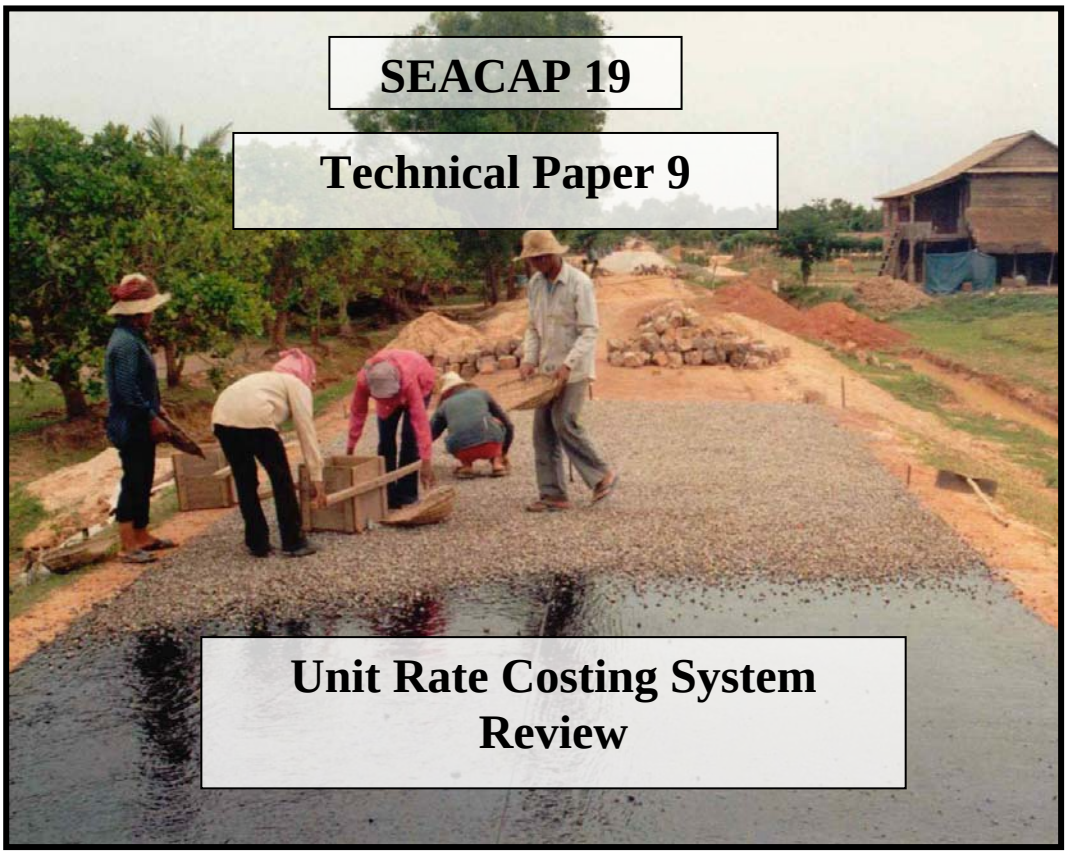
ROYAL GOVERNMENT OF CAMBODIA

SOUTH EAST ASIA COMMUNITY ACCESS PROGRAMME

DEVELOPMENT OF LOCAL RESOURCE BASED STANDARDS



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SOUTH EAST ASIA COMMUNITY ACCESS PROGRAMME

SEACAP 19
DEVELOPMENT OF LOCAL RESOURCE BASED STANDARDS

Technical Report 9

Unit Rate Costing System Review

By

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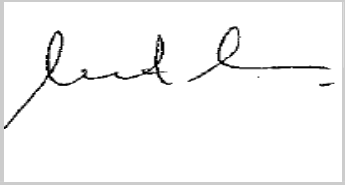
Task Manager **Akram Ahmedi**	
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ABBREVIATIONS & ACRONYMS

ADB	Asian Development Bank
CNCTP	Cambodia National Community of Transport Practitioners
DfID	Department for International Development
EIC	Engineering Institution of Cambodia
ENS	Engineered Natural Surface
gTKP	global Transport Knowledge Partnership
ILO	International Labour Organisation
ITC	Institute of Technology of Cambodia
KACE	Khmer Associated Consulting Engineers
KaR	Knowledge and Research
km	kilometre
LBAT	Labour-Based Appropriate Technology
m	metre(s)
mm	Millimetre(s)
MPa	Mega pascals
MPW&T	Ministry of Public Works and Transport (Cambodia)
MRD	Ministry of Rural Development (Cambodia)
NGOs	Non-Governmental Organisations
NRDP	North-western Rural Development Project
ORN	Overseas Road Note
PDP	Provincial Development Programme
PDRD	Provincial Department of Rural Development
PIARC	World Road Association
QA	Quality Assurance
Ref.	Reference
RFP	Request for Proposal
RGoC = RGC	Royal Government of Cambodia
SEACAP	South East Asia Community Access Programme
SEILA	Multilateral donors - Government Rural Infrastructure Development Programme
SIDA	Swedish International Development Agency
SOE	State Owned Enterprise
TMP	Transport Mainstreaming Partnership
ToR	Terms of Reference
TRIP	Tertiary Roads Improvement Project
TRL	Transport Research Laboratory
UK	United Kingdom
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNOPS	United Nations Office for Project Services
WB	World Bank
WLC	Whole Life Costs

- **TASK 9 – UNIT RATE COSTING SYSTEM**

Appendix A

1 Introduction

The SEACAP 19 Task 9 ToR require a Unit rate-costing system that will**:**

- Prepare a unit rate-costing system which relates to materials, surface options and expected maintenance costs.
- Prepare the computer program to do this with supporting guidelines for operation.
- Present the outcome to the stakeholders.
- Upload the outcomes of the research onto the CNCTP and gTKP websites.

On proceeding with this assignment it was noted that a unit rate costing system had in fact already been prepared by the Ministry of Public Works and Transport (MPWT). The system was in fact quite comprehensive. The costing system relates to materials, equipment and labour used for road works. Following discussions with the Ministry this study therefore focused on the review of the system. Essentially this constituted reviewing the "Construction Cost Analysis" - (CCA) document proposed by the Ministry of Public Works and Transport (MPWT). This document in turn relates to the MPWT Cambodian Construction Specification.

Before analysing the document there is need to discuss some important issues relating to costing which are often neglected. The situation can lead to unsupported and incorrect decision making at policy, investment and operational level and the inefficient or inappropriate use of the resources available. Some of these issues referred to include:

Method of Implementation

Actual costs are affected by method of implementation. For a force account operation, finance and depreciation components for equipment and operational overheads may not be documented or appreciated. However they will be incurred somewhere in the system. Contractors will naturally have to include all of these costs in their contract prices, plus allowances for profit, late payment and other risks. To make a valid comparison between force account and contractor implementation, a full costing should be carried out of both systems to include all of the components discussed in this paper.

Outline Costing: Operating Environment Factors

Actual costs can vary according to a range of 'operating environment' factors. This will influence tender prices. These factors may include the following and need to be considered in preparation of unit costs:-

For efficient management of a road network it is necessary to keep careful historical and current records of works costs. This will be necessary for planning and budgeting purposes, and also for evaluation of tenders from contractors.

It will probably be necessary to adjust figures for inflation, as this may be significant. This can sometimes be achieved with reference to statistics collected and presented by the Government statistical office. Where these are not reliable, or are non-existent, then costing and inflation adjustment becomes both more problematic and resource consuming.

Historical costs can be inflated approximately using knowledge of the percentage components affected by key items such as labour, new plant costs, diesel, transport haulage, and applying inflation factors to these components. Significant movements in currency exchange rates will also affect imported items/components and overall construction and maintenance costs.

- size of project (economies of scale)
- location (mobilisation & demobilisation costs) & type of project
- contractor's experience and expertise
- financial arrangements and health of the contracting enterprise
- availability of resources
- market conditions (scarcity or surplus of work)
- nature of the competition
- general reputation of the client and client's advisers
- specifications and quality standards and how strictly they will be adhered to
- client's reputation and ability to ensure timeliness of due payments
- labour relations and government attitude/directives regarding labour issues
- local inflation, loan interest rates and currency exchange rate stability
- quality and adequateness of the contract documents and arrangements
- actual or perceived risks.

:

2 Document Structure

2.1 Cambodian Construction Specification

The Cambodian Construction Specification (CCS) comprises the following sections:

- Section 1 General Specification
- Section 2 Earthworks and Allied Activities
- Section 3 Sub-base and Base Course
- Section 4 Bituminous Works
- Section 5 Structures
- Section 6 Drainage and Protection Works
- Section 7 Ancillary Works
- Section 8 Unexploded Ordnance
- Section 9 Miscellaneous
- Section 10 Dayworks

2.2 Construction Cost Analysis

The Construction Cost Analysis (CCA) document comprises the following sections:

- Unit cost rates for works activities
- Cost rates for material
- Cost rates for equipment
- Cost rates for labour
- Breakdown of unit cost rates
- Haulage costs
- Labour outputs in manual operations
- Loose factors for materials

2.2.1 Unit Costs Rates

The first part of the CCA document lists unit cost rates that relate to activities specified in the Cambodian Construction Specification for which payment will be made. These unit cost rates are reviewed in detail in Section 3.

The unit costs of the works activities comprise costs associated with material, equipment and labour. These individual costs are listed in the following sections of the CCA document as detailed below.

2.2.2 Materials

In the CCA document, materials are categorised as follows:

- Generated Materials from Nature
- Steel Construction

- Petroleum Products
- Factory Products/Concrete
- Factory Products/Plastic
- Factory Products/Timber
- Other Products

Generated Materials from Nature
In this category unit costs are provided for various materials such as soil, laterite, sand, crushed rock, aggregate, rock rip rap, crusher dust, cement, lime and brick.

Steel construction
In this category unit costs are provided for various steel products such as steel reinforcement, steel shapes (U, L, I, O, H), pipes, plates, piles, railings, zinc (corrugated sheets), bolt & nut, nail, wire and tools (pickaxe, machete, shovel, axe, hammer, chisel).

Petroleum Products
In this category unit costs are provided for various petroleum products such as a range of bitumens (pen grades, emulsions, prime coat, seal coat), fuels (kerosene, gasoline, diesel), oils (engine, hydraulic, braking), welding (rod, acetylene, oxygen) and paint.

Factory Products/Concrete
In this category unit costs are provided for various concrete products such as a range of box girders, piles, pipes, concrete of different strengths, etc.

Factory Products/Plastic
Unit costs are provided for a range of PVC pipes.

Factory Products/Timber
In this category unit costs are provided for different types of timber and plywood.

Other Products
In this category unit costs are provided for items such as piles, gabion mattresses, geotextile, basket, hoes and grass.

2.2.3 Equipment

In section 10 of the CCS document, 20 types of construction equipment are listed. In the CCA document the unit costs of these 20 types plus other construction equipment have been listed. The equipment ranges from dozers, rollers, motor grader, loader, trucks, cranes, concrete mixer, bitumen distributor, chip spreader, asphalt paver, generator, etc.

2.2.4 Labour

In section 10 of the CCS document, 10 types of labourer are listed. In the CCA document many more types of labourers are listed which have been split into 3 categories:

- Technical Personnel
- Administrative and Support Personnel
- Workshop and Construction Personnel

Technical Personnel
Monthly cost rates are provided for a range of engineers, draftsman and a technician.

Administrative and Support Personnel
Monthly cost rates are provided for office staff (manager, assistant), accountant, secretary, typist, clerk, cleaner, etc.

Workshop and Construction Personnel
Hourly fee rates are provided for labourers, ganger, mason, carpenter, plumber, electrician, glazier, drivers and equipment operators.

2.2.5 Cost Breakdown

This section of the CCA document gives unit cost breakdowns in terms of material, equipment and labour of the works activities listed in the first part of the CCA document. These unit costs also include a 25% increase for overheads and miscellaneous items. The derived daily cost for each activity is based on an assumed productivity level of that activity.

2.2.6 Haulage Costs

The next section of the CCA document lists the cost of hauling material in either a dump truck or a trailer. Rates per cubic metre and per ton are given for hauling distances from 1 km to 200 km.

2.2.7 Labour Outputs

The next section of the CCA document lists the outputs of labour in manual operations for the following activities:

- Open Excavation – sand, loam, clay (man-hours / m^3)
- Trench excavation – earth, clay, soft shale (man-hours / m^3)
- Loading excavated materials – sand, loam, clay broken stone (man-hours / m^3)
- Spreading and levelling – sand, loam, clay (man-hours / m^3)
- Loading onto trucks – steelwork, reinforcement, pipes, timber (man-hours / tonne)
- Laying and jointing pipes (man-hours / m)
- Reinforcement, handling and fixing (man-hours / tonne)
- Reinforcement, laying mesh (man-hours / m^2)
- Painting (man-hours / m^2)

2.2.8 Loose Factors

A proportion of the quantity of a material is lost during the transportation and handling processes. Furthermore, the volume of a material may be reduced (e.g. compacted) during the installation process. The last section in the CCA document lists these ‘loose factors’ for a wide range of materials.

For example, 1.5% of diesel is lost during the transportation & handling process compared with 10% for sand. There is no reduction in the volume of diesel when used, whereas it is estimated that the volume of sand is reduced by 30% when compacted. Therefore the 'loose factor' for diesel is 1.015 and 1.40 for sand. It is perhaps worth noting that figures for natural construction materials do not appear to include a "bulking factor" from in situ volumes to loose excavated volumes.

3 Unit Cost Rates

Unit cost rates in the CCA document are cross referenced to activities in the CCS document for which payment will be made as detailed below.

3.1 Earthworks and Allied Activities

The activities covered under Earthworks and Allied Activities in Section 2 of the CCS document are as follows:

- Clearing and Grubbing
- Roadway Excavation
- Borrow
- Channel Excavation
- Structural Excavation and Backfill
- Embankment
- Removal of Existing Structures

The unit costs provided in the CCA document related to these activities are summarised below.

3.1.1 Clearing and Grubbing

The specifications state that payment for clearing and grubbing will be made on a per m^2 basis. The CCA document gives a unit cost rate for clearing and grubbing. This cost rate is based on a productivity level of 3000 m^2 per day and comprises the following items:

- Equipment
  - Dozer
  - Excavator
  - Dump Truck
- Labour
  - Foreman
  - Labourers (4)

3.1.2 Roadway Excavation

The specifications state that payment for three types of roadway excavation (common, unsuitable and rock) will be made on a per m^3 basis. Unit costs are given in the CCA document for these three types of roadway excavation. These cost rates are based on a productivity level of 450, 400 and 70 m^3 per day for common, unsuitable and rock excavation respectively, and comprise the following items:

- Equipment
  - Excavator
  - Dump Trucks (5 for common & unsuitable; 2 for rock)
- Labour
  - Foreman
  - Labourers (4)

3.1.3 Borrow

The specifications state that no payment will be made to a Contractor for borrow. Hence, no unit costs are provided in the CCA document for borrow.

3.1.4 Channel Excavation

The specifications state that payment for two types of channel excavation (common and rock) will be made on a per m^3 basis. Unit costs are given in the CCA document for these two types of channel excavation. These cost rates are based on a productivity level of 450 and 70 m^3 per day for common and rock excavation respectively, and comprise the following items:

- Equipment
  - Excavator
  - Dump Truck (5 for common; 2 for rock)
- Labour
  - Foreman
  - Labourers (4)

3.1.5 Structural Excavation and Backfill

The specifications state that payment for three activities, namely structural excavation (common and rock) and structural backfill, will be made on a per m^3 basis. Unit costs are provided for these three activities in the CCA document. Also provided is a unit cost for structural excavation in water.

A breakdown of costs for structural excavation (common, rock and in water) is provided but no breakdown for structural backfill is given. The structural excavation cost rates are based on a productivity level of 170, 40 and 30 m^3 per day for common, rock and in water excavation respectively, and comprise the following items:

- Equipment
  - Excavator
  - Dump Truck (2 for common; 1 for rock and in water)
- Labour
  - Foreman
  - Labourers (4)

3.1.6 Embankment

The specifications state that payment for three activities, namely embankment, sand embankment and selected subgrade material, will be made on a per m^3 basis. Unit costs are given in the CCA document for these three activities. Also in this section unit costs for a rock embankment and for drilling and blasting solid rock material are given.

A breakdown of costs for embankment, subgrade material and for drilling and blasting rock is provided but no breakdown for sand or rock embankment is given. The cost rates are based on a productivity level of 800 and 600 m^3 per day for embankment and subgrade respectively, and comprise the following items:

- Material

- Soil (subgrade material only)

- Equipment
  - Motor Grader
  - Excavator
  - Dozer
  - Vibratory Roller
  - Pneumatic tyred Roller (embankment only)
  - Water Truck with spraybar
- Labour
  - Foreman
  - Labourers (6 for embankment, 10 for subgrade material)

The cost rate for drilling and blasting rock is based on a productivity level of 200 m^3 per day and comprises the following items:

- Material
  - Ammonium Nitrate
  - Detonators
  - Leg Wire
- Equipment
  - Crawler driller
  - Pneumatic Hand Driller
  - Air Compressor
- Labour
  - Foreman
  - Labourers (4)

3.1.7 Removal of Existing Structures

The specifications state that no separate items for the removal of existing drainage structures are in contracts. Hence, no unit costs are provided in the CCA document for this activity.

3.2 Sub-base and Base Course

The items covered under Sub-base and Base Course in Section 3 of the CCS document are as follows:

- Sub-base
- Reconstructed Sub-base
- Aggregate Base
- Cement Stabilised Base and Sub-base
- Lime Stabilised Base
- Shoulders

The unit costs provided in the CCA document related to these items are summarised below.

3.2.1 Sub-base

The specifications state that payment for sub-base and sand cushion will be made on a per m^3 basis. Unit costs are given in the CCA document for these two activities.

A breakdown of costs for sub-base is provided but no breakdown for sand cushion is given. The cost rate for sub-base is based on a productivity level of 550 m^3 per day and comprises the following items:

- Material
  - Laterite
- Equipment
  - Motor Grader
  - Dozer
  - Vibratory Roller
  - Water Truck with spraybar
- Labour
  - Foreman
  - Labourers (10)

The use of "laterite" as a specific and sole material is potentially misleading. The term laterite is much abused and in practical terms is often used to describe materials varying from red clays to true clayey gravels. Unless "laterite" is clearly defined in accompanying documents it should be avoided and the term "suitable natural gravel" used.

3.2.2 Reconstructed Sub-base

The specifications state that payment for reconstructed sub-base and for additional sub-base material will be made on a per m^2 and m^3 basis respectively. Unit costs are given in the CCA document for these two activities. No breakdown of the unit costs for these two activities is provided.

3.2.3 Aggregate Base

The specifications state that payment for aggregate base course will be made on a per m^3 basis. Unit costs are given in the CCA document for this activity. This cost rate is based on a productivity level of 300 m^3 per day and comprises the following items:

- Material
  - Crushed rock
- Equipment
  - Motor Grader
  - Vibratory Roller
  - Water Truck with spraybar
- Labour
  - Foreman
  - Labourers (10)

It is possible that high quality "natural gravels" may also be suitable for use as base material, particularly in Low Volume Rural Road construction.

3.2.4 Cement Stabilised Base and Sub-base

The specifications state that payment for cement stabilised base and sub-base will be made on a per m^3 basis. Unit costs are given in the CCA document for these two activities. Also listed in the specifications is payment for cement on a per tonne basis for which a unit cost is provided in the CCA document. In addition the CCA document gives the unit cost of cement per m^3.

The breakdown of costs for cement stabilised base is for overlaying soil cement on the top of the base course, based on a productivity level of 350 m^3 per day. Included in the breakdown is a unit cost for 'base course' which is the total cost of all the items listed in Section 3.2.3. The additional items in the breakdown are:

- Material
  - Laterite
  - Cement
- Equipment
  - Concrete Mixer Truck

The breakdown of costs for cement stabilised sub-base comprises all the individual items required for this activity. It is based on a productivity level of 350 m^3 per day and comprises the following items:

- Material
  - Laterite
  - Cement
- Equipment
  - Motor Grader
  - Vibratory Roller
  - Dump Truck
  - Water Truck with spraybar
  - Concrete Mixer Truck
- Labour
  - Foreman
  - Labourers (10)

The comments on the term "laterite" should not be used here. Not only is the term misleading (see 3.2.1) but cement stabilisation is not likely to be a common option for "laterite". Lime stabilisation is a much more likely option, (See SEACAP 19 Technical Report 3)

3.2.5 Lime Stabilised Base

The payment for providing aggregate base is covered in the relevant section described earlier. The specifications state that the additional work of mixing in lime will be made on a per m^3 basis and a unit cost for this activity is provided for in the CCA document. As for cement, the specifications state payment for lime will be made on a per tonne basis, for which a unit cost is provided in the CCA document. No breakdown of the costs for mixing in lime is given.

3.2.6 Shoulders

The specifications state that payment for soil aggregate shoulder will be made on a per m^3 basis. Unit costs are given in the CCA document for this activity. The breakdown of costs

for soil aggregate shoulder is based on a productivity level of 400 m^3 per day and comprises the following items:

- Material
  - Selected Material
- Equipment
  - Motor Grader
  - Vibratory Roller
  - Water Truck with spraybar
- Labour
  - Foreman
  - Labourers (5)

3.3 Bituminous Works

The items covered under Bituminous Works in Section 4 of the CCS document are as follows:

- Bituminous Prime Coat
- Bituminous Surface Treatment
- Bituminous Tack Coat
- Asphaltic Roadbase and Surface Courses
- Asphaltic Concrete Surfacing
- Cold Asphalt
- Repair of Bituminous Works

The unit costs provided in the CCA document related to these items are summarised below.

3.3.1 Bituminous Prime Coat

The specifications state that payment for bituminous prime coat will be made on a per m^2 basis and will include cost of providing, hauling and spraying the prime coat. The unit cost of prime coat in the CCA document is incorrectly labelled as the cost per litre rather than per m^2. The breakdown of costs for prime coat is based on a productivity level of 3000 m^2 per day and comprises the following items:

- Material
  - Concrete
  - Sand
- Equipment
  - Mechanical Road Broom
  - Bitumen Distributor with spraybar
  - Air Compressor
- Labour
  - Foreman
  - Labourers (10)

The specifications also list the provisional payment for prime coat material on a per litre basis. The unit cost for prime coat material is listed in the CCA document as the cost per tonne rather than per litre.

3.3.2 Bituminous Surface Treatment

The specifications state that payment for two bituminous seal coats and two sealing aggregates (19mm & 12mm) will be made on a per m^2 and m^3 basis respectively. Unit costs are given in the CCA document for these four items.

The breakdown of costs for the two bituminous seal coats is based on a productivity level of 3000 m^2 per day and comprises the following items:

- Material
  - Bitumen Emulsion
  - Diesel
- Equipment
  - Mechanical Road Broom
  - Bitumen Distributor with spraybar
  - Air Compressor
- Labour
  - Foreman
  - Labourers (5)

The breakdown of costs for the two sealing aggregates is based on a productivity level of 60 m^3 per day and comprises the following items:

- Material
  - Crushed Rock
- Equipment
  - Chip Spreader
  - Vibratory Roller
  - Dump Truck
- Labour
  - Foreman
  - Labourers (6)

The specifications also list the provisional payment for bitumen and bitumen additives on a per litre basis. The unit costs for a range of bitumen, cutback bitumen, emulsified bitumen and bitumen additive are listed in the CCA document.

3.3.3 Asphalt Roadbase and Surface Courses

Payments related to these items are covered in the other respective sections of the specifications.

3.3.4 Asphalt Concrete Surface

The specifications state that payment will be made for asphaltic concrete levelling course, wearing course and binder course. Payment for the levelling course is on a per tonne basis and on a per m^3 basis for the wearing course and binder course. Unit costs are given in the CCA document for these three activities, but no breakdown of the costs is provided.

The specifications also list the provisional payment for bitumen and bitumen additives on a per litre basis. The unit costs for a range of bitumens are listed in the CCA document as described for bituminous surface treatment in Section 3.3.2.

3.3.5 Cold Asphalt

The specifications state that payment will be made for three types of cold asphalt (fluxed, cutback and emulsion) on a per m^3 basis. Unit costs are provided for these three types of cold asphalt in the CCA document, but no breakdown of the costs is provided.

3.3.6 Repair of Bituminous Works

The specifications state that payment will be made for repair of cracking, potholes, edge break, depressions and pavement failure on a per m^2 basis. Unit costs are provided for these types of repair in the CCA document. The breakdown of costs for soil aggregate shoulder is based on a productivity level of 500 m^2 for cracking, depressions and failures, and 250 m^2 per day for potholes and edge break. The costs comprise the following items:

- Material
  - Bitumen Emulsion
  - Laterite
  - Crushed Rock
  - Diesel
- Equipment
  - Air Compressor
  - Rammer (2 for cracking and potholes, 1 for edge break, depressions & failures)
  - Vibratory Roller (cracking, depressions and failures)
  - Flat-bed Truck
  - Mechanical Road Broom (failures only)
  - Chip Spreader (failures only)
  - Excavator (failures only)
- Labour
  - Foreman
  - Labourers (10 for cracking and potholes, 5 for edge break, depressions, failures)

Also provided are costs for patching with water-bound or penetration macadam and SBST. The breakdown of costs for patching with macadam and SBST is based on a productivity level of 1200 m^2 per day and comprises the following items:

- Material
  - Bitumen Emulsion
  - Soil (Water-bound Macadam only)
  - Crushed Rock (SBST only)
  - Aggregate
  - Diesel
- Equipment
  - Mechanical Road Broom
  - Bitumen Distributor
  - Air compressor
  - Backhoe/Loader

- Vibratory Roller
- Pneumatic-tyred Roller (macadam only)
- Water Truck with spraybar
- Dump Trucks (6)
- Flat-bed Truck

➢ Labour
- Foreman
- Labourers (15)

The breakdown of costs for filling road surface with laterite is based on a productivity level of 2400 m^2 per day and comprises the following items:

➢ Material
- Laterite

➢ Equipment
- Dozer
- Motor Grader
- Mechanical Road Broom
- Vibratory Roller
- Pneumatic-tyred Roller
- Water Truck with spraybar
- Dump Trucks (6)

➢ Labour
- Foreman
- Labourers (6)

3.4 Structures

The items covered under Structures in Section 5 of the CCS document are as follows:

- Concrete
- Reinforcement
- Driven Piles
- Prestressed Concrete
- Steel Structures
- Railing
- Damp Proofing and Waterproofing
- Porous Backfill Material
- Expansion Materials in Bridges
- Conduits, Fittings and Boxes
- Painting Metal Structures
- Foundation Investigation
- Survey

The unit costs provided in the CCA document related to these items are summarised below.

3.4.1 Concrete

The specifications state that payment will be made for five classes of concrete on a per m^3 basis. Unit costs are provided for seven classes of concrete in the CCA document. The breakdown of costs for concrete is based on a productivity level of 24 m^3 per day and comprises the following items:

- Material
  - Cement
  - Coarse Concrete Aggregate
  - Sand
- Equipment
  - Concrete Mixer Truck
  - Backhoe/Loader
- Labour
  - Foreman
  - Labourers (10)

3.4.2 Reinforcement

The specifications state that payment will be made for three types of reinforcement (plain reinforcing bar, deformed reinforcing bar and wire mesh) on a per tonne basis. Unit costs are provided for a range of steel reinforcement sizes in the CCA document. No breakdown of costs for these items is given.

3.4.3 Driven Piles

The specifications state that payment will be made for three types of piles (RC, PSC and timber) on a per metre basis. Unit costs are provided for several sizes of RC piles in the CCA document but not for PSC or timber piles. No breakdown of costs for these items is given.

The specifications also state that payment will be made for static and dynamic load tests on the three types of piles based on the number of tests. Unit costs are provided for both static and dynamic load tests on the three types of piles in the CCA document. No breakdown of costs for these items is given.

3.4.4 Prestressed Concrete

The specifications state that payment will be made for PSC deck units, PSC super T units and transverse stressing bars based on the number of tests. Unit costs are provided for the construction of a range of prestressed concrete deck units, super T units and transverse stressing bars.

3.4.5 Steel Structures

The specifications state that payment will be made for two grades of structural steel (grades 36 and 50) on a per tonne basis. Unit costs are provided for these two grades of steel structure in the CCA document. No breakdown of costs for these items is given.

3.4.6 Railing

The specifications state that payment will be made for railings on a per linear metre basis. Unit costs are provided for these three types of railings in the CCA document. No breakdown of costs for these items is given.

3.4.7 Damp Proofing and Waterproofing

The specifications state that payment will be made for damp proofing, membrane waterproofing and thin membrane waterproofing on a per m^2 basis. Unit costs are provided for these three activities in the CCA document. No breakdown of costs for these items is given.

3.4.8 Porous Backfill Material

The specifications state that payment will be made for two types of porous backfill material (rock and sand) on a per m^3 basis. Unit costs are provided for these two types of backfill material in the CCA document. No breakdown of costs for these items is given.

3.4.9 Expansion Material in Bridges

The specifications state that payment will be made for six types of expansion material for bridges. Unit costs are provided for a variety of these six types of material in the CCA document. No breakdown of costs for these items is given.

3.4.10 Conduits, Fittings and Boxes

The specifications state that payment will be made for each item under this activity. Unit costs are provided for these items in the CCA document. No breakdown of costs for these items is given.

3.4.11 Painting Metal Structures

The specifications state that payment will be made for two protective treatments of metal structures (shop and field) on a per m^2 basis. Unit costs are provided for these two activities in the CCA document. No breakdown of costs for these items is given.

3.4.12 Foundation Investigation for Bridges

The specifications state that payment will be made for foundation investigation for bridges. Unit costs are provided for this activity in the CCA document. No breakdown of costs for these items is given.

3.4.13 Survey

The specifications state that payment will be made for survey for bridges and box culverts. Unit costs are provided for this activity in the CCA document. No breakdown of costs for these items is given.

3.5 Drainage and Protection Works

The items covered under Drainage and Protection Works in Section 6 of the CCS document are as follows:

- Reinforced Concrete Culvert Pipes
- Rip Rap and Concrete Slope Protection
- Sub-Surface Drains
- Minor Drainage Structures
- Concrete Barrier, Curb and Gutter
- Grassing of Slopes
- Topsoil
- Bridge Drainage
- Gabions

The unit costs provided in the CCA document related to these items are summarised below.

3.5.1 Reinforced Concrete Culverts

The specifications state that payment will be made for a range of reinforced concrete pipes on a metre basis. Unit costs are provided for a wide range of concrete pipes in the CCA document. The breakdown of costs for reinforced concrete pipes (excluding excavation and backfilling) is given on a per metre basis and comprises the following items:

- Material
  - Reinforced Concrete Pipe
  - Installation
- Labour
  - Foreman
  - Labourers (4)

3.5.2 Rip Rap and Concrete Slope Protection

The specifications state that payment will be made for a range of rip raps, reinforced concrete slope protection, ditch lining and drain chutes. Unit costs are provided for these items in the CCA document. No breakdown of costs for these items is given.

3.5.3 Sub-Surface Drains

The specifications state that payment will be made for subdrains. Unit costs are provided for perforated PVC pipe and rockfill subdrains in the CCA document. No breakdown of costs for these items is given.

3.5.4 Minor Drainage Structures

The specifications state that payment will be made for curbs, gutters, barriers and markings. Unit costs are provided for a variety of these types of drainage structures in the CCA document. No breakdown of costs for these items is given.

3.5.5 Grassing of Slopes

The specifications state that payment will be made for grassing by sodding, sprigging and seeding on a per m^2 basis. Unit costs are provided for these types of grassing in the CCA document. The breakdown of costs for sodding is based on a productivity level of 230 m^2 per day and comprises the following items:

- Material
  - Grass
  - Other Materials (5% of other material costs)
- Equipment
  - Dump Truck
  - Water Truck with spray bar
  - Other Equipment (5% of other equipment costs)
- Labour
  - Foreman
  - Labourers (25)

3.5.6 Topsoil

The specifications state that payment will be made for topsoil for medians, embankment slopes and side drains. Unit costs are provided for these activities in the CCA document.

3.5.7 Bridge Drainage

The specifications state that payment will be made for two types of bridge drainage (gully and grating). Unit costs are provided for both types of drainage in the CCA document. No breakdown of costs for these items is given.

3.5.8 Gabions

The specifications state that payment will be made for gabion boxes and mattresses on a per m^3 basis. Unit costs are provided for the supply of various gabions and mattresses, and for their placement on either a per m^3 basis or by the number. The breakdown of costs for placing gabions is based on a productivity level of 5 per day and comprises the following items:

- Material
  - Heavy Galvanised Gabion Mattresses
  - Rock Rip Rap
  - Other Materials (5% of other material costs)
- Equipment
  - Dump Truck
  - Excavator
  - Other Equipment (5% of other equipment costs)
- Labour
  - Foreman
  - Labourers (10)

3.5.9 Special

Unit costs are provided in the CCA document for the placement of geotextiles and stone masonry on a per m^2 basis, and for cleaning culverts and side drains on a per metre basis. These activities are not listed in the CCS document and hence have been labelled as special in the CCA document.

The breakdown of costs for placing geotextiles is based on a productivity level of 1500 m^2 per day and comprises the following items:

- Material
  - Geotextile
  - Other Materials (5% of other material costs)
- Equipment
  - Dump Truck
  - Other Equipment (5% of other equipment costs)
- Labour
  - Foreman
  - Labourers (10)

No breakdown of costs is given for the placement of stone masonry.

The breakdown of costs for cleaning culverts and side drains is based on a productivity level of 10 culverts per day and 500 metres of side drains per day. The costs comprise the following items:

- Material
  - Baskets (5 for culverts, 10 for side drains)
  - Hoes (2 for culverts, 10 for side drains)
  - Shovels (2 for culverts, 10 for side drains)
- Equipment
  - Flat-bed Truck
- Labour
  - Foreman (1 for culverts, 2 for side drains)
  - Labourers (4 for culverts, 20 for side drains)

4 Ancillary Works

The items covered under Ancillary Works in Section 7 of the CCS document are as follows:

- Concrete Sidewalks
- Guard Rail
- Fencing
- Markers and Guide Posts
- Road Signs
- Street Lighting
- Road Traffic Signals
- Road Markings
- Bus Stop Shelter

No unit costs have been listed for these items in the CCA document.

5 Unexploded Ordnance

The items covered under Unexploded Ordnance in Section 8 of the CCS document are as follows:

- Land Mine Clearance
- Unexploded Ordnance Clearance

No unit costs have been listed for these items in the CCA document.

6 Miscellaneous

The items covered under Miscellaneous in Section 9 of the CCS document are as follows:

- Facilities for the Engineer
- Transport for the Engineer
- Materials Testing & Quality Control
- Survey and Setting Out
- Traffic and Traffic Control
- Progress Photographs
- Site Clean-up
- Socially Transmitted Diseases Information and Education Programme

No unit costs have been listed for these items in the CCA document.

7 Dayworks

This section of the specifications deals with works associated with furnishing of labour, materials and equipment to carry out specific activities instructed by the Engineer. The CCS document lists 10 labourers and 20 types of equipment (see Sections 2.2.3 and 2.2.4 of this report). As stated in these sections, the CCA document provides unit costs for these and other types of labourer and equipment, which are used to provide unit cost rates for the various activities described in Section 3 of this report.

8 Discussion

8.1 General

The Construction Cost Analysis document produced by MPWT is an important step in developing a recognised structure for estimating unit cost rates for activities associated with road works in Cambodia. A great deal of work has gone into producing this report which is now subject to review and further enhancements. Comments on the CCA document made in this report under Task 9 of SEACAP 19 should be viewed as constructive views aimed at improving a valuable document.

The CCA document has been developed for broad use within the Cambodian road construction environment. If a version of the CCA document is intended specifically for use in LVRR situations, it is recommended that a review is necessary to remove unnecessary items, focus on appropriate technology and add items related to recently developed pavement options.

Activities that have been costed in the CCA document relate to activities listed in the Cambodian Construction Specification. However, not all activities listed in the specifications have been included in the CCA document. A thorough review of the two documents has therefore to be undertaken to ensure all activities listed in the specifications have unit cost rates.

Also not all the unit cost rates quoted in the CCA document have been broken down into components in the cost breakdown section. It is understood that a spreadsheet exists which contains the cost breakdown of activities. Only part of this spreadsheet was made available for this review. This is attached as Appendix A to this report.

That the full spreadsheet was not made available suggests that the CCA is not extensively available. As indicated earlier the CCA is a very useful tool that should be easily accessible. It is recommended that the spreadsheet be made available as a full package. If this has not been initiated a small extension to the SEACAP 19 project could easily achieve this.

Some of the activities that have been costed should be more clearly defined. For example, the activity ‘repair of cracking’. Cracks can be repaired in several ways such as crack sealing, surface patching or removing areas that are cracked to the full depth of the bituminous layer and then full depth patching these areas. The costs of these various activities will obviously be different and so the activity should be clearly defined. The specifications refer to crack sealing as the method of repairing cracks. Hence repair of cracking should be more appropriately labelled as ‘crack sealing’.

The activity ‘repair of pavement failure’ is costed on a per m^2 basis. The depth that the pavement is repaired will vary from case to case. Hence it is probably more appropriate to cost this activity on a per m^3 basis. Similarly the other activities under the ‘repair of bituminous works’ section should be costed on a per m^3 basis.

The unit costs of material are sometimes based on an average haul distances. It may be useful to have the material unit costs listed explicitly as a function of haul distance so that users can readily adjust these costs for varying haul distances.

Labour cost rates may vary from region to region. For example labour rates in Phnom Penh are likely to be higher than in remote rural areas. Hence it may be appropriate to have several labour rates for different regions of the country.

The unit costs listed in the CCA document are average costs based on values used in contracts. Comments made during meetings with MPWT indicated that many of these unit costs are out-of-date, primarily due to the current large increases in fuel costs. However, the proportion of the unit cost that is accounted for by fuel is not evident in the CCA document.

It is therefore suggested that unit costs of these items could be broken down into smaller components so that changes in the cost of any individual component would be reflected in the total unit cost of that item, as illustrated in the examples below.

Example 1 - Equipment

Unit costs for equipment are given as daily rates. These daily rates could be broken down by components.

For example, daily rates for motorised equipment could be estimated by summing the daily cost rates for components such as those shown in Table 1.

Table 1 Motorised Equipment Unit Cost Rate Components

		Component	Quantity per day	Unit cost per day	Daily cost
Vehicle (motor grader, vibrating roller, front end loader, bulldozer, truck, water bowsers, etc)	Daily	Fuel	a	b	a.b
		Engine Oil	c	d	c.d
	Annual Services	Engine Oil	e	f	e.f/240
		Gear oil	g	h	g.h/240
		Hydraulic Oil	i	j	i.j/240
		Brake Fluid	k	l	k.l/240
		Filters	m	n	m.n/240
		Grease	o	p	o.p/240
		Parts	q	r	q.r/240

NB – To estimate the daily costs from the annual costs, it is assumed that there are on average 20 working days in a month – i.e. 240 working days a year.

The annual quantity of each component can be estimated from service records. The daily fuel consumption can be estimated either from vehicle log books or by knowing the daily kilometrage of the vehicle together with its fuel consumption rate.

By having unit cost rates split into various components, it is relatively straightforward to update the costs if there are changes in the cost of a particular component, such as the current situation with the regular global price increases in oil.

Example 2 – Routine Maintenance

Similarly routine maintenance such as culvert clearing carried out by labour could be broken down by components as shown in the example in Table 2.

Table 2 Culvert Clearing Unit Cost Rate Components

	Component	Quantity per day	Unit cost per day	Daily cost
Labour	Technician	a	b	a.b
	Labourer	c	d	c.d
Equipment	Shovels	e	f	e.f
	Pick Axes	g	h	g.h
	Hoes	i	j	i.j
	Pakeak	k	l	k.l
	Road Working Signs	m	n	m.n
	Luminous Jackets	o	p	o.p
	Transport to/from site	q	r	q.r

The daily unit costs of the equipment could be estimated based on the cost of a new item divided by the length of time (in working days) that on average the item lasts.

In summary, the unit rate cost system is quite comprehensive and will be very useful in preparing costs estimates of projects at all levels including in preparing departmental budgets but it does need to be readily available to all the stakeholders. Presently it seems to lack that and therefore consideration should be given to prepare a thorough and comprehensive system that is readily available. It also needs to be disseminated effectively.

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SOUTH EAST ASIA COMMUNITY ACCESS PROGRAMME

SEACAP 19
DEVELOPMENT OF LOCAL RESOURCE BASED STANDARDS

Technical Report 9

Unit Rate Costing System Review

Appendix A

Cost-Breakdown of Typical Items

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1100

Patch Bituminous Surface (Cold Mix)

	Q'ty	Unit							
Surface	100	m^2							
Transport Distance									
Agg. Mix M30	40	Km	x	2	=	80	Km		
Water	15	Km	x	2	=	30	Km		
Site to P.P	100	Km	x	2	=	200	Km		
Materials									
Agg.Mix	100	m^2	x	0.2	x	1.2	24	m^3	
Cold Mix							100	m^2	
		24	x	12	$/m^3$	=	$ 288.00		
		100	x	7.5	$/m^2$	=	$ 750.00		
					Total	**=**	**$ 1,038.00**		

Fuel for Equipment and Transport Materials:										
Agg. M30	24	x	1.6	x	80	x	0.045	138.24	L
Water	24	x	0.05	x	30	x	0.06	2.16	L
Air Comprssor	100	/	100	x	6	x	6	36	L
Breaker Machine	100	/	30	x	6	x	6	120	L
Compact.	24	/	100	x	6	x	6	8.64	L
Site to P.P			1	x	200	x	0.15	30	L
							D.O	**335.04**	**L**
Water Pump E.A	24	x	0.05	x	1.2	x	0.2	0.29	L
Fuel Cost									
	D.O		335.04	x	0.43	=	$ 144.07		
	E.A		0.29	x	0.625	=	$ 0.18		
	M.O	3%	10.060	x	2	=	$ 20.12		
						Total	**$ 164.37**		
Labor Cost	100	/	5	=	20	Men day			
	Skill Labor		30%	20	x	2.5	=	$ 15.00	
	Unskill Labor		70%	20	x	2	=	$ 28.00	
						Total	=	**$ 43.00**	

Total Payment

1	Labor Cost		$	43.00
2	Fuel Cost		$	164.37
3	Mat. Cost		$	1,038.00
4	**Sub-Total 1+2+3**		**$**	**1,245.37**
5	Study cost	2%	$	24.91
6	Equipm.Mobile & Camp	4%	$	49.81
7	Miscellaneous works	3%	$	37.36
8	Repair Equipm.	15%	$	186.81
9	**Total 4+5+6+7+8**		**$**	**1,544.25**

Unit cost per square meter:	**$**	**15.44**	**/m^2**

Note : Cells in blue are changeable

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1170

Patch Bituminous Surface (By MACADAM)

		Q'ty	Unit							
	Surface	100	m^2							
	Transport Distance									
	Agg.	40	Km	x	2	=	80	Km		
	Site to P.P	100	Km	x	2	=	200	Km		
1	**Materials**									
	Agg. 4x6	100	m^2	x	0.12	x	1.2	14.40	m^3	
	Agg. 2x3	14.4	m^3	x	20%		=	2.88	m^3	
	Agg. 1x2	100	m^2	x	0.01	x	1.2	1.20	m^3	
	Asphalt	100	m^2	x	4.5	x	1.06	477.00	Kg	
	Materials									
	Agg. 4x6		14.40	x	8	$/$m^3$	=	$ 115.20		
	Agg. 2x3		2.88	x	16	$/$m^3$	=	$ 46.08		
	Agg. 1x2		1.20	x	16	$/$m^3$	=	$ 19.20		
	Asphalt		477.00	x	0.4	$/Kg	=	$ 190.80		
						Total	=	**$ 371.28**		
2	**Fuel for Equipment and Transport Materials:**									
	Agg.	18.48	x	1.6	x	80	x	0.045	106.44	L
	Air Comprssor	100	/	100	x	8	x	6	48.00	L
	Breaker Machine	100	/	30	x	6	x	6	120.00	L
	Asphalt Sprayer	100	/	100	x	1	x	48	48.00	L
	Diesel for burning Bituminous				477.00		x	0.05	23.85	L
	Compact. 4x6	14.40	/	45	x	6	x	6	11.52	L
	Compact. 2x3	2.88	/	45	x	6	x	6	2.30	L
	Compact. 1x2	100.00	/	500	x	6	x	6	7.20	L
	Site to P.P			1	x	200	x	0.15	30.00	L
								D.O	**397.32**	**L**
	Water Pump E.A	18.48	x	0.05			x	0.2	0.18	L
3	**Fuel Cost**									
		D.O		397.32	x	0.43	=	$ 170.85		
		E.A		0.18	x	0.625	=	$ 0.12		
		M.O	3%	11.925	x	2	=	$ 23.85		
							Total	**$ 194.81**		
4	**Labor Cost**									
	Agg. 4x6 & 2x3	17.28	x	0.5	=	8.64	Men day			
	Asphalt Spray	100	/	5	=	20	Men day			
						28.64	**Men day**			
		Skill Labor		30%	28.64	x	2.5	=	$ 21.48	
		Unskill Labor		70%	28.64	x	2	=	$ 40.10	
							Total	=	**$ 61.58**	

		Total Payment		
1	Asphalt Spray		$	61.58
2	Fuel Cost		$	194.81
3	Mat. Cost		$	371.28
4	**Sub-Total 1+2+3**		**$**	**627.67**
5	Study cost	2%	$	12.55
6	Equipm.Mobile & Camp	4%	$	25.11
7	Miscellaneous works	3%	$	18.83
8	Repair Equipm.	15%	$	94.15
9	**Total 4+5+6+7+8**		**$**	**778.31**

Unit cost per square meter:	**$**	**7.78**	**/m^2**

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1160

Patch Bituminous Surface (DBST)

		Q'ty	Unit								
	Surface	100	m^2								
	Transport Distance										
	Agg. Mix M30	40	Km	x	2	=	80	Km			
	Agg.	40	Km	x	2	=	80	Km			
	Water	15	Km	x	2	=	30	Km			
	Site to P.P	100	Km	x	2	=	200	Km			
1	**Materials**										
	Agg.Mix M30	100	m^2	x	0.2	x	1.2	24.00	m^3		
	Asphalt	100	m^2	x	4.5	x	1.06	477.00	Kg		
	Agg. 19mm	100	m^3	x	0.03	x	1.2	3.60	m^3		
	Agg. 12mm	100	m^2	x	0.01	x	1.2	1.20	m^3		

Materials

Agg.Mix M30	24.00	m3	12	$/m^3$	=	$	288.00
Asphalt	477.00	Kg	0.4	$/Kg	=	$	190.80
Agg. 19mm	3.60	m3	16	$/m^3$	=	$	57.60
Agg. 12mm	1.20	m3	16	$/m^3$	=	$	19.20
				Total	=	**$**	**555.60**

2	**Fuel for Equipment and Transport Materials:**									
	Agg. Mix M30	24.00	x	1.6	x	80	x	0.045	138.24	L
	Agg.	4.80	x	1.6	x	80	x	0.045	27.65	L
	Water	24.00	x	0.05	x	30	x	0.06	2.16	L
	Air Comprssor	100	/	100	x	6	x	6	36.00	L
	Breaker Machine	100	/	30	x	6	x	6	120.00	L
	Compact. M30	24.00	/	100	x	6	x	6	8.64	L
	Compact. Agg. 19mm	3.60	/	45	x	6	x	6	2.88	L
	Compact. Agg. 12mm	100.00	/	500	x	6	x	6	7.20	L
	Diesel for burning Bituminous				477.00		x	0.05	23.85	L
	Site to P.P			1	x	200	x	0.15	30.00	L
								D.O	**396.62**	**L**
	Water Pump E.A	24.00	x	0.05	x	1.2	x	0.2	0.29	L

3	**Fuel Cost**								
	D.O		396.62	x	0.43	=	$	170.55	
	E.A		0.29	x	0.625	=	$	0.18	
	M.O	3%	11.907	x	2	=	$	23.81	
						Total	**$**	**194.54**	
4	**Labor Cost**	100	/	5	=	20	Men day		
	Skill Labor		30%	20	x	2.5	=	$	15.00
	Unskill Labor		70%	20	x	2	=	$	28.00
						Total	=	**$**	**43.00**

			Total Payment		
1	Labor Cost			$	43.00
2	Fuel Cost			$	194.54
3	Mat. Cost			$	555.60
4	**Sub-Total 1+2+3**			**$**	**793.14**
5	Study cost		2%	$	15.86
6	Equipm.Mobile & Camp		4%	$	31.73
7	Miscellaneous works		3%	$	23.79
8	Repair Equipm.		15%	$	118.97
9	**Total 4+5+6+7+8**			**$**	**983.49**

Unit cost per square meter:	**$**	**9.83**	**$/m^2$**

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1130

Patch Bituminous Surface (SBST)

		Q'ty	Unit							
	Surface	100	m^2							
	Transport Distance									
	Agg. 12mm	40	Km	x	2	=	80	Km		
	Site to P.P	100	Km	x	2	=	200	Km		
1	**Materials**									
	Agg.Mix M30	100	m^2	x	0.1	x	1.2	12.00	m^3	
	Agg. 12mm	100	m^2	x	0.015	x	1.2	1.80	m^3	
	Asphalt	100	m^2	x	1.5	x	1.06	159.00	Kg	
	Agg.Mix M30			12.00	x	12	$/m^3	=	$ 144.00	
	Agg. 12mm			1.80	x	16	$/m^3	=	$ 28.80	
	Asphalt			159.00	x	0.4	$/Kg	=	$ 63.60	
							Total	=	**$ 236.40**	
2	**Fuel for Equipment and Transport Materials:**									
	Agg. 12mm	1.80	x	1.6	x	80	x	0.045	10.37	L
	Air Comprssor	100	/	100	x	6	x	6	36.00	L
	Breaker Machine	100	/	30	x	6	x	6	120.00	L
	Compact. Agg. 12mm	100	x	0.002	x	6	x	6	7.20	L
	Site to P.P			1	x	200	x	0.15	30.00	L
								D.O	**203.57**	**L**
3	**Fuel Cost**									
		D.O		203.57	x	0.43	=	$ 87.53		
		M.O	3%	6.107	x	2	=	$ 12.21		
							Total	**$ 99.75**		
4	**Labor Cost**	100	/	5	=	20	Men day			
		Skill Labor		30%	20	x	2.5	=	$ 15.00	
		Unskill Labor		70%	20	x	2	=	$ 28.00	
							Total	=	**$ 43.00**	

		Total Payment		
1	Labor Cost		$	43.00
2	Fuel Cost		$	99.75
3	Mat. Cost		$	236.40
4	**Sub-Total 1+2+3**		**$**	**379.15**
5	Study cost	2%	$	7.58
6	Equipm.Mobile & Camp	4%	$	15.17
7	Miscellaneous works	3%	$	11.37
8	Repair Equipm.	15%	$	56.87
9	**Total 4+5+6+7+8**		**$**	**470.14**

Unit cost per square meter:	**$**	**4.70**	**/m^2**

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1190

Scarify & Fill Surface by Laterite

		Q'ty	Unit							
	Surface	100	m^2							
	Transport Distance									
	Laterite	35	Km	x	2	=	70	Km		
	Water	15	Km	x	2	=	30	Km		
	Site to P.P	100	Km	x	2	=	200	Km		
1	**Materials**									
	Laterite	100	m^2	x	0.2	x	1.2	24.00	m^3	
	Laterite			24.00	x	5	$/m^3$	=	$ 120.00	
							Total	=	**$ 120.00**	
2	**Fuel for Equipment and Transport Materials:**									
	Laterite	24.00	x	1.6	x	70	x	0.045	120.96	L
	Water	24.00	x	0.05	x	30	x	0.06	2.16	
	Scarity	24.00	x	0.0032	x	7	x	18	9.68	L
	Grading	100	/	1200	x	12	x	4	4.00	L
	Compact.	24.00	/	100	x	6	x	6	8.64	L
	Site to P.P			1	x	200	x	0.15	30.00	L
								D.O	**175.44**	**L**
	Water Pump E.A	24.00	x	0.05	x	1.2	x	0.2	0.29	L
3	**Fuel Cost**									
		D.O		175.44	x	0.43	=	$ 75.44		
		E.A		0.29	x	0.625	=	$ 0.18		
		M.O	3%	5.263	x	2	=	$ 10.53		
							Total	**$ 86.14**		
4	**Labor Cost**									
	Grading & Compact.	24.00	x	15	/	x	241.5	1.49	Men day	
	Scarity	24.00	x	15	/	x	241.5	1.49	Men day	
							Total	**2.98**	**Men day**	
		Skill Labor		30%	2.98	x	2.5	$ 2.24		
		Unskill Labor		70%	2.98	x	2	$ 4.17		
							Total	**$ 6.41**		

		Total Payment		
1	Labor Cost		$	6.41
2	Fuel Cost		$	86.14
3	Mat. Cost		$	120.00
4	**Sub-Total 1+2+3**		**$**	**212.55**
5	Study cost	2%	$	4.25
6	Equipm.Mobile & Camp	4%	$	8.50
7	Miscellaneous works	3%	$	6.38
8	Repair Equipm.	15%	$	31.88
9	**Total 4+5+6+7+8**		**$**	**263.57**

Unit cost per square meter:	**$**	**2.64**	**/m^2**

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1200

Grading Shoulder & add Laterite 10%

		L					1000	m		
		W	2	+	2	=	4	m		
	Surface	S	**4000**	**m^2**	x	10%	=	400	m^2	
	Transport Distance									
	Laterite	35	Km	x	2	=	70	Km		
	Water	15	Km	x	2	=	30	Km		
	Site to P.P	100	Km	x	2	=	200	Km		
1	**Materials**									
	Laterite	400		x	0.1	x	1.2	48.00	m^3	
	Laterite			48.00	x	5	$/m^3$	=	$ 240.00	
							Total	=	**$ 240.00**	
2	**Fuel for Equipment and Transport Materials:**									
	Laterite	48	x	1.6	x	70	x	0.045	241.92	L
	Water	48	x	0.05	x	30	x	0.06	4.32	
	Grading	4000	/	1200	x	4	x	12	160.00	L
	Compact.	48	/	100	x	6	x	6	17.28	L
	Site to P.P			1	x	200	x	0.15	30.00	L
								D.O	**453.52**	**L**
3	**Fuel Cost**									
		D.O		453.52	x	0.43	=	$ 195.01		
		M.O	3%	13.606	x	2	=	$ 27.21		
							Total	**$ 222.22**		
4	**Labor Cost**									
			4000	x	0.1	=	**400**	**m^3**		
		400	x	15	/	241.5	24.84	Men day		
		48	x	15	/	241.5	2.98	Men day		
							27.83	**Men day**		
		Skill Labor		30%	27.83	x	2.5	$ 20.87		
		Unskill Labor		70%	27.83	x	2	$ 38.96		
							Total	**$ 59.83**		

			Total Payment	
1	Labor Cost		$	59.83
2	Fuel Cost		$	222.22
3	Mat. Cost		$	240.00
4	**Sub-Total 1+2+3**		**$**	**522.05**
5	Study cost	2%	$	10.44
6	Equipm.Mobile & Camp	4%	$	20.88
7	Miscellaneous works	3%	$	15.66
8	Repair Equipm.	15%	$	78.31
9	**Total 4+5+6+7+8**		**$**	**647.34**

Unit cost per one kilometer:	**$**	**647.34 /Km**	

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1250

Scarify, Grading & Compaction for Road Embankment

		L	1000	m						
		W	6	m						
	Surface	**S**	**6000**	**m^2**						
	Transport Distance									
	Site to P.P	100	Km	x	2	=	200	Km		
1	**Materials**									
2	**Fuel for Equipment and Transport Materials:**									
	Scarify	6000	x	0.2	x	0.0032	x	126	483.84	L
	Grading	6000	/	1200	x	4	x	12	240.00	L
	Compact.	1200	/	100	x	6	x	6	432.00	L
	Site to P.P			1	x	200	x	0.15	30.00	L
								D.O	**1185.84**	**L**
3	**Fuel Cost**									
		D.O		1185.84	x	0.43	=	$	509.91	
		M.O	3%	35.575	x	2	=	$	71.15	
							Total	**$**	**581.06**	
4	**Labor Cost**									
			6000	x	0.1	=	**600**	**m^3**		
		600	x	15	/	241.5	37.27	Men day		
		Skill Labor		30%	37.27	x	2.5	$	27.95	
		Unskill Labor		70%	37.27	x	2	$	52.17	
							Total	**$**	**80.12**	

		Total Payment		
1	Labor Cost		$	80.12
2	Fuel Cost		$	581.06
3	Mat. Cost		$	-
4	**Sub-Total 1+2+3**		**$**	**661.19**
5	Study cost	2%	$	13.22
6	Equipm.Mobile & Camp	4%	$	26.45
7	Miscellaneous works	3%	$	19.84
8	Repair Equipm.	15%	$	99.18
9	**Total 4+5+6+7+8**		**$**	**819.87**

Unit cost per one kilometer : $ 819.87 /Km

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1250

Scarify, Grading & Compaction for Road Embankment

		L	1000	m						
		W	6	m						
	Surface	**S**	**6000**	**m^2**						
	Transport Distance									
	Site to P.P	100	Km	x	2	=	200	Km		
1	**Materials**									
2	**Fuel for Equipment and Transport Materials:**									
	Scarify	6000	x	0.2	x	0.0032	x	126	483.84	L
	Grading	6000	/	1200	x	4	x	12	240.00	L
	Compact.	1200	/	100	x	6	x	6	432.00	L
	Site to P.P			1	x	200	x	0.15	30.00	L
								D.O	**1185.84**	**L**
3	**Fuel Cost**									
		D.O		1185.84	x	0.43	=	$	509.91	
		M.O	3%	35.575	x	2	=	$	71.15	
							Total	**$**	**581.06**	
4	**Labor Cost**									
			6000	x	0.1	=	**600**	**m^3**		
		600	x	15	/	241.5	37.27	Men day		
		Skill Labor		30%	37.27	x	2.5	$	27.95	
		Unskill Labor		70%	37.27	x	2	$	52.17	
							Total	**$**	**80.12**	

		Total Payment		
1	Labor Cost		$	80.12
2	Fuel Cost		$	581.06
3	Mat. Cost		$	-
4	**Sub-Total 1+2+3**		**$**	**661.19**
5	Study cost	2%	$	13.22
6	Equipm.Mobile & Camp	4%	$	26.45
7	Miscellaneous works	3%	$	19.84
8	Repair Equipm.	15%	$	99.18
9	**Total 4+5+6+7+8**		**$**	**819.87**

Unit cost per one kilometer :	**$**	**819.87**	**/Km**

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 1260

Scarify, Grading & Fill Laterite 10% to Embankment

		L	1000	m						
		W	6	m						
	Surface	**S**	**6000**	**m^2**	**x**	**10%**	**=**	**600**	**m^2**	
	Transport Distance									
	Laterite	40	Km	x	2	=	80	Km		
	Water	15	Km	x	2	=	30	Km		
	Site to P.P	100	Km	x	2	=	200	Km		
1	**Materials**									
	Laterite	600	m^2	x	0.2	x	1.2	144.00	m^3	
	Laterite		144.00	x	5	$/m^3$	=	$ 720.00		
							Total	**$ 720.00**		
2	**Fuel for Equipment and Transport Materials:**									
	Laterite	144	x	1.6	x	80	x	0.045	829.44	L
	Grading	600	/	1200	x	4	x	12	24.00	L
	Compact.	144	/	100	x	6	x	6	51.84	L
	Water	144	x	0.05	x	30	x	0.06	12.96	L
	Site to P.P			1	x	200	x	0.15	30.00	L
								D.O	**948.24**	**L**
	Water Pump E.A	144	x	0.05	x	1.2	x	0.2	1.73	L
3	**Fuel Cost**									
		D.O		948.24	x	0.43	=	$ 407.74		
		E.A		1.73	x	0.625	=	$ 1.08		
		M.O	3%	28.499	x	2	=	$ 57.00		
							Total	**$ 465.82**		
4	**Labor Cost**									
	Grading&Comp.Laterite	144	x	15	/	241.5	8.94	Men day		
	Grading Embankment	1200	x	7	/	241.5	34.78	Men day		
							43.73	**Men day**		
		Skill Labor		30%	43.73	x	2.5	$ 32.80		
		Unskill Labor		70%	43.73	x	2	$ 61.22		
							Total	**$ 94.01**		

		Total Payment	
1	Labor Cost		$ 94.01
2	Fuel Cost		$ 465.82
3	Mat. Cost		$ 720.00
4	**Sub-Total 1+2+3**		**$ 1,279.83**
5	Study cost	2%	$ 25.60
6	Equipm.Mobile & Camp	4%	$ 51.19
7	Miscellaneous works	3%	$ 38.40
8	Repair Equipm.	15%	$ 191.98
9	**Total 4+5+6+7+8**		**$ 1,586.99**

Unit cost per one kilometer : $ 1,586.99 /Km

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 4150

Control Vegetation and Clean Roadside 30%

	L	1000	m						
	W	1.5	m						
Surface	**S**	**1500**	**m^2**	**x**	**30%**	**=**	**450**	**m^2**	
Transport Distance									
Labors	25	Km	x	2	=	50	Km		

1 **Materials**

Small Tools

Long Knifes	5	x	4	=	$ 20.00	
Axes	2	x	3	=	$ 6.00	
				Total	**$ 26.00**	

2 **Fuel for Equipment and Transport Materials:**

Labors	1	x	50	x	0.15	7.50	L
					D.O	**7.50**	**L**

3 **Fuel Cost**

D.O		7.50	x	0.43	=	$	3.23
M.O	3%	0.225	x	2	=	$	0.45
					Total	**$**	**3.68**

4 **Labor Cost**

450	/	100	=	4.50	Men day		
Skill Labor		30%	4.50	x	2.5	$	3.38
Unskill Labor		70%	4.50	x	2	$	6.30
					Total	**$**	**9.68**

		Total Payment		
1	Labor Cost		$	9.68
2	Fuel Cost		$	3.68
3	Mat. Cost		$	26.00
4	**Sub-Total 1+2+3**		**$**	**39.35**
5	Study cost	2%	$	0.79
6	Equipm.Mobile & Camp	4%	$	1.57
7	Miscellaneous works	3%	$	1.18
8	Repair Equipm.	15%	$	5.90
9	**Total 4+5+6+7+8**		**$**	**48.79**

Unit cost per one kilimeter : $ 48.79 /Km

UNIT COST ESTIMATION FOR EACH CODE NUMBER

Estimate Cost for Code Number 3100

Cleaning for Culverts

1 Culvert

Transport Distance

Labors	25	Km	x	2	=	50	Km		

1 **Materials**

Small Tools

Baskets		5	x	1.5	=	$ 7.50			
Hoes		2	x	3	=	$ 6.00			
Shovels		2	x	3	=	$ 6.00			
					Total	**$ 19.50**			

2 **Fuel for Equipment and Transport Materials:**

Labors			1	x	50	x	0.15	7.50	L
							D.O	**7.50**	**L**

3 **Fuel Cost**

	D.O		7.50	x	0.43	=	$	3.23	
	M.O	3%	0.225	x	2	=	$	0.45	
						Total	**$**	**3.68**	

4 **Labor Cost**

	1	x	5	=	5	Men day			
	Skill Labor		30%	5.00	x	2.5	$	3.75	
	Unskill Labor		70%	5.00	x	2	$	7.00	
						Total	**$**	**10.75**	

Total Payment

1	Labor Cost		$	10.75
2	Fuel Cost		$	3.68
3	Mat. Cost		$	19.50
4	**Sub-Total 1+2+3**		**$**	**33.93**
5	Study cost	2%	$	0.68
6	Equipm.Mobile & Camp	4%	$	1.36
7	Miscellaneous works	3%	$	1.02
8	Repair Equipm.	15%	$	5.09
9	**Total 4+5+6+7+8**		**$**	**42.07**

Unit cost per one culvert :	**$**	**42.07 /Culvert**