ARAB REPUBLIC OF EGYPT

MINISTRY OF WATER RESOURCES AND IRRIGATION
MECHANICAL AND ELECTRICAL DEPARTMENT
ON BEHALF OF
NORTH SINAI DEVELOPMENT ORGANIZATION

NORTH SINAI DEVELOPMENT PROJECT

CONVEYANCE SYSTEM OF EL SHEIKH GABER EL SABBAH CANAL BETWEEN KM 118.560 AND KM 132.500

TENDER DOCUMENTS

VOLUME I (2)

MODEL NO. 2333B <COMMITTEE>
ARTICLE 69: DETAILS AND GENERAL CONDITIONS

(month) 200x

In the Name of God, Most Gracious, Most Merciful

Ministry of Water Resources and Irrigation
The Executive Agency for North Sinai Development Project
Studies, Specifications and Designs Sector
New East Qantara

CONTRACT
EARTH WORKS, LINING AND APPURTENANT STRUCTURES REQUIRED FOR THE CONSTRUCTION OF SHEIKH GABER EL-SABBAH CANAL FROM KM 118.560 TO KM 132.500 NORTH SINAI GOVERNORATE

Table of Contents

Article 69 Details and General Conditions

First: Contract Contents

1. Earth works required to construct the Canal from KM 86.500 to KM 108.47
2. Lining works in plain concrete
3. Required protection works for embankments and berms.
4. Appurtenant structures required for the Canal (Bridges – intakes – syphons, etc)
5. Any other works necessitated by execution circumstances to be entrusted to the Contractor in the work area.

Second: Work Location

Work location is located in North Sinai Governorate. It is the area shown on the map attached with the contract drawings.

Third: Contract Drawings

1. All drawings included in the Contract Documents as well as any other drawings approved by the NSDO and issued during work progress are an integral part to the Contract and its General and Special Conditions, and the Priced Bill of Quantities. All these drawings are liable to amendments; and the Contractor has no right to object to the amendments deemed as appropriate by the NSDO.

2. The Contractor must review the drawings and technical specifications before starting to carry out the works required in the Contract. He must notify NSDO in due time of any observations concerning them; and the Contractor is solely responsible for all the designs included in the working drawings, and technical specifications concerning the works of this Contract, as if they were submitted by him unless a written notification had been previously issued by him that there is a defect or technical default in them.

3. The Contractor must verify by himself of the nature of land on which the Project - the subject matter of this Contract will be executed. He must make the necessary borehole drillings and necessary tests to make sure of the suitability of the soil to lay foundation thereon at the levels and by the method shown on the approved drawings; also, making chemical analysis of the soil at each construction work (like bridges, syphon... etc) to define the ratio of salts and chemical materials in the soil; and also to define the kind and ratio of the cement used, and the treatment method required for protecting the structure.

4. Any amendments to the drawings contained in the Contract, which the Contractor finds proper to suggest to NSDO must be submitted by the Contractor through a specialized consultant office to be accepted by NSDO. These amendments must be supported by a design report, and he shall reply to any inquiries requested by NSDO in this concern, in the way which facilitates NSDO to review and approve before execution.

5. NSDO has the full right to refuse any of these studies, and the Contractor is bound to amend them, or re-submit other studies. All costs incurred for this are included in the contract rates, and the Contractor shall be paid nothing for them.

6. NSDO has the full right, and without the right of any objection from the Contractor to change or amend the canal alignment, and also to amend the drawings or change the cross-section according to what it regards as appropriate for achieving public interest and to finish the work properly.

7. All quantities shown on the drawings and the bill of quantities are estimated quantities. What is to be taken into consideration are the final quantities, verified by NSDO.

8. Before the start of supply or execution, the Contractor must verify the correctness of the quantities estimated on the drawings or the bill of quantities, as well as the required specifications, the rejected materials shall not be paid for.

9. The Contractor must be aware that certain works included in this Contract necessitate coordination with the Armed Forces, and in particular the locations of all appurtenant structures (like bridge, barrage... etc) works. He is bound to carry out all provisions and specifications requested by the Armed Forces through the instructions issued to him from NSDO in this context.

Fourth: Specifications and Special Stipulations:

In addition to what is stated in the General Contract Form 2333 B "Committee" used in the Ministry of Water Resources and Irrigation, the following specifications and conditions are considered complementary and amending it, and to the mentioned specifications and conditions, binding the contractor, while observing that the labor, materials, etc. which are necessary for the execution of the conditions, nothing shall be paid for them to the Contractor unless prescribed explicitly otherwise, or it had a rate in the bill of quantities. The Contractor must ask for a clarification of what he regards necessary from NSDO in this concern.

1- Specifications of Materials Used in Ordinal Works :

- All materials used in the ordinary works must fulfill the conditions prescribed in the Egyptian Standard Specifications, and for all introduced amendments that are released before opening tender envelopes.

* **Soils:**
  Soils used in backfilling around structures or to raise levels must be clean, fine, free from any clods, alien, organic matters, or leftover stones which allows for compression and shall be subject to carry out standard compaction tests on them according to the specifications.

* **Sand:**
  The sand used in all works must be natural, siliceous, desert imported, clean, free from massed blocks, organic or alien or harmful materials, such as salts, silt, mud, shells, alkaline materials and gypsum.

  The Department has the right to issue order for washing the sand and separating the impurities. The source of sand must be identified and samples must be supplied from it and tested before using it. The sand must be graded (according to the specifications and in conformity with gradation tests, and not to be of one size). It must not contain more than 5% of thin stones, and what passes of it through sieve No. (4) ranges between 95% to 100%, and what passes of it through sieve No. 50 by weight must not be more than 30%.

* **Gravel:**
  Gravel must be homogeneous, clean and free from impurities, dust, organic matters, shells and massed blocks. The Department has the right to issue order for washing the gravel if it is not clean. Gravel stone quarry must be identified, and from which samples must be provided for test before using it. Gravel used in ordinary concrete must all pass through sieve with a capacity of 7 cm, and does not pass through shaker with a capacity 0.5 cm (according to granular gradation test that ought to be done before issuing the order) to supply. The gravel used in the fino concrete (concrete with fine gravel) must be of fine size where the biggest size therein is not more than 2 cm, and the rate of shells therein shall not be more than 1%. There must not be more than 5% flattened or rectangular gravel. The gravel used in the reinforced concrete must be graded in such a manner that all of it passes through a sieve whose opening size is 2.5 cm, and does not pass through a sieve whose opening capacity is 0.5 cm.

* **Cement**

The cement shall be ordinary Portland cement or sulfate resistant cement in conformity with Standardization Specifications.

The cement must be supplied at different times, in closed bags, and according to work needs little by little so that the elapsing time from its manufacturing date shall not exceed the fixed period (not to exceed validity date) according to the attached lists.

Kinds of Cement:

- Ordinary Portland cement must not exceed 60 days from its manufacturing date.
- Ferro cement 25 must not exceed 60 days from its manufacturing date.
- Mixed Portland cement (Karnack) must not exceed 60 days from its manufacturing date.
- Quick setting cement must not exceed 40 days from its manufacturing date.
- Sea Water cement must not exceed 40 days from its manufacturing date.
- White cement must not exceed 60 days from its manufacturing date.
- Tank cement (low height) must not exceed 30 days from its manufacturing date.

The Contractor must prepare the places required for storing the cement supplied to work site to protect it completely from ground moisture, rains, air moisture, and to stow it in an orderly way allowing the use of the oldest incoming consignments first pursuant to their arrival dates to the site.

The Contractor is solely responsible for any losses or damages resulting from not abiding by these instructions. The Department has the right to make the required tests on the cement at any time, in one of the approved laboratories at the Contractor expense without objection from his side against it.

The cement must be of the best quality, fulfilling the conditions prescribed in the Egyptian Standard Specifications, as well as any amendments introduced thereupon in any print to be issued before the date of opening tenders envelopes.

* **Additives:**
It is stated as a condition that the additives used must not have effect on the concrete or reinforcement steel. The maximum limit of the quantity used of all additives must be defined. It is estimated as a percentage of cement weight, and a leaflet is to be presented concerning the production of this material to be approved by the Department before starting to use it.

* **Water:**
The water used whether in works of spraying or soil compaction or concrete works...etc. must be from the fresh pure Nile water, free from materials harmful to the works, such as oils, salts, alkaline and organic materials, and also weeds and silt. The rate of water used in concrete works must be the lowest rate in order to give the sufficient consistency for mixing as a percentage of the cement weight according to the design of the concrete mixture according to the specifications of Building Researches Institute. It will be absolutely impermissible to use well water or any underground water. The Contractor solely is held responsible for procuring the water required for completing the works in a perfect manner.

* **Reinforcement Steel:**
Reinforcement steel used in reinforced concrete must be one of the following kinds:

1. Ordinary Mild Steel No. 37
2. High Tensile Steel
   a) Mild 52 or more with protrusions.
   b) Cold Twisted Round Steel Bars.

Type of Steel	Yield Stress	Guarantee Tension at 0.2%	Tensile Strength	Elongation Percentage
	Kilogram Per Square Millimeter			
Ordinary Steel 37	23	-	37	20%
Steel 52	-	36	52	18%
Cold Twisted Round Steel Bars	-	40	50	10%

Reinforced steel must fulfill its relevant specifications stated in the Standardization Specifications (S.S. No. 262/1936). In case reinforcement steel bars are indicated on drawings; it shall be considered the reinforcement steel No. 37 unless stipulated otherwise.
The steel bars must be stored and protected by a way minimizing its being exposed to rust.

The Department has the right to carry out chemical tests to know the texture of the used steel. In this case, the chemical structure must be in conformity with what is stated in the Standardization Specifications for this type of steel.

Steel bars must be cleaned from impurities before cutting them (grease, paints and rust). Steel bars must be cold bent to shape them according to drawings.

* **Wooden Bracing:**
In case of huge construction works, the Contractor must present wooden bracing drawings to be approved by the Department before executing them. They must be designed and established in such a manner that no downfall or contraction occur to any part of the construction works more than that determined, and there should be tenacity among its elements.

The wood used in bracing must be in good conditions and faultless. The poles used must bear the loads to which they are liable. It should be observed to give 1mm bent each one meter in the opening at the middle to face contraction.

- On removing the bracing it should be observed to clear the site and make it empty from the remaining of the concrete, removing all leftovers of the bracing, and painting all its faces adjacent to damp concrete by oil or by any material approved by the Department and to prevent sticking of concrete with the surfaces of bracing.

- The Contractor must not start dismantling the bracing without the approval of the NSDO. In case of using ordinary Portland cement, and at the normal temperature degrees, the bracing may be dismantled 3+2.5 x span (in meter), with a maximum limit of 28 days. In case of cantilever, they shall be
  3+5 x length of cantilever (in meters).

2- Specifications for Earthworks:

Earth Works in Excavation and Backfilling:
They include excavation works of the water course – excavation works for bridges – foundations – abutments – culverts.
Excavation works are divided into four sections:
- Ordinary excavation works
- borrow area excavation works for the purpose of backfilling.
- Excavation works in rocky soil.
- Excavation for structures. (like bridge, syphon...)
- Ordinary excavation works are the works which are carried out by conventional means. They are done according to drawings and instructions under the supervision of NSDO engineer.

As for excavation works in borrow areas, they are the excavation works required for backfilling, and they must be carried out from the borrow areas to be approved by NSDO.

With respect to excavation in rocky areas, they can be defined as rocky areas as they are the areas which are impossible to cut and remove by (Caterpillar D8 tractor) or similar to it, having a single blade. Old concrete or foundations and wall and the like are not considered rocks.

As for excavation works for structures, they are earthworks required for foundations, bases for bridges and barrages and all appurtenant structures. They include all what is required of casing works, supporting embankments, discharging underground water and draining surface and undersurface water, using blinding to protect slopes, construction, maintenance and removal of barriers.

* **General:**

1. All materials unsuitable for use in backfilling will be excluded.

2. The Contractor has the right to use the suitable excavated soil in forming embankments and inclined surfaces of the water course, making designed form for these water courses according to drawings, instructions and specifications.

3. The Contractor is solely held fully responsible to procure all earth materials suitable for use in backfilling, from any distance, provided that the NSDO approves this used earth.

4. During construction, the Contractor is bound to keep the site dry continuously at all times and by any means which he regards proper, by controlling the surface and subsurface water as well as the underground water, and from flooding the site and round work area. This will be done through the methods of draining water (by the different kinds of pumps and wells, or by any other appropriate means).

5. The Contractor must take into consideration that he is fully responsible for promoting and draining water to maintain the safety of excavation and structures.

6. All side slopes shall be according to drawings and the Department instructions, and the Contractor must make sure of the safety and appropriateness of slopes and their balance.

7. On completion of excavation, the sides and bottom will be tested, and in case they do not give results 80% of the relative density, removal of these soils shall be made at a depth of at least one meter; and replacement shall be made on layers with a thickness not exceeding 30 cm, and to compact it up to 80% of the relative density. This layer will be compacted up to a thickness which rises 50 cm over the final surface level of excavation. After that it will be trimmed before lining little by little.

   Backfilling and replacement shall be paid at the rate of compacted backfilling or impermeable backfilling (The Core). Also, trimming shall be paid.

8. Leveled earthworks in excavation sections shall be compacted up to 95% of maximum density or 80% of the relative density under the supervision of the Department engineer, and according to the American Specifications (AASHTO 180 Method D).

9. The Contractor must get approval of the Department to use borrow area in backfilling. All necessary steps and tests shall be at the Contractor's own expense.

   These borrow areas must be used at a depth not result in the accumulation of water. After operation the borrow area must be left in orderly shape satisfactory to the Department.

10. Excavation works by means of blasting shall not be carried out except by the approval of the Department and other concerned bodies.

- Excavation works include all excavation works and removal of all kinds of soil necessary for executing foundation for bridges, barrage and the different structures.

- Excavation for foundations must be carried out by the method which allows for the works of executing these foundations and walls without any amendment or change therein for any reason, and according to the Department approval.

- Excavation works for these structures must be carried out to the levels shown on the drawings or instructions and according to the results of probes and tests, during design or execution.

  Excavation must be made according to the levels; and it is impermissible to start pouring these foundations without obtaining the approval of the Department on excavation works and handing them over.

  Any increase in excavation depths than the foundation levels defined by the Department shall be filled with the same kind of foundation concrete at the Contractor's own expense.

11. In case of the existence of unfit, or unsuitable or harmful materials under the foundations, and pursuant to the approval of the Department, the Contractor will remove these materials and replace them with an appropriate replacement layer under the Department supervision, and to be in conformity with the specifications.

12. All concrete foundations will be poured inside wooden or iron forms unless the Department approves otherwise. In any case, the Contractor is fully responsible for any foundation works not excavated in its right location. He is solely responsible for treating this wrong excavation either by pouring ordinary concrete for foundations, or by placing appropriate replacement layer, and according to the approval of the Department.

13. The Contractor is allowed to use the excavated soil in backfilling around structures if its serviceability is established.

14. It should be observed to make the necessary tests and chemical analysis at the sites of the appurtenant structures (like bridge...) works to determine percentage of soluble salts, and to develop the required and appropriate solutions for each case. These tests are included in Contract rates, and nothing shall be paid for it to the Contractor.

15. All excavation and backfilling works for the appurtenant structures construction from substructure or replacement level to designed embankment level are included in the Contract rates, and nothing will be paid for it to the Contractor. They will be measured with the full length of the industrial work including the course of stones.

3- Excavation Works for Constructing Canals:

1- Excavation works required for the construction of water courses according to pattern, drawings and instructions to a depth and width less by about 25 cm than the required pattern measured vertically on the slope, provided that the bottom and slopes will be compacted according to the above-mentioned specifications.

2- The Contractor must observe complete accuracy in excavation works for constructing water courses because this is connected with lining works. In all cases if excavation levels for any reason exceeds the determined designed levels, the Contractor at his own expense is bound to use suitable backfilling, spreading it and compacting it on layers. The thickness of the layer after compaction shall not exceed 20 cm in order to obtain a dry density not less than 98% of the maximum dry density, or 80% of the relative density according to the Department instructions.

3- Rates of earthworks in excavation include and are charged with transporting and disposing of the soils - surplus excavation not used in backfilling and forming embankments and inclined surfaces - outside public utilities and in such a manner not to contradict with public interest

whatever is the transport distance. All what is required for that is charged to the item unit price and nothing for it is to be paid to the Contractor.

4- Rates of earthworks in excavation include all works of water draining necessitated by work needs and operation circumstances in order to reach the determined levels, widths and slopes, as well as making, maintaining and removing barriers if needed.

5- The Contractor has the right to take backfilling soils from the surplus of excavation works, provided that they are fit for the purpose for which they will be used. The Contractor shall maintain the whole cross section of the Canal till the final handing over, and the final approval of works.

6- The Contractor is bound to bring any equipment - concerning excavation, transporting the excavated materials - which he regards appropriate and acceptable by the Department, such as mechanical excavators - bulldozers, motor graders, scrapers, dump trucks, Dicovil trucks... etc.

4- Backfilling Works:

Generals:

1. The Contractor is allowed to use the excavated materials in backfilling works required to construct embankments (OM road), berms, provided that they are fit for this purpose.

2. The Contractor can obtain the soils required for backfilling and construction of embankments (OM road) and berms from borrow areas approved by the Department.

3. The Contractor must submit to the Department his program concerning earthworks, in which the means and places of obtaining backfilling soil required for work are indicated. Works will not start in any earthworks till the Department approves the program submitted by him.

4. Backfilling materials and soils must be free from plant roots, weeds, building leftovers, stones and blocks withheld on standard sieve No. (100).

* **Kinds of Backfilling:**

Granular Fill

Backfilling materials shall be granules not exceeding 75 mm sorted as follows:
Gw, Gp, Gm, Gc, Sw, Sp, Sm.orsc
Or from a blend of that. Backfilling materials must not contain concentrated soluble salts (sulfates or chlorides) and must not exceed 3% by weight. Also, gypsum rates should not exceed 5% by weight.

impermeable Backfilling:

They are soils containing sorted materials (SM, SC) either obtained from the excavated materials or from outside borrow areas. It should be observed that clay and mud compacted, blended and mixed with sand and thin gravel can be used, provided that the mixture should be enough for impermeability, and suitable for compaction by tire roller. The quantity of this mixture passing through sieve No. (200) will be from 15 - 30 % by weight.

- All sorting works for unexecuted soils shall be done according to the American Specifications ASTM.

- Before the start of processing the soils, the Contractor must submit his arrangements for soil processing program and method of processing to approve them by the Department ; and it must include excavation method.

- In all cases, it is impermissible to process soil works before obtaining the approval and authorization of these proposals from the Department.

- In All cases, the selected backfill, whether from the soils of excavation outcome, or from dirt quarries, or improved soils must be done pursuant to the Department approval, after the submission of samples by the Contractor and approving them before processing in backfilling.

  Anyhow, these materials must be free from the things which affect the structure balance, and embankments balance, and efficiency, such as organic materials, bashred blocks and stones exceeding 10 mm, and substances finer than 0.02 mm at a rate of more than 20%.

Backfilling Behind Structures:

All backfill materials giving acceptable density and compaction will be used therein. Backfilling with materials containing weeds, plant roots, and organic materials will be excluded. Small masses of stones or rocks may be used pursuant to the Department approval, provided that the gaps between them will be filled with fine and graded materials.

It is impermissible to place backfill behind any appurtenant structure (bridge...) construction without a written permission from the Department; and generally it must be observed to avoid exposing the structures to side pressures as a result of backfilling works before concrete setting process. Also, it should be observed to backfill round culverts, pipes and abutments from both sides in order not to expose such works - due to the non balance of backfilling - to horizontal powers that may affect the safety of the structure. Backfilling can be done on layers and stages to avoid any pressures.

It is impermissible to use water under high pressure by means of the different hydraulic methods in compacting works for this backfilling behind the appurtenant structures.

The backfill must be laid in layers, and compacted by the suitable equipment, or compaction by hand or mechanical rammers. Each layer must be compacted up to 95% of the maximum density according to the specifications. In all cases, the layer thickness must not be more than 15 cm after compaction.

Leakage water must be drained from the surface areas which will be backfilled behind the structures after obtaining the approval of the Department, or to be backfilled with the existence of leakage water on small layers. Compaction is to be carried out when the backfilling would have absorbed all leakage water.

The Contractor must resume backfilling works to the level of the natural ground or the designed embankment (OM roads) level. All these backfilling works must be compacted according to the specifications.

*** Methods of Controlling Moisture and Compaction Works:**

The Contractor must submit - his proposals about backfilling works, soil compacting works, control of moisture content and the required compaction and mixing equipment to complete compacting earthworks according to the specifications - to the Department in order to obtain its approval and authorization. These proposals must include the following:

- Statement of the source of water used - methods of measuring the quantity of water used - number and capacity of the water tanks designated for this purpose - kind and number of compaction equipment - kind and number of mixing and stirring, equipment, and control of moisture rate homogeneity equipment.

The Contractor also, must submit a detailed report to review and approve it about the methods of laying backfill soils, the way of operating, leveling, driving away, mixing and compacting

them; as well as all suitable compaction steps, taking into account that the Department approval and acceptance of any of the steps or all of them will not relieve the Contractor in any way from his responsibility for work safety.

5- Earthworks Required for Trimming the Canal :

Typical cross sections show the canal sections on which cross section is indicated. The quantity for which the Contractor will be paid according to **Item No. (5)** of the Main Bill of Rates are the quantity resulting from trimming the cross section **with a thickness of 45 cm including lining thickness,** along the length of the bed and two side slopes to the top level of the berms

The rate includes and applies to removal of all what obstruct excavation works in the course of buildings, or concrete or petrified layers whether visible or dipped.. Also, the rate includes storing the outcome of patterning outside public utilities. It also includes all what is required of experiments and tests for reaching serviceability extent of the soil bearing the lining.

6- Earthworks for Forming the Soil Bearing the Lining (Core):

A) Cases Necessitating This Kind of Backfilling (Core)

1- When the natural ground level is lower than designed water level in the canal to the extent where this difference in levels affect the efficiency and safety of the canal cross section.

2- In case the canal route is passing through an area having a harmful nature on the lining which necessitates making replacement for this whole area.

3- If the Canal route is passing through a narrow area having a bad effect on work safety.

4- Any other cases to be accepted by the Department.

B) Method and Steps of Making This Core:

1- First, excavation and removing excavated soils must be done with a thickness of at least 0.50 meter from natural ground level, with the aim of getting rid of the unserviceable and salty areas, herbs and weeds areas. This will be done before the start of making and carrying out the earth works of the core in particular, as well as all backfilling works required for embankments and berms in general in all parts of the sections where the natural ground level therein is lower than the levels of embankments and berms.

2- In the cases concerning the core, breaking and removing soil will be with a thickness of 0.50 meter of the natural ground level, or one meter from designed bottom level whichever is lower level. The formation of the core soil will be carried out according to the following:

(a) The level of the top core soil will be the designed level of the berm.

(b) Width of the core soil at the top is the width of the berm on each side of the canal, in addition to 0.5 meter to be measured vertically on the Canal slope from the side of the canal centerline, and at the same slope when the designed width of the canal bed is more than 6.00 meter.

(c) The core soil will be made by a width including the two berms and the whole canal section in case of the cross section where the width of the canal bed is 6.00 meter and less.

(d) The outer slope of the core soil under embankments (OM road) are 2:1 and they extend till they meet with the natural ground level after the above mentioned excavation and removal.

C) Principles of Payment:

payment for the Contractor with respect to these works will be as follows:

1- Work of excavation and, removal and excavation with a thickness of at least 0.50 meter will be at the rate of Item No. (1).
2- Works of supply and forming core soil will be at the rate of Item No. (3).
3- Re-excavation works of the water section will be at the rate of Item No. (2).
4- Trimming works will be at the rate of Item No. (5) of the Main Bill of Quantities.

D) The rate of establishing and forming the core soil include all works of tests required to determine the extent of soil serviceability for its being used for this purpose, and the whole works of excavation, transport, dumping, spraying with water, compaction, as well as the required machines, equipment and all the necessary tests to verify work efficiency till the completion of its execution and its conformity with the specifications.

E) Due to the importance of this part of work, no deficiency in its leveling works will be accepted, and in any case the deficiency will not exceed one half percent. It is not allowed for the Contractor to start backfilling behind the core soil, that is to say, to resume completing embankments and berms, except after these works are handed over to the NSDO in such a way satisfactory to it.

F) It must be well known to the Contractor that payment to him for the rate of core soil works will be at an estimated rate related to the rate till the full verification of the inclusive serviceability of the cross section.

G) Principles of payment for the works of establishing and forming the core soil are as follows:

1- 75% of the rate mentioned in the priced Bill of Quantities for any cubic meters to be processed of this soil and to be accepted by the Department.

2- 100% of the rate mentioned in the priced Bill of Quantities after the completion of work for the whole designed section and for a distance accepted by the NSDO.

This is together with observing the principles on which payment is to be made in the periodical payment for the current works and according to the Contract.

H) Tests of estimating soil serviceability in core:
1- Complete mechanical analysis.
2- Distribution of granules by using the hydrometer.
3- Liquidity limit (L.L) or Plasticity limit (P.L) for the granules passing through sieve No. 40.
4- Granules relative density not to be less than 2.50
5- Dry specific gravity (not less than 100 Kg/M3).
6- Total rate of soil salts (Not more than 2%).
7- Total rate of lime (Calcium carbonate) not more than 4%.
8- Total rate of gypsum content (Calcium sulfate) not more than 5%.
9- In some cases, the Contractor needs to make the following tests:

   a- Direct shears test
   b- Triaxial shears test
   c- Expansion after compression test.
   And these tests need undisturbed samples.

10- Core acceptance tests:

a- Layers compaction verification test is used by the means of sand replacement if the core is having big granules, or by means of the cutting core if the core is of the fine particles.
b- Stability verification test (shear test, and measuring permeability).

11- Standards of Core Acceptance:
With respect to verifying layers Compaction:

a- If the soil is of big particle

Retained on Sieve	Maximum Required Density	Maximum Relative Density
From Zero to 25%	85%	70%
From 25% to 100%	80%	65%

b- If the Soil is of Fine Granules

From Zero to 25 %	98%	95%
From 26 % to 50 %	95%	92.5%
From 51 % to 70 %	92%	90%

12- In case of the results of compaction tests are in disagreement with what is shown on the table, the Contractor is bound to re-compact the unaccepted layer till it reaches the minimum limit.
The Department has the absolute right to estimate the number, sites and kind of tests required to be carried out according to the specifications and technical principles.

* **Soil Works Compaction:**

This work includes compacting soil works either by the method of tamping or rolling or by both of them, according to specifications, drawings and instructions, and pursuant to what is mentioned in the American Standard Specifications.

With respect to canals excavation works, after the completion of most of these works, side slopes and bottom of these canals will be trimmed to a depth of about 15 cm, and to be compacted with a masher with (3 roller passes). Flooding with water can be used for compaction and hardening and after trimming to the final condition. The surface will be dampened again and re-compacted to the density mentioned in the specifications.

* **Required Works of Compaction Control:**

Backfilling must be carried out on layers not more than 30 cm thick and compaction will be according to the specifications. The next layer must not be made without obtaining the approval of the Department on this layer.

Leveling works shall be followed to ascertain the safety of each layer accompanied by using the proper compaction equipment regularly.

Also, it should be observed that compaction with respect to canal water section will be made to a level higher with 25 cm than the slopes and final bottom. The final trimming and correction will be made before lining.

- **METHODS OF TESTING:**

(1) Moisture Density Test:

A preliminary study will be made for each kind of the soil to obtain the maximum density rate and average of moisture required for the soil to obtain a sufficient compaction.

Field Density will be obtained, and rate of moisture content for the compacted embankments by field tests according to the American Specifications.
This test will be made in case of embankments and inclined surfaces of canals at a rate of :

- **One test for each 1000 cubic meters.**

or - **One test / one layer / one day, which of them is more repeated.**

Also, it shall be made for remaining kinds of backfilling, including backfilling behind structures at an average:

- **One test for each 200 cubic meters.**

or - **One test / one layer / one day, which of them is more repeated.**

(2) Relative Density Test:

It is for the loose soil which does not give a fixed rate of moisture with view to the maximum density. This will be done according to the American Specifications.

This test will be made with respect to embankments berms at a rate of:

- **One test for each 1000 cubic meters.**

or - **One test / one layer / one day, which of them is more repeated.**

It will also be made for rest kinds of back filling including back filling behind structures at an average of:

- **One test for each 200 cubic meters.**

or - **One test / one layer / one day, which of them is more repeated.**

(3) Material Testing

These tests will be carried out by the Contractor to reach the most suitable materials for use. The following averages are subject to increase or decrease according to the degree of serviceability or materials and pursuant to the NSDO instructions:

a- Particle Size Distribution:
One test for each 1000 cubic meters
Or, One test / one layer / 3 days, which of them is more repeated.

b- Rate of Gypsum Content:
One test for each 1000 cubic meters
Or, one test / layer / 3 days whichever is more repeated.

c- Rate of Soluble Salts:
One test for each 1000 cubic meters
Or, one test / layer / 3 days whichever is more repeated.

d- Direct Shear Test:
One test for each 1000 cubic meters
Or, one test / layer / 3 days whichever is more repeated.

e- **Triaxial Shear Test**
One test for each 2000 cubic meters
Or, one test / layer / one week, whichever is more repeated.

f- **Obtaining the Maximum Density, and Rate of Moisture Content:**
One test for each 1000 M3
Or, one test / layer / 3 days whichever is more repeated.

g- **Obtaining Specific Gravity:**
One test for each 2000 cubic meters
Or, one test / layer/ one week whichever is more repeated.

h- **Obtaining Plasticity Limit**

i- **Rate of Calcium Carbonate By Weight**
One test for each 5000 cubic meters
Or one test / one layer / one month whichever is more repeated.

7- Lining Works:

What is mentioned in this item is specifications concerning lining works such as concrete and joints, and what is concerned with them. These specifications are not applicable to concrete of the appurtenant structures on the cross section, unless there is explicit stipulation for that in subsequent places in these specifications or on the drawings concerning this Contract.

First: Materials Used in Lining:

1- Specifications of Big Aggregate:

- The big aggregates used in lining concrete with sizes not more than 4 cm.
- The aggregates must be of siliceous formation kind, free from tenacious blocks, organic materials, also from harmful materials such as salts, clay, shells, and alkaline materials, and to be with graded size.
- Specific density for the aggregates must not be less than 2.6 .
- Rate of water absorption ranges between 1% and 3% after 24 hours.
- Rate of impurities such as silt and mud which passes through sieve No. (200) (0.0074 mm) must not be more than 2% of the dry sample total weight.
- Stability towards chemical agents of cement reactions is stipulated as a condition. Loss rate in weight must not be more than 10% after carrying out series of sodium sulphate test to the parts passing through sieve No. (3)
- Losses in Los Angles Test for abrasion must not exceed 10% of the original weight after one hundred rounds or 40 % after 500 rounds.
- The non existence of rectangular granules in the aggregates is preferable in order not to increase consumption of cement, sand and water, and to cause coarseness in concrete surface.