



**LEB**

**RELIEF**

**SPECIFICATIONS**

# TECHNICAL SPECIFICATIONS

The following Specifications are prepared for civil work applying Labour based appropriate technology road works. Each item corresponds to the item in the Bill of Quantity in the contract. These Specifications cover: Specification for agricultural road works, irrigation canal work, structure and retaining walls

## *Technical Specification for the construction of Agricultural road, Irrigation canal and retaining wall*

### SECTION 1, GENERAL ITEMS

#### CONTRACTOR'S ESTABLISHMENT+ SITE CAMP

##### 1. Description

This item is the mobilization and demobilizes 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. 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 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.

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

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.

### **1. Details**

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

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

Approximate quantities and fixed unit rates for this activity will be agreed between the Contractor and LebRelief 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.

## **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 test should include: Gradation test, Plasticity test, Proctor test and CBR test. The result of the test shall be submitted to LebRelief 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. during mixing the concrete and curing for 7 days then send the moulds for compressive strength test.
- **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. .

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

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

## **Additional labour**

### **1. Description**

This item is to employ workers to carry out work that is not listed elsewhere in the BoQ. The contractor should include a unit rate to employ additional workers.

## **SECTION 2, SITE CLEARANCE**

### **BUSH CUTTING, GRASS CLEARING AND GRUBBING**

#### **1. Description**

This item is the cutting of bush, clearing grass, grubbing, removal and safe disposal of all vegetation, bush and grass except woody trees with a diameter larger than 10 cm. It includes the removal of other items, such as dead vegetation and small rocks.

#### **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 of in a safe.

#### **4. Equipment**

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

#### **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.

#### **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**

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

### **REMOVAL OF TREES**

#### **1. Description**

This item is the complete removal and safe disposal of trees of diameter between 10 to 20 cm including stump and roots.

#### **2. Material**

No additional materials are required.

### **REMOVAL OF TOP SOIL**

#### **1. Description**

This item is the removal and safe disposal of topsoil layers and of unsuitable soils such as soft clay and saturated soil to a depth of 20 cm.

#### **2. Materials**

No additional materials are required.

#### **3. Method**

The area from which topsoil is to be removed will be marked by LebRelief Project Engineer. The top soil, which typically consist of unsuitable materials for road construction such as soft clay and saturated soil should be removed to a depth up to 20 cm and disposed of in a safe place

## Equipment

This activity requires hand tools.

### **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:

- Complete removal of the topsoil
- Safe disposal

### **7. Measurement and payment**

This item will be paid by the area from which topsoil is removed, measured in m<sup>2</sup>.

## **REMOVAL OF ROCK FROM CARRIAGE WAY IRRIGATION ALIGNMENT**

### **1. Description**

This item is the removal and safe disposal of large rocks in or on road carriage way, typically with a volume of more than 0.5 m<sup>3</sup>.

Smaller rocks should be removed during activity 2.1 (bush and grass clearing).

### **2. Materials**

No additional materials are required.

### **3. Method**

The rock to be removed will be marked by the Project Engineer. It should be broken into pieces as required and then disposed of in a safe place with the agreement of the Project Engineer.

### **4. Equipment**

The activity requires hand tools.

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

- Attention must be paid when splitting rocks workers must wear boots eye protection glasses/goggles and gloves. When boulders are to be buried, care must be taken so that the boulder does not roll into the pit while workers are still digging or working inside the pit.
- Safety gear refers to item 1.3

### **6. Checking**

The following will be checked:

- Complete removal of the rock
- Safe disposal

### **7. Measurement and payment**

This item will be paid by the volume of the rock, measured in m<sup>3</sup>

**Payment:** The unit rate 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.

## **SECTION 3, EARTH WORKS**

### **EXCAVATE AND DISPOSAL -SOFT SOIL**

#### **1. Description**

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

The soil may be kept on the road or canal and used to form a camber or fill canal embankment or disposed of safely.

#### **2. Materials**

No additional materials are required.

#### **3. Method**

The soil should be excavated as instructed by the 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 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 the road camber/ or embankment filling, the shaping, watering and compaction work will be done using item 3.6 (Fill and form camber by selected material).
- If the soil is of poor quality or a camber or leveling layer or embankment is not required, the Project Engineer may instruct that the soil should be disposed of in a safe place.

#### **4. Equipment**

The activity requires hand tools.

#### **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**

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

**Payment:** The unit rate 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.

## **EXCAVATE AND DISPOSAL -HARD SOIL**

### **1. Description**

This item is the cutting (or excavation/digging) of hard soil from the road carriage way, the alignment of an intended drain or a slope next to the road or irrigation canal. Hard soil is defined as that which can be cut with pick axe.

The soil may be kept on the road and used to form a camber or levelling layer or canal embankment or disposed of safely.

### **2. Materials**

No additional materials are required.

### **3. Method**

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

- If the soil is of good quality (well graded, hard particles, clean of organic material, low plasticity) and a camber or canal embankment is to be constructed, the LEIP Project Engineer may instruct that the soil should be spread along the road or along the canal for subsequent use in the camber or embankment.
- If the soil is to be used in the road camber or fill canal embankment, the shaping, watering and compaction work will be done using item 3.6 (Fill and form camber by selected material).
- If the soil is poor quality or a camber or embankment is not required, the Project Engineer may instruct that the soil should be disposed of in a safe place.

### **4. Equipment**

The activity requires hand tools.

### **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**

This item will be paid by the volume of soil cut and removed to either the road surface/canal alignment a safe place, measured in m<sup>3</sup>.

**Payment:** The unit rate 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.

# **EXCAVATE AND DISPOSAL -SOFT ROCK**

## **1. Description**

This item is the cutting (or excavation/digging) of rock from the road surface, the alignment of an intended drain or canal or a slope next to the road. Rock is defined as that which can be cut with a hammer and chisel.

The rock may be kept on the road or near-by the canal alignment and used to form a camber or road base or fill canal embankment or disposed of safely.

## **2. Materials**

No additional materials are required.

## **3. Method**

The soft rock should be cut or excavated as instructed by the Project Engineer.

- If the rock is of good quality (well graded, strong, clean of organic material) and a camber or embankment is to be constructed, the Project Engineer may instruct that the rock should be spread along the road or near-by the canal alignment for subsequent use in the camber or road base or embankment.
- If the rock is to be used in the road camber or road base or embankment, the shaping, watering and compaction work will be done using item 3.6 (Fill and form camber by selected material).
- If the rock is good quality and if instructed by the Project Engineer, it may also be used for other structural works.
- If the rock is poor quality or a camber or embankment is not required, the Project Engineer may instruct that the rock should be disposed of in a safe place.

## **4. Equipment**

The activity requires hand tools.

## **5. Safety on site**

- Attention must be paid when splitting rocks workers must wear boots eye protection glasses /goggles and gloves. When boulders are to be buried, care must be taken so that the boulder does not roll into the pit while workers are still digging or working inside the pit.
- 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 rock at the instructed location, to the instructed slope and volume.
- Spreading or disposal as instructed

## **7. Measurement and payment**

This item will be paid by the volume of rock excavated and removed to either the road surface or a safe place, measured in m<sup>3</sup>

**Payment:** The unit rate 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.

# **FILL AND LEVEL BY SELECTED MATERIAL (HAULAGE WITHIN 50M)**

## **1. Description**

This item is the excavation, haul, the selected material, spread to level and compact of selected soil or natural gravel from a source within 50 metres of the work site. The soil can be used to fill erosion channels or potholes, backfill behind retaining walls, fill and raise the embankment 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 LEIP Project Engineer must approve all soil before it is used.

## **3. Method**

The following steps should be followed:

- Find a source of good quality soil
- Obtain approval from LebRelief Project Engineer for the soil
- Excavate the soil
- Haul the soil to the site
- The existing road surface should be cleaned of topsoil and other unsuitable soils such as soft clay and saturated soil using activity 2.3
- Fill and spread the soil in layers no thicker than 15 cm and to the required shape.
- Water the soil and allow it to soak until the entire layer is at optimum moisture water 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 until reaching the level of the road shoulder.

#### **4. Equipment**

This item requires hand tools to excavate, spread and shape, light haulage equipment (wheel borrow) to carry, and compaction equipment (roller and water truck / water bowzer) 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 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**

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 and any other incidentals that may be required in carrying out the work for this item.

## **FILL AND LEVEL BY SELECTED MATERIAL (HAULAGE DISTANCE - KM)**

### **1. Description**

This item is the excavation, haul (transport), spreading to level and compaction of good quality soil from a long distance km of the work site.

The soil can be used to fill 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

LebRelief 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:

- Find a source of good quality soil

- Obtain approval from the Project Engineer for the soil
- Excavate and load the soil into trucks
- If space is available, pile up and mix the soil next to the source to improve its uniformity
- Carry the soil to the site by hauling by truck
- The existing road surface should be cleaned of topsoil and other unsuitable soils such as soft clay and saturated soil using activity 2.3
- 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 water 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 to excavate, haulage equipment (like truck) to carry, and compaction equipment (roller and water truck / water bowzer) 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 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**

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 and any other incidentals that may be required in carrying out the work for this item.

## **FILL AND FORM CAMBER BY SELECTED MATERIAL**

### **1. Description**

This item is the excavation, haul (or transport), spreading to form a road camber and compaction of good quality soil from a selected source. In some cases the formation of a camber can use soil which has been cut from the road surface, the alignment of an intended drain or a slope next to the road, and which is good quality.

## **2. Material**

The soil for the camber should be of good quality (well graded, hard particles, clean of organic material, low plasticity) as characteristic mentioned in 3.6 above. The soil should be approved and instructed for use in the camber by LebRelief Project Engineer

## **3. Method**

The following steps should be followed:

- The existing road surface should be cleaned of topsoil and other unsuitable soils such as soft clay and saturated soil using item 2.3
- If the surface is damaged it may be leveled using item 3.4 (Fill and level by selected material)
- Find a source of good quality soil
- Obtain approval from LebRelief Project Engineer for the soil
- Excavate, haul (transport) , fill and spread the soil in layers no thicker than 15 cm to the required camber, as instructed by LebRelief Project Engineer
- Water the soil and allow it to soak until the entire layer is at optimum moisture water 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
- After one layer has been fully compacted, if more layers are required, fill and spread, water and compact as above
- Continue until the camber is as instructed, the crown is sharp, super-elevation is present where instructed and the longitudinal profile is smooth

If a camber can be formed from soil from cut from the existing road with material approved by the Project Engineer, it is not necessary to identify and obtaining approval of a new source of materials for the camber.

## **4. Equipment**

This activity requires hand tools to excavate, spread and shape, light haulage equipment (wheel borrow) to carry, and compaction equipment (roller and water truck / water bowzer) 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, LebRelief Project Engineer will assess the soil manually and visually.

The following will be checked:

- Layer thicknesses
- Moisture content before compaction
- Compaction to refusal
- Final shape of the fill

- Cross fall, crown and profile if the soil has been formed into a camber

## **7. Measurement and payment**

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 and any other incidentals that may be required in carrying out the work for this item.

## **FILL EMBANKMENT**

### **1. Description**

This item is the excavation, carrying/haul, spreading to level, sloping and compaction of good quality soil from a selected source. The soil to be filled and spread in layers no thicker than 15 cm and to the required level.

### **2. Material**

The soil for the filling of the embankment layers should be of good quality (well graded, hard particles, clean of organic material, low plasticity) as characteristic mentioned in 3.6 above.

### **3. Method**

The following steps should be followed:

- Find a source of good quality soil
- Obtain approval from LebRelief Project Engineer for the soil
- Excavate, carry the soil to the site: If the source of soil within 150m soil should be carried by wheel borrow and source of the soil beyond 150 m soil should be carry by trucks
- The existing road surface should be cleaned of topsoil and other unsuitable soils such as soft clay and saturated soil using item 2.3
- Fill and spread the soil in layers no thicker than 15 cm and to the required shape.
- Water the soil and allow it to soak until the entire layer is at optimum moisture water 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
- After one layer has been fully compacted, fill, spread, water and compact another layer as before until reach to the level of road shoulder.
- Sloping and use material from the sloping to form road camber, watering and compaction.

### **4. Equipment**

This activity requires hand tools to excavate, spread and shape, haulage equipment (wheel borrow or truck) to carry, and compaction equipment (roller and water truck / water bowzer) 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, LebRelief 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, shape of the slopes and compacted soil

## 7. Measurement and payment

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 and any other incidentals that may be required in carrying out the work for this item.

# SECTION 4, ROAD PAVEMENT AND SURFACING

## GRAVEL SURFACE

### 1. Description

This item is the excavation, haul, , spread, shape and compaction of gravel on a prepared cambered surface. The gravel will be used as a riding surface.

### 2. Material

The gravel should have the following characteristics:

- Well graded from fine to coarse with a maximum particle size of 50 mm
- The particles should be strong and not crush under compaction equipment
- The particles should be angular and not rounded
- The gravel should not contain organic soil, sticks, leaves, etc
- The gravel should have some plasticity
- The gravel should be obtained from an approved quarry or a river bed

If the proportions of stones, sand and clay can be determined (in the field by a settling test in a water filled jar) the proportions by volume should be approximately:

- Stones (>2 mm): 35-65%
- Sand (0.06-2 mm): 20-40%
- Clay and silt (<0.06 mm): 10-25%

If more sophisticated testing is available, the gravel should have the following characteristics:

Grading	
Sieve, mm	Percentage passing by weight
50	100
37.5	80-100
25	75-100
9.5	50-75
4.75	35-65
2	25-50
0.425	15-30
0.075	5-20
Liquid Limit (LL)	< 40
Plasticity Index (PI)	5-20
Linear Shrinkage	3-10
Grading Coefficient	16-34
Shrinkage Product	120-400
CBR% at 95% mdd / Bearing strength	> 20%
CBR% at 95% mdd	

LebRelief Project Engineer must approve all gravel before it is used. All gravel must be obtained with minimum environmental damage.

### 3. Method

The following steps should be followed:

- Find a source of good quality gravel
- Obtain approval from the Project Engineer for the gravel
- Excavate the gravel, manually or, if instructed by the Project Engineer, with equipment.
- If space is available, pile up and mix the gravel next to the source to improve its uniformity
- Carry the gravel to the site
- If the cambered surface is old, has lost its shape or dirty, it should be restored and cleaned of topsoil and other unsuitable soils such as soft clay and saturated soil using item 2.3 above
- Carry out a short trial to determine the maximum layer thickness that can be compacted to its full depth by the available compaction equipment
- Spread the gravel in layers as specified in the contract, no thicker than 15 cm and form a camber of 6-8 % Water the gravel and allow it to soak until the entire layer is at optimum moisture water content. This is achieved when the gravel can be squeezed into a ball but water does not drip out
- Compact the gravel 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, if more layers are required, spread, water and compact as above



- Continue until the compacted thickness is 10-15 cm, the camber is 6-8% , the crown is sharp and straight, super-elevation is present where instructed and the longitudinal profile is smooth
- Place and compact any remaining gravel at the edges of the gravel used for the carriageway to prevent the gravel moving outwards

#### **4. Equipment**

This activity requires hand tools and haulage equipment to carry the gravel and compaction equipment to compact the gravel (roller and water truck or water bowzer and if instructed by the Project Engineer 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**

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. If not available, LebRelief Project Engineer will assess the quality of the gravel layer manually and visually.

The following will be checked:

- Width of the gravel layer
- Thickness of the gravel layer
- Camber
- Super elevation, if instructed
- Sharp and straight crown
- Smooth longitudinal profile
- The entire layer is at optimum water content when compacted
- The surface has been compacted to refusal

#### **7. Measurement and payment**

This item will be paid by volume of gravel placed, measured in m<sup>3</sup> after compaction.

**Payment:** The unit rate 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.

**ROAD BASE** (where the natural gravel is not available this material will be used as road surface for the agricultural road)

#### **1. Description**

The item is the supply of suitable base materials on site, spreading on a compacted sub base layer (or cambering layer) and compaction. Materials selected for use as road base should be crushed aggregate 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 base material should have the following characteristics:

- Well graded from fine to coarse with a maximum particle size of 50 mm

- The particles should be strong and not crush under compaction equipment
- The particles should be angular and not rounded
- The material should not contain organic soil, sticks, leaves, etc
- The material should have very low plasticity
- The material should be obtained from an approved crusher
- Detail characteristic of the material is shown in table below

Tables below show required grading and characteristic of base material

***Grading Requirements for Base Course Material***

Sieve Size		Percent by Weight Passing
ASTM	(mm)	
2"	50	
1 1/2"	37,5	100
1"	25,0	79 - 85
3/8"	9,50	44 - 58
No.4	4,75	29 - 44
No.10	2,0	17 - 30
No.40	0,425	7 - 17
No.200	0,075	2 - 8

***Material Properties required for base course material***

<i>Property</i>	<i>Gravel</i>
Plasticity Index PI (%)	0 - 6
Liquid Limit LL (%)	0 - 25
CBR of 98% MDD	min.80 %

LebRelief Project Engineer must approve all granular crushed aggregate base material before it is used. All base material must be obtained with minimum environmental damage.

**3. Method**

The following steps should be followed:

- Find a source of good quality base material
- Obtain approval from the Project Engineer then supply on site
- If the prepared surface is old, has lost its shape or dirty, it should be restored, cleaned of topsoil and other unsuitable soils such as soft clay and saturated soil using item 2.3 above
- If the surface is damaged it may be repaired using item 4.1 (graveling)
- Spread the base material in layers as specified in the contract, no thicker than 15 cm and to a camber of 6-8 %

- Watering to optimum moisture contain and compaction of 8-10 passes by roller capacity more than 6 tons with vibration. Compaction shall be done from edge of the road toward the road center in layer by layer which each layer should not be exceeded 15cm loss thickness.

#### **4. Equipment**

This activity requires hand tools and haulage equipment (trucks) to carry the base material and compaction equipment (roller and water truck/water bowzer).

#### **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**

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. If not available, the Project Engineer will assess the quality of the gravel layer manually and visually.

The following will be checked:

- Width of the material layer
- Thickness of the material layer
- Camber
- Sharp and straight crown
- Smooth longitudinal profile
- The entire layer is at optimum water content when compacted
- The surface has been compacted to refusal

#### **7. Measurement and payment**

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

**Payment:** The unit rate 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.

*Technical Specifications for Structural Works*

**SECTION 5, STRUCTURE WORKS**

## **CONCRETE (LEAN CONCRETE) OF MIX PROPORTION 1:3:6**

### **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 a foundation on which a water crossing structure will be constructed. Steel reinforcement is not fixed in this type of concrete.

### **2. Materials**

Material required for the concrete proportion in volume 1:3:6.

- The lean concrete should be made from fresh cement, clean angular sand and clean hard aggregate (stones 20 mm down) mixed by volume in the ratio 1:3:6
- 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 table consists in 5.7)
- Fresh clean water should be added to give a workable mix
- The strength of the concrete after 28 days, if it can be measured, should be 10 N/mm<sup>2</sup>

The table in section 5.7 below show gradations specification of aggregate for the concrete work (proportions: 1:3:6, 1:2:4 and 1:1.5:3)

LebRelief 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 concrete of 1:3:6 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 0.2 to 0.4 m<sup>3</sup>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 5 days by keeping it wet and covered with dampened sand, cloths or sacks

### **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.
- Safety gear refers 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**

This item is paid by the volume of lean concrete constructed, measured in m<sup>3</sup>. The unit rate includes the cost of the side formwork and the curing.

**Payment:** The unit rate 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.

# CONCRETE OF MIX PROPORTION 1:2:4

## 1. Description

This item is the supply and construct of an element of a concrete structure using structural concrete. This concrete is used in situations where medium strength is required, such as the infill between culvert barrels, slab of small culvert or low level elements of a water crossing structure. Steel reinforcement is normally fixed in structural concrete.

## 2. Materials

Material for the concrete should:

- Be made from fresh cement, clean angular sand and clean hard aggregate (stones 20 mm down) mixed by volume in the ratio 1:2:4
- 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 table consists in 5.9)
- Have clean fresh water added to give a workable mix
- The strength of the concrete after 28 days, if it can be measured, should be 20 N/mm<sup>2</sup>

The table in section 5.9 below show gradations specification of aggregate for the concrete work (proportions: 1:3:6, 1:2:4 and 1:1.5:3)

The concrete 1:2:4 normally includes reinforcement steel. All details relating to reinforcement steel are given in the specification for activity 5.10.

LebRelief 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 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 0.2 to 0.4 m<sup>3</sup>
- 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 5 days by keeping it wet and covered with dampened sand, cloths or sacks
- The underside formwork can be removed after 14 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.
- Safety gear refers 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 the materials used, including cement, sand aggregate and steel
- Quality of the reinforcement (see 5.10)
- Quality of the structural 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

This item is paid by the volume of concrete constructed, measured in m<sup>3</sup>. The unit rate include curing. Cost of the side and under side formwork and supports is paid under activity 5.13. The reinforcement is paid under activity 5.10.

**Payment:** The unit rate 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.

# CONCRETE OF MIX PROPOTION 1:1.5:3

## 1. Description

This item is the supply and construct a concrete structure using structural concrete. 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) mixed by volume in the ratio 1:1.5:3
- 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 strength of the concrete after 28 days, if it can be measured, should be 25 N/mm<sup>2</sup>

Structural concrete normally includes reinforcement steel. All details relating to reinforcement steel are given in the specification for activity 5.10.

LebRelief 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 below show Gradations of Aggregate for the concrete work (proportion: 1:3:6, 1:2:4 and 1:1.5:3)

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 0.2 to 0.4 m<sup>3</sup>
- 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 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.

- Safety gear refers 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 steel
- Quality of the reinforcement (see 5.10)
- Quality of the structural concrete during 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

**Table below show Compressive strength and Slump test requirement for concrete reference concrete mix (minor works)**

<i>Mixed Minimum</i>	<i>Minimum Compressive Strength</i>				<i>Permitted Slump (mm)</i>	<i>Purpose</i>
	<i>Cube 15 cm</i>		<i>Cylinder 15 x 30 cm</i>			
	<i>7 days</i>	<i>28 days</i>	<i>7 days</i>	<i>28 days</i>		
1 : 1.5 : 3	175	260	145	215	50-125	Culvert or bridge slab. Reinforced Structure
1 : 2 : 4	150	210	125	175	50-125	Culvert slab. Lightly Reinforced Structure
1 : 3 : 6	-	-	-	-	25-100	Non-reinforced Structure

## 7. Measurement and payment

This item is paid by the volume of structure concrete constructed, measured in m<sup>3</sup>. The unit rate include curing. Cost of the side and under side formwork and supports is paid under activity 5.13. The reinforcement is paid under activity 5.10.

**Payment:** The unit rate 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.

## 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

All reinforcement steel bars is shown on the contract drawings, either high tensile or mild steel. 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 contract 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 concrete 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 contract drawings, two lengths can be used with an overlap equal to 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 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. The whole 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;
- Safety gear refers 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**

This item is paid by the weight of reinforcement fixed, measured in kg. The unit rate includes the cost of the overlaps, fixing wire and spacer blocks.

**Payment:** The unit rate 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.

## **BACK FILLING FOR STRUCTURES**

### **1. Description**

Backfilling is required for structures, foundation walls, abutment walls, retaining walls, culvert, gabion works and shall be done in accordance with the Drawings. This item includes supply selected material, backfilling, levelling, shaping and compacting the approaches of constructed structures to a required length as directed by LebRelief Project Engineer.

## **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 50 mm
- 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
- If the soil is to be used as a riding surface, it should have some plasticity

LebRelief 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:

- Find a source of good quality soil
- Obtain approval from the Project Engineer for the soil. Excavate, load and carry the soil to the construction site
- All excavated foundations shall be backfilled around the permanent structure to original ground level.
- Any protective supports, bracing or shoring shall be removed as the backfilling progresses
- After one layer has been fully compacted, spread, water and compact another layer as before to reach level as instructed by Project Engineer.
- The back of abutment and wing walls with weep holes shall be provided with a vertical layer of granular fill materials in the specified thick 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**

- 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 Project Engineer will assess the soil manually and visually.

- Layer thicknesses.
- Filter material is used for vertical fill layer for the abutment walls and wing walls
- Compaction to refusal
- Final shape and level of the fill and compacted soil

## **7. Measurement and payment**

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 and any other incidentals that may be required in carrying out the work for this item.

## **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 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. LeRelief 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 gear refers 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 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 Project Engineer before placing steel bars

### **7. Measurement and payment**

This item is paid by the number of structures as a lump sum amount after completion of the formwork. Payment for removal of formwork is included in this item.

**Payment:** The unit rate 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.

## **SUPPLY AND INSTALL REINFORCED CULVERT PIPE INTERNAL DIAMETER: 60 CM, 80 CM, 100 CM**

### **1. Description**

This Item consists of supplying the concrete pipe rings, laying and joining the rings. Excavation and back filling, culvert head and wing walls and aprons are not included in this Item.

### **2. 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 LebRelief Project Engineers. The ring shall in standard length of 1 m.
- The culvert gradient including the outlet shall be minimum 2%.
- Culvert joints shall be sealed with mortar of 1:3.

### **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,
- 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 Project Engineers.
- Where there is traffic, excavation of trench(s) and laying of pipe rings shall be carried out in stages to allow vehicles to pass.
- Installation work shall wherever possible start from the outlet side.

### **4. Equipment**

- The activity requires hand tools, truck, mechanical tamper

### **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 pipe
- 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

## **7. Measurement and payment**

Payment shall be effected upon completion of culvert lines to sealing stage and upon approval of the works and on the basis of the length measured and computed after construction.

**Payment:** The unit rate 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.



## **SECTION B, GROUND WORKS/EARTH WORKS**

### **EXCAVATION AND DISPOSAL OF UNUSABLE SOIL**

#### **1. Description**

This item includes the excavation and collection of the site soil that cannot be used for backfill nor planting purposes. The unwanted soil piles are to be safely disposed of or moved based on the client's instructions.

#### **2. Materials**

No additional materials are required.

#### **3. Method**

The area from which unusable soil is to be removed will be marked by the Project Engineer. The unusable soil should be removed and disposed of in a safe place with the agreement of LebRelief Project Engineer.

#### **4. Equipment**

This activity requires hand tools.

#### **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:

- Complete removal of the unusable soil. All areas shall be free unusable soil
- Safe disposal

#### **7. Measurement and payment**

Measurement Unit =m<sup>3</sup>. The measurement shall be 'Measurement as Planned' based on the drawing and the quantity mentioned in the BOQ.

**Payment:** The unit rate 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.

### **FILL, LEVEL BY SELECTED MATERIAL**

#### **1. Description**

This item is the treatment of topographic recesses, or areas that are currently lower than the design level, by adding approved structural backfill material, fill the selected material, spread to level and compact with the use of hand temper or rollers, and approved by the project engineer prior to the commencement of further activity.

#### **2. Material**

Selected soil should be in good quality as instructed by the Project Engineer

#### **3. Method**

The following steps should be followed:

- Topography survey and mark the finishing level in wooden pages
- Transport the soil from an approved source.
- Fill and spread the selected soil layer by layer (each layer should not be exceeded 15 cm) to the specified level
- Watering the soil and allow it to soak until the entire layer is at optimum moisture water content.

- Compact the soil using compaction equipment

#### **4. Equipment**

Hand tools, truck, and compaction equipment (roller and water truck / water bowser).

#### **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**

- Quality of soil before deliver on site
- Layer thicknesses
- Moisture content before compaction
- Mechanical Compaction
- Final shape of the filling, level of the filled and compacted soil

#### **7. Measurement and payment**

Measurement Unit =m<sup>3</sup>. The measurement shall be 'Measurement as Planned' based on the drawing and the quantity mentioned in the BOQ.

**Payment:** The unit rate 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.

### **ADDITION OF TOP SOIL AND PLANTING MEDIA**

#### **1. Description**

This item includes supply the final level of the areas designated for planting by adding the approved layers of materials and top soil. The soil mix shall be porous and well aerated to provide sufficient drainage and water percolation, whilst retaining moisture adequately.

#### **2. Material**

The selected soil for planting media should be free of weeds, pathogens, and noxious chemicals with a recommended structure of Sand, Silt, Clay, Peatmoss, Perlite, and Organic matter (ratio to be provided based on the project)

#### **3. Method**

- The soil should be delivered and stock pile in a location as identified by the project engineer.
- Spread the soil to a uniform thickness

#### **3. Equipment**

This activity requires hand tools, truck,

#### **3. 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

#### **4. Measurement and payment**

Measurement Unit =m<sup>3</sup>. The measurement shall be 'Measurement as Planned' based on the drawing and the quantity mentioned in the BOQ.

**Payment:** The unit rate 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.

# SOIL STABILIZATION

## 1. Description

This item describes the mechanical and chemical stabilization of soil areas that are designated to remain bare and exposed. Possible ways of stabilization are the use of structural elements such as soil dipped stabilizing grids, or chemical compounds that strengthen the texture of the existing soil. The client is to provide specific instructions for the treatment of such areas and slopes on a project by project basis.

## 2. Material

References to detailed drawing

## 3. Equipment

Hand tools, truck, and mixing equipment

## 4. Safety on site

- Safety gear refers to item 1.3

## 5. Check

The following will be checked

- Mixing of soil and stabilizer in a correct mixing proportion
- Uniformly spread the mix material and propose

## 6. Measurement and payment

Measurement Unit =m<sup>3</sup>. The measurement shall be 'Measurement as Planned' based on the drawing and the quantity mentioned in the BOQ.

**Payment:** The unit rate 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.

# **WATER DRAINAGE CANALS**

## **1. Description**

This item includes the excavation and paving of the exposed water canals where applicable to drain out water to a main canal and a lower areas as instructed by the project Engineer. The work shall correspond to the designs listed in the construction drawings of the project.

## **2. Material**

- The required material shall be referred to the pavement design as mentioned in the detailed drawing

## **3 Method**

- Excavate canal in the specified shape. The excavate soil shall be disposed in a safe place as instructed by LebRelief project engineer
- Pave the canal surface by the material as specified in the detailed drawing

## **3 Equipment**

This activity requires hand tools and setting out tools and equipment

## **4. Safety on site**

- Safety gear refers to item 1.3

## **5. Checking**

The following will be checked:

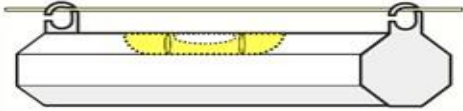
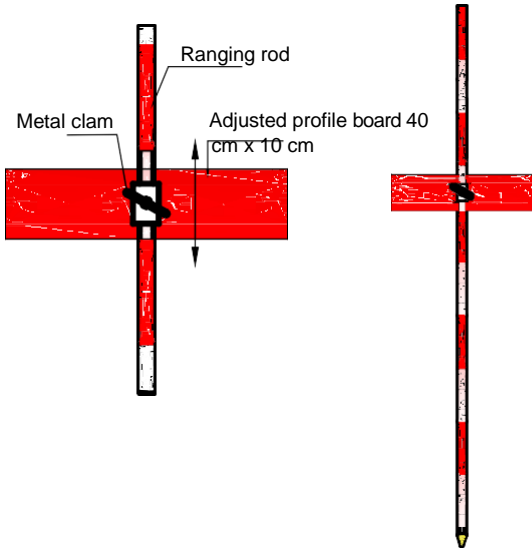
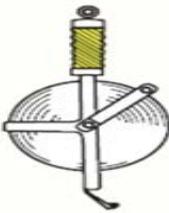
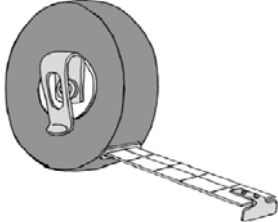
- Check shape of the canal before commencing the pavement
- Check the pavement material shall be complied with the detailed drawing
- The final pavement surface shall be leveled

## **6. Measurement and payment**

Measurement Unit =m length of the completed the canal. The measurement shall be 'Measurement as Planned' based on the drawing.

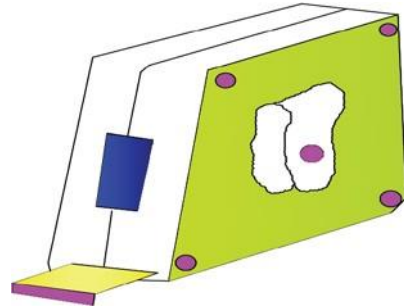
**Payment:** The unit rate shall be the full compensation for labour, tools, materials and any other incidentals that may be required in carrying out the work for this item.

# Technical Specifications for Hand Tools

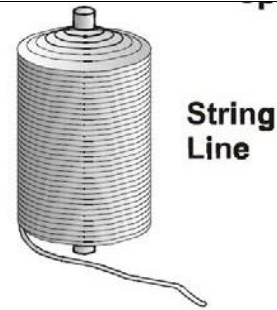
Description	Setting out tools	
<p><b>Line level</b> is used with a clear nylon string to transfer the exact level of one location to another point. The line level is a short spirit level (about 100mm long) with a hook at each end to hang it from a smooth nylon string. This instrument needs two persons to operate – one at the end of the line, and the second to watch the spirit level.</p>		
<p><b>Ranging rod and profile board:</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 made 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, sag 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><b>Measuring tape:</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/marking on the tape becomes unreadable after a period of use. Important is to keep tape clean</p>		

and avoid dirt from entering the dust.

Note: The zero point is not always located at the same place on different tape measures.



**String line** 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.



**Hammer:** 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.



**Peg:** 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.



**Metal spike/pointed chisel:** 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.

This instruments is used with hammer to make a hole before placing the ranging rods or pegs in the ground,

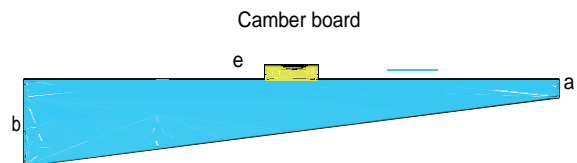


when the setting out is carried out in hard and compact soils.

**Camber board** 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  $a$ ,  $b$  and  $e$  as shown in the right hand side figure depend on designed width of the road and cross slop of the camber:

*Example width of road is 4 m and camber 10%,  $a=5$  cm so  $e=200$ cm and  $b=5+200/10=25$ cm.*

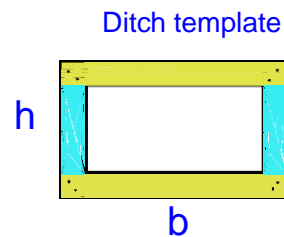
A spirit level is placed at middle of the plank as shown in the figure right hand side to ensure the plank is horizontally placed during checking or setting out for camber.



**Ditch template** is used for checking ditch of a road side drain before allowing to cut slop of the side drain.

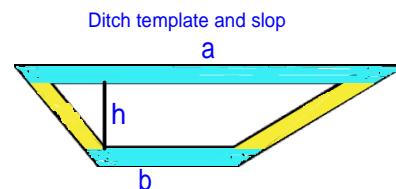
The ditch template is made of timber frame of rectangular shape. Width of the timber frame between 5-7 cm and thickness 2-3 cm.

Size of the template depends on side drain design. Commonly size of the ditch template is  $b=50-60$  cm and  $h=30-50$  cm



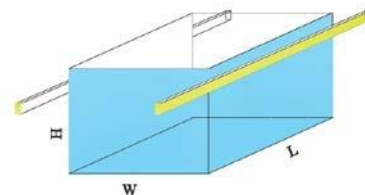
**Side drain template** is used for checking earth side drain of a road. The side drain template is made of timber frame of trapezium shape. Width of the timber frame between 5-7 cm and thickness 2-3 cm.

Size of the template is commonly:  $b=50-60$  cm and  $h=30-50$  cm and  $a=140-150$  cm


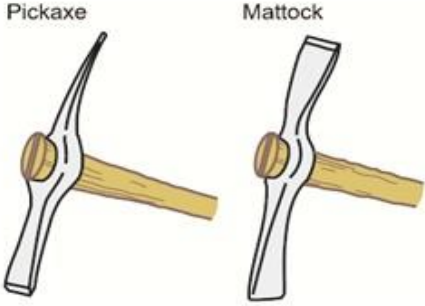
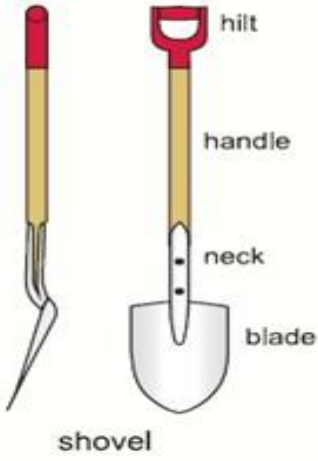


**Gauge boxes** are used to batch, or measure volumes of the material, to control the mix proportions of concrete. The gauge box should be prepared based on quantity of 1 bag of cement

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.



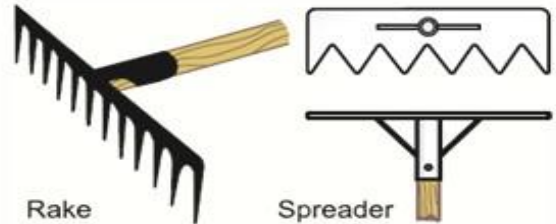


<p><b>For 1 bag of cement (40 kg)</b>  W= 30 cm, H= 30 cm, L= 32 cm  Volume= 0.029 m<sup>3</sup></p>	
<p style="text-align: center;"><b>Description</b></p>	<p style="text-align: center;"><b>Hand tools</b></p>
<p><b>Hoe</b> is used for excavation of soil, spread gravel, mix concrete or mortar. It consists of a blade and a handle.</p> <p>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>	

**Spreader and rake**

**Rake** 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.

**Spreader** 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.

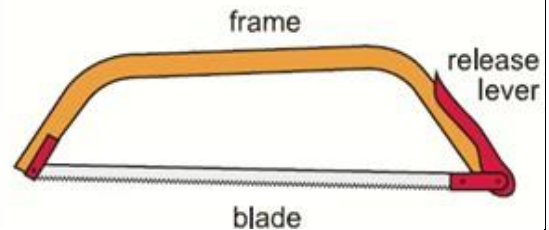


**Saws** are used to cut trees, branch of tree, bush and wood. There are difference type of saws are used for cutting difference size of tree, bush or wood.

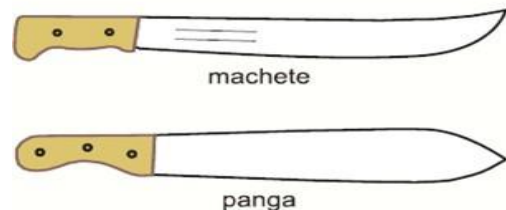
**Big saw** is used to cut big tree or wood operate with two persons while small saw (steel frame bow saw )can be sue single person.

Big saw is made from steel blade of 1.5-2 m long with wooden handles fixed at both end of the blade.

**Small saw (steel framed bow saws)** 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.



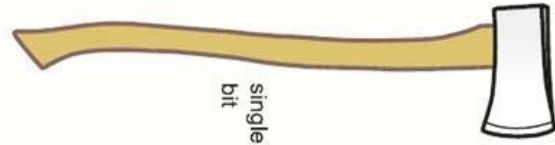
**Bush knives:** Bush knife is used for clearing the bush and cutting tree branches along the road alignment. It is also used for cutting and sharpening peg. The bush knife is made of steel shape blade and wooden round handle.



**Axe** 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 axecan be used instead of hammer.

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.

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.



**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.

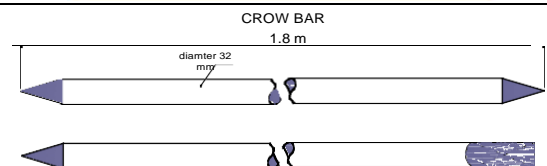


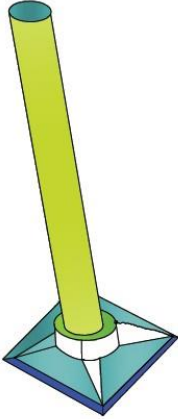

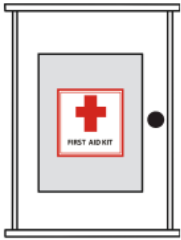
**Basket** is used for carrying soil or gravel for a short distance. A typical basket has a pay-load of 5 to 6 kilograms of soil. Basket can be made from local basket making materials (bamboo) or used tyres or manufactured in plastic. Baskets are very suitable for dry soil, and although they are not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



<p>strong material that does not bend easily and be well designed to function properly.</p> <p>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>	
<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>	

**Markings and detours** 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. The text on the warning signs should read: "KUIDADU" or " HALAI NENEIK"

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.



**Safety Goggles** should be used when there is a risk for eye injury, eg when:

- breaking rocks
- welding



**Boots** should be used when:

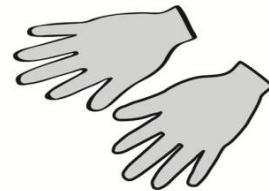
- mixing concrete and mortar
- working in wet or muddy places
- working with sharp tools

**Closed shoes** should be worn at all other times



**Gloves** should be used when:

- carrying heavy load and when using hand tools
- working with concrete and masonry work (rubber gloves)
- bending and fixing steel bars
- breaking rocks



**Safety hat or helmet** should be used when working in dangerous of falling objects like:

- in deep drain or foundation excavation
- under bridge
- under tall tree



**Bright vest** should 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.



**Masks** are used when working in places that produce a lot of dust or bad smell.

