

TECHNICAL SPECIFICATIONS EARTH WORK

1.0 PREPARATION OF WORK AREAS

- 1.01 The centre line of the canal is to be marked on the ground at 30 metre intervals in straight reaches, and at 10 meter interval in the curve portions. The extent of bed width shall have to be marked at similar intervals on both sides. And at other suitable portions for checking of the alignment and gradient of the canal.
This will be done by the Contractor at his own cost and under the guidance of the Engineer-in-Charge or his authorized representative. Bench mark value of permanent pillar will be supplied by the Executive Engineer. for record and guidance. Labour, materials and tools etc. required for the job shall have to be provided by the Contractor, at his own cost.
- 1.02 All shrubs etc. lying along the alignment, and in the entire width of canal area shall have to be cut destumped, aproted and removed by the Contractor within item rate of excavation or stripping. The disposal of these materials shall have to be done as per direction of Engineer-in-Charge.
- 1.03 The degbelling of the canal showing different location, like centre line edged of canal service road spoil, bank drains, berms etc. shall have to be done in the field by the Contractor at his own cost under the direction of the Engineer-in-Charge or his authorized representatives.
- 1.04 All measurements. Drawing and plans shall have to be prepared and kept for records. No separate payment will be made for these works.

2.0 STRIPPING :

- 2.01 Wherever the canal runs in partial cutting or filling carthen embankment is to be provided as per approved plan, drawings and directions of E/I. The area of land falling under the such embankments with an additional margin of 3 meter on either side shall have to be stripped to suitable depth by means of manual or Mechanical methods. All top soil, organic materials weathered rocks, stumps and roots of trees upto 300mm girth, bushes etc. or these stripped earth shall have to be done beyond 160 meters including all lifts and at places indicated by the Engineer-in-Charge. The stripping works done with in the canal banks will be paid at item rates. But no payments for stripping in borrow area will be as this rate is including in the rate of borrowing of fill materials.

3.0 EXCAVATION WORKS :

The sub-surface logging has been indicated in the longitudinal section of the canal as carried out during explorations studies. This information is furnished only as an indication of nature of soil to be met with – Payment will however, be made on actual classification of soil met with during excavation.

The item rates include the cost of dewatering and all other drainage arrangements. The excavation rate also provides for the excavation to be done in most conditions which lie below water table for no separate item rate is provided.

3.01 EXCAVATION OF SOIL :

This shall comprise of vegetable or organic soil, turf, sand, loam clay, mud peat black cotton soil, soft shale for loose moorum, a mixture of these and similar materials which yield to be ordinary application of pick and shovel rack or any other moulder materials having diameter in any one direction not exceeding 300mm. occurring such start shall be deemed to be covered under this category.

This shall also include:

- i. Stiff, heavy, hard shale or compact moorum requiring tools, or pick or both and shovel closely applied.
- ii. Gravel and cobble stone heaving 300mm maximum diameter in one direction.
- iii. Soling of roads paths, etc. and hard core.
- iv. Macadam surfaces such as water bound and bitumen tar bound.
- v. Lime concrete, stone asonary in lime mortar and brick work in lime cement mortar mud mortar below ground level.
- vi. Soft conglomaterial which requires the close application of picks or scarifier to loosen and not offering reistance to digging greater than the hardness of any soil mentioned in (i) to (ii) above.

3.02 EXCAVATION IN SOFT ROCK:

Soft rock excavation shall include only excavation in rocks in hardness and texture as can be carried or split with crowbars. This shall include.

- i) Lime stone and stone, laterite, hard conglomerate or other disintegrated rock which may be carried or split with crowbars.
- ii) Unreinforced cement concrete which may be broken up with crowbars on picks and stone masonry in cement mortar below ground level.
- iii) The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor. Hereby the use of explosive in excavation will not be considered as a reason for higher classification.

3.03 EXCAVATION IN HARD ROCK:

This will include all solid rock in place which can not be removed until loosened by blasting and wedging and all boulders or detached pieces of solid rocks of having dimension of not less than 300 mm. The rock should be such hardness and texture that it can not be loosened or broken down by 'Sabals'. Blasting shall be resorted only after it has been certified by the Engineer-in-charge that blasting is necessary.

The hard rock shall comprise of :

- i) Any rock or cement concrete for the excavation of which the use of compressor, Jack manner and blasting is required.

- ii) Reinforced cements concrete reinforcement thought but not separated from the concrete below ground level.
- iii) Boulders having minimum diameter of 300 mm. requiring blasting, Hard rock requiring blasting as described above but where blasting is prohibited for any season. Excavation has to be carried by chiseling, wedging or any other agreed method, blasting will be permitted only when proper precautions are taken for the protect on of life and all other properties and any damage done to the work or the property of life blasting shall be made good by the Contractor at his expense. No extra Payment shall be made for this.

Blasting shall have to be done in case where removal of hard rock is necessary is bulk.

Blasting near the finished section shall be done with light charges so as not to disturb the sub grade and the bed and slop finished. The blasting so done shall not create checks of fissures lower down as this may result. In. the hard rock so obtained will be nearly stacked by the contractor in sizeable and leveled stacks. No hard rock in such stake should be of size more than 300 mm. in any direction. They will be subject to inspection and no extra payment for stacking or further breaking shall be made. This material will be the property of the department. The same may be issued to the contractor if required.

The rock needed for work of pitching, filter or stone chips etc. shall be utilized out of the excavated hard rock and will be issued by the department at recovery rates decided by the department.

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Excavation in hard rock is supposed to be carried out by use of mechanical meaas in some and by blasting in general case. The mode of measurement of excavation of hard rock shall be as under:

- i) If the area to be excavated comprises of visible hard rock this shall be marked out in specified way in block level plan and the excavated hard rock as calculated by block level and as calculated by stock measurement (deducting voids) shall be correlated by variation worked out. The stack measurement of hard rock shall not ordinarily be less than 90% the maximum 10% difference may be left out for wastage in blasting and carriage which stall be ascertained but the Engineer-in-charge & a certificate therefore shall be recorded in measurement book. If a higher variation is found after being got verified by the Executive Engineer, a report shall be forwarded to the Superintending Engineer for approval.
- ii) For mixed zone where ordinary (soft) rock, moorum etc. and hard rock are so mixed that separate measurement of hard rock by block level is not possible, excavation shall be carried out in usual way by ordinary tools and by blasting. The excavated rock shall be

picked up to 150mm. size and properly stacked. For size 150mm. and below separate stacks shall be made and accounted for which shall be the part of void as discounted and not payment shall be allowed in it. Soft rock and murum etc. shall however be disposed off in suitable way as instructed by Engineer-in-charge.

The total excavation shall measured by block level and quantity worked out for the composite excavation, quantity of hard rock shall be permissible only to the extent of stack measurement.

- iii) In case of stack measurement of hard rock as mentioned para (i) and (ii) the volume shall be computed after making 25% deduction for voids therefrom.
- iv) Wherever blasting is done a proper account of blasting materials has to be kept by the agency and shown to Engineer-in-charge whenever required.

3.04 SEQUENCE OF EXCAVATION WORKS:

After the area has been properly dagbelled and reference points depending upon the contour of the area fixed up and all other arrangements completed. The contractor shall take up work of excavation, work shall be taken up starting from one end of the allotted reach proceeding towards the other end. Only ¼ length will be taken up the slope due to rains, storms of any natural happenings shall be done by the Contractor at his own cost.

3.05 SIDE SLOPES AND GRADES:

The side slopes of the canal is to be excavated and finished as per approved plan, section as indicated in the original drawings or subsequently revised one. It will be better to leave a cover of 30 cm. to 60 cm. over the ultimate finished side slopes in case of earth in the initial stage. This portion may be taken up later in when the canal is completely excavated upto bed level. In case the canal is to be cut in rock portion the specified slopes shall be completed, true to shape and finished as and when the excavation proceed.

The deep cutting, the side slopes above the 1st beam of the canal will depend upon the strata conditions. Suitable berms and drains are to be provided as per approved drawings, The side slope may be as follow between 1st berm and 2nd berm:

In all kinds of soil	1.25	H: 1 vertical
In soft rock	1.00	H:1 vertical
In hard soil	1.25	H: 1 vertical
In between and berm to ground level :		
In all kinds of soil	1	: 1
In soft rock	0.75	H:1 vertical
In hard soil	0.25	H: 1 vertical

Similar slopes & berms are to be provided at both the ends of the allotted reach. In portions of high water table where the side slope is likely to be deshaped earl, the excavation in side slope shall be done so that a cover of 30 cm. to 60 cm. is soft over the finished profiles.

This cover will be removed only when lining work will be taken up.

3.06 DEWATERING AND DRAINAGE:

The item rates of excavation include the cost of dewatering and all other drainage arrangements. Pumps of requisite horse power shall be arranged so that the progress is maintained proportionately. The water is to be discharged in the nearest valley through suitable drains or pipes. The process of dewatering is to continued till the excavations is completed true the profit and section and till the reach is handed over to the department.

Drainage arrangement during construction period shall be done so as to keep the area also free from rain water. These drains shall be provided along the outer toe of the spoil bank or embankment portions at a distance of not less than 2.5 meters at the toe and the inner slope of spoil or embankment are also to be provided to drain the low lying areas where slope is met in the drains suitable stone pitching shall be done to save the soil from deep cuts and erosion.

3.07 SPOIL BANK:

When the earth of obtained from cutting is in excess of the requirement of canal bank the same shall be disposed on side bend the service in safe of squire band. At place it may be practical to disposed the squire on one side only depending upon the line available. Therefore the actual disposed of the shall be made as per direction of the engineer –in –charge. No spoil bank is to be formed out of the excavated earth when the same can be in the embankment before any earth or soft crock disposed in safe of spoil bank . Written permission of Executive Engineer shall be taken point this surplus Earth may also be utilized in filling ditches or other shallow areas as directed by the project Engineer. The areas where spoil is to be made at disposed. It to marked and approved. Suitable profiles are to be made at regular intervals by means of shall not exceed 6 metres above the natural ground level and will depend the depth of cutting and width and the volume of spoil earth.

The formatting of spoil bank shall be made by disposing soil or soft in layers not exceeding 22 cm. (9"from the outer edge. After one layers is spread uniformly the next layers will be spread. The outer slopes shall be finally dressed up when the spoil is brought to correct profiles and grade. The inner edge of the spoil bank is to be kept straight as for as practicable

3.08 MODE OF MEASUREMENT AND PAYMENT FOR EARTH WORK IN EXCAVATION:

The quoted rate for item of earth work shall include:

(a) Ground work including demarcation. layout measurement. making profile of canal selection etc.

(b) Removing grass vegetable organic matter and uprooting trees below 30 cm girth at ground level

Providing machine equipments and tools and plants required for the work

(c)Providing labour amenities. such as Hutments, Kitchen ,Latrines, Water Supply Lightning etc. as per prevalent labour etc.

Final measurement shall be done on the basis of detailed sectional measurement. For this longitudinal section at every 30 meters along the center line of the canal and across section at every 15 meters (or at closer interval wherever required) shall be taken before starting of the work. The cross selection will extend upto 15 meters beyond the proposed outer line of the bank. The long section and cross selection shall be taken in the presence of the

Contractor and plotted and got signed by the Contractor in token of acceptance of the correctness of preconstruction level . Wherever . the original ground may have undulation . the cross section and level shall from the basis for the final measurement , these shall be recorded on the measurement book and got signed by Contractor before starting the work . All cutting should be initialed in full with date and no erasing shall be done . the books containing such measurement along with the plottings, level books (in original) shall be submitted to the superintendent Engineer concerned, who will keep the same in safe custody Certified copy of the same will be kept by the Executive Engineer, who be responsible for check and payment after verification of the finally recorded measurement of the work actually executed. The quantity of earth work to be paid finally will be worked out with reference to the initial section and the final section limited to if the Engineer-in-charge thinks it proper it shall be got restored to the designed section excess of work so found shall be removed departmentally at Contractors cost.

Payments at full rate shall be allowed only for the complete section of the embankment payment for incomplete works on aforesaid sectional measurement basis can be made on reduced rate as decided by the Engineer-in-Charge, if work is found acceptable otherwise.

EARTH WORK IN CANAL EMBANKMENT:

4.00 BORROW AREA (*General*)

All materials required for the construction of impervious, semi-impervious or pervious zones of the embankment and backfill and which are not available from canal excavation or other required excavation, shall be obtained from the designated borrow area as shown in drawing or as designated by the field laboratory.

The limits of each borrow area to be used in the various zones of embankment shall be lagged in the field and materials from each borrow area shall be placed only in the zones for which it has been specified.

The depth of cut in all borrow area will be designated by the E/I. and the cut shall be made to such designated depth only. No shallow cuts will be permitted. Each designated borrow area shall be fully excavated before switching over to the next designated borrow area. Haphazard excavation of borrow pits shall not be permitted.

The type of equipment used and the operations in the excavation of materials in borrow area shall be such as will produce the required uniformity of mixture of materials of the embankment. Borrow pits shall not be opened with a distance of five times the height of the embankment from the outer toe. Borrow pits shall be operated from the outer limit towards the inner limit of the borrow area so that the distant materials will be utilized first. The surface of wasted materials shall be left in reasonably smooth and level condition.

Unless otherwise prohibited, initially earth for making canal embankments shall be obtained manually from the adjoining area upto 160 m. leaving an undisturb strip of 15m. from the outer toe of the embankments. As these areas will mainly be paddy fields, the depth of excavation shall not exceed 0.45m. ensuring the depth of good earth left for agriculture is in no case less than 0.5m. such adjoining areas are not designated as borrow area, as discussed in the paragraph above and shall be left properly leveled by the Contractor, so that it does not affect the subsequent use of the land for agriculture. If the contractor leaves these areas unleveled, it will be made good by the department at the cost of the contractor.

4.01 PREPARATION OF BORROW AREA:

All areas required for borrowing earth for embankment shall be cleared of all stumps rootshushes rubbish and other objectionable materials. Particular case shall be taken to exclude all organic matter from the materials to be placed in the canal embankment. All cleared organic materials shall be completely burnt to ashes or disposed off as directed. Areas shall be maintained free of vegetable growth during the progress of the work. No tree or standing crops are to be cut or destroyed.

4.02 STRIPPING OF BORROW AREA:

Borrow are shall be stripped off top soil sod and another materials which is unsuitable for the purpose of filling. Stripping operation shall be limited only to designed borrow areas. Materials from stripping shall be disposed in exhausted borrow areas of in the preparation of haul roads, cofferdarns, (for water storage) etc or as directed by the Executive Engineer.

4.03 BORROW AREA WATERING:

Borrow areas watering will be doing wherever necessary. It shall be prepared by irrigating the borrow area 48 hours in advance, so that materials may be carried with adequate moisture preferable at O.M.C. determined for the particular type of soil by the laboratory.

The initial moisture content of materials in the borrow area shall be estimated with the help of laboratory tests. The optimum moisture content for the materials in the particular borrow area shall be obtained from the field laboratory. From the optimum moisture content and initial moisture content the amount of additional water required shall be decided. The required additional moisture so decided shall be introduced into the borrow area by watering well in advance of the excavation of ensure uniformity of misture content. If in any location of a borrow area before or during excavation there is excessive moisture, step shall be taken reduce the moisture closest to the optimum by excavation of drainage ditches, by allowing adequate tune for drying for by any other means to aboard formation of pools in the borrow area. During excavation operation drainage ditches from borrow area to the outlet shall be excavated wherever necessary.

No extra a payment shall be admissible for stripping the borrow area of top soil etc as indicated.

Construction and maintenance of approach roads and haulage road will be the responsibility of the contractor for which no extra payment will be made. The department would have full right of way to those roads for inspection purpose. Proper roads signs as directed have to be provided for safety at no extra cost. Contractor shall as directed provide adequate lighting in borrow area and on haulroad. No extra payment will be made for extension of L.T. power line to the borrow area.

4.04 DAM/EMBANKMENT:

The embankment shall be constructed to the lone and grades shown in the drawings. The Dam/canal embankment is divided into zones within which fill materials having different characters area to be placed. The placement of fill within those zones as per the drawings shall be performed in an ordinary sequence and in efficient and workmen like manner, so as to

produce with each zone, fill having such qualities of density strength and permeability as will ensure the highest practicable of stability and performance of the whole embankment.

No bushes, roots, stumps or other perishable or unsuitable materials shall be placed in the embankment. The suitability of each part of the foundation for placing embankment materials there on and on all materials which are to be used in embankment construction will be determined by the field laboratory. The difference in elevation between core and shell zones of the embankment at any cross section above the embankment foundation shall not exceed 0.6m unless specifically authorized by the Executive Engineer.

The embankment for each zone shall be maintained in continuous and approximately horizontal layers in the reach programme for construction in that section. The embankment may be constructed in the discontinuous portion or reaches provided that the slopes of the benching surface parallel to canal exist between previously completed portion of the embankment and materials to be placed in such zone shall not be steeper than 3 to 1 core and 2 1/2 to 1 in the other zones having suitable benches in intervals.

The striping over old existing earth work also includes benching as and where required as per the direction of Engineer in charge.

4.05 PLACING EARTH FILL:

The distribution and gradation of the materials throughout the earth fills shall be as shown on the drawings or as directed. The fill shall be free from lenses, pockets, strakes or layers of materials differing substantially in texture or gradation from the surrounding materials. The combined excavation and placing shall be such that the material when compacted in the earthfill will be blended sufficiently to produce the practicable degree of compaction and ability. No excessive loads of materials than needed for one layer shall be dumped on the earthfill so as to produce the best practicable distribution of the materials. For this purpose the location in the earthfill where the individual loads shall be deposited with a view to ensuring that the placed on the outer shoulders be decided earlier.

The movement of trucks, tippers shall be so guided that they do not pass along the same route, otherwise no proper bond between successive layers will be achieved. The vehicle should have separate to and from path of travel at the levels. Particular care shall be taken to ensure the materials are not so placed as will be conducive to the formation of intermittent relatively impervious blankets in the shell zones, which will interfere with the satisfactory drainage.

No stones, pebbles or rock fragments, having maximum dimension of more than 13 cms.(5") shall be allowed to get mixed with the earthfill. Such stones and pebbles shall be removed either at the borrow pits or canal excavation before being transported to the embankments in any case this shall be removed before materials in the earthfill are rolled and compacted. Such stones or pebbles shall be used in the rip-rap or rock toe of the embankment if suitable or wasted as directed. The materials shall be placed in the earthfill in the continuous horizontal layers, is not more than 22 cms. In thickness to be rolled to 15 cms. or minimum of specified proctors efficiency. The layers shall be so laid to avoid pools of water from in the embankment due to rains. If it is felt that the rolled surface of any layer of earthfill is too dry or smooth to bond properly with the layers of materials to be placed on it the same shall be moistened or be worked with borrow, scarifier or any other suitable equipment, to a sufficient depth as directed Engineer-in-charge, so as to provide satisfactory bonding before the next succeeding layer or earthfill materials is placed. If the rolled surface of any earthfills found to be too wet for proper

compaction of the layers of earthfill materials to be placed thereon, it shall be rocked up and allowed to dry or be worked with borrower scarifier or any other suitable equipment to reduce the moisture content to the required amount, and then it shall be compacted before the next succeeding layer of earthfill materials is placed, when compacting the soil against step rock abutment or wells or masonry or concrete structure and if the foundation surface is too irregular to allow the use of large roller directly against a structure of rock outcrop the large roller shall be used to compact the soil as close to the structure of the outcrop as possible and the portion of the embankment directly against the rock or the structure shall be completed with pneumatic hand tampers within layers contents of the earthfill placed against the rock or the structure shall be slightly above the optimum to allow it to be compacted in all irregularities of the rock and this shall be determined by the field laboratory. In placing the earthfill or rock foundation the foundation shall first be prepared as detailed earlier. Care shall be taken in placing the first employed for compaction. The soil for the first layer shall be placed in embankment at moisture content sufficient to enable satisfactory bonding of the fill with the bottom surface.

4.06 WEATHER CONDITIONS:

Embankment materials shall be placed only when the weather conditions are satisfactory to permit accurate control of the moisture content in the Embankment materials, during shall be graded and rolled with a smooth wheeled roller to facilitate run off. Prior to resuming work. The top surface shall be scarified and moistened or allowed to dry as necessary and approved by the Engineer - in - Charge for resumption.

4.07 MOISTURE CONTROL:

The water content of the earthfill materials prior to and during compaction shall be distributed uniformly throughout earth layers of materials and shall be between 2 to 17 or the optimum moisture content. Moisture determination of soils as well as needle moisture determination of soil shall be carried out as per designation of E 9 and E-22 of USBR/Earth Manual (JULY 60). Laboratory investigation may impose some restrictions on the lower limits of the practicable moisture contents on the basis of studies on consolidation characteristic of soil in embankment. Hereinafter, the term range of optimum practicable moisture content shall refer to the value as described above. As far as practicable the materials shall be brought to the proper moisture content in the borrow before excavation. If additional moisture is greater than requires, the materials shall be spread and allowed to dry before starting rolling. Moisture control shall be strictly adhered to. The moisture content shall be relatively uniform through out the layer material. If necessary, ploughing, Disking, borrowing or blending with other materials may have to be resorted to obtain uniform moisture distribution. If the moisture content is more or less than the range of optimum and adding of further level shall be stopped. Further work shall be started again only when the above conditions are satisfied.

4.08 COMPACTION EQUIPMENTS:

While the specification below provide details of some compaction equipments however, the equipment of particular type and size to be encouraged as may be most suited to the prevailing condition and the programme of construction.

Tamping rollers use for compacting earthfill shall conform to the following requirement.

4.09 ROLLER DRUMS:

Double drum sheep foot rollers shall be used for compaction. Each drum of a roller shall have an out side diameter not less than 140.25cms. (56") shall not be less than 122 cms. (48") in length. The space between two adjacent drums when on level surface shall not be less than 30 cms. (12") not more than 33 cms. (15"). Each drum shall be free to pivot about an axis parallel to the direction of travel.

4.10 TAMPING FEET:

The total number of feet per drum shall be 88. At least one tamping foot shall be provided for 860 cm² (150 sq. inches) of the drum surface area. The length of each tamping foot from the outside surface of the drum shall be maintained at not less than 18 cms. (7"). The cross section area, bearing surface area of each tamping feet shall not be less than 25.80 sq.(4 sq. inches) not more than 645 sq. cms. (10 sq. inches) at plane normal the axis of shank 15 cms. (6") from surface.

4.11 ROLLER WEIGHT :

The weight of the roller when full loaded shall not less 7091 kg. (15.500 lbs.) and the ground pressure when fully loaded shall not be less than 40 kg/cm² (570 psi).

The loading use in the roller drum shall be required to obtain the desired compaction. Tractor use for pulling rollers shall be 50 HP to 65 HP power to pull the rollers satisfactorily at speed of 5 km. per hour when the drums are fully loaded with wet sand blast during operation of rolling. The spaces between the tamping foot shall be kept clear of materials sticking to the drum which could impair the effectiveness of the tamping rollers.

4.12 ROLLING:

When each layer of materials has been conditioned so as to have the proper moisture content uniformly distributed throughout the material, it shall be compacted by passing the sheep foot rollers, the exact number of passes shall be designated by the field laboratory after necessary test. The layers shall be compacted in strips overlapping not less than 0.6 m. The rollers or loaded vehicles shall travel in a direction parallel to the axis of the dam/canal. Turns shall be made carefully to ensure uniform compaction, rollers shall always pulled. Density test shall be made after rolling. Dry density obtained shall satisfy the compaction standards specified on catteries for control of compacted canal embankment of U.S. Bureau of Recalvation (Table-4, Page-275 of earth manual of Bureau of reclamation).

4.13 TAMPING:

Rollers will not be permitted to operate within 1 metre of concrete and masonry structures. The locations where compaction of the earthfill materials by means of the roller is impracticable or undesirable, the earthfill shall be compacted as specified here under.

1. Portions of the earthfill in dam/canal embankment adjacent to masonry structures and embankment foundation designated to be treated as specially compacted earthfill.
2. Earthfill in dam/canal embankment adjacent to sheep abutments.
3. Earthfill in location specially designated.

Earthfill shall be spread in layers not greater than 15 cms. In thickness when loose and shall be moistened to have the required moisture content in accordance with paragraph 4.6. when each layer of materials has been conditioned to the required moisture content. It shall be compacted to specific density by special rollers, pneumatic tampers or by other approved equipment based on evidence of actual performance and filled compaction tests. The moisture control and compaction shall be equivalent to that obtained in earthfill actually placed in the canal embankment in accordance with para 4.6.

4.14 DRESSING SLOPES :

The outside slopes of the embankment shall be neatly dressed to lines as the placing of fill progress. Compaction shall extend over the full designed width of the embankment and materials in earth slopes shall also be compacted to ensure proper compaction of the edge. The cross section of the fill during construction shall be kept suitable wider and the cross section dressed on the designed requirement only after proper compaction.

All humps and hollows varying more than 15mm (6") from the neat lines of the embankment shall be regarded. Materials used to fill depression shall be thoroughly compacted acceptance. Any materials that is lost by rains, weathering or other causes shall be replaced.

4.15 SETTLEMENT ALLOWANCE:

In the earthfill embankment, settlement allowance of 2% will be provided. Accordingly extra height shall be provided but payment for only designed will be made. The base width of the embankment shall not be increased to maintain the designed slopes indicated in the drawing for the additional height as settlement allowance, but the following procedure will be adopted. Settlement allowance will be calculated at various levels where the slope to be changed and the elevation including settlement allowance will be derived. The embankment which at the designed levels remaining same. The edges of embankment at the increased elevations (including settlement.) when joined with the point where the slope has change earlier below shall give and slope to be adopted for contraction.

If the embankment is raised is more than one season provision for settlement shall be made in the last season's constructions by light steepening of slopes over the top.

4.16 MODE OF MEASUREMENT AND PAYMENT FOR EARTHFILL IN DAM/CANAL EMBANKMENT:

The mode of measurement and payment will be the same as described in clause-3.8 of this chapter (mode of measurement and payment and payment for earth work by excavation) The earthfill will involve earth work by head load up to 160m. from the outer toe of embankment as well as transportation by truck or tipper for load up to 160 m. from the outer toe of embankment as well as rate for earthfill shall include all lifts for work done manually or by machine. The designed particulars such as hed width top width. hed level bank formation level etc. and the existing ground level have been indicated in the drawing attached with tender Document. The Contractors are required to quote the rate after complete analysis of the lead and inspecting side condition the contractor shall be required to use the quantity of earthfill available within manual lead and only after utilizing all such quantity earthfill should be transported by truck or tipper first the quantity available up to ½ Km. lead will be utilised. If the quantity within ½ km. lead is exhausted then only earthfill shall be brought from lead exceeding ½ Km. & upto 1 Km only on written order of the Engineer-in-charge

4.17 INSPECTION FAND TESTS:

It is necessary to maintain a through check on the quantity of fill materials delivered to the embankment and that the data and in situ properties of the materials after compaction be obtained for compairs on with design assumptions. To achieve these objective programme of fill testing and inspection shall be planned to effect quality control.

4.17.1 SCOPE OF TESTING AND INSPECTION REQUIRED:

Field control of fill materials will require visual and laboratory checks. The check on the effectiveness of placement and compaction procedures will require to be made by field density tests at prescribed intervals. The control shall be both of the method type and or / on end result basis.

4.17.2 EMBANKMENT TEST SECTION:

Placement of compaction methods specified will have to be verified by test of an embankment section for different zones to be built prior to start in fill operation or at an early stage of construction. Either the initial stage of embankment construction itself could be mode to serve the purpose of test embankment or test embankment or test embankments section could be established in borrow areas. The test sections referred herein shall be used to materials.

- a) Layer thickness of fill materials.
- b) Optimum practicable moisture content.
- c) Number of passes of sheep-foot roller, or weight of vibratory rollers Vis-a Vis number of passes for effective compaction.
- d) For pneumatic type compaction equipment, the test required will be such as to determine. The most suitable ballast loding, tyre pressures, moisture contents and number of coverages for compacting the materials in the zone.

When as appreciable change in materials occurs, additional rest sections should be made during construction. He procedure for construction of test embankment section is as follows :

- i) Select a location the embankment where additional test are being performed. The area 15 M x 30 M (about 50' x 100') should be carefully marked and referenced so that its limits will be easily recognized. In order to expedite the determination of moisture content to be used. More than one set section may be established on the embankment at the same time.
- ii) During construction of the test section which will most probably continue for several shifts, a complete record of the procedure should be kept. This record should include the number of layer placed and the spread thickness of each layer the moisture content at which the materials were rolled, the designation (No 1, No 2 etc.) of the rollers used, the conditions of the rolers (clean or dirty) condition of the materials being rolled such as under the rollers, amount of penetration of the materials being same.
- iii) Check the rollers to make certain that they meet all the requirements of the specifications.

- iv) Determine the required spread layer that will compact to the specified thickness after rolling specified number of times and maintain this thickness as long as number of rollers passes is kept the same.
- v) Using the available data from borrow pit investigation of the materials to be used in the test section, the optimum moisture content as determined by laboratory test will be known and 3 percent less than this moisture content should be used in the 3 or 4 layers rolled.
- vi) After 3 or 4 layers have been placed at 3% less than the laboratory optimum moisture content, field density test should be made through the section. These tests should be made for at least each 93 sq. metres (1000 sq. ft.) of test section area and should be so distributed over the area that they will detect the effects of different compaction conditions encountered during construction for example if the section is located near abutment certain parts of the area will receive more compaction from travel than others, hence some tests should be made in the portion compacted only by the roller and as reported.
- vii) The next step is to compact another 3 to 4 layers at the moisture content slightly higher (1% or 2%) than the moisture content previously used, maintaining the same rolled thickness of layer density tests are again made over the test section
- viii) If the resulting field dry densities (or material passing no 4 sieve) from (vii) above show an increase with increase of moisture then increase the moisture again by another 1% or 2% and repeat the test. If an increase in moisture results in a decrease in field density then place the next layers slightly drier than the original moisture content used and repeat the test. This procedure is nothing more than developing on the embankment a moisture density
- ix) relation or compaction curve for a certain roller, thickness of layers and a given number of roller passes. Special studies during investigation have indicated that the materials being tested should be placed within certain moisture limits to be used have been specified. The procedures outlined above should include tests at these
- x) moisture contents or a moisture contents both greater and smaller than the specified limits
- xi) The roller compaction curve is now compared with the standard laboratory compaction curve. If the field density of materials passing the no. 4 sieve (from the roller curve) is greater than the standard compaction density at the specified moisture content the test section should be continued decreasing the number of roller trips while maintaining the specified desirable moisture content until the most economical compactive effect is determined when the roller trips are decreased, the required spread thickness of layer that will compact to the specified thickness of compacted material should be reworked.

4.17.3 BEFORE COMPACTION :

Materials delivered to the fill shall be visually examined and their properties estimated by way of inspection. These checks shall include.

4.17.4 BORROW AREA:

- i) The maximum depth of excavation from the borrow area will be 1 meter subject to provision that soil cover of latest 0.5 metre above the rocky strata is available for cultivation after excavation.
- ii) Estimation of moisture content of materials by visual examination and feel.
- iii) Samples shall be taken for laboratory analysis in case the soil is of different characteristics.

These inspection checks shall be supplemented by sampling the materials at prescribed minimum intervals and by the resting samples in the laboratory for gradation and moisture content.

4.18.5 EMBANKMENT:

- i) Water content tests shall be carried out in the laboratory while placing the fill materials.
- ii) Moisture content shall be controlled by adding water or aerating the soil according in laboratory tests.
- iii) It shall be ensured that the methods of dumping, spreading and moisture conditions are such that which results in reducing segregation and or variation moisture content to a minimum.

4.18.6 DRIVING COMPACTION:

It is intended that the checks in operation during compactions shall verify:

- i) That the layer thickness of the materials is as specified.
- ii) That the fill is compacted by the specified number of passes of the specific machinery
- iii) That no excessive cutting weaving and scaling of the fill occur during compaction.

4.18.7 AFTER COMPACTION:

The condition of the fill after compaction shall be observed and recorded particularly in respect of cutting of weaving, however, the properties of materials after compaction shall be determined primarily by fill density, routine tests on samples taken from constructed embankments shall be included besides density tests drain size distribution atterberg limit, permeability shear and consolidation characteristics.

4.18.8 FREQUENCY OF TESTING:

It will be necessary to carry out sampling and resting of materials before and after compaction at sufficient frequencies so that the effective checks on the fill operation all maintained. The testing frequencies proposed should correspond to the frequencies shown in table-1. however, the actual frequencies should be adjusted to suit the nature materials placed and the rate of fill placement.

Testing shall be performed at higher rates than those given in table-I during initial stages of placing each zone in order to establish control and testing techniques. Also testing should be conducted at higher rates in case at special problem of control caused by such factors as materials variation, equipment performance and of weather.

In addition, these tests shall be made:

- i) In areas where the degree of compaction is doubtful.
- ii) Areas where embankment in operation is concentrated.
- iii) For "record" tests at the location of all embedded instruments.

Area of doubtful density may be detected by observation by the inspector. Possible locations of in-sufficient compaction include.

The junction between areas of mechanical tamping and filled embankment along abutments or cut of walls.

Areas where rollers turn during rolling operations.

Areas where too thick a layer is being compacted.

Areas where less than specified number of roller passes were made.

Areas where less than specified number of roller passes were made.

Areas where dirt-clogged rollers are being use to compact the materials.

Areas where oversized rock which has been overlooked is contained in the fill.

Areas where materials have been placed when they contained minor amount of frost or at nearly freezing temperature.

Areas that were compacted by rollers that have possible lost part of their ballast.

Areas containing materials differing substantially from the average.

4.18.9 RECORDS AND REPORTS:

Record to borrow area materials and embankment placing operations be maintained in order to have continuous check on the suitability and availability of fill materials and quality of the fill. Thus it will be possible to have a complete description of materials in any portion of the embankment.

5.0 TURFING:

The outer slope of the embankment shall have to be turfed with humous-sods of 6" thick dub or Jamarah grass. Light tamping with proper watering shall have to be done true to the profile and slope. Suitable precautions will be necessary for giving watering facilities to ensure quick growth of turfs at least for a fortnight. Final payment for turfing will be made after the sods catch root.

The humous-sods used shall be in rectangular shape 6" thick and laid so that their edges are in close contact, they shall be gently rammed till they from a level and compact mat. The item rate includes the cost of turf. Homous-sods, their transportation and placing with all leads & lifts.

6.0 ROCK TOE :

The materials for rock toe shall consist of the most durable rock fragments of approved quality selected for the purpose. The quality of rock fragments shall be dense sound resistant to abrasion and shall be free from crack seems shale parting conglomerate bands and other weathering action. The shape of the individual rock fragments shall be angular, Stones of size less than 0.019 cm. shall not be used in the rock toe, if necessary. The rock fill materials shall consist of rock fragments reasonable well graded as determined by Engineer-in-charge upto the maximum size of available stones.

Successive loads of materials shall be dumped so as to ensure the best practicable distribution to the materials as determined by the Engineer-in-charge to the extent practicable the large rock fragments shall be placed on the outer slopes and the smaller rock fragment approximately horizontal layers not exceeding 90 cm. in thickness. The rock fragments need not be hand placed but shall be dumped and roughly leveled in manner to maintain a reasonably spaces with the fill. The voids between the bigger stones after rough leveling shall be filled up. The exposed surface of the rock toe shall be neatly finished as to conform to the designed lines and grades as shown in the drawings.

7.0 DRAINS:

Longitudinal drains as per plan and detailed drawings shall be necessary for leading the rain water away from the canal to the natural valleys. The drains shall be constructed in the prescribed slope and grade. The longitudinal and the side drain leading transversely will be pitched with stone boulders hand packed and flush pointed with cement mortar (1:4). Necessary provision will be made at the toe to transverse drains to dissipate the energy of the falling water wherever leading channels are necessary the same shall have to be constructed. The measurement of earth in drain will be volumetric.

8.0 RIP-RAP/BOULDER PITCHING:

Wherever indicated in the drawing or decided at the letter stage the Contractor shall have to do pitching with good stone boulders of approved quality not less than 9" thick with tight joints. The boulder used for pitching shall be clean, hard, dense and durable. The requirement of pitching to be done just at the edge of concrete, concrete is to be save from getting damaged by the placing of boulders.

The pitching stone shall have the average volume of not less than 3.4. cubic feet the boulder shall be roughly squared and single hammered chisel hand placed, with close joints to the line and grade established by the Engineer in Charge and spaces between stones shall be filled with required size of metal.

9.0 METHOD OF MEASUREMENT:

The method of measurement shall not be in accordance with is : 1200 latest revision, and described in the clause 17.8 and 18.17 of this chapter.

Not with standing any thing contained to the contrary in IS : 1200 1958 the classification of different items of work shall be as per classification adopted in the schedule of item. Further the following works shall not be measured in addition to those which are measured in accordance with IS: 1300-1958 and the quoted item rates shall cover the cost thereo:

- i. Setting out the works including surveying and making of level and co-ordinate with help of reference pillars.
- ii. Providing, fencing, light post, sign board, notice board watchmen, guards barricades ragmen, signals etc. for guarding against accident.
- iii. Proving necessary scaffolding for excavation of work upto completion
- iv. Site clearance including cleaning of fence, logs stumps vegetation rubbish, slush etc. including stacking of serviceable materials as directed by the Engineer-in-charge

- v. Filling of unauthorized excavation hed with concrete pf approved mix as direction by the engineer-in-charge.
- vi. Removal of earth slips
- vii. Removal of slush and dewatering during and after earth work or at any stage of construction till the construction is completed.
- viii. Provision of diversion or surface drains, surface roads and fencing.
- ix. Stripping in the borrow areas.
- x. Extra earth bed for the settlement allowance @ 290 of the height.
- xi. Dewatering and drainage works.
- xii. Curing works:

CLASSIFICATION OF SOIL

All Materials involved in excavation shall be classified by the Engineer Incharge in the following groups:-

(A) Ordinary soil.

This shall comprises of vegetables or organic soil, turf sand silt loam, clay, mud, peat, back, cotton soil, soft shale or loose moorum mixture of these and similar materials which yield to the ordinary application of pick and shovel rake or other ordinary digging implement. Removal of Gravel or any other nodular materials having diameter in any one direction not exceeding 75mm occurring such strata shall be deemed to be covered under this category.

(B) Hard soil

This shall include:-

- (i) stiff heavy clay hard shale or compact moorum requiring, grafting tool or pick or both and shovel closely applied.
- (ii) Gravel and cobble stone having maximum diameter in any one direction in any one direction between 75mm and 300,,:
- (iii) macadam surface such as water bound and bitumen/tar bounds.
- (iv) Soling of roads, path etc. and hard core.
- (v) Lime concrete, stone masonry in lime mortar and brick work in lime/ Cement mortar, below ground level.
- (vi) Soft conglomerate where the stone may be detached from the matrix with picks.
- (vii) Generally any material which requires the close application of picks of scarifies to loosen & not affording resistance of digging greater than the hardest of any soil mentioned in (i) to (vi) above;

(C) Ordinary of Soft rock (Not requiring blasting)

This shall include:-

- (i) Lime stone, sand-stone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars.
- (ii) Unreinforced cement concrete which may be broken up with crowbars of pick & stone masonry in cement mortar below ground level.
- (iii) Boulders which do not require blasting having maximum diameter in any direction of more than 300mm, found lying loose on the surface of embedded in river bed, soil, talus, slope, wash & terrace material of dissimilar origin.

(iv) Any rock which in dry state may be hard requiring blasting but which when wet becomes soft and manageable by means other than blasting.

(v)

(D) Hard Rock:) (Requiring Blasting

This shall comprise of :-

(i) Any rock of cement concrete for the excavation of which the use of mechanical plant of blasting is required.

(ii) Reinforced cement concrete (Reinforcement out through but not separated from concrete) below ground level.

(iii) Boulders requiring blasting.

(iv)

(E) Hard Rock (Blasting prohibited)

Hard Rock requiring blasting as described under (D), but where blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

(F) Marshy Soil:

This shall include soils excavated below the original ground level of marshes and swamps and soils excavated from other requiring pumping or bailing out of water.

MODE OF MEASUREMENT

(A) Earth Work (As per T.E.C.Letter No. 147 dt. 08.04.1976):

(i) Pit measurement shall apply to routine maintenance and repair works as well as to widening and strengthening work.

(ii) Sectional measurement shall apply to the construction of new embankments and other works which shall be applicable to compacted section.

(B) Boulders, stone metal and stone chips etc.

As per decision taken in the meeting of central schedule rate committee held on 15/16.03.1985):

(i) Stacks of boulder of specified size and weight shall be 300mm. for 375 mm. height (25% deduction for voids shall be made)

(ii) Stacks of graded stone metal as per design (size 50 mm, and above) shall be 300mm, for 350mm. height (14% deduction for voids shall be made).

(iii) Stacks of stone chips (Size 50mm, and down) and stone metal of grade III shall be 300mm. for 325mm, height (8% deduction for voids shall be made).

(C) Deduction for voids in boulder pitching work

(As per decision taken in the meeting of central schedule rate committee held on 15/16.03.1985):

(i) 10% deduction shall be made for voids in pitching works on slope & apron under water.

(ii) 5% deduction shall be made for voids in pitching works o slope & apron above water.

(D) Procedure for the measurement of blasted hard rock/soft rock.

Excavation in hard rock is supposed to be carried out by use of mechanical means in some and by blasting in general case. The mode of measurement of excavated hard rock shall be as under:

(i) if the area to be excavated comprises of visible hard rock, this shall be marked out in specified way in block level plan and the excavated hard rock as calculated by block level and as calculated by stack measurement (deducting voids) shall be correlated and variation worked out. This stack measurement of hard rock, shall not ordinarily be less than 90%. The maximum ten percent (10%) difference may be leftout for wastages in blasting and carriage which shall be as ascertained by the engineer-in-charge and a certificate there from shall be recorded in measurement book. If a higher variation is found, after being got verified by the Executive Engineer, report shall be forwarded to the Superintending Engineer for approval.

(ii) For mixed zone where ordinary (soft rock, moorum, etc. and hard rock are so mixed that separate measurement of hard rock by block level is not possible, excavation shall be carried out in usual way by ordinary tools and by blasting. The excavated rock shall be made and accounted or which shall form the part of void as discounted and no payment shall be allowed for it. Soft rock and moorum etc. shall however, be disposed off in suitable way as instructed by Engineer-in-charge.

The total excavation shall be measured by block level and quantity worked out for the composite excavation. Quantity of hard rock shall be permissible only to the extent of stack measurement after deducting voids.

(iii) In case of stack measurement of hard rock as mentioned in para (i) and (ii) the volume shall be computed after making 25% deduction for voids therefrom. No extra payment for stacking shall be made. Hard rock so obtained will be the property of the department and that shall be used in the work as required and the cost of hard rock will be recovered from the contractors bill at prevalent departmental rates. The department has the right to use the hard rock so obtained for any other construction work or in the work if required.

CONTRACTOR

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