



International  
Labour  
Organization

# **Employment Intensive Infrastructure Programme in Lebanon (EIIP)**

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## **BID DOCUMENT**

**ITB 64/2019**

**Annex E-1**

**Particular Technical Specifications**

**Construction of agricultural roads and retaining  
walls in**

**Marjeyoun Municipality,  
Nabatieh Governorate**

**Lebanon, September 2019**



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# SECTION E1 SPECIFICATIONS

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## ***E-1 General Specifications***

### **GENERAL**

#### **Preamble**

Each work item specified in section E corresponds to the same number in the Bill of Quantity.

Works specified under this contract shall include:

- preparatory and general works, materials and works of any kind necessary for the due and satisfactory rehabilitation, construction, completion and maintenance of the works to the intent and meaning of the Drawings and this Specification and any further drawings and orders that may be issued by the Project Chief Technical Advisor.
- compliance by the Contractor with all Conditions of Contract, whether specifically mentioned or not in this Specification;
- all materials, apparatus, plant, machinery, tools, fuel, water, strutting, timbering, and tackle of every description, transport, offices, stores, workshops, staff, labour;
- the provision of proper and sufficient protective works, temporary fencing, lighting, and watching required for the safety of the Public and the protection of the works and adjoining land;
- the provision and maintenance of first aid equipment, sanitary accommodation for the staff and workmen;
- the management and effecting of the payment of wages, salaries, fees, royalties, duties and other charges;
- the clearance of rubbish, reinstatement and clearing up and leaving the site in good condition.

These Specifications are written on the basis that the Works shall be constructed using a labour-based (light equipment supported) technology. The Contractor will be expected to maximise the use of labour for all operations where it can be effectively used to attain the required standards.

#### **Provision of Land**

The EIIP Project shall be based on agreement with the local authorities and the community make available free of charge to the Contractor all land on which the works are to be executed or carried out; all as indicated on the Drawings or as detailed in this Specification. Such land shall include the road reserve, road deviations, borrow pits outside of the road reserve and access roads thereto but shall exclude any land required by the Contractor for his own camps, offices, houses, other temporary works or any other purpose.

The Contractor shall be responsible for the payment of compensation for crops, structures and any other costs in respect of land temporarily acquired, including the Contractor's spoil areas outside of the road reserve, work areas outside of the road reserve for camps, offices, temporary works, etc. The Contractor should allow in his rates for making such compensation payments for land temporarily acquired as no separate payment will be made.

#### **Programme of Work**

The programme of work required in the scope of the Contract shall be submitted to the EIIP Project Engineer not later than 15 days after the issuing to the Contractor of the Notification of Award.

The programme shall be in the form of a time/location chart and shall clearly show the anticipated quantities of work to be performed each month, as well as a plan of labour inputs over the programme period. The contractor should update the programme each month. However, in cases where quantities fall substantially

below targets, the parties shall establish in writing an amended work plan which shall be attached to the Contract.

If the programme is to be revised by reason of the Contractor falling behind his programme, he/she shall produce a revised programme showing the modifications to the original programme necessary to ensure completion of the works or any part thereof within the time for completion as defined in the Appendix to the Contract. Any proposal to increase the tempo of work must be accompanied by positive steps to increase production by providing more labour and plant on site, or by using the available labour and plant in a more efficient manner.

Failure on the part of the Contractor to work according to the programme or revised programmes, shall be a sufficient reason for the EIIP Project to take steps as provided for in the Conditions of Contract and shall be construed, as not executing the Works in accordance with the Contract.

The approval by the EIIP Project Engineer of any programme shall have no contractual significance other than that the EIIP Project Engineer would be satisfied if the work is carried out according to such programme and that the Contractor undertakes to carry out the work in accordance with the programme, nor shall it limit the right of the EIIP Project Engineer to instruct the Contractor to vary the programme should circumstances make this necessary. The above shall not be taken to limit the right of the Contractor to claim for damages or extension of the time to which he/she may be fairly entitled to in accordance with the Contract for delay or disruption of his activities.

Should the EIIP Project request, and the Contractor undertakes to finish the whole or part of the Works ahead of the time originally required by the Contract, payment for accelerating the work shall only be made if agreed to beforehand by the parties in writing and according to the terms of such agreement.

### **Environment, Safety and Health**

The Contractor will ensure compliance with applicable national requirements and international good practice standards regarding occupational and public health and safety, and will ensure that the implementation of the Works is consistent with applicable occupational health and safety sections of the World Bank Environmental, Health and Safety Guidelines. An Environmental Management Plan must be prepared by the contractor and submitted to the Employer for approval. Further guidelines in Section E-8.

The Contractor will be responsible for the safety of all activities on the Site. It will provide all personnel on site with adequate safety protection equipment and clothing as appropriate to the work being performed, as well as instruction on Occupational Health and Safety as part of the induction process for new workers.

### **Workmanship and Quality Control**

The onus rests on the Contractor to produce work, which complies in quality and accuracy of detail with the requirements of the Specifications and Drawings. The Contractor must, at his/her own expense, institute a quality control system and provide experienced and qualified engineer and foremen, together with all transport, instruments and equipment, to ensure adequate supervision and positive control of the works at all times. The Contractor must provide assistance and labourers for the EIIP Project Engineer to carry out checks on the works.

The costs of all supervision and process control, including testing carried out by the Contractor, shall be deemed to be included in the rates tendered for the related items of work except that the cost of certain tests and the provision of certain items of testing and sampling equipment will be paid for separately as provided for in those sections of the Specifications where this applies.

The Contractor shall submit to the EIIP Project Engineer the results of all relevant tests, measurements and levels indicating compliance with the Specifications on completion of every part of the work and submission thereof to the EIIP Project Engineer for examination.

### **Liaison with Government Officials**

The Contractor shall maintain close contact with the police and other responsible local authorities regarding their requirements as to the control of traffic and other matters and shall provide all assistance or facilities which may be required by such authorities in the execution of their duties.

### **Maintenance of Traffic**

Prior to any works, the Contractor shall prepare and submit to the EIIP Project Engineer, a Traffic Management and Safety Plan (TMSP) for his operation during the maintenance and construction phase.

Throughout the duration of the Contract, traffic shall be maintained over a reasonable smooth travelled way which shall be marked in such a manner that any person who has no knowledge of the conditions may safely and with a minimum of inconvenience and discomfort, drive or walk, day or night, over all or any portion of the road under construction - provided that such a section of the road was passable to traffic prior to the Contractor having taken possession of the site.

Unless approval in writing has been obtained from the EIIP Project Engineer, no road shall be closed to traffic or public access.

The measurement for Traffic Management and Safety is paid at a lump sum amount and shall be the full compensation for labour, tools, materials and any other incidentals that may be required in carrying out the work for this item. This amount is to be included in the general item 1.3.

### **Temporary Works**

The Contractor shall allow in his/her rates where appropriate, for provision and maintenance of any temporary works including structures and deviations, and for the provision, erection and maintenance of the road signs for the safe passage of traffic during construction of the road and ancillary works.

Unless provided for separately the accommodation of traffic shall be included in the general rates except that any detours required and instructed by the EIIP Project Engineer shall be paid for under the appropriate items in the Bills of Quantities.

### **Land Compensation**

The Contractor shall not take possession of the site, nor enter any land or commence any operations until such time as he/she receives formal confirmation from the EIIP Project Engineer. Should the Contractor enter land or commence any operations without first obtaining this confirmation he/she shall be solely liable for all additional costs and/or legal charges, which might arise there from.

The EIIP Project shall be responsible for negotiations with the community in respect of land to be permanently acquired and incorporated in the works within the road reserve, together with all buildings, crops, trees and any other properties so defined from the land.

The Contractor shall be responsible for payment of compensation in respect of land temporarily acquired, Contractor's spoil areas and working areas, sites for Contractor's accommodation, and land acquired for gravel quarries.

### **Measurement**

(a) Units of measurements

All work shall be measured in accordance with the S.I. System of metric units.

(b) Bill of Quantities

The quantities set out in the Bill of Quantities are estimated quantities and are used for the comparison of Tenders and awarding the Contract. It must be clearly understood that only the actual quantities of work completed will be measured for payment, and that the billed quantities may be increased or decreased as provided for in the Conditions of Contract.

(c) Measurement of completed work

The work is measured for payment on the satisfaction completed basis

- (d) The contractor should allow in his/her rates for compliance with all requirements of this Specification for which separate payment is not made under the Contract.

### **Payment**

- (a) Contract rates

In computing the final Contract price, payments shall be based on actual quantities only of authorised work done in accordance with the Specification and Drawings. The tendered and negotiated rates shall apply, subject to the provisions of the Conditions of Contract, irrespective of whether the actual quantities are more or less than the billed quantities.

- (b) Prices to be inclusive

The Contractor shall accept the payment provided in the Contract and represented by the prices tendered by him/her in the Bill of Quantities, as payment in full for executing and completing the work as specified, for procuring and furnishing all materials, labour, supervision, plant, tools and equipment, for wastage, transport, loading, offloading, handling, maintenance, temporary work, testing, quality control including process control, overheads, profit, risk and other obligations and for all other incidentals necessary for the completion of the works and maintenance during the Construction Period.

This Clause shall be applicable in full to all pay items except as these requirements may be specifically amended in each case.

- (c) Meaning of certain phrases in payment clauses.

(i) where any of the words "supply", "procure" or "furnish" (material) are used in the description of a pay item it shall mean the supply and delivery to the point of use of all materials of any kinds required for the work covered by the particular pay items, including all taxes, (unless otherwise notified by the EIIP Project Engineer purchase costs, claims, damages, royalties and transport costs involved excluding overhaul. In the case of gravel, stone and sand, it shall also include all negotiations with owners concerned, royalties, excavating, producing, preparing, processing, testing, hauling and delivering the material to the point of use; the construction, repair, maintenance and making good after completion of all access roads, and all work required in opening, using and finishing borrow pits to ensure that soil and water from these do not interfere with the adjacent road or give rise to erosion more generally and in all respects do not have un-aesthetic appearances, which is not covered by other pay items in the Bill of Quantities.

- (ii) "Placing material"

The phrase "placing material" shall mean the off-loading, spreading, blending, processing, watering, mixing, shaping and compacting (where specified) the material in the location of the work as procuring, furnishing, applying and mixing of water; breaking down oversize material, removing which cannot be broken down, correcting irregular or uneven surfaces or deficient thickness, finishing off to within the specified tolerances, refilling test holes and maintaining the completed work.

- (d) Pay items

The descriptions under the pay items in the various sections of the Specifications, indicating the work to be allowed for in the tendered prices for such pay items, are for the guidance of the Contractor and do not necessarily repeat all the details of work and materials required by and described in the Specifications.

These descriptions shall be read in conjunction with the relevant Specifications and Drawings and the Contractor shall, when tendering, allow for his/her prices to be inclusive as specified in Sub-clause (b) above.

Guidance on the measurement method is also provided as follows;

1. Measured Before Construction (MBC)
2. Standard Design Drawings (SDD)
3. Actual Work Done (AWD)

#### **1. Measured Before Construction (MBC)**

This is the preferred quantity measurement method under EIIP and where ever feasible this approach shall be applied. All measurements under this category are based on a detailed Bill of Quantity prepared by EIIP during detailed survey of the work. In case of any discrepancy between quantities by EIIP Project Engineer and contractor a third joint-measurement shall be carried out. The EIIP Project Engineer and the contractor will then certify that these quantities are final by their signatures on revised BoQ prior to Possession of Site by the contractor.

#### **2. Standard Design Drawings (SDD)**

This measurement category applies for all pay items for which standard drawings have been prepared, primarily standardised structure items. The drawings shall be accurate enough to provide the contractor with all key dimensions and quantities so that he/she shall be able to cost an "all inclusive" price per pay item. The location of where a particular structure item shall be needed will be indicated in the Contract.

#### **3. Actual Work Done (AWD)**

This measurement category shall only be used for pay items that are difficult to assess accurately in advance of construction. Actual quantities of these pay items shall then be jointly measured by the EIIP Project Engineer and the contractor during construction and the measurement sheets be signed by both parties.

## **SECTION 1, GENERAL ITEMS**

### **1.1 CONTRACTOR'S ESTABLISHMENT+ SITE CAMP**

#### **1. Description**

This item is the mobilization and demobilize of equipment, plants and hand tools to and from the site and establishment of site camp. The lump sum figure in the BoQ is the maximum available amount for this activity, which has been fixed by the project

#### **2. Details**

- **Mobilization and demobilize of equipment, plants and hand tools.**

The Contractor shall mobilize equipment, plants and hand tools that listed in the equipment plan to the site of works. In no case shall the Contractor remove from the site, equipment, plant and tools without the written approval of the EIIP Project Engineer. The equipment and plants shall include roller, water, dump trucks, concrete mixers and hand tools. Quantity of the hand tools is vary depending on number of labour to be employed.

After completion of the contract the contractor shall demobilization of equipment, plants and hand tools from the work site to original locations

- **Establishment of site camp**

The Contractor must establish a site camp for the efficient operation of the contract. This can be by renting a local house or by constructing a temporary office. These buildings must include: site office for the Contractor's staff, adequate warehouses for cement, bitumen, fuel, tools and other materials, kitchen, toilets and sleeping accommodation if required. Establishment shall include security and operation of the site camp.

The buildings must be made of locally available durable materials. They must be well ventilated and protected against flooding. Toilets must be private and secure and within 500 metres of all work sites, beyond the camp limits as required.

Offices and warehouses must be lockable and secure against attempts to break in. Offices and first aid rooms must have adequate tables and chairs. The buildings should be kept in good condition during the contract. The location of each building will be selected by the contractor in consultation with the EIIP Project Engineer and community members before construction can start.

Upon completion of the Contract, and after receiving approval in writing from the EIIP Project Engineer, the Contractor shall take down and remove all structures forming part of his own camp, yard and workshops including removal of all drains and culverts, back-filling of trenches, filling of pit latrines, etc. and shall restore the site, as far as practicable, to its original condition and leave it neat and tidy.

- **Site camp facilities**

The Contractor shall also include pricing in the BOQ for the site camp facilities and operation. The site facilities include but not limited to, security guard, electricity power, lighting, ventilation and humidity control, sanitation facilities, fire extinguisher, and water service.

### **3. Payment**

This item is paid in full after all the equipment, plants, hand tools mobilized and site camp has been established and all the required site camp facilities have been equipped.

## **1.2 INSURANCE**

### **1. Description**

This item is to cover injury or death of workers recruited by the contractor and third party liability for damage to property of third parties. The lump sum figure in the BoQ is the maximum available for this activity and fixed by the project. The amount is reimbursable upon contractor's submission of proof of payment of the insurance policy.

### **2. Method**

- The successful bidders shall take a workers compensation and third party liability insurance before mobilizing the works
- The insurance should cover injury or death of workers and damage to third parties properties
- A copy of the Insurance should be submitted to EIIP office for filing.
- The insurance should cover:
  - Personal accident insurance for the average number of workers and the duration of the contract with a maximum cover of insert appropriate amount and currency
  - Third party liability insurance with a maximum cover of insert appropriate amount and currency

### **3. Payment**

The cost of the insurance will be reimbursed upon receipt of proof that the payment of the insurance premium has been paid in full.



## 1.3 SAFETY AND HEALTH

### 1. Description

This item is the provision of general safety and health measures for labourers on site. The lump sum figure in the BoQ is the maximum available for this activity and fixed by the project. However, specific safety measures may be included in other pay items.

### 2. Details

#### *Safety Measures*

- Carry out a safety briefing for all workers before works begin. Make sure work is organized so that each worker has enough space to carry out his or her task without endangering coworkers.
- The Contractor shall keep the entire length of the project in such condition that traffic shall be accommodated safely and road user's, Contractor's, Employer's shall be protected. The Contractor shall place warning signs or cones at each end of the work area. The warning signs should be placed 50-100 m away from the working areas.
- All equipment operators must be trained in the use of their equipment (trucks, rollers, mixers, etc). Equipment must be in good condition and safety covers for moving parts should be used.
- Deep excavations (more than 1.5 m) for foundations etc shall be clearly marked and fenced off in a way that people cannot fall into the excavation. The sides of excavations must be made safe, either by ensuring a sufficient angle of the slope or by shoring up the side walls with planks, so that they do not fall onto workers in the excavation. See also pay item 5.10 below.
- Reinforcement bars sticking out where concrete has not yet been poured must be clearly marked to avoid cutting or spearing accidents. The whole such area should be clearly marked and sealed off to make sure no one accidentally steps or falls into uncompleted structure works.
- No children are allowed enter in the work area.
- The contractor shall not allow the use of alcohol or drugs on the works site or in the site camp.

**Drinking water:** Drinking water must be available within 50 meters of all work sites approximately 2 liters should be available per worker per day

**Safety Gear:** The Contractor is responsible for safety on site and must explain clearly for all workers any potential danger of various work activities and what precautions to take to avoid any accidents on site. The Contractor shall provide appropriate safety gear in sufficient numbers. All workers must be instructed how and when to use safety gear and items shall be replaced when unusable or lost: The Contractor shall provide safety gear as listed below.

- Safety jackets in bright colors for supervisors and for all workers if working on a road that has frequent traffic
- Closed shoes and gloves for all workers for general works. Note that cotton gloves need to be replaced regularly
- Gum boots and good quality gloves when working with sharp tools (e.g. pick axes), Carrying heavy loads, masonry work, working in muddy places
- Hard hats (or helmets) for workers working in danger of falling objects, eg, in deep drains, in quarries, under a bridge, etc.
- Dust masks when working with activities that produces lot of dust or bad smell. Note that dust masks must be replaced regularly
- Safety goggles must be used when breaking rock or crushing stone or anytime there is a risk for eye injury

**First Aid:** A first aid box must be provided on site and must be regularly checked and restocked.

- Plasters
- Bandages
- Disinfectant
- Antiseptic cream
- Clean fresh water for washing eyes
- Saline
- Irrigation syringe
- Sterile dressings
- Adhesive tape
- Scissors
- Disposable gloves

### **3. Measurement and payment**

This item is paid as lump sum amount when all measures described above are in place and available during site inspection.

## **1.4 REINSTATEMENT OF QUARRIES**

### **1. Description**

This item is used to quickly and simply reinstate quarries and other damaged sites, such as those where spoil is dumped. It will include trimming slopes, removing loose material, covering with topsoil, etc.

If the required works are more substantial, other activities in the BoQ (retaining walls, bio-engineering works, etc) will be used. The lump sum figure in the BoQ is the maximum available for this activity. It may not all be used.

### **2. Details**

Each item of work will be agreed between the Contractor and the EIIP Project Engineer before the work starts. In many cases the work will follow activities in these specifications.

### **3. Measurement and payment**

Approximate quantities and fixed unit rates for this activity will be agreed between the Contractor and the EIIP Project Engineer before each item of work starts. When the work is similar to other activities in the BoQ, those unit rates will be used.

The item will be paid based on unit rates agreed in advance of the activity and based on measured quantities after the work has been completed.

## **1.5 MATERIAL TESTING**

### **1. Description**

This item is the testing of material in a laboratory such as gravel for surfacing, compressive strength test for concrete for major structures and gradation test for aggregate and sand to be used for major structures. The lump sum figure in the BoQ is the maximum available amount for this activity and fixed by the project.

### **2. Details**

- **Test for gravel:** This activity is the testing for gravel before selection of a gravel quarry. The contractor with the agreement of EIIP Project Engineer to identify a gravel quarry and take a sample of gravel of about 50 kg for the testing in a Laboratory. The test should include: Gradation test, Plasticity test,

Proctor test and CBR test. The result of the test shall be submitted to the EIIP office before deciding whether or not to use the quarry.

- **Testing for concrete (compressive strength test):** This activity is the testing for concrete strength for major structures such as a bridge or drift or concrete for a big box culvert. The contractor with the agreement of EIIP Project Engineer to fill in minimum 3 molds (cube or cylinder) during mixing the concrete and curing for 7 days then send the moulds for compressive strength test. The result of the test shall be submitted to EIIP office.
- **Gradation test for aggregate or sand.** This activity is the gradation test in laboratory for aggregate or sand to use for concrete work or road base. When requested by the EIIP Project Engineer the contractor shall send a sample of aggregate or sand for the test. The result of the test shall be submitted to the EIIP office before deciding whether or not to use the quarry.

### **3. Measurement and payment**

The cost of laboratory tests is reimbursed after receiving test results by the contractor.

## **1.6 SURVEYOR AND SETTING OUT**

### **1. Description**

This item is paid for the services to be provided the surveying engineer and setting out the locations, alignment, resection, and elevations of each activity, and location of the drainage structures to be carried out by the contractor. This provision sum is fixed and shall cover for the completion of the works. The EIIP Project Engineer will monitor the work and provide necessary instruction.

### **2. Payment**

The cost of the surveyor and setting out in Lump sum up on satisfaction of the performance by the EIIP Engineer.

## **1.7 WORK PERMITS**

### **1. Description**

This item is paid for the work permits for all foreign skilled and unskilled workers who work for this contract. The contractor is responsible to apply and process the work permits. It is estimated that each worker will work for a minimum of two months. Therefore the work permits shall be in a minimum validity of two months

### **2. Payment**

The cost of the work permits will be reimbursed upon receipt of the proof that the payment of the work permits has been paid in full.

## **1.8 AS BUILT DRAWING**

### **1. Description**

The Contractor shall (i) neatly and professionally prepare as-built drawings for all work completed, on reproducible copies of the drawings and on electronic media storage in a program stipulated by the Engineer for all the trades Architectural, Structural, Mechanical, Electrical, Environmental, Landscape and other utilities and such other “As Built” drawings as are called for by the Specification and (ii) submit them to the Engineer for approval, and shall (iii) provide additional drawings of those parts of the permanent work designed by the Contractor to clearly show details such as electrical signal line and wiring connections, piping and instrumentation diagram, and other applicable drawings and sketches prepared for the work as required (being drawings which the Contractor or any subcontractor has to prepare for the purpose of the Works) and shall (iv) transmit the As- Built drawings to the Engineer on a continuous

basis before completion of construction and in all cases prior to issuance of the certificate of completion of the Works.

The Contractor shall maintain on site one complete set of the Contract drawings which shall be available to the Engineer at all times and upon which the Contractor shall record on a continuous basis all changes and field adjustments. On a continuous basis shall mean as the work is progressively accomplished in relation to each Drawing. As Built drawing progress prints shall be submitted to the Engineer for review and approval as each Contract drawing reaches the 50 percent, 75 percent, and 100 percent completion stages.

As Built Drawings shall be considered as part of the Contractor's work effort. Failure to submit as-built drawings will result in delay of the Engineer's issuance of the Certificate of Completion.

## **2. Measurement and payment**

This item is paid a lump sum amount when all build drawings are submitted to the satisfaction of the EIIP engineer.

## **1.9 SHOP DRAWING**

### **1. Description**

The Contractor shall prepare and submit for approval, design and shop drawings, specifications, calculations, manufacturers' data etc. as required by the Engineer within 2 weeks days after receiving the instruction from the EIIP engineer. Drawings shall be carefully checked before submission to ensure that no conflict exists with other parts of the work.

### **2. Measurement and payment**

This item is paid a lump sum amount when all shop drawings are submitted to the satisfaction of the EIIP engineer.

## ***E-2 Technical Specifications for Earth Works***

## **SECTION 2, SITE CLEARANCE**

### **2.1 BUSH CUTTING, GRASS CLEARING, DEBRIS AND ROCK REMOVAL**

#### **1. Description**

This item is the cutting of bush, clearing grass, rock and dead vegetation removal, grubbing, removal and safe disposal to approved dump sites of all vegetation, bush, rock and grass.

#### **2. Materials**

No additional materials are required.

#### **3. Method**

The area of bush, grass and vegetation which should be cleared and grubbed will be marked by the supervisor. The bush, grass and vegetation should be cleared and grubbed to a depth of 15 cm. The cleared grass, bush and vegetation should be disposed to the approved dump sites. Note that no burning is allowed unless authorized by the EIIP Project Engineer.

#### **4. Equipment**

This activity requires hand tools, such as bush knives, slashers, wheel barrow, rakes and dump truck.

### 5 Safety on site

- Workers must be well spaced to limit the risk of injury when using cutting tools.
- Safety gear refers to item 1.3.
- Where burning of debris is necessary (authorized by the EIIP Project Engineer), care must be taken to prevent fire spreading outside the cleared width. Water and/or sand must be readily available at the site when burning is to be carried out.

### 6. Checking

The following will be checked:

- Adequate clearing, cutting, grubbing and removal of the grass, bush and vegetation
- Safe disposal

### 7. Measurement and payment (MBC)

This item will be paid by the area of cut, cleared and grubbed of vegetation, bush and grass measured in m<sup>2</sup>

**Payment:** The unit rate shall be the full compensation for labour, tools, materials, equipment and any other incidentals that may be required in carrying out the work for this item.

## SECTION 3, EARTH WORKS

### 3.1 EXCAVATE AND DISPOSAL

#### 1. Description

This item is the cutting (or excavation/digging) of common soil from the road way, the alignment of an intended drain or a slope next to the road or irrigation canal. The common excavation is defined that the soil which can be cut by labour with a shovel or hoe.

The suitable soil that approved by the EIIP engineer may be kept next to the proposed structures to be reused for filling road layer, while bad soil and exceeded soil to be transported and exposed to a dump safe as directed by the EIIP engineer.

#### 2. Materials

No additional materials are required.

#### 3. Method

The soil should be excavated by labour as instructed by the EIIP Project Engineer.

- If the soil is of good quality (well graded, hard particles, clean of organic material, low plasticity) and a road camber/filling embankment of a canal is to be constructed, the EIIP Project Engineer may instruct that the soil should be spread along the road or canal for subsequent use for the camber/embankment filling of the canal.
- If the soil is to be used for filling road layer, the shaping, watering and compaction work will be done using in separate item.
- If the soil is of poor quality or a camber or leveling layer or embankment is not required, the EIIP Project Engineer may instruct that the soil should be disposed to approved dump sites.
- Where the road side drain is excavated, toe slope and back slope of the side drain shall be included in this activities.

#### 4. Equipment

The activity requires hand tools and dump truck.

### **5. Safety on site**

- Slopes must be excavated as per instruction. Attention must be paid when excavating high slopes to avoid soil or rocks or trees falling uncontrollably.
- Workers must be well spaced to limit the risk of injury when using hand tools.
- Safety gear refers to item 1.3

### **6. Checking**

The following will be checked

- Cutting and excavating of the soil at the instructed location, to the instructed slope and volume
- Spreading or disposal as instructed

### **7. Measurement and payment (MBC)**

This item is paid by the volume of soil cut and removed to either the road surface or to a dump site, measured in m<sup>3</sup>

**Payment:** The unit rate shall be the full compensation for labour, tools, materials, equipment and any other incidentals that may be required in carrying out the work for this item.

## **3.2 FILL AND LEVEL BY SELECTED SOIL**

### **1. Description**

This item is the haul (transport), spreading to level and compaction of selected good quality soil from an approved quarry.

The selected soil can be used to fill road layer, road camber, erosion channels or potholes, backfill behind retaining walls, raise the level.

### **2. Material**

To be of good quality, the soil should have the following characteristics:

- Well graded from fine to coarse with a maximum particle size of 60 mm
- The particles should be strong and not crumble under compaction equipment
- The particles should be angular and not rounded
- The soil should not contain organic soil, sticks, leaves, etc
- If the soil is to be covered with another layer, it should have very low plasticity
- If the soil is to be used as a riding surface, it should have some plasticity

The EIIP Project Engineer must approve all soil before it is used. All soil should be obtained with minimum environmental damage.

### **3. Method**

The following steps should be followed (spreading soil to form road camber shall be done by labour):

- Source of good quality soil should be approved by the EIIP engineer prior to transport the soil on site
- The prepared subgrade should be well compacted and cleaned of topsoil and other unsuitable soils such as soft clay before the selected soil is delivered.
- Fill and spread the soil in layers no thicker than 15 cm to the required shape.
- Water the soil and allow it to soak until the entire layer is at optimum moisture content. This is achieved when the soil can be squeezed into a ball but water does not drip out

- Compact the soil using compaction equipment until the point at which it does not compact any more under successive passes of the equipment (this is called 'refusal')
- After one layer has been fully compacted, spread, water and compact another layer as before reach to the level of road shoulder.

#### **4. Equipment**

This activity requires hand tools, dump truck and compaction equipment (roller and water truck / water bowser) to compact the soil.

#### **5. Safety on site**

- Workers must be well spaced to limit the risk of injury when using hand tools.
- All operators must be trained in the use of their equipment (water truck, roller, tampers). Equipment must be in good condition and safety covers for moving parts should be used.
- Safety gear refers to item 1.3

#### **6. Checking**

When available, simple tests should be used to test the soil for grading, particle strength, particle shape, absence of organic material and plasticity. If not available, the EIIP Project Engineer will assess the soil manually and visually.

- Layer thicknesses
- Moisture content before compaction
- Compaction to refusal
- Final shape of the fill, level of the filled and compacted soil

#### **7. Measurement and payment (MBC)**

This item will be paid by the total volume filled, measured in m<sup>3</sup> after compaction.

**Payment:** The unit rate shall be the full compensation for labour, tools, materials, equipment and any other incidentals that may be required in carrying out the work for this item.

### **3.3 SCARIFY AND REMOVAL OF EXISTING ASPHALT SURFACE**

#### **1. Description**

This item is the scarifying the existing broken asphalt road surface to a design depth, removal and disposal of the broken asphalt to an approved dump site, spread and level the scarified gravel, watering and compaction before applying a new layer of road base course.

#### **2. Materials**

No additional materials are required.

#### **3. Method**

- The area for of the broken asphalt to be scarified should be clearly marked before commencing the scarifying activity.
- The scarifying the broken asphalt within the marked areas to a depth not less than 10 cm.
- The scarified asphalt shall be removed, transport for disposal to the approved dump site
- Spread and level the scarified gravel to form a surface cross fall 2-3 %,
- After spreading the material shall be thoroughly compacted by rolling and sprinkling, when necessary.
- Rolling shall progress gradually from the sides to the centre of the lane under construction, or from one side towards previously placed material, by lapping uniformly each preceding track by at least 300mm.

- The rolling shall continue until the material is thoroughly set and stable, before place a new layer of the base course

#### 4. EQUIPMENT

This activity requires hand tools and haulage equipment (trucks), roller and excavator.

#### 5. Safety on site

- Workers must be well spaced to limit the risk of injury when using hand tools.
- All operators must be trained in the use of their equipment (water truck, roller, tampers). Equipment must be in good condition and safety covers for moving parts should be used.
- Safety gear refers to item 1.3.

#### 6. Checking

The following will be checked:

- Sufficient scarified depth
- Final surface well compacted
- No broken asphalt remind on the road surface
- Safe disposal of the broken asphalt

#### 7. Measurement and payment (MBC)

This item will be paid by the areas scarified and compacted to the satisfaction of the EIIP engineer, measured in m<sup>2</sup>

**Payment:** The unit rate shall be the full compensation for labour, tools, materials, equipment and any other incidentals that may be required in carrying out the work for this item.

### ***E-3 Technical Specifications for Surfacing Works***

## **SECTION 4, ROAD SURFACING**

### **4.1 ROAD SUB BASE**

#### **1. DESCRIPTION**

This item shall consist of a sub base course composed of granular materials, constructed on a prepared subgrade or underlying course in accordance with this specification and in conformity with the dimensions shown on the drawings and with the lines and grades as established by the EIIP Engineer. The activity is the supply of suitable sub base materials on site, spreading on a compacted sub grade layer and compaction. Materials selected for use as road sub base should be with proper proportion of gradation and fine material that meet the requirements in the specification and shall be free of lumps of organic, or other deleterious materials.

#### **2. MATERIALS**

The sub base material should have the following characteristics:

- The Subbase material shall consist of hard durable particles or fragments of granular aggregates. The material will be mixed or blended with fine sand, stone dust, or other similar binding or filler material produced from approved sources. This mixture must be uniform and shall



comply with the requirements of this specification and shall be capable of being compacted into a dense and stable sub base. The material shall be free from vegetable or organic, matter, lumps, dirt or clay, and other objectionable or foreign substances.

- The combined dry aggregate delivered to the site shall have the gradation of class A or class B material as shown in the following table, when tested in accordance with AASHTO T-27 after dry mixing and just before spreading and compacting. The class of granular material to be used shall be as shown on drawings or as selected by the Engineer. The actual gradation shall, in all cases, be continuous and smooth within the specified limits for each class.

<b><u>ASTM sieve</u></b>	<b><u>Percentage of dry weight passing</u></b>	
	Class A	Class B
2"	100	100
1"	-	75-95
3/8"	30-65	40-75
No. 4	25-55	30-60
No. 10	15-40	20-45
No. 40	8-20	15-30
No. 200	2-8	5-20

The sub base material shall pass the following tests and the results shall be within the following limits:

Liquid Limit (AASHTO T89)	25
Max. Plasticity Index (AASHTO T90)	6
Max. Sand Equivalent (AASHTO T176)	25
Min. Loss by Abrasion (AASHTO T96)	35 Max

- The selection of the grading within this envelope shall however be such that the maximum size aggregate used shall be not more than one-half of the thickness of the layer to be constructed. Maximum size of aggregate should not exceed 31 mm.).
- The CBR of a laboratory compacted sample shall be not less than 60%. Samples shall be prepared in accordance with ASTM D 1883, and shall be soaked for four days.

### **Operation in pits and quarries**

All work involved in clearing and stripping of quarries and pits including handling unsuitable material encountered shall be performed by the Contractor at his own expense. The material shall be obtained from sources that have been approved. The material in the pits shall be excavated and handled in such a manner that a uniform and satisfactory product can be secured. Unless otherwise directed, pits shall, if possible, be adequately drained and shall be left in a neat and presentable condition with all slopes dressed uniformly. Quarries shall be left as neat and presentable as practicable.

### **Plant mixing**

When materials from several sources are to be blended and mixed, these materials shall be processed in a central or travelling mixing plant. The material, together with any blended material, shall be thoroughly mixed with the required amount of water. After the mixing is complete, the material shall be transported to and spread on the underlying course without undue loss of the moisture content.

**Materials acceptable in existing condition**

When material is secured in a uniform and satisfactory condition, such approved material may be moved directly to the spreading equipment for placing. The materials from these sources shall meet the requirements for gradation, quality and consistency. The moisture content of the material shall be brought up to approximately that percentage required to obtain maximum density. Any deficiency or excess of moisture may be corrected by surface sprinkling or by aeration. In such instances, mixing or manipulation may be required, immediately preceding the rolling, to obtain the required moisture content.

**3. METHOD**

The following steps should be followed:

- Before any sub base material is placed, the underlying course shall be prepared and conditioned as specified. The course shall be checked and accepted by the Engineer before placing and spreading operations are started.
- The sub base shall be constructed in layers. Spread the delivered sub base material by labour in layers as specified in the drawing, no thicker than 15 cm and to a camber (surface slope/cross fall) of 4-5 %. The material, as spread, shall be of uniform gradation with no pockets of fine or coarse materials. No material shall be placed on a soft or muddy course. During the placing and spreading, sufficient caution shall be taken to avoid segregation. Exercised to prevent the incorporation of subgrade, or foreign material in the sub base mixture.
- After spreading the material shall be thoroughly compacted by rolling and sprinkling, when necessary. Sufficient rollers shall be furnished to adequately handle the rate of placing and spreading of the course.
- Rolling shall progress gradually from the sides to the centre of the lane under construction, or from one side towards previously placed material, by lapping uniformly each preceding track by at least 300mm.
- The rolling shall continue until the material is thoroughly set and stable, and the course has been compacted to not less than 100% of maximum dry density at optimum moisture as determined by ASTM D 1556, Method D.
- Tests for field density shall be made in at least one location for every 500 square metres of each compacted layer in accordance with ASTM 1556. Blading and rolling shall be done alternatively, as required or directed, to obtain a smooth, even, and uniformly compacted course. The course shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the underlying course or sub base. Water shall not be added in such a manner or quantity that free water will reach the underlying layer and cause it to become soft.
- Along places inaccessible to rollers, the material shall be tamped thoroughly with mechanical tampers, until satisfaction compaction is obtained. Each layer of sub base course must be completely compacted and approved by the Engineer prior to the delivery of the materials for the succeeding layer.

**4. EQUIPMENT**

This activity requires hand tools and haulage equipment (trucks) to carry the base material and compaction equipment (roller of minimum 6 tons capacity with vibration and water truck/water bowzer, mechanical stamper ).

**5. Safety on site**

- Workers must be well spaced to limit the risk of injury when using hand tools.
- All operators must be trained in the use of their equipment (water truck, roller, tampers). Equipment must be in good condition and safety covers for moving parts should be used.
- Safety gear include closed shoes and gloves

## 6. CHECKING

A simple laboratory tests shall be carried out to test the gravel for grading, particle strength, particle shape and plasticity before using the quarry. The strength of the compacted layer should be checked by DCP.

### Surface finish tests

After the course is completely compacted, the surface shall be tested for smoothness and accuracy of grade and level, any portion found to lack the required smoothness or to fail in accuracy of grade or level shall be scarified, reshaped, re-compacted, and otherwise manipulated as the Engineer may direct until the required smoothness and accuracy are obtained. The finished surface shall not vary more than 10mm when tested with a 3 metre straightedge applied parallel with and at right angles to the centre line.

### Thickness and finished levels

- The thickness of the completed course may be checked by depth tests or cores taken at intervals, so that each test shall represent no more than 400 square meters.
- Deficiencies in thickness are allowed between the tolerances for elevation of the underlying layer and the top of the constructed course.
- The elevations of the finished surface shall not vary more than 10mm from the design elevations. The leveling of the finished course shall be performed by the Contractor in a grid as indicated by the Engineer. The Contractor shall submit all levels in due time to the Engineer for checking and approval. Any deviation of the finished elevations from the design elevations outside the tolerances, shall be corrected by the Contractor by scarifying, removing and/or adding material, sprinkling, rolling, reshaping, and finishing in accordance with these specifications. The Contractor shall replace at his expense the material when borings are taken for test purposes.

## 7. MEASUREMENT AND PAYMENT (MBC)

This activity will be paid by the volume of base material placed, measured in m<sup>3</sup> after compaction and acceptable Laboratory testing result.

**Payment:** The unit rate shall be the full compensation for labour, tools, equipment, materials and any other incidentals that may be required in carrying out the work for this item.

## 4.2 ROAD BASE COURSE

### 1. DESCRIPTION

This item shall consist of a gravel (tout-venant) composed of a mixture of crushed stone and stone dust materials, constructed on a compacted existing road surface or sub base layer in accordance with this specification and in conformity with the dimensions shown on the drawings and with the lines and grades as established by the EIIP Engineer. The activity is the supply of selected gravel (tout-venant) materials on site, spreading on a compacted existing surface or sub base layer and compaction. Materials selected for use as road gravel surface should be with proper proportion of gradation and fine material that meet the requirements in the specification and shall be free of lumps of organic, or other deleterious materials.

### 2. MATERIALS

- The aggregate shall be either crushed gravel or crushed stone. The fine aggregate shall be screenings obtained from crushed stone or crushed gravel.
- The crushed gravel and stone shall consist of hard durable stones, rock, boulders, large cobble stones etc. crushed to specified sizes and shall not contain more than 8% flat, elongated, soft or disintegrated pieces, dirt or other objectionable matter.

- A flat particle is one having a ratio of width to thickness greater than 3 and an elongated particle is one having a ratio of length to width greater than 3. The method used in production of crushed gravel and stone shall be such that the finished product shall be as uniform as practicable. The crushing shall result in a product, of which the material retained on a No. 4 sieve shall have at least 90% by weight of particles with at least one fracture face.
- Each fractured face shall have an area being at least equal to 75% of the smallest mid- sectional area of the particle. When two fractures are adjacent, the angle between the planes of the fracture must be at least 30o to count as two fractured faces.
- If so required gravel and rock etc. shall be screened before crushing to meet the requirements or to eliminate an excess of fine particles. All inferior materials and excess fine aggregates shall be wasted.
- The crushed aggregate shall have a percentage of wear of not more than 30 after 500 revolutions as determined by ASTM C 131 (Los Angeles Rattler Test).
- The gradation shall be within the limits of the gradations shown in the following table:

**Gradation Requirements for Base Course or re-graveling**

ASTM Sieve	Mass Percent Passing					
	Grading A	Grading B	Grading C	Grading D	Grading E	Grading F
1 in.	---	75-95	100	100	100	100
3/8 in.	30-65	40-75	50-85	60-100	---	---
No. 4	25-55	30-60	35-65	50-85	55-100	70-100
No. 10	15-40	20-45	25-50	40-70	40-100	55-100
No. 40	8-20	15-30	15-30	25-45	20-50	30-70
No. 200	2-8	5-20	5-15	5-20	6-20	8-25

- The gradations in the table represent the limits which shall determine the suitability of aggregate. The final gradation decided on within the limits designated in the table shall be uniformly graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieves, or vice versa.
- The amount of the fraction of material passing the No. 200 mesh sieve shall not exceed one-half the fraction passing the No. 40 mesh sieve.
- The portion of the aggregate, including any blended material, passing No. 40 mesh sieve shall have a liquid limit of not more than 25% and a plasticity index of not more than 6% when tested in accordance with ASTM D 423 and D 424.
- The crushed aggregate base course material shall have a 4 days soaked CBR of not less than 80, when compacted at 100% of modified proctor according to ASTM D-1557 (method D) and tested in accordance with ASTM D-1883.

**Additional fine material**

- If additional fine material, in excess to that naturally present in the base course material is necessary for correcting the gradation to the limitations of the specified gradation, or for changing the soil constants of the material passing the No. 40 mesh sieve, it shall be uniformly blended and mixed with the base course material at the crushing plant or by an approved blending plant.

- There shall be no reworking of the base course material in place to obtain the specified gradation. The additional fine material for this purpose shall be obtained from the crushing of gravel and/or stone.
- For cement stabilized base course road surface option, fresh Portland cement is used.

#### **Plant mixing**

The selected gravel shall be uniformly blended during crushing operations or mixed in an approved blending plant. The type of plant may be either a central proportioning and mixing plant or a travelling plant. The plant shall blend and mix the materials to meet these specifications and to secure the proper moisture content for compaction.

Whenever there is a change in the material source a full set of tests shall be required.

### **3. METHOD**

The following steps should be followed:

- Before any gravel material is placed, the existing road surface or sub base layer shall be prepared and conditioned as specified. The prepared existing road surface or sub base layer shall be checked and accepted by the Engineer before placing and spreading operations are started.
- The gravel shall be constructed in layers. Spread the delivered gravel material by labour in layers as specified in the drawing, no thicker than 15 cm and to a camber of 4-5 %. The material, as spread, shall be of uniform gradation with no pockets of fine or coarse materials. No material shall be placed on a soft or muddy course. During the placing and spreading, sufficient caution shall be taken to avoid segregation.
- After spreading the material shall be thoroughly compacted by rolling and sprinkling, when necessary. Sufficient rollers shall be furnished to adequately handle the rate of placing and spreading of the base course.
- Rolling shall progress gradually from the sides to the centre of the lane under construction, or from one side towards previously placed material, by lapping uniformly each preceding track by at least 300mm.
- The rolling shall continue until the material is thoroughly set and stable, and the course has been compacted to not less than 100% of maximum dry density at optimum moisture as determined by ASTM D 1557, Method D.
- Tests for field density shall be made in at least one location for every 500 square metres of each compacted layer in accordance with ASTM 1556. The gravel shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the underlying course. Water shall not be added in such a manner or quantity that free water will reach the underlying layer and cause it to become soft.
- Along places inaccessible to rollers, the material shall be tamped thoroughly with mechanical tampers, until satisfaction compaction is obtained. Each layer of base course must be completely compacted and approved by the Engineer.
- For cement stabilized base course road surface option, mixing cement and aggregate shall be done on site by manual labour with appropriate hand tools.

### **4. EQUIPMENT**

This activity requires hand tools and haulage equipment (trucks) to carry the base material and compaction equipment (roller of minimum 8 tons capacity with vibration and water truck/water truck, mechanical stamper).

### **5. SAFETY ON SITE**

- Workers must be well spaced to limit the risk of injury when using hand tools.
- All operators must be trained in the use of their equipment (water truck, roller, tampers). Equipment must be in good condition and safety covers for moving parts should be used.
- Other safety measure and safety gears shall refers to item 1.3.

## 6. CHECKING

A simple laboratory tests shall be carried out to test the gravel for grading, particle strength, particle shape and plasticity before using the quarry. The strength of the compacted layer should be checked by DCP.

### Surface finish tests

After the course is completely compacted, the surface shall be tested for smoothness and accuracy of grade and level, any portion found to lack the required smoothness or to fail in accuracy of grade or level shall be scarified, reshaped, re compacted, and otherwise manipulated as the Engineer may direct until the required smoothness and accuracy are obtained. The finished surface shall not vary more than 10mm when tested with a 3 metre straightedge applied parallel with and at right angles to the centre line.

### Thickness and finished levels

- The thickness of the completed road surface may be checked by depth tests or cores taken at intervals, so that each test shall represent no more than 400 square meters.
- Deficiencies in thickness are allowed between the tolerances for elevation of the underlying layer and the top of the constructed base course.
- The elevations of the finished surface shall not vary more than 10mm from the design elevations. The leveling of the finished road surface shall be performed by the Contractor in a grid as indicated by the Engineer. The Contractor shall submit all levels in due time to the Engineer for checking and approval. Any deviation of the finished elevations from the design elevations outside the tolerances, shall be corrected by the Contractor by scarifying, removing and/or adding material, sprinkling, rolling, reshaping, and finishing in accordance with these specifications. The Contractor shall replace at his expense the material when borings are taken for test purposes.

## 7. MEASUREMENT AND PAYMENT (MBC)

This activity will be paid by the volume of base material placed, measured in m<sup>3</sup> after compaction and acceptable Laboratory testing result.

**Payment:** The unit rate shall be the full compensation for labour, tools, equipment, materials and any other incidentals that may be required in carrying out the work for this item.

## 4.3 BITUMINOUS PRIM COAT/TACK COAT

### 1. DESCRIPTION:

This item shall consist of brush and clean the compacted road base course, spray bituminous prime coat/tack coat to a pre defined rate of the bitumen.

### 2. MATERIALS:

**BITUMENT**, of medium curing cut- back of grade MC- 70

### 3. WOK METHOD:

- Prior to applying bituminous coats, the compacted base course shall be thoroughly cleaned of all dirt, oil, grease and other objectionable matter, by using air compressor.
- Apply the bitumen on top of clean base course, at the rate of 1.0 kg/m<sup>2</sup>,

- Bituminous coats shall be applied one day before the next layer is placed on top of them.
- The bitumen shall be heated in boilers of an approved type and spreading shall be carried out by means of mechanical pressure distributors.

#### 4. EQUIPMENT

This activity requires

- Hand tools
- Trucks to carry material
- Air compressor
- Pneumatic roller

#### 5. SAFETY ON SITE

- Workers must be well spaced to limit the risk of injury when using hand tools.
- All operators must be trained in the use of their equipment (truck, roller). Equipment must be in good condition and safety covers for moving parts should be used.
- Other safety measure and safety gears shall refer to item 1.3.

#### 6. CHECKING

- Checking the bitumen before deliver on site
- Check the cleanness of the base course before applying the bituminous coat
- Check the application rate of the bitumen during he spaying the bituminous coat

#### 7. MEASUREMENT AND PAYMENT (MBC)

**Measurement:** This item will be paid by the m<sup>2</sup> of the sprayed areas to the acceptable of the EIIP Project engineer.

**Payment:** The unit rate shall be the full compensation for labour, tools, equipment, materials and any other incidentals that may be required in carrying out the work for this item.

### 4.4 ASPHALTIC CONCRETE-5 CM

#### 1. DESCRIPTION:

This item shall consist of supply Asphalt Concrete layer of min 5 cm on the prim coat layer and compact. The final layer shall be compacted immediately by a pneumatic roller.

#### 2. MATERIALS:

**ASPHALT CONCRETE.** All aggregates and bituminous materials to be used in asphalt concrete shall be subject to approval by the EIIP Project Engineer. Samples of the materials shall be submitted to the EIIP Project Engineer at least 7 days prior to their use.

All aggregates, except natural sand, shall be obtained by crushing natural quarry stone, and the use of river gravel, whether crushed or not, will not be permitted. Coarse aggregate shall be of uniform quality, with the particles as nearly cubiform as possible, clean of dust or foreign matter, and shall comply with the requirements above for base course aggregate. The grading of the aggregates shall be if not specified in the Particular Specification as follows:

A.S.T.M.Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
3/4"	100%
1/2"	80-100

No. 4	50-70
No. 10	32-47
No. 40	16-26
No. 80	10-18
No. 200	4-10

Mix design shall be carried out as follows. The proposed aggregate mixture shall be mixed with 5.5% bitumen (if no other percentage is required in the Particular Specification). This sample shall be subjected to a set of Marshall tests (A.S.T.M.-D-1559 and A.S.T.M.-D-1188) at a laboratory in order to determine the optimum bitumen content. The Engineer may change the grading of the aggregates and the bitumen content according to the results of laboratory tests conducted on samples of materials supplied from time to time by the Contractor at the request of the EIIP Engineer.

### 3. METHOD

The following steps should be followed:

- The Sprayed prime coat should be keep for 1 day before placing the Asphalt concrete layer.
- Placing the Asphalt Concrete layer of a minimum 50mm and spread to level, ensuring that the final level of the Asphalt concrete shall be 5-10 mm above the surrounding asphalt level.
- Compaction shall start immediately by a pneumatic roller to reach a density not less than 97% of the Marshall density. The permissible variations of the top surface from the design levels shall be -0 or + 15 mm.

### 4. EQUIPMENT

This activity requires

- Hand tools
- Trucks to carry material
- Pneumatic roller

### 5. SAFETY ON SITE

- Workers must be well spaced to limit the risk of injury when using hand tools.
- All operators must be trained in the use of their equipment (truck, roller). Equipment must be in good condition and safety covers for moving parts should be used.
- Other safety measure and safety gears shall refer to item 1.3.

### 6. CHECKING

- Testing or base course shall refer to Section 4.2
- **Tests on asphalt concrete mixture**
  - Tests to determine the grading of aggregates and the bitumen content
  - Marshall tests to determine the stability and density of bitumen-covered aggregates.

These tests shall be carried out before the commencement of works and repeated to the satisfaction of the Engineer.

- **Control of placing asphalt concrete**
  - Throughout placing and compacting aggregates works, the temperature shall be controlled permanently in order to be  $\geq 135^{\circ}$  C.



- After compaction, density shall be equal to 98% of the Marshall density; one core sample shall be taken of each 1000 m<sup>2</sup> of finished layer. These samples shall also be used to control the layer thickness.
- No layer shall be executed by the Contractor unless the under laying one has been duly taken over by the Engineer.

## 7. MEASUREMENT AND PAYMENT (MBC)

**Measurement:** This item will be paid by the m<sup>2</sup> of the completed Asphalt concrete and to the satisfaction of the EIIP Project engineer.

**Payment:** The unit rate shall be the full compensation for labour, tools, equipment, materials and any other incidentals that may be required in carrying out the work for this item.

## 4.5 REINSTATEMENT ASPHALT PAVEMENT, PATCHING POTHoles AND REPAIR ROAD EDGES

### 1. DESCRIPTION:

This item shall consist of cutting existing asphalt (or Broken asphalt) pavement to a rectangular shape. All materials from the cut, unsuitable/degraded material shall be removed to a minimum depth of 15 cm. Fill the holes with the selected base course material (tout-venont), watered and compacted using a mechanical compactor or small roller, spray bituminous prime coat/tack coat and fill the final layer by Asphalt Concrete layer of min 5 cm. The final layer shall be compacted immediately by a pneumatic roller.

### 2. MATERIALS:

- Base course material. Referred to the Section 3.1 of this specifications
- Bituminous prime coat/tack coat
- Asphalt Concrete

### 3. METHOD

The following steps should be followed:

- Mark and cut the potholes or trench areas in rectangular shapes, remove all the cut, excavated material and unsuitable material to a depth of not less than 15 cm reach to the firm base course or sub base layer.
- Level and compact the holes by mechanical compactor, fill the hole by selected base course material on layer by layer. Each layer shall not be greater than 10 cm, watering and compaction (see the Section 4.1). The compacted layer should be 50mm below the surrounding asphalt level.
- Spray bituminous prime coat/tack coat over the compacted base course layer. The application rate of the Prime coat is above mentioned. The Sprayed prime coat should be kept for 1 day before placing next layer (Asphalt concrete layer).
- Placing the Asphalt Concrete layer of a minimum 50mm and spread to level, ensuring that the final level of the Asphalt concrete shall be 5-10 mm above the surrounding asphalt level.
- Compaction shall start immediately by a pneumatic roller to reach a density not less than 97% of the Marshall density. The permissible variations of the top surface from the design levels shall be -0 or + 15 mm.

### 4. EQUIPMENT

This activity requires

- Hand tools

- Trucks to carry material
- Asphalt cutter
- Plate compactor, tamper
- Pneumatic roller

#### 5. SAFETY ON SITE

- Workers must be well spaced to limit the risk of injury when using hand tools.
- All operators must be trained in the use of their equipment (truck, roller). Equipment must be in good condition and safety covers for moving parts should be used.
- Other safety measure and safety gears shall refer to item 1.3.

#### 6. CHECKING

Refers to section 4.3 and 4.4

#### 7. MEASUREMENT AND PAYMENT (MBC)

**Measurement:** This item will be paid by the m<sup>2</sup> of the completed potholes or trenches patching and acceptable to the EIIP Project engineer.

**Payment:** The unit rate shall be the full compensation for labour, tools, equipment, materials and any other incidentals that may be required in carrying out the work for this item.

### *E-4 Technical Specifications for Structure works*

## SECTION 5, STRUCTURE WORKS

### 5.1 EXCAVATE FOR FOUNDATION FOR STRUCTURES

#### 1. DESCRIPTION

This item is the excavation, removal, load and disposal any type of soil for foundation of retaining walls/cut wall, mountain slopes next to the walls and other drainage structures. The good quality of the excavated soil that approved by the EIIP engineer may be kept next to the proposed structures to be reused for back filling, while bad soil and exceeded soil to be transported and exposed to a dump safe as directed by the EIIP engineer.

#### 2. MATERIALS

No additional materials are required.

#### 3. Method

- Mark the proposed areas to be excavated.
- The foundation or mountain slope should be excavated and loaded on a truck by labour where is appropriate as instructed by the EIIP Project Engineer and disposed to a safe place.

#### 4. EQUIPMENT

The activity requires hand tools, dump truck, excavator (where rocky soil that can not be excavated by labour and as approved by the EIIP engineer)

#### 5. SAFETY ON SITE

- Workers must be well spaced to limit the risk of injury when using hand tools.

- Safety gear refers to item 1.3

## 6. CHECKING

The following will be checked

- Dimension and depth of the foundation

## 7. MEASUREMENT AND PAYMENT (MBC)

This item is paid by the volume of soil excavated and removed to a dump site or keep for reusing, measured in m<sup>3</sup>

**Payment:** The unit rate shall be the full compensation for labour, tools, materials, equipment and any other incidentals that may be required in carrying out the work for this item.

## 5.2 BACK FILL FOR STRUCTURES

### 1. DESCRIPTION

This item is the back fill for structures, foundation walls, abutment walls, retaining walls, culvert, gabion works by selected soil or gravel and shall be done in accordance with the Drawings. This item includes supply selected material, backfilling, levelling, shaping and compacting the backfill material to a required level as shown in the drawing or as directed by the EIIP Project Engineer.

### 2. MATERIAL

The Contractor shall obtain approval of the material, proposed method to be used and rate of placing of backfill before backfilling commences.

Backfill materials shall be uniformly graded granular material, capable of being compacted to required compaction, and having adequate permeability to permit free drainage through it. Backfill material shall also conform to the following:

- The particles should be strong and not crush under compaction equipment
- The particles should be angular and not rounded
- The soil should not contain organic soil, sticks, leaves, etc
- If the soil is to be covered with another layer, it should have very low plasticity. Maximum Plasticity Index 10 per cent
- If the soil is to be used as a riding surface, it should have some plasticity
- The initial backfill material shall consist of crushed, open graded material conforming to the following gradation:

ASTM Sieve Size	Percentage Passing
3/8"	100
No. 4	< 85
No. 30	< 45
No. 200	< 5

The EIIP Project Engineer must approve all soil before it is used. All soil should be obtained with minimum environmental damage.

### 3. METHOD

The following steps should be followed:

- Water shall be drained from the areas to be backfilled,
- All excavated foundations shall be backfilled around the permanent structure to original ground level or top level of the structure as per the detailed drawing or as instructed by the EIIP engineer.
- Any protective supports, bracing or shoring shall be removed as the backfilling progresses
- Compaction: after one layer has been fully compacted, spread, water and compact another layer as before to reach level as instructed by EIIP Project Engineer.
- The back of retaining walls, abutment walls, and wing walls with weep holes shall be provided with a vertical layer of granular fill materials (mini thickness shall be greater than 20 cm) in the specified thick and rap with geotextile to serve as a filter.
- Back filling of the foundation shall be filled in layer of not thicker than 100mm, watering and compaction by using compaction equipment (mechanical tamper).
- The backfill for embankment for approach road, soil shall be laid and compacted in layer of not thicker than 150mm. Compact the soil using compaction equipment until the point at which it does not compact any more under successive passes of the equipment.

#### **4. EQUIPMENT**

The activity requires hand tools, truck and compaction equipment (roller, mechanical tamper and water truck)

#### **5. SAFETY ON SITE**

- Refers to item 1.3.

#### **6. CHECKING**

- Simple tests should be used before delivering the back fill material to test the soil for grading, proctor test, particle strength, particle shape, absence of organic material and plasticity.
- Layer thicknesses.
- Filter material is used for vertical fill layer for the abutment walls, retaining walls and wing walls
- Compaction to refusal
- Final shape and level of the fill and compacted soil

#### **7. MEASUREMENT AND PAYMENT (MBC)**

This item will be paid by the volume filled, measured in m<sup>3</sup> after compaction.

**Payment:** The unit rate shall be the full compensation for labour, tools, materials, equipment and any other incidentals that may be required in carrying out the work for this item.

### **5.3 BLIND CONCRETE / LEAN CONCRETE CLASS 110/25**

#### **1. DESCRIPTION**

This item is the supply and construct of an element of a concrete structure using lean concrete or mass concrete. This concrete is normally used in situations where high strength is not required, such as base of retaining walls, abutment walls, foundation of cross drainage structure will be constructed. Steel reinforcement is not fixed in this type of concrete.

#### **2. MATERIALS**

Material required for the lean concrete

- The lean concrete should be made from fresh cement, clean angular sand and clean hard aggregate (stones 25 mm down)

- Ideally the aggregate should be angular, but this may not be possible if the aggregate is taken from a river. (Details required size of aggregate is shown in the section 5.5)
- Fresh clean water should added to give a workable mix
- The strength of the concrete after 28 days, shall comply to the table in the section 5.5

The EIIP Project Engineer must approve all cement, sand and aggregate before it is used. All sand and aggregate must be obtained with minimum environmental damage.

### **3. METHOD**

- The layer on which the lean concrete will be constructed should be prepared and strong and clean
- Formwork should be fixed in place to the required width and height
- The concrete should be mixed by labour using small concrete mixer of a capacity of 1 to 3 bags of cement per mixing . The concrete should be used within 30 minutes of the water being added
- The concrete should be placed between the side formwork and then compacted until no more air bubbles are seen
- The concrete should be protected from use for 2 days after which the side formwork can be removed, and should be cured for a minimum of 5 days by keeping it wet.

### **4. EQUIPMENT**

This activity requires hand tools and mechanical or manual concrete mixer and concrete vibrating equipment

### **5. SAFETY ON SITE**

- Attention must be paid when mixing concrete. Workers must use boots and strong gloves. When moving or transporting heavy materials such as cement bags, aggregates for mixing the concrete etc, either use a wheelbarrow or make sure that two lift together.
- All operators must be trained in the use of their equipment (concrete mixers, truck, rollers). Equipment must be in good condition and safety covers for moving parts should be used.
- Other safety measure and safety gears shall refer to item 1.3

### **6. CHECKING**

The following will be checked:

- Quality of the layer on which the concrete will be constructed
- Quality of the side formwork
- Quality of materials used for the concrete, include cement, sand and aggregate
- Quality of the lean concrete after mixing and after curing
- Protection of the concrete while it is curing
- When possible concrete cubes will be made and tested for strength after 28 days
- Required strength and slump

### **7. MEASUREMENT AND PAYMENT**

The work prescribed in this section shall not be measured for direct payment. The payment for this item shall be deemed to be included by the contractor in his unit rates for the various items for the concrete work and stone masonry and shall not be paid for separately.

## 5.4 CEMENT STONE MASONRY

### 1. DESCRIPTION

This item is the supply and construct of cement stone masonry retaining walls, storm water drain walls, abutment walls, and other structures using stones held together with cement mortar (or concrete). All stone masonry structures should be constructed on a stable and prepared foundation. Most structures will be backfilled after completion.

### 2. MATERIALS

This activity requires stones and cement mortar.

#### The stones:

- Stones for masonry walls shall consist of field stones furnished in broad flat shapes to the maximum extent practicable. All stone shall be hard, sound, durable, and highly resistant to weathering and shall be suitable as protection material for the intended purpose.
- Samples of the stone material proposed for use in the Works shall be submitted to the Engineer for approval prior to its use in the Work.
- The minimum apparent specific gravity shall be 2.5 and the maximum absorption shall be 6% when tested in accordance with AASHTO T 85. The stone shall have an abrasion loss not greater than 45% when tested in accordance with AASHTO T 96.
- Stones for masonry walls shall be angular, neither elongated nor flat: Dimensions shall range from 200-300 mm to approximately 250 mm diameters. Not more than 5% shall be smaller than 100 mm.

#### The cement mortar:

- Mortar for mortared masonry walls shall consist of 1:3 cement: sand mortar by volume with a compressive strength at 28 days of 5Mpa. Water added shall be the least amount which will yield a mix of suitable consistency to ensure proper mortaring of masonry.
- Mortar for masonry walls shall be composed of 300 kg of cement to one cubic meter of sand and shall be thoroughly mixed prior to the addition of water.
- The EIIP Project Engineer must approve all materials before they are used.

### 3. EQUIPMENT

This activity requires hand tools and mechanical or manual mortar mixing.

### 4. METHOD

Construction of the stone masonry structure should follow normal good construction practice. This practice includes:

- The surfaces upon which foundations and bases are to be replaced shall be excavated and compacted to the required grades and lines. Subgrade or base shall be firm or compacted as directed by the EIIP engineer,
- The construction of masonry walls shall be carried out in layers perpendicular to the vertical wall surface and no layer shall be started before completion of the previous layer.
- Stones should be wet before mortar is applied. All gaps between stones should be filled with mortar. Smaller stones can be used to fill large gaps
- Stones in mortared masonry walls shall be laid on a full even bed of cement mortar with joints between stones filled and not than 12 mm wide. Bonding stones of a length two thirds the thicknesses of the wall shall be built, one to every square meter of each side of the retaining wall and staggered.

Expansion joints shall be constructed at every 10 meters or at the intervals or places shown on Drawings.

- The top and faces should be finished without present of holes or gaps so that water cannot enter the structure or collect on the surface.
- All stone masonry should be cured properly by keeping the surface wet for 7 days – cloths or sacks can be spread over the surface to retain water
- If backfill is to be placed behind a masonry structure, weep-hole pipes and granular material should be installed as per drawings

The location and detailed design of the masonry structures should be agreed with the EIIP Project Engineer before it is constructed.

## 5. SAFETY ON SITE

- Attention must be paid when mixing mortar. Workers must use boots and strong gloves. When moving or transporting heavy materials such as cement bags, aggregates for mixing the concrete etc, either use a wheelbarrow or make sure that two lift together.
- All operators must be trained in the use of their equipment (concrete mixers, truck, rollers). Equipment must be in good condition and safety covers for moving parts should be used.
- Other safety measure and safety gears shall refer to item 1.3

## 6. CHECKING

Samples of the stone material proposed for use in the Works shall be submitted to the EIIP Engineer for approval prior to its use in the Work. Simple tests will be used to test the stones for particle strength and shape.

### Testing mortar:

Mortar that can be worked easily but still provide adequate strength can be identified by two tests:

**Spade Test.** The mortar should not flow off a spade. If it does easily, it is too wet. If it is too dry, cracks will appear in the surface and lumps will fall off.

**Hand Molding Test.** The mortar should be able to be moulded by hand and retain its shape. To check that it is not too dry, pick a handful of ready-made mortar and form a ball in the hand, drop the ball onto a hard surface from a height of about 20-30cm. If the ball totally collapses, the mix is too dry.

### The other following will be checked:

- The stability of the masonry structure
- Size of the masonry structure
- The quality of the materials
- Quality of the masonry
- Protection of the mortar while it is curing
- The final top surface and side faces
- Ensure pointing is proper done with cement mortar

## 7. MEASUREMENT AND PAYMENT (MBC)

This item will be paid in cubic meter of masonry constructed, to the satisfaction of the EIIP engineer, measured in (m<sup>3</sup>), including the weep-hole pipes and the curing.

**Note:** Payment for back fill and lean concrete work shall be included in this item

**Payment:** The unit rate shall be the full compensation for labour, tools, equipment, materials and any other incidentals that may be required in carrying out the work for this item.

## 5.5 CONCRETE FOR STRUCTURE CLASS 250/20

### 1. DESCRIPTION

This item is the supply and construct the structural concrete for concrete structures. Structural concrete is used in situations where high strength is required, such as high walls or the deck slabs of a water crossing structure. Steel reinforcement is normally fixed in structural concrete.

### 2. MATERIALS

This activity requires structural concrete.

The structural concrete should:

- Be made from fresh cement, clean angular sand and clean hard aggregate (stones 20 mm down)
- Ideally the aggregate should be angular, but this may not be possible if the aggregate is taken from a river
- Have clean fresh water added to give a workable mix
- The required strength of the concrete after 28 days, shall comply to the below table 5.5.2

The EIIP Project Engineer must approve all cement, sand and aggregate before it is used. All sand and aggregate must be obtained with minimum environmental damage.

**Table 5.5.1 below show Gradations of Aggregate for different class of concrete works**

Sieve Size		Weight per cent of which passes aggregate					
Inch (in)	Standard (mm)	Fine	Coarse				
			Size max. 37.5 mm	Size max. 25 mm	Size max. 19 mm	Size max. 12.5 mm	Size max. 10 mm
2	50.8	-	100	-	-	-	-
1,5	38.1	-	95-100	100	-	-	-
1	25.4	-	-	95-100	100	-	-
0.75	19	-	35-70	-	90-100	100	-
0.5	12.7	-	-	25-60	-	90-100	100
3/8	9.5	100	10-30	-	20-55	40-70	95-100
#4	4.75	95-100	0-5	0-10	0-10	0-15	30-65
#8	2.36	80-100	-	0-5	0-5	0-5	20-50
#16	1.18	50-85	-	-	-	-	15-40
#50	0.300	10-30	-	-	-	-	5-15
#100	0.150	2-10	-	-	-	-	0-8



### 3. METHOD

- The layer on which the structural concrete will be constructed should be prepared and strong and clean
- Side formwork, underside formwork and all necessary falsework/scaffolding should be fixed in place as shown on the contract drawings
- Reinforcement should be fixed as shown on the contract drawings
- The concrete should be mixed by labour using small concrete mixer of a capacity of 1-3 bas of cement for 1 mix,
- The concrete should be used within 30 minutes of the water being added
- The concrete should be placed within the formwork and then compacted until no more air bubbles are seen
- Place the concrete in layers no thicker than 30 cm, remove the air from this layer before placing more concrete
- The concrete should be protected from use for 5 days after which the side formwork can be removed, and should be cured for a minimum of 5 days by keeping it wet. and covered with dampened sand, cloths or sacks
- The underside formwork can be removed after 21 days

### 4. EQUIPMENT

This activity requires hand tools and mechanical or manual concrete mixing equipment.

### 5. Safety on site

- Attention must be paid when mixing concrete. Workers must use boots and strong gloves. When moving or transporting heavy materials such as cement bags, aggregates for mixing the concrete etc, either use a wheelbarrow or make sure that two lift together.
- All operators must be trained in the use of their equipment (concrete mixers, truck, rollers). Equipment must be in good condition and safety covers for moving parts should be used.
- Other safety measure and safety gears shall refer to item 1.3

### 6. CHECKING

The following will be checked:

- Quality of the layer on which the structural concrete will be constructed
- Quality of the side and underside formwork and the falsework, the absence of leaks and its rigidity against movement
- Quality of materials used including cement, sand, aggregate and water
- Quality of the structural concrete during after mixing and after curing
- Protection of the concrete while it is curing
- Compressive strength test. The ultimate compressive strength of concrete shall be determined on test specimens obtained and prepared in accordance with AASHTO T23 and AASHTO T126. The Contractor shall furnish single-use cylinder moulds conforming to AASHTO M205, or when approved by the Engineer, re-usable vertical moulds made from heavy gauge metal.

**TABLE 5.5.2 BELOW SHOWS CONCRETE CLASS AND REQUIRED DESIGN MIXES**

---

<i>Cylinder Equivalent</i>			
<i>Works</i>	<i>Works</i>	<i>Cube</i>	<i>Maximum</i>
			<i>Minimum</i>

<i>Class of Concrete</i>	<i>Strength @ 28 days kg/cm<sup>2</sup></i>	<i>Strength Size of @ 28 days kg/cm<sup>2</sup></i>	<i>Cement Aggregate mm</i>	<i>Content kg/m<sup>3</sup></i>
110/25	110	140	25	220
140/25	140	180	25	250
170/60	170	210	60	275
210/50	210	260	50	300
210/25	210	260	25	325
210/20	210	260	20	325
250/20	250	310	20	350
250/30	250	310	30	350
310/20	310	385	20	375
360/20	360	450	20	425

## 7. MEASUREMENT AND PAYMENT (MBC)

This item is paid by the volume of the structural concrete constructed, measured in m<sup>3</sup>. The unit rate shall also include reinforcement steel bar (item 5.6) all formworks, supports and curing.

**Payment:** The unit rate shall be the full compensation for labour, tools, equipment, materials and any other incidentals that may be required in carrying out the work for this item.

## 5.6 REINFORCEMENT STEEL BAR

### 1. DESCRIPTION

This item is the supplying, cutting, bending and fixing of reinforcement steel bars within a space into which concrete will be poured, typically to form part of a structure.

### 2. MATERIALS

The contractor should submit sample of the reinforcement steel bars to be used, and specifications from the suppliers for the approval of the EIP engineer before the steels are delivered.

All reinforcement steel bars is shown on the detailed drawings, use high tensile. All reinforcement steel should be bought from a known and good quality source. Reinforcement steel normally rusts slightly when in storage so it should be cleaned before use with a wire brush. It should be stored in as dry a place as possible.

Good quality fixing wire is required.

It is also necessary to make spacer blocks in advance, normally from cement/sand mortar with a length of fixing wire embedded in the block. These blocks will be fixed to the outer surface of the steel mesh so that it does not move close to formwork when the concrete is being poured.

### 3. METHOD

- The reinforcement steel should be cut and bent to match each bar as shown on the detailed drawings
- Each bend should be made around a post of 5 times the diameter of the steel so that the reinforcement steel is not excessively deformed
- Steel should not be heated as it is being bent
- These bars should be fixed together to match the mesh as shown on the detailed drawings
- Spacer blocks should be fixed to the reinforcement steel to prevent it moving close to the formwork when the concrete is being poured

- All fixing wire should be bent inwards away from the formwork
- At no point may the reinforcement steel or the fixing wire be closer to the formwork than the cover as given on the concrete drawings, usually the cover must be at least 30mm.
- The entire mesh should be fixed tightly so that it does not bend or move closer to the formwork when concrete is being poured or when workers walk on the mesh
- If necessary a length of reinforcement bent into a shape which can keep the top and bottom mat of a deck mesh at the required separation when concrete is being poured or when workers walk on the mesh
- A single length of reinforcement steel is not long enough to form an entire bar as shown on the detailed drawings, two lengths can be used with an overlap equal to a minimum of 40 times to the diameter of the steel for rounded bar and 28 times to the diameter of the steel for deformed bar (at least 30 cm). The overlap must be fixed with at least three separate loops of fixing wire.

The reinforcement steel must be checked and approved by the EIIP Project Engineer before the concrete is poured.

#### **4. EQUIPMENT**

This activity requires hand tools to clean, cut and bend the reinforcement steel and fix it securely in place.

#### **5. SAFETY ON SITE**

- Care must be taken when cutting and bending reinforcement bars.
- Reinforcement bars sticking out where concrete has not yet been poured must be clearly marked to avoid cutting or spearing accidents. In area where the reinforcement steels are fixing for foundation, such area should be clearly marked and sealed off to make sure no one accidentally steps or falls into uncompleted structure works
- Reinforcement bars are sometimes used as offset pegs. In such cases they must be clearly marked and the end pointing upwards must be bent to avoid cutting or spearing accidents;
- Other safety measure and safety gears shall refer to item 1.3

#### **6. CHECKING**

The following will be checked:

- The quality of the reinforcement steel
- The correctness of the fixing to match the contract drawings
- Cleanliness of the reinforcement steel
- Adequacy of the overlaps
- Placement of spacer blocks
- Adequacy of the cover
- Strength of the fixing so that the reinforcement steel does not move when the concrete is being poured

#### **7. MEASUREMENT AND PAYMENT**

The payment for this item shall be included in the (item **5.5** CONCRETE FOR STRUCTURE)

### **5.7 FORMWORK AND SUPPORT**

#### **1. DESCRIPTION**

Formwork shall include all temporary forms required for forming the concrete slab of bridges, culverts or building together with all temporary construction required for their support. This item include supply, cut

and fix timber for the formworks, place timber or wooden supports for the formworks and fix necessary wooden / bamboo bracing for the supports

## **2. MATERIALS**

All timbers for the formwork must be approved by the EIIP Project Engineer before fixing. Timber plank should be of quality medium to good timber and thickness should not be less than 20 mm. Size of timber for poles should be 50 mm x 50 mm. Size of timber for beam should be 100mm x 50 mm. The supports can be timber of size of 50 mm x 50 mm or wooden poles of 70 - 100 mm diameter.

## **3. METHOD**

- Place poles for the supports on solid ground. If the ground is not firm enough put the poles on a rock or piece of timber/wood. The space from one pole to another should be between 40-50 cm. If the height of the poles is more than 2 m bracing is required to connect from one pole to other. The bracing should be placed at the middle of the poles
- Timber beams are placed for each row of the support poles and fixed by nails. The timber beams should be placed and align with the abutment wall of a bridge, culvert or building
- Place timber poles and cross the beams with spacing from one to other not larger than 50 cm. The crossbeams must be fixed by nails
- Place timber planks on and cross the poles as close as possible to minimize gap at joint between each plank. The planks must be fixed by nails
- Place side formworks of all edges and fix by nails.
- Removal of formwork. The formwork must be removed after minimum 21 days after the concrete is poured. The EIIP Project Engineer shall be informed in advance by the Contractor of his/her intention to remove any formwork.

## **4. EQUIPMENT**

This activity requires carpentry tools.

## **5. SAFETY ON SITE**

- Safety measure and safety gears shall be referred to item 1.3.

## **6. CHECKING**

The following will be checked:

- The quality of the timber and wooden poles
- The correctness of the fixing to match the instruction of the EIIP Project Engineer
- Spacing between the support poles and ensuring the support poles are placed on firm ground. Ensure bracing are place and nails properly
- Level of surface of the timber planks after placing and ensuring minimum gaps at the joint of each timber plank

The formworks and support must be checked by the EIIP Project Engineer before placing steel bars

## **7. MEASUREMENT AND PAYMENT**

The work prescribed in this section shall not be measured for direct payment. The payment for this item shall be deemed to be included by the contractor in his unit rates for the various items for the concrete work and shall not be paid for separately.

## **5.8 SUPPLY AND INSTALL REINFORMCED CONCRETE PIPE CULVERT**

### **1. Description**

This Item consists of supplying the concrete pipe rings, laying and joining the rings. Excavation and back filling, preparing bedding and construction of reinforced concrete headwall and wing walls and aprons to the satisfaction of the EIIP engineer.

#### **1. Material**

- The pipe rings shall be of reinforced concrete with ogee (male and female) joints, of concrete Class 20, at least 28 days cured, and where possible, manufactured on site.
- If the pipe rings are not manufactured on site the supplier must be approved by the EIIP Project Engineers.
- The culvert gradient including the outlet shall be minimum 2%.
- Culvert joints shall be sealed with mortar of 1:3.
- Material for the reinforced concrete for head walls, wing walls and apron construction as mentioned in section 5.6 and 5.5 (crushed stone, sand, cement, and steel bars)

#### **3. Method**

- Supply or manufacture reinforced concrete culvert pipe rings, cure concrete pipes for not less than 28 days, transport culvert pipes to the locations of work. The concrete culvert pipe shall be approved by the EIIP engineer before delivering on site,
- Excavate and shape trench, place pipes and join them, lay to minimum 2% gradient → establish levels or as described by the drawings.
- The disposal of surplus material shall be done at locations approved by the EIIP Engineers.
- Prepare concrete bedding as specified in the detailed drawing,
- Where there is traffic, excavation of trench(s) and lying of pipe rings shall be carried out in stages to allow vehicles to pass.
- Installation work shall wherever possible start from the outlet side.
- Construction of concrete head walls, wing wall and apron as details dimension shown in the drawing.
- Back fill by selected soil/gravel and compact in layer of not more than 10 cm by mechanical stamper to the refusal.

#### **4. Equipment**

- The activity requires hand tools, truck, mechanical tamper, concrete mixer with capacity 1-3 bags of cement per 1 mix

#### **5. Safety on site**

- Safety gear refers to item 1.3
- Adequate traffic signs shall be provided

#### **6. Checking**

The following will be checked:

- Quality of the concrete culvert pipe comply to AASHTO M86
- Ensure the foundation is well prepared and appropriate gradient as per drawing
- Ensuring the concrete pipes are in good condition before and after laying on the foundation

- Concrete work refers to quality check in section 5.6 and 5.8 and backfill check refers to section 5.10

### **7. Measurement and payment (MBC)**

Measurement Unit = LM of the completed culvert line.

**Payment:** The unit rate shall be the full compensation for labour, tools, materials, equipment and any other incidentals that may be required in carrying out the work for this item.

## ***E-5 Technical Specifications for Road Furniture***

### **SECTION 6, ROAD FURNITURE**

#### **6.1 PROJECT SIGN BOARD**

##### **1. DESCRIPTION**

This item involves the supply and construction of a durable signboard to present information on the contract, funding and contractor to passing road users.

ILO will provide the contractor with the final template. Contractor should follow attached visibly plans and submit all documents for approval before execution. Contractor must not change, add, distort or edit ILO template without ILO approval.

##### **2. MATERIALS**

This activity requires steel and normal concrete. The EIIP Project Engineer must approve all materials before they are used.

Contractor shall supply and install one frame printing- two post sign Direct print UV ink Full color printing, eco-friendly, weather resistant and abrasion resistant with 120x80 cm board dimensions.

Signage shall be made of galvanized metal sheet thickness 1mm, with two metal posts rounded and painted with anti-corrosion paint, length 2 m. Posts shall be 7 cm in diameter and should be dug underground and poured with concrete, and they should be welded together with the sign board fixed with clips.

##### **3. METHOD**

The design of the signboard will be given to the contractor after award of the contract. It will present information about the contract and the contractor and will include logos of the various parties.

The location of each signboard should be agreed with the EIIP Project Engineer at the start of the work on site.

The Contractor is to:

- Construct the signboard
- Install the signboards at each location with a concrete foundation, usually at the start of the contract section and at the Contractor's camp
- Ensure the signboard face is 1.2 m x 1.0 m
- Ensure the lower edge of the signboard is 1.7 metres above the ground.

The following information will be provided and shall be included on each signboard:

- Project Name:

- Funding:
- Activity by who:
- Project name:
- Duration: [start date-end date]

**4. EQUIPMENT**

This activity requires hand tools and either mechanical or manual concrete mixing.

**5. SAFETY ON SITE**

- Safety gear refers to item 1.3 of the General Specifications (starting on page E7)

**6. CHECKING**

The following will be checked:

- Durability of the signboard
- Correctness of the signboard design
- Quality of the structure

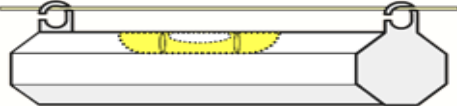
If the signboard and structure deteriorates during the contract period or is removed, it must be replaced.

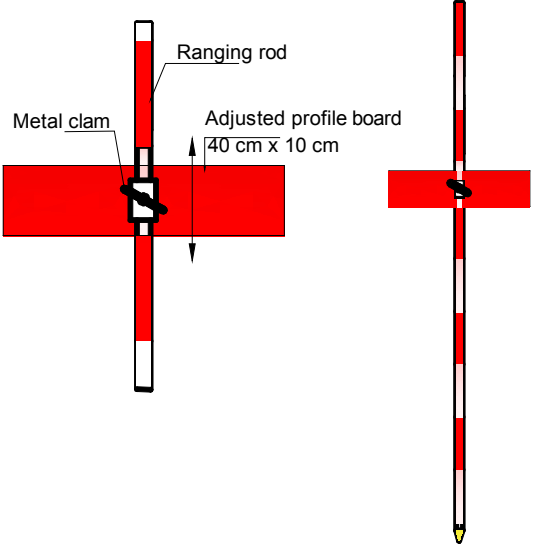
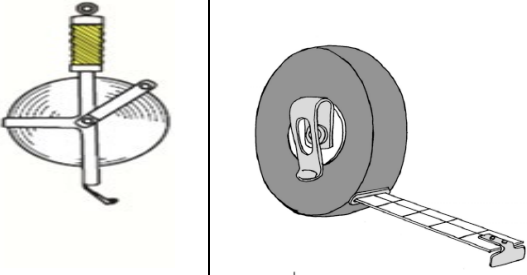

**7. MEASUREMENT AND PAYMENT (MBC)**

This item will be paid by the as a lump sum when agreed number of signboards have been erected and approved.




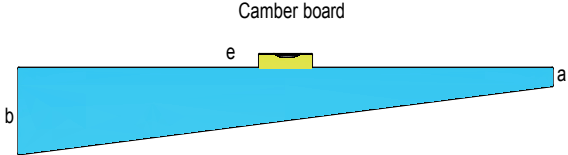
**Payment:** The unit rate shall be the full compensation for labour, tools, equipment, materials and any other incidentals that may be required in carrying out the work for this item.

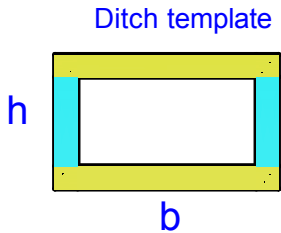
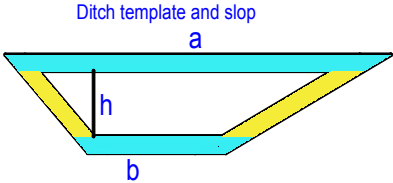
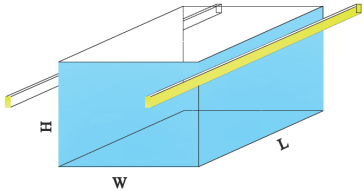

***E-7 Technical Specifications for Hand Tools***

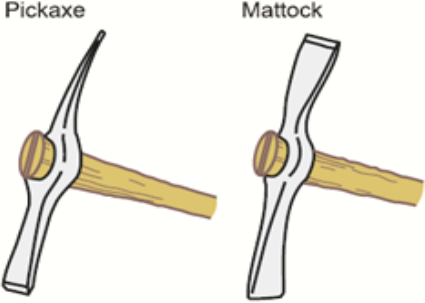
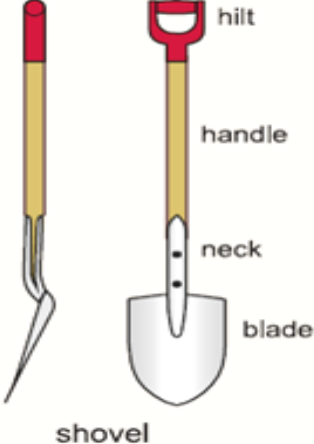
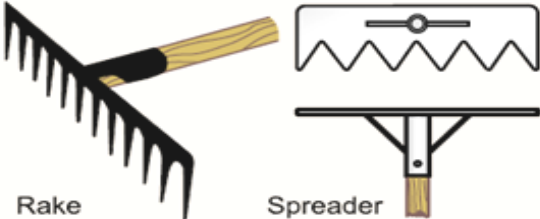
<i>Description</i>	<i>Setting out tools</i>
<p><b>Line level</b> is used with a clear nylon string to transfer the exact level of one location to another point. The line level is a short spirit level (about 100mm long) with a hook at each end to hang it from a smooth nylon string. This instrument needs two persons to operate – one at the end of the line, and the second to watch the spirit level.</p>	

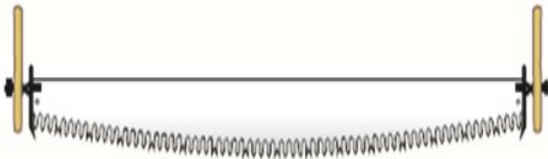
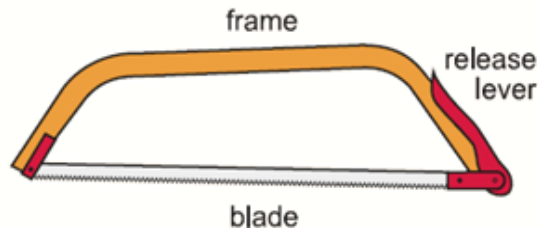
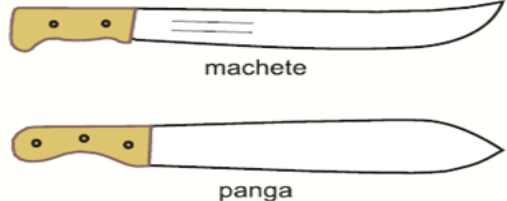
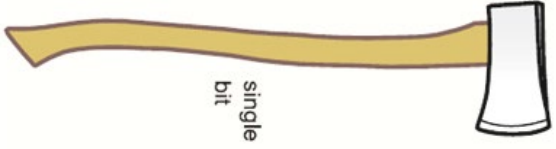
<p><b><u>Ranging rod and profile board:</u></b>  <b>Ranging rods</b> are used to set out the straight and curve lines and to support profile boards on both straight and curved sections of the road.</p> <p>Ranging rods are mad of hollow metal tube, often 20-25mm diameter galvanized pipes, with a pointed end of sharpened reinforcement steel and have 2m long. They are painted alternately red and white to make them easy to see during setting out. The length of red/white sections is 250mm.</p> <p><b>Profile boards</b> are used to set out the road profile in straight grade, sage or crest sections. A profile board is used to attach to a ranging rod. It has a screw mechanism that enables the profile board to slide up and down on the ranging rod and be fixed at any desired point simply by tightening the screw.</p>	 <p>The diagram illustrates the components of a ranging rod and profile board. On the left, a vertical ranging rod with alternating red and white segments is shown. A metal clam is attached to the rod, which is used to hold a red profile board. The profile board is labeled as 'Adjusted profile board 40 cm x 10 cm'. On the right, the ranging rod is shown vertically without the clam and board.</p>
<p><b><u>Measuring tape:</u></b> The most common length of tape measures used for setting out are: Long tape 30-50m and short tape 5-7.5m.</p> <p>The measuring tapes are made of steel or linen. The long tape is used for measuring long distance especially for measuring longitudinal alignment while short tape is used for measuring short distance and cross section of a road.</p> <p>The numbers/markings on the tape becomes unreadable after a period of use. Important is to keep tape clean and avoid dirt from entering the dust.</p> <p>Note: The zero point is not always located at the same place on different tape measures.</p>	 <p>The top-left illustration shows a long measuring tape (30-50m) with a circular metal case and a handle. The top-right illustration shows a short measuring tape (5-7.5m) with a circular metal case and a handle.</p>
<p><b><u>String line</u></b> is used with pegs for setting out activity and quality control for road work and drainage structure works. The string line is commonly made of nylon string of diameter 3-4 mm.</p>	 <p>The illustration shows a spool of string line, which is a coiled nylon string. The text 'String Line' is written next to the spool.</p>



<p><b>Hammer:</b> There are difference size and weight of hammers that are used for difference purposes. Big hammer is made of solid steel with wooden handle. Weight of the hammer between 3-5 kgs fixed with wooden handle of length between 50-70cm depends on weight of the hammer. This big hammer is commonly used for breaking stone. Small hammer is also made of solid steel with wooden handle. Weight of the hammer between 1-3 kgs. Length of the wooden handle between 30-40 depends on weight of the hammer. This small is commonly use for hammering pegs, metal spike for setting out activity. It is also used for carpentry work for structure works.</p>	 <p style="text-align: center;"><b>Club Hammer</b></p>
<p><b>Peg:</b> is a locally made material for setting out. The peg is made from bamboo / wood stick. The length is required to be within 30 cm to 50 cm. The stick can be diameter between 3-5 cm and bamboo strip of 3-5 cm and has one shape pointed end. When setting out on a hard soil metal peg should be used. The metal peg can be a deformed bar of 12-14 mm diameter.</p>	
<p><b>Metal spike/pointed chisel:</b> The metal spike / pointed chisel is usually manufactured either as round or octagonal section rods. For the setting out the diameter should be minimum 20mm. The length is required to be within 30 cm to 40 cm. The spike is made of carbon steel and should have one pointed end.</p> <p>This instruments is used with hammer to make a hole before placing the ranging rods or pegs in the ground, when the setting out is carried out in hard and compact soils.</p>	 <p style="text-align: center;"><b>Metal Spike</b></p>
<p><b>Camber board</b> is used for setting out of a road camber or checking camber of a road. The camber board consists of timber plank of trapezium shape. The longer side of the plank is designed of half width road carriage way. Thickness of the plank between 2-3 cm. Dimensions of <i>a</i>, <i>b</i> and <i>e</i> as shown in the right hand side figure depend on designed width of the road and cross slop of the camber:</p> <p><i>Example width of road is 4 m and camber 10%, a=5 cm so e= 200cm and b=5+200/10=25cm.</i></p> <p>A spirit level is placed at middle of the plank as shown in the figure right hand side to ensure the plank is horizontally placed during checking or setting out for</p>	

<p>camber.</p> <p><b>Ditch template</b> is used for checking ditch of a road side drain before allowing to cut slop of the side drain. The ditch template is made of timber frame of rectangular shape. Width of the timber frame between 5-7 cm and thickness 2-3 cm. Size of the template depends on side drain design. Commonly size of the ditch template is <math>b=50-60\text{ cm}</math> and <math>h= 30-50\text{ cm}</math></p>	 <p style="text-align: center;">Ditch template</p>
<p><b>Side drain template</b> is used for checking earth side drain of a road. The side drain template is made of timber frame of trapezium shape. Width of the timber frame between 5-7 cm and thickness 2-3 cm. Size of the template is commonly: <math>b=50-60\text{ cm}</math> and <math>h= 30-50\text{ cm}</math> and <math>a=140-150\text{ cm}</math></p>	 <p style="text-align: center;">Ditch template and slop</p>
<p><b>Gauge boxes</b> are used to batch, or measure volumes of the material, to control the mix proportions of concrete. The gauge box should be prepared based on quantity of 1 bag of cement</p> <p>The gauge box must be filled level with the top so that the volume of the sand and stone measured out is equal to the volume of a bag of cement. The sand and stone in the gauge box must not be compacted when filled up.</p> <p><b>For 1 bag of cement (40 kg)</b>  <math>W= 30\text{ cm}</math>, <math>H= 30\text{ cm}</math>, <math>L= 32\text{ cm}</math>  <math>Volume= 0.029\text{ m}^3</math></p>	
<p><b>Description</b></p>	<p><b>Hand tools</b></p>
<p><b>Hoe</b> is used for excavation of soil, spread gravel, mix concrete or mortar. It consists of a blade and a handle. The blade of the common hoe has a straight cutting edge. The eye can be round or oval, although for road works the oval eye is recommended. The round eye makes it easier to replace the handle but the blade tends to turn while working. The hoe should have a suitable length handle (1.2-1.5m) so that the labourer can work standing upright.</p>	

<p><b>Pickaxes and mattocks</b> are used for excavating stony, hard soils which are difficult to penetrate with hoes. These tools have an oval eye so that the handle cannot turn in the eye. Weights of the pickaxe is between 2.7 and 3.6kg and the mattock between 1.8 and 2.7kg. They have double edge striking tools and have straight handle with an elliptical rather than circular cross-section. The handle should be provided with a raised safety grip which prevents the handle slipping out of worker's hands.</p>	
<p><b>Shovel</b> is used for scooping up material and throwing it on to a truck, wheelbarrow or directly to where the material is needed and use for mixing concrete and mortar. The shovel has a rounded or pointed blade.</p> <p>The handle for the shovel should be long enough to allow the worker to throw the soil with little effort. Shovels should not have sharp joints which damage the hands of user.</p>	
<p><b>Spreader and rake</b></p> <p><b>Rake</b> is used in road works for collecting vegetation from loose soil when grubbing, but can also be used for spreading if the soil is not stony. Rakes have 10 to 16 teeth, each about 75-100mm long, with an overall width of about 400-450mm. They require straight handles made of hard wood or metal tubes.</p> <p><b>Spreader</b> is used for spreading out the soil on fills. A spreader can be a heavy-duty rake. The spreader is very useful when forming the camber and for spreading gravel. It is made of sheet metal (3-4mm thick) and have a ridge for crushing lumps of soil. Spreader can be pointed or flat, depending upon the nature of the gravel to be spread.</p>	

<p><b>Saws</b> are used to cut trees, branch of tree, bush and wood. There are difference type of saws are used for cutting difference size of tree, bush or wood.</p> <p><b>Big saw</b> is used to cut big tree or wood operate with two persons while small saw (steel frame bow saw )can be sue single person.</p> <p>Big saw is made from steel blade of 1.5-2 m long with wooden handles fixed at both end of the blade.</p>	
<p><b>Small saw (steel framed bow saws)</b> is used for cutting small trees, tree branches and bush. A narrow blade is held in tension by the frame. A quick release lever applies tension to the blade. The lever, combined with an oval sectioned frame, provides a comfortable handgrip. Blades are 20-25mm wide and are produced in a standard length. The frame is made of mild steel and the blade is made of high carbon alloy steel.</p>	
<p><b>Bush knives:</b> Bush knife is used for clearing the bush and cutting tree branches along the road alignment. It is also used for cutting and sharpening peg. The bush knife is made of steel shape blade and wooden round handle.</p>	
<p><b>Axe</b> is used to cut bush, tree, branch and stripping branches of felled trees. The axe can be shaped as cutting edge (blade) while the head of the axe can be used instead of hammer.</p> <p>The eye of the axe is oval and is fixed to the handle with a wedge. Handles are normally 70 to 90cm long made from seasoned hardwood shaped in an ergonomically sound fashion.</p> <p>Smaller axes, also referred to as hatchets, are often used for cutting small trees and branches instead of a bush knife. They are also used for producing setting out pegs.</p>	

**Wheelbarrow:** The wheelbarrow can be a useful piece of transportation equipment over short distance (up to 200 metres). Wheelbarrows are used at sites in earthworks and structure construction for transport the construction material such as soil, sand, aggregate, stone, concrete etc. Wheelbarrows are made in many different types and qualities. A good wheelbarrow should take a big load (struck capacity approximately 60 to 70 litres) and be easy to balance and tip. The common wheelbarrow is a single front rubber tyre.



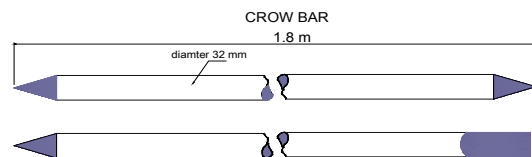
**Basket** is used for carrying soil or gravel for a short distance. A typical basket has a pay-load of 5 to 6 kilograms of soil. Basket can be made from local basket making materials (bamboo) or used tyres or manufactured in plastic. Baskets are very suitable for dry soil, and although they are not as durable, they can be fixed with local materials and cost about half the price.



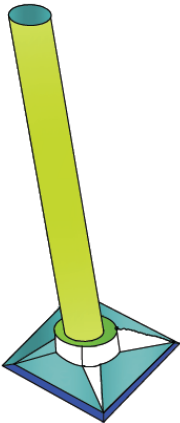
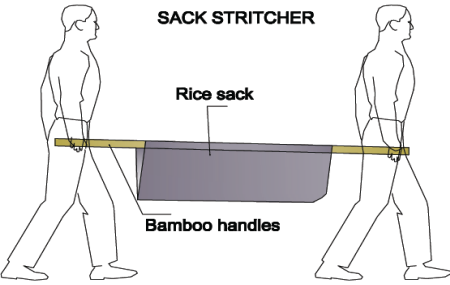
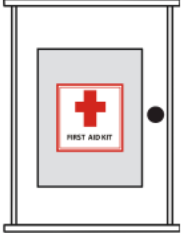

Plastic and Rubber Tyre baskets are most suitable for wet soils. Baskets can be carried individually or two can be balanced on a shoulder pole, at the end of ropes, like a scale, depending upon the workers strength and preference.



**Crow bar** is used mostly for digging stony, very hard soils or moving the boulders or heavy things when used in the right way as a lever. The crowbar looks like a simple tool, but it has to be of very strong material that does not bend easily and be well designed to function properly.



Crowbar is manufactured either as round or octagonal section rods. For infrastructure work the diameter should be minimum 30mm. The length is required to be within 1.5 to 1.8 meters. The bar is made of carbon steel and should have one pointed and one chisel end

<p><b>Hand rammer</b> is used for compacting soil and gravel and consists of a weight with a long handle. The weight can be made of various materials such as steel, concrete or solid wood. Ideally the weight should be as large as possible and the area as small as possible. A rammer which can be handed by a worker should therefore have a weight of some 6– 8kg and a bitumen surface size: 13 cm x13 cm or 15cm x 15 cm. The handle must be long enough between 1.5 to 2 m.</p> <p>Hand rammer is used to compact in small and confined areas such as around culverts, potholes and other places where it is impractical or difficult to access with rollers.</p>	<p style="text-align: center;"><b>HAND RAMMER</b></p> 
<p><b>Sack Stretcher:</b> A Sack Stretcher is a locally made for carrying soil and gravel. An empty rice sack is cut open. Two thick straight bamboo poles about 1.5 meters long are sewn along the length of either side of the cloth, to make a stretcher.</p> <p>The Soil to be carried is placed on the sack carry by two persons.</p>	<p style="text-align: center;"><b>SACK STRITCHER</b></p> 
<p><i>Description</i></p>	<p><i>Safety measures and safety gear</i></p>
<p><b>First aid kit</b> must include items like plasters, bandages, disinfectant, antiseptic cream, clean fresh water for washing eyes, saline, irrigation syringe, sterile dressings, adhesive tape, scissors, disposable gloves.</p> <p>The First Aid Kit must be available on site, regularly checked and restocked</p>	
<p><b>Markings and detours</b> Warning signs or cones must be placed at each end of the work area. The warning signs should be placed 50-100 m away from the working areas. The text on the warning signs should read: "KUIDADU" or " HALAI NENEIK"</p> <p>Deep excavations (more than 1.5 m) for foundations etc shall be clearly marked and fenced off in a way that people cannot drive or fall into the excavation.</p>	

<p><b>Safety Goggles</b> should be used when there is a risk for eye injury, eg when:</p> <ul style="list-style-type: none"> <li>• breaking rocks</li> <li>• welding</li> </ul>	
<p><b>Boots</b> should be used when:</p> <ul style="list-style-type: none"> <li>• mixing concrete and mortar</li> <li>• working in wet or muddy places</li> <li>• working with sharp tools</li> </ul> <p><b>Closed shoes</b> should be worn at all other times</p>	
<p><b>Gloves</b> should be used when:</p> <ul style="list-style-type: none"> <li>• carrying heavy load and when using hand tools</li> <li>• working with concrete and masonry work (rubber gloves)</li> <li>• bending and fixing steel bars</li> <li>• breaking rocks</li> </ul>	
<p><b>Safety hat or helmet</b> should be used when working in dangerous of falling objects like:</p> <ul style="list-style-type: none"> <li>• in deep drain or foundation excavation</li> <li>• under bridge</li> <li>• under tall tree</li> </ul>	
<p><b>Bright vest</b> are to be used by site supervisors to easily identifying who is responsible on the worksite. If working on a road with frequent traffic then all workers must wear a safety vest.</p>	
<p><b>Masks</b> are used when working in places that produce a lot of dust or bad smell.</p>	

***E-8 Environmental Guidelines***

<b>Activity</b>	<b>Impact</b> This activity may...	<b>Mitigation</b> Note: Mitigations apply to specified project phase: <i>Planning and Design (P&amp;D), Construction (C), or Operation and Maintenance (O&amp;M)</i>
<b>During Construction</b>		
Construction camp and Contractor	<ul style="list-style-type: none"> <li>• Damage local habitat, compact soil and create erosion via building and occupation of construction camp</li> <li>• Contaminate surface water and spread disease via solid waste and feces generated by camp</li> <li>• Spread communicable diseases including malaria, tuberculosis, and HIV/AIDS via construction crew members who come from outside the region</li> <li>• Introduce alcohol or other socially destructive substances via construction crew</li> <li>• Generate trash due to lack of solid waste management</li> <li>• Adversely effect local fauna and flora (especially game and fuel wood) via poaching and collection by construction crews</li> </ul>	<ul style="list-style-type: none"> <li>• Explore and agree off-site accommodation/camps with contractor. Avoid wet, muddy sites (P&amp;D) (C)</li> <li>• Keep camp size to a minimum. Require that contractor preserve as much vegetation as possible, e.g., by creating defined foot paths. Define areas of use (with rocks or fencing) (P&amp;D) (C)</li> <li>• Contractor should provide potable water for staff and workers (O&amp;M)</li> <li>• Contractor should provide temporary sanitation on site, e.g. employ soil mining (digging a pit for human waste and covering with soil immediately after use) (P&amp;D) (C)</li> <li>• Use local or regional labor, if possible. EIIP Lebanon project will provide hygiene and public health information to contractors, including information about transmission of HIV/AIDS and other sexually transmitted diseases (P&amp;D) (C)</li> <li>• Contractor to collect all solid waste (metal, glass, and burnable materials) from all work and living areas. Dispose of waste in local dump or landfill. If this is not possible, sell recyclables for reuse/recycling, place organic wastes in well-screened waste pits, covering with soil weekly, bury the remainder (excluding toxic materials).</li> <li>• Contracting guidelines prohibiting the poaching and collection of plants/wood, with meaningful consequences for violation, such as termination of employment. Contractor shall provide enough food and cooking fuel; both should be of good quality (C)</li> <li>• Restore site through re-vegetation and similar measures after camp is broken down (C)</li> <li>• Contractor responsible to employ operators who know how to use the equipment properly, including follow grade, slope, and contour design standards. (P&amp;D) (C)</li> <li>• Provide workers with appropriate safety equipment, e.g., earplugs or headgear to mute noise from very loud equipment; masks for workers exposed to large amounts of dust; safety glasses for workers doing jobs that may generate sharp projectiles</li> </ul>
Use of heavy equipment and hazardous materials	<ul style="list-style-type: none"> <li>• Cause erosion due to machinery tracks, damage to roads, stream banks, etc.</li> <li>• Compact soil, changing surface and groundwater flows and</li> </ul>	<ul style="list-style-type: none"> <li>• Minimize use of heavy machinery (P&amp;D) (C)</li> <li>• Contractor to establish appropriate procedures for vehicle maintenance, such as requiring that repairs and fueling occur elsewhere or over an impervious surface such as plastic sheeting. Prevent dumping of hazardous materials. Capture leaks or spills with drop cloths or wood shavings. Burn waste oil if it is not reusable/readily recyclable, does not contain heavy metals and is flammable. Prohibit use of waste oil as cooking fuel (P&amp;D) (C)</li> </ul>



	<p>adversely affecting future use for agriculture</p> <ul style="list-style-type: none"> <li>• Contaminate ground or surface water when (1) machinery repairs result in spill or dumping of hydraulic oil, motor oil or other harmful mechanical fluids; and (2) hazardous construction materials are spilled or dumped</li> <li>• Put workers at risk from exposure to hazardous materials</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate and use less toxic alternative products (P&amp;D) (C)</li> <li>• Prevent fuel tank leaks. Contractor shall regularly be (a) monitoring and cross-checking fuel levels deliveries and use, (b) checking pipes and joints for leaks, (c) tightening generator fuel lines, and (d) preventing over-filling of main storage and vehicle tanks (C)</li> </ul>
<p>Materials extraction: Quarrying, logging</p>	<ul style="list-style-type: none"> <li>• Damage aquatic ecosystems through erosion and siltation</li> <li>• Harm terrestrial ecosystems via harvesting of timber or other natural products</li> <li>• Spread vector-borne diseases when stagnant water accumulates in active or abandoned quarries or borrow pits and breeds insect vectors</li> <li>• Take land out of other useful production</li> <li>• The quarry may become a safety hazard</li> </ul>	<ul style="list-style-type: none"> <li>• Identify the most environmentally sound source of materials that is within budget (P&amp;D) (O&amp;M)</li> <li>• Use material from local road cuts first, but only if it produces a fairly suitable, durable aggregate for either embankment fill or surface stabilization material. Local borrow material can be very cost-effective. Upon removal of material, the area should be restored and receive erosion control measures (P&amp;D) (C)</li> <li>• Develop logging, quarrying and borrowing plans that take into account cumulative effects (P&amp;D)</li> <li>• Take photos of site before initiating excavation, so that restoration can match original site characteristics as much as possible (C) (O&amp;M)</li> <li>• Site quarries and gravel pits so that they are not visible to travelers on the roads (P&amp;D) (C) (O&amp;M)</li> <li>• Monitor adherence to plans and impacts of extraction practices. Modify as necessary (C) (O&amp;M)</li> <li>• Install drainage structures to direct water away from pit (C) (O&amp;M)</li> <li>• Implement safety protocols to minimize risks from falling rock or debris, collapsing quarry walls, or accidental falls from cliffs (P&amp;D) (C) (O&amp;M)</li> <li>• Develop specific procedures for storing topsoil, as well as for phased closure, reshaping and restoration when extraction has been completed. Include plans for segregating gravel and quarry materials by quality and grade for possible future uses. Where appropriate, include reseeded or re-vegetation to reduce soil erosion, prevent gulleying and minimize visual impacts (P&amp;D) (C) (O&amp;M)</li> <li>• Discuss with local community the option of retaining quarry pits as water collection ponds for watering cattle, irrigating crops or similar uses. Highlight issues of disease transmission and the need to prohibit its use for drinking, bathing, and clothes washing (P&amp;D) (C) (O&amp;M)</li> </ul>
<p>Storing materials</p>	<ul style="list-style-type: none"> <li>• Deplete water resources</li> <li>• Damage valuable ecosystems and habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Pre-wet gravel when water is more available (i.e., not during dry season) and store gravel in a way that will keep it wet, e.g., covered with plastic sheeting (P&amp;D) (C)</li> <li>• When siting storage areas, avoid using sensitive areas or sites that drain directly into a sensitive area (P&amp;D) (C)</li> </ul>

<p>Site clearing and/or leveling</p>	<ul style="list-style-type: none"> <li>• Damage or destroy sensitive terrestrial ecosystems</li> <li>• Produce areas of bare soil which cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems</li> </ul>	<ul style="list-style-type: none"> <li>• Minimize disturbance of native flora (vegetation) during construction. Minimize the amount of clearing. Clear small areas for active work one at a time (P&amp;D) (C)</li> <li>• Avoid use of herbicides. Any use should follow health and safety procedures to protect people and the environment. At a minimum, herbicides should be used according to manufacturer’s specifications (C)</li> <li>• Where possible, remove large plants and turf without destroying them, and preserve them for replanting in temporary nurseries (P&amp;D) (C)</li> <li>• Move earth and remove vegetation only during dry periods. Store topsoil for re-spreading. If vegetation must be removed during wet periods, disturb ground only just before actual construction (P&amp;D) (C)</li> <li>• Install temporary erosion control features when permanent ones will be delayed. Use erosion control measures such as hay bales, berms, straw or fabric barriers (C)</li> <li>• Re-vegetate with recovered plants and other appropriate local flora immediately after equipment is removed from a section of the site (C)</li> </ul>
<p>Excavation</p>	<ul style="list-style-type: none"> <li>• Cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems when excavated soil is piled inappropriately</li> <li>• Expose inhabitants and crew to risk of falls and injuries in excavation pits</li> <li>• Deprive down-gradient populations and ecosystems of water if upper regions of aquifer are blocked</li> </ul>	<ul style="list-style-type: none"> <li>• Avoid deep excavation pits (P&amp;D)</li> <li>• Prepare slope protection where necessary</li> <li>• Provide adequate road drainage systems, take note of new water flows, increase in velocity and provide necessary protection at outlets</li> <li>• Have construction contractors and supervisors be alert for buried historic, religious and cultural objects and provide them with procedures to follow if such objects are discovered.</li> <li>• Ensure that excavation is accompanied by well-engineered drainage (P&amp;D) (C)</li> </ul>
<p>Filling</p>	<ul style="list-style-type: none"> <li>• Block water courses when fill is inappropriately placed</li> <li>• Destroy valuable ecosystems when fill is inappropriately placed</li> <li>• Cause later land subsidence or landslides when fill is inappropriately placed, causing injuries and damages.</li> </ul>	<ul style="list-style-type: none"> <li>• Do not fill the flow line of a watershed. Even in arid areas, occasional rains may create strong water flows in channels. A culvert may not supply adequate capacity for rare high-volume events(P&amp;D)</li> <li>• Design so that filling will not be necessary. Transplant as much vegetation and turf as possible (P&amp;D) (C)</li> <li>• Use good engineering practices. For example, do not use soil alone; first lay a bed of rock and gravel (P&amp;D) (C)</li> <li>• Balance the cuts and fills (to minimize earthwork movement) whenever possible.</li> </ul>
<p>Cutting and filling</p>	<ul style="list-style-type: none"> <li>• Cause soil erosion Degrade water quality Alter hydrology Damage valuable ecosystems and habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Contractor must employ operators with ability to follow design standards for grades, slopes, and contours. Train if necessary (P&amp;D) (C)</li> </ul>

<p>Compacting to improve road materials performance</p>	<ul style="list-style-type: none"> <li>• Deplete freshwater resources</li> </ul>	<ul style="list-style-type: none"> <li>• Water the road immediately before compacting it to strengthen the road surface. (P&amp;D) (C)</li> <li>• When possible, delay compaction activities until the beginning of the wet season or when water becomes more available (P&amp;D) (C)</li> </ul>
<p>Blasting/rock breaking</p>	<ul style="list-style-type: none"> <li>• Cause soil erosion Degrade water quality Alter hydrology Damage valuable ecosystems and habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Minimize blasting (P&amp;D) (C)</li> <li>• Take safety precautions to protect workers and others from being injured by flying or falling rock and avalanches (P&amp;D) (C)</li> </ul>
<p>Design verification Quality control</p>		<ul style="list-style-type: none"> <li>• Conduct independent inspections of work periodically to see that it conforms to original plan and design specifications. Provide incentives and disincentives to ensure conformance (C)</li> <li>• Drive roads after moderate rains to identify areas that collect or gully water. Mark and instruct the contractor to repair/rehabilitate as necessary (C)</li> </ul>