**2.1.3 Borrow Areas**

**2.1.3.1 Earth Borrowed from Land**

The materials to be used for embankments shall be obtained from borrow areas proposed and managed by the Contractor but approved by the Engineer. The contractor shall be bounded under this sub-clause to arrange or purchase earth from private land for fill material. The borrow area shall preferably be located on the river side of embankment and the minimum set back distance shall be 20 m from the toe of the embankment for Sea Dyke, 10 m for Interior Dyke and 6 m for Marginal Dyke. If the Contractor choose the borrow area at the country side of the embankment, the minimum set back distance shall be 20 m from the toe of the embankment for all type of Dyke. The maximum depth of the borrow area shall not be more than I 5 metre. For borrowing earth more than 1.5 metre, approval of the Engineer have to be obtained, The Borrow Area has to be surrounded by putting a ring dyke to prevent the pit from being flooded by river water due to rise in water level in high tide.

**2.1.3.2 Earth borrowed from riverbed by dredging**

Earth borrowed from riverbed by dredging, if found suitable for construction of embankment, can be used upon prior approval of the Engineer. Under this situation, the contractor shall submit, for Engineer’s approval, his methodology of borrowing earth from riverbed. The contractor shall be fully responsible under this sub-clause to arrange Dredgers/Machinery, lease or purchase of private land for disposal of dredged spoil. The dredging area shall preferably be the river portion passes along the location of embankment to be constructed. The dredging of river bed for collecting of suitable soil shall be done following the approved cross section of the river supplied by the Engineer.

The dredged material before being used in constructing the embankments shall be retained in temporary disposal yard until its moisture content attains +10%.

The Contractor shall undertake construction of palisade works, bunds and intermediate bunds, uninterrupted and controlled passage of waste water and other activities as are required to retain the dredged material in the temporary disposal yard.

The Contractor shall carry out operation in discharging of water from the temporary heap/disposal areas without disturbance to existing works, structure, flood embankments, river bank and farm land etc. Pipelines required for disposition of fill materials shall be laid along routes and corridors approved by the Engineer. Any road or river crossings of pipelines shall be constructed so as to minimize interference of all types of traffics both during construction and operation of pipelines.

**2.1.4 Construction Procedure**

i. The Contractor shall plan all fill works to allow for delays in preparing, compaction and testing for compaction, allow for drainage, stockpiling, mixing with dry material or watering to enable the material to be placed in the fill work at the appropriate moisture content for compaction to be effective, take all appropriate and necessary measures to ensure that the filling is undertaken in self-draining layers.

ii. The Contractor shall submit to the Engineer for his approval the details of his proposed method of obtaining embankment materials at least seven (7) days ahead he intends to commence the works. The Contractor shall not commence any filling work necessary for Construction *I* Re- sectioning of Embankment until the Engineer’s approval regarding suitability of filling materials and foundation of the embankment has been obtained.

iii. Unsuitable material shall be stripped from the embankment foundation. The area shall then be scarified or ploughed prior to placing of any fill material.

iv. All foundations of fill works shall be inspected and approved by the Engineer before filling commences.

v. The em6ankment toe shall be marked by nicking out lines 75mm deep and 75mm wide.

vi. The embankment height shall be raised uniformly at all stages during construction. Each layer shall have to maintain a camber at the center during filling so that rain water can drain smoothly from the top of the embankment with no pockets of stagnant water. The crest of the embankment shall be provided with 150 mm cambering at the centre.

vii. In Re-sectioning of existing embankment, the new fill material shall be fully keyed into the old embankment by means of stripping and benching which shall be in steps, each not less than 300 mm. high and 600mm wide. Steps shall be cut in advance of the filling.

viii. The contactor shall make model sections at 500m interval and as per requirement of the Engineer. The model sections should have a length of at least 50m and full height of the embankment. The contractor will notify the Engineer and submit a complete ‘working plan’ describing location of the embankment, staff and labor, tools and plants, quantity of earth work, means of handling and placing etc. No work shall be started until the Contractor’s working plan has been approved in writing by the Engineer.

ix. Notwithstanding the Engineer’s approval of any of the Contractor’s equipment or methods, the Contractor shall at all times be solely responsible for executing the works in accordance with the Specifications.

x. For embankments, if the results of the field density tests show less than the specified density (90% maximum dry density at optimum moisture content with reference to laboratory density test AASHTO modified hammer, ASSHTO T 180) in a certain layer, the whole reach will be rejected and re-compaction shall be required. Successive layers shall not be placed until the layer under construction has been approved by the Engineer.

xi. The Contractor shall provide necessary equipment, labour and transport for carrying out the sampling and testing in the Site laboratory. The soil samples shall be stored and tested at the Site laboratory under the supervision of the Engineer.

**2.1.5 Mechanical Compaction**

i. Embankments shall be mechanically compacted to the lines and grades shown on the Drawings or established by the Engineer.

ii. The material to be compacted shall be deposited in horizontal layers not more than 230 mm thick, and the distribution of materials shall be such that the compacted material will be homogeneous and free from lenses, pockets, streaks or other imperfections. The placing operations shall be such that the materials when compacted will be blended sufficiently to secure the best practicable degree of compaction, impermeability and stability, and for this reason the preceding compacted layer shall be scarified before placing the new layer.

iii. Each layer of material shall be compacted uniformly by use of adequate and appropriate compaction equipment (bull dozer *I* sheep Foot lolIer *I* Vibratory Compactor). Compaction shall be done in a longitudinal direction along the embankment and generally begin at the outer edges and progress towards the center in such a manner that each receives equal compaction effort,

iv. The material shall be compacted to attain 90% maximum dry density at optimum moisture conteflt. with reference to laboratory density test AASHTO modified hammer (AASHTO T180). The Engineer will take samples of the material being compacted (1 sample for each 1000 square metre area compacted in each layer) and will perform tests required to determine that the, compaction is meeting the requirements of these Specifications. The Contractor shall provide a’ necessary aid to the Engineer in obtaining representative samples for testing and performing test at no extra cost.

v. The in situ dry density of the compacted fill shall be determined by the sand replacement method. described in AAHSTO T 191 or similar approved test at locations ordered by the Engineer.

**2.1.6 Schedule of Test**

Following Test shall be carried out at the frequencies shown in the Table to check the suitability of materials, moisture contents of the fill material and dry density of compacted fill as per specifications;

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No.** | **Name of Test** | **Frequency of Test** | **Test Method** |
| 1 | Atterberg's Limit  (Plastic Limit &  Liquid Limit) | 1. For each source of fill materials  2. One Sample for each 10,000 Cum of fill material  3. Change3 in the Characteristics of the material noticed on visual examination. | ASTM D 4318  or Equivalent |
| 2 | Grain Size Distribution | As stated above | ASTM D 422  or  Equivalent |
| 3 | Standard Proctor Test | 1. For each source of fill material;  2. As per direction of the Engineer. | ASSTO T 180  or |
| 4 | Moisture Content | I .For each 5000 cum of fill material  2. As per direction of Engineer | ASTM D 4346 & ASTM D 4944  or V  Equivalent |
| 5 | Dry Density  V | 1. One Sample for each 1000 sqm of compacted surface in each layer  2. As per direction of Engineer | AAHSTO T191  or  Equivalent |
|  |  |  |  |

**2.1.7 Measurement**

Embankment shall be measured in cubic meters based on the cross sections of accepted embankment constructed and completed in accordance with the Specifications, to the lines, levels and grades required or as directed by the Engineer.

**2.1.8 Payment**

Measurements for payment of construction/re-sectioning of embankment with earth borrowed from private land and or riverbed shall be made for the material placed and compacted as per specifications to the prescribed lines, grades and dimensions shown on the Drawings under BoQ Bill No.02, Item No.2.01. The rate includes full compensation of labour, construction equipment: arranging earth from private land/riverbed by dredging (including making all necessary measures as required), arrange land for disposal of dredged earth, hauling, compacting etc. as per specifications.

**2.2 Construction of Cofferdam! Ring Bundh**

**2.2.1 General**

The term ‘Cofferdam/ Ring Bundh’ denotes any temporary or removable structure, constructed to hold the surrounding earth, water or both, out of the foundation pit whether such structure is constructed by earth, timber, steel, concrete or any combination of these. Notwithstanding any other provision made anywhere in the bidding document, the Cofferdam! Ring Bundh under this Clause shall be constructed with the suitable earth obtained from the excavation of foundation trench of structure or borrowed earth or with combination of both as the case be in the field. The Contractor shall be fully responsible for arranging land, borrowing & carrying earth to Cofferdam *I* Ring bundh area with the aid of equipment /labours or any other means.

Cofferdam/Ring Bundhs shall be constructed so as to control water to preclude sliding and caving-in of the walls of the excavation. The interior dimension of cofferdam/ring bundhs shall be such as to give sufficient clearance for the construction and removal of any required forms and the inspection of the interior and to permit pumping.

Palisade works to protect the Cofferdam/ *I* Ring Bundh from being damaged by the wave actions/ thrusts as will be required shall be provided by the Contractor.

Unless otherwise provided, cofferdam/ring bundhs shall be removed on completion of the structure without disturbing or marring the finished work. The Engineer may order the Contractor to leave any part or the whole of the cofferdam/ring bundh in place and this shall not entitle the Contractor to claim for any additional payment.

The Contractor shall submit Drawings showing his proposed method of cofferdam/ring bundh at least ten days prior to the commencement of construction. However, the Contractor shall remain fully responsible the adequacy of the design strength and stability and the safety of the people working therein.

**2.2.2 Construction Procedures**

i) The earth borrowed from the foundation pit of structure or land shall be placed along the alignment of Cofferdam *I* Ring Bundh in horizontal layers parallel to the finished grade not exceeding a loose thickness of 150 mm. The earth of each bucket/basket is to be placed near to the earth placed before it and spread systematically. Throwing/dumping of earth in heaps will not be allowed.

ii) The clods of earth shall be broken down to a maximum size of 100 mm by striking the clods with the back of a spade or by other suitable method before the next bucket/basket of earth is thrown close to it. The earth shall be compacted manually using rammers made of wood, iron or concrete weighing =>7 kg, fitted with shafts of about 1.5 m long. Ramming shall reduce the voids and to be continued until no further shrinkage of earth is possible by ramming.

iii) Before commencing ramming, the moisture content of the soil shall be increased or decreased as necessary by sprinkling the soil with water or by allowing natural drying of the soil as necessary so that the ramming can achieve the compaction as specified. Both wetting and drying may be aided by furrowing the fill and then re-spreading when the moisture content is suitable.