

**UNITED NATIONS OFFICE FOR PROJECT SERVICES (UNOPS)**

**AFGHANISTAN**

**IBN**

**(Infrastructure for Basic Human Needs)**

**Annex 2**

**UNOPS Small Works Specification**

**and Measurement Rules**

**UNOPS (Afghanistan)**

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## **SECTION 1100: GENERAL REQUIREMENTS AND PROVISIONS**

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## **SECTION 1: GENERAL REQUIREMENTS AND PROVISIONS**

### **1101 SCOPE**

This section covers matters which relate to the construction work as a whole.

### **1102 PROGRAMME OF WORK**

The Contractor shall submit a detailed programme of work to the UNOPS Engineer no later than 14 days after the Contractor has been issued with the order to commence.

The Programme shall be in the form of a bar chart. If, during the progress of the work, the quantities of work performed per week/month fall below those shown in the programme, or if the sequence of operations is altered, or if the programme is deviated from in any other way, the Contractor shall, within one week after being notified by the UNOPS Engineer, submit a revised programme.

If the programme is to be revised by reason of the Contractor falling behind his programme, he 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 Clause 15 of the Conditions of Contract or any extended time granted pursuant to Clause 23 of the Conditions of Contract.

The approval by the UNOPS Engineer of any programme shall have no contractual significance other than that the UNOPS 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 UNOPS 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 time to which he may be fairly entitled to in terms of the General Conditions of Contract for delay or disruption of his activities.

Should the UNOPS Project Manager request and the Contractor undertake 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 in writing and according to the terms of such agreement.

### **1103 WORKMANSHIP AND QUALITY CONTROL**

The onus is on the Contractor to produce work which conforms in quality and accuracy of detail to the requirements of the Specifications and/or Drawings, and the Contractor must, at his own expense, institute a quality control system and provide experienced Engineers, foremen, surveyors, materials technicians, other technicians and other technical staff, together with all transport, instruments and equipment, to ensure adequate supervision and positive control of the Works at all times.

The cost of all supervision and process control, including testing, so 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.

Unless otherwise instructed by the UNOPS Engineer, the Contractor shall obtain written approval for each layer of the works, in embankments, subgrade, or any gravel or pavement layers and shall not proceed with subsequent layers until each approval is granted. The Contractor shall be required to give reasonable notice to the UNOPS Engineer to allow any inspection to be carried out. If any test is required to verify compliance with these specifications, then the Contractor shall plan his Works so as to allow the UNOPS Engineer sufficient time to witness such tests. Unless instructed otherwise, the Contractor may proceed with the Works even though the results of tests may not yet be available. However, the Contractor shall be required to re-execute work if tests

indicate non-compliance with these Specifications. Any approval given by the UNOPS Engineer shall not relieve the Contractor of any of his obligations under the Contract.

To ensure and as a record that the works have been carried out in accordance with the Design (including the sequence of works carried out) the contractor must complete the quality record sheets that will be provided by the UNOPS for the works. The record sheets must be completed as the works are carried out and will necessitate a number of entries to be made on each day.

The UNOPS Lead Construction Management Engineer for each city will ensure that a pragmatic approach is taken to the adherence of the specification during the implementation of the Project Works. While the requirements of the specification relating to the management of health and safety cannot be relaxed, a pragmatic approach can be considered to material testing should the quantities of each material be such that the full suite of testing as described within the specification be deemed to be inappropriate. In such cases previously approved material sources can be used providing that similar tests have already been carried out and the material have been found to be in compliance with the specified requirements.

Where no source testing has previously been completed, the UNOPS Lead Construction Management Engineer can apply to the UNOPS Urban Lead for a dispensation which would allow specifically identified testing to be omitted. Any request for a dispensation must be recorded in writing and must be approved by both the UNOPS Urban Lead and the UNOPS Project Quality Manager. Any such dispensation whether granted or not will not relieve the Contractor of the requirement to carry out the specified testing or to ensure the quality of the material or product being supplied or placed / fitted.

## **1104 MEASUREMENT AND PAYMENT**

### ***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 done or materials supplied will be measured for payment, and that the billed quantities may be increased or decreased as provided for by the General Conditions of Contract.

### ***Contract Rates***

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

The Contractor shall accept the payment provided in the Contract and represented by the prices tendered by him 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 and unloading, 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 work and maintenance during the Period of Maintenance.

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

At the discretion of UNOPS, provided that the completed tasks do not pose safety concerns or compromise structural integrity, the Engineer and contractor may mutually agree upon a reduced unit cost for the defective works which doesn't fully match the contract requirements.

### ***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/or Drawings and the Contractor shall, when tendering, allow for his prices to be inclusive as indicated above.

### ***Materials on Site***

No payment will be made in any Certificate for any materials on site until such time as they have been incorporated in the permanent works and approved.

### ***Provisional Sums***

The Bill of Quantities may contain certain Provisional Sums so designated and entered as a preliminary allowance to cover the cost of work, materials, goods or services to be provided by the Contractor and which have not been fully specified or measured or to cover the cost of unforeseen items of work or contingent expenditure. Work done under a Provisional Sum shall only be executed upon a written order by the UNOPS Engineer which order shall also specify the method of payment.

The Contractor shall furnish to the UNOPS Engineer such receipts or other vouchers as may be necessary to prove the amounts paid and, before ordering materials, shall submit to the UNOPS Engineer quotations for the same for his approval. In respect of such of the works executed on a dayworks basis, the Contractor shall, during the continuance of such work, deliver each day to the UNOPS Engineer an exact list of the names, occupation and time of all workmen employed on such work and a statement showing the description and quantity of all materials and equipment used other than the Contractor's equipment which is included in the percentage addition in accordance with such daywork schedule. Each list and statement will, if correct, or when agreed, be signed by the UNOPS Engineer and a copy returned to the Contractor.

The Contractor shall not be entitled to any payment unless such lists and statements have been fully and punctually provided. Where the UNOPS Engineer considers that for any reason the provision of such lists was impracticable he shall nevertheless be entitled to authorise payment for such work provided that, such work or value thereof shall, in his opinion, be fair and reasonable.

## **1105 PROTECTION OF THE WORKS AND REQUIREMENTS TO BE MET BEFORE CONSTRUCTION OF NEW WORK ON TOP OF COMPLETED WORK IS COMMENCED**

Where required the Contractor is to provide, at its own cost, temporary drainage works such as drains, open channels, banks, etc. and furnish and operate temporary pumps and such other equipment as may be necessary to adequately protect, drain and dewater the works and temporary

works. This will be in addition to any permanent drainage works specifically paid for separately. Care shall be exercised to keep all completed layers properly drained, not to cause dumps of material on completed layer work to inhibit surface drainage or to form wet spots under and around dumps, and to protect all parts of the work against erosion by floods and rain.

Material shall not be spread on a layer that is so wet such as to damage underlying layers or prevent adequate compaction of overlying layers. Such wet layers shall be dried and recompact or removed. Excavations for pipe drains, culverts, sewer drains, water mains, manholes, service ducts and similar structures shall be adequately protected against the possible ingress of water during rainstorms.

All completed layer work shall be protected and maintained until the following layer is applied. Maintenance shall include immediate repairs to any damage or defects which may occur and shall be repeated as often as is necessary to keep the layer continuously intact and in a good condition. Before any completed layer is primed or a succeeding layer constructed thereon, any damage to the existing layer shall be repaired so that after repair or reconstruction if necessary, it will conform in all respects to the requirements specified for that layer. All repair work other than minor surface damage repairs shall be submitted to the UNOPS Engineer before covering up.

Work performed as part of the above obligations shall not be measured and paid for separately

#### **1106 REMEDIAL WORK**

When any part of the Works or any equipment or material is found upon examination by the UNOPS Engineer not to conform to the requirements or is at any stage before final acceptance damaged so that it no longer conforms to the requirements of the Specifications, the UNOPS Engineer may order its complete removal and replacement, at the Contractor's expense, with satisfactory work, equipment or material or he may permit the Contractor to apply remedial measures in order to make good any such defects or damage. The actual remedial measures taken shall at all times be entirely at the Contractor's own initiative, risk and cost, but subject to the UNOPS Engineer's approval regarding the details thereof.

In particular, remedial measures shall ensure full compliance with the Specifications of the final product, shall not endanger or damage any other part of the Works and shall be carefully controlled.

#### **1107 WATER**

Where required the Contractor shall make his own arrangements for procuring, transporting, storage, distribution and application of water needed for construction and other purposes, except where otherwise specified. No direct payment will be made for providing water and the cost thereof shall be included in the prices tendered for the various items of work for which water is needed. Only clean water, free from undesirable concentrations of deleterious salts and other materials shall be used. The Contractor shall ensure that sufficient supply of water is at all times available to ensure continuity of work. All sources of water used must be approved by the UNOPS Engineer.

#### **1108 ELECTRICITY SUPPLY**

Where required the Contractor shall provide and maintain at his own expense his own electrical supply and shall provide and maintain all temporary power and lighting and all associated

apparatus for the duration of the Contract at his own expense. Once equipment becomes redundant, and having received the approval from the UNOPS Engineer, the Contractor shall disconnect and remove said equipment and make any works disturbed at his own expense.

#### **1109 TOLERANCES**

The work specified in the various sections of these Specifications shall comply with the various dimensional and other tolerances specified in each case. Where no tolerances are specified, the standard of workmanship shall be in accordance with normal good practice.

#### **1110 PHOTOGRAPHIC RECORDS**

The UNOPS Engineer shall make photographs and other records to be agreed with the Contractor of the condition of the surfaces of the site immediately before entering upon them for the purpose of constructing the Works. Each month, the Contractor shall provide a set of digital colour photographs illustrating progress of the Works, or any other photograph that he may deem necessary for record purposes, and provide these to the UNOPS Engineer for his records. The copyright of all photographs shall be vested in the UNOPS Project Manager and the Contractor shall not use any photograph for any purpose whatsoever without the UNOPS Engineer's approval.

#### **1111 ACCESS TO SITE**

The Contractor shall make his own arrangements for access to the various parts of the Site where works are to be constructed but all such accesses shall be subject to the approval of the UNOPS Engineer.

Where the access to the Site proposed to be used by the Contractor lies across the land of any third party the Contractor shall produce to the UNOPS Engineer the written consent of the owner and the occupier of the land over which the access lies before making use of the same.

The Contractor shall also make a record to be agreed by the UNOPS Engineer of the conditions of the surfaces of any land (and of any crops on such land) over which access lies before he uses it for access purposes and he shall keep all such surfaces in a reasonable state of repair during the executing of the Works. On the termination of the Contractor's use of such access he shall restore any lands, roads or other property to a condition at least equal to that existing before his first entry upon them.

#### **1112 CO-OPERATION**

All work shall be carried out in such a way as to allow access and afford all reasonable facilities for any other contractor and his workmen and for any persons working on or visiting the site on behalf of the UNOPS.

The Contractor shall use his best endeavours to co-operate with such persons without interfering with them and shall observe all the instructions and orders of the UNOPS Engineer in that connection.

In the preparation of his programme of work the Contractor shall at all times take full account of and coordinate with the programming of work of other contractors.

### **1113 ROADS AND SITE TO BE KEPT CLEAN**

The Contractor shall take great care and all reasonable precautions to ensure that roads and thoroughfares used by him either for the construction of the Works or for the transport of plant, labour and materials are not made dirty as a result of such construction or transport and in the event of their becoming thus dirtied in the opinion of the UNOPS Engineer the Contractor shall take all necessary and immediate steps to clean them.

### **1114 SECURITY OF THE WORKS**

Watching of the Works shall be provided by the Contractor at his own expense. If the UNOPS Engineer considers it necessary he will order in writing that additional watchmen be provided all at the Contractor's expense.

### **1115 SUPPRESSION OF NOISE**

The Contractor shall make every reasonable endeavour both by means of temporary works and by the use of appropriate plant or silencing devices to ensure that the level of noise resulting from the execution of the Works does not constitute a nuisance.

### **1116 SAFETY**

#### **1116a GENERAL PROVISIONS**

The UNOPS places the highest priority on the occupational health, safety and welfare of all individuals who will be involved with this sub project, whether they be direct employees, sub-contractors, service providers, suppliers, visitors to the site or members of the general public .

For the duration of the site works the UNOPS and any Contractors, Sub Contractors, Suppliers and Visitors, shall consider local communities and the local environment to ensure that the works do not compromise the safety of others or cause an adverse environmental impact.

The Contractor will be required to ensure that the management of Health, Safety, Security and the Environment is given the highest priority and that the associated works, services and attendances are provided and carried out in a robust and professional manner.

The appointed Contractor shall:

- Create and maintain a safe and healthy working environment in all work areas by taking reasonable measures to prevent or address personal injuries, ill health and damage to property;
- Monitor and continuously improve **Health Safety Security and Environmental** management and performance;
- Promote excellence in **Health Safety Security and Environmental**, by aligning with the UN Common System Frameworks, international standards and best practices as appropriate;
- Manage all site activities and facilities in a manner that respects the principles of social and environmental responsibility, with the primary purpose of protecting people and the environment, and mitigating the negative impacts of its activities and facilities.
- Prevent pollution to air, water and land by adopting sound environmental practices;
- Encourage reuse and recycling of materials and products to reduce material intensity and generation of waste;
- Prevent the infringement of human rights in all activities;

- Uphold good labour practices that include freedom of association; the elimination of all forms of discrimination at work; and not using or benefiting from forced labour and child labour;
- Anticipate, avoid or minimize adverse impacts on the rights of minority groups. Prevent all forms of discrimination, such as those based on race, colour, sex, language, religion or political opinion; in particular, promote gender equality and advance equal opportunities between men and women in all projects and operations;

To support the achievement of the above Objectives all Contractors and Sub-Contractors engaged on the Sub Project shall be required to:-

- Identify the major hazards and risks associated with its facilities as well as risks to the environment and society arising from its activities and take the necessary steps to eliminate or manage these risks;
- Engage with the UNOPS personnel, partners, contractors and suppliers on **Health Safety Security** and Environmental issues to ensure that everyone understands the requirements and obligations within their context;
- Encourage all site personnel to adopt good health and safety practices and aim to raise their working standards;
- Operate an appropriate **Health Safety Security** and Environmental management system on site to the approval of the UNOPS Project Manager.
- Promote a safe working culture and ensure that practitioners are aware of the environmental and social impacts of their activities and know how to operate in a socially and environmentally responsible manner through training and awareness;

## **1116b SAFETY MANAGEMENT RESPONSIBILITIES**

### **UNOPS Director / Country Manager**

For each country where UNOPS has activities and facilities, the Director of the Region overseeing the country in question, or the UNOPS personnel to whom the Regional Director has delegated authority to do it, shall be responsible and accountable for:

- The correct and proper implementation and management of **Health Safety Security** and Environmental policies and procedures in all activities and facilities under their responsibility;
- The reporting on HSSE performance including significant incidents occurring in their units in accordance, so that corporate performance may be collated.

### **UNOPS Project Manager**

The overall responsibility and accountability for the management of all aspects of **Health Safety Security** and Environmental issues on the Afghanistan Community Resilience and Livelihoods Project shall rest with the UNOPS Project Manager. The UNOPS Project Manager may delegate roles and responsibilities (in writing) to other UNOPS Staff, but the UNOPS Project Manager retains overall responsibility and accountability.

Specific Responsibilities of the UNOPS Project Manager

- Complying with all UNOPS HSSE requirements
- Taking all reasonable actions to prevent and address incidents – even if that means temporarily stopping work when significant hazards or issues are identified;
- Reporting of HSSE incidents and assisting in the review of the incidents
- Contributing to positive HSSE planning, implementation and performance

**Contractor' Project Manager**

The Contractors Project Manager will be responsible to the UNOPS Project Manager for the health, safety, security and environment of all project related works and operations carried out by the Contractor on and off site.

**Contractors Site Manager or Site Supervisor**

The Contractors Site Manager or Site Supervisor will be responsible to the Contractors Project Manager for the health, safety, security and environment of all project related works which they are supervising on behalf of the Contractor.

**Contractors Drivers and Plant / Equipment operators**

The Contractors Drivers and Plant Equipment Operators will be responsible to the Contractors Project Manager for the safe and proper use of all plant and equipment used by the Contractor both on and off site. This responsibility includes the responsibility to only drive or operate vehicles, plants or equipment which are fully functional and have no safety related defects.

**Contractors Employees**

Each and every employee of the contractor on site whether directly employed, sub contracted, management, skilled, tradesperson or general labourer is responsible for his or her own actions and for ensuring that they work in a manner that not only ensures their own safety, but which ensures the safety of others as well. This responsibility extends to all site rules and safety instructions and following all method statements and work instructions at all times.

**1116c CONTRACTORS STAFF**

The Contractor should make sure to onboard the key staff that are approved during the evaluation of the bid. If for some unprecedented reasons , the key staff can not be available the contractor should propose a replacement with equal qualification and experience and get the approval of UNOPS lead construction management engineer.

**Contractors Site Manager**

The Contractor must employ a full-time site-based Site Manager that is capable of taking instruction from the UNOPS Project Manager and who has the authority to represent the Contractor in all aspects of the Contract and Project Works. The Contractors Project Manager must be dedicated to the Afghanistan Community Resilience and Livelihoods Project and must not be involved with any other projects which the Contractor may have. The person appointed must be on site at all times during working hours, and be fluent in English and technical terminology.

**Contractors Drivers and Plant /Equipment operators**

All items of plant and equipment must be operated by trained, qualified and experienced operators. If in the opinion of the UNOPS Project Manager the operator does not have the necessary qualifications, skills or experience, or should the UNOPS Project Manager after watching the operator at work consider that the operator does not have the capacity to operate the piece of plant or equipment safely, the contractor shall remove and replace the said operator to the satisfaction of the UNOPS Project Manager.

Prior to mobilization to site and prior to any Projects works being undertaken the Contractor must provide to the UNOPS Project Manager the documents, listed below. This list is indicative and may be added to by the UNOPS Project Manager at any time. These documents are required to ensure that the full scope complexity and nature of the works have been understood, the hazards and risks

associated with the works are understood and that sufficient, suitable, experienced and qualified resources have been identified as being required to safely execute them within the given and required timescales.

The UNOPS Project Manager will review each document and either approve it or provide written comments for the Contractor to address. Only once the UNOPS Project Manager has approved each document in writing will the works on site be allowed to start. No extension of time will be given to the Contractor as a result of time spent in preparing or revising the undernoted documents.

Documents to be provided will include:-

- The Contractor's proposed site management structure.
- The Contractor's proposed site staff, including details of all relevant experience, training (safety training and skills training), language skills.
- A fully developed Site Health and Safety Plan
- A fully developed Emergency Plan – to include, fire, evacuation, security events etc.
- A fully developed Environmental and Social Management Plan (see section 16 of this document)
- A fully detailed method statement(s) for the works containing full details of as a minimum:-
  - o The scope of works to which the Method Statement refers;
  - o A fully detailed methodology which clearly shows how the works will be carried out safely and how the members of the public using the bridge will be safeguarded during the course of the works;
  - o The identification of any potential safety issues and the means in which they will be managed;
  - o Any restrictions which may need to be placed on the use of the bridge by the public
  - o The resources that will be required to safely undertake and complete the works;
  - o Any materials (including quantities) which will be required to complete the works;
- The Contractors Master Programme of works. This should be based on the Contract Programme.
- A detailed programme works planned for the next two weeks on site. This programme should be based on the Contractors Master Programme and should be revised every week. The detailed programme should include the following information
  - o Sequence of work.
  - o An allowance for holidays.
  - o Activity relationships or logic links
  - o Activity durations
  - o The resources required for each operation.
  - o Periods within which various stages or parts of the Works are to be executed.
  - o The Programme should be broken down to show working days and must be updated every week. The Contractor should identify changes since the previous version, and show the estimated percentage of completion for each item of work.

#### **1116d CONTRACTORS OFFICES AND WELFARE FACILITIES**

The Contractor is required to provide adequate toilet and washroom facilities for his staff and workforce. These facilities shall be kept clean and serviceable at all times. Failure of the Contractor to ensure that suitable toilet and washroom facilities are provided on-site will result in an

immediate 'stop work' order being issued. All costs and time delays resulting from any such 'stop work' order will be entirely the Contractors responsibility.

The Contractor is required to provide adequate first aid equipment on-site to the satisfaction of the UNOPS Project Manager. Failure of the Contractor to ensure the availability of first aid equipment on-site will result in an immediate 'stop work' order being issued. All costs and time delays resulting from any such 'stop work' order will be entirely the Contractors responsibility.

A site office shall be established by the Contractor at the work site which will include a suitable place to hold meetings with the UNOPS Project Manager. The Contractor shall ensure that the office has a complete set of the contract documents, including all contract drawings printed to scale. The contractor office should be approved by the UNOPS Engineer.

The Contractor shall maintain a safe, healthy and tidy worksite at all times and all work activities are to be performed with protective and safety equipment appropriate for the task. The Contractor is entirely responsible for workplace safety and unsafe work practices will be identified and recommendations made for revised work methods as appropriate. Should the UNOPS Project Manager or any of his staff identify any unsafe practices the works shall be stopped until such time as suitable measures have been put in place to rectify such matters. The costs associated with any such stoppages and with rectifying any unsafe circumstances will be borne by the contractor.

#### **1116e CONSTRUCTION PLANT AND EQUIPMENT**

All plant and equipment provided by the Contractor (whether owned or hired) must be in good order and free from defects. Any item of plant or equipment found to be unsafe or unsuitable will be removed from site at no cost to the UNOPS if directed by the UNOPS Project Manager. Examples of reasons why an item of equipment may be deemed to be unsuitable may include but not be limited to:-

- being undersized or oversized;
- having defective brakes, exhaust or tyres;
- leaking fluids – oil, water etc;
- making excessive noise or vibration
- having non-approved parts i.e. manufacturers parts replaced by locally fabricated ones.
- having other non-specific defects which in the opinion of the UNOPS Project Manager renders the item of plant unsafe to be used on site.

All items of plant and equipment must be operated by trained, qualified and experienced operators. The Contractor must provide the UNOPS Project Manager with a copy of the qualifications and details of the experience of each plant or equipment operator. If in the opinion of the UNOPS Project Manager the operator does not have the necessary qualifications, skills or experience, or should the UNOPS Project Manager after watching the operator at work consider that the operator does not have the capacity to operate the piece of plant or equipment safely, the contractor shall remove and replace the said operator to the satisfaction of the UNOPS Project Manager

#### **1116f PROTECTION OF PERSONS AND PROPERTY**

The Contractor must –

Provide any and all Personal Protective Equipment (PPE) which may be required by its employees, sub-contractors, visitors and suppliers when working on or visiting a site. All PPE will be provided without charge to the contractor's employees, sub-contractors, visitors and suppliers and will be replaced free of charge whenever required due to loss, damage or wear. All PPE must be of good

quality and be approved by the UNOPS Project Manager.

- Provide and maintain required barricades, guards, fencing, shoring, temporary roadways, footpaths, signs, lighting and traffic flagging.
- Not obstruct or damage road ways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Determine the location of such services. If damage occurs, immediately repair it at the Contractors own cost.
- Not damage property which is to remain on or adjacent to the site, including adjoining property encroaching onto the site. If damage occurs, immediately repair it at the Contractors cost.
- Maintain safe pedestrian access at all times unless agreed in writing with the UNOPS Project Manager.

N.B. All PPE provided by the Contractor must be new and must be both suitable and appropriate for its intended use. Prior to the works commencing, the Contractor will provide the UNOPS Lead Construction Management Engineer with a sample of any item of PPE that it plans to use on site for their approval. Only approved items of PPE can be used on site – if the UNOPS Lead Construction Management Engineer believes that any PPE being used on site is not suitable, appropriate or of the agreed standard the Contractor will be required to replace it at its own cost.

#### **1116g SERVICES**

Before any works are started on site the Contractor must ensure that any underground or overhead services either within the site itself or which cross the site access route are identified and protected.

**Underground Services-** Before any works are started, the Contractor must satisfy himself that there are no existing services in the area where it plans to carry out any works.

It is the Contractor's responsibility to identify, protect, divert or remove any buried underground services. If necessary the contractor should carry out Cat Scanning of the site and excavate by hand in areas of particular concern. The identification, protection, diversion or removal of any buried underground services is deemed to have been allowed for within the Contractors Rates or prices and as such no additional payment will be made nor time granted for any works associated with these works.

If the underground services are disrupted or damaged due to the contractor's negligence in protection measures, the contractor is responsible for rectifying the situation at their own expense, and the project will not cover the costs.

**Overhead Services** - It is the Contractor's responsibility to identify, protect, divert or remove any overhead services. The identification, protection, diversion or removal of any overhead services is deemed to have been allowed for within the Contractors Rates or prices and as such no additional payment will be made nor time granted for any works associated with these works.

All works associated with overhead and buried underground services must be planned in advance and a specific method statement must be provided to the UNOPS Project Manager for approval before the works commence on site. The Method Statement must clearly show how the works will be carried out safely and how the services will be adequately protected. Special attention should be given to barriers and signage. If the overhead services are disrupted or damaged due to the contractor's negligence in protection measures, the contractor is responsible for rectifying the situation at their own expense, and the project will not cover the costs.

**1116h ADJOINING PROPERTY**

The Contractor must carry out a final joint inspection of any adjacent or affected properties with the UNOPS Project Manager or his designee before start of work.

Ensure that a written and photographic record of the condition of each property is kept and signed by the Contractor, The UNOPS Project Manager and the Property Owner. The record should include the condition of the existing property (internal and external) with special attention being given to any visible structural defects and other damage or defacement.

- Provide the UNOPS Project Manager with a full copy of each record, including drawings, written descriptions, and photographs, endorsed (signed) in writing by the owners and occupants, or their representatives, as evidence of conditions existing before commencement of work.
- Record and agree any damage that has occurred since the pre-commencement inspection. The UNOPS Project Manager will determine if the Contractor is to make repairs or if the damage will be deducted from the Contractor's final invoice.

**1116i ACCIDENTS**

The UNOPS Engineer shall be notified by the Contractor immediately any accident occurs whether on Site or off Site in which the Contractor is directly involved which results in any injury to any person whether directly concerned with the Site or whether a third party. Such initial notification may be verbal and shall be followed by a written comprehensive report within 24 hours of the accident.

Transportation of any material by the Contractor shall be in suitable vehicles which when loaded do not cause spillage and all loads shall be suitably secured. Any vehicle which does not comply with this requirement or any of the local traffic regulations and laws shall be removed from the Site.

**1116j Measurement and Payment**

<b>Item</b>	<b>Unit</b>
Environmental and Social Management	Provisional Sum

Payment for the Management of Environmental and Social including Health and Safety as set out within this section of the Specification and Environmental and Social Management Plan (ESMP) shall only be made upon the Contractor **fully** complying with all and every requirement relating to the ESMP as set out in this document or elsewhere within the Contract to the satisfaction of and the requirements of the UNOPS Project Manager whether specifically identified within this document or not.

The sum or amount submitted by the Contractor in its price shall not be subject to change and shall not be subject to remeasurement or re rating for any reasons whatsoever and will be deemed to be sufficient to cover any changes in the quantities or scope of the work whether instructed or not.

No advance payment will be made for the Management of environmental and Social including Health and Safety, however the Contractor may request that part payment is made on account each month based on the breakdown approved by the UNOPS Engineer. On account payments should not exceed the provisional sum value included within the Contract.

The full value of the provisional sum will be payable subject to the Contractor having fully complied with all and every requirement relating to the management of Health and Safety during the course of the work

### **1117 METHOD OF WORKING**

The Contractor shall adopt a method of working such as to permit the satisfactory and timely completion of the Works and to limit disturbance and damage to a minimum.

### **1118 TEMPORARY WORKS**

The Contractor shall provide, maintain and remove on completion of the Works all temporary works necessary for the construction of this permanent works. All temporary works shall be properly designed and constructed to carry such loads as may be imposed upon them and shall be safe and suitable in every respect for providing access or carrying plant or for the construction of the Works or other purposes.

### **1119 ACCOMMODATION OF VEHICULAR AND PEDESTRIAN TRAFFIC**

The Contractor shall plan his operation so as to maintain the flow of pedestrians and traffic through the Works without disruption or delay. Road or footpath closures may be permitted by the UNOPS Engineer in exceptional circumstances. The Contractor shall give at least 7 day's notice of any proposed road closure.

Upon completion of a day's work, or if the Works are to be left unattended, the Contractor shall leave the Works in such a condition so as to allow the safe passage of pedestrians and traffic. The Contractor shall be responsible for complying with all regulations relating to the temporary closure of roads and footpaths.

Should the road width be restricted or should there be any form of obstruction or danger to traffic, the Contractor shall supply adequate flagmen, signs, barriers, lights, communications and staff to ensure that the traffic is safely conducted through the Works.

### **1120 ENVIRONMENTAL MEASURES**

#### **General**

The Contractor shall take all reasonable precautions, whether specified in the contract or not to prevent damage to the natural environment occurring as a result of the execution of the Works and shall strictly observe all regulations procedures etc. in relation to entry upon land, whether within the Site or not.

This section of the specification shall prevail over any other section in the event of ambiguity or conflict in requirements for environmental protection or treatment of social issues.

#### **Provision of construction materials**

The Contractor will be responsible for all payments in respect of all materials required for use in the Works. The Contractor must fully acquaint himself with required protocol and legislation regarding the sourcing of earthworks and pavement materials. The Contractor shall, unless otherwise stated, be solely responsible for negotiation and payment of all fees, licences, goodwill, royalty and any other charge in respect of materials obtained from any land.

**Erosion control**

The Contractor is required to enter into the spirit of environmental protection and conservation and to construct works in terms of agreed programmes, methods and sequences that will prevent or mitigate against erosion. The Contractor shall employ such temporary measures as are necessary to prevent or mitigate against erosion or siltation of any natural water course in addition to permanent drainage or erosion control systems that are detailed in the contract documents.

**Clearing**

The Contractor shall only clear vegetation from within the site area as shown in the drawings, on no account is the Contractor to damage vegetation outside the site area. Should such damage occur the Contractor shall forthwith take such steps as are necessary to prevent erosion and to re-establish vegetation.

**Disposal of materials**

The Contractor shall locate waste excavation disposal areas as agreed with the UNOPS Engineer. All excavated material which by virtue of its organic content, moisture content, or other characteristics, which is unsuitable for re incorporation into the works or which is surplus to the works requirements shall be transported and placed in such waste excavation disposal areas.

**1121 SETTING OUT**

Setting out the horizontal alignment and elevation levels of the works will be the responsibility of the Contractor. The contractor shall ensure that the setting out is maintained for the entire period required to achieve the dimensions of the road according to the drawings.

The contractor is required to conduct a topographic survey, create profiles and cross-sections at various intervals, and document the existing ground elevation. The contractor should utilise the UNOPS design drawings and develop an earthwork calculation sheet, and shall submit it as part of the Joint Inspection report. The Contractor shall be deemed to have examined the documents comprising the contract and to have included in his tender for the cost of complying with the provisions thereof whether itemised in the Bill of Quantities or not.

**Measurement and Payment -**

No specific item has been provided in the Bill of Quantities for compliance with the provisions of this section of the specification. The cost of complying with these provisions is to be included in rates for work items.

**1122 PROJECT INFORMATION BOARDS**

Where provided for within the Bills of Quantities, the Contractor shall provide, erect and maintain at least two information boards per road in a format acceptable to the UNOPS Engineer. Each sign shall be of no less than 2 m<sup>2</sup> area and comprise white lettering on a blue background. The board information shall be instructed by the UNOPS Engineer.

These information boards shall be erected at locations to be selected by the UNOPS Engineer. The boards are to be erected as the Contractor commences work on a particular Project road. The Contractor shall be responsible for removing the sign at the end of the Defects Liability Period.

### **1123 MINES AND UNEXPLODED ORDNANCE (UXO)**

As the LIWs are implemented in urban areas which are fully residential, the areas can be considered clear of explosives. However, it is the contractor's responsibility to raise awareness among the labourers that it is not guaranteed that the site is clear of all risk and that during excavation and trenching, further UXO can be found. Therefore, the contractor shall launch a proper approach to take required precautions in case of any risk observation and contacting relevant authorities as soon as possible.

The UXO risk has been identified in the ESMP and appropriate mitigation measures have been proposed. The UNOPS Team and the Contractors HSSE focal point will conduct the risk assessment briefing to the workers prior to their mobilisation at the site. The Project has developed a protocol which would be implemented in the event an UXO is discovered. The UXO Protocol is attached to the ESMF documents

In addition to the UXO Protocol, the project team and contractor HSSE focal point will also conduct regular awareness training and toolbox talks in order to reduce/eliminate the risk of HSSE incidents.

### **1124 PREPARATION OF "AS-BUILT" DRAWINGS**

The contractor shall submit a full set of draft "As-Built" drawings in hard and soft copy for the Engineer's consent. A full set of final "As-Built" drawings shall then be submitted by the contractor that incorporates any revisions required by the Engineer, before Taking Over of the works. Taking Over Certificate should not be issued until a complete set of satisfactory "As-Built" drawings are submitted.

The contractor shall submit one set of hard prints of the final "As-Built" drawings signed and sealed by the contractor and signed by the Engineer's representative, together with a copy of each drawing in an agreed electronic format.

#### **Measurement and Payment -**

No specific item has been provided in the Bill of Quantities for compliance with the provisions of this section (As-Built Drawings) of the specification. The cost of complying with these provisions is to be included in rates for work items.

**SECTION 1200 : CONTRACTOR'S ESTABLISHMENT**

## CONTENTS

1201	SCOPE
1202	GENERAL REQUIREMENT
1203	MEASUREMENT AND PAYMENT

**SECTION 1200 : CONTRACTOR'S ESTABLISHMENT**

**1201 SCOPE**

This section covers the setting up of the Contractor's establishment on the site, maintenance of the site establishment and the removal thereof after completion, and compliance with the provisions of the contract.

**1202 GENERAL REQUIREMENTS**

***Provision of facilities, plant and equipment***

The Contractor shall provide all facilities, personnel, equipment, plant and all other things whether of a permanent or temporary nature required for the execution and maintenance of the works. For performing the required material testing and routine quality control testing, the contractor shall assign a well-equipped and qualified material testing laboratory, for doing so, the contractor shall propose three construction material testing laboratories, and submit their profile to the UNOPS QA department for review and approval. The UNOPS QA department will approve one of the proposed laboratories for testing, and within 10 days of the site handover the laboratory shall mobilise the necessary testing facilities and equipment to the project site. It shall be noted that the approval of the laboratory doesn't relieve the contractor from their overall responsibility for ensuring the quality and timeliness of the results.

***Compliance with the Conditions of Contract***

The Contractor shall be deemed to have examined the documents comprising the contract and to have included in his tender for the cost of complying with the provisions thereof whether itemised in the Bill of Quantities or not.

**1203 PAYMENT**

<b>Item</b>	<b>Unit</b>
1203.1 Mobilisation	Lump Sum

Payment for mobilisation shall be compensation in full for the cost of establishing plant equipment facilities and personnel upon the site and shall include (but not necessarily be limited to).

- i. Mobilize manpower, equipment and establishing office buildings and other necessary facilities for contractor site operation. .
- ii. Provision and erection of temporary buildings, office facilities on the site.
- iii. Maintenance of the contractor's establishment
- iv. Provision of temporary access roads, hard standings etc as may be required to carry out the works. (iv) Temporary accommodation during the mobilisation phase, permits, bonds etc.
- v. Testing and process control requirements.
- vi. Erection of contract signboards where required.

The mobilization item cost to the contractor shall be paid based on the work progress percentage with the UNOPS Engineer approval.

No Payment shall be made to the contractor for the Maintenance of the Contractor's Establishment stated in above and its cost and expenses shall be compensated by the contractor own expenses.

<b>Item</b>	<b>Unit</b>
1203.2 Demobilisation	Lump Sum

Payment for demobilisation shall be compensation in full for the costs of removing plant, equipment, facilities and personnel from the site and shall include (but not necessarily be limited to).

- (i) Transport of plants, buildings, temporary facilities from the site and export if required.
- (ii) Dismantling and removal of all temporary facilities, services and sealing of disused services on the site.
- (iii) Removal of contract sign boards.
- (iv) Restoration of all construction camp areas to a satisfactory condition.
- (v) Disposal of surplus material

Payment shall be made upon completion of demobilisation to the satisfaction of the UNOPS Engineer. This item shall be payable only in respect of the whole of the Works and shall not apply in cases of sectional completion.

<b>Item</b>
1203.3 Performance Bond

The Contractor shall obtain (at his cost) a Performance Security (if stated in the contract) for proper performance, in the amount stated in the Contract Data and denominated in the currency(ies) of the Contract or in a freely convertible currency acceptable to the UNOPS. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply. The Contractor shall deliver the Performance Security to the UNOPS within 14 days after receiving the Letter of Acceptance, and shall send a copy to the UNOPS regional office(s). The Performance Security shall be issued by a reputable bank or financial institution selected by the Contractor, and shall be in the form annexed to the Particular Conditions, as stipulated by the UNOPS in the Contract Data, or in another form approved by the UNOPS. The Contractor shall ensure that the Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects. If the terms of the Performance Security specify its expiry date, and the Contractor has not become entitled to receive the Performance Certificate by the date 14 days prior to the expiry date, the Contractor shall extend the validity of the Performance Security until the Works have been completed and any defects have been remedied. The UNOPS shall not make a claim under the Performance Security, except for amounts to which the Employer is entitled under the Contract. The UNOPS shall indemnify and hold the Contractor harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from a claim under the Performance Security to the extent to which the UNOPS

was not entitled to make the claim. The UNOPS shall return the Performance Security to the Contractor within 21 days after receiving a copy of the Performance Certificate.

<b>Item</b>	<b>Unit</b>
1203.4 Insurances	Lump Sum

Payment for insurances shall be compensation in full for the cost of providing all insurances required by the contract (if applicable). Payment shall become due when evidence of satisfactory insurances has been provided to the UNOPS Engineer.

Unless the Insurance of the Works has been affected for the whole of the contract period, payment of the lump sum shall be made only in the proportion that the period of the insurance coverage (in respect of the Works) bears to the contract period named in the Contract Data.

In the event of extensions to the contract period (excepting extensions for which costs are not due to the Contractor) the UNOPS Project Manager shall pay the cost of extending the period of validity of the insurances.

**SECTION 1300: LABOUR****Contents**

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- 1313** Record keeping
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### **1301 Scope**

The objective of the Afghanistan Community Resilience and Livelihoods Project is to provide paid work in communities which have been affected by the recent economic downturn. The project places particular emphasis on providing employment to women and vulnerable adults who may otherwise find difficulty in finding paid employment.

The Contractor will be required to maximise the use of labour for all operations where it can be effectively used to attain the required standards. This means utilising labour instead of mechanical plant and equipment whenever possible.

### **1301 Labours Daily Wage**

The contractor is required to pay a daily wage of 450 AFs for unskilled laborers and 700 AFs for skilled laborers, payable every 21 calendar days for an 8-hour working day. When pricing the labor items of Bills of Quantities (BOQ) it's required to quote a minimum daily wage of 450 AFs for unskilled laborers and 700 AFs for skilled laborers considering the allocated wages unit rate with indirect cost (if any). This amount is the minimum amount that each person should take home after any deductions have been made. This wage is applicable to both men and women.

### **1302 Unskilled labour requirement.**

Each sub – project will have a stated unskilled labour requirement. This requirement will be assessed by the UNOPS and will be included within the Bills of Quantities (**item 1314.01**) in the form of the provision of a number of unskilled labourers for a number of days (labourer days). The Contractor will be required to engage the stated number of unskilled labourers for the stated number of days. The contractors unit rate for the provision of each labourer must ensure that each labourer is paid the minimum daily wage as defined in **Clause 1301** (above).

### **1303 Selection of unskilled labourers**

Enough before the start of the works, the Contractor should communicate with the local community and inform it of the project and need for unskilled labourers or launch a notice board as instructed by the UNOPS considering the POM requirements. A clear description of the recruitment process and the terms of employment should be made widely available prior to actual recruitment. Communication should include announcements on a public address system and the display posters in public places. The Contractor, working with representatives of local communities and the UNOPS will prepare two lists (male and female) of locally available unskilled labourers that meet the project's criteria for employment.

The Contractor must utilise a self-selection method to enlist the necessary unskilled labourers for the project, ensuring an equitable distribution of these workers in the community. This approach aims to facilitate fair and effective allocation of scarce job opportunities within the community, with a condition that the procedures remain transparent and impartial

### **1304 Unskilled labour selection criteria**

The Contractor shall ensure that at least 7% of all unskilled labourers that are selected from the lists of available people are female. In the event that insufficient female names are included in the lists, the Contractor will make up any shortfall by selecting males. Special efforts should be taken to achieve the desired gender mix in each subproject (if applicable). This has been recognized as necessary as there are often biases in the methods of recruitment against women's involvement. If special efforts are not taken, women's participation will remain low. If few women are employed,

consider whether women have had the opportunity to take up employment. If there has been a blockage on women taking jobs, consider ways of removing it. Persons below the minimum age for employment in the country should not be recruited. Nor should children be allowed to work unofficially, or assist in activities.

Recruitment for jobs should not be based on distinctions such as gender, political opinion, ethnic or social origins or any other criteria not related to the ability to do the job. There will be no restriction placed on the employment of mentally or physically handicapped persons. If such a person is selected via the lottery the Contractor will employ them and find them a suitable role on site.

At the end of the recruitment process the employer and each worker should know that one is obliged to the other: the worker to perform certain work under certain conditions, and the employer to provide the necessary inputs to get the work done and to pay the worker. Two things are implied by this. First, that the employer knows what sort of work will be needed, at what time and where in this case planning is therefore required. Second, that these requirements are communicated to the worker, as well as the terms of work.

### **1305 Shortfall in unskilled labour**

Should the Contractor believe that the UNOPS assessment of unskilled labour is insufficient to carry out the works it shall engage all other labour that it believes is required selecting any additional unskilled labour that it may require in accordance with specification **Clauses 1303** and **1304**. It is the Contractor's responsibility to ensure that it has included within its price sufficient resources to complete the contracted works or the shortfall of the unskilled labour has to be reviewed and approved by the UNOPS Engineer.

### **1306 Excess unskilled labour**

Priority employment must be given to all labourers selected from the lists of names prepared based on the public announcement by the contractor. In the event that there is insufficient identified work within the quantum of works set out within Bills of Quantities for the unskilled labour as assessed by the UNOPS, the UNOPS working in liaison with the local community will identify additional works with a high unskilled labour content. Such works may include but may not be limited to ditch cleaning, litter picking etc. Additional high labour content works will be instructed by the UNOPS engineer and will be carried out at no extra cost by the contractor as the labour will be paid for under measurement item 1314.1 – ref **Clause 1301** of the specification

### **1307 Supervision of unskilled/skilled labour**

As part of its management of the site the contractor will be responsible for supervision of all labourers. With particular regard to the unskilled labourers selected from the lists, the Contractor will be responsible for their supervision whether engaged in pre-identified and quantified works or whether they are engaged on any additional works which may be required to ensure their full employment. The need for regular attendance of workers at the worksite should be considered by the contractor, unreliability in the workforce, reflected in irregular attendance, can be used by many factors. The worker(s) should clearly understand what expectation is placed on attendance, where the obligation is for the worker to attend every day the site is open, the worker should be notified how he/she is to know that the site is open, i.e., announcement the day before, or assume so unless told otherwise the day before.

**1308 Works to be carried out by unskilled/skilled labourers**

The unskilled labourers selected from the list should be used by the Contractor to carry out the sub project works as shown on the drawings and as described and quantified in the Bills of Quantities. Where the quantity of unskilled labourers as assessed by the UNOPS is insufficient to complete the works, the provision of specification **Clause 1305** will apply. Where there is an excess of unskilled labourers the provisions of specification **Clause 1306** will apply

**1309 Provision of Personal Protective Equipment (PPE)**

The Contractor must assess the need for and supply any necessary PPE free of charge to all unskilled labourers and other persons that it employs to work on the project or visit the site. All provided PPE must be of a good quality and be in a good usable condition. The Contractor will replace any lost or damaged PPE free of charge and will not make any charges or deductions to payable wages for its provision or replacement.

**1310 Provision of hand tools and equipment**

The Contractor will be required to provide free of charge all tools and other equipment that may be required for the works, including any tools or equipment which may be required for any additional works pursuant to specification **Clause 1306**.

**1311 Training**

The Contractor will be responsible for carrying out an initial site induction for all skilled and unskilled labourers and for any other training that may be required.

**1312 Record Keeping**

- a) The Contractor will be required to maintain a daily written record of the workers that are on site as per UNOPS Engineer instruction and direction. The record must include:-
- The name each worker;
  - The identity number of each worker;
  - The sex of each worker (male or female);
  - The job description of each worker – skilled labourer, unskilled labourer, machine operator, etc
  - Start time – finish time and the hours worked.

Each day, the Contractor must provide a copy of the previous day's record sheet to the UNOPS engineer.

- b) Within two days of each person starting work on site, the Contractor must provide to the UNOPS engineer a written record of the induction talk given to them. The induction should include details of how the works will be carried out safely, where toilets, water and welfare facilities are, who the supervisors are and what the grievance procedure is. The record must be signed by the person giving the induction and the person being inducted
- c) The Contractor must provide to the UNOPS engineer a written record of any training given to persons working on site.
- d) The worker should know when he or she is counted as being absent, for example, non-completion of a task, failure to appear for work by a particular time, or departure in the middle of the working day.
- e) For avoiding future conflict between the contractor and worker the rules and criteria

should be applied in a fair manner. For example, a warning should be given before termination of employment where absences are becoming a problem in a given case.

- f) The Contractor must provide the UNOPS engineer with a summary of all payments made to its workforce demonstrating that the daily minimum wage has been paid to all. The summary sheet should be supported by copies of wage receipts signed by the person named on the daily timesheets. N.B. The receipt of wages by other persons on behalf of the named worker will not be allowed.

**1313 Grievance Procedure**

The UNOPS will establish a formal grievance procedure to allow all workers and interested parties related to the project to raise any relevant issues. A grievance committee will be formed by and chaired by the UNOPS for each project and will include representatives of the community and the Contractor.

The grievance committee will hear and consider all grievances raised in relation to the project. The committee will decide on each matter by voting. The UNOPS will have the casting vote. The Contractor will be bound by the findings of the grievance committee.

**1314 Measurement and Payment**

When pricing the works the contractor should take into account that a payment for unskilled labour as assessed by the UNOPS will be made under Bill of Quantities item 1314.01 and adjust all other rates accordingly. Record sheets as required under specification **Clause 1312(a)** will be used for the basis of payment subject to them being complete, and being countersigned by the UNOPS engineer. No payment will be made for unskilled labourers who are either found to be missing from the record sheets or found to be missing from site by the UNOPS engineer or other members of the UNOPS staff.

<b>Item</b>	<b>Unit</b>
1314.01A labour Day	Unskilled
1314.01B labour Day	Skilled

All other labour (skilled, unskilled, operatives etc) should be included within the rates for other items.

## SECTION 1400: TERMS AND DEFINITIONS

Fill Materials (also termed as "Fill") :Naturally occurring inorganic soils and soil like materials including sand and crushed rock but excluding individual particles of sizes greater than 75mm.

Ordinary Fill:		Fill material to be used for forming the road embankments other than in improved subgrade and in backfill behind bridge abutments.
Sub-Base:		The pavement layer composed of a homogeneous mixture of river gravel / crushed stone aggregates and local sand and soil lying immediately below the base course
Base Course:		The pavement layer composed lying between the bituminous surfacing at its top and the sub-base course at its bottom and within the carriageway on either side of the centre line.
Surfacing:		Gravel or stone or bituminous bound layer at the top of the pavement structure extending full width of carriageway only.
Hard Shoulder :		Compacted gravel or any hard strips beyond the carriageway of the roadway width, adjacent to the surfacing.
Earth Shoulder:		Compacted earth strips protected on top at the extremities of the roadway width, adjacent to the hard shoulders.
Maximum Density(MDD):	Dry	Maximum dry density as determined in the laboratory using Standard Compaction
Optimum Content (OMC)	Moisture	Optimum moisture content as determined in the laboratory from moisture-density relationship tests for Standard Compaction.
Dynamic Penetrometer (DCP)	Cone	Device for field checking of in situ CBR.
Boulders:		River-borne or blasted hard stone materials of sizes exceeding 100mm.
Sand equivalent:		Test used for evaluating the plastic properties of the sand fraction of aggregate
Application (spread) rate:		The rate of spreading chippings or spraying bitumen on the surface
Wearing Coarse :		The surface allowed to ply the traffic
Plasticity Limits (PL) :		The limits that are used to estimate the Engineering behaviour of clayey soils. They include the Liquid Limit and Plastic Limit, which are determined by arbitrary tests on the fine soil fraction passing the 0.425 mm sieve.

Liquid Limit (LL) :	The water content of the soil that allows the divided soil sample to flow together after fixed times of applying dynamic force on it.
Plastic Limit (PL) :	The water content of the soil when the thread crumbles
Plasticity Index (PI) :	The difference between PL and LL
Plasticity Product (PP) :	The combined product of PI and fine content California Bearing
California Bearing Ratio (CBR) :	Test method to evaluate the bearing capacity of the soil Ratio
Speedy Moisture Tester :	The speedy moisture tester needs a chemical i.e. Calcium carbide that mixed with a measured amount of moist soil in a closed container. The gas formed by reaction gives the % moisture through a pressure gauge (Calibrated accordingly). The % moisture is found in "Wet weight basis" and this is transformed to "Dry weight basis" using a Conversion curve.
Formation width :	Full width of road, including drains and embankments.
Roadway :	Width of road, including shoulders.
Carriage way :	Pave width of the road, available for traffic
Shoulders :	Paved or unpaved width of road next to the edge of the carriage way adjacent to the ditch or embankment slope.
Camber :	A camber road has a cross-section like a roof on a house, to drain the rainwater away from the carriage way to the side drains.
Gravel surfacing :	A layer of compacted laterite which forms the surface (or pavement) of the carriage way
Embankment :	Compacted earth fill below the roadway.
Cut :	Excavation in the natural ground on the hill side of the road usually with graded slopes. The material dug out is used to fill the embankment on the valley side of the road.

Sub grade surface :	Upper layer of the soil (natural material) supporting the roadway including embankment and slopes.
Side drain :	The side drain runs along the road and collects the water from the carriage way and adjoining land, and transports it to a convenient point of disposal.
Original ground level :	The natural surface of the cross-section prior to construction.
Back slope :	The outer slope of the side drain with an appropriate angle to prevent the soil from sliding to the ditch.
Ditch slope :	Inside slope from the shoulder to the side drain.
Embankment slope :	Natural material slope on embankment.
Crown :	Peak or highest point of the camber.
Road centre line :	The line running along the centre of the road (important in surveying and setting out the road alignment).
Chainage :	is a term frequently used for describing distances measured along the centre line of the road.
High flood level (HFL) :	The highest elevation to which the peak flood waters are expected to rise
Mitre drains :	Mitre drains (or turnout drains) lead the water out of the side drains and safely disperse it on adjoining land. Mitre drains should be provided as often as possible so that the accumulated water volume in each drain is not too high and does not cause erosion to the adjoining land
Catch water drains :	Where the road is situated on a hillside a significant amount of rainwater may flow down the hill towards the road. This may cause damage to the cut face (back slope) of the road and may even cause landslides. Catch water drains intercept or "catch" surface water flowing towards the road from adjacent land, and lead it away.
Scour checks :	Scour checks prevent erosion inside drains on steep gradients by slowing down the water (steps). Scour checks are usually built using locally available material, such as stones or wooden sticks.

Culvert :	The culvert is a transverse drain built under the road and its function is to lead water from the upper, uphill side of the road to the lower, valley side. In tropical countries with high rainfalls three or four culverts are required per kilometre. Culvert rings are usually made of concrete or prefabricated corrugated steel rings.
Head wall :	A wall 300 mm. thick stone masonry constructed perpendicular to the culvert pipes (at the end ) to retain backfill material. The headwall shall extend vertically to an elevation of 200mm above the surface of the road.
Wing wall :	Continuation of headwall at an angle, generally 45 degrees, and shall extend a minimum of 1m out from the pipes, to retain the soil of the road side slope and to allow the free flow of water into and away from the pipes.
Reinforced concrete pipes	Reinforced concrete pipes prefabricated in a standard steel mould.
Pipe bedding :	The foundation on which pipes are laid.
Upstream apron :	Part of a culvert at the upstream inlet made of stone/masonry, where water enters into the pipes to prevent any scour or damage to the pipes.
Downstream apron :	Part of a culvert at the downstream outlet, where the water goes out slowly to the natural water course, to prevent any scour or damage to the pipes
Cut- off wall:	Wall generally constructed at the downstream end of a structure and constructed into the ground, to prevent scouring of the apron, as well as the structure.
Headwall foundation :	Headwall foundation provided to the main culvert headwall so that it can retain the earth pressure.
Gravel :	gravel is defined as stones (2-60mm) but for roadwork use, a more useful definition is a mixture of stones (maximum 30mm), sand and clay
Sand:	A coarse-to-fine gritty soil, with grains of size 0.06-2mm. Sand is normally firm when damp.
Silt :	A soil with very small particles (0.002-0.06mm), which is powdery when dry but very soft when wet. For a quick test, when you roll a lump of silt between

your hands they will not get stained

- Clay : This is a soil with even smaller particles (<0.002mm). It forms hard lumps when dry and the surface is cracked, but is sticky and soft when wet. For a quick test, your hands will be stained if you roll a lump of clay between your hands.
- Organic Soil : This is dull and dark in colour, and often has a distinct smell. Topsoil is almost always organic. Swamp soils usually contain remains of plants (fibres, roots, and so on).
- Well-graded : Material with a wide range of particle sizes which are well distributed (Note: a mixture of particle sizes means that the soil will be easier to compact)
- Poorly-graded : Material with too much of some sizes and too little of others
- Uniformly-graded : Material with a limited range of sizes mainly concentrated in one size category.

## **OTHER CHARACTERISTICS**

- Cohesive : The particles of a soil stick together (mainly the clay fraction)
- Non-cohesive : Does not stick together (mainly sand and gravel).
- Coarse-grain soil : Mainly sand and gravel (little or no clay, little or no sand)
- Fine-grain soil : Mainly silt and clay.

## **SOIL CONDITIONS**

- Density : In a dense soil the particles are close together (or well-compacted)
- Compaction : The process that packs the particles close together, and so increases the density

Bearing capacity :	The strength of the soil (measured by the weight that can be loaded on to a specified area without penetration or the amount of penetration under a certain load on a specified area)
Plasticity :	Measures whether soil can be moulded and hold its new shape
Permeability :	The degree to which water can penetrate a particular soil
Optimum moisture content :	The water content that gives the best effect of soil compaction

## **SECTION 1500: SPECIFICATIONS STANDARDS**

The following Specifications issued by widely recognised bodies are referred to in this Specification:

BS	British Standard
AASHTO	American Association of State Highway and Transportation officials
ASTM	American Society for Testing Materials

**SERIES 2000: CLEARING****SECTION 2100 : GENERAL CLEARING****2101 SCOPE AND GENERAL REQUIREMENTS****2102 MEASUREMENT AND PAYMENT**

## 2101 SCOPE AND GENERAL REQUIREMENTS

This section covers general clearing activities and includes cutting back of vegetation and cleaning out existing drains and ditches.

Clearing of vegetation shall consist of cutting back all trees, brush, other vegetation, rubbish, fences and all other objectionable material including the disposal of all material resulting from the clearing operations.

Cleaning out existing drainage paths will consist of removing all soil, stones/boulders and vegetation (including trees, bushes), rubbish and objectionable material from existing drains, ditches and culverts. Any reinstatement works will be measured and paid for in accordance with relevant sections of these specifications, provided that such reinstatement has not arisen out of the actions of the contractor.

The extent of any clearance will be clearly shown on the project drawings. All grass, weeds, and bushes shall be cut back to as close as practicable to ground level ensuring that the root structure remains. Where required branches of large trees, which overhang the road, will be lopped to allow passage of regular traffic.

- All the solid waste material must be transported to the designated area outside of the city.
- Proper traffic control and signage should be established to alert drivers that maintenance works are being performed and to ensure the safety of workers on site.
- During planning, the contractor should determine what to do with the waste material that will be cleaned out of the ditch.
- When cleaning ditches, machinery should be operated adjacent to the ditch and no heavy equipment should be allowed in the bottom of the ditch to minimise disturbance and compaction of the undisturbed soil in the bottom of the ditch. The machinery should only be used for the purpose of waste transportation to outside the city, all other activities must be carried out as far as possible by manual labour.

Drainage paths, ditches and the like which are required to be cleaned will be as shown on the drawings or will be as instructed by the UNOPS Engineer. Cleaning of existing drainage paths will include removal of all materials that block or cover the drains and/or culverts and shall include all small, localised slips/slumps etc. In cases where no existing drain is apparent the contractor will be required to investigate (through trial holes, local knowledge etc.) the existence of any such feature as may be instructed by the UNOPS Engineer.

## 2012 MEASUREMENT AND PAYMENT

Item		Unit
2102.1	Clearing of vegetation in all areas apart from ditches	m <sup>2</sup>
2102.2	Clearing out existing drainage ditches and watercourses	lin m
2103.3	Clearing of all other features as described in the Bills of Quantities	Number

**SERIES 3000: Drainage****CONTENTS**

3100	SCOPE AND GENERAL REQUIREMENTS
3200	OPEN DRAINS
3300	SUB-SURFACE DRAINS
3400	MASONRY LINED OPEN DRAINS
3500	PRECAST CONCRETE SIDE DRAINS
3600	MEASUREMENT AND PAYMENT

### **3100 SCOPE AND GENERAL REQUIREMENTS**

This section covers all work in connection with the excavation and construction of open drains, sub surface drains, banks and dykes at the locations and to the sizes, shapes, grades and dimensions as shown on the Drawings or as directed by the UNOPS Engineer.

### **3200 OPEN DRAINS**

Open drain excavation shall consist of re-excavating or excavating open drains and channels inside, including channels to direct the course of streams, all as shown on the Drawings or directed by the UNOPS Engineer.

Open drains shall be constructed true to line, grade and cross section and shall be so maintained for the duration of the contract. Care shall be exercised to avoid excavation below the required grade for the drains and any excavation carried below the required grade shall be backfilled with suitable material and compacted to at least 93% MDD (BS Heavy) density.

Material resulting from the excavation of open drains may be used in the construction of fills, banks and dykes, or for other purposes, or disposed of to spoil, depending on the classification of such material.

### **3300 SUB-SURFACE DRAINS**

#### **Materials**

Pipes for subsurface drains shall have the specified internal diameter, which shall not be less than 100 mm, and shall be Perforated or slotted UPVC (Un plasticised) pipes. Pipes without slots or perforations that are required for transporting subsoil water from the subsoil drain proper to the point of discharge, shall be unperforated UPVC

Permeable filter materials for subsurface drains shall consist of sand, all of which shall pass the 6.70 mm sieve and not more than 10% passing the 0.150 mm sieve. Use may also be made of synthetic fibre filter fabrics.

#### **Sub-surface Pipe Drains**

Trenches for pipe drains shall be excavated to the dimensions and gradients shown on the Drawings or directed by the UNOPS Engineer. A layer of permeable material of the class and thickness as shown on the drawings shall be placed on the bottom of the trench and lightly tamped and finished to the required gradient.

Pipes of the type and size required shall then be firmly bedded on the permeable material true to level and grade, coupled where required and the trench backfilled with further permeable material to such height above the pipes as shown on the Drawings or directed by the UNOPS Engineer. The permeable material shall be lightly compacted and finished to the required level. Further layers of finer permeable material shall then be placed, lightly compacted and finished to an even surface as directed by the UNOPS Engineer. The remainder, if any, of the trench shall be backfilled with approved impermeable material, as required by the UNOPS Engineer, in layers not exceeding 100 mm and compacted to at least the same density as the surrounding material.

The trench must be specially protected against the ingress of water before completing the

impermeable layer. If directed by the UNOPS Engineer, or shown on the Drawings, the pipe drains may be surrounded by a synthetic fibre filter.

Care shall be taken to prevent the contamination of permeable material during construction of the subsurface drains and all permeable material contaminated by soil or silt shall be removed and replaced by the Contractor at his own expense.

Perforated pipes shall be laid with the perforations on top or in the bottom as instructed. The higher end of subsurface pipe drains shall be sealed off with a loose concrete cap of Class 20/20 concrete and, at the lower end, the pipe drain shall be built into a concrete head wall providing a positive outlet or connection to storm water pipes, culverts or drains.

Any section of subsurface drain constructed from pipes without perforations or slots shall be backfilled with impermeable backfill material as described above. Where suitable, the excavated material may be used for backfilling.

### **Synthetic Fibre Filter Fabric**

Where specified for use in subsoil drains, filter blankets and other applications, synthetic fibre filter fabrics shall be procured, furnished and installed as shown on the Drawings or as directed by the UNOPS Engineer. Filter fabric shall not be exposed to direct sunlight for prolonged periods and protected from mechanical damage during installation and construction.

## **3400 MASONRY LINED OPEN DRAINS**

### **3401 SCOPE**

As shown on the drawing, side drains should be constructed in stone or brick masonry works with cement mortar. The Specification of cement and sand should comply with the standards specified in clauses of materials in respective sections.

### **3402 MATERIALS**

The materials shall be dressed stone or bricks comply with the specifications in clause no 5700 and 8200

### **3403 PREPARATION OF SAND BEDDING**

A layer of sand as shown in the drawing should be placed over the excavated side drain prior construction of lined drain. Sand should be spread in uniform thickness, brought up to the optimum moisture content and compacted with proper equipment such as a vibrating plate compactor.

### **3404 PLASTERING SIDE DRAIN IN CEMENT MORTAR**

Unless shown otherwise on the drawings, all brick works should plaster in cement mortar (1:3). The plaster should be even and smooth. No cracking is allowed.

### **3405 NET CEMENT FINISHING**

Where shown in the drawings, the internal sides of the drains shall be plastered with net cement finishing. The layer should be even and smooth.

### **3406 BACKFILLING**

All spaces which have been excavated shall be backfilled and compacted with material as shown in the drawing. The layers shall not be more than 150 mm in depth and shall be compacted to a density comparable with the adjacent undisturbed material.

### **3500 PRE-CAST CONCRETE SIDE DRAINS**

This work consists of supply and installation of precast or in-situ concrete side drains.

#### **3501 PLACING SIDE DRAINS**

The precast concrete drains shall be placed according to the drawings or as instructed by the UNOPS Engineer. Care has to be taken to maintain the alignment specified in the drawings. The drains shall be connected by both mechanical and plaster joints.

### **3600 MEASUREMENT AND PAYMENT**

<b>Item</b>		<b>Unit</b>
3601.01	Open Drains – trapezoidal shaped unlined ditch invert depth 1m to 2m below commencing surface	Lin m
3601.02	Open Drains – trapezoidal shaped unlined ditch invert depth 2m to 3m below commencing surface	Lin m
3601.03	Open Drains – trapezoidal shaped unlined ditch invert depth 3m to 4m below commencing surface	Lin m
3601.04	Unperforated UPVC subsurface drains - pipe diameter 100mm to 250mm invert depth 0.5m to 1m below commencing surface	Lin m
3601.05	Unperforated UPVC subsurface drains - pipe diameter 100mm to 250mm invert depth 1m to 2m below commencing surface	Lin m
3601.06	Unperforated UPVC subsurface drains - pipe diameter 100mm to 250mm invert depth 2m to 3m below commencing surface	Lin m
3601.07	Unperforated UPVC subsurface drains - pipe diameter 250mm to 400mm invert depth 0.5m to 1m below commencing surface	Lin m
3601.08	Unperforated UPVC subsurface drains - pipe diameter 250mm to 400mm invert depth 1m to 2m below commencing surface	Lin m
3601.09	Unperforated UPVC subsurface drains - pipe diameter 250mm to 400mm invert depth 2m to 3m below commencing surface	Lin m
3601.10	Unperforated UPVC subsurface drains - pipe diameter 400mm to 600mm invert depth 0.5m to 1m below commencing surface	Lin m
3601.11	Unperforated UPVC subsurface drains - pipe diameter 400mm to 600mm invert depth 1m to 2m below commencing surface	Lin m
3601.12	Unperforated UPVC subsurface drains - pipe diameter 400mm to 600mm invert depth 2m to 3m below commencing surface	Lin m

3601.13	Perforated UPVC subsurface drains - pipe diameter 100mm to 250mm invert depth 0.5m to 1m below commencing surface	Lin m
3601.14	Perforated UPVC subsurface drains - pipe diameter 100mm to 250mm invert depth 1m to 2m below commencing surface	Lin m
3601.15	Perforated UPVC subsurface drains - pipe diameter 100mm to 250mm invert depth 2m to 3m below commencing surface	Lin m
3601.16	Perforated UPVC subsurface drains - pipe diameter 250mm to 400mm invert depth 0.5m to 1m below commencing surface	Lin m
3601.17	Perforated UPVC subsurface drains - pipe diameter 250mm to 400mm invert depth 1m to 2m below commencing surface	Lin m
3601.18	Masonry lined road side drain	Lin m
3601.19	Masonry lined Pre-cast or in-situ road side drain	Lin m
3601.20	Banks and dykes as shown on the Contract drawings	m <sup>3</sup>
3601.21	Manholes and inspection chambers – 0.5 m to 1.0m in diameter and up to 1m deep	No
3601.22	Manholes and inspection chambers – 0.5 m to 1.0m in diameter and between 1 and 2m deep	No
3601.23	Manholes and inspection chambers – 0.5 m to 1.0m in diameter and between 2 and 3m deep	No
3601.24	Manholes and inspection chambers – 1m to 1.5m in diameter and up to 1m deep	No
3601.25	Manholes and inspection chambers – 1 m to 1.5m in diameter and between 1 and 2m deep	No
3601.26	Manholes and inspection chambers – 1 m to 1.5m in diameter and between 2 and 3m deep	No
3601.27	Manholes and inspection chambers – 1.5m to 2.0m in diameter and up to 1m deep	No
3601.28	Manholes and inspection chambers – 1.5 m to 2.0m in diameter and between 1 and 2m deep	No
3601.29	Manholes and inspection chambers – 1.5 m to 2.0m in diameter and between 2 and 3m deep	No

The unit of measure for all drainage runs shall be in linear meters.

The tendered rate shall include full compensation for the supply of all materials including excavation, backfilling, loading, transporting and offloading, plastering, neat cement finishing, sand cushions, lean concrete, tools, local haulage etc complete. No extra item shall be measured.

**SERIES 4000: EARTHWORKS****CONTENTS**

4100 SCOPE AND GENERAL REQUIREMENTS

4200 EXCAVATION

4300 FILL CONSTRUCTION

4400 APPROVAL OF SOURCE MATERIALS

4500 STOCKPILING MATERIALS

4600 EXCAVATION FOR STRUCTURES

4700 MEASUREMENT AND PAYMENT

## 4100 Scope and general requirements

This section covers all works connected with the construction areas of cuts and fills, the removal and the disposal of unsuitable or surplus material, the provision of materials, compaction, and trimming of all surfaces.

**Suitable material** - Where possible all suitable materials arising from the Works shall be reused as fill material. All surplus material will be removed from site and disposed of in a suitable offsite location.

**Unsuitable material** - All unsuitable material will be removed from site and disposed of in a suitable offsite location.

Offsite disposal locations - All offsite disposal locations are to be located by the Contractor and agreed with the UNOPS Engineer. The Contractor will be responsible for obtaining any necessary permissions or approvals and for the payment of all fees associated with the use of any offsite disposal areas.

During construction, the works shall be kept well-drained and protected at all times and damaged sections shall be repaired by the Contractor at his own cost.

## 4200 EXCAVATION

***All excavation should be carried out using unskilled labour and hand tools rather than using mechanical plant and equipment unless otherwise agreed with the UNOPS engineer on site.***

### 4201 Classification

The excavation of earthworks material shall be classified as follows for the purpose of measurement and payment :

**Excavation** - shall be any material which does not comply with the definition for '**Hard Excavation**' given below.

**Hard excavation** - shall be excavation in material which, in the opinion of the UNOPS Engineer, cannot be effectively excavated by labourers using picks and shovels and which requires the use of pneumatic or other similar hand-held breakers or the use of mechanical excavation equipment. Isolated boulders shall be measured as excavation and not as Hard Excavation

### 4202 Subgrade treatment

The Contractor shall seek instructions from the UNOPS Engineer regarding the treatment of the sub-grade in cut areas. This may include excavation of the floor or base of the cutting to a depth as directed by the UNOPS Engineer and replacement with suitable material. The finished level of the excavation shall be within +25mm and -25mm of the required level.

## 4300 FILL CONSTRUCTION

### 4301 Layer thickness

The thickness of individual layers shall depend upon the type of material used and the maximum size of the particles in such material. The layer thickness shall however not exceed 150mm after compaction except where otherwise specified or instructed by the UNOPS Engineer (especially for

compaction commencing by hand tools that will not exceed than 100mm). Fill shall be placed in successive layers parallel to the final surface.

Backfilling for hand compaction shall be placed in layers of thickness (before compaction) not exceeding **100mm**. Each layer shall be compacted using hand tampers.

#### **4302 Common fill**

Material used shall be capable of achieving a CBR of at least 5 (or as directed by UNOPS Engineer considering the site requirements) at 92% MDD (BS Heavy compaction)/AASHTO T180). Where directed by the UNOPS Engineer, special measures shall be employed to ensure the stability of high fills or of fills constructed over weak subgrade. Such measures may include the use of selected materials (as working platforms or sandwich layers), strict control of moisture content during construction and limitations upon the rate of construction. Should any instability become apparent during the construction of the fill area, the Contractor shall immediately cease construction and seek direction from the UNOPS Engineer.

#### **4303 Sub-grade**

Under tertiary roads or streets, the top 150mm of all embankments (the subgrade) shall be constructed using select granular materials to provide a subgrade CBR of at least 8 at 92% AASHTO T-180 method D. In case of natural subgrade or excavation bed, the existing material shall have a CBR of 5% at 92% AASHTO T-180 method D. If the material of natural subgrade cannot fulfil the required CBR, some extra granular materials shall be mixed with the existing material to achieve the required compaction and material requirements without extra cost of the contractor. The finished level of the fill shall be within +25mm and -50mm of the required level.

#### **4304 Compaction**

Mechanical equipment and hand tools shall be used for compacting materials by rolling, tamping and watering (if needed and will be specified based on the project nature and site requirements). For other operations such as spreading, mixing and shaping, manually operated tools and equipment are preferred on mechanical equipment alone or a combination of the two shall be used. The choice of equipment and the procedure for their use shall be subject to the approval of the UNOPS Engineer upon his being satisfied about their effectiveness based on trial compaction.

Compaction of backfilling to trenches (areas not subject to traffic)

- Backfilling to trenches shall be placed in layers of thickness (before compaction) not exceeding 100mm.
- Each layer shall be compacted using hand stampers or mechanical rolling equipment and machineries; a) to 85% MDD AASHTO (85% in sidewalk area);

Fill materials shall be compacted to a density of not less than 92% for major streets and 90% for minor streets where heavy machinery cannot operate easily (for sidewalks it would be considered as 85%) of MDD AASHTO T180 in common fill and sub-grade respectively. Any loose or un-compacted material shall be trimmed from the slope surface as the embankment is raised and used as fill within the embankment if suitable, or disposed of if not.

In the absence of site testing facilities, the UNOPS Engineer shall instruct the Contractor on the method of compaction with the available equipment. The compaction equipment type and weight shall be determined by the Engineer as per site requirements.

It should be understood by the Contractor that different types of material are likely to require different kinds of compaction equipment, including successive applications thereof, to achieve the specified degrees of compaction, and the Contractor shall keep available compaction equipment of the requisite kind, size and number.

For compacting narrow strips and for compaction in restricted areas smaller sized compacting equipment may be required and if so, the same shall be provided for by the Contractor.

#### **On-site Testing Required for QA/QC Purpose**

In-place or Field Density Test (FDT):

- One test for each 500m<sup>2</sup>, or for each 75 linear metre, whichever results in more numbers of tests for each lift of Embankment and subgrade
- One test for each 75 LM of each lift of the embankment layers and/or foundation bed of retaining walls.
- One test for each 100 m<sup>2</sup> of the culvert bed.

Optimum Moisture and Laboratory Maximum Dry Density: one test per material type but not less than one per 1000 LM each lift of road/street.

Note: If the project engineer cannot satisfy the above mentioned testing frequency, he can increase the frequency or add any other test as per site or his satisfaction requirements without extra cost by the contractor.

#### **4400 APPROVAL OF SOURCES OF MATERIALS**

The sources of the materials shall be selected by the Contractor, but approved by the UNOPS Engineer prior to their incorporation in the Works. For this purpose, the Contractor shall furnish all relevant test data for representative samples from each source area as desired by the UNOPS Engineer and also afford opportunities for the UNOPS Engineer to visit the source areas. The number of representative samples to be tested shall not be less than two for each type of material in each source area. Notwithstanding approval of sources of materials, materials as brought to the work site for use in the work shall be subject to acceptance or rejection by the UNOPS Engineer based on quality control tests to be performed before use in construction.

#### **4500 STOCKPILING OF MATERIAL**

All materials brought to the site shall be stockpiled and stored in a systematic manner so as to prevent deterioration or mixing of materials or intrusion of foreign matter.

#### **4501 Control Tests on Material Stockpiles**

The Contractor shall use only such materials in construction as conform to the requirements regarding composition, grading, physical properties and the technical requirements specified for different kinds of material.

## **4600 EXCAVATION FOR STRUCTURES**

### **4601 Scope**

This work shall consist of excavation in any material for the foundation of structures, disposal of excavated materials, Temporary Works in protecting the stability and safety of excavated foundations, pumping and bailing of water from foundations and backfill of foundations to natural ground or excavated road level.

Excavation and backfill for structures may involve the use of cofferdams or other forms of temporary ground support. Cofferdams and or any other forms of temporary ground support are not paid separately and the cost of this Temporary Work is deemed to be included as part of the Tender Sum.

The work shall be carried out at the locations and according to the lines, levels, grades and dimensions shown in the Drawings, or as directed by the Engineer.

### **4602 Materials**

*Excavated Material* : All excavated material shall be classified by the Engineer either as suitable for fill or as waste. Approved suitable excavated material free of large lumps, wood or other objectionable material shall be placed as backfill for the structures and/or in the roadway embankment, except where other materials are shown on the Drawings or required by the Engineer.

*General Fill* : General suitable fill material shall be used as backfill except where other materials are shown on the drawings or required by the Engineer.

*Sand* : Sand shall be used as backfill material if shown on the drawings or required by the Engineer.

*Aggregate* : 75 mm downgraded aggregate, shall be placed adjacent to any abutment or wing wall in which weep holes have been provided. The aggregate to be used shall be approved by the Engineer prior to placing.

*Blinding Concrete*: Blinding concrete shall be placed as backfill where shown on the Drawings or ordered by the Engineer.

### **4603 Construction Methods**

#### **Excavation :**

The Contractor shall notify the Engineer before commencing excavation of foundations so that the cross-section, elevations and measurements of the undisturbed ground may be taken.

Foundations for structures shall be excavated to the lines, grades and elevations shown on the Drawings or as directed by the Engineer. The elevations of the bottom of the foundations shown on the Drawings are approximate only, and the Engineer may order such changes as are deemed necessary to provide a secure foundation.

Should the Contractor excavate beyond the required level he shall fill the additional depth back to foundation bottom level with sand or other approved material, placed in layers and thoroughly compacted, at his own expense.

The excavation shall be sufficiently large to provide for the necessary working space, shuttering and any other Temporary Works.

Boulders, roots and any other objectionable material encountered in excavation shall be removed. The excavated foundation shall be cleared of all loose material and cut to a firm surface.

The final 100mm of excavation under footings or abutments shall be deferred so that the foundation bottom is not exposed until just before brickwork or concrete work begins.

The Contractor shall be solely responsible for the safety and stability of the excavation and shall provide all protective supports, bracing and shoring as required.

Excavated material classified as suitable for fill shall be stockpiled. Waste material, and suitable fill material in excess of requirements, shall be disposed by the Contractor outside the limits of the Site.

No footings, bedding material or structure shall be placed in any foundation until the Engineer has inspected and approved the depth of excavation and the foundation material.

**Poor Foundation Material :**

When, in the opinion of the Engineer, the bottom of any excavated foundation is of soft or otherwise unsuitable material the Contractor shall remove the unsuitable material and fill with sand or blinding concrete at the direction of the Engineer. The sand or concrete shall be placed as specified for backfilling.

**Pumping and Bailing :**

The foundation shall be kept free of water at all times during the construction period. Pumping and bailing from any foundation shall be done so as to preclude the possibility of the movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the placing of concrete and for at least 24 hours thereafter unless it is done from a suitable sump separated from the concrete work by a watertight wall or from well points.

**Backfilling :**

All excavated foundations shall be backfilled around the permanent structure to original ground level. No backfilling shall be placed against any structure without the prior permission of the Engineer.

Any protective supports, bracing or shoring shall be removed as the backfilling progresses, in such a manner as to prevent caving-in.

Ordinary fill placed as backfill within the embankment and road areas shall be laid and compacted as specified in Clause 4300. Sand backfill shall be placed and thoroughly compacted in layers of not more than 150mm.

The back of abutment, wingwall and return walls with weep holes shall be provided with a vertical layer of granular fill materials about 450mm thick to serve as a filter medium.

The filter shall consist of 75 mm downgraded stone chips mixed with sand, F.M. not less than 1.30 in proportion of 1:1. It shall be placed and compacted in layers with subsequent embankment fill. The weepholes shall be covered with synthetic mesh.

In placing backfill, and any subsequent embankment fill the material shall be placed insofar as possible to approximately the same height on each side of the structure. If conditions require appreciably higher backfilling on one side, the additional material shall not be placed until permission is given by the Engineer after satisfying himself that the structure has enough strength to withstand any pressure created. Backfill and embankment fill shall not be placed behind the walls of bridges or box culverts until the superstructure or top slab has been cast and cured. Backfill and embankment behind abutments held at the top by superstructure shall be carried up simultaneously behind opposite abutments and side walls. The placing of embankment shall continue in such a manner that at all times there is a horizontal berm of thoroughly compacted material for a distance at least equal to the height of the abutment or wall being backfilled.

Adequate provision shall be made for drainage during backfilling and subsequent embankment work.

#### **4700 GENERAL EARTHWORKS MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
4701.1 Excavation and transportation of suitable and unsuitable in material in all areas	m <sup>3</sup>

The unit of measurement shall be the cubic metre measured in situ.

The tendered rate for excavation shall include for excavation of material from works, for loading and transporting the material to designated areas, shaping and trimming to required lines levels and tolerances, for draining and keeping the earthworks free of water, and for furnishing all labour, tools, equipment and incidentals necessary to complete the work in accordance with the specifications.

<b>Item</b>	<b>Unit</b>
4701.02 Excavation and disposal of surplus material (suitable and unsuitable)	m <sup>3</sup>

Excavation and disposal of each shall be measured as the net difference between the total volume of cut and the net volume of fill. The net volume of fill shall include any fill, sub-base or any other material used elsewhere on the Works, which is measured and paid for as per these specifications under a separate pay item and originated from a cut.

No account shall be taken of variations in actual quantities due to bulking. All excavations shall be measured to the net lines and levels specified on the drawings or otherwise by the Engineer. Any additional width of excavation necessary for the installation of Formwork, Free working space, or leveling concrete or structural concrete exceeding the area of lower plane will not be measured for payment and the cost of this excavation will be deemed to be included in the unit price for the measured quantity as described above.

The tendered rates for cut to spoil shall include full compensation for disposal of surplus materials, including the subgrade preparation (compaction and shaping of existing ground), cost of providing disposal sites outside of the site, shaping, compacting, landscaping and drainage such sites.

<b>Item</b>	<b>Unit</b>
4701.03      Excavation in hard material Extra over Item 4701.01 or 4701.02	m <sup>3</sup>

The unit of measurement shall be the cubic metre measured in situ.

The Contractor must agree in advance with the UNOPS engineer the top surface of any hard material that is encountered. The Contractor will be responsible for preparing an accurate record drawing of the top surface and providing a copy of it to the UNOPS engineer. The Contractor must agree in advance the extent of any hard material that is to be excavated (Hard Material is defined in 4201) a copy of this agreement must be obtained by the Contractor from the UNOPS engineer in writing. No material in excess of the authorised quantity will be measured for payment.

The tendered rate shall be paid as an extra over the rate tendered for item 4701.01 or item 4701.02 and shall include full compensation for executing hard excavation, including the cost of all additional effort, specialised plant and personnel, explosives, tools, materials, blasting mats, safety measures and labour.

<b>Item</b>	<b>Unit</b>
4701.04                  Fill (Imported Material)	m <sup>3</sup>

The unit of measurement shall be the net volume of fill in place.

The tenders rate shall be full compensation for excavating, transportation, placing, spreading and compacting the material (common fill and subgrade fill) at the site of the fill, forming benches in side-long ground, and for trimming the fill to the required profile and level tolerance and all works necessary to prepare the subgrade to receive following layers including subgrade preparation and compaction. Note there will be no distinction between common fill and subgrade fill.

The tendered rate for material supplied from out with the site shall include all royalties, the cost of negotiations, payments, compensation of any description to landowners, the removal of overburden, excavation loading haulage to the point of deposition, and restoration, landscaping.

No allowance or adjustment shall be made for bulking as this will be deemed to be included within the Contractors rate.

Item	Unit
4701.05 Sub-grade preparation	m <sup>2</sup>

The unit of measurement shall be the square metre of the subgrade prepared.

The existing embankment or surface shall be scarified (at least 150 mm), bladed, and shaped to conform to the line, grade, and cross-section shown on the Drawings or as established by the Engineer. Any high place in the embankment shall be cut to grade and scarified; the resulting material hauled and deposited on low areas or on fill slopes as directed by the Engineer. All depressions shall be filled with approved material so as to bring the surface of the subgrade to the elevation shown on the Drawings or approved by the Engineer. All soft and yielding material, other than material that would be satisfactory but for its high moisture content or any other objectionable materials (except stone particles) in the subgrade, shall be removed and replaced with suitable material, which shall be thoroughly compacted. All buried roots, stumps, or other perishable matter encountered in the preparation of the subgrade shall be removed to a depth of not less than 500 mm below expected road finish level.

Measurement shall be the nominal plan area of the lower surface of the gravel wearing course or pavement layer overlying the area of sub-grade prepared in accordance with requirements specified above for cut / fill areas. This item shall only be used when no specific cut and/or fill operation is required, where such operations are required preparation of the subgrade shall be deemed to be included in the respective rates for those operations.

The tendered rate shall be full compensation for trimming and compacting material of any description to the specified levels and tolerances and all works necessary to prepare the sub-grade to receive following layers.

**SERIES 5000: Concrete Works****CONCRETE STRUCTURES**

- 5100 SCOPE AND GENERAL REQUIREMENTS
- 5200 MATERIALS
- 5300 TESTING OF MATERIALS
- 5400 COMPOSITION AND STRENGTH OF CONCRETE
- 5500 TRIAL MIXES
- 5600 TESTING OF CONCRETE
- 5700 CONSTRUCTION METHODS
- 5800 REPAIR OF EXISTING CONCRETE STRUCTURES
- 5900 MEASUREMENT AND PAYMENT

## 5100 SCOPE AND GENERAL REQUIREMENTS

This work shall consist of the construction of all Portland cement concrete in structures, with or without reinforcement, in accordance with these Specifications and to the strengths, lines, levels, grades and dimensions shown on the Drawings or as required by the Engineer.

Concrete shall consist of a mixture of Portland cement, coarse and fine aggregates, and water.

### 5101 Weather / Climate conditions

#### Cold weather

The cold weather as defined in ACI 306R-16, is when the air temperature has fallen to, or is expected to fall below 40°F (4°C) during the protection period, the protection period is defined as at least 72 hours after the concrete placement and finishing.

- Subbase/ blinding : Ensure that the subbase or blinding concrete surface is free of snow, ice and frost.
- Cold weather concreting shall be in accordance with the following:
  - a. The guidelines of The American Concrete Institute's guidelines to Cold Weather Concreting (ACI 306R) shall be followed when the Forecasted air temperature drops below 4°C the protection period. The minimum concrete temperature when delivered at the site shall be in accordance with the **Minimum cold weather temperature table**.
  - b. If water or aggregate is heated above 38°C, the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 38°C.
  - c. Concrete shall only be poured when the ambient temperature is rising.
  - d. All concrete shall be insulated from freezing for the greater of following:
    - i. 3 days
    - ii. Until the concrete reaches an in-place compressive strength of 25 kg/cm<sup>2</sup>, Before placing concrete, the formwork, reinforcement, and any surface with which the fresh concrete will be in contact shall be free from snow, ice and frost.
  - e. Accelerating admixtures shall not be used without approval from the UNOPS Project Manager.
  - f. Maintain the concrete at a temperature of at least 10°C for at least 72 hours after placing.

#### Admixtures

**General:** Do not add calcium chloride, salts, chemicals or other material to the mix to lower the freezing point of the concrete.

Minimum Cold Weather Temperature Table

Air Temperature °C	Minimum Concrete Temperature °C, at discharge point	
	For Sections with smallest Dimension Less Than 300 mm	For Sections with smallest Dimension More Than 300 mm
1 to 4	16	13
-18 to -1	18	16
Below -18	21	18

### Hot weather

Avoid premature stiffening of the mix and reduce water absorption and evaporation losses. If the temperature of the surrounding air is higher than 32°C:

- Mix, transport, place and compact the concrete as rapidly as possible, and cover with an impervious membrane or hessian kept wet until moist curing begins.
- Hold the concrete to a temperature 32°C when placed.

Hot weather concreting shall be in accordance with the following:

- Concrete temperatures shall be kept within desirable limits using methods recommended by The American Concrete Institute's guidelines to Hot Weather Concreting (ACI 305R).
- For mass concrete, i.e. concrete sections having a minimum dimension of 750mm or greater, the maximum acceptable concrete temperature is 21°C at time of discharge.
- For other concrete structures, the maximum acceptable concrete temperature is 32°C at time of discharge. - If ice is used as part of the mixing water, mixing should be continued until the ice has completely melted.
- Re-tempering shall not increase the water content above that in the mix design.

### 12.6c Placing in fixed forms

- Place concrete uniformly over the width of the pour and so that the face is generally vertical and normal to the direction of placing. Hand spread concrete using shovels, not rakes.
- Compact concrete using internal mechanical vibration of sufficient amplitude to produce noticeable vibrations at 300 mm radius.
- Insert vibrators into the concrete to the depth which will provide the best compaction for a duration sufficient to produce satisfactory compaction, but not longer than 30 seconds in any one location.

### Elapsed delivery time

General: Ensure that the elapsed time between the wetting of the mix and the discharge of the mix at the site is in conformance with the **Elapsed delivery time table**. Do not discharge below 10°C or above 32°C.

Elapsed Delivery Time Table

Concrete temperature at time of discharge (°C)	Maximum elapsed time (hours)
10 – 24	2.00
24 – 27	1.50
27 – 30	1.00
30 – 32	0.75

### Compaction

- Use immersion and screed vibrators accompanied by hand methods as appropriate to remove air bubbles and to fully compact the mix.
- Do not allow vibrators to come into contact with partially hardened concrete, reinforcement or items including pipes and conduits embedded in concrete.
- Do not use vibrators to move concrete along the forms.
- Avoid over-vibration that may cause segregation.
- A sufficient number of vibrators in serviceable condition shall be on site to ensure that spare equipment is always available in the event of breakdowns.
- There shall be no excess water on the top surface on completion of compaction.

### Rain

General: Do not expose concrete to rain before it has been placed and set.

## 5200 MATERIALS

The sources of the materials shall be selected by the Contractor, but approved by the UNOPS Engineer prior to their incorporation in the Works. For this purpose, the Contractor shall furnish all relevant test data for representative samples from each source area as desired by the UNOPS Engineer and also afford opportunities for the UNOPS Engineer to visit the source areas. The number of representative samples to be tested shall not be less than two for each type of material in each source area. Notwithstanding approval of sources of materials, materials as brought to **the work site for use in** the work shall be subject to acceptance or rejection by the UNOPS Engineer based on quality control tests to be performed before use in construction

### 5201 Cement :

Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.

Cement shall be free from any hardened lumps and foreign matter. It shall have a minimum of 90% of particles by weight passing the 75 micron sieve, an initial setting time not less than 45 minutes and a final setting time not more than 375 min.

**5202 Coarse Aggregate :**

Except where otherwise stated, coarse aggregate shall consist of hard, durable angular fragments of crushed stone and/or crushed natural gravel conforming to the following grading :

Sieve Size (mm)	% Passing by Weight
25.00	100
19.50	90-100
12.50	20-55
9.50	0-15
4.75	0-5

The aggregate shall not have a Los Angeles abrasion value of more than 50%, when tested as per ASTM C131. When tested as per ASTM C88, the aggregate shall not result in more than 12% loss when subjected to five cycles of immersion and drying when sodium sulphate solution is used, or 18% when magnesium sulphate solution is used. The material finer than No.200 sieve in the aggregate shall not be more than 1%, when tested as per ASTM C117. These tests will be conducted only for the material source approval (not as a routine testing system), unless the source of the material, and/or production properties of the material changes than those used for the material source approval.

**5203 Fine Aggregate :**

Fine aggregate shall consist of natural sand with a FM of not less than 2.3. All the material shall pass 4.75mm sieve and not more than 3% by weight shall pass a 75 micron sieve.

The fine aggregate shall be clean and free from deleterious substances. When tested as per ASTM C88, the aggregate shall not result in more than 10% loss when subjected to five cycles of immersion and drying when sodium sulphate solution is used, or 15% when magnesium sulphate solution is used. These tests shall be conducted only for the material source approval (not as part of the routine tests), and whenever the material source and/or properties of the material changes than those used for the material source approval.

**5204 Water :**

Water shall be subject to the approval of the Engineer and shall be reasonably clear, free from oil, alkali, salts, acid and organic substances and other deleterious materials or objectionable quantities of suspended materials.

**5205 Storage of Materials :**

Cement shall be stored in a waterproof shaded area. The cement stacks shall be placed at a minimum distance of 300mm from the walls. The damp proof floor shall be constructed by raising it minimum 300mm above the ground. If the cement is damaged and becomes lumpy due to defective storage, it shall be removed from the site within 24 hours of receipt of instructions from the Engineer.

The Contractor shall maintain a record of deliveries of cement to site and its use in the work.

## 5300 TESTING OF MATERIALS

### 5301 Cement :

Each batch of cement delivered to site shall be sampled and tested before being approved for incorporation into the works. The test certificates for quality tests from the factory may be requested to be submitted by the contractor prior to start the concreting works. The cement shall be sampled at site, most conveniently upon delivery, and tested for fineness and setting time. The lumpy/cake cement shall be rejected at site and the contractor shall dispose of it at his own cost.

The Engineer may order additional testing requirements.

### 5302 Aggregate :

The Contractor shall supply samples of the aggregate materials proposed to be used for testing of grading and other required properties as required by the Engineer.

If the Contractor proposes to change the source of supply of aggregate, samples from the new source shall similarly be supplied and tested.

Grading of mixed coarse aggregate shall be checked on Site.

## 5400 COMPOSITION AND STRENGTH OF CONCRETE

### 5401 Concrete Specifications :

The concrete mix shall be designed to achieve the specified strength stated in the design drawings if not as below:

Concrete in reinforced structures shall have a minimum 28 day compressive strength (cylinder test) of 25MPa (N/mm<sup>2</sup>) unless otherwise stated on the Drawings, a maximum aggregate size of 20 mm, and a minimum cement content of 360 kg per cubic meter.

Concrete in Prestressing member shall have a minimum 28 day compressive strength (cylinder test) of 34 MPa (N/mm<sup>2</sup>) unless otherwise stated on the Drawings, a maximum aggregate size of 20 mm and a minimum cement content of 450 kg per cubic meter with or without admixtures for concrete.

Wearing course concrete shall have a minimum 28 day compressive strength (cylinder test) of 25MPa (N/mm<sup>2</sup>), a maximum aggregate size of 12mm, and a minimum cement content of 360 kg per cubic meter.

**Blinding** concrete shall have a minimum 28 days compressive strength (cylinder test) of 15 Mpa (N/mm<sup>2</sup>), or a maximum aggregate size of 20mm and a minimum cement content of 300 kg per cubic meter.

Cube strength (150x150x150 mm) of concrete shall be **17.5 percent** higher than cylinder strength, and 7 day strength of concrete shall be minimum **70 percent** of 28 day strength.

The ratio of water to cement in concrete shall be as low as possible and may vary from 0.45:1 to 0.50:1 by weight. In concrete barriers, edge beams and bridge decks directly exposed to traffic, or concrete in piles, pile caps or abutments in contact with the ground, the ratio shall not exceed 0.45:1.

The concrete shall be of suitable workability to obtain full compaction, and slump shall be maintained as follows

Beams and Slabs :	50-75mm
Pavements :	25-75mm
Columns, Retaining Walls:	60-100mm
Abutments and Piers	
Railings and Posts :	75-100mm
Blinding Concrete :	25-50mm

### **5500 TRIAL MIXES**

The Contractor shall prepare trial mixes with concrete of designed proportions for testing of slump and strength. The trial mixes shall be made and compacted in the presence of the Engineer using the same equipment that will be used for the works.

The trial mix proportions shall be approved if the required strength is obtained and the consistency and surface finish is satisfactory.

When a proposed mix has been approved, no variations shall be made in the mix proportions, or in the type, size, grading zone or source of any of the constituents without the consent of the Engineer.

Until the results of the trial mix have been approved by the Engineer, no concrete of that Specification shall be placed in the Works.

### **5600 TESTING OF CONCRETE**

#### **5601 Compressive Strength :**

Cylinder testing of concrete strength shall be carried out as required by the Engineer (in case of cube test, consider the extra percentage) as per ASTM C39 / AASHTO T22. A minimum of three test cylinders shall be taken for each day's casting or for every 15 cubic metres of concrete cast in larger pores.

2 sets of three test moulds (cylinder) shall be made available at site by the Contractor. Samples for testing shall be taken in the presence of the Engineer and shall be dated.

Test cylinders shall be tested for 7 day and 28 day compressive strength, by submitting a 24hrs advance notice to the Engineer.

The average strength of the cylinders, tested at 28 days, shall exceed the specified strength. One out of the three cylinders or cubes tested may have a value less than the specified strength provided that it is not less than 85% of the specified strength, except that not more than one test result per

element may be below the specified strength.

In case the cylindrical specimen's compressive strength fails in 28 days crushing age, the UNOPS Engineer will conduct a field visit, if the physical appearance of the concrete seems good enough, the UNOPS Engineer shall recommend field retesting for verification as applicable for the structural concrete.

**5602 Slump test:**

Slump testing of concrete shall be carried out as required by the Engineer. The minimum is one test at the commencement of each casting, one per hour of casting and one each time a strength test specimen is taken.

A complete set of slump shall be made available on site by the contractor engineer.

**5700 CONSTRUCTION**

**5701 Form work :**

All Form work shall be of timber or steel and shall be built mortar tight and rigid enough to maintain the concrete in position during placing, compacting, setting and hardening.

The Form work shall be rigidly constructed, supported on a firm bearing base, and braced so as to retain its shape and position and shall be set to the specified lines and levels. Form work shall be constructed so that loose material can be removed from inside without disturbing the Form work.

Metal ties or anchorages within the form shall be constructed to permit their removal to a depth of 50mm from the face without disturbing the concrete, and shall be of such design that the size of the cavity left is minimized.

Timber Formwork shall be of dressed timber, smoothed on the concrete face side or with a form liner of approved type, to impart a "fair faced" finish to the concrete.

Steel Formwork shall be rigid with no surface blemish that will impair the quality of finish of the concrete surface. Forms shall be sufficiently tight to prevent loss of mortar from concrete. But Metal formwork shall not be used in cold weather use.

Moulding strips shall be placed in the corners of forms to produce edges on permanently exposed concrete surfaces as shown on the drawings.

Except where otherwise directed, all forms shall be coated with oil on the concrete face side. The oil used must be non staining and have no adverse effect on paint or any other finish.

All Form work shall be approved by the Engineer before placing of concrete commences.

**5702 Construction Joints :**

Construction joints shall be made only where shown on the drawings or as directed by the Engineer.

Prior to laying of new concrete, the face of the concrete that has already hardened shall be treated and prepared as follows :

- a. If the new concrete is to be laid within 48 hours, the face of the old concrete shall be cleaned with a wire brush and water, and a coating of cement mortar grout shall be applied before placing new concrete.
- b. If the new concrete is to be laid after 48 hours, the face of the old concrete shall be roughened by chiselling. It shall then be cleaned of all loose aggregates and other foreign matter, watered, and a coating of cement mortar grout shall be applied before placing new concrete.

**5703 Expansion Joints :**

Formers for expansion joints shall be placed in the locations shown on the Drawings or as directed by the Engineer.

The open joints shall be constructed by the insertion and subsequent removal of wood strips, metal plates or other approved materials. Care shall be taken to remove the former without chipping or breaking the corners of the concrete.

Reinforcement shall not extend across any expansion joint unless so specified on the Drawings.

**5704 Contraction Joints :**

Contraction joints should be formed using one of the two methods of tooling or sawing, in locations shown in the drawings or as directed by the Engineer. Usually the width of the contraction joints shall be 5 - 9mm, with a depth of (slab thickness/4 - slab thickness/3).

Tooled joints could be formed during the finishing operation of the concrete, by inserting a grooving tool of the specified dimensions.

Contraction joints using sawing shall be done as soon as practical, when the concrete can withstand the energy of sawing without travelling or dislodging particles.

**5705 Mixing of Concrete :**

Concrete shall be thoroughly mixed in a batch mixer of an approved size and type which will ensure a uniform distribution of the materials throughout the mass. No mixer having a rated capacity of less than one bag of cement shall be used nor shall a mixer be charged in excess of its rated capacity.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon cessation of mixing for a considerable period, the mixer shall be thoroughly cleaned.

Containers for measuring aggregates, sand, water and cement shall be approved by the Engineer.

When mixing coarse aggregates shall be fed first, then sand and then cement. These materials shall be mixed dry before water is added.

All concrete shall be mixed for not less than 2 minutes after all materials, including water, are in the mixer. Every batch shall be mixed until a uniform consistency of the mixture is obtained. The entire contents of the mixer shall be removed from the drum before mixing of the next batch commences.

Concrete shall be placed and compacted within 30 minutes of batching. Concrete which has experienced an initial set shall not be used. Remixing of concrete is not permitted.

**5706 Handling and Placing of Concrete :**

Concrete shall not be placed until the reinforcement and the forms have been inspected and approved by the Engineer. Before placing of concrete all sawdust, wood chips and other construction debris and extraneous matter shall be removed from the interior of the forms, the reinforcement shall be thoroughly cleaned; and the forms and reinforcement shall be thoroughly wetted.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs and chutes requires the permission of the Engineer. The chutes or troughs shall be kept clean and free from hardened concrete.

Concrete to be placed from a height of more than 1.5m shall be poured through troughs/tremie pipes, or as directed by the Engineer.

Struts, stays and braces serving temporarily to hold the forms in correct position pending the placing of concrete shall be removed when the concrete has reached an elevation rendering their service unnecessary. They shall not be buried in the concrete.

Concrete shall be laid in layers of 150mm to 300mm in thickness and each layer shall be properly vibrated before laying the next one.

**5707 Curing of concrete:**

Curing shall continue for a period of not less than seven days after placing the concrete, and shall be done by one of the following methods :

- a) The exposed surface shall be covered with moist sand or gunny bags and shall be kept moist by flushing or sprinkling water.
- b) Floors or other horizontal surfaces may be cured by impounding water in earthen bunds in squares over the entire area. The depth of water in the enclosed square shall be minimum 50mm.
- c) Columns, walls or other vertical surfaces shall be cured by wrapping gunny bags or canvas tightly over the surface and keeping the wrapped material continuously wet by sprinkling water.

**5708 Protection of Concrete Work :**

No load shall be applied or other work carried out that will damage new concrete or interfere with its curing. Where work is necessary on new concrete to complete a structure, the workmen and materials shall be kept off the concrete for at least 36 hours after it was placed and until such time as it will not be damaged by the work in progress. Care shall be taken to prevent damaging the bond between new concrete and the embedded portion of reinforcing bar projecting from it.

**5709 Removal of Formwork :**

Form work shall be removed only with the approval of the Engineer.

Forms used on exposed vertical faces shall remain in place for at least 3 days after placing the concrete.

Forms under slabs, beams and girders shall remain in place for at least 21 days after placing the

concrete.

Form work shall be removed in such a manner as to ensure the safety of the structure. All bracing shall be removed at the same time as the forms.

Cavities left in the concrete by metal ties and anchorages shall be filled with cement mortar and the surface left smooth and even.

#### **5710 Finishing Concrete Surfaces:**

All concrete shall be given a fair faced finish unless otherwise specified in the Drawings or as directed by the Engineer.

When requested by the Engineer, the following surfaces shall be given a rubbed finish; the exposed faces of piers, abutments, wing walls and retaining walls; faces of girders, T-beams, slabs, columns, brackets, headwalls, arch rings, spandrel walls and parapets; but not the top and bottom surfaces of floor slabs and sidewalks, bottoms of beams and girders, sides of interior beams and girders, back walls above bridge seat level or the underside of coping.

The surface finish on piers and abutments shall include all exposed surfaces below bridge seat level to 300mm below low water elevation or 300mm below finished ground line when this is above the water surface.

Wing walls shall be finished from the top to 600mm below the finish slope lines on the outside face and shall be finished on top and for depth of 300mm on the back sides.

Honeycombing, if it appears, shall not be covered up except as directed by the Engineer.

#### **5711 Placing Concrete Under Water :**

Concrete shall not be deposited in water except with the approval of the Engineer and under supervision. Concrete deposited in water shall contain 10% additional cement. It shall be placed in a compact mass in its final position by means of a tremie pipe or a bottom-opening bucket, and shall not be disturbed after deposition.

### **5800 REPAIR OF EXISTING CONCRETE STRUCTURES**

#### **5801 SCOPE**

This work shall consist of the reconstruction of existing localized defective concrete (including that associated with small extensions of existing concrete structures), rehabilitation of existing concrete facing, and repair of minor cracks in structural concrete, and anchoring and tying of existing structural members.

The work shall be carried out in accordance with these Specifications and to the locations, lines and dimensions shown on the Drawings or as required by the Engineer.

Any extension work associated with repair of existing localized defective concrete is covered under Clauses 7300 and 7400 and the extension work shall be measured and paid for under those Clauses.

**5802 Materials**

Concrete shall comply with Clause 7300 of these Specifications.

Cement mortar shall comply with Clause 8200 of these Specifications except that the mix may vary as shown on the Drawings.

**5803 CONSTRUCTION METHODS****General :**

The Contractor and the Engineer shall jointly survey structures to be repaired, and the location of all repairs shall be permanently marked in paint on each structure. The repair work shall be carried out by skilled, experienced personnel well versed in this work.

**Repair of Existing Localized Defective Concrete :**

Where existing defective concrete is to be repaired, or extended, the existing concrete shall be carefully broken back to ensure that all defective material is removed and that, where necessary, sufficient reinforcement is exposed. All loose concrete shall be removed, the exposed reinforcement shall be carefully cleaned, and the exposed concrete shall be cleaned of all dust. A construction joint shall be prepared on the exposed face to ensure a good feature between the existing section and the repair/extension work.

The construction of replacement concrete work, and of any extension, shall conform to Clauses 7300 and 7400 The prepared face shall be inspected and approved by the Engineer before new work commences.

**Repairs to Concrete Surfaces :**

Defective concrete on the face of substructure walls, particularly adjacent to the water line; in soffits to beams, slabs and other superstructure; and on the web faces of main beams and other superstructures shall be carefully removed in a sequence and in accordance with the strict instructions of the Engineer. Such works shall be permanently supervised by a representative of the Engineer and the Contractor shall ensure technical staff are permanently available on the Site to receive instructions. The structural integrity of existing members shall not be impaired and the Contractor shall be fully responsible for ensuring strict procedures are followed. Defective concrete shall be carefully and cleanly removed by manual methods using hammers and chisels. The concrete exposed shall be cleaned of all dust and loose material. Any reinforcement shall be carefully cleaned using wire brushes unless alternative instructions are given by the Engineer.

The removed concrete shall be replaced by a method proposed by the Contractor and approved by the Engineer after inspection of the exposed work. The Contractor shall demonstrate that the method he proposes to adopt is capable of giving a facing equivalent to the workmanship standards that would be accepted in new works.

**Repair of Minor Cracks in Concrete :**

Minor cracks shall be cleaned to remove all loose material to expose a sound surface. After approval by the Engineer of the cleared crack it shall be grouted to full depth with cement mortar and trimmed flush with the face of the concrete.

**Anchoring and Tying :**

Structural concrete members that exhibit cracking and relative movement may be anchored or tied as instructed by the Engineer. Prior to commencing work, the Contractor shall obtain the approval of the Engineer of the methods to be adopted. This shall cover the provision of temporary stages;

the drilling methods; safety measures; anchoring methods and subsequent testing for ground anchors to ensure tie bars are capable of carrying twice the working load; stressing methods and ultimate grouting of anchor bars. The Contractor shall take instructions from the Engineer on the precise requirements for the provision, installation and anchoring of all tie bars incorporated in the Works.

### **5900 Measurement and Payment**

<b>Item</b>		<b>Unit</b>
5901.01	Concrete of the required strength as shown on the drawings and as described in the BoQ	m3
5901.02	Concrete of the required strength as shown on the drawings and as described in the BoQ	m3
5901.03	Concrete of the required strength as shown on the drawings and as described in the BoQ	m3
5901.04	Concrete of the required strength as shown on the drawings and as described in the BoQ	m3
5901.05	Concrete of the required strength as shown on the drawings and as described in the BoQ	m3
5901.06	Concrete wearing course of the required strength as shown on the drawings	m3
5901.07	Blinding concrete of the required strength as shown on the drawings	m3

The work measured shall be paid for at the Contract unit prices per cubic metre as shown in the Bill of Quantities. This payment shall be full compensation for manufacturing the concrete including all materials, Form work and bracing, finishing and all labour, equipment, tools and incidentals necessary to complete the work.

This work shall be measured as the volume in cubic metres of concrete of the specified strength placed and finished complete and accepted. Volumes shall be computed from the dimensions shown on the Drawings or as ordered by the Engineer. No deductions shall be made from the measured quantities for drainage, openings or pipes less than 300mm in diameter, conduits, chamfers, reinforcing bars, expansion joints or pile heads embedded in the concrete.

<b>Item</b>		<b>Unit</b>
5901.08	Repair of Existing Defective Concrete	m3
5901.09	Repair of Existing Concrete Surfaces	m2
5901.10	Repair of Minor Cracks in Existing Concrete	Lin m
5901.11	Supply and Fix Anchors and Tie Bars	Tonnes

Repair of defective concrete shall be measured as the volume in cubic metres marked up, replaced to original lines and accepted. Concrete surface repairs shall be measured as the area in square metres marked up, repaired and accepted. Repair of minor cracks shall be measured as the length in linear metres marked up, grouted and accepted. Anchoring and tie bars shall be measured as the weight in Kg of anchors and tie bars ordered, installed and accepted.

The work measured shall be paid at the relevant Contract unit prices per cubic metre, per square metre, per linear metre or per Tonnes. The payment shall be full compensation for the work including all materials, preparatory work and removal of defective materials, Temporary Works, and all labour, equipment, tools and incidentals necessary to complete the work. For anchoring and tying the payment shall also be full compensation for fixing or drilling, installation, grouting in stages and stressing.

**SERIES 6000: Reinforcement for Concrete Structures**

## CONTENTS

6100 SCOPE AND GENERAL REQUIREMENTS

6200 MATERIALS

6300 CONSTRUCTION METHODS

6400 MEASUREMENT AND PAYMENT

## 6100 SCOPE AND GENERAL REQUIREMENTS

This work shall consist of the supply and placing of steel reinforcement in concrete structures, bored cast-in-situ and precast concrete piles. The work shall be in accordance with these Specifications, and the types, sizes and positions of reinforcement shall be as shown on the Drawings.

## 6200 MATERIALS

### **Reinforcing Bar :**

**6201 - Mild Steel Plain Round Bar (MS Bar) – Not used .**

**6202 - Mild Steel Deformed Bar Not used.**

**6203 - High Strength Deformed Bar (HSD Bar)** conforming to ASTM specification A615 or BS4461 with a yield strength of not less than 420MPa (N/mm<sup>2</sup>) i.e 60 grade.

**6204 - Prestressing Steel - Not used**

### **6205 - Binding Wire :**

Reinforcement binding wire shall be 24 BWG galvanized iron wire.

## 6300 CONSTRUCTION METHODS

### **6301 - Storage of Reinforcing Bar:**

Reinforcing bar shall be handled and stored so as to prevent undue bending and accumulation of oil, grease, dirt or mud.

All bars shall be cleaned and brushed to remove any oil, grease, dirt, mud, paint, loose scale and rust or other foreign substances, immediately before use.

### **Cutting and Bending of Reinforcing Bar:**

All bars shall be cut and bent cold to the dimensions indicated on the Drawings using equipment and methods approved by the Engineer.

Plain MS bars shall have standard hooks at the end as follows :

- a) a semi-circular bend plus an extension at the free end of at least four bar diameters or 62mm, whichever is the larger; or
- b) a 90° bend plus an extension at the free end of at least twelve bar diameters;

Stirrups and tie anchorages shall have either a 90° or 135° bend plus an extension at the free end of at least six bar diameters or 62 mm, whichever is the larger.

The radii of bends for standard hooks measured on the inside of the bar shall have the following minimum values

<u>Bar Diameter (mm)</u>	<u>Minimum Radius</u>
10, 12, 16	2.5 bar diameter
20, 22, 25	3.0 bar diameter
28, 30, 38	4.0 bar diameter

The radii of bends for stirrups and tie anchorages, measured on the inside of the bar, shall be not less than two bar diameters.

### **6302 - Splicing of Reinforcement :**

The length of lap for MS plain bar shall be 40 bar diameters with hooks and 56 bar diameters without hooks.

The length of lap for M.S. or High Strength Deformed bar shall be 30 bar diameters up to 16mm diameter bars and 40 bar diameters for larger sizes of bar.

Splicing of reinforcement shall generally be at points of minimum tensile stress. Where more than one half of the bars are spliced within a length of 40 bar diameters, or where splices are made at points of maximum stress special precautions shall be taken by increasing the length of lap and use of spirals or closely-spaced stirrups around the length of the splice.

Use and splicing of bars shorter than those shown on the Drawings requires the permission of the Engineer. Reinforcing bars in structures shall not be welded unless otherwise specified on the Drawings, or approved by the Engineer.

### **6303 - Placing of Reinforcement :**

Reinforcement shall be placed, supported and maintained in the positions shown on the Drawings. All intersecting bars shall be tied together with binding wire. The ends of the wire shall be short and turned into the main body of the concrete.

Reinforcement shall be supported on pre-cast mortar blocks or metal supports (chairs) of adequate strength but minimum size. The mix proportion for mortar blocks shall be one part Portland cement to two parts sand. Wire shall be cast into the blocks to attach them to the reinforcement. The mortar blocks and chairs to be used shall be approved by the Engineer

Substitution of reinforcing bars requires the permission of the Engineer. If bars are substituted they shall be of the same type as, and have a cross-section area the same as or larger than, the specified bars.

All placed reinforcement shall be approved by the Engineer before pouring of concrete begins.

## **6400 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
6401.1 Supply and Place Reinforcement	Tonnes

This work shall be measured as the computed weight in Tones reinforcing bar shown on the Drawings, placed and accepted. In computing the weight, the theoretical weights of the bars of the types and cross-sections shown on the Drawings shall be used. The computed weight shall include

hooks, stirrups, tie anchorages and laps. The extra material necessary when bars larger in diameter or shorter in length than those specified are used shall not be measured.

Reinforcement for concrete piles shall be measured and paid for under Clauses.....

The work measured shall be paid for at the Contract unit prices per kilogram of reinforcing bar as shown in the Bill of Quantities. The payment shall be full compensation for supply and placing of the reinforcement including all materials, supports and binding wire, cutting and bending, and labour, equipment, tools and incidentals necessary to complete the work.

**SERIES 7000: PAVEMENTS****CONTENTS**

7100	SUB-BASE COURSE
7200	CRUSHED AGGREGATE BASE COURSE
7300	CRUSHED AGGREGATE SURFACE COURSE
7400	DRESSED STONE PAVEMENT
7500	INTERLOCKING PRECAST CONCRETE BLOCKS PAVING
7600	NATURAL STONE TILES PAVEMENT
7700	PLUM CONCRETE PAVEMENT

**SECTION 7100: SUBBASE COURSE****CONTENTS**

7101 SCOPE AND GENERAL REQUIREMENTS

7102 MATERIALS

7103 CONSTRUCTION

7104 INSPECTION AND TESTING

7105 MEASUREMENT AND PAYMENT

### 7101 SCOPE AND GENERAL REQUIREMENTS

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as subbase or lower subbase and upper subbase (termed as subbase hereinafter) as necessary according to lines, grades and cross-sections shown in the Design Drawings or as directed by the Engineer.

### 7102 MATERIALS

Material shall be obtained from sources located by the Contractor and approved by the Engineer. The subbase course material shall consist of crushed or rounded stone from river, gravel, shell, sand, or other sound, durable, approved natural materials processed and blended or naturally combined. The material shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. The material shall be free from organic or other deleterious constituents. The subbase shall conform to A or B grading given in table below or other international codes and standards (AASHTO M 147) approved by the Engineer.

Grading Requirements for Subbase Course Material

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)	
	Grading Designation	
	A	B
3 inch (75 mm)	100	
2 inch (50 mm)	97 – 100	100
1½ inch (37.5 mm)	--	97 – 100
1 inch (25 mm)	65 – 79	--
¾ inch (19 mm)	--	--
½ inch (12.5 mm)	45 – 59	--
⅜ inch (9.5 mm)	--	--
No. 4 (4.75 mm)	28 – 42	40 – 60
No. 40 (425 µm)	9 – 17	
No. 200 (75 µm)	4.0 – 8.0	4.0 – 12.0

Due to frost heave in the cold areas, the fine material (material passing # 200 sieve) shall not exceed than 12% for subbase course material and or as approved by the Engineer.

#### Strength of Subbase Course

The material shall be locally available granular material that meets the mechanical (CBR) and physical (Gradation) properties. It shall be ensured prior to actual execution that the material to be used in the subbase satisfies the requirements of CBR and other physical requirements when compacted and finished. The CBR of subbase courses shall not be less than 25% in the field compaction level when tested in accordance with ASTM D 1883 or AASHTO T 193 after 96 hrs soaking.

#### Compaction Requirements

The subbase layer shall be compacted at least to 95% of maximum dry density for major streets and 92% for minor streets where heavy machinery cannot operate easily (for sidewalks it would be considered as 90%) when tested in accordance with the AASHTO T 180 or ASTM D 1557, Method D.

### **7103 CONSTRUCTION**

The subbase course shall only be constructed provided that the underlying subgrade layers conform to the requirements specified. Immediately before placing the material, the subgrade shall be checked by the Contractor for any damage or deficiencies which shall be made good as directed by the Engineer. Oversize material or material not conforming to specified requirements shall be removed, by appropriate methods, from the subbase course material before transportation to the placement area. The subbase material shall be placed, spread, watered, graded and compacted in order to achieve the specified requirements and surface tolerances. As the subprojects consist of labour intensive works, the spreading and placing of subbase material shall be done by the labourers and or as directed by the Engineer. The watering, grading and compaction processes shall be carried out by suitable and required machineries in the field. The subbase may be mixed in the plant or in a specific location of the project site and then transferred to the street/roads where required. In areas where the machineries can't operate (especially in sidewalks and narrow streets), the watering, grading and compaction processes shall be carried out by labourers with usage of water sprinkling tools, handing tempers, manual operated roller and other equipment and tools recommended by the Engineer.

The Contractor shall protect and maintain the completed subbase course at his own expense. Maintenance shall include immediate repairs of any damage or defects which may occur and shall be repeated as often as is necessary to keep the subbase continuously intact. Repairs shall be made in a manner that will ensure restoration to an even and uniform surface. Where the subbase is required to carry traffic in both directions using part width only, the Contractor shall ensure that the wheel path position is varied, by means of coning or similar traffic control measures. If exposure to traffic over a part width is expected to be prolonged, the Engineer may order a protective layer of not less than 100mm of subbase quality material to be spread and compacted over the part width exposed to traffic.

The sub-base shall be finished to give a hard-dense surface throughout and free from irregularities of any kind. The finished surface shall vary not more than +/- 25 millimetres below the planned levels at any point. The deviation from a straight edge 3 metres long laid on the surface parallel to the centreline or at right angles to the centreline on a cross fall. Sub-base which do not conform to the above requirements shall be reworked, watered and thoroughly recompacted to conform.

### **7104 INSPECTION AND TESTING**

Routine inspection and testing will be carried out by the contractor to test the quality of materials and workmanship for compliance with the requirements of this section. The density, CBR and grading requirements specified in Clause 7102 shall be tested in the project site lab.

Perform testing by a third party professional commercial testing laboratory approved by the UNOPS QA Team. The following number of tests, if performed at the appropriate time, will be the minimum acceptable criteria for each type operation.

#### **Tests required for material source selection**

- Gradation: one test per type and source of material.
- Natural Moisture Content: one test per type and source of material.
- Optimum Moisture and Laboratory Maximum Dry Density: one test per type and source of material.
- California Bearing Ratio (CBR): one test per type and source of material.

Note: the above mentioned test's results shall be attached with a summary and brief report to enhance whether the material production plant or barrow area's satisfied the requirements of subbase materials or not. The report shall be submitted to the Engineer at least 7 days in advance for the acceptance of material source. If the project engineer cannot satisfy the above mentioned testing frequency, he can increase the frequency or add any other test as per site or his satisfaction requirements. Likewise, if delivered subbase material to the project site does not meet the requirement the UNOPS QA/QC will take the sample from the site material for re-testing for assurance.

#### **On-site Testing Required for QA/QC Purpose**

In-place or Field Density Test (FDT), the testing location is selecting by the Engineer with the random selection procedure:

- One test for each 500m<sup>2</sup> of each lift of the sub-base course.
- One test for each 75 LM of each lift of side drainage subbase layers.
- One test for each 30 LM of each lift of culvert subbase layers.
- One test for each 75 LM of each lift of shoulders/sidewalk subbase layers.

Optimum Moisture and Laboratory Maximum Dry Density: one test per material type but not less than one per 1000 LM each lift of road/street.

Note: If the project engineer cannot satisfy the above mentioned testing frequency, he can increase the frequency or add any other test as per site or his satisfaction requirements.

Any materials or workmanship that do not comply with the specified requirements shall be removed and replaced with materials and workmanship complying with the specified requirements, or if the Engineer permits, be repaired so that after being repaired it will comply with the specified requirements.

### **7105 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
7105.01      Subbase Course	m <sup>3</sup>

The unit of measurement shall be the cubic metre of material, measured in the final position after compaction to the specified density and other quality testing and the quantity shall be calculated as the product of the nominal depth, the required surface plan width and the required length measured horizontally along the centre line. No additional payment will be made for alternative types of construction proposed and/or adopted by the contractor.

The tendered rate shall include full compensation for procuring, including royalties, furnishing, crushing and screening (if required) and placing all materials, including transporting and the removal of all oversize material and for control, testing, protecting and maintaining the work specified in this section, except the skilled and unskilled labour's wages.

**SECTION 7200: CRUSHED AGGREGATE BASE COURSE****CONTENTS**

7201	SCOPE AND GENERAL REQUIREMENTS
7202	MATERIALS
7203	CONSTRUCTION
7204	INSPECTION AND TESTING
7205	MEASUREMENT AND PAYMENT

## 7201 SCOPE AND GENERAL REQUIREMENTS

This work shall consist of the supply, mixing, placing, shaping and compaction of a crushed aggregate base course composed of a homogeneous mixture of crushed aggregate and sand in accordance with the Specifications and to the lines, levels, dimensions and cross-falls shown on the Design Drawings or as directed by the Engineer.

## 7202 MATERIALS

The material for the crushed aggregate course shall consist of a homogeneous mixture of crushed stone aggregate and sand, free from vegetation, soft particles and excess clay or any other substance. The aggregate used for the crushed aggregate base course shall comply with the following requirements:

### Coarse Aggregate Requirements

Provide coarse aggregates with angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

The coarse aggregate of base course shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent for the fraction retained on the 9.5 mm sieve, when tested as per ASTM D4791. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 85 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with ASTM D 5821.

### Fine Aggregate Requirements

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

Provide fine aggregate consisting of angular particles produced by crushing stone. Fine aggregate shall be produced by crushing only particles larger than 4.75 mm sieve in size. Fine aggregate shall be manufactured from gravel particles 90 percent of which by weight are retained on the 12.5 mm sieve.

Grading Requirements for Crushed Aggregate Base Course Material

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)		
	Grading Designation		
	C (Base)	D (Base)	E (Base)
2 inch (50 mm)	100		
1½ inch (37.5 mm)	--		
1 inch (25 mm)	80 – 100	100	
¾ inch (19 mm)	64 – 94	86 – 100	100
½ inch (12.5 mm)	--	--	--
⅜ inch (9.5 mm)	40 – 69	51 – 82	62 – 90

No. 4 (4.75 mm)	31 – 54	36 – 64	36 – 74
No. 40 (425 µm)	--	12 – 26	12 – 26
No. 200 (75 µm)	3.0 – 7.0	3.0 – 7.0	3.0 – 7.0

Due to frost heave in the cold areas, the fine material (material passing # 200 sieve) shall not exceed than 8% for crushed aggregate base course material and or as approved by the Engineer. If other types of grading curve is proposed for the crushed aggregate base course by the Design Drawings such as open or gap graded curve, the contractor is required to produce such a material considering the requirements of international codes and standards (AASHTO, FP-14, etc.) approved by the Engineer.

### **Strength of Crushed Aggregate Base Course**

The material shall meet the mechanical (CBR) and physical (Gradation) properties. It shall be ensured prior to actual execution that the material to be used in the base course satisfies the requirements of CBR and other physical requirements when compacted and finished. The CBR of crushed aggregate base course shall not be less than 65% in the field compaction level when tested in accordance with ASTM D 1883 or AASHTO T 193 after 96 hrs soaking.

### **Compaction Requirements**

The crushed aggregate base course shall be compacted at least to 97% maximum dry density for major streets and 95% for minor streets where heavy machinery cannot operate easily (for sidewalks it would be considered as 93%) when tested in accordance with the AASHTO T 180 or ASTM D 1557, Method D.

### **7203 CONSTRUCTION**

Screening and mixing of materials to achieve the specified grading shall be done in a stacking yard. The mixing may be done by mechanical means or by manual labour if approved by the Engineer. The materials shall be mixed thoroughly and uniformly to have a homogenous mass or as directed by the design drawings. During mixing, water shall be added to keep the mixed materials moist so as to prevent segregation.

The crushed aggregate base course material shall be placed, spread, watered, graded and compacted in order to achieve the specified requirements and surface tolerances. As the subprojects consist of labour intensive works, the spreading and placing of material shall be done by the labourers and or as directed by the Engineer. The watering, grading and compaction processes shall be carried out by suitable and required machineries in the field. In areas where the machineries can't operate (especially in sidewalks and narrow streets), the watering, grading and compaction processes shall be carried out by labourers with usage of water sprinkling tools, handing tempers, manual operated roller and other equipment and tools recommended by the Engineer.

The base course shall be spread in a single layer to give a compacted thickness of 100mm to 150mm or as directed by design drawings. The relationship between the loose thickness and compacted thickness shall be determined from field trials and used in controlling the loose thickness at the time of spreading the mixed materials (if required).

Water shall be added as necessary during spreading so that at the time of compaction the moisture content is within  $\pm 4\%$  of the OMC.

The compacted surface shall be checked for levels and cross-falls and any irregularities shall be corrected by loosening the affected areas, adding or removing the necessary quantities of mixed material and re-compacting until the entire surface conforms to the correct levels and cross falls. The material shall be compacted to a density of not less than 97% of the laboratory MDD.

The finished surface shall be within  $\pm 20$  mm of the elevation shown in the drawings or as directed by the Engineer.

#### **7204 INSPECTION AND TESTING**

Routine inspection and testing will be carried out by the contractor to test the quality of materials and workmanship for compliance with the requirements of this section. The density, CBR, grading and other requirements specified in Clause 7202 shall be tested in the project site lab.

Perform testing by a third party professional commercial testing laboratory. The following number of tests, if performed at the appropriate time, will be the minimum acceptable criteria for each type operation.

#### **Tests required for material source selection**

- Gradation: one test per type and source of material.
- Optimum Moisture and Laboratory Maximum Dry Density: one test per type and source of material.
- California Bearing Ratio (CBR): one test per type and source of material.
- Los Angeles Abrasion: one test per type and source of material.
- Flat and Elongated Particles: one test per type and source of material.
- Fracture Faces: one test per type and source of material.

Note: the above mentioned test's results shall be attached with a summary and brief report to enhance whether the material production plant or barrow area's satisfied the requirements of crushed aggregate base course materials or not. The report shall be submitted to the Engineer at least 7 days in advance for the acceptance of material source. If the project engineer cannot satisfy the above mentioned testing frequency, he can increase the frequency or add any other test as per site or his satisfaction requirements.

#### **On-site Testing Required for QA/QC Purpose**

In-place or Field Density Test (FDT), the testing location is selecting by QA/QC or CM engineer:

- One test for each 400m<sup>2</sup> of each lift of the base course.
- One test for each 50 LM of each lift of the side drainage base course.
- One test for each 30 LM of each lift of the culvert base course.
- One test for each 50 LM of each lift of shoulders/sidewalk base course.

Optimum Moisture and Laboratory Maximum Dry Density: one test per material type but not less than one per 1000 LM each lift of road/street.

Note: If the project engineer cannot satisfy the above mentioned testing frequency, he can increase the frequency or add any other test as per site or his satisfaction requirements.

Any materials or workmanship that do not comply with the specified requirements shall be removed and replaced with materials and workmanship complying with the specified requirements, or if the Engineer permits, be repaired so that after being repaired it will comply with the specified requirements.

**7205 MEASUREMENT AND PAYMENT****Item****Unit**

7205.01 Crushed aggregate base course

m3

The unit of measurement shall be the cubic metre of material, measured in the final position after compaction to the specified density and other quality testing and the quantity shall be calculated as the product of the nominal depth, the required surface plan width and the required length measured horizontally along the centre line. No additional payment will be made for alternative types of construction proposed and/or adopted by the contractor.

The tendered rate shall include full compensation for procuring, including royalties, furnishing, crushing, placing all materials, including transporting and the removal of all oversize material and for control, testing, protecting and maintaining the work specified in this section, except the skilled and unskilled labour's wages.

**SECTION 7300: CRUSHED AGGREGATE SURFACE COURSE**

7301 SCOPE AND GENERAL REQUIREMENTS

7302 MATERIALS

7303 CONSTRUCTION

7304 INSPECTION AND TESTING

7305 MEASUREMENT AND PAYMENT

### 7301 SCOPE AND GENERAL REQUIREMENTS

This work shall consist of the supply, mixing, placing, shaping and compaction of a crushed aggregate surface course composed of a homogeneous mixture of crushed aggregate and sand in accordance with the Specifications and to the lines, levels, dimensions and cross-falls shown on the Design Drawings or as directed by the Engineer.

### 7302 MATERIALS

The material for the crushed aggregate surface course shall consist of a homogeneous mixture of crushed stone aggregate and sand, free from vegetation, soft particles and excess clay or any other substance. The aggregate used for the crushed aggregate surface course shall comply with the following requirements:

#### Coarse Aggregate Requirements

Provide coarse aggregates with angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

The coarse aggregate of base course shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent for the fraction retained on the 9.5 mm sieve, when tested as per ASTM D4791. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 85 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with ASTM D 5821.

#### Fine Aggregate Requirements

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

Provide fine aggregate consisting of angular particles produced by crushing stone. Fine aggregate shall be produced by crushing only particles larger than 4.75 mm sieve in size. Fine aggregate shall be manufactured from gravel particles 90 percent of which by weight are retained on the 12.5 mm sieve.

Grading Requirements for Crushed Aggregate Surface Course Material

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)
	Grading Designation
1 inch (25 mm)	100
½ inch (12.5 mm)	70 - 80
No. 4 (4.75 mm)	40 - 50
No. 10 (2.0 mm)	25 - 40
No. 40 (425 µm)	15 - 25
No. 200 (75 µm)	8 - 14 Or as directed by the Engineer considering the project site requirements and needs

If other types of grading curve is proposed for the crushed aggregate surface course by the Design Drawings such, the contractor is required to produce such a material considering the requirements of international codes and standards (AASHTO, FP-14, etc.) approved by the Engineer.

### **Strength of Crushed Aggregate Surface Course**

The material shall meet the mechanical (CBR) and physical (Gradation) properties. It shall be ensured prior to actual execution that the material to be used in the surface course satisfies the requirements of CBR and other physical requirements when compacted and finished. The CBR of crushed aggregate surface course shall not be less than 65% when tested in accordance with ASTM D 1883 or AASHTO T 193 after 96hrs soaking.

### **Compaction Requirements**

The crushed aggregate surface course shall be compacted at least to 97% maximum dry density for major streets and 95% for minor streets where heavy machinery cannot operate easily when tested in accordance with the AASHTO T 180 or ASTM D 1557, Method D.

### **7303 CONSTRUCTION**

Screening and mixing of materials to achieve the specified grading shall be done in a stacking yard. The mixing may be done by mechanical means or by manual labour if approved by the Engineer. The materials shall be mixed thoroughly and uniformly to have a homogenous mass or as directed by the design drawings. During mixing, water shall be added to keep the mixed materials moist so as to prevent segregation.

The crushed aggregate surface course material shall be placed, spread, watered, graded and compacted in order to achieve the specified requirements and surface tolerances. As the subprojects consist of labour intensive works, the spreading and placing of material shall be done by the labourers and or as directed by the Engineer. The watering, grading and compaction processes shall be carried out by suitable and required machineries in the field. In areas where the machineries can't operate (especially in sidewalks and narrow streets), the watering, grading and compaction processes shall be carried out by labourers with usage of water sprinkling tools, handing tempers, manual operated roller and other equipment and tools recommended by the Engineer.

The surface course shall be spread in a single layer to give a compacted thickness of 100mm to 150mm or as directed by design drawings. The relationship between the loose thickness and compacted thickness shall be determined from field trials and used in controlling the loose thickness at the time of spreading the mixed materials (if required).

Water shall be added as necessary during spreading so that at the time of compaction the moisture content is within  $\pm 4\%$  of the OMC.

The compacted surface shall be checked for levels and cross-falls and any irregularities shall be corrected by loosening the affected areas, adding or removing the necessary quantities of mixed material and re-compacting until the entire surface conforms to the correct levels and cross falls. The material shall be compacted to a density of not less than 97% of the laboratory MDD.

The finished surface shall be within  $\pm 20\text{mm}$  of the elevation shown in the drawings or as directed by the Engineer.

### **7304 INSPECTION AND TESTING**

Routine inspection and testing will be carried out by the contractor to test the quality of materials and workmanship for compliance with the requirements of this section. The density, CBR, grading

and other requirements specified in Clause 7302 shall be tested in the project site.

Perform testing by a third party professional commercial testing laboratory. The following number of tests, if performed at the appropriate time, will be the minimum acceptable criteria for each type operation.

**Tests required for material source selection**

- Gradation: one test per type and source of material.
- Optimum Moisture and Laboratory Maximum Dry Density: one test per type and source of material.
- California Bearing Ratio (CBR): one test per type and source of material.
- Los Angeles Abrasion: one test per type and source of material.
- Flat and Elongated Particles: one test per type and source of material.
- Fracture Faces: one test per type and source of material.

Note: the above mentioned test’s results shall be attached with a summary and brief report to enhance whether the material production plant or barrow area’s satisfied the requirements of crushed aggregate base course materials or not. The report shall be submitted to the Engineer at least 7 days in advance for the acceptance of material source. If the project engineer cannot satisfy the above mentioned testing frequency, he can increase the frequency or add any other test as per site or his satisfaction requirements.

**On-site Testing Required for QA/QC Purpose**

In-place or Field Density Test (FDT), test location is specifying by the Engineer based on the random selection procedure:

- One test for each 400m2 of each lift of the base course.
- One test for each 50 LM of each lift of the side drainage base course.
- One test for each 30 LM of each lift of the culvert base course.
- One test for each 50 LM of each lift of shoulders/sidewalk base course.

Optimum Moisture and Laboratory Maximum Dry Density: one test per material type but not less than one per 1000 LM each lift of road/street.

Note: If the project engineer cannot satisfy the above mentioned testing frequency, he can increase the frequency or add any other test as per site or his satisfaction requirements.

Any materials or workmanship that do not comply with the specified requirements shall be removed and replaced with materials and workmanship complying with the specified requirements, or if the Engineer permits, be repaired so that after being repaired it will comply with the specified requirements.

**7305 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
7305.01 Crushed aggregate surface course	m3

The unit of measurement shall be the cubic metre of material, measured in the final position after compaction to the specified density and other quality testing and the quantity shall be calculated as the product of the nominal depth, the required surface plan width and the required length measured horizontally along the centre line. No additional payment will be made for alternative types of construction proposed and/or adopted by the contractor.

The tendered rate shall include full compensation for procuring, including royalties, furnishing, crushing, placing all materials, including transporting and the removal of all oversize material and for control, testing, protecting and maintaining the work specified in this section, except the skilled and unskilled labour's wages.

## **SECTION 7400: DRESSED STONE PAVEMENT**

### **CONTENTS**

- 7401 SCOPE AND GENERAL REQUIREMENTS
- 7402 MATERIALS
- 7403 CONSTRUCTION
- 7404 PLACING AND PACKING STONES
- 7405 JOINT FILLING
- 7406 MEASUREMENT AND PAYMENT

#### **7401 SCOPE AND GENERAL REQUIREMENTS**

This work shall consist of the supply, shaping, packing and compaction of a pavement course composed of dressed stone blocks packed on a prepared base or subbase to the lines, levels, dimensions and cross-falls shown on the drawings or as directed by the Engineer.

## 7402 MATERIALS

*Dressed Stone Blocks* : The stone blocks shall be hand broken blocks. The stone to be used for the pavement must be clean, hard, durable, solid and free from soft material or loose pieces. Cracked and hollow stones must not be used. Stones should be cubic or rectangular in shape. The stone should not be able to be cracked under the impact of compaction equipment. Round shape stone or river stones are not recommended for this purpose. The faces of the blocks shall form 90 degree angles with one face being relatively level to provide a good riding surface. The size of the stones may vary depending on the functions of the stones or as otherwise specified in the drawings. Recommended size and shape of the stones to use for the stone surface are:

- Stone for the surface should be 10cm thick and 10 cm x 15 cm width and length. Stones should be cubic or rectangular shaped. Stone from a quarry should be dressed or shaped to the required shape when delivered to site.
- Stones for edge kerbs (if recommended by design drawings) should ideally be 20 cm x 30 cm with the smallest acceptable size 15 cm x 25 cm. The kerbstones should be cubic or rectangular shaped. Kerbstones from a quarry should be dressed to shape when delivered. The kerb stone is crucial for holding the other stones in place.
- Small stones for filling the gaps should be 2 cm x 3 cm and 3 cm x 5 cm or as required in the project site.

*Blinding materials*: Screening material to fill voids shall consist of coarse sand produced from the crushing of rocks or gravel in the crush-plant. The sand must be clean, free of leaves, grass, compost, clay lumps, or dust etc. The sand fraction passing 75 micron sieve does not exceed 5% or as directed by the Engineer considering the project site requirements and needs.

*Crushed Aggregate Base Course*: This work shall comply with the requirements of Section 7200 of this specification if proposed in design drawings.

*Subbase Course*: This work shall comply with the requirements of Section 7100 of specification if proposed in design drawings.

*Subgrade material*: Subgrade material shall comply with the requirements of Section 4303 of this specification.

## 7403 CONSTRUCTION

### **Subgrade:**

This work shall comply with the requirements of Series 4000 of specification.

### **Subbase:**

This work shall comply with the requirements of Section 7100 of specification.

### **Crushed Aggregate Base Course:**

This work shall comply with the requirements of Section 7200 of specification.

**Dressed Stone Pavement:**

The dressed stone pavement shall be constructed considering the following steps:

**Step 1:**

**Setting Out:** Before installation of dressed stone, ensure that the road-base (crushed aggregate base course or subbase course as directed by the design drawings) is well compacted, clean, free from soft material and approved by the Engineer. Meanwhile, it shall also be assured that the road-base surface is constructed based on the elevation given in the design drawings or as instructed by the Engineer. The edgeline of pavement and or side drain shall be layouted based on the design and site requirements with the approval of the Engineer.

Setout the road/street cross section by setting centre line pegs and pegs at the edge of the pavement. The cross section should be set for every 5 m interval. Mark the finished level of the stone surface at the centre line and transfer with the design cross-fall to edge pegs. The cross-fall from the centre line to the edge pegs should be 3-4% or as directed by the design drawings.

Excavate foundation for Kerbstones (dressed stone kerb). If recommended by design drawings, the foundation should be excavated along all road/street edges. The width of the foundation should be 25-30 cm and depth should be 15-20 cm. Bed level of the foundation of both edges should be checked using a level to ensure they are at the same level. Position Kerbstones in the excavated foundation in vertical position by keeping the top level of the stone as set in the peg. The kerbstones should then be placed as tightly as possible. Backfill the kerb stones with gravel and provide compaction by hand rammer. Repeat the same process of placing kerbstones along the other edge of the road.

**Step 2:**

**Placing Blinding Course:** Place and spread the blinding course layer of coarse sand of 5 cm thickness or as directed by design drawings by labores through hand operated equipment/tools such as wheelbarrow. The sand shall be placed in uniform thickness.

**Step 3:**

**Placing of Dressed Stones:** Ensure the string line is tightened at the marked levels and connected from edge pegs to centre line pegs. Place the stones on the spread sand as close together as possible but considering the joint spacing requirements (5-15mm). Where some stones are slightly wedge-shape it is necessary to place the wider end down onto the sand layer. The stones should be placed starting from the outside edge and then working towards the centre line of the road. Ensure the top level of the stones is at the level set by the string line. Where-ever the top level of the stone is higher than the set string line; such stones should be hammered down into the sand to level. After the large stones are placed it is important to use small stones to tighten the larger stones by inserting the small stones into gaps between the large stones. The laying of the stone surface requires skilled labour to achieve good workmanship.

**Step 4:**

To avoid movement of the stone, a thin layer of coarse sand is spread over the stone surface and washed into the voids by water if required or as directed by the Engineer.

In order to make the stone surface water-tight and to provide a smoother surface for vehicles, the

stone paving should then be covered by a thin layer of coarse sand as required for filling of stone gaps and providing smooth rideability services. This coarse sand should contain a small portion of clay if required or as directed by the Engineer. The sand is spread on the stone surface. Some portions of the coarse sand will then be filled in the stones gaps to further strengthen the stability of the stones and other portions of sand will remain on the surface.

After spreading the selected course sand, final compaction will be carried out, by required passes using a required weight of roller. The compaction will level the height of the stones providing a smoother surface on the carriageway. The compaction should be carried out from the road/street edge towards the centre-line.

#### **7404 QUALITY CONTROL**

The construction of a dressed stone pavement includes the selection and testing of materials, preparation of base layers, preparation and placement of dressed stone, joint filling, compaction, etc. Quality control and tests for these works include checking the suitability of the materials and properly conducting installation and construction procedures. Some of the tests can be carried out in the field but certain tests should be carried out in a third party laboratory.

##### **Material Stone Surface:**

Aggregate, sand, and water: All materials used shall be in accordance with the relevant sections of specification. Visual inspections shall be conducted on site for all materials being used in the project site.

Dressed Stones: The hardness, strength and durability requirements of dressed stones are similar to stones applicable for stone masonry works. The shape of stone shall be as much as cubical in shape. Regularly check the size of stone visually to see if it is in compliance with the specified size and shape.

##### **Construction of Stone Surface:**

Base Layer: Visually check that the road-base (crushed aggregate base course or subbase course as directed by the design drawings) layer is compacted, cleaned and levelled. Also check the width, length, thickness, levels and camber.

Blinding Course: Assure that the course sand has the specification requirements and uniformly placed on the prepared base.

Dressed Stone: Check the followings in the site:

- Visually check base layer is compacted, cleaned and levelled as directed by design drawings and specification.
- Take the required number of field tests (field density tests) as directed by specification.
- Check thickness of sand bedding and uniformity of spread.
- Check the stones are shaped (slightly dressed) for cubic or rectangular shape and size.
- Check stones are placed as close to each other as possible considering the joints spacing.
- Check gaps are filled by smaller stones as required.
- Check top levels are on an even plane.
- Check all the gaps between the stones are fully filled with coarse sand considering the specified requirements.
- Check the compaction process is carried out properly.
- Assure required number of laboratory testing is carried out.

Final check for finishing work: Check the followings in the site:

- Check all remaining materials have been cleared from site;
- Check on overall appearance is good;
- Check that all holes or side borrow are filled and level;
- Check that shoulder works and slope protection works have been satisfactorily completed.

#### **7405 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
7405.01 Dressed Stone Pavement	m2
7405.02 Bedding Material	m3

This work shall be measured as the area in Square metres of Dressed Stone pavement compacted and accepted. Area shall be computed from field measurement of the width of the pavement at its top surface and the nominal depth as shown in the Drawing or as ordered by the Engineer.

The tendered rate shall include full compensation for procuring, including royalties, furnishing, crushing, placing all materials, including transporting, quality control, testing, protecting and maintaining the work specified in this section, except the skilled and unskilled labour's wages.

### **SECTION 7500: INTERLOCKING PRECAST CONCRETE BLOCK PAVING**

#### **CONTENTS**

- 7501 SCOPE
- 7502 MATERIALS
- 7503 CONSTRUCTION
- 7504 PLACING BLOCKS
- 7505 JOINT FILLING
- 7506 MEASUREMENT AND PAYMENT

### **7501 – SCOPE AND GENERAL REQUIREMENTS**

This work shall consist of the supply, shaping, packing and compaction of a pavement course composed of interlocking precast concrete blocks packed on a prepared base or subbase to the lines, levels, dimensions and cross-falls shown on the design drawings or as directed by the Engineer.

## **7502 MATERIALS**

*Interlocking Precast Concrete Blocks* : The interlocking blocks will be precast shaped with 60mm thick unless otherwise shown on the design drawings.

The interlocking precast concrete blocks shall comply with the following requirements:

- Compressive strength of the interlocking paving sample units shall not be less than 40MPa, with no individual unit less than 35MPa, when tested as per ASTM C140, at least three full size samples shall be tested for determining the compressive strength of the interlocking units.
- Maximum aggregate size for concrete mix 9.5mm
- The size of the blocks shall be according to the design drawings with the tolerances of  $\pm 3$  mm
- The colour and shape of blocks shall be identified by the Engineer based on the project's site needs and requirements.
- Interlocking blocks shall be free from scratch, crack, deformation, and other defects.

*Bedding Sand*: The bedding sand shall be concrete sand, which shall be clean, dry and of moisture content approximately 4 - 8%. The sand must be clean, free of leaves, grass, compost, clay lumps, or dust etc.

*Filler Sand*: Filler sand shall be finer than 1.18 mm and shall contain approximately 10% silt material. The sand must be clean, free of leaves, grass, compost, clay lumps, or dust etc. The filler sand shall be dry enough to fill the joints properly.

*Crushed Aggregate Base Course*: This work shall comply with the requirements of Section 7200 of this specification if proposed in design drawings.

*Subbase Course*: This work shall comply with the requirements of Section 7100 of specification if proposed in design drawings.

*Subgrade material*: Subgrade material shall comply with the requirements of Section 4303 of this specification.

## **7503 CONSTRUCTION**

### **Subgrade:**

This work shall comply with the requirements of Series 4000 of specification.

### **Subbase:**

This work shall comply with the requirements of Section 7100 of specification.

**Crushed Aggregate Base Course:**

This work shall comply with the requirements of Section 7200 of specification.

**Interlocking Precast Concrete Pavement:**

The dressed stone pavement shall be constructed considering the following steps:

**Step 1:**

Setting Out: Before installation of paving blocks, ensure that the road-base (crushed aggregate base course or subbase course as directed by the design drawings) is well compacted, clean, free from soft material and approved by the Engineer. Meanwhile, it shall also be assured that the road-base surface is constructed based on the elevation given in the design drawings or as instructed by the Engineer. The edgeline of pavement and or side drain shall be layouted based on the design and site requirements with the approval of the Engineer.

**Step 2:**

Placing Blinding Sand: Place and spread the bedding sand of 5 cm thickness or as directed by design drawings by labores through hand operated equipment/tools such as wheelbarrow. The sand shall be placed in uniform thickness.

**Step 3:**

Placing and packing of interlocking precast concrete blocks: Before placing the blocks, string lines shall be placed using metal pegs made of reinforced steel. The peg interval shall be 5 metres or as directed by the Engineer. Lines shall be placed longitudinally and along the cross section of the pavement to indicate the desired camber. If kerbstones or side drains are included in the design, they should be laid first. Concrete paving blocks shall be placed from the edges of the area working in an uphill direction. Blocks should be laid so that each block settled on the sand cushion without any support from the blocks nearby and with an average space of 3-5mm between each block.

**Step 4:**

The voids between the blocks shall then be filled with filler sand packed in with proper tools. A regular top surface should be achieved during the laying operation. It shall be assured that the filler sand is dry enough to properly fill the spaces between blocks.

**Step 5:**

Compaction should be carried out to level the height of the concrete blocks, providing a smooth and regular final surface with the usage of suitable size of roller or as directed by the Engineer considering the site requirements.

**7504 QUALITY CONTROL**

The construction of an interlocking precast concrete pavement includes the selection and testing of materials, preparation of base layers, preparation and placement of interlocking pavers, joint filling, compaction, etc. Quality control and tests for these works include checking the suitability of the materials and properly conducting installation and construction procedures. Some of the tests can be carried out in the field but certain tests should be carried out in a third party laboratory.

**Material Stone Surface:**

Aggregate and sand: All materials used shall be in accordance with the relevant sections of specification. Visual inspections and laboratory testing shall be conducted on site for all materials being used in the project site.

Interlocking Precast Pavement Blocks: The interlocking precast concrete blocks shall be produced considering the requirements presented in the design drawing and specification. Regularly check the size of blocks visually to see if it is in compliance with the specified size and shape.

**Construction of Interlocking Precast Concrete Pavement:**

Base Layer: Visually check that the road-base (crushed aggregate base course or subbase course as directed by the design drawings) layer is compacted, cleaned and levelled. Also check the width, length, thickness, levels and camber.

Bedding Sand: Assure that the bedding sand has the specification requirements and uniformly placed on the prepared base.

Filler Sand: Assure that the filler sand has the specification requirements.

Interlocking Precast Concrete Blocks: Check the followings in the site:

- Visually check base layer is compacted, cleaned and levelled as directed by design drawings and specification.
- Take the required number of field tests (field density tests) as directed by specification.
- Check thickness of bedding sand and uniformity of spread.
- Check the size and shape of interlocking blocks.
- Conduct required compressive strength (3 tests per 3000 blocks) as per ASTM C140, at the laboratory on the samples taken from the site.
- Check blocks are placed with the requirements of joint spacing.
- Check top levels are on an even plane.
- Check all joints are fully filled with fillers sand considering the specified requirements.
- Check the compaction process is carried out properly (if required or recommended by the Engineer).
- Ensure the remaining laboratory testing is carried out if any.

Final check for finishing work: Check the followings in the site:

- Check all remaining materials have been cleared from site;
- Check on overall appearance is good;
- Check that all holes or side borrow are filled and level;
- Check that shoulder works and slope protection works have been satisfactorily completed if they exist in the project site.

**7505 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
7505.01 Interlocking Precast Concrete Block including filler sand	m2
7505.02 Bedding Sand	m3

This work shall be measured as the area in Square metres of interlocking precast concrete blocks

compacted and accepted. Area shall be computed from field measurement of the width of the top surface of the finished pavement and the nominal depth as shown in the Drawing or as ordered by the UNOPS Engineer.

The work as measured shall be paid for at the Contract unit price shown in the Bill of Quantities. The tendered rate shall include full compensation for procuring, including royalties, furnishing, crushing, placing all materials, including transporting, quality control, testing, protecting and maintaining the work specified in this section, except the skilled and unskilled labour's wages.

## **SECTION 7600: NATURAL STONE TILES PAVEMENT**

### **CONTENTS**

- 7601 SCOPE AND GENERAL REQUIREMENTS
- 7602 MATERIALS
- 7603 CONSTRUCTION

7604 PLACING AND PACKING STONE TILES

7605 MEASUREMENT AND PAYMENT

### **7601 SCOPE AND GENERAL REQUIREMENTS**

This work shall consist of the supply, shaping, packing and compaction of a pavement course composed of natural stone tiles packed on a prepared road-base layer (crushed aggregate base course or subbase course as directed by the design drawings) to the lines, levels, dimensions and cross-falls shown on the drawings or as directed by the Engineer. The natural stone tiles shall be properly bounded by cement/sand mortar from the bottom and sides to provide a tight and flat surface for walking and riding.

### **7602 MATERIALS**

*National Stone Tiles:* The stone tiles shall be hand broken and dressed from stone of good and sound

quality, uniform in texture, free from defects, hard, durable and flat in shape to serve as ideal material for stone surface sidewalk pavement and approved by the Engineer. Cracked and hollow stones should not be used. The tiles shall also be free from vegetation, soft particles and excess clay or any other substance, which is considered deleterious. The faces of the tiles shall form 90 degree angles with one face being relatively level to provide a good walking and riding surface. The thickness of the natural stone tile shall not be less than 40 mm. The size of the tiles shall be according to the design drawings or as instructed by the Engineer. The colour of the stone tiles shall be identified by the Engineer in advance before starting of physical works at site.

*Crushed Aggregate Base Course:* This work shall comply with the requirements of Section 7200 of this specification if proposed in design drawings.

*Subbase Course:* This work shall comply with the requirements of Section 7100 of specification if proposed in design drawings.

*Cement:* Cement specification shall comply with the requirements of Section 5201 of specification.

*Sub grade material:* Sub grade material shall comply with the requirements of Section 4303 of this specification.

## **7603 CONSTRUCTION**

### **Subgrade:**

This work shall comply with the requirements of Series 4000 of specification.

### **Subbase:**

This work shall comply with the requirements of Section 7100 of specification.

### **Crushed Aggregate Base Course:**

This work shall comply with the requirements of Section 7200 of specification.

### **Filter Drains:**

The drains, if proposed in the Design Drawings shall be continuous, rectangular and 200mm deep on both sides of the road/street's cross section under the side edges of the subgrade and the shoulders. The drain shall be between 1 and 1.5m long depending on the width of the shoulders and the drain's longitudinal slope, which shall vary between 2-5%.

The drain shall be excavated to a suitable depth (200-300mm) under the subgrade, reaching the side of the embankment or defined discharge point. Dry compaction by hand rammer shall be carried out. The drain shall be watered and compacted again.

The box shall then be filled with a 100mm layer of broken stone and sand (1:1) to reach the level of the subgrade according to drawings. Watering and hand compaction shall be carried out to assure a dense mixture of stones and sand.

### **Cross Drains:**

See Filter Drain above.

### **Placing and Packing Stone Tiles:**

Before placing the stones, string lines shall be placed using metal pegs made of reinforced steel. The peg interval shall be 5 metres and or as directed by the Engineer. Lines shall be placed longitudinally

and along the cross section of the pavement to indicate the desired camber.

Before placing the stone tiles, the landscaping and colour of tiles shall be specified by the contractor and approved by the Engineer considering the project site requirements and needs.

The curbstones and or side drains walls shall be constructed first. In case of concrete works, the concrete shall be cured for the required number of days to achieve the required strength as specified by the Engineer. Before placing stone tiles, the benet surface and edge walls shall be properly watered. Stone tiles shall be placed from the edges of the pavement to the centreline on the 1:3 ratio cement/sand mortar with a minimum thickness of 30mm or as directed by the design drawings. Stone tiles should be laid so that each tile settled on the cement/sand mortar without any support from the tiles nearby and with an average space of 20-50mm between tiles or as directed by the Engineer. The stone tiles shall be levelled by the using of cement/sand mortar at the bottom. The voids between the stone tiles shall then be filled with cement/sand mortar with a ratio of 1:3 to provide a flash pointed surface. A regular top surface should be achieved during the laying operation. A camber board shall be used longitudinally and across the section to assure an even surface.

**Protection of Site and Curing (Watering):**

The constructed portion of the pavement shall be protected for a 7 to 14 days or as directed by the Engineer from walking and riding. The constructed portion of pavement shall also be cured (watered) properly for a 7 to 14 days or as directed by the Engineer.

**7604 QUALITY CONTROL**

The Engineer shall exercise assure and control over quality of the materials incorporated and works performed through quality control tests and visual inspection carried out to the frequencies indicated in relevant sections. The frequencies are the minimum, and the Engineer shall have the authority to have these tests at more frequent intervals where quality of a material or work is in doubt.

**Material Natural Stone Tiles:**

Aggregate, sand, cement and water: All materials used shall be in accordance with the relevant sections of specification. Visual inspections shall be conducted on site for all materials being used in the project site.

Stone Tiles: The hardness, strength and durability requirements of stone tiles are similar to stones applicable for stone masonry works. The shape of stone tile shall be in flaky irregular shape with a minimum thickness of 40mm. Regularly check the size of stone visually to see if it is in compliance with the specified size and shape.

**Construction of Natural Stone Tile:**

Edge support (curbstones or side drains): Visually check that the edge supports are constructed within a proper level, alignment and size as directed by the design drawings or Engineer.

Cement Mortar for bedding: Check the procedure of mixing and pouring of cement/sand mortar on a prepared base. Before pouring the mortar, the base surface shall be properly watered. Check the proportion of cement and sand as directed by the design drawings and other relevant sections of specification.

Placing stone, mixing and pouring mortar: Check the followings in the site:

- Take the required number of field tests (field density tests) as directed by specification.
- Placing procedure of stone tiles;
- Check gap between each stone is between 20 - 50mm;
- Check no stones are placed overlapping each other;
- Check top level of the stone tiles are not higher than level of edge supports;
- Check mix and placement of the mortar is according to the requirements of specification;
- Check the mortar fills all gaps (voids) between the stone tiles;
- Check the thickness of the stone tile pavement (stone tile + bedding mortar) as directed by design drawings;
- Check surface levels are as specified or as directed by the Engineer considering the site requirements and needs;
- Check a clean and smooth flash pointing with 1:3 cement/sand is formed on the top surface of pavement.

Curing: Check finished stone tile surface is being kept wet or damp for a duration of 7 - 14 days as well as properly protected from walkways and ridings.

Final check for finishing work: Check the followings in the site:

- Check all remaining materials have been cleared from site;

## **7605 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
7605.01 Natural Stone Tiles	m <sup>2</sup>

This work shall be measured in square metres of pavement as accepted. Area shall be computed from field measurement of the width and length of the pavement as shown in the Drawing. Payment shall be full compensation for performing the work including supplying all materials, tools, equipment, forming, construction, finishing, curing, testing, and incidentals necessary. The work as measured shall be paid for at the Contract unit price shown in the Bill of Quantities, except the skilled and unskilled labour's wages.

## **SECTION 7700: PLUM CONCRETE PAVEMENT**

### **CONTENTS**

7701	SCOPE AND GENERAL REQUIREMENTS
7702	MATERIALS
7703	CONSTRUCTION
7704	QUALITY CONTROL
7705	MEASUREMENT AND PAYMENT

## **7701 SCOPE AND GENERAL REQUIREMENTS**

This work shall include preparing the road-base layer (crushed aggregate base course or subbase course as directed by design drawings), mixing of plum concrete, hauling and placing the concrete on a prepared base (or sub-base), supply of materials, shaping, jointing, joint sealing, etc. on a prepared subgrade to the lines, levels, dimensions and cross-falls shown on the drawings or as directed by the Engineer.

## **7702 MATERIALS**

*Concrete:* This concrete consists of cement, aggregate and water, mixed to the proportions or specified strength as recommended by design drawings for both the Lean-mix bedding and the pavement concrete which is placed over large stones (plum) as the main concrete activity. The

concrete specification shall comply with the requirements of Series 5000 of this specification.

*Crushed Aggregate Base Course:* This work shall comply with the requirements of Section 7200 of this specification if proposed in design drawings.

*Subbase Course:* This work shall comply with the requirements of Section 7100 of specification if proposed in design drawings.

*Cement:* Cement specification shall comply with the requirements of Section 5201 of specification.

*Plum (Large Stones):* The large stones to be used for plum concrete work must be clean, hard, durable, solid and free from soft material or loose pieces. Cracked and hollow stones should not be used. Stones can be chosen round or cubic shaped. The stone should not be able to be cracked under impact or compaction equipment or crack when dropped three times onto a hard rock surface from shoulder height. The size of the stone shall be used as specified on the drawings otherwise the maximum dimension (length) of the stone shall not be greater than 15 cm or thickness of designed slab, whichever is less, the breadth of the stone shall be the same as the thickness of the stone, and as shown on the drawings.

*Sub grade material:* Sub grade material shall comply with the requirements of Section 4303 of this specification.

*Lean Concrete Material:* The lean concrete material used for the plum concrete shall comply with the requirements of Section 5200 of specification.

*Joints Sealing Material:* The fine sand and 60/70 paving grade bitumen mix shall be used for the sealant of all construction and expansion joints forming in the in plum concrete pavement. The mix shall consist of 50-70% (by weight) 60/70 paving grade bitumen and 30-50% (by weight) fine sand.

## **7703 CONSTRUCTION**

### **Subgrade:**

This work shall comply with the requirements of Series 4000 of specification.

### **Subbase:**

This work shall comply with the requirements of Section 7100 of specification.

### **Crushed Aggregate Base Course:**

This work shall comply with the requirements of Section 7200 of specification.

### **Plum Concrete:**

The plum concrete surface should be constructed in blocks of maximum 5 metres in length and the width should be half of the road width (when the pavement width is 5 or more than 5 metres). As the concrete work is poured in-situ on the work site, it is important to keep traffic open during the construction period. Therefore the concrete work should normally be done for half of the width of the road and with the other side open for traffic. The steps for the construction of each section should be carried out as follows.

### **Step 1:**

Setting out and placement of formwork (edge supports): Before placing formwork ensure that the road-base (crushed aggregate base course or subbase course as directed by the design drawings) is well compacted, clean, free from soft material and approved by the Engineer. Meanwhile, it shall also be assured that the road-base surface is constructed based on the elevation given in the design drawings or as instructed by the Engineer. Cleaning the road-base will require the use of a broom. The edgeline of pavement and or side drain shall be layouted based on the design and site requirements with the approval of the Engineer.

The formwork should be fixed in place for half the width of the road (or as directed by the engineer) and set to the designed height stated in design drawings. The level of the formwork at the centre line must be higher than the edge support placed at the shoulder with 2% of cross fall or as directed by design drawings. The Line level should be used to transfer levels from the top of the formwork at the road centre line to the edge of the road.

For providing or furnishing the construction joint, a smooth wooden plate (8mm thick plywood board) or styrofoam sheet with 10-20 mm thickness will be used during the construction of pavement slabs.

The size of each section (box) should therefore be: width = half width of the road (if pavement width is 5m or more than 5m), and for the Length one of the two following condition has to be followed, as directed by the UNOPS Engineer:

- 1 - Expansion joints have to be provided at each 16m length with a width of 20mm, with contraction joints at each 4m interval with a minimum joint width of 5mm.
- 2 - If no contraction joints are to be provided, then expansion joints at each 5m interval the width of the construction joint shall be 10mm.

The formwork, once removed will provide a joint gap in between the boxes with usage of wooden plate or styrofoam sheet (or as approved by the Engineer) which will serve as an expansion joint which will need sealing with an Engineered approved flexible filler such as sand/bitumen mixture (50-70% by weight 60/70 grade bitumen and 30-50% by weight fine sand).

### **Step 2:**

Mixing lean concrete and placing plums on: This is done on the prepared road-base (crushed aggregate base course or subbase course as directed by the design drawings) inside the form work. Mixing lean concrete should follow the mixing procedure stated in Section 5704 of specification. The lean concrete should be mixed by a mobile concrete mixer with mixing proportion as specified in the drawing or concrete mix design. The required number of specimens shall be taken from the fresh mixed concrete complying Section 5600 of specification.

Pour the lean concrete to the specified thickness as shown in the drawing (generally the thickness of the lean concrete is 50mm). The large stones (plums) shall then be laid on the lean concrete while the lean-mix is still within the initial setting time (means as soon as possible to make a monolithic structure). But, the concrete should then be sufficiently stiff to prevent complete submergence or toppling over of the stones. The bottom part of the stones (about 1/3 of stone thickness) should be embedded in the concrete to remove the air void below the plums and the remaining part exposed so as to form a key with the next layer of concrete. The large stones (plums) should be placed with gaps between them of no less than 50 mm.

### **Step 3:**

Final concrete layer: Once the large stones (plums) are placed, concrete for the last layer shall be

mixed and placed following normal practice with the mixing proportion as specified in the drawings or concrete mix design. The final layer concrete shall be placed while the lean-mix (lower layer) is still within the initial setting time (means as soon as possible to make a monolithic structure).

The concrete should be poured between the formwork and around the large stones ensuring a minimum of 3 cm cover and over the top of the stones ensuring a minimum of 5 cm cover and then tamped and compacted until all air is removed. Normally the total volume of plums should not exceed the volume stated in the design drawings by considering the size and spacing of plums. Note: the Step 1, Step 2 and Step 3 should be conducted while the concretes of below and top layers are in its initial stage to make a monolithic pavement structure.

#### **Step 4**

**Concrete finishing:** The finishing of the concrete shall involve screeding with an aluminium screed board and the floating of the surface to achieve the specified surface profile or as directed by the Engineer. Prior to the concrete "going-off" the surface must be made safe for future traffic through either the grooving of the surface or the application of a hard broom strokes making 1 to 2 mm ridges in the concrete surface which should be align transversely and in parallel in a distinctive pattern according to the directions of the Engineer.

#### **Step 5**

**Curing:** The concrete formwork (edge supports) can be removed after 48 hrs and or as directed by the Engineer. The concrete should be cured for a duration of 7 to 14 days as per site requirements. The curing shall commence 3-4 hours after the placing of the concrete or as directed by the Engineer. The curing process is most critical during the initial days after pouring and it is necessary to keep the concrete surfaces continuously wet during the curing period.

Curing can be achieved by:

- Sprinkling water on the concrete surface, taking care to keep a permanent wet surface.
- Covering the concrete surface with either empty cement bags, or sand or sawdust (minimum 5cm layer), wet jute, hessian mats or banana leaves. These covers must also be kept continuously wet,
- Making a pond of water on the concrete if this is practical.

Once the first half of the plum concrete surface curing has achieved the minimum required strength, it can be opened for traffic while the second half of the road can then be constructed following the steps as described for construction of the first half of the road.

#### **Step 6**

**Joint Sealing:** Before joints sealing, the joints shall be properly cleaned and make them empty from extra or hazardous materials. In the case of a styrofoam sheet usage, the sheet shall be removed to the minimum depth of  $\frac{1}{3}$  to  $\frac{1}{4}$  of pavement thickness and refilled with joint sealing material. The formed joints between the concrete slabs (boxes) shall be property filled with sand/bitumen mixture complying with the requirements of the Joints Sealing Material stated in Section 7402 of specification. The sealing material shall not exceed the joints top surface (preferably 5 mm below the top surface).

### **7704 QUALITY CONTROL**

The construction of Plum concrete surface activity includes the selection and the testing of materials, mixing, placing, curing of the concrete, finishing and joints sealing. Quality control and testing for these works includes checking the suitability of the material. Some tests can be carried

out in the field but some tests can only be carried out in a laboratory and as specified.

### **Material Plum Concrete:**

Aggregate, sand, cement and water: All materials used shall be in accordance with the sections of specification. Visual inspections shall be conducted on site for all materials being used in the project site.

Stones (Plums): The hardness, strength and durability requirements of plums are similar to stones applicable for stone masonry works. The shape of stone (plum) shall be as much as cubical or rounded in shape to minimise the air void and increase the pavement slab strength. Regularly check the size of stone visually to see if it is in compliance with the specified size and shape.

### **Construction of Plum Concrete:**

Placing formwork/edge support: Visually check that the road-base (crushed aggregate base course or subbase course as directed by the design drawings) layer is compacted, cleaned and levelled. Also check the width, length, thickness, levels and camber of the slab sections (boxes).

Lean Concrete for bedding: Check the procedure of mixture and pouring of concrete as stated in Series 5000 of specification. Before pouring of lean concrete, the road-base surface shall be properly watered. Also check the slump of the lean concrete as directed by design drawings. The required number of specimens shall be taken from the fresh mixed concrete complying Section 5600 of specification or as directed by design drawings.

Placing stone, mixing and pouring concrete: Check the followings in the site:

- Take the required number of field tests (field density tests) as directed by specification.
- Placing procedure of large stones (Plums);
- Check gap between each stone is not less than 50mm;
- Check no stones are placed overlapping each other;
- Check top level of the large stones are not higher than level of edge support Concrete work;
- Prepare concrete specimens for strength testing of concrete in the laboratory complying Section 5600 of specification or as directed by design drawings;
- Check mix and placement of the concrete is according to the requirements of specification;
- Check the duration for concrete pouring is complying with section 5700 specification or as directed by the design drawings or Engineer;
- Check the concrete fills all gaps (voids) of the large stones and is well compacted by vibratory tools/equipment considering the Engineer direction;
- Check the thickness of the concrete slabs as directed by design drawings;
- Check surface levels are as specified or as directed by the Engineer considering the site requirements and needs;
- Check surface has been grooved or hard broom brushed for roughness;
- Check the joints are properly sealed as presented in Step 6 of Section 7403 of specification.

Curing: Check finished concrete is being kept wet or damp using one of the recommended or specified methods for curing as stated in Step 5 of Section 7403 of specification.

Final check for finishing work: Check the followings in the site:

- Check all remaining materials have been cleared from site;
- Check formwork is removed after minimum of 14 days and taken away from site;
- Ensure joint sealing is completed as specified;
- Check that shoulder works and slope protection works have been satisfactorily completed.

## **7705 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
7705.01 Plum Concrete	m3

This work shall be measured in cubic metres of road pavement as accepted. Area shall be computed from field measurement of the width and length of the pavement and then multiply by the depth as shown in the Drawing. Payment shall be full compensation for performing the work including supplying all materials, tools, equipment, forming, construction, finishing, curing, joint sealing, material testing, and incidentals necessary. The work as measured shall be paid for at the Contract unit price shown in the Bill of Quantities, except the skilled and unskilled labour's wages.

## **SERIES 8000: ANCILLARY WORKS**

### **CONTENTS**

- 8100 PITCHING AND STONWORK
- 8200 BRICKWORK
- 8300 GABIONS

8400 TREE PLANTING

8500 SNOW CLEARING / LITTER PICKING etc

## **SECTION 8100: PITCHING AND STONEMWORK**

### **CONTENTS**

8101 SCOPE

8102 MATERIALS

8103 S	TONE PITCHING
8104	RIPRAP
8105	STONE MASONRY WALLS
8106	MEASUREMENT AND PAYMENT

## **SECTION 8100: PITCHING AND STONework**

### **8101 SCOPE**

This section covers the furnishing of materials and construction of a protective covering in stone pitching, or cast in situ concrete pitching on exposed surfaces such as earth slopes, drains and stream beds, as well as heavier protection in the form of riprap and stone masonry retaining walls all as shown on the Drawings or as instructed by the UNOPS Engineer.

### **8102 MATERIALS**

#### **Stone**

Stone for pitching and masonry shall be sound, tough and durable, with no stone less than 200 mm in minimum dimension, except that smaller pieces or spalls may be used for filling spaces between the larger stones. Rocks or stone shall be of such a shape as to form a stable protection structure of the required section. Rounded boulders or cobbles shall not be used on slopes steeper than 2:1 unless grouted. All stone intended for use on any particular pitching or masonry job shall receive the prior approval of the UNOPS Engineer.

Stone for riprap shall be hard field or quarry stone not susceptible to disintegration or excessive weathering on exposure to the atmosphere or water. It shall be free from soft material such as sand, clay, shale or organic material and shall not contain an excessive amount of elongated stone. The required size of stone will be determined by the "critical mass" specified. At least 50% of the material comprising the riprap shall consist of stones having a mass heavier than the critical mass and not more than 10% by mass of the material shall consist of stone having a mass of less than 10% of the critical mass or more than 5 times the critical mass.

### **Cement**

Cement shall be ordinary Portland cement complying with the requirements of ASTM C 150, Type I.

### **Sand**

Sand for the cement mortar shall comply with the requirements of ASTM C144.

### **Concrete**

Concrete works shall be carried out in accordance with the provisions of Section 7300.

## **8103 STONE PITCHING**

### **Plain stone pitching**

The area shall be prepared by excavating, shaping and trimming to accommodate the stone work and shall be thoroughly compacted by hand-ramming to minimise subsequent settlement. A trench shall be excavated as directed by the UNOPS Engineer along the toe of any slope to be pitched or along the unprotected edge of the pitching in the beds of stream.

Commencing at the bottom of the trench, the stone shall be laid and firmly bedded into the slope and against adjoining stones. The stones shall be laid with their longitudinal axes at right angles to the slope and with their surfaces in contact so as to break joint. The stones shall be well rammed into the bank or surface to be protected and the spaces between the larger stones shall be filled with fragments of approved pitching stone securely rammed into place. Placing of rock by dumping shall not be allowed.

The finished surface of the pitching shall present an even, tight and neat appearance with no stones varying by more than 25 mm from specified surface grades or lines. The thickness of the pitching, measured at right angles to the surface, shall not be less than 200 mm, or as indicated on the drawings.

### **Grouted stone pitching**

This work shall be done in accordance with all the requirements specified for plain pitching

described above, except that the spaces between the stones shall be filled with cement mortar composed of one part of cement to three parts of sand. Before the mortar is applied the surfaces of the stones shall be thoroughly cleaned of adhering dirt and clay then moistened.

The mortar shall be placed in a continuous operation for any day's run at any one location. The mortar shall be worked into the pitching so as to ensure that all spaces or voids between the stones are completely filled with mortar, and to the depth of stone pitching. After the grout has been placed, the stones shall be thoroughly brushed so that their top surfaces are exposed. The grouted pitching shall be cured for a period of not less than four days after grouting with wet sacking or other approved wet cover, and shall not be subjected to loading until adequate strength has been developed. Where required, weep holes shall be formed in the pitching.

#### **8104 RIPRAP**

Riprap shall consist of a course or courses of large rock placed on bank slopes and toes, river and stream beds and other localities where protection of this type may be required. Two types of riprap are specified, one type where the rocks are individually packed, designated as packed riprap and another type where the stone is dumped and then spread by machines, designated as dumped riprap.

The surface of areas to receive riprap shall be neatly trimmed to line and level and all loose material compacted. The perimeters of riprap shall be protected by the construction of either rock-filled trenches, walls or other structures as may be required. Perimeter trenches shall normally be backfilled with rock of the same size and quality as used in the construction of the riprap it adjoins but any cavities shall be filled with smaller material and the whole backfill well consolidated.

#### **8105 STONE MASONRY WALLS**

Stone masonry walls may be plain with dry joints or constructed with stones set in cement mortar as indicated on the Drawings, specified or ordered. The stone used for the masonry wall shall comply with the conditions specified in paragraph 8102 Materials.

##### **Plain stone masonry walls**

A foundation trench shall be excavated down to rock, or to material of adequate bearing capacity at a minimum depth of 300 mm below ground level. Large selected stones shall be laid with the largest dimension in the horizontal plane. Stones shall be individually placed to break joints and to provide a minimum of voids, and shall be firmly bedded against adjoining stones. The spaces between the larger stones shall be filled with spalls securely rammed into place. The larger stones shall not bear on the spalls used to fill the voids. The top and ends of the wall shall be neatly finished with selected coping stones. The resulting appearance of the wall shall present an even, tight surface.

##### **Cement mortared stone masonry walls**

The wall shall be constructed as for plain walls above, with the exception that the stones shall be wetted and set in a 3:1 sand : cement mortar. Exposed stones on the wall faces shall be cleaned of mortar by washing or wire brushing. The mortar shall be flush pointed to the approval of the UNOPS Engineer who may require a capping and end treatment in the same mortar. Weep holes shall be provided as ordered and shall be cleaned of mortar and any other clogging material that may have entered during construction. The wall shall be protected from the elements and kept moist for a

minimum period of four days after completion.

## **8106 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
Stone Pitching:	
8106.01 Plain stone pitching	m2
8106.02 Grouted stone pitching	m2

The unit of measurement for pitching shall be the square metre of each type of pitching in place.

The tendered rate for each type of stone pitching shall include full compensation for furnishing all materials, excavations excluding trench and bulk excavations, compaction and trimming of excavated areas, forming and cleaning of weepholes, placing of stones, grouting where applicable; and for all other work necessary to complete the pitching as specified.

Excavations for foundation trenches and edge beams and the construction of edge beams will be paid for separately.

<b>Item</b>	<b>Unit</b>
Riprap	
8106.03 Packed riprap (critical mass of stone as stated on drawings and in Bills of Quantities)	m3
8106.04 Dumped riprap (critical mass of stone as stated on drawings and in Bills of Quantities)	m3

The unit of measurement for riprap shall be the cubic metre of riprap in place including rock in trench backfill.

The rates tendered shall include full compensation for the preparation of surfaces, including excavation but excluding excavation for trenches and bulk excavations and for the furnishing, transporting, handling and placing of riprap. Collectively the rates shall also include full compensation for all other incidentals necessary for completing the work as specified.

<b>Item</b>	<b>Unit</b>
Stone masonry walls	
8106.05 Plain stone masonry walls	m3
8106.06 Cement-mortared stone masonry walls	m3

The unit of measurement for stone masonry walls shall be the cubic metre of actual wall constructed and accepted.

The tendered rate for each type shall include full compensation for furnishing all materials, trimming of areas, placing of stones and cement-mortar where necessary and all other work necessary to complete the walls as specified. Excavation of foundation trenches will be paid separately.

#### **SECTION 8200 : BRICKWORK**

- 8201 SCOPE
- 8202 MATERIALS
- 8203 CONSTRUCTION
- 8204 MEASUREMENT AND PAYMENT

## **8201 SCOPE**

This work shall consist of the following activities, including supply of all necessary materials :

- a) Construction of new masonry brickwork in specific locations where stone cost is high
- b) Laying of brick flat soling and brick on-edge.
- c) Pointing of brickwork.

All work shall be carried out in accordance with these Specifications, and as shown on the Drawings or as directed by the Engineer.

## 8202 MATERIALS

### **Bricks :**

First Class Bricks shall be made from good brick earth free from saline deposits, and shall be sand moulded. They shall be thoroughly burnt by coal without being vitrified, of uniform and good colour, shall be regular and uniform in size, shape and texture with sharp square edges and parallel faces. They must emit a clear metallic ringing sound when struck one against another. They shall be free from flaws, cracks, chips, stones, nodules of lime or canker. A First Class Brick shall not absorb more than 1/6th of its weight of water after being soaked for one hour. The brick shall be tested for Efflorescence, when tested as per ASTM C67 for Efflorescence shall result as "not effloresced".

Second Class Bricks shall be as well burnt as First Class or may be slightly over burnt but not vitrified, and must give a clear ringing sound when struck one against another. Slight irregularities in size, shape or colour are acceptable provided irregular or uneven courses do not result. Second Class Bricks may have slight chips or flaws but must be free from lime or canker nodules. They shall not absorb more than 1/4th of their weight of water after being soaked for one hour.

Machine made pressed bricks shall be standard commercial products. The use of machine made pressed bricks shall be approved by the Engineer prior to use in the Works.

Bricks not meeting the above requirements shall not be used in brickwork. Jhama bricks are those which are so over burnt as to become vitrified or distorted. Picked Jhama bricks are those Jhama bricks which, although vitrified, are not distorted. Picked Jhama bricks may be broken and used for aggregate in road work provided the vitrified mass has not become porous, at the discretion of the Engineer.

First and Second Class Bricks should have the following dimensions after burning: 250mm x 120mm x 70mm. The unit weight of First and Second Class Bricks shall not be less than 1100 kg/m<sup>3</sup>. The crushing strength of bricks shall be tested in the specified laboratory. The average crushing strength of First and Second Class Bricks shall not be less than 7MPa (N/mm<sup>2</sup>) when tested as per ASTM C67.

At the start of the works samples of the bricks which the Contractor proposes to use for brickworks shall be tested for crushing strength and water absorption, and brickwork shall only commence when the bricks have been approved by the Engineer. The Contractor may then only change the source of supply of bricks after samples from the new supplier have similarly been tested and approved.

### **Mortar :**

Cement mortar shall consist of a mixture of cement and sand in specified proportions given on the drawings. The cement shall be proportioned only by weight, by taking its unit weight as 1440 kg/cubic meter and the sand shall be proportioned by volume, F.M. not less than 1.50, after making due allowance for bulking. The water cement ratio shall not exceed 0.50:1 by weight.

The mixing shall be done intimately in a mechanical mixer unless hand-mixing is specifically permitted by the Engineer. If hand-mixing is done, the operation shall be carried out on a clean watertight platform and cement & sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water.

In case of cement mortar that has stiffened because of evaporation of water, the same may be re-tempered by adding water as frequently as needed to restore the requisite consistency but the re-tempering shall be permitted only within thirty (30) minutes from the time of initial mixing of water.

**Pointing and plastering**

Mortar for Pointing and plastering shall consist of a mixture of cement and sand, both as specified in Clause no 8202.

**Neat Cement Finish:**

Only cement paste shall be used

**8203 CONSTRUCTION****Masonry Brickwork :**

Construction of masonry brickwork shall not commence until the footings on which it is to be placed have been accepted by the Engineer.

Brickwork shall be built plumb, curved or battered as shown on the Drawings or as may be required, by skilled masons and workmen properly supervised. Bricks shall be clean and if necessary, they shall be scrubbed. Bricks shall be soaked in water for at least three hours before use.

Unless otherwise specified bricks shall be laid in English Bond, with frogs downward. All horizontal joints shall be parallel and level. Vertical joints in alternate courses shall come directly over one another. Joint thicknesses shall be 6mm and shall in no case exceed 8mm. The height of four courses including 4 bed joints shall rise 300mm. Cement Mortar shall be mixed in such quantities as can be used in the work within 30 minutes. Mortar which has taken the initial set shall not be used, nor shall it be re-mixed with fresh mortar.

Walls shall always be carried up regularly along their entire length unless otherwise directed by the Engineer. All face work bricks shall be specially selected for size, shape and edges. Any fixtures such as clamps or brackets shall be provided in the brickwork during construction.

The brickwork shall be cured for at least seven days before pointing. The pointing shall be trimmed flush with the brickwork in earth side

**Brick Flat Soling :**

The brick flat soling shall be laid on a compacted, trimmed and prepared surface. The surface shall be approved by the Engineer before laying of the brick flat soling commences. The bricks shall be laid flat in one layer, frog downwards, with the shortest side vertical, in English bond unless otherwise shown on the Drawings or instructed by the Engineer. The brick laying shall be regular and uniform. The joints between the bricks shall be filled with local sand and watered so that the sand completely fills the joints.

### **Pointing and plastering :**

No brickwork shall be covered by plastering unless otherwise approved by the Engineer. Rule pointing shall be done to the all earth surfaces of brickworks.

For pointing, the joints shall be squarely raked out to a depth of 15 mm while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted. The mortar shall be filled and pressed into the raked out joints before giving the required finish. The pointing shall then be finished to proper type given on the drawings. If the type of pointing is not mentioned on the drawing, the same shall be ruled pointing.

For ruled pointing after the mortar has been filled and pressed into the joints and finished off level with the edges of the bricks, it shall while still green be ruled along the centre with a half round tool of such width as may be specified by the Engineer. The superfluous mortar shall then be cut off from the edges of the lines and the surface of the masonry shall also be cleaned of all mortar.

For plastering, the thickness shall not be more than 12 mm by trowel and wooden templates. The surface shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

### **Neat Cement finish:**

Minimum 3 mm thick Cement paste shall be applied over the plastering works after initial setting of plasters and leave the smooth surface.

### **Curing of finishes :**

Curing shall be started as soon as the mortar used for finishing has hardened sufficiently not to be damaged when watered. It shall be kept wet for a period of least 7 days. During this period, it shall be suitably protected from all damages.

## **8204 MEASUREMENT AND PAYMENT**

<b>Item</b>		<b>Unit</b>
8204.01	Construction of Brick masonry including pointing (if applicable) works	m3
8204.02	Plastering works	m2
8204.03	Brick flat soling	m2
8204.04	Neat Cement Finish	m2

Construction of new masonry brickwork shall be measured as the volume in cubic metres, pointing, plastering, neat cement finish & brick flat soling shall be measured as area in square metre of brickwork completed and accepted. The dimensions of masonry brickwork shown on the Drawings

shall be used as the basis for measurement. The work measured shall be paid at the relevant Contract unit prices as shown in the Bill of Quantities. The payment shall be full compensation for supply of materials and execution of the work including all preparatory work and all necessary labour, equipment, tools and incidentals.

## **SECTION 8300 : GABIONS**

### CONTENTS

- 8301 SCOPE
- 8302 MATERIALS
- 8303 CONSTRUCTION OF GABION CAGES
- 8304 CONSTRUCTION OF GABIONS
- 8305 MEASUREMENT AND PAYMENT

## **SECTION 8300 : GABIONS**

### **8301 SCOPE**

This section covers the construction of gabion walls and aprons for the construction of retaining walls, lining of channels, revetments and other anti-erosion structures.

### **8302 MATERIALS**

Rocks used as filling for cages shall be clean, hard, sound, durable and unweathered boulders or rock fragments. No rock particles shall exceed the maximum size given below and at least 85% of the rocks shall have a size equal to or above minimum size given below:

TABLE 6202/1

Depth of cage (m)	Rock size according to largest dimension of rock	
	Minimum (mm)	Maximum (mm)
0.2	75*	125
0.3	95**	125
0.5	100	250
1.0	100	300

\* Using 60 x 80 mm mesh

\*\* Using 80 x 100 mm mesh

All wire used in the fabrication of the gabions and in the wire operations during construction shall be to BS 1052, having a tensile strength of not less than 350 MPa. All wire used in the fabrication of gabions shall be galvanised in accordance with the provisions of BS 729 for Class A heavy galvanised mild steel wire. The minimum mass of the zinc-coating shall be according to the figures shown in the table below:

TABLE 6202/2

Nominal diameter of coated wire (mm)	Mass of coating (g/m <sup>2</sup> ) surface area
3.7 - 4.0	290
3.0 - 3.6	275
2.2 - 2.9	260
Below 2.2	245

The adhesion of the zinc coating to the wire shall be such that when the wire is wrapped six turns around a mandrel of four times the diameter of the wire, it shall not flake nor crack to such an extent that any zinc can be removed by rubbing with the bare fingers.

Wire mesh shall be hexagonal-woven mesh wherein the joints are formed by twisting each pair of wires through the three half turns. The tightness of the twisted joints shall be such that a force of not less than 1, 7 kN is required when pulling on one wire in order to separate it from the other wire provided each wire is prevented from turning and the applied forces and the wire are all kept in the same plane. The diameter of the wire and the size of mesh used shall be as follows.

TABLE 6202/3

Depth of Gabion	Mesh size (mm)	Wire diameter (mm)
0.5m and over	8 x 100	2.5

	100 x 120	2.7
0.2m - 0.3m	80 x 100	2.2
	60 x 800	2.0

The shorter dimensions of the mesh shall be taken from centre to centre of the twisted joints, and the larger dimensions shall be between the inside ends of twisted joints.

Where indicated on the drawings or ordered by the UNOPS Engineer, one layer of geotextile filter fabric shall be placed on the prepared surface prior to the placing of gabions. The material shall be placed as directed in vertical strips with a minimum overlap of 300 mm, and shall be properly fastened to prevent any movement or slipping during the placing of gabions.

### **8303 FORMING THE GABION CAGES**

Gabion cages shall be fabricated of wire mesh of the size and type and selvedge as specified below. The cages shall be subdivided into cells by wire mesh diaphragms and will be of two types:

**Boxes :** which are generally used for the construction of gabion walls. Boxes are sub-divided into cells by diaphragms spaced at 1.0 intervals.

**Mattresses :** which are generally used as single layer aprons only in revetments, channel linings, etc., and in which the maximum width shall be 2.0 m, the maximum depth shall be 0.5m. Mattresses shall be sub-divided by diaphragms into cells having a width of 600 mm or 1.0 m as specified in the Bill of Quantities.

Standard sizes of boxes and mattresses as follows:

**Boxes:**

- Lengths: 1, 2, 3 and 4 metres
- Width: 1 m
- Depths 0.3 m, 0.5 m and 1.0 m
- Diaphragm spacing: 1.0 metre

**Mattresses:**

- Lengths: 6 m
- Widths: 2 m
- Depths: 0.2 m, 0.3 m and 0.5 m
- Diaphragm spacing: 600 mm or 1.0 m as directed

Other gabions may be supplied, provided the UNOPS Engineer's approval is obtained beforehand.

The cut edges of all mesh used in the construction of gabions, except the bottom edge of diaphragms and end panels, shall be selvedged with wire of at least twice the diameter of the mesh wire diameter. Where the selvedge is not woven integrally with the mesh but has to be fastened to the cut ends of the mesh, it must be attached by finding the cut ends of the mesh, about it so that a force of not less than 8.5 kN applied in the same panel as the mesh, at a point on the selvedge of a mesh sample 1 m long, is required to separate it from the mesh.

The diaphragms and end-panels shall be selvedged on the top and vertical sides only. The end-panels shall be attached by twisting the cut ends of the mesh wires at the bottom of the panel about the selvedge on the base of gabions. Similarly, the diaphragms shall be attached by twisting the cut ends of the mesh to the twisted joints of the mesh of the base of the gabion. In each case the force required to separate the panels from the base should not be less than that required to break the mesh over the same length.

Sufficient binding and connecting wire must be supplied with the gabion cages to perform all the wiring operations to be carried out in the construction of the gabion work specified below. The diameter of wire shall be 2.0 mm. A tolerance on the specified diameters of all wire of + 2% shall be permitted. The length of the cages is subject to a tolerance of + 3% and the width of cages is subject to a tolerance of + 3% up to a maximum of 25 mm.

#### **8304 CONSTRUCTION OF GABIONS**

The bed on which the gabion cages are to be laid prior to filling, has to be levelled to a depth as shown on the drawings or as directed by the UNOPS Engineer so as to present an even surface. If necessary, cavities between rock protrusions shall be filled with material. Where required, a foundation trench along the toe of the revetment or wall shall be excavated to the dimensions shown on the drawings or indicated by the UNOPS Engineer.

The methods of erection, stretching, aligning, wiring and filling the gabions shall generally be in accordance with the manufacturer's instructions as approved by the UNOPS Engineer but, nevertheless, sufficient connecting wire braces shall be provided and tensioned between the vertical sides of each of the outer visible cells to prevent the deformation of boxes as they are being filled with stone.

It is essential that the corners of gabion cages be securely wired together to provide a uniform surface and ensure that the structure does not appear as a series of posts or panels. Consecutive courses of boxes should preferably be 'bonded' as in brickwork to avoid the coincidence of vertical joints.

Particular care shall be exercised in filling visible faces of gabion boxes where only selected stone of adequate size shall be used and prepacked to obtain a fair faced finish. The filling of boxes shall be done in stages in order to prevent deformation and bulging. Boxes shall be filled to just below the level of the wire braces after which the braces shall be twisted to provide tension. Care must be taken to ensure that consecutive layers of cages being filled are filled evenly to a level surface ready to receive the next course.

The filling of the 0.3 m and 0.5 m gabion mattresses forming aprons and revetments has to be carried out by spreading random stones on the first layer and using selected stones for the top layer so as to present a dry stone-pitched surface.

#### **8305 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
Foundation trench excavation	

8305.01 In hard material m3

8305.02 In all other classes of material. m3

The unit of measurement shall be the cubic metre of each class of excavation made in accordance with the authorised dimensions.

The tendered rates shall include full compensation for excavating in each class of material including for unavoidable over break, for trimming trenches and compacting trench inverts, for backfilling and consolidating backfill, and for disposal of surplus excavated material.

<b>Item</b>	<b>Unit</b>
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8305.03 Surface preparation for gabions	m2
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The unit of measurement for the levelling and preparation of areas to receive gabions shall be the square metre to the neat dimensions of wall foundations, revetments or aprons.

The tendered rate shall include full compensation for the excavation, filling cavities with rock; for levelling the ground surface ready to receive gabion cages in retaining walls, aprons and revetments.

<b>Item</b>	<b>Unit</b>
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8305.04 Gabion boxes (size of box and mesh shown in Bills of Quantities)	m3
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8305.05 Gabion mattresses (depth of mattresses, mesh size and diaphragm spacing shown in Bills of BoQ)	m3
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The unit of measurement shall be the cubic metre of the rock-filled cages and the quantity shall be calculated from the dimensions of the gabions indicated on the drawings or ordered by the UNOPS Engineer, irrespective of any deformation or bulging of gabions as constructed.

The tendered rate shall include full compensation for the supply of all materials including rockfill, wire mesh cages, binders, connectors; for loading, transporting and offloading; for the assembly and filling of the cages and for any other work necessary for the construction of the gabions. UNOPS (Afghanistan) Minor Works Specification - Rev 1 – May 2022 Page no: 97 of 101

<b>Item</b>	<b>Unit</b>
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8305.06 Filter fabric. . . . .	m2
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The unit of measurement shall be the square metre area covered with filter fabric placed in position.

The tendered rate shall include full compensation for the supply of the filter fabric, cutting, waste, placing, joining, overlapping, and fastening the material in position.

**SECTION 8400: TREE PLANTATION****8401 SCOPE**

This work shall consist of planting tree seedlings as shown on the sub project drawings

**8402 PLANTING METHODS**

The planting shall be carried out at intervals and locations as directed by the UNOPS Engineer. The tree seedlings shall be planted with their root system substantially undamaged, well buried in firm material, and packed around with moist earth in which they have grown.

Tree seedlings shall be planted at such a time and the work shall be done in such a way that at the time of the final construction inspection all seedlings are well established, firmly rooted and the planted area is free from erosion channels.

The Contractor shall maintain the seedlings at his expense until the issuance of the Practical Completion Certificate. Maintenance shall consist of preserving, protecting, watering and replacing seedlings and such other work as may be necessary to keep them in a healthy condition.

**8403 MEASUREMENT AND PAYMENT**

<b>Item</b>	<b>Unit</b>
8403.01 Tree plantation	Number

The unit of measurement shall be the Number of planted trees and accepted.

The tendered rate shall include full compensation for the supply of all materials including trees, watering regularly, and cage protecting the trees from animals.

**8500 SNOW CLEARING / LITTER PICKING etc**

All works carried out under Section 8500 of the specification will be as described in the drawings, bills of quantities and terms of reference for each individual sub project.

The works will be measured in accordance with provision of Series 1000 of this specification