \text{Damage Probability}$$

This is based on the understanding that various work outputs under these works are of random occurrence and the impact of damage is also inconsistent.

In case, the damage probability is set higher than the reality, cost estimation will be higher; and in case, that the damage probability is set lower than the reality, cost estimation falls short of what is actually required. In order to minimize occurrence of such, it should be high priority to collect vital information as accurate as possible.

The Manual recommends that works utilizing such pre-surveyed quantities should not be treated as Other PBC Works, but as a part of Instructed Works so that the risk is borne by the road agency at this stage. This measure should be taken until such a time that a stable database of Other PBC Works is available.

Example:

Km Post repair: Simple Quantity (Km Posts) 100 nos. x Damage Probability 3%
 = Presurveyed Quantity 3 number

Difference of cost computation method is indicated in **Table 6-10**.

Table 6-10 Cost Estimation Methods

No	Categories	Description	Computation Method
1	Patrol and Self-Inspection (Self Control Unit)	For patrolling under Road Usability and for self-inspection	Quantity *× Productivity ×Unit Rate × Work Frequency (* Road Length)
2	Selected 6 On-Carriageway Works (Table 5-2)	Essentially the work is on-carriageway and not only is it Labour based but also On-Carriageway	Presurveyed Quantity = Simple Quantity x Damage Probability
3	6 Major Labour Based Works (Table 5-3)	Essentially the work is off carriageway and labour based	Quantity *× Productivity ×Unit Rate × Work Frequency (*length of drains, area of grass cutting etc.)
4	Other PBC Works	Works involving non-labour based work	Presurveyed Quantity = Simple Quantity x Damage Probability

6.6 Survey on Percentage Add-ons on Indirect Cost and Overhead & Profit

This section covers the survey required to determine the percentage add-ons to determine the costs of Indirect Cost and Overhead & Profit.

Indirect Cost and Overhead & Profit are the costs to cover items indicated in **Table I-4** and are generally computed as percentages. Indirect cost is computed as a percentage of the Direct Cost whereas Overhead & profit is computed as a percentage of the sum of the Direct Cost and the Indirect Cost. These percentages are generally smaller when the contract amount is large and are larger when the amount is small.

The survey to understand what desirable percentages to apply must be conducted by the cost estimation administrator. For deriving such percentages, the cost estimation administrator requires to conduct interviews with PBC contractors to determine the amount the contractors actually incur as Indirect Costs and Overhead & Profit in relation to the actual amount the contractor incurs on the Direct Cost. The survey needs to be established completely from first principles as no information is available in Kenya at this moment.

In case the above survey is not possible, the percentage add-on can be established by collecting tendered prices on recent road construction projects in Kenya as the benchmark. There are sums indicated in Bill No. I General and Preliminaries which covers the cost of the indirect work. Normally, overhead & profit are spread all over the bill of quantities. Since PBC projects do not require major site establishment costs, the percentage for road construction project should be computed by deducting such site establishment costs from Bill No. I.

6.7 Survey on Standardized Quantities-for 6 Major Labour Based Works

In order to obtain precise cost estimation, understanding the volume of work outputs for road facility maintenance is vital. However, this involves elaborate time-consuming tasks. Sometimes the purpose of cost estimation may not require such preciseness and a simpler way of obtaining work outputs will be required. In such a case, the Manual recommends adoption of standardized quantities of work outputs for the six (6) Major Labour Based which works on a Kilometre (KM) format.

Such KM Standardized quantities are computed in simple quantity for each road authority in this survey. Similarly, the percentage ratios of such simple and actual quantities for various road facilities have been also computed by Productivity Survey so that the cost estimation method using only a project length as an acquired parameter can be used. The details of cost estimation methods using KM Standardized Quantities are explained in Vol. 2 for Government Cost Estimators together with other two methods.

This section covers the survey method for obtaining a list of standardized quantities for road facilities for each road agency.

The survey for road facilities is conducted in the following order:

1. Selection of Roads for Obtaining Standardized Quantities

The selected road should possess typical features of roads in Kenya.

The selected road should be simple in its own nature and PBC is either being implemented or to be implemented. Selected roads thus become the Standardized Road.

2. Selection of Survey Section

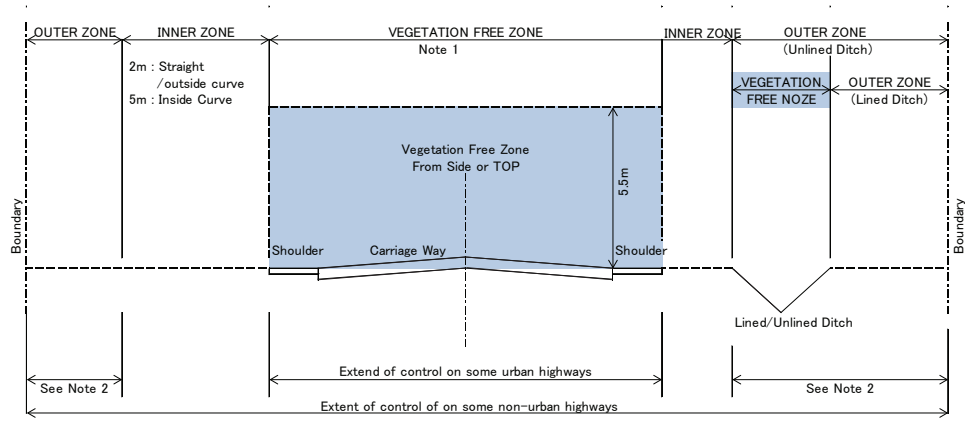
Survey sections will be selected taking into consideration that the section is simple in its own nature. Either a section or sections maybe selected. However, each section should be at least 1km in length and the total section should be between 3km to 5km in length.

These sections thus become the Standardized Road Section.

3. Computation of Simple Quantities for Each Road Facility

The Standardized Road Section will also be surveyed for simple quantities for each road facility, based on the following computation methods;

- i. *Grass Cutting*: The length of the Standardized Road Section $\times$ (The road reserve – Carriage Way – Side Walk – Lined ditch). See **Figure 6-4**.
- ii. *Cross Culvert*: The total metre length of cross culverts regardless of whether maintenance is required or not in the Standardized Road Section.
- iii. *Catch Basin*: The total number of catch basins regardless of whether maintenance is required or not in the Standardized Road Section.
- iv. *Lined Ditch*: The total length of Lined Ditches regardless of whether maintenance is required or not in the Standard Road Section.
- v. *Unlined Ditch*: The total length of Unlined Ditches regardless of whether maintenance is required or not in the Standard Road Section.
- vi. *Carriageway*: The paved length of the Standardized Road Section $\times 1.0\text{m} \times 2 \times$ No of lanes. (1.0m for de-silting purpose)



Note 1 Vegetation free zone must be maintained free of all vegetation

Note 2 These area must be maintained according to the local requirements

Figure 6-4 Typical Section for Grass Cutting Maintenance Work

7 Analytical Results Based on Surveys Conducted

This section covers analytical results required to be obtained by the cost estimation administrator using the data/information obtained from Cost and Affiliated Surveys as explained in Chapter 6. These results are of paramount importance for proper cost estimation by road agencies.

For traditional road maintenance, cost estimation involves identifying and quantifying work inputs required for performance outputs, identifying applicable unit rates for work inputs and arriving at mathematical summation of costs of all required work inputs using estimated quantities and unit rates.

For PBC road maintenance, cost estimation requires additional considerations to convert and break down service levels into applicable outputs then down to work inputs. Suitable work frequencies for each output needs to be identified so that specific service levels are maintained throughout the duration of the project.

The cost estimation administrator is required to determine and provide the following data for cost estimation to be carried out by each road agency on a yearly basis, or as indicated otherwise in applicable sections.

- i. Unit Rates applicable for the year of cost estimation
- ii. Standard SRUQs for 6 Major Labour Based Works
- iii. Standard SRUQs for selected 6 on-carriageway works
- iv. Data on KM Standardized Quantities and the percentage ratios of such actual and simple quantities for various road facilities for 6 Major Labour Based Works
- v. Pre-surveyed quantity for selected 6 on-carriageway Works
- vi. Data on Self-Control Unit
- vii. Data on Percentage Add-ons on Indirect Cost and Overhead & Profit

7.1 Unit Rates

No specific analysis is required. Data obtained from the unit rates survey will be used, every year, the cost estimation administrator must determine applicable unit rates and provide the data in a summarized format to all Road Agencies, sample shown in **Table 6-2**. Please refer to Appendix 2 for the unit rate data applicable in FY 2018.

7.2 Standard SRUQs for 6 Major Labour Based Works

Based on an agreed frequency, the cost estimation administrator must provide the data on the standard SRUQs and P/Rs to all road agencies by conducting desk reviews.

From the Productivity Survey, field data must be compiled into Excel sheets – an excel sheet for each work item – and analysis conducted taking into consideration the various parameters affecting work productivity.

Firstly, the data on the field forms is encoded into an excel sheet as shown in **Table 7-1**. In this form, date of survey, road name, road agency, region, contractors name, Work measurements i.e. simple and actual quantities, Work Difficulty Level (WDL), work time, workforce, equipment and safety measures are recorded. Whether the project is under the initial mobilization period or not, seasonal conditions will be checked and recorded using this table.

Secondly, the encoded data is then used to calculate the SRUQs and P/Rs of the workforce in a calculation sheet shown in **Table 7-2**. A summary table of the calculation table is then prepared by dividing and summing the data into their different WDLs.

Table 7-1 Productivity survey Encoding Sheet

								9																						
								Work Measurement																						
								Simple		Actual		Work Volume		Work Time																
								L	W	H	D	I	w	h	d	%	m²	Simple	Actual	Start	End									
No.	Date of Survey	Road Name	Road Agency	Region/ Location	Contractor's Name	Work Frequency (in a month)	Weather											WDL	SVR	FR3	USL									
1	20/04/2017	Southern Bypass	KeNHA (2+lanes)	Nairobi	Ebenezer	Four times	Cloudy/sunny	14.6	1.78	-	-	14.6	1.78	-	-	100	25.99	25.99	11:48am	12:00	Normal	0	0	1	-	-	1	0	1	0
2	19/05/2017	Southern Bypass	KeNHA (2+lanes)	Nairobi	Ebenezer	Four times	Sunny	100	3.3	-	-	100	3.3	-	-		330	330	10:24am	11:00am	Normal	0	0	1	-	-	0	1	1	0
3	19/05/2017	Southern Bypass	KeNHA (2+lanes)	Nairobi	Ebenezer	Four times	Cloudy	82	3.3	-	-	82	3.3	-	-		270.6	270.6	11:02am	11:32am	Low	0	1	0	-	-	0	1	1	1
4	08/06/2017	Red Hill	KURA	Kiambu	Ebenezer	Once	Sunny	124	8.7	-	-	124	7.3	-	-		1078.8	905.2	09:13am	03:45pm	Heavy	0	0	1	-	-	1	0	1	1
5	16/06/2017	Lower Kabete Road	KURA	Nairobi	Ebenezer	once	Sunny	178	0.64	-	-	178	0.39	-	-		113.92	69.42	07:30am	03:36pm	Heavy	0	0	1	-	-	1	0	1	1
6	19/06/2017	Southern Bypass	KeNHA (2+lanes)	Nairobi	Ebenezer	Four times	Cloudy	150	3.5	-	-	150	3	-	-		525	450	11:00am	12:00	Normal	0	0	1	-	-	1	0	1	0
7	06/07/2017	Southern Bypass	KeNHA (2+lanes)	Nairobi	Ebenezer	Four times	Sunny	130	3	-	-	130	3	-	-		390	390	02:00pm	03:25pm	Normal	0	0	1	-	-	0	1	2	1
8	13/07/2017	Lower Kabete Road	KURA	Nairobi	Ebenezer	once	Sunny	32.7	10.9	-	-	32.7	10.1	-	-		356.43	330.27	10:59am	02:30pm	Normal	0	0	1	-	-	1	0	1	1
9	19/07/2017	Lower Kabete Road	KURA	Nairobi	Ebenezer	once	Sunny	36.2	11.5	-	-	30	5	-	-		416.3	150	11:53am	03:25pm	Normal	0	0	1	-	-	1	0	1	0
10	25/07/2017	Northern Bypass	KURA	Kiambu	Bashku Supplies	twice	Cloudy/sunny	76.2	2	-	-	76.2	2	-	-		152.4	152.4	11:20am	12:25pm	Normal	0	0	2	-	-	2	50	2	0
11	27/07/2017	Northern Bypass	KURA	Kiambu	Bashku Supplies	twice	Cloudy/sunny	20	5	-	-	20	2.5	-	-		100	50	11:35am	01:05pm	Normal	0	0	1	-	-	1	0	1	0
12	31/07/2017	Thika Superhighway	KeNHA (2+lanes)	Nairobi	Interways	twice	Cloudy	1537	1.7	-	-	1537	1.7	-	-		2612.9	2612.9	10:00am	02:50pm	Normal	4	0	18	-	-	22	0	22	0
13	16/08/2017	Thika Superhighway	KeNHA (2+lanes)	Thika	Interways	twice	Sunny	158	4.1	-	-	141	3	-	-		647.8	423	11:16am	01:00pm	Heavy	1	0	4	-	-	5	0	5	0
14	16/08/2017	Thika Superhighway	KeNHA (2+lanes)	Thika	Interways	twice	Sunny	133.6	2.3	-	-	133.6	2.3	-	-		307.28	307.28	11:40am	12:50pm	Normal	1	0	3	-	-	3	0	3	1
15	18/08/2017	Thika Superhighway	KeNHA (2+lanes)	Juja	Interways	twice	Sunny	150	2.5	-	-	150	2.5	-	-		375	375	02:20pm	03:20pm	Normal	0	0	4	-	-	4	0	3	0
16	28/08/2017	Thika Superhighway	KeNHA (2+lanes)	Kiambu	Interways	twice	Sunny	35.2	10.1	-	-	35.2	9.6	-	-		355.52	337.92	11:57am	01:00pm	Heavy	1	0	4	-	-	5	0	5	0
17	07/09/2017	Southern Bypass	KeNHA (2+lanes)	Nairobi	Ebenezer	four times	Sunny	300	2	-	-	300	2	-	-		600	600	10:30am	12:45pm	Normal	0	0	1	-	-	1	0	1	2
18	08/09/2017	Thika Superhighway	KeNHA (2+lanes)	Nairobi	Interways	twice	Sunny	98	3.1	-	-	98	3	-	-		303.8	294	02:26pm	03:30pm	Normal	0	0	2	-	-	2	0	2	0
19	02/10/2017	Thika Superhighway	KeNHA (2+lanes)	Kiambu	Interways	twice	Sunny	70	9	-	-	70	7.8	-	-		630	546	12:20pm	01:00pm	Normal	1	0	6	-	-	7	0	7	0
20	31/10/2017	WLR - Mbagathi Road	KURA	Nairobi	Faldi	once	Sunny	69	2.2	-	-	69	2.2	-	-		151.8	151.8	11:15am	12:40pm	Low	0	0	1	-	-	1	0	1	0

Table 7-2 Productivity survey Calculation Sheet

No.	Work Volume		WDL	Workforce (Manpower)																	
	Simple	Actual		SVR				FRM				USL					Combined				
	m ²	m ²		No.	Working Hour	Total Working Hour	SRUQ	PR	No.	Working Hour	Total Working Hour	SRUQ	PR	No.	Working Hour	Total Working Hour	SRUQ	PR	Overall Total working hrs		
1	25.99	25.99	Normal	0	0.2	0	0	0	0	0.2	0	0	0	0	1	0.2	0.2	0.0011	909.65	0.2	909.7
2	330	330	Normal	0	0.6	0	0	0	0	0.6	0	0	0	0	1	0.6	0.6	0.0003	3850	0.6	3850
3	270.6	270.6	Low	0	0.5	0	0	0	1	0.5	0.5	0.0003	3788.4	0	0	0.5	0	0	0	0.5	3788.4
4	1078.8	905.2	Heavy	0	6.53	0	0	0	0	6.53	0	0	0	0	1	6.53	6.53	0.001	969.86	6.53	970.4
5	113.92	69.42	Heavy	0	8.1	0	0	0	0	8.1	0	0	0	0	1	8.1	8.1	0.0167	59.99	8.1	60
6	525	450	Normal	0	1	0	0	0	0	1	0	0	0	0	1	1	1	0.0003	3150	1	3150
7	390	390	Normal	0	1.42	0	0	0	0	1.42	0	0	0	0	1	1.42	1.42	0.0005	1927.06	1.42	1922.5
8	356.43	330.27	Normal	0	3.52	0	0	0	0	3.52	0	0	0	0	1	3.52	3.52	0.0015	657.41	3.52	656.8
9	416.3	150	Normal	0	3.53	0	0	0	0	3.53	0	0	0	0	1	3.53	3.53	0.0034	297.17	3.53	297.5
10	152.4	152.4	Normal	0	1.08	0	0	0	0	1.08	0	0	0	0	2	1.08	2.17	0.002	492.37	2.17	491.6
11	100	50	Normal	0	1.5	0	0	0	0	1.5	0	0	0	0	1	1.5	1.5	0.0043	233.33	1.5	233.3
12	2612.9	2612.9	Normal	4	4.83	19.33	0.0011	946.05	0	4.83	0	0	0	0	18	4.83	87	0.0048	210.23	106.33	172
13	647.8	423	Heavy	1	1.73	1.73	0.0006	1708.27	0	1.73	0	0	0	0	4	1.73	6.93	0.0023	427.07	8.66	341.9
14	307.28	307.28	Normal	1	1.17	1.17	0.0005	1843.68	0	1.17	0	0	0	0	3	1.17	3.5	0.0016	614.56	4.67	460.6
15	375	375	Normal	0	1	0	0	0	0	1	0	0	0	0	4	1	4	0.0015	656.25	4	656.3
16	355.52	337.92	Heavy	1	1.05	1.05	0.0004	2252.8	0	1.05	0	0	0	0	4	1.05	4.2	0.0018	563.2	5.25	450.6
17	600	600	Normal	0	2.25	0	0	0	0	2.25	0	0	0	0	1	2.25	2.25	0.0005	1866.67	2.25	1866.7
18	303.8	294	Normal	0	1.07	0	0	0	0	1.07	0	0	0	0	2	1.07	2.13	0.001	964.69	2.13	966.2
19	630	546	Normal	1	0.67	0.67	0.0002	5733	0	0.67	0	0	0	0	6	0.67	4	0.001	955.5	4.67	818.4
20	151.8	151.8	Low	0	1.42	0	0	0	0	1.42	0	0	0	0	1	1.42	1.42	0.0013	750.07	1.42	748.3

SNo.	Work Volume		WDL	Workforce (Manpower)																
	Simple	Actual		SVR			FRM			USL			Combined							
	m ²	m ²		No.	Working Hour	Total Working Hour	SRUQ	PR	No.	Working Hour	Total Working Hour	SRUQ	PR	No.	Working Hour	Total Working Hour	SRUQ	PR	Overall Total working hrs	
	422.4	422.4	Low	0	0	0	0	0	0	0	0.5	0.000169	5913.6	1	1.42	0.00048	2082.25	1.92	0.0006	1540
	7099.11	6587.85	Normal	0	0	0	0	0	0	0	0	0	0	42	116.62	0.00253	395.43	137.79	0.003	334.7
	2196.04	1735.54	Heavy	0	0	0	0	0	1	1	0	0	0	10	25.76	0.00212	471.61	28.54	0.0023	425.7
	9717.55	8745.79	Combined	0	0	0	0	0	0	0	0.5	0.00235	425.73	53	143.8	0.00235	425.73	168.25	0.0027	363.9

NOTE

SVR

FRM

USL

SUPERVISOR

FOREMEN

UNSKILLED LABOURERS

Using information as obtained in **Table 7-2**, erroneous data is identified, removed and a revised summary table prepared.

Table 7-3 Compilation of SRUQs, P/Rs, Percentage Ratio of Simple Quantity/Actual Quantity ((Simple/Actual) %)

A subsequent summary as shown in **Table 7-3** is prepared by arranging data according to the work items, labour inputs (in person-days) and Work Difficulty Levels.

The table computes the field data to applicable field SRUQs for both simple and actual quantities together with the field percentage ratio of simple quantity /actual quantity.

Correction exercises may be required at this stage if sufficient data to cover the entire sphere of activities has not been obtained under the survey. In this case, a judgment must be provided to cover such deficiencies.

Table 7-3 Summary of SRUQs for 6 Major Labour Based Works

Work item	Unit	Level	P/R (Actual)	SRUQ (Actual)	SRUQ (Actual) *1000	Simple/ Actual	Actual/ Simple	P/R (Simple)	SRUQ (Simple)	SRUQ (Simple) *1000
Grass Cutting	m ²	Heavy	354.20	0.0028	2.82			1,062.6	0.0009	0.94
		Normal	455.78	0.0022	2.19			1,367.3	0.0007	0.73
		Light	907.80	0.0011	1.10			2,723.4	0.0004	0.37
		Ave	490.29	0.0020	2.04	300%	33%	1,470.9	0.0007	0.68
Cross Culvert	m	Heavy	1.78	0.5624	562.37			2.8	0.3628	362.82
		Normal	55.47	0.0180	18.03			86.0	0.0116	11.63
		Light	100.00	0.0100	10.00			155.0	0.0065	6.45
		Ave	5.08	0.1968	196.80	155%	65%	7.9	0.1270	126.97
Catch Basin 2.52m ² (ave.)/ pcs	pcs	Heavy	1.27	0.7902	790.18			3.8	0.2634	263.39
		Normal	5.00	0.2000	200.00			15.0	0.0667	66.67
		Light	23.15	0.0432	43.19			69.5	0.0144	14.40
		Ave	2.90	0.3445	344.46	300%	33%	8.7	0.1148	114.82
Lined Side Ditch	m	Heavy	35.39	0.0283	28.26			71.1	0.0141	14.06
		Normal	62.54	0.0160	15.99			125.7	0.0080	7.96
		Light	502.13	0.0020	1.99			1,009.3	0.0010	0.99
		Ave.	64.88	0.0154	15.41	201%	50%	130.4	0.0077	7.67
Unlined Side Ditch	m	Heavy	14.47	0.0691	69.09			40.8	0.0245	24.50
		Normal	26.99	0.0370	37.04			76.1	0.0131	13.14
		Light	38.43	0.0260	26.02			108.4	0.0092	9.23
		Ave.	22.70	0.0441	44.05	282%	35%	64.0	0.0156	15.62
Carriageway Cleaning	m ²	Heavy	19.40	0.0515	51.55			60.7	0.0165	16.47
		Normal	459.51	0.0022	2.18			1,438.3	0.0007	0.70
		Light	563.72	0.0018	1.77			1,764.4	0.0006	0.57
		Ave.	54.05	0.0185	18.50	313%	32%	169.2	0.0059	5.91

Based on difference of Work Difficulty Levels, applicable SRUQs and P/Rs are used for cost estimation as shown below:

- Initial Mobilization Period: SRUQs and P/Rs under Heavy
- Wet Season: SRUQs and P/Rs under Normal
- Dry Season: SRUQs and P/Rs under Light

Using information derived in **Table 7-3**, **Table 7-4** is produced for use by cost estimators. Please refer to **Appendix 2** for the final results for COSTES 2018.

Table 7-4 Final Results for Cost Estimators

Work item	Unit	Level	P/R (Simple)	Unit	SRUQ (Simple)	Unit
Grass Cutting	m ²	Heavy	1,062.6	m ² /per-d	0.0009	m ² /per-d
		Normal	1,367.3		0.0007	
		Light	2,723.4		0.0004	
		Ave	1,470.9		0.0007	
Cross Culvert	m	Heavy	2.8	m/per-d	0.3628	m/per-d
		Normal	86.0		0.0116	
		Light	155.0		0.0065	
		Ave	7.9		0.1270	
Catch Basin 2.52m ² (ave.) / pcs	pcs	Heavy	3.8	pcs/per-d	0.2634	pcs/per-d
		Normal	15.0		0.0667	
		Light	69.5		0.0144	
		Ave	8.7		0.1148	
Lined Side Ditch	m	Heavy	71.1	m/per-d	0.0141	m/per-d
		Normal	125.7		0.0080	
		Light	1,009.3		0.0010	
		Ave.	130.4		0.0077	
Unlined Side Ditch	m	Heavy	40.8	m/per-d	0.0245	m/per-d
		Normal	76.1		0.0131	
		Light	108.4		0.0092	
		Ave.	64.0		0.0156	
Carriageway Cleaning	m ²	Heavy	60.7	m ² /per-d	0.0165	m ² /per-d
		Normal	1,438.3		0.0007	
		Light	1,764.4		0.0006	
		Ave.	169.2		0.0059	

7.3 Standard SRUQs for selected 6 on-carriageway works

As stated earlier, on-carriageway works are divided into activities based on how the execution of the work item is done hence filled in several productivity survey sheets on the field. Similarly, the field data is compiled into an excel sheet with several excel worksheets as shown in the **Figure 7-1** below.

No	SS No	Date of Survey	Inspected By	Road Name	Region	Contractor's Name	Weather	Start time	End time	Work Frequency	WOL (Level 1, level 2, level 3)	LENGTH(m)	WIDTH(m)	Actual
001		09/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny	2:18 PM	3:03 PM			49	49	0.233
002		10/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny	2:18 PM	3:24 PM			77.2	32.78	0.125
003		10/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny/Cloudy	11:39 AM	11:53 AM			115.55	115.55	0.275
004		14/11/2017	Team A	Ngong Road	Nairobi	WVKK	Cloudy/Sunny	1:45 PM	3:15 PM			181.2	178.2	0.1
005		15/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny	1:17 PM	3:15 PM			197	197	0.1
006		16/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny	10:45 AM	1:03 PM			215.6	215.6	4.5
007		24/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny	7:50 AM	10:31 AM			415	415	0.1
008		27/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny/Cloudy	1:35 PM	3:20 PM			155	155	3.5
009		30/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny/Cloudy	3:00 AM	11:10 AM			70.5	69.5	0.15
010		30/11/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny/Cloudy	2:18 PM	3:30 PM			148	148	0.1
011		01/12/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny	10:32 AM	11:20 AM			142	142	0.2
012		01/12/2017	Team A	Ngong Road	Nairobi	WVKK	Sunny	11:25 AM	12:00 PM			113	113	0.1
013		15/09/2017	Team B	Eastern Bypass	Utalawa	Bashku general supplies	Cloudy	11:50 AM	12:45 AM			1900	1900	0.1
014		22/09/2017	Team B	Eastern Bypass	Utalawa	Bashku general supplies	Cloudy	10:20 AM	2:30 PM			4800	4800	0.1
015		25/09/2017	Team B	Eastern Bypass	Utalawa	Bashku general supplies	Cloudy	11:00 AM	12:45 AM			2500	2500	0.1
016		26/09/2017	Team B	Eastern Bypass	Utalawa	Bashku general supplies	Sunny	11:00 AM	1:30 PM			2600	2600	0.1
017		22/09/2017	OBANYAGA	Ruambwa-Hambengele	Busa	Haslowe Kenya LTD	Sunny	8:54 AM	2:59 PM			460.5	460.5	0.1
018		08/12/2018	Team B	Mombasa Road	Nairobi	Ebenezer	Sunny	8:30 AM	3:50 PM			1600	1600	0.3
019		23/01/2018	Team B	Mombasa Road	Nairobi	Ebenezer	Sunny	11:30 AM	3:40 PM			3000	3000	0.2
020		24/01/2018	Team A	Mombasa Road	Nairobi	Ebenezer	Sunny	11:30 AM	12:17 PM			175.8	175.8	0.1
021		24/01/2018	Team A	Mombasa Road	Nairobi	Ebenezer	Sunny	1:50 PM	3:18 PM			1617	1617	0.1
022		24/01/2018	Team A	Mombasa Road	Nairobi	Ebenezer	Sunny	10:09 AM	11:38 PM			650	650	0.1
023		07/02/2018	Team A	Western Link Road	Nairobi	Machine East	Sunny	1:54 PM	2:59 PM					
024		07/02/2018	Team A	Western Link Road	Nairobi	Machine East	Sunny	11:39 AM	12:20 PM					
025		07/02/2018	Team A	Western Link Road	Nairobi	Machine East	Sunny	12:23 PM	12:18 PM					

5 Worksheets

Figure 7-1 Example excel sheet for Road Marking

The encoded data in the worksheets is compiled in an excel worksheet similar to the encoding sheet in **Table 7-1**. The encoded data is then used to obtain the SRUQs and PRs for the Workforce, Machinery and Materials. A summary table of the calculation table is then prepared by dividing and summing the data into the different work items in that on-carriageway work.

Subsequently, a SRUQ and PR summary table of the calculation sheet is obtained as shown below

Table 7-5 SRUQ & PR summary for Grading and Regravelling

		SRUQ Units	M001-1		M001-2	
			SRUQ	PR	SRUQ	PR
Labour	Supevisor	person-day/m ³	-	-	-	-
	Foreman	person-day/m ³	0.0014	708.1	1.3500	0.7407
	Unskilled labourers	person-day/m ³	0.0035	285.4	0.0014	697.0578
	Combined	person-day/m ³	0.0049	203.4	1.3514	0.7400
Equipment	Motor Grader	No-day/m ³	0.0012	861.3	0.0004	2523.0588
	Vibratory roller	No-day/m ³	0.0008	1275.6	0.0022	449.4603
	Water tanker	No-day/m ³	0.0002	6617.6	0.0000	0.0000
Materials	Water	litre/m ³	1.8210	0.5	0.0000	0.0000
	Murram	m ³ /m ³	0.2469	4.1	0.0065	152.7811
	Fuel(Grader)	litre/hr	0.0598	16.7	-	-
	Fuel(Roller)	litre/hr	0.0118	84.7	3.7078	0.2697
	Fuel(Waterbowser)	litre/hr	0.0000	407101.2	0.0000	0.0000

The data for SRUQ and PR summary for the selected 6 on-carriageway works is shown in **Appendix 2**.

7.4 KM Standardized Quantities for 6 Major Labour Based Works

Introduction of the Percentage of Actual Quantity/Simple Quantity

Based on Productivity Survey, the percentage ratios of such actual and simple quantities (Actual/ Simple %) for various road facilities can be computed. Using the percentage Actual/ Simple quantity ratio computed, the KM Standardized Quantities obtained from field survey as stated in **chapter 6.7**, which is in a simple quantity format, can be converted to actual quantity. The result will be summarized in a format indicated in **Table 7-6**, which was the result of the Productivity Survey performed in 2015.

Table 7-6 Percentages of Actual Quantities/Simple Quantities

KeNHA

Item	Unit	(1) Simple Quantity / 1km	(2) Actual Quantity / 1km	(3) Actual/Simple %
1) Grass Cutting	m ²	6055	2,018.3	33%
2) Cross Culvert Desilting	m	100	64.5	64%
3) Catch Basin Desilting	Pcs	10	3.3	33%
4) Lined Ditch Desilting	m	200	99.5	50%
5) Unlined Ditch Desilting	m	1400	496.5	35%
6) Carriageway Cleaning	m ²	2000	639.0	32%

By conducting the survey periodically, together with the Productivity Survey on the 6 Major Labour Based Works, simpler and rough cost estimation can be completed in addition to more precise cost estimation methods.

KM Standardized Quantities for each road agency are indicated in **Appendix 2-2**.

7.5 Pre-surveyed quantity for selected 6 on-carriageway works

Presurveyed quantity (q2) for the selected 6 On-Carriageway works is computed using the following formula:

$$q2 = \beta \times FQ \times d2$$

Where: β – damage probability/ deterioration rate for the selected 6 On-carriageway works

FQ – Facility Quantity (Simple Quantity)

d2 – Decision Ratio/ Adjustment factor for PBC works

7.5.1 Damage Probability (β)

The damage probability refers to the most likely occurrence of the work items, in percentage per year. Determination of this probability depend on the following factors:

- i. Age of the Road
- ii. Road Classification and
- iii. Other factors such as climate, soil type, quality of materials used etc.

7.5.2 Facility Quantity (FQ)

This refers to an estimated quantity of the selected on-carriageway works for cost estimation during a contract period. This quantity can be determined by on-site survey or data from past projects. The Facility Quantity is obtained using the following formula:

$$\text{Facility Quantity (FQ)} = \text{KM Standardised Simple Quantity} \times \text{Contract Length (km)}$$

7.5.3 Decision Ratio / Adjustment factor for PBC works

As much as the damage probability may be obtained through surveys or determined through research, the percentage obtained may not be applicable to the different road conditions. If the probability is set higher than the reality, cost estimation will be higher and in case its set lower, cost estimation will fall short of what is actually required. Therefore, the decision ratio/ adjustment factor is determined by the cost estimator. This factor, which is in percentage, is set at the estimator's discretion and judgement.

Table 7-7 shows a summary table for presurveyed quantities for the selected 6 On-Carriageway works for KeNHA 2 lanes. The proposed presurveyed quantities for the selected on-carriageway works for the road agencies are given in Appendix 2.

Table 7-7: Summary of Presurveyed Quantities

No.	Agency	Road Type	Work Item Category	Check Box (Yes/No)	Work Items	Unit	Contract Length (km)	Single Qty /km		Unit Price		Check Box (Yes/No)	Coefficient Factors	[P] PBC-Works Rate (¥/year)	[Q] based by	[RQ] Facility Qty	[QZ] decision Ratio	[QZ]/[RQ] Quantification for PBC	PBC Work Total Cost		PBC Work-COST/1km-month
								A	B	C1	C2								H1=CI+G	H2=CI+G	
1				☒	Road Marking for smooth pavement	m ²	20		20.0	934	988	-	-	200.00%	Programmed Maintenance, Assumption= Q=30m*2km. (b enter to survey before contract)	400	100%	800.0	747,200	790,400	3,113
2			Road Marking	☐	Road Marking for surface drainage pavement	m ²	20		20.0	2,270	2,482	-	-	200.00%	Programmed Maintenance, Assumption= Q=30m*2km. (b enter to survey before contract)	400	0%	0.0	-	-	-
3				☐	Light Grading (Grading and Compaction)	m ³	20		0.0	13	13	-	-	200.00%	No Data KeRRA	0	0%	0.0	-	-	-
4			Grading and Graveling	☐	Regraveling (Graveling and Compaction with graveling)	m ³	20		0.0	1,393	1,393	-	-	200.00%	No Data KeRRA	0	0%	0.0	-	-	-
5				☒	Culvert installation 4600m	m	20	22.3		10,699	9,419	-	-	1.00%	No Survey data	446	100%	4.5	47,718	42,009	199
6			Concrete Repair	☒	Headwall construction	pair	20	1.8		21,725	18,256	-	-	1.00%	No Survey data the minimum amount shall be set	36	100%	0.4	7,821	6,572	33
7				☒	Cold Mix AC (Manufactured)	m ³	20	38.2		79,960	92,840	☐	Road age 0-3 years	0.00%	History Survey	765	0%	0.0	-	-	-
8							20	38.2		79,960	92,840	☒	Road age 4-6 years	1.00%	History Survey	765	20%	1.5	122,326	142,030	510
9							20	38.2		79,960	92,840	☐	Road age 7 and above	5.00%	History Survey	765	0%	0.0	-	-	-
10			Pothole Repair	☒	Cold Mix AC (made in site/plant)	m ³	20	38.2		44,800	48,500	☐	Road age 0-3 years	0.00%	History Survey	765	0%	0.0	-	-	-
11							20	38.2		44,800	48,500	☒	Road age 4-6 years	1.00%	History Survey	765	80%	6.1	274,147	296,789	1,142
12				☐	Hot Mix AC	m ³	20	38.2		26,940	29,720	☐	Road age 7 and above	0.00%	History Survey	765	0%	0.0	-	-	-
13				☒	Straightening of beams	m	20	161.4		1,362	1,349	☐	Road Classification 5	1.00%	History Survey	3,228	0%	0.0	-	-	-
14							20	161.4		1,362	1,349	☒	Road Classification 6	0.75%	History Survey	3,228	45%	10.9	14,838	14,697	62
15				☒	Straightening of beams and realignment of joints	m	20	161.4		1,362	1,349	☐	Road Classification B, C	0.50%	History Survey	3,228	0%	0.0	-	-	-
16							20	161.4		1,549	1,498	☐	Road Classification 5	1.00%	History Survey	3,228	0%	0.0	-	-	-
17							20	161.4		1,549	1,498	☒	Road Classification 6	0.75%	History Survey	3,228	45%	10.9	16,876	16,320	70
18				☒	Replacing of beams and realignment of joints	m	20	161.4		1,549	1,498	☐	Road Classification B, C	0.50%	History Survey	3,228	0%	0.0	-	-	-
19							20	161.4		9,142	9,142	☐	Road Classification 5	1.00%	History Survey	3,228	0%	0.0	-	-	-
20				☒	Crack Sealing	m	20	161.4		9,142	9,142	☒	Road Classification B, C	0.75%	History Survey	3,228	10%	2.4	22,133	22,133	92
21							20	161.4		9,142	9,142	☐	Road Classification 6	0.50%	History Survey	3,228	0%	0.0	-	-	-
22			Crack Sealing	☒	Crack Sealing	m	20	-	-	333	333	☐	Road age 0-3 years	-	Assumed Qty 0 m/month	0	0%	0.0	-	-	-
23							20	-	-	333	333	☒	Road age 4-6 years	-	Assumed Qty 25 m/month	300	100%	300.0	99,900	99,900	416
24							20	-	-	333	333	☐	Road age 7 and above	-	Assumed Qty 100 m/month	1,200	0%	0.0	-	-	-
TOTAL																					5,637

7.6 Data on Percentage Add-ons on Indirect Cost and Overhead & Profit

7.6.1 Indirect Cost

The cost estimation administrator is required to determine the percentage add-ons based on the survey carried out in accordance with Chapter 5. By collection of sufficient data and interviews with contractors who participated in past PBC projects, a percentage add-on can be determined.

The Manual recommends a percentage of Indirect Cost as **30%** over the Direct Cost. This is the default value used in COSTES for PBC 2018. The percentage is based on other classical road contracts in Kenya.

In Japan, the standard values of the indirect cost percentage on public road infrastructure projects are indicated in **Table 7-8**.

Table 7-8 Percentage Add-ons on Indirect Cost and Overheads & Profits in Japan

Percentage of Indirect Cost/Direct Cost for Road Infrastructure Project in Japan			
Limit	Qty	Unit	Remarks
Upper Limit	32.73	%	For projects under US\$ 58,000
Lower Limit	24.71	%	For projects over US\$ US\$ 8,300,000
Percentage of Overhead & Profit/(Direct Cost + Indirect Cost) for Road Infrastructure Project in Japan			
Limit	Qty	Unit	Remarks
Upper Limit	20.29	%	For projects under US\$ 42,000
Lower Limit	7.41	%	For projects over US\$ US\$ 25,000,000

7.6.2 Overhead & Profit

The cost estimation administrator is required to determine the percentage add-ons based on the survey carried out in accordance with Chapter 5. By collection of sufficient data and interviews with contractors who participated in past PBC projects, a percentage add-on can be determined.

The Manual recommends a percentage of the Overhead/Profit as **10%** over the summation of the Direct Cost and the Indirect Cost. This is the default value used in COSTES for PBC 2018. This percentage is also based on other classical road contracts in Kenya. It is to be noted that the profit margins and overheads include only those incurred by the Contractor but not the Client.

The default values of percentage for Indirect Cost and Overhead/Profit should be modified once comprehensive survey has been conducted.

8 Manual Revisions

This section describes the timing of revisions required so that the Manual is maintained and continues to serve its useful purpose.

Volume 1	Administrators — Revision is necessary whenever Cost Surveys are amended. — Biannual revision of Cost Estimation Parameters 2018.
Volume 2	Government Cost Estimators — Revision is necessary whenever work/service items are added or excluded. — Biannual revision of Cost Estimation Parameters 2018.
Volume 3	Contractors — Revision is necessary to synchronize with the revision made in Vol.2. — Biannual revision of Cost Estimation Parameters 2018 for Use by Contractors.

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Appendix 1 COST Estimation System 2018 for Cost Estimation Administrators

1. Basic flow of iCOSTES

1.1 iCOSTES Program flow and Data relationship

iCOSTES program refers to tables in the database (**jicadata**) as shown in Figure 1.1 below.

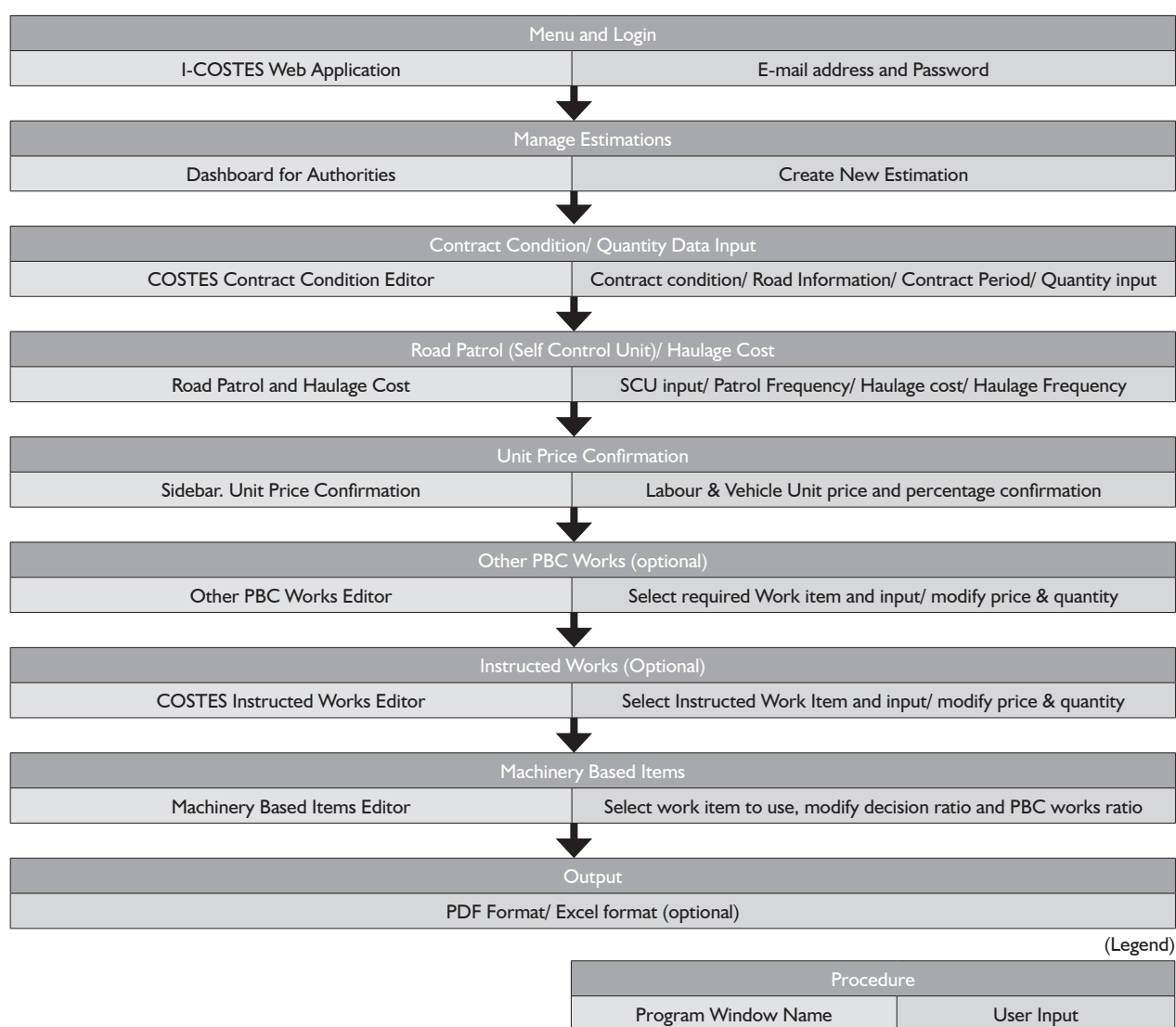


Figure 1.1 – Basic Data input and Program flow inside the COSTES2018

2. Users Management

On the Welcome screen, program users have to enter passwords in order to use ICOSTES. Therefore, iCOSTES under User Management handles information of users i.e. user name, e-mail, telephone, Role and password.

1. Adding new user account

The screenshot shows the 'Add New User Account' form in the iCOSTES User Management module. The form includes fields for Name, Email, Telephone, Role (set to Administrator), Password, and Confirm Password. A 'Create User' button is at the bottom. The footer indicates '© 2019 iCOSTES Web Application - Developed By OOI All Rights Reserved'.

2. Users Account List

This gives a list of all added users in the iCOSTES system and their different roles. It is in this window that the admin can edit users' details, reset passwords and assign/revoke role of a user by clicking on the "Action" option for each user.

The screenshot shows the 'User Account List' table in the iCOSTES User Management module. The table lists users with columns for Action, Name, Email Address, Access Level, Mobile, City, Country, Postal Address, and ID Number. The first user listed is DreamBuild Engineering.

Action	Name	Email Address	Access Level	Mobile	City	Country	Postal Address	ID Number
Action	DreamBuild Engineering	dreambuildeng@gmail.com	Contractors	+254710699696	Nairobi	Kenya	123456	2174 - 00621
Action	Nakuru	nakuru@county.com	County Government					
Action	Migori	migori@county.com	County Government					
Action	Kisumu	kisumu@county.com	County Government					
Action	Iten	iten@county.com	County Government					

3. System Roles and Adding a new role.

The iCOSTES system has set the following roles as shown in figure xx. The system is however not limited to the provided roles. The administrator can add new roles by clicking on the “Add New Role” option and even edit the existing roles by clicking on the “edit details icon under the Action column”.

The screenshot displays the iCOSTES User Management interface. At the top, there is a search bar labeled "Enter keyword" and a user profile icon labeled "System Admin". The main heading is "User Management", with a sub-heading "System Roles". A button labeled "+Add New Role" is visible. Below this, a table lists the system roles. The table has columns for ID, Name, Description, and Action. The roles listed are: Administrator, Agency Admin, Contractors, County Government, KRB Admin, Ministry Admin, and User. Each role has a description and an action icon (edit and delete). The interface also shows a pagination bar at the bottom indicating "Showing 1 to 7 of 7 entries" and "Previous 1 Next".

ID	Name	Description	Action
1	Administrator	This is account for System Super User and has all permissions	Edit Delete
2	Agency Admin	This is a person who manages road agency account...he or she can add road agency user and perform password reset	Edit Delete
3	Contractors	This account belongs to Contractor	Edit Delete
4	County Government	This is a county among the 47 counties in Kenya	Edit Delete
7	KRB Admin	Alternate admin	Edit Delete
8	Ministry Admin	in charges	Edit Delete
9	User	users from ministry, counties and road agencies who can do estimations	Edit Delete

2.1. Data Update

iCOSTES can identify several user types grouped by their roles. It has several categories including “Road Agency”, “Administrator”, “Contractors”, “Ministry Admin”, “Ministry Staff”, “County Governments” etc. Adding extra members is possible. It is advised that Passwords should be changed frequently.

3. Basic Parameters by Road Agency

“Agency Configurations” table handles basic condition for cost estimation. Parameters can be set by each Road Agency.

3.1. Contents of the table

Item	Value type/ value range/ condition	Description	Manual vol. I
Road Agency	Letter String/ up to 100 characters/ At least the name includes “KeNHA”, “KURA”, “KeRRA” or “KWS”	Defines the name of the road agencies. Alternatives include: “KeNHA”, “KURA”, “KeRRA”, and “KWS”. iCOSTES recognizes these names by exact word and character.	-
Indirect Cost	Decimal Number / 0.000 to 1.500 (3 decimal points)	Ratio of the indirect cost. ICOSTES calculates indirect cost by multiplying total direct cost (including PBC and Instructed work) by this ratio (see pp.33).	1.5/6.6/7.6.1
VAT	Decimal Number / 0.00 to 1.00 (2 decimal points)	Ratio of Value Added Tax	1.5
Overhead Profit	Decimal Number / 0.0000 to 1.5000 (4 decimal points)	Ratio of the overhead and profit. ICOSTES calculates overhead cost and profit by multiplying this ratio with the sum of direct and indirect cost.	1.5/6.6/7.6.2
Miscellaneous	Decimal Number/ 0.0000 to 1.5000 (4 decimal points)	Ratio of the miscellaneous cost. ICOSTES calculates miscellaneous cost by multiplying total labour cost by this ratio. This ratio is used on the detail cost sheets of 6 Major Labour Based Works in the “Detail Contents (B)” sheets.	6.2.3
Labour/ Foreman	No Decimal point / 0 to 300	Defines how many labours should be allocated to ONE foreman. This value is used in the detail cost sheets of 6 Major Labour Based Works in the “Detail Contents (B)” sheets.	5.3.5.4*

Labour/ Supervisor	No Decimal point / 0 to 300	Defines how many labourers should be allocated to ONE Supervisor. This value is used on the detail cost sheets of 6 Major Labour Based Works6 Major Labour Based Works in the “Detail Contents (B)” sheets.	5.3.5.4*
Truck_Kilo_ per_Litre	No Decimal point / 0 to 30	Defines truck’s diesel fuel consumption efficiency. The Unit is “Litres per km”. This value is used for the Self inspection and Haulage expenses, and related to the truck distance travelled.	5.3.7*
Pick-Up_Kilo_ per_Litre	No Decimal point / 0 to 40	Defines Pick-up’s petrol fuel consumption efficiency. The Unit is “Litres per km”. This value is used for the Self inspection and Haulage expenses and related to the pickup distance travelled.	5.3.7*
Truck_working_ days_per_ month	No Decimal point / 0 to 30	Defines the number of days when each maintenance work is carried out. It affects the calculation of the labour quantity per month in the “Detail Contents (B)”. Default value is 25 days.	5.3.7*
PickUp_ working_days_ per_month:	No Decimal point / 0 to 30	Defines the number of days when each self-inspection work is carried out. It affects the calculation of the travel distance of the pickup per month in the “Detail Contents (B)” sheets. Default value is 30 days because Road Patrol is executed every day.	5.3.7*
Password	Letter String / up to 100 characters	ICOSTES currently does not use this item	-
Self_Control_ Unit(patrol)_ Frequency	Decimal 2 decimal points/ 0.03 to 100.00	Specifies how many times the self-inspection crew patrols the road per day. This value can be changed in the “Data Input” form in ICOSTES.	5.3.3*
Survey Year	Numeric value / 2010 to 2030	Survey Year	6
SCU Foreman, SCU Inspector, SCU Driver, Truck, Truck for Haulage, Driver for Haulage, PickUp for Haulage	Checkbox / checked or non-checked	If checkbox is checked, SCU Table and Haulage Table in ICOSTES Contract Condition Editor will be checked. That is, checked items are regarded as the default member of SCU/Haulage Unit.	6.3
	Number / integer/ If non-checked, the number is zero	These values become default values in the SCU/ Haulage Editor if checked.	6.3

* Refer to the Manual for Government Cost Estimators (vol.2)

3.2. Data Update

It is essential to modify parameters (2015 data), except for “Road Agency”, for each agency otherwise ICOSTES cannot find any parameters if 2016 or later data have not been registered. One parameter set can be installed for each year by the Road Agency. It is important to note that two or more parameter sets cannot be registered in the same year.

If a new data set is obtained, please input them but the year should be unique. iCOSTES uses the data of the year which the user specifies on the “DataInput” form.

It is strongly recommended that both Road Agency and Contractor candidates use the data of the same year.

4. Standard Resource Usage per Quantity (SRUQs) by Road Agency (Table: SRUQ)

Standard Resource Usage per Quantity (SRUQ) Table defines:

1. The productivity rate (P/R);
2. Simple/Actual quantity ratio; and,
3. Standard quantity per km.

These parameters are defined for every 6 Major Labour Based Works and every type of contract period.

P/Rs have been surveyed, collected and classified into “Road Agency”, “Type of work”, “IMP/RMP”, and “Dry/Wet”. The “Simple/Actual quantity ratio” and “standard quantity per km” are collected and classified into “Road Agency” and “Type of work”. These parameters are used in the calculation of labour quantity in the “Detail Contents (B)” Sheets.

I-COSTES

Enter keyword

System Admin

SRUQ

Home SRUQ Index

+ Add SRUQ Import List

Standard Resource Usage Per Quantity By Road Authority

Authority Work Item Type Period Level Year

Show 50 entries

Previous 1 2 3 4 Next

Action	Authority	Project	Work Item	IMP/ROUTING	Period	Level	Year	Quantity/KM	SRUQ	SRUQ2
	KENHA	P-1	GC	IMP	Dry	Heavy	2015	6055	0.0033333333333333	0.01
	KWS	P-1	CC	IMP	Dry	Heavy	2017	10	0.36281947529913	0.56237018671364
	KWS	P-1	UD	RMP	Dry	Light	2015	1800	0.00059066785950856	0.0016666666666667
	KWS	P-1	CW	IMP	Dry	Heavy	2015	0	0.0063866775330444	0.02
	KWS	P-1	CW	RMP	Wet	Normal	2015	0	0.0027361689635587	0.0085683642219352
	KWS	P-1	CW	RMP	Wet	Normal	2015	0	0.0027361689635587	0.0085683642219352
	KWS	P-1	CW	RMP	Dry	Light	2015	0	0.0011051608762056	0.0034608319286123
	KWS	P-1	GC	IMP	Dry	Heavy	2017	2310	0.00094109394268911	0.0028232818280673
	KWS	P-1	GC	RMP	Wet	Normal	2017	2310	0.00073134463183928	0.0021940338955178
	KWS	P-1	GC	RMP	Dry	Light	2017	2310	0.00036718930565807	0.0011015679169742

Showing 1 to 50 of 162 entries

Previous 1 2 3 4 Next

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4.1. Contents of the table

Item	Value type/ value range/ condition	Description	Manual
Road Agency	Links to the list of “Road Agency” in “Others” Table	“Road Agency” in “Others” Table	-
Project	Letter String	Not used at present (future preparation)	-
SRUQ:	One of the lists consists of “GC”, “CC”, “BC”, “LD”, “UD”, “CW”	Specifies types of work. Values are for: “GC (Grass Cutting)”, “CC (Cross Culvert)”, “BC (Catch Basin Cleaning)”, “LD (Lined Ditch Cleaning)”, “UD (Unlined ditch Cleaning)”, and “CW (Carriage Way Cleaning)”.	1.6/6.2.2/7.2
IMP/routine_Maintenance_Period	Selection from “IMP” or “RMP”	Initial Mobilization Period (IMP) or Routine Maintenance Period (RMP)	
Dry/Wet	Selection from “Dry” or “Wet”	Selection of Dry or Wet season	
Work_Difficulty_Level	Automatically assigned Work_Difficulty_Level	See table below	
SRUQ	Decimal Number/ 0 to 100 (any number of decimal places)	Defined as how many labour-days are necessary for doing each task for pre-determined unit when carrying out maintenance to SIMPLE quantity.	
SRUQ2	Decimal Number/ 0 to 100 (any number of decimal places)	Defined as how many labour-days are necessary for doing each task for pre-determined unit when carrying out maintenance to ACTUAL quantity.	
Quantity/1 km	Decimal Number/ 0 to 100 (any number of decimal places)	Defined as the quantity of subject maintenance work per km. This value is collected through survey.	6.7
Year	Numeric value / 2010 to 2030	The year when the Productivity Rate / SRUQ is surveyed	-

The Work_Difficulty_Level allocated to IMP and RMP, in accordance with the prevailing season, are as follows:

IMP/RMP	Dry/Wet	Work Difficulty Level
IMP	Dry or Rain (No concern)	Heavy
RMP	Wet	Normal
	Dry	Light

Users can calculate work quantities by choosing one of the following formulas in ICOSTES:

- 1: Quantity per km: $SRUQ \text{ (Standard Resource Usage per Quantity)} * (\text{Simple quantity per km}) * (\text{Project Length})$
- 2: Simple quantity input: $SRUQ \text{ (Standard Resource Usage per Quantity)} \text{ for SIMPLE Quantity} * (\text{Simple Quantity input})$
- 3: Actual quantity input: $SRUQ \text{ for ACTUAL Quantity input} * (\text{Actual Quantity input})$

In the case of 2 and 3 above, users have to collect the information of total quantity of the project prior to the cost estimation.

Conversion between Productivity Rate and Standard Resource Usage per Quantity is described in Clause 1.5 of the Manual.

4.2. Data Update

For addition of new data into the iCOSTES, there are two ways it can be achieved:

1. Click on the “Add SRUQ”. A pop-up window appears as shown in the figure below. This way is good when adding a small amount of data which can be added one at a time but is very tedious when there is a large amount of data.

The screenshot shows the 'Create New SRUQ' pop-up window over the iCOSTES SRUQ table. The table has columns: Action, Authority, Project, Work Item, IMP/Routing, Period, Level, Year, Quantity/KM, SRUQ, and SRUQ2. The 'Create' button is highlighted in blue.

2. Click on the “Import List”. A pop-up window as shown in the figure below. Click the “Choose File” option to select an excel file with the updated data. This way, multiple data can be added at once.

The screenshot shows the 'Import List' pop-up window over the iCOSTES SRUQ table. The 'Choose File' button is highlighted in blue. The background table shows data for various road maintenance projects.

For editing of already existing data, click on the “Edit details icon” in the Action column” and a pop-up window as shown in the figure below will appear.

Edit Details

Road Authority: KENHA(2+Lanes) | Work Item: Grass Cutting

Type: IMP | Period: ---Select Period---

Work Difficulty Level: Heavy | Year: 2015

SRUQ: 0.0033333333333333 | SRUQ2: 0.01

Quantity /Km: 6055

Update

Action	Authority	Project	Work Item	Year	SRUQ	SRUQ2
	KENHA	P-1	IMP	2015	0.0033333333333333	0.01
	KWS	P-1	RMP	2015	0.0027361689635587	0.0085683642219352
	KWS	P-1	RMP	2015	0.0011051608762056	0.0034608319286123
	KWS	P-1	RMP	2015	0.0063866775330444	0.02
	KWS	P-1	RMP	2015	0.00059066785950856	0.0016666666666667
	KWS	P-1	RMP	2015	0.0027361689635587	0.0085683642219352
	KWS	P-1	RMP	2015	0.0011051608762056	0.0034608319286123

The Year 2015 Value sets can be changed but should not be removed. The Road Agency name should not be changed. The Year 2015 Value sets are necessary for each Road Agency specified in the “Others” table. Data Update is possible per Work Item. In this regard, Year 2016 or later have to be chosen as “Survey Year” and ICOSTES will automatically search the latest data for each work item.

If the other conditions are identical, do not allocate the same year because ICOSTES cannot recognize which one is the correct one.

5. Unit Rates Information (Database Table: Unit Price)

Unit rate information is currently a set of 11 core unit rates. Rates information has to be excluded in the case of the ICOSTES distribution to the contractor candidates. “Haulage” table also includes the information related to vehicle operation. Detail of the unit rate survey is presented in Clause 5 of the Manual. In addition, Clause 6.3 of the manual refers to SCU Survey.

The screenshot shows the I-COSTES web application interface. The main heading is "Unit Price". Below it are buttons for "Add Unit Price" and "Import List". A search bar is present. The table displays unit price data for various locations (Nairobi, Mombasa, Kisumu) and items (Labour, Machinery, Material). The table columns are: Action, Location, Code, Item, Name, Unit, Unit Price, Source, Source Type, and Year. The table shows 27 entries, with the first 12 visible in the screenshot.

Action	Location	Code	Item	Name	Unit	Unit Price	Source	Source Type	Year
	Nairobi, Mombasa, Kisumu	21.00.001	Labour	Supervisor	month	37079.25	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu	21.00.002	Labour	Foreman	month	30126	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu	21.00.003	Labour	Labour	day	527.1	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu	21.00.004	Labour	SCU Leader	month	37079.25	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu	21.00.005	Labour	SCU Inspector	month	30126	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu	21.00.006	Labour	Driver(Truck)	month	24719.5	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu	21.00.010	Machinery	Vehicle(2ton Truck)	number	191800	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu	21.00.011	Machinery	Vehicle(Pick up)	number	88200	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu	21.00.012	Material	Fuel(Diesel)	Lit	79.99	Oct2015	a	2015
	Nairobi, Mombasa, Kisumu				Lit	102.65	Oct2015	a	2015

Showing 1 to 27 of 27 entries

5.1. Contents of the table

Item	Value type/ value range/ condition	Description	Manual
Item	Selection from “Labour”, “Machinery”, or” Material”	Classification of each item (Category) Labour, Machinery, or Material	6.1
Location	Letter String	Tables should complete 11 sets of unit price data for each area. At present “Nairobi, Mombasa, Kisumu” and (All other area) are listed as sample.	6.1
Code	Letter String	Sample data. Allocate unique code number (not used for the current ICOSTES).	6.1
Name	Selection from specified list	DO NOT Change the name for 11 price set. “Labours”, “Supervisors” (Foreman), “Fuel”, “SCU Leader”, “SCU Inspector”, “Driver”, “Vehicle (Pick up)”, “Foreman”, “Fuel”, “Vehicle (2ton Truck)”	6.1
Type:	Selection from specified list	“Petrol” or “Diesel” for Fuel. “Operating Loss” for Vehicle. Blank for others	6.1
Unit	Automatic selection linked to the “Name”	Unit for each item. Current ICOSTES does not use it.	6.1
Unit Price	Numeric value / 0 to 1,000,000	Unit price If the ICOSTES file set is distributed to contractor candidates, unit price should be zero for all items in the database.	6.1

Item	Value type/ value range/ condition	Description	Manual
Source	Letter String	For reference purpose. Current ICOSTES does not use it.	6.1
Survey Year	Numeric value / 2010 to 2030	The year when the unit price was surveyed and collected. ICOSTES automatically selects the latest year's unit price if unit price was surveyed for several years.	6.1

5.2 Data Update

Unit price information is currently a set of 11 core unit prices. This set should be kept.

If a new set of unit prices is allocated for a new area, then all 11 costs should be surveyed as initial dataset. The addition of the new set can be added in two ways:

1. Click on the “Add SRUQ”. A pop-up window will appear as shown below:

2. Click on the “Import List”. A pop-up window as shown in the figure below. Click the “Choose File” option to select an excel file with the updated data. This way, multiple data can be added at once.

Yearly update is possible per item. However, two or more unit prices cannot be allocated for the same year as ICOSTES will search for the latest year's price.

In the case of Haulage expense for instructed works, there is no classification by Road Agency nor location. (This option is future discussion)

6. Other PBC Works

Variables for the estimation of Other PBC Works consist of the following items. Cost survey method is described in clause 6.5 of the manual.

I-COSTES Enter keyword 🔍  0  System Admin ▾

Other PBC Work Items Home / Other PBC Work Items / Index

[+ Add Other PBC Work Item](#)

Other PBC Work Items

Location Work Item Condition Category Service Scope Year

Show entries Previous 2 Next

Action	Work Item	Location	Year of Survey	Pavement Condition	Category	Service Scope
	Slopes in Cuts	Area1	2016	UnPaved	Road User Comfort	Structure
	Traffic Regulatory Control Signs	Area1	2015	Unpaved	Road Usability	A)Road Usability
	Rut Depth	Area1	2015	Unpaved	Road User Comfort	B) Pavement, Shoulders and ROW for f
	Corrugation Amplitude	Area1	2015	Unpaved	Road User Comfort	B) Pavement, Shoulders and ROW for f
	Cleanliness of the road	Area1	2015	Unpaved	Road User Comfort	B) Pavement, Shoulders and ROW for f
	Minimum Traffic Speed	Area1	2015	Unpaved	Road Usability	A)Road Usability

6.1. Contents of the table

Item	Value type/ value range/ condition	Description	Manual (for admin.)
ID	Letter String	Unique ID. ICOSTES does not need it	5.4
Area	Letter String	Area is necessary if the same work item has a different value	5.4
Paved/ Unpaved	Selection from “Paved” or “Unpaved”	Paved or Unpaved	5.4
Category	Selection from “Road Usability”, “Road User Comfort”, or “Road Durability”	Category is based on Table 4-19 in the manual	4/5.4
Service Scope	Selection from A) through to H)	Category is based on Table 4-19 in the manual vol.2	4/5.4
Work Item	Letter String	Category is based on Table 4-19 in the manual but expressed as “Service Criteria”	5.4
Survey Year	Numeric value / 2010 to 2030	The year when each item was collected. ICOSTES recognizes the latest year’s unit price if the same item has different value by surveyed year	5.4
Unit	Letter String	Unit will be determined	5.4
Unit Price	Numeric value / 0 to 1000000	Current ICOSTES does not use Unit Price (Future 5.4 Option) If the ICOSTES file set is distributed to contractor candidates, unit price should be zero for all items in the database.	

6.2 Data Update

If a new service criterion is added, it is possible to add them one by one. However, do not use the same service criteria in the identical year (ICOSTES cannot distinguish which item is the correct one).

7. Instructed Work Items (Table: Instructed Works List)

Instructed works list for ICOSTES2015 comes from the format of ICOSTES 0_1

The screenshot shows the 'I-COSTES' web application interface. At the top, there is a search bar with the placeholder 'Enter keyword' and a magnifying glass icon. To the right of the search bar are a notification bell icon with a red '0' and a user profile icon labeled 'System Admin'. Below the search bar, the main heading is 'Instructed Work Items'. There are two buttons: '+ Add Instructed Works Item' and 'Import List'. Below these buttons is a section titled 'Instructed Works List' which contains a table. The table has columns for 'Action', 'Location', 'Work Item', and 'Sub Item'. The 'Location' column has a dropdown menu. The 'Work Item' column has a dropdown menu. The 'Sub Item' column has a dropdown menu. The 'Year' column has a dropdown menu. Below the table, there is a 'Show' dropdown menu set to '50' entries. To the right of the table, there are pagination links: 'Previous', '1', '2', '3', '4', '5', '...', '12', and 'Next'.

Action	Location	Work Item	Sub Item
	Nairobi, Mombasa, Kisumu	04. Site Clearance and Topsoil Stripping	Mechanical mowing
	All other area	12. Natural Material Base and Subbase	Provide, place and compact quarry waste
	All other area	15. Bituminous Surface Treatment & Surface Dressing	Provide and roll 14/20 mm precoated chipping
	All other area	15. Bituminous Surface Treatment & Surface Dressing	Provide and roll 10/14 mm precoated chipping
	All other area	15. Bituminous Surface Treatment & Surface Dressing	Provide and roll 6/10 mm precoated chipping
	All other area	15. Bituminous Surface Treatment & Surface Dressing	Provide and roll 3/6 mm precoated chipping
	All other area	15. Bituminous Surface Treatment & Surface Dressing	Tack Coat (bitumen emulsion)
	All other area	15. Bituminous Surface Treatment & Surface Dressing	Tack Coat (grade bitumen cutback)

7.1. Contents of the table

Item	Value type/ value range/ condition	Description	Manual
ID	Letter String	Unique ID. ICOSTES does not need it	
Code	Letter String	ICOSTES does not use the code but may be necessary for the arrangement of items	
Unit Rate	Numeric value / 0 to 1,000,000	Rate for each item per specified unit If the ICOSTES file set is distributed to contractor candidates, unit rate should be zero for all items in the database.	
Unit	Letter String	Unit for each item	
Work Item	Letter String	Category for the item. Suffix as xx. Is preferred	
Sub Item	Letter String	Name and specification of the item	
Description	Letter String	Explanation of each item	
Area	Letter String	Area is necessary if the same work items have different values	
Survey Year	Numeric value / 2010 to 2030	The year when each item was collected. ICOSTES recognizes the latest year's unit price if the same item has different value by surveyed year	

7.2. Data Update

Addition of items is possible by either clicking on the “Add Instructed Works Item” or “Import List” for multiple additions at a time using excel file.

The screenshot shows the 'Add Instructed Works Item' dialog box in the I-COSTES system. The dialog is open over the 'Instructed Work Items' table. The table has columns for Action, Location, Work Item, Sub Item, and Unit Price. The 'Add Instructed Works Item' dialog box contains the following fields:

- Work Item: Text input field
- Sub Item: Text input field
- Location: Dropdown menu with '---Select Region---
- Survey Year: Text input field
- Unit: Text input field
- Unit Price: Text input field
- Description: Large text area
- Create: Blue button with a checkmark icon

or

The screenshot shows the 'Import List' dialog box in the I-COSTES system. The dialog is open over the 'Instructed Work Items' table. The 'Import List' dialog box contains the following fields:

- Select Excel File: Section header
- Choose File: Button with a file icon
- No file chosen: Text label
- Complete: Blue button

Removal of items is also possible, one by one by clicking on the delete icon  in the action column. However, completion of all fields is necessary.

Yearly update is possible for the same item (e.g. there are two items and the difference is surveyed yearly). However, two, or more, unit prices cannot be allocated within an identical year as ICOSTES searches the latest year's price by each item.

8. Machinery Based Items

The screenshot shows the 'Machinery Based Items' interface in the I-COSTES system. It includes a sidebar with navigation icons, a top header with 'I-COSTES' and a search bar, and a main content area titled 'Machinery Based Items'. Below the title is an 'Import List' button. The main area contains a 'Machinery Based Item List' table with columns: Action, Road Agency, Road Type, Region Name, Work Item, Work Difficulty Level, Use It, IW/PBC, and Unit. The table lists several items for road marking and grading.

Action	Road Agency	Road Type	Region Name	Work Item	Work Difficulty Level	Use It	IW/PBC	Unit
	KENHA	Paved	Nairobi, Mombasa, Kisumu	Road Marking	Road Marking for AC	1	PBC	m^2
	KWS	Unpaved	Nairobi, Mombasa, Kisumu	Grading and Graveling	Regraveling (Graveling and Compaction with graveling)	1	PBC	m^3
	KeRRA	Unpaved	(All other area)	Guardrail	Straightening of beams and realignment of posts	1	PBC	m
	KeRRA	Unpaved	(All other area)	Guardrail	Replacing of beams and realignment of posts	1	PBC	m
	KeRRA	Unpaved	(All other area)	Crack Sealing	Crack Sealing	0	PBC	m/1000r
	KWS	Unpaved	Nairobi, Mombasa, Kisumu	Road Marking	Road Marking for AC	0	PBC	m^2

Figure 1: Machinery Based Items list

User's inputs for each work items are as follows

User Input	Description
Use This Item	Include selected item to for the calculation (Check Box)
Simple or Actual	Simple Quantity Input (Unit quantity (generally per km) or Actual Quantity Input (selection and input)
Actual Quantity	numerical input (in case of Actual Quantity Input)
Road Classification	Selection based on the maintenance grade (if alternatives have prepared)
PBC Works Ratio	Default value is ready based on Road Classification, manual adjustment is possible
Decision Ratio	Default value is ready based on Road Classification, manual adjustment is possible

Basic editing flow is based on the above input...

- “Facility Quantity”, “Quantity”, “Price Ksh”, “Total Price” and monthly unit price or “Per Month” Are instantly and automatically calculated. Hence User can check how much the money is needed for the Machinery Based Items.

8.1. Basic Usage

Table is entire candidate work items from the database. Users select necessary items by **selecting subject row** as shown above and checking “Use_it” checkbox. Users cannot edit table directly.

8.1.1. Road Marking:

- Cost Survey Guideline by manual 2.4.3
- Simple Quantity is given
- Actual quantity: direct input is possible
- Road Classification: Grade (A or B) default value is given and adjustable

Unit Price Calculation

Work Item: Road Marking

Work Difficulty Level: Road Marking for AC

Use This Item: ☒

Road Classification: Urban Roads

Input Method: ☐ Simple Quantity

Simple Quantity/KM: 20

Contract Length: 100

Facility Quantity: 2000

PBC Works Ratio: 2

Decision Ratio: 1

Quantification: 4000

Unit: m²

Unit Price: 934

Sub Total/Price Ksh: 3736000

Apply

Figure 2: Road Marking

8.1.2. Grading and Graveling:

- Cost Survey Guideline 2.2.1
- Simple Quantity is given
- Actual quantity: direct input is possible
- Road Classification: 2.0 is a default value for PBCWorksRatio, 0.0 is given for Decision Ratio. Each Item is editable

Unit Price Calculation

Work Item: Grading and Graveling

Work Difficulty Level: Light Grading (Grading and Compaction)

Use This Item: ☐

Road Classification: Urban Roads

Input Method: ☐ Simple Quantity ☐ Actual Quantity

Simple Quantity/KM: 1050

Contract Length: 100

Facility Quantity: 105000

PBC Works Ratio: 2

Decision Ratio: 0

Quantification: 0

Unit: m³

Unit Price: 13

Sub Total/Price Ksh: 0

Apply

Figure 3: Grading and Graveling

8.1.3. Concrete Repair:

- Cost Survey Guideline 2.1
- Simple Quantity is given
- Actual quantity direct input is possible
- Road Classification: default value is 0.01 for PBCWorksRatio, 1.0 for Decision Ratio respectively.

Unit Price Calculation

Work Item: Concrete Repair

Work Difficulty Level: Culvert installation 600m

Use This Item: ☒

Road Classification: Urban Roads

Input Method: ☐ Simple Quantity ☐ Actual Quantity

Simple Quantity/KM: 22.3

Contract Length: 100

Facility Quantity: 2230

PBC Works Ratio: 0.01

Decision Ratio: 1

Quantification: 22.3

Unit: m

Unit Price: 10699

Sub Total/Price Ksh: 238587.7

Apply

Figure 4: Concrete Structure Repair

8.1.4. Pothole Patching

- Cost Survey Guideline 2.4.1
- Simple Quantity is given
- Actual quantity : direct input is possible
- Road Classification : automatically calculated based on road age. The result is presented in PBCRatio but adjustable. Contract terms have to be modified in the “Data Input” window.

Unit Price Calculation

Work Item: Pothole Repair

Work Difficulty Level: Cold Mix AC (Manufactured)

Use This Item: ☒

Road Classification: Urban Roads

Input Method: ☐ Simple Quantity ☐ Actual Quantity

Simple Quantity/KM: 38.246

Contract Length: 100

Facility Quantity: 3824.6

PBC Works Ratio: 0

Decision Ratio: 0.2

Quantification: 0

Unit: m³

Unit Price: 79960

Sub Total/Price Ksh: 0

Apply

Figure 5: Pothole Repair

8.1.5. Guardrail

- Cost Survey Guideline 2.3.1
- Simple Quantity is already given
- Actual quantity is editable by input
- Road Classification: Road Grade (S,A,B or C) gives us each default value but editable.

The screenshot shows the 'Unit Price Calculation' dialog box in the I-COSTES application. The 'Work Item' is 'Guardrail' and the 'Work Difficulty Level' is 'Straightening of beams'. The 'Road Classification' is set to 'Urban Roads'. The 'Input Method' is 'Simple Quantity'. The 'Simple Quantity/KM' is 161.4, 'Contract Length' is 100, and 'Facility Quantity' is 16140. The 'PBC Works Ratio' is 0.01, 'Decision Ratio' is 0.45, and 'Quantification' is 72.63. The 'Unit' is 'm', 'Unit Price' is 1362, and 'Sub Total/Price Ksh' is 98922.06. The 'Apply' button is visible at the bottom right of the dialog.

Figure 6: Guardrail Repair

8.1.6. Cracksealing:

- Cost Survey Guideline 2.4.2
- There is no Simple Quantity data. Users have to prepare Actual quantity if included in the calculation
- PBCRatio and Decision Ratio is zero therefore users have to prepare these coefficients.

The screenshot shows the 'Unit Price Calculation' dialog box in the I-COSTES application for 'Crack Sealing'. The 'Work Item' is 'Crack Sealing' and the 'Work Difficulty Level' is 'Crack Sealing'. The 'Road Classification' is set to 'Urban Roads'. The 'Input Method' is 'Actual Quantity'. The 'Simple Quantity/KM' is 0, 'Contract Length' is 100, and 'Facility Quantity' is 0. The 'PBC Works Ratio' is 0, 'Decision Ratio' is 1, and 'Quantification' is 0. The 'Unit' is 'm/1000m2/year', 'Unit Price' is 333, and 'Sub Total/Price Ksh' is 0. The 'Apply' button is visible at the bottom right of the dialog.

Figure 7: Crack Sealing

9. Program Configuration (Table: Configuration)

The Administrator can control how iCOSTES works by setting the following factors:

- 1: Allow PBC Optional works input (YES/NO)
This option allows/does not allow the input of independent PBC works other than six major labour based works.
- 2: Allow Instructed Works Input (YES/NO)
This option allows/does not allow the input of instructed works.
- 3: Allow to select input method of major labour based works one by one (YES/NO)
When this option is “YES”, user can select input method per work item. This is advantageous if the user does not know simple/actual quantity. The user can then select each quantity and others can be calculated by using standard quantity per km in the database. However, mixture of input methods might cause complexity in the estimation.
- 4: Cost estimation by Excel format
When this option is “YES”, ICOSTES generates not only PDF format cost estimation sheets but also excel format raw-data.

10. Data Distribution

10.1. For Road Agency Officials (Client)/ 8.2 For Contractor Candidates

The difference of database between two user categories is whether the database has “Price” information or not. Price information is included in “UnitPriceI”, “Other PBC Works”, and “Instructed Works” tables.

Road Agencies can use the pre-surveyed unit price as standard value. Then they can check the price before performing cost estimation and modify if possible. Contractor candidates have to register all price sets by their own survey or responsibility. No price data will be given.

COSTES program can automatically open the **jicadata** database because the password is included in the program and almost impossible to open the **jicadata** database unless one has the password. However, distribution version to the contractor candidates should not include any price data for security purposes. In this case, it is recommended that administrators should create two types of database: (1) one including price information: and, (2), another without price information. Please do not remove all the columns of price information because COSTES have to recognize all data fields regardless of the column value.

Appendix 2: Cost Estimation Parameters 2018

Appendix 2-1: Dataset

1. Selected 6 On-Carriageway Works under PBC

KeNHA (2 lanes)

Work Items Category	Check Box (Yes/ No)	Work Items	Unit	Contract Length (km)	Simple Qty /km		Unit Price		q2					PBC Works Total Cost		PBC Works COST/ km-month			
					Simple Qty/ km	Based by	Nairobi, Kisumu & Mombasa	Other Area	Check Box (Yes/ No)	Co-efficient factors	[B] PBC Works Ratio (%/ year)	Based by	[FQ] Facility Qty	[d2] decision Ratio	[d2] = [B]*[FQ] Quantification for PBC	Nairobi, Kisumu & Mombasa	Other Area	Nairobi, Kisumu & Mombasa	Other Area
Road Marking		Road Marking for Smooth Pavement		A	B		C1	C2			D		E=A*B	F	G=D*E*F	H1=C1*G	H2=C2*G		
	☒		m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q ≈ 20 m ² /km (better to survey before contract)	934	988	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	100%	800.0	747,200	790,400	3,113	3,293
	☐	Road Marking for Surface Dressed Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q≈70m ² /2km (better to survey before contract)	2,270	2,482	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	0%	0.0	0	0	0	0
Grading and Graveling	☐	Light Grading (Grading and compaction)	m ³	20	1050.0	No Data KeRRA	13	13	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	21,000	0%	0.0	0	0	0	0
	☐	Regraveling (Graveling and compaction with graveling)	m ³	20	1050.0	No Data KeRRA	1,393	1,393	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	21,000	0%	0.0	0	0	0	0
	☒	Culvert installation 6600m	m	20	22.3	survey data	10,699	9,419	-	-	1.00%	No Survey data the minimum amount shall be set	446	100%	4.5	47,718	42,009	199	175
Concrete Repair	☒	Headwall construction	pair	20	1.8	survey data	21,725	18,256	-	-	1.00%	No Survey data the minimum amount shall be set	36	100%	0.4	7,821	6,572	33	27
	☒	Cold Mix AC (Manufactured)	m ³	20	38.2	survey data	79,960	92,840	☐	Road age: 0-3 years	0.00%	Monitory Survey	765	0%	0.0	0	0	0	0
				20	38.2	survey data	79,960	92,840	☒	Road age: 4-6 years	1.00%	Monitory Survey	765	20%	1.5	122,326	142,030	510	592
Pothole Repair				20	38.2	survey data	44,800	48,500	☐	Road age: 7 and above	5.00%	Monitory Survey	765	0%	0.0	0	0	0	0
	☒	Cold Mix AC (made in site/place)	m ³	20	38.2	survey data	44,800	48,500	☐	Road age: 0-3 years	0.00%	Monitory Survey	765	0%	0.0	0	0	0	0
				20	38.2	survey data	44,800	48,500	☒	Road age: 4-6 years	1.00%	Monitory Survey	765	80%	6.1	274,147	296,789	1,142	1,237
	☐	Hot Mix AC	m ³	20	38.2	survey data	44,800	48,500	☐	Road age: 7 and above	5.00%	Monitory Survey	765	0%	0.0	0	0	0	0
				20	38.2	survey data	26,940	29,720	☐	Road age: 0-3 years	0.00%	Monitory Survey	765	0%	0.0	0	0	0	0
				20	38.2	survey data	26,940	29,720	☒	Road age: 4-6 years	1.00%	Monitory Survey	765	0%	0.0	0	0	0	0
	☒	Straightening of beams	m	20	161.4	survey data	1,362	1,349	☐	Road age: 7 and above	5.00%	Monitory Survey	3,228	0%	0.0	0	0	0	0
				20	161.4	survey data	1,362	1,349	☒	Road Classification: S	1.00%	Monitory Survey	3,228	0%	0.0	0	0	0	0
				20	161.4	survey data	1,362	1,349	☐	Road Classification: A	0.75%	Monitory Survey	3,228	45%	10.9	14,838	14,697	62	61
Guardrail	☒	Straightening of beams and realignment of posts	m	20	161.4	survey data	1,549	1,498	☐	Road Classification: B, C	0.50%	Monitory Survey	3,228	0%	0.0	0	0	0	0
				20	161.4	survey data	1,549	1,498	☒	Road Classification: S	1.00%	Monitory Survey	3,228	0%	0.0	0	0	0	0
				20	161.4	survey data	1,549	1,498	☒	Road Classification: A	0.75%	Monitory Survey	3,228	45%	10.9	16,876	16,320	70	68
	☒	Replacing of beams and realignment of posts	m	20	161.4	survey data	9,142	9,142	☐	Road Classification: B, C	0.50%	Monitory Survey	3,228	0%	0.0	0	0	0	0
				20	161.4	survey data	9,142	9,142	☐	Road Classification: S	1.00%	Monitory Survey	3,228	0%	0.0	0	0	0	0
				20	161.4	survey data	9,142	9,142	☒	Road Classification: A	0.75%	Monitory Survey	3,228	10%	2.4	22,133	22,133	92	92
Crack Sealing	☒	Crack Sealing	m	20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☐	Road Classification: B, C	0.50%	Monitory Survey	3,228	0%	0.0	0	0	0	0
				20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☒	Road age: 0-3 years	-	Assumed Qty 0 m ³ month	0	0%	0.0	0	0	0	0
				20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☒	Road age: 4-6 years	-	Assumed Qty 25 m ³ month×12month	300	100%	300.0	99,900	99,900	416	416
																1,352,959	1,430,850	5,637	5,962

KeNHA (2*2 lanes)

Work Items Category	Check Box (Yes/No)	Work Items (Work Difficulty Level)	Unit	Contract Length (km)	Simple Qty /km		Unit Price		q2					PBC Works Total Cost		PBC Works COST /km-month			
					simple Qty /km	Based by	Nairobi, Kisumu & Mombasa	Other Area	Check Box (Yes/No)	Co-efficient factors	[β] PBC Works Ratio (%/year)	Based by	[FQ] Facility Qty	[d2] decision Ratio	[q2] = [β][FQ] Quantification for PBC	Nairobi, Kisumu & Mombasa	Other Area	Nairobi, Kisumu & Mombasa	Other Area
Road Marking	☒	Road Marking for Smooth Pavement	m ²	20	40.0	Programmed Maintenance, Assumption ⇒ Q=20m ² 2/km (better to survey before contract)	934	988	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	800	100%	1,600.0	1,494,400	1,580,800	6,227	6,587
	☐	Road Marking for Surface Dressed Pavement	m ²	20	40.0	Programmed Maintenance, Assumption ⇒ Q=20m ² 2/km (better to survey before contract)	2,270	2,482	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	800	0%	0.0	0	0	0	0
Grading and Graveling	☐	Light Grading (Grading and Compaction)	m ³	20	1344.8	No Data: KeRRA*2	13	13	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	26,896	0%	0.0	0	0	0	0
	☐	Regraveling (Graveling and Compaction with graveling)	m ³	20	1344.8	No Data: KeRRA*2	1,393	1,393	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	26,896	0%	0.0	0	0	0	0
Concrete Structure	☒	Culvert installation 4600m	m	20	53.2	survey data	10,699	9,419	-	-	1.00%	No Survey data the minimum amount shall be set	1,064	100%	10.6	113,837	100,218	474	418
	☒	Headwall construction	pair	20	4.6	survey data	21,725	18,256	-	-	1.00%	No Survey data the minimum amount shall be set	92	100%	0.9	19,987	16,796	83	70
Pothole Repair	☒	Cold Mix AC (Manufactured)	m ³	20	76.5	No Data: KeHNA 2Lane*2	79,960	92,840	☐	Road age: 0-3 years	0.00%	Monitory Survey	1,530	0%	0.0	0	0	0	0
	☐			20	76.5	No Data: KeHNA 2Lane*2	79,960	92,840	☒	Road age: 4-6 years	1.00%	Monitory Survey	1,530	20%	3.1	244,652	284,061	1,019	1,184
	☐			20	76.5	No Data: KeHNA 2Lane*2	79,960	92,840	☐	Road age: 7 and above	5.00%	Monitory Survey	1,530	0%	0.0	0	0	0	0
	☒	Cold Mix AC (made in site/place)	m ³	20	76.5	No Data: KeHNA 2Lane*2	44,800	48,500	☐	Road age: 0-3 years	0.00%	Monitory Survey	1,530	0%	0.0	0	0	0	0
	☐			20	76.5	No Data: KeHNA 2Lane*2	44,800	48,500	☒	Road age: 4-6 years	1.00%	Monitory Survey	1,530	80%	12.2	548,295	593,578	2,285	2,473
	☐			20	76.5	No Data: KeHNA 2Lane*2	44,800	48,500	☐	Road age: 7 and above	5.00%	Monitory Survey	1,530	0%	0.0	0	0	0	0
	☐	Hot Mix AC	m ³	20	76.5	No Data: KeHNA 2Lane*2	26,940	29,720	☐	Road age: 0-3 years	0.00%	Monitory Survey	1,530	0%	0.0	0	0	0	0
	☒	Straightening of beams	m	20	266.1	survey data	1,362	1,349	☐	Road age: 7 and above	5.00%	Monitory Survey	1,530	0%	0.0	0	0	0	0
Guardrail	☐			20	266.1	survey data	1,362	1,349	☒	Road Classification: A	0.75%	Monitory Survey	5,322	45%	18.0	24,464	24,230	102	101
	☐			20	266.1	survey data	1,362	1,349	☐	Road Classification: B, C	0.50%	Monitory Survey	5,322	0%	0.0	0	0	0	0
	☒	Straightening of beams and realignment of posts	m	20	266.1	survey data	1,549	1,498	☐	Road Classification: S	1.00%	Monitory Survey	5,322	0%	0.0	0	0	0	0
	☐			20	266.1	survey data	1,549	1,498	☒	Road Classification: A	0.75%	Monitory Survey	5,322	45%	18.0	27,823	26,907	116	112
	☐			20	266.1	survey data	1,549	1,498	☐	Road Classification: B, C	0.50%	Monitory Survey	5,322	0%	0.0	0	0	0	0
	☒	Replacing of beams and realignment of posts	m	20	266.1	survey data	9,142	9,142	☐	Road Classification: S	1.00%	Monitory Survey	5,322	0%	0.0	0	0	0	0
	☐			20	266.1	survey data	9,142	9,142	☒	Road Classification: A	0.75%	Monitory Survey	5,322	10%	4.0	36,490	36,490	152	152
	☐			20	266.1	survey data	9,142	9,142	☐	Road Classification: B, C	0.50%	Monitory Survey	5,322	0%	0.0	0	0	0	0
Crack Sealing	☒	Crack Sealing	m	20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☐	Road age: 0-3 years	-	Assumed Qty: 0 m/ month	0	0%	0.0	0	0	0	0
	☐			20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☒	Road age: 4-6 years	-	Assumed Qty: 25 m/ month× 12month	300	100%	300.0	99,900	99,900	416	416
	☐			20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☐	Road age: 7 and above	-	Assumed Qty: 100 m/ month× 12month	1,200	0%	0.0	0	0	0	0
															2,609,848		2,762,980	10,874	11,512

KURA

Simple Qty /km			Unit Price		q2										PBC Works Total Cost		PBC Works COST /km-month			
Work Items Category	Check Box (Yes/ No)	Work Items (Work Difficulty Level)	Unit	Contract Length (km)	Simple Qty /km	Based by	Nairobi, Kisumu & Mombasa	Other Area	Check Box (Yes/ No)	Co-efficient factors	[β] PBC Works Ratio (%/year)	Based by	[FQ] Facility Qty	[d2] decision Ratio	[q2] = [β][EQ][d2] Quantification for PBC	Nairobi, Kisumu & Mombasa	Other Area	Other Mombasa		
Road Marking	☒	Road Marking for Smooth Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q=20m × 2/km (better to survey before contract)	934	988	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	100%	800.0	747,200	790,400	3,113	3,293	
	☐	Road Marking for Surface Dressed Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q=20m × 2/km (better to survey before contract)		2,270	2,482	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	0%	0.0	0	0	0	0
Grading and Graveling	☐	Light Grading (Grading and Compaction)	m ³	20	672.4	No Data: KeRRA		13	13	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	13,448	0%	0.0	0	0	0	0
	☐	Regraveling (Graveling and Compaction with graveling)	m ³	20	672.4	No Data: KeRRA		1,393	1,393	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	13,448	0%	0.0	0	0	0	0
Concrete Structure	☒	Culvert installation φ600m	m	20	25.9	survey data		10,699	9,419	-	-	1.00%	No Survey data. The minimum amount shall be set	518	100%	5.2	55,421	48,790	231	203
	☒	Headwall construction	pair	20	3.3	survey data		21,725	18,256	-	-	1.00%	No Survey data. The minimum amount shall be set	66	100%	0.7	14,339	12,049	60	50
Pothole Repair	☒	Cold Mix AC (Manufactured)	m ³	20	38.2	No Data: KeHNA 2Lane		79,960	92,840	☐	Road age: 0-3 years	0.00%	Monitory Survey	765	0%	0.0	0	0	0	0
	☐			20	38.2	No Data: KeHNA 2Lane		79,960	92,840	☒	Road age: 4-6 years	1.00%	Monitory Survey	765	20%	1.5	122,326	142,030	510	592
	☐			20	38.2	No Data: KeHNA 2Lane		79,960	92,840	☐	Road age: 7 and above	5.00%	Monitory Survey	765	0%	0.0	0	0	0	0
	☒	Cold Mix AC (made in site/place)	m ³	20	38.2	No Data: KeHNA 2Lane		44,800	48,500	☐	Road age: 0-3 years	0.00%	Monitory Survey	765	0%	0.0	0	0	0	0
	☐			20	38.2	No Data: KeHNA 2Lane		44,800	48,500	☒	Road age: 4-6 years	1.00%	Monitory Survey	765	80%	6.1	274,147	296,789	1,142	1,237
	☐			20	38.2	No Data: KeHNA 2Lane		44,800	48,500	☐	Road age: 7 and above	5.00%	Monitory Survey	765	0%	0.0	0	0	0	0
	☐	Hot Mix AC	m ³	20	38.2	No Data: KeHNA 2Lane		26,940	29,720	☐	Road age: 0-3 years	0.00%	Monitory Survey	765	0%	0.0	0	0	0	0
	☐			20	38.2	No Data: KeHNA 2Lane		26,940	29,720	☒	Road age: 4-6 years	1.00%	Monitory Survey	765	0%	0.0	0	0	0	0
Guardrail	☒	Straightening of beams	m	20	149.8	survey data		1,362	1,349	☐	Road age: 7 and above	5.00%	Monitory Survey	2,996	0%	0.0	0	0	0	0
	☐			20	149.8	survey data		1,362	1,349	☒	Road Classification: S	1.00%	Monitory Survey	2,996	45%	10.1	13,772	13,640	57	57
	☐			20	149.8	survey data		1,362	1,349	☐	Road Classification: B, C	0.50%	Monitory Survey	2,996	0%	0.0	0	0	0	0
	☒	Straightening of beams and realignment of posts	m	20	149.8	survey data		1,549	1,498	☐	Road Classification: S	1.00%	Monitory Survey	2,996	0%	0.0	0	0	0	0
	☐			20	149.8	survey data		1,549	1,498	☒	Road Classification: A	0.75%	Monitory Survey	2,996	45%	10.1	15,663	15,147	65	63
	☐			20	149.8	survey data		1,549	1,498	☐	Road Classification: B, C	0.50%	Monitory Survey	2,996	0%	0.0	0	0	0	0
	☒	Replacing of beams and realignment of posts	m	20	149.8	survey data		9,142	9,142	☐	Road Classification: S	1.00%	Monitory Survey	2,996	0%	0.0	0	0	0	0
	☐			20	149.8	survey data		9,142	9,142	☒	Road Classification: A	0.75%	Monitory Survey	2,996	10%	2.2	20,542	20,542	86	86
	☐			20	149.8	survey data		9,142	9,142	☐	Road Classification: B, C	0.50%	Monitory Survey	2,996	0%	0.0	0	0	0	0
	☒	Crack Sealing	m	20	-	=Contract Length(m) Unit Price = Japanese SRUQ		333	333	☐	Road age: 0-3 years	-	Assumed Qty 0 m ³ month	0	0%	0.0	0	0	0	0
Crack Sealing	☐			20	-	=Contract Length(m) Unit Price = Japanese SRUQ		333	333	☒	Road age: 4-6 years	-	Assumed Qty 25 m ³ month× 12month	300	100%	300.0	99,900	99,900	416	416
	☐			20	-	=Contract Length(m) Unit Price = Japanese SRUQ		333	333	☐	Road age: 7 and above	-	Assumed Qty 100 m ³ month× 12month	1,200	0%	0.0	0	0	0	0
																1,363,309	1,439,288	5,680	5,997	

KeRRA (Paved)

Simple Qty /km			Unit Price		q2					PBC Works Total Cost		PBC Works COST /km-month					
Work Items Category	Check Box (Yes/No)	Work Items (Work Difficulty Level)	Unit	Contract Length (km)	simple Qty / km	Based by	Nairobi, Kisumu & Mombasa	Other Area	Check Box (Yes/No)	Co-efficient factors	(B) PBC Works Ratio (%/year)	Based by	[FQ] Facility Qty	[d2] decision Quantification Ratio	[d2] = [B]*[EQ]*[d2] Quantification for PBC	Nairobi, Kisumu & Mombasa	Other Area
Road Marking	☐	Road Marking for Smooth Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q=20m ² /km (better to survey before contract)	934	988	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	0%	0.0	0	0
	☒	Road Marking for Surface Dressed Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q=20m ² /km (better to survey before contract)	2,270	2,482	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	100%	800.0	1,816,000	1,985,600
Grading and Graveling	☐	Light Grading (Grading and Compaction)	m ³	20	672.4	No Data: KeRRA	13	13	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	13,448	0%	0.0	0	0
	☐	Regraveling (Graveling and Compaction with graveling)	m ³	20	672.4	No Data: KeRRA	1,393	1,393	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	13,448	0%	0.0	0	0
Concrete Structure	☒	Culvert installation φ600m	m	20	23.1	survey data	10,699	9,419	-	-	1.00%	No Survey data. The minimum amount shall be set	462	100%	4.6	49,429	43,516
	☒	Headwall construction	pair	20	5.4	survey data	21,725	18,256	-	-	1.00%	No Survey data. The minimum amount shall be set	108	100%	1.1	23,463	19,716
Pothole Repair	☒	Cold Mix AC (Manufactured)	m ³	20	36.4	survey data	79,960	92,840	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0
				20	36.4	survey data	79,960	92,840	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	20%	1.5	116,422	135,175
				20	36.4	survey data	79,960	92,840	☐	Road age: 7 and above	5.00%	Monitory Survey	728	0%	0.0	0	0
	☒	Cold Mix AC (made in site/place)	m ³	20	36.4	survey data	44,800	48,500	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0
				20	36.4	survey data	44,800	48,500	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	80%	5.8	260,915	282,464
				20	36.4	survey data	44,800	48,500	☐	Road age: 7 and above	5.00%	Monitory Survey	728	0%	0.0	0	0
	☐	Hot Mix AC	m ³	20	36.4	survey data	26,940	29,720	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0
				20	36.4	survey data	26,940	29,720	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	0%	0.0	0	0
Guardrail	☒	Straightening of beams	m	20	31.2	survey data	1,362	1,349	☐	Road age: 7 and above	5.00%	Monitory Survey	624	0%	0.0	0	0
				20	31.2	survey data	1,362	1,349	☒	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0
				20	31.2	survey data	1,362	1,349	☐	Road Classification: A	0.75%	Monitory Survey	624	45%	2.1	2,868	2,841
	☒	Straightening of beams and realignment of posts	m	20	31.2	survey data	1,362	1,349	☐	Road Classification: B, C	0.50%	Monitory Survey	624	0%	0.0	0	0
				20	31.2	survey data	1,549	1,498	☐	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0
				20	31.2	survey data	1,549	1,498	☒	Road Classification: A	0.75%	Monitory Survey	624	45%	2.1	3,262	3,155
				20	31.2	survey data	1,549	1,498	☐	Road Classification: B, C	0.50%	Monitory Survey	624	0%	0.0	0	0
	☒	Replacing of beams and realignment of posts	m	20	31.2	survey data	9,142	9,142	☐	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0
Crack Sealing				20	31.2	survey data	9,142	9,142	☒	Road Classification: A	0.75%	Monitory Survey	624	10%	0.5	4,278	4,278
	☒	Crack Sealing	m	20	31.2	survey data	9,142	9,142	☐	Road Classification: B, C	0.50%	Monitory Survey	624	0%	0.0	0	0
				20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☐	Road age: 0-3 years	-	Assumed Qty: 0 m/ month	0	0%	0.0	0	0
				20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☒	Road age: 4-6 years	-	Assumed Qty: 25 m/ month×12month	300	100%	300.0	99,900	99,900
			20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☐	Road age: 7 and above	-	Assumed Qty: 100 m/ month×12month	1,200	0%	0.0	0	0	
															2,376,538	2,576,646	9,902
																	10,736

KeRRA (Unpaved)

Simple Qty /km			Unit Price		q2										PBC Works Total Cost		PBC Works COST /km-month	
Work Items Category	Check Box (Yes/No)	Work Items (Work Difficulty Level)	Unit	Contract Length (km)	simple Qty /km	Based by	Nairobi, Kisumu & Mombasa	Other Area	Check Box (Yes/No)	Co-efficient factors	[B] PBC Works Ratio (%) /year	Based by	[FQ] Facility Qty	[d2] decision Ratio	[d2] = [B]*[FQ]*[d2] Quantification for PBC	Nairobi, Kisumu & Mombasa	Other Area	
Road Marking	☐	Road Marking for Smooth Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q=20m ^ 2/km (better to survey before contract)	934	988	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	0%	0.0	0	0	0
	☐	Road Marking for Surface Dressed Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q=20m ^ 2/km (better to survey before contract)	2,270	2,482	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	0%	0.0	0	0	0
Grading and Graveling	☒	Light Grading (Grading and Compaction)	m ³	20	672.4	survey data	13	13	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	13,448	50%	13,448.0	174,824	174,824	728
	☒	Regraveling (Graveling and Compaction with graveling)	m ³	20	672.4	survey data	1,393	1,393	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	13,448	50%	13,448.0	18,733,064	18,733,064	78,054
Concrete Structure	☒	Culvert installation φ600m	m	20	4.0	survey data	10,699	9,419	-	-	1.00%	No Survey data the minimum amount shall be set	80	100%	0.8	8,559	7,535	36
	☒	Headwall construction	pair	20	0.7	survey data	21,725	18,256	-	-	1.00%	No Survey data the minimum amount shall be set	14	100%	0.1	3,042	2,556	13
Pothole Repair	☐	Cold Mix AC (Manufactured)	m ³	20	36.4	No Data: KeRRA paved	79,960	92,840	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0	0
				20	36.4	No Data: KeRRA paved	79,960	92,840	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	0%	0.0	0	0	0
				20	36.4	No Data: KeRRA paved	79,960	92,840	☐	Road age: 7 and above	5.00%	Monitory Survey	728	0%	0.0	0	0	0
	☐	Cold Mix AC (made in site/place)	m ³	20	36.4	No Data: KeRRA paved	44,800	48,500	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0	0
				20	36.4	No Data: KeRRA paved	44,800	48,500	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	0%	0.0	0	0	0
				20	36.4	No Data: KeRRA paved	44,800	48,500	☐	Road age: 7 and above	5.00%	Monitory Survey	728	0%	0.0	0	0	0
	☐	Hot Mix AC	m ³	20	36.4	No Data: KeRRA paved	26,940	29,720	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0	0
				20	36.4	No Data: KeRRA paved	26,940	29,720	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	0%	0.0	0	0	0
Guardrail	☒	Straightening of beams	m	20	31.2	No Data: KeRRA paved	1,362	1,349	☐	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0	0
				20	31.2	No Data: KeRRA paved	1,362	1,349	☒	Road Classification: A	0.75%	Monitory Survey	624	45%	2.1	2,868	2,841	12
				20	31.2	No Data: KeRRA paved	1,362	1,349	☐	Road Classification: B.C	0.50%	Monitory Survey	624	0%	0.0	0	0	0
	☒	Straightening of beams and realignment of posts	m	20	31.2	No Data: KeRRA paved	1,549	1,498	☐	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0	0
				20	31.2	No Data: KeRRA paved	1,549	1,498	☒	Road Classification: A	0.75%	Monitory Survey	624	45%	2.1	3,262	3,155	14
				20	31.2	No Data: KeRRA paved	1,549	1,498	☐	Road Classification: B.C	0.50%	Monitory Survey	624	0%	0.0	0	0	0
	☒	Replacing of beams and realignment of posts	m	20	31.2	No Data: KeRRA paved	9,142	9,142	☐	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0	0
				20	31.2	No Data: KeRRA paved	9,142	9,142	☒	Road Classification: A	0.75%	Monitory Survey	624	10%	0.5	4,278	4,278	18
Crack Sealing	☐	Crack Sealing	m	20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☐	Road age: 0-3 years	-	Assumed Qty: 0 m/ month	0	0%	0.0	0	0	0
				20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☒	Road age: 4-6 years	-	Assumed Qty: 25 m/ month× 12month	300	0%	0.0	0	0	0
				20	-	=Contract Length(m) Unit Price= Japanese SRUQ	333	333	☐	Road age: 7 and above	-	Assumed Qty: 100 m/ month× 12month	1,200	0%	0.0	0	0	0
															18,929,898	18,928,233	78,875	78,868

Simple Qty /km			Unit Price		q2							PBC Works Total Cost		PBC Works COST /km-month						
Work Items Category	Check Box (Yes/No)	Work Items (Work Difficulty Level)	Unit	Contract Length (km)	simple Qty/ km	Based by	Nairobi, Kisumu & Mombasa	Other Area	Check Box (Yes/No)	Co-efficient factors	(B) PBC Works Ratio (%) /year	Based by	(FQ) Facility Qty	(d2) declassification Ratio	[q2] = [B]*[EQ]*[d2] Quantification for PBC	Nairobi, Kisumu & Mombasa	Other Area	Nairobi, Kisumu & Mombasa	Other Area	
Road Marking	☐	Road Marking for Smooth Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q=20m ^ 2/km (better to survey before contract)	934	988	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	0%	0.0	0	0	0	0	
	☐	Road Marking for Surface Dressed Pavement	m ²	20	20.0	Programmed Maintenance, Assumption ⇒ Q=20m ^ 2/km (better to survey before contract)	2,270	2,482	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	400	0%	0.0	0	0	0	0	
Grading and Graveling	☒	Light Grading (Grading and Compaction)	m ³	20	1050.0	survey data	13	13	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	21,000	50%	21,000.0	273,000	273,000	1,138	1,138	
	☒	Regraveling (Graveling and Compaction with graveling)	m ³	20	1050.0	survey data	1,393	1,393	-	-	200.00%	Programmed Maintenance 2 times / Year (Every 6 months)	21,000	50%	21,000.0	29,253,000	29,253,000	121,888	121,888	
Concrete Structure	☒	Culvert installation Ø600m	m	20	7.0	survey data	10,699	9,419	-	-	1.00%	No Survey data the minimum amount shall be set	140	100%	1.4	14,979	13,187	62	55	
	☒	Headwall construction	pair	20	1.7	survey data	21,725	18,256	-	-	1.00%	No Survey data the minimum amount shall be set	34	100%	0.3	7,387	6,207	31	26	
Pothole Repair	☐	Cold Mix AC (Manufactured)	m ³	20	36.4	No Data: KeRRA paved	79,960	92,840	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0	0	0	
				20	36.4	No Data: KeRRA paved	79,960	92,840	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	0%	0.0	0	0	0	0	
				20	36.4	No Data: KeRRA paved	79,960	92,840	☐	Road age: 7 and above	5.00%	Monitory Survey	728	0%	0.0	0	0	0	0	
	☐	Cold Mix AC (made in site/place)	m ³	20	36.4	No Data: KeRRA paved	44,800	48,500	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0	0	0	0
				20	36.4	No Data: KeRRA paved	44,800	48,500	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	0%	0.0	0	0	0	0	0
				20	36.4	No Data: KeRRA paved	44,800	48,500	☐	Road age: 7 and above	5.00%	Monitory Survey	728	0%	0.0	0	0	0	0	0
Guardrail	☐	Hot Mix AC	m ²	20	36.4	No Data: KeRRA paved	26,940	29,720	☐	Road age: 0-3 years	0.00%	Monitory Survey	728	0%	0.0	0	0	0	0	0
				20	36.4	No Data: KeRRA paved	26,940	29,720	☒	Road age: 4-6 years	1.00%	Monitory Survey	728	0%	0.0	0	0	0	0	0
				20	36.4	No Data: KeRRA paved	26,940	29,720	☐	Road age: 7 and above	5.00%	Monitory Survey	728	0%	0.0	0	0	0	0	0
	☐	Straightening of beams	m	20	31.2	No Data: KeRRA paved	1,362	1,349	☐	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0	0	0	0
				20	31.2	No Data: KeRRA paved	1,362	1,349	☒	Road Classification: A	0.75%	Monitory Survey	624	0%	0.0	0	0	0	0	0
				20	31.2	No Data: KeRRA paved	1,362	1,349	☐	Road Classification: B, C	0.50%	Monitory Survey	624	0%	0.0	0	0	0	0	0
Crack Sealing	☐	Straightening of beams and realignment of posts	m	20	31.2	No Data: KeRRA paved	1,549	1,498	☐	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0	0	0	0
				20	31.2	No Data: KeRRA paved	1,549	1,498	☒	Road Classification: A	0.75%	Monitory Survey	624	0%	0.0	0	0	0	0	0
				20	31.2	No Data: KeRRA paved	1,549	1,498	☐	Road Classification: B, C	0.50%	Monitory Survey	624	0%	0.0	0	0	0	0	0
	☐	Replacing of beams and realignment of posts	m	20	31.2	No Data: KeRRA paved	9,142	9,142	☐	Road Classification: S	1.00%	Monitory Survey	624	0%	0.0	0	0	0	0	0
				20	31.2	No Data: KeRRA paved	9,142	9,142	☒	Road Classification: A	0.75%	Monitory Survey	624	0%	0.0	0	0	0	0	0
				20	31.2	No Data: KeRRA paved	9,142	9,142	☐	Road Classification: B, C	0.50%	Monitory Survey	624	0%	0.0	0	0	0	0	0
Crack Sealing	☐	Crack Sealing	m	20	-	=Contract Length(m) Unit Price = Japanese SRUQ	333	333	☐	Road age: 0-3 years	-	Assumed Qty: 0 m/ month	0	0%	0.0	0	0	0	0	0
				20	-	=Contract Length(m) Unit Price = Japanese SRUQ	333	333	☒	Road age: 4-6 years	-	Assumed Qty: 25 m/ month× 12month	300	0%	0.0	0	0	0	0	0
				20	-	=Contract Length(m) Unit Price = Japanese SRUQ	333	333	☐	Road age: 7 and above	-	Assumed Qty: 100 m/ month× 12month	1,200	0%	0.0	0	0	0	0	0
															29,548,365	29,545,394	123,118	123,106		

2. 6 Major Labour Based Works

Road Authority	Project	Work Item	IMP /Routine	Dry /Wet	WDL	Year	Quantity /1km	SRUQ (Simple)	SRUQ2 (Actual)
KeNHA (2+Lanes)	P-I	GC	IMP	Dry	Heavy	2017	12110	0.0009	0.0028
KeNHA (2+Lanes)	P-I	GC	RMP	Wet	Normal	2017	12110	0.0007	0.0022
KeNHA (2+Lanes)	P-I	GC	RMP	Dry	Light	2017	12110	0.0004	0.0011
KeNHA (2+Lanes)	P-I	CC	IMP	Dry	Heavy	2017	200	0.3628	0.5624
KeNHA (2+Lanes)	P-I	CC	RMP	Wet	Normal	2017	200	0.0116	0.0180
KeNHA (2+Lanes)	P-I	CC	RMP	Dry	Light	2017	200	0.0065	0.0100
KeNHA (2+Lanes)	P-I	CB	RMP	Dry	Heavy	2017	20	0.2634	0.7902
KeNHA (2+Lanes)	P-I	CB	RMP	Wet	Normal	2017	20	0.0667	0.2000
KeNHA (2+Lanes)	P-I	CB	RMP	Dry	Light	2017	20	0.0144	0.0432
KeNHA (2+Lanes)	P-I	LD	IMP	Dry	Heavy	2017	400	0.0141	0.0283
KeNHA (2+Lanes)	P-I	LD	RMP	Wet	Normal	2017	400	0.0080	0.0160
KeNHA (2+Lanes)	P-I	LD	RMP	Dry	Light	2017	400	0.0010	0.0020
KeNHA (2+Lanes)	P-I	UD	IMP	Dry	Heavy	2017	2800	0.0245	0.0691
KeNHA (2+Lanes)	P-I	UD	RMP	Wet	Normal	2017	2800	0.0131	0.0370
KeNHA (2+Lanes)	P-I	UD	RMP	Dry	Light	2017	2800	0.0092	0.0260
KeNHA (2+Lanes)	P-I	CW	IMP	Dry	Heavy	2017	4000	0.0165	0.0515
KeNHA (2+Lanes)	P-I	CW	RMP	Wet	Normal	2017	4000	0.0007	0.0022
KeNHA (2+Lanes)	P-I	CW	RMP	Dry	Light	2017	4000	0.0006	0.0018
KURA	P-I	GC	IMP	Dry	Heavy	2017	6819	0.0009	0.0028
KURA	P-I	GC	RMP	Wet	Normal	2017	6819	0.0007	0.0022
KURA	P-I	GC	RMP	Dry	Light	2017	6819	0.0004	0.0011
KURA	P-I	CC	IMP	Dry	Heavy	2017	100	0.3628	0.5624
KURA	P-I	CC	RMP	Wet	Normal	2017	100	0.0116	0.0180
KURA	P-I	CC	RMP	Dry	Light	2017	100	0.0065	0.0100
KURA	P-I	CB	IMP	Dry	Heavy	2017	50	0.2634	0.7902
KURA	P-I	CB	RMP	Wet	Normal	2017	50	0.0667	0.2000
KURA	P-I	CB	RMP	Dry	Light	2017	50	0.0144	0.0432
KURA	P-I	LD	IMP	Dry	Heavy	2017	1400	0.0141	0.0283
KURA	P-I	LD	RMP	Wet	Normal	2017	1400	0.0080	0.0160
KURA	P-I	LD	RMP	Dry	Light	2017	1400	0.0010	0.0020
KURA	P-I	UD	IMP	Dry	Heavy	2017	200	0.0245	0.0691
KURA	P-I	UD	RMP	Wet	Normal	2017	200	0.0131	0.0370
KURA	P-I	UD	RMP	Dry	Light	2017	200	0.0092	0.0260
KURA	P-I	CW	IMP	Dry	Heavy	2017	2000	0.0165	0.0515
KURA	P-I	CW	RMP	Wet	Normal	2017	2000	0.0007	0.0022
KURA	P-I	CW	RMP	Dry	Light	2017	2000	0.0006	0.0018
KeRRA (Unpaved)	P-I	GC	IMP	Dry	Heavy	2017	2310	0.0009	0.0028
KeRRA (Unpaved)	P-I	GC	RMP	Wet	Normal	2017	2310	0.0007	0.0022
KeRRA (Unpaved)	P-I	GC	RMP	Dry	Light	2017	2310	0.0004	0.0011
KeRRA (Unpaved)	P-I	CC	IMP	Dry	Heavy	2017	10	0.3628	0.5624
KeRRA (Unpaved)	P-I	CC	RMP	Wet	Normal	2017	10	0.0116	0.0180
KeRRA (Unpaved)	P-I	CC	RMP	Dry	Light	2017	10	0.0065	0.0100
KeRRA (Unpaved)	P-I	CB	IMP	Dry	Heavy	2017	10	0.2634	0.7902
KeRRA (Unpaved)	P-I	CB	RMP	Wet	Normal	2017	10	0.0667	0.2000
KeRRA (Unpaved)	P-I	CB	RMP	Dry	Light	2017	10	0.0144	0.0432
KeRRA (Unpaved)	P-I	UD	IMP	Dry	Heavy	2017	1800	0.0245	0.0691
KeRRA (Unpaved)	P-I	UD	RMP	Wet	Normal	2017	1800	0.0131	0.0370

Road Authority	Project	Work Item	IMP /Routine	Dry /Wet	WDL	Year	Quantity /1km	SRUQ (Simple)	SRUQ2 (Actual)
KeRRA (Unpaved)	P-I	UD	RMP	Dry	Light	2017	1800	0.0092	0.0260
KWS	P-I	GC	IMP	Dry	Heavy	2017	2310	0.0009	0.0028
KWS	P-I	GC	RMP	Wet	Normal	2017	2310	0.0007	0.0022
KWS	P-I	GC	RMP	Dry	Light	2017	2310	0.0004	0.0011
KWS	P-I	CC	IMP	Dry	Heavy	2017	10	0.3628	0.5624
KWS	P-I	CC	RMP	Wet	Normal	2017	10	0.0116	0.0180
KWS	P-I	CC	RMP	Dry	Light	2017	10	0.0065	0.0100
KWS	P-I	CB	IMP	Dry	Heavy	2017	10	0.2634	0.7902
KWS	P-I	CB	RMP	Wet	Normal	2017	10	0.0667	0.2000
KWS	P-I	CB	RMP	Dry	Light	2017	10	0.0144	0.0432
KWS	P-I	UD	IMP	Dry	Heavy	2017	1800	0.0245	0.0691
KWS	P-I	UD	RMP	Wet	Normal	2017	1800	0.0131	0.0370
KWS	P-I	UD	RMP	Dry	Light	2017	1800	0.0092	0.0260
KeNHA	P-I	GC	IMP	Dry	Heavy	2017	6055	0.0009	0.0028
KeNHA	P-I	GC	RMP	Wet	Normal	2017	6055	0.0007	0.0022
KeNHA	P-I	GC	RMP	Dry	Light	2017	6055	0.0004	0.0011
KeNHA	P-I	CC	IMP	Dry	Heavy	2017	100	0.3628	0.5624
KeNHA	P-I	CC	RMP	Wet	Normal	2017	100	0.0116	0.0180
KeNHA	P-I	CC	RMP	Dry	Light	2017	100	0.0065	0.0100
KeNHA	P-I	CB	IMP	Dry	Heavy	2017	10	0.2634	0.7902
KeNHA	P-I	CB	RMP	Wet	Normal	2017	10	0.0667	0.2000
KeNHA	P-I	CB	RMP	Dry	Light	2017	10	0.0144	0.0432
KeNHA	P-I	LD	IMP	Dry	Heavy	2017	200	0.0141	0.0283
KeNHA	P-I	LD	RMP	Wet	Normal	2017	200	0.0080	0.0160
KeNHA	P-I	LD	RMP	Dry	Light	2017	200	0.0010	0.0020
KeNHA	P-I	UD	IMP	Dry	Heavy	2017	1400	0.0245	0.0691
KeNHA	P-I	UD	RMP	Wet	Normal	2017	1400	0.0131	0.0370
KeNHA	P-I	UD	RMP	Dry	Light	2017	1400	0.0092	0.0260
KeNHA	P-I	CW	IMP	Dry	Heavy	2017	2000	0.0165	0.0515
KeNHA	P-I	CW	RMP	Wet	Normal	2017	2000	0.0007	0.0022
KeNHA	P-I	CW	RMP	Dry	Light	2017	2000	0.0006	0.0018
KeRRA (Paved)	P-I	GC	IMP	Dry	Heavy	2017	2310	0.0009	0.0028
KeRRA (Paved)	P-I	GC	RMP	Wet	Normal	2017	2310	0.0007	0.0022
KeRRA (Paved)	P-I	GC	RMP	Dry	Light	2017	2310	0.0004	0.0011
KeRRA (Paved)	P-I	CC	IMP	Dry	Heavy	2017	10	0.3628	0.5624
KeRRA (Paved)	P-I	CC	RMP	Wet	Normal	2017	10	0.0116	0.0180
KeRRA (Paved)	P-I	CC	RMP	Dry	Light	2017	10	0.0065	0.0100
KeRRA (Paved)	P-I	CB	IMP	Dry	Heavy	2017	10	0.2634	0.7902
KeRRA (Paved)	P-I	CB	RMP	Wet	Normal	2017	10	0.0667	0.2000
KeRRA (Paved)	P-I	CB	RMP	Dry	Light	2017	10	0.0144	0.0432
KeRRA (Paved)	P-I	UD	IMP	Dry	Heavy	2017	1800	0.0245	0.0691
KeRRA (Paved)	P-I	UD	RMP	Wet	Normal	2017	1800	0.0131	0.0370
KeRRA (Paved)	P-I	UD	RMP	Dry	Light	2017	1800	0.0092	0.0260
KeRRA (Paved)	P-I	CW	IMP	Dry	Heavy	2017	2000	0.0165	0.0515
KeRRA (Paved)	P-I	CW	RMP	Wet	Normal	2017	2000	0.0007	0.0022
KeRRA (Paved)	P-I	CW	RMP	Dry	Light	2017	2000	0.0006	0.0018

Appendix 2-2: Summary Results 2018

1. Selected 6 On-Carriageway Works

SRUQs and P/Rs of Selected 6 On-Carriageway Works

Machinery Productivity

	Item	Machineries	SRUQ Units	Survey		CEM 2017	
				SRUQ	P/R	SRUQ	P/R
1	Grading and Regravelling	Motor grader	No-day/m ²	0.00013	7,754.89	0.000069	14,545.45
2	Patching	Asphalt Cutter	No-day/m ²	0.0045	222.50	0.0025	400.00
		Sprayer	No-day/m ²	0.000053	18,918.92	0.0037	269.36
		Roller	No-day/m ²	0.0002	5,000.00	0.0034	295.20
3	Resealing	Asphalt finisher	No-day/m ³	0.0116	86.40	0.025	40.00
4	Road Marking	Road marking machine	No-day/m ²	0.0019	528.63	0.0117	85.41
5	Repair on Concrete Structures	Concrete mixer	No-day/m ³	0.055	18.18	-	-
6	Guardrail Repair/Replacement	N/A	-	-	-	-	-

Labor Productivity

	Item	Categories	SRUQ Units	Survey		CEM 2017	
				SRUQ	P/R	SRUQ	P/R
1	Grading and Regravelling	Unskilled Labor	person-day/m ³	0.0014	714.29	0.07	14.29
		Artisans	person-day/m ³	-	-	-	-
		Supervisor	person-day/m ³	0.0036	277.78	0.016	62.50
2	Patching	Unskilled Labor	person-day/m ²	0.034	33.33	0.0013	769.23
		Supervisor	person-day/m ²	0.0054	185.19	0.0004	2,500.00
3	Resealing						
4	Road Marking	Unskilled Labor	person-day/m ²	0.015	66.89	0.083	12.00
		Artisans	person-day/m ²	-	-	0.064	15.65
		Supervisor	person-day/m ²	0.00044	225.23	0.028	36.00
5	Repair on Concrete Structures - Headwall	Unskilled Labor	person-day/ l no.	2.3188	0.43	3.2248	0.31
		Artisans	person-day/ l no.	0.5539	1.81	4.5978	0.22
		Supervisor	person-day/ l no.	0.0852	11.74	1.769	0.57
	Repair on Concrete Structures - Culvert installation	Unskilled Labor	person-day/m	0.9002	1.11	0.879	1.14
		Artisans	person-day/m	0.2407	4.16	1.353	0.74
		Supervisor	person-day/m	0.03174	31.51	0.5065	1.97
6	Guardrail Repair/Replacement	Unskilled Labor	Person day/m	0.0874	11.00	-	-
		Artisans	Person day/m	0.104	9.62	-	-
		Supervisor	Person day/m	0.3073	3.25	-	-

Unit Price Calculation Tables

I. Grading and regravelling

Light Grading

No.	M001-I
Work Category	Grading
Code	10.50.003
Work Item Name	Light Grading
Description	Trim with motor grader existing carriageway to camber, including slopes and ditches
Unit	m ³
Quantity	5

				NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	
22.50.007	Skilled Labour: Overseer	Foreman	Person Day	1,014	0.0144	14.65	971	0.0144	14.03	Based on average productivity in Kenya
22.50.002	Unskilled labour		Person Day	416	0.0072	2.98	411	0.0072	2.95	Based on average productivity in Kenya
M1	Motor Grader driving	131hp	Day	22,246	0.0020	44.09	22,239	0.0020	44.07	Based on average productivity in Kenya
	Subtotal					61.72			61.05	
	Miscellaneous Cost		%		5	3.09		5	3.05	% of Subtotal
	Total					64.80			64.10	
	Per unit					13.00			12.80	Total/Quantity

- Note**
- The quantities are based on M.o.P.W.:2011: Activity No. 1050004
 - The unit price does not include haulage cost.
 - Miscellaneous cost is for general reusable equipment to execute the work. (e.g. hand tools, scaffoldings, safety gears)

M1 Motor Grader Driving

Per day

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	1.00	1,014	971	1.00	971	1 day = 7 hours = 0.143 day (= 1 hour) * 2 (operator + mechanic) = 0.25
22.74.002	Fuel	Diesel	litre	89.8	177.23	15,915	90	177.23	15,951	Based on average productivity in Kenya
22.63.012	Motor Grader (e.g. CAT 112F): 100 - 130 HP	0	day	5,317	1.00	5,317	5,317	1.00	5,317	Based on average productivity in Kenya
	Miscellaneous Cost		%	-	0.00		-	0.00		
	Total					22,246			22,239	

Regravelling

No.	M001-2
Work Category	Gravelling
Code	10.60.001
Work Item Name	Regravelling
Description	Prepare for road formation and provide, place spread, shape and compact with watering
Unit	m ³
Quantity	5

NAIROBI, KISUMU & MOMBASA							OTHER AREAS			Remarks
Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	
22.50.007	Skilled Labour: Overseer	Foreman	Person Day	1,014	0.007	7.16	971	0.007	6.86	Based on average productivity in Kenya
22.50.002	Unskilled labour		Person Day	416	0.018	7.29	411	0.018	7.20	Based on average productivity in Kenya
22.72.102	Gravel material (murrum)		m ³	960	6.000	5,760.00	960	6.000	5,760.00	Based on average productivity in Kenya
M1	Motor Grader driving	131hp	Hour	51,839	0.006	300.93	51,827	0.006	300.86	Based on average productivity in Kenya
M2	Roller driving	130hp	Hour	129,206	0.004	506.47	129,386	0.004	507.18	Based on average productivity in Kenya
M3	Water tanker driving	10t	Hour	68,480	0.001	51.74	68,600	0.001	51.83	Based on average productivity in Kenya
	Subtotal					6,633.59			6,633.92	
	Miscellaneous Cost		%		5	331.68		5	331.70	% of Subtotal
	Total					6,965.27			6,965.62	
	Per unit					1,393.10			1,393.10	Total/Quantity

- Note**
1. The quantities are based on field survey.
 2. The unit price does not include haulage cost.
 3. Miscellaneous cost is for general reusable equipment to execute the work. (e.g. hand tools, scaffoldings, safety gears)

M1 Motor Grader driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day (= 1 hour) * 2 (operator + mechanic) = 0.25
22.74.002	Fuel	Diesel	Hour	89.78	20.34	1,827	90	20.34	1,831	Based on average productivity in Kenya
22.63.012	Motor Grader (e.g. CAT 112F): 100 - 130 HP	0	Hour	5,434	1.00	5,434	5,434	1.00	5,434	Based on average productivity in Kenya
	Miscellaneous Cost		%	-	0.00		-	0.00		
	total					7,406			7,404	

M2 Roller driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	Hour	89.78	144.754	12,996	90	144.754	13,028	Based on average fuel efficiency per horsepower in Japan 0.084l/hp*130hp = 10.92l
22.64.005	Road Roller 10T, 130Hp		day	5,317	1.000	5,317	5,317	1.000	5,317	Based on average productivity in Kenya
	Miscellaneous Cost		%	-	0.000		-	0.000		
	total					18,458			18,484	

M3 water tanker driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	0.01497	971	0.143	0.01497	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	Hour	89.78	78	7,003	90	78	7,020	Based on average fuel efficiency per horsepower in Japan 0.04ℓ/hp*180hp = 7.2ℓ
22.62.015	Water Tanker: 6000 - 8000 Lt.	0	Hour	1,780	1	1,780	1,780	1	1,780	Based on average productivity in Kenya
22.70.003	water		m ³	1,000	1	1,000	1,000	1	1,000	Temporarily estimated quantity
	Miscellaneous Cost		%	-	0		-	0		
	Total					9,783			9,800	

II. Patching

Pothole Patching – Hot Mix AC

No.	M002-I
Work Category	Pavement Repairing
Code	16.50.001
Work Item Name	Pothole Patching – Hot Mix AC
Description	Repair potholes on bituminous surface by hot bituminous mixture (5 cm thickness)
Unit	m ²
Quantity	100 (thickness=5cm) (5 m ³)

Code	Name	Type	Unit	NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
				Unit Price (Ksh)	Quantity	Sum (Ksh)	Unit Price (Ksh)	Quantity	Sum (Ksh)	
B1	Pothole Cutting and Cleaning		m ²	163	100	16,300	213	100	21,300	
B2	Pothole Patching		m ²	1,184	100	118,400	1,273	100	127,300	
	Subtotal					134,700			148,600	
	Total per unit					1,347			1,486	

Note I. The Unit price does not include haulage cost

B1	Pothole Cutting and Cleaning
Unit	m ²
Quantity	100

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer	Foreman	Person Day	1014	0.000	0	971	0.000	0	
22.50.005	Artisans G2	Supervisor	Person Day	819	0.360	295	787	0.360	283	
22.50.002	Unskilled labour		Person Day	416	2.500	1,040	411	2.500	1,027	
M1	Asphalt cutter driving		Hour	775	18.29	14,175	1,036	18.29	18,948	Based on a unit pothole of 50cm *50cm * 5cm thickness. Cut length: 0.5*4=2m for 0.25m ² (for 100m ² , cut length=800m) 800m/43.7322 m per hour = 18.29 hrs.
	Subtotal					15,510			20,259	
	Miscellaneous Cost		%		5	775		5	1,013	% of subtotal
	Total					16,285			21,272	
	Per unit					163			213	Total/Quantity

M1 Asphalt cutter driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	litre	89.78	1.451	130	90	1.451	131	
22.67.109	Asphalt/Bitumen cutter	0	Hour	500	1	500	767	1	767	
	Miscellaneous Cost		%	0	0		0	0		
	Total					775			1,036	

B2 Pothole Patching

Unit m²
Quantity 100

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014		0	971		0	
22.50.005	Artisans G2		Person Day	819	0.175	143	787	0.175	138	
22.50.002	Unskilled labour		Person Day	416	0.949	395	411	0.949	390	
22.73.003	Premix - AC Type I (hot)		m ³	18,413	5.500	101,272	19,800	5.500	108,900	5*1.1 (loss margin) = 5.5
22.73.012	MC 30 Bitumen		litre	98	99.00	9,702	108	99.00	10,692	1 kg = 1 litre 90 * 1.1 (loss margin) = 99
M2	Sprayer driving		Hour	647	0.037	24	642	0.037	24	
M3	Truck Driving		Hour	2,103	0.170	357	2,098	0.170	356	
M4	Roller driving		Hour	6,442	0.140	901	5,212	0.140	729	
	Subtotal					112,793			121,228	
	Miscellaneous Cost		%		5	5,640		5	6,061	% of subtotal
	Total					118,433			127,290	
	Per unit					1,184			1,273	Total/Quantity

M2 Sprayer driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.50.002	Unskilled labour		Person Day	416		0	411		0	
22.74.002	Fuel	Diesel	litre	89.78	1.030	92	90	1.030	93	Based on average fuel efficiency per horsepower in Japan 0.151 l/hp*6.8hp=1.03l
22.67.004	Bitumen Sprayer H/ Operated	200L	Hour	410	1	410	410	1	410	
	Miscellaneous Cost		%	0	0		0	0		
	Total					647			642	

M3 Truck driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	litre	89.78	5.320	478	90	5.320	479	Based on average fuel efficiency per horsepower in Japan 0.041 l/hp*133hp=5.32 l
22.61.101	Truck Flat bed : 2.5-5 tons	0	Hour	1480	1	1,480	1480	1	1,480	
	Miscellaneous Cost		%	0	0		0	0		
	Total					2,103			2,098	

M4 Roller driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.50.002	Unskilled labour		Person Day	416		0	411		0	
22.74.002	Fuel	Diesel	litre	89.78	10.92	980	90	10.92	983	Based on average fuel efficiency per horsepower in Japan 0.084 l/hp*130hp=10.92l
22.64.004	Single drum steel Vibrator roller: 9-10T, 130 HP	0	Hour	5317	1	5,317	4090	1	4,090	
	Miscellaneous Cost		%	0	0		0	0		
	Total					6,442			5,212	

Pothole Patching – Cold Mix AC (manufactured)

No.	M002-2
Work Category	Pavement Repairing
Code	16.50.004
Work Item Name	Pothole Patching – Cold Mix AC
Description	Repair potholes on bituminous surface by cold bituminous mixture (5 cm thickness)
Unit	m ²
Quantity	100 (thickness=5cm) (5 m ³)

				NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
Code	Name	Type	Unit	Unit Price (Ksh)	Quantity	Sum (Ksh)	Unit Price (Ksh)	Quantity	Sum (Ksh)	
B1	Pothole Cutting and Cleaning		m ²	40	100	4,000	48	100	4,800	
B2	Pothole Patching		m ²	3,958	100	395,800	4,594	100	459,400	
	Subtotal					399,800			464,200	
	Total per unit					3,998			4,642	

Note 1. The Unit price does not include haulage cost

B1 Pothole Cutting and Cleaning
Unit m²
Quantity 100

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer	Foreman	Person Day	1014		0	971		0	
22.50.005	Artisans G2	Supervisor	Person Day	819	0.360	295	787	0.360	283	
22.50.002	Unskilled labour		Person Day	416	2.500	1,040	411	2.500	1,027	
M1	Asphalt cutter driving		Hour	775	3.146	2,438	1,036	3.146	3,259	Based on a unit pothole of 50cm * 50cm * 5cm thickness. Cut length: 0.5*4=2m for 0.25m ² (for 100m ² , cut length=800m) 800m/43.7322 m per hour = 18.29 hrs.
	Subtotal					3,773			4,570	
	Miscellaneous Cost		%		5	189		5	229	% of subtotal
	Total					3,962			4,799	
	Per unit					40			48	Total/Quantity

M1 Asphalt cutter driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	litre	89.78	1.451	130	90	1.451	131	
22.67.109	Asphalt/Bitumen cutter	0	Hour	500	1	500	767	1	767	
	Miscellaneous Cost		%	0	0		0	0		
	Total					775			1,036	

B2 Pothole Patching

Unit m²

Quantity 100

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.000	0	971	0.000	0	
22.50.005	Artisans G2		Person Day	819	0.000	0	787	0.000	0	
22.50.002	Unskilled labour		Person Day	416	0.949	395	411	0.949	390	
22.73.003	Premix - AC Type I (cold)		m ³	66,528	5.500	365,904	77,400	5.500	425,700	5*1.1 (loss margin) = 5.5
22.73.012	MC 30 Bitumen		litre	98	99.00	9,702	108	99.00	10,692	1 kg = 1 litre 90 * 1.1 (loss margin) = 99
M2	Sprayer driving		Hour	647	0.037	24	642	0.037	24	
M3	Roller driving		Hour	6,442	0.140	901	5,212	0.140	729	
	Subtotal					376,926			437,535	
	Miscellaneous Cost		%		5	18,846		5	21,877	% of subtotal
	Total					395,772			459,411	
	Per unit					3,958			4,594	Total/Quantity

M2 Sprayer driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.50.002	Unskilled labour		Person Day	416		0	411		0	
22.74.002	Fuel	Diesel	litre	89.78	1.030	92	90	1.030	93	Based on average fuel efficiency per horsepower in Japan 0.151 l/hp*6.8hp = 1.03 l
22.67.004	Bitumen Sprayer H/ Operated	200L	Hour	410	1	410	410	1	410	
	Miscellaneous Cost		%	0	0		0	0		
	Total					647			642	

M3 Roller driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.50.002	Unskilled labour		Person Day	416		0	411		0	
22.74.002	Fuel	Diesel	litre	89.78	10.92	980	90	10.92	983	Based on average fuel efficiency per horsepower in Japan 0.084 l/hp*130hp = 10.92 l
22.64.004	Single drum steel Vibrator roller: 9-10T, 130 HP	0	Hour	5317	1	5,317	4090	1	4,090	
	Miscellaneous Cost		%	0	0		0	0		
	total					6,442			5,212	

Pothole Patching – Cold Mix AC (Made on site)

No.	M002-3
Work Category	Pavement Repairing
Code	–
Work Item Name	Pothole Patching – Cold Mix AC (made on site)
Description	Repair potholes on bituminous surface by cold bituminous mixture (5cm thickness)
Unit	m ²
Quantity	100 (thickness=5cm) (5 m ³)

				NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
Code	Name	Type	Unit	Unit Price (Ksh)	Quantity	Sum (Ksh)	Unit Price (Ksh)	Quantity	Sum (Ksh)	
B1	Pothole Cutting and Cleaning		m ²	161	100	16,100	199	100	19,900	
B2	Pothole Patching		m ²	735	100	73,500	771	100	77,100	
	Subtotal					89,600			97,000	
	Total per unit					896			970	

Note I. The Unit price does not include haulage cost

B1 Pothole Cutting and Cleaning

Unit m²

Quantity 100

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer	Foreman	Person Day	1014	0.243	246	971	0.000	0	
22.50.005	Artisans G2	Supervisor	Person Day	819	0.360	295	787	0.000	0	
22.50.002	Unskilled labour		Person Day	416	1.685	701	411	0.000	0	
M1	Asphalt cutter driving		Hour	773	18.29	14,138	1,034	18.29	18,912	Based on a unit pothole of 50cm * 50cm * 5cm thickness. Cut length: 0.5*4=2m for 0.25m ² (for 100m ² , cut length=800m) 800m/43.7322 m per hour = 18.29 hrs.
	Subtotal					15,380			18,912	
	Miscellaneous Cost		%		5	769		5	946	% of subtotal
	Total					16,149			19,857	
	Per unit					161			199	Total/Quantity

M1 Asphalt cutter driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	litre	89.78	1.429	128	90	1.429	129	10 litres per day = 1.4286 litres per hour
22.67.109	Asphalt/Bitumen cutter	0	Hour	500	1	500	767	1	767	
	Miscellaneous Cost		%	0	0		0	0		
	Total					773			1,034	

B2 Pothole Patching
 Unit m²
 Quantity 100

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.057	58	971	0.000	0	
22.50.005	Artisans G2		Person Day	819	0.000	0	787	0.000	0	
22.50.002	Unskilled labour		Person Day	416	0.467	194	411	0.000	0	
22.72.016	Coarse aggregates (chippings) - 3/6mm		m ³	1,360	1.788	2,431	1,792	1.788	3,203	density=2000 l/m ³ . Qty= 78l/2000 l/m ³ = 0.039 m ³ for 2.1818 m ² = 1.7875 m ³ for 100m ²
22.72.017	Coarse aggregates (chippings) - 6/10mm		m ³	1,840	0.963	1,771	1,792	0.963	1,725	Density=2000 l/m ³ . Qty= 42l/2000 l/m ³ = 0.021 m ³ for 2.1818m ² = 0.9625 m ³ for 100 m ²
22.73.006	Bituminous sealant (K-160)		m ³	75500	0.825	62,288	83000	0.825	68,475	Density= 1000 l/m ³ . Qty= 18l/1000 l/m ³ = 0.018 m ³ for 2.1818m ² = 0.825 m ³ for 100 m ²
M1	Mixer driving		Hour	753	3.89	2,932	747	0.00	0	
M2	Sprayer driving		Hour	647	0.109	71	642	0.000	0	
M3	Roller driving		Hour	6,442	0.041	264	5,212	0.000	0	
	Subtotal					70,008			73,403	
	Miscellaneous Cost		%		5	3,500		5	3,670	% of subtotal
	Total					73,509			77,073	
	Per unit					735			771	Total/Quantity

M1 Mixer driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.50.002	Unskilled labour		Person Day	416	0.000	0	411	0.000	0	
22.74.002	Fuel	Diesel	litre	89.78	0.429	38	90	0.429	39	3 litres per day = 0.4286 litres per hour
	Concrete mixer		Hour	570	1	570	570	1	570	
	Miscellaneous Cost		%	0	0		0	0		
	Total					753			747	

M2 Sprayer driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.50.002	Unskilled labour		Person Day	416		0	411		0	
22.74.002	Fuel	Diesel	litre	89.78	1.030	92	90	1.030	93	Based on average fuel efficiency per horsepower in Japan 0.151 l/hp*6.8hp= 1.03 l
22.67.004	Bitumen Sprayer H/Operated	200L	Hour	410	1	410	410	1	410	
	Miscellaneous Cost		%	0	0		0	0		
	Total					647			642	

M3 Roller driving

Per hour

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.50.002	Unskilled labour		Person Day	416		0	411		0	
22.74.002	Fuel	Diesel	litre	89.78	10.92	980	90	10.92	983	Based on average fuel efficiency per horse-power in Japan 0.084ℓ/hp*130hp= 10.92ℓ
22.64.004	Single drum steel Vibrator roller: 9-10T, 130 HP	0	Hour	5317	1	5,317	4090	1	4,090	
	Miscellaneous Cost		%	0	0		0	0		
	Total					6,442			5,212	

III. Road Marking (Mechanical)

Road Marking on Smooth Pavement

No.	M004-I
Work Category	Road Marking
Code	–
Work Item Name	Road Markings - white thermoplastic paint
Description	Renew faded or missing white road markings with thermoplastic material
Unit	m ²
Quantity	100

				NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.444	450	971	0.444	431	
22.50.005	Artisans G2		Person Day	819	0.000	0	787	0.000	0	
22.50.002	Unskilled labour		Person Day	416	1.495	622	411	1.495	615	
22.79.006	Thermoplastic paint white		kg	318	163.31	51,934	349	163.31	56,996	
	Reflecting Glass Beads		kg	527.88	58.33	30,793	527.88	58.33	30,793	
M1	Compressor Driving		Day	7,055	0.06	292	7,054	0.06	291	for cleaning
M2	Road Marking Machine Driving		Hour	715	1.119	800	709	1.119	793	
M3	Melting pod driving		Hour	2,148	1.132	2,431	2,299	1.132	2,602	
M4	Truck driving	3~3.5t	Hour	2,137	0.759	1,622	2,132	0.759	1,618	for Melting pod
	Subtotal					89,057			94,254	
	Miscellaneous Cost		%	-	5.00	4,453	-	5.00	4,713	% of subtotal
	Total					93,390			98,846	
	Per unit					934			988	Total/Quantity

Note

1. 2t truck is for hauling equipment and materials, 3~3.5t truck is for the fusion movement in the site.
2. Quantity of materials shall include the loss margin.
3. Not including the traffic control, haulage cost.
4. Miscellaneous Cost is for the minor equipment, materials and supplementary work such as primer, gas, stick chalk and so on.

M1 Compressor Driving

Per Day

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	litre	89.78	3.613	324	90.00	3.613	325	
22.67.108	Air compressor	150CFM, 4250LPM	Day	4,600	1	4,600	4,600	1	4,600	
	Miscellaneous Cost		%	-	0	0	-	0	0	
	Total					5,069			5,064	

M2 Road Marking Machine Driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143day
22.65.008	Road Marking Machine		Hour	570	1	570	570	1	570	
	Miscellaneous Cost		%	-	0	0	-	0	0	
	Total					715			709	

M3 Melting pod driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	1.132	1,148	971	1.132	1,099	1 day = 7 hours 1 hour = 0.143day
22.65.101	Melting pod (for paint)	200 - 350kg	Hour	1,000	1	1,000	1,200	1	1,200	
	Miscellaneous Cost		%	-	0	0	-	0	0	
	Total					2,148			2,299	

M4 Truck driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143day
22.74.002	Fuel	Diesel	litre	89.78	5.700	512	90.00	5.700	513	0.041l/ hp*133hp=5.32l
22.61.101	Truck Flat bed: 2.5 - 5 tons	0	Hour	1,480	1	1,480	1,480	1	1,480	
	Miscellaneous Cost		%	-	0	0	-	0	0	
	Total					2,137			2,132	

Road Marking on Surface Dressed pavement

No. M004-2

Work Category Road Marking

Code –

Work Item Name Road Markings - white thermoplastic paint

Description Renew faded or missing white road markings with thermoplastic material

Unit m²

Quantity 100

				NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.604	613	971	0.604	587	Based on average productivity in Kenya
22.50.005	Artisans G2		Person Day	819	0.000	0	787	0.000	0	Based on average productivity in Kenya
22.50.002	Unskilled labour		Person Day	416	1.253	521	411	3.876	1,593	Based on average productivity in Kenya
22.79.006	Thermoplastic paint white		kg	318	894.446	284,434	349	894.446	312,162	Based on average productivity in Kenya
	Reflecting Glass Beads		kg	527.88	9.94	5,247	527.88	9.94	5,247	Based on average productivity in Kenya
M1	Compressor Driving		Day	4,745	0.35	1,656	4,739	0.35	1,654	for cleaning
M2	Road Marking Machine Driving		Hour	715	0.349	250	709	0.349	247	
M3	Melting pod driving		Hour	1,145	0.349	400	1,339	0.349	467	
M4	Truck driving	3~3.5t	Hour	2,103	0.349	734	2,098	0.349	732	for Melting pod
	Subtotal					293,949			321,703	
	Miscellaneous Cost		%	-	5.00	14,697	-	5.00	16,085	% of subtotal
	Total					337,689			337,788	
	Per unit					3,086			3,378	Total/Quantity

Note

1. 2t truck is for hauling equipment and materials, 3~3.5t truck is for the fusion movement in the site.
2. Quantity of materials shall include the loss margin.
3. Not including the traffic control, haulage cost.
4. Miscellaneous Cost is for the minor equipment, materials and supplementary work such as primer, gas, stick chalk and so on.

M1 Compressor Driving

Per Day

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143day
22.74.002	Fuel	Diesel	litre	89.78	0.002	0	90.00	0.002	0	
22.67.108	Air compressor	150CFM, 4250LPM	Day	4,600	1	4,600	4,600	1	4,600	
	Miscellaneous Cost		%	-	0	0	-	0	0	
	Total					4,745			4,739	

M2 Road Marking Machine Driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143day
22.65.008	Road Marking Machine		Hour	570	1	570	570	1	570	
	Miscellaneous Cost		%	-	0	0	-	0	0	
	Total					715			709	

M3 Melting pod driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.65.101	Melting pod (for paint)	200 - 350kg	Hour	1,000	1	1,000	1,200	1	1,200	
	Miscellaneous Cost	%		-	0	0	-	0	0	
	Total					1,145			1,339	

M4 Truck driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled Labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	litre	89.78	5.32	512	90.00	5.32	513	0.041 l/hp*133hp=5.32 l
22.61.101	Truck Flat bed: 2.5-5 Tons	0	Hour	1,480	1	1,480	1,480	1	1,480	
	Miscellaneous Cost	%		-	0	0	-	0	0	
	Total					2,103			2,098	

IV. Repair on concrete structures

Pipe Culvert 600mm Dia. Installation

No.	M005-I
Work Category	Pipe Culvert Installation
Code	08.60.025
Work Item Name	Culvert Installation – 600mm with surround
Description	Provide, lay and joint pipe culvert of 600mm in diameter with surround
Unit	m
Quantity	10

Code	Name	Type	Unit	NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
				Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	
B1	Blinding		m ³	9,519	0.52	4,926	9,219	0.52	4,771	Volume of concrete : 10m*0.9m*0.05m + 0.9m*0.3m*0.05m*5No
B2	Installation		m	4,101	10	41,010	365	10	3,650	
B3	Form work		m ²	551	19	10,469	21	19	399	(0.6 + 0.05*2 + 0.15 (top surrounding) + 0.1 (bottom surrounding)) * 2 (both sides) * 10 = 19.0
B4	Concrete mixing, placing and curing		m ³	8,172	5.0	40,860	7,906	5.0	39,530	0.5 (standard volume for surround and bed) * 10 = 5
	Subtotal					97,265			48,350	
	Miscellaneous Cost				10.0	9,727		10.0	4,835	
	Total					106,992			53,185	
	Per unit					10,699			5,318	Total/Quantity
Note	1. The quantities are based on standard drawings									
	2. The unit price does not include haulage cost.									
	3. The unit cost includes blinding for base and concrete formwork but not excavating and filling.									
	4. Miscellaneous cost is for general reusable equipment to execute the work. (e.g. hand tools, scaffoldings, safety gears) - 5%: clearing, cleaning, earthwork, base and surfacing works, simple street furniture works (e.g. marking, sign installation) - 10%: concrete works, structural works, complicated street furniture works (e.g. Microtunneling, street lamp works)									

B1	Blinding C15/20
Unit	m ³
Quantity	10

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	6.80	6,898	971	6.80	6,605	
22.50.005	Artisans G2		Person Day	819	1.94	1,592	787	1.94	1,530	
22.50.002	Unskilled labour		Person Day	416	9.20	3,827	411	9.20	3,781	
22.50.101	Skilled Labour: Operator		Person Day	1014	1.62	1,642	971	1.62	1,573	For Concrete Mixer
22.70.004	Cement (ordinary Portland)		Kg	18	2365.00	42,570	19	2365.00	44,935	2150*1.1 (loss margin) = 2365
22.69.009	Fine aggregates (sand)		m ³	2270	5.06	11,486	1854	5.06	9,381	4.6*1.1 (loss margin) = 5.06
22.70.002	Graded aggregates (ballast)		m ³	1716.25	10.12	17,368	1440	10.12	14,573	9.2*1.1 (loss margin) = 10.12
22.70.003	Water		m ³	1000	2.99	2,993	1000	2.99	2,993	1.1 loss margin included
22.74.999	Fuel	Petrol	litre	101.05	11.34	1,145.69	101.05	11.34	1,145.69	Fuel for Concrete Mixer
22.67.997	Concrete mixer		Hour	500	11.34	5,668.93	500	11.34	5,668.93	
	Total					95,192			92,186	
	Per unit					9,519			9,219	Total/Quantity

B2 Installation

Quantity 10

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.00	0	971	0.00	0	
22.50.005	Artisans G2		Person Day	819	1.71	1,404	787	1.71	1,349	
22.50.002	Unskilled labour		Person Day	416	5.14	2,139	411	5.14	2,114	
22.72.002	Precast concrete culvert - 600mm		m	3747	10	37,470	19	10	190	
	Total					41,013			3,653	
	Per unit					4,101			365	Total/Quantity

B3 Form workUnit m²

Quantity 100

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.00	0	971	0.00	0	
22.50.005	Artisans G2		Person Day	819	1.06	871	787	1.06	837	
22.50.002	Unskilled labour		Person Day	416	3.19	1,327	411	3.19	1,311	
22.78.102	Wooden formwork panel		m ²	882	60.00	52,920	327	0.00	0	50 * 1.2 (loss margin) = 60 To be re-used second time
	Total					55,117			2,147	
	Per unit					551			21	Total/Quantity

B4 Concrete mixing, placing and curingUnit m³

Quantity 1

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.06	64	971	0.06	62	
22.50.005	Artisans G2		Person Day	819	0.10	81	787	0.10	78	
22.50.002	Unskilled labour		Person Day	416	0.65	271	411	0.65	268	
22.50.101	Skilled Labour: Operator		Person Day	1014	0.07	76	971	0.07	72	For Concrete Mixer
22.70.004	Cement (ordinary Portland)		Kg	18	236.50	4,257	19	236.50	4,494	215*1.1 (loss margin) = 236.5
22.69.009	Fine aggregates(sand)		m ³	2270	0.51	1,149	1854	0.51	938	0.46*1.1 (loss margin) = 0.506
22.70.002	Graded aggregates (ballast)		m ³	1716.25	1.01	1,737	1440	1.01	1,457	0.92*1.1 (loss margin) = 1.012
22.70.003	Water		m ³	1000	0.27	270	1000	0.27	270	1.1 loss margin included
22.74.999	Fuel	Petrol	litre	101.05	0.44	44.90	101.05	0.44	44.90	Fuel for Concrete Mixer
22.67.997	Concrete mixer		Hour	500	0.44	222.18	500	0.44	222.18	
B6	Concrete curing		m ³	0	1	0	0	1	0	
	Total					8,172			7,906	
	Per unit					8,172			7,906	Total/Quantity

B5 Concrete curingUnit m³

Quantity 10

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.00	0	971	0.00	0	
22.50.005	Artisans G2		Person Day	819	0.00	0	787	0.00	0	
22.50.002	Unskilled labour		Person Day	416	0.00	0	411	0.00	0	
22.70.003	Water		m ³	1000	0.00	0	1000	0.00	0	1.1 loss margin included
	Total					-			-	
	Per unit					-			-	Total/Quantity

Pipe Culvert 600mm Dia. Headwall Repair

No.	M005-2
Work Category	Headwall Construction
Code	08.60.019a
Work Item Name	Headwall Construction for 600mm pipe culvert
Description	Provide, lay and joint pipe culvert of 600mm in diameter with surround Reconstruct or repair damaged headwall (wing wall and apron) for 600mm pipe culvert to prevent the collapse and the potential slip of the material and pavement above the culvert.
Unit	No. (a pair)
Quantity	1

				NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	
B1	Form work and Reinforcement		m ²	678	9.3	6,333	343	9.3	3,204	Formwork for headwall and wingwalls = 9.34 SM
B2	Concrete Mixing, Placing and Curing		m ³	10,873	1.2	13,417	10,853	1.2	13,393	Concrete Required for wingwalls and headwall = 1.234 CM
	Subtotal					19,750			16,596	
	Miscellaneous Cost		%		10	1,975		10	1,660	% of subtotal
	Total (per unit)					21,725			18,256	

- Note**
1. The quantities are based on standard drawings
 2. The unit price does not include haulage cost.
 3. The unit cost includes gravelling for base and concrete formwork but not excavating and filling.
 4. Head wall construction is assumed to include that of wingwalls and aprons. For detail, refer to the standard drawing

B1 Formwork and Reinforcement

Unit m²

Quantity 100

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.00	0	971	0.00	0	
22.50.005	Artisans G2		Person Day	819	4.42	3,623	787	4.42	3,482	
22.50.002	Unskilled labour		Person Day	416	15.63	6,502	411	15.63	6,423	
22.78.102	Wooden formwork panel		m ²	882	60.00	52,920	327	60.00	19,620	50 * 1.2 (loss margin) = 60 To be reused second time
22.77.001	Mesh wire 8' x 4' gauge 18		m ²	299	15.78	4,718	300	15.78	4,734	
	Total					67,763			34,259	
	Per unit					678			343	Total/Quantity

B2

Unit m³

Quantity 10

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.89	899	971	0.89	861	
22.50.005	Artisans G2		Person Day	819	1.36	1,114	787	1.36	1,070	
22.50.002	Unskilled labour		Person Day	416	8.59	3,573	411	8.59	3,530	
22.50.101	Skilled Labour: Operator		Person Day	1014	1.04	1,056	971	1.04	1,011	
22.70.004	Cement (ordinary Portland)		Kg	18	4015.00	72,270	19	4015.00	76,285	3650*1.1 (loss margin) = 4015
22.69.009	Fine aggregates (sand)		m ³	2270	4.18	9,489	1854	4.18	7,750	3.8*1.1 (loss margin) = 4.18
22.70.002	Graded aggregates (ballast)		m ³	1716.25	8.36	14,348	1440	8.36	12,038	7.6*1.1 (loss margin) = 8.36
22.70.003	Water		m ³	1000	1.99	1,988	1000	1.99	1,988	1.1 loss margin included
22.74.999	Fuel	Petrol	litre	101.05	5.84	590.51	101.05	5.84	590.51	Fuel for Concrete Mixer
22.67.997	Concrete mixer		Hour	500	6.81	3,403.82	500	6.81	3,403.82	
B6	Concrete curing			0	10.00	0.00	0	10.00	0.00	
	Subtotal					108,730			108,528	
	Total					108,730			108,528	
	Per unit					10,873			10,853	Total/Quantity

B3 Concrete curing

Unit m³

Quantity 10

Code	Name	Type	Unit	Unit price (Ksh)	Quantity	Sum (Ksh)	Unit price (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled Labour: Overseer		Person Day	1014	0.00	0	971	0.00	0	
22.50.005	Artisans G2		Person Day	819	0.00	0	787	0.00	0	
22.50.002	Unskilled labour		Person Day	416	0.00	0	411	0.00	0	
22.70.003	Water		m ³	1000	0.00	0	1000	0.00	0	1.1 loss margin included
	Total					-			-	
	Per unit					0			0	Total/Quantity

V. Guardrail repair/ replacement

Guardrail repair by straightening of beams

No.	M006-1
Work Category	On-Carriageway work items for PBC
Code	—
Work Item Name	Guardrail Repair
Description	Removal of damaged guardrail and replacement with the straightened beam
Unit	m
Quantity	4

Code	Name	Type	Unit	NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
				Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	
B1	Removal & Fixing & Realignment of posts		m	1,106	4.000	4,422	1,100	4.000	4,402	Based on average productivity in Kenya
B2	Straightening of Beam		m	44	4.000	176	44	4.000	176	Based on average productivity in Kenya
B3	Spacers Repair		No	424	2.000	848	409	2.000	818	Based on average productivity in Kenya
						5,447			5,396	
	Total					5,447			5,396	
	Per unit					1,362			1,349	Total/Quantity

Note:

1. 2ton truck is for hauling guardrail material and equipment and tool.
2. Quantity for materials shall include the loss margin.
3. No including the traffic control
4. Miscellaneous Cost is for the equipment and tools of repair.

B1	Removal & Fixing & realignment of posts
Unit	m
Quantity	4

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled labour: Overseer	Supervisor	Person Day	1,014	0.105	107	971	0.105	102	Based on average productivity in Kenya
22.50.005	Artisans General		Person Day	819	0.243	199	787	0.243	191	Based on average productivity in Kenya
22.50.002	Unskilled labour		Person Day	416	0.175	73	411	0.175	72	Based on average productivity in Kenya
	Bolts	New	No	150	14	2,053	150	14	2,053	Based on average productivity in Kenya
M1	Truck driving		Day	14,727	0.108	1,588	14,676	0.108	1,583	Based on average productivity in Kenya
	Subtotal					4,020			4,001	
	Miscellaneous Cost		%	-	10	402	-	10	400	% of subtotal
	Total					4,422			4,402	
	Per unit					1,106			1,100	Total/Quantity

M1 Truck driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	Person Day	90.0	5.32	479	90	5.32	478	Based on average fuel efficiency per horsepower in Japan 0.041l/hp*133hp=5.32l
22.61.101	Truck	2 Ton	Hour	1,480	1	1,480	1,480	1	1,480	Based on average productivity in Kenya
	Miscellaneous Cost		%	-	0		-	0		
	Total					2,104			2,097	

B2 Beam Straightening

Unit m

Quantity 4

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled labour: Overseer	Supervisor	Person Day	1,014	0.002	2	971	0.002	2	Based on average productivity in kenya
22.50.005	Artisans General		Person Day	819	0.002	2	787	0.002	2	Based on average productivity in kenya
22.50.002	Unskilled labour		Person Day	416	0.003	1	411	0.003	1	Based on average productivity in kenya
M1	Beam Straightener		day	73,340	0.002	155	73,297	0.002	155	Quotation rate
	Subtotal					160			160	
	Miscellaneous Cost		%	-	10	16	-	10	16	% of subtotal
	Total					176			176	
	Per unit					44			44	Total/Quantity

Note Miscellaneous costs include:

M1 Beam Straightening

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled labour: Operator		#N/A	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
	Electricity		Kw/h	15	22.00	332	15	22.00	332	Based on average productivity in kenya
	Beam Straightener		Hour	10,000	1	10,000	10,000	1	10,000	Quotation rate
	Miscellaneous Cost		%	-	0		-	0		
	Total					10,477			10,471	

B3 Spacer repair

Unit No

Quantity 1

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled labour: Overseer	Supervisor	Person Day	1,014	0.171	174	971	0.171	166	Based on average productivity in kenya
22.50.005	Artisans General		Person Day	819	0.171	140	787	0.171	135	Based on average productivity in kenya
22.50.002	Unskilled labour		Person Day	416	0.171	71	411	0.171	70	Based on average productivity in kenya
	Subtotal					386			372	
	Miscellaneous Cost		%	-	10	39	-	10	37	% of subtotal
	Total					424			409	
	Per unit					424			409	Total/Quantity
Note: Miscellaneous costs include: Welding equipment, welding rods, anvil and 10kg hammer										

Guardrail repair by straightening of beams and realignment of posts

No.	M006-2
Work Category	On-Carriageway work items for PBC
Cod	—
Work Item Name	Guardrail Repair
Description	Removal of damaged guardrail, replacement with the straightened beam and Realignment of Posts

Unit m
Quantity 4

				NAIROBI, KISUMU & MOMBASA			OTHER AREAS			
Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
B1	Removal & Fixing & Realignment of posts		m	1,293	4.000	5,170	1,288	4.000	5,152	Based on average productivity in kenya
B2	Straightening of Beam		m	44	4.000	176	44	4.000	176	Based on average productivity in kenya
B3	Spacers Repair		No	424	2.000	848	409	2.000	818	Based on average productivity in kenya
						6,195			6,146	
	Total					6,195			6,146	
	Per unit					1,549			1,537	Total/Quantity

Note:

1. 2ton truck is for hauling guardrail material and equipment and tool.
2. Quantity for materials shall include the loss margin.
3. No including the traffic control
4. Miscellaneous Cost is for the equipment and tools of repair.

B1 Removal & Fixing & realignment of posts
Unit m
Quantity 4

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled labour: Overseer	Supervisor	Person Day	1,014	0.096	97	971	0.096	93	Based on average productivity in kenya
22.50.005	Artisans General		Person Day	819	0.197	161	787	0.197	155	Based on average productivity in kenya
22.50.002	Unskilled labour		Person Day	416	0.291	121	411	0.291	120	Based on average productivity in kenya
	Bolts	New	No	150	14	2,053	150	14	2,053	Based on average productivity in kenya
	Concrete Placing		m3	10,624	0.064	680	10,624	0.064	680	
M1	Truck driving		Day	14,719	0.108	1,588	14,676	0.108	1,583	Based on average productivity in kenya
	Subtotal					4,700			4,684	
	Miscellaneous Cost		%	-	10	470	-	10	468	% of subtotal
	Total					5,170			5,152	
	Per unit					1,293			1,288	Total/Quantity

M1 Truck driving

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled labour: Operator		Person Day	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
22.74.002	Fuel	Diesel	Person Day	90.0	5.32	479	90	5.32	478	Based on average fuel efficiency per horsepower in Japan 0.041 l/hp*133hp=5.32 l
22.61.101	Truck	2 Ton	Hour	1,480	1	1,480	1,480	1	1,480	Based on average productivity in kenya
	Miscellaneous Cost		%	-	0		-	0		
	Total					2,104			2,097	

B2 Beam Straightening

Unit m

Quantity 4

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled labour: Overseer	Supervisor	Person Day	1,014	0.002	2	971	0.002	2	Based on average productivity in kenya
22.50.005	Artisans General		Person Day	819	0.002	2	787	0.002	2	Based on average productivity in kenya
22.50.002	Unskilled labour		Person Day	416	0.003	1	411	0.003	1	Based on average productivity in kenya
M1	Beam Straightener		day	73,340	0.002	155	73,297	0.002	155	Quotation rate
	Subtotal					160			160	
	Miscellaneous Cost		%	-	10	16	-	10	16	% of subtotal
	Total					176			176	
	Per unit					44			44	Total/Quantity
Note	Miscellaneous costs include:									

M1 Beam Straightening

Per hour

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled labour: Operator		#N/A	1,014	0.143	145	971	0.143	139	1 day = 7 hours 1 hour = 0.143 day
	Electricity		Kw/h	15	22.00	332	15	22.00	332	Based on average productivity in kenya
	Beam Straightener		Hour	10,000	1	10,000	10,000	1	10,000	Quotation rate
	Miscellaneous Cost		%	-	0		-	0		
	Total					10,477			10,471	

B3 Spacer repair

Unit No

Quantity 1

Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.007	Skilled labour: Overseer	Supervisor	Person Day	1,014	0.171	174	971	0.171	166	Based on average productivity in kenya
22.50.005	Artisans General		Person Day	819	0.171	140	787	0.171	135	Based on average productivity in kenya
22.50.002	Unskilled labour		Person Day	416	0.171	71	411	0.171	70	Based on average productivity in kenya
	Subtotal					386			372	
	Miscellaneous Cost		%	-	10	39	-	10	37	% of subtotal
	Total					424			409	
	Per unit					424			409	Total/Quantity

Note: Miscellaneous costs include: Welding equipment, welding rods, anvil and 10kg hammer

Guardrail replacement and realignment of posts

No.	M006-3
Work Category	On-Carriageway work items for PBC
Cod	—
Work Item Name	Guardrail Repair
Description	Complete removal and installation with new guardrail beam, posts and spacers
Unit	m
Quantity	4

				NAIROBI, KISUMU & MOMBASA			OTHER AREAS			Remarks
Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	
22.50.007	Skilled labour: Overseer	Supervisor	Person Day	1,014	0.045	46	971	0.045	44	Based on average productivity in Kenya
22.50.005	Artisans General		Person Day	819	0.179	146	787	0.179	141	Based on average productivity in Kenya
22.50.002	Unskilled labour		Person Day	416	0.329	137	414	0.329	136	Based on average productivity in Kenya
	Guardrail Beam		No	10,000	1	10,000	10,000	1	10,000	
	Concrete posts	2m	No	5,200	2	10,400	5,200	2	10,400	
	Spacers		No	3,500	2	7,000	3,500	2	7,000	
	Bolts		No	150	19	2,850	150	19	2,850	Based on average productivity in Kenya
No. 114	Concrete placing		m ³	10,624	0.128	1,360	10,624	0.128	1,360	Based on average productivity in Kenya
MI	Truck driving		Day	14,727	0.108	1,588	14,622	0.108	1,577	Based on average productivity in Kenya
	Subtotal					33,527			33,507	
	Miscellaneous Cost		%	-	10	3,353	-	10	3,351	% of subtotal
	Total					36,880			36,858	
	Per unit					9,220			9,215	Total/Quantity

Note:

1. 2ton truck is for hauling guardrail material and equipment and tool.
2. Quantity for materials shall include the loss margin.
3. No including the traffic control
4. Miscellaneous Cost is for the equipment and tools of repair.

MI Truck driving										Per hour
Code	Name	Type	Unit	Unit rate (Ksh)	Quantity	Sum (Ksh)	Unit rate (Ksh)	Quantity	Sum (Ksh)	Remarks
22.50.101	Skilled labour: Operator		Person Day	1,014	0.143	145	917	0.143	131	1 day = 7 hours 1 hour = 0.143day
22.74.002	Fuel	Diesel	litre	90.0	5.32	479	90	5.32	478	Based on average fuel efficiency per horsepower in Japan 0.041l/hp*133hp=5.32l
22.61.101	Truck	2 Ton	Hour	1,480	1	1,480	1,480	1	1,480	Based on average productivity in Kenya
	Miscellaneous Cost		%	-	0		-	0		
	Total					2,104			2,089	

2. 6 Major Labour Based Works

SRUQs and P/Rs of 6 Major Labour Based Works

(Simple)

Work item	Unit	Level	P/R (Simple)	Unit	SRUQ (Simple)	Unit
Grass Cutting	m ²	Heavy	1,062.6	m ² /per-d	0.0009	m ² /per-d
		Normal	1,367.3		0.0007	
		Light	2,723.4		0.0004	
		Ave	1,470.9		0.0007	
Cross Culvert	m	Heavy	2.8	m/per-d	0.3628	m/per-d
		Normal	86.0		0.0116	
		Light	155.0		0.0065	
		Ave	7.9		0.1270	
Catch Basin 2.52m ² (ave.)/ pcs	pcs	Heavy	3.8	pcs/per-d	0.2634	pcs/per-d
		Normal	15.0		0.0667	
		Light	69.5		0.0144	
		Ave	8.7		0.1148	
Lined Side Ditch	m	Heavy	71.1	m/per-d	0.0141	m/per-d
		Normal	125.7		0.0080	
		Light	1,009.3		0.0010	
		Ave.	130.4		0.0077	
Unlined Side Ditch	m	Heavy	40.8	m/per-d	0.0245	m/per-d
		Normal	76.1		0.0131	
		Light	108.4		0.0092	
		Ave.	64.0		0.0156	
Carriageway Cleaning	m ²	Heavy	60.7	m ² /per-d	0.0165	m ² /per-d
		Normal	1,438.3		0.0007	
		Light	1,764.4		0.0006	
		Ave.	169.2		0.0059	

* use for COSTES

(Actual)

Work Items	Unit	WDL	P/R (Actual)	Unit	SRUQ (Actual)	Unit
Grass Cutting	m ²	Heavy	354.20	m ² /per-d	0.0028	per-d/m ²
		Normal	455.78		0.0022	
		Low	907.80		0.0011	
		Ave	490.29		0.0020	
Cross Culvert De-Silting	m	Heavy	1.78	m/per-d	0.5624	per-d/m
		Normal	55.47		0.0180	
		Low	100.00		0.0100	
		Ave	5.08		0.1968	
Catch Basin De-silting 2.52m ² (ave.)/pcs	pcs	Heavy	1.27	pcs/per-d	0.7902	per-d/pcs
		Normal	5.00		0.2000	
		Low	23.15		0.0432	
		Ave	2.90		0.3445	
Lined Side Ditch	m	Heavy	35.39	m/per-d	0.0283	per-d/m
		Normal	62.54		0.0160	
		Low	502.13		0.0020	
		Ave	64.88		0.0154	
Un-Lined Side Ditch	m	Heavy	14.47	m/per-d	0.0691	per-d/m
		Normal	26.99		0.0370	
		Low	38.43		0.0260	
		Ave	22.70		0.0441	
Carriageway Cleaning	m ²	Heavy	19.40	m ² /per-d	0.0515	per-d/m ²
		Normal	459.51		0.0022	
		Low	563.72		0.0018	
		Ave	54.05		0.0185	

3. KM Standardized Quantities for Each Road Authority

KeNHA (Single Carriageway)

Item	Unit	Simple Quantity/1km	Actual/Simple	Actual Quantity/1km
Grass Cutting	m ²	6055	33%	2,018.3
Cross Culvert	m	100	65%	64.5
Catch Basin	Pcs	10	33%	3.3
Lined Ditch	m	200	50%	99.5
Unlined Ditch	m	1400	35%	496.5
Carriageway	m ²	2000	32%	639.0

Note: Figures are from survey on the Paved Road.

KeNHA (Dual Carriageway)

Item	Unit	Simple Quantity/1km	Actual/Simple	Actual Quantity/1km
Grass Cutting	m ²	12110	33%	4,036.7
Cross Culvert	m	200	65%	129.0
Catch Basin	Pcs	20	34%	6.7
Lined Ditch	m	400	50%	199.0
Unlined Ditch	m	2800	35%	992.9
Carriageway	m ²	4000	32%	1,278.0

Note: Figures are from survey on the Paved Road.

KURA

Item	Unit	Simple Quantity/1km	Actual/Simple	Actual Quantity/1km
Grass Cutting	m ²	6819	33%	2,273.0
Cross Culvert	m	100	65%	64.5
Catch Basin	Pcs	50	33%	16.7
Lined Ditch	m	1400	50%	696.5
Unlined Ditch	m	200	35%	70.9
Carriageway	m ²	2000	32%	639.0

Note: Figures are from survey on the Paved Road.

KeRRA (Paved)

Item	Unit	Simple Quantity/1km	Actual/Simple	Actual Quantity/1km
Grass Cutting	m ²	2310	33%	770.0
Cross Culvert	m	10	65%	6.5
Catch Basin	Pcs	10	33%	3.3
Lined Ditch	m	—	—	—
Unlined Ditch	m	1800	35%	638.3
Carriageway	m ²	2000	32%	639.0

KeRRA (Unpaved)

Item	Unit	Simple Quantity/1km	Actual/Simple	Actual Quantity/1km
Grass Cutting	m ²	2310	33%	770.0
Cross Culvert	m	10	65%	6.5
Catch Basin	Pcs	10	33%	3.3
Lined Ditch	m	—	—	—
Unlined Ditch	m	1800	35%	638.3
Carriageway	m ²	—	—	—

KWS

Item	Unit	Simple Quantity/1 km	Actual/Simple	Actual Quantity/1 km
Grass Cutting	m ²	2310	33%	770.0
Cross Culvert	m	10	65%	6.5
Catch Basin	pcs	10	33%	3.3
Lined Ditch	m	—	—	—
Unlined Ditch	m	1800	35%	638.3
Carriageway	m ²	—	—	—

Note: Figures are from survey on the Unpaved Road.

4. Unit Rate

Category	Item	Unit	Rate		Remarks
			Nairobi, Mombasa, Kisumu	Other Areas	
Labor	Unskilled Labor	Ksh/day	622.00	571.45	General Labourer
	Foreman	Ksh/month	35,548.65	30,597.85	Artisan G II × 1.5
	Supervisor	Ksh/month	43,753.50	38,605.65	Artisan G I × 1.5 ⁱⁱⁱ
	SCU Leader	KSH/month	43,753.50	38,605.65	Artisan G I × 1.5
	SCU Inspector	KSH/month	35,548.65	30,597.85	Artisan G II × 1.5
	Driver (Pick up)	KSH/month	21,942.30	17,982.10	Driver
	Driver (Truck)	KSH/month	29,169.00	25,737.10	Driver
Machinery Cost (Dry Rate)	Motor Grader	Ksh/hour		5,434	M&T MoR Hire Rate
	Vibratory Steel wheel roller	Ksh/hour		5,317	M&T MoR Hire Rate
	Pedestrian Roller	Ksh/hour		1,150	M&T MoR Hire Rate
	Pneumatic Roller	Ksh/hour		3,650	M&T MoR Hire Rate
	Asphalt Cutter	Ksh/hour		500	M&T MoR Hire Rate
	Bitumen Sprayer	Ksh/hour		410	M&T MoR Hire Rate
	Road Marking Machine	Ksh/hour		570	M&T MoR Hire Rate
	Melting Pod	Ksh/hour		1,000	M&T MoR Hire Rate
	Air Compressor	Ksh/hour		4,600	M&T MoR Hire Rate
	Concrete Mixer	Ksh/hour		370	M&T MoR Hire Rate
	Asphalt Finisher	Ksh/hour		7,500	M&T MoR Hire Rate
Vehicle Cost ^{iv} (Dry rate)	Truck (2 ton)	KSH/month		191,800	Truck flat-bed (2.5-5 ton)
	Pick up (Double Cabin)	KSH/month		88,200	Pick Up (4x4)
Material Cost	Gravel (murrum)	Ksh/m ³		960	CEM 2017; Nairobi, Mombasa, Kisumu
	Premix AC	Ksh/m ³		18,413	CEM 2017; Nairobi, Mombasa, Kisumu
	Bitumen Emulsion	ksh/litre		79.6	CEM 2017; Nairobi, Mombasa, Kisumu
	Thermoplastic Paint	Ksh/kg		318	CEM 2017; Nairobi, Mombasa, Kisumu
	Glass Beads	Ksh/kg			
	Fine Aggregates	Ksh/m ³		2,270	CEM 2017; Nairobi, Mombasa, Kisumu
	Graded Aggregates	Ksh/m ³		1,716	CEM 2017; Nairobi, Mombasa, Kisumu
Fuel Cost ^v	Diesel	Ksh/litre		108.10	Price listed is for Nairobi region. Price for other regions vary from region to region
	Petrol	Ksh/litre		116.70	
Fuel Consumption	Motor Grader	Km/litre			
	Truck	Km/litre			
	Vibratory Steel wheel roller	Km/litre			
	Pedestrian Roller	Km/litre			
	Pneumatic Roller	Km/litre			
	Asphalt Cutter	Km/litre			
	Bitumen Sprayer	Km/litre			
	Road Marking Machine	Km/litre			
	Melting Pod	Km/litre			
	Air Compressor	Km/litre			
	Concrete Mixer	Km/litre			
	Asphalt Finisher	Km/litre			

Note

- For the Labour Category, rates obtained from COLUMN 2 in the SPECIAL ISSUE, Kenya Gazette Supplement No. 107, Legislative Supplement No. 52, LEGAL NOTICE NO. 111, 14th July, 2017.
- For the Labour Category, rates obtained from COLUMN 4 in the SPECIAL ISSUE, Kenya Gazette Supplement No. 107, Legislative Supplement No. 52, LEGAL NOTICE NO. 111, 14th July, 2017. Column 3 has been used to estimate General labour rate in the case of Other

Areas after considering the market rates.

- iii. Factor for market price
- iv. Fees of Mechanical and Technical Services of MOTI Mechanical and Transport Division
Truck flat-bed (2.5-5 ton); $(1,480 \times 7\text{hrs} \times 25\text{days} + 3000 \times 5\text{days} \times 0.7^{\text{iii}}) = 191,800$ Pick Up (4x4);
 $1,050 \times 4\text{hrs} \times 30\text{days} \times 0.7^{\text{iii}} = 88,200$
- v. Pump Price for Sep-Oct 2018 from Energy Regulatory Commission

5. Percentage Add-ons (%)

Item	Miscellaneous Costs	Indirect Cost	Overhead and Profit	VAT
%	5.0	30	10	16.0

Appendix 3: Concept of SRUQ / Productivity Rate (P/R)

(I) Flow

Direct Cost shall be computed as per the following flow (Figure A3-1).

Figure A3-1 Flow of Estimate of Direct Cost

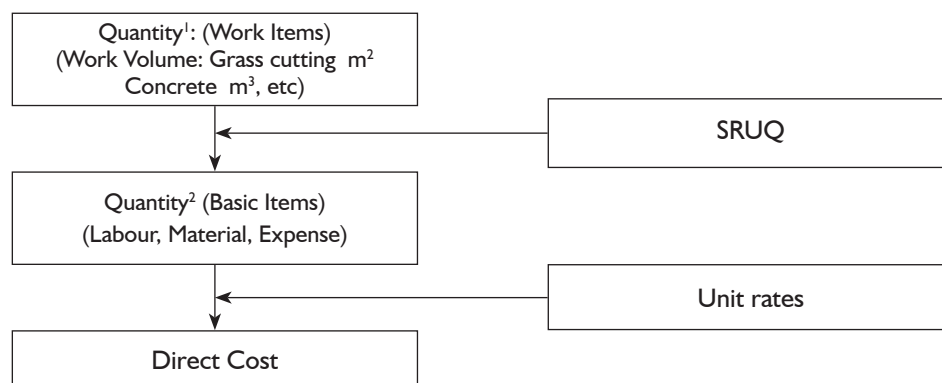


Table A3-1 Formula for Calculating Direct Cost

$$\begin{aligned}
 & \text{Q'ty}^2 \text{ (Basic Items: breakdown on labour, equipment, material required for the work)} = \text{Q'ty}^1 \text{ (Work Volume)} \times \text{SRUQ} \\
 & \text{Direct Cost} = \text{Q'ty}^2 \text{ (Basic Items: labour, equipment, material)} \times \text{Unit Rates}
 \end{aligned}$$

SRUQ is the conversion rate from Q'ty¹: Work Volume to Q'ty²: Basic Items (means breakdown of labour, equipment, material required for the work). Examples of SRUQ for concrete mixing are shown in the following table.

Table A3-2 Example of SRUQ (concrete mixing)

(per 10m³)

	Description	Unit	SRUQ	Unit Rate		Rate	Remarks
Quantity 1	Concrete	M³	-	-		-	
Quantity 2	Labourers	Person hours	6.25	100	Ksh/hr	625	
	Supervisor	Person hours	1.25	200	Ksh/hr	250	
	Aggregates	m³	7.5	100	Ksh	750	5% loss included
	Sand	m³	5.5	200	Ksh	1100	5% loss included
	Water	m³	3.0	100	Ksh	300	
	Concrete Mixer	Hours	8.0	200	Ksh	1600	
	Total					4625	Per 10m³
Unit Rates for concrete mixing							
							462.5 Ksh/m³

(2) Sample of Work Items / Q'tyI

For cost estimate, at first, work items shall be determined. Any work items can be selected as long as their scopes are clearly defined. Sample of work items and SRUQ are shown below.

Table A3-3 Sample of Work Items/Q'ty1

Work Items	Scope of Work	Unit	Q'ty ¹	P/R		Q'ty ² (Labour, Materials, etc)
Excavation	Excavation, Hauling	m ³	Excavated volume	SRUQ _I	ma day	Labour
				SRUQ _m	M ³ , ton etc.,	Material
				SRUQ _e	hours	Equipment / Expenses
Concrete	Materials, scaling, weighing, mixing	m ³	Mixed volume	SRUQ _I	man day	Labour
				SRUQ _m	M ³ , ton etc.,	Material
				SRUQ _e	hours	Equipment / Expenses

Two samples for work items / Q'tyI for PBC road maintenance works are shown below.

Table A3-4 Work Items and SRUQ for PBC Road Maintenance (individual)

Work Items	Scope of Work	Unit	Q'ty ¹	P/R		Q'ty ² (Labour, Materials, etc)
Grass cutting	Cutting, Piling, loading	m ²	Area for grass cutting	P/R _{ime}	man day	L/M/EE
Clearing obstructions	Picking up, piling, hauling	m ²	Area of carriage way	P/R _{ime}	man day	L/M/EE
Desilting	Picking up, piling, hauling	m	Length or number of drainages	P/R _{ime}	man day	L/M/EE
Cleaning	cleaning, piling, hauling	m ²	Maintained area	P/R _{ime}	man day	L/M/EE
Pruning trees	Pruning, hauling	m ²	Area of carriage way	P/R _{ime}	man day	L/M/EE

Table A3-5 Work Items and SRUQ for PBC Road Maintenance (average)

Work Items	Scope of Work	Unit	Q'ty ¹	P/R		Q'ty ² (Labour, Materials, etc)
Maintenance works	All work items	m ²	Maintained area	SRUQ _{ime}	man day	L/M/EE

(3) Illustration for SRUQ and calculation of numbers of required labourers

The illustration shows SRUQ and calculation for the number of labourers for PBC works.

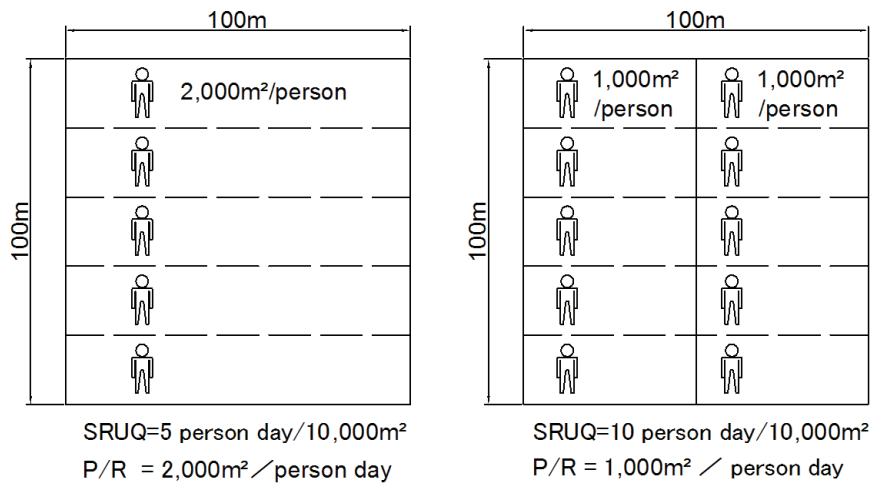


Figure A3-2 Example of SRUQ =5 (persons day/10000m²) and SRUQ= 10 for maintenance Works

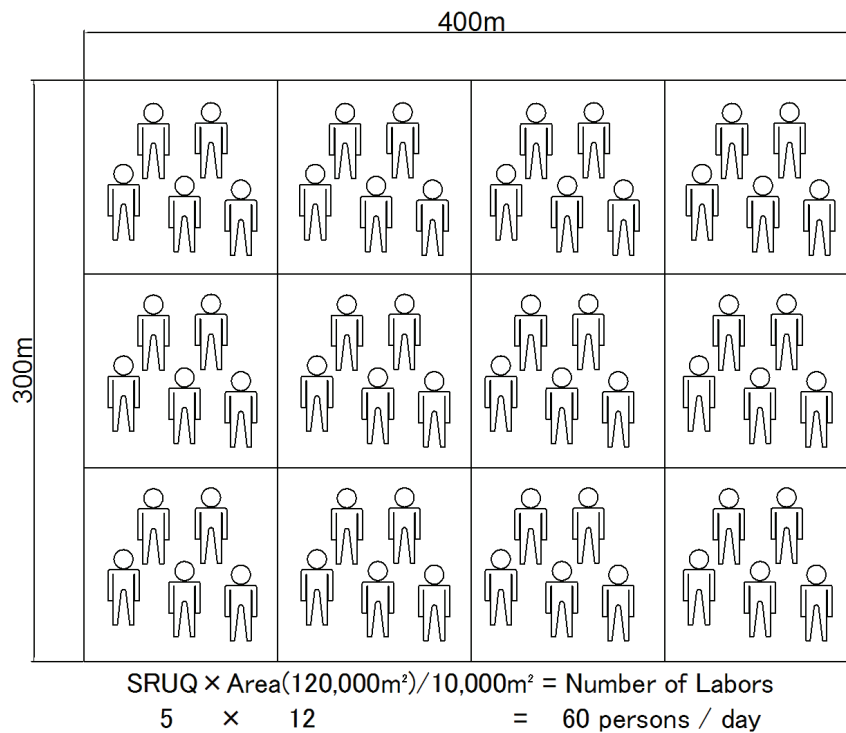


Figure A3-3 Example of calculation of number of labourers from SRUQ
(SRUQ = 5 person days/10,000m²)

Appendix 4: Productivity Survey Forms

I) Form PRI Productivity Survey Sketch Sheet

[Form.PRI] SKETCH SHEET		Date: _____ Inspected by: _____	
Road Name: _____		Region/ Location: _____	
Section No.: _____ Station: _____ + _____ ~ _____ + _____ Work item: _____			
<Top View> <Typical Section> L Start ⇨ R			

2) Form PR2 — Productivity Survey Sheet

[illegible]

Appendix 5: Determination of parameters on deterioration Criteria of Road Marking

In this appendix, 1. Survey method, 2. Survey for determination of damage probability β by Observation method, 3. Survey for New Criteria for Deterioration of Road Marking by Mesh/Grid and Retro-reflectometer method 4. Evaluation methods of Survey Results are introduced. Among the introduced methods, observation method which is the cheapest and fastest is adopted for 2. *Survey for determination of damage probability β* and Mesh/ Grid Method and Retro-Reflectometer Method is adopted for 3. *Survey for New Criteria for Deterioration of Road Marking by Mesh/Grid and Retro-reflectometer method*. In future, it is expected that the proposed new criteria for the deterioration of road markings shown in Table 3-4 will be widely utilised in future for better evaluation of the road markings.

Survey Method

There are three method of survey for road markings, which are categorized by objective of the survey as following shown **Table A5-1**.

Table A5-1 Road Marking Survey Methods

Objective	Observation	Mesh/Grid Method	Retro-Reflectometer Method
Wearing Value	✓	✓	
Reflective Luminance Value			✓

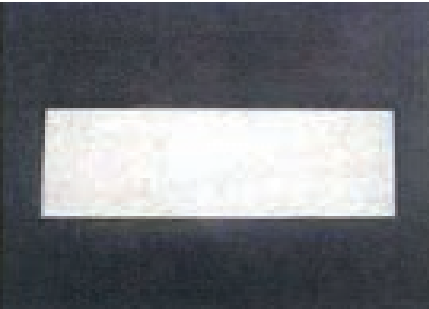
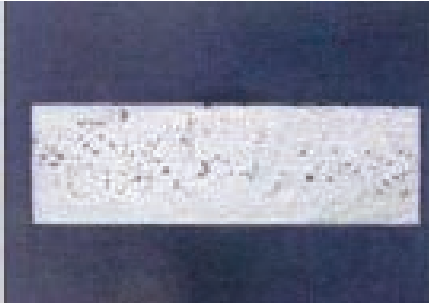
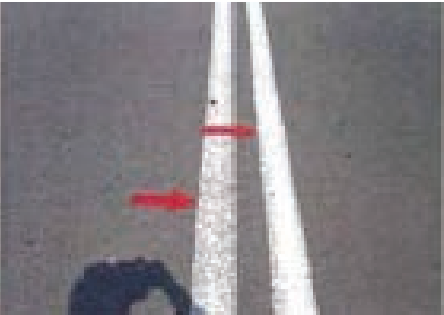
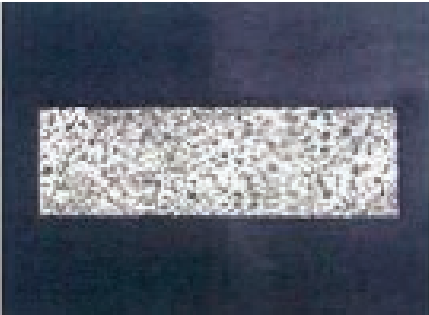
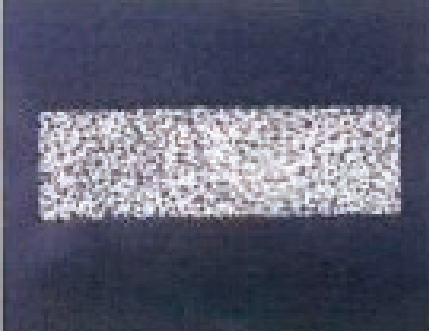
i) Observation Method

Observation Method is used to give the wearing values. In this method, the visual criteria is used to determine the rank of a specific point using the grid chart which rates the condition of the marking into 5 categories. The chart ranks the condition of the road marking from C5 (good condition) to C1 (poor condition). Also, the dirt of the survey point is observed and rated as (0: No dirt; 1: Light; 2: Normal; 3: Heavy). The criteria is shown in Table A5-2.

The following are the procedures carried out during the study using this method;

- i. Select suitable target points for the survey in different parts of the road. The selected points can be saved using the GPS essentials installed in the android phone for location purposes since the survey will be conducted on monthly basis on the same points.
- ii. Observe the marking and dirt on the target point and rank the condition of the marking and the dirt using the grid chart provided.
- iii. Record the values in the monitory survey sheet and take the photo of the surveyed point.

Table A5-2 Deterioration Criteria of Observation Method for Road Marking

Deterioration Rank	Sample Photos		
C5			
C4			
C3			
C2			
C1			

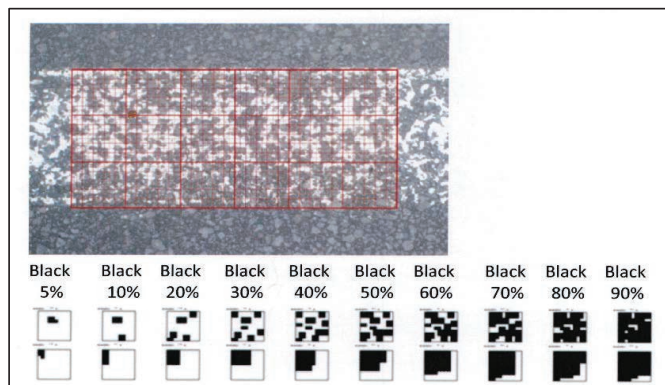
2. Mesh/Grid Method

Mesh/Grid Method is used to give the wearing values. The survey shall be conducted as per the following procedure.

- i. A rectangular grid divided into square units (50mm×50mm) is placed on the target point with paint to identify the wearing ratio using the grid chart provided.



- ii. The wearing ratio will be measured by **Mesh Method** at each point. Place the Grid and classify the wearing percentage of paint at each square unit using the grid chart and record the values. Take photos of the condition of the marking.



- iii. Compute the average of the value to get the wearing value.

3. Retro-Reflectometer Method

A retroreflectometer machine as shown below is used to give the reflective values.



Figure 1-1 Retroreflectometer

The survey is conducted as per the following procedure.

- i. Identify target section of survey i.e. roundabouts, humps, bus bays, straight road sections etc.
- ii. Using the observation method, identify the deterioration ranks C1 to C5 for the target section.
- iii. For each deterioration rank, select 3 points where the reflectometer machine can obtain their reflective values as shown in the figure below.

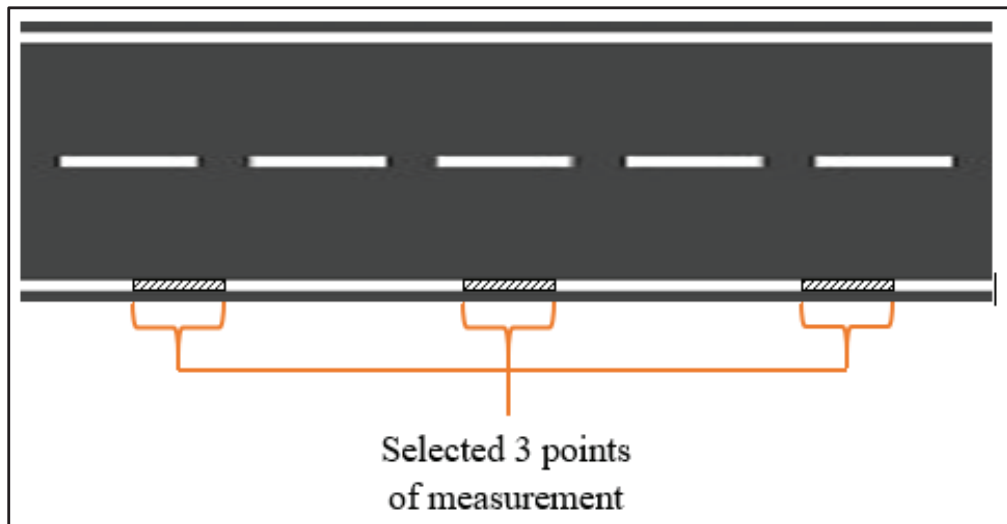


Figure 1-2 Sample of 3 points selected on a deterioration rank C5 road section

- iv. Measure the reflective luminance values using the retroreflectometer machine at each point in 3 steps, that is 1.) before sweeping, 2.) after sweeping with brush and 3.) after cleaning the points with water. Record the reading values in each step and take photos.



- v. Repeat step iv above till reflective luminance values for all deterioration ranks are obtained and recorded.

Survey for determination of damage probability β by Observation method

Based on the deterioration rank criteria C5-C1 shown in Table A5-2 for observation methods, the markings on the six different roads by type of marking had been monitored from May 29, 2018 to October 2, 2018. The type of the road markings are shown in Table A5-3.

Table A5-3 Type of Road Markings

Category	Type of Road Markings
Straight Road Markings (RMs)	Center Line
	Outer Line
Other Road Markings (RMs)	Roundabout
	Zebra Crossing
	Bus Bay
	Warning Paint
	Humps

The results of monitoring are recorded as per the rule shown in Table A5-4.

Table A5-4 Criteria and Recorded Results

Criteria	Recorded Results (Unit : Level)
C5	5
C4	4
C3	3
C2	2
C1	1

The results of the monitoring by type on May 29, 2018 and October 2, 2018 are shown in Table A5-5.

Table A5-5 Results of the Monitoring of Road Markings

Description	Date	Straight Line (S)		Other Lines (O)					All RM (S+O)		Other Lines (O)	
		Outer Line	Center Line	Round About	Zebra Crossing	Bus Bay	Warning Paint	Humps	Ave.	Diff/ month	Ave.	Diff/ month
Ngong Road	05/29/18	4.50	4.88	3.40	3.00	3.67	0.00	0.00	2.78	0.181	2.01	0.178
	10/02/18	3.75	4.13	3.00	1.50	2.00	0.00	0.00	2.05		1.30	
Western Link Road	05/29/18	4.75	4.73	4.67	4.00	4.50	0.00	0.00	3.23	0.073	2.63	0.067
	10/02/18	4.50	4.27	4.33	4.00	3.50	0.00	0.00	2.94		2.37	
Argwings Kodhek Road	05/29/18	5.00	4.50	5.00	4.00	0.00	0.00	4.00	3.21	0.125	2.60	0.150
	10/02/18	5.00	4.00	4.00	3.00	0.00	0.00	3.00	2.71		2.00	
Commercial Street	05/29/18	2.50	3.14	0.00	1.50	0.00	0.00	0.00	1.02	0.028	0.30	0.000
	10/02/18	2.00	2.86	0.00	1.50	0.00	0.00	0.00	0.91		0.30	
Southern Bypass	05/29/18	3.80	4.27	0.00	0.00	2.00	2.67	0.00	1.82	-0.063	0.93	-0.050
	10/02/18	4.20	4.64	0.00	0.00	4.00	1.67	0.00	2.07		1.13	
Eastern Bypass	05/29/18	3.50	3.70	2.00	0.00	4.00	0.00	0.00	1.89	0.038	1.20	0.000
	10/02/18	2.75	3.40	3.00	0.00	3.00	0.00	0.00	1.74		1.20	
Average without southern Bypass	05/29/18	4.05	4.19	3.01	2.50	2.43	0.44	0.80	2.43	0.089	1.75	0.079
	10/02/18	3.60	3.73	2.87	2.00	1.70	0.28	0.60	2.07		1.43	
Difference (level) / 4 months		0.45	0.46	0.15	0.50	0.73	0.17	0.2	0.36		0.32	
Difference (level)/ month		0.11	0.11	0.04	0.13	0.18	0.04	0.05	0.09		0.09	

The summary of the deterioration rate by type of Road Markings is shown in Table A5-6 and Figure A5-1. However, the data of the Southern Bypass is excluded from the average since the improvement works of the road markings were observed in this monitoring period.

Table A5-6 Deterioration rate by RM type (level)

Group	Type of Road Markings	Deterioration Rate using the Observation Method
Straight RMs	Outer Line	0.09
	Center Line	0.11
Other RMs	Roundabout	0.03
	Zebra Crossing	0.13
	Bus Bay	0.18
	Warning Paints	0.04
	Humps	0.05

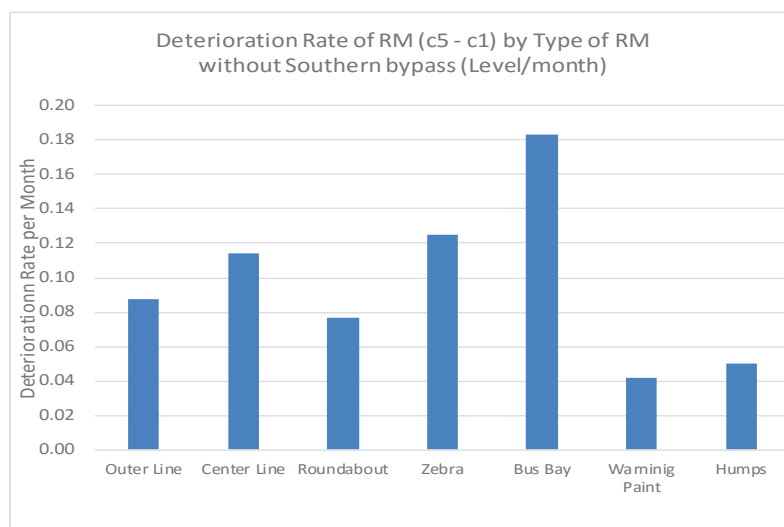


Figure A5-1 Deterioration rate on reflective luminance by type of road marking

The summary of the deterioration rate of other RMs on reflective luminance by road is shown in Table A5-7 and Figure A5-2.

Table A5-7 Deterioration rate by road

Road Name	Deterioration Rate
Ngong	0.156
Western Link	0.073
Argwings Kodhek	0.125
Commercial Street	0.028
Souther Bypass	-0.063
Eastern Bypass	0.038

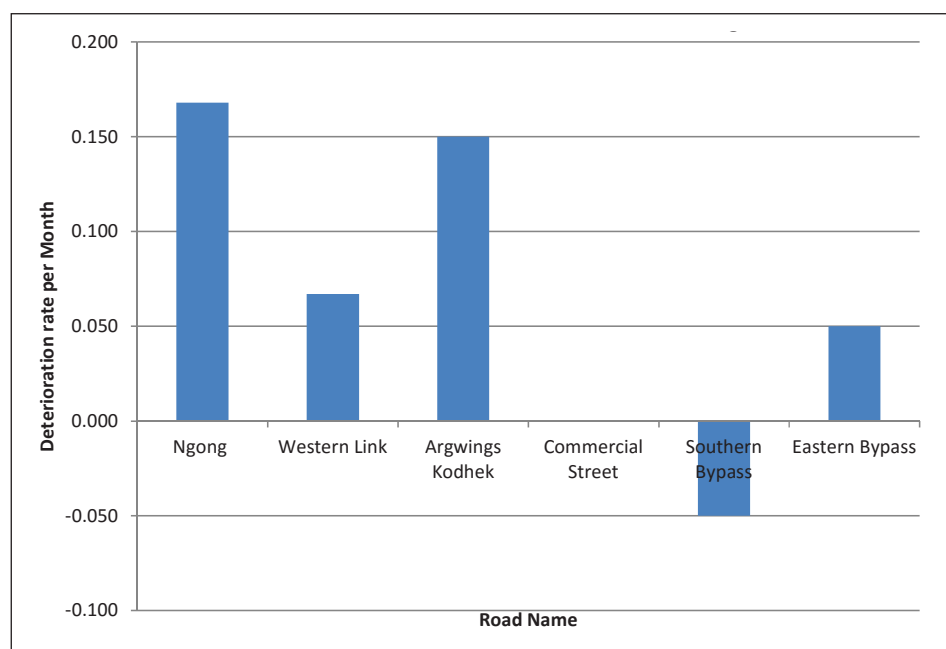


Figure A5-2 Deterioration rate of other RMs on each road

It is assumed that the maintenance of the road markings delineating the lanes are not required during PBC works since it is observed that the deterioration of the road markings delineating the lanes is much slower than other road markings. Therefore, deterioration rate on reflective luminance of other RMs is set in Table A5-8 based on Figure A5-3.

Table A5-8 Deterioration Rate of other RMs on reflective luminance (level / month)

Road Classification	Road Name	Deterioration Rate
N.A.	All Roads	0.1 level / month

The Ratio of the other roads markings over all the marking are outlined in Table A-9

Table A5-9 Proportion of other road marking

Road Classification	Road Name	Ratio
A: Urban Road	Western Link Road, Argwings Kodhek Road, Ngong Road	10%
B: Highway and Rural Road	Thika Road, Southern Bypass, Northern Bypass, Eastern Bypass	3%

It is assumed that the average of values observed during observation method is ranked C4, then the PBC works start. And when the level comes down upto c1, maintenance / repainting is required. Therefore, 3 levels down is required for the next repainting. It is also assumed that the maintenance of the road markings delineating the lanes is not required as aforementioned.

Based on Table A5-8 and Table A5-9, Damage Probability (%/year) is computed as per Table A5-10.

Table A5-10 Computation of Damage Probability β_{rm} (%/month)

Road Classification	Period for next maintenance (C4→C1)	β (%/month) of other RMs	Ratio of other RMs over all RMs	β_{rm} (%/month) of all RMs	β_{rm} (%/year) of all RMs
	A	B = 1/A	C (Table 2.416)	D = B×C	E = D×12
A	3 levels / 0.1 = 30 month	3.3%	10%	0.33% / month	4.00% / year
B			3%	0.10%/month	1.20% / year

2. Quantification Method

Sample of quantification of PBC works on road markings is shown in A5-11.

Table A5-11 Sample Quantification PBC Works

No	Work Item	Total FQ	β_{rm}	Quantity /year	Cotract Period	Total Q'ty	Decision Rate	Q'ty for PBC
		m ²	%	m ²	years	m ²	%	m ²
		A	B	C = A×B	D	E = C×D	F	G = E×F
1	Straight RMs (Center, Outer)	10,000	4.0	400m ²	2	800m ²	100%	800m ²
2	Other RMs (Roundabout, Zebra, Bus Bay, Warning Paint, Humps)							

Survey for New Criteria for Deterioration of Road Marking by Mesh/Grid and Retro-reflectometer method

The survey on wearing ratio and reflective luminance values (Rl: co-efficient of retroreflected luminance; and Qd: luminance co-efficient under diffuse illumination) for road markings in white and yellow at 24 points in Nairobi was conducted with MTRD to propose New Criteria for deterioration of Road Markings. The results and the correlation curves are shown in Table A5-12.

Table A5-12 Survey Results of White Line

Road Name	Point	Wearing Ratio	RL	Qd
Commercial Street	1	83.0	9	70
Commercial Street	2	59.7	10	62
Commercial Street	3	51.1	18	76
Southern Bypass	1	8.3	79	182
Southern Bypass	2	5.3	81	182
Southern Bypass	3	5.5	83	176
Southern Bypass	1	7.5	116	204
Southern Bypass	2	5.8	133	203
Southern Bypass	3	5.0	107	202
Western Link Road	1	44.5	12	62
Western Link Road	2	12.0	23	78
Western Link Road	3	25.8	27	73
Western Link Road	1	24.5	22	77
Western Link Road	2	30.0	25	52
Western Link Road	3	11.5	24	80
Argwings Kodhek Road	1	7.8	55	102
Argwings Kodhek Road	2	7.8	57	112
Argwings Kodhek Road	3	6.3	61	105
Argwings Kodhek Road	1	5.0	43	129
Argwings Kodhek Road	2	5.0	41	124
Argwings Kodhek Road	3	5.0	40	121
Ralphe Bunch Road	1	5.0	33	87
Ralphe Bunch Road	2	5.3	27	84
Ralphe Bunch Road	3	5.5	34	84

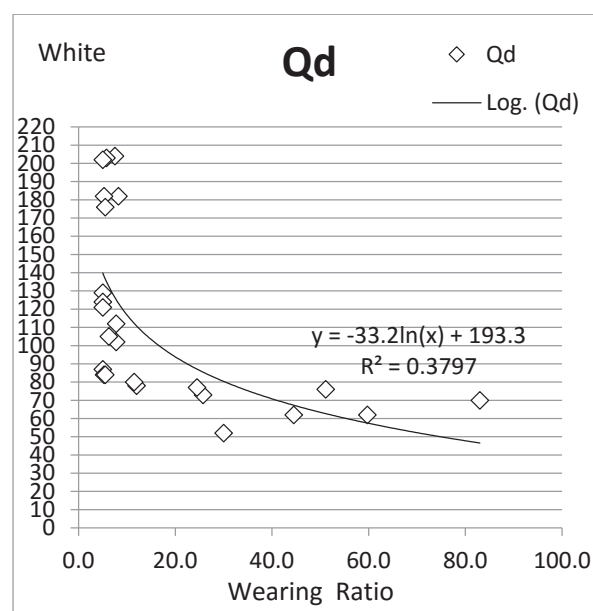
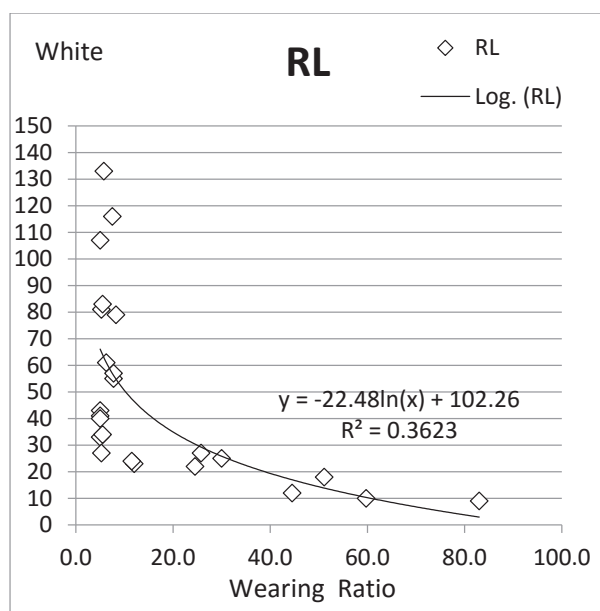


Figure A5-3 Correlation Curve between Wearing Ratio and Reflective Luminance Value (White Line)

Table A5-13 Survey Results of Yellow Line

Road Name	Point	Wearing Ratio	RL	Qd
Commercial Street	1	23.8	28	87
Commercial Street	2	29.4	30	86
Commercial Street	3	35.5	30	89
Southern Bypass	1	11.0	32	114
Southern Bypass	2	10.3	35	112
Southern Bypass	3	7.8	31	108
Southern Bypass	1	7.5	27	104
Southern Bypass	2	11.0	32	108
Southern Bypass	3	9.8	26	106
Western Link Road	1	5.0	41	91
Western Link Road	2	5.0	45	89
Western Link Road	3	5.0	45	87
Western Link Road	1	5.0	45	95
Western Link Road	2	6.5	41	93
Western Link Road	3	6.3	48	92
Argwings Kodhek Road	1	5.3	35	111
Argwings Kodhek Road	2	5.0	43	111
Argwings Kodhek Road	3	5.3	53	111
Argwings Kodhek Road	1	5.0	30	106
Argwings Kodhek Road	2	5.0	35	105
Argwings Kodhek Road	3	5.0	34	98
Ralphe Bunch Road	1	5.0	31	89
Ralphe Bunch Road	2	6.3	25	100
Ralphe Bunch Road	3	5.0	30	90

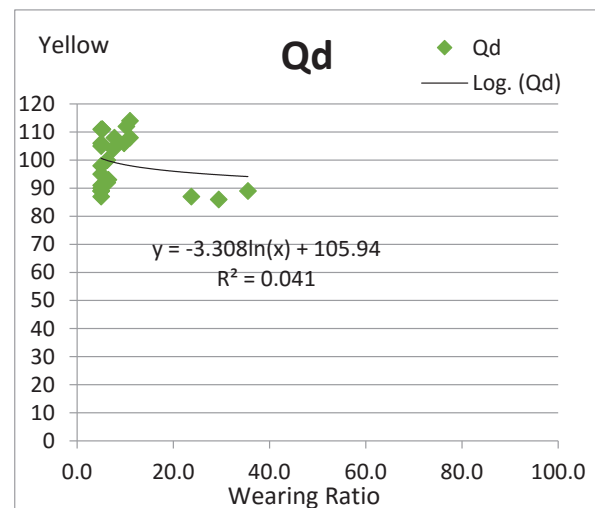
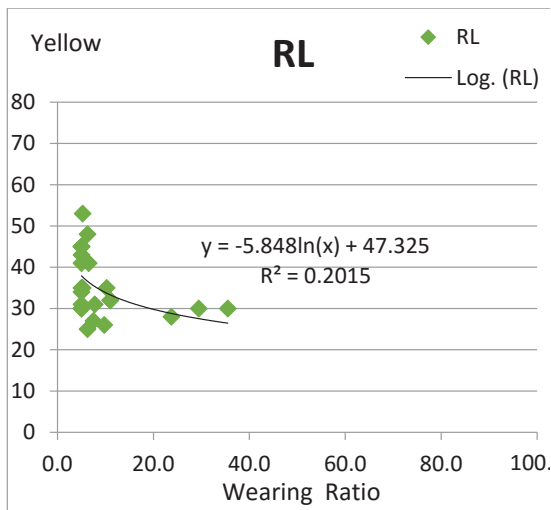


Figure A5-4 Correlation Curve between Wearing Ratio and Reflective Luminance Value (Yellow Line)

Particularly the correlation curve for white line, it is observed that reflective luminance value drops drastically while the wearing value drops slowly at the beginning part and the reflective luminance value drop slowly at middle and ending part of the curve to form logarithmic correlation curve. It can be understood that the peeling of glass beads contributed to form this curve. It means at the beginning part reflective luminance value descends due to the peeling of glass beads while wearing value remains constant.

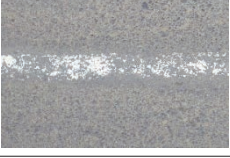
Therefore, the coverage of the wearing ratio shall be small at the beginning and the coverage of the wearing ratio shall be big at the middle and end part of the curve. The proposed criteria for deterioration of Road Markings are shown below. Criteria for C5 refers to the criteria used in Japan.

Table A5-14 Criteria for deterioration of Road markings

	Wearing Ratio
C5	0-5
C4	6-10
C3	11-25
C2	26-40
C1	41-

Based on these criteria and the correlation curve shown in the four graphs, the proposed criteria of Reflective luminance is as shown below:

Table A5-15 Proposed Criteria for Deterioration of Road Marking

White					Yellow				
Rank	Picture	Wearing Value	Reflective Value		Rank	Picture	Wearing Value	Reflective Value	
			RI	Qd				RI	Qd
5		0 ~ 5	66	140	5		0 ~ 5	38	101
4		6 ~ 10	50	117	4		6 ~ 10	34	98
3		11 ~ 25	30	86	3		11 ~ 25	29	95
2		26 ~ 40	19	71	2		26 ~ 40	26	94
1		41 ~			1		41 ~		

Evaluation Methods of the survey results

Three evaluation methods are available based on the conducted survey due to the budget and time constraint. The evaluation methods are:

Evaluation based on Observation Method

This evaluation is the cheapest and fastest.

Evaluation based on Mesh/Grid Method

This method is more accurate compared to Observation method. However, it takes more time than the observation method.

Evaluation based on Mesh/Grid Method and Retro-Reflectometer Method

This is the most accurate because of the use of the Retroreflectometer. However the cost of purchase or hiring of the equipment should be considered.

Appendix 6: Information on Volume 3 for Contractors' Reference Use

Cost Estimation Manual for Road Maintenance under Performance Based Contracts has 3 separate volumes.

Volume 1 for Cost Estimation Administrator

Volume 2 for Government Cost Estimators

Volume 3 for Contractors' Reference Use

The computer system COSTES for PBC 2018 is to be used in conjunction with Volumes 1 and 2, whereas COSTES for PBC 2018 for Contractors is to be used especially for cost estimators from private contractors using Volume 3.

Since the Cost Estimation Manual for Road Maintenance under Performance Based Contracts has been developed essentially for use by government officials and Volume 3 has been prepared for reference use by contractors, the following restrictions have been placed on Volume 3 to safeguard information which should only be confidential to government officials.

Restrictions placed on Volume 3 in comparison to Volumes 1 and 2

(This applies same as for COSTES for PBC 2018 for Contractors.)

1. Cost Estimation Parameters 2018 used in Volume 3 has no information on unit rates and percentage add-ons. However, Volume 3 has information on productivity rates such as SRUQs and P/Rs only. Volumes 1 and 2 have all information.
In COSTES for PBC 2018, cost estimators for contractors are required to use their own unit rates and percentage add-ons to obtain the Project Cost.
2. For cost estimation for the 6 Major Labour Based Works, Volumes 1 and 2 includes three types of cost estimation including the type using KM Standardized Quantity.
3. Volume 3 does not include the type using KM Standardized Quantity.

