REPÚBLICA DEMOCRÁTICA DE TIMOR-LESTE
GABINETE DO PRIMEIRO MINISTRO
AGÊNCIA DE DESENVOLVIMENTO NACIONAL

INSTRUCTION

NO:.....

With the completion of the first edition:

TIMOR-LESTE STANDARD METHOD OF MEASUREMENT (TL-SMM) which contains:

1. SMM for Building Construction (SMM-1)
2. SMM for Road and Bridge Construction (SMM-2)
3. SMM for Irrigation and River Construction (SMM-3)
4. Standard Coefficient of Unit Price Analysis for Civil Works
5. Standard Coefficient of Productivity Analysis for heavy Equipment
6. Standard Cost of Building Component & Standard of Consultant Fee.

I, hereby, instruct all Government Institutions in Timor-Leste to use TL-SMM as a guide in calculating construction cost as well as design and supervision cost including budget of each Government's construction in Timor Leste.

This instruction is to be implemented accordingly and enter into force starting from the launch of this book.

Dili, January 2015
Prime Minister of Timor-Leste

Kay Rala Xanana Gusmão

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INTRODUCTION

For over 3 years ADN has been performing its duties based merely on decree law No.11/2011; in the absence of an acceptable costing, standard for infrastructure projects in Timor-Leste many government institutions, contractors and consultants experienced various differences and perceptions in design, Specification and BOQ, thereby affecting the starting, implementation and completion of a project. Faced with such situation A.D.N. has been playing a delicate balancing act in both safeguarding the common interest of the people and at the same time providing a just and fair costing to the project thereby promoting the local contractors. This Standard will provide impetus for A.D.N., project owners, state and non-state actors, contractors and consultants in determining a realistic project costing, especially those projects that are complex in nature.

This document is named TIMOR-LESTE STANDARD METHOD OF MEASUREMENT, referred to as SMM, a document that can serve as a guide in calculating cost of infrastructure project in Timor-Leste. It is published as a supplement to other documents that have been in effect in other ministries such as standard specification, Standard Bill of Quantity, Unit Price etc. We hope that most, if not all, of our problems related to project costing in Timor-Leste can be addressed through this standard document.

Contents of this document are:

1. SMM for Building Construction (SMM-1)
2. SMM for Road and Bridge Construction (SMM-2)
3. SMM for Irrigation and River Construction (SMM-3)
4. Standard Coefficient of Unit Price Analysis for Civil works
5. Standard Coefficient of Productivity Analysis for Heavy Equipment
6. Standard Cost of Building Component & Standard of Consultant Fee

SMM-1, SMM-2 and SMM-3 Serve as guidance for uniformity and facilitate us in measuring and calculating, includes the scope of calculation which is used in calculating the quantity and the unit price of a construction activity.

Method of Measurement explains about the cost structure of a project which consists of: **Total net of construction cost, Total net of Project cost, total gross of project cost**, with the purpose to breakdown each project in such a way, so that what is referred to as cost of a project does not just cover the physical cost of the project but already include the cost of physical construction, consultant fee, project management unit as well as tax associated with the project.

Therefore, **Total gross of project cost is defined as a complete budget of the project (Orsamento) which will be presented to the Parliament.**

Standard Coefficient of Unit Price Analysis for Civil Works – is created based on the standards that have been in effect and some feedback from contractors, consultants, and Line Ministries which can be used by all stakeholders.

Standard Coefficient of Productivity Analysis for heavy Equipment – serves as a guide in calculating productivity of various types of heavy equipment for various works and provides also some examples of its application.

Standard Cost of Building Component & Standard of Consultant Fee – is a guide for government and private sectors to avoid any discrepancy in preparing budget for various categories of a project.

TL-SMM first edition is just the beginning of an effort in improving the system, and ADN is planning to prepare the following SMM in the future:

- SMM-4 for harbour/port
- SMM-5 for Air Port
- SMM-6 for High Voltage Transmission Network
- Specification Standard for road and bridge
- Standard of Construction Contract
- Integrated Management System for Cost, Time and Quality

We would like to acknowledge that with the limitation of time and resources, this first edition still needs improvement to meet all the necessities in preparing the project cost/budget. Therefore any comments and inputs from everyone is welcomed and since we are using two languages, any discrepancy in interpretation, Indonesian version shall prevail.

Dili, January 2015
NATIONAL DEVELOPMENT AGENCY

Samuel Marçal
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Standard Method of Measurement (TLSMM-2) Road and Bridge

Standard Method of Measurement (TLSMM-3) Irrigation and River

1.0. DOCUMENT TITLE

The title of this document is TIMOR LESTE STANDARD METHOD OF MEASUREMENT – 1 , For Building, First Edition (January 2015), referred as TLSMM – 1.

TLSMM-1 is intended to be utilized in conjunction with the General Condition of Contract, General Specifications or any other relevant provisions provided elsewhere in the Contract Document.

The works shall be itemized and described in Bill of Quantity in sufficient details to enable contractors to price it adequately and the method of measurement shall be stated in the Preamble to the Bill of Quantity. The preamble shall state the method of measurement other than TLSMM-1, if any, which are adopted while preparing the Bill of Quantity and to be used for measurement of completed parts of the works. Such method of measurement shall comprise those not covered by TLSMM-1.

2.0. OBJECTIVE

The objective of TLSMM-1 is to set forth the procedure according to which the Bill of Quantity shall be prepared, priced and the quantities expressed and measured.

3.0. DEFINITIONS

3.1. In this document and in Bill of Quantity prepared according to the procedure set forth herein the following words and expressions have the meanings hereby assigned to them, except where the context otherwise required.

3.2. "Condition of Contract" means the "General Condition of Contract" as provided in the Bidding/Contract Documents prepared by Owner

3.3. Word and expression defined in the Condition of Contract have the same meaning herein

3.4. All references to clauses are references to clauses numbered in the Condition of Contract and reference to paragraphs are references to paragraphs numbered herein

3.5. The word "Work" includes work to carried out, goods, materials and services to be supplied, and the liabilities, obligations and risks to be undertaken by the Contractor under the Contract

3.6. The expression "expressly required" means as shown on the Drawings or as described in the Specifications or as instructed by the Engineer pursuant to the relevant provisions of Condition of Contract

3.7. "Day work" means the method of valuing work on the basis of time spent by the workmen, the materials used and the plant employed

3.8. "Original Ground Surface" means the surface of ground before any work has been carried out

3.9. "Final Excavated Surface" means the surface indicated on the Drawings to which the final excavation is carried out

3.10. "Commencing Ground Surface" for an item in a Bill of Quantity means, the surface of the ground from where that particular item of works commence.

3.11. "Excavated Ground Surface for an item in the Bill of Quantity means, the surface to which excavation included in that particular item of work is to be carried out

4.0. GENERAL PRINCIPLES

4.1. Unit of measurement

The unit of measurement for each item shall be stated for the item in the TLSMM-1. The unit of measurement stated against a descriptive feature in the TLSMM-1 shall apply to all items to which that descriptive feature applies. Meter, Kilogram, Second (MKS) system of units has been adopted in this TLSMM-1.

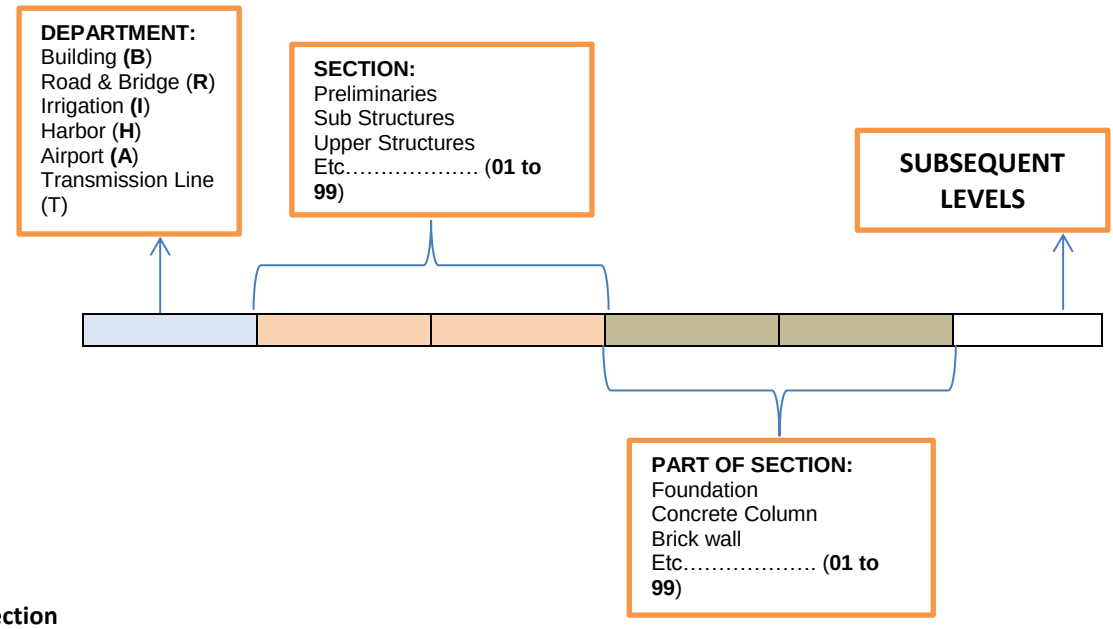
In discribing the dimension of a certain works, its sequence should be as followed, length, width and height or thickness. Each work should be calculated its net volume, excluding its disposal, overlapping, compactness, widening etc. For all items either stated in this

TLSMM-1 or not such as transportation, warehouse, permit, loading and unloading, etc will be calculated in unit price of its work.
The unit of each work will followed the unit as stated in point 5.0.
The volume is rounded to two (2) decimal digits, ex. 1,234.78 not 1,234.7765.

4.2. TLSMM Codes

Works are classified into various "Sections". Unique code has been allocated to each item of work for its identification and presentation in the TLSMM – 1, Bill of Quantities and elsewhere. Coding arrangement is as given hereunder:

. First digit represents the "Department"
. Next two digits represent the"Section"
. Next two digits represent the"sub Section"
. Next digits represent the subsequent levels.



4.3 Sub Section

Each part of the Section would be defined to execute and measure for payment (Pay item).

4.4 Measurement Rules

Measurement rules set out the conditions under which work shall be measured and the method by which the quantities shall be computed. In addition to measurement rules, following general conditions shall also apply:

a. Quantities of acceptable completed work relating to any part of specification shall be computed net using dimensions from the drawing and as per method given in this document except otherwise specified in special provisions or else in contract documents. No allowance shall be made for bulking, shrinkage or wastage.
b. All the work to be measured related to any part of specification, if required, shall be classified and measured separately as per Bill of Quantity.
c. The contractor is not entitled to claim difference in quantity calculated by the standard method of measurement and actual quantity as per site of a specific item except provision made herein, special provisions, or elsewhere in the contract documents.

4.5 Definition

Definition means the limitation and the function of work item represented by a word or expression used in the work classification and in the Bill of Quantity which prepared in accordance with TLSMM – 1.

4.6 Measurement Coverage

Measurement coverage provides that the work stated is deemed to be included in the appropriate items to the extent that such work is included in the Contract. In addition to measurement coverage, following general conditions shall also apply:

a. Loading, unloading and transportation of material related to any item of work
b. All the items and activities in TLSMM – 1 shall deem to be included all operations required to perform the work as per Contract Documents.
c. Additional measurement coverage which is necessary for complete understanding of method of measurement is given against relevant item or activity.

4.7 Additional Descriptions

Additional descriptions which are necessary for complete understanding of works/activities covered under method of measurement are provided against such particular item of work.

5.0 UNITS AND ABBREVIATIONS

The following units of measurement and abbreviations shall be used :

Unit	Abbreviation
Millimeter	**mm**
Meter	**M**
Square millimeter	**mm^2 or mm2**
Square meter	**M^2 or M2**
Hectare	**Ha**
Cubic meter	**M^3 or M3**
Kilogram	**Kg**
Tone	**Ton**
Metric Tone	**M.Ton**
Summary	**Sum**
Number	**No.**
Horse Power	**Hp**
Week	**Wk**
Litre	**Ltr**
Lump Sum	**Ls**
Hour	**Hr**
Day	**Day**

6.0 CONVERSION TABLE

To convert	Into	Multiply
LENGTH		
Millimeter	Inch	0.03937
Inch	Millimeter	25.40005
Meter	Foot	3.28084
Foot	Meter	0.3048
Meter	Yard	1.09361
Yard	Meter	0.9144
Kilometer	Mile	0.62137
Mile	Kilometer	1.60935
MASS WEIGHT		
Kilogram	Pound	2.20462
Pound	Kilogram	0.45359
Gram	Ounce	0.03527
Ounce	Gram	28.34949
Kilogram	Quintal	0.01
Milligram	Grain	0.01543
Kilogram	Hundred Weight	0.01968
Hundred weight	Tone	0.0508
Kilogram	Tone	0.001
Kilogram	Ton	0.00098
Pound	Ton	0.00045
Tone	Ton	0.98421
Kilogram	Seer	1.01605
Kilogram	Maund	0.02679
Gram	Tola	0.08573
VOLUME		
Litre	Pint (UK)	1.75975
Litre	Gallon (imperial)	0.21997
Litre	Gallon (US)	0.26417
Litre	Cubic Foot	0.3531
Litre	Cubic Meter	0.001
Cubic Foot	Liter	28.31682
Milliliter	Fluid ounce	0.0352
Gallon Imperial	Liter	4.5461
Gallon US	Liter	3.78541
Gallon Imperial	Gallon US	1.20095
Cubic millimeter	Cubic inch	0.00006
Cubic meter	Cubic foot	35.31472
Cubic foot	Cubic meter	0.02832
Cubic meter	Cubic Yard	1.30795
Cubic yard	Cubic meter	0.76456
AREA		
Square millimeter	Square inch	0.00155
Square inch	Square millimeter	645.1613
Square meter	Square foot	10.76392
Square foot	Square meter	0.0929
Square meter	Square yard	1.19599
Square yard	Square meter	0.83613
Square meter	Acre	0.00025
Hectare	Acre	2.47105
Acre	Hectare	0.40469
Square meter	Hectare	0.0001
Square kilometer	Square mile	0.3861
Square mile	Square kilometer	2.58999
Hectare	Square mile	0.00386

Square mile	**Hectare**	**258.9989**
MASS/UNIT AREA		
Kilogram per square kilometer	**Ton per square mile**	**0.00255**
Kilogram per square meter	**Pound per square foot**	**0.20482**
Pound per square foot	**Kilogram per square meter**	**4.88243**
MASS PER UNIT VOLUME		
Kilogram per cubic meter	**Pound per cubic foot**	**0.06243**
Grams per liter	**Pound per cubic foot**	**0.06243**
Pound per cubic foot	**Kilogram per cubic meter**	**16.01845**
Pound per cubic foot	**Grams per liter**	**10.01845**

While converting unit from one system to other system the measurement shall be taken nearest to three (3) digits for MKS system and nearest to two digits for FPS system.

7.0 METHOD OF MEASUREMENT

Section 01 : Preliminaries

Section 02 : Sub Structure

Section 03 : Upper Structure

Section 04 : Walls

Section 05 : Doors and Windows

Section 06 : Ceiling Finishes

Section 07 : Floor Finishes

Section 08 : Roof

Section 09 : Finishing Works

TOTAL CIVIL & ARCHITECTURAL WORK (01 to 09)……. (A)

Section 10 : Mechanical Works

Section 11 : Electrical Works

TOTAL MECHANICAL & ELECTRICAL WORK (10 to 11),…… (B)

TOTAL NET BUILDING COST, ……. C = (A+B)

Section 12 : External Works

Section 13 : Final Site Clearing

TOTAL NET PROJECT COST ,……D = (C+12+13)

Section 14 : Furniture

Section 15 : Equipment

Section 16 : General Expenses

Section 17 : Profit

Section 18 : Provisional sum

Section 19 : Contingency

Section 20 : Consultant Fee

Section 21 : PMU cost

Section 22 : Tax

TOTAL GROSS PROJECT COST, ……. E =D+(14 to 22)

7.1. PRELIMINARIES: (B01)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-01-01	**DEMOLITION**	Demolition means demolish all the existing buildings in the location of the building plan	If in the BOQ described in details the item of demolition works, then the unit price should also accordingly to the BOQ item, and the unit is LS	In all unit price analysis should be included tools, equipment, labors, permit, safety and security and transportation of disposals to the certain place
B-01-02	**SITE CLEARANCE**	To clean the site from all rubbish , debris, small trees diameter under 15 cm	Calculated in square meter (m2)	Include equipment, tools, labors, permits, safety and security, and transportation to the certain place.
B-01-03	**MOBILIZATION**	Mobilization is the first action to mobilize all the equipment, labors, facilities, permission needed, before starting the physical action on site	All of the equipment, labors, facilities and permission should be described in detail include the specification, capacity, numbers and unit price. The unit is Lump Sum.	Unit prices of each item should include cost for transportation, holding, permission needed, rental or purchase and any others social cost.
B-01-04	**DEMOBILIZATION**	Demobilization is the action to demobilize all equipment, labors, facilities, after finished the project	All of the equipment, labors, facilities and permission should be described in detail include the specification, capacity, numbers and unit price. The unit is Lump Sum.	Unit prices of each item should be included cost for transportation, holding, and any others social cost.
B-01-05	**SITE CLEANING AND GRUBBING**	To clean all the site from rubbish and debris where the building will be constructed	The quantity is calculated in square meter (m2)	Include remove all debris and rubbish, small trees include the roots, remove stones and fill holes in the area of site operation.
B-01-06	**DOCUMENTATION PHOTOS**	Each photo should inform the physicsal condition at a certain time	The unit should be in Lump Sum	Minimum it should be taken from 4 same point of view, start from the beginning of 0% progress, the second photos periodically until finish according to specifaction
B-01-07	**TEMPORARY FENCE AND GUARD HOUSE**	Temporary fence for the security of the site, built on the boundary of site, complete with in and out door.	The unit of fence in line meter (m'), the door in square meter (m2). Guard house in	The fence, guard house and the gate should be strong enough during the construction period. The frame of Entrance door is made wood class III size 5/7 and

		Guard house be placed at the entrance and at the other place needed	square meter (m2)	covers with Zinc BJLS 30. The guardhouse is made for wood class III and covers with Zinc BJLS 30
B-01-08	**PROJECT SIGN BOARD**	Project sign board should include the description of the project, and posted in front of the project	The quantity measured in unit	The sign board should be done according to the drawing and specification, and shoud be fixed at the location that could easily seen before the works is started until the completion of the project.
B-01-09	**BENCH MARK**	Bench Mark (BM) is a permanent reference point +- 0.00	The quantity is in unit	It should be protected during the construction time, and could be demolished under instruction of the Engineer
B-01-10	**BATTER BOARD**	Batter board is a helping tools to determine the center lines of the building	The quantity should be calculated along the outside round of building, in line meter (m')	Include all necessary tools such as theodolite, the specialist surveyor and the material needed. It should be strong enough and maintained after all of the center line of building already fixed to the permanent building center line
B-01-11	**TEMPORARY PROJECT SITE OFFICE**	Temporary project site office is a temporary building for the project staff to do their activities during the construction period	The quantity should be calculated in square meter (m2)	Should include all furniture needed, first aid tools and medicine, record book, stetionary, etc.
B-01-12	**TEMPORARY BARRACK AND WAREHOUSE**	1.Barrack will be used for workers to do their works 2. Warehouse for tools and materials	The quantity should be calculated in square meter (m2)	Include all necessary tools needed
B-01-13	**TEMPORARY WATER AND POWER SUPPLY**	1.Temporary water supply for construction, cleaning, toilet 2.Temporary power supply for construction, lighting.	The quantity of temporary water and power supply should be calculated in Lump Sum (LS)	Include all tools and equipment needed, permission, operation and maintenance cost

7.2. SUB STRUCTURE: (B02)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-02-01	**EXCAVATION**	Excavation for foundation, drainages, septic tank, basement.	The quantity of excavation should be calculated net, based on width, and depth of foundation measured from the original ground level, in cubic meter (m3). The quantity of disposal excavated material should be calculated based on rigid volume not loose volume, in cubic meter (m3) The quantity for leveling, sloping compacting and cleaning should be calculated separately in square meter (m2)	Include all tools, equipment, labours needed, shoring needed, temporary deposit , and transported to the out site disposal area
B-02-02	**BACKFILL**	Is a work of filling back the foundation hole using the existing excavation	The volume of backfilling is computes its rigid volume in m3	Including work of backfilling, all equipment and tools needed.
B-02-03	**EARTH FILLING**	Earth filling is filled back the existing excavation for foundation, can be used the existing excavated material or delivered from outside the project	The quantity should be calculated based on rigid /compacted volume (not loose volume) in cubic meter (m3)	Include all tools, equipment and labours needed according to construction method and specification
B-02-04	**TERMITE CONTROL AND WATER TIGHT**	Termite control and /or water tight installed under and surround the foundation, under floor slab which straight contact with soil	The quantity should be calculated based on the net contact area with the soil, in square meter (m2)., and should be separated in horizontal, vertical and sloping parts. The overlapping more than 30 cm should be calculated separately in square meter (m2)	Include the standard overlapping, sealent especially for the membrane waterproofing sheet.
B-02-05	**FOUNDATION**	Foundation is the main support structure of the building, can be as shallow foundation consist of	a.For the shallow foundation can be calculated according to the drawing and specification, in cubic meter (m3) b. Deep foundation can be calculated according to the	a.Include all material, labours, tools and equipments. b. Include all materials, labours, tools, equipment needed, loading test, cut off the pile head, ready to

		stone, reinforced concrete, or deep foundation , like driven pile, bored pile etc., and the material can be consist of reinforced concrete pile or steel.pipe pile	drawing and spesification, in unit (each). For loading test can be calculated in unit (each)	receive the pile cap structure
B-02-06	**PILE CAP**	Pile cap is a part of foundation structure to distribute the column load to the foundation	Pile cap consist of reinforced concrete according to the drawing and specification. The quantity of concrete is not necessary to deduct with the quantity of reinforcement, and should be calculated separately between concrete, reinforcement and formwork. Concrete should be calculated in cubic meter (m3) Reinforcement be calculated based on the bar bending schedule, in kg Formwork is calculated based on the net contact area between concrete and formwork, in square meter (m2)	a. For concrete include transportation of material, curing and any others supported material like additive etc. b. For reinforcement should included bending, cutting, wire,lean concrete supporting, bar (beton tahu) and steel supporting bar (kaki ayam) c.For formwork should be included assembling and installing, additive material (mud oil, plastic sheet etc)and scaffolding
B-02-07	**TIE BEAM**	Tie beam is a part of foundation structure with the function to tie the pile caps and to distribute the load from column to pile cap	Tie beam consists of reinforced concrete according to the drawing and specification. The quantity of concrete is not necessary to deduct with the quantity of reinforcement, and should be calculated separately between concrete, reinforcement and formwork. Concrete is calculated based on the length measured from edge of pile cap to pile cap, or from edge of column to edge of column, in cubic meter (m3) Reinforcement is calculated based on the bar bending schedule, in kg	For concrete include transportation of material, curing and any others supported material like additive etc. For reinforcement should included bending, cutting, wire,lean concrete supporting, bar (beton tahu) and steel supporting bar (kaki ayam) For formwork should be included assembling and installing, additive material (mud oil, plastic sheet etc)and scaffolding

			Formwork is calculated based on the net contact area between concrete and formwork, in square meter (m2)	

7.3. UPPER STRUCTURE: (B03)

For reinforced concrete structure, the BOQ of concrete, reinforcement and formwork should be calculated separately according to the quality of concrete stated in the drawing and specification. The reinforcement should be separated according to the diameter and the quality. The formwork also separately according to the kind of material and function of the formwork. For wiremesh reinforcement should be calculated base on the net measurement without overlapping. For steel construction, the BOQ should be calculated separately according to the function and the type of profile.

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-03-01	**COLUMN**	Column is a part of vertical structure to support the horizontal structure like beam or plate.	The quantity should be measured from the top edge of the under floor to the top edge of the upper floor. The concrete in cubic meter (m3), the reinforcement in kg, and the formwork in square meter (m2)	For concrete include transportation of material, curing and any others supported material like additive etc. For reinforcement should included bending, cutting, wire,lean concrete supporting, bar (beton tahu) and steel supporting bar (kaki ayam) For formwork should be included assembling and installing, additive material (mud oil, plastic sheet etc)and scaffolding
B-03-02	**BEAM**	Beam is a part of horizontal structure to support the wall, floor slabs and stairs of a building.	The quantity should be measured from the edge of one column to the other edge of another column.The height of the beam should be measured up to the top of the supported slab. The concrete in cubic meter (m3), the reinforcement in kg The scaffolding in square meter (m2) or Lump Sum.(LS).	For concrete include transportation of material, curing and any others supported material like additive etc. For reinforcement should included bending, cutting, wire,lean concrete supporting, bar (beton tahu) and steel supporting bar (kaki ayam) For formwork should be included assembling and installing, additive material (mud oil, plastic sheet etc)and scaffolding
B-03-03	**FLOOR SLAB**	Floor is a part of structure straight to support the	The quantity should be measured with the length and the width measured from the edge of the	For concrete include transportation of material, curing and any others supported material like

		dead load and the live load.	supported beam, and the thickness according to the drawing and the specification.. Holes on the floor slab for ducting, piping etc., could not be deducted from the quantity of slab.. Only the holes more than .1 m2 should be deducted.. The concrete in cubic meter (m3), the reinforcement in kg The scaffolding in square meter (m2) or Lump Sum.(LS	additive etc. For reinforcement should included bending, cutting, wire,lean concrete supporting, bar (beton tahu) and steel supporting bar (kaki ayam) For formwork should be included assembling and installing, additive material (mud oil, plastic sheet etc)and scaffolding
B-03-04	**STEEL STRUCTURE**	The structure to support the building, similar functions with the concrete structure, but consist of steel profiles according to the drawing and the spesification.	The quantity should be calculated separately according to the function and the type of profiles., include the joint plate, in kg.. Bolt, anchor and welding should be calculated separately. Bolt and anchor in kg, and welding in line meter (m') . .	Include all material, tools, equipment needed for fabrication, holding, and installation on site. There is no difference between workshop fabricated and site fabricated
B-03-05	**PRECAST CONCRETE**	The structure to support the building, similar function with the concrete structure and the steel structure, but consist of precast concrete structure profiles according to the drawing and the spesification	The quantity should be calculated according to the type and function of each part, such as column, beam, slab, stair etc., in unit (each). The quantity of jointing be calculated per-each For non-structural precast concrete such as drainage, kerb, list, etc should be calculated separately.	Include all material, tools, equipment needed for fabrication, holding, installation on site
B-03-06	**PRE-STRESSED CONCRETE**	Pre-stressed concrete is a high quality concrete structure which have the common reinforced and a special stressed cable/wire strand to increase the supporting power of the structure.	The quantity should be calculated in unit (each), according to the types, drawing and specification.	Include all material, tools, equipment needed for fabrication, holding, transportation, stressing, grouting and installation on site

		Pre-stressed concrete can be done with post-tension or pre-tension		

7.4. WALL: (B04)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-04-01	**CONCRETE (BATAKO) AND BRICK WALL**	Concrete /brick wall installed as a devider between internal rooms, or external walls	The net area(square meter) of walls should be based on length, width and height measured from edge of column/beam. Holes/opening for doors, windows should be deducted from the area of walls.Opening for piping, cabling could not be deducted. If in the concrete (batako) walls inserted reinforcement, it should be calculated separately in kg. If there are glass block wall inserted, then should be calculated separately in unit (each). For Batako/brick installed as a riser or tread on stairs, could be calculated separately in line meter (m')	Include all material, tools and labours needed for mix the mortar, transportation and install the wall at the right position. Include groove according to specification
B-04-02	**PLASTERING AND RENDERING**	As a finishing work to cover the surface of batako/brick wall Render is the finished surface of plaster ready to receive painting works	The area of plaster should be calculated in square meter (m2), separately per-quality of mortar. The area of render should be calculated separately from the plaster work, in square meter (m2) If the wall covered with ceramic or the like, the area of ceramic should be calculated separately in square meter (m2).	Include all material, tools and labours needed for mix the mortar, transportation and install the plaster and render at the right position.
B-04-03	**CURTAIN WALL**	Curtain wall is a glass wall with alluminium frame, installed at the outsite wall of building, to protect the building from heat and noise	Alluminium frame should be measured in line meter (m') for each type of profile. Glass measured in square meter net, calculated from the opening, and according to the type and thickness. For iron monger, decorative etc. should be calculated separately.	Include all tools, labours, supporting materials (sealent etc.) needed for fabrication, assembling and installing on the right position

7.5. DOORS AND WINDOWS: (B05)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-05-01	**DOORS AND WINDOWS**	Doors and windows is a part of room's cover , made of woods, glass, metal etc.	Wooden doors/windows frame be calculated in cubic meter (m3), according to the type and dimension Metal frame be calculated in line meter (m') according to the type and dimension. Wooden doors/windows leafs be calculated in square meter (m2) according to the type and dimension. All quantities be calculated in net area, according to the drawing and specification. Glass is calculated in net area (m2). Not be allowed to calculate the overlapping/list For louvre glass be calculated in line meter (m') For doors/windows, can also be calculated in unit (each) per-type if in the BOQ mentioned.	Include all tools and labours, supporting material needed for fabrication, assembling and installing on the right position. Iron monger should be calculated separately in unit (each), according to the type and dimension and specification.
B-05-02	**PARTITION**	Partition is a devider wall, that made of wooden, metal frame and covered by wooden, gypsum, glass or any other materials	In calculating the quantity of partition,shoul be separated between frame and covers. If wooden frame it should be calculated in cubic meter (m3). If metal frame, it should be calculated in line meter (m'). For wooden, glass or metal covers, should be calculated in square meter (m2). All quantity should be calculated net, according to the drawing and specification. For skirtings should be calculated separately in line meter (m') If in the BOQ mention in unit per-type complete, it can be calculated in unit (each) per-type.	Include all tools, labour and supporting material needed for fabrication, assembling and installation on the right position

7.6. CEILING FINISHES: (B06)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-06-01	**CEILING**	Ceiling is a part of work to cover the upper part of a room, that made of wooden or metal frame, covered by glass, wooden, gypsum, acoustic board, plastic board etc.	In calculating the quantity of ceiling, should be separated between frame and covers. If wooden frame it should be calculated in cubic meter (m3). If metal frame, it should be calculated in line meter (m'). For wooden, glass, gypsum, acoustic or metal covers, should be calculated in square meter (m2). All quantity should be calculated net, according to the drawing and specification. The space for lamp, diffuser, loud speakers, sprinkler and others, could not be deducted the area of ceiling. For heat/sound insulation work, should be calculated separately in square meter (m2). Cornices and list should be calculated separately in line meter (m')	Include all tools, labour and supporting material needed (hangers) for fabrication, assembling and installation on the right position. Ceiling trim, sound barriers, heat barriers which should be calculated separately according to specification

7.7. FLOOR FINISHES: (B07)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-07-01	**FLOOR**	Floor is a part of work to cover the bottom part of a room/field, made of ceramic, granite, vinyl, carpet or others.	Floors be measured in square meter (m2) according to the floor schedule, type and dimensions, mentioned in the specification and drawing. Skirting, tread and riser of stairs, be measured in line meter (m')	Include all tools and labours and supporting materials, include polishing according to specification

7.8. ROOF: (B08)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-08-01	**ROOF FINISHES**	Roof finishes/roof covers to protect the building from heat, rain water, dust ect. Made of singles, ceramic, zinc, concrete, etc	Roof covers be measured in square meter (m2). Ridge capping, gutters be measured in line meter (m') Water proofing, insulation or the like, should be calculated separately, in square meter (m2).	Include all tools and labours, and supporting materials (nail, screw, or the like).

B-08-02	**ROOF FRAME**	Roof frame to support the roof cover, made of concrete, steel, wood or the like	Wooden roof frame measured in net dimension according to the drawing and be calculated in cubic meter (m3), The wastes not be allowed to be calculated as the quantity of the frame. Steel frame also measured in net dimension and be calculated in line meter (m') or kg according to the drawing and type /dimension of the profile. Concrete frame can be calculated same with the others reinforced concrete works.	Include all tools, labours, supporting materials as nails, anchors, rivets,and the likes needed.

7.9. FINISHING WORKS (B09)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-09-01	**PAINTS, FURNISH**	Painting, furnish are the finishing works on the plaster, wooden or the like to cover the surface that looks fine	The quantity should be measured in square meter (m2). For cornice, hand rail and part that less than 30 cm wide should be measured in line meter (m').	Include all tools, labours, supporting materials,the first and second layer of base, putty and the like.
B-09-02	**METAL WORKS**	Include here all non structural metal work such as railing, balustrade, netting and any others artistic metal work.	The quantity should be calculated in square meter (m2), except for cornice or the like in line meter (m')	Include all tools, labours and supporting materials for fabrication, assembling and installing on good condition, clean .

7.10. MECHANICAL WORKS: (B10)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-10-01	**DIESEL GENERATING SETS**	Generate power, with diesel machine as a prime mover to produce energy needed to turn the generator rotor	Measured in complete unit according to the specification.	Include all related works, installation, supporting materials, tools, equipment such as out door and indoor panel, Automatic Transfer Switch/Automatic Main Failure, testing and commissioning, operation manual
B-10-02	**TRANSFORMER**	Transformer is a fixed or moveable electrical machine, to change the primary electric	Measured in complete unit according to the specification	Include all related works such as installation, lightning arrestor, cut – out,

		power/tension to the secondary power/tension with constant frequency, through a pair magnetic and electromagnetic conduction.		distribution panel, testing and commissioning, operation manual.
B-10-03	**UNINTERRUPTIBLE POWER SUPPLY (UPS)**	UPS is a reserve power supply tools in case of emergency	Measured in complete unit according to the specification	Include all related works such as installation, , testing and commissioning, operation manual.
B-10-04	**AIR CONDITIONING (AC)**	Air condition is equipment that is able to balance the temperature as needed. Compose of compressor, condenser, orife tube, evaporator, and expanse valves.	Measured in complete unit and sub unit, according to the drawing and specification	Include all related works to AC units, installations, supporting materials so that the AC would install on its position and provide temperature as needed. Including also commissioning test, operational and maintenance manual.
B-10-05	**FIRE FIGHTING**	Fire fighting are an associated fire fighting installation system such as : Fire hydrand with hosereel system, audio/visual advisory system, sprinkler system,gaseus extinguisher system, automatic fire alarm and & detection system, portable hand operated system, complete with installation system and control system.	Measured in unit and sub unit, according to the drawing and spesification	Include all related works, installations, and supported materials, testing and commissioning, operation manual
B-10-06	**EMERGENCY FIRE FIGHTING**	Emergency fire fighting is a portable fire fighting, just for emergency and small fire.(APAR = alat pemadam api tingan)	Measured in unit (each)	Include installation, and supporting materials to fix at the position stated in the drawing and specification
B-10-07	**HORIZONTAL AND VERTICAL MOVEMENT SYSTEM (LIFT & ESCALATOR)**	Horizontal and vertical movement system in a building is a system for movement of people, or goods/materials, in vertical or horizontal direction, such as lift, escalator, conveyor etc	Measured in complete unit (each), according to the specification and drawing.	Include all related works, supported materials to fix at the position stated in the drawing and specification, tesing and commissioning, operation manual
B-10-08	**BUILDING AUTOMATION**	Building Automation is an automatic associated/integrated all	Measured in unit and sub unit of IT, CCTV, Electrical, security,	Include all related works, supported materials to fix at the

		system in a building, reloaded to building management system.	acces control system, AC system, fire system and the like	position stated in the drawing and specification, tesing and commissioning, operation manual
B-10-09	**FRESH WATER INSTALLATION**	Fresh water installation is a system to accomodate the availability of fresh water in a building in healthy condition and certain capacity	Pipe should be measured in line meter (m'), include length of fittings per-diameter, for pipe with diameter less than 3 inches.. For pipe with diameter more than 3 inches, fittings should be calculated separately in No. (Numbers) per-diameter. For main water source from shallow/deep well or city water, should be calculated separately in unit or Lump Sum For pump and accessories should be calculated separately in unit complete	Include cutting, bending, jointing of pipes and fittings, crossing with walls or floors. For fittings more than 3 inches diameter, the unit cost should be included in the fitting's cost. For main water source cost should be included all tools, equipment, permission Fittings means elbow, bends, tees, unions, sockets, nipples and the like
B-10-10	**WASTE WATER INSTALLATION**	Waste water installation is an installation system for drained waste water in/out of the building, using piping and fittings. Fittings means all accessories needed to connect the pipes such as elbow, bends, tees, unions, sockets, nipples ect. All the pipes should classified in types, diameter, method of connection and installations	Pipe should be measured in line meter (m'), include length of fittings per-diameter, for pipe with diameter less than 3 inches.. For pipe with diameter more than 3 inches, fittings shoul be calculated separately in No. (Numbers) per-diameter. For concrete/ceramic pipe be measured as long as the center line of pipes separately in diameters, in line meter (m') For sanitairy fittings likes elbow, bends, sockets, nipples etc. should be calculated separately in unit (each) complete with accessories and according to the drawing and specification.	Include cutting, bending, jointing of pipes and fittings, crossing with walls or floors. For fittings more than 3 inches diameter, the unit cost should be included in the fitting's cost

B-10-11	**(WWTP/STP)**	Waste water treatment plant/ sewerage treatment plant is a complete treatment unit to process the waste water before convet to the city/public drain	Measured in complete unit and sub unit	Include all treatment installation, but not include the civil works, testing and commissioning, operation manual

7.11. ELECTRICAL WORKS: (B11)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-11-01	**ELECTRICAL INSTALLATION**	Electrical Installation is an installation inside the building start from main panel distribution (MDP) or main circuit breaker (MCB) to lighting point or power/socket point	All cables should calculated separately in diameter and type/kind of cables, in line meter(m'),according to the wiring diagram. For lamps, sockets, power switch and the like be calculated in Number (No. or each). For cable trunking in line meter (m')	Include all insulation and supporting material, as build drawing, merger, testing and commissioning.
B-11-02	**LIGHTNING ARRESTOR**	Lightning arrestor is an installation to arrest the lightning, by using Franklin system or any others such as radio active or the like	Measured in a complete system, in unit	Include all tools, supporting materials, earthning, testing and commissioning
B-11-03	**SOUND SYSTEM**	Sound system is an in door/outdoor sound system installation	Measured in a complete unit system in unit in accordance with design and specification	Include all accessories needed such as loud speakers, microphones, wiring, mixers and the like
B-11-04	**INFORMATION AND TECHNOLOGI (IT) SYSTEM**	IT system is an integrated installation system for communication and information line	Measured in a complete unit system in unit	Include all permission needed, software, hardware, and supported material needed and install according to specification

7.12. EXTERNAL WORKS: (B12)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-12-01	**BOUNDARY FENCE**	Boundary fence is a permanent fence soround the building site, for safety and aesthetic, consist of bricks, stone or	The fence measured in line meter, and the door measured in unit	Include all supporting construction such as foundation, painting, fabrication and transportation , install on site

		steel		according to the drawing and specification.
B-12-02	**INTERNAL ROAD AND PARKING**	Road and parking area inside the boundary.	Road and parking area measured in square meter (m2). Kerbs measured in line meter (m')	Include traffic marking needed
B-12-03	**LANDSCAPING**	All the landscaping work inside the boundary	The grass should be measured in square meter, and the plantation in unit (each), according to the kind of plantation	Include fertilizers, and maintenance to guarantee the proper growth of grass and plantation
B-12-04	**FITTING AND TOOLS**	Fittings and tools mean all necessary play ground, out door chairs needed in garden	Measured in unit according to the type/kind of fittings/tools	Include all necessary supporting construction/tools
B-12-05	**DRAINAGE**	An outside drainage system integrated with inside drainage in buildings	The canal and the culvert measured in line meter (m'), manhole and the like in unit (each)	Include excavation, filling and masonry needed
B-12-06	**WWTP/STP**	Waste water treatment plant/ sewerage treatment plant is a complete treatment unit to process the waste water before convet to the city/public drain	Measured in complete unit and sub unit	Include all treatment installation, but not include the civil works, testing and commissioning, operation manual

7.13. FINAL SITE CLEARING: (B13)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-13-01	**GENERAL CLEANING**	General cleaning outside the building but inside the boundary, to prepare for the external works like garden parking etc.	Measured in square meter (m2). Prepared field for external building facilities such as parking, landscaping, park etc.	Include all cleaning from debris/rubbish and remove to outsite location

7.14. FURNITURE: (B14)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-14-01	**FURNITURE**	All kind of furniture needed for each room	Measured in unit/pair (each) according to the furniture schedule and drawing.	Include all supporting material and fix at the position.

7.15 EQUIPMENT: (B15)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-16-01	**TOOLS**	All special tools or equipment not mention in other item, such as kitchen equipment, gondola, medical equipment/tools, boilers etc.	Measured in complete unit (each)	Include all supporting materials, fixing at the position, testing and commisioning

7.16. GENERAL EXPENSES: (B16)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-16-01	**GENERAL EXPENSES**	General expences are all non physical cost/expences needed to support the progress of the project, such as project management cost, insurances etc	Should be described per-item, such as insurance, ceremonial cost, social cost, bank guarantee, etc, in Lump Sum	All general expenses should be described in cost structure/cost breakdown schedule and valid as a pay item

7.17. PROFIT: (B 17)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-17-01	**PROFIT**	Profit is a sum calculated as the profit of contractors according to the Government regulation.	Profit should calculated as % from the Total Net Project Cost	Total Net Project Cost can be seen in item 7.0. (Method of Measurement)

7.18. PROVISIONAL SUM: (B18)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-18-01	**PROVISIONAL SUM**	A certain value that is reserved for a particular work but has not yet calculated its cost at the time of contract agreement.	It should be determined by owner in USD, and include in the contract amount	Can only be used upon the written order of the owner

7.19. CONTINGENCY: (B19)

Code	Work Item	Definition	Measurement Rules	Meausrement Coverage
B-19-01	**CONTINGENCY SUM**	A certain value that is reserved for a particular work that has not known yet for its usage.	It should be determined by owner in USD, and include in the contract amount	Can only be used upon the written order of the owner

7.20. CONSULTANT FEE: (B 20)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-20-01	**CONSULTANT FEE**	Fee for design and supervision consultant,	It should be calculated based on Standard Fee for Consultant in Timor Leste	For design consultant include but limited to feasibility study, pre- design, detail design, specification, BOQ, Cost Estimate, and support the owner in the pre-bid meeting. For supervision consultant include but not limited to daily, weekly and monthly report, day by day supervise the contractor's works, approve all shop drawing and as built drawing, and final report

7.21. PMU COST: (B21)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-21-01	**PMU COST**	PMU cost is a specific funds allocated in the project for the purposes of the Project Management Unit, in performing project management activities	PMU cost should be calculated based on the certain percentage from Total Net Project Cost. List of PMU cost for various type of building could be seen in Standard Fee for Consiltant.in Timor Leste.	Total Net Project Cost can be seen in item 7.0. (Method of Measurement)

7.22. TAX: (B22)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
B-22-01	**TAX**	The income tax according to the govennment of Timor Leste regulation	Calculated by a certain percentage from the Total Net Project Cost	Integrated in Total Gross Project Cost as Total Project Budget (Orsamento)

8.0. DOCUMENT TITLE

The title of this document is TIMOR LESTE STANDARD METHOD OF MEASUREMENT – 2 , For Road and Bridge, First Edition (January 2015), which is abbreviated to TLSMM – 2.

TLSMM-2 is intended to be utilized in conjunction with the General Condition of Contract, General Specifications or any other relevant provisions provided elsewhere in the Contract Document.

The works shall be itemized and described in Bill of Quantity in sufficient details to enable Contractors to price it adequately and the method of measurement shall be stated in the Preamble to the Bill of Quantity. The preamble shall state the method of measurement other than TLSMM-2, if any, which are adopted while preparing the Bill of Quantity and to be used for measurement of completed parts of the Works. Such method of measurement shall comprise those not covered by TLSMM-2.

9.0. OBJECTIVE

The objective of TLSMM-2 is to set forth the procedure according to which the Bill of Quantity shall be prepared, priced and the quantities expressed and measured**.**

10.0. DEFINITIONS

10.1. In this document and in Bill of Quantity prepared according to the procedure set forth herein the following words and expressions have the meanings hereby assigned to them, except where the context otherwise required

10.2. "Condition of Contract" means the "General Condition of Contract" as provided in the Bidding/Contract Documents prepared by Owner.

10.3. Word and expression defined in the Condition of Contract have the same meaning herein

10.4. All references to clauses are references to clauses numbered in the Condition of Contract and reference to paragraphs are references to paragraphs numbered herein

10.5. The word "Work" includes work to carried out, goods, materials and services to be supplied, and the liabilities, obligations and risks to be undertaken by the Contractor under the Contract

10.6. The expression "expressly required" means as shown on the Drawings or as described in the Specifications or as instructed by the Engineer pursuant to the relevant provisions of Condition of Contract

10.7. "Day work" means the method of valuing work on the basis of time spent by the workmen, the materials used and the plant employed

10.8. "Original Ground Surface" means the surface of ground before any work has been carried out

10.9. "Final Excavated Surface" means the surface indicated on the Drawings to which excavation is to be carried out

10.10. "Commencing Ground Surface" for an item in a Bill of Quantity means, the surface of the ground from where that particular item of work has commenced

10.11. "Excavated Ground Surface for an item in the Bill of Quantity means, the surface to which inal excavation included in that particular item of work is to be carried out.

11.0. GENERAL PRINCIPLES

11.1. Unit of measurement

The unit of measurement for each item shall be stated for the item in the TLSMM-2. The unit of measurement stated against a descriptive feature in the TLSMM-2 shall apply to all items to which that descriptive feature applies. Meter, Kilogram, Second (MKS) system of units has been adopted in this TLSMM.

In discribing the dimension of a certain works, its sequence should be as followed, length, width and height or thickness.

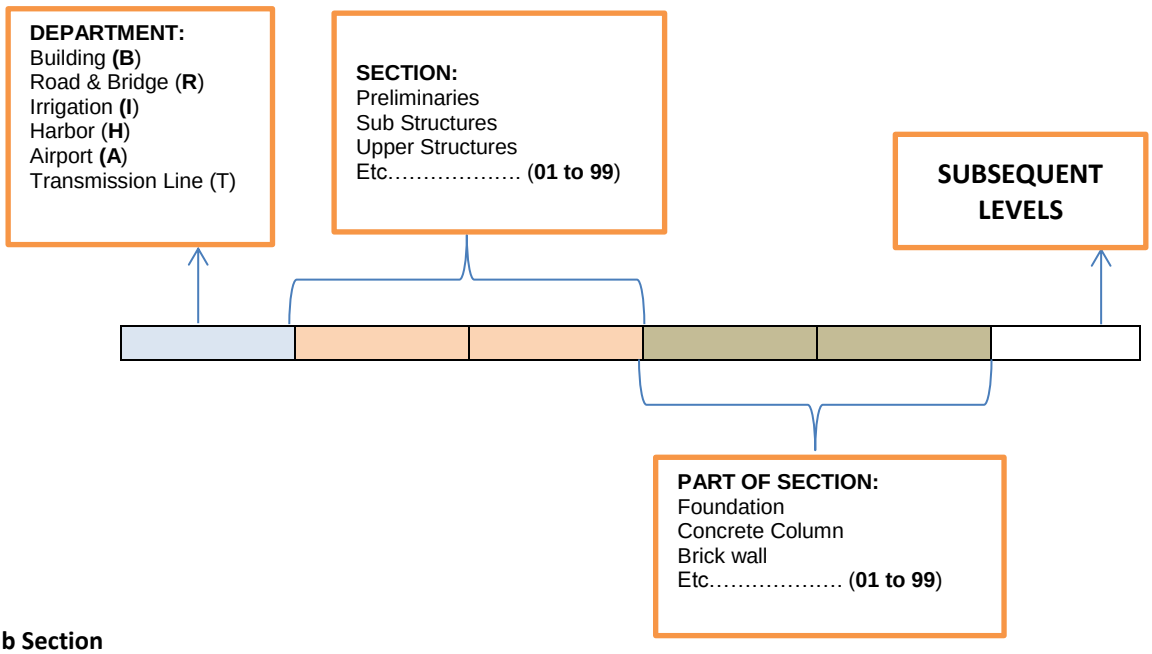
Each work should be calculated its net volume, excluding its disposal, overlapping, compactness, widening etc. For all items either stated in this TLSMM-1 or not such as transportation, warehouse, permit, loading and unloading, etc will be calculated in unit price of its work.

The unit of each work will follow the unit as stated in point 5.0.
The volume is rounded to two (2) decimal digits, ex. 1,234.78 not 1,234.7765.

11.2. TLSMM Codes

Works are classified into various "Sections". Unique code has been allocated to each item of work for its identification and presentation in the TLSMM – 1, Bill of Quantity and elsewhere. Coding arrangement is as given hereunder:

. First digit represents the "Department"
. Next two digits represent the"Section"
. Next two digits represent the"sub Section"
. Next digits represent the subsequent levels



11.3 Sub Section

Each part of the Section would be defined to execute and measure for payment (pay item).

11.4 Measurement Rules

Measurement rules set out the conditions under which work shall be measured and the method by which the quantities shall be computed. In addition to measurement rules, following general conditions shall also apply:

a. Quantities of acceptable completed work relating to any part of specification shall be computed net using dimensions from the drawing and as per method given in this document except otherwise specified in special provisions or else in contract documents. No allowance shall be made for bulking, shrinkage or wastage.

b. All the work to be measured related to any part of specification, if required, shall be classified and measured separately as per Bill of Quantity.

c. The contractor is not entitled to claim difference in quantity calculated by the standard method of measurement and actual quantity as per site of a specific item except provision made herein, special provisions, or elsewhere in the contract documents.

11.5 Definition

Definition means the extent and limit of the item of work represented by a word or expression used in the work classification and in the Bill of Quantity prepared in accordance with TLSMM – 2.

11.6 Measurement Coverage

Measurement coverage provides that the work stated is deemed to be included in the appropriate items to the extent that such work is included in the Contract. In addition to measurement coverage, following general conditions shall also apply :

a. Loading, unloading and transportation of material related to any item of work
b. All the items and activities in TLSMM – 2 shall deem to be included all operations required to perform the work as per Contract Document.
c. Additional measurement coverage which is necessary for complete understanding of method of measurement is given against relevant item or activity**.**

11.7 Additional Descriptions

Additional descriptions which are necessary for complete understanding of works/activities covered under method of measurement are provided against such particular item of work.

12.0 UNITS AND ABREVIATIONS

The following units of measurement and abreviations shall be used:

Unit	Abbreviation
Millimeter	**Mm**
Meter	**M**
Square millimeter	**mm^2 or mm2**
Square meter	**M^2 or M2**
Hectare	**Ha**
Cubic meter	**M^3 or M3**
Kilogram	**Kg**
Tone	**Ton**
Metric Tone	**M.Ton**
Summary	**Sum**
Number	**No.**
Horse Power	**Hp**
Week	**Wk**
Litre	**Ltr**
Lump Sum	**Ls**

13.0 CONVERSION TABLE

To convert	Into	Multiply
LENGTH		
Millimeter	Inch	0.03937
Inch	Millimeter	25.40005
Meter	Foot	3.28084
Foot	Meter	0.3048
Meter	Yard	1.09361
Yard	Meter	0.9144
Kilometer	Mile	0.62137
Mile	Kilometer	1.60935
MASS WEIGHT		
Kilogram	Pound	2.20462
Pound	Kilogram	0.45359
Gram	Ounce	0.03527
Ounce	Gram	28.34949
Kilogram	Quintal	0.01
Milligram	Grain	0.01543
Kilogram	Hundred Weight	0.01968
Hundred weight	Tone	0.0508
Kilogram	Tone	0.001
Kilogram	Ton	0.00098
Pound	Ton	0.00045
Tone	Ton	0.98421
Kilogram	Seer	1.01605
Kilogram	Maund	0.02679
Gram	Tola	0.08573
VOLUME		
Litre	Pint (UK)	1.75975
Litre	Gallon (imperial)	0.21997
Litre	Gallon (US)	0.26417
Litre	Cubic Foot	0.3531
Litre	Cubic Meter	0.001
Cubic Foot	Liter	28.31682
Milliliter	Fluid ounce	0.0352
Gallon Imperial	Liter	4.5461
Gallon US	Liter	3.78541
Gallon Imperial	Gallon US	1.20095
Cubic millimeter	Cubic inch	0.00006
Cubic meter	Cubic foot	35.31472
Cubic foot	Cubic meter	0.02832
Cubic meter	Cubic Yard	1.30795
Cubic yard	Cubic meter	0.76456
AREA		
Square millimeter	Square inch	0.00155
Square inch	Square millimeter	645.1613
Square meter	Square foot	10.76392
Square foot	Square meter	0.0929
Square meter	Square yard	1.19599
Square yard	Square meter	0.83613
Square meter	Acre	0.00025

Hectare	**Acre**	**2.47105**
Acre	**Hectare**	**0.40469**
Square meter	**Hectare**	**0.0001**
Square kilometer	**Square mile**	**0.3861**
Square mile	**Square kilometer**	**2.58999**
Hectare	**Square mile**	**0.00386**
Square mile	**Hectare**	**258.9989**
MASS/UNIT AREA		
Kilogram per square kilometer	**Ton per square mile**	**0.00255**
Kilogram per square meter	**Pound per square foot**	**0.20482**
Pound per square foot	**Kilogram per square meter**	**4.88243**
MASS PER UNIT VOLUME		
Kilogram per cubic meter	**Pound per cubic foot**	**0.06243**
Grams per liter	**Pound per cubic foot**	**0.06243**
Pound per cubic foot	**Kilogram per cubic meter**	**16.01845**
Pound per cubic foot	**Grams per liter**	**10.01845**

In converting unit from one system to other system the measurement shall be taken nearest to three digits for MKS system and nearest to two digits for FPS system.

14.0 METHOD OF MEASUREMENT

Section 01: General

Section 02: Drainage

Section 03: Earth Work

Section 04: Pavement widening and Shoulder

Section 05: Granular sub-base and base

Section 06: Soil and Granular Material Stabilization

Section 07: Bituminous Pavement

Section 08: Structure

Section 09: Reinstatement of Existing Structure and Minor Works

Section 10: Daily Work

Section 11: Routine Maintenance

TOTAL NET CONSTRUCTION COST, …….. (A)

Section 12: Cleaning

TOTAL NET PROJECT COST, …… (B = A + 12)

Section 13: General Expenses

Section 14: Profit

Section 15: Provisional Sum

Section 16: Contingency

Section 17: Consultant Fee

Section 18: PMU Cost

Section 19: Tax

TOTAL GROSS PROJECT COST, …….. C = B+(13+14+15+16+17+18+19)

14.1. GENERAL: (R-01)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-01-01	**MOBILIZATION**	Mobilization is a primary activity done by the contractor to mobilize personnel, construction equipment, quality testing facilities, other facilities and licensing, before project is started	Each personnel, construction equipment, quality testing facilities and permission/licensing shall be specified in detailed their types and specifications to facilitate the calculation of mobilization cost. Unit of measurement is **Lumpsum.**	In the calculation of mobilization cost, shall include transportation, shipping, loading/unloading, licensing, rental/purchase and other social cost.
R-01-02	**DEMOBILIZATION**	Demobilization is final activities done by the contractor to demobilize personnel, construction equipment, and other facilities that are no longer use for the project.	Each personnel, construction equipment, quality testing facilities and permission/licensing shall be specified in detailed their types and specifications to facilitate the calculation of mobilization cost. Unit of measurement is **Lumpsum.**	In the calculation of demobilization cost, shall include transportation, shipping, loading/unloading, licensing, rental/purchase and other social cost.
R-01-03	**LAND PROVISIONING FOR BASE CAMP**	Land provisioning for base camp is an activity done by the contractor to purchase or rent land for constructing base camp with its area in accordance with contract	The area of land purchased or rented should be as required The measurement is in **Lumpsum**	Provisioning of land for base camp shall include renting fees and licensing fee as needed.
R-01-04	**CONSTRUCTION OF BASE CAMP**	Base camp is a temporary facility that shall be constructed by the contractor for project implementation in accordance with contract, include: a. Field Office; b. Accommodation; c. Quality Laboratory; d. Workshop; e. Warehouse; f. Crushing Plant; g. Asphalt Mixing Plant; h. Batching Plant; i. Casting yard, and j. Access Road	Each facility should be detailed: a. Field Office (m2); b. Accommodation (m2); c. Quality Laboratory (m2); d. Workshop (m2); e. Warehouse (m2); f. Crushing Plant (unit); g. Asphalt Mixing Plant (unit); h. Batching Plant (unit); i. Casting yard (unit), and j. Access Road (m2). The Measurement	Include furniture, tools and necessary accessories.

			unit is in **Lumpsum.**	
R-01-05	**DEMOLITION**	Demolition is contractor activity to demolish the existing building which locates within the corridor of planned area for construction	Measurement of demolition shall comply as stated in BOQ and the payment shall be in **Lumpsum.**	Unit price of demolition work shall include equipment, manpower, permission, pacification, and disposal hauling to decided location.
R-01-06	**RELOCATION OF UTILITY**	Relocation of Utility is an activity that shall be done by the contractor to move obstructed utilities which will hamper the work implementation in the decided location. Relocation of utilities shall include: a. Electrical Pole and cable b. Telephone pole and cable c. water supply pipe d. gas supply pipe e. underground cable f. traffic light g. traffic sign h. fences	Specified in detailed and shall be paid in **Lumpsum**.	Including transportation, accommodation and necessary Permit fee.

14.2. DRAINAGE: (R-02)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-02-01	**SIDE DITCH AND DRAINAGE CHANNEL**	Side ditch is a channel to canal the runoff surface water. Drainage channel is a channel to canal and hold water coming from side ditch.	Quantity measurement of side ditches and drainage channel is in **m3**.	Including the disposal hauling to the decided location.
R-02-02	**MORTARED STONE WORKS**	Mortared stone work is lining the side wall and bottom of the channel and constructing aprons, entry pits with mortared cement stone in accordance with design and specified materials.	The measurement of the work volume is in **m3**	a. Mortared stone work include: • Both side of the channel. • Bottom of the channel. b. Mortar side work is excluded from excavation works.
R-02-03	**CULVERT**	Culvert is water crossing channel beneath road surface with type, shape and dimension in accordance with design, which	Work volume of culvert is calculated in linear meter	Including: installing and joining the culvert.

		has function to channeling water from one side to other side of the road. The types of culverts are as follow: a. plain concrete pipe b. reinforced concrete pipe c. corrugated steel pipe d. reinforce concrete plate on stone masonry channel e. reinforced concrete box	(lin. m)	
R-02-04	**SUB - SURFACE DRAINAGE**	Sub-surface drainage is a drainage system constructed under the surface of the road with type, shape, dimensions and depth shall be in accordance with drawing and its material shall comply with specifications	Quantity of sub-surface drainage is calculated per item of material used with the following rules: • Backfill : (m3) • Granular Material: (m3). • Geotextile : m2) • perforated pipe : (linear m)	Including: installation of perforated pipe, compaction of granular and backfill material but excluding the excavation and disposal hauling.

14.3. EARTH WORK: (R-03)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-03-01	**EXCAVATION**	Excavation is digging of soil, rock, mud, and existing pavement with geometric, shape and dimension in accordance with drawings	Calculated in **M3**	Excavation work shall include hauling of disposal to decided location
R-03-02	**EMBANKMENT**	Embankment is heaped up materials based on the specification and drawing plan	Quantity measurement of embankment work is in **m3**	Embankment work include: a. Material hauling, spreading and compacting. b. Quality testing of material and field density of embankment
R-03-03	**SUBGRADE PREPARATION**	Preparation of subgrade is preparing, sacrificing and compacting the subgrade surface for placement of aggregate sub-base, unsealed road base, soil cement base in those areas of the carriage way	Quantity measurement of subgrade preparation work is in unit of m2.	Subgrade preparation work shall include: a. Leveling and profiling b. Quality testing of material

		with dimension, line and grade as showing in the drawing.		
R-03-04	**CLEARING AND GRUBBING**	Is clearing and grubbing the surface ground with thickness as specified.	Quantity measurement is calculated along corridor of road length (ROW) in **m2**	Clearing and grubbing work include: a. Grubbing stumps as well as grass and trees with less than 15 cm in diameter. b. Hauling of disposal to decided location.
R-03-05	**TREE REMOVAL**	Tree removal is removal of all trees measuring 15 cm or more in diameter which grew within corridor of road length RIDE OF WAY (ROW)	Quantity of tree removal shall be calculated by each classified diameter as below: • diameter 15-30 cm • diameter 30 – 50 cm • diameter 50 – 75 cm In principal the diameter of tree is measured at 1.m above the surface level. Except for ***tali palm*** *tree in which its* diameter Measurement of shall be **0.30 m** above the ground surface.	Tree removal work shall include hauling of disposal to decided location.

14.4. PAVEMENT WIDENING AND SHOULDER: (R-04)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-04-01	**PAVEMENT WIDENING**	This work is extending the width of the existing pavement based on the drawing.	Measurement of quantity shall be based on the following: a. excavation of bituminous pavement : (m2) b. excavation of granular base : (m3) c. construction of new granular base : (m3) d. construction of new	Pavement widening work shall include: a. excavation of the existing pavement b. disposing materials resulting from excavation to decided location c. compacting subgrade d. spreading and compacting new granular base e. spraying bituminous prime coat

			bituminous pavement : (m2) e. spraying bituminous tack coat and prime coat : (m2)	f. spreading and compacting new bituminous layer g. Spraying bituminous tack coat. h. quality testing of materials
R-04-02	**SHOULDERS**	Shoulder is part of road located along outer of the pavement edge with dimension, line and grade shown in the drawing. There are two types of shoulder, i.e.: a. Granular Shoulder, b. Bituminous paved shoulder	Quantity measurement of the shoulder shall be based on the following: a. granular shoulder: m3 b. Bituminous paved shoulder: m2	Include: **a. Granular shoulder** Provisioning, hauling, spreading, and compacting of the material **b. Bituminous paved shoulder** Provisioning, mixing, hauling, spreading, and compacting and also spraying of prime coat. c. quality testing of material and field quality control.

14.5. GRANULAR SUB-BASE AND BASE (R-05)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-05-01	**SUB-BASE COARSE**	Sub-base course is part of the pavement on the prepared subgrade with thickness, dimension, line, and grade as shown on the drawings and use material that comply with the specifications.	Quantity measurement of the subbase shall be in **m3**	Sub-base coarse work shall include: a. Provisioning, hauling, spreading and compacting b. quality testing of materials and field quality control
R-05-02	**BASE COARSE**	Base coarse is a part of the pavement on the prepared subbase with the thickness, dimension, line and grade as shown on the drawings and use material that comply with the specifications	Work volume of base coarse is calculated in **m3**	This work includes: a. Provisioning, hauling, spreading, and compacting. b. Quality testing material and field quality control.
R-05-03	**GRANULAR PAVEMENT**	Granular pavement is construction of aggregate pavement without bituminous cover according to the specification and drawings.	The quantity measurement of the granular pavement shall be in **m3**	Granular pavement work shall include: a. Provisioning, hauling, spreading, and compacting; b. Quality test of material and field quality control.

14.6 SOILS AND GRANULAR MATERIAL STABILIZATION (R-06)				
R-06-01	**SOIL CEMENT BASE**	Soil cement base is base coarse using soil or aggregate mixed with certain portion of Portland cement, with thickness, dimension, line and grade as shown in the drawing and after compacted shall have compressive strength in accordance with the specifications	Quantity measurement of soil cement base are as follow: a. soil or aggregate : **m3** b. Portland cement ; **tons**	Soil cement base shall include: a. Provisioning and hauling of materials, mixing, spreading and compacting. b. Quality testing of material and field quality control.
R-06-02	**CEMENT TREATED BASE**	Cement treated base is base coarse using Portland cement aggregate mixture with thickness, dimension, line and grade as shown on the drawing and composition of material shall comply with specifications	The following rules shall applied for quantity measurement of cement treated base: **a.** aggregate material : **m3** b. Portland cement : **tons**	Soil treated base shall include : a. provisioning and hauling of materials, mixing, spreading, and compacting b. quality testing of materials and field quality control
R-06-03	**SOIL-LIME STABILIZATION**	Soil-lime stabilization is base or subbase using lime-soil mixture with thickness, dimension, line and grade as shown on the drawing and mixture composition shall comply with the specifications	The following rules shall be applied for quantity measurement a. soil : **m3** b. lime **: tons**	Soil-lime base work shall include: a. provisioning, and hauling of materials, mixing, spreading, and compacting b. quality testing of materials and field quality control
R-06-04	**BITUMINOUS STABILIZATION**	Bituminous stabilization is base coarse using granular material mixed with bituminous material with composition shall comply with the specification and the thickness, dimension, line and grade as shown on the drawing.	The following rule shall be applied for quantity measurement: a. granular material : **m3** b. Bituminous materials : **tons**	Include: a. provisioning and hauling of materials, mixing, spreading and compacting b. quality testing of materials and field quality control

R-06-05	**CHEMICAL STABILIZATION**	is soil mixed specified chemical substance by certain composition to improve its performance and strength as to improved subgrade, subbbase and base coarse	Quantity measurement of chemical stabilization is calculated in **m3**	Chemical stabilization shall include: a. Provisioning, hauling, mixing, spreading and compacting. b. Quality testing of materials and field quality control

14.7 BUTIMINOUS PAVEMENT: (R-07)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-07-01	**PRIME COAT**	Prime coat is bituminous binder sprayed homogenously on dust free and dry surface of granular base coarse, before spreading asphaltic layer.	Quantity measurement is in **m2**	Prime coat work shall include: a. removing loose dirt and other objectionable material from surface of granular base b. spraying prime coat materials evenly throughout the surface based on the specification c. quality testing of prime coat and field spraying test
R-07-02	**TACK COAT**	Tack coat is bituminous binder sprayed homogenously and uniformly on dust free and fully dry surface of asphaltic layer, before spreading next asphaltic layer.	Measured in unit of **m2**	Tack coat work shall include: a. Cleaning the whole surface. b. Spraying tack coat evenly to the whole surface. c. quality testing of tack coat and field spraying test
R-07-03	**SAND SHEET**	Sand sheet is thin layer of wearing coarse with thickness, dimension, lines and grade as shown on drawing, consist of sand and bituminous material, mixed, spreaded and compacted in hot condition at a certain temperature in accordance with specifications	Measured in **m2**	Sand sheet work shall include: a. Provisioning, mixing, spreading, and compacting. b. Prior to spreading conducting the surface compaction. 1. Clearing, 2. Spreading tack coat. 3. Material quality testing and field quality control.
R-07-04	**HOT ROLLED SHEET**	Hot rolled sheet is wearing coarse or base coarse with thickness, dimension, lines and grade as shown on	Quantity of hot rolled sheet work shall be measured in **m2**	Hot rolled sheet work shall include: a. Surface Provisioning: • Cleaning • Tack Coat

		drawing, consist of granular materials mixed, spreaded and compacted in hot condition at a temperature and composition in accordance with specification. The thickness of Hot rolled sheet is 40mm		b. Material Provisioning, Mixing, spreading, and compacting. c. Quality testing of materials and field control
R-07-05	**HOTMIX ASPHALTIC CONCRETE**	Hotmix asphaltic concrete is constructing or assembling rigid asphaltic layer on its rigid base. Its composition are : coarse aggregate, fine aggregate, filler, asphalt which then mixed, spreaded and compacted in hotmix in accordance with drawing .	The work volume of hotmix Asphaltic concrete is calculated in unit: • AC-base (m3) • AC-Binder (m2) • AC wearing (m2)	AC-BASE work shall include: a. Provisioning materials, mixing, spreading, and compacting. b. Quality testing of material and field quality control
R-07-06	**ASPHALT TREATED BASE = ATB, AND ASPHALT TREATED SUB BASE = ATSB)**	ATB is hot mix of aggregate bituminous mixtures as base or subbase, with thickness, dimension, lines and grades as shown in drawings, quality of material and composition should be in accordance with specification	Asphalt treated base is measured in m3	AC-BC work shall include: a. Provisioning, hauling, mixing, spreading and compacting b. Quality test of materials and field quality control.
R-07-07	**HOTMIX**	The work that includes provisioning of durable solid layer either for leveling, basing, wearing, which compose of required/specified aggregate and asphalt, mixed in hotmix at installation Asphalt Mixing Plant then spreaded and compacted with certain thickness and conform with elevation line and horizontal cut in accordance with drawing plan.	The volume measurement of hotmix is done in the following method: a. Sand Sheet Class A, class B, HRS-WC, AC-WC, is calculated in m2, the width is set in rigid condition. b. HRS-Base, AC-BC, dan AC-Base is calculated in M3. Multiply with the surface width.	include: a. Sand Sheet Class A-SSA with minimum thickness of 15mm. b. Sand Sheet Class B-SSB with minimun thickness of 20mm. c. HRS-WC with minimum thickness of 30mm. d. HRS-Base with minimum thickness of 35mm. e. Asphaltic Concrete Wearing Course; AC-WC: minimum thickness of 40mm. f. Asphaltic Concrete Binder Course, AC-BC: minimum

			c. HRS-WC, AC-WC, AC-BC dan AC-Base is calculated in ton, multiply to weight per unit rigid volume	thickness of 50mm. g. Asphaltic Concrete Base, AC-Base: minimum thickness of 60mm.
R-07-08	**SURFACE DRESSING**	Surface dressing is The work of dressing the asphalt on the surface on aggregate base A which already applied asphalt binder or on the existing asphalt, then spreaded with fine aggregate in which its quality and grade as required/specified.	The work volume is calculated as followed: a. Cover aggregate of single and double surface dressing is in m2. b. asphaltic materials for spreading is in m2 and multiply to weight per unit rigid volume	Includes: a. Single surface dressing, is asphalt dressing which covered with chipping. b. Double surface dressing, is asphalt dressing with double surface (chipping), each layer is given asphalt binder.
R-07-09	**BITUMINOUS COLDMIX**	Bituminous coldmix is pavement with thickness, dimension, lines and grades as shown on drawing; consist of aggregate and bituminous material, mixed, stored, spreaded and compacted in cold condition	Quantity of bituminous cold mix shall be measured in **m3** as approved by Engineer.	Bituminous coldmix shall include: a. Provisioning, hauling, mixing, storage, spreading, and compacting b. Quality test of material and field quality control
R-07-10	**PENETRATION MACADAM**	Penetration Macadam is a regulating coarse of stabilized aggregate bitumen with the thickness, dimension, line and grade as shown on drawing; consist of coarse of aggregate, key aggregate and cover aggregate in accordance with specifications. Penetration on macadam may function as base.	Quantity of penetration macadam is measured in **m3** as agreed by the project owner	Penetration macadam pavement shall include: a. Provisioning and hauling of materials, spreading, compacting. b. Bituminous spraying on every surface that has been compacted. c. Quality test of materials and field quality control.

R-07-11	**SURFACE DRESSING**	a. Surface dressing is: Installation of the thin layer on the rough surface on the existing road by spraying hot liquid asphalt, then overlay with chipping in accordance with specification. b. There are 2 types of surface dressing structure: • Single Surface Dressing. • Double Surface Dressing.	The volume of surface dressing work is calculated in: **(m2).**	Surface dressing work include: a. Cleaning the asphalt surface to be overlaid. b. Provisioning of materials c. Spraying hot liquid asphalt. d. Overlaying and chipping. **e.** Quality test of materials and field quality control**.**
R- 07-12	**SANDING**	Sanding is a maintenance work of the existing pavement surface by spraying bitumen binder on the surface and dry cleaned sand	Quantity of sanding is measured in **m2**	Sanding work shall include: a. Provisioning, bitumen heating, and spraying and spreading of sand. b. Quality test of materials and field quality control.

14.8. STRUCTURE: (R-08)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-08-01	**CEMENT CONCRETE**	Cement concrete is construction of all concrete structures, including reinforced, unreinforced/plain concrete, cast in place or precast and composite with thickness, dimension, lines, level and grade as shown on the drawing	Quantity of concrete structure is measured in **m3**	Construction of cement concrete includes: a. Provisioning material, mixing, Pouring, compacting, and curing • Lean Concrete • Reinforced Concrete • Pre Cast and cast in situ prestressed concrete b. Quality test of materials and field quality control.
R-08-02	**PRESTRESSED CONCRETE**	Prestressed concrete is constructing of structures with shape, dimension, line, and	Quantity of prestressed concrete structure is measured in the following rules:	Prestressed concrete structure shall include: a. fabrication, transportatio

		grade as shown on drawing. By using precast, prestressed, cast in place, either post tension or pre-tension and shall use materials in accordance with specification	a. Precast prestressed concrete girder : **eac**h b. diaphragm : **m3** **c.** stressing wire : **kg**	n/shipping, storage, jointing and erection/launching b. Quality test of materials and field quality control
R-08-03	**REINFORCING-STEEL**	Reinforcing steel is furnishing and placing reinforced steel with type, shape, diameter, length and quality based on the specification.	Quantity of reinforcing steel is measured in **kg**	Reinforcing steel shall include: a. Furnishing, transportation, and storage b. Fabrication (cutting and bending) c. installation d. Quality test of materials and field quality control.
R-08-04	**STRUCTURAL STEEL**	Structural steel is construction steel girder with type, shape, dimension, level , lines and grade as shown on drawing and the steel quality is in accordance with specifications	Quantity of structural steel shall be measured in **KG**	Structural steel work shall include: a. Provisioning, transporting, fabricating and storage b. Erection/launching.
R-08-05	**STEEL TRUSSES BRIDGE**	Steel trusses bridge is a construction of bridge by using steel trusses with type, shape, dimension, level, lines and grade as shown on drawing and the steel quality is in accordance with specification	Quantity of steel truss bridge is measured in **KG**	Structural steel work shall include: a. Provisioning, transporting, fabricating and storage b. Erection/launching.
R-08-06	**PILE FOUNDATION**	Pile foundation is construction of foundation to support bridge structures, consisting of timber, reinforced concrete, prestressed concrete and steel pile, with shape, dimension, length and configuration as shown on drawing and the quality shall be in accordance with specifications. There are two types of pile foundation: a. Driven Pile - Timber Pile	Quantity of construction of pile foundation is measured as follow: **a.** furnishing timber pile : **m3** **b.** furnishing of reinforced concrete pile : **lin. m** **c.** Furnishing of prestress concrete : **lin. m** **d.** furnishing steel pile: **lin. m** **e.** driving pile: **lin. m** **f.** construction of bore pile: **lin.m**	Construction of pile foundation shall include: a. Furnishing, transporting, storing, precast concrete casting, boring and driving. b. Quality test of material and field quality control.

		- steel pile - reinforced concrete - prestressed concrete b. Cast in place - Bore pile	**g.** construction of concrete sheet pile: **m2** h. construction of steel sheet pile : **m2**	
R-08-07	**OPEN CAISSON FOUNDATION/ WELL FOUNDATION**	Open caisson foundation is a construction of open caisson to support bridge structures, with shape, dimension, elevation and depth as shown on drawing and the quality of materials should be in accordance with specification	Quantity of open caisson foundation is measured in **lin. m**	Construction of caisson foundation shall include: a. Provisioning of caisson wall : • Segmental precast • Cast in situ b. installing caisson wall
R-08-08	**MORTAR CEMENT**	Cement mortar is producing and applying mortar cement to use in various work, consisting of Portland cement and sand mixed with water in composition and quality as stated in specification.	Quantity of cement mortar work is measured in **m3**	Cement mortar shall include: a. Provisioning and mixing of material and finishing. b. Quality test of materials
R-08-09	**STONE MASONRY**	Stone masonry is construction of structure with shape, dimension, lines and grades as shown on the drawing, consisting of stone diameter 10-20 cm and mortar cement in accordance with specifications	Quantity of stone masonry work is measured in **m3**	Construction of stone masonry structure shall include: a. supplying of materials; b. stone assembly with mortar cement c. Quality test of material and field quality control. Excluded excavation and lean concrete laying.
R-08-10	**RIP RAP**	Riprap is a constructing scour protection of surface composed of erodible material, consisting of stone formation 40-50 cm in diameter with shape, dimension, level, lines and grade as shown on the drawings	Quantity of riprap is measured in **m3**	Construction of riprap shall include: a. Provisioning materials b. Stone assembly
R-08-11	**GABION**	Gabion is construction of scour protection or retaining wall with type, shape, dimension as shown on drawings, consisting the wire mesh boxes filled with stone 10-20 cm in diameter	Quantity of gabion Is measured in **m3**	Construction of gabion shall include: a. Material provision b. Structure installation

R-08-12	**BLINDING STONE**	Blind stone is a construction underlying of foundation base consisting of stone grouted with mortar cement with thickness, dimension, lines and grades as shown on drawing.	Quantity of blinding stone is measured in **m3**	Construction of blinding stone shall include: a. Preparation of soil bed surfaces. b. Supplying and installing
R-08-13	**EXPANSION JOINT**	Expansion joint is supplying and installing metallic or elastomeric deck joints and any fillers and sealers, and joint structures in accordance with drawing and specification	Quantity of expansion joint is measured in **lin.m** as agreed by project owner**.**	Construction of expansion joints shall include: a. supplying and installing of materials b. Quality test of materials.
R-08-14	**BRIDGE BEARING**	Bridge bearing is furnishing and erecting metal or elastomeric bearing to support deck beams and slabs as indicated on the drawings	Quantity of bridge bearing is measured as follow: a. Elastomeric bearing : **each** **b.** strip bearing : **lin.m**	Bridge bearing shall include: a. Preparation of surface for direct setting of bearing, preparation of bedding. b. Quality test of materials
R-08-15	**BRIDGE RAILING**	Bridge railing is a construction of rail along both side of the bridge, such as galvanized and reinforced concrete with type, shape, dimension, lines and grades as shown on the drawing	Quantity of bridge railing is measured in **lin.meter**	Construction of bridge railing shall include: provision materials, fabrication, and installation.
R-08-16	**BRIDGE NAME BOARD**	Bridge name board is furnishing and installing bridge name plate based on the drawing	Quantity of bridge name plate is measured in unit of : **Each**	Bridge name board shall include: Installing at the location that agreed by the project owner.
R-08-17	**DEMOLITION OF EXISTING STRUCTURE**	Demolition of existing structure is removing wholly or in part and disposes of existing bridge culvert, head wall, and aprons, building, walls and other structure.	Quantity of demolition of existing structure is measured as follows: **a.** Demolition of stone masonry : **m3** b. demolition of reinforced and prestressed concrete: **m3** **c.** demolition of building: **m3** **d.** demolition of timber	Demolition of existing structure shall include: a. Removal of structure b. Disposal hauling

			bridge: **lin. m** e. Hauling the excess : m3/KM **f.** Wood bridge structure **(m2)**	
R-08-18	**CEMENT CONCRETE PAVEMENT**	Portland cement concrete pavement is a construction of concrete pavement with thickness, dimension, lines and grades as shown on drawing and the quality of materials in accordance with specification	Quantity of Portland cement concrete pavement is measured as follows: a. concrete : **m3** **b.** steel tie bar and dowels: **KG** c. Joint sealant : **Meter**	Construction of concrete pavement shall include: a. Provisioning materials, mixing, compacting and curing. b. Installing of dowels bar and tie bar c. Cutting and sealing of expansion/construction joint. d. Quality test of materials and performance
R-08-19	**LEAN CONCRETE**	Lean concrete is construction of leveling layer with thickness, lines and granular as shown on drawing. Composed of fine, coarse aggregate, Portland cement and water, mixed homogenously and laying on well prepared ground surface.	Quantity of lean concrete is measured in m3	Construction of lean concrete shall include: a. Provisioning materials, mixing, compacting and curing. b. Quality test of materials and performance

14.9. REINSTATEMENT OF EXISTING STRUCTURE AND MINOR WORKS: (R-09)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-09-01	**REINSTATEMENT OF EXISTING PAVEMENT**	Reinstatement of existing pavement is repairing of minor works, consisting of pot holes, line crack, corrugation, rutting, deformation and other minor failure to provide driving quality.	Quantity of reinstatement of existing pavement is measured as follows: a. Base aggregate A for minor work : **m3** **b.** subbase aggregate B for minor work : **m3** c. Aggregate pavement : **m3** d. waterbound macadam for minor works : **m2** e. hotmix asphaltic concrete : **m3** f. Penetration macadam : **m3**	Reinstatement of existing pavement shall include: a. Minor works on aggregate base b. Minor works on water bound macadam c. Minor works on hotmix asphalt. d. Minor works with penetration on macadam. e. Minor works with coldmixing. f. Minor works on surface dressing.

			g. coldmix asphaltic concrete : **m3** h. Asphalt Dressing: m2	
R-09-02	**REINSTATEMENT OF EXISTING DRAINAGE**	Reinstatement of existing drainage is repairing work of existing drainage, consisting minor repairing of lining, and sediment cleaning and other minor work	Quantity of reinstatement of existing drainage is measured in: a. Widening/deepen of drainage canal in m b. Repairing wall/bed of drainage canal : m	Reinstatement of existing drainage shall include: a. Material provisiong b. Widening and deepening the channel base c. Repairing the wall and base of the channel.
R-09-03	**REINSTATEMENT OF SHOULDERS**	Reinstatement of shoulder is repairing and other minor works of shoulder on both sides along the existing road	Quality of reinstatement of shoulder is measured as follows: a. Vegetation cleaning and removal : **m2** b. Minor excavation: m3 c. Overlay of additional aggregate: m3 d. Tree removal: each	Reinstatement of shoulders shall include: a. Vegetation clearing b. Minor Excavation c. overlay of additiona aggregate d. Tree removal
R-09-04	**REINSTATEMENT OF EXISTING ROAD SIDE**	Reinstatement of existing road side is minor work to recondition of existing road side, including embankment slope and cutting slope	Quantity of reinstatement of existing road side is measured as follows: a. repairing minor embankment slope : m3 b. Repairing minor cutting slope : m3 c. Grass sodding : m2	Recondition work of road side shall include: a. provisioning, spreading and compacting b. Disposal hauling
R-09-05	**REINSTATEMENT OF EXISTING ROAD ACCESORIES AND TRAFFIC CONTROL DEVICES**	Reinstatement of existing road accessories and traffic control devices is repairing, replacement, and other minor work of road accessories and traffic control devices.	Quantity of reinstatement of road accessories and traffic control devices is measured as follow: a. Installation fo road marking with thermoplastic paint : **m2** b. Traffic sign : **each** c. Guide post : **each** d. Kilometer Post : **each** e. Guide Rail : Lin. **Meter** f. Precast concrete curb : **lin. Meter**	Reinstatement of existing road furniture and traffic control devices shall include : a. Provisioning and transporting, b. Installing c. Traffic Management

R-09-06	**REINSTATEMENT OF EXISTING BRIDGES**	Reinstatement of existing bridge is repairing and other minor works of the existing bridge, including temporary bridge to extend its service life	Quantity of repairing and other minor work is measured as follow: **a.** Repairing concrete bridge deck : **m2** **b.** Repairing timber bridge deck : **m2** **c.** surface of steel structure : **m2** d. Railing : **lin. Meter**	Repairing of existing bridge shall include: a. Minor repair on bridge deck b. Repairing surface of steel structure c. Railing improving
R-09-07	**REINSTATEMENT OF EXISTING CONCRETE CURB OF LANE DIVIDER**	Reinstatement of existing concrete curb is repairing and/or replacement of concrete curb	Quantity of reinstatement of concrete curb shall be measured in : **lin Meter**	Reinstatement of existing curb shall include: a. Provisioning and installing curb b. quality test of material
R-09-08	**REINSTATEMENT OF EXISTING ROAD LIGHTING**	Reinstatement of existing road lighting is repairing lighting system according to the drawing and specification.	Quantity of reinstatement of existing road lighting is measured in : **unit/each**	Reinstatement of existing road lighting shall include : a. Supplying and installing b. Licensing/coordinating with related institutions.
R-09-09	**REINSTATEMENT OF EXISTING PEDESTRIAN FENCES**	Reinstatement of pedestrian fences is repairing work according to the drawing and specification.	Quantity of reinstatement of pedestrian fences is measured in: **linear Meter.**	Reinstatement of existing pedestrian fences shall include: Supplying, fabricating, and installing

14.10. DAILY WORKS: (R-10)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-10-01	**DAILY WORKS**	Daily work is an approved and instructed operation work not originally envisaged during design process and not included in original BoQ but in which it becomes apparent during construction phase as being necessary for the satisfactory execution and completion of the project	Quantity of daily works is measured as follow: a. Actual materials quantity delivered by suppliers and approved daily work recorded as regulation in part 1 to 9 b. Actual construction equipment approved in daily work record in : **hour** c. Actual number of daily work labor approved in daily works record : **hour**	Daily work shall include : a. additional drainage work b. additional excavation, filling, and stabilization work c. restitution of existing pavement line d. testing e. additional overlay f. additional structure works

14.11. ROUTINE MAINTENANCE (R-11)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-11-01	**ROUTINE MAINTENANCE OF EXISTING ROAD AND ITS ACCESSORIES**	Routine maintenance of existing road is a routine maintenance work to ensure that the pavement, shoulder, drainage, road accessories and bridges are maintained at all times in a serviceable condition to the satisfaction for road user.	Quantity of maintenance works for payment in monthly installment from the lumpsum bid for the various elements of works. Measured in **Lumpsum**	Routine maintenance work shall include: a. Routine maintenance of pavement b. Routine maintenance of shoulder c. Routine maintenance of drainage canal d. Routine maintenance of road accessories
R-11-02	**ROUTINE MAINTENANCE OF ADJACENT ROAD AND BRIDGE**	Routine maintenance of adjacent road and bridge is a maintenance work to ensure that during the project execution , all of the existing roads and bridges either adjacent to or leading to the site of the work that are traversed by the construction plant and equipment are kept open for traffic and are maintained in a safe and usable condition	Quantity of maintenance of adjacent road and bridges shall be measured in **lumpsum**	Routine maintenance of adjacent road and bridge shall include : • acces road and detour including brigde maintenance during project construction, ensure the smoothness of the traffic • Bridge strengthning at the access road, detour in order for vehicles to pass safely.

14.12 CLEANING: (R12)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-12-01	**CLEANING**	Cleaning is project cleaning along corridor of the road and/or project site consist of removing and hauling all of the materials resulting by the contractor activity during project execution	Measured in : **Lumpsum**	Clearing work shall include: Hauling of all disposal and other materials resulting by the contractor activities

14.13. GENERAL EXPENSES: (R13)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-13-01	**GENERAL EXPENSES**	General expenses are costs incurred in addition to the	Should clearly outline all of the costs, i.e. Insurance fee inauguration costs,	All of the general cost should be stated clearly in the structure of

		physical cost of the project so that the project can run smoothly during the project implementation period.	social fee, security fee, bank guarantee fee, and other necessary fees.	project cost and should be stated as a pay item.

14.14. PROFIT: (R 14)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-14-01	**PROFIT**	The profit of service provider of the construction whose value is set by the Government.	Calculated profit is certain % multiplied by the total net of the project cost	TOTAL NET of the project cost can be found in 7.0. method of Measurement

14.15. PROVISIONAL SUM: (R15)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-15-01	**PROVISIONAL SUM**	A certain value that is reserved for a particular work but has not yet calculated its cost at the time of contract agreement.	Set by the owner in terms of USD, it includes in the total contract value	Can only be used upon the written order by the owner.

14.16. CONTINGENCY : (R16)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-16-01	**CONTINGENCY**	A certain value that is reserved for a particular work that has not known yet for its usage.	Set by the owner in terms of USD, it includes in the total contract value	Can only be used upon the written order by the owner

14.17. CONSULTANT FEE: (R17)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-17-01	**CONSULTANT FEE**	Consultant fee for design and/or consultant fee for supervision in which its value is specified in the contract.	Calculated based on the standard fee for consultant.	For designer consultant , starts from the feasibility study, pre-design, detail design, specification, BoQ, details drawing, cost estimate, and mentoring during pre-bid meeting For supervision consultant, it includes daily, weekly, and monthly supervision report, checking all of the working drawings, as-built drawing, and final report.

14.18. PMU COST: (R 18)

Code	Work Item	Definition	Measurement Rules	Measurement Coverage
R-18-01	**PMU COST**	PMU cost is a specific fund allocated in the project for the purpose of the Project Management Unit, in performing project management activities	PMU cost is calculated based on a certain percentage multiplied by Total Net of the project cost. List of PMU cost percentage for various types of buildings can be found in the STANDARD FEE for CONSULTANT	TOTAL NET of the project cost can be found in 7.0. method of Measurement

14.19. TAX: (R19)

TLSMM Code	Part Name	Definition Rules	Measurement Rules	Coverage Rules
R-19-01	**TAX**	In this context, tax is referred to the income tax which is in accordance with government of Timor-Leste regulation	Calculated as one unit (integrated) in total gross of the project cost.	Includes the total gross of the project cost which will be stated as total budget of the project (Orsamento).

15.0. DOCUMENT TITLE

The title of this document is TIMOR LESTE STANDARD METHOD OF MEASUREMENT – 3 , For Irrigation and River, First Edition (January 2015), referred as TLSMM – 3.

TLSMM-3 is intended to be utilized in conjunction with the General Condition of Contract, General Specifications or any other relevant provisions provided elsewhere in the Contract Document.

The works shall be itemized and described in Bill of Quantity in sufficient details to enable contractors to price it adequately and the method of measurement shall be stated in the Preamble to the Bill of Quantity. The preamble shall state the method of measurement other than TLSMM-3, if any, which are adopted while preparing the Bill of Quantity and to be used for measurement of completed parts of the works. Such method of measurement shall comprise those not covered by TLSMM-3.

16.0. OBJECTIVE

The objective of TLSMM-3 is to set forth the procedure according to which the Bill of Quantity shall be prepared, priced and the quantities expressed and measured.

17.0. DEFINITIONS

17.1. In this document and in Bill of Quantity prepared according to the procedure set forth herein the following words and expressions have the meanings hereby assigned to them, except where the context otherwise required.

17.2. "Condition of Contract" means the "General Condition of Contract" as provided in the Bidding/Contract Documents prepared by Owner

17.3. Word and expression defined in the Condition of Contract have the same meaning herein

17.4. All references to clauses are references to clauses numbered in the Condition of Contract and reference to paragraphs are references to paragraphs numbered herein

17.5. The word "Work" includes work to carried out, goods, materials and services to be supplied, and the liabilities, obligations and risks to be undertaken by the Contractor under the Contract

17.6. The expression "expressly required" means as shown on the Drawings or as described in the Specifications or as instructed by the Engineer pursuant to the relevant provisions of Condition of Contract

17.7. "Day work" means the method of valuing work on the basis of time spent by the workmen, the materials used and the plant employed

17.8. "Original Ground Surface" means the surface of ground before any work has been carried out

17.9. "Final Excavated Surface" means the surface indicated on the Drawings to which excavation is to be carried out

17.10. "Commencing Ground Surface" for an item in a Bill of Quantities means, the surface of the ground from where that particular item of work has commenced

17.11. "Excavated Ground Surface for an item in the Bill of Quantity means, the surface to which excavation included in that particular item of work is to be carried out.

18.0. GENERAL PRINCIPLES

18.1. Unit of measurement

The unit of measurement for each item shall be stated for the item in the TLSMM-3. The unit of measurement stated against a descriptive feature in the TLSMM-3 shall apply to all items to which that descriptive feature applies. Meter, Kilogram, Second (MKS) system of units has been adopted in this TLSMM-3.

In discribing the dimension of a certain works, its sequence should be as followed, length, width and height or thickness.

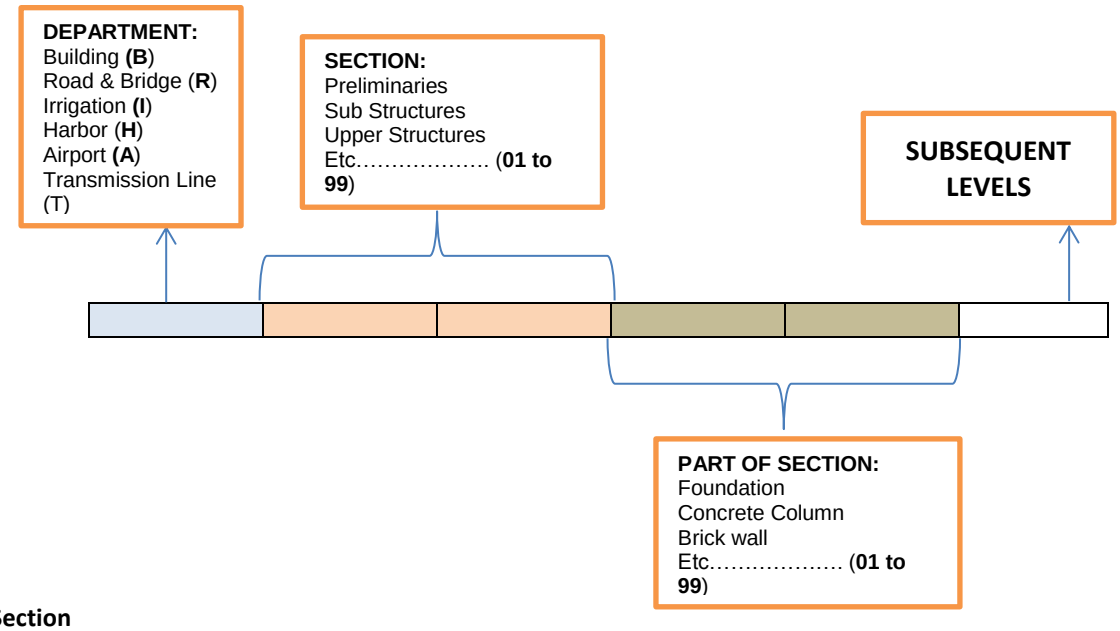
Each work should be calculated its net volume, excluding its disposal, overlapping, compactness, widening etc. For all items either stated in this TLSMM-3 or not such as transportation, warehouse, permit, loading and unloading, etc will be calculated in unit price of its work.

The unit of each work will follow the unit as stated in point 5.0.
The volume is rounded to two (2) decimal digits, ex. 1,234.78 not 1,234.7765.

18.2. TLSMM Codes

Works are classified into various "Sections". Unique code has been allocated to each item of work for its identification and presentation in the TLSMM –3, Bill of Quantity and elsewhere. Coding arrangement is as given hereunder:

. First digit represents the "Department"
. Next two digits represent the"Section"
. Next two digits represent the"Sub Section"
. Next digits represent the subsequent levels



18.3 Sub Section

Each part of the section would be defined to execute and measure for payment (pay item).

18.4 Measurement Rules

Measurement rules set out the conditions under which work shall be measured and the method by which the quantities shall be computed. In addition to measurement rules, following general conditions shall also apply:

a. Quantities of acceptable completed work relating to any part of specification shall be computed net using dimensions from the drawing and as per method given in this document except otherwise specified in special provisions or else in contract documents. No allowance shall be made for bulking, shrinkage or wastage.

b. All the work to be measured related to any part of specification, if required, shall be classified and measured separately as per Bill of Quantity.

c. The contractor is not entitled to claim difference in quantity calculated by the standard method of measurement and actual quantity as per site of a specific item except provision made herein, special provisions, or elsewhere in the contract documents.

18.5 Definition

Definition means the extent and limits of the item of work represented by a word or expression used in the work classification and in the Bill of Quantity prepared in accordance with TLSMM – 3.

18.6 Measurement Coverage

Measurement coverage provides that the work stated is deemed to be included in the appropriate items to the extent that such work is included in the Contract. In addition to measurement coverage, following general conditions shall also apply:

a. Loading, unloading and transportation of material related to any item of work

b. All the items and activities in TLSMM – 3 shall deem to be included all operations required to perform the work as per Contract Documents.

c. Additional measurement coverage which is necessary for complete understanding of method of measurement is given against relevant item or activity.

18.7 Additional Descriptions

Additional descriptions which are necessary for complete understanding of works/activities covered under method of measurement are provided against such particular item of work.

19.0 UNITS AND ABREVIATIONS

The following units of measurement and abreviations shall be used:

Unit	Abbreviation
Millimeter	Mm
Meter	M
Square millimeter	mm^2 or mm2
Square meter	M^2 or M2
Hectare	Ha
Cubic meter	M^3 or M3
Kilogram	Kg
Tone	Ton
Metric Tone	M.Ton
Summary	Sum
Number	No.
Horse Power	Hp
Week	Wk
Litre	Ltr
Lump Sum	Ls

20.0 CONVERSION TABLE

To convert	Into	Multiply
LENGTH		
Millimeter	Inch	0.03937
Inch	Millimeter	25.40005
Meter	Foot	3.28084
Foot	Meter	0.3048
Meter	Yard	1.09361
Yard	Meter	0.9144
Kilometer	Mile	0.62137
Mile	Kilometer	1.60935
MASS WEIGHT		
Kilogram	Pound	2.20462
Pound	Kilogram	0.45359
Gram	Ounce	0.03527
Ounce	Gram	28.34949
Kilogram	Quintal	0.01
Milligram	Grain	0.01543
Kilogram	Hundred Weight	0.01968
Hundred weight	Tone	0.0508
Kilogram	Tone	0.001
Kilogram	Ton	0.00098
Pound	Ton	0.00045
Tone	Ton	0.98421
Kilogram	Seer	1.01605
Kilogram	Maund	0.02679
Gram	Tola	0.08573
VOLUME		
Litre	Pint (UK)	1.75975
Litre	Gallon (imperial)	0.21997
Litre	Gallon (US)	0.26417
Litre	Cubic Foot	0.3531
Litre	Cubic Meter	0.001
Cubic Foot	Liter	28.31682
Milliliter	Fluid ounce	0.0352
Gallon Imperial	Liter	4.5461
Gallon US	Liter	3.78541
Gallon Imperial	Gallon US	1.20095
Cubic millimetre	Cubic inch	0.00006
Cubic meter	Cubic foot	35.31472
Cubic foot	Cubic meter	0.02832
Cubic meter	Cubic Yard	1.30795
Cubic yard	Cubic meter	0.76456
AREA		
Square millimeter	Square inch	0.00155
Square inch	Square millimeter	645.1613
Square meter	Square foot	10.76392
Square foot	Square meter	0.0929
Square meter	Square yard	1.19599
Square yard	Square meter	0.83613
Square meter	Acre	0.00025
Hectare	Acre	2.47105
Acre	Hectare	0.40469
Square meter	Hectare	0.0001

Square kilometer	Square mile	0.3861
Square mile	Square kilometer	2.58999
Hectare	Square mile	0.00386
Square mile	Hectare	258.9989
MASS/UNIT AREA		
Kilogram per square kilometer	Ton per square mile	0.00255
Kilogram per square meter	Pound per square foot	0.20482
Pound per square foot	Kilogram per square meter	4.88243
MASS PER UNIT VOLUME		
Kilogram per cubic meter	Pound per cubic foot	0.06243
Grams per liter	Pound per cubic foot	0.06243
Pound per cubic foot	Kilogram per cubic meter	16.01845
Pound per cubic foot	Grams per liter	10.01845

While converting unit from one system to other system the measurement shall be taken nearest to three digits for MKS system and nearest to two digits for FPS system.

21.0 METHOD OF MEASUREMENT

Section 01: Preliminaries

Section 02: Excavation

Section 03: Filling

Section 04: Dewatering

Section 05: Stone Masonry

Section 06: Weephole

Section 07: Concrete Work

Section 08: Sodding

Section 09: WaterGate

Section 10: Trash Rack

Section 11: Gabion

Section 12: Geotextile

Section 13: Piling

Section 14: Water Breaker/ Wave Breaker Equipment

Section 15: Staff Gauge

Section 16: Embankment

Section 17: Groin

Section 18: Waterstop

TOTAL NET OF CONSTRUCTION COST ……. A

Section 19: Field Clearing

TOTAL NET OF PROJECT COST,……. B = A+19

Section 20: General Expenses

Section 21**:** Profit

Section 22: Provisional sum

Section 23: Contingency

Section 24: Consultant Fee

Section 25: PMU cost

Section 26: Tax

TOTAL GROSS OF PROJECT COST C = B +(20+21+22+23+24+25+26)

21.1 PRELIMINARIES WORK

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-01 **I-01-01**	**PREPARATION WORK** **MOBILISATION**	Mobilization is an initial activity to mobilize equipment, workforce, facility, and required permission, before the project began physically.	Each type of the equipment, workforce, facility and permit should be broken down its quantity as well as its specification in such a way to facilitate the calculation of price/cost of mobilization. The unit is a Lump Sum.	In calculating mobilization price/cost of each item, should have already included transportation fee, loading and unloading, permits, rent/purchase fee as well as other social fees
I-01-02	**DEMOBILISATION**	Demobilization is a final activity to demobilize equipment, workforce, and facility that is no longer used for the project	Each type of the equipment, workforce, facility and permit should be broken down its quantity as well as its specification in such a way to facilitate the calculation of price/cost	In calculating demobilization cost of each item, there should have included transportation cost, loading and unloading, permits, rent/purchase costs, as well as other social fees.

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-01-03	**ACCESS ROAD**	access road (driveway) is an activity of making new road or make use of an existing road or improve the functionality of existing road for the purpose of entrance and exit roads to the project location including its maintenance	Rules of work Measurement of making access road (driveway) has to be in accordance with the terms stated in the contract documents, and, planning design & technical specification. Unit of measurement is length (KM)	All of the items of access road work and its maintenance. Includes: permit, land acquisitions, land clearing, stripping sewers, bridges, side drain, etc.

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-01-04	SIGNBOARD	Signboard contains information about the work that to be carried out. the content of information are: the name of the work, the owner of the project, costs, start & end date of Project, name of the contractor, name of the supervision consultant and contract number.	Signboard must correspond to that indicated on the technical specifications. The unit of measurement is unit.	Installation, permits & supporting Equipment.

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-01-05	LAND CLEARING	Is the work of clearing the land from trees (diameter ≤15 cm), shrub-scrub, grass that are grown in the planned location of the building	The clearing areal land should be done in accordance with the technical specifications. unit of measurement is m2	-Including dumping of garbage in the disposal area. -Supporting equipment.
I-01-06	STRIPPING	is stripping the top surface including leveling the ground.	The stripping area should be cleaned and aligned in accordance with technical specification, unit is m2	- Including dumping of garbage in the disposal area. - Supporting equipment.
I-01-07	RELOCATION PUBLIC FACILITY	Relocation of utilities and other available services is an activity to move the entire underground installation network which is affected by the construction of new road or widening of the existing road in accordance with terms and planning design.	Measurement of work volume done on a lumpsum, i.e a. relocation of telephone utility (lumpsum) b. relocation electric utility (lumpsum) c. relocation clean water utility (lumpsum) d. relocation of gas utility (lumpsum) e. Relocation of other utility	Scope of the work: Relocate underground network, including: clean water distribution pipes, electrical wiring, telephone wiring. Relocate electrical pole, telephone pole, street light pole, traffic pole and traffic signs

21.2 EXCAVATION

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-02	EXCAVATION			
I-02-01	GROUND EXCAVATION	excavations on ground layer that can be excavated with hoe	- should be in accordance with planning design, vertical profile & horizontal profile, - Unit of Measurement is M3.	- Dumping of digging material in the disposal area, - Supporting Equipment for ground excavation.
I-02-02	ROCKSOIL EXCAVATION	Excavation on rock soil that can be done using breaker equipment.	- should be in accordance with planning design, vertical profile & horizontal profile, - Unit of Measurement is M3.	- dumping of digging material in the disposal area, - Supporting Equipment for Rock soil excavation
I-02-03	HARDROCK EXCAVATION	Excavation on hard rock that can be done by breaker equipment	- should be in accordance with planning design, vertical profile & horizontal profile, - Unit of Measurement is M3.	- dumping of digging material in the disposal area, - Supporting Equipment for hard rock excavation.
I-02-04	MUD EXCAVATION	Is ground excavation on soft and aqueous soil	- should be in accordance with planning design, vertical profile & horizontal profile, - Unit of Measurement is M3.	- Dumping of digging material in the disposal area, - Supporting Equipment for mud digging.
I-02-05	RIVER DEPOSIT EXCAVATION	excavation on the river or certain areas in the river in which its digging materials consist of rock soil, sand and gravel	- should be in accordance with planning design, vertical profile & horizontal profile, - Unit of Measurement is M3.	- Dumping of material to the disposal area, - Supporting Equipment for river deposit excavation.

21.3 FILLING

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-03	FILLING			
I-03-01	SOIL FILLING	Work of Filling using ordinary soil which is required.	- should be in accordance with planning design, vertical profile & horizontal profile, - Unit of	- preparation of filling materials, spreading, and compacting - Supporting equipment for

			Measurement is M3.	filling soil.
I-03-02	**SELECTED MATERIAL FILLING**	Filling using selected material with certain parameter and transported from the borrow area in accordance with required technical specifications.	- should be in accordance with planning design, vertical profile & horizontal profile, - Unit of Measurement is M3.	- preparation of filling materials, spreading, and compacting - Supporting equipment for filling of selected material

21.4 DEWATERING

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-04	**DEWATERING**	Is rechanneling water from excavated area for construction in the river bed or in the area containing water in order to provide the construction site free of water(dry) before and during the construction	- Unit of measurement is lumpsum.	- equipment for dewatering - other components of supporting equipment

21.5 STONE MASONRY

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-05	**STONE MASONRY**			
I-05-01	**(RIP-RAP)**	Rip-rap is installing the stone without coating with mortar, arranged in such a way in a specific location as protector from water flow as required in the technical specifications	- The measurement of rip-rap should be in accordance with planning design, - Unit of measurement is M^3.	- Provisioning, transporting, placement and assembly
I-05-02	**STONE MASONRY (Cleave Stone)**	Stone masonry Is placing/assembling the stones that are already cleaved (not oval/Round Rock) using particular mortar according to the required technical specifications.	- Based on required technical specification. - Unit of measurement is M^3.	- Provisioning, transporting, placement and assembly.

I-05-03	**SURFACE MASONRY**	Surface masonry is a part of installing structural rock, arranged in such a way that looks aesthetic as required in technical specifications.	- Unit of measurement is M^3.	Stone selection and its installation
I-05-04	**PLASTERING**	Plaster is part of work in covering brick/concrete brick/concrete wall. stucco is as part of smoothing the surface of the plaster to be ready for the priming	Plaster is calculated in meter square (m2), and separate its item according to the quality of each mixture. Stucco is separated from plastering and calculated in meter square (m2).	Including all the necessary equipment and labor for stirring mortar, transporting and installing plaster in its position based on the design.
I-05-05	**GROOVE (SIAR)**	A masonry work, overhang the mounted as deep as 1- 2 cm, on gaps between stones.	Unit of measurement is M2.	Stripping of assembly on gaps between rocks for lining
I-05-06	**FLOOR WORK**	The work of spreading certain mortar/lean concrete evenly along the foundation prior to constructing the foundation with thickness and elevation in accordance with planning design.	- Unit is m3.	- Ground leveling, - floor installation

21.6 WEEPHOLES

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-06	**WEEPHOLE**	Is a work of installing waste water pit absorption on stone retaining wall and/or concrete retaining wall. On its base mounted the filter, Its function is to escaping water pressure material and the placement should be in accordance with the technical specifications and planning design.	- Unit of measurement is Unit.	- Filter installation.

21.7 CONCRETE WORK

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-07	**CONCRETE WORK**			
I-07-01	**CONCRETE CYCLOP**	An assembly that consists of the mixture of stone and concrete with composition of 60% stone and 40% concrete. Stone diameter and concrete quality should be in accordance with technical specification.	- Unit of measurement is M^3.	Assembling and other components of supporting equipment.
I-07-02	**CONCRETE**	Cement concrete structure is construction of cement concrete for bridge structure retaining walls and other concrete structures with shapes and dimensions in accordance with design and should use materials that meet specification	The measurement of work volume are as follow: a. *Concrete* Measured based on design and its unit of measurement is m3 b. *formwork* is measured based on design and the work method with its net area is measured from contact area with concrete in m2 c. *Reinforce* is calculated in kg, and calculate separately per-diameter. the length of the reinforce should have included the bending and the joint (distribution length)	The scopes are: a. Preparation and storage of materials that are based on the specification. b. Formulating Job Mix Formula. c. Construction of formwork by using a waterproof material; shape, dimensions, elevation and location should be based on the drawing. d. Mixing of components materials is according to JMF and casting mixture with its procedure should be based on the specifications. e. Concrete treatment procedure should be in accordance with its specification. f. Formwork discharge.

I-07-03	**REINFORCEMENT**	Reinforce is the work of provisioning, transporting, fabricating and installing of steel reinforcement with diameter and quality steel should be in accordance with specifications.	Steel reinforcement is calculated in kg unit, and calculated separately per-diameter. The length of reinforcement should have included bending and joint (distribution length) For steel reinforcement wire mesh. Calculating its net area without overlapping, the unit is m2. if there is any welding work, it is calculated in m1	The scopes are as follow: a. Provisioning, transporting and storing of steel reinforcement with a diameter and quality should be in accordance with specifications. b. The diameter, length, shape and amount of fabricated reinforce should be in accordance with specification. c. installation of reinforce at location, configuration distance, the amounts of the reinforce should be based on drawing
I-07-04	**FORMWORK**	Formwork is a reference form of concrete that can be constructed from wood, iron or others	The area of formwork is the contacted area between concrete and formwork measured in m2 unit. The hole in the formwork which is less than 1 m2 is not counted as deduction of the area.	Including all supporting construction so that the formwork is strong, rigid and clean from dirt until attached to its position.

21.8 SODDING

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-08	**SODDING**	Work of assembling, sodding on ground channel wall, cliff wall as an effort to prevent soil erosion	- The quality and sodding area should be based on technical specification and detail planning design. - unit is m2	Transporting, fertilizing, planting, nurturing, until they grow and other components of supporting equipment

21.9 WATERGATE

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-09	**WATER GATE**	Installing and building the water gate for the purpose of controlling water flow based on its functions.	- The unit of measurement is Unit	- DED, constructing, transporting, installing, and field testing. - door components accessories, - Door protective coating.

21.10 TRASH RACK

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-10	**TRASH RACK**	Build and install formwork, installed as a filter on the inlet, its function is to hold trash as to keep them from going into irrigation canals and should be based on the detail desing planning.	Unit of measurement is Unit	Building, transporting, and trash rack installation including its component and supporting equipment.

21.11 GABION

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-11	**GABION**	A box that is made of woven stainless wire with certain diameter, hexagonal-shaped wicker, with a minimum of 3 wire coils which are made manually or fabricated. Gabion box is filled with rocks, wire diameter, hole dimension and the dimensions of the stones should be in accordance with technical specifications.	- the measurement of gabion construction should be in accordance with detail planning design, - Unit of measurement is M^3.	Constructing, transporting and installing the construction including its component and supporting equipment.

21.12 GEOTEXTILE

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-12	**GEOTEXTILE**	Installing/spreading geotextile coat at the specified location in the detail planning design. One of the geotextile functions	- the calculated area is the net area based on technical specification and detail design planning	Including transportation, installation, necessary overlapping connection and other necessary

		is to hold grains while allowing water to flow through.	- unit of measurement is M2	supporting equipment.

21.13 PILING

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-13	**PILING**	Piling foundation is a foundation to support structure (pillar, abutment, retaining wall) and other structures, consist of wooden pile, pre-fabricated concrete pile, steel pile or cast in place by using materials which meet specifications and the dimensions, numbers and length should be as specified in the design.	The quantity of piling foundation is calculated in unit as follow: a. Supply of wood pile (m3). b. Supply of prefabricated reinforces concrete pile: (m3). c. Supply of prefabricated prestress concrete beam: (m3). d. Preparation of steel beam piling : Kg e. Driving the Pile : Meter (m) f. cast in Place pile: (m) g. timber and concrete revetment: (m2) h. steel revetment (m2)	The scope include: a. preparation of material and piling materials for cast in Place b. quality test of materials and services.

21.14 WATER BREAKER/WAVE BREAKER EQUIPMENT

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-14	**WATER BREAKER) / WAVE BREAKER EQUIPMENT**	Building and setting up construction to break and weaken the influence, concentration and energy of wave so as to reduce sea erosion and abrasion. Dimension, shape and its number should be in accordance as specified in detail planning design. The wave breaker material can be made from armor and reinforce concrete	- Dimension, shape and type of wave breaker should be in accordance with detail planning design and technical specification. - Material from natural rock is measured in m^3. - Material from concrete, its unit is unit.	Building, transporting, installation of wave breaker materials in place and other components of supporting equipment.

21.15 STAFF GAUGE

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-15	**STAFF GAUGE**	Installing staff gauge at a specific location	- quality, number and installation	Transporting, installing and

		fo find out the water surface elevation.	location of staff gauge should be in accordance with technical specification and detail planning design, - Unit of measurement is unit.	other components of supporting equipment

21.16 EMBANKMENT

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-16	**EMBANKMENT**	Build a construction to withstand water surge which could be made from heap of soil, rocks, stone masonry, concrete, etc.	- Dimension, location, and material should be in accordance with detail planning design and technical specification, - Unit is M^3	Transporting, spreading material, compacting, building and other components of supporting equipment.

21.17 GROIN

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-17	**GROIN**	Building a construction to direct and reduce flow speed of river. Type of construction can be made of stone masonry, concrete, gabion and pile.	- Dimension, location, and materials should be in accordance with detail design planning and technical specification. - Unit of measurement should be based on type of construction (Concrete, stone masonry, gabion is in m^3, pile is in m).	Transporting, building, and other components of supporting equipment.

21.18 WATERSTOP

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-**18**	**WATERSTOP**	Setting up waterstop (holding water material) on joint of concrete casting so that to avoid water infiltration on the referred joint.	- The quality, dimension and location of waterstop installation are determined in technical specification and details planning design. - unit of measurement is M	Installation, overlapping waterstop and other components of supporting equipment.

21.19 FIELD CLEARING

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-19	**FIELD CLEARING**	Is a cleaning activity after irrigation or river construction is completed	Measured in lumpsum.	Includes all the remaining dirt and debris along the irrigation/river construction that must be removed and cleaned

21.20 GENERAL EXPENSES

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-20	**GENERAL EXPENSES**	General expenses are costs incurred in addition to the physical cost of the project so that the project can run smoothly during the project implementation period.	Should clearly outline all of the costs, i.e. Insurance fee inauguration costs, social fee, security fee, bank guarantees fee, and other necessary fees.	All of the general cost should be stated clearly in the structure of project cost and should be stated as a pay item.

21.21 PROFIT

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-21	**PROFIT**	Profit is a sum calculated as the profit of contractors according to the Government regulation.	Calculated profit is a certain % multiplied by the total net of the project cost	TOTAL NET of the project cost can be found in 7.0. method of Measurement

21.22 PROVISIONAL SUM

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-22	**PROVISIONAL SUM**	A certain value that is reserved for a particular work but has not yet calculated its cost at the time of contract agreement.	Set by the ower in terms of USD, it includes in the total contract value	Can only be used upon the written orders by the owner.

21.23 CONTINGENCY

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-23	**CONTINGENCY**	Is a certain value that is reserved for a particular work that has not known yet for its usage.	Set by the owner in terms of USD, it includes in the total contract value	Can only be used upon the written orders by the owner

21.24 CONSULTANT FEE

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-**24**	**CONSULTANT FEE**	Consultant fee for planning and/or consultant fee for supervision in which its value is specified in the contract.	Calculated based on the standard fee for consultant.	For planner consultant , it starts from the feasibility study, pre-design, detail design, specification, BoQ, details drawing, cost estimate, and mentoring during pre-bid meeting For supervisory consultant, it includes daily, weekly, and monthly supervision report, checking all of the working drawings, drawing as built, and final project report.

21.25 PMU COST

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-**25**	**PMU COST**	PMU cost is a specific funds allocated in the project for the purposes of the Project Management Unit, in performing project management activities	PMU cost is calculated based on a certain percentage multiplied by Total Net of the project cost. List of PMU cost percentage for various types of buildings can be found in the STANDARD FEE for CONSULTANT	TOTAL NET of the project cost can be found in 7.0. method of Measurement

21.26 TAX

CODE NO.	WORK ITEM	DEFINITION	MEASUREMENT RULES	MEASUREMENT COVERAGE
I-**26**	**TAX**	In this context, tax is referred to the income tax which is in accordance with government of Timor-Leste regulation	Calculated as one unit (integrated) in total gross of the project cost.	Includes the total gross of the project cost which will be stated as total budget of the project (Orsamento).

STANDARD COEFFICIENT OF UNIT PRICE ANALYSIS

I. PREPARATION WORK

REQUIREMENT		UNIT	COEFFICIENT
1 M Temporary Fence of Corrugated Iron, 2m high			
MATERIAL	Portland Cement	Kg	2.5000
	0.2 corrugated iron	Sheet	1.2158
	Concrete sand	M^3	0.0050
	Gravel	M^3	0.0090
	Wooden rafters 5/7	M^3	0.0410
	Common Nail 2 "-5"	Kg	0.0829
LABOR	Unskilled labor	Day	0.2495
	Carpenter	Day	0.2858
	Skilled head	Day	0.0200
	Foreman	Day	0.0200
1 M Measuring and Installing Batter Board			
MATERIAL	Wooden rafters 5/7	M^3	0.0177
	Common Nail 2 " -5 "	Kg	0.0200
	Wood boards 3/20	M^3	0.0070
LABOR	Unskilled labor	Day	0.1000
	Carpenter	Day	0.1000
	Skilled head	Day	0.0100
	Foreman	Day	0.0050
1 M2 Build Cement Warehouse and Tools			
MATERIAL	Dolken wood Ø 8-10 / 4m	Piece	1.7000
	Wood	M^3	0.2074
	Common Nail 2 " -5 "	Kg	0.3000
	Portland Cement	Kg	10.5000
	Concrete sand	M^3	0.0300
	Gravel	M^3	0.0500
	Corrugated BJLS 28	Sheet	1.5306
LABOR	Unskilled labor	Day	1.0000
	Carpenter	Day	2.0000
	Skilled head	Day	0.2000
	Foreman	Day	0.0500

1M² Guard House Construction (Wood Construction)			
MATERIAL	Dolken wood Ø 8-10 / 4m	Piece	3.0500
	Wood	M³	0.2807
	Common Nail 2 " -5 "	Kg	0.7117
	Corrugated BJLS 28	Sheet	1.7090
LABOR	Unskilled labor	Day	1.0167
	Carpenter	Day	1.5250
	Skilled head	Day	0.1527
	Foreman	Day	0.0510
1 M² Site Clearing and Site Levelling			
LABOR	Unskilled labor	Day	0.1000
	Foreman	Day	0.0500
1 Piece Installation of Project Signage			
MATERIAL	Project name plate	Piece	1.0000
	5/7 wooden rafter class II	M³	0.0235
	Common Nail 2 " - 5 "	Kg	0.1665
LABOR	Unskilled labor	Day	0.2503
	Foreman	Day	0.0443
1 M2 Make Barrack Labor			
MATERIAL	Dolken wood Ø 8-10 / 4m	Piece	1.2500
	Wood	M³	0.1860
	Nail 2 " -5 "	Kg	0.3000
	Portland Cement	Kg	18.0000
	concrete sand	M³	0.0300
	Gravel	M³	0.0500
	Corrugated BJLS 28	Sheet	1.5401
	Plywood 4 mm	Sheet	0.5883
LABOR	Unskilled labor	Day	1.0000
	Carpenter	Day	2.0000
	Skilled head	Day	0.2000
	Foreman	Day	0.0500
1 M2 Make Mortar Tub (40x50x20) cm			
MATERIAL	Wood outstretched	M³	0.0370
	Nail 2 " -5 "	Kg	0.0820
	Rafter 5/7 - 4m	Piece	1.0250
LABOR	Carpenter	Day	0.3075
	Foreman	Day	0.0020

1M² Temporary Road Construction			
MATERIAL	Cleaved Stone 15/20	M³	0.1500
	Crushed stone 5/7	M³	0.0900
	Sand	M³	0.0100
LABOR	Unskilled labor	Day	1.0000
	Foreman	Day	0.0500
1 M³ Demolition of Reinforced Concrete			
LABOR	Unskilled labor	Day	6.6670
	Foreman	Day	0.3330
1 M³ Demolition of Red Brick Wall			
LABOR	Unskilled labor	Day	6.6670
	Foreman	Day	0.0330

II. EARTH WORKS

REQUIREMENT		UNIT	COEFFICIENT
1 M³ Ordinary Soil Excavation of 1 Meter Depth			
LABOR	Unskilled labor	Day	0.6700
	Foreman	Day	0.0320
1 M³ Ordinary Soil Excavation of 2 Meters Depth			
LABOR	Unskilled labor	Day	0.7500
	Foreman	Day	0.0470
1 M³ Ordinary Soil Excavation of 3 Meters Depth			
LABOR	Unskilled labor	Day	0.8900
	Foreman	Day	0.0685
1 M³ Hard Soil Excavation of 1 Meter Depth			
LABOR	Unskilled labor	Day	0.9500
	Foreman	Day	0.0530
1 M³ Ground Rock Excavation of 1 Meter Depth			
LABOR	Unskilled labor	Day	1.5000
	rock soil	Day	0.0600
1 M³ Mud Soil Excavation of 1 Meter Depth			
LABOR	Unskilled labor	Day	0.9163
	Foreman	Day	0.0700
1 M² Cliff stripping work (1 meter high)			
LABOR	Unskilled labor	Day	0.4230
	Foreman	Day	0.0260

1 M³ Disposing of Land 30 Meters Distance			
LABOR	Unskilled labor	Day	0.3300
	Foreman	Day	0.0126
1 M³ Backfilling of Excavated Area			
LABOR	Unskilled labor	Day	0.2142
	Foreman	Day	0.0143
1 M³ Soil Compaction (per 20 cm)			
LABOR	Unskilled labor	Day	0.5000
	Foreman	Day	0.0500
1 M³ Sand Filling			
MATERIAL	Filled sand	M³	1.2000
LABOR	Unskilled labor	Day	0.3023
	Foreman	Day	0.0127
1 M³ Installation of 10 cm Thick Layer Of Ijuk (Palm Tree Fibers)			
MATERIAL	Ijuk (palm tree fiber/filter material)	M³	2.7577
LABOR	Unskilled labor	Day	0.1500
	Foreman	Day	0.0150
1 M³ Compacted Sand-Gravel Mixed to Raise Building Floor			
MATERIAL	Sand - gravel mixed (Sirtu)	M³	1.2000
LABOR	Unskilled labor	Day	0.3046
	Foreman	Day	0.0379
III. FOUNDATION WORKS			
REQUIREMENT		**UNIT**	**COEFFICIENT**
1 M³ Construction of Stone Masonry Foundation (1 Pc : 3 Sand)			
MATERIAL	Stone masonry 15/20 cm	M³	1.1490
	Portland Cement	Kg	202.0000
	Sand	M³	0.4850
LABOR	Unskilled labor	Day	1.5000
	Stonemason	Day	0.6000
	Skilled head	Day	0.0905
	Foreman	Day	0.0973
1 M³ Construction of Stone Masonry Foundation (1 Pc : 4 Sand)			
MATERIAL	Stone masonry 15/20 cm	M³	1.2000
	Portland Cement	Kg	163.0000
	Sand	M³	0.5348

LABOR	Unskilled labor	Day	1.8313
	Stonemason	Day	0.8404
	Skilled head	Day	0.0991
	Foreman	Day	0.0750
1 M³ Construction of Stone Masonry Foundation (1 Pc : 5 Sand)			
MATERIAL	Stone masonry 15/20 cm	M³	1.2000
	Portland Cement	Kg	136.0000
	Sand	M³	0.5440
LABOR	Unskilled labor	Day	1.7141
	Stonemason	Day	0.7130
	Skilled head	Day	0.1095
	Foreman	Day	0.1919
1 M³ Construction of Rip Rap Foundation			
MATERIAL	Stone masonry 15/20 cm	M³	1.2000
	Filled sand	M³	0.3033
LABOR	Unskilled labor	Day	0.7800
	Stonemason	Day	0.3900
	Skilled head	Day	0.0579
	Foreman	Day	0.0579
1 M³ Construction of Cyclop Foundation, Φ 1 m			
MATERIAL	Stone masonry 15/20 cm	M³	0.4500
	Portland Cement	Kg	213.4000
	Concrete sand	M³	0.3837
	Gravel / coral	M³	0.5670
LABOR	Unskilled labor	Day	2.2353
	Stonemason	Day	0.4580
	Skilled head	Day	0.0457
	Foreman	Day	0.0900

IV. CONCRETE WORKS

REQUIREMENT		UNIT	COEFFICIENT
10 Kgs of Steel Reinforcement			
MATERIAL	Steel Reinforced	Kg	10.5000
	Concrete wire	Kg	0.1500
LABOR	Unskilled labor	Day	0.0949

	Blacksmith	Day	0.0757
	Skilled head	Day	0.0109
	Foreman	Day	0.0223
1 M Formwork for Foundation			
MATERIAL	Wood class III	M^3	0.0329
	Nail 5 ' - 10 '	Kg	0.1586
	formwork oil	Ltr	0.0168
LABOR	Unskilled labor	Day	0.5200
	Carpenter	Day	0.2600
	Skilled head	Day	0.0260
	Foreman	Day	0.0260
1 M Formwork for Tie Beam			
MATERIAL	Multiplex 9mm	Sheet	0.3500
	Wood class III	M^3	0.0450
	Nail 5 ' - 10 '	Kg	0.3000
	formwork oil	Ltr	0.0256
LABOR	Unskilled labor	Day	0.5200
	Carpenter	Day	0.2600
	Skilled head	Day	0.0260
	Foreman	Day	0.0260
1 M^2 Formwork for Columns			
MATERIAL	Wood class III	M^3	0.0400
	Nail 5 ' - 12 '	Kg	0.4000
	formwork oil	Liter	0.0555
	Wooden beams Class II	M^3	0.0150
	9 mm thick plywood	Sheet	0.3500
	Dolken wood 8 " -10 " / 4 m	Piece	2.0000
LABOR	Unskilled labor	Day	0.6600
	Carpenter	Day	0.3300
	Skilled head	Day	0.0330
	Foreman	Day	0.0330
1 M^2 Formwork for Beams			
MATERIAL	Wood class III	M^3	0.0400
	Nail 5 ' - 12 '	Kg	0.4000
	formwork oil	Ltr	0.0536
	Wooden beams Class II	M^3	0.0360
	9 mm thick plywood	Sheet	0.3500

	Dolken wood 8 " -10 " / 4 m	Piece	2.0000
LABOR	Unskilled labor	Day	0.6600
	Carpenter	Day	0.3300
	Skilled head	Day	0.0330
	Foreman	Day	0.0330
1 M^2 Formwork for Floor			
MATERIAL	Wood class III	M^3	0.0400
	Nail 5 ' - 12 '	Kg	0.4000
	formwork oil	Liter	0.0536
	Wooden beams Class II	M^3	0.0360
	9 mm thick plywood	Sheet	0.3500
	Dolken wood 8 " -10 " / 4 m	Piece	2.0000
LABOR	Unskilled labor	Day	0.6600
	Carpenter	Day	0.3300
	Skilled head	Day	0.0330
	Foreman	Day	0.0330
1 M^2 Formwork for Stairs			
MATERIAL	Wood class III	M^3	0.0300
	Nail 5 ' - 12 '	Kg	0.4000
	formwork oil	Liter	0.1500
	Wooden beams Class II	M^3	0.0183
	9 mm thick plywood	Sheet	0.3455
	Dolken wood 8 " -10 " / 4 m	Piece	2.0000
LABOR	Unskilled labor	Day	0.6600
	Carpenter	Day	0.3300
	Skilled head	Day	0.0330
	Foreman	Day	0.0161
1 M^2 Concrete trolley platform			
MATERIAL	Wood class III (board)	M^3	0.0260
	Nail 5 ' - 12 '	Kg	0.6000
	Dolken wood 8 " -10 " / 4 m	Piece	0.5000
LABOR	Unskilled labor	Day	0.1500
	Carpenter	Day	0.0500
	Skilled head	Day	0.0051
	Foreman	Day	0.0080
1 M^3 Reinforced Concrete Foundation of K 175 , F'c = 14.5 MPa (150 kg steel + Formwork)			

MATERIAL	Wood class III	M^3	0.2000
	Nail 5 ' - 12 '	Kg	1.5000
	formwork oil	Liter	0.0667
	Steel Reinforced	Kg	150.0000
	Concrete wire	Kg	2.2500
	Portland Cement	Kg	323.0000
	Concrete sand	M^3	0.5200
	Gravel	M^3	0.7800
LABOR	Unskilled labor	Day	4.2108
	Stonemason	Day	0.3093
	Carpenter	Day	1.0842
	Blacksmith	Day	1.0500
	Skilled head	Day	0.2450
	Foreman	Day	0.1922
1 M^3 Reinforced Concrete Sloop K 175 , F'c = 14.5 MPa (200 kg steel + Formwork)			
MATERIAL	Wood class III	M^3	0.2700
	Nail 5 ' - 12 '	Kg	2.0000
	formwork oil	Liter	0.1000
	Steel Reinforced	Kg	200.0000
	Concrete wire	Kg	3.0000
	Portland Cement	Kg	323.0000
	Concrete sand	M^3	0.5200
	Gravel	M^3	0.7800
LABOR	Unskilled labor	Day	4.9152
	Mason	Day	0.3093
	Carpenter	Day	1.5600
	Blacksmith	Day	1.4000
	Skilled head	Day	0.3270
	Foreman	Day	0.2013
1 M^3 Reinforced Concrete Column K 175 , F'c = 14.5 MPa (300 kg steel + Formwork)			
MATERIAL	Wood class III	M^3	0.4000
	Nail 5 ' - 12 '	Kg	4.0000
	formwork oil	Liter	2.0000
	Steel Reinforced	Kg	300.0000
	Concrete wire	Kg	4.5000
	Portland Cement	Kg	323.0000

	Concrete sand	M^3	0.5200
	Gravel	M^3	0.7800
	Class II wood beams	M^3	0.1500
	9 mm thick plywood	Sheet	3.5000
	Dolken wood 8 " / 4 m	Piece	16.0000
LABOR	Unskilled labor	Day	7.1750
	Mason	Day	0.3093
	Carpenter	Day	2.7920
	Blacksmith	Day	2.1000
	Skilled head	Day	0.4883
	Foreman	Day	0.2747
1 M^3 Reinforced Concrete Beam K 175 , F'c = 14.5 MPa (200 kg Steel + Formwork)			
MATERIAL	Wood class III	M^3	0.3200
	Nail 5 ' - 12 '	Kg.	3.2000
	formwork oil	Liter	2.0000
	Steel Reinforced	Kg	200.0000
	concrete wire	Kg	3.0000
	Portland Cement	Kg	323.0000
	concrete sand	M^3	0.5200
	Gravel	M^3	0.7800
	Class II wood beams	M^3	0.1500
	9 mm thick plywood	Sheet	3.5000
	Dolken wood 8 " / 4 m	Piece	16.0000
LABOR	Unskilled labor	Day	7.1750
	Mason	Day	0.3093
	Carpenter	Day	1.6500
	Blacksmith	Day	1.4000
	Skilled head	Day	0.4883
	Foreman	Day	0.2747
1 M^3 Reinforced Concrete Plate K175 , f * c 14.5 MPa (150 kg Steel + Formwork)			
MATERIAL	Wood class III	M^3	0.1350
	Nail 5 ' - 12 '	Kg	1.3497
	formwork oil	Liter	0.6750
	Steel Reinforced	Kg	157.5000
	Concrete wire	Kg	2.2500
	Portland Cement	Kg	323.0000
	Concrete sand	M^3	0.5200

	Gravel	M³	0.7800
	Class II wood beams	M³	0.0505
	9 mm thick plywood	Sheet	2.1810
	Dolken wood 8 " / 4 m	Piece	16.0000
LABOR	Unskilled labor	Day	6.7690
	Mason	Day	0.3093
	Carpenter	Day	1.3000
	Blacksmith	Day	1.0500
	Skilled head	Day	0.2650
	Foreman	Day	0.2650
1 M Practical Reinforced Concrete Columns (11 x 11) cm			
MATERIAL	Wood class III	M³	0.0025
	Nail 5 ' - 12 '	Kg	0.0452
	Steel Reinforced	Kg	3.0000
	Concrete wire	Kg	0.4500
	Portland Cement	Kg	4.1750
	Concrete sand	M³	0.0063
	Gravel	M³	0.0093
LABOR	Unskilled labor	Day	0.1588
	Stonemason	Day	0.0473
	Carpenter	Day	0.0113
	Blacksmith	Day	0.0118
	Skilled head	Day	0.0108
	Foreman	Day	0.0100
1 M³ Concrete f *c = 7.4 MPa (K 100)			
MATERIAL	Portland Cement	Kg	254.0000
	Gravel	m3	0.8197
	Concrete sand	m3	0.6200
LABOR	Unskilled labor	Day	1.6500
	Stonemason	Day	0.2890
	Skilled head	Day	0.0290
	Foreman	Day	0.0200
1 M³ Concrete f *c = 9.8 MPa (K 125)			
MATERIAL	Portland Cement	Kg	284.5500
	Gravel	m3	0.8273
	Concrete sand	m3	0.6175
LABOR	Unskilled labor	Day	1.6820

	Stonemason	Day	0.2805
	Skilled head	Day	0.0280
	Foreman	Day	0.0200
1 M³ Concrete f *c = 12.2 MPa (K 150)			
MATERIAL	Portland Cement	Kg	315.7000
	Gravel	m3	0.8180
	Concrete sand	m3	0.5845
LABOR	Unskilled labor	Day	1.6915
	Stonemason	Day	0.2820
	Skilled head	Day	0.0285
	Foreman	Day	0.0200
1 M³ Concrete f *c = 14.5 MPa (K 175)			
MATERIAL	Portland Cement	Kg	323.0000
	Gravel	m3	0.7800
	Concrete sand	m3	0.5200
LABOR	Unskilled labor	Day	1.6500
	Stonemason	Day	0.2675
	Skilled head	Day	0.0267
	Foreman	Day	0.0200
1 M³ Concrete f *c = 16.9 MPa (K 200)			
MATERIAL	Portland Cement	Kg	325.0000
	Gravel	m3	0.8100
	Concrete sand	m3	0.5400
LABOR	Unskilled labor	Day	1.6500
	Stonemason	Day	0.2750
	Skilled head	Day	0.0380
	Foreman	Day	0.0300
1 M³ Concrete f *c = 19.3 MPa (K 225)			
MATERIAL	Portland Cement	Kg	377.0200
	Gravel	m3	0.8200
	Concrete sand	m3	0.5000
LABOR	Unskilled labor	Day	1.6694
	Stonemason	Day	0.3050
	Skilled head	Day	0.0456
	Foreman	Day	0.0400

1 M³ Concrete f *c = 21.7 MPa (K 250)			
MATERIAL	Portland Cement	Kg	384.0000
	Gravel	m3	0.7368
	Concrete sand	m3	0.4697
LABOR	Unskilled labor	Day	1.6500
	Stonemason	Day	0.2750
	Skilled head	Day	0.0458
	Foreman	Day	0.0400
1 M³ Concrete f *c = 24 MPa (K 275)			
MATERIAL	Portland Cement	Kg	412.0000
	Gravel	m3	0.7800
	Concrete sand	m3	0.5560
LABOR	Unskilled labor	Day	1.6820
	Stonemason	Day	0.3125
	Skilled head	Day	0.0500
	Foreman	Day	0.0500
1 M³ Concrete f *c = 26.4 MPa (K 300)			
MATERIAL	Portland Cement	Kg	413.0000
	Gravel	m3	0.7206
	Concrete sand	m3	0.4769
LABOR	Unskilled labor	Day	1.6500
	Stonemason	Day	0.2750
	Skilled head	Day	0.0459
	Foreman	Day	0.0400
1 M³ Concrete f *c = 31.2 MPa (K 350)			
MATERIAL	Portland Cement	Kg	464.3500
	Gravel	m3	0.7800
	Concrete sand	m3	0.4867
LABOR	Unskilled labor	Day	2.1000
	Stonemason	Day	0.3500
	Skilled head	Day	0.0717
	Foreman	Day	0.0700
1 M³ Reinforced Concrete Tie Beam K 350 , F * c = 31.2 MPa (150 kg steel + Formwork)			
MATERIAL	Wood class III	M³	0.2770
	Nail 5 ' - 12 '	Kg	2.0500
	Formwork oil	Liter	0.6150

	Steel Reinforced	Kg	150.0000
	Concrete wire	Kg	2.2500
	Portland Cement	Kg	464.3500
	Concrete sand	M^3	0.4867
	Plywood 9mm thick	piece	2.9160
	Gravel	M^3	0.7800
LABOR	Unskilled labor	Day	4.3460
	Stonemason	Day	0.2820
	Carpenter	Day	1.3325
	Blacksmith	Day	1.0765
	Skilled head	Day	0.2700
	Foreman	Day	0.2000
1 M^3 Reinforced Concrete Beam Quality of K 350 , f * c = 31.2 MPa (175kg steel + Formwork)			
MATERIAL	Wood class III	M^3	0.3280
	Nail 5 ' - 12 '	Kg	3.2800
	Formwork oil	Liter	1.6400
	Steel Reinforced	Kg	175.0000
	Concrete wire	Kg	2.6250
	Portland Cement	Kg	464.3500
	Concrete sand	M^3	0.4867
	Gravel	M^3	0.7800
	Class II wood beams	M^3	0.1500
	9 mm thick plywood	Sheet	4.0000
	Dolken wood 8 " / 4 m	Piece	16.0000
LABOR	Unskilled labor	Day	5.4325
	Stonemason	Day	0.3415
	Carpenter	Day	1.6500
	Blacksmith	Piece	1.4000
	Skilled head	Day	0.3330
	Foreman	Day	0.3000
1M^3 Reinforced Concrete Beam Quality of K 275 ,f * c 24 MPa (175kg steel + Formwork)			
MATERIAL	Wood class III	M^3	0.3280
	Nail 5 ' - 12 '	Kg.	3.2800
	Formwork oil	Liter	1.6400
	Steel Reinforced	Kg	175.0000

	Concrete wire	Kg	2.6250
	Portland Cement	Kg	412.0000
	Concrete sand	M^3	0.5560
	Gravel	M^3	0.7800
	Class II wood beams	M^3	0.1400
	9 mm thick plywood	Sheet	4.0000
	Dolken wood 8 " / 4 m	Piece	16.0000
LABOR	Unskilled labor	Day	5.4325
	Stonemason	Day	0.3415
	Carpenter	Day	1.6500
	Blacksmith	Day	1.4000
	Skilled head	Day	0.3330
	Foreman	Day	0.3000

V. ROOF WORKS

REQUIREMENT		UNIT	COEFFICIENT
1 kg Steel Truss Works			
MATERIAL	Steel truss Box 60x10x1.5mmx600mm	Kg	1.0250
	Self-Drilling Screws 12-14x20mm	Piece	1.0250
LABOR	Unskilled labor	Day	0.0410
	Skilled Labor	Day	0.0200
	Skilled Head	Day	0.0100
	Foreman	Day	0.0100
1 kg Steel Purlin Works			
MATERIAL	Steel Purlin 50x20x10x1.5x600mm	Kg	1.0250
	Self-Drilling Screws 12-14x20mm	Piece	1.0250
LABOR	Unskilled labor	Day	0.0205
	Skilled Labor	Day	0.0105
	Skilled head	Day	0.0011
	Foreman	Day	0.0005
1 M Roof Truss Work			
MATERIAL	RHS 100.50.5	Piece	0.2050
	Welding wire	Kg	0.0105
LABOR	Unskilled labor	Day	0.0615

	Welder	Day	0.0615
	Skilled head	Day	0.0060
	Foreman	Day	0.0030
1 M Install Purlin Canal C 75.35.15.1.5			
MATERIAL	Canal C 75.35.15.1.5	Piece	0.2050
	Welding wire	Kg	0.0105
LABOR	Unskilled labor	Day	0.0585
	Welder	Day	0.0300
	Skilled head	Day	0.0060
	Foreman	Day	0.0030
1 M² Light Steel Trusses			
MATERIAL	Light Steel Profile	M	4.5600
	Screw	Ls	1.0000
	Dynabolt	Ls	1.0000
LABOR	Unskilled labor	Day	0.0770
	Blacksmith	Day	0.1540
	Skilled head	Day	0.0155
	Foreman	Day	0.0040
1 M^2 Install Corrugated Zinc			
MATERIAL	Corrugated Zinc	Sheet	0.7000
	Nail	Kg	0.0200
LABOR	Unskilled labor	Day	0.1409
	Carpenter	Day	0.1256
	Skilled head	Day	0.0510
	Foreman	Day	0.0067
1 M Install Shingle Ridge Capping			
MATERIAL	Zinc plate 3 " x 6 " BJLS 28	Sheet	0.4000
	Nail ½ " - 1 "	Kg	0.0600
	Nail 2 " - 5 "	Kg	0.0500
	Wood boards 3 cm	M³	0.0060
LABOR	Unskilled labor	Day	0.1250
	Carpenter	Day	0.2500
	Skilled head	Day	0.0420
	Foreman	Day	0.0063
1 M^2 Install Roof Tile (large "Plentong")			
MATERIAL	Tile "Plentong"	Piece	23.0770
LABOR	Unskilled labor	Day	0.1500

	Carpenter	Day	0.0656
	Skilled head	Day	0.0070
	Foreman	Day	0.0070
1 M^2 Install Ridge Tiles "Plentong"			
MATERIAL	Ridge "Plentong"	Piece	4.4351
	Portland Cement	Kg	8.0000
	Sand	M^3	0.0320
LABOR	Unskilled labor	Day	0.4000
	Carpenter	Day	0.2000
	Skilled head	Day	0.0200
	Foreman	Day	0.0020
1 M2 Install Corrugated Asbestos Roof 1.80 x 0.92m wave x 5mm			
MATERIAL	Asbestos wave	Sheet	0.7577
	Nail	Kg	0.1200
LABOR	Unskilled labor	Day	0.1400
	Carpenter	Day	0.0670
	Skilled head	Day	0.0070
	Foreman	Day	0.0070
1 M^2 Install Shingle Roof			
MATERIAL	Shingle tile	Piece	61.0000
	Nail ½ " - 1 "	Kg	0.2033
LABOR	Unskilled labor	Day	0.1687
	Carpenter	Day	0.2543
	Skilled head	Day	0.0253
	Foreman	Day	0.0080
1 M2 Setting Reed Roof			
MATERIAL	Reed	Sheet	6.6625
	Strap	Kg	0.5125
LABOR	Unskilled labor	Day	0.2050
	Foreman	Day	0.0105
VI. WALL WORKS			
REQUIREMENT		**UNIT**	**COEFFICIENT**
1 M^2 Install Brick (concrete block) 40x20x10 cm, spec. 1Pc : 4Sand			
MATERIAL	Brick / Concrete block	Piece	12.5000
	Portland Cement	Kg	12.0000
	Sand	M^3	0.0380

LABOR	Unskilled labor	Day	0.3518
	Stonemason	Day	0.1131
	Skilled head	Day	0.0193
	Foreman	Day	0.0288
1 M^2 Install Paving Blocks 20x25x6 cm			
MATERIAL	Paving blocks	Piece	20.6000
	Portland Cement	Kg	8.3200
	Sand	M^3	0.0620
LABOR	Unskilled labor	Day	0.3210
	Stonemason	Day	0.4370
	Skilled head	Day	0.0220
	Foreman	Day	0.0175
1 M^2 Install Paving Blocks 20x10x6 cm			
MATERIAL	Paving blocks	Piece	51.5000
	Portland Cement	Kg	8.3200
	Sand	M^3	0.0620
LABOR	Unskilled labor	Day	0.3210
	Stonemason	Day	0.4370
	Skilled head	Day	0.0220
	Foreman	Day	0.0175
1 M^3 Install Gabion River Stone (2 x 1 x 1 m)			
MATERIAL	Stone River	M^3	1.1000
	Gabion	Unit	0.5000
LABOR	Unskilled labor	Day	0.6667
	Foreman	Day	0.0240
VII. PLASTER WORKS			
REQUIREMENT		**UNIT**	**COEFFICIENT**
1 M^2 Plastering 1 Pc : 3 Sand , 15 mm thick			
MATERIAL	Portland Cement	Kg.	7.0521
	Sand	M^3	0.0200
LABOR	Unskilled labor	Day	0.2559

	Stonemason	Day	0.1500
	Skilled head	Day	0.0167
	Foreman	Day	0.0167
1 M^2 Plastering 1 Pc : 4 Sand , 15 mm thick			
MATERIAL	Portland Cement	Kg	6.2400
	Sand	M^3	0.0214
LABOR	Unskilled labor	Day	0.2559
	Stonemason	Day	0.1500
	Skilled head	Day	0.0167
	Foreman	Day	0.0167
1 M^2 Plastering 1 Pc : 2 Sand, 20 mm thick			
MATERIAL	Portland Cement	Kg	12.7500
	Sand	M^3	0.0270
LABOR	Unskilled labor	Day	0.3500
	Stonemason	Day	0.1500
	Skilled head	Day	0.0202
	Foreman	Day	0.0273
1 ^{M2} Plastering 1 Pc : 3 Sand, 20 mm thick			
MATERIAL	Portland Cement	Kg	10.3500
	Sand	M^3	0.0310
LABOR	Unskilled labor	Day	0.3500
	Stonemason	Day	0.1500
	Skilled head	Day	0.0202
	Foreman	Day	0.0273
1 M^2 Plastering 1 Pc : 4 Sand, 20 mm thick			
MATERIAL	Portland Cement	Kg	8.3200
	Sand	M^3	0.0320
LABOR	Unskilled labor	Day	0.3500
	Stonemason	Day	0.1500
	Skilled head	Day	0.0202
	Foreman	Day	0.0273
1 M^2 Plastering Cement splashes, 1 Pc : 2 Sand			
MATERIAL	Portland Cement	Kg	5.6080
	Sand	M^3	0.0110
LABOR	Unskilled labor	Day	0.2559
	Stonemason	Day	0.1270

	Skilled head	Day	0.0130
	Foreman	Day	0.0150
1 M^2 Plastering 1 Pc : 5 Sand, 15 mm thick			
MATERIAL	Portland Cement	Kg	4.7751
	Sand	M^3	0.0220
LABOR	Unskilled labor	Day	0.2559
	Stonemason	Day	0.1500
	Skilled head	Day	0.0167
	Foreman	Day	0.0167
1 M2 Plastering 1 Pc : 5 Sand, 20 mm thick			
MATERIAL	Portland Cement	Kg	6.4490
	Sand	M^3	0.0230
LABOR	Unskilled labor	Day	0.3500
	Stonemason	Day	0.1500
	Skilled head	Day	0.0202
	Foreman	Day	0.0273
VIII. FINISHING WORKS			
REQUIREMENT		**UNIT**	**COEFFICIENT**
1 m^2 Finishing Cement Groove of Red Brick Wall			
MATERIAL	Portland Cement	Kg	3.8220
LABOR	Unskilled labor	Day	0.1500
	Stonemason	Day	0.0731
	Skilled head	Day	0.0074
	Foreman	Day	0.0069
1 M^2 Finishing Cement Groove of Conblock Wall			
MATERIAL	Portland Cement	Kg	1.6400
LABOR	Unskilled labor	Day	0.0720
	Stonemason	Day	0.0360
	Skilled head	Day	0.0040
	Foreman	Day	0.0040
1 M^2 Finishing Cement Groove of Stone Masonry, 1 PC : 2 Sand			
MATERIAL	Portland Cement	Kg	6.3400
	Sand	M^3	0.0120
LABOR	Unskilled labor	Day	0.3000
	Stonemason	Day	0.1500
	Skilled head	Day	0.0150

	Foreman	Day	0.0270
1 M^2 Render			
MATERIAL	Portland Cement	Kg	3.4988
LABOR	Unskilled labor	Day	0.1753
	Stonemason	Day	0.1057
	Skilled head	Day	0.0146
	Foreman	Day	0.0146

IX. WOOD WORKS

REQUIREMENT		UNIT	COEFFICIENT
Make and Install 1 M^3 Door and Window, Wooden Frame Class I			
MATERIAL	Wood beams	M^3	1.1080
	Nail 10 cm	Kg	1.0031
	Wood glue	Kg	1.0000
LABOR	Unskilled labor	Day	6.9380
	Carpenter	Day	20.8140
	Skilled head	Day	2.1521
	Foreman	Day	0.4283
Make and Install 1 M^3 Door and Window, Wooden Frame Class II/III			
MATERIAL	Wood beams	M^3	1.1080
	Nail 10 cm	Kg	1.0031
	Wood glue	Kg	1.0000
LABOR	Unskilled labor	Day	6.0000
	Carpenter	Day	18.0000
	Skilled head	Day	2.0000
	Foreman	Day	0.3890
Make and Install 1 M^2 Standard Clamp Doors, Wood Class II			
MATERIAL	Wooden board	M^3	0.0400
	Nail 5-7 cm	Kg	0.4750
LABOR	Unskilled labor	Day	0.5725
	Carpenter	Day	1.5508
	Skilled head	Day	0.1551
	Foreman	Day	0.0956
Make and Install 1 M^2 Simple Clamp Doors , Wood Class III			
MATERIAL	Wooden board	M^3	0.0400
	Nail 5-7 cm	Kg	0.4750
LABOR	Unskilled labor	Day	0.5725

	Carpenter	Day	1.5508
	Skilled head	Day	0.1551
	Foreman	Day	0.0956
Make and Install 1 M² Door leave, Wood Class I/II			
MATERIAL	Wooden board	M³	0.0400
	Wood glue / nail	Kg	0.5000
LABOR	Unskilled labor	Day	1.0000
	Carpenter	Day	2.5543
	Skilled head	Day	0.2556
	Foreman	Day	0.0500
Make and Install 1 M² Door and Window Glass, Wooden Frame Class I/II			
MATERIAL	Wooden board	M³	0.0240
	Wood glue / nail	Kg	0.1593
LABOR	Unskilled labor	Day	0.8000
	Carpenter	Day	2.1006
	Skilled head	Day	0.2043
	Foreman	Day	0.0400
Make and Install 1 M² Door and Window Louvre, Wood Class I/II			
MATERIAL	Wooden board	M³	0.0385
	Wood glue	Kg	0.5000
LABOR	Unskilled labor	Day	1.0000
	Carpenter	Day	3.0000
	Skilled head	Day	0.3000
	Foreman	Day	0.0500
Make and Install 1 M² Double Plywood Door, with Wood Frame Class II (width up to 90 cms)			
MATERIAL	Wooden board	M³	0.0250
	Nail 1 to 2.5 cm	Kg	0.0300
	Wood glue	Kg	0.5000
	Plywood 4 mm size 90x220cm	Sheet	1.0000
LABOR	Unskilled labor	Day	0.6359
	Carpenter	Day	2.0127
	Skilled head	Day	0.2000
	Foreman	Day	0.0546
Make 1 M² Double Plywood Door, Exposed Frame, Wood Class I/II			
MATERIAL	Wooden board	M³	0.0260
	Nail 1 to 2.5 cm	Kg	0.0300

	Wood glue	Kg	0.5000
	Plywood 4 mm size 90x220cm	Sheet	1.0000
LABOR	Unskilled labor	Day	0.6651
	Carpenter	Day	2.1006
	Skilled head	Day	0.2043
	Foreman	Day	0.0560
Make and Install 1 M^2 Louvre Frame, Wood Class I/II			
MATERIAL	Wooden board	M^3	0.0600
	Nail 1 to 2.5 cm	Kg	0.1500
LABOR	Unskilled labor	Day	0.5743
	Carpenter	Day	2.0000
	Skilled head	Day	0.2000
	Foreman	Day	0.0764
Make and Install 1 M^2 Double Teakwood, Expose Frame, Wood Class I			
MATERIAL	Wooden board	M^3	0.0217
	Nail 1 to 2.5 cm	Kg	0.0300
	Wood glue	Kg	0.3000
	Teakwood 4 mm size 90x220cm	Sheet	1.0000
LABOR	Unskilled labor	Day	0.6366
	Carpenter	Day	2.0434
	Skilled head	Day	0.2043
	Foreman	Day	0.0560
Install 1 M^3 Conventional Wooden Truss, Class I, II and III , spans 6 m			
MATERIAL	wood beams	M^3	1.1000
	5mm thick iron strips	Kg	15.0000
	Nail 12 cm	Kg	3.4460
LABOR	Unskilled labor	Day	4.4054
	Carpenter	Day	10.1540
	Skilled head	Day	1.0154
	Foreman	Day	0.2000
Install 1 M^3 Exposed Truss, Wood Class I			
MATERIAL	wood beams	M^3	1.1150
	5mm thick iron strips	Kg	15.0000
	Nail 12 cm	Kg	2.4260
LABOR	Unskilled labor	Day	4.7508
	Carpenter	Day	20.1000

	Skilled head	Day	2.0100
	Foreman	Day	0.2375
Install 1 M³ Purlin, wood Class II			
MATERIAL	wood beams	M³	1.1000
	5mm thick iron strips	Kg	15.0000
	Nail 12 cm	Kg	3.0000
LABOR	Unskilled labor	Day	2.4000
	Carpenter	Day	7.2000
	Skilled head	Day	0.7200
	Foreman	Day	0.1200
Install 1 M² Roof Frame of Ceramic Tile , Wood Class II			
MATERIAL	Wooden rafters (5x7) cm	M³	0.0140
	Batten (2x3) cm	m3	0.0038
	Nail 5 and 10 cm	Kg	0.2500
LABOR	Unskilled labor	Day	0.1000
	Carpenter	Day	0.1000
	Skilled head	Day	0.0100
	Foreman	Day	0.0050
Install 1M ² Concrete Tile of Roof Frame, Wood Class II			
MATERIAL	Wooden rafters (5x7) cm	M³	0.0140
	Batten (3x4) cm	M³	0.0070
	Nail 5 and 10 cm	Kg	0.2500
LABOR	Unskilled labor	Day	0.1000
	Carpenter	Day	0.1000
	Skilled head	Day	0.0100
	Foreman	Day	0.0050
Install 1M ² Shingle Roof Frame, Wood Class II			
MATERIAL	Wood Class II	M³	0.1690
	Nail 5 to 10 cm	Kg	0.2050
LABOR	Unskilled labor	Day	0.1230
	Carpenter	Day	0.1230
	Skilled head	Day	0.0123
	Foreman	Day	0.0060
Install 1M² Ceiling Frame, (50x100) cm Wood Class II / III			
MATERIAL	Wooden rafters (5x7) cm	M³	0.0150
	Nail 7 to 10 cm	Kg	0.2000

LABOR	Unskilled labor	Day	0.1500
	Carpenter	Day	0.3000
	Skilled head	Day	0.0300
	Foreman	Day	0.0750
Install 1M² Ceiling Frame, (60x60) cm wood class II / III			
MATERIAL	Wooden rafters (5x7) cm	M³	0.0163
	Nail 7 and 10 cm	Kg	0.2543
LABOR	Unskilled labor	Day	0.2033
	Carpenter	Day	0.3050
	Skilled head	Day	0.0305
	Foreman	Day	0.0750
Install 1m Roof Edge Board Size 3x20 cm, wood class I / II			
MATERIAL	Wooden board	M³	0.0100
	Nail 5 to 7 cm	Kg	0.0759
LABOR	Unskilled labor	Day	0.1194
	Carpenter	Day	0.2390
	Skilled head	Day	0.0239
	Foreman	Day	0.0050
Install 1M Roof Edge Board Size 3x30 cm, wood class I / II			
MATERIAL	Wooden board	M³	0.0110
	Nail 5 to 7 cm	Kg	0.0759
LABOR	Unskilled labor	Day	0.1194
	Carpenter	Day	0.2390
	Skilled head	Day	0.0239
	Foreman	Day	0.0050
Install 1M² Wall Partition Frame, 60x120 cm , wood Class II / III			
MATERIAL	Wooden beams	M³	0.0283
	Nail 5 to 7 cm	Kg	0.1527
LABOR	Unskilled labor	Day	0.1527
	Carpenter	Day	0.4577
	Skilled head	Day	0.0473
	Foreman	Day	0.0080
Install 1 M² Double Teakwood Partition Wall , wood Class II			
MATERIAL	Wooden beam 6/12 cm	M³	0.0275
	Nail 5 and 10 cm	Kg	0.1500

	4 mm Teakwood size 120x240 cm	Sheet	0.8451
	Wood glue	Kg	0.4500
LABOR	Unskilled labor	Day	0.1436
	Carpenter	Day	0.4307
	Skilled head	Day	0.0431
	Foreman	Day	0.0077
Install 1 M² Double Plywood Partition Wall , wood Class II			
MATERIAL	Wooden beam 6/12 cm	M³	0.0280
	Nail 5 and 10 cm	Kg	0.1440
	4 mm plywood size 120x240cm	Sheet	0.8451
	Wood glue	Kg	0.4500
LABOR	Unskilled labor	Day	0.1914
	Carpenter	Day	0.5742
	Skilled head	Day	0.0574
	Foreman	Day	0.0096
Install 1 M² Wooden Board Walls, wood class I			
MATERIAL	Wooden board	M³	0.0070
	Nail 5 and 10 cm	Kg	0.1025
	Nail couplers 10 cm	Kg	0.1538
LABOR	Unskilled labor	Day	0.6150
	Carpenter	Day	1.8450
	Skilled head	Day	0.1845
	Foreman	Day	0.0308
Install 1 M² Plywood (Lambriziring) Wall, Size 120 x 240 cm			
MATERIAL	4 mm (Lambraziring) plywood size 120x240 cm	Sheet	0.4100
	Nail 1 and 2.5 cm	Kg	0.0515
LABOR	Unskilled labor	Day	0.0255
	Carpenter	Day	0.0770
	Skilled head	Day	0.0077
	Foreman	Day	0.0010
X. FLOOR & WALL WORKS			
REQUIREMENT		**UNIT**	**COEFFICIENT**
1 M² Install Grey Floor Tile pc 20 x20 cm			
MATERIAL	Gray tiles 20 x 20 cm	Piece	25.3588
	Portland Cement	Kg	10.4000
	Sand	M³	0.0450

	Colored Cement	Kg	0.3467
LABOR	Unskilled labor	Day	0.3228
	Stonemason	Day	0.1966
	Skilled head	Day	0.0197
	Foreman	Day	0.0197
1 M Install Gray Tile Skirting 15 x20 cm			
MATERIAL	Plinth tiles	Piece	6.1554
	Portland Cement	Kg	1.2724
	Sand	M^3	0.0033
LABOR	Unskilled labor	Day	0.0900
	Stonemason	Day	0.0900
	Skilled head	Day	0.0090
	Foreman	Day	0.0045
1 M^2 Install Wood Floor			
MATERIAL	Wooden floor (gym floor)	M^2	1.1177
	Wood glue	Kg	0.6100
LABOR	Unskilled labor	Day	0.7000
	Carpenter	Day	0.3560
	Skilled head	Day	0.0407
	Foreman	Day	0.0407
1 M^2 Install Carpet Floor			
MATERIAL	Carpet	M^2	1.0500
	Glue	Kg	0.3500
LABOR	Unskilled labor	Day	0.1710
	Carpenter	Day	0.1270
	Skilled head	Day	0.0176
	Foreman	Day	0.0091
1 M^2 Install Brushed Coral, mix 1 : 2			
MATERIAL	Brushed Coral	Kg	10.0000
	Portland Cement	Kg	3.8950
	Sand	M^3	0.0665
LABOR	Unskilled labor	Day	0.5125
	Stonemason	Day	0.2050
	Skilled head	Day	0.0205
	Foreman	Day	0.0205

Install 1M Wood Skirting Class II size (2 x 10) cm			
MATERIAL	Wooden board class II	M^3	0.0023
	Nail screw 5 cm	Kg	0.0500
LABOR	Unskilled labor	Day	0.1200
	Stonemason	Day	0.1200
	Skilled head	Day	0.0120
	Foreman	Day	0.0060
Install 1 m^2 of Ceramic Floor Tile Size (30 x 30) cm			
MATERIAL	Ceramics	Piece	11.8700
	Portland Cement	Kg.	8.0000
	Sand	M^3	0.0450
	Cement color	Kg	1.5000
LABOR	Unskilled labor	Day	0.7000
	Stonemason	Day	0.3500
	Skilled head	Day	0.0350
	Foreman	Day	0.0350
Install 1 m^2 of Ceramic Floor Tile Size (40 x 40) cm			
MATERIAL	Ceramics	Piece	6.6250
	Portland Cement	Kg	8.0000
	Sand	M^3	0.0450
	Cement color	Kg	0.9400
LABOR	Unskilled labor	Day	0.7000
	Stonemason	Day	0.3500
	Skilled head	Day	0.0350
	Foreman	Day	0.0350
Install 1 m^2 of Ceramic Floor Tile Size (60 x 60) cm			
MATERIAL	Ceramics	Piece	3.0000
	Portland Cement	Kg	8.0000
	Sand	M^3	0.0450
	Cement color	Kg	0.9321
LABOR	Unskilled labor	Day	0.7000
	Stonemason	Day	0.3500
	Skilled head	Day	0.0350
	Foreman	Day	0.0350
Install 1 m^2 of Natural Stone			
MATERIAL	Natural stone	M^2	1.1000

	Portland Cement	Kg	11.5453
	Sand	M^3	0.0193
LABOR	Unskilled labor	Day	2.3360
	Stonemason	Day	0.3047
	Skilled head	Day	0.0117
	Foreman	Day	0.0138

XI. CEILING WORKS

REQUIREMENT		UNIT	COEFFICIENT
Install 1 M^2 Asbestos Cement Ceiling 4 / 5 / 6mm			
MATERIAL	Plate asbestos	M^2	1.1000
	Nail ½ " - 1 "	Kg	0.0100
LABOR	Unskilled labor	Day	0.0300
	Carpenter	Day	0.0700
	Skilled head	Day	0.0070
	Foreman	Day	0.0400
Install 1 M^2 Plywood Ceiling			
MATERIAL	Plywood	Sheet	0.3750
	Nail ½ " - 1 "	Kg	0.0300
LABOR	Unskilled labor	Day	0.1000
	Carpenter	Day	0.1000
	Skilled head	Day	0.0100
	Foreman	Day	0.0050
Install 1 M^2 Wood Ceiling 9cm			
MATERIAL	Wooden board	M^3	0.0155
	Nail ½ " - 1 "	Kg	0.0105
LABOR	Unskilled labor	Day	0.8200
	Carpenter	Day	0.8200
	Skilled head	Day	0.0820
	Foreman	Day	0.0410
Install 1 M Wooden Trim Profile for Ceiling			
MATERIAL	Wood trim profile	M'	1.0500
	Nail trim	Kg	0.0329
LABOR	Unskilled labor	Day	0.0500
	Carpenter	Day	0.1235
	Skilled head	Day	0.0050
	Foreman	Day	0.0030

Install 1 M² Gypsum Board Ceiling Size (1200x2400x9) mm			
MATERIAL	Gypsum board	Sheet	0.3646
	Screw	Kg	0.1100
LABOR	Unskilled labor	Day	0.2280
	Carpenter	Day	0.4158
	Skilled head	Day	0.0416
	Foreman	Day	0.0140

XII. STEEL AND ALUMINIUM WORKS

REQUIREMENT		**UNIT**	**COEFFICIENT**
Install 1 kg of Iron Profile			
MATERIAL	Steel profile	Kg	1.1000
	Zincromate	kg	0.0710
LABOR	Unskilled labor	Day	0.0600
	Blacksmith	Day	0.0242
	Skilled head	Day	0.0060
	Foreman	Day	0.0023
Install 1 m^2 Louvre Window Include Steel Guard			
MATERIAL	Frame + 5 mm glass	M2	1.1000
	Screw 1 cm - 2.5 cm	Piece	10.0000
	Iron strip	M'	7.0000
LABOR	Unskilled labor	Day	0.2000
	Blacksmith	Day	0.2000
	Skilled head	Day	0.0200
	Foreman	Day	0.0010
Install 1 m Roof Gutter Zinc BJLS 28 width 90 cm			
MATERIAL	Zinc plate	M'	1.0500
	Nail 1 cm - 2.5 cm	Piece	0.0150
	Wooden planks Class II or III	M3	0.0190
LABOR	Unskilled labor	Day	0.2310
	Blacksmith	Day	0.4000
	Skilled head	Day	0.0400
	Foreman	Day	0.0100
Install 1 m Gutter ½ circle D - 15 cm , BJLS 30 Zinc Plate			
MATERIAL	Zinc plate	M'	1.0500
	Nail 1 cm - 2.5 cm	kg	0.010

	Wooden planks Class II or III	M3	0.0125
LABOR	Unskilled labor	Day	0.1500
	Blacksmith	Day	0.3000
	Skilled head	Day	0.0300
	Foreman	Day	0.0080

XIII. KEY AND GLASS WORKS

REQUIREMENT		UNIT	COEFFICIENT
	1 Unit Ordinary Locks		
MATERIAL	Ordinary Lock	Piece	1.0000
LABOR	Unskilled labor	Day	0.0100
	Blacksmith	Day	0.5000
	Skilled head	Day	0.0100
	Foreman	Day	0.0050
	1 Unit Door Hinge		
MATERIAL	Door hinges	Piece	1.0000
LABOR	Unskilled labor	Day	0.0150
	Blacksmith	Day	0.1500
	Skilled head	Day	0.0150
	Foreman	Day	0.0010
	1 Unit Butterfly Hinge for Window		
MATERIAL	Hinge window	Piece	1.0000
LABOR	Unskilled labor	Day	0.0100
	Blacksmith	Day	0.1000
	Skilled head	Day	0.0100
	Foreman	Day	0.0010
	1 Unit Wind Hook		
MATERIAL	Hooks wind	Piece	1.0000
LABOR	Unskilled labor	Day	0.0150
	Blacksmith	Day	0.1500
	Skilled head	Day	0.0150
	Foreman	Day	0.0010
	1 Unit Latch Lock		
MATERIAL	Latch lock	Piece	1.0000
LABOR	Unskilled labor	Day	0.0098
	Blacksmith	Day	0.0683
	Skilled head	Day	0.0068
	Foreman	Day	0.0010

1 M^2 Install Glass , thickness 3-5 mm			
MATERIAL	Glass	Piece	1.1000
LABOR	Unskilled labor	Day	0.0150
	Blacksmith	Day	0.1500
	Skilled head	Day	0.0150
	Foreman	Day	0.0010

XIV. SANITATION WORKS

REQUIREMENT		UNIT	COEFFICIENT
Install 1 Piece Mono Block Closet			
MATERIAL	Sitting closet (complete)	Piece	1.0000
LABOR	Unskilled labor	Day	1.4501
	Stonemason	Day	1.2366
	Skilled head	Day	0.1236
	Foreman	Day	0.1600
Install 1 Piece Porcelain Squat Closet			
MATERIAL	Porcelain squat closet	Piece	1.0000
	Portland Cement	Kg	6.1000
	Sand	M^3	0.0103
LABOR	Unskilled labor	Day	1.0000
	Stonemason	Day	1.5250
	Skilled head	Day	1.5000
	Foreman	Day	0.1627
Install 1 Piece Urinal			
MATERIAL	Urinal (complete)	Piece	1.0000
LABOR	Unskilled labor	Day	1.0000
	Stonemason	Day	1.0000
	Skilled head	Day	0.1000
	Foreman	Day	0.1000
Install 1 Piece Sink			
MATERIAL	Sink (complete)	Piece	1.0000
LABOR	Unskilled labor	Day	1.2000
	Stonemason	Day	1.2366
	Skilled head	Day	0.1236
	Foreman	Day	0.1000

Install 1 Piece Fiberglass Tub, the volume of 220 L			
MATERIAL	Fiberglass tub 220 liter	Piece	1.0364
LABOR	Unskilled labor	Day	1.9474
	Stonemason	Day	2.7000
	Skilled head	Day	0.5400
	Foreman	Day	0.1189
Install 1 Piece Masonry Control Pit 30 x 30 / T35 cm			
MATERIAL	Brick / concrete block	Piece	53.0000
	Portland Cement	Kg	44.0000
	Sand	M^3	0.0700
	Gravel concrete	M^3	0.0700
	Steel Reinforced	Kg.	1.4150
	Concrete sand	M^3	0.0600
LABOR	Unskilled labor	Day	3.2000
	Stonemason	Day	1.0150
	Skilled head	Day	0.1015
	Foreman	Day	0.0160
Install 1 M Galvanized Pipe Ø ½ " - 1 "			
MATERIAL	Galvanized pipe	M'	1.2000
	Accessories (% of the pipe price)	%	35.0000
LABOR	Unskilled labor	Day	0.0540
	Stonemason	Day	0.0900
	Skilled head	Day	0.0090
	Foreman	Day	0.0270
Install 1 M Galvanized Pipe Ø 1½ " - 3 "			
MATERIAL	Galvanized pipe	M'	1.2000
	Accessories (% of the pipe price)	%	35.0000
LABOR	Unskilled labor	Day	0.1080
	Stonemason	Day	0.1800
	Skilled head	Day	0.0180
	Foreman	Day	0.0054
Install 1 M PVC Pipe Ø ½ " - 1 ½ ", type AW			
MATERIAL	PVC pipe	M'	1.2000
	Accessories	%	35.0000
LABOR	Unskilled labor	Day	0.0360

	Stonemason	Day	0.0706
	Skilled head	Day	0.0075
	Foreman	Day	0.0043
Install 1 M PVC pipe Ø 2", type AW			
MATERIAL	PVC pipe	M'	1.2000
	Accessories	%	35.0000
LABOR	Unskilled labor	Day	0.0450
	Stonemason	Day	0.0750
	Skilled head	Day	0.0090
	Foreman	Day	0.0025
Install 1 M PVC pipe Ø 3" - 4", type AW			
MATERIAL	PVC pipe	M'	1.2000
LABOR	Unskilled labor	Day	0.0810
	Stonemason	Day	0.1879
	Skilled head	Day	0.0189
	Foreman	Day	0.0070
Install 1 Piece Faucet Ø ¾ " or ½ "			
MATERIAL	Faucet	Piece	1.0000
	Seal tape	Piece	0.0245
LABOR	Unskilled labor	Day	0.0100
	Stonemason	Day	0.1000
	Skilled head	Day	0.0100
	Foreman	Day	0.0050

XV. PAINTING WORKS

REQUIREMENT		UNIT	COEFFICIENT
1 M^2 Painting New Wooden Board (1 layer of foundation, 1 layer of primer , two coats cover)			
MATERIAL	Zincromate	Kg	0.1850
	Putty	Kg	0.1380
	Priming	Kg	0.1700
	Cover paint 2 x	Kg	0.2730
	Paint brush	piece	0.0294
LABOR	Unskilled labor	Day	0.0847
	Painter	Day	0.8900
	Skilled head	Day	0.0139
	Foreman	Day	0.0051

1 M^2 Painting Wood with Varnish			
MATERIAL	Varnish	Kg	0.2930
	Putty	Kg	0.0934
	Sandpaper	Sheet	0.8924
	Paint brush	Piece	0.0294
LABOR	Unskilled labor	Day	0.0539
	Painter	Day	0.0806
	Skilled head	Day	0.0129
	Foreman	Day	0.0046
1 M^2 New Wall Painting (1 layer, 1 layer of primer, two coats cover)			
MATERIAL	Foundation (Plamir)	Kg	0.1154
	Priming	Kg	0.0920
	Cover Paint (2 times)	Kg	0.2600
	Brush	Piece	0.0294
LABOR	Unskilled labor	Day	0.0362
	Painter	Day	0.0630
	Skilled head	Day	0.0064
	Foreman	Day	0.0064
1 Meter Old Wall Painting (1 layer of primer, two coats cover)			
MATERIAL	Priming	Kg	0.1200
	Cover Paint (2 times)	Kg	0.1839
	Brush	piece	0.0294
LABOR	Unskilled labor	Day	0.0361
	Painter	Day	0.0420
	Skilled head	Day	0.0051
	Foreman	Day	0.0037
1 M^2 Painting Steel Surface With Zincromate (Priming)			
MATERIAL	Zincromate	Kg	0.1230
	Paint oil	ltr	0.0136
	Brush	Piece	0.0227
LABOR	Unskilled labor	Day	0.0636
	Painter	Day	0.2000
	Skilled head	Day	0.0204
	Foreman	Day	0.0114
1 M^2 Painting Steel Surfaces, one Layer with Zincromate And Scaffolding			
MATERIAL	Zincromate	Kg	0.1000

	Paint brush	Piece	0.0100
	Wooden scaffolding	M^3	0.0020
LABOR	Unskilled labor	Day	0.2500
	Painter	Day	0.2250
	Skilled head	Day	0.0230
	Foreman	Day	0.0080

EMBANKMENT WITH MATERIAL FROM BORROW EXCAVATION

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	cubic meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Excavator	-	-	-	
2.	Wheel loader	-	-	-	
3.	Dump truck	-	-	-	
4.	Motor grader	-	-	-	
5.	Water tank truck	-	-	-	
6.	Vibratory roller	-	-	-	
7.	Rubber tire roller	-	-	-	
8.	Helping tools	-	-	-	
	MATERIALS				
1.	Fill material in accordance with specification	-	-	-	
	LABOR				
1.	Common labor	-	-	-	
2.	Foreman	-	-	-	
3.	Skilled Labor	-	-	-	
	WORK ORDER				
1.	Construction shall be performed mechanically.	-	-	-	
2.	Effective work hour per day for equipment.	TE	-	hour	
3.	Material loose factor.	FL	-	-	
4.	Layer thickness of dense material.	d	-	m	
5.	Average hauling distance to project location.	L	-	km	
6.	Excavation of material at borrowed pit performed by excavator, loaded by wheel loader and hauled to project by dump truck.	-	-	-	
7.	At project site, material unloaded and spreaded by motor grader.	-	-	-	
8.	Before compacted by vibrator roller and tire roller, water tank truck sprayed amount of water.	-	-	-	
9.	During spreading and compacting, group of labors set up the edge of spreading and level the surface using helping tools.	-	-	-	
	COEFFICIENT ANALISYS OF EQUIPMENT				
1.	EXCAVATOR				
	1.1. Bucket capacity	V	-	cum	TC = T1 + T2
	1.2. Bucket factor	FB	-	-	
	1.3. Efficiency factor	FE	-	-	
	1.4. Cycle time	TC	-	min	$Q = \frac{V.FB.FE.60}{TC}$
	a. Excavation	T1	-	min	
	b. Other	T2	-	min	
	1.5. Productivity per hour	Q	-	cum/h	

	1.6. Coefficient of equipment	E10	-	hour	$E10 = \frac{1}{Q}$
2.	WHEEL LOADER				
	2.1. Bucket factor	FB	-	-	TC = T1 + T2
	2.2. Capacity	V	-	cum	
	2.3. Efficiency factor	FE	-	-	$Q = \frac{V.FB.FE.60}{TC}$
	2.4. Cycle time	TC	-	min	
	a. Loading	T1	-	min	
	b. Unloading	T2	-	min	$E015 = \frac{1}{Q}$
	2.5. Productivity per hour	Q	-	cum/h	
	2.6. Coefficient of equipment	E15	-	hour	
3.	DUMP TRUCK				
	3.1. Capacity	V	-	cum	TC = T1 + T2 + T3
	3.2. Efficiency factor	FE	-	-	
	3.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{L}{V1} \text{ x } 60$
	3.4. Average unloading trip velocity	V2	-	km/h	
	3.5. Cycle time	TC	-	min	
	a. Loading time	T1	-	min	$T2 = \frac{L}{V2} \text{ x } 60$
	b. Unloading time	T2	-	min	
	c. Other	T3	-	min	
	3.6. Productivity per hour	Q	-	cum/h	$Q = \frac{V.FE.60}{TC.FL}$
	3.7. Coefficient of equipment	E09	-	hour	
					$E09 = \frac{1}{Q}$
4.	MOTOR GRADER				
	4.1. Spreading length	LS	-	m	TC = T1 + T2
	4.2. Effective width	b	-	m	
	4.3. Efficiency factor	FE	-	-	$T1 = \frac{LH.60}{V1.1000}$
	4.4. Average velocity	V1	-	km/h	
	4.5. No of passing	n	-	-	
	4.6. Cycle time	TC	-	min	
	a. Time for one passing	T1	-	min	$Q = \frac{LH.b.t.FE.60}{n.TC}$
	b. Other	T2	-	min	
	4.7. Productivity per hour	Q	-	cum/h	
	4.8. Coefficient of equipment	E13	-	hour	$E013 = \frac{1}{Q}$
5.	WATER TANK TRUCK				
	5.1. Volume	V	-	cum	$Q = \frac{V.n.FE}{WC}$
	5.2. Water required per cum of dense material	WC	-	cum	
	5.3. No of passing	n	-	-	$E023 = \frac{1}{Q}$
	5.4. Efficiency factor	FE	-	-	
	5.5. Productivity per hour	Q	-	cum/h	
	5.6. Coefficient of equipment	E23	-	hour	
6.	VIBRATORY ROLLER				
	6.1. Average velocity	V	-	km/h	$Q = \frac{v.1000.b.t.FE}{n}$
	6.2. Effective width	b	-	m	
	6.3. No of passing	n	-	nos	
	6.4. Efficiency factor	FE	-	-	$E019 = \frac{1}{Q}$
	6.5. Productivity per hour	Q	-	cum/h	
	6.6. Coefficient of equipment	E19	-	hour	
7.	RUBBER TIRE ROLLER				
	7.1. Average velocity	V	-	km/h	$Q = \frac{v.1000.b.t.FE}{n}$

	7.2. Effective width 7.3. No of passing 7.4. Efficiency factor 7.5. Productivity per hour 7.6. Coefficient of equipment	b n FE Q E05	- - - - -	m - - cum/h hour	$E05 = \frac{1}{Q}$
8.	HELPING TOOLS 8.1. Shovel 8.1. Fork				} Lump sum
	COEFFICIENT ANALYSIS FOR LABOR				
1. 2. 3. 4.	Productivity motor grader per hour. Productivity motor grader per day. Labor required a. Common labor b. Foreman Coefficient of labor: 4.1. Common labor 4.2. Foreman	Q Q_t CL FO L01 L03	- - - - - -	cum/h cum/d man man day day	 Q_t = Q.TE $L01 = \frac{CL}{Q_t}$ $L03 = \frac{FO}{Q_t}$
	COEFFICIENT ANALYSIS OF MATERIAL				
1.	Fill material	W10	-	cum	W10 = 1.FL

EMBANKMENT WITH COMMON MATERIAL

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	cubic meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Excavator	-	-	-	
2.	Wheel loader	-	-	-	
3.	Dump truck	-	-	-	
4.	Motor grader	-	-	-	
5.	Water tank truck	-	-	-	
6.	Vibratory roller	-	-	-	
7.	Rubber tire roller	-	-	-	
8.	Helping tools				
	8.1. Push cart	-	-	-	
	8.2. Shovel	-	-	-	
	8.3. Fork	-	-	-	
	MATERIALS				
1.	Common excavation	-	-	-	
	LABOR				
1.	Common labor	CL	-	man	
2.	Foreman	FO	-	man	
	WORK ORDER				
1.	Embankment shall be performed mechanically.				
2.	Effective work hour per day for	TE	-	hour	

	equipment.				
3.	Material loose factor.	FL	-	-	
4.	Dense thickness of each layer	t	-	m	
5.	Wheel loader load material to dump truck and haul at distant to project location.	L	-	km	
6.	At project location, material spreaded by motor grader.	-	-	-	
7.	Before compacted by vibro roller and rubber tire roller, spreded material sprayed with water by water tank truck.	-	-	-	
8.	During spreading and compacting, group of labors set up the edge of spreading and level of surface using helping tools.	-	-	-	
	COEFFICIENT ANALISYS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.1. Bucket factor	FB	-	-	TC = T1 + T2
	1.2. Capacity	V	-	cum	
	1.3. Efficiency factor	FE	-	-	$Q = \frac{V.FB.FE.60}{TC}$
	1.4. Cycle time	TC	-	min	
	c. Loading	T1	-	min	
	d. Unloading	T2	-	min	$E015 = \frac{1}{Q}$
	1.5. Productivity per hour	Q	-	cum/h	
	1.6. Coefficient of equipment	E15	-	hour	
2.	DUMP TRUCK				
	2.1. Capacity	V	-	cum	TC = T1 + T2 + T3 + T4
	2.2. Efficiency factor	FE	-	-	
	2.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{V}{Q_0} \text{ x } 60$
	2.4. Cycle time	TC	-	min	
	a. Loading time	T1	-	min	
	b. Loading trip	T2	-	min	$T2 = \frac{L}{V1} \text{ x } 60$
	c. Unloading trip	T3	-	min	
	d. Other	T4	-	min	$T3 = \frac{L}{V2} \text{ x } 60$
	2.5. Productivity per hour	Q	-	cum/h	
	2.6 Coefficient of equipment	E08	-	hour	$Q = \frac{V.FE.60}{TC.FL}$
					$E08 = \frac{1}{Q}$
3.	MOTOR GRADER				
	3.1. Spreading length	LS	-	m	TC = T1 + T2
	3.2. Effective width	b	-	m	
	3.3. Efficiency factor	FE	-	-	$T1 = \frac{LS.60}{V1.1000}$
	3.4. Average velocity	V	-	km/h	
	3.5. No of passing	n	-	-	
	3.6. Cycle time	TC	-	min	
	a. Time for one passing	T1	-	min	$Q = \frac{LS.b.t.FE.60}{n.TC}$
	b. Other	T2	-	min	
	3.7. Productivity per hour	Q	-	cum/h	
	3.8. Coefficient of equipment	E13	-	hour	$E013 = \frac{1}{Q}$
4.	WATER TANK TRUCK				

	4.1. Volume 4.2. Water required per cum of dense material 4.3. No of passing 4.4. Efficiency factor 4.5. Productivity per hour 4.6. Coefficient of equipment	V WC n FE Q E23	- - - - - -	cum cum - - cum/h hour	$Q = \frac{V.n.FE}{WC}$ $E023 = \frac{1}{Q}$
5.	VIBRATORY ROLLER 5.1. Average velocity 5.2. Effective width 5.3. No of passing 5.4. Efficiency factor 5.5. Productivity per hour 5.6. Coefficient of equipment	 V b n FE Q E19	 - - - - - -	 km/h m nos - cum/h hour	$Q = \frac{v.1000.b.t.FE}{n}$ $E019 = \frac{1}{Q}$
6.	RUBBER TIRE ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 V b n FE Q E018	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.1000.b.t.FE}{n}$ $E018 = \frac{1}{Q}$
7.	HELPING TOOLS 7.1. Push cart 7.2. Shovel 7.3. Fork				} Lump sum
	COEFFICIENT ANALYSIS FOR LABOR				
1. 2. 3. 4.	Group of labors serve rubber tire roller operation. Productivity RTR per day. Labor required 3.1. Common labor 3.2. Foreman Coefficient of labor: 4.1. Common labor 4.2. Foreman	 Q_t CL FO L01 L03	 - - - - -	 cum/d man man md md	Q_t = Q.TE $L01 = \frac{CL}{Q_t}$ $L03 = \frac{FO}{Q_t}$
	COEFFICIENT ANALYSIS OF MATERIAL				
1.	Common material required for 1 m^3 of dense layer	Q_d	-	cum	Q_d = Q.FL

COMMON EXCAVATION

PROJECT	:	UNIT OF MEASUREMENT
LOCATION	:	cubic meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1. 2.	Excavator Dump truck	- -	- -	- -	
	MATERIALS				
1.	Not used	-	-	-	

	LABOR				
1.	Foreman	FO	-	man	
2.	Common labor	CL	-	man	
	WORK ORDER				
1.	Excavation shall be performed mechanically.				
2.	Effective work hour per day for equipment.	TE	-	hour	
3.	Material loose factor.	FL	-	-	
4.	Average distance of disposal to project	L	-	km	
5.	Excavator excavates and load material to dump truck.	-	-	-	
6.	Dump truck hauls material to disposal location.	-	-	-	
7.	Group of labors serve excavator operation.	-	-	-	
	COEFFICIENT ANALISYS OF EQUIPMENT				
1.	EXCAVATOR				
	1.1. Bucket capacity	V	-	cum	TC = T1 + T2
	1.2. Bucket factor	FB	-	-	
	1.3. Efficiency factor	FE	-	-	
	1.4. Cycle time	TC	-	min	$Q_0 = \frac{V.FB.FE.60}{TC.FL}$
	a. Excavation	T1	-	min	
	b. Other	T2	-	min	
	1.5. Productivity per hour	Q_0	-	cum/h	$E10 = \frac{1}{Q_0}$
	1.6. Coefficient of equipment	E10	-	hour	
2.	DUMP TRUCK				
	2.1. Capacity	V	-	cum	TC = T1 + T2 + T3
	2.2. Efficiency factor	FE	-	-	
	2.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{V}{Q_0} \times 60$
	2.4. Average unloading trip velocity	V2	-	km/h	
	2.5. Cycle time	TC	-		
	a. Loading time	T1	-	min	$T2 = \frac{L}{V1} \times 60$
	b. Unloading time	T2	-	min	
	c. Unloading travel time	T3	-	min	
	d. Other	T4	-	min	$T3 = \frac{L}{V2} \times 60$
	2.6. Productivity per hour	Q	-	cum/h	
	2.7. Coefficient of equipment	E08	-	hour	$Q = \frac{V.FE.60}{TC.FL}$
					$E08 = \frac{1}{Q}$
	COEFFICIENT ANALYSIS FOR LABOR				
1.	Productivity excavator per day.	Q_t	-	cum	
2.	Labor required				Q_t = Q.TE
	a. Common labor	CL	-	man	
	b. Foreman	FO	-	man	$L01 = \frac{CL}{Q_t}$
3.	Coefficient of labor:				
	a. Common labor	L01	-	m.d	
	b. Foreman	L03	-	m.d	$L03 = \frac{FO}{Q_t}$

CLEARING AND GRUBBING

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Bulldozer	-	-	-	
2.	Excavator	-	-	-	
3.	Dump truck	-	-	-	
	MATERIALS				
1.	Not used	-	-	-	
	LABOR				
1.	Foreman	FO	-	man	
2.	Skill labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Clearing and grubbing shall be performed mechanically.	-	-	-	
2.	Effective work hour per day for equipment.	TE	-	hour	
3.	Material loose factor.	FL	-	-	
4.	Clearing and grubbing thickness.	d	-	m	
5.	Location of disposal at average distance.	L	-	km	
6.	Clearing and grubbing area along the project by using bulldozer.	-	-	-	
7.	Excavator load disposal material and haul by dump truck.	-	-	-	
	COEFFICIENT ANALISYS OF EQUIPMENT				
1.	BULLDOZER	FB			
	1.7. Blade factor	FE	-	-	V = H.2B.FB
	1.8. Efficiency factor	B	-	cum	TC = T1 + T2 + T3
	1.9. Blade width	h	-	-	
	1.10. Blade height	v1	-	min	$T1 = \frac{L.60}{V1}$
	1.11. Forward velocity	v2	-	min	
	1.12. Backward velocity	LC	-	min	
	1.13. Clearing distance	V	-	cum/h	
	1.14. Clearing production per time	E15	-	hour	$T2 = \frac{L.60}{V2}$
	1.15. Cycle time	TC	-	min	
	c. Forward	T1	-	min	
	d. Backward	T2	-	min	
	e. Other	T3	-	min	$Q = \frac{V.60.FE}{TC.FL.d}$
	1.16. Productivity per hour	Q	-	cum/h	
	1.17. Coefficient of equipment	E04	-	hour	$E04 = \frac{1}{Q}$
2.	EXCAVATOR				
	2.1. Bucket capacity	V	-	cum	TC = T1 + T2
	2.2. Bucket factor	FB	-	-	
	2.3. Efficiency factor	FE	-	-	
	2.4. Cycle time	TC	-	min	$Q = \frac{V.FB.FE.60}{TC.FL.d}$
	c. Excavation	T1	-	min	

	d. Other 2.5. Productivity per hour 2.6. Coefficient of equipment	T2 Q E10	- - -	min cum/h hour	$E10 = \frac{1}{Q}$
3.	DUMP TRUCK 3.1. Capacity 3.2. Efficiency factor 3.3. Average loading trip velocity 3.4. Average unloading trip velocity 3.5. Cycle time a. Loading time b. Unloading time c. Other 3.6. Productivity per hour 3.7. Coefficient of equipment	 V FE V1 V2 TC T1 T2 T3 Q E08	 - - - - - - - - - -	 cum - km/h km/h min min min min cum/h hour	TC = T1 + T2 + T3 $T1 = \frac{L}{V1} \times 60$ $T2 = \frac{L}{V2} \times 60$ $Q = \frac{V.FE.60}{TC.FL.d}$ $E08 = \frac{1}{Q}$
	COEFFICIENT ANALYSIS FOR LABOR				
1. 2. 3. 4.	Group of labor serve bulldozer operation. Productivity motor grader per day. Labor required c. Common labor d. Foreman Coefficient of labor: 4.1. Common labor 4.2. Foreman	 Q_t CL FO L01 L03	 - - - - -	 cum man man m.d m.d	Q_t = Q.TE $L01 = \frac{CL}{Q_t}$ $L03 = \frac{FO}{Q_t}$

SUB GRADE PREPARATION

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Bulldozer	-	-	-	
2.	Motor grader	-	-	-	
3.	Wheel loader	-	-	-	
4.	Dump truck	-	-	-	
5.	Water tank truck	-	-	-	
6.	Vibratory roller	-	-	-	
7.	Rubber tire roller	-	-	-	
8.	Helping tools	-	-	-	
	MATERIALS				
1.	Material used shall be complied with specification	-	-	-	
	LABOR				
1.	Foreman	FO	-	man	
2.	Common labor	CL	-	man	
	WORK ORDER				
1.	Preparation of subgrade shall be performed mechanically.				

2.	Effective work hour per day for equipment.	TE	-	hour	
3.	Material loose factor.	FL	-	-	
4.	Dense thickness of sub base.	t	-	m	
5.	Excavation and loosing material by bulldozer at borrow area and load to dump truck by wheel loader.	-	-	-	
6.	Material haul from borrow area by dump truck and unloaded to project location.	-	-	-	
7.	Average distance of borrow area to project location.	L	-	km	
8.	At project location material spreaded by motor grader.	-	-	-	
9.	Before compacting, material is watered with amount of water by water tank truck.	-	-	-	
10.	Compacting of material to specified MMD performed by vibro roller and tire roller.	-	-	-	
11.	During spreading and compacting, group of labors put edge of spread and level of surface using helping tools.	-	-	-	
	COEFFICIENT ANALISYS OF EQUIPMENT				
1.	BULLDOZER	FB	-	-	
	1.18. Blade factor	B	-	cum	$V = (h)^2.B.FB$
	1.19. Blade width	h	-	-	
	1.20. Blade height	v1	-	min	$TC = T1 + T2 + T3$
	1.21. Forward velocity	v2	-	min	
	1.22. Backward velocity	LC	-	min	$T1 = \frac{L.60}{V1.1000}$
	1.23. Clearing distance	V	-	cum/h	
	1.24. Clearing production per time	E15	-	hour	
	1.25. Cycle time	TC	-	min	
	f. Forward	T1	-	min	$T2 = \frac{L.60}{V2.1000}$
	g. Backward	T2	-	min	
	h. Other	T3	-	min	
	1.26. Productivity per hour	Q	-	cum/h	$Q = \frac{V.60.FE}{TC}$
	1.27. Coefficient of equipment	E04	-	hour	$E04 = \frac{1}{Q}$
2.	WHEEL LOADER				
	2.7. Bucket factor	FB	-	-	$TC = T1 + T2$
	2.8. Capacity	V	-	cum	
	2.9. Efficiency factor	FE	-	-	$Q = \frac{V.FB.FE.60}{TC}$
	2.10. Cycle time	TC	-	min	
	e. Loading	T1	-	min	
	f. Unloading	T2	-	min	$E015 = \frac{1}{Q}$
	2.11. Productivity per hour	Q	-	cum/h	
	2.12. Coefficient of equipment	E15	-	hour	
3.	DUMP TRUCK				
	3.1. Capacity	V	-	cum	$TC = T1 + T2 + T3$
	3.2. Efficiency factor	FE	-	-	

	3.3. Average loading trip velocity 3.4. Average unloading trip velocity 3.5. Cycle time a. Loading travel time b. Unloading travel time 3.6. Productivity per hour 3.7. Coefficient of equipment	V1 V2 TC T1 T2 Q E09	- - - - - - -	km/h km/h min min min cum/h hour	$T1 = \frac{L}{V1}$ x 60 $T2 = \frac{L}{V2}$ x 60 $Q = \frac{V.FE.60}{TC.FL}$ $E09 = \frac{1}{Q}$
4.	MOTOR GRADER 4.1. Spreading length 4.2. Effective width 4.3. Efficiency factor 4.4. Average velocity 4.5. No of passing 4.6. Cycle time a. Time for one passing b. Other 4.7. Productivity per hour 4.8. Coefficient of equipment	 LH b FE V1 n TC T1 T2 Q E13	 - - - - - - - - - -	 m m - km/h - min min min cum/h hour	TC = T1 + T2 $T1 = \frac{LH.60}{V1.1000}$ $Q = \frac{LH.b.t.FE.60}{n.TC}$ $E13 = \frac{1}{Q}$
5.	WATER TANK TRUCK 5.1. Volume 5.2. Water required per m^3 of dense material 5.3. Water filling per hour 5.4. Efficiency factor 5.5. Productivity per hour 5.6. Coefficient of equipment	 V Wc n FE Q E23	 - - - - - -	 cum cum - - cum/h hour	$Q = \frac{V.n.FE}{Wc}$ $E23 = \frac{1}{Q}$
6.	VIBRATORY ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 V1 b n FE Q E19	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{V1.1000.b.t.FE}{n}$ $E019 = \frac{1}{Q}$
7.	PNEUMATIC TIRE ROLLER 7.1. Average velocity 7.2. Effective width 7.3. No of passing 7.4. Efficiency factor 7.5. Productivity per hour 7.6. Coefficient of equipment	 V b n FE Q E18	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.1000.b.t.FE}{n}$ $E018 = \frac{1}{Q}$
8.	HELPING TOOLS 8.1. Push cart 8.2. Shovel 8.3. Fork				} Lump sum
	COEFFICIENT ANALYSIS FOR LABOR				
1.	During spreading, group of labor put edge of spreaded material and level the surface of sub grade.				Q_t = Q.TE

	Productivity motor grader per hour.	Q			$L01 = \frac{CL}{Q_t}$
2.	Productivity motor grader per day.	Q_t	-	cum/h	
	Labor required				
3.	c. Common labor	CL	-	cum/d	$L03 = \frac{FO}{Q_t}$
	d. Foreman	FO	-	man	
4.	Coefficient of labor:		-	man	
	5.1. Common labor	L01	-	day	
	5.2. Foreman	L03	-	day	
5.					
	COEFFICIENT ANALYSIS OF MATERIAL				
1.	Volume of material	Q	-	cum	
2.	Loose factor	FL	-	-	Q = 1 cum
3.	Volume of material required	Qr	-	cum	Qr = 1.FL

SUB BASE AGGREGATE B

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	cubic meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Wheel loader	-	-	-	
2.	Dump truck	-	-	-	
3.	Motor grader	-	-	-	
4.	Water tank truck	-	-	-	
5.	Vibratory roller	-	-	-	
6.	Pneumatic tire roller	-	-	-	
7.	Helping tools:				
	7.1. Push cart	-	-	-	
	7.2. Shovel	-	-	-	
	7.3. Fork	-	-	-	
	MATERIALS				
1.	Crushed rock aggregate class with quality in accordance with specification	-	-	-	
	LABOR				
1.	Foreman	FO	-	man	
2.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically.				
2.	Average distance of base camp to project site.	L	-	Km	
3.	Dense thickness of sub base.	t	-	m	
4.	Material loose factor.	FL	-	-	
5.	Effective work hour per day for equipment.	TE	-	hour	
6.	Wheel loader mix and load aggregate to dump truck at base camp.	-	-	-	
7.	Dump trucks haul aggregate to project site, then spreaded by motor grader.	-	-	-	
8.	Before compaction, aggregate	-	-	-	

9.	sprayed water by water tank truck. Compaction of aggregate performed by tandem steel roller and pneumatic tire roller.	-	-	-	
10.	During spreading and compacting, group of labors set up the edge of spreaded aggregate and surface level using helping tools.	-	-	-	
	COEFFICIENT ANALISYS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.28. Bucket factor	FB	-	-	TC = T1 + T2
	1.29. Capacity	V	-	cum	
	1.30. Efficiency factor	FE	-	-	$Q = \frac{V.FB.FE.60}{TC}$
	1.31. Cycle time	TC	-	min	
	g. Loading	T1	-	min	
	h. Unloading	T2	-	min	$E15 = \frac{1}{Q}$
	1.32. Productivity per hour	Q	-	cum/h	
	1.33. Coefficient of equipment	E15	-	hour	
2.	DUMP TRUCK				
	2.1. Capacity	V	-	cum	TC = T1 + T2 + T3
	2.2. Efficiency factor	FE	-	-	
	2.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{L}{V1} \text{ x } 60$
	2.4. Average unloading trip velocity	V2	-	km/h	
	2.5. Cycle time	TC	-	min	
	a. Loading travel time	T1	-	min	$T2 = \frac{L}{V2} \text{ x } 60$
	b. Unloading travel time	T2	-	min	
	c. Other	T3	-	min	
	2.6. Productivity per hour	Q	-	cum/h	$Q = \frac{V.FE.60}{TC}$
	2.7. Coefficient of equipment	E09	-	hour	
					$E09 = \frac{1}{Q}$
3.	MOTOR GRADER				
	3.1. Spreading length	LS	-	m	TC = T1 + T2
	3.2. Effective width	b	-	m	
	3.3. Efficiency factor	FE	-	-	$Q = \frac{LS.b.t.FE.60}{n.TC}$
	3.4. Average velocity	V1	-	km/h	
	3.5. No of passing	n	-	-	
	3.6. Cycle time	TC	-	min	$E13 = \frac{1}{Q}$
	a. Time for one passing	T1	-	min	
	b. Other	T2	-	min	
	3.7. Productivity per hour	Q	-	cum/h	
	3.8. Coefficient of equipment	E13	-	hour	
4.	WATER TANK TRUCK				
	4.1. Volume	V	-	cum	$Q = \frac{V.n.FE}{Wc}$
	4.2. Water required per m^3 of dense material	Wc	-	cum	
	4.3. Water filling per hour	n	-	-	$E23 = \frac{1}{Q}$
	4.4. Efficiency factor	FE	-	-	
	4.5. Productivity per hour	Q	-	cum/h	
	4.6. Coefficient of equipment	E23	-	hour	
5.	VIBRATORY ROLLER				
	5.1. Average velocity	v	-	km/h	$Q = \frac{v.1000.b.t.FE}{n}$
	5.2. Effective width	b	-	m	
	5.3. No of passing	n	-	-	
	5.4. Efficiency factor	FE	-	-	

	5.5. Productivity per hour 5.6. Coefficient of equipment	Q E19	- -	cum/h hour	$E19 = \frac{1}{Q}$
6.	PNEUMATIC TIRE ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 v b n FE Q E18	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.1000.b.t.FE}{n}$ $E018 = \frac{1}{Q}$
7.	HELPING TOOLS 7.1. Push cart 7.2. Shovel 7.3. Fork				} Lump sum
	COEFFICIENT ANALYSIS FOR LABOR				
1. 2. 3.	Productivity motor grader per hour. Productivity motor grader per day. Coefficient of labor: 3.1. Common labor 3.2. Foreman	Q Q_t L01 L03	- - - -	cum/h cum/d day day	 Q_t = Q.TE $L01 = \frac{CL}{Q_t}$ $L03 = \frac{FO}{Q_t}$
	COEFFICIENT ANALYSIS OF MATERIAL				
1. 2.	Volume of material Quantity of material required	V W104	- -	cum cum	 W104 = V.FL

BASE AGGREGATE A

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	cubic meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Wheel loader	-	-	-	
2.	Dump truck	-	-	-	
3.	Motor grader	-	-	-	
4.	Water tank truck	-	-	-	
5.	Vibratory roller	-	-	-	
6.	Pneumatic tire roller	-	-	-	
7.	Helping tools:				
	7.1. Push cart	-	-	-	
	7.2. Shovel	-	-	-	
	7.3. Fork	-	-	-	
	MATERIALS				
1.	Crushed rock aggregate class with quality in accordance with specification	-	-	-	
	LABOR				
1.	Common Labor	CL	-	man	
2.	Foreman	FO	-	man	
	WORK ORDER				

1.	Construction shall be performed mechanically.				
2.	Average distance of base camp to project site.	L	-	Km	
3.	Dense thickness of sub base.	t	-	m	
4.	Material loose factor.	FL	-	-	
5.	Effective work hour per day for equipment.	TE	-	hour	
6.	Wheel loader mix and load aggregate to dump truck at base camp.	-	-	-	
7.	Dump trucks haul aggregate to project site, than spreaded by motor grader.	-	-	-	
8.	Before compaction, aggregate sprayed water by water tank truck.	-	-	-	
9.	Compaction of aggregate performed by tandem steel roller and pneumatic tire roller.	-	-	-	
10.	During spreading and compacting, group of labors set up the edge of spreaded aggregate and surface level using helping tools.	-	-	-	
	COEFFICIENT ANALISYS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.34. Bucket factor	FB	-	-	TC = T1 + T2
	1.35. Capacity	V	-	cum	
	1.36. Efficiency factor	FE	-	-	$Q = \frac{V.FB.FE.60}{TC}$
	1.37. Cycle time	TC	-	min	
	i. Loading	T1	-	min	
	j. Unloading	T2	-	min	$E15 = \frac{1}{Q}$
	1.38. Productivity per hour	Q	-	cum/h	
	1.39. Coefficient of equipment	E15	-	hour	
2.	DUMP TRUCK				
	2.1. Capacity	V	-	cum	TC = T1 + T2 + T3
	2.2. Efficiency factor	FE	-	-	
	2.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{L}{V1} \times 60$
	2.4. Average unloading trip velocity	V2	-	km/h	
	2.5. Cycle time	TC	-	min	
	a. Loading travel time	T1	-	min	$T2 = \frac{L}{V2} \times 60$
	b. Unloading travel time	T2	-	min	
	c. Other	T3	-	min	
	2.6. Productivity per hour	Q	-	cum/h	$Q = \frac{V.FE.60}{TC}$
	2.7. Coefficient of equipment	E09	-	hour	
					$E09 = \frac{1}{Q}$
3.	MOTOR GRADER				
	3.1. Spreading length	LS	-	m	TC = T1 + T2
	3.2. Effective width	b	-	m	
	3.3. Efficiency factor	FE	-	-	$Q = \frac{LS.b.t.FE.60}{n.TC}$
	3.4. Average velocity	V1	-	km/h	
	3.5. No of passing	n	-	-	
	3.6. Cycle time	TC	-	min	$E13 = \frac{1}{Q}$
	a. Time for one passing	T1	-	min	
	b. Other	T2	-	min	
	3.7. Productivity per hour	Q	-	cum/h	

	3.8. Coefficient of equipment	E13	-	hour	
4.	WATER TANK TRUCK				
	4.1. Volume	V	-	cum	$Q = \frac{V.n.FE}{Wc}$
	4.2. Water required per m^3 of dense material	Wc	-	cum	
	4.3. Water filling per hour	n	-	-	$E23 = \frac{1}{Q}$
	4.4. Efficiency factor	FE	-	-	
	4.5. Productivity per hour	Q	-	cum/h	
	4.6. Coefficient of equipment	E23	-	hour	
5.	VIBRATORY ROLLER				
	5.1. Average velocity	v	-	km/h	$Q = \frac{v.1000.b.t.FE}{n}$
	5.2. Effective width	b	-	m	
	5.3. No of passing	n	-	-	$E19 = \frac{1}{Q}$
	5.4. Efficiency factor	FE	-	-	
	5.5. Productivity per hour	Q	-	cum/h	
	5.6. Coefficient of equipment	E19	-	hour	
6.	PNEUMATIC TIRE ROLLER				
	6.1. Average velocity	v	-	km/h	$Q = \frac{v.1000.b.t.FE}{n}$
	6.2. Effective width	b	-	m	
	6.3. No of passing	n	-	-	
	6.4. Efficiency factor	FE	-	-	
	6.5. Productivity per hour	Q	-	cum/h	$E18 = \frac{1}{Q}$
	6.6. Coefficient of equipment	E18	-	hour	
7.	HELPING TOOLS				
	7.1. Push cart				} Lump sum
	7.2. Shovel				
	7.3. Fork				
	COEFFICIENT ANALYSIS FOR LABOR				
1.	Productivity motor grader per hour.	Q	-	cum/h	
	Productivity motor grader per day.	Q_t	-	cum/d	Q_t = Q.TE
2.	Coefficient of labor:				
	3.1. Common labor	L01	-	day	$L01 = \frac{CL}{Q_t}$
3.	3.2. Foreman	L03	-	day	$L03 = \frac{FO}{Q_t}$
	COEFFICIENT ANALYSIS OF MATERIAL				
1.	Volume of material	V	-	cum	
2.	Quantity of material required	W104	-	cum	W104 = V.FL

PRIME COAT

PROJECT	:	UNIT OF MEASUREMENT
LOCATION	:	square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Asphalt sprayer	-	-	-	
2.	Compressor	-	-	-	
3.	Dump truck	-	-	-	
	MATERIALS				

1.	Bituminous cut back or emulsified asphalt in accordance specification	-	-	-	
	LABOR				
1.	Foreman	FO	-	man	
2.	Skilled labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically.				
2.	Average distance of base camp to project site.	L	-	Km	
3.	Effective work hour per day for equipment.	TE	-	hour	
4.	Loose factor of materials.	FL	-	-	
5.	Type of material: bituminous cut back.	-	-	-	
6.	Composition of mixtures:	AS	-	%	
	a. Asphalt cement	KE	-	%	
	b. Kerosene				
7.	Unit weight of material:				
	a. Asphalt cement	D1	-	Kg/liter	
	b. Kerosene	D2	-	Kg/liter	
8.	All material provided at base camp and transported to project location.	-	-	-	
9.	Asphalt cement and kerosene mixed homogeneously and heated to be bituminous cut back.	-	-	-	
10.	Before bituminous cut back sprayed, surface shall be cleaned from dust, dirty and other materials by air compressor.	-	-	-	
11.	Asphalt cement and kerosene transported to project by dump truck.	-	-	-	
12.	Cut back asphalt sprayed by asphalt sprayer.				
13	Group of labors are required to serve asphalt sprayer and air compressor.	-	-	-	
	COEFFICIENT ANALYSIS OF EQUIPMENT				
1.	ASPHALT SPRAYER				
	1.1. Capacity	V	-	sq.m	$Q = \frac{V.EF.PC}{TC}$
	1.2. Efficiency factor	EF	-	-	
	1.3. Cycle time	TC	-	hour	
	1.4. Application of prime coat	PC	-	liter/sq.m	$E05 = \frac{1}{Q}$
	1.5. Productivity per hour	Q	-	liter	
	1.6. Coefficient of equipment	E05	-	hour	
2.	AIR COMPRESSOR				
	2.1. Capacity	V	-	sq/hour	Q = V.EF
	2.2. Efficiency factor	EF	-	-	
	2.3. Productivity per hour	Q	-	-	$E05 = \frac{1}{Q}$
	2.4. Coefficient of equipment	E05	-	hour	
3.	DUMP TRUCK				
	3.1. Dump truck serve asphalt sprayer and air compressor				$Q = \frac{V.EF.PC}{TC}$
	3.2. Productivity dump truck = productivity asphalt sprayer	Q	-	-	

	3.3. Coefficient of equipment	E08	-	hour	$E08 = \frac{1}{Q}$
	COEFFICIENT ANALYSIS OF LABOR				
1.	Foreman	FO	-	man	
2.	Common labor	CL	-	man	
3.	Productivity asphalt sprayer per hour	Q_t	-	liter	$Q_t = \frac{V.EF.PC.TE}{TC}$
	Coefficient of labor:				
4.	4.1 Foreman	L03	-	m.d	$L03 = \frac{FO}{Q_t}$
	4.2 Common Labor	L01	-	m.d	$L01 = \frac{CL}{Q_t}$
	COEFFICIENT ANALYSIS OF MATERIALS				
1.	For one liter of prime coat required:				
	1.1. Asphalt cement				M10 = As.PC.D1
	1.2. Kerosene	M10	-	Kg	
		M11	-	liter	M11 = KE.PC.D2

TACK COAT

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Asphalt sprayer	-	-	-	
2.	Compressor	-	-	-	
3.	Dump truck	-	-	-	
	MATERIALS				
1.	Bituminous cut back or emulsified asphalt in accordance specification	-	-	-	
	LABOR				
1.	Foreman	FO	-	man	
2.	Skilled labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically				
2.	Average distance of base camp to project site	L	-	Km	
3.	Effective work hour per day for equipment	TE	-	hour	
4.	Loose factor of materials	FL	-	-	
5.	Type of material: bituminous cut back	-	-	-	
6.	Composition of mixtures:	AS	-	%	
	c. Asphalt cement	KE	-	%	
	d. Kerosene				
7.	Weigh unit of material:				
	c. Asphalt cement	D1	-	Kg/liter	
	d. Kerosene	D2	-	Kg/liter	
8.	All material provided at base camp and transported to project location.	-	-	-	

9.	Asphalt cement and kerosene mixed homogeneously and heated to be bituminous cut back.	-	-	-	
10.	Before bituminous cut back sprayed, surface shall be cleaned from dust, dirty and other materials by air compressor.	-	-	-	
11.	Asphalt cement and kerosene transported to project by dump truck.	-	-	-	
12.	Cut back asphalt sprayed by asphalt sprayer.				
13.	Group of labors are required to serve asphalt sprayer and air compressor.	-	-	-	
	COEFFICIENT ANALYSIS OF EQUIPMENT				
1.	ASPHALT SPRAYER				
	1.7. Capacity	V	-	sq.m	$Q = \frac{V.EF.PC}{TC}$
	1.8. Efficiency factor	EF	-	-	
	1.9. Cycle time	TC	-	hour	
	1.10. Application of prime coat	PC	-	liter/sq.m	$E05 = \frac{1}{Q}$
	1.11. Productivity per hour	Q	-	liter	
	1.12. Coefficient of equipment	E05	-	hour	
2.	AIR COMPRESSOR				
	2.1. Capacity	V	-	sq/hour	Q = V.EF
	2.2. Efficiency factor	EF	-	-	
	2.3. Productivity per hour	Q	-	-	$E05 = \frac{1}{Q}$
	2.4. Coefficient of equipment	E05	-	hour	
3.	DUMP TRUCK				
	3.1. Dump truck serve asphalt sprayer and air compressor				$Q = \frac{V.EF.PC}{TC}$
	3.2. Productivity dump truck = productivity asphalt sprayer	Q	-	-	
	3.3. Coefficient of equipment	E08	-	hour	$E08 = \frac{1}{Q}$
	COEFFICIENT ANALYSIS OF LABOR				
1.	Foreman	FO	-	man	
2.	Common labor	CL	-	man	$Q_t = \frac{V.EF.PC.TE}{TC}$
3.	Productivity asphalt sprayer per hour	Q_t	-	liter	
	Coefficient of labor:				
4.	4.1 Foreman	L03	-	m.d	$L03 = \frac{FO}{Q_t}$
	4.2 Common Labor	L01	-	m.d	$L01 = \frac{CL}{Q_t}$
	COEFFICIENT ANALYSIS OF MATERIALS				
1.	For one liter of tack coat required:				
	1.3. Asphalt cement				M10 = As.PC.D1
	1.4. Kerosene	M10	-	Kg	
		M11	-	liter	M11 = KE.PC.D2

ASPHALT CONCRETE BASE
AC - BASE

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Wheel Loader	-	-	-	
2.	Asphalt Mixing Plant	-	-	-	
3.	Generator	-	-	-	
4.	Dump Truck	-	-	-	
5.	Asphalt Finisher	-	-	-	
6.	Tandem Steel Roller	-	-	-	
7.	Pneumatic Tire Roller	-	-	-	
8.	Helping Tools:				
	a. Control stick of spreading thickness	-	-	-	
	b. Thermometer asphalt	-	-	-	
	c. Push cart	-	-	-	
	d. Shovel	-	-	-	
	e. Fork	-	-	-	
	MATERIALS				
1.	Coarse aggregate	CA	-	%	
2.	Fine aggregate	FA	-	%	
3.	Filler	FF	-	%	
4.	Bituminous material	AS	-	%	
	The quality of all materials shall be complied with requirements in specification				
	LABOR				
1.	Foreman	FO	-	man	
2.	Skilled labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically				
2.	All material provided and mixing process in base camp				
3.	Average distance of base camp to project site	L	-	Km	
4.	Layer thickness	t	-	m	
5.	Effective work hour per day for equipment	TE	-	hour	
6.	Loose factor of materials				
	a. Aggregate	FL1	-	-	
	b. Asphalt cement	FL2	-	-	
7.	Mixer composition				
	e. Coarse aggregate	CA	-	%	
	f. Fine aggregate	FA	-	%	
	g. Filler	FF	-	%	
NO	**DESCRIPTION**	**CODE**	**COEFF.**	**UNIT**	**CALCULATION FORMULA**
	h. Asphalt cement	AS	-	%	
8.	Unit density of materials				
	a. Asphalt concrete	D1	-	ton/m3	
	b. Coarse & Fine Aggregate	D2	-	ton/m3	
	c. Filler	D3	-	ton/m3	
	d. Asphalt cement	D4	-	ton/m3	

9.	Wheel loader load aggregate to cold bin and labor load asphalt cement to asphalt kettle.	-	-	-	
10.	Aggregate and asphalt cement mixed and heated in AMP and load in to dump truck and transported to project site.	-	-	-	
11.	Hot aggregate-asphalt cement mix spreaded by asphalt finisher, than compacted by tandem roller and pneumatic roller.	-	-	-	
12.	During spreading and compacting, group of labors set up the edge and level using helping tools.	-	-	-	
	COEFFICIENT ANALYSIS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.1. Bucket capacity	V	-	cum	TC = T1 + T2
	1.2. Bucket factor	FB	-	-	
	1.3. Efficiency factor	FE	-		$Q = \frac{V.FB.FE.60}{TC}$
	1.4. Cycle time	TC	-	min	
	a. Loading	T1	-	min	
	b. Others	T2	-	min	$E15 = \frac{1}{Q}$
	1.5. Productivity per hour	Q	-	cum/h	
	1.6. Coefficient of equipment	E15	-	cum	
2.	ASPHALT MIXING PLANT				
	2.1. Capacity	V	-	ton/h	$Q = \frac{V.FE}{D1}$
	2.2. Efficiency factor	FE	-	-	
	2.3. Productivity per hour	Q	-	cum/h	
	2.4. Coefficient of equipment	E01	-	hour	$E01 = \frac{1}{Q}$
3.	GENERATOR				
	3.1. Generator is required to supply electrical power to AMP	-	-	-	
	3.2. Productivity of generator is same with productivity of AMP	Q	-	cum/h	$E12 = \frac{1}{Q}$
	3.3. Coefficient of equipment	E12	-	hour	
NO	**DESCRIPTION**	**CODE**	**COEFF.**	**UNIT**	**CALCULATION FORMULA**
4.	DUMP TRUCK				
	4.1. Capacity	V	-	cum	TC = T1 + T2 + T3 + T4
	4.2. Efficiency factor	FE	-	-	
	4.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{V.T_b}{Q_2}$
	4.4. Average unloading trip velocity	V2	-	km/h	
	4.5. AMP productivity per bath	Q_b	-	ton	$T2 = \frac{L}{V1}$ x 60
	4.6. Time to product one bath	T_b	-	min	
	4.7. Cycle time	TC	-	min	
	a. Loading time	T1	-	min	$T4 = \frac{L}{V2}$ x 60
	b. Hauling, waiting	T2	-	min	
	c. Queuing, waiting	T3	-	min	
	d. Unloading, return	T4	-	min	$Q = \frac{V.FE.60}{D1.TC}$
	4.8. Productivity per hour	Q	-	cum/h	
	4.9. Coefficient of equipment	E09	-	hour	$E09 = \frac{1}{Q}$

5.	ASPHALT FINISHER 5.1. Capacity 5.2. Efficiency factor 5.3. Productivity per hour 5.4. Coefficient of equipment	 V FE Q E05	 - - - -	 ton/h - cum/h hour	$Q = \frac{V.FE}{D1}$ $E05 = \frac{1}{Q}$
6.	TANDEM STEEL ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 v b n FE Q E17	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.t.1000.b.FE}{n}$ $E17 = \frac{1}{Q}$
7.	PNEUMATIC TIRE ROLLER 7.1. Average velocity 7.2. Effective width 7.3. No of passing 7.4. Efficiency factor	 v b n FE	 - - - -	 km/h m - -	
8.	HELPING TOOLS 8.1. Control stick of spreading thickness 8.2. Thermometer asphalt 8.3. Push cart 8.4. Shovel 8.5. Fork				Lump sum

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULTATION FORMULA
	COEFFICIENT ANALYSIS OF MATERIALS				
1. 2. 3. 4.	Coarse aggregate Fine aggregate Filler Asphalt cement	W101 W102 W105 M10	- - - -	cu.m cu.m kg kg	$W101 = \frac{CA.D1.t.FL1}{D2}$ $W102 = \frac{FA.D1.t.FL1}{D2}$ $W105 = FF.D1.t.FL1$ $M10 = AS.D1.t.FL2$
	COEFFICIENT ANALYSIS OF LABOR				
1. 2. 3. 4.	Labor required at AMP 1.1 Common labor 1.2 Skilled Labor 1.3 Foreman Productivity of AMP per hour Productivity of AMP per day Coefficient of Labor 4.1 Common Labor 4.2 Skilled Labor 4.3 Foreman	 CL SK FO Q Q_t L01 L02 L03	 - - - - - - - -	 man man man cum/h cum/d md md md	$Q_t = Q.TE$ $L01 = \frac{CL}{Q_t}$ $L02 = \frac{SK}{Q_t}$ $L03 = \frac{FO}{Q_t}$

ASPHALTIC CONCRETE
BINDER COURSE

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Wheel Loader	-	-	-	
2.	Asphalt Mixing Plant	-	-	-	
3.	Generator	-	-	-	
4.	Dump Truck	-	-	-	
5.	Asphalt Finisher	-	-	-	
6.	Tandem Steel Roller	-	-	-	
7.	Pneumatic Tire Roller	-	-	-	
8.	Helping Tools:				
	f. Control stick of spreading thickness	-	-	-	
	g. Thermometer asphalt	-	-	-	
	h. Push cart	-	-	-	
	i. Shovel	-	-	-	
	j. Fork	-	-	-	
	MATERIALS				
1.	Coarse aggregate	CA	-	%	
2.	Fine aggregate	FA	-	%	
3.	Filler	FF	-	%	
4.	Bituminous material	AS	-	%	
	The quality of all materials shall be complied with requirements in specification				
	LABOR				
1.	Foreman	FO	-	man	
2.	Skilled labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically				
2.	All material provided and mixing process in base camp				
3.	Average distance of base camp to project site	L	-	Km	
4.	Layer thickness	t	-	m	
5.	Effective work hour per day for equipment	TE	-	hour	
6.	Loose factor of materials				
	c. Aggregate	FL1	-	-	
	d. Asphalt cement	FL2	-	-	
7.	Mixer composition				
	i. Coarse aggregate	CA	-	%	
	j. Fine aggregate	FA	-	%	
	k. Filler	FF	-	%	
NO	**DESCRIPTION**	**CODE**	**COEFF.**	**UNIT**	**CALCULATION FORMULA**
	l. Asphalt cement	AS	-	%	
8.	Unit density of materials				
	e. Asphalt concrete	D1	-	ton/m3	
	f. Coarse & Fine Aggregate	D2	-	ton/m3	

	g. Filler	D3	-	ton/m3	
	h. Asphalt cement	D4	-	ton/m3	
9.	Wheel loader load aggregate to cold bin and labor load asphalt cement to asphalt kettle.	-	-	-	
10.	Aggregate and asphalt cement mixed and heated in AMP and load in to dump truck and transported to project site.	-	-	-	
11.	Hot aggregate-asphalt cement mix spreaded by asphalt finisher, than compacted by tandem roller and pneumatic roller.	-	-	-	
12.	During spreading and compacting, group of labors set up the edge and level using helping tools.	-	-	-	
	COEFFICIENT ANALYSIS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.7. Bucket capacity	V	-	cum	TC = T1 + T2
	1.8. Bucket factor	FB	-	-	
	1.9. Efficiency factor	FE	-		$Q = \frac{V.FB.FE.60}{TC}$
	1.10. Cycle time	TC	-	min	
	c. Loading	T1	-	min	
	d. Others	T2	-	min	$E15 = \frac{1}{Q}$
	1.11. Productivity per hour	Q	-	cum/h	
	1.12. Coefficient of equipment	E15	-	cum	
2.	ASPHALT MIXING PLANT				
	2.1. Capacity	V	-	ton/h	$Q = \frac{V.FE}{D1}$
	2.2. Efficiency factor	FE	-	-	
	2.3. Productivity per hour	Q	-	cum/h	
	2.4. Coefficient of equipment	E01	-	hour	$E01 = \frac{1}{Q}$
3.	GENERATOR				
	3.4. Generator is required to supply electrical power to AMP	-	-	-	$E12 = \frac{1}{Q}$
	3.5. Productivity of generator is same with productivity of AMP	Q	-	cum/h	
	3.6. Coefficient of equipment	E12	-	hour	
4.	DUMP TRUCK				
	4.1. Capacity	V	-	cum	TC = T1 + T2 + T3 + T4
	4.2. Efficiency factor	FE	-	-	
	4.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{V.T_b}{Q_2}$
	4.4. Average unloading trip velocity	V2	-	km/h	
	4.5. AMP productivity per bath	Q_b	-	ton	$T2 = \frac{L}{V1}$ x 60
	4.6. Time to product one bath	T_b	-	min	
	4.7. Cycle time	TC	-	min	
	a. Loading time	T1	-	min	$T4 = \frac{L}{V2}$ x 60
	b. Hauling, waiting	T2	-	min	
	c. Queuing, waiting	T3	-	min	
	d. Unloading, return	T4	-	min	$Q = \frac{V.FE.60}{D1.TC}$
	4.8. Productivity per hour	Q	-	cum/h	
	4.9. Coefficient of equipment	E09	-	hour	$E09 = \frac{1}{Q}$

5.	ASPHALT FINISHER 5.1. Capacity 5.2. Efficiency factor 5.3. Productivity per hour 5.4. Coefficient of equipment	 V FE Q E05	 - - - -	 ton/h - cum/h hour	$Q = \frac{V.FE}{D1}$ $E05 = \frac{1}{Q}$
6.	TANDEM STEEL ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 v b n FE Q E17	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.t.1000.b.FE}{n}$ $E17 = \frac{1}{Q}$
7.	PNEUMATIC TIRE ROLLER 7.1. Average velocity 7.2. Effective width 7.3. No of passing 7.4. Efficiency factor	 v b n FE	 - - - -	 km/h m - -	
8.	HELPING TOOLS 8.1. Control stick of spreading thickness 8.2. Thermometer asphalt 8.3. Push cart 8.4. Shovel 8.5. Fork				Lump sum

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	COEFFICIENT ANALYSIS OF MATERIALS				
1. 2. 3. 4.	Coarse aggregate Fine aggregate Filler Asphalt cement	W101 W102 W105 M10	- - - -	cu.m cu.m kg kg	$W101 = \frac{CA.D1.t.FL1}{D2}$ $W102 = \frac{FA.D1.t.FL1}{D2}$ $W105 = FF.D1.t.FL1$ $M10 = AS.D1.t.FL2$
	COEFFICIENT ANALYSIS OF LABOR				
1. 2. 3. 4.	Labor required at AMP 1.4 Common labor 1.5 Skilled Labor 1.6 Foreman Productivity of AMP per hour Productivity of AMP per day Coefficient of Labor 4.1 Common Labor 4.2 Skilled Labor 4.3 Foreman	 CL SK FO Q Q_t L01 L02 L03	 - - - - - - - -	 man man man cum/h cum/d md md md	$Q_t = Q.TE$ $L01 = \frac{CL}{Q_t}$ $L02 = \frac{SK}{Q_t}$ $L03 = \frac{FO}{Q_t}$

ASPHALTIC CONCRETE
WEARING COURSE

PROJECT :	UNIT OF MEASUREMENT
LOCATION :	square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Wheel Loader	-	-	-	
2.	Asphalt Mixing Plant	-	-	-	
3.	Generator	-	-	-	
4.	Dump Truck	-	-	-	
5.	Asphalt Finisher	-	-	-	
6.	Tandem Steel Roller	-	-	-	
7.	Pneumatic Tire Roller	-	-	-	
8.	Helping Tools:				
	k. Control stick of spreading thickness	-	-	-	
	l. Thermometer asphalt	-	-	-	
	m. Push cart	-	-	-	
	n. Shovel	-	-	-	
	o. Fork	-	-	-	
	MATERIALS				
1.	Coarse aggregate	CA	-	%	
2.	Fine aggregate	FA	-	%	
3.	Filler	FF	-	%	
4.	Bituminous material	AS	-	%	
	The quality of all materials shall be complied with requirements in specification				
	LABOR				
1.	Foreman	FO	-	man	
2.	Skilled labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically				
2.	All material provided and mixing process in base camp				
3.	Average distance of base camp to project site	L	-	Km	
4.	Layer thickness	t	-	m	
5.	Effective work hour per day for equipment	TE	-	hour	
6.	Loose factor of materials				
	e. Aggregate	FL1	-	-	
	f. Asphalt cement	FL2	-	-	
7.	Mixer composition				
	m. Coarse aggregate	CA	-	%	
	n. Fine aggregate	FA	-	%	
	o. Filler	FF	-	%	

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	p. Asphalt cement	AS	-	%	
8.	Density unit of materials				

	a. Asphalt concrete	D1	-	ton/m3	
	b. Coarse & Fine Aggregate	D2	-	ton/m3	
	c. Filler	D3	-	ton/m3	
	d. Asphalt cement	D4	-	ton/m3	
9.	Wheel loader load aggregate to cold bin and labor load asphalt cement to asphalt kettle.	-	-	-	
10.	Aggregate and asphalt cement mixed and heated in AMP and load in to dump truck and transported to project site.	-	-	-	
11.	Hot aggregate-asphalt cement mix spreaded by asphalt finisher, than compacted by tandem roller and pneumatic roller.	-	-	-	
12.	During spreading and compacting, group of labors set up the edge and level using helping tools.	-	-	-	
	COEFFICIENT ANALYSIS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.13. Bucket capacity	V	-	cum	TC = T1 + T2
	1.14. Bucket factor	FB	-	-	
	1.15. Efficiency factor	FE	-		$Q = \frac{V.FB.FE.60}{TC}$
	1.16. Cycle time	TC	-	min	
	a. Loading	T1	-	min	
	b. Others	T2	-	min	$E15 = \frac{1}{Q}$
	1.17. Productivity per hour	Q	-	cum/h	
	1.18. Coefficient of equipment	E15	-	cum	
2.	ASPHALT MIXING PLANT				
	2.1. Capacity	V	-	ton/h	$Q = \frac{V.FE}{D1}$
	2.2. Efficiency factor	FE	-	-	
	2.3. Productivity per hour	Q	-	cum/h	
	2.4. Coefficient of equipment	E01	-	hour	$E01 = \frac{1}{Q}$
3.	GENERATOR				
	3.7. Generator is required to supply electrical power to AMP	-	-	-	
	3.8. Productivity of generator is same with productivity of AMP	Q	-	cum/h	$E12 = \frac{1}{Q}$
	3.9. Coefficient of equipment	E12	-	hour	
4.	DUMP TRUCK				
	4.1. Capacity	V	-	cum	TC = T1 + T2 + T3 + T4
	4.2. Efficiency factor	FE	-	-	
	4.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{V.T_b}{Q_2}$
	4.4. Average unloading trip velocity	V2	-	km/h	
	4.5. AMP productivity per bath	Q_b	-	ton	
	4.6. Time to produce one bath	T_b	-	min	$T2 = \frac{L}{V1}$ x 60
	4.7. Cycle time	TC	-	min	
	a. Loading time	T1	-	min	
	b. Hauling, waiting	T2	-	min	$T4 = \frac{L}{V2}$ x 60
	c. Queuing, waiting	T3	-	min	
	d. Unloading, return	T4	-	min	
	4.8. Productivity per hour	Q	-	cum/h	$Q = \frac{V.FE.60}{D1.TC}$
	4.9. Coefficient of equipment	E09	-	hour	
					$E09 = \frac{1}{Q}$

5.	ASPHALT FINISHER 5.1. Capacity 5.2. Efficiency factor 5.3. Productivity per hour 5.4. Coefficient of equipment	 V FE Q E05	 - - - -	 ton/h - cum/h hour	$Q = \frac{V.FE}{D1}$ $E05 = \frac{1}{Q}$
6.	TANDEM STEEL ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 v b n FE Q E17	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.t.1000.b.FE}{n}$ $E17 = \frac{1}{Q}$
7.	PNEUMATIC TIRE ROLLER 7.1. Average velocity 7.2. Effective width 7.3. No of passing 7.4. Efficiency factor	 v b n FE	 - - - -	 km/h m - -	
8.	HELPING TOOLS 8.1. Control stick of spreading thickness 8.2. Thermometer asphalt 8.3. Push cart 8.4. Shovel 8.5. Fork				Lump sum
NO	**DESCRIPTION**	**CODE**	**COEFF.**	**UNIT**	**CALCULATION FORMULA**
	COEFFICIENT ANALYSIS OF MATERIALS				
1. 2. 3. 4.	Coarse aggregate Fine aggregate Filler Asphalt cement	W101 W102 W105 M10	- - - -	cu.m cu.m kg kg	$W101 = \frac{CA.D1.t.FL1}{D2}$ $W102 = \frac{FA.D1.t.FL1}{D2}$ $W105 = FF.D1.t.FL1$ $M10 = AS.D1.t.FL2$
	COEFFICIENT ANALYSIS OF LABOR				
1. 2. 3. 4.	Labor required at AMP 1.7 Common labor 1.8 Skilled Labor 1.9 Foreman Productivity of AMP per hour Productivity of AMP per day Coefficient of Labor 4.1 Common Labor 4.2 Skilled Labor 4.3 Foreman	 CL SK FO Q Q_t L01 L02 L03	 - - - - - - - -	 man man man cum/h cum/d md md md	$Q_t = Q.TE$ $L01 = \frac{CL}{Q_t}$ $L02 = \frac{SK}{Q_t}$ $L03 = \frac{FO}{Q_t}$

HOT ROLLED SHEET WEARING
HRS - WC

PROJECT	:		UNIT OF MEASUREMENT
LOCATION	:		square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Wheel Loader	-	-	-	
2.	Asphalt Mixing Plant	-	-	-	
3.	Generator	-	-	-	
4.	Dump Truck	-	-	-	
5.	Asphalt Finisher	-	-	-	
6.	Tandem Steel Roller	-	-	-	
7.	Pneumatic Tire Roller	-	-	-	
8.	Helping Tools:				
	p. Control stick of spreading thickness	-	-	-	
	q. Thermometer asphalt	-	-	-	
	r. Push cart	-	-	-	
	s. Shovel	-	-	-	
	t. Fork	-	-	-	
	MATERIALS				
1.	Coarse aggregate	CA	-	%	
2.	Fine aggregate	FA	-	%	
3.	Filler	FF	-	%	
4.	Bituminous material	AS	-	%	
	The quality of all materials shall be complied with requirements in specification				
	LABOR				
1.	Foreman	FO	-	man	
2.	Skilled labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically				
2.	All material provided and mixing process in base camp				
3.	Average distance of base camp to project site	L	-	Km	
4.	Layer thickness	t	-	m	
5.	Effective work hour per day for equipment	TE	-	hour	
6.	Loose factor of materials				
	g. Aggregate	FL1	-	-	
	h. Asphalt cement	FL2	-	-	
7.	Mixer composition				
	q. Coarse aggregate	CA	-	%	
	r. Fine aggregate	FA	-	%	
	s. Filler	FF	-	%	

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	t. Asphalt cement	AS	-	%	
8.	Density unit of materials				
	e. Asphalt concrete	D1	-	ton/m3	
	f. Coarse & Fine Aggregate	D2	-	ton/m3	

	g. Filler	D3	-	ton/m3	
	h. Asphalt cement	D4	-	ton/m3	
9.	Wheel loader load aggregate to cold bin and labor load asphalt cement to asphalt kettle.	-	-	-	
10.	Aggregate and asphalt cement mixed and heated in AMP and load in to dump truck and transported to project site.	-	-	-	
11.	Hot aggregate-asphalt cement mix spreaded by asphalt finisher, than compacted by tandem roller and pneumatic roller.	-	-	-	
12.	During spreading and compacting, group of labors set up the edge and level using helping tools.	-	-	-	
	COEFFICIENT ANALYSIS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.19. Bucket capacity	V	-	cum	TC = T1 + T2
	1.20. Bucket factor	FB	-	-	
	1.21. Efficiency factor	FE	-		$Q = \frac{V.FB.FE.60}{TC}$
	1.22. Cycle time	TC	-	min	
	c. Loading	T1	-	min	
	d. Others	T2	-	min	$E15 = \frac{1}{Q}$
	1.23. Productivity per hour	Q	-	cum/h	
	1.24. Coefficient of equipment	E15	-	cum	
2.	ASPHALT MIXING PLANT				
	2.1. Capacity	V	-	ton/h	$Q = \frac{V.FE}{D1}$
	2.2. Efficiency factor	FE	-	-	
	2.3. Productivity per hour	Q	-	cum/h	
	2.4. Coefficient of equipment	E01	-	hour	$E01 = \frac{1}{Q}$
3.	GENERATOR				
	3.10. Generator is required to supply electrical power to AMP	-	-	-	
	3.11. Productivity of generator is same with productivity of AMP	Q	-	cum/h	$E12 = \frac{1}{Q}$
	3.12. Coefficient of equipment	E12	-	hour	
4.	DUMP TRUCK				
	4.1. Capacity	V	-	cum	TC = T1 + T2 + T3 + T4
	4.2. Efficiency factor	FE	-	-	
	4.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{V.T_b}{Q_2}$
	4.4. Average unloading trip velocity	V2	-	km/h	
	4.5. AMP productivity per bath	Q_b	-	ton	$T2 = \frac{L}{V1}$ x 60
	4.6. Time to produce one bath	T_b	-	min	
	4.7. Cycle time	TC	-	min	
	a. Loading time	T1	-	min	$T4 = \frac{L}{V2}$ x 60
	b. Hauling, waiting	T2	-	min	
	c. Queuing, waiting	T3	-	min	
	d. Unloading, return	T4	-	min	$Q = \frac{V.FE.60}{D1.TC}$
	4.8. Productivity per hour	Q	-	cum/h	
	4.9. Coefficient of equipment	E09	-	hour	$E09 = \frac{1}{Q}$

5.	ASPHALT FINISHER 5.1. Capacity 5.2. Efficiency factor 5.3. Productivity per hour 5.4. Coefficient of equipment	 V FE Q E05	 - - - -	 ton/h - cum/h hour	$Q = \frac{V.FE}{D1}$ $E05 = \frac{1}{Q}$
6.	TANDEM STEEL ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 v b n FE Q E17	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.t.1000.b.FE}{n}$ $E17 = \frac{1}{Q}$
7.	PNEUMATIC TIRE ROLLER 7.1. Average velocity 7.2. Effective width 7.3. No of passing 7.4. Efficiency factor	 v b n FE	 - - - -	 km/h m - -	
8.	HELPING TOOLS 8.1. Control stick of spreading thickness 8.2. Thermometer asphalt 8.3. Push cart 8.4. Shovel 8.5. Fork				Lump sum

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	COEFFICIENT ANALYSIS OF MATERIALS				
1. 2. 3. 4.	Coarse aggregate Fine aggregate Filler Asphalt cement	W101 W102 W105 M10	- - - -	cu.m cu.m kg kg	$W101 = \frac{CA.D1.t.FL1}{D2}$ $W102 = \frac{FA.D1.t.FL1}{D2}$ $W105 = FF.D1.t.FL1$ $M10 = AS.D1.t.FL2$
	COEFFICIENT ANALYSIS OF LABOR				
1. 2. 3. 4.	Labor required at AMP 1.10Common labor 1.11Skilled Labor 1.12Foreman Productivity of AMP per hour Productivity of AMP per day Coefficient of Labor 4.1 Common Labor 4.2 Skilled Labor 4.3 Foreman	 CL SK FO Q Q_t L01 L02 L03	 - - - - - - - -	 man man man cum/h cum/d md md md	$Q_t = Q.TE$ $L01 = \frac{CL}{Q_t}$ $L02 = \frac{SK}{Q_t}$ $L03 = \frac{FO}{Q_t}$

HOT ROLLED SHEET BASE
HRS - BASE

PROJECT	:	UNIT OF MEASUREMENT
LOCATION	:	square meter

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Wheel Loader	-	-	-	
2.	Asphalt Mixing Plant	-	-	-	
3.	Generator	-	-	-	
4.	Dump Truck	-	-	-	
5.	Asphalt Finisher	-	-	-	
6.	Tandem Steel Roller	-	-	-	
7.	Pneumatic Tire Roller	-	-	-	
8.	Helping Tools:				
	u. Control stick of spreading thickness	-	-	-	
	v. Thermometer asphalt	-	-	-	
	w. Push cart	-	-	-	
	x. Shovel	-	-	-	
	y. Fork	-	-	-	
	MATERIALS				
1.	Coarse aggregate	CA	-	%	
2.	Fine aggregate	FA	-	%	
3.	Filler	FF	-	%	
4.	Bituminous material	AS	-	%	
	The quality of all materials shall be complied with requirements in specification				
	LABOR				
1.	Foreman	FO	-	man	
2.	Skilled labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically				
2.	All material provided and mixing process in base camp				
3.	Average distance of base camp to project site	L	-	Km	
4.	Layer thickness	t	-	m	
5.	Effective work hour per day for equipment	TE	-	hour	
6.	Loose factor of materials				
	i. Aggregate	FL1	-	-	
	j. Asphalt cement	FL2	-	-	
7.	Mixer composition				
	u. Coarse aggregate	CA	-	%	
	v. Fine aggregate	FA	-	%	
	w. Filler	FF	-	%	
NO	**DESCRIPTION**	**CODE**	**COEFF.**	**UNIT**	**CALCULATION FORMULA**
	x. Asphalt cement	AS	-	%	
8.	Unit density of materials				
	i. Asphalt concrete	D1	-	ton/m3	
	j. Coarse & Fine Aggregate	D2	-	ton/m3	

	k. Filler	D3	-	ton/m3	
	l. Asphalt cement	D4	-	ton/m3	
9.	Wheel loader load aggregate to cold bin and labor load asphalt cement to asphalt kettle.	-	-	-	
10.	Aggregate and asphalt cement mixed and heated in AMP and load in to dump truck and transported to project site.	-	-	-	
11.	Hot aggregate-asphalt cement mix spreaded by asphalt finisher, than compacted by tandem roller and pneumatic roller.	-	-	-	
12.	During spreading and compacting, group of labors set up the edge and level using helping tools.	-	-	-	
	COEFFICIENT ANALYSIS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.25. Bucket capacity	V	-	cum	TC = T1 + T2
	1.26. Bucket factor	FB	-	-	
	1.27. Efficiency factor	FE	-		$Q = \frac{V.FB.FE.60}{TC}$
	1.28. Cycle time	TC	-	min	
	e. Loading	T1	-	min	
	f. Others	T2	-	min	$E15 = \frac{1}{Q}$
	1.29. Productivity per hour	Q	-	cum/h	
	1.30. Coefficient of equipment	E15	-	cum	
2.	ASPHALT MIXING PLANT				
	2.1. Capacity	V	-	ton/h	$Q = \frac{V.FE}{D1}$
	2.2. Efficiency factor	FE	-	-	
	2.3. Productivity per hour	Q	-	cum/h	
	2.4. Coefficient of equipment	E01	-	hour	$E01 = \frac{1}{Q}$
3.	GENERATOR				
	3.13. Generator is required to supply electrical power to AMP	-	-	-	
	3.14. Productivity of generator is same with productivity of AMP	Q	-	cum/h	$E12 = \frac{1}{Q}$
	3.15. Coefficient of equipment	E12	-	hour	
4.	DUMP TRUCK				
	4.1. Capacity	V	-	cum	TC = T1 + T2 + T3 + T4
	4.2. Efficiency factor	FE	-	-	
	4.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{V.T_b}{Q_2}$
	4.4. Average unloading trip velocity	V2	-	km/h	
	4.5. AMP productivity per bath	Q_b	-	ton	$T2 = \frac{L}{V1}$ x 60
	4.6. Time to produce one bath	T_b	-	min	
	4.7. Cycle time	TC	-	min	
	a. Loading time	T1	-	min	$T4 = \frac{L}{V2}$ x 60
	b. Hauling, waiting	T2	-	min	
	c. Queuing, waiting	T3	-	min	
	d. Unloading, return	T4	-	min	$Q = \frac{V.FE.60}{D1.TC}$
	4.8. Productivity per hour	Q	-	cum/h	
	4.9. Coefficient of equipment	E09	-	hour	$E09 = \frac{1}{Q}$

5.	ASPHALT FINISHER 5.1. Capacity 5.2. Efficiency factor 5.3. Productivity per hour 5.4. Coefficient of equipment	 V FE Q E05	 - - - -	 ton/h - cum/h hour	$Q = \frac{V.FE}{D1}$ $E05 = \frac{1}{Q}$
6.	TANDEM STEEL ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 v b n FE Q E17	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.t.1000.b.FE}{n}$ $E17 = \frac{1}{Q}$
7.	PNEUMATIC TIRE ROLLER 7.1. Average velocity 7.2. Effective width 7.3. No of passing 7.4. Efficiency factor	 v b n FE	 - - - -	 km/h m - -	
8.	HELPING TOOLS 8.1. Control stick of spreading thickness 8.2. Thermometer asphalt 8.3. Push cart 8.4. Shovel 8.5. Fork				Lump sum

NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	COEFFICIENT ANALYSIS OF MATERIALS				
1. 2. 3. 4.	Coarse aggregate Fine aggregate Filler Asphalt cement	W101 W102 W105 M10	- - - -	cu.m cu.m kg kg	$W101 = \frac{CA.D1.t.FL1}{D2}$ $W102 = \frac{FA.D1.t.FL1}{D2}$ $W105 = FF.D1.t.FL1$ $M10 = AS.D1.t.FL2$
	COEFFICIENT ANALYSIS OF LABOR				
1. 2. 3. 4.	Labor required at AMP 1.13Common labor 1.14Skilled Labor 1.15Foreman Productivity of AMP per hour Productivity of AMP per day Coefficient of Labor 4.1 Common Labor 4.2 Skilled Labor 4.3 Foreman	 CL SK FO Q Q_t L01 L02 L03	 - - - - - - - -	 man man man cum/h cum/d md md md	$Q_t = Q.TE$ $L01 = \frac{CL}{Q_t}$ $L02 = \frac{SK}{Q_t}$ $L03 = \frac{FO}{Q_t}$

ASPHALT TREATED BASE
ATB

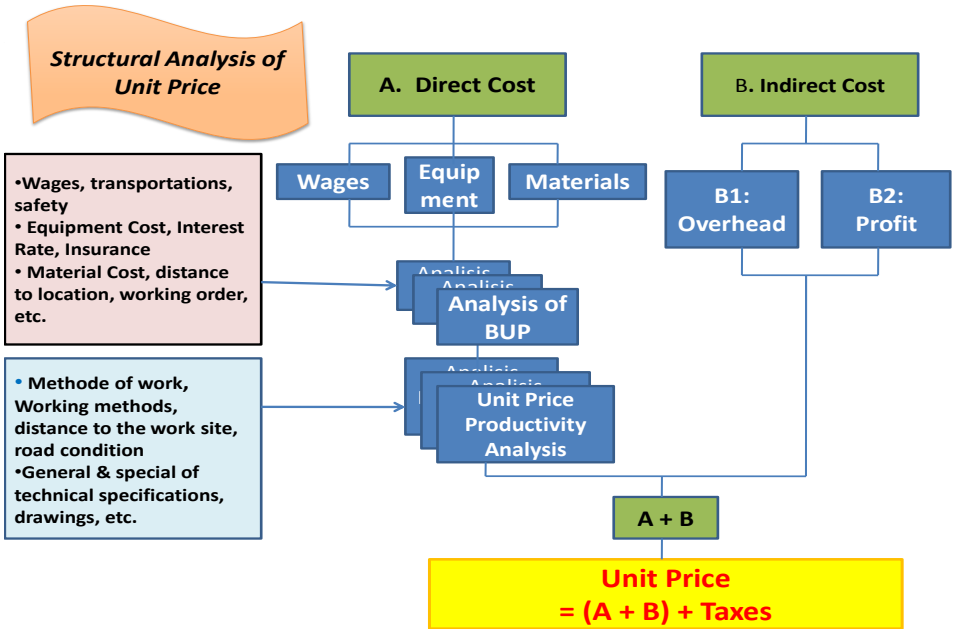
PROJECT	:		UNIT OF MEASUREMENT
LOCATION	:		square meter

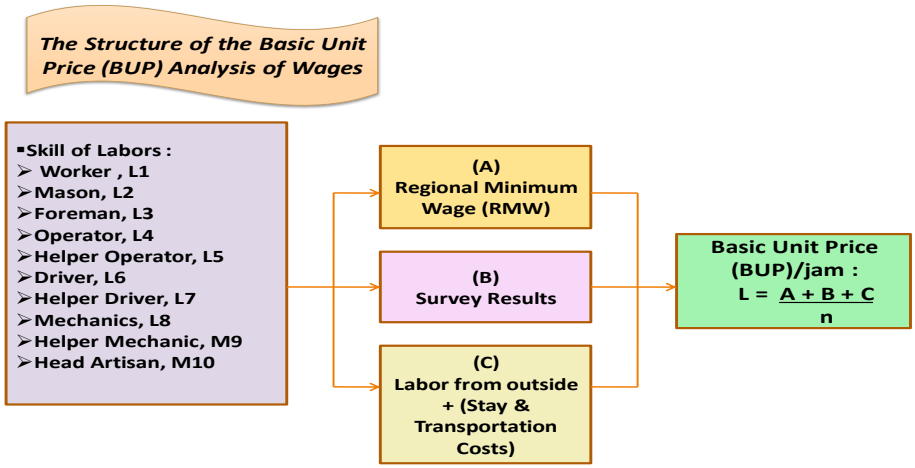
NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	EQUIPMENT				
1.	Wheel Loader	-	-	-	
2.	Asphalt Mixing Plant	-	-	-	
3.	Generator	-	-	-	
4.	Dump Truck	-	-	-	
5.	Asphalt Finisher	-	-	-	
6.	Tandem Steel Roller	-	-	-	
7.	Pneumatic Tire Roller	-	-	-	
8.	Helping Tools:				
	z. Control stick of spreading thickness	-	-	-	
	aa. Thermometer asphalt	-	-	-	
	bb. Push cart	-	-	-	
	cc. Shovel	-	-	-	
	dd. Fork	-	-	-	
	MATERIALS				
1.	Coarse aggregate	CA	-	%	
2.	Fine aggregate	FA	-	%	
3.	Filler	FF	-	%	
4.	Bituminous material	AS	-	%	
	The quality of all materials shall be complied with requirements in specification				
	LABOR				
1.	Foreman	FO	-	man	
2.	Skilled labor	SK	-	man	
3.	Common labor	CL	-	man	
	WORK ORDER				
1.	Construction shall be performed mechanically				
2.	All material provided and mixing process in base camp				
3.	Average distance of base camp to project site	L	-	Km	
4.	Layer thickness	t	-	m	
5.	Effective work hour per day for equipment	TE	-	hour	
6.	Loose factor of materials				
	k. Aggregate	FL1	-	-	
	l. Asphalt cement	FL2	-	-	
7.	Mixer composition				
	y. Coarse aggregate	CA	-	%	
	z. Fine aggregate	FA	-	%	
	aa. Filler	FF	-	%	
NO	**DESCRIPTION**	**CODE**	**COEFF.**	**UNIT**	**CALCULATION FORMULA**
	bb. Asphalt cement	AS	-	%	
8.	Unit density of materials				
	m. Asphalt concrete	D1	-	ton/m3	
	n. Coarse & Fine Aggregate	D2	-	ton/m3	

	o. Filler	D3	-	ton/m3	
	p. Asphalt cement	D4	-	ton/m3	
9.	Wheel loader load aggregate to cold bin and labor load asphalt cement to asphalt kettle.	-	-	-	
10.	Aggregate and asphalt cement mixed and heated in AMP and load in to dump truck and transported to project site.	-	-	-	
11.	Hot aggregate-asphalt cement mix spreaded by asphalt finisher, than compacted by tandem roller and pneumatic roller.	-	-	-	
12.	During spreading and compacting, group of labors set up the edge and level using helping tools.	-	-	-	
	COEFFICIENT ANALYSIS OF EQUIPMENT				
1.	WHEEL LOADER				
	1.31. Bucket capacity	V	-	cum	TC = T1 + T2
	1.32. Bucket factor	FB	-	-	
	1.33. Efficiency factor	FE	-		$Q = \frac{V.FB.FE.60}{TC}$
	1.34. Cycle time	TC	-	min	
	g. Loading	T1	-	min	
	h. Others	T2	-	min	$E15 = \frac{1}{Q}$
	1.35. Productivity per hour	Q	-	cum/h	
	1.36. Coefficient of equipment	E15	-	cum	
2.	ASPHALT MIXING PLANT				
	2.1. Capacity	V	-	ton/h	$Q = \frac{V.FE}{D1}$
	2.2. Efficiency factor	FE	-	-	
	2.3. Productivity per hour	Q	-	cum/h	
	2.4. Coefficient of equipment	E01	-	hour	$E01 = \frac{1}{Q}$
3.	GENERATOR				
	3.16. Generator is required to supply electrical power to AMP	-	-	-	
	3.17. Productivity of generator is same with productivity of AMP	Q	-	cum/h	$E12 = \frac{1}{Q}$
	3.18. Coefficient of equipment	E12	-	hour	
4.	DUMP TRUCK				
	4.1. Capacity	V	-	cum	TC = T1 + T2 + T3 + T4
	4.2. Efficiency factor	FE	-	-	
	4.3. Average loading trip velocity	V1	-	km/h	$T1 = \frac{V.T_b}{Q_2}$
	4.4. Average unloading trip velocity	V2	-	km/h	
	4.5. AMP productivity per bath	Q_b	-	ton	$T2 = \frac{L}{V1}$ x 60
	4.6. Time to produce one bath	T_b	-	min	
	4.7. Cycle time	TC	-	min	
	a. Loading time	T1	-	min	$T4 = \frac{L}{V2}$ x 60
	b. Hauling, waiting	T2	-	min	
	c. Queuing, waiting	T3	-	min	
	d. Unloading, return	T4	-	min	$Q = \frac{V.FE.60}{D1.TC}$
	4.8. Productivity per hour	Q	-	cum/h	
	4.9. Coefficient of equipment	E09	-	hour	$E09 = \frac{1}{Q}$

5.	ASPHALT FINISHER 5.1. Capacity 5.2. Efficiency factor 5.3. Productivity per hour 5.4. Coefficient of equipment	 V FE Q E05	 - - - -	 ton/h - cum/h hour	$Q = \frac{V.FE}{D1}$ $E05 = \frac{1}{Q}$
6.	TANDEM STEEL ROLLER 6.1. Average velocity 6.2. Effective width 6.3. No of passing 6.4. Efficiency factor 6.5. Productivity per hour 6.6. Coefficient of equipment	 v b n FE Q E17	 - - - - - -	 km/h m - - cum/h hour	$Q = \frac{v.t.1000.b.FE}{n}$ $E17 = \frac{1}{Q}$
7.	PNEUMATIC TIRE ROLLER 7.1. Average velocity 7.2. Effective width 7.3. No of passing 7.4. Efficiency factor	 v b n FE	 - - - -	 km/h m - -	
8.	HELPING TOOLS 8.1. Control stick of spreading thickness 8.2. Thermometer asphalt 8.3. Push cart 8.4. Shovel 8.5. Fork				Lump sum

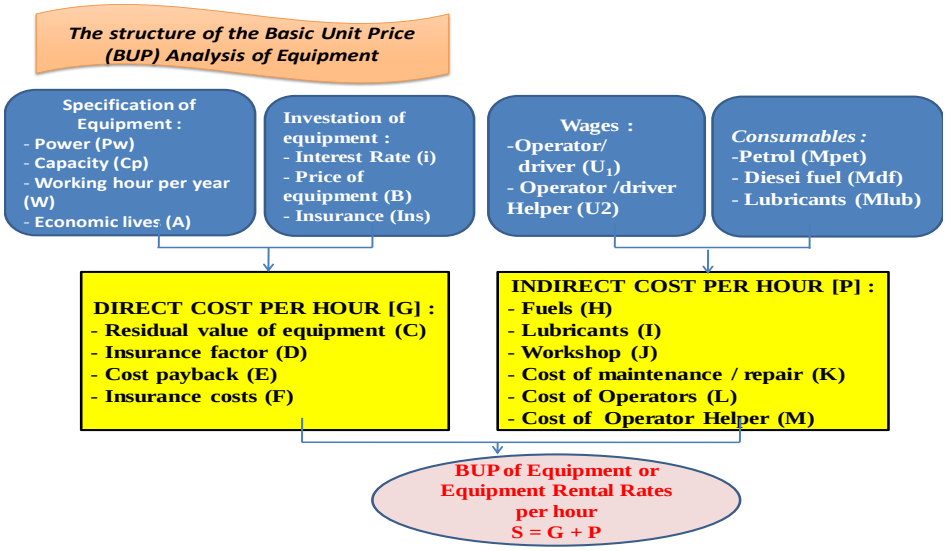
NO	DESCRIPTION	CODE	COEFF.	UNIT	CALCULATION FORMULA
	COEFFICIENT ANALYSIS OF MATERIALS				
1. 2. 3. 4.	Coarse aggregate Fine aggregate Filler Asphalt cement	W101 W102 W105 M10	- - - -	cu.m cu.m kg kg	$W101 = \frac{CA.D1.t.FL1}{D2}$ $W102 = \frac{FA.D1.t.FL1}{D2}$ $W105 = FF.D1.t.FL1$ $M10 = AS.D1.t.FL2$
	COEFFICIENT ANALYSIS OF LABOR				
1. 2. 3. 4. 	Labor required at AMP 1.16Common labor 1.17Skilled Labor 1.18Foreman Productivity of AMP per hour Productivity of AMP per day Coefficient of Labor 4.1 Common Labor 4.2 Skilled Labor 4.3 Foreman	 CL SK FO Q Q_t L01 L02 L03	 - - - - - - - -	 man man man cum/h cum/d md md md	$Q_t = Q.TE$ $L01 = \frac{CL}{Q_t}$ $L02 = \frac{SK}{Q_t}$ $L03 = \frac{FO}{Q_t}$





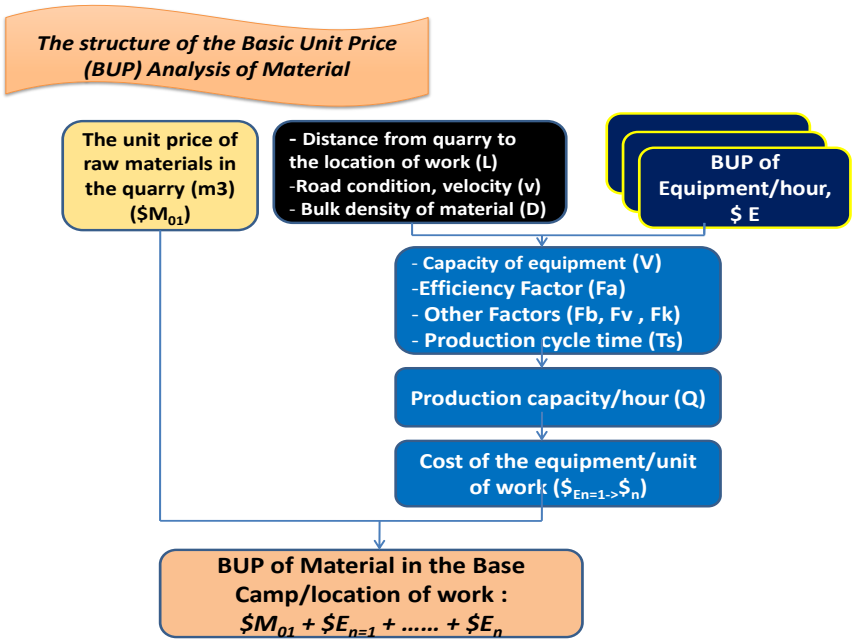
Note :

Basic Unit Price (BUP) of Labors is the cost of labor component (in unit of time) to produce a specific job.



Note :

Basic Unit Price (BUP) of Equipment is the cost of component (in unit of time) to produce a specific job.



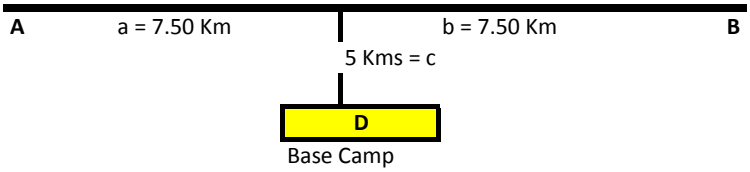
Note :

Basic Unit Price (BUP) of Materials is the cost of component (in unit of time) to produce a specific job.

THE BASIC UNIT PRICE (BUP) ANALYSIS

Examples of Job Activity Information Sheet

No	Description	Information
1	Contract package name	: .....
2	Name of Package	: .....
3	District	: .....
4	Location of work	Periksa lampiran
5	Condition of existing road	
6	Effective length (see sketch below)	15 kilometers (Leff = a + b)
7	Width of existing road (shoulder + pavement + shoulder)	(0.50 + 4.50 + 0.50) meter
8	Design width (shoulder + pavement + shoulder)	(1.00 + 6.00 + 1.00) meter
9	A cross road, type & volume ot basic work	se attachment
10	Period of implementation of the work	360 calender days
11	Average distance from Base Camp to location of work, L	L = {(c+a/2) x a + (c+b/2)} / (a+b) L = 8.75 Kilometers
	Sketch as the basis for calculation :	
12	Effective of working time in 1 day :	7 hours
13	Insurance, taxes, etc for equipment :	0.002 x Cost of equipment
14	Interest rate of investment in equipment :	6.00%
15	SUMMARY OF THE METHOD OF IMPLEMENTATION	



A. Basic Unit Price (BUP) Analysis of Wages

Wage data varies according to the location of the work. The amount depending on the market price or set by the local government.

The wages do not include health & safety equipment such as helmets, vests, shoes, raincoats, etc.

Example of cost analysis for the health and safety equipment			
No.	**Type of Equipment**	**Unit**	**Price (USD)**
1	Helmet	unit	6.00
2	Vest	unit	7.00
3	Shoes	pair	8.00
4	Mask	unit	0.50
5	Cap	unit	2.00
6	Gloves	pair	1.50
7	Protective glasses	pair	4.00
8	Raincoat	unit	3.00
	Total		**32.00**
	Construction Period	Day	180.00
	The number of Usage hours per day		8.00
	Hourly usage fee of 32.00 (180 x 8)	**USD**	**0.02**

Table - 1 : Example of the basic unit price list (BUP) hourly wage					
No	**Description**	**Code**	**Unit**	**Unit Price (USD)**	**Notes**
1	Unskilled Labor	L1	hour	0.71	
2	Stonemason, carpenter, etc	L2	hour	1.14	
3	Skilled Head	L3	hour	1.71	
4	Foreman	L4	hour	1.71	
5	Operator	L5	hour	2.86	
6	Assistant Operator	L6	hour	1.71	
7	Driver	L7	hour	2.29	
8	Assistant Driver	L8	hour	0.71	
9	Mechanic	L9	hour	2.86	
10	Assistant Mechanic	L10	hour	1.71	

Note: unit price already includes the cost of equipment hire occupational health and safety.

B. The basic unit price (BUP) Analysis of Equipment (Rental Fee Equipment per hour)

Taking into account the BUP equipment, required data:

1. Wage Labor
2. The price of the acquisition of equipment
3. The price of fuel, lubricant and others

Table 2 : Example of Price list acquisition of equipment

No	Name of Equipment	Acquisition Price (USD)	Notes
1	Asphalt Mixing Plant	120,377	The acquisition
2	Asphalt Finisher	84,667	
3	Asphalt Sprayer	3,341	
4	Asphalt Liquid Mixer		
5	Asphalt Distributor		
6	Cold Milling		
7	Buldozer 100 – 150 Hp	63,587	
8	Dump Truck 3.5 Ton		
9	Dump Truck 110 Hp, 4 Tires, 5.2 Ton, Long chassis	26,825	
10	Dump Truck 10 Ton		
11	Excavator 80 – 140 Hp		
12	Excavator 200 Hp	130,000	
13	Motor Grader >100 Hp	47,761	
14	Track Loader 75-100 Hp		
15	Wheel Loader 1.0 – 1.6 M3	39,848	
16	Three Wheel Roller		
17	Tandem Roller 6-8 T	84,457	
18	Tire Roller 8-10 T	63,587	
19	Vibratory Roller 5-8 T	64,929	
20	Tamper		
21	Aggregate (chip) Spreader		
22	Flat Bed Truck 3-4 m3		
23	Stone Crusher		
24	Pedestrian Roller		
25	Jack Hammer	2,473	
26	Rock Drill Breaker		
27	Cold Recycler		
28	Hot Recycler		
29	Slip Form Paver		
30	Concrete Mixer 0.3 – 0.6 M3		
31	Concrete Vibrator		
32	Concrete Pump		
33	Concrete Pan Mixer		
34	Concrete Breaker		
35	Concrete Mixer (350)		
36	Truck Mixer		
37	Compressor 4000 – 6500 L/M	7,772	
38	Generator Set	14,625	
39	Water Pump 70-100 Mm		
40	Water Tanker 3000-4500 L	7,418	
41	Fulvi Mixer		
42	Vibrating Rammer		
43	Crane 10 – 15 Ton		
44	Trailer 20 Ton		
45	Pile Driver + Hammer		
46	Crane On Track 35 Ton		
47	Bore Pile Machine		

Example of the Basic Unit Price (BUP) Analysis of Excavator 200 HP

I. EQUIPMENT DESCRIPTION

Description		Code	Price	Unit	Notes
Power		Pw	200	Hp	
Capacity (bucket)		Cp	1	M3	
New equipment:	a. Economic Lives	A	5	Year	
	b. Working hours in 1 year	W	1,600	Hour	
	c. Equipment Price	B	130,000	USD	

II. OTHERS

Description	Code	Price	Unit	Notes
Interest Rate	i	6.00	% / year	
Operator Wage	U1	2.86	$ / hr	
Assistant Operator Wage	U2	1.71	$ / hr	
Fuel Petrol	Mpet	1.29	Liter	
Diesel Fuel	Mdf	1.25	Liter	
Lubricating Oil	Mlub	4.00	Liter	
Insurance and others	Ins	0.20	%	
Note: Taxes calculated on a Job Cost sheet of Recapitulation				

III. FIXED COST PER HOUR

Description	Code	Price	Unit	Notes
Residual value of the equipment = 10% x B	C	13,000.00	USD	
Factor Capital Installments $= \frac{i\,x\,(1+i)^A}{(1+i)^A - 1}$	D	0.24	-	
Fixed Cost per hour				
a. Payback Cost $= \frac{(B\ -C)\,x\,D}{W}$	E	17.36	USD	
b. Insurance, and others $= \frac{Ins\ x\ B}{W}$	F	0.16	USD	
Fixed Cost per hour = (E + F)	G	**17.52**	USD	

IV. OPERATION COSTS PER HOUR

Description		Code	Price	Unit
Fuel	= (10% - 12%) x Pw x Mdf If W < 1500, taken 10%	H	27.50	USD
Lubricant Oil	= (1.5% - 2.5%) x Pw x Mlub If W < 1500 taken1.5%	I	16.00	USD
Workshop cost (including tire)	= (2.5% and 5%) x B/W If W< 1500, taken 2.5%	J	2.44	USD
Maintenance & repair	= 5% x B / W	K	4.06	USD
Operator	= (1 Person / hour) x U1	L	2.86	USD
Assistant Operator	= (1 Person / hour) x U2	M	1.71	USD
Operation Cost per hour	= (H + I + J + K + L + M)	P	**54.57**	USD
THE TOTAL COST OF RENTAL EQUIPMENT / BUP OF EQUIPMENT EXCAVATOR 200 HP / HOUR = (G + P)		S	**72.09**	USD

Example of the Basic Unit Price (BUP) Analysis of Dump Truck 110 Hp, 5.2 Ton

I. EQUIPMENT DESCRIPTION

Description		Code	Price	Unit	Notes
Power		Pw	110	Hp	
Capacity		Cp	3.25	M3	
New equipment:	a. Economic Lives	A	5	Year	
	b. Working hours in 1 year	W	1,600	hr	
	c. Equipment Price	B	26,825	USD	

II. OTHERS

Description	Code	Price	Unit	Notes
Interest Rate	i	6.00	% / year	
Driver Wage	U1	2.29	$ /hr	
Assistant Driver Wages	U2	0.71	$ / hr	
Fuel Petrol	Mpet	1.29	Liter	
Diesel Fuel	Mdf	1.25	Liter	
Lubricating Oil	Mlub	4.00	Liter	
Insurance and others	Ins	0.20	%	
Note: Taxes calculated on a Job Cost sheet of Recapitulation				

III. FIXED COST PER HOUR

Description	Code	Price	Unit	Notes
Residual value of the equipment = 10% x B	C	2,682.52	USD	
Factor Capital Installments $= \frac{i\ x\ (1+i)^A}{(1+i)^A - 1}$	D	0.24	-	
Fixed Cost per hour				
a. Payback Cost $= \frac{(B\ -C)\ x\ D}{W}$	E	3.58	USD	
b. Insurance, and others $= \frac{Ins\ x\ B}{W}$	F	0.03	USD	
Fixed Cost per hour = (E + F)	G	**3.62**	USD	

IV. OPERATION COSTS PER HOUR

Description		Code	Price	Unit
Fuel	= (10% - 12%) x Pw x Mdf If W < 1500, taken 10%	H	15.13	USD
Lubricant Oil	= (1.5% - 2.5%) x Pw x Mlub If W < 1500 taken1.5%	I	8.80	USD
Workshop cost	= (2.5% and 5%) x B/W If W< 1500, taken 2.5%	J	0.50	USD
Maintenance & repair	= 5% x B / W	K	0.84	USD
Driver	= (1 Person / hour) x U1	L	2.29	USD
Assistant Driver	= (1 Person / hour) x U2	M	0.71	USD
Operation Cost per hour	= (H + I + J + K + L + M)	P	**28.27**	USD
Note: Percentage of fuel / lubricants, workshop costs, and treatment depend on the number of hours of work in one year and, depending on the severity of the job, the more strenuous work, take the highest value.				
THE TOTAL COST OF RENTAL EQUIPMENT / BUP OF EQUIPMENT DUMP TRUCK 5.2 TON / HOUR = (G + P)		**S**	**31.88**	**USD**

Tabel – 3 : Example of Equipment Rental Rate / BUP of Equipment							
No.	**Name of Equipment**	**Code**	**HP**	**Capacity**	**Unit**	**Price, $**	**Rental Rate ($)**
1	Asphalt Mixing Plant	E1	294	50.0	T/hr	120,377	**90.76**
2	Asphalt Finisher	E2	72.4	10.0	Ton	84,667	**35.96**
3	Asphalt Sprayer	E3	4	850.0	Liter	3,341	**6.06**
4	Asphalt Liquid Mixer	E4	5	20,000.0	Liter		
5	Asphalt Distributor	E5	115	4,000.0	Liter		
6	Cold Milling	E6	248	1,000.0	m		
7	Buldozer 100 – 150 Hp	E7	155	-	-	63,587	**50.03**
8	Dump Truck 3.5 Ton	E8	100	3.5	Ton	0	
9	Dump Truck 5.2 Ton	E8a	110	5.2	Ton	26,825	**33.45**
10	Dump Truck 10 Ton	E9	190	10.0	Ton		
11	Excavator 80 – 140 Hp			65,989			
12	Excavator 200 Hp	E10	133	0.9	m3	130,000	**72.09**
13	Motor Grader >100 Hp	E11	135	10,800.0	-	47,761	**42.76**
14	Track Loader 75-100 Hp	E12	70	0.8	m3		
15	Wheel Loader 1.0 – 1.6 M3	E13	96	1.5	m3	39,848	**32.81**
16	Three Wheel Roller 6-8 Ton	E14	55	8.0	Ton		
17	Tandem Roller 6-8 T	E15	82	8.1	Ton	84,457	**38.01**
18	Tire Roller 8-10 T	E16	100.5	9.0	Ton	63,587	**38.48**
19	Vibratory Roller 5-8 T	E17	82	7.1	Ton	64,929	**34.40**
20	Tamper	E18	4.7	121.0	Ton		
21	Aggregate (chip) Spreader	E19	115	3.5	m		
22	Flat Bed Truck 3-4 m3	E20	190	10.0	Ton		
23	Stone Crusher	E21	220	50.0	T/hr		
24	Pedestrian Roller	E22	8.8	835.0	Ton		
25	Jack Hammer	E23	0	1,330.0	-	2,473	**5.68**
26	Rock Drill Breaker	E24	3	-	-		
27	Cold Recycler	E25	900	2.2	m		
28	Hot Recycler	E26	400	3.0	m		
29	Slip Form Paver	E27	105	2.5	m		
30	Concrete Mixer 0.3 – 0.6 M3	E28	134	500.0	Liter		
31	Concrete Vibrator	E29	5.5	25.0	-		
32	Concrete Pump	E30	100	8.0	m3		
33	Concrete Pan Mixer	E31	134	600.0	Liter		
34	Concrete Breaker	E32	290	20.0	m3/hr		
35	Concrete Mixer (350)	E33	20	350.0	Liter		
36	Truck Mixer (Agitator)	34	220	5.0	m3		
37	Compressor 4000 – 6500 L/M	E35	60	5,000.0	CPM/(L/m)	7,772	**19.06**
38	Genset	E36	180	135.0	KVA	14,625	**46.42**
39	Water Pump 70-100 Mm	E37	6	-	-		
40	Water Tanker 3000-4500 L	E38	100	4,000.0	Liter	7,418	**27.69**
41	Fulvi Mixer	E39	345	2,005.0	-		
42	Vibrating Rammer	E40	4.2	80.0	kg		
43	Crane 10 – 15 Ton	E41	138	15.0	Ton		
44	Trailer 20 Ton	E42	175	20.0	Ton		
45	Pile Driver + Hammer	E43	25	2.5	Ton		
46	Crane On Track 35 Ton	E44	125	35.0	Ton		
47	Bore Pile Machine	E45	150	60.0	CM		

C. Analysis of the Basic Unit Price (BUP) materials and processed materials

Materials or materials used in the execution of a work can be categorized into three types, namely :

- Raw material in the source material (quarry), the price is the price that has local royalty including the cost of retributions;
- Processed material at the base camp, the price is also influenced by the distance from the quarry;
- Finished material at the job site, so the price is made up of materials plus the cost of transportation to the work site.

Therefore, the price of raw materials in the quarry, the distance from the quarry to the base camp or to the location of the work, the cost of renting tools or tool BUP per hour, and the production capacity of the tool will determine the price of materials at the job site.

Table - 4 : Example of raw material prices in Quarry

No.	Description	Unit	Price royalty (USD)	The distance from	**Notes**
1	M1 - Sand	m3	8.00	10	To Base Camp
2	M2 - Concrete Sand	m3	16.00	20	Into Job Location
3	M3 - Sirtu (sand gravel mix)	m3	10.00	20	Into Job Location
4	M4 - Sand piled	m3	8.00	15	Into Job Location
5	M5 - Gravel	m3	8.00	25	To Base Camp
6	M6 - Stone River	m3	12.00	20	Into Job Location
7	M7 - Stone cleaved	m3	15.00	25	Into Job Location
8	M8 - Soil stockpiling	m3	8.00	10	Into Job Location
9	M9 - Selected Material	m3	8.00	10	Into Job Location
10	M10 - Asphalt Cement	ton	90.00	150	To Base Camp

Table - 5 : Sample Analysis of the Basic Unit Price (BUP) of cement

No	**Description of Activity**	**Cost**		**Total (USD)**
		$ / Unit	Sub Total	
1	Prices at the factory	$ / ton	150.00	150.00
2	Handling	-	-	-
3	Transport to the work site	$ / ton	-	-
4	Demolition, warehouse	$ / ton	2.30	2.30
5	Waste 3%	$ / ton	4.50	4.50
	sub-total	$ / ton	155.30	156.80
6	Advantages & Overhead 5% (only for daily work)	$ / ton		7.77
	Total	$ / ton		**164.57**
7	Price per sack, 50 kg	$ / sack		**8.23**
8	Price per kg	$ / kg		**0.16**

Note: The price of cement is received in the base camp by taking into account the cost of handling, transport, unloading, and wasted materials (waste) 2% - 3%.

Example of BUP analysis of concrete sand quarry to the site or base camp

The equipment used is Excavator 200 Hp and transported by 5.2 Ton Dump Truck.

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
The road condition: Medium				
Distance quarry to the base camp	L	5	Kms	
The unit price of concrete sand (standard price)	$\$_{M2}$	1	M3	10.00
BUP Excavator 200 Hp	$\$_{E10}$	1	hour	72.09
BUP 5.2 Ton Dump Truck	$\$_{E9}$	1	hour	33.45
Density of material	D	1.4	Ton/m3	

II. SEQUENCE OF WORK

1). Excavators dug the sand, as well as loading of sand that are dug into the Dump Truck

2). Dump Truck hauling sand to the site of Base Camp

III. CALCULATION OF EQUIPMENT COST PER M3

III.1 EXCAVATOR

Description	Code	Coefficient	Unit
Bucket Capacity	V	0.93	M^3
Bucket factors	F_b	0.9	-
Equipment efficiency factor	F_a	0.75	-
Cycle time	T_{s1}		
- Excavate / load	T_1	0.5	Minute
- Others	T_2	0.5	Minute
Total	T_{s1}	1	Minute
Production capacity / hour $Q_1 = \frac{V\ x\ Fb\ x\ Fa\ x\ 60}{Ts_1}$	Q_1	37.665	M^3 / hour
Cost Excavator / M3 $= \frac{1}{Q_1}\ x\ BUP$	S_1	**1.91**	USD

III.2 DUMP TRUCK

Description	Code	Coefficient	Unit
Capacity	V	5.50	Ton
Equipment efficiency factor	F_a	0.75	Moderate condition
The average speed of charged	v_1	20.00	Kms/hour
The average speed of empty	v_2	30.00	Kms/hour
Cycle time	Ts_2		
-Loading $= \frac{V\ x\ 60}{Q_1\ x\ D}$	T_1	6.26	Minute
-Time traveled charged $= \frac{L}{V_1}\ x\ 60$	T_2	15.00	Minute
-Time traveled vacant $= \frac{L}{V_1}$ x 60	T_3	10.00	Minute
-Others	T_4	1.00	Minute
Total	Ts_2	32.26	Minute
Production capacity / hour $= \frac{V\ x\ Fa\ x\ 60}{Ts_2\ x\ D}$	Q_2	5.48	M^3 / hour
Dump Truck Cost / m3 $= \frac{1}{Q_2}\ x\ E9$	S2	**6.10**	USD

IV. BASIC UNIT PRICE (BUP) CONCRETE SAND MATERIAL AT BASE CAMP LOCATION

Description	Code	Price	Unit
BUP Concrete Sand = (S_{M2} + S_1 + S_2)		18.02	USD
Rounded	**M2**	**22.00**	**USD**

Conclusions :

Materials	The raw price quarry	Distance to Base Camp	Prices in Base Camp
Concrete Sand	10	5	22.00
Sand	4	2.5	12.00
		5	16.00

From the table above it can be concluded, that the transport distance from the quarry to the base camp strongly influences the price of materials.

Example of Analysis of the Basic Unit Price (BUP) Raw Materials River Stone at Base Camp

The equipment used to produce the material in the quarry are Excavator 200 Hp and 5.2 Ton Dump Truck .

Prices of materials at work sites or at the base camp is determined by the price of raw materials in the quarry , the production capacity of the equipment (m3) , the price of equipment rental (BUP of equipment) per hour , and the distance from the quarry to the base camp .

With the same assumptions on the basis of unit price calculation example (BUP) concrete sand , to the following process :

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
Density of river stone	D	0.95	Ton/m3	

II. SEQUENCE OF WORK

Same with the BUP analysis of concrete sand .

III. CALCULATION OF EQUIPMENT COST PER M3

III.1. EXCAVATOR

Description	Code	Coefficient	Unit
Equipment efficiency factor	F_a	0.76	Moderate condition
Cycle time :	Ts_1		
- Excavating / load	T_1	0.75	Minute
- Others	T_2	0.5	Minute
Total	Ts_1	1.25	Minute
Production capacity / hour $= \frac{V \times Fb \times Fa \times 60}{Ts_1}$	Q_1	30.53	M^3 / hour
Cost Excavator / M3 $= \frac{1}{Q_1}$ x BUP	S_1	**2.36**	USD

III.2 DUMP TRUCK

Description	Code	Coefficient	Unit
-Loading $= \frac{V \times 60}{Q_1 \times D}$	T_1	20.68	Minute
-Time traveled charged $= \frac{L}{V_2} \times 60$	T_2	15.00	
-Time traveled vacant $= \frac{L}{V_1}$ x 60	T_3	10.00	
-Others	T_4	1.00	Minute
Total	Ts_2	46.68	Minute
Production capacity / hour $= \frac{V \times Fa \times 60}{Ts_1 \times D}$	Q_2	208.42	M^3 / hour
Cost Dump Truck / m3 $= \frac{1}{Q_2} \times E9$	S2	**0.16**	USD

IV . BASIC UNIT PRICE (BUP) STONE RIVER MATERIALS AT BASE CAMP

Description	Code	Price, $	Unit
BUP Stone river = ($\$_{M6}$ + $\$_1$ + $\$_2$)	M1	14.52	USD

Example of procurement work coarse aggregate / fine (BUP processed materials)

Coarse or fine aggregate made of river stones were broken and sand .

Required data as follows :

1) Stone raw material price

2) The cost of equipment rental (BUP equipment) stonecutters per hour .

3) The cost of equipment rental (BUP equipment) Wheel Loader .

4) Wage price

I. ASSUMPTIONS

Description		Code	Coeff.	Unit	Notes
The basic material (stone and sand) is received at the location appliance					
Rock breaker (at Base Camp)					
The activities carried out at the site of Base Camp					
The production equipment	- Fine Aggregate	H	30.00	%	
Stone Crusher :	-Coarse Aggregate	K	70.00	%	
Density of materials	-Stone / Gravel	D_1	1.20	Ton/m3	Hollow
	-Stone Broke	D_3	1.35	Ton/m3	Hollow
Unit Price Basic Materials	- Stone River	$\$_1$	20	$/m3	Tables 4 & 5
Operating Cost of equipment	- Stone Crusher (Stone Crusher)	$\$_2$	13.73	$/hour	Table 3
The capacity of the equipment	- Wheel Loader	$\$_3$	10.86	$/hour	
Equipment Efficiency Factor :	- Stone Crusher (Stone Crusher)	Cp_1	50.00	Ton/hour	
	- Wheel Loader	Cp_2	1.50	M3	Capacity Bucket
Equipment Efficiency Factor :	- Stone Crusher (Stone Crusher)	Fa_1	0.70	-	Bad condition
	- Wheel Loader	Fa2	0.83	-	Good condition
- Material Loss Factor		F_h	1.08	-	

II . IMPLEMENTATION METHOD

1) Wheel loaders to transport the stone / gravel from the place / pile and pour it into the tool breaking stones.

2) Stone/gravel split with Stone Crusher Equipment (Stone Crusher) resulting Aggregate Coarse and Fine Stone Broke .

III. CALCULATION

	Description	Code	Coeff.	Unit	Notes
III.1	**AGGREGATE PRODUCTION UNIT PRICE ST CRUSHER**				
1.a.	**Work Stone Crusher break gravel**				
	- Working time Stone Crusher	Tst	1	hour	
	- Production of Stone Crusher in 1 hour = (FA1 x CP1): D3	Qb	25.926	M3/hr	crushed stone
	- Needs stone / gravel 1 hour = (FA1 x CP1): D1	Qg	29.167	M3/hr	
1.b	**Wheel Loader work to serve the Stone Crusher**				
	- Capacity / one-way = (FA2 x CP2)	Ka	1.245	M3	
	- Cycle time (loading, pouring, waiting, etc.)	T_s	2	minute	
	-Time Work Wheel Loader supplying gravel = ((Qg: Ka) x Ts): 60 minutes	T_w	0.78	hour	
1.c.	**Production costs of Crush Stone** = ((Tst x $\$_3$) + (Tw x $\$_3$)) : Qb	Bp	0.7456	$/m3	
1.d	**Unit Price of Crushed Stone produced by Stone Crusher /** = ((Q_g : Q_b) x F_h x $\$_1$) + B_p	HSb	25.046	$/m3	

Example of BUP analysis of materials and processed materials					
No.	**Name of materials**	**Code**	**Unit**	**Price, $**	**Location**
1	Sand (Medium)	M1	m^3	12	Base Camp
2	Concrete Sand (Coarse)	M2	m^3	18.02	Base Camp
3	Gravel (sand mixed with gravel)		m^3		
4	Piled sand (no element of clay)		m^3		
5	Gravel		m^3		
6	River stone	M6	m^3	14.52	Base Camp
7	Split stone / gravel		m^3		
8	Soil Material Stockpiles		m^3		
9	Selected material		m^3		
10	Asphalt Cement		m^3		
11	F i l l e r		kg		
12	Kerosene		liter		
13	Cement PC (50 kg)		zak		
14	Cement / PC (kg)		kg		
15	Reinforcement		kg		
16	Concrete wire		kg		
17	Gabion wire		kg		
18	Paint for marking (Non Thermoplastic)		kg		
19	Paint for marking (Thermoplastic)		kg		
20	Nail		kg		
21	Wood Scaffolding		m^3		
22	Gasoline		liter		
23	Diesel fuel		liter		
24	Grease / lubricants / Oil		liter		
25	Plastic Filter		m^2		
26	Galvanized pipe. 1.6 "		rod		
27	Porous pipe		m'		
28	Coarse Aggregates	M28	m^3	25.05	Base Camp
29	Fine aggregate	M29	m^3	25.05	**Process/B. Camp**
30	Materials Aggregate Base Class A		m^3		
31	Materials Aggregate Base Class B		m^3		
32	Materials Aggregate Base Class C		m^3		
33	Geotextile		m^2		
34	Asphalt emulsion	M34	kg	2.00	Base Camp

THE UNIT PRICE ANALYSIS OF WORKS

Example of Material Volume Calculation on the earth work

Moving the original land of 1,000 m3:

Each material of clay and sand excavated and transported in a loose condition, then spread and compacted.

What volume of excavated soil (in loose condition) to be transported?

What volume of soil after compacted?

By taking a conversion factor obtained the following results:

Soil type	Original	Original - loose	Loose - compacted
Sand	1,000 m3	1.11 x 1,000 = 1,110 m3	0.86 x 1,100 = 935 m3
Ordinary soil (sandy clay)	1,000 m3	1.25 x 1,000 = 1,250 m3	0.72 x 1,250 = 900 m3
Split rock (gravel)	1,000 m3	1.13 x 1,000 = 1,130 m3	0.91 x 1,030 = 1,030 m3
Soft rock (rock or soft rock fragments)	1,000 m3	1.65 x 1,000 = 1,650 m3	0.74 x 1,650 = 1,220 m3

Example of Unit Price Analysis of Earthwork (Excavation and Embankment)

Example 1a : Common Soil Excavation Work (1 m3)

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
Road condition: bad				
Using the tool mechanically				
Locations along the road				
Effective working hours per day	Tk	7	hour	
Factors of loose material.	Fk	1.2	-	
Soil density (loose)	D	1.6	Ton/m3	
Distance to the disposal site	L	0.5	km	

II. SEQUENCE OF WORK

1) Land which is cut generally located on the side of the road;

2) The excavation is done by using the excavator;

3) Excavator pour materials that are dug into the dump truck;

4) Dumptruck dispose of materials that are dug out the location of the road as far as L = 0.5 km.

III. USE OF EQUIPMENT AND PERSONNEL

1) EQUIPMENT

Description	Code	Coefficient	Unit	Notes
1a) Excavator				
Bucket capacity	V	0.9300	M3	
Factors Bucket	Fb	1.0000		
Equipment efficiency factor	Fa	0.6700		
Conversion factor, depth < 40%, 47%: 0.47 x 6.37 m = 3 m	Fv	1.5000		Maksimum 6.37
Cycle time:	Ts1			
- Excavating, loading	T_1	0.3200	Minute	
-Other (Delay time, etc.)	T_2	0.1000	Minute	
	Ts_1	0.4200		
Production capacity per hour : $Q_1 = \frac{V\ x\ Fb\ x\ Fa\ x\ 60\ x\ Fk}{Ts_1\ x\ Fv}$	Q_1	71.2114	M3/hr	
Equipment coeff. / m3 = 1/Q_1		**0.0140**	**hour**	

1b) Dump Truck				
Description	**Code**	**Coefficient**	**Unit**	**Notes**
Capacity of truck tub	V	5.5	m3	
Equipment efficiency factor	F_a	0.75		Unfavourable condition
The average speed when loaded	V_1	20	km/hr	
The average speed when empty	V_2	30	km/hr	
Cycle time:	Ts_2			
- Load = (V x 60) / (D x Q1)	T_1	2.90	minute	
-Time Traveled charged = (L / v1) x 60	T_2	1.5	minute	
-Time Traveled empty = (L / v2) x 60	T_3	1	minute	
-Others	T_4	2	minute	
	Ts_2	7.40	minute	
Production capacity $Q_1 = \frac{V \times Fa \times 60}{Ts_2 \times D}$	Q_2	20.91	M3/hr	
Coeff. of equipment/m3 = 1/Q_2		0.0478	hour	

1) LABORS

Description	**Code**	**Coefficient**	**Unit**	**Notes**
Production dominant: Excavator	Q_1	71.2114	M3/hr	
Production excavation / day = Tk x Q1 = 7 x Q1	Q_t	498.4800	M3	
Labor requirement :				
Unskilled Labor	P	2.0000	Person	
Foreman	M	1.0000	Person	
The coefficient of labors / m3:				
- Unskilled Labors = (Tk x P) / Q1	L_1	0.1966	hour	
- Foreman = (Tk x M) / Q1	L_3	0.0983	hour	

IV . SAMPLE OF FORM FILLING UNIT PRICE

Common Soil Excavation Work (per m3)

No	**Description**	**Unit**	**Coefficient**	**Unit Price**	**Total Price ($)**
A.	Labors :				
1	Unskilled Labor	hour	0.1966	0.71	0.14
2	Foreman	hour	0.0983	1.71	0.17
				Total labor cost	**0.31**
B.	Materials	-	-	-	-
				Total material cost	**0.00**
C.	Equipment :				
1	Excavator	hour	0.0140	72.09	1.01
2	Dump Truck	hour	0.0478	33.45	1.60
				Total equipment cost	**2.61**
D.				**Unit Price (A + B + C)**	**2.92**

Example of Unit Price Analysis of Earthwork (Excavation and Embankment)
Example 1b : Common Soil Excavation Work (1 m3)

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
Road condition: bad				
Using the tool mechanically				
Locations along the road				
Effective working hours per day	Tk	7	hour	
Factors of loose material.	Fk	1.2	-	
Soil density (loose)	D	1.6	Ton/m3	
Distance to the disposal site	L	2	kms	

II. SEQUENCE OF WORK

1) Land which is cut generally located on the side of the road;

2) The excavation is done by using the excavator;

3) Excavator pour materials that are dug into the dump truck;

4) Dumptruck dispose of materials that are dug out the location of the road as far as L = 2 km.

III. USE OF EQUIPMENT AND PERSONNEL

1) EQUIPMENT

Description	Code	Coefficient	Unit	Notes
1a) Excavator				
Bucket capacity	V	0.9300	M3	
Factors Bucket	Fb	1.0000		Common/normal soil
Equipment efficiency factor	Fa	0.6700		Unfavourable condition
Conversion factor, depth 47%: 0.47 x 6:37 m = 3 m	Fv	1.5000		Maksimum 6.37
Cycle time:	Ts1			
- Excavating, loading	T_1	0.3200	Minute	
-Other (Delay time, etc.)	T_2	0.1000	Minute	
	Ts_1	0.4200		
Production capacity per hour : $Q_1 = \frac{V\ x\ Fb\ x\ Fa\ x\ 60\ x\ Fk}{Ts_1\ x\ Fv}$	Q_1	71.2114	M3/hr	
Equipment coeff. / m3 = 1/Q_1		**0.0140**	**hour**	

1b) Dump Truck

Description	Code	Coefficient	Unit	Notes
Capacity of truck tub	V	5.5	m3	
Equipment efficiency factor	F_a	0.75	-	Unfavourable condition
The average speed when loaded	V_1	20	km/hr	
The average speed when empty	V_2	30	km/hr	
Cycle time:	Ts_2			
- Load = (V x 60) / (D x Q1)	T_1	2.90	minute	
-Time Traveled charged = (L / v2) x 60	T_2	6	minute	
-Time Traveled empty = (L / v2) x 60	T_3	4	minute	
-Others	T_4	2	minute	
	Ts_2	14.90	minute	
Production capacity $Q_1 = \frac{V\ x\ Fa\ x\ 60}{D\ x\ Ts_2}$	Q_2	10.38	M3/hr	
Coeff. of equipment/m3 = 1/Q_2		0.0963	hour	

1) LABORS

Description	Code	Coefficient	Unit	Notes
Production specify: Excavator	Q_1	71.2114	M3/hr	
Production excavation / day = Tk x Q1 = 7 x Q1	Q_t	498.4800	M3	
Labor requirement :				
- Unskilled Labors	P	2.0000	Person	
-Foreman	M	1.0000	Person	
The coefficient of labors / m3:				
- Unskilled Labors = (Tk x P) / Q1	L_1	**0.1966**	hour	
- Foreman = (Tk x M) / Q1	L_3	**0.0983**	hour	

IV . SAMPLE OF FORM FILLING UNIT PRICE

Ordinary Soil Excavation Work (per m3)

No	Description	Unit	Coefficient	Unit Price	Total Price ($)
A.	Labors :				
1	Unskilled Labor	hour	0.1966	0.71	0.14
2	Foreman	hour	0.0983	1.71	0.17
				Total labor cost	**0.31**
B.	Materials	-	-	-	-
				Total material cost	**0.00**
C.	Equipment :				
1	Excavator	hour	0.0140	72.09	1.01
2	Dump Truck	hour	0.0963	33.45	3.22
				Total equipment cost	**4.23**
D.				**Unit Price (A + B + C)**	**4.54**

Example 2 : Rock Excavation Work				

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
Work done mechanically				
The road condition: Moderate				
Location: along the road				
Effective working hours per day	T_k	7	hour	
Factors of loose material.	F_k	1.2	-	
Material density (loose)	D	1.8	Ton/m3	
Distance to the disposal site	L	1	Kms	

II. SEQUENCE OF WORK

1) The stone which is cut generally located beside the road

2) The excavation carried out by excavators, compressors, and a jack hammer, loaded in the truck with Loader.

3) Dump Truck dispose materials that are dug out to the location of the road as far as (L) Km.

III. USE OF EQUIPMENT AND PERSONNEL

1) Equipment

Description	Code	Coefficient	Unit
1a) Compressor, excavator, jack hammer, dan loader			
Production per hour, Q1		8.00	M3/hour
Coefficient equipment / m3 = 1 / Q1	(E5/26)	0.1250	hour
1b) Dump Truck 5.2 Ton (E8) :			
Capacity of truck tub	V	5.50	m3
Equipment efficiency factor	F_a	0.80	-
The average speed when loaded	v_1	20.00	Km/hour
The average speed when empty	v_2	30.00	Km/hour
Cycle time:	Ts_2		
- Load = (V x 60) / (D x Q1)	T_1	22.92	minute
-Time Traveled charged = (L / v2) x 60	T_2	3.00	minute
-Time Traveled empty = (L / v2) x 60	T_3	2.00	minute
-Others	T_4	2.00	minute
	Ts_2	29.92	minute
Production capacity/hour: $Q_2 = \frac{V\ x\ Fa\ x\ 60}{D\ x\ Ts_2}$	Q_2	4.9025	M3/hour
Coefficient of equipment/m3 = $1/Q_2$	E8	0.2040	hour

2) LABORS

Description	Code	Coefficient	Unit
Production specify: Jack Hammer	Q_1	8	M3/hour
Production excavation / day = Tk x Q1 = 7 x Q1	Q_t	56	M3
Manpower needs :			
- Unskilled Labors	P	8	Person
- Foreman	M	1	Person
The coefficient of labor / m3			
- Unskilled Labors = (Tk x P) / Qt	L_1	1	hour
- Foreman = (T_k x M) / Q_t	L_3	0.125	hour

IV . SAMPLE OF FORM FILLING UNIT PRICE

Rock excavation work

No.	Description	Unit	Coefficient	Unit Price, $	Total Price, $
A.	Labors :				
1	Unskilled Labor	hour	1	0.71	0.71
2	Foreman	hour	0.125	1.71	0.21
				Total labor cost	0.92
B.	Materials	-	-	-	-
				Total material cost	0.00
C.	Equipment :				
1	Compressor (E35)	hour	0.125	19.06	2.38
2	Jack hammer (E23)	hour	0.125	5.68	0.71
3	Wheel loader (E15)	hour	0.125	32.81	4.10
4	Excavator (E10)	hour	0.125	72.09	9.01
5	Dump Truck 5.2 Ton (E8)	hour	0.2040	33.45	6.82
6	Tools	Ls	1		0.00
				Total equipment cost	**23.03**
D.				**Unit Price (A + B + C)**	**23.95**

Example of Structure Excavation Work with depth 0-2 meters

Location : around the bridge

Equipment used : excavator and bulldozer.

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
Work done mechanically				
Road condition:				
Effective working hours per day	T_k	7	hour	
Factors of loose material.	F_k	1.2	-	
Backfilling to structure	U_k	50	%/m^3	

II. SEQUENCE OF WORK

1) Land that is cut around the locations

2) The excavation carried out by means of Excavator

3) Bulldozer transport / displacing the excavation results to landfill around the pitch location.

4) Wooden slope protection

III. USE OF MATERIALS, EQUIPMENT AND PERSONNEL

1) MATERIALS

Description	Code	Coefficient	Unit
Selected fill materials (for backfilling) = U_k x 1 m^3		0.5	M^3
2) Equipment			
1a) <u>Excavator (E10)</u>			
Bucket capacity	V	0.93	M3
Factors Bucket	F_b	1	
Equipment efficiency factor	F_a	0.75	
Conversion factor, depth <40%: 0.4 x 6.37 m = 2.55 m	F_v	0.9	
Material density	D	0.85	
Cycle time			
- Excavate / load, etc (standard)	T_1	0.32	minute
Cycle time = T_1 x Fv	T_{s1}	0.29	minute
Production capacity / hour $Q_1 = \frac{V\ x\ Fa\ x\ Fb\ x\ 60}{Ts_1\ x\ Fk}$	Q_1	120.26	M3/hour
Coefficient of equipment/m3 = 1 / Q_1	(E10)	0.0083	hour
<u>1b) Buldozer (E7)</u>			
Blade factor	F_b	0.7	-
Equipment efficiency factor	F_a	0.75	-
Speed peeling	V_f	20	Km/hour
Speed reverse	V_r	30	Km/hour
Capacity of blade	q	5.4	M3
Slope factor (grade) of blade (horizontal)	F_m	1	-
Cycle time	T_s		-
- Displacing time = (L x 60) / Vf	T_1	2	minute
- Time back = (L x 60) / Vr	T_2	1.2	minute
- Others	T_3	0.05	minute
	T_s	3.25	minute
Production capacity/hour : $Q_2 = \frac{V\ x\ Fa\ x\ Fb\ x\ 60}{Ts_2\ x\ Fk}$	Q_2	7.51	M3/hour
Coefficient of equipment/m3 = 1/Q_2	(E7)	0.1331	hour

3) LABORS

Description	Code	Coefficient	Unit
Labors			
Production specify : Excavator	Q_1	120.26	M3/hour
Production excavation/day = T_k x Q_1	Q_t	841.81	M3
Need of labors			
- Unskilled Labor	P	4	Person
- Foreman	M	1	Person
Labor coefficient/m3			
- Unskilled Labor = (Tk x P) / Qt	(L_1)	0.0333	hour
- Foreman = (T_k x M) / Q_t	(L_3)	0.0083	hour

IV . SAMPLE OF FORM FILLING UNIT PRICE

Structure Excavation Work with depth 0-2 meters

No.	Description	Unit	Coefficient	Unit Price, $	Total Price, $
A.	Labors				
1	Unskilled Labor (L1)	hr	0.0333	0.71	0.024
2	Foreman (L4)	hr	0.0083	1.71	0.014
				Total labor cost	**0.038**
B.	Materials Selected filling material	M3	0.5	-	-
				Total material cost	**0.000**
C.	Equipment				
1	Excavator	hr	0.0083	72.09	0.599
2	Buldozer	hr	0.1331	50.03	6.660
				Total equipment cost	**7.26**
D.				**Unit Price (A + B + C)**	**7.30**

Example of Common Earthfill Work

The work is done by using Wheel Loader, Dump Truck, Motor Grader, Vibrator Roller, and Water Tank Truck.

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
Work done mechanically				
Location of work : along the road				
Road condition: moderate/unfavourable				
Effective working hours per day	T_k	7	hour	
Factors of loose material.	F_k	1.2	-	
Thickness of solid expanse	t	0.15	m	
Distance from quarry to work site	L	5.00	kms	

II. SEQUENCE OF WORK

1) Wheel Loader to load into the Dump Truck

2) Dump Truck transporting the material from the quarry to the field with a distance of L.

3) Material leveled by using a motor grader.

3) Material compacted by using vibratory roller.

4) The overlay material watered with Watertank Truck before implementation of compaction and compacted.

5) During solidification, a group of unskilled labors will smooth edges of expanse and level the expanse surface using tools.

III. USE OF MATERIALS, EQUIPMENT AND LABOR

1) MATERIALS

Description	Code	Coefficient	Unit	Notes
Fill material = 1 x Fk		1.2	m3	Borrow pit

2) EQUIPMENT

Description	Code	Coefficient	Unit	Notes
2a) WHEEL LOADER (E13)				
Bucket capacity	V	1.50	M3	
Factors Bucket	F_b	1.00	-	
Equipment efficiency factor	F_a	0.60	-	
Cycle time				
- Loading	T_1	0.50	Minute	
- Others	T_2	0.50	Minute	
	Ts_1	1.00		
Production capacity / hour $Q_1 = \frac{V\ x\ Fa\ x\ Fb\ x\ 60}{Ts_1\ x\ Fk}$	Q_1	45.00	M3/hour	
Coefficient of equipment/m3 = 1 / Q_1	(E13)	0.0222	hour	
2b) Dump Truck 5.2 Ton (E8) :				
Capacity of truck tub	V	5.50	M3	
Equipment efficiency factor	F_a	0.80	-	
The average speed when loaded	v1	20.00	Km/hour	
The average speed when empty	v2	30.00	Km/hour	
Cycle time:				
-Time Traveled charged = (L / v1) x 60	T_1	15.00	Minute	
-Time Traveled empty = (L / v2) x 60	T_2	10.00	Minute	
-Others	T_3	3.00	Minute	
	Ts_2	28.00	Minute	
Production capacity/hour: $Q_2 = \frac{V\ x\ Fa\ x\ 60}{Ts_2\ x\ Fk}$	Q_2	7.86	M3/hour	
Coefficient of equipment/m3 = 1/Q_2	**E8**	**0.1273**	**hour**	
2c) Motor Grader (E11)				
Length of expanse	Lh	50	m	
Effective working width of Blade	b	2.4	m	
Equipment efficiency factor	F_a	0.8	-	

The average speed of equipment	v	4	kms/hr	
Number of tracks	n	2	trajectory	
cycle time				
- Flatten 1 time trajectory = (Lh x 600)/ (v x 1000)	T_1	0.6	minute	
- Other	T_2	0.3	minute	
	Ts_3	0.9	minute	
Production capacity / hour $Q_3 = \frac{Lh\ x\ b\ x\ t\ x\ Fa\ x\ 60}{Ts_3\ x\ n}$	Q_3	480.00	M3/hr	
Coefficient of equipment/m3 = 1 / Q_3	E11	0.0021	hour	
2d) Vibrator Roller (E17)				
Average speed	v	5	kms/hr	
Effective width compaction	b	1.2	M3/hour	
Number of trajectory	n	1	trajectory	
Equipment efficiency factor	F_a	0.6	-	
Production capacity / hour $Q_4 = \frac{[v\ x\ 1000\ x\ b\ x\ t\ x\ Fa]}{n}$	Q_4	540.00	M3/hour	
Coefficient of equipment/m3 = 1 / Q_4	E17	0.0019	hour	
2e) Water tank truck (E 38)				
Water tank volume	V	4	M3	
Water demand/m3 of solid materials	W_c	0.07	M3	
Filling the tank / hour	n	4	times	
Equipment efficiency factor	F_a	0.6	-	
Production capacity / hour $Q_5 = \frac{v\ x\ n\ x\ Fa}{W_c}$	Q_5	137.14	M3/hr	
Coefficient of equipment/m3 = 1 / Q_5	E 38	0.0073	hour	
2f) Tools				
- Shovels = 3 pieces				Lump sum

IV . SAMPLE OF FORM FILLING UNIT PRICE

Common Earthfill Work/M3

No.	Description	Unit	Coefficient	Unit Price, $	Total Price, $
A.	Labors				
1	Unskilled Labor (L1)	hour	0.0435	0.71	0.0309
2	Foreman (L4)	hour	0.0109	1.71	0.0186
				Total labor cost	**0.0495**
B.	Materials				
	Fill material	M3	1.2	-	-
				Total material cost	**0.0000**
C.	Equipment				
1	Excavator (E10)	hr	0.0109	72.09	0.79
2	Dump truck (E8)	hr	0.1273	33.45	4.26
3	Motor grader (E11)	hr	0.0037	42.76	0.16
4	Vibro roller (E17)	hr	0.0042	34.40	0.14
5	Water tank truck (E38)	hr	0.0070	27.69	0.19
				Total equipment cost	**5.54**
D.				**Unit Price (A + B + C)**	**5.59**

Example of Unit Price Analysis of Asphalt Concrete AC-WC (gradation coarse / fine), m2

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
1) Using the equipment (mechanically)				
2) The condition of the existing road : moderate / unfavourable				
3) Location of work : along the road				
4) The average distance from the base camp to the work site	L	4.00	km	
5) Thick solid pavement AC-WC	t	0.04	m	
6) Effective working hours per day	T_k	7.00	hour	
7) Material loss factor:				
- Aggregate	F_{h1}	1.20	-	
- Asphalt	F_{h2}	1.05	-	
8) The composition of the mixture of AC-WC				
- Coarse Aggregate 5-10 and 10-20 mm	CA	40.00	%	
- Fine Aggregate 0-5 mm	FA	52.80	%	
- Fraction Filler	FF	1.00	%	
- Asphalt (minimum 5 %)	As	6.20	%	
9) Material density :				
- AC-BC	D1	2.25	ton/m3	
- Coarse Aggregate & Fine Aggregate	D2	1.80	ton/m3	
- Fraction Filler	D3	2.00	ton/m3	
- Asphalt	D4	1.03	ton/m3	……

II. SEQUENCE OF WORK

1. Wheel Loader load aggregate into Cold Bin AMP

2. Aggregates and asphalt are mixed and heated on AMP to be loaded directly into a dump truck and transported to the work site

3. The mixture is spread with a Finisher air conditioning heat and compacted with Tandem & Pneumatic Tire Roller

4.The overlay edge trimmed by a group of unskilled labors as well as the level of the surface using tools.

III. USE OF MATERIALS, EQUIPMENT AND PERSONNEL

1) Material

Description		Code	Coefficient	Unit	Notes
Coarse Aggregates	=(CA x (D1 x t M^3) x F_{h1}) /D_2	M..	0.0240	m^3	
Fine aggregate	=(FA x (D1 x t M^3) x F_{h1}) / D_2	M..	0.0317	m^3	
- Fraction Filler	=(FF x (D1 x t M^3) x F_{h1}) x 1000	M..	1.0800	kg	
- Asphalt	=(As x (D1 x tM3) x F_{h2}) x 1000	M..	5.8590	kg	

2) Equipment

Description	Code	Coefficient	Unit	Notes
2a) WHEEL LOADER (E13)				
Bucket capacity	V	1.5	m^3	
Factors bucket	F_b	0.9	-	
Equipment efficiency factor	F_a	0.65	-	
cycle time	T_s			
- Loading	T_1	3	minute	
- Others	T_2	1	minute	
Total	T_{s1}	4	minute	
Production Capacity / hr : $Q1 = \frac{(D2\ x\ V\ x\ Fb\ x\ Fa\ x\ 60)}{D1\ x\ t\ x\ Ts_1}$	Q1	263.25	ton	
Coefficient of equipment / m3 = 1 / Q1	E13	0.0038	hour	
2b) ASPHALT MIXING PLANT (AMP) (E1)				
Production Capacity	V	50.00	ton/hr	
Equipment efficiency factor	F_a	0.65	-	Condition : moderate
Production capacity/hr = (V x F_a) / (D1 x t)	Q_2	361.11	ton	
Coefficient of equipment / ton = 1 / Q2	E01	0.0028	hour	
2c) GENERATOR SET (E36)				
Production capacity / hr = AMP	Q_3	361.11	m^3	
Coefficient of equipment / ton = 1 / Q_3	E36	0.0028	hour	
2d) DUMP TRUCK (DT) (E8)				
Capacity of truck tub	V	5.50	Ton	
Equipment efficiency factor	F_a	0.65	-	Condition: unfavourable
The average speed when loaded	v1	20.00	Km/hr	
The average speed when empty	v2	30.00	Km/hr	
Capacity of AMP / batch	Q2b	0.50	ton	
Time to prepare one batch of AC-WC	T_b	1.00	minute	
Cycle time	T_{s2}			
- Loading = (V: Q2b) x Tb	T_1	11.00	minute	
- Transports = (L: v1) x 60	T_2	12.00	minute	
-Wait + Dump + swivel	T_3	15.00	minute	
- Return = (L: v2) x 60	T_4	8.00	minute	
Total	T_{s2}	46.00	minute	
Production capacity/hr, $Q_4 = \frac{(V\ x\ Fa\ x\ 60)}{D1\ x\ t\ x\ Ts_2}$	Q_4	51.81	m^3	
Coefficient of equipment / ton = 1 / Q_4	E36	0.0193	hour	
2e) ASPHALT FINISHER (E2)				
Production capacity	V	10	ton / hr	
Equipment efficiency factor	F_a	0.65	-	Good Condition
Prod. capacity / H: Q5 = (V x Fa) / (t x D1)	Q_5	72.22	m2	
Coefficient of equipment / ton = 1 / Q5	E2	0.0138	hour	

2f) TANDEM ROLLER (E15)				
The average forward speed of the equipment	v	2.5	km/hr	
Effective width compaction	b	1.2	m	
Number of passes	n	4	Passes	
Equipment efficiency factor	F_a	0.75	-	
Production capacity / hr: $Q_6 = \frac{\{(v \times 1000) \times b \times t \times Fa\}}{n \times t}$	Q6	562.50	m^2	
Coefficient of equipment / ton = 1 / Q6	E15	0.0018	hour	
2g) PNEUMATIC TIRE ROLLER (E16)				
The average speed of the equipment	v	3.5	km/hr	
Effective width compaction	b	1.2	m	
Number of passes	n	4	Passes	
Equipment efficiency factor	F_a	0.65	-	
Production capacity / hr: $Q_7 = \frac{((v \times 1000) \times b \times t \times Fa]}{n \times t}$	Q_7	682.50	m^2	
Coefficient of equipment / ton = 1 / Q7	E16	0.0015	hour	
2h) TOOLS (Lumpsum)				Lump Sum
- Signs = 2 pieces				
- Trolley = 2 pieces				
- Shovels = 3 pieces				
- Fork = 2 pieces				
- Thickness control stick of the expanse				

3) Labors

Production decisive : **Asphalt Mixing Plant**		Q_2	361.11	m^2 / hr
Production of AC-WC / day = T_k x Q_2		Q_t	2527.78	m^2
Required labors :	- Unskilled Labor	P	10	person
	- Foreman	M	1	person
Coefficient of labor / m^2				
- Unskilled Labor	= (Tk x P) / Qt	(L1)	**0.0277**	hour
- Foreman	= (Tk x M) / Qt	(L4)	**0.0028**	hour

IV . SAMPLE OF FORM FILLING UNIT PRICE

Asphalt concrete (AC-WC) gradation fine / coarse per m2

No.	Description	Unit	Coefficient	Unit Price, $	Total Price,$
A	**LABORS**				
1	Unskilled Labor (L1)	hour	0.0277	0.71	0.020
2	Foreman (L4)	hour	0.0028	1.71	0.005
				Total labor cost	**0.024**
B	**MATERIALS**				
1	Coarse aggregate	M^3	0.0240	25.00	0.600
2	Fine aggregate	M^3	0.0317	25.00	0.792
3	Filler	Kg	1.0800	0.16	0.173
4	Asphalt	Kg	5.8590	2.00	11.718
				Total material cost	**13.283**
C	**EQUIPMENT**				
1	Wheel Loader	hour	0.0038	32.81	0.12
2	AMP	hour	0.0028	90.76	0.25
3	Genset	hour	0.0028	46.42	0.13
4	Dump Truck	hour	0.0193	33.45	0.65
5	Asphalt Finisher	hour	0.0138	35.96	0.50
6	Tandem Roller	hour	0.0018	38.01	0.07
7	Pneumatic Tire Roller	hour	0.0015	38.48	0.06
8	Tools	Ls	1.0000	0.01	0.01
				Total equipment cost	**1.78**
D				**Unit Price (A + B + C)**	**15.09**

Example of Analysis Unit Price of Aggregate Base Class A , CBR Minimum 80 %

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
1) Using the equipment (mechanically)				
2) Location of work : along the road				
Condition of the existing road : unfavourable				
4)Average distance Base Camp to the work site	L	3.0	km	
5) Thick layers of densed aggregate	t	0.15	m	
6) Material loose factor	Fk	1.40	-	
7) Effective working hours per day	Tk	7.00	hour	
8) Mixed Proportion :				
- Coarse Aggregate	Ak	55.00	%	
- Fine Aggregate	Ah	45.00	%	

II . SEQUENCE OF WORK

1. Wheel Loader Aggregate mixing and loading into the Dump Truck at Base Camp
2. Dump Truck transports the aggregate to the job site and is spread by Motor Grader
3. Aggregate overlay moistened with Water Tank Truck before compacted with Tandem Roller
4) During solidification, a group of unskilled labors will smooth edges of expanse and level the expanse surface using tools.

III . USE OF MATERIALS , EQUIPMENT AND PERSONNEL

1. MATERIALS

Coarse Aggregate = Ak x 1 M3 x Fk	M03	**0.7700**	m3	
Fine Aggregate = Ah x 1 M3 x Fk	M04	**0.6300**	m3	

2. EQUIPMENT

2a) WHEEL LOADER	(E13)			
Bucket capacity	V	1.50	m3	
Factors bucket	Fb	0.90	-	Light loading
Equipment Efficiency Factor	Fa	0.80	-	
Cycle time	Ts1			
- Mixing	T1	3.00	minute	
- Loading and others	T2	2.00	minute	
	Ts1	5.00	minute	
Production capacity/hr = $\frac{V \times Fb \times Fa \times 60}{Fk \times Ts1}$	Q1	9.26	m3	
Coefficient of equipment / M3 = 1/Q1	(E13)	**0.1080**	hour	
2b) DUMP TRUCK	(E09)			
Dump Truck tub capacity	V	5.50	m3	
Equipment Efficiency Factor	Fa	0.80	-	
The average speed of charged	v1	45.00	kms / hr	
The average speed is empty	v2	60.00	kms / hr	
Cycle time :				
- Time to load = V : Q1 x 60	T1	35.65	minute	
-Time Traveled charged = (L / v1) x 60	T2	4.00	minute	
-Time Traveled empty = (L / v2) x 60	T3	3.00	minute	
- Other , including pouring Aggregate	T4	5.00	minute	
	Ts2	47.65	minute	
Production capacity/hr = $\frac{V \times Fa \times 60}{Fk \times Ts2}$	Q2	3.96	m3	
Equipment Coefficient = 1 : Q2	(E09)	**0.2527**	hour	
2c) MOTOR GRADER	(E11)			
Length of expanse	Lh	50.00	m	
Effective width of the blade	b	2.40	m	
Equipment efficiency factor	Fa	0.80	-	
Average speed of equipment	v	3.00	km /hr	

Number of passes	n	1.00	passes	3 times round-trip
Cycle time:	Ts3			
- Flatten 1 time trajectory = (Lh x 60) : (vx 1000)	T1	1.00	minute	
- Others	T2	1.00	minute	
	Ts3	2.00	minute	
Production capacity/hr = $\frac{Lh\ x\ b\ x\ t\ x\ Fa\ x\ 60}{n\ x\ Ts3}$	Q3	432.00	m3	
Coefficient of equipment / M3 = 1/Q3	(E11)	**0.0023**	hour	
2d) TANDEM ROLLER	(E15)			
The average forward speed of the equipment	v	3.00	km /hr	
Effective width compaction	b	1.20	m	
Number of passes	n	4.00	passes	
Equipment efficiency factor	Fa	0.75	-	
Prod. capacity/hr = $\frac{(v\ x\ 1000)\ x\ b\ x\ t\ x\ Fa}{n}$	Q4	101.25	m3	
Coefficient of tools / M3 = 1/Q4	(E15)	**0.0099**	hour	
2e) WATER TANK TRUCK	(E38)			
The volume of water tank	V	4.00	m3	
Water demand / m3 solid aggregate	Wc	0.07	m3	
Filling the tank / hour	n	1.00	times	
Equipment efficiency factor	Fa	0.80	-	
Prod. capacity / hr = $\frac{V\ x\ n\ x\ Fa}{Wc}$	Q5	45.71	m3	
Coefficient of equipment / M3 = 1 / Q5	(E38)	**0.0219**	**hour**	
2f) TOOLS				
Required :				Lump Sum
- Trolley = 2 pieces				
- Shovels = 3 pieces				
- Fork = 2 pieces				
3. LABORS				
Production specify : WHEEL LOADER	Q1	9.26	m3/hr	
Aggregate Production / day = Tk x Q1	Qt	64.80	m3/hr	
Power requirement :				
- Unskilled Labors	P	10.00	person	
- foreman	M	1.00	person	
The coefficient of labor / M3 :				
- Unskilled Labors = (Tk x P) : Qt	(L01)	**1.0802**	hour	
- Foreman = (Tk x M) : Qt	(L03)	**0.1080**	hour	

IV . SAMPLE OF FORM FILLING UNIT PRICE

Aggregate Base Class A , CBR Minimum 80 %

No.	Description	Unit	Coefficient	Unit Price, $	Total Price,$
A	**LABORS**				
1	Unskilled Labor (L1)	hour	1.0802	0.71	0.77
2	Foreman (L4)	hour	0.1080	1.71	0.18
				Total labor cost	**0.95**
B	**MATERIALS**				
1	Coarse aggregate (M03)	M^3	0.7700	25.00	19.25
2	Fine aggregate (M04)	M^3	0.6300	25.00	15.75
				Total material cost	**35.00**
C	**EQUIPMENT**				
1	Wheel Loader (E13)	hour	0.1080	32.81	3.54
2	Dump Truck (E9)	hour	0.2527	33.45	8.45
3	Motor Grader (E11)	hour	0.0023	42.76	0.10
4	Tandem Roller (E15)	hour	0.0099	38.01	0.38
5	Water Tank Truck (E38)	hour	0.0219	27.69	0.61
6	Tools	Ls	1.0000	0.01	0.01
				Total equipment cost	**13.09**
D				**Unit Price (A + B + C)**	**49.04**

Example of Analysis Unit Price Aggregate Base Class B , CBR Minimum 35%

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
1) Using the equipment (mechanically)				
2) Location of work : along the road				
3) Condition of the existing road : moderate				
4)Average distance Base Camp to the work site	L	3.0	KM	
5) Thick layers of dense aggregates	t	0.15	M	
6) Material loose factor	Fk	1.20	-	
7) Effective working hours per day	Tk	7.00	hour	
9) Mixed Proportion :				
- Coarse Aggregate	Ak	35.00	%	
- Fine Aggregate	Ah	20.00	%	
- Sirtu (Sand mixed with stone / gravel)	St	45.00	%	

II . SEQUENCE OF WORK

1. Wheel Loader Aggregate mixing and loading into the Dump Truck at Base Camp
2. Dump Truck transports the aggregate to the job site and is spread by Motor Grader
3. Aggregate overlay moistened with Water Tank Truck before compacted with Tandem Roller
4. During solidification, a group of unskilled labors will smooth edges of expanse and level the expanse surface using tools.

III . USE OF MATERIALS , EQUIPMENT AND PERSONNEL

1. MATERIALS

Coarse Aggregate = Ak x 1 M3 x Fk	M03	0.4200	M3	
Fine Aggregate = Ah x 1 M3 x Fk	M04	0.2400	M3	
- Sirtu (Sand mixed with stone / gravel) = St x 1 m3 x Fk	M16	0.5400		

2. EQUIPMENT

2a) WHEEL LOADER	(E13)			
Bucket capacity	V	1.50	M3	
Factors bucket	Fb	0.90	-	Light loading
Equipment Efficiency Factor	Fa	0.80	-	
Cycle time	Ts1			
- Mixing	T1	3.00	minute	
- Loading and others	T2	2.00	minute	
	Ts1	5.00	minute	
Production capacity/hr = $\frac{V \times Fb \times Fa \times 60}{Fk \times Ts1}$	Q1	10.80	M3	
Coefficient of equipment / M3 = 1/Q1	(E13)	**0.0926**	hour	
2b) DUMP TRUCK	(E09)			
Dump Truck tub capacity	V	5.50	M3	
Equipment Efficiency Factor	Fa	0.80	-	
The average speed of charged	v1	45.00	kms / hr	
The average speed is empty	v2	60.00	kms / hr	
Cycle time :				
- Time to load = V : Q1 x 60	T1	30.56	minute	
-Time Traveled charged = (L / v1) x 60	T2	4.00	minute	
-Time Traveled empty = (L / v2) x 60	T3	3.00	minute	
- Other, including pouring Aggregate	T4	3.00	minute	
	Ts2	40.56	minute	
Production capacity/hr = $\frac{V \times Fa \times 60}{Fk \times Ts2}$	Q2	5.42	M3	

Equipment Coefficient = 1 : Q2	(E09)	**0.1843**	hour	
2c) MOTOR GRADER	(E11)			
Length of expanse	Lh	50.00	M	
Effective width of the blade	b	2.40	M	
Equipment efficiency factor	Fa	0.83	-	
Average speed of equipment	v	4.00	kms/hr	
Number of passes	n	6.00	passes	3 times round-trip
Cycle time:	Ts3			
- Flatten 1 time trajectory = Lh: (vx 1000) x 60	T1	0.75	minute	
- Others	T2	1.00	minute	
	Ts3	1.75	minute	
Production capacity/hr = $\frac{Lh\ x\ b\ x\ t\ x\ Fa\ x\ 60}{n\ x\ Ts3}$	Q3	85.37	M3	
Coefficient of equipment / M3 = 1/Q3	(E11)	**0.0117**	hour	
2d) TANDEM ROLLER	(E15)			
The average forward speed of the equipment	v	3.00	kms/hr	
Effective width compaction	b	1.20	m	
Number of passes	n	4.00	passes	
Equipment efficiency factor	Fa	0.80	-	
Production capacity/hr = $\frac{(v\ x\ 1000\ x\ b\ x\ t\ x\ Fa)}{n}$	Q4	108.00	M3	
Coefficient of tools/ M3 = 1/Q4	(E15)	**0.0093**	hour	
2e) WATER TANK TRUCK	(E38)			
The volume of water tank	V	4.00	M3	
Water demand / m3 solid aggregate	Wc	0.07	M3	
Filling the tank / hour	n	1.00	times	
Equipment efficiency factor	Fa	0.80	-	
Prod. capacity / hr = $\frac{V\ x\ n\ x\ Fa}{Wc}$	Q5	45.71	M3	
Coefficient of equipment / M3 = 1 / Q5	(E38)	**0.0219**	**hour**	
2f) TOOLS				
Required :				Lump Sum
-Trolley = 2 pieces				
- Shovels = 3 pieces				
- Fork = 2 pieces				
3. LABORS				
Production specify : WHEEL LOADER	Q1	10.80	m3/hr	
Aggregate Production / day = Tk x Q1	Qt	75.60	m3/hr	
Power requirement :				
- Unskilled Labors	P	7.00	person	
- foreman	M	1.00	person	
The coefficient of labor / M3 :				
- Unskilled Labors = (Tk x P) : Qt	(L01)	**0.6481**	hour	
- Foreman = (Tk x M) : Qt	(L03)	**0.0926**	hour	

IV . SAMPLE OF FORM FILLING UNIT PRICE

Aggregate Base Class A , CBR Minimum 35 %

No.	Description	Unit	Coefficient	Unit Price, $	Total Price,$
A	**LABORS**				
1	Unskilled Labor (L1)	hour	0.6481	0.71	0.46
2	Foreman (L4)	hour	0.0926	1.71	0.16
				Total labor cost	**0.62**
B	**MATERIALS**				
1	Coarse aggregate	M^3	0.4200	25.00	10.50
2	Fine aggregate	M^3	0.2400	25.00	6.00
				Total material cost	**16.50**
C	**EQUIPMENT**				
1	Wheel Loader (E13)	hour	0.0926	32.81	3.04
2	Dump Truck (E9)	hour	0.1843	33.45	6.17
3	Motor Grader (E11)	hour	0.0117	42.76	0.50
4	Tandem Roller (E15)	hour	0.0093	38.01	0.35
5	Water Tank Truck (E38)	hour	0.0219	27.69	0.61
6	Tools	Ls	1.0000	0.01	0.01
				Total equipment cost	**10.67**
D				**Unit Price (A + B + C)**	**27.79**

Example of analysis unit price for reinstatement and minor work :
Examples of thermoplastic road marking work (per m2)

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
Work was carried out using a machine marking paint				
Location of work : along the memories road				
Basic materials (paint markers and glass beads) are all accepted at the job site				
The average distance Base Camp to the work site	L	8	km	
Effective working hours per day	T_k	7	hour	
Material loss factor	F_h	1.05	-	
Thick layers of paint manually	t	0.003	m	Specification
Density of paints	BJ cat	1.3	kg/liter	
Weight of the paint per m2 = 1 m2 x 0.003 m x 1000 x BJ paint	Bc	3.9	kg	

II . SEQUENCE OF WORK

1. The road surface is cleaned of dust / dirt
2. The road surface to be painted is measured and marked
3. Paint markers inserted into the machine , heated to melt
4. Painting done while sprinkled with glass beads

III . USE OF MATERIALS , EQUIPMENT AND PERSONNEL

1) MATERIAL

Description	Code	Coefficient	Unit	Notes
Thermoplastic marking paint = Bc x Fh		4.095	Kg	
Glass bead		0.45	Kg	

2) EQUIPMENT

Description	Code	Coefficient	Unit	Notes
2a) MACHINE - marking paint	E..			
Capacity painting	V	40	kg/hr	
Production capacity / h = V / Bc	Q_1	10.26	m^2	
Coefficient Tools / m2 = 1 / Q1	E	0.0975	hour	
2b) DUMP TRUCK 5.2 TON	E			
This machine is used together machine marking paint	Q_2	10.26	m^2	
Coefficient Equipment / m2 = 1 / Q2	E	0.0975	hour	
2c) TOOLS				
Required :				
Roller feet 5 m = 2 pieces				
Broom = 3 pieces				
Brush fibers = 3 pieces				
Safety Sign = 2 pieces				

3) LABORS

Production jobs per day = Q1 x Tk	Q_t	71.79	M^2	
Labor requirement :				
- Unskilled Labors	P	8	person	
-Skilled labor	T	3	person	
- foreman	M	1	person	
Labor coefficient :				
- Unskilled Labors = (P x Tk) / Qt	L1	0.7800	hour	
-Skilled labor = (T x Tk) / Qt	L2	0.2925	hour	
- Foreman = (M x Tk) / Qt	L4	0.0975	hour	

IV . SAMPLE OF FORM FILLING UNIT PRICE

Thermoplastic road markings per m2

No	Description	Unit	Coefficient	Unit Price, $	Total Price, $
A	**LABORS**				
1	Unskilled Labors, L1	hour	0.7800	0.71	0.55
2	Painter	hour	0.2925	1.14	0.33
3	Foreman, L4	hour	0.0975	1.71	0.17
				Total cost of labors	**1.05**
B	**MATERIALS**				
1	Paint markings	Kg	4.0950		
2	Glass bead	Kg	0.4500		
				Total cost of materials	
C	**EQUIPMENT**				
	Marking paint engine	hour	0.0975		
	Dump Truck	hour	0.0975	33.45	3.26
				Total cost of equipment	
D				**Unit Price (A + B + C)**	

Example of tree cutting work , diameter 30-50 cm (Units)

I. ASSUMPTIONS

Description	Code	Coefficient	Unit	Notes
Using labor / equipment				
Location of work : along the road				
Road conditions : moderate / good				
Effective working hours per day	T_k	7	hour	
1 tree 30-50 cm diameter equal to the volume	V_p	3	M^3	
Density of wood	D	0.9	Ton/m^3	
Distance to the work site where material removal logging results	L	0.5	km	

II . SEQUENCE OF WORK

1. Cutting of trees using chainsaw , axe and machete ;
2. Trees are cut starting from the top ;
3. Excavation root of the tree is done by Unskilled Labors ;
4. Falling trees cut and loaded into dump trucks by Unskilled Labors ;
5. Dump Truck dumping materials harvested off the job site .

II . USE OF MATERIALS , EQUIPMENT AND PERSONNEL

1) MATERIAL

Nothing	-	-	-	-

2) Equipment

Description	Code	Coefficient	Unit	Notes
2a) DUMP TRUCK 5.2 Ton (E..)	(E..)			
Capacity of truck tub	V	5.2	Ton	
Equipment efficiency factor	F_a	0.83		
The average speed when loaded	v_1	20	Km/hr	
The average speed when empty	v_2	30	Km/hr	
Cycle time	Ts_1		minute	
- Loading	T_1	15	minute	
- Travel time when charged = (L / V1) x 60	T_2	1.5	minute	
- Travel time when empty = (L / V2) x 60	T_3	1	minute	
- Others	T_4	5	minute	
	Ts_1	22.5	minute	
Production capacity / hr = $Q_1 = \frac{V \times Fa \times 60}{D \times Fk \times Ts_1}$	Q_1	4.26	M^3/hr	
Coefficien of equipment / m^3 = 1 / Q_1		0.2346	hour	
2b) CUTTING TOOLS (Chainsaw)	(E..)			
Production determine :				
In one day can cut	H	7	u nit	
Production capacity / h = H / Tk	Q_2	1	u nit	
Coefficient Tools / unit = 1 / Q2	E..	1	hour	
2c) TOOLS (dig the roots of trees and closed back former pit)				
- Shovels				
Axe , machete				
- Hoe				
- Ropes , and others				

3) LABORS

Description	Code	Coefficient	Unit	Notes
Production jobs per day = Q1 x Tk	Q_t	29.8390	M^2	
Requirement of labors :				
- Foreman	M	1	person	
- Unskilled Labors	P	10	person	
Coefficient of labor / m2 :				
Foreman = (M x Tk) / Qt	L4	0.2346	hour	
Unskilled Labors = (P x Tk) / Qt	L1	2.3459	hour	

IV . SAMPLE OF FORM FILLING UNIT PRICE

Tree Removal works, diameter 30 – 50 cm (tree)

No	Description	Unit	Coefficient	Unit Price, $	Total Price, $
A	**LABORS**				
1	Unskilled Labors (L1)	hour	2.3459	0.71	1.67
2	Foreman (L4)	hour	0.2346	1.71	0.40
				Total cost of labors	**2.07**
B	**MATERIALS**				
		-			0.00
				Total cost of materials	0.00
C	**Equipment**				
	Dump Truck	hour	0.2346	33.45	7.85
	Chainsaw	hour	1	2	2.00
				Total cost of equipment	**9.85**
D				**Unit Price (A + B + C)**	**11.91**

TABLE FOR TOOLS EFFICIENCY FACTOR

Table 1: Tools Efficiency Factor

Operation Condition	Machine Maintenance				
	Very good	**Good**	**Moderate**	**Bad**	**Very bad**
Very good	0.83	0.81	0.76	0.70	0.63
Good	0.78	0.75	0.71	0.65	0.60
Moderate	0.72	0.69	0.65	0.60	0.54
Bad	0.63	0.61	0.57	0.52	0.45
Very bad	0.53	0.50	0.47	0.42	0.32
Source: *Rochmanhadi, Ir. 1992. Kapasitas & Produksi alat-alat berat.*					

Table 2: Tools Efficiency Factor – BULLDOZER (F_{aBul})

Working Condition	Work Efficiency
Good	0.83
Moderate	0.75
Not so good	0.67
Bad	0.58

Table 3 Bulldozer Blade factor

Working Condition	Surface Condition	Blade Factor
Easy	Not hard/compacted, ordinary soil, less water content, piling material	1.10 – 0.90
Moderate	Not so hard/compacted, slightly content sand, gravel, fine aggregate	0.90 – 0.70
Slightly Difficult	Water content slightly high, content clay, sandy, dry/hard	0.70 – 0.60
Difficult	Rock from explosion, large size of cleave stone	0.60 – 0.40

Table 4: Tools Efficiency Factor – DUMP TRUCK

Working Condition	Work Efficiency
Good	0.83
Moderate	0.80
Not so good	0.75
Bad	0.70
Source: *Lamp PAHS No. 008/BM/2010*	

Table 5: Velocity of Dump Truck and Field Condition

Field Condition	Load Condition	Velocity, V (Km/h)
Flat	Full	**40**
	Empty	**60**
Slope Upward	Full	**20**
	Empty	**40**
Slope Downward	Full	**20**
	Empty	**40**
Source : Lamp PAHS No. 008/BM/2010		

Table 6: Bucket Fill Factor / (F_b)

Operation Condition	Field Condition	Bucket Fill Factor (F_b)
Easy	Ordinary Soil, Sandy, dry	1.0 – 1.1
Slightly Difficult	Ordinary soil, Stony	1.0 – 0.9
Difficult	Stone from explosion	0.9 – 0.8
Source: Specification and application hand book. Contoh-contoh perhitungan kapasitas produksi 2005. Komatsu Edition 26		

Table 7: Excavation Conversion Factor ($F_{v)}$ – Excavator

Excavation Condition (Excavation Depth/ Maximum Excavation Depth)	Disposal Condition (Dumping)			
	Easy	Normal	Slightly Difficult	Difficult
< 40%	0.70	0.9	1.1	1.4
(40 -75)%	0.80	1.0	1.3	1.6
>75%	0.90	1.1	1.5	1.8
Source : Specification and application hand book. Contoh-contoh perhitungan kapasitas produksi 2005. Komatsu Edition 26				

Table 8: Tools Efficiency Factor (F_a) Excavator

Operation Condition	Efficiency Factor
Good	0.83
Moderate	0.75
Slightly Less	0.67
Less	0.58
Source : Specification and application hand book. Contoh-contoh perhitungan kapasitas produksi 2005. Komatsu Edition 26	

Table 9: Tools Efficiency Factor (F_a) Motor Grader

Operation Condition	Efficiency Factor
Road Repairing, Levelling	0.8
Relocating	0.7
Spreading, Grading	0.6
Trenching	0.5
Source: Specification and application hand book. Contoh-contoh perhitungan kapasitas produksi 2005. Komatsu Edition 26	

Table 10: Bucket Fill Factor / (F_b)

Dumping Condition	Wheel loader	Track loader
Easy	1.0 – 1.1	1.0 – 1.1
Moderate	0.85 – 0.95	0.95 – 1.1
Slightly Difficult	0.80 – 0.85	1.0 – 0.9
Difficult	0.75 - 0.80	0.9 – 0.8
Source : Specification and application hand book. Contoh-contoh perhitungan kapasitas produksi 2005. Komatsu Edition 26		

Table 11: Velocity, Compaction Width and Tools for Compacted

Types of Compactor	Average Velocity (v) km/hr	Effective Compaction width ($b - b_0$), m	Number of rounds (n)
Road roller	± 2	Tire width total – 0.2	4 – 8
Tire roller	± 2.5	Tire width total – 0.3	3 – 5
Large vibrating roller	± 1.5	Tire width – 0.2	4 – 12
Small vibrating roller		Tire width – 0.1	
Soil compactor	4 – 10	Tire width drive – 0.2	4 – 12
Tamper	± 1		
Macadam roller		Tire width total – 0.2	
Tandem roller		(Shoes width x 2) – 0.2 m	
Bulldozer			
Source : Specification and application hand book. Contoh-contoh perhitungan kapasitas produksi 2005. Komatsu Edition 26			

Table 12: Capacity of Tools for several types of materials

Type of Static Compactor	Rock fill	Sand and Gravel	Silt	Clay
	T (m) / Q (m^3/jam)			
Vibrating plate compactor, kg				
50 – 100		0.15 / 15		
100 – 200		0.20 / 20		
400 – 500		0.35 / 35	0.25 / 25	
600 - 800	0.50 / 60	0.50 / 60	0.35 / 40	0.25 – 20
Vibrating tamper (rammer)				
75		0.35 - 10	0.25 - 8	0.20 – 6
Double drum roller				
600 - 800				
Vibrating plate compactor				
1200 - 1500		0.20 / 80	0.15 / 50	0.10 / 30
Source: Specification and application hand book. Contoh-contoh perhitungan kapasitas produksi 2005. Komatsu Edition 26				

TABEL A1 PERCENTAGE COST OF BUILDING COMPONENT

SIMPLE GOVERNMENT BUILDING (Use supervision consultant)

Total construction cost (1000 USD) / Construction Component	<= 600	600 - 1,200	1,200 - 2,400	2,400 - 5,000	5,000 - 7,500	7,500 - 10,000	10,000 - 12,500	12,500 - 25,000	25,000 - 50,000	50,000 - 125,000	125,000 - 250,000	250,000 - 500,000
1	2	3	4	5	6	7	8	9	10	11	12	13
1. PHYSICAL CONSTRUCTION (%)	87,70	87,70 sd 89,29	89,29 sd 90,92	90,92 sd 93,18	93,18 sd 93,79	93,79sd 94,39	94, 39 sd 94,72	94,72 sd 94,97	94,97 sd 95,65	95,65 sd96,22	96,22 sd 96,83	96,83 sd 97,19
2. DESIGN (%)	7,00	7,00 sd 5,80	5,80 sd 4, 70	4,70 sd 3, 75	3, 75 sd 3,50	3,50 sd 3,25	3,25 sd 3,07	3,07 sd 2,94	2,94 sd 2,57	2,57 sd 2,25	2,25 sd 1,89	1,89 sd 1,66
3. SUPERVISION (%)	4,00	4,00 sd 3,70	3,70 sd 3,50	3,50 sd 2,50	2,50 sd 2,24	2,24 sd 2,00	2,00 sd 1,88	1,88 sd 1, 78	1,78 sd 1,53	1,53 sd 1,33	1,33 sd 1,14	1,14 sd 1,03
4. PROJECT MANAGEMENT (%)	1,30	1,30 sd 1,21	1,21 sd 0,88	0,88 sd 0,57	0,57 sd 0,47	0,47 sd 0,36	0,36 sd 0,33	0,33 sd 0,31	0,32 sd 0,25	0,25 sd 0,20	0,20 sd 0,14	0,14 sd 0,12
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

SIMPLE GOVERNMENT BUILDING :

* Elementary schools

*Traditional market

*Polyclinic

* Office in District

TABEL A2 PERCENTAGE COST OF BUILDING COMPONENT

SIMPLE GOVERNMENT BUILDING

(Use construction management consultant)

Total Construction Cost (1000 USD) / Construction Component	<= 600	600 - 1,200	1,200 - 2,400	2,400 - 5,000	5,000 - 7,500	7,500 - 10,000	10,000 - 12,500	12,500 - 25,000	25,000 - 50,000	50,000 - 125,000	125,000 - 250,000	250,000 - 500,000
1	2	3	4	5	6	7	8	9	10	11	12	13
1. PHYSICAL CONSTRUCTION (%)	86,70	86,70 sd 88,36	88,36 sd 90,04	90,04 sd 92,55	92,55 sd 93,23	93,23 sd 93,89	93, 89 sd 94,25	94,25 sd 94,52	94,52 sd 95,26	95,26 sd 95,88	95,88 sd 96,54	96,54 sd 96,93
2. DESIGN (%)	7,00	7,00 sd 5,80	5,80 sd 4, 70	4,70 sd 3, 75	3, 75 sd 3,50	3,50 sd 3,25	3,25 sd 3,07	3,07 sd 2,94	2,94 sd 2,57	2,57 sd 2,25	2,25 sd 1,89	1,89 sd 1,66
3. SUPERVISION (%)	5,00	5,00 sd 4,63	4,63 sd 4,38	4,38 sd 3,13	3,13 sd 2,80	2,80 sd 2,50	2,50 sd 2,35	2,35 sd 2, 23	2,23 sd 1,92	1,92 sd 1,67	1,67 sd 1,43	1,43 sd 1,29
4. PROJECT MANAGEMENT (%)	1,30	1,30 sd 1,21	1,21 sd 0,88	0,88 sd 0,57	0,57 sd 0,47	0,47 sd 0,36	0,36 sd 0,33	0,33 sd 0,31	0,32 sd 0,25	0,25 sd 0,20	0,20 sd 0,14	0,14 sd 0,12
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

SIMPLE GOVERNMENT BUILDING :

* Elementary schools
*Traditional market
*Polyclinic
* Office in District

TABEL B1 PERCENTAGE COST OF BUILDING COMPONENT
NOT SIMPLE GOVERNMENT BUILDING
(Use SUPERVISION CONSULTANT)

Total Construction Cost ((1000 USD) Construction Component)	<= 600	600 - 1,200	1,200 - 2,400	2,400 - 5,000	5,000 - 7,500	7,500 - 10,000	10,000 - 12,500	12,500 - 25,000	25,000 - 50,000	50,000 - 125,000	125,000 - 250,000	250,000 - 500,000
1	2	3	4	5	6	7	8	9	10	11	12	13
1. PHYSICAL CONSTRUCTION (%)	86,70	86,70 sd 88,29	88,29 sd 89,92	89,92 sd 92,18	92,18 sd 92,79	92,79 sd 93,39	93, 39 sd 93,72	93,72 sd 93,97	93,97 sd 94,65	94,65 sd 95,22	95,22 sd 95,81	95,81 sd 96,19
2. DESIGN (%)	7,00	7,50 sd 6,30	6,30 sd 5,20	5,20 sd 4,25	4, 25 sd 4,00	4,00 sd 3,75	3,75 sd 3,57	3,57 sd 3,44	3,44 sd 3 ,07	3,07 sd 2,75	2,75 sd 2,39	2,39 sd 2,16
3. SUPERVISION (%)	5,40	4,50 sd 4,20	4,620sd 4,00	4,00 sd 3,00	3,00 sd 2,74	2,74 sd 2,50	2,50 sd 2,38	2,38 sd 2, 28	2,28 sd 2,03	2,03 sd 1,83	1,83 sd 1,64	1,64 sd 1,53
4. PROJECT MANAGEMENT (%)	1,30	1,30 sd 1,21	1,21 sd 0,88	0,88 sd 0,57	0,57 sd 0,47	0,47 sd 0,36	0,36 sd 0,33	0,33 sd 0,31	0,32 sd 0,25	0,25 sd 0,20	0,20 sd 0,16	0,16 sd 0,12
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

NOT SIMPLE GOVERNMENT BUILDING :

* Ministry Office, Agency office, which have special installation such as escalator, IT, building automation, central hospital, church

TABEL B2 PERCENTAGE COST OF BUILDING COMPONENT
NOT SIMPLE GOVERNMENT BUILDING
(Use Construction Management consultant)

Total Construction Cost (1000 USD) / Construction Component	<= 600	600 - 1,200	1,200 - 2,400	2,400 - 5,000	5,000 - 7,500	7,500 - 10,000	10,000 - 12,500	12,500 - 25,000	25,000 - 50,000	50,000 - 125,000	125,000 - 250,000	250,000 - 500,000
1	2	3	4	5	6	7	8	9	10	11	12	13
1. PHYSICAL CONSTRUCTION (%)	85,58	85,58 sd 87,24	87,24 sd 88,92	88,92 sd 91,43	91,43 sd 92,11	92,11 sd 92,77	92, 77 sd 93,13	93,13 sd 93,40	93,40 sd 94,14	94,14 sd 94,76	94,76 sd 95,40	95,40 sd 95,81
2. DESIGN (%)	7,00	7,50 sd 6,30	6,30 sd 5,20	5,20 sd 4,25	4, 25 sd 4,00	4,00 sd 3,75	3,75 sd 3,57	3,57 sd 3,44	3,44 sd 3 ,07	3,07 sd 2,75	2,75 sd 2,39	2,39 sd 2,16
3. SUPERVISION (%)	5,62	5,62 sd 5,25	5,25 sd 5,00	5,00 sd 3,75	3,75 sd 3,42	3,42 sd 3,12	3,12 sd 2,97	2,97 sd 2, 85	2,85 sd 2,54	2,54 sd 2,29	2,29 sd 2,05	2,05 sd 1,91
4. PROJECT MANAGEMENT (%)	1,30	1,30 sd 1,21	1,21 sd 0,88	0,88 sd 0,57	0,57 sd 0,47	0,47 sd 0,36	0,36 sd 0,33	0,33 sd 0,31	0,32 sd 0,25	0,25 sd 0,20	0,20 sd 0,16	0,16 sd 0,12
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

NOT SIMPLE GOVERNMENT BUILDING :

* Ministry Office, Agency office, which have special installation such as escalator, IT, building automation, central hospital, church

TABEL C PERCENTAGE COST OF BUILDING COMPONENT

SPECIAL GOVERNMENT BUILDING

(Use Construction Management consultant)

Total Construction Cost (1000 USD) / Construction Component	<= 600	600 - 1,200	1,200 - 2,400	2,400 - 5,000	5,000 - 7,500	7,500 - 10,000	10,000 - 12,500	12,500 - 25,000	25,000 - 50,000	50,000 - 125,000	125,000 - 250,000	250,000 - 500,000
1	2	3	4	5	6	7	8	9	10	11	12	13
1. PHYSICAL CONSTRUCTION (%)	84,70	84,70 sd 86,39	86,39 sd 88,09	88,09 sd 90,68	90,68 sd 91,39	91,38 sd 92,06	92, 06 sd 92,43	92,43 sd 92,71	92,71 sd 93,47	93,47 sd 94,11	94,11 sd 94,76	94,76 sd 95,18
2. DESIGN (%)	8,00	8,00 sd 6,80	6,80 sd 5,70	5,70 sd 4,75	4,75 sd 4,50	4,50 sd 4,25	4,25 sd 4,07	4,07 sd 3,94	3,94 sd 3,57	3,57 sd 3,25	3,25 sd 2,89	2,89 sd 2,66
3. SUPERVISION (%)	6,00	6,00 sd 5,60	5,60 sd 5,33	5,33 sd 4,00	4,00 sd 3,65	3,65 sd 3,33	3,33 sd 3,17	3,17 sd 3, 04	3,04 sd 2,71	2,71 sd 2,44	2,44 sd 2,19	2,19 sd 2,04
4. PROJECT MANAGEMENT (%)	1,30	1,30 sd 1,21	1,21 sd 0,88	0,88 sd 0,57	0,57 sd 0,47	0,47 sd 0,36	0,36 sd 0,33	0,33 sd 0,31	0,32 sd 0,25	0,25 sd 0,20	0,20 sd 0,16	0,16 sd 0,12
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

SPECIAL GOVERNMENT BUILDING :

* Monumental building,
security & safety building,
nuclear/reactor building,
international port and harbour

TABLE D PERCENTAGE COST BUILDING COMPONENT
GOVERNMENT BUILDING WITH PROTOTYPE DESIGN (for total up to USD.250,000)

BUILDING COMPONENT	PERCENTAGE COST OF BUILDING COMPONENT			
	IF DONE BY CONSULTANT		IF DONE BY PUBLIC WORKS	
1	2	3	4	5
1. PHYSICAL CONSTRUCTION	-	91,20%	-	94,20%
2. DESIGN MODIFICATION	50% x 7%	3,50%	Max 60% x 50% x 7%	2,10%
3. SUPERVISION	-	4,00%	60% x 4%	2,40%
4. PROJECT MANAGEMENT	-	1,30%	-	1,30%
TOTAL		100,00%		100,00%

TABEL E PERCENTAGE COST OF BUILDING COMPONENT
FOR ROAD , BRIDGE, AND IRRIGATION
(Use Construction Management consultant)

Total Construction Cost (1000 USD) / **Construction Component**	**<= 600**	**600 - 1,200**	**1,200 - 2,400**	**2,400 - 5,000**	**5,000 - 7,500**	**7,500 - 10,000**	**10,000 - 12,500**	**12,500 - 25,000**	**25,000 - 50,000**	**50,000 - 125,000**	**125,000 - 250,000**	**250,000 - 500,000**
1	2	3	4	5	6	7	8	9	10	11	12	13
1. PHYSICAL CONSTRUCTION (%)	84,70	84,70 sd 86,39	86,39 sd 88,09	88,09 sd 90,68	90,68 sd 91,39	91,38 sd 92,06	92, 06 sd 92,43	92,43 sd 92,71	92,71 sd 93,47	93,47 sd 94,11	94,11 sd 94,76	94,76 sd 95,18
2. DESIGN (%)	8,00	8,00 sd 6,80	6,80 sd 5,70	5,70 sd 4,75	4,75 sd 4,50	4,50 sd 4,25	4,25 sd 4,07	4,07 sd 3,94	3,94 sd 3,57	3,57 sd 3,25	3,25 sd 2,89	2,89 sd 2,66
3. SUPERVISION (%)	6,00	6,00 sd 5,60	5,60 sd 5,33	5,33 sd 4,00	4,00 sd 3,65	3,65 sd 3,33	3,33 sd 3,17	3,17 sd 3, 04	3,04 sd 2,71	2,71 sd 2,44	2,44 sd 2,19	2,19 sd 2,04
4. PROJECT MANAGEMENT (%)	1,30	1,30 sd 1,21	1,21 sd 0,88	0,88 sd 0,57	0,57 sd 0,47	0,47 sd 0,36	0,36 sd 0,33	0,33 sd 0,31	0,32 sd 0,25	0,25 sd 0,20	0,20 sd 0,16	0,16 sd 0,12
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

CLOSING

We thank the SMM Team whose names apper below, for their tireless effort which has resulted in the completion of this TIMOR LESTE STANDARD METHOD OF MEASUREMENT, we hope that our work does not only end here but continue to improve alongside the rapid development in science and technology as well as with the experience of all of the stakeholders. We also thank the relevant stakeholders such as Line Ministries, Contractors, and Consultants in Timor-Leste who have given valuable and useful feedback in preparing this document.

We thank the Prime Minister of Timor-Leste for his vision and leadership and his continuous support to A.D.N. particularly in the area of Standard Method of Measurement.

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We hope that what has been started by our colleagues will be continued by the next generation of ADN in the future for the development of Timor-Leste.
We welcome any comments and inputs to further improve the document in its next publication.

Dili, January 2015
National Development Agency

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