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2 SURFACE EXCAVATION AND BACKFILL WHEREVER REQUIRED

2.1 SCOPE OF WORK

i) The specifications described herein cover the surface excavation and backfilling in and around structures, buildings, pipes, foundations, trenches, pits, channels, cable ducts, underground facilities & similar works and shall include all labour, materials, plant, and equipment necessary to carry out the excavation in all materials, the transportation and stockpiling or disposal of all excavated materials into stockpiles or disposal areas including all leads and lifts as shown on the drawings or as approved by the Project Manager.

ii) Excavation shall be made to the lines, grades and dimensions shown on the drawings or as otherwise directed by the Project Manager.

iii) Contractor shall maintain the excavated slopes, drainage, and trenches and prepare foundations as shown on the drawings or as required by the Project Manager.

iv) Where, in the opinion of the Project Manager, clearing is necessary, the area of surface excavation shall be cleared of all trees, bushes, rubbish and other matter and the materials removed shall be burnt or otherwise disposed off as directed by the Project Manager.

v) When the contractor for his own convenience requires additional excavation outside the lines and grades shown on the drawings, such additional excavation shall be required to be backfilled with acceptable material and compacted by the contractor in a manner satisfactory to the Project Manager. Contractor shall submit his plans for such proposed work in writing for Project Manager's acceptance prior to the commencement of the Work.

vi) When necessary, or when requested by the Project Manager, the Contractor shall remove mud and slush resulting from heavy rains or flooding of the sites in order to ensure the safe and effective performance of the Work.

vii) At all times during construction, the Contractor shall adopt excavation procedures such that at no time shall the stability of any slope be impaired.

viii) The approval given by the Project Manager to the Contractor's methods and equipment shall not relieve the Contractor of his full responsibility for a proper and safe execution of excavations, or of liability for injuries to, or death of persons, or any obligations under this Contract.

ix) Contractor shall comply with all safety procedures and requirements as stipulated in the Chapter "Safety Precautions".

x) Seepage water from springs or rainwater shall be suitably collected and drained away by gravity, wherever it is possible to do so. Where, however, drainage by gravity is not feasible, pumping could be resorted to. All stipulations laid down separately in Chapter "Construction Drainage and Dewatering" shall be followed.

xi) Contractor shall install an adequate illumination system on the work sites as stipulated separately in the Part I, Chapter "Site Installations, Services and Environmental Obligations".

2.2 SUBMITTALS

i) Prior to the commencement of excavation, the Contractor shall submit details of his excavation methods and sequences for all surface excavation works including details of deployment of plant & equipment.

ii) The description of drilling and blasting procedures shall include the following:

a) Diameter, spacing, depth, pattern and orientation of blast holes,

b) Type, strength, amount and distribution of explosives to be used per hole,

c) Description and purpose of any special method to be adopted by the Contractor,

d) Sequence of various activities of the excavation work with an indication of corresponding time requirements.

iii) Well in advance prior to dumping or stockpiling of any material, the Contractor shall submit the layout of the spoil and stockpile areas, which shall be within the areas designated on the bidding drawings.

iv) To enable the Project Manager to verify all necessary setting out and elevations carried out by the Contractor, the latter shall notify the Project Manager in writing, his intentions to start excavation.

v) The Project Manager reserves the right to require any additional information deemed necessary to be included in the submitted documents.

2.3 STANDARDS

The methods and practices for surface excavation shall conform to the latest editions of the following Indian Standards or, where not covered by these Standards, to the equivalent International Standards subject to the approval of the Project Manager:

IS: 2720 Methods of test for soils.

IS: 3764 Excavation work - code of safety.

IS: 4081 Safety code for blasting and related drilling operations.

IS: 9759 Guidelines for de-watering during construction.

Indian Explosives Act 1940, as updated.

2.4 SETTING OUT

i) Contractor shall establish, at suitable points, to the satisfaction of the Project Manager permanent reference marks on the centre lines, as may be necessary and directed. The permanent marks shall be inscribed on permanent pegs, set in concrete blocks where they will be free from any likelihood of disturbance. Suitable benchmarks shall be established.

ii) As the work progresses, centre line marks shall be made on pegs, inserted at convenient intervals to the satisfaction of the Project Manager, for checking alignment, grades, levels etc. The Contractor shall at all times,

remain responsible for the sufficiency and accuracy of all such bench marks and reference points.

iii) Accuracy of Alignment, Grades and Levels etc.:

a) Bench marks and fixed reference points will be fixed by the Project Manager in the work areas. The plans showing the position, coordinates and the levels of the salient points will be supplied to the Contractor. Contractor shall fix his permanent points and benchmarks in relation to these,

b) Contractor shall take all precautions to ensure that the points fixed by the Project Manager are not disturbed by his work and shall make good the damage, if any,

c) Contractor shall provide, all facilities like labour, instruments, etc. and all co-operation to the Project Manager to check the alignment, grades, levels etc. whenever and every time they are asked for,

d) Any discrepancy or error detected during the course of excavations and/or at the end of work shall be set right by the Contractor.

2.5 CLASSIFICATION OF EXCAVATION

2.5.1 GENERAL

Surface excavation shall be classified by the Project Manager into one of the following groups:

a) Clearing,

b) Excavation in soil,

c) Excavation in soft and disintegrated rock,

d) Excavation in hard rock.

2.5.2 CLEARING

i) Clearing shall consist of cutting and disposing of all trees, stumps, roots, rubbish, bushes, any other vegetation and existing structures, foundations of structures, fences or any other objectionable materials.

ii) All flammable material resulting from clearing shall be either burnt or disposed of by the Contractor in a manner acceptable to the Project Manager. Contractor shall be responsible for taking all safety measures required for burning of the materials, and he shall be responsible for any damage done by fire resulting from his work. The fire shall, at no time be left unattended, until it has been fully extinguished. Contractor shall have suitable equipment and supplies for fighting fire. None of the disposed material shall be piled in stream of river or in a location, where in the opinion of Project Manager it is liable to be washed away by floods.

2.5.3 EXCAVATION IN SOIL

i) This group shall include all over-burden dry or wet restricted to materials such as silt, earth, clay, sand, gravel, soft morum, soft and disintegrated rock up to 0.75 m^3 in volume which can be removed by hand or by power shovels or by backhoe or by drag line, without blasting. This shall also include removal of all material wet or dry deposited during the monsoon over the portion excavated prior to monsoon.

ii) Stripping consists of removing all or part of the organic topsoil in the areas and to the depth as indicated on the construction Drawings or as directed by the Project Manager.

iii) Loose excavation means general excavation of material such as organic topsoil, clay, silt, sand, gravel, and boulders of up to 0.75 m^3 in volume and soft or disintegrated rock, which can be removed by earth moving equipment without ripping or blasting.

iv) Stripping and loose excavation shall be accomplished by proper excavation and hauling equipment suitable for the work which allows for an efficient work progress adopted to the soil conditions encountered.

2.5.4 EXCAVATION IN SOFT AND DISINTEGRATING ROCK

i) Excavation in soft and disintegrated rock is that which do not require systematic and continuous blasting. After a few sporadic low intensity blasts, excavation in this class could be carried out by backhoe or other earth moving equipments.

ii) This group shall also include loose boulders less than 0.75 m^3 in volume not requiring continuous and systematic blasting in any type of formations mentioned above which cannot be quarried or split with crow bars or wedges.

2.5.5 EXCAVATION IN HARD ROCK

This group shall include excavation progress by systematic line drilling and blasting in locations specified by the Project Manager. All excavations in which water may exist, shall be dewatered and the materials removed as far as possible to the satisfaction of the Engineer in charge.

2.6 METHODS OF EXCAVATION

2.6.1 ROCK EXCAVATION BY BLASTING

i) Rock excavation by blasting includes all solid rock in place which cannot be removed until loosened by blasting, barring or wedging, removal of all boulders or detached pieces of solid rock larger than 0.75 m^3 in volume, as well as any existing structural foundation made of concrete or masonry placed in mortar.

ii) Lines shown on the Tender or Construction Drawings such as “sound rock”, “top of rock” etc. are approximate and for information only. They will not be used for measurement purpose.

iii) All excavations shall be performed using methods and techniques that will produce smooth and sound rock surfaces with minimum overbreak and fracturing beyond the lines and grades or limits of excavation shown on the Construction Drawings, or as required by Project Manager, and will preserve the structural integrity of the excavated openings. All precautions shall be taken by the Contractor to achieve this result and also preserve, in a soundest possible and undisturbed condition all the materials beyond the limits of the excavation of lines and grades shown on the drawings. Particular care shall be exercised where vertical or near vertical faces are required.

iv) Drilling and blasting shall be done in such a manner as to ensure that the rock will break along the desired lines and grades. Rock shattered by blasting operations outside the established limits of excavation shall be removed and replaced by concrete if necessary. Rock faces and slopes shall be scaled or cleaned of loose or overhanging rock immediately after excavation. Rock surfaces, both temporary and permanent, shall be regularly inspected by the Contractor and rectified whenever necessary.

v) The diameter and the spacing of the blast holes shall be constantly adapted to the actual conditions at the Site. Contractor shall develop the blasting techniques as the work progresses to obtain the best possible excavation surface after blasting. The techniques used shall be at all times subject to the agreement of the Project Manager, who may order blasting tests to be undertaken by the Contractor to substantiate his proposed methods of blasting. The Contractor shall engage a qualified professional blasting consultant to assist in establishing satisfactory techniques.

vi) Rock excavation close to the final excavated surfaces shall be performed using controlled blasting methods such as “pre-splitting”, “cushion blasting”, smooth blasting” as defined hereinafter. Line-drilling and broaching shall be used to limit the overbreak and damage of surrounding rock.

vii) Shattering or splitting of rock, or the opening up of seams and joints in the rock, beyond the limits of excavation, shall be avoided. If in the opinion of

Project Manager such damage occurs due to Contractor's negligence, then additional rock support shall be installed and any resultant shattered material beyond such lines shall be removed and backfilled as required by Project Manager.

viii) Immediately after the blasting, and at any time throughout the duration of the Contract, the Contractor shall scale and remove from the excavations all loose material, which appears to be unsafe or to endanger persons, work or property. The fact that such scaling and removal may enlarge the excavation beyond the required excavation lines shall not relieve the Contractor from the necessity of performing such scaling and removal.

ix) After scaling and prior to excavation of the next bench or round, the Contractor shall install rock stabilization and reinforcement, and provide any surface treatment need, as shown on the Construction Drawings or as directed by the Project Manager.

x) All blasted rock shall be removed from the bench toe before the succeeding bench is shot. The maximum bench height shall be as indicated on the Drawings and may be changed only with approval of Project Manager. Rock excavation where the vertical height of benches is more than 10 m shall be done in a descending direction from horizontal berms by benching.

xi) The excavation shall be made to sufficient depths to secure foundations of structures on sound rock free from weathered materials or other objectionable defects, as determined by the Project Manager. The exploratory investigations of the foundations are not sufficiently complete to disclose all seams, defects, and other irregularities that may exist in the foundation rock. The lines of excavation shown on the Construction Drawings shall therefore not be interpreted as indicating the final or actual lines of excavation or that no defects exist. The excavations at all elevations shall be so shaped as to produce as uniform and regular a profile as is practicable to obtain using excavation methods described herein.

xii) The final excavated surfaces shall have no abrupt changes in slope and sharp projections greater than 500 mm. Projections in excess of 500 mm

shall be treated where necessary by supplementary excavation as determined by the Project Manager, to produce the desired surface of contact between concrete and rock.

xiii) Whenever, in the opinion of the Project Manager, further blasting may injure the rock upon or against which concrete is to be placed, or is otherwise undesirable, the use of explosives shall be limited to light charges or discontinued, and the excavation shall be completed by wedging, barring, line-drilling or other suitable methods approved by the Project Manager.

xiv) Should the presence of rock appear to make excavation for the foundations of any structures unnecessary to the extent, which is shown on the Construction Drawings, the Contractor shall consult the Project Manager before proceeding with such work. The Project Manager will issue a direct order in writing on whether to proceed with the work as shown or to define how the work shall be modified.

xv) When the excavation has been completed to the approximate grade, as shown on the Construction Drawings or established by the Project Manager, the surface shall be cleaned off by barring, wedging, picking or other approved methods, and with an air and/or water jet under high pressure for purpose of inspection. If the foundation is found to be not satisfactory, as determined by the Project Manager, supplementary excavation shall be made as directed, and the surface again cleaned for inspection. This procedure shall be repeated until a satisfactory foundation is obtained. Just prior to placing the concrete, a final cleanup of the rock surface shall be made. All loose, shattered, or disintegrated material shall be removed, and the final surface cleaned with jets of air and/or water under high pressure.

xvi) Contractor shall regularly monitor and inspect all excavations made under this Contract, and shall forthwith promptly remove and dispose of any rock which Contractor or Project Manager deems loose, unsound or disintegrated, or in any other way unsafe.

xvii) Blasting shall be permitted only when proper precautions are taken for the protection of persons, work and property. Any damage done to the work or property by blasting shall be repaired immediately, at the cost of contractor.

xviii) Blasting may be done only to depth and extent approved by the Project Manager with explosives of only approved type and quality and in such locations as may neither crack nor damage the rock outside the prescribed limits of excavations.

xix) Holes shall be drilled not exceeding two-third of the depth of rock to be excavated, from the elevation at which the hole is started. The holes shall not be larger than necessary to permit easy passage of whole sticks of explosives to the bottom of the holes. As the excavation approaches its final limits, the depth of holes for blasting and the amount of charges for the holes shall be reduced progressively.

xx) Whenever in the opinion of the Project Manager further blasting may injure the rock, upon or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation shall be completed by wedging, barring, channelling, drilling or broaching or by other suitable methods. Care should be taken to remove all loose slabs before concrete is placed.

xxi) Charging, tamping and firing of drilled holes shall be done by an approved licensed person under his personal direction. Proper signals by siren shall be given before each operation of blasting.

xxii) The final prepared foundations shall roughly present a tooth cut line and shall have at least 50% horizontal or nearly horizontal area to give resistance against sliding, or as per direction of Project Manager as per site conditions.

2.6.2 <u>CONTROL PERIMETER BLASTING</u>

i) Bench or open-cut excavation of permanent rock slopes shall be carried out using the cushion blasting or pre-splitting techniques. However, depending

upon the detailed geometry of rock slopes, other techniques, such as line-drilling, may be used with written approval of Project Manager. Production holes within 3 m of the perimeter row of holes shall be drilled at a reduced spacing and charged with a reduced load. Perimeter holes shall be drilled in such a manner to meet the following tolerances with respect to length, collar, locations and alignment:

a) The collar of perimeter holes shall be located within 75 mm of the perimeter line,

b) Perimeter holes shall not be longer than 6.0 m unless agreed otherwise by Project Manager,

c) All perimeter holes shall be aligned so that each hole terminates within 20 mm of the line to which the holes are being drilled,

d) Within 1 m of corners, the hole spacing shall be reduced by drilling intermediate holes so that satisfactory and high-quality excavation lines are maintained. The intermediate guide holes may or may not be loaded, depending on the results obtained and as required by Project Manager.

ii) Holes for perimeter blasting technique shall be at spacing of 450 mm, 600 mm or 750 mm. The selection of centre-to-centre of holes for perimeter blasting shall be developed by trial. In initial stages of excavation, perimeter holes shall be assumed, drilled at 450 mm spacing and based on results, this spacing may be varied.

iii) Contractor's controlled perimeter drilling and blasting techniques shall be considered acceptable and in conformity with these Specifications for controlling the completed rock surfaces if:

a) At least 50% of the drill hole traces of each round are visible in the final rock surface, distributed uniformly, after the scaling down of all loose and shattered rock that is liable to fall before or during rock reinforcement installation and if all drill hole traces are close to the lines shown in the Construction Drawings,

b) Project Manager may modify the above criteria if, in its opinion, the achievement of such results is not reasonably possible because of adverse rock conditions.

iv) Drill holes for controlled perimeter blasting shall be loaded in a manner and detonated in a sequence so as to ensure a minimum of damage to the rock beyond the excavation lines.

2.6.3 LINE-DRILLING

i) Line-drilling is defined as a single row of unloaded holes drilled along the neat excavation line, spaced no more than two to four times the hole diameter on centers. The spacing of the drill holes shall be sufficiently close to ensure that the rock will break to the desired lines. These holes will form a surface of weakness to which the primary blast can break.

ii) Line-drilling shall be used where control perimeter blasting may cause excessive damage to the surrounding rock or where there are structures adjacent to the excavation.

iii) Where vertical or square faces of rock are required, such faces of excavations shall be formed by line-drilling and broaching.

2.6.4 MINOR EXCAVATION

i) Minor excavation work consists of excavation, in all materials, of trenches or holes of less then, or equal to, 2 m of width, and in other small or restricted areas, which will be carried out manually or using small items of equipment.

ii) Contractor shall excavate to the limits, lines and grades shown on the Construction Drawings.

iii) Bracing, shoring or other methods or supporting the excavation shall be carried out as necessary.

iv) Mechanical excavation of trenches, except those in rock, shall be stopped not less than 10 cm above final bottom level. The remainder of the excavation shall be removed, shaped, and graded manually.

v) In rock, the trenches shall be excavated to such depth than space for placing of compacted sand bedding at least 10 cm thick shall be provided between the rock and the underside of any equipment or pipe.

2.7 ADDITIONAL EXCAVATION

i) Contractor may be directed by the Project Manager to perform excavation beyond the lines and grades of already completed work. Such excavation shall be defined as additional excavation.

ii) Additional excavation may consist of any or all classes of excavation stipulated in this Chapter.

iii) Excavation outside the excavation limits, which is required by the Contractor for his own convenience may be performed only with agreement by the Project Manager, who may direct the Contractor to refill it with concrete or rockfill in a satisfactory manner.

2.8 QUARRY EXCAVATION

i) Excavation in quarry areas shall be carried out in a way described under various sections in this chapter

2.9 GEOLOGICAL OVERBREAK

i) All excavation shall be done according to the lines, levels and dimensions shown in the drawings. All overbreak and excess excavation shall be carefully avoided. Only Excavation that has been accepted by the Project Manager will be measured and paid.

ii) Overbreak will only be accepted by the Project Manager if it has occurred entirely for geological reasons, and acceptance will only be made if the Contractor request measurement directly after excavation, and as long as the overbreak can clearly be determined as being due to adverse geological conditions.

iii) Excess excavation shall be filled by the materials specified by the Project Manager according to the location of work.

iv) In case of special situations, where excavation is not possible according, to lines, levels and dimensions shown in the drawing the Project Manager at his discretion may permit over excavation.

2.10 DISPOSAL OF EXCAVATED MATERIALS

i) All materials from surface excavation suitable for use as backfill, concrete aggregates or for other purposes shall be stockpiled on the Site within a radius of 3.0 km, as directed or approved by the Project Manager, if the immediate placement in the final location in permanent Works is not possible.

ii) Excavated materials, which is not suitable for or is in excess of the permanent construction requirements, shall be disposed of within a radius of 3.0 km from the excavation place in the waste disposal areas shown on the drawings, or in areas designated as such by the Project Manager in the course of the Work.

iii) Contractor shall shape and trim the disposal areas and stockpiles to the lines and grades as directed or approved by the Project Manager, and shall provide for adequate diversion of existing water courses. The area over which the excavated material is to be disposed shall be stripped of all vegetation and topsoil and the topsoil shall be stockpiled nearby. If the area is steeply dipping, precautions shall be taken to ensure stability of the material in the area, including base drainage and surface protection against erosion. The material dumped shall be compacted, by movement of the dumping vehicles, and grading as necessary, in layers not exceeding 0.5 m in depth. It shall be the responsibility of the Contractor to remove any material from any slide that may occur in the disposal dump or its base and re-dispose the removed material properly. Prior to the commencement of excavation Work, the Contractor shall have prepared the disposal area and the methods proposed for disposal shall also have received approval of the Project Manager.

iv) Contractor shall be liable for any damage to Temporary or Permanent Works or to the property of third parties caused by poor drainage or poor dumping in the waste disposal or stockpile areas.

v) If additional areas are required for disposal of the excavated materials, the Contractor shall propose such areas for approval of the Project Manager.

vi) Contractor shall ensure that no excavated materials are disposed off in the streams or at locations where in the opinion of the Project Manager, these are liable to be washed away by the floods.

vii) On completion of the disposal or removal of the stockpiles, the contractor shall replace the topsoil and seed the area with an approved grass mixture.

2.11 BACKFILL

2.11.1 GENERAL

i) Contractor shall place and compact backfill to the specified type of the lines, grades and dimensions in the locations shown on the Construction Drawings, behind structures, in overbreak, over excavation, or where directed by the Project Manager.

ii) Material to be used as backfill shall be approved by the Project Manager, and shall be, as far as possible, obtained from required excavation for Permanent or Temporary Works.

iii) The distribution and gradation of backfill material shall be such that the finished backfill is free from lenses, pockets, streaks or layers of material differing substantially in texture or gradation from the surrounding material. Backfill material shall include no organic matter, and the Project Manager reserves the right to reject entire loads of material that contain unacceptable percentages of organic matter, and which cannot be satisfactorily removed.

iv) The traffic over the backfill shall be adequately controlled to avoid rutting or cutting the placed backfill. Each load of material shall be placed in such a way as to achieve an even distribution of material. The operation of trucks

and heavy equipment shall be restricted near buildings, walls, piers or other facilities to avoid damage to any Permanent Works.

v) Any material that is objectionable or inadequate shall be removed by the Contractor and at the Contractor's own cost. If the compacted surface of any layer of material is determined to be too smooth to bond properly with the subsequent layer it shall be loosened by harrowing, or by any other method approved by the Project Manager, before the subsequent layer is placed thereon.

vi) Backfilling adjacent to concrete structures 1 m and over in height, shall not commence before 7 days from the time the concrete was cast. Prior to backfilling, forms shall be removed and the areas cleaned of trash and debris. All Works to be covered by backfill shall be inspected and approved by the Project Manager prior to start of backfilling. Backfill shall be placed in proper sequences so that no substantial differential earth pressures occur on footings, pipes, or other structures. A substantial differential earth pressures is deemed to occur if backfill on one side of an object exceeds the other side by more than one layer difference, unless calculations are done to show that a higher differential pressure is acceptable.

vii) Backfilling operation shall not be performed with frozen materials and lumps, and at low temperatures if the material will affect adversely the Works.

viii) Contractor shall maintain and protect the finished backfill in satisfactory conditions at all times until completion and acceptance of the Works. After backfilling operations have been finished and prior to finish grading, the Contractor shall slope the surfaces with at least a 0.5% grade to prevent ponding of water.

2.11.2 <u>BACKFILL MATERIALS</u>

i) Random backfill:

a) Random backfill shall consist of earth and rock-fill of unspecified gradation placed as it comes from excavations. It shall be placed

and compacted in horizontal layers 20 to 40 cm of loose thickness, depending on the equipment used. The final thickness will be determined by the Project Manager,

b) The moisture content prior and during compaction shall be near the optimum moisture content distributed evenly throughout each layer of material,

c) Random backfill shall be compacted to at least 90% Standard Proctor in accordance with IS: 2720. For roads, parking areas, and for footing of structures the backfill shall be compacted to 95% Standard Proctor,

d) Random backfill to be placed adjacent to structures shall be carefully placed to prevent any displacement or damage. Material to be placed within 1 m of the structure shall contain no material greater than 100 mm.

ii) Selected backfill from excavation:

a) Selected backfill from excavation shall consist of specified gradation of earth and/or rock,

b) Selected backfill from excavation shall be compacted to at least 97% Standard Proctor in accordance with IS: 2720,

c) The moisture content prior and during compaction shall be near the optimum moisture content distributed evenly throughout each layer of material.

iii) Free-draining backfill:

a) Free-draining backfill material shall consist of a well graded mixture of sandy gravels and cobbles with a maximum particle size of 300 mm (except as stated below), and a maximum of 3% by weight passing U.S. Standard Sieve No. 200 (0.075 mm) or Indian Standard sieve of 0.08 mm,

b) Material to be placed within 1 m of the structure shall contain no material greater than 100 mm,

c) Free-draining backfill shall be placed moist in layers not exceeding 30 cm before compaction. It shall be compacted to 70% relative density as defined in IS: 2720. For roads and footings of important structures the backfill shall be compacted to 80% relative density,

d) Free-draining backfill shall be compacted by vibratory rollers. Where backfill is required to be placed adjacent to structures or in other restricted areas, it shall be compacted by mechanical tampers or other approved method of compaction.

iv) Sand-gravel backfill of trenches:

Reasonably well-graded sand and gravel shall be used for backfilling of trenches for pipes, cables, ducts, bedding for ditches, etc. The maximum particle size shall not exceed 75 mm of 5% by weight passing U.S. Standard Sieve No. 200 (0.075 mm) or Indian Standard sieve of 0.08 mm. The material shall be spread in layers of 200 mm and compacted by hand-held mechanical tamping.

v) Backfill Concrete:

Concrete to be used in backfill shall conform to Chapter "Concrete".

2.11.3 TESTING OF BACKFILL

i) Testing of backfill shall be done every 300 m^3 or 600 m^2 or 1 test per shift. Proctor testing shall be done in random backfill and impervious backfill; whereas the relative density testing of IS: 2720 shall be done for free-draining backfill.

ii) Contractor shall do all the tests required for by these specifications and by the Indian standards. If however, the Project Manager chooses to make the tests themselves, the Contractor shall take and provide the necessary samples and remunerate the Project Manager at the same Unit Price given in the Bill of Quantities.

iii) The Project Manager may ask supplemental tests.

2.12 MEASUREMENT AND PAYMENTS

2.12.1 CLEARING

i) Measurement for clearing shall be made for the actual area of ground cleared as directed by the Project Manager.

ii) Payment will be made at the Unit Price per square meter entered in the Bill of Quantities and shall include cutting and disposing of all trees, stumps, roots, rubbish, bushes, any other vegetation and existing structures, foundations of structures, fences or any other objectionable materials.

2.12.2 EXCAVATION

i) Measurement for surface excavation will be made of the materials excavated in each class irrespective of the method adopted. Separate quantities for various types of excavation are provided in the Bill of Quantities.

ii) The definitions of the excavation classes are only relevant for the measurement and payment of the excavation works. The decision of the Project Manager regarding excavation class shall be final and binding.

iii) The estimated quantities for each excavation class given in the Bill of Quantities are not to be considered as an accurate indication of the quantity of work since the predicted classification of excavation may differ during the course of the work.

iv) Measurements for surface excavation shall be made by volume in cubic metres, of material excavated, as measured in place from the surface of the natural ground or the surface exposed by previous excavation or clearing, to the lines and grades shown on the drawings, or to rock or as required by the Project Manager.

v) The elevation of the natural ground or surface exposed by previous excavation shall be established and agreed by the contractor and Project

Manager before starting excavation of any section of the work by actual survey of the area.

vi) The Unit Prices, if not specifically stipulated otherwise, shall be deemed to include the entire cost of, but not limited to the following:

a) Provision of all labour, plant, equipment and materials required for surface excavation of all types of soil and rock as classified in various locations including drilling holes for blasting, developing and improving controlled blasting methods, performance of blasting, line-drilling, wedging or barring, cleaning, washing, protection and maintaining excavated surfaces in satisfactory conditions and additional excavations if any, required by the contractor for his construction methods,

b) Provisions for loading, hauling and dumping the excavated material on stockpiles, dumping areas or points of incorporation into permanent works including all lift and lead upto 3.0 km from the site of excavation, shaping and trimming of the excavated materials in the dumping areas as specified, clearing of the stockpile areas, formation and maintenance of stockpiles,

c) Complying with all requirements of statutory laws and regulations relating to the works and any restrictions resulting there from, obtaining all necessary permits and licenses for the purchase, use, storage and transport of explosives and other material,

d) Surveying, setting out, checking of excavated profile, layouts and any subsequent rectification works resulting from undue or incorrect surveys, provision of suitable equipment for, and delays due to carrying out this work,

e) Furnishing, installation, operation, maintenance and removal of communication and illumination systems and observing safety precautions,

f) Recording and preparation of reports related to excavation progress and procedures,

g) All works involved with and any partial or short interruptions or inconveniences caused by the check surveys, performance of the various tests, installation and monitoring of instruments and geological mapping, for which no separate payment is provided elsewhere in these specifications,

h) Seepage water or rainwater collected and drained away suitably.

vii) Extra payment will be made for handling the excavated material beyond 3.0 km. Payment for handling of excavated material will be made at the Unit Price per cubic metre per km and the same will be applicable for all leads beyond initial 3.0 km. Measurement will be based on the hauled volume. The volume of the material will be measured during hauling operations by counting the number of return truck loads, and will be calculated by applying the following bulking factors:

a) For common excavation material: 1.2

b) For excavated rock: 1.4

c) And using the formula:

- Total volume = Number of truck loads x truck capacity/bulking factor
- Payment for the resulting calculated volume will be made at the Unit Price per cubic meter and entered in the Bill of Quantities. No payment will be made for any trips by empty trucks.

viii) Measurement of additional volumes of excavation resulting from modification of slopes and grades shown on the Construction Drawings, which may be necessary in the course of the work, will be of the in-situ volume as measured between the original and the modified lines and grades.

2.12.3 GEOLOGICAL OVERBREAK

i) Measurement for the removal of material arising from overbreak accepted by the Project Manager as occurring entirely for geological reasons, will only be made if the Contractor request measurement directly after excavation, and as long as the overbreak can clearly be determined as being due to adverse geological conditions.

ii) Excavation and refill ordered in writing by the Project Manager due to slides or overbreak for geological reasons or unsuitable foundations will be measured and paid for as follows:

a) Removal of material resulting from overbreak accepted by the Project Manager will be paid per cubic meter in-situ, at the Unit Price for excavation entered in the Bill of Quantities,

b) In-situ volumes of the additional excavation required in connection with geological overbreak will be measured in cubic meters and payment will be made at the Unit Price for excavation of approved classification,

2.12.4 BACKFILL

i) Measurement for backfilling shall be made by volume in cubic meter of the compacted volume of fill in place based on levels recorded before and after filling, less the volume of structure, foundation, pipe etc. falling within the fill volume so determined.

ii) The concrete placed for refilling additional excavation in rock foundation will be measured in cubic meter of the in-situ compacted volume and payment will be made at the Unit Price per cubic meter for the concrete class as ordered by the Project Manager.

iii) The unit rate, if not specifically stipulated otherwise, shall be deemed to include the entire cost, but not limited to the following:

a) Provision of all labour, equipment and materials required for filling using excavated materials including all lifts & leads,

b) Provision for cost of excavation from stockpiles, loading, carriage up to fill area, unloading, compaction, testing etc. complete as per specifications & instruction of Project Manager,

c) Provision for cost of water, dewatering and other incidental like rolling of natural ground level etc. required such that the filling can be compacted in layers to the desired degree of compaction and in the dry conditions.

2.12.5 EXCLUSIONS

No extra measurement or payment will be made for the following:

a) Over excavation beyond the excavation lines shown on the drawings, removal of material or backfilling with concrete or acceptable material and compaction where and when as required by the Project Manager,

b) Replacement of survey points fixed by the Project Manager which are damaged due to Contractor's negligence,

c) Formation of berms or ramps, sump pits for installation of dewatering pumps at places, which fall beyond the specified excavation lines,

d) Treatment of rain cuts, gullies and holes left by removal of boulders by properly packing with excavated rock spoil,

e) Methods adopted for specially controlled excavation at foundation level or near the faces where plain surfaces are required,

f) Replacement or repair of concrete or other works damaged by blasting,

g) Working of all rock surfaces of excavation when required by the Project Manager,

h) Additional work of removing materials and backfilling voids with approved material where over excavation occurs due to Contractor's poor working method or negligence,

i) Silt/Slush deposit if any during the course of construction due to rain and floods etc. shall have to be removed and properly deposited by the contractor and no extra payment shall be made on this account and deemed to have been included in the item of excavation of Bill of Quantities of bid,

j) Over-excavation required for Contractor's convenience. The concrete required to fill such excavation shall also be at the Contractor's expense.

k) Excavation in quarry areas

End of Chapter