



Cost Estimation Manual for Performance Based Road Maintenance Contract



Volume 3: Manual for Contractors' Reference & Use

Edition 1.1

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JAPAN INTERNATIONAL COOPERATION AGENCY

Strengthening of Capacity on Road Maintenance Management through Contracting (Phase 2)



COST ESTIMATION MANUAL
FOR PERFORMANCE BASED
ROAD MAINTENANCE CONTRACT

Volume 3: Manual for Contractors' Reference & Use

Edition 1.1

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Foreword

The concept of performance based contracting in road maintenance and management has been adopted in Kenya and was commenced in 2010 on a pilot basis. However, the method of estimating cost of works under performance based contracts was not clear as it was based on traditional method of road maintenance. It was therefore noted that a more scientific and accurate way of cost estimation of PBC road maintenance contracts need to be formulated since these types of contracts differ from the traditional maintenance contracts. To this end, JICA under the Project for strengthening of capacity on road maintenance and management through contracting (phase 2), embarked on the noble task of developing this manual.

The manual has been prepared based on surveys conducted on the ongoing performance based contracts and wide stakeholder consultations. The manual does not only provides scientific method of estimating the cost of PBC road maintenance works but also provides survey techniques for collection of data necessary for regular updating of the manuals. The manual consist of three volumes. Volume I is tailored to be used by the Road Administrator (KRB) who provide estimation parameters and will be in charge of updating of the database. Volume 2 will be used by the road authorities for estimation of Project Cost i.e. determining the ceiling price for purposes of budget allocation, planning and tendering. Volume 3 has been prepared specifically for contractors who will be interested in tendering for PBC works. In volume 3, a deliberate move was taken to exclude information on unit prices and percentages of indirect cost, overheads/profits which the contractors are required to provide during the tendering processes. A computer program known as COSTES for PBC 2015 was also developed with data collected from surveys on the ongoing PBC contracts. The computer program will be used with the manual to ease rigorous computation processes. Explanations on how to operate the program have been appended in the manual.

It is hoped that this manual will be very useful in implementation of this new concept of road maintenance and will be beneficial to both the clients and the contractors.

I urge all stakeholders to make proper use of the manual in costing of PBC road maintenance works to arrive at more accurate cost of PBC contracts, thus guaranteeing value for money and best return to the taxpayer.

Finally, I recognize and 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 formulating this manual. 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 authorities and other government agencies which include KRB, KeNHA, KURA, KeRRA, KWS, KIHBT, NCA and PPOA for their valuable support in the development of this manual.



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Abbreviations and Acronyms

IMP	—	Initial Mobilization Period
P/R	—	Productivity Rate
RA	—	Road Authority
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.

I. Introduction

1.1. Background and Objectives

Performance Based Contract (PBC) is a new type of contract, which was introduced in Kenya recently but is increasingly becoming very common as a 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's in road maintenance, no standard cost estimation method has been developed. This creates a situation that no scientifically based judgment can be made when the Engineer's cost estimate is very different from the actual tender price.

Therefore, the need for development of such standard cost estimation method is vital for sustainable application of PBC. Utilizing the standard cost estimation method is one of the basic fundamentals of project management of PBC's and will enable staff in various road authorities to have proper understanding of the tender price..

This Cost Estimation Manual for Road Maintenance under Performance Based Contract (hereinafter referred to as "the Manual") aims to develop a scientific cost estimation method for PBC road maintenance using cost breakdown sheets and standardized estimation procedures.

The Manual includes not only how to estimate costs but also provide information on survey methods required for revisions and updates of various parameters such as the Standard Resource Usage per (Unit) Quantity (SRUQ) and important cost items such as unit rates.

The Manual is in line with COST Estimation System for PBC 2015 (hereinafter referred to as "COSTES for PBC 2015"), the computer tool used for actual cost estimation exercises.

The Manual and COSTES for PBC 2015 are intended for use by engineers and managers who are responsible for road maintenance in each road authority in Kenya, and who require scientifically based judgment when planning and implementing PBC road maintenance projects.

Volume 3 is for Contractors' Reference and Use. It is issued for use by private contractors participating or interested in PBC projects for better understanding of cost estimation required for successful implementation of such projects. It should be understood that COSTES for PBC 2015 for Contractors, the computer tool used for reference cost estimation by contractors, is not equipped with cost information database unlike COSTES for PBC 2015, the original version for use by the cost estimation administrator and road authorities.

1.2. Structure of Cost Estimation Manual

Three (3) Cost Estimation Manuals are prepared according to the purpose and user shown in **Table I-1**.

Table I-1 Structure of Cost Estimation Manuals

Vol	Name of Manual	User	Objectives
1	Manual for Cost Estimation Administrators	KRB	Cost Survey Provision of Standard Indices Update and Maintenance of database and manual How to Revise Vol.2 and 3
2	Manual for Government Cost Estimators	Road Authorities and KWS	Estimation of Project Cost for Budget Allocation Estimation of Project Cost for Tender
3	Manual for Contractors' Reference & Use	Contractors	Estimation of Project Cost

1.3. 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.

The PBC Works mainly consists of:

- 1) Labour-based works and services such as repair and maintenance of drainage, vegetation, road cleanliness, and provision of a Self Control Unit for self-management of road maintenance; and,
- 2) Other works and services such as repair and maintenance of the carriageway and shoulders, repair of structures, repair on road furniture, profile, width and embankment and slopes.

Table I-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 I-3**.

Table I-3 Details of Instructed Works

Instructed Works	Bill of Quantities	Payment
Rehabilitation Works <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 COSTES Manual 2011.

This Manual is a new edition and focuses exclusively on the PBC Works. It tries to correctly estimate labour-based works and services based on surveys conducted on on-going PBC projects. The Manual therefore reflects the result of the surveys and recommends methods of standard estimation procedures using the results obtained from PBC projects undertaken in 2014 and 2015.

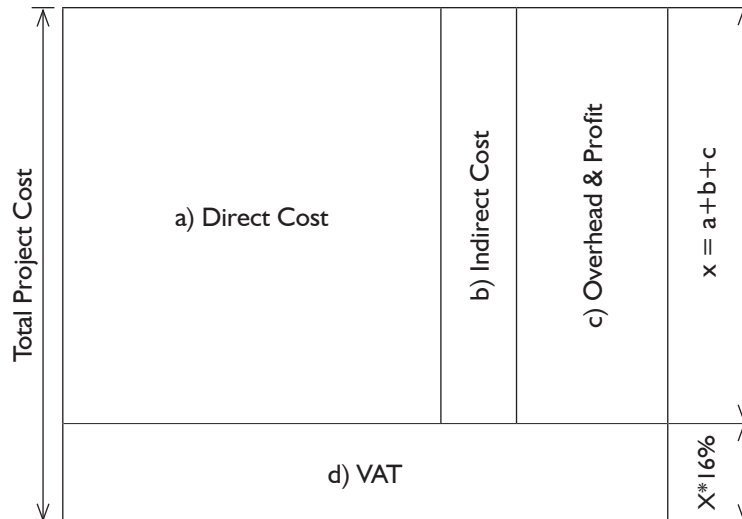
It is important to appreciate that some future projects may be different from those projects surveyed for the purpose of determining various values incorporated into this Manual. For example, in projects surveyed, there were no physical repairs of scour checks and headwalls, and no physical maintenance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

In such cases, the COSTES Manual 2011 should be used to correctly modify the cost estimation by incorporating the additional costs for such physical repairs. Similarly, if a road authority is required to estimate the cost of Instructed Works in addition to the PBC Works, the COSTES Manual 2011 should be used after correctly assessing quantities of the Instructed Works required. In order that the Manual is useful for such cases, an attempt has been made to allow adding such costs as deemed necessary from past experience/data, and collection of estimates for such works, based on prudent judgment of the cost estimator. Default values set out in COSTES for PBC 2015 may also be used.

Contractors are requested to obtain information on unit rates and other cost estimation parameters as required to be able to use Volume 3 for Contractors' Reference and Use.

1.4. Cost Structure for Estimation

The cost structure for estimation is shown in **Figure I-1** and the contents of each cost estimation element 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 COSTES Manual 2011

Figure I-1 Principal Structure of PBC Cost Estimation

Table I-4 Contents of Cost Estimation Components

Components	Cost Estimation Elements	
Direct Cost	Off Carriageway Maintenance Costs (6 Major Labour Based Works and Self Control Unit)	Maintenance costs which are required for the PBC Works such as repair and maintenance of drainage, vegetation, road cleanliness and provision of Self Control Unit for self-management of road maintenance.
	Other PBC Works	Maintenance costs for the PBC Works such as repair of carriageway and shoulders, repair of structures, repair of road furniture, repair of road profile and width, and repair of embankment and slopes.
	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 and necessary haulage cost for transporting labour, materials and equipment from/to the site.
Indirect Cost	<ul style="list-style-type: none"> • 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 a percentage of the Direct Cost
Overhead & Profit	<ul style="list-style-type: none"> • Head Office Management Cost • Head Office Staff Salaries and Allowances • Cooperate Social Charges • Research and Development • Advertisement and Publicity • Depreciation Costs for Fixed Asset • Profit Margin 	Cost computation for these items is taken as a percentage of the sum of Direct Cost and Indirect Cost

The structure of a typical project is shown in **Figure I-2**. The Direct Cost consists of Labor Based Maintenance Costs, Non Labor Based Maintenance Costs and Miscellaneous Costs and Others. Quantities for Labor Based Maintenance Costs are computed as the product of quantities and SRUQs.

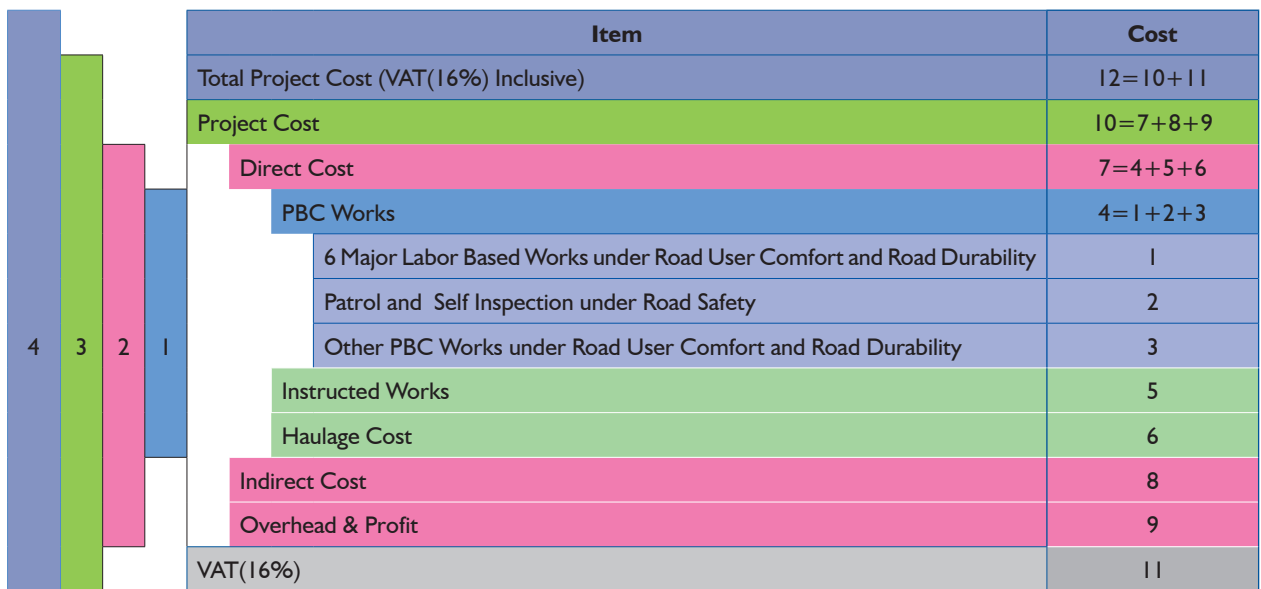


Figure I-2 Structure of Cost Estimation of Direct Cost

1.5. Definition of SRUQ and P/R

Standard Resource Usage per (Unit) Quantity (SRUQ) is the ratio of the number of person-days divided by the volume of work completed. On the other hand, Productivity Rate (P/R) is an inverse of SRUQ.

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

Example:

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

Example:

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

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

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

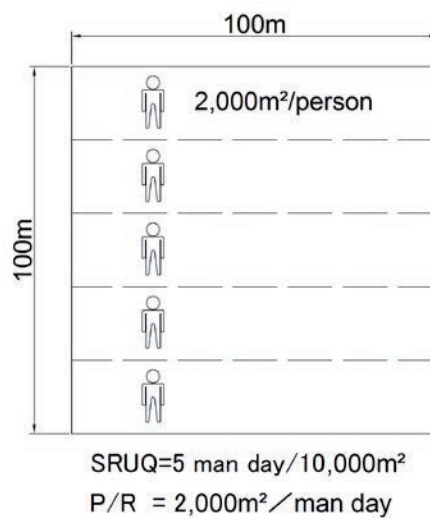


Figure I-3 SRUQ and P/R

2. Role of Cost Estimators

The roles of a cost estimator are as follows;

1. Performing cost estimation based on adequate work/service items and adequate costs.
2. Performing cost estimation based on standardized methodologies.
3. Performing cost estimation based on understanding of individual features of the project concerned.

3. Cost Estimation Methods of PBC Works

Cost estimation is performed in two stages.

The first stage involves cost estimation of the PBC Works. The contents of the PBC Works maybe split into three (3) categories as indicated in **Table 3-1** based on cost elements involved. The details of the sic (6) Major Labor Based Works are indicated in **Table 3-2**.

Compatibility of such three categories in respect to the specific service scope are indicated in **Table 3-3**.

Table 3-1 PBC Works

No	Categories	Description	Cost Element
1	Patrol and Self-Inspection (Self Control Unit)	For patrolling under Road Usability and for self-inspection	Labour, vehicles and fuel costs.
2	6 Major Labor Based Works (Table 3-2)	Essentially the work is labor based and off-carriageway activity.	Labour cost only. Vehicle and fuel costs are included in Haulage Cost.
3	Other PBC Works	Works involving the carriageway and others.	Labour, materials, machineries and equipment. Vehicle and fuel costs are included in Haulage Cost.

Table 3-2 6 Major Labour Based Works

No	Item
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	Carriage Way Cleaning

Table 3-3 Compatibility of the PBC Works and Service Scope

Category	Service Scope	Patrol and Self Inspection	6 Major Labour Based Works	Other PBC Works
Road Usability	A) Road Usability	○		
Road User Comfort	B) Pavement, Shoulders and ROW for Paved Roads (P-B-1) & Unpaved Roads (UP-B-2)	Δ	○ (Cleanliness)	○ (repairing items)
Road Durability	C) Drainage	Δ	○	
	D) Vegetation	Δ	○	
	E) Structures	Δ		○
	F) Road Furniture	Δ		○
	G) Profile and Road width	Δ		○
	H) Embankment and slopes	Δ		○

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

4. Cost Estimation Procedure

This section covers the cost estimation procedure.

4.1 Cost Estimation Flow

Cost estimation required for a PBC project is to estimate the cost by adopting suitable productivity rates and quantities of the required work inputs (resources) for certain work outputs. Since there are numerous works/services to fully complete the PBC project, the cost estimator should be aware of the contents of such works and services as well as the standardized cost estimation flow.

COSTES for PBC 2015 for Contractors has been developed as a part of the Manual to perform actual cost estimation exercises.

Cost estimators are required to be instructed on use of *COSTES for PBC 2015 for Contractors*. The Manual contains the instruction manual for *COSTES for PBC 2015 for Contractors* in Appendix I.

The cost estimation flow is illustrated in **Figure 4-1**.

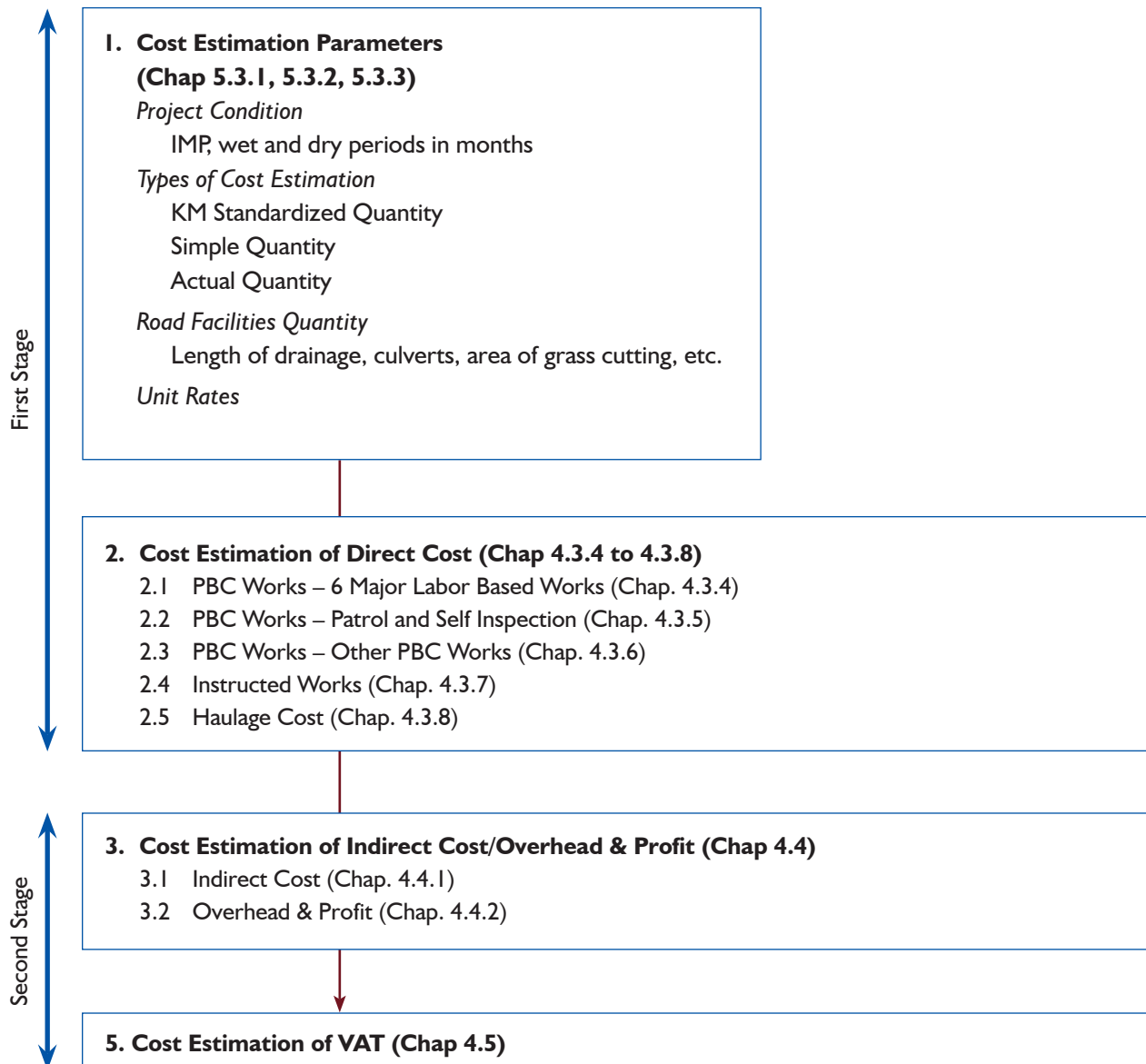


Figure 4-1 Flow of Cost Estimation Method

4.2. Cost Estimation Structure

This section covers the cost estimation structure.

4.2.1 Unit Rates and SRUQs

- SRUQs are obtained from the result of surveys undertaken by the cost estimation administrator. The results are attached in Appendix 3 - Cost Estimation Parameters.
- *COSTES for PBC 2015 for Contractors* is equipped with the above data for 2015.

4.2.2 Layered Structure for Cost Estimation Exercise

- The cost structure for estimation is indicated in **Figure I-1** in Chapter 1.4. In order to standardize the actual structure for cost estimation exercise, the Manual adopts the layered structure as indicated in **Figure 4-2**. *COSTES for PBC 2015 for Contractors* has been developed using the same layered structure.
- **Direct Cost:** This is the summation of PBC Works, Instructed Works (if required) and Haulage Cost for the 6 Major Labor based Works. PBC Works are the summation of the 6 Major Labor Based Works under Road Durability, Patrol and Self Inspection under Road Usability and “Other PBC Works”.
- **Project Cost:** This is the summation of Direct Cost, Indirect Cost and Overhead & Profit.
- **Total Project Cost:** This is the summation of Project Cost and VAT.

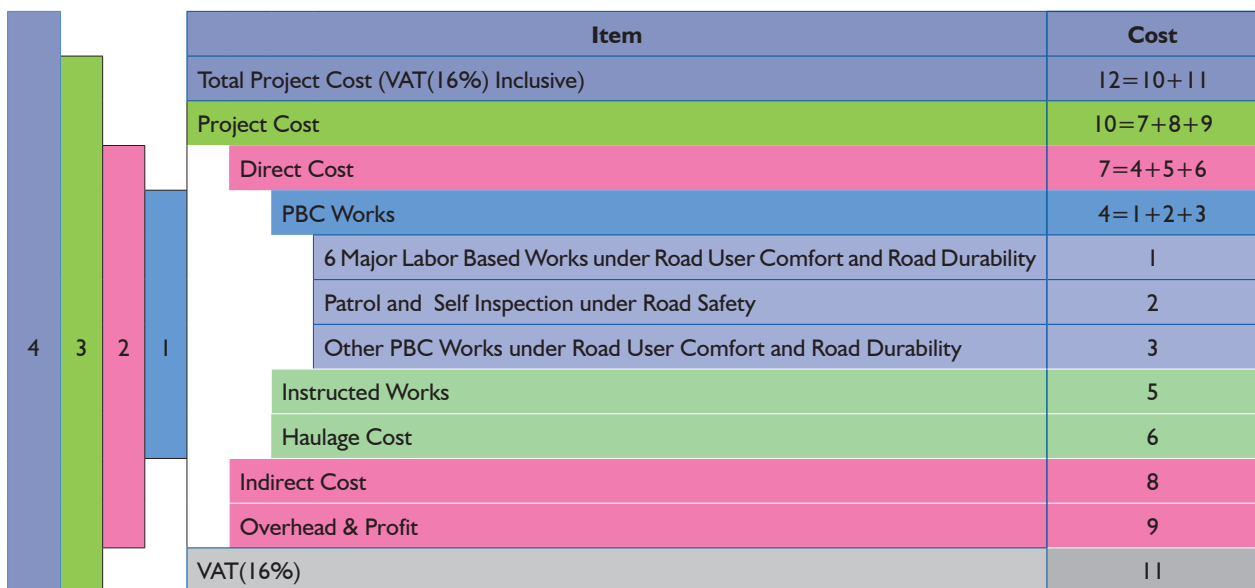


Figure 4-2 Layered Structure for Cost Estimation Exercise

4.3. Estimation Procedure on Direct Cost

This section covers the estimation procedure for computation of the direct cost.

4.3.1. Understanding Project Conditions

4.3.1.1. Project Schedule (Dry/Wet Periods)

Cost estimators are required to split the contract duration into three periods as indicated in **Table 4-1**. These are: (1) the initial mobilization period as specified in the contract document or otherwise fixed by each road

authority; (2) the wet period; and, (3) the dry period under the routine maintenance period. It is necessary for cost estimators to determine the dry and wet periods.

Table 4-1 Information on Project Schedule

No	Periods	What to be Considered	COSTES for PBC 2015
1	Initial Mobilization Period (IMP)	This is the transition period specified in the contract document to allow the contractor to bring up the existing road condition to the required service level in order to prepare the road for PBC Works. It is understood that the volume of work required during IMP is not important whether the period is dry or wet. IMP is normally 3 months.	The default value is set as 3 months.
2	Routine Maintenance Period	Dry Period	No default value is set. It is the duty of the cost estimator to input appropriate values.
3		Wet Period	

Dry and wet periods may be determined from historical precipitation data. The sample for Nairobi region is indicated in **Figure 4-3**. Regional differences may arise and should be taken into account.

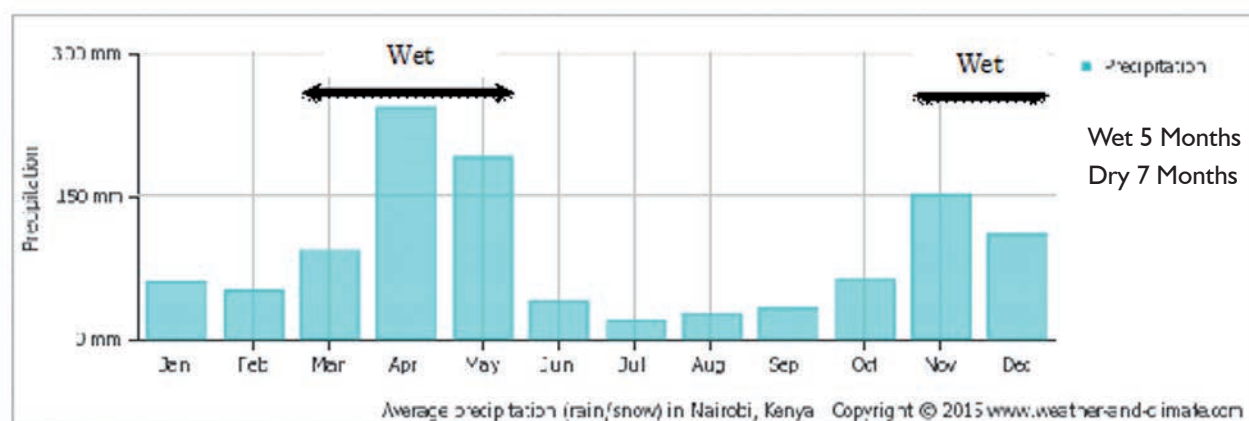


Figure 4-3 Nairobi Region Precipitation Data and Dry/Wet Periods

4.3.1.2. Regional differences

Cost estimators must be aware of the fact that some estimation parameters may differ from one region to another.

- Unit Rates (Labor costs, material costs and hire of machineries and equipment) must be reviewed from one region to another.
- Work Frequency may differ from one region to another. (Generally speaking, high precipitation calls for higher volume of work)

4.3.2. Understanding Types of Cost Estimation

Accuracy of cost estimation reflects the magnitude of survey inputs to ascertain what road facilities are required to be maintained and how such road facilities should be maintained. However, cost estimation is used for various purposes and sometimes accuracy can be of lower priority compared to the delivery time of cost estimation information. COSTES for PBC 2015 for Contractors is equipped with two types of cost estimation which can be chosen based on the purpose of the cost estimation (**Table 4-2**). The magnitude of survey input decreases from 1 to 2. However, the accuracy of cost estimation is higher from 2 and 1.

Table 4-2 3 Types of Cost Estimation

Type	Applicable For	Contents of Cost Estimation
1. Simple Quantity	Obtaining standard cost estimation. On-site survey to determine simple quantities is required.	On-site surveys used to determine works and simple quantities for the 6 Major Labour Based Works.
2. Actual Quantity	Obtaining detailed cost estimation. On-site survey to determine actual quantities is required.	On-site survey used to determine works and actual quantities for the 6 Major Labour Based Works. Actual quantities refer to quantities based on the result of the survey reflecting deduction of the area for vegetation such as car park areas. Please refer to Table 4-4.

For both types, cost estimators must dispatch a team to undertake on-site survey to collect information on what works are required under the 6 Major Labor Based.

It is necessary that cost estimators must sufficiently be aware of various service levels and tolerances required in the PBC Works in relation to work outputs. The result of cost estimation should be double checked to confirm all service levels are covered.

The relationship among each type of cost estimation, cost estimation parameters already in-built in *COSTES for PBC 2015 for Contractors* and are to be used as fixed parameters. Data/information required to be obtained from on-site surveys by cost estimators are indicated in **Table 4-3**. Further information is presented in **Table 4-4** for understanding differences on Simple Quantity and Actual Quantity..

Table 4-3 Relationship of 2 Types of Cost Estimation, Fixed Parameters and On Site Survey

Cost Estimation Method	$\text{cost estimation} = \text{quantity of work output} \times \text{SRUQ of labor input} \times \text{unit rates of labor}$
<p>Cost estimation parameters pre equipped in COSTES for PBC 2015</p> <p>Periodical surveys are required by the cost estimation administrator so that cost estimation parameters are maintained.</p>	
<p>1 Use of 'actual quantity' as the quantity of the work output</p> <p><i>On-site survey is required before cost estimation to obtain actual quantities on all work outputs</i></p> <p>2 Use of 'simple quantity' as the quantity of the work output</p> <p><i>On-site survey is required before cost estimation to obtain simple quantities on all work outputs</i></p> <p>3 Use of 'km standardized quantity' as the quantity of the work output</p> <p><i>No on-site survey is required before cost estimation Only the project length required</i></p>	<p>1 $\text{cost estimation} = \text{actual quantity} \times \text{SRUQ of labor input} \times \text{unit rates of labor}$</p> <p>2 $\text{cost estimation} = \text{simple quantity (simple/actual)} \times \text{SRUQ of labor input} \times \text{unit rates of labor}$</p> <p>3 $\text{cost estimation} = \text{km standardized quantity} \times \text{project length} \times \text{SRUQ of labor input} \times \text{unit rates of labor}$</p>

Pre determined cost estimation parameters

Cost estimation parameters to be checked on site by cost estimator

Table 4-4 Two Types of Quantities

What are Simple Quantity and Actual Quantity ?

(1) Simple Quantity

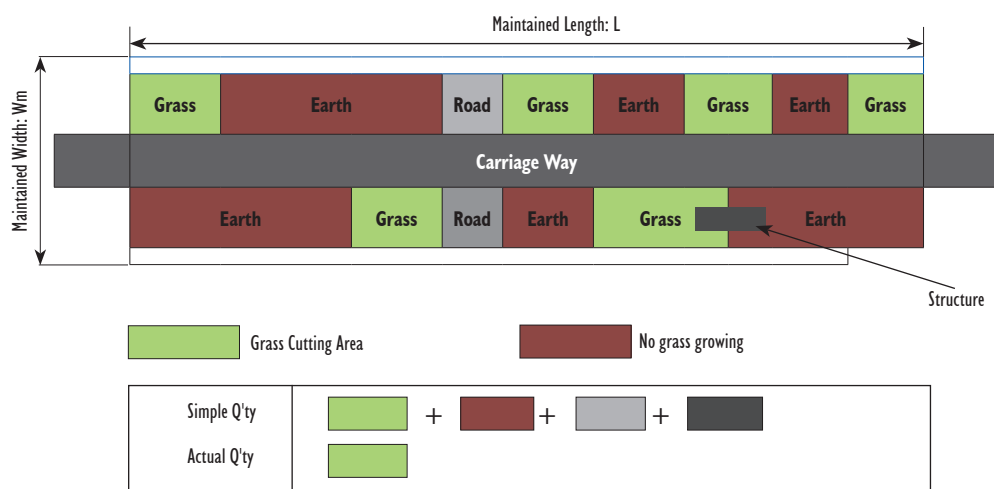
The quantity of road facilities obtained purely from mathematical calculation based on the lengths, widths and numbers obtained from on-site survey to be included in the Contract.

(2) Actual Quantity

The quantity of road facilities obtained from the on-site survey and determined by the survey team as the quantity required to be maintained under the contract.

Example: Grass Cutting

Simple quantity and actual quantity for Grass Cutting are defined as shown in the figure below.



In **Table 4-5**, a reference fixed percentage of Simple Quantity/Actual Quantity (which is labelled '(Simple/Actual)%' in Table 4-3 and which is termed as 'Quantity Ratio' in COSTES for PBC 2015 for Contractors is indicated for 6 Major Labor Based Works. This has been obtained from surveys conducted in 2014 and 2015. This data is indicated for reference only and cost estimators are advised to carry out own survey to ensure authenticity for their own use.

Table 4-5 Reference Fixed Percentage of Simple Quantity/Actual Quantity

6 Major Labour Based Works	Unit	(Simple/Actual) %
Grass Cutting	m ²	33%
Cross Culvert De-silting	m	65%
Catch Basin De-silting	pcs	33%
Lined Side Ditch De-silting	m	50%
Unlined Side Ditch De-silting	m	35%
Carriage Way Cleaning	m ²	32%

Remarks: COSTES for PBC 2015 for Contractors uses data above based on surveys conducted from May to June 2014 and February to April 2015.

4.3.3. Adopting Unit Rates

The list of unit rates to be used for cost estimation is shown in **Table 4-6**.

Cost estimators are required to fix suitable unit rates for each item.

The list of unit rates may be reviewed periodically by contractors so that proper unit rates can be used by cost estimators.

For operating *COSTES for PBC 2015 for Contractors*, cost estimators must have this list ready in hand.

Table 4-6 Unit Rates List

Category	Item	Unit	Rate		Remarks
			Mombasa, Nairobi, Kisumu ⁱ	Other Area ⁱⁱ	
Labor	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			
Vehicle Cost ^v (Dry rate)	Truck(2 ton)	KSH/month			
	Pick up (Double Cabin)	KSH/month			
Fuel Cost ^v	Diesel	KSH/litre			
	Gasoline	KSH/litre			
Fuel Consumption	Truck(2 ton)	km/litre			
	Pick up	km/litre			

4.3.4. Estimating Cost for the 6 Major Labor Based Works

Majority of the PBC Works currently underway is comprised of the 6 major labor based works indicated in **Table 4-7**.

Table 4-7 Major Labour Based Work for the 6 items

No	Item
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	Carriage Way Cleaning

This section covers how estimation procedure is followed on estimating the cost of the 6 Major Labour Based Works.

4.3.4.1 Standard Resource Usage per (Unit) Quantity (SRUQ) and Productivity Rate (P/R)

Both SRUQs and P/Rs are labour productivity factors for the 6 Major Labour Based Works explained in Chapter 1.5. They are obtained from the productivity survey and computed into 3 different levels (Heavy, Normal, and Light in relation to Work Difficulty Level). P/R is the inverse of SRUQs.

Cost estimators are simply required to select the periods of the Initial Mobilization Period, the dry period and the wet period. Then either the SRUQs or P/R for the respective levels will be used in cost estimation in accordance with **Table 4-9**.

Table 4-8 Work Difficulty Level and Applications to Cost Estimation

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

Table 4-9 List of Productivity Rates for the 6 Major Labour Based Works (based on simple quantities md: man x days)

Work item	Level	P/R (Simple)		SRUQ (Simple)	
			Unit		Unit
Grass Cutting (m ²)	Heavy	300.0	m ² /md	0.0033	md/m ²
	Normal	1,383.7		0.0007	
	Light	3,304.0		0.0003	
	Total(Ave.)	1,900.3		0.0005	
Cross Culvert (m)	Heavy	11.5	m/md	0.0869	md/m
	Normal	86.1		0.0116	
	Light	155.3		0.0064	
	Total(Ave.)	17.5		0.0570	
Catch Basin (pcs)	Heavy	2.6	pcs/md	0.3810	md/pcs
	Normal	15.0		0.0667	
	Light	69.5		0.0144	
	Total(Ave.)	22.2		0.0449	
Lined Side Ditch (m)	Heavy	31.9	m/md	0.0313	md/m
	Normal	90.6		0.0110	
	Light	1,217.5		0.0008	
	Total(Ave.)	203.8		0.0049	
Unlined Side Ditch (m)	Heavy	114.7	m/md	0.0087	md/m
	Normal	117.1		0.0085	
	Light	1,693.0		0.0006	
	Total(Ave.)	115.2		0.0087	
Carrageway Cleaning (m ²)	Heavy	156.6	m ² /md	0.0064	md/m ²
	Normal	365.5		0.0027	
	Light	904.8		0.0011	
	Total(Ave.)	573.0		0.0017	

* use for COSTES

4.3.4.2. Manpower - Number of Labour (MD₃)

The number of labourers required for labour based works can be computed as shown in **Table 4-10**.

$MD_3 = \lambda \times Q$ is the basic formula.

Table 4-10 Table for Computation of MD₃ (dry season)

	SRUQ * (a)	Quantity (b)	Labourers (MD3) (a) × (b)
1. Grass Cutting	λ_{-1gc} md /m ²	Q_{gc}	MD _{gc} (md)
2. Cross Culvert De-silting	λ_{-2cc} md /m	Q_{cc}	MD _{cc} (md)
3. Catch Basin De-silting	λ_{-3cb} md /pcs	Q_{cb}	MD _{cb} (md)
4. Lined Side Ditch De-silting	λ_{-4ld} md /m	Q_{ld}	MD _{ld} (md)
5. Unlined Side Ditch De-silting	λ_{-5ud} md /m	Q_{ud}	MD _{ud} (md)
6. Carriageway Cleaning	λ_{-6cw} md /m ²	Q_{cw}	MD _{cw} (md)
Total			MD ₃ (md)

Note) md : man day

* SRUQ is selected from **Table 4-9** according to IMP, dry period and wet period.

4.3.4.3. Manpower – Number of Foreman and Supervisor (MD₁ and MD₂)

The number of foremen and supervisors required for labour based works can be computed as shown in **Table 4-11**.

Foreman: $MD_1 = MD_3/90$

Supervisors: $MD_2 = MD_3/30$ are the basic formula.

The above prefixed formula is based on organizing the labour team in accordance with **Figure 4-4**.

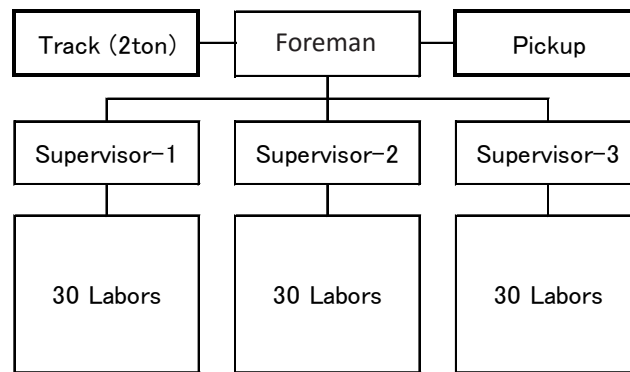
Table 4-11 Calculation of required number of foreman and supervisor

Productivity Rate: P/R (Labour) (per 10,000m²)

Item	Unit	Quantity	Remark
Foreman	man day	MD ₁	MD ₁ = MD ₃ /90
Supervisor	man day	MD ₂	MD ₂ = MD ₃ /30
Labour	man day	MD ₃	From Table 4-9

Number of the Foreman (MD₁) and Supervisor (MD₂) are computed based on understanding the typical organization format indicated in the following **Figure 4-4**.

Figure 4-4 Typical Organization for PBC works



4.3.4.4. Cycle Number (Work Frequency)

In some locations, it is required to perform works frequently to meet the specified service levels. An example is a location that rubbish and debris are likely to be deposited compared to other locations because of the topography. Another example is the case where trees and grass have grown excessively due to ambient environment so that the work must be done frequently. For such cases, an adjustment function called Cycle Number is included in COSTES for PBC 2015 for Contractors

The default values of Cycle Number, which is a value related to work frequency are set as indicated in **Table 4-12**. COSTES for PBC 2015 for Contractors allows the values to be replaced when the need arises.

Table 4-12 Default Cycle Number under COSTES for PBC 2015

Period	Default Frequency under COSTES for PBC 2015	Remarks
Initial Mobilization Period	Once during the Initial Mobilization Period	If IMP is 3 months, the frequency is 1.
Dry Period	Once a month	The default value may be replaced as the case may be.
Wet Period	Once a month	The default value may be replaced as the case may be.

The concept of Cycle Number is explained as follows;

The frequency of the work required to maintain the entire section in a single month is defined as “Cycle Number (CN)”. The quantity of the total monthly work input can therefore be computed by multiplying the quantity of each work input as required with the frequency of the work required to maintain the entire section in a single month. Therefore, the quantity for a specific work during a month can be calculated by using the following formula.

$$\text{Monthly Quantity} = \text{Quantity for an entire section} \times \text{CN}$$

The relationship between CN and the monthly quantity is shown in **Figure 4-5**. The frequency of the work will vary depending upon the period (dry or wet).

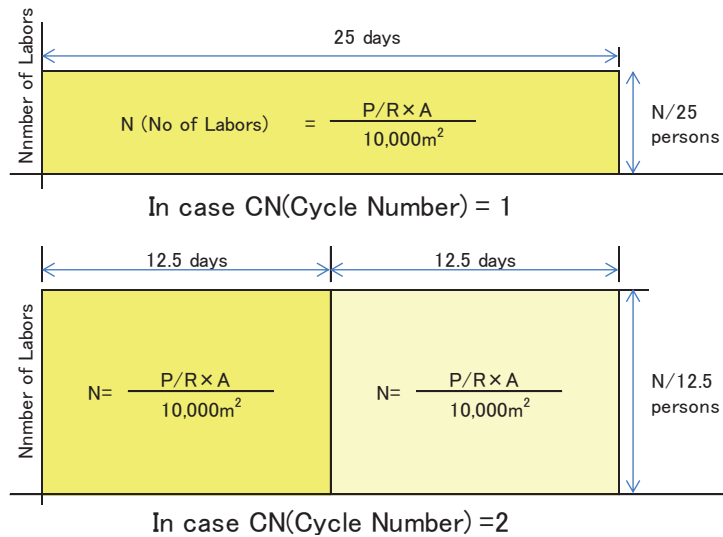


Figure 4-5 Relation between CN and Monthly Quantity of PBC Works

4.3.4.5. Miscellaneous Costs

Cost estimators are required to apply the percentage over the cost of workers as indicated in **Table 4-13**. The percentage is required to cover the cost of miscellaneous costs such as tools, equipment and safety gears required for completing the 6 Major Labour Based Works. The reference list is indicated in **Table 4-14**.

The cost estimators are also required to perform the same for *COSTES for PBC 2015 for Contractors*. Based on the trials conducted, the value of 5% appears to be sufficient for such costs.

Table 4-13 Miscellaneous Costs

Item	Unit	Qty	Q'ty	Remark
Miscellaneous Expenses	%	By Cost estimators	Cost of Foremen, Supervisors, and Labourers	

Table 4-14 Reference List of Items for Miscellaneous Costs

(Per 100 person year)

Item	Unit	Q'ty	Rate	Amount	Remarks
Safety Jacket	Pcs	100			
Helmet	Pcs	100			
Safety Boots	Pcs	100			
Safety Cones	Pcs	20			
Grass Slasher	Pcs	200			
Wheel borrow	Pcs	40			
Shovel	Pcs	20			
Hoe	Pcs	20			
Fork foe	Pcs	10			
Pick-axe	Pcs	2			
Rake	Pcs	20			
Broom	Pcs	600			50 pcs/month
Machete	Pcs	5			
Tape Measure	Pcs	2			
Total					(a)
				%	(a)/(b)%
Workers Total	persons				Labor: 100 persons x 12 months Foremen and Supervisors as required (b)

4.3.5 Estimating Cost of Patrol and Self Inspection (Self Control Unit)

Patrol and self-inspection are basic activities of Self Control Unit that is to be established by the contractor for proper management of the PBC project. This is an important item and especially, cost estimators must be sensitive on the frequency of road patrol.

Cost estimation is based on the formation as indicated in **Table 4-15** below. Cost estimators are required to apply unit rates for cost computation. Cycle number is as indicated in **Table 4-16**.

Table 4-15 Staffing Structure of Self Control Unit

	Position	Task	Requirements	Number of staffs (Depends on the road type and complexity)		
				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	1	1	1
2	SCU Inspector	Data collection Patrol	Experience more than 3 years in 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 assistant (1 vehicle required)

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

Source: PBC Guideline

This table is used as the default setting in COSTES for PBC 2015 for Contractors

Table 4-16 Cycle Number for Self-Control Unit

Description	Cycle Number	Remarks
Road Patrol	4 trips/day (default value) for Paved Road, High	1 trip is patrolling the project length once one way only. Hence, patrolling the project length two round trips a day.
	2 trips/ day for Paved Road, Standard	Patrolling the project length one round trip per day.
	2trips/week for Unpaved Road	Patrolling the project length one round trip per week.

4.3.6. Estimating Cost of Other PBC Works

All service criteria applicable for the PBC Works are listed in **Table 4-18**. The PBC Works are categorized into: (1) Patrol and Self Inspection, (2) 6 Major Labor Based Works and (3) Other PBC Works.

This section covers how to derive the cost of “Other PBC Works”.

As “Other PBC Works” are non-labour based works but are a combination of supply of materials, effective use of machineries and labour service being a supplemental portion, a completely different style of cost estimation must be introduced. At the same time, it must be understood that occurrence of “Other PBC Works” is difficult to predict, therefore accuracy in quantification of work outputs remains low.

In the Manual, three ways of deriving the cost are presented.

- ◆ Bottom-up Method : Identify work outputs, quantify work outputs, compute the volume of resources required, obtain unit rates for each resource and derive the cost for the work
- ◆ Quotations based Method : Identify work outputs, quantify work outputs, obtain quotations for the work outputs and derive the cost for the work; and,

- ◆ Percentages based Method : Based on the past performance, quantify work outputs based on the percentage over the Direct Cost excluding the cost of Instructed Works and derive the cost for the work

From the point of cost estimation accuracy, the Bottom-up Method is the most effective and preferred method. However, since there is no sufficient database to back up the frequency of occurrence of Other PBC Works and on site survey to supplement information is time consuming, the Manual recommends introduction of Percentages based Method at the initial stage, then gradually transferring to either Bottom-up Method and Quotations based Method upon building a sufficient database.

COSTES for PBC 2015 for Contractors is compatible with all the three methods presented above.

Table 4-17 Estimating Cost of Other PBC Works

Method	Key Elements	Remarks
1. Bottom-up Method	<ol style="list-style-type: none"> Contractors have database on identification of work outputs, damage probability, conversion of productivity to work inputs and unit rates. Cost estimators are required to estimate the probable quantity of work outputs. 	COSTES for PBC 2015 for Contractors is compatible.
2. Quotations based Method	<ol style="list-style-type: none"> Contractors have database on identification of work outputs and damage probability Cost estimators are required to estimate the probable quantity of work outputs. Cost estimators are required to obtain quotations. 	COSTES for PBC 2015 for Contractors is compatible.
3. Percentages based Method	<ol style="list-style-type: none"> The percentage of the cost of work over the cost of the Direct Cost excluding the Instructed Works is established from past performance. 	The preferred method by the Manual. COSTES PBC 2015 is compatible

The probable quantity for Other PBC Works can be computed using the following formula;

$$\text{Probable Quantity} = \text{Simple Quantity} \times \text{Damage Probability} \times \text{Contract Duration}$$

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

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 contractor. The Probable Quantity may be computed by multiplying the simple quantity with the damage probability of repairs necessary under Other PBC Works from the database and by contract duration.

In case, the damage probability is set higher than the reality, the cost estimate will be higher and in case, the damage probability is set lower than the reality, cost estimate will fall short of what is actually required. In order to minimize occurrence of such, it is a high priority to collect vital costs information as quick as possible.

Example:

Pothole repair: Simple Quantity (Paved Area) 1,000m² × Damage Probability 0.5%
= Probable Quantity 5m²/Year

Km Post repair: Simple Quantity(Km Posts) 100nos. × Damage Probability 0.3%
= Probable Quantity 0.3 nos./Year

Table 4-18 List of Service Criteria and Cost Estimation

Category	Service Scope	Service Criteria (Paved Road)		Service Criteria (UnPaved Road)		Cost Estimation
Road Usability	A) Road Usability	1	Passability	1	Passability	Patrol and Self Inspection
		2	Road Works Advance Warning Signs	2	Traffic Regulatory Control Signs	
		3	Roughness	3	Roughness	Equipment for measurement IRI needs to add as required.
				4	Average Traffic Speed or Roughness	
				5	Minimum Traffic Speed	
Road User Comfort	B) Pavement, Shoulders and ROW for Paved Roads (P-B-1) & Unpaved Roads (UP-B-2)	1	Road Cleanliness	1	Road Cleanliness	6 Major Labour Based Works
		2	Potholes	2	Corrugation Amplitude	Other PBC Works
		3	Cracking in flexible Pavement	3	Rut Depth	Other PBC Works
		4	Multiple cracks in the pavement	4	Potholes	Other PBC Works
		5	Rutting			Other PBC Works
		6	Ravelling			Other PBC Works
		7	Loose pavement edges			Other PBC Works
		8	Height of shoulders vs. height of pavement			Other PBC Works
		9	Paved shoulders			Other PBC Works
		10	Cracks in Concrete Pavement			Other PBC Works
		11	Interlocking Block Pavement			Other PBC Works
		12	Medians			Other PBC Works
Road Durability	C) Drainage	1	Side Drains, Mitre Drains and cut off drains (lined)	1	Side Drains, Mitre Drains and cut off drains (lined)	6 Major Labour Based Works
		2	Side Drains, Mitre Drains and cut off drains (unlined)	2	Culverts and Access Drifts	6 Major Labour Based Works
		3	Culverts and Access Drifts	3	Scour Checks, gabions and other erosion protection structures	6 Major Labour Based Works
		4	Scour Checks, gabions and other erosion protection structures			Other PBC Works
		5	Manholes and Gulleys			6 Major Labour Based Works
	D) Vegetation	1	Vegetation free zone	1	Vegetation free zone	6 Major Labour Based Works
		2	Outer/inner vegetation	2	Outer/inner vegetation	6 Major Labour Based Works
		3	Growth encroaching into vegetation free zone from the side or top	3	Growth encroaching into vegetation free zone from the side or top	6 Major Labour Based Works
		4	Trees within ROW	4	Trees within ROW	6 Major Labour Based Works
	E) Structures	1	Concrete structures	1	Concrete structures	Other PBC Works
		2	Steel structures	2	Steel structures	Other PBC Works
		3	Expansion joints	3	Riverbeds	Other PBC Works
		4	Riverbeds			Other PBC Works
	F) Road Furniture	1	Warning signs/Mandatory signs	1	Warning signs/Mandatory signs	Other PBC Works
		2	Information signs, Edge marker posts, Guide posts, Kilometre post	2	Information signs, Edge marker posts, Guide posts, Kilometre post	Other PBC Works
		3	Traffic signals	3	Guardrails and Pedestrian rails	Other PBC Works
		4	Street Lighting			Other PBC Works
		5	Road Markings/Road studs			Other PBC Works
		6	Guardrails and Pedestrian rails			Other PBC Works
	G) Profile and Road width			1	Gravel Thickness	Other PBC Works
				2	Camber	Other PBC Works
				3	Usable Road Surface Width	Other PBC Works
	H) Embankment and slopes	1	Embankment slopes	1	Embankment slopes	Other PBC Works
		2	Slopes in Cuts	2	Slopes in Cuts	Other PBC Works

4.3.7. Estimating Cost of Instructed Works

The scope of the Instructed Works is provided for in the tender document by the road authority with quantities for work outputs indicated in the bill under the Instructed Works.

Cost estimators are required to apply applicable unit rates for each work output.

COSTES for PBC 2015 for Contractors is equipped with cost computation for the above.

4.3.8 Estimating Cost of Haulage Cost

The haulage cost is the cost required for transporting materials, labour and equipment to and from the site.

Cost estimators are required to fix the cost to cover for such activities as deemed necessary..

COSTES for PBC 2015 for Contractors is equipped with cost estimation for two options of using either a 2-ton truck or a single pick-up truck as indicated in **Table 4-19**.

Cost estimation is based on the formation as indicated in **Table 4-20**. Cost estimators are required to apply unit rates for vehicles, fuel and drivers for cost computation.

Table 4-19 SRUQ for Vehicles (Per Month)

Vehicles	Quantity	Applicable for	Remarks
Truck (2 ton, flat bed)	1	For general roads × This is the default setting for COSTES for PBC 2015. (25 working days/month on hire based)	Including transport of removed earth, weeds and other materials generated from the site.
Pick up	1	For minor or local roads where trucks are not widely used. (25 working days/month or hire based)	

Table 4-20 Cost for Vehicles for Haulage

Description Truck (Flat bed, 2 ton)

Unit Month

Quantity 1

Item	Specs	Unit	Unit Rate	Quantity	Amount	Remarks
Vehicle	Truck (2.5-5ton)	Unit	Appendix 2	1		
Fuel		Litre				4km/litre
Driver		Persons		1		

Description Pick up

Unit Month

Quantity 1

Item	Specs	Unit	Unit Rate	Quantity	Amount	Remarks
Vehicle	Pick up (Double Cab)	Unit	Appendix 2	1		
Fuel		Litre				10km/litre
Driver		Persons		1		

4.4 Estimating Procedure on Indirect Cost/Overhead & Profit

4.4.1. Indirect Cost

The cost component applicable for PBC projects as well as other infrastructure projects in Japan are indicated in **Table 4-21**.

In *COSTES for PBC for Contractors*, cost estimators are required to apply a percentage add-on for indirect cost deemed required to the cost of the direct cost computed by the system.

Table 4-21 Construction Project Content Table in Japan

Indirect Work Cost	Site Establishment	Labour Camp Water for Camp Electricity for Camp Access Road
	Site Management	Site Staff Salary/Allowances/Social Charges Office Expenses including Water & Electricity General Safety Measures Human Resource Management Cost
Overhead	Overhead	Head Office Expenses HO Staff Salary/Allowances/Social Charges Director's Remuneration Corporate Social Charges Advertisement and Publicity
Profit	Profit	Profit

4.2.2. Overhead & Profit

Similarly, as in clause 4.4.1, under *COSTES for PBC 2015 for Contractors* cost estimators are required to apply the percentage add-on for overhead and profit deemed necessary on the cost of the total of the direct cost and the indirect cost computed by the system

4.5. Estimating Procedure on VAT

All of the costs are summed up to derive the Project Cost, which is the sum of the Direct Cost, the Indirect Cost and Overhead & Profit. The applicable VAT rate is used to compute the cost of VAT as a percentage of the project cost.

16% VAT is set as the default value in *COSTES for PBC 2015 for Contractors*. In case, VAT percentage is changed by the government, VAT percentage can be modified accordingly.

Appendix

- [Appendix 1](#) COSTES Manual for Contractors
- [Appendix 2](#) Cost Estimation Parameters 2015
- [Appendix 3](#) Examples of Cost Estimation by COSTES for PBC 2015 for Contractors

Appendix I: COST Estimation System for PBC 2015 For Contractors

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I. Introduction

1.1 What is COST Estimation System for PBC 2015?

COST Estimation System for PBC 2015 or “COSTESforPBC2015” is a program to create cost estimation sheets by minimum input of contract condition. Current version can easily calculate the following items:

1. 6 Major Labour Based Works
 - a. Self-Inspection (Road Patrol)
 - b. Works to Sustain Road Durability;
 - i. Grass Cutting, Cross Culvert Desilting, and Catch Basin Desilting; and,
 - ii. Lined Side Ditch Desilting, Unlined Side Ditch Desilting, and Carriageway Cleaning
2. Haulage cost
3. Indirect Cost
4. Overhead and Profit
5. VAT

In addition, the current version can get the cost of the following items:

1. Cost of Other PBC Works
2. Cost of Instructed works

However, unit cost survey and setup of unit cost table are required.

1.2 Concept of the calculation inside COSTES2015

COSTES 2015 calculates cost estimation of the project considering the cost structure are shown in Figure I.1 below. Details of the cost structure are presented in clause 1.4 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3.

Direct Cost		
6 Major Labour Based Works (Major works)	Other PBC Works	Instructed Works
Indirect Cost		
Overhead and Profit		
VAT		

Figure I.1 - Cost Structure from COSTES 2015

1: Direct work Cost (Clause 1.4 & 4.3 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3)

Based on the contract conditions, works quantity and unit price, COSTES calculates “Direct Cost” first. Cost of Other PBC Works, Instructed Works and haulage costs are registered as direct costs.

2: Indirect Cost (Clause 1.4 & 4.4.1 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3)

Indirect Cost is calculated as a percentage of direct cost.

3: Overhead and Profit (Clause 1.4 & 4.4.2 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3)

Overhead and Profit are calculated as percentages of the sum of direct cost and indirect cost.

4: Calculate VAT (Clause 1.4 & 4.5 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3)

VAT is calculated as a percentage (currently 16%) of the sum of direct cost, indirect cost, and overhead and profit.

2. COSTES Program Outline

2.1 System Requirements

1: COSTES2015 is a compact program and works in most computers used in the office.

COSTES2015 development team has tested it with Windows7, Windows8, Windows8.1 (English and Japanese version). Testing COSTES 2015 in Windows 10 is on-going, but not in Windows XP and Vista.

2: Microsoft Excel version 2007 or later

Output is in pdf format but data can be processed in Excel.

ATTENTION If Excel 2013 or later is used, COSTES 2015 might not work properly. In this case, by downloading and installing “AccessDatabaseEngine2010 32bit” from Microsoft Website, COSTES2015 will work.

2.2 Program Files

COSTES2015 consists of three files as shown in Figure 2.1, which should be copied to any folder of the user’s computer.

ATTENTION: Three files should be included in the same folder.




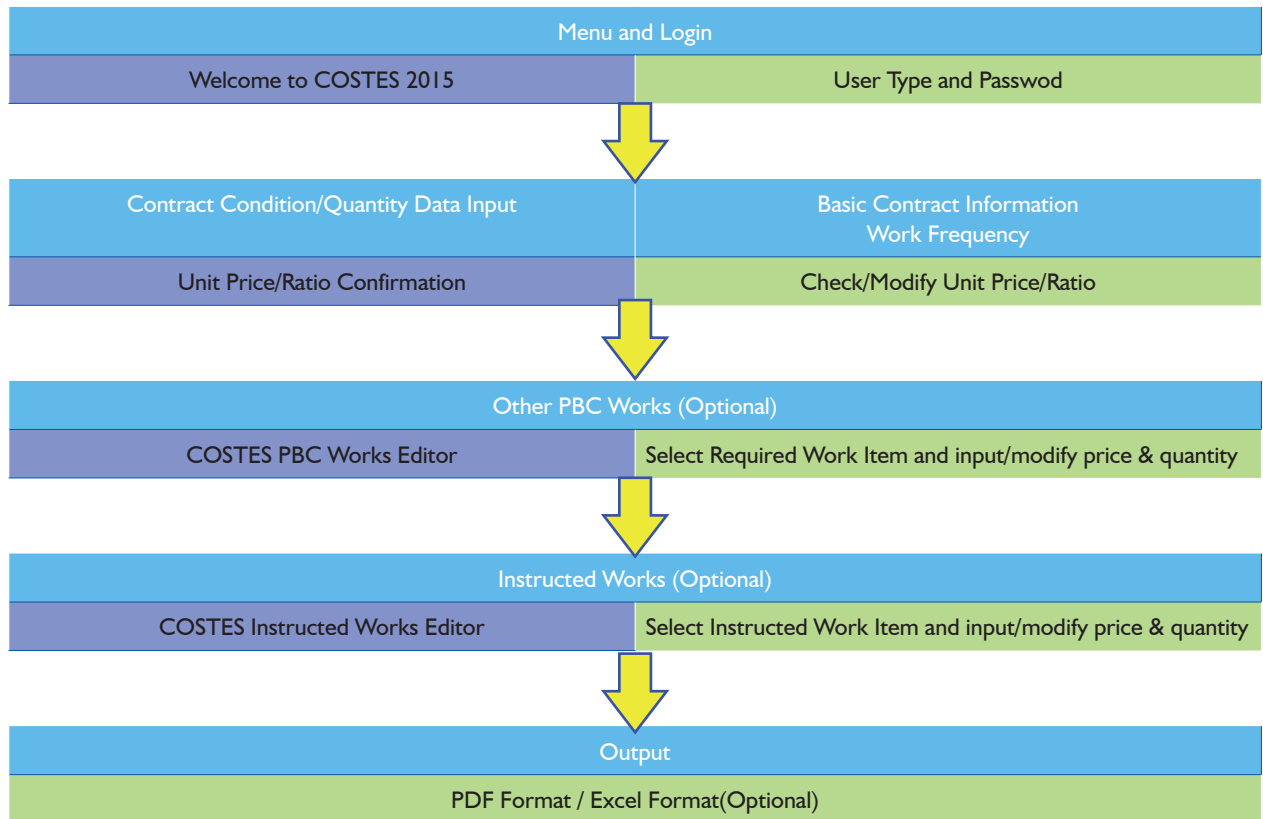
Name	Date modified	Type	Size
 Costes210116	21/01/2016 10:38	Application	1,305 KB
 COSTESini	19/01/2016 16:02	CSTS File	104 KB
 jicadata	21/01/2016 09:04	Microsoft Access ...	1,436 KB

Figure 2.1 - Program File List

- 1: Costes.exe Main Cost Estimation Program
- 2: COSTESini.csts...system file (do not modify)
- 3: Jicadata.accdb...database file (PIN Protected, do not modify)

2.3 Program Structure and Work Flow

Input data and output of the COSTES 2015 is shown in Figure 2.2. Users have to input very basic contract conditions only. After input, COSTES 2015 automatically seeks proper productivity rates (SRUQs), unit prices, and unit quantities per km, if necessary. Then, COSTES2015 automatically generates a cost estimation sheet/s in PDF format. By administrator’s configuration, Excel output can be generated. Users are therefore saved from precise cost searches and making complicated excel worksheets.



(Legend)

Procedure	
Program Window Name	User Input

Figure 2.2 – Basic Data input and Program flow inside the COSTES2015

3. Program Step and User Input

3.1 Menu and Login – “Welcome to COSTES 2015”

Double click “Costes.exe” and below window will appear

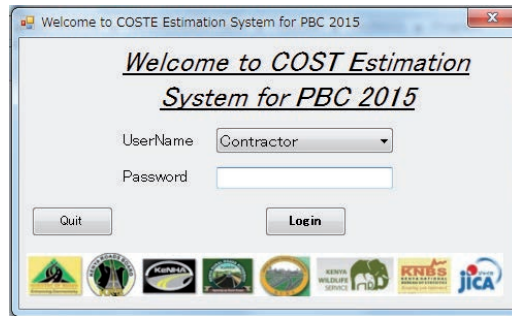


Figure 3.1 – Welcome Window

USERNAME	PIN
Contractor	COSTES

Table 3.1 – PIN for Login

ATTENTION: PIN code is subject to change. Users should ask the administrator for the latest PIN.

3.2 Contract Data Input – “COSTES for PBC Contract Condition Editor”

All editable fields should be filled out otherwise COSTES will not proceed to the next step/form.

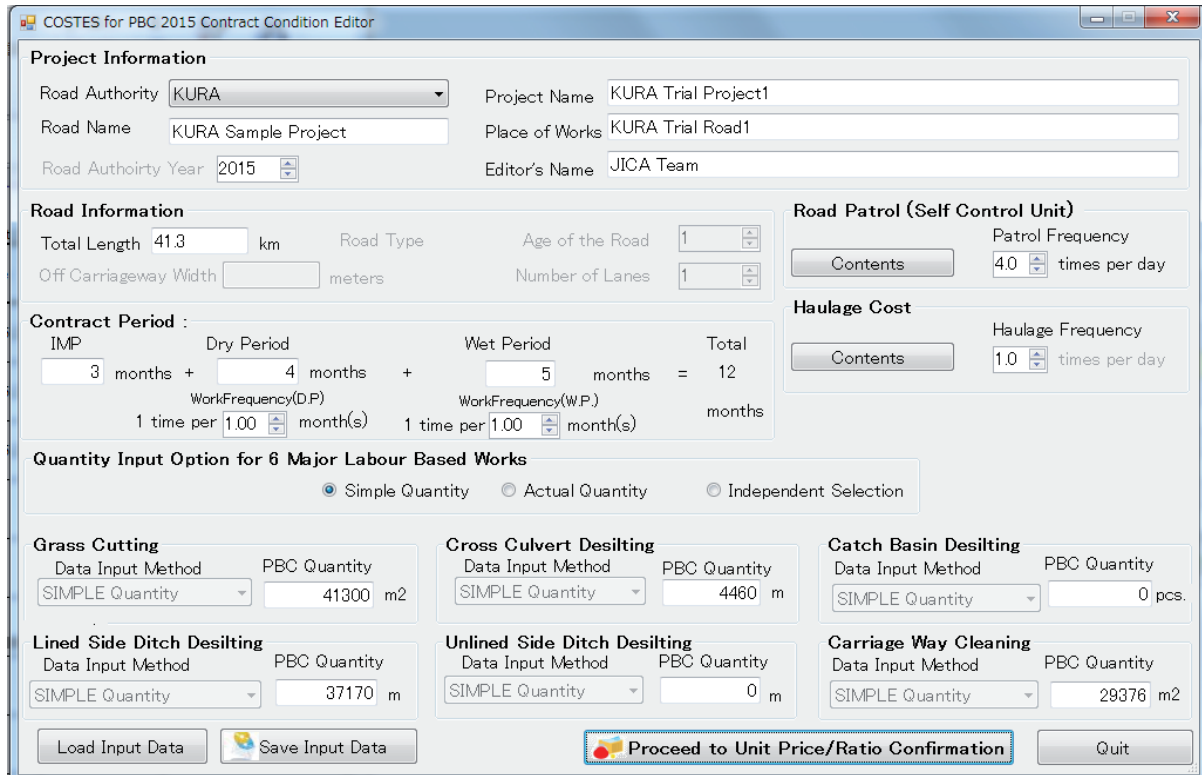


Figure 3.2 - COSTES Contract Condition Editor Window

Input fields and their explanation are listed in Table 3.2.

Table 3.2 - Contract Condition Input

Input Filed	Input Data Type	Description
Road Authority	One Possible Choice	Select user's road authority
Road Name, Project Name, Place, Editor's Name	Type Text	Type information based on the condition
Total Project Length	Numeric	Type Project Length by kilometers
Age, Off-Carriageway, Number of lanes, Road type	Numeric/One Possible Choice	Not available (Future Option)
Contract Periods: Dry Period and Wet Period (Clause 4.3.1.1 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3)	Numeric	Type Project Length by month Decimal input is possible. Default value for Initial Mobilization Period (IMP) is 3 months. Respective work frequency setting is available.
Work Frequency by Period (Clause 4.3.4.4 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3)	Numeric	Number of frequency per month for the 6 Major Labour Based Works. Decimal input is possible (e.g. 0.5 means once per two months). Users can define frequency by each period.
Frequency of Self Control Unit (Road Patrol) (Clause 4.3.5 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3)	Numeric	Number of frequency per day. Decimal input is possible (ex. 0.5 means once every two days)
Haulage Frequency	Numeric	Number of frequency per day. Decimal input is possible (e.g. 1 means one-way haulage / 2 means one round trip)

Users should prepare the size of the maintained area and the work frequency for each of the six major labor-based work items to obtain the quantity input i.e., Based on the kind of data, users can choose input method from one of the following methods. The detail of the quantity input is described in clause 4.3.2 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3.

Table 3.3 - Quantity Input Method

Input Method	Description	Site Survey
Use km Standardized QUANTITIES	By using project length, COSTES automatically calculates quantity using standardized quantity register in COSTES program. No specific quantity is needed but estimation accuracy is relatively low.	Not required (Refer Project length)
Simple Quantity	Fill out the blank with total quantity including both maintained and non-maintained area. Estimation accuracy is moderate but officials have to collect data by on-site survey.	Required
Actual Quantity	Fill out the blank with actual quantity. Estimation accuracy is the best among input methods. However, classification of facilities on whether they are subject to maintenance or not is necessary during on-site survey to obtain the size of maintained area.	Required
Independent Selection	Select input method independently. This option might not be selectable by the administrator.	Depends on each input method

Table 3.4 contains the meanings of some commands.

Table 3.4 - Command list and their Descriptions

Command	Description
“Load Input Data”	Save current inputs as a “boq file.
“Save Input Data”	Load saved contract condition data from file. Entire edited data are saved as a file.
“Setup Unit Price”	Proceed to the next window (Unit Price /Ratio Confirmation). Entire filed should be filled out otherwise error message would appear.
“Quit”	Terminate COSTES. Current data is not saved unless saving as a bod data.

In addition, users can modify the road patrol (Self Control Unit) and haulage inputs by editing tables shown in Figure 3.3 and Figure 3.4 below. The details are shown in Clauses 4.3.5 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3.

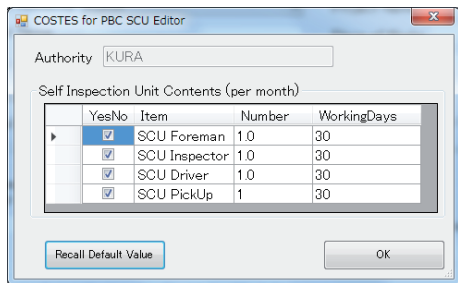


Figure 3.3 - COSTES for PBC SCU Editor

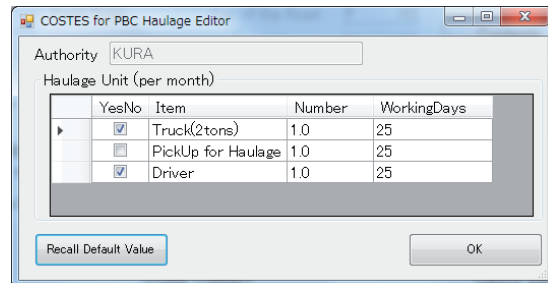


Figure 3.4 – COSTES for PBC Haulage editor

Default contents can be available by clicking “Recall Default Value”. If the box is checked, this content is the member of SCT/Haulage Unit. Default value (30days) assumes that SCU patrols the roads every day. 25days means that the haulage works are carried out on all days of the week except on Sunday. Numbers and working days can be changed based on the condition.

CAUTION In the initial use, users have to set up “default” value by clicking “Recall Default Value” command button to edit the entry.

CAUTION Users have to check the member of SCU and Haulage member at least once.

3.3 Unit Price/Ratio Confirmation – “Unit Price/Ratio Confirmation”

Users can modify and check unit price and ratio by “Unit Price/Raito Confirmation” window shown in Figure 3.5. Firstly, uses have to select the area of “Unit Price Set”. Then default unit prices and ratios will be displayed. Users can modify each value.

CAUTION If logging in as a Contractor, “Unit Price Set” selection is not shown and all fields are blank. Contractor has to fill out all unit prices from their own experience and information from the site visits and surveys. Contractor can choose from “percentage input” or “input by cash amount” for Indirect Cost and Overhead Profit calculation.

Figure 3.5 - Unit Price/Ratio Confirmation Window

Table 3.5 - Fields and their Descriptions

Field	Description	PBC Manual
Unit Price Set (Only Road Authorities)	COSTES has a unit price database of listed area.	4.3.3
Unit Price	Confirm Unit Price. Change them if necessary.	
Miscellaneous (%/Ksh)	Input each cost by percent, miscellaneous cost is multiplied by direct cost. VAT is multiplied by direct cost, indirect cost and overhead & profit.	4.3.4.5
VAT (%)		4.5
Indirect Cost (%/Ksh)	Users can choose input method from “Percentage of direct cost” or “Input each cost by Ksh”	1.4 / 4.4.1
Overhead & Profit (%)		1.4 / 4.4.2

Table 3.6 - Command list and their Descriptions

Command	Description
Recall Default value: (Road Administrator only)	If default value set is required, press this button to recall. Default value set is defined by area.
Proceed to Other PBC Other Works Editor	If values of all fields are filled out, it is possible to proceed to the next window. (COSTES Other PBC Works Editor)
Back to Contract Condition Editor	Back to the Contract Condition Editor form.

3.4 Other PBC Works (Optional) – “COSTES PBC Works Editor”

There are various kinds of maintenance work except for six major labour based works. Therefore, COSTES has prepared other PBC work item list based on the “Other PBC Works” in Table 4-18 of Cost Estimation Manual

for Road Maintenance under Performance Based Contracts Vol.3. Users can select necessary work item(s) and specify price. If other PBC works are not necessary, users can skip this editing process.

Detail explanation is in clause 4.3.6 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3, respectively.

CAUTION Current database is a “sample”. This editor will be effective after specific item list will have been prepared.

CAUTION If logging in as a Contractor, COSTES does not present default unit price.

Figure 3.6 – Other PBC Works Editor Confirmation Window

Table 3.7 – Fields and their Descriptions

Field	Description
Items in Year/any Years	If checked, all item list is selectable no matter the year when the item is registered. If not checked, item list of selected year only is subject to selection.
Region/Pavement/Scope/Item	Select from top to bottom to filter work item

As for the Price Input, users can select one of three methods shown in Table 3.8. Other commands are listed in Table 3.9.

Table 3.8 - Input method options for Other PBC Works

Option	Description
Percentages based method	Calculated by the product of the sum of six major labour based works' cost by constant ratio. Default value is 5 percent.
Quotations based method- "Use own unit price and quantity"	If users want to use own unit price and quantity, users should select this option to enable specific input.
Quotations based method- "Use lump-sum price"	If users want to lump-sum price such as quotation, choose this option and specify lump-sum price, quantity input is not possible.
From Instructed Work List (Bottom-up Method)	In order to achieve Service Criteria, the user should edit necessary works from the work list developed in 2011 to create a new package

If users choose "From Instructed Work List " an editing window as shown in Figure 3.7 will appear. This editor can be used to edit one PBC work item or a set of specific instructed work items.

Side Drains, Mitre Drains and cut off drainsContents Editor

**Side Drains, Mitre Drains and cut off drains
Contents of Work Item Editor (Unit: 1 workunit)**

Region Items in Year Items in any Years

Work Category

WorkItem

Price Input

Item Quantity Unit Unit Price Price

Item ID

ID	Area	Category	WorkItem	Unit	UnitPrice	Quantity	Price	Surv
05.50.006a	Nairobi, Mombasa, Kusumu	05. Earth Works	Fill in soft material and compact (soil purchased)	m3	50000	1	50000	2011

Figure 3.7 - Specific PBC Work Item editor (Usage method is described in section 3.5)**Table 3.9 - Commands and their Descriptions on PBC other works editor**

Command	Description
"Add/Refresh Item"	Add items to the list based on the conditions and values specified above. If an item is selected in the grid and quantity/price is changed, this item is refreshed.
"Delete Item"	Remove items from the list.
"OK"	Back to the gateway.

3.4 Instructed Works (Optional) – "COSTES Instructed Works Editor"

In addition to Other PBC Works, roads require various kinds of special works. COSTES 2015 refers to them as "Instructed works" and users can select necessary work items and input quantities and prices. Editor image is shown in Figure 3.8 and commands/items are listed in Table 3.10 and Table 3.11. Clause 4.3.7 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3 describes the detail.

CAUTION Current items and price database is the Costes2011 table. Therefore a new database is required.

CAUTION If logging in as a Contractor, COSTES does not present default unit price. Therefore, users have to input unit price and quantities, or one set of lump-sum price.

Figure 3.8 – COSTES Instructed Works Editor

Table 3.10 – Items and their Descriptions

Item	Description
Items in Year/any Years	If checked, all item list is selectable no matter the year when the item is registered. If not checked, item list of selected year only is subject to selection.
Category/Work Item Name	Select from top to bottom to filter and select work item.
Item Quantity	Specific quantity of selected work item. Unit is specified in the window

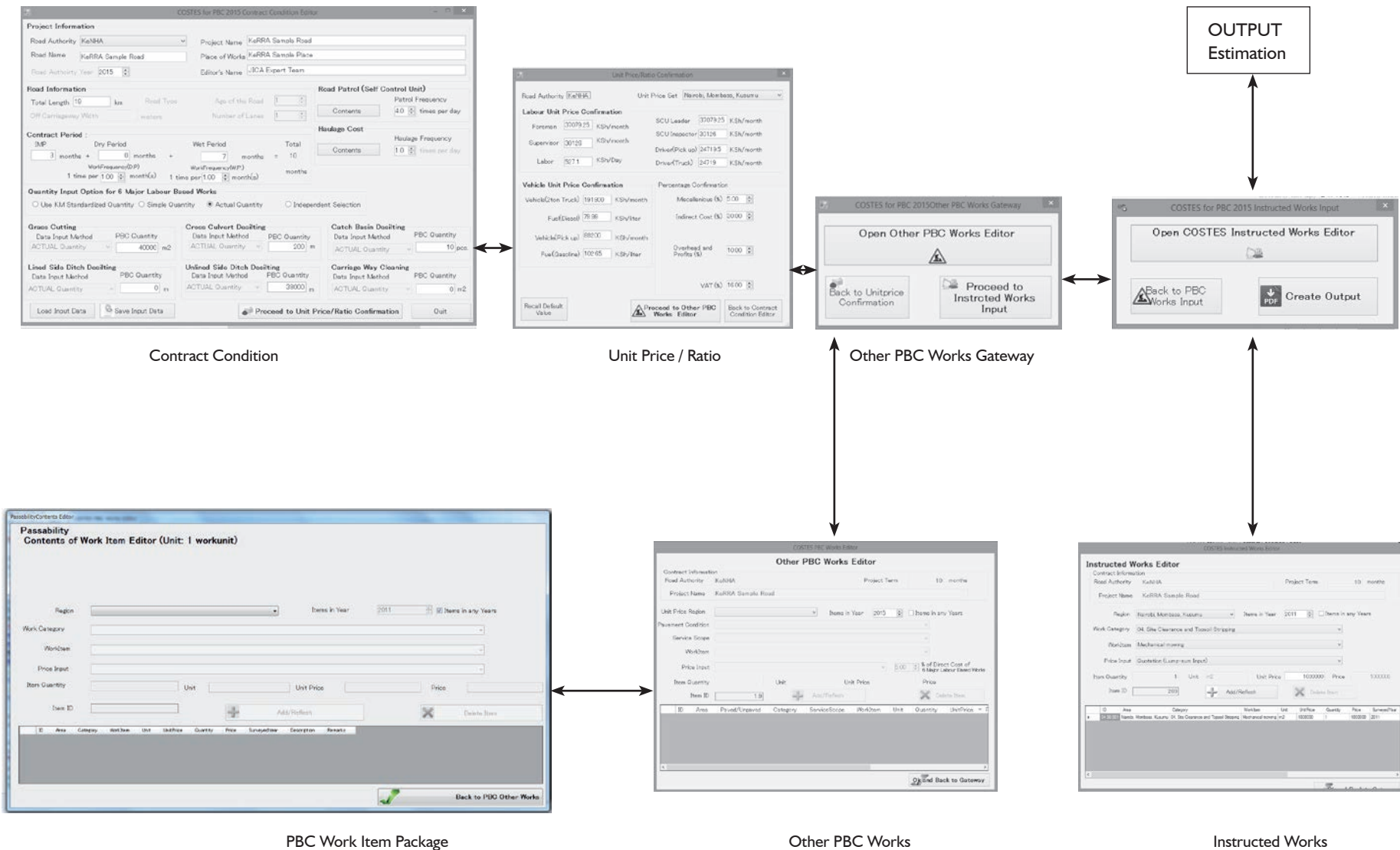
Other commands are listed in Table 3.9.

Table 3.11 - Commands on PBC (other works editor) and their Descriptions

Command	Description
“Add/Refresh Item”	Add items to the list based on the conditions and valued specified above. If an item is selected in the grid and quantity/price is changed, this item is refreshed.
“Delete Item”	Remove selected items.
“OK”	Back to the gateway. List is preserved until program termination.

3.6 From Start to the Goal

Relationship among Unit Price Confirmation, PBC Other works, and Instructed works editor is as follows.



4. COSTES for PBC 2015 OUTPUT

4.1 Cover Page

Fiscal year 2015-2016		Summary of works
Project Name	KURA Trial Project I	
Road Name	KURA Sample Road	
Place of Works	KURA Trial Road I	
Total Length	41.3km	
Contents of Works	PBC Works	
	Self Inspection	41.3km
	Grass Cutting	41.3km
	Cross Culvert Cleaning	41.3km
	Catch Basin Cleaning	
	Lined Side Ditch Cleaning	41.3km
	Unlined Side Ditch Cleaning	
	Carrigeway Cleaning	41.3km
	PBC Other Works	
	Haulage Cost	41.3km
Work Period (Contractor Estimation)	12months (Initial Mobilization Period:3months, Rainy Season:5months, Dry Season:4months)	
	Kenya Urban Roads Authority	

Figure 4.1 – Cover page

The Cover Page contains basic conditions of the Contract such as Names, project length, contents of item, work period, etc...

4.2 Summary Contents

Summary Contents							Page 1
Category	Type of Works	Unit	Quantity	Unit Price	Price	Remarks	
Total Project Cost(VAT 16% Inclusive)		Unit	1		11,052,149	22,301/km/month	
Project Cost(VAT 16%Exclusive)		Unit	1		9,527,715	Direct Cost+Indirect Cost+ Overhead & Profit	
Project Cost w/o Overhead & Profit		Unit	1		8,284,970	Direct Cost + Indirect Cost	
	Direct Cost	Unit	1		6,627,976	PBC Works + Instructed Works + Haulage Cost	
	PBC Works	Unit	1		4,497,204		
	Patrol and Self Inspection under Road Safety	Month	12		2,019,720	A-1	
	Grass Cutting	Month	12		162,030	A-2	
	Cross Culvert Cleaning	Month	12		365,936	A-3	
	Catch Basin Cleaning	Month	12		-	A-4	
	Lined Side Ditch Cleaning	Month	12		1,603,846	A-5	
	Unlined Side Ditch Cleaning	Month	12		-	A-6	
	Carrigeway Cleaning	Month	12		345,672	A-7	
	Other PBC Works	LS	1		-	Other PBC Works Summary	

4.4 Detail Contents (B):

“Detail Contents (B)” summarizes how much and how many resources are expended for a time (cycle) of each maintenance work.

Items of Self Control Unit Inspection (SCU) are; machinery cost (pick up vehicle), material cost (petro fuel) and necessary labor cost (SCU Leader, Inspector and driver). Miscellaneous cost will be calculated as a product of percentages (Manual page 18) and labour costs. Table 4.2 and Figure 4.5 represent images of SCU. Detailed information is in clause 4.3.5 of Cost Estimation Manual for Road Maintenance under Performance Based Contracts Vol.3.

Table 4.2 - Sample output of a Detail Contents (B) (SCU)

Self Inspection Detail Contents (B)						
Ksh 168,310		(Unit; /month {Conditions;41.3km, 4times/day})				B-1
Item	Specs	Unit	Quantity	Unit Price	Price	Remarks
SCU Leader		month	I	30,000	30,000	1Persons/month, Workingdays: 30days
SCU Inspector		month	I	25,000	25,000	1Persons/month, Workingdays: 30days
Driver		month	I	20,000	20,000	1Persons/month, Workingdays: 30days
Vehicle (Pick up)		month	I	40,000	40,000	1Persons/month, Workingdays: 30days
Fuel		Lit	495.6	100	49,560	41.3km * 1.00vehicles * 4times / 10km/lit. *30 days
Micellenious Cost		%	5	75,000	3,750	5%
Total					168,310	

COSTES Output: Self Inspection (SCU)					
Description	Unit	Unit Rate	Quantity	Amount	Remarks
SCU Leader	month	a	I	A = a*I	
SCU Inspector	month	b	II	B = b*II	
Driver (Pick Up)	month	c	III	C = c*III	
Vehicle (Pick Up)	Car	d	IV	D = d*IV	
Fuel	Lit	e	V	E = e*V	
Miscellaneous Expenses	%	f	I	F = d*(A+B+C)	Manual 5.3.4.5
Total				Sum of (A to F)	

Figure 4.5 - Image of SCU calculation.

4.5 Other PBC Works Summary and Instructed Works Summary

Other than the 6 major labour based works, Cost estimation for Other PBC Works and Instructed Works are necessary if they are part of the contract. The information required is already set up in COSTES window and their outputs are shown in Table 4.6 and Table 4.7 below. The total price is sent to the “Table of Summary contents” directly.

Table 4.6 – Other PBC Works Summary; sample output (Clause 6.3.6 of the manual)

Other PBC Works Summary

Direct Cost of Six Major Works: 2122516

ID	Work Category	Work Item	Unit	Quantity	Unit Price	Price	Remarks
10.1	F) Road Furniture	Warning signs/Mandatory signs	Percent	5.00	2,122,516	106,125	Estimate as the ratio of 6 major Labor Based Works, Category Road Durability
10.1	F) Road Furniture	Information signs, Edge marker posts, Guide posts, Kilometre Post	Percent	5.00	2,122,516	106,125	Estimate as the ratio of 6 major Labor Based Works, Category Road Durability
10.1	F) Road Furniture	Traffic Signals	Percent	5.00	2,122,516	106,125	Estimate as the ratio of 6 major Labor Based Works, Category Road Durability
10.1	F) Road Furniture	Street Lighting	Percent	5.00	2,122,516	106,125	Estimate as the ratio of 6 major Labor Based Works, Category Road Durability
10.1	F) Road Furniture	Road Markings/Road studs	Percent	5.00	2,122,516	106,125	Estimate as the ratio of 6 major Labor Based Works, Category Road Durability
10.1	F) Road Furniture	Guardrails and Pedestrian rails	Percent	5.00	2,122,516	106,125	Estimate as the ratio of 6 major Labor Based Works, Category Road Durability
Sub total						637,750	

Table 4.7- Instructed works Summary; sample output (Clause 4.3.7 of the manual)

Instructed Works Summary

Direct Cost of Six Major Works: 2122516

ID	Work Category	Work Item	Unit	Quantity	Unit Price	Price	Remarks
07.05.001	07. Excavation and Filling for Structure	Excavate for structure in soft material (manual)	m ³	10.00	251	2,510	Use Registered Unit Price, Description: Excavate manually soft material for structures.
08.70.0041	07. Excavation and Filling for Structure	Gabion installation	m ²	10.00	628	6,280	Use Registered Unit Price, Description: Provide and place Macaferri or equivalent gabion boxes (2m*1m*1m
08.70.005.	07. Excavation and Filling for Structure	Rock fill to Gabions	m ³	10.00	2,190	21,900	Use Registered Unit Price, Description: Provide and place rock fill to gabions.
08.70.001	07. Excavation and Filling for Structure	Stone pitching	m ²	10.00	3,278	32,780	Use Registered Unit Price, Description: Provide stone pitching including grouting of ratio 1:4 cement to mortar
Sub total						63,470	

5. Conclusion

COSTES for PBC 2015 has been developed for road maintenance engineers and officials of Kenyan road authorities to enable them easily get a standard cost for road maintenance. For contractors, COSTES will help in making their estimation faster and easier for bidding purposes.

Appendix 2

Cost Estimation Parameters 2015

SRUQs and P/Rs for the 6 Major Labor Based Work

Work item	Level	P/R (Simple)		SRUQ (Simple)	
			Unit		Unit
Grass Cutting (m2)	Heavy	300.0	m2/md	0.0033	md/m ²
	Normal	1,383.7		0.0007	
	Light	3,304.0		0.0003	
	Total (Ave.)	1,900.3		0.0005	
Cross Culvert (m)	Heavy	11.5	m/md	0.0869	md/m
	Normal	86.1		0.0116	
	Light	155.3		0.0064	
	Total (Ave.)	17.5		0.0570	
Catch Basin (pcs)	Heavy	2.6	pcs/md	0.3810	md/pcs
	Normal	15.0		0.0667	
	Light	69.5		0.0144	
	Total (Ave.)	22.2		0.0449	
Lined Side Ditch (m)	Heavy	31.9	m/md	0.0313	md/m
	Normal	90.6		0.0110	
	Light	1,217.5		0.0008	
	Total (Ave.)	203.8		0.0049	
Unlined Side Ditch(m)	Heavy	114.7	m/md	0.0087	md/m
	Normal	117.1		0.0085	
	Light	1,693.0		0.0006	
	Total (Ave.)	115.2		0.0087	
Carrageway De-silting(m2)	Heavy	156.6	m2/md	0.0064	md/m ²
	Normal	365.5		0.0027	
	Light	904.8		0.0011	
	Total (Ave.)	573.0		0.0017	

** Used in COSTES for PBC 2015*

Appendix 3

Examples of Cost Estimation by COSTES for PBC 2015 for Contractors

Samples are provided for reference.

Fiscal year 2015-2016		Summary of works
Project Name	KeRRA Sample Project	
Road Name	KeRRA Sample Road	
Place of Works	KeRRA Sample Road I	
Total Length	19 km	
Contents of Works	PBC Works	
	Self Inspection	19 km
	Grass Cutting	19 km
	Cross Culvert Cleaning	19 km
	Catch Basin Cleaning	
	Lined Side Ditch Cleaning	19 km
	Unlined Side Ditch Cleaning	
	Carrigeway Cleaning	19km
	PBC Other Works	
	Haulage Cost	19km
Work Period (Contractor Estimation)	18 months (Initial Mobilization Period: 3 months, Rainy Season: 7months, Dry Season: 8 months) Kenya Rural Roads Authority	

Summary Contents							Page I
Category	Type of Works	Unit	Quantity	Unit Price	Price	Remarks	
Total Project Cost(VAT 16% Inclusive)		Unit	1		16,695,330	22,301/km/month	
Project Cost(VAT 16%Exclusive)		Unit	1		14,392,526	Direct Cost+Indirect Cost+ Overhead & Profit	
Project Cost w/o Overhead & Profit		Unit	1		13,084,115	Direct Cost + Indirect Cost	
	Direct Cost	Unit	1		10,064,704	PBC Works + Instructed Works + Haulage Cost	
	PBC Works	Unit	1		7,389,354		
	Patrol and Self Inspection under Road Safety	Month	18		3,039,426	A-1	
	Grass Cutting	Month	18		897,778	A-2	
	Cross Culvert Cleaning	Month	18		391,726	A-3	
	Catch Basin Cleaning	Month	18		338,200	A-4	
	Lined Side Ditch Cleaning	Month	18		-	A-5	
	Unlined Side Ditch Cleaning	Month	18		2,154,843	A-6	
	Carrigeway Cleaning	Month	18		-	A-7	
	Other PBC Works	LS	1	567,381	567,381	Other PBC Works Summary	

<u>Grass Cutting Detail Contents (A)</u>						
Ksh 897,778		(Unit; /12months)				A-2
Item	Specs	Unit	Quantity	Unit Price	Price	Remarks
Initial Mobilization Period		Times	1	267,705	267,705	B-2 (Unit; 1time/3months)
Wet Period		Times	7.	60,007	420,049	B-3 (Unit; 1time/1months)
Dry Period		Times	8.	25,128	201,024	B-4 (Unit; 1time/1months)
Total					897,778	

<u>Cross Culvert Desilting Detail Contents(A)</u>						
Ksh 391,726		(Unit; /18months)				A-3
Item	Specs	Unit	Quantity	Unit Price	Price	Remarks
Initial Mobilization Period		Times	1	155,052	155,052	B-5 (Unit; 1time/3months)
Wet Period		Times	7.	20,694	144,858	B-6 (Unit; 1time/1months)
Dry Period		Times	8.	11,477	91,816	B-7 (Unit; 1time/1months)
Total					391,726	

<u>Catch Basin Desilting Detail Contents (A)</u>						
Ksh 338,200		(Unit; /18 months)				A-4
Item	Specs	Unit	Quantity	Unit Price	Price	Remarks
Initial Mobilization Period		Times	1	133,759	133,759	B-8 (Unit; 1time/3months)
Wet Period		Times	7.	23,431	164,017	B-9 (Unit; 1time/1months)
Dry Period		Times	8.	5,053	40,424	B-10 (Unit; 1time/1months)
Total					338,200	

<u>Lined Side Ditch Desilting Detail Contents (A)</u>						
Ksh 1,603,846		(Unit; /12months)				A-5
Item	Specs	Unit	Quantity	Unit Price	Price	Remarks
Initial Mobilization Period		Times	1	-	559,347	B-11 (Unit; 1time/3months)
Wet Period		Times	7.	-	985,695	B-12 (Unit; 1time/1months)
Dry Period		Times	8.	-	58,804	B-13 (Unit; 1time/1months)
Total					-	

<u>Haulage Cost Detail Contents (A)</u>						
Ksh 1,675,350		(Unit; /18 months)				A-8
Item	Specs	Unit	Quantity	Unit Price	Price	Remarks
Haulage Cost		Months	18	93,075	1,675,350	B-20
Total					1,675,350	

<u>Self Inspection Detail Contents (B)</u>						
Ksh 168,857		(Unit; /month {Conditions; 19 km, 4 times/day})				B-1
Item	Specs	Unit	Quantity	Unit Price	Price	Remarks
SCU Leader		month	1	32,716	32,716	1Persons/month, Workingdays: 30days
Driver		month	1	21,811	21,811	1Persons/month, Workingdays: 30days
Vehicle (Pick up)		month	1	88,200	88,200	1Persons/month, Workingdays: 30days
Fuel		Lit	228	103	23,404	41.3km * 1.00vehicles * 4times / 10km/lit. *30 days
Miscellaneous Cost		%	5	54,527	2,726	5%
Total					168,857	

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