

## **Chapter 2**

### **EARTHWORK**

- 2.0 Definitions**
- 2.1 Classification of Soils**
- 2.2 Antiquities and Useful Materials**
  - 2.2.1 Findings of archeological interest during excavation**
  - 2.2.2 Useful material obtained during excavation**
- 2.3 Protections**
  - 2.3.1 Safety during excavation**
  - 2.3.2 Protection to adjoining structures during excavation**
  - 2.3.3 Excavation below foundation level of adjoining buildings**
- 2.4 Site Investigations**
- 2.5 Site Clearance**
  - 2.5.1 Clearing o vegetation cover and miscellaneous facilities**
  - 2.5.2 Removal of Trees of girth upto 300 mm**
  - 2.5.3 Salvaging of useable material**
  - 2.5.4 Clearing and grubbing**
  - 2.5.5 Felling of Trees**
  - 2.5.6 Dismantling and Demolition of Structures**
  - 2.5.7 Dismantling and Demolition of Buildings**
- 2.6 Setting out and Making Profiles**
  - 2.6.1 Erection of Bench Marks for setting out**
  - 2.6.2 Recording ground levels**
- 2.7 Excavation**
  - 2.7.1 General**
- 2.8 Excavation in Water, Mud or Foul Position**
  - 2.8.1 Pumping of water during excavation**
  - 2.8.2 Measurement**
- 2.9 Blasting**
  - 2.9.1 General**
  - 2.9.2 Supervision of blasting operation**
  - 2.9.3 General precaution during blasting**
  - 2.9.4 Precaution against misfire**
- 2.10 Excavation in Rock by Chiseling**
- 2.11 Excavation for Pipeline Works**
  - 2.11.1 Excavation for Pipeline in Open Cut**
  - 2.11.2 Trenchless excavation**

- 2.11.3 Earthwork and Pipe Bedding**
- 2.12 Dewatering**
- 2.13 Support of Excavation (Shoring)**
  - 2.13.1 Open and close shoring**
  - 2.13.2 Close planking and strutting**
  - 2.13.3 Position of Boards**
  - 2.13.4 Steel sheet piling**
  - 2.13.5 Approval of Engineer prior to excavation**
  - 2.13.6 Measurements**
- 2.14 Filling**
  - 2.14.1 General**
  - 2.14.2 Obtaining fill material by contractor**
  - 2.14.3 Quality of fill material**
  - 2.14.4 Testing of fill material**
  - 2.14.5 Compaction**
  - 2.14.6 Placing of fill material**
  - 2.14.7 Stripping of top soil**
  - 2.14.8 Construction operations for fill material**
  - 2.14.9 Removal of unsuitable material**
  - 2.14.10 Measurement prior to commencement of filling**
- 2.15 Compaction Quality Control**
  - 2.15.1 Compaction tests**
  - 2.15.2 Moisture content during compaction**
  - 2.15.3 Degree of compaction required**
  - 2.15.4 Compaction of top 300 mm layer**
  - 2.15.5 Frequency of quality control tests**
  - 2.15.6 Tests for compaction around structures**
  - 2.15.7 Measurement and Payments**
- 2.16 Backfilling**
  - 2.16.1 Backfill material**
  - 2.16.2 Backfilling**
  - 2.16.3 Backfilling using sand**
- 2.17 Granular Material for Bedding to Pipelines**
  - 2.17.1 Measurements for granular material in bedding**
  - 2.17.2 Rates**
- 2.18 Sand Filling in Plinth**
  - 2.18.1 Sand for filling in plinth**

**2.18.2 Filling in plinth**

**2.18.3 Granular material for bedding to pipelines**

**2.18.4 Measurements**

**2.18.5 Rates**

**2.19 Surplus Excavated Material**

**2.20 Anti termite treatment**

**2.20.1 Safety precaution for anti-termite treatment**

**2.20.2 Chemical treatment**

## CHAPTER 2: EARTH WORK

### 2.0 DEFINITIONS

**Burjis:** Short pillars of brick/ stone having top surface finished with cement plaster for marking etc.

**Deadmen or Tell Tales:** Mounds of earth left undisturbed in pits dug out for borrowing earth.

**Excavation:** Means open cut down to levels required as per specified drawings.

**Formation or Profile:** Final shape of the ground after excavation or filling up.

**Foul position:** Filthy and unhygienic conditions where physical movements are hampered such as soil mixed with sewage or night soil.

**Lead:** The distance for removal, measured over the shortest practicable route and not necessarily the route actually taken.

**Safety rules:** Safety rules as laid down by the statutory authority.

**Top Soil:** Any surface material including turf.

### 2.1 CLASSIFICATION OF SOILS

The earthwork shall be classified under the following categories and measured separately for each category:

- (a) All Kinds of Soils: Sand, gravel, loam, clay, mud, black cotton moorum, shingle, river or nallah bed boulders, soling of roads, paths etc. and hard core, macadam surface of any description (water bound, grouted tarmac etc.), lime concrete, mud concrete and their mixtures which for excavation yields to the application of picks, showels, jumper, sacrifiers, ripper and other manual digging implements come under this classification.
- (b) Ordinary Rock: Generally any rock which can be excavated by splitting with crow bars or picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and unreinforced cement concrete below ground level. If required light blasting may be resorted to, for loosening the materials but this will not in any way entitle the material to be classified as 'Hard rock'.
- (c) Hard Rock: Generally any rock or boulder for the excavation of which blasting is required such as quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.
- (d) Hard Rock (blasting prohibited): Hard rock requiring blasting as described under (c) but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

### 2.2 ANTIQUITIES AND USEFUL MATERIALS

**2.2.1** Any finds of archaeological interest such as relics of antiquity, coins, fossils or other articles of antique or monetary value shall be delivered to the Engineer-in Charge and shall be the property of the Government. Necessary security and/ or watching arrangements shall be provided by the Contractor until the antiquities are taken over by the Government, if it is necessary in the opinion of the Engineer

**2.2.2** Any material obtained from the excavation which in the opinion of the Engineer is useful, shall be stacked separately in regular stacks as directed by the Engineer and shall be the property of the Employer.

### 2.3 PROTECTIONS

**2.3.1** Excavation where directed by the Engineer shall be securely fenced and provided with proper caution signs, conspicuously displayed during the day and properly illuminated with red lights during the night to avoid accidents. While working in roads having traffic, additional caution boards shall be displayed and maintained at 50 metres away from the ends of working reach or as directed by the Engineer and to compliance with traffic regulations.

**2.3.2** The Contractor shall take adequate protective measures to see that the excavation operations do not damage the adjoining structures or dislocate the services. Water supply pipes, sluice valve chambers, sewerage pipes, manholes, drainage pipes & chambers, communication cables, power supply cables etc. met with in the course of excavation shall be properly supported and adequately protected, so that these services remain functional.

**2.3.3** Excavation shall not be carried out below the foundation level of the adjacent buildings until underpinning; shoring etc. is done as per the directions of the Engineer.

## **2.4 SITE INVESTIGATION**

The Contractor shall carefully examine the site and make all inspections necessary in order to determine the full extent of the work required making the completed work conform to the drawings and specifications. The Contractor shall satisfy himself as to the nature and location of the work, conditions, the formation and condition of the existing ground surface, the character of the existing ground surface and the character of equipment and facilities needed prior to and during the execution of the work. The Contractor shall satisfy himself as to the character, quality, and quantity of surface and subsurface materials or obstacles or utilities to be encountered. Any inaccuracies or discrepancies between the actual field conditions and the drawings or between the drawings and specifications shall be brought to the Engineer's attention immediately in order to obtain necessary clarifications on the exact nature of the work to be performed.

## **2.5 SITE CLEARANCE**

**2.5.1** Before the earthwork is started, the area coming under excavation shall be cleared of all vegetation, organic material and all existing miscellaneous facilities which will interfere with the construction activity and rubbish shall be removed outside of the site boundary which will be identified by the contractor. The roots of trees and saplings shall be removed, and the holes or hollows filled up with the earth, rammed and leveled.

**2.5.2** The trees of girth above 30 cm measured at a height of one metre above ground shall be cut only after permission of the Engineer is obtained in writing.

**2.5.3** Salvage of any/all items decided to be usable by the Engineer shall be stacked separately at approved locations. A detailed record of salvaged items shall be maintained and made available for inspection by the Engineer. Such salvages will be the property of the Employer.

### **2.5.4 Clearing and Grubbing**

#### **2.5.4.1 Scope**

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

**2.5.4.2 Preservation of Property/Amenities**

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials etc., and the schedules for carrying out temporary and permanent erosion control works.

**2.5.4.3 Methods, Tools And Equipments**

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500 mm of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several metres, shall be suitably treated.

**2.5.4.4 Disposal of Materials**

All materials arising from clearing and grubbing operations shall be the property of the employer and shall be disposed of by the Contractor.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones which is suitable for auction or execution etc., shall be done at specified spots as directed by the engineer inside or outside of the site boundary.

All products of clearing and grubbing, which, in the opinion of the Engineer, cannot be used or auctioned, shall be cleared to the location identified by the contractor outside the site boundary and the same should be approved by the engineer-in-charge. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, subgrade and road construction.

**2.5.4.5 Measurements for Payment**

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of hectares. Clearing and grubbing of borrow areas shall

be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees upto 300 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operations. Removal of stumps left over after trees have been cut by any other agency shall also be considered incidental to the clearing and grubbing operations.

Cutting, including removal of stumps and roots of trees of girth above 300 mm and backfilling to required compaction shall be measured in terms of number according to the sizes given below:

- i) Above 300 mm to 600 mm
- ii) Above 600 mm to 900 mm
- iii) Above 900 mm to 1800 mm
- iv) Above 1800 mm

For this purpose, the girth shall be measured at a height of 1 metre above ground or at the top of the stump if the height of the stump is less than one metre from the ground.

#### **2.5.4.6 Rates**

The Contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with all lifts and leads.

**2.5.4.7** The Contract unit rate for cutting (including removal of stumps and roots) of trees of girth above 300 mm shall include excavation and backfilling to required compaction, handling, salvaging, piling and disposing of the cleared materials with all lifts and leads.

**2.5.4.8** Where a Contract does not include separate items of clearing and grubbing, the same shall be considered incidental to the earthwork items and the Contract unit prices for the same shall be considered as including clearing and grubbing operations.

**2.5.4.9** The unsuitable material should be disposed outside the site boundary which location to be identified by the contractor and same should be approved by the engineer incharge. All the necessary required approvals should be taken by the contractor to dispose the unsuitable material outside the site boundary and a copy of the same should be submitted to Engineer – incharge.

#### **2.5.5 Felling Trees**

**2.5.5.1 Felling:** While clearing jungle, grown trees above 30 cm girth (measured at a height of one metre above ground level) to be cut, shall be approved by the Engineer and then marked at site. Felling trees shall include taking out roots up to 1 metre below ground level

All excavations below general ground level arising out of the removal of trees, stumps etc. shall be filled with suitable material in 20 cm layers and compacted thoroughly so that the surface at these points conforms to the surrounding area. The trunks and branches of trees shall be cleared of limbs and tops and cut into suitable pieces as directed by the Engineer.

**2.5.5.2 Stacking and Disposal:** Wood, branches, twigs of trees and other useful material shall be the property of the Employer. The serviceable materials shall be stacked in the manner as directed by the Engineer.

All unserviceable material, which in the opinion of Engineer cannot be used or auctioned, shall be- removed from the area and disposed outside the site boundary location identified by the contractor and the same should be approved by the engineer in charge.

**2.5.5.3 Measurements:** Cutting of trees above 30 cm in girth (measured at a height of one metre above ground level) shall be measured in numbers according to the sizes given below:

- (a) Beyond 30 cm girth, upto and including 60cm girth.
- (b) Beyond 60 cm girth, upto and including 90cm girth.
- (c) Beyond 90 cm girth, upto and including 180 cm girth.
- (d) Above 180 cm girth.

**2.5.5.4 Rate:** The rate includes the cost involved in all-the operations described above. The contract unit rate for cutting trees above 30 cm in girth shall include removal of stumps as well.

## **2.5.6 Dismantling And Demolition Of Structures**

### **2.5.6.1 Scope**

This work shall consist of removing, as hereinafter set forth, existing culverts, bridges, pavements, kerbs and other structures like guard-rails, fences, utility services, manholes, catch basins, inlets, etc., which are in place but interfere with the new construction or are not suitable to remain in place, and of salvaging and disposing of the resulting materials and back filling the resulting trenches and pits.

Existing culverts, bridges, pavements and other structures, which are within the site and which are designated for removal, shall be removed up to the limits and extent specified in the drawings or as, indicated by the Engineer.

Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed, adjacent pavement, structures and any other work to be left in place.

All operations necessary for the removal of any existing structure which might endanger new construction shall be completed prior to the start of new work.

### **2.5.6.2 Dismantling Culverts and Bridges**

The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the serviceable materials to be salvaged, the part of the structure to be retained and any other properties or structures nearby.

Unless otherwise specified, the superstructure portion of culverts/bridges shall be entirely removed and other parts removed below the ground level or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent material, if required in connection with the dismantling of the structures, shall be incidental to this item.

Where existing culverts/bridges are to be extended or otherwise incorporated in the new work, only such part or parts of the existing structure shall be removed as are necessary and directed by the Engineer to provide a proper connection to the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Due care should be taken to ensure that reinforcing bars which are to be left in place so as to project into the new work as dowels or ties are not injured during removal of concrete.

Pipe culverts shall be carefully removed in such a manner as to avoid damage to the pipes.



Steel structures shall, unless otherwise provided, be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawings or directed by the Engineer that the structure is to be removed in a condition suitable for re-erection, all members shall be match-marked by the Contractor with white lead paint before dismantling; end pins, nuts, loose plates, etc., shall be similarly marked to indicate their proper location; all pins, pin holes and machined surfaces shall be painted with a mixture of white lead and tallow and all loose parts shall be securely wired to adjacent members or packed in boxes.

Timber structures shall be removed in such a manner as to avoid damage to such timber or lumber as is designated by the Engineer to be salvaged.

### **2.5.6.3 Dismantling Pavements and Other Structures**

In removing pavements, kerbs, gutters, and other structures like guard-rails, fences, manholes, catch basins, inlets, etc., where portions of the existing construction are to be left in the finished work, the same shall be removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing structure. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer.

Where flexible pavements are to be dismantled to a larger width (not trenches) the area to be removed shall be marked and shall be removed using pneumatic jack hammers correct to the demarcated lines. The debris shall be disposed to approved tip.

For cutting and removing flexible pavements like asphalt surface, the pavement shall be dismantled using pneumatic jack hammer. The thickness of pavement and macadam shall be taken as 10 cms. The debris shall be disposed off to approved tip.

All concrete pavements, base courses in carriageway and shoulders etc., designated for removal shall be broken to pieces whose volume shall not exceed 0.02 cu.m. and stockpiled at designated locations if the material is to be used later or otherwise arranged for disposal as directed.

### **2.5.7 Dismantling and Demolition of Buildings**

The term dismantling refers to carefully separating the parts without damage and removing. The term demolition implies breaking up, either whole or part. IS 1200 and IS 4130 shall be the guidelines for dismantling and demolition.

#### **Precautions: dismantling and demolition**

The demolition shall be well planned in advance and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer before starting the work. Due care shall be taken to maintain the safety measures stipulated in IS 4130.

Necessary propping, shoring and /or underpinning shall be provided to ensure the safety of the adjoining work or property, before dismantling and demolition is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions shall also be provided, as directed by the Engineer.

Necessary precautions shall be taken up to keep down the dust nuisance to the minimum.

The materials likely to be damaged by dropping from a height or by demolishing roofs, masonry, etc. shall be carefully removed first. The dismantled articles shall be removed manually or otherwise, lowered to the ground (not thrown) and then properly stacked as directed by the Engineer.

Dismantling of the parts fixed by nails, screws, bolts, rivets, etc. shall be done by taking out the fixing with proper tools and skill and not by tearing or ripping off.

The contractor shall maintain or disconnect existing services, whether temporary or permanent, as required by the Engineer.

All materials obtained from dismantling and demolition shall be the property of the Employer, unless otherwise specified and shall be kept in safe custody until they are taken over by the Engineer.

All usable materials obtained during dismantling and demolition shall be separated out and stacked properly as directed by the Engineer including all leads and lifts. All unserviceable materials, rubbish, debris, etc. shall be disposed outside the site boundary location identified by the contractor and the same should be approved by the engineer in charge.

### **Measurements**

General.

All works shall be measured as fixed in its place, subject to the following limits, unless otherwise stated hereunder

- a. Dimensions shall be measured correct to a centimetre.
- b. Areas shall be worked out in squaremetre correct to two places of decimal.
- c. Cubical contents shall be worked out to the nearest 0.01 cubic metre.

Measurements of all work except hidden works shall be taken before dismantling or demolition and no allowance for increase in bulk shall be allowed.

Specification for deduction for voids, openings, etc. shall be on the same basis as that adapted for new construction works.

Works executed in the following conditions shall be measured separately, unless otherwise specified.

- a. Work in or under water and /or liquid mud.
- b. Work in or under foul position.

### **Flooring and Paving**

Dismantling of floors, except concrete and brick floors, shall be measured in square metres. Supports such as joists, beams, etc., if any, shall be measured in quintals.

### **Concrete and Brick Floors**

Demolition of floors and roofs of concrete or brick shall be measured in cubic metres. Beams, cantilevers or other subsidiary supports of similar materials shall be included in the item. In measuring thickness of roofs provided with water proofing treatment shall be ignored. Measurement shall be for the effective thickness of concrete or brick, measured as total thickness less the thickness of water proofing treatment.

### **Walls and Piers**

Demolishing walls, independent piers or columns of brick, stone or concrete shall be measured in cubic metres. All copings, corbels, cornices and other projections shall be included in the measurements. In measuring the thickness of plastered walls, the thickness of plaster shall be ignored.

Ashlar face stones, dressed stone work, precast concrete articles, etc. if required to be taken down intact shall be so stated and measured separately in cubic metres.

Cleaning bricks stacking for measurements including all extra handling and removal and disposing of the rubbish as stated shall be enumerated in thousands of cleaned bricks.

Cleaning stones obtained from demolished/dismantled stone masonry of any description including ashlar facing dressed stone work, stone slabs and precast concrete blocks including all extra handling and disposing of the rubbish as stated shall be measured in

cubic metres of cleaned stone.

Honey comb works or cavity walls of brick, stone or concrete shall be measured as solid.

### **Reinforced Concrete and Brick Work**

Reinforced concrete structures and reinforced brick work (roof, wall, etc) shall be measured in cubic metres and if reinforcement is required to be salvaged, it shall be so stated. Where reinforcement is required to be separated, scraped and cleaned, the work shall be measured separately in quintal of salvaged steel.

### **Partitions, Trellis, etc**

Partitions and light walls of lath and plaster, trellis work, expanded metal, thin concrete or terracotta slabs and other similar materials including frame work, if any, shall be measured in square metres, stating the overall thickness.

### **Wood work**

All wood works including Karries averaging 40 square centimetres or over in section shall be measured in cubic metres while that under 40 square centimetre in section in running metres. Boarding including wooden chajjas and sunshades along with supports shall be measured in square metres in its plane.

### **Steel and Iron Work**

All steel and iron works shall be measured in quintals. The weight shall be computed from standard tables unless the actual weight can readily be determined.

Riveted work where rivets are required to be cut shall be measured separately.

Marking of structural steel required to be re-erected shall be measured separately.

In framed steel items, the weight of any covering material or fitting such as iron sheets and expanded metal shall be included in the weight of the main article unless such covering is not ordered to be taken out separately.

### **Doors, Windows and Ventilators**

Dismantling of doors, windows, ventilators, etc. shall be enumerated. Those exceeding 3 square metres each shall include removal of hold fasts and other attachments. If only shutters are to be taken out, it shall be measured separately.

### **Pipes and Sewer Lines**

All water and sewer pipe lines including rain water pipes with clamps and specials of all materials shall be described by diameter and length measured in running metres inclusive of joints.

If the joints, specials and fittings, etc. are required to be separated, it shall be so stated and enumerated.

Valves, cisterns, public fountain platforms, fire hydrants, etc. shall be enumerated.

Manholes and inspection chambers shall be enumerated stating the size and depth of manholes/inspection chambers. They shall be classified into different groups depending upon the depth in unit of half and one metre depth. The depth of the manhole/inspection chamber shall be the vertical distance between the top of manhole cover and invert level of the pipe/drain.

Ventilating shafts, gully traps, flushing cisterns and other appurtenant items shall be enumerated.

### **Posts and Struts**

Posts or struts of wood, steel or RCC including taking out embedded portion shall be

measured in running metres.

### **Fencing with Mesh**

Wire mesh fencing of any type with frames shall be measured in square metres.

### **Glazing**

Taking out any portion of serviceable glass except polished plate, skylights, etc. of any thickness, size or weight, raking out old putty shall be measured in square metres. Irregular or circular panes shall be measured as rectangle or square enveloping the same. The width and height shall be measured correct to 0.5cm.

### **Road Work**

Different types of road surfaces shall be measured separately.

Road surfaces metalling or soling shall be measured in square metres.

Concrete paving shall be measured as in cubic metres.

## **2.6 SETTING OUT AND MAKING PROFILES**

**2.6.1** A masonry pillar to serve as a bench mark will be erected at a suitable point in the area, which is visible from the largest area. This bench mark shall be connected with the standard bench mark as approved by the Engineer. The Contractor shall supply labour and material for constructing bench mark. The Contractor shall set out and make profiles and connect bench mark with the standard bench mark at his own cost. The bench mark shall be maintained by the Contractor at his own cost during the excavation to check the profiles. The Contractor shall supply labour for checking by the Engineer.

**2.6.2** The ground levels shall be taken at 5 to 15 metres intervals (as directed by the Engineer) in uniformly sloping ground, and at closer intervals where local mounds, pits or undulations are met with. The ground levels shall be recorded in field books and plotted on plans. The plans shall be drawn to a scale of 5 metres to one cm or any other suitable scale decided by the Engineer. North direction line and position of bench mark shall invariably be shown on the plans. These plans shall be signed by the Contractor and the Engineer or their authorised representatives before the earth work is started. The labour required for taking levels shall be supplied by the contractor at his own cost.

## **2.7 EXCAVATION**

### **2.7.1 General**

General excavation means excavation required for structures and from borrows areas, but not including trench excavation. General excavation may also include miscellaneous isolated lengths of trenches beneath or adjacent to other structures.

The ground shall be excavated by such methods and to such dimensions and depths as shall allow for the proper construction of the works and safety of personnel and equipment used on excavation. Slopes required for stable formation of sides shall be provided.

The excavation in earth, moorum, boulders, soft and hard rock shall be carried out to the correct levels required and specified and no tolerance, plus or minus, shall be permitted. However, if any depressions are formed due to removal of boulders, they shall be made good by filling with M-10 concrete. Excavation in hard rock may be done either by blasting, controlled blasting or chiseling depending upon the area to be excavated. In case of blasting, it shall be done close but not exceeding the desired level. Where blasting is resorted to, small charges shall be used to minimize occurrence of heavy over cut. The Contractor shall make every effort to carryout the excavation to correct formation level as far as practicable. In order to minimize the over break and loosening of materials at the finished surfaces, final cutting for the last 450 mm to 600mm in rock shall be carried out

by controlled basting and trimming with the help of pneumatic or other power tools. Unless otherwise specified, the over break shall not exceed 75 mm. The over breakage excavating of 75 mm shall not be measured for payment and therefore the Contractor while quoting his rates for rock excavation has to take into account the permissible over breakage of 75 mm. Quantity of hard rock so removed shall be arrived at measuring compactly formed stacks of the excavated rock. Deduction of 40% or higher percentage as may be decided by the Engineer shall be made to allow for the voids. Stacks shall not be of width greater than 1.5 m nor of height less than 1 m.

Payment for all types of excavation shall be made by detailed measurement supported by ground levels recorded prior to and after completion of excavation, subject to the limit for payment indicated by the slopes of excavation in the drawing. Any additional excavation will be at the contractor's expense, unless specifically approved by the Engineer.

#### **2.7.1.1 Excess excavation to be made good**

The Contractor at his own expense shall, if directed, remove from the site all material resulting from excess excavation and shall make good the same with such class of concrete as may be reasonably required by the Engineer having regard to the circumstances.

#### **2.7.1.2 Stripping top soil**

Where ordered by the Engineer, topsoil shall be stripped to such depths and over such areas as he may direct, as a separate operation prior to any further excavation, which may be required. No separate payment shall be made for this item of work. This is deemed included in relevant pay item.

#### **2.7.1.3 Excavation in all kinds of Soils**

All excavation operations shall include excavation and stacking of the excavated materials. In case of excavation for isolated short trenches, basements, water tanks etc. suitable material stacking shall be done at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases suitable material stacking shall be done at places directed by the Engineer including all leads and lifts and disposal of unsuitable material outside the site boundary location identified by the contractor and the same should be approved by the engineer in charge.

**2.7.1.4** During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

**2.7.1.5** In firm soils, the sides of the trenches shall be kept vertical up to a depth of 2 metres. For greater depths, the excavation profiles shall be widened by allowing suitable steps of not less than 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of sides equal to the angle of repose of the soil.

**2.7.1.6** The excavation shall be done true to levels, slope, shape and pattern indicated by the drawing or as directed by the Engineer. If excavation is done for greater depth, no measurement will be taken for excess excavation and the excess depth shall be made good by the Contractor at his cost, with concrete M10.

**2.7.1.7** In case the excavation is done wider than that shown on the drawings or as required by the Engineer, additional filling wherever required on this account shall be done by the contractor at his own cost.

### **2.8 EXCAVATION IN WATER, MUD OR FOUL POSITION**

**2.8.1** All water that may accumulate in excavations during the progress of the work from springs, tidal or river seepage, broken water mains or drains (not due to the negligence of the contractor), and seepage from subsoil aquifer shall be bailed, pumped out or otherwise removed. The Contractor shall take adequate measures for bailing and/or

pumping out water from excavations and construct diversion channels, bunds, sumps, coffer dams etc. as may be required

Pumping shall be done in such a way as not to cause damage to the work or adjoining property by subsidence etc. Disposal of water shall not cause inconvenience or nuisance in the area or cause damage to the property and structure nearby.

To prevent slipping of sides, planking and strutting may also be done with the approval of the Engineer

## **2.8.2 Measurements:**

**2.8.2.1** The unit, namely, metre depth shall be the depth measured from the level of sub-soil from where water seeps in up to the bottom of excavation actually done. Metre depth shall be reckoned correct to 0.1 m., 0.05, or more shall be taken as 0.1 m and less than 0.05 m ignored.

**2.8.2.2** Bailing or pumping out water accumulated in excavation, due to rains is included under respective items of earthwork and is not to be paid separately.

**2.8.2.3 Rates:** The rates for excavation in mud or foul position described above shall include cost of all the operations as may be applicable.

## **2.9 BLASTING**

### **2.9.1 General**

Where hard rock is met with and blasting operations are considered necessary, the Contractor shall obtain the approval of the Engineer in writing for resorting to blasting operation.

Note: In ordinary rock, blasting operations shall not be generally adopted. However, the Contractor may resort to blasting with the permission of the Engineer, but no extra payment shall be made for such blasting operations.

The Contractor shall obtain license from the competent authority for undertaking blasting work as well as for obtaining and storing the explosive as per the latest amendment of the “Explosive Act, 1884”. The Contractor shall purchase the explosives fuses, detonators, etc. only from a licensed dealer. Transportation and storage of explosive at site shall conform to the aforesaid Explosive Act and Explosive Rules. The Contractor shall be responsible for the safe custody and proper accounting of the explosive materials. Fuses and detonators shall be stored separately and away from the explosives. The Engineer or his authorized representative shall have the right to check the Contractor's store and account of explosives. The Contractor shall provide necessary facilities for this.

The Contractor shall be responsible for any damage arising out of accident to workmen, public or property due to storage, transportation and use of explosive during blasting operation.

**2.9.2** Blasting operations shall be carried out under the supervision of a responsible authorized agent of the Contractor (referred subsequently as agent only), during specified hours as approved in writing by the Engineer. The agent shall be conversant with the rules of blasting. In case of blasting with dynamite or any other high explosive, the position of all the bore holes to be drilled shall be marked in circles with white paint. These shall be inspected by the Contractor's agent.

Boreholes shall be of a size that the cartridge can easily pass down. After the drilling operation, the agent shall inspect the holes to ensure that drilling has been done only at the marked locations and no extra hole has been drilled. The agent shall then prepare the necessary charge separately for each borehole. The boreholes shall be thoroughly cleaned before a cartridge is inserted. Only cylindrical wooden tamping rods shall be used for tamping. Metal rods or rods having pointed ends shall never be used for tamping. One

cartridge shall be placed in the borehole and gently pressed but not rammed down. Other cartridges shall then be added as may be required to make up the necessary charge for the borehole. The top most cartridge shall be connected to the detonator which shall in turn be connected to the safety fuses of required length. All fuses shall be cut to the length required before being inserted into the holes. Joints in fuses shall be avoided. Where joints are unavoidable, a semi-circular snitch shall be cut in one piece of fuse about 2 cm deep from the end and the end of other piece inserted into the snitch. The two pieces shall then be wrapped together with string. All joints exposed to dampness shall be wrapped with rubber tape.

The maximum of eight bore holes shall be loaded and fired at one occasion. The charges shall be fired successively and not simultaneously. Immediately before firing, warning shall be given and the agent shall see that all persons have retired to a place of safety. The safety fuses of the charged holes shall be ignited in the presence of the agent, who shall see that all the fuses are properly ignited.

Careful count shall be kept by the agent and others of each blast as it explodes. In case all the charged boreholes have exploded, the agent shall inspect the site soon after the blast but in case of misfire the agent shall inspect the site after half an hour and mark red crosses (X) over the holes which have not exploded. During this interval of half an hour, nobody shall approach the misfired holes. No driller shall work near such bore until either of the following operations have been done by the agent for the misfired boreholes.

- (a) The Contractor's agent shall very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper and withdraw the fuse, primer and detonator.  
After this a fresh detonator, primer and fuse shall be placed in the misfired hole, and fired, or
- (b) The holes shall be cleaned for 30 cm-of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired holes shall also explode along with the new one.

Before leaving the site of work, the agent of one shift shall inform the other agent relieving him for the next shift, of any case of misfire and each such location shall be jointly inspected and the action to be taken in the matter shall be explained to the relieving agent.

The Engineer shall also be informed by the agent of all cases of misfires, their causes and steps taken in that connection.

**2.9.3 General Precautions:** For the safety of persons red flags shall be prominently displayed around the area where blasting operations are to be carried out. All the workers at site, except those who actually ignite the fuse, shall withdraw to a safe distance of at least 200 metres from the blasting site. Audio warning by blowing whistle shall be given before igniting the fuse.

Blasting work shall be done under careful supervision and trained personnel shall be employed. Blasting shall not be done within 200 metres of an existing structure, unless specifically permitted by the Engineer in writing.

All procedures and safety precautions for the use of explosives drilling and loading of explosives before and after shot firing and disposal of explosives shall be taken by the contractor as detailed in IS: 4081, safety code for blasting and related drilling operation.

**2.9.4 Precautions against misfire:** The safety fuse shall be cut in an oblique direction with a knife. All saw dust shall be cleared from inside of the detonator. This can be done by blowing down the detonator and tapping the open end. No tools shall be inserted into the detonator for this purpose.

If there is water present or if the borehole is damp, the junction of the fuse and detonator shall be made water tight by means of tough grease or any other suitable material.

The detonator shall be inserted into the cartridge so that about one-third of the copper tube is left exposed outside the explosive. The safety fuse just above the detonator shall be securely tied in position in the cartridge. Water proof fuse only shall be used in the damp borehole or when water is present in the borehole.

If a misfire has been found to be due to defective fuse, detonator or dynamite, the entire consignment from which the fuse, detonator or dynamite was taken shall be got inspected by the Engineer or his authorised representative before resuming the blasting or returning the consignment.

- 2.9.5 All usable materials obtained during blasting shall be separated out and stacked properly as directed by the Engineer including all leads and lifts. The unsuitable material should be disposed outside the site boundary which location to be identified by the contractor and same should be approved by the engineer incharge. All the necessary required approvals should be taken by the contractor to dispose the unsuitable material outside the site boundary and a copy of the same should be submitted to Engineer – incharge.

## **2.10 EXCAVATION IN ROCK BY CHISELING**

This includes rock which is easily excavated by blasting, but due to close proximity of structures or any other reason that the Engineer may consider, will have to be excavated by chiseling.

The Contractor may resort to any of the following methods to excavate rock by chiseling:

1. Wedging by means of crowbars, pick axes or pneumatic drills.
2. Heating and quenching.
3. Controlled blasting with a small charge just sufficient to make a crack in rock, which will be subsequently removed by wedging.
4. Chiseling.

## **2.11 EXCAVATION FOR PIPE LINE WORKS**

### **2.11.1 Pipeline Excavation in Open Cut**

- 2.11.1.1 Trenches for pipes shall be excavated to a sufficient depth and width to enable the pipe and any specified or agreed joint, bedding, haunching and surrounding, to be accommodated. For rigid jointed pipes trenches shall be of width not exceeding external diameter plus 300mm or as that shown on the Drawings up to a level of 300 mm above the top of the pipe barrel. Trench width for rigid jointed larger pipes shall be the outer diameter plus 400 mm. The width of trenches for flexibly jointed pipes shall not be less than the outside diameter of the pipe plus 300mm.

- 2.11.1.2 The sides of trenches, manholes and other excavations shall be adequately supported at all times. Trench sides must be vertical, and no battering will be allowed without the express permission, in writing, of the Engineer. Where shown on the Drawing, or directed by the Engineer, the supports shall be left in trenches or pits.

- 2.11.1.3 All surplus unsuitable excavated material shall be carted to outside the site boundary, location identified by the contractor and same should be approved by the engineer incharge.

- 2.11.1.4 No back throwing shall be allowed and all materials must be brought to the surface and placed clear of the trench side.

- 2.11.1.5 Trenches shall not be opened up too far in advance of pipe laying and shall be backfilled as soon as practicable.



- 2.11.1.6** Where dewatering is required, the Contractor shall submit to the Engineer for approval the proposals for the operations including the route of the discharge pipe and outfall location to keep the trench excavation free from water all the times.
- 2.11.2** Excavation for Shafts, Tunnels and Headings (Trenchless construction)
- 2.11.2.1** Construction of pipes in tunnel or heading and associated working shafts shall be executed in a manner approved by the Engineer.
- 2.11.2.2** Working shafts shall be constructed at each end of headings and tunnels at locations as agreed with the Engineer.
- 2.11.2.3** Excavations for working shafts headings and tunnels shall be of minimum practical size to enable the permanent work to be properly constructed. Excavation shall be carried out with great care and in such a way as to avoid any ground movement.
- 2.11.2.4** The Contractor shall employ only specialist labour experienced in shaft sinking and tunneling on these Works.
- 2.11.2.5** The Contractor shall supply and fix to the satisfaction of the Engineer all supports and other temporary construction necessary for the security of the work and adjacent structures.
- 2.11.2.6** Timber used in the construction of headings shall be hardwood treated with an approved wood preservative.
- 2.11.2.7** The Contractor shall provide, operate and maintain suitable lighting and ventilation systems to the approval of the Engineer in all headings, tunnels and shafts. Electricity shall be supplied at no greater than 110 volts for all necessary electrically operated services required during the construction of headings, tunnels and shafts.
- 2.11.2.8** Working shafts shall have a separated ladder bay complete with ladders in addition to any other bay or bays required for the construction of the Works.
- 2.11.2.9** The whole of the working shaft shall be fenced with close boarded timber barriers at least 1.80 metres in height and equipped with red safety warning lights.
- 2.11.2.10** Unless otherwise directed by the Engineer tunnel and heading faces at which work has discontinued for any reason shall be securely timbered.
- 2.11.2.11** All temporary supports or temporary construction of any kind in working shafts tunnels or headings shall be left in place unless otherwise directed by the Engineer.
- 2.11.2.12** No Permanent Works shall be constructed until the heading or tunnel has been driven from working shaft to working shaft and approved by the Engineer.
- 2.11.2.13** Tolerance for excavation of tunnels and heading shall be plus 100 mm per 60m length of drive.
- 2.11.3** **Earth Work and Pipe bedding**
- a) Trench widths shall be as per the following Tables 2.1 to 2.3

**TABLE 2.1: Pipes laid under the roads wider than 3.0 m**

Sl. No.	Outside dia of pipe (mm)	Width of Trench (mm)	Depth of trench (mm)	Remarks
1	50	500	1200	Provide 150 mm thick sand bedding where soils are poor or rock is met with. Increase the depth of trench by 150mm in such cases
2	63	500	1250	
3	75	500	1250	
4	90	500	1250	
5	110	550	1300	
6	125	550	1300	

7	140	550	1300	
8	160	600	1350	
9	180	600	1350	
10	200	600	1350	
11	225	650	1400	
12	250	650	1400	
13	280	700	1450	
14	315	750	1500	
15	355	750	1550	
16	400	800	1550	

**TABLE 2.2: Pipes laid under the roads less than 3.0 m wide/foot paths and valves provided**

Sl. No.	Dia of pipe (mm)	Width of Trench (mm)	Depth of trench (mm)	Remarks
1	50	500	900	Provide 150mm thick sand bedding where soils are poor or rock is met with. Increase the depth of trench by 150mm in such cases
2	63	500	950	
3	75	500	950	
4	90	500	950	
5	110	550	1000	
6	125	550	1000	
7	140	550	1000	
8	160	600	1050	
9	180	600	1050	
10	200	600	1050	
11	225	650	1100	
12	250	650	1100	
13	280	700	1150	
14	315	750	1200	
15	355	800	1250	
16	400	800	1250	

**TABLE 2.3: Pipes laid under roads less than 3.0 wide /foot paths and no valves provided**

Sl. No.	Dia of pipe (mm)	Width of Trench (mm)	Depth of trench (mm)	Remarks
1	50	500	800	Provide 150mm thick sand bedding where soils are poor or rock is met with. Increase the depth of trench by 150mm in such cases
2	63	500	800	
3	75	500	850	
4	90	500	850	
5	110	550	900	
6	125	550	900	
7	140	550	900	
8	160	600	950	
9	180	600	950	
10	200	600	950	
11	225	650	1000	
12	250	600	1000	
13	280	700	1050	

14	315	750	1100	
15	355	800	1150	
16	400	800	1150	

The trench spoil material should be placed where it will not interfere with stringing and jointing of the pipes

## 2.12 DEWATERING

All excavations shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The contractor shall remove by pumping any water inclusive of rain water and sub-soil water accumulated in excavation and keep all excavations dewatered until the foundation work is completed and backfilled. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. Method of pumping shall be approved by Engineer but in any case, the pumping arrangement shall be such that there shall be no movement of sub-soil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. Manual bailing out of water shall be resorted to at locations where mechanical means/pumping out is not practicable.

## 2.13 SUPPORT OF EXCAVATION (SHORING)

The contractor shall provide the necessary support for excavations and shall submit his proposals for the supporting of excavations at least seven days prior to the commencement of any excavation work. His proposals shall take into account the nature of the ground to be excavated, level of water table at the site and the proximity of buildings and roads. Where the depth of excavation exceeds 2 metres the contractor shall:

1. Batter back the sides of excavation to a gradient compatible with the angle of repose of the soil or,
2. Support the sides of the excavation with a system of sheeting and shoring or,
3. Adopt a combination of these.

**2.13.1** When the depth of trench in soft/loose soil exceeds 2 metres, stepping/sloping and / or shoring of sides shall be done. In case of loose and slushy soils, the depth at which these precautions are to be taken shall be determined by the Engineer according to the nature of soil.

Shoring shall be 'close' or 'open' depending on the nature of soil and the depth of trench. The type of planking and strutting shall be determined by the Engineer. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches from collapse. Engineer shall take guidance from IS: 3764 for Scrutiny of design for the shoring and strutting arrangements, and specifying the profile of excavation, submitted by the contractor.

**2.13.2** Close planking and strutting: Close planking and strutting shall be done by-completely covering the sides of the trench generally with short, upright, members called 'poling boards'. These shall be 250 x 38 mm in section or as directed by the Engineer.

**2.13.3** The boards shall generally be placed in position vertically in pairs, one board on either side of cutting. These shall be kept apart by horizontal wailings of strong wood at a maximum spacing of 1.2 metres, cross strutted with ballies or as directed by the Engineer. The length and diameter of the ballic strut shall depend upon the width of the trench.

**2.13.4** Steel Sheet Piling: Steel sheet piling shall be used wherever necessary, as directed by the Engineer.

**2.13.5** Prior to commencement of work the contractor shall submit detailed calculations and drawings of the measures he proposes to adopt to the Engineer and shall obtain his written approval thereof. The engineering calculations and drawings shall be in English and shall

be signed by a Professional Engineer. The calculations shall include slope stability calculations, details of lateral earth pressure, supporting site investigation results, and anticipated surcharged and equipment loads during installation, removal and backfilling.

If in the opinion of the Engineer the support proposed for the excavations by the Contractor is insufficient then the Engineer will order the provision of stronger support than that provided by the Contractor and in this event the Contractor shall adopt the methods so ordered by the Engineer and shall have no claim against the Employer for any costs incurred in adopting this method.

The Engineer shall have right to stop the works at any site, if in his opinion, the Contractor is not adopting a safe method of working.

The Contractor shall not remove temporary works supporting the excavations until in the opinion of the Engineer the permanent work is sufficiently advanced to permit such removal.

Any advice, permission, approval or instruction given by the Engineer related to such support or the removal thereof shall not relieve the contractor from his responsibilities under the Contract.

All temporary works supporting the excavation should be removed during backfilling unless previous approval to the contractor has been obtained from the Engineer. Where temporary supports have been used in the excavations, any such supports left in because it is impracticable to remove them, shall be at the expense of the Contractor.

Should temporary supports get left in any excavation carried out in open cut owing to the Engineer deciding that their permanent installation is necessary for the stability of an adjacent structure or service, the cost such temporary support shall be reimbursed to the Contractor in accordance with the provisions of the Contract.

**2.13.6 Measurements:** The dimensions shall be measured correct to the nearest cm and the area of the face supported shall be worked out in square metres correct to two places of decimal.

**2.13.6.1** Works shall be grouped according to the following :

- (a) Depth not exceeding 1.5 m.
- (b) Depth exceeding 1.5 m in stages of 1.5 m.

**2.13.6.2 Rates:** Rates shall include use and waste of all necessary timber work as mentioned above including fixing and subsequent removal.

## **2.14 FILLING**

**2.14.1** This section of the Specification relates to the use of selected fill materials for general construction purposes, including the backfilling of excavations, isolated trenches and general filling of areas.

**2.14.2** The Contractor shall be solely responsible for finding and obtaining the necessary fill material for the Works. The rates and prices entered in the Bills of Quantities shall include all costs involved in obtaining, delivering, depositing, spreading and compacting the material, including all royalties and other costs/levies, expenses and charges whatsoever in connection with, or arising out of, this work.

**2.14.3** All selected fill material shall be approved excavated or imported granular material, free from lumps of clay, timber, organic matter, rubbish or any other deleterious substance, and containing not more than 20% by weight of clay or silt as defined by the amount passing No. 200 BS sieve.

**2.14.4** The Contractor shall provide representative disturbed samples of selected fill material and shall arrange for tests to be made, as defined in Clause above, at an approved laboratory. He shall submit further samples to the Engineer, and if required, shall be tested in another

laboratory, if directed by the Engineer.

The Contractor shall measure the insitu dry density of the compacted fill, as directed by the Engineer, using the procedures given in IS 2720 – part XXVIII.

The costs of all insitu and laboratory testing and the delivery of all samples will be deemed to be included in the Contractor's rates and prices in the priced Bills of Quantities.

- 2.14.5 Compaction:** Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth wheeled, vibratory, pneumatic tyred, sheepsfoot or pad foot rollers, etc. of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations. The compaction shall be done with the help of vibratory roller of 80 to 100 kN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction. The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval. Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account. Each layer of the material shall be thoroughly compacted to the densities specified. Subsequent layers shall be placed only after the finished layer has been tested according and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identical to that obtained from tests in accordance with IS: 2720 (Part 28). A record of the same shall be maintained by the Contractor. When density measurements reveal any soft areas in the embankment/subgrade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.
- 2.14.6** Soil fill shall be placed and spread evenly to a loose-layer thickness not more than 250mm before compaction. No fresh layer shall be placed or spread until the preceding layer or surface has been compacted as specified and approved.
- 2.14.7** Top soil containing organic matter shall be stripped from the ground surface upon which the fill is to be placed and the cleared surface shall be broken up by ploughing or scarifying to a minimum depth of 200mm. This layer of material which will form the foundation to the fill shall be watered and compacted as per the specification.
- 2.14.8** Selected material shall be spread, leveled and consolidated in layers to the specified levels. It shall be deposited in layers of no greater thickness than 250 mm (loose thickness). Water shall be added as necessary to maintain the optimum moisture content of the fill material. Compaction plant shall be operated so as to give a uniform soil density for each layer. All plant, vehicles and equipment shall be routed evenly over the surface of each layer. Each layer shall be compacted to an insitu dry density of not less than 95% of the maximum dry density obtained using the procedure given in IS-2720-part VII. No layer shall be deposited until the previous layer has been compacted to the satisfaction of the Engineer.
- 2.14.9** Any selected fill material found to be soft or loose, or otherwise not in compliance with this Specification, shall be removed and replaced with approved material, compacted as specified, all at the Contractor's expense.
- 2.14.10** The Contractor shall not fill any area including excavations or trenches until they have been approved, and measured by the Engineer.

**2.15 COMPACTION QUALITY CONTROL**

- 2.15.1** Testing shall be carried out as specified and as directed by the Engineer.
- 2.15.2** The moisture content of each fill layer at the time of compaction shall be within  $\pm 0.5\%$  of the optimum moisture content.
- 2.15.3** Each layer shall be compacted to 95% of the maximum dry density. For all fill soils containing more than 10% oversize material retained on a 19 mm sieve, the maximum dry density obtained shall be adjusted for the oversize material by a procedure approved by the Engineer.
- 2.15.4** Layers placed in the top 300mm of the fill shall be compacted to 98% of maximum dry density.
- 2.15.5** The frequency of Quality Control density testing of each fill layer shall be 1 per 4000 square of compacted soil, or as instructed by the Engineer.
- 2.15.6** Where fill is placed adjacent to structures, or at locations where it is not practicable to use normal plant, each layer shall be compacted by use of pedestrian rollers, mechanical rammers or other suitable equipment. Each layer shall be compacted to the specified density and shall not be greater than 250mm (loose measurement) in thickness.
- 2.15.7 Measurement and Payment**
- 2.15.7.1** Measurement for filling to raise the ground shall be solely based on initial and final levels taken and plotted immediately before and after filling. Both level sheets shall be checked and approved for trenches; basements etc. taped measurement shall be used.
- 2.15.7.2 Rate:** Payment shall include for cost and conveyance of selected material, multiple handling and conveyance of excavated material, labour charges, hire of tools and plants, testing to the satisfaction of the Engineer etc. complete for the finished work.

**2.16 BACKFILLING**

This description pertains to back filling of trenches for continuous pipe lines in large stretches and narrow strips around structures.

**2.16.1 Fill Material**

- 2.16.1.1** All fill material whether such material is brought from outside borrow areas or excavation within the site, will be subject to Engineer's approval. Notwithstanding any approval given to the fill material or borrow areas from which fill material is proposed to be brought, the Engineer reserves the right to reject such material which in his opinion either does not meet the specification requirements or is unsuitable for the purpose for which it is intended.
- 2.16.1.2** Roads, of a temporary nature, required to be constructed for access and for movement of men, materials, equipment, transport vehicles, vehicles carrying fill material, etc, to or over borrow areas and/or to other areas on which fill has to be deposited shall be constructed by the Contractor. Such access roads shall be maintained in good condition during all seasons to ensure completion of the work according to the time schedule. No separate payment shall be made for such items of work.
- 2.16.2 Backfilling**
- 2.16.2.1** Excavated material used as backfilling to excavations or completed structures shall be free from rubbish, vegetation, clods and lumps and shall be approved by the Engineer. The approved materials shall be placed in layers, not exceeding 200 mm in depth before compaction and shall be compacted to minimum 95% dry density.
- 2.16.2.2** Soft material shall not be used for backfilling around structures in rock. The Contractor shall backfill such excess excavation with concrete, rubble, stone or rock fill as directed by the Engineer. Filling other than concrete shall be placed in layers not exceeding 200

mm in thickness, and it shall be thoroughly compacted and have adequate fines content to fill the voids.

**2.16.2.3** Should the material being placed as backfilling, while acceptable at the time of selection, become unacceptable to the Engineer due to exposure to weather conditions or due to flooding or have become puddled, soft or segregated during the progress of the Works, the Contractor shall remove such damaged, softened or segregated material and replace it with fresh approved material at his expense.

**2.16.2.4** The Contractor shall when placing the backfilling make due allowance for any settlement that may occur before the end of the Defects Liability Period, remove any excess material or make up any deficiency by backfilling to the specified levels. As a rule material to be backfilled shall be stacked temporarily at a suitable place.

**2.16.2.5 Measurement and payment**

**2.16.2.5.1** Payment for back filling of earth shall be made on the basis of measurement arrived at by measuring the quantity of excavation less the volume occupied by the structure below formation level.

**2.16.2.6 Rate:** Payment shall include for cost and conveyance of selected material, multiple handling and conveyance of excavated material, labour charges, hire of tools and plants, testing to the satisfaction of the Engineer etc. complete for the finished work.

**2.16.3 Back filling using sand**

**2.16.3.1** Backfilling shall be carried out with sand at places as directed by the Engineer. The sand used shall be clean, medium grained and free from impurities. The filled-in sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded conditions shall be to the Contractor's account. The surface of the consolidated sand shall be dressed to the required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer has inspected and approved the fill.

**2.16.3.2 Measurements:** The length, breadth and depth of consolidated sand shall be measured with steel tape correct to the nearest cm and cubical contents worked out in cubic meters correct to two places of decimal.

**2.16.3.3 Rates:** The rates include the cost of material and labour involved in all the operations described above.

**2.17 GRANULAR MATERIAL FOR BEDDING TO PIPELINES**

Granular bedding material for pipes unless otherwise specified shall consist of free-draining hard, clean, chemically suitable sand of grain size between 1.00mm and 4.5mm.

This item may be included in pipe laying/trench preparation work, in which case no separate measurement and payment are necessary. In case of treating as separate item, shall be measured and paid separately.

**2.17.1 Measurements:** The length, breadth and depth of consolidated sand shall be measured with steel tape correct to the nearest cm and cubical contents worked out in cubic meters correct to two places of decimal.

**2.17.2 Rates:** The rates include the cost of material and labour involved in all the operations described above.

**2.18 SAND FILLING IN PLINTH**

**2.18.1 Sand:** Sand used for filling shall be free from dust organic and foreign matter and its grading shall be within the limits of passing at least 90% through IS sieve 4.75mm and less than 10% through sieve of 150 microns.

**2.18.2 Filling:** Sand filling shall be done in a manner similar to earth filling, in layers not

exceeding 300mm, watering, ramming etc. The surface of the consolidated sand filling shall be dressed to the required level or slope and shall not be covered till the Engineer has inspected and approved the sand filling.

### **2.18.3 Granular Material for Bedding to Pipelines**

Granular bedding material for HDPE pipe unless otherwise specified shall consist of free-draining hard, clean, chemically suitable sand of grain size between 1.00mm and 4.5mm.

**2.18.4 Measurements:** The length, breadth and depth of consolidated sand shall be measured with steel tape correct to the nearest cm and cubical contents worked out in cubic meters correct to two places of decimal.

**2.18.5 Rates:** The rates include the cost of material and labour involved in all the operations described above.

### **2.19 SURPLUS EXCAVATED MATERIAL**

The Contractor shall be responsible for making all arrangements for the disposal of surplus excavated material/unsuitable material arising on any part of the Site to outside the site boundary, location identified by the contractor and same should be approved by the engineer incharge.

### **2.20 ANTI TERMITE TREATMENT**

Prevention of termite is achieved by treating the soil beneath the building and around the foundation with a suitable insecticide approved by the Engineer.

#### **2.20.1 Safety Precautions:**

During application, precautionary measures recommended by the manufacturer shall be strictly followed.

Care should be taken in the application of chemicals to see that they are not allowed to contaminate sources of water, which serve as source of drinking water

#### **2.20.2 Chemical Treatment**

“CHLOROPYRIFOS EMULSIFIABLE CONCENTRATE – 1%” shall be used for anti termite treatment.

The anti termite treatment shall be applied to the soil beneath the building and around the foundation. Further, the treatment shall be applied on the sides of foundation and basement and to the top surface of the filled earth within the plinth walls.

Treatment to soil is provided in accordance with IS 6313 (part II) and on sides of structures as per IS 6313 (Part III). The chemical shall be applied by spraying using hand operated pressure pumps.

##### **2.20.2.1 Application on soil**

Application to soil shall be done over the finished surfaces of excavation at the rate of 5 lit per sq. metre. On top surface of filled earth within the plinth walls shall also be treated at the rate of 5 lit per sq.metre. The chemical shall be applied when the surface is quite dry. Treatment should not be carried out when it is raining or soil is wet.

##### **2.20.2.2 Application of surface of foundation and basement**

On the surface of masonry or concrete foundation and basement chemical shall be applied at the rate of 7.5 lit per sq.metre. If soil is used for backfilling with watering and compacting, after the ramming operation of each layer, chemical treatment shall be carried out by rodding the earth at 150 mm centers close to the structure surface and spraying the chemical at the rate of 7.5 lit per sq. metre. At junctions of walls and floor a small channel 30 mm × 30 mm shall be made at all junctions of walls and columns with the floor and before laying subgrade rod holes are made in the channel 150 mm apart and



chemical applied at the rate of 7.5 lit per sq.metre.

At all expansion joints in contact with floor chemical shall be applied at the rate of 2 lit per linear metre of expansion joint. When pipes or conduits enter the building, treatment shall be provided on sides of the structure where the pipes or conduits are in touch with soil, protection shall be given for a length of 300 mm.

#### **2.20.2.3 Measurement**

Measurement shall be for supplying chemicals and application separate or as a single item. In case of supply and application measured separate, the supply of concentrated chemical in sealed containers shall be measured in litres. Chemicals of different type and/or concentration shall be measured separately. The application shall be measured in square metres correct to 0.01 square metre.

In the case of supply and application as a single item, the measurement shall be applied surface area in square metres correct to 0.01 sq.metre.

#### **2.20.2.4 Rate**

For separate supply and application, rate of supply shall include the cost for supply at site including cost, taxes, duties, conveyance and storing safely. Rate for application shall include cost of labour and hire charges of tools.

Rate for supply and application as a single item, the rate shall include cost, taxes, duties conveyance, storing in a safe place at site, hire of tools and labour charges.