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 86.500 AND KM 108.466

TENDER DOCUMENTS

VOLUME I (2)

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

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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 86.500 TO KM 108.466
NORTH SINAI GOVERNORATE

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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.

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:**
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- 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.

- **Granular Distribution of Aggregates will be as follows:**

Size of Aggregate	Percentage
0.75 : 1/50 Inch	40 : 55 %
3/16 : 0.75 inch	45 : 60 %
3/8 : 0.75 inch	55 : 73 %
3/16 : 3/8 inch	40 : 60 %

Taking into consideration that the most important rate in the aggregate is the macadam, and it must be observed accurately in order to obtain the best service for the surface.

- The Department has the absolute right to entrust the Contractor with carrying out all or some of the above-mentioned tests as follows:
- At the start of work to define the suitable stone quarry.
- On changing the stone quarry.
- During work progress, and whenever the NSDO regards that as a necessity.

All these tests are included in the Contract rates, and nothing to be paid of them to the Contractor.

- The Contractor must take into account that the quantity of aggregates used in the works of this Contract are considered huge, therefore, it is obligatory that the Contractor should be completely ready with all required equipment for preparing the gravel such as sieves and mechanical, equipment for transport and mixing aggregates at the original rates to obtain ideal gradation.

- The used aggregates shall not be stored unless they are clean in accordance with the method determined by the Department.

- The Contractor is bound to remove any aggregates not conforming to the specifications, promptly upon the Department notifies him of that without delay, and the Department has the right to take what it regards necessary for work interest to be charged to the Contractor account.

- All stages of preparing the big aggregates whether extraction or transport, sieving, separating, mixing, grading, washing, storing and conveying to mixers shall be subject to the control of the Department which will have the absolute right in any of these stages and at any time to take the necessary measures to guarantee perfect execution. The Contractor is bound to cooperate with the Department in this concern.

2- <u>Sand Specifications:</u>

- The sand will be of the desert kind, clean, coarse, free from excessive impurities, and organic materials.

- Rate of acceptable impurities passing through sieve No. (200) should not exceed 7%.

- It is impermissible to use fine materials resulting from crushers in concrete works due to its containment of a high rate of lime in addition to its huge consumption of cement.

Granular Gradation:

Sieve No.	Size (Millimeter)	Rate of Single Weight of this Diameter to Total Weight of Dry Sample
4	2.67	Zero : 5%
8	2.38	5% : 15 %
16	1.19	10% : 25%
30	0.59	10% : 30%
50	0.297	15% : 35%
100	0.149	12% : 20%
20	0.074	3% : 7%

It should be observed that the rate for sieve No. 50 is not less than15% due to considerations concerning the possibility of serving the surface.

- During any of the stages concerning this work, the Department has the right to carry out the appropriate tests in order to guarantee the serviceability of the sand used. The Contractor must observe that these tests are included in the Contract rates, and nothing will be paid for it to the Contractor.

3- Cement Specifications:

- The Egyptian Standard Specifications, and its approved successive amendments will be applied to select and accept or reject any cement consignment arriving at the site, even if it is a local production. The Results of a consignment should not be generalized on other consignments and each incoming consignment must be treated separately.

- Any bags that arrive at the site opened or containing hardened parts or with expired validity will be rejected.

- The Contractor must use the correct method in storing the cement so as to facilitate using the quantities by the order of arrival to the site, as well as protecting the cement from rain and dampness.

- The Contractor is authorized to use unpacked (bulk) cement stored in special silos; provided that these silos - either for transporting or storing must be tight against humidity, and the manual method shall not be used in charging or discharging.

- Cement used in lining is (the ordinary Portland cement).

- It may be necessary to put other additives in the cement in case the gypsum rate is more than 5%, or the sulphate in water is more than 2000 parts in one million. The Contractor must make sure of that either by making the necessary tests or by defining the kind of cement and additives, and its quantity through the specialized consultant office, and to obtain the approval of the NSDO in this concern.

4- Water Specifications:

The Contractor is bound to procure water sources at work site whether for washing, mixing or curing and the like. This water must be clean and free from harmful materials such as oils, acids, alkali, salts, suspended organic materials and any other impurities. In case this water was from wells, the Contractor is bound to carry out the tests to be approved by the NSDO, and among them the tests of comparing cement setting period, pressure resistance and durability of concrete. The Contractor shall not be entitled to any indemnities in return of these tests. Also, he is not entitled to any indemnities in case of transporting the water from places far away from work site.

Second: **Preparing Canal Cross Section Before Placement of Concrete:**

1- It should be observed to carry trimming not earlier than one day before placement of concrete in order not to expose the soil to erosion, inclement weather conditions, rains, winds, dust and escape of humidity.

2- In all excavation works for upper and lower steps, and upper leakage prevention step, they will be included in the rates of lining item, and the Contractor shall not be entitled to any allowance for them.

3- If rocky stretches appear in the canal alignment, the NSDO shall be consulted to determine the appropriate method of lining. Prices will be agreed upon in due time.

4- For all the different kinds of canal surfaces, the Contractor must spray them heavily with water immediately before concrete placement, in such a manner that the soil will be saturated with water. In view of the importance of this matter, the Contractor must procure the required machines and equipment suitable for this purpose.

Third: **The Concrete Mix:**

1- It is impermissible to measure concrete by volume or by manual methods.

2- Rates of concrete and its contents shall be defined on the following principles:
   a- Drop of concrete from 2 : 3 inch.
   b- Minimum limit of the used cement whatever its kind is 300 (Three Hundred) kilogram cement to one cubic meter of the produced mild concrete.
   c- Minimum compressive strength for ordinary concrete after 28 days will be 220 Kg per each cm2, and taken from the average of three test cubes size 15x15x15 cm carried out in suitable laboratory conditions.
   d- Ratio of water to cement shall range between 0.5 to 0.6 by weight according to the design of the batch submitted for approval.

3- As soon as the order is issued to the Contractor in execution works, he must entrust a specialized consultant office to develop designs for the suitable proposed mixes which fulfill all above mentioned conditions. These designs shall include aggregates grading works, ratio of water and quantities of cement. It is impermissible for the Contractor to start execution works without the review of these designs by the NSDO. In case of the Contractor's delay in carrying out that, the NSDO has the absolute right to entrust whom it regards appropriate to carry out these tests, to be charged to the Contractor's account, and to be deducted from his dues, including costs of labor force, means of travel, transport, materials and cost of tests and consultation fees, as well as all what is required without any right of objection to the Contractor whatever the amount of cost, and without any indemnity to the Contractor for that.

4- The NSDO shall approve the mix design of Contractor within a period of 15 (fifteen days) from the date of receiving it from the Contractor, while considering that concrete mix with ordinary Portland cement is the basis of settling the account of lining concrete costs. The NSDO approval of the concrete mix with its enclosures (if any) are considered part of the Contract documents.

   The Department has the right to make the amendments which it regards as necessary in these mixes after its approval due to new convincing reasons that have arisen during execution and must be taken into consideration.

5- If there is a need to change the cement from ordinary Portland cement to resistant cement, or vice versa according to the NSDO instructions, the NSDO shall pay or deduct only the difference of official price of cement at the time of envelopes opening session without any other differences such as freight or the like.

Fourth: Concrete Mixing:

1- The Contractor has the right to choose the suitable method of mixing concrete whether by using movable mechanical mixers with a capacity from one to two cubic meters, or by using truck concrete mixer with a capacity from 5 to 7 cubic meters, or by using central mixers.

2- Using manual equipment in concrete mixing works is completely prohibited.

3- Mixing time for either movable or central mixers shall be with a minimum limit of one and half times the capacity by cubic meter per minute. As for movable trucks, the number of rounds shall be from 70 to 100 rounds after the completion of putting all components of the batch.

4- Concrete contents shall be placed in the mixer according to the following order, and after weighing each of them separately. (Gravel + Sand + Cement + Water) as water will be added after putting all other contents and during the first quarter of the suitable mixing time.

5- The Contractor should observe that it is permanently required to procure the requirements of testing concrete consistency which must be done periodically each 30 (Thirty cubic meters) provided that the results of these tests shall be recorded in the daily report, and on the form prepared for that.

6- Before starting concrete works, the Contractor must submit a complete list for concrete mixing equipment attached with a complete statement of their technical specifications, together with making them available by the sufficient numbers. All required mixers, weighing scales, and cranes shall be subject to the supervision and control of the Department which shall have the right of moving in any of the stages of concrete preparation till pouring process, to be completely sure of its serviceability and testing accuracy. Resolutions of the Department in this concern on site are considered final and binding the Contractor.

7- In case of rise in weather temperature degrees during the day or bad weather conditions work in pouring concrete will be suspended. In case work program is compressed, the Contractor shall be authorized to work at night pursuant to the NSDO Approval.

Fifth: Transporting Concrete to Placement Site:

1- placement works by manual methods such as large bowl (kettle) hand wheel or dumpers will be excluded with the exception of small works.

2- The Contractor has the right to use the following equipment in conveying concrete from mixers to the placement sites. They are truck mixers or conveying belts or pumping by concrete pumps, or by any other means proposed by the Contractor and to be approved by the Department.

3- The allowed period for transport between the stage of concrete mixing completion and the stage of pouring till placing the concrete in its location is 45 (Forty Five minutes) as a maximum limit. The Department has the right to decrease this period in case of rise in weather temperature.

Sixth: Pouring Concrete:

1- Manual pouring is impermissible, nevertheless it can be carried in the sites of appurtenant structures only.

2- placement of concrete is considered a stage among lining of the canal and it is not an independent work.. Therefore, the Contractor must comply with this work as well as

carrying out the appurtenant structures interfering with the water course if requested before executing lining and concrete placement successively.

3- The Contractor must abide by the dimensions and thickness mentioned in these specifications and Contract drawings, and any increase in concrete surface and thickness shall not be paid to the Contractor as long as no official instructions for it were issued by the NSDO.

Seventh: <u>Concrete Joints:</u>

Concrete joints for lining works are considered of the important works in execution, to guarantee the safety of lining and to ensure performing its function successfully. The one in charge of execution must take into account the importance of this subject to prevent or reduce heat effect to the minimum limit.

Joints are considered an integral part of the concrete structure, with respect to lining, full accuracy must be observed in its execution. All joints and their materiel shall be included in lining item.

(1) Kinds of Joints:

a- Shrinkage Joints

It is a surface cavity in the concrete from the waterside. It extends to a depth of one third of the concrete thickness. Shrinkage joints shall be in the longitudinal direction of the water course, each 3 (three) meters in such a manner that the surface confined between longitudinal and cross joints of lining concrete shall not be more than 12 (twelve) square meters.

With view to the fact that the longitudinal joints whether for the bottom or sides depend on the design and efficiency of the sliding bracing. These joints shall be subject to amendment by the Department. The width of shrinkage shall be 3 cm at the surface and 1.- cm at the bottom.

b- Expansion Joints:

It is a complete gap between two slabs in the traverse direction of the water course to be filled with suitable materials according to what is mentioned in the filling materials specifications among the appropriate conditions of this Contract. Distances between expansion joints shall be each 30 (Thirty) meters, and each (9) shrinkage joints will be followed by one expansion joint, (complete joint).

c- Placement the Joints

They will be where the placement process stops whether this was at the end of a working day, or at the end of a shift, or for rest periods, or for any emergency reason. It is preferable that the placement joint be at the location of the expansion joint.

(2) Forming Joints

First: Shrinkage Joints:

a- With respect to surface shrinkage joints which do not exceed one third of the concrete thickness, they shall be cut while the concrete is still elastic during a period ranging between 3 – 12 hours of the completion of leveling the surfaces according weather conditions. This will be done by cutting edges having the same shape of the joint sector, according to what is shown on the drawings, and pursuant to the instructions.

b- The Contractor must observe full accuracy in forming shrinkage joint and executing it at its determined spaces and dimensions, and by choosing the suitable time for cutting so that it does lead to the irregularity of the opening or the escape of aggregates or the occurrence of irregular cracks.

c- With respect to bottom works, the Contractor is authorized to place fixed moulds to separate the slabs in such a manner that conforms with the dimensions of the joint sector, and provided that they shall be removed prior to the tenacity of concrete on them.

d- Direction of the joint shall be perpendicular to the concrete outer surface at the joint location. This is to participate in resisting the slipping of slabs, and exposing the filling materials to the least possible stresses.

Second: Expansion Joints:

a- Expansion joint will be formed by filling the proposed gap location before pouring at the full thickness of the lining slab. This is by placing a wooden joint to be removed after pouring.

b- The Contractor is authorized to shape expansion joints by the method of cutting or sawing in the fixed locations and exactly to the fixed dimensions. This will be done at the complete thickness of concrete from the surface till the soil behind lining slabs or down it, and provided that the expansion joint shall be filled with a suitable filling material to be approved by the Department.

c- This applies to the cases of joints at the end of an work day.

d- If work is suspended in lining slabs for any emergent reason, expansion joints will be created by leaving a space in the suitable area, and which its elastic state allows for that, and the rest of concrete after the joint will be excluded.

(3) Joints Preparations for Receiving Filling Materials

a- Expansion and shrinkage joints must be clean so as not to hinder adhesion and tenacity of the joint material to the concrete sides.

b- After opening the joints, they will be cleaned by a mixture of compressed air and water to remove concrete sediments, such as scrap of cutting concrete or deposits of pouring concrete.

c- After washing the joints by a mixture of compressed air and water, the joints will be sand blasted by compressed air charged with sand to guarantee a perfectly clean joint surface.

d- After finishing sanding process, the joints will be blasted with compressed air to remove remains of sand and sanding, and to make sure that the openings are dry from water and humidity.

e- Using solvents for cleaning process is prohibited due to the concrete porosity.

f- After that, all joints will be handed over ready to representatives of the NSDO in order to be inspected to make sure that they are clean, dry and with correct dimensions before authorizing the Contractor to carry out painting process which precedes the filling process.

g- After the elapse of 12 hours of painting process, the Contractor will be authorized to carry out filling works.

h- The Contractor must supply all equipment, machines and instruments, and labor force trained on this kind of work, as well as all work requirements according to what is mentioned before.

(4) Filling the Joints:

a- With respect to the front material for filling expansion and shrinkage joints, it will be supplied to the site in a liquid form originally. It hardens quickly within minutes after mixing and placing it in its place exposed to weather conditions and water. Also, it prevents water from passing through the joints. It should be observed in filling materials that they have the properties of each processing, tight cohesion to concrete surfaces, and similarity of formation.

After filling its shrinkage will be extremely little, and it must have a high tensile strength, and high leaking strength, and high laxity strength. The allowable limit for shrinkage and compression should not be less than 25%, and this materials should not contain compounds harmful to health.

The filling material required for joints in this Contract is Polysulphide Material, it shall be mixed in the site with two groups of liquid compounds. It hardens at high temperature degree, and does not need heating but it solidifies by means of chemical materials. This material must fulfill and conform with the Egyptian Standard Specifications, and American Standard Specifications and the British Standard Specifications.

Before concluding a contract for supplying these materials, the Contractor must furnish the Department with its specifications and method of employing it. The Department has the absolute right to
request analysis of Polysulphide samples in specialized centers before approving it with the aim of making sure of its conformity with the above mentioned specifications; and the Contractor shall bear the cost.

b- **With respect to the back material for Filling the Joints**

It shall be supplied solid. It is fixed and placed between the front filling material and the final back material for the joint from the soil side with the aim of improving the performance of the front joint material and maintaining it. It must be of a material that does not stick to the front joint filling material, and no bitumen materials enter in its manufacturing. Also, it must be characterized by complete elasticity.

Accepted kinds are Neoprene or Cork material.

Before concluding an agreement for the supply of these materials to the site, the Contractor must furnish the Department with their specifications showing its complete fixation, properties of resistance and elasticity, and the methods of employment for obtaining approval.

The Contractor is prohibited to supply any quantity of joints filling materials before the Department approves these materials.

(5) <u>Method of Filling the Joints</u>:

a- The Contractor must provide trained manpower for the process of filling the joints, and in particular because it is a process that needs accuracy and skill.

b- Joints will be filed with back material or after spraying joint surface with the preparation solution by about 12 hours and its being dried. The back material shall be placed by wooden chisels, or special wheels that presses it to its location exactly. Then the joints will be filled with the front material.

c- The front material shall be prepared for use by carrying out the process of mixing, stirring and blending to the determined rates according to the specifications, and pursuant to the producer instructions. Processing shall be carried out by a suitable

method in such a manner that filling will be from top to bottom at a constant speed, for guaranteeing material homogeneity. It should be observed to avoid confining air inside the filling material and also the non flow of the material outside the joints. After the completion of filling, the surface will be leveled by means of an iron; and a proper plastic tape can be stuck on both sides of the joint opening to let the filling material stick to it. Then it will be removed after ironing.

d- It should be observed to fill the joints at the time of low degree of weather temperature to facilitate work and reduce initial stresses on the filling materials.

e- The Contractor must take all precautions to protect workers performing work, by providing protective goggles and gloves, and protecting the material itself from water and fire during storing or transporting. It shall be impermissible to use a mixture more than needs, together with observing to clean the filling stools after each use.

f- It should be observed not to expose the back filling material to sun rays during its storing to avoid its being liable to twisting and dissolution.

g- The Contractor is bound to submit all specifications of filling materials to approve them by the Department, and to submit also brochures of filling materials for reviewing and approving them

Eighth: <u>Concrete Treatment:</u>

1- The Contractor must take all appropriate measures to reduce capillary splitting in the concrete with all possible means. He must observe that treatment of concrete starts immediately after the completion of pouring, and leveling, and the disappearance of free water from the surface.

2- The Contractor is bound to treat the concrete by using chemical materials which shall be sprayed on concrete surface immediately after pouring to fill the pores, and to maintain the humidity required for the complete reaction of the cement, and in such a manner to guarantee maximum possible resistance of the concrete, and to prevent quick dryness of the concrete surface, to avoid the occurrence of any splitting or cracks in concrete surfaces. These materials shall be corresponding to the American Specifications for Testing Materials issued on 1965 and its successive amendments.

3- White color hangings are the only preferable hangings to contribute in reflecting sun rays from concrete surface. Spraying shall be carried out according to the American Specifications for Testing Materials, above-mentioned.

4- Treatment of suspended particles shall be sprayed by special sprayers, either to be attached to the sliding bracing or to move behind them independently, provided that spraying pressure shall be from 5 to 6 kilogram / square centimeter.

5- The period between completion of concrete surface leveling and spray of treatment suspended particles shall not be more than two hours in a suitable ordinary weather conditions. It shall be carried out after the disappearance of brightness of this surface. But in hot weather conditions spray will be carried out immediately after leveling the surface.

6- The Contractor must maintain the suspended particles layer sticking to the concrete for a period of at least two weeks after spraying it. He must spray or paint any areas in which this layer is scratched and specially at joint locations.

7- Treatment suspended particles shall not be sprayed except on the finished surfaces.

8- No other treatment method shall be accepted from the Contractor save the suspended particles and paintings, as the method of spraying with water in treatment is for the side inclinations.

Ninth : Lining Repair:

1- The Contractor must observe full accuracy in carrying out the specifications and drawings of this Contract. Any violation of one of the conditions leading to unacceptable defect in the works shall be born by the Contractor alone, and at his own cost, and without any indemnity from the NSDO.

2- Repair works of the capillary cracks that may appear in lining slabs and do not exceed 2 mm can be treated by painting with any waterproof solution after preparing concrete surface for these paints, and according to the NSDO instructions.

3- Repair works for shifted, twisted, dropping or inclined slabs shall be made by the complete removal of these slabs and pouring other replacement slabs, either by pouring in the location, or these slabs may be pre-cast or reinforced. All these works shall be carried out at the cost of the Contractor, and without any indemnities from the NSDO.

4- Repair works for joints shall be made by removing them completely, then returning them to their place by the suitable method to be approved by the NSDO.

Tenth: Bases of Payment for Concrete Lining Works:

1- The surface area computed for the Contractor is the surface confined between the outer edge for lining of the two berms including horizontal lining, and both side slopes and the bottom measured in a perpendicular direction to the bottom width. As for the vertical steps either in the berm or bottom or lower beams works if any, they are included in the rate of surface.

2- The rate includes and is charged with supplying the equipment, machines, material and required manpower, as well as installation, operation, maintenance, supplying, piling and storing, works of protection, and the different kinds of repair, and all what is required of embankments works and dewatering suitable for the nature of the area.

Also, the rate includes and is charged with all what is mentioned on the Contract drawings, regarding lining unless stipulated explicitly otherwise.

3- With respect to in process payments, and without prejudice to what is mentioned in the General Contract applicable in the Ministry of Water Resources and Irrigation and Water Resources – Form No. 2333 B "Committee", and all financial laws, regulations and instructions, and the provisions of the Law No. 89/1998 concerning the organization of Tenders and Biddings and its executive regulations promulgated by the Decree No. 1367/1998, The Contractor shall be paid according to the following bases:

- 80% (Eighty percent) of the rate for lining item which was submitted by the Contractor in his accepted tender when pouring a continuous and complete distance for bottom, inclinations and the two side slopes, or one of them.
- 90% (Ninety Percent) of the rate for lining item on the completion of joints and filling them for the same above mentioned continuous distances.
- 100% (One Hundred Percent) of the rate of lining item on the success of the inclusive testing experiment shown on the Bill of Quantities.

It should be observed in all works to deduct a rate of five percent of the Contractor dues, for any amount spent as mentioned in the Contract stipulations.

Eleventh: Inclusive Testing of the Water Section:

Comprehensive test for the water section works is a test of the serviceability of one of the reaches on the Canal – the subject matter of this Contract, with the aim of making sure of the safety of the canal water section after lining it, and the extent of its impermeability for water, as well as its durability after launching water therein. The success of this test for one of the

reaches will not prejudice what is mentioned in the General Provisions of this Contract with respect to the date of initial handing over and final handing over and insurance.

(1) **Preliminary Works**

- It is necessary first to complete soil and lining works in the reach required to be tested.
- At the start and end of the reach required to be tested a barrier will be constructed.
- It should be observed that the pipes of the well for levels measuring instruments must be ready or to be executed during work progress in such a manner that it does not disagree with it.
- The tested reach must be cleaned of the accumulated fine sand on the bottom and sides of the reach, and it should be taken into consideration to clean the fine sand with full accuracy, as the existence of fine sand reduces to a great extent leakage from the canal bottom, and consequently gives incorrect results about the permeability of lining works. The Contractor will be allowed to release water in the tested reach except after its being thoroughly cleaned from fine sand by the Contractor.
- On the upper step of lining and on both banks points will be marked out by paint in clear color each 50 meters (Fifty meters) and for each KM of the Canal, and to define their levels accurately to the nearest cm by the NSDO engineers, and the contractor engineers. It will be reviewed by the concerned assistant manager of the works.
- The automatic set for measuring the levels will be installed in its fixed location and in its relevant well.

(2) **Works of Launching Water and Measuring Leakage:**

- After the preliminary works, water will be launched in the tested reach by one of two ways – either by using powerful pumps which draw water from the source to the tested reach, or by constructing small channel through the front barrier of the reach by means of which filling the reach will be organized. The Contractor will be authorized to use connecting method between the above mentioned two methods. However, whatever was the method by which the reach will be filled, and in any case the filling period must not be less than ten days and not to exceed fifteen days.
- Filling works will continue till water levels reach fifty cm from the level of the concrete berm (Lining upper step) in the location of levels measuring set. It will not be allowed to stop filling works before reaching the level even if the above mentioned filling period was exceeded.
- Water levels must be observed during the filling process till reaching the Final level exactly.
- After the completion of fillings works, water source will be closed, and the paper of the set will be adjusted for recording and the hour and starting date of measuring leakage will be fixed.
- Measuring works of dropping levels in water level in the well shall continue to the nearest of the following two periods:
  360 hours calculated from the hour where water levels in the tested reach be in the defined level.
  Dropping of water to the level of the guide pipe of the levels monitoring set, and consequently the impossibility of taking readings by the set.

- It should be observed that the NSDO engineer will daily inspect the set even if the test period was during official holiday.

  Also, It should be observed that the NSDO engineers will personally change levels papers weekly, and adjust drawing scale and the location of observation needle according to the instructions shown in the set brochure. Generally, operating the set and maintaining it shall be carried out by the NSDO engineer personally.

  Also safeguarding the set is entrusted to the Contractor and his representatives on the Site.

  Any acting fraudulently with the instrument or negligence will lead to canceling the test and making it again and at his own cost.

(3) **Works following the Completion of Observing Dropping Levels of the Water Surface:**

- The levels previously defined shall be reviewed first to know the dropping value, and this will be done by the same method in the referred to period.

- All concrete slabs will be checked to determine their safety and their being free from defaults according to what is indicated in subsequent place. It must be observed that all slabs of the reach are unimpaired before starting the works of the comprehensive test and without apparent defects.

- All joints between concrete slabs shall be checked to determine their safety and their staying in their places.

- Observe discharging the whole reach of water by means of pumps to enable inspecting the slabs and joints for the complete sector of the canal with the full length of the reach if the results of tests are meeting the standards shown in the norms of success of the experiment mentioned thereafter. This will be mentioned in an official report between the NSDO representatives and the Contractor. The report must be consolidated with the documents of the experiment, and specially the diagrams of levels measuring appliance.

  In Case of fulfilling the required standards, the Contractor will be entitled to be paid his remaining dues of the lining item, in addition to payment of the experiment amount – Item 12 of the Bill of Quantities.

- In case the experiment results are not complying with the acceptable standards according to the terms (a & b) of paragraph (6) regarding the standards of the success of the comprehensive test, whereas the terms (C, D & E) of the same paragraph are corresponding, the experiment will be repeated again. In this case, the Contractor is entitled to an additional allowance for this experiment which is equal to the value of Item No. (12) of the Bill of Quantities concerning the works of the comprehensive experiment. No additional period will be added in favor of the Contractor for the works of this Contract as a result of this.

- In case the terms (a & b) concerning the standards of success of the experiment of the paragraph are corresponding, whereas the terms (c, d & e) of the same paragraph are not corresponding, in this case, the Contractor is bound to carry out all repair works for lining slabs or joints or both of them, by the methods that were mentioned in previous places in these specifications, or by any other method regarded appropriate by the NSDO in due time. In this case, the Contractor shall not have the right to claim for any material or time indemnity for repair works.

- But if all terms or acceptance standards are not corresponding, in this case, the Contractor is bound to carry out all necessary repair works in this reach whatever they were, and no matter what their cost will be, even if it is necessary to remove all what was done, and repeat it once again. Also, the Contractor is bound to carry out an experiment concerning leakage measuring with its derivatives once again till the full realization of the success standards.

  The Contractor will bear alone all obligations, expenses, and the results of the delay caused by the non realization of the works of acceptance standards.

  The Contractor will not be authorized to continue in works of the reaches following the tested reach which does not realize the acceptance standards due to the possible existence of a significant defect in the works which he is performing until the safety of the works of the tested reach is verified.

  After finishing the slight repair works of the tested reach which is fulfilling the acceptance terms, the front earth barrier will be removed according to the technical principles.

(4) Automatic Instrument for Observing Levels:

It is an instrument for observing water provided with a lower float and wires to convey movement to the upper instrument, and a pen point to record the levels on diagrammatic paper for recording by a special movement instrument provided with a clock to be wind up once per week, and a hoop for recording and a box for transport. There are various types of it. The type used must be fit for recording levels to varied drawing scales the smallest of them is 1:10 to be wind up once per week.

It is provided with a reserve pen point and a quantity of recording ink.

The Contractor is bound to supply the required instrument, taking care of it, maintaining, transporting, guarding and installing it under the supervision of the NSDO engineer.

Before supplying the instrument to work site, the Contractor is bound to submit its brochures to the NSDO for approving it before supply.

Any instrument supplied to the site not conforming to the above mentioned conditions, and without a prior approval of the NSDO shall not be authorized for use, and the Contractor alone shall bear the obligations resulting from that. The Contractor must take into account that the instrument has special diagrammatic paper size (10x50) cm to be supplied with the instrument. The one sheet of paper is sufficient for the use throughout the experiment period. The Contractor is bound to procure all requirements of the instruments of papers, ink and recording pen points throughout the operation period. The Contractor is bound to fix the instrument accurately, and to install it tight on the mouth of the observation well according to what is shown on the drawings, and pursuant to instructions in a manner that it will be stable and not to be affected by vibrations. Also, an iron box will be placed round the instrument. It has a lock with a key to be kept by the NSDO engineer personally, to enable him to follow up personally observation works daily.

All costs of this work are included in the rate of item No. (12).

(5) Leakage Calculation:

Calculation of leakage for the tested reach will be done on the special form prepared for that purpose by the NSDO in due time. This calculation will be carried out pursuant to the following principles:

- Dropping period will be divided into intervals each of them is 24 hours and according to the levels at the start of each interval and at its end. The following can be calculated:

a) Width of water surface at the start of interval (X1) and at its end (X2). Arithmetic average will be taken for it.
Its arithmetic average $\frac{X1 + X2}{2} = X$

b) Wetted Perimeter of the weir at the start of interval
(B + 2Z1 = Wp1)
and at its end (B + 2Z2 = Wp2) arithmetic average for it is to be taken
$\frac{(Wp1 + Wp2)}{2} = Wp$

c) Cube of water lost by leakage (QL), and vapor (QE) during the interval = QE + QL = X.Y.L = Qt
Where (Y) amount of daily dropping, (L) length of test reach.

d) Thus the cube lost by leakage is : Qt – QE = QL
Where QE equals the lost cubes of water as a result of vapor
- leakage coefficient equals net leaking cubes of the paragraph shown in (D) divided on average water surface shown in (b)
- Leakage coefficient = $\frac{QL \times 10000}{L \times Wp}$

- Arithmetic average of actual leakage coefficient will be taken for intervals each of them is 24 hours since the start of setting aside the levels and till the end determined in (5), and to be compared with the standards shown in paragraph (b) of the item – Success Standards of the Comprehensive Experiment.

Arithmetic average will be taken for leakage coefficients confined within the limits of the highest level (Half meter lower than the berm level), and the lowest operational level (the level of lowest requirements according to the approved longitudinal section).

This will be considered the coefficient of leakage from the Canal, and will be compared with the standards in paragraph No. (a) of the item – Success Standards of the Comprehensive Experiment.

(6) Success Standards of the Comprehensive Experiment:

The test is considered successful if it realized all the following conditions collectively :

a- Leakage Coefficient shown in the above mentioned paragraph ranges between thirty to fifty liters per square meter per day (24) hours.

b- Leakage Coefficient shown in the previous paragraph (5) ranges between ten to thirty liters per square meter per day (24) hours

c- The non-occurrence of dropping for lining upper step exceeding 3 cm from the original level, and also the non increase of the length of lined water section opening at the berm level than 7 (seven) cm.

d- If the number of slabs free from defects and specially cracks, splits, twist and dent exceeds ninety five percent of the total number of the tested weir slabs.

e- If the joints are free from defects and specially projection outside the concrete or dropping exceeds ninety five percent of the tested reach total lengths.

f- Payment for the Comprehensive Test Item:

Payment will be made by number with respect to the reach specified by the NSDO to the Contractor either on drawings or official instructions. The rate includes and is charged with the works of filling the reach by a suitable method from any appropriate water source whatever the distance of this tested reach, water section discharging works, the works of providing, installing, operating, maintaining and guarding the measuring instrument, as well as installing the pipes of levels measuring well, including the additional works in concrete thickness, and the like; as well as supplying sheets of paper , pens and ink required for the instrument. Also, the rate includes and is charged with the works of earth barriers specified for each reach, and removing them after finishing the test, survey works and cleaning the water section of the fine sands.

8 - Works of Plain Concrete:

1- The materials used in concrete and its components must be corresponding to the Egyptian Standard Specifications. The mechanical mixer must be used in mixing it.

2- The materials constituting concrete must be thoroughly mixed while dry till its color becomes homogenous, then the water will be poured on it gradually in suitable quantities together with continuous mixing till it becomes a paste with flexible consistency having one color. Mixing period in the mixer must not be less two minutes and number of mixer rounds will be not less than 25 rounds per minute.

3- The concrete must have a suitable consistency so that it can be operated and in such a manner that on leveling it off it becomes yielding.

4- After mixing it, the plain concrete shall be placed with the full thickness and sizes in the places indicated on the drawings and according to instructions, provided that it will be on layers, the one of them with a thickness not exceeding 25 cm, to be thoroughly leveled. Any concrete to be placed in excess of what is indicated on the drawings shall not be computed.

5- Concrete joints must be cleaned after raising the forms, and it is preferable to carry out this cleaning while the concrete is in the hardening phase. Also, the concrete will be thoroughly cleaned with wire brushes and washing by water before placing new concrete on it.

6- The Department has the absolute right to amend the rates of pebbles and sand provided that their total quantities are balanced if it is found out that the results of this amendment will lead to make a concrete having a higher strength or a more suitable workability.

7- Concrete surfaces must be kept damp after finishing them for a period not less than 15 days.

8- All plain concrete works will be geometrically measured.

9- Plain concrete rate includes and is charged with supply of mortars, equipment, machines, packages, and the required workmanship, as well as works of draining water (if any), and the whole works of excavations, trimming, back filling with compaction and all what is necessary for finishing the work perfectly according to drawings, specifications and instructions.

9 - Works of Reinforced Concrete:

1- All materials – components of concrete must be corresponding to the Egyptian Standard Specifications.

2- The reinforced concrete is composed of gravel, sand, cement and water at the quantities shown on the Bill of Quantities of the contract, and reinforcement shall be according to the drawings, specifications and conditions.

3- Concrete works must be executed according to the sections and tables shown on the drawings. The NSDO shall have the right to introduce what it regards proper of amendments during

work progress. The Contractor is not entitled to claim for any additional amounts due to these amendments unless the resulted in increase in the rate of reinforcement steel or cement, or the occurrence of a fundamental change in its shape or the method of its execution.

4- The lowest quantitiy of cement used in concrete is 350 kg/M3, and that to reach the least crushing tension acceptable to the NSDO which is 275 kg/cm2 after 28 days, and 225 kg/cm2 after 7 days.

The Contractor can submit a proposal through a specialized consultation office accepted by the NSDO about any method to fulfill the required stress without claiming for any amounts in return of the increase of the given cement rate or the like.

5- The concrete must be of a suitable consistency in order to process it as indicated in the works of quality control for concrete. On compacting it, the result will be a mild concrete. In general, concrete consistency can be in such a manner that it fulfills the following:

- The mortar is cohesion to the stones and gravel.
- The gravel is not segregated from concrete on transporting it to the place prepared for placement.
- During mixing the batch, and discharging it from the mixer, the concrete flattens in the middle of the patch, and the batch stops and does not flow.
- No free water will appear on the concrete or the mortar when discharging from the mixer.
- The final concrete surface shall be free from water after serving and leveling it.
- During work progress, specimens in the shape of cubes must be taken to make test on them, and to verify concrete quality.

  This procedure is essential in case of the original cubes which exceeds 50 M3. The taken specimens shall be dampened in the

  Site under the same circumstances affecting the parts of the structure, and to make sure that the designed batches are giving the minimum limit of the required operating strengths.

  Preliminary tests will be carried out by using the same materials, rates, and quantity of water added to the cement at the same quantities being used on producing the required cement, by defining crushing stress by pressure to be obtained. The results must be bigger than those required with what shall be not less than 15%. It is preferable to take the specimens for carrying out the tests after 7 and 28 days. The tests will be considered enough if the average results of the three cubes after 7 days are equal or bigger than 70% of the assumed small strength resulting after 28 days. It will not be necessary to carry out other tests after 28 days.

- It will be impermissible to use a stored concrete with more than 20 minutes elapsed since its processing.

  The NSDO engineer has the right to postpone pouring the concrete in disturbed weather conditions warning with rain fall or strong winds or increased temperature as indicated in Concrete Quality Control Works.

- Reinforced concrete must be mixed by mechanical mixers of the approved types, and in such a manner that it guarantees a uniform batch in formation, color and consistency, i.e., homogenous.

- If it needed to transport the concrete from the mixer to the required location where it will be placed, this will be done by the method which guarantees the non occurrence of materials separation from each other. The mixing process must be carried out in the nearest place to the location where it will be placed.

- Mechanical vibrators must be used in compaction operations, and the poured concrete in this case must have dried much.

- The used additives must have no harmful effect on the concrete or the reinforcement steel, and the quantity will be estimated as a percentage of the cement weight. All these additives are included in on the item rate.

- The Department shall have the right to instruct the Contractor to submit drawings of the wooden bracing for approval before its erection. It must be constructed in such a manner that no down fall or contraction happen to any part of the structure. There must be a tenacity between the parts of the bracing.

  The wood used in bracing must be sound and free from the defects which affect its safety. The bracing poles shall be of wood or iron so as to bear the weights to which it is liable. The Contractor is considered responsible for verifying the safety of the bracing and its installation.

- All wooden forms must be made of hard dry wood so that no bending may happen to it due to the loads on them or the shock or vibrations until they are dismantled. These forms should be free from cracks or holes preventing the leakage of mortar. These forms must comply with the dimensions and drawings. The Contractor must obtain a permission for pouring after the complete revision of reinforcement steel. The Contractor is alone the one responsible for the bracing safety in spite of the NSDO approval of it. Also, he is bound to carry out the bracing on parts to allow dismantling any part of it alone without affecting the adjacent parts.

- The inside of the forms must be clean, smooth and free from dirt, thoroughly sprayed with water immediately before placing the concrete.

- The rate of reinforced concrete includes supply of reinforcement steel, its processing, cutting and fixing. Reinforcement steel must fulfill the conditions stated in the Egyptian Standard Specifications. Reinforcement steel bars must be cleaned from impurities before cutting them, such as grease, paints, crusty rust. The bars shall be cold bent, and joining bars must be minimized to the least possible limit. The reinforcement steel will be placed exactly in its specified location according to the drawings, and to be fixed in such a manner guaranteeing its non dislodging from its place during installation or pouring. Pouring concrete will not be authorized unless cutting, installing and fixing reinforcement steel and putting it in its place are approved by the NSDO engineer entrusted to make the sample, and to verify its complying with the drawings, and that the concrete cover must not be less than the biggest diameter used of reinforcement steel.

- The concrete must be protected from rains and sun rays, and it must be dampened by a correct method till it sets up to obtain its maximum durability, and this is for a period not less than three weeks of the end of its placement process.

- The forms and stands must not be removed before the elapse of four weeks of the end of the pouring process. The Contractor must not start dismantling operations except after the approval of the Department. Removal must be carried out by a method preventing the occurrence of any damage or harm to the concrete.

- All iron angles of entrances, pavements, joints, and all horizontal and vertical isolating layers – unless otherwise is mentioned shall be charged on the item rates, and nothing for them shall be paid to the Contractor. The Contractor is bound to execute them according to the drawings and instructions.

- Reinforced concrete works shall be measured geometrically, and the rate includes and is charged with supplying all requirements, materials, packages, bracing, scaffoldings, and supports, as well as supplying and installing reinforcement steel, workmanship, procuring

water fit for pouring and all what is required to finish the work perfectly according to specifications, drawings, and instructions.

10 - Fino Concrete :

1- Diameter of the gravel used in this concrete must not be more than one cm.

2- In case of executing copings, the fino concrete must be poured inside dry, hard wooden form. The wood must be thoroughly planed, tongued or grooved with each other, and painted with a fatty substance to give a smooth surface which does not need painting.

3- Joints of copings with lengths exceeding 2 meters shall be made and poured alternately after making vertical isolating layer to be approved by the NSDO, then the remaining parts will be placed.

4- The wooden forms will be taken off after 24 hours of placement in order to enable making any roughening or leveled to obtain even, clean and smooth surfaces.

5- The fino concrete must remain damp for a period not less than 15 days of the date of placement.

6- If the NSDO found it appropriate to paint concrete faces, painting will be made by cement and sand mortar at a rate of 700 (seven hundred) kg. cement to one cubic meter sand. This will be done by the Contractor and at his own cost.

7- The rates of fino concrete include with supplying mortar, materials, requirements, machines, packages and workmanship required to finish the work perfectly according to the specifications, drawings and instructions.

8- The rate of fino concrete include with the contractor supplying and fixing Nos. 2 (two plaques size 75 x 50 cm, and a thickness not less than 2.50 cm of Karara marble. This is for each appurtenant structure on which the NSDO name, project, kilometer location, loads, date of finishing the work and any other information approved by the NSDO are indicated. The writing shall be indicated by engraving method and filled with melt or compressed lead. The board will be fixed on the building with four copper bolts for each board.

9- All works of fino concrete will be measured geometrically.

11 - Concrete Quality Control Works:

Concrete consists of a mixture of ordinary Portland cement, water and aggregates. It will not be carried out except after obtaining the approval of the NSDO engineer. The Contractor must observe that the standard specifications valid for concrete works in this Contract is the Egyptian Standard Specifications included in the Egyptian Code for Concrete Structures. The Contractor, immediately upon issuing the work order for him, must submit to the NSDO and at his own cost two copies of these specifications according to latest print before the date of issuing the order.

Quality Control Tests will be made for each of the two kinds of aggregates, cement and the water for mixing, reinforcement steel and additives (if any), as well as executing steps for these works, and the fresh concrete shall be according to what is mentioned in the Egyptian Code. The Contractor should observe that the NSDO has the right to take samples from time to time, and according to its absolute valuation from any of the used water, cement, small and big aggregates, reinforcement steel, additives and the fresh concrete to carry out quality control tests on them. The Contractor must take into consideration that all costs involved are charged to the Contract items, and nothing for them shall be paid to the Contractor.

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Quality Control works include the following:

1- With respect to the used cement – An Egyptian Standard Specifications Compatible Certificate from the Producer, and periodical tests on it.
2- With respect to Anggregates
   - An Egyptian Standard Specifications Compatible Certificate
   - Verification of the conformity of gradation with the limits of the Egyptian Standard Specifications (E.S.S.) 1109 /1971.
   - Conformity of the chemical tests with the limits of Egyptian Standard Specifications(E.S.S.) 1109/1971.

3- Additives - Conformity with the limits of the Egyptian Standard Specifications(E.S.S.)

4- Mixing Water: Making sure of the non existence of substances which affect hardening.

5- Reinforcement steel : Verifying that the used steel bars are fulfilling the Egyptian Standard Specifications(E.S.S.) 262/1974

6- Fresh Concrete: Verifying the conformity of the concrete consistency with the Egyptian Standard Specifications(E.S.S.)

   * Verification of concrete durability (Test Cubes).

Weather Conditions with Respect to Concrete:

1- The contractor must organize and schedule his work in placing concrete required for the industrial works, and lining works in the times where temperature degree in shade will not exceed 33 degree centigrade. In such cases work will not be carried out except by the NSDO approval.

2- It is necessary to use additives to facilitate the operations of placing and processing or chemical treatment for lining work. This will be pursuant to the NSDO approval, and to bring certificates for all products indicative of the non occurrence of any harmful effect on the concrete. These mixtures are subject to the American Specifications.

Works of Placing Concrete At Night:

It will be impermissible to mix, placing and finishing any concrete works when the light is not enough to perform this work (that is to say pouring will be done in day light). Pursuant to the NSDO approval in case the Contractor provides sufficient industrial lighting concrete works can be carried out at night, provided that fresh concrete quality, method of placement and final processing surfaces are verified.

12 - <u>Stone Pitching Works</u>:

1- The stone used must be of the hard kind free from stains, mild or clay veins and from approved stone quarries.

2- The stone must be solid, sound and homogenous, do not dissolve by the influence of water, and the amount of water absorption is not more than 10%. The biggest dimension of the stone will not be less than the thickness or step thickness. In case of increasing the thickness of casing, it will be at least 80% of stone with dimension not less than 40 cm.

3- Rates of Building with rubble include with excavation and back filling works either for steps or inclinations, all scaffolds, workmanship and all what is required for completing the work perfectly.

4- On building stone steps, stones of the biggest volume must be chosen, and to be built vertically, and its biggest dimension should be in the vertical direction. The stones will be at the step full length; that is to say the step will never be made on layers, and in particular in the case of stone dry pitching.

5- Full accuracy must be observed in preparing inclinations for these stone pitching in such a manner that the levels and inclination angles shall be in conformity with the drawings.

6- On making stone pitching for entrances of appurtenant structures and embankments, the width of the road must be increased so that excavation can be made for placing stones in the compacted earth embankment to establish the inclination, in order to guarantee the accuracy and safety of the casing.

7- Stones must be sprayed with water one day at least before its use. Stones must be protected before placing them to enable interlocking them in such a manner that the stones are dipped into the mortar together with the avoidance of making gaps.

8- During making upper steps, it must be observed that surface of the upper step are regular and thoroughly boxed.

9- If stone pitching length more than 15 meters, a joint with a width not more than 5 cm must be made. Full accuracy must be observed in making these joints. The joint will be made whether the stone pitching were dry or by mortar.

10-Stone pitching must remain sprayed and damped for a period of at least 15 days. In case the Contractor neglected to carry out this work, the Department shall have the right to carry out this work at the Contractor own expense.

11-All rubble building surfaces either exposed to air or water shall be grouted to a level of 15 cm under back filling level. The joints will be emptied with a depth not less than 3 cm with a suitable tool. The joints will be sprayed with water by using the grout mortar.

In case of making projected grout, it must be with a width not less than 3 cm, and protrusion not less than 1cm, and not more than 2 cm. In this case, the joints will be emptied to a depth of 3cm as mentioned in building mortar, then, they shall be sprayed while they are damp and the joints to be filled with grouting mortar 700 kg cement to one cubic meter sand.

13 - <u>Steel Works:</u>

1- The submitted drawings and attached with the Contract for the steel Works are general drawings for seeking guidance from them only. The Contractor must submit detailed drawings for these works and their designed calculations and their weights for their being reviewed and approved by the NEDO This will be done through a consultant office only, taking into account that such action will not by any way relieve the Contractor from his legal responsibility prescribed in the Contract.

2- All drawings found in the Contract Album or the drawings submitted by the Contractor thereafter or any revised or detailed drawings approved by the NSDO, and to be issued during work progress according to Article (54) of the Contract – are an integral part to it and to its Special and General Conditions, the Bill of Quantities, and Appendix of Bill of Quantities. All These drawings are liable to amendment, and the Contractor shall have not right to object against any amendments regarded by the NEDO as appropriate for the welfare of work and its safety.

3- Immediately upon issuing the order to him to start execution, the Contractor is bound to submit drawings and catalogues approved by expertise houses or one of the engineering

consultative office for the steel works of the Contract, together with indicating operation method, and providing all what is necessary of details, calculation memoranda for revision and approval.

4- The Contractor shall have no right to claim for extension of the operation period due to delay incurred in submitting the drawings and calculation memoranda for these works.

5- Steel works must be operated in a workshop to be approved by the NSDO.

6- It is a prerequisite that the workmanship is at a high degree of quality and accuracy in all aspects. Also, extreme accuracy should be observed when assembling the different parts together in the workshop, to guarantee the discipline of installation and operation in the site.

7- Before starting the operations of preparing the plates and sectors it should be observed to straighten them in order to become free from any bending. This is to guarantee that the assembled surfaces will stick together. The methods used in this concern must not have influence on the metal or damaging it. Sectors in which sharp twists or bends are found shall be rejected.

8- With respect to the structural and porous steel, rivets and bolts, their specifications must be complying with the Standardization Specifications (S.S) for the year 1992. The galvanized steel must be sound and free from overlapping structure, cracks and surface splitting, galvanizing crusts, harmful accumulation of impurities, coarse irregular or sharp edges and the like of harmful defects during usage. Also, this steel must agree from all aspects with the tests mentioned in the standard specifications, and in its finishing works the principles of industry should be observed.

9- The NSDO shall have the absolute right to instruct its representatives to pay visit to the factories in which the steel is produced to make sure that it is produced according to the specifications and conditions of the contract. The Contractor must facilitate for the NSDO doing that, together with presenting the serviceability certificate indicative of the steel fulfilling the conditions of these specifications whenever the NSDO finds that appropriate.

10-It is impermissible for the Contractor to transport the steel to the site except after its being checked by the NSDO by the methods, which prove its conformity with the specifications. If it is found out that some of the steel is not in conformity with these specifications during operation and after supply, the NSDO shall have the absolute right to reject it in spite of its previous approval.

11-Welding material for structures must be conforming to the specifications on the basis that these welding joints shall perform the work of structure steel which has the properties of steel 44 or steel 37 prescribed in the Contract or any other kind of steel mentioned in the drawings or the Contract.

12-The welding material must be of the kind and degree stipulated upon in the specifications which give the best welding by the hand of a trained welder, and without flattening in lower, upper, vertical or inclined positions. Also, the tests mentioned in the specification (welding quality) must be realized.

13-With respect to cast iron works, pours shall be made of solid gray iron which does not contain more that 0.1 % sulfur. These pours shall as near as possible to the sample free from air and undulations, having few contractions. They shall be at the thickness stated on the drawings with clear angles and sharp moulds and with corrected edges. Cast iron pours shall be subject to the inspections and tests prescribed in the Egyptian Standard Specifications.

14-The steel used in structures must fulfill the following conditions:

A) Failure stress in the tension for all plates, sectors and strips shall not be less than 35 Kg/mm2 of section area.
B) Steel at point of yield for all plates, sectors and strips shall not be less than 22 kg/mm2 of section area.
C) Elongation carried out on the sample of standard tests shall not be less than 12%.
D) Maximum shear force for rivets and bolts shall not be less than 30 kg/mm2 of the section area.

Operation must be of the first class and full accuracy must be observed in it to make sure that the parts will be agreeable with each other on installation, and the similar parts will be made in such a manner that one will replace the other.

15-Preparation will be made by machine for edges and ends of plates by a good method which guarantees their perfect sticking and correctness of their ends.

16-It is preferable to make holes in the thick blocks by drills, and to perforate by pressure for the places with a thickness of 15 mm and less, together with cleaning it from iron filings.

17-Before carrying out steel welding works they must be cleaned by hammer blasting and wire brushes, sand blasting sprayers under pressure to remove oxides, dirt and paints. Also, any material or slag that may be hanging to it before making the welding. The welded surfaces must be free from zigzags in order to give the thickness prescribed in the welding.

18-Welding material must be free from cracks, and big permeability, and splits, and welded surfaces must be at a regular level and thoroughly adhered to the original material.

14- Steel Pipes Works :

1- Steel pipes must be made of sheets with sufficient sizes to give the required diameters when wrapped with cylindrical shape without joints. The pipes must be painted before delivering them two coats tar after cleaning them thoroughly from rust.

2- The pipes must be thoroughly caulked at joints; and the pipes will bear a pressure equaling 14 pounds/ square inch unless explicitly stipulated otherwise.

3- The NSDO shall have the absolute right whenever it regards that appropriate, to carry out the experiment of testing on all pipes joints or some of them. These tests will be carried out at the Contractor own expense, and without paying anything to him in return, and he will be responsible for all what is required to carry out these tests.

4- Iron pipes required for the culverts shall be from riveted or welded steel. Both ends of each joint therein shall be equipped with iron angles. The assembly forming these pipes must be thoroughly caulked to be waterproof.

5- On using these pipes as stands for the aqueducts, wooden elbows shall be supplied for placement under these pipes before tapping on them. Also, these stands shall be of one piece tamped steel pipes, to be cleaned internally and thin concrete shall be poured inside it after fixing the crescent shaped bearers. These posts must be painted with tar in the parts under water level. As for the parts over the water level, they must be pained two coats of red lead and at least two coats by oil paint with a suitable color.

6- The NSDO shall have the right to carry out the tests which it regards appropriate on any part of this work to verify its being conforming to the specifications and to guarantee finishing it perfectly at the Contractor own cost and under his responsibility.

7- The ordinary or processed galvanized pipes shall be of the special American mild steel. The Contractor can use them provided that the NSDO approves them. The Contractor shall submit a statement about linear meter weight, thickness of iron before each diameter, the trade

mark and commercial name, and method of tying the pipes to each other to the NSDO to obtain its approval.

8- The rate of this item include all what is required of supply, transport, excavation, works of draining water and all equipment, machines labor force, paintings, and all what is required for finishing the work perfectly.

9- Payment shall be calculated per one ton according to the actual weights or averages and in accordance with the specifications and industry principles whichever is less.

15- Handrail Works :

1- Specifications of materials used in the construction shall be corresponding to the conditions and Egyptian Standard Specifications

2- Works of establishing handrails shall be made at the dimensions and at the levels mentioned on the drawings and according to the instructions. The joint of handrails must be exactly identical with beams joints and floor (slab).

3- Arrangement must be made for installing the handrail components after removing the wooden forms for pavements either by fixing studs or bolts or making gaps, or by any other means facilitating installation operation.

4- The contractor is bound to submit detailed drawings to review and approve them before installation, with full obligation that no structural weakness of the handrail or disfiguring of its general view will result from that.

5- In case of using welds in the construction, it is provided that the conditions and Egyptian Standard Specifications shall apply to it with respect to shape, strength and durability.

6- In case of operating and assembling the metal installations in the workshop, they must be made in units to make its handling, transporting and installing easy. In case of installation with bolts, their heads should be hammered so that untying the nuts will not be easy.

7- It must be observed to facilitate installing replacement parts, which may be damaged of the handrail in the future, on making the detailed drawings, which will be approved and determined by the NSDO.

8- It is impermissible to have bending or indentation in the straight parts.

9- Metal parts will be painted with red lead once in the workshop, and another time after arrival to the site, then two other coats with an approved kind of paint, while observing that the method and kind of paint must agree with the weather and conditions of the appurtenant structure location and the extent of its being near seas and coastal areas.

10-Handrail metal parts must not be stored for a long time after supplying them from the workshop. They must be stored by a sound method away from ground humidity, and protected from weather humidity.

11-Handrails rate is given (by linear meter). The rate includes and is charged with supply, installation, workmanship, fixing and all what is required to finish this work according to the technical principles and pursuant to the sample stated in the drawings.

16- Entrance Angles Works :

1- Angles must be used with the dimensions shown on the drawings and according to the instructions.

2- Angles and steel sheets must be of steel 37.

3- It is preferable to use long units with the full width of the road with respect to entrance angles at the cross joints, and angles will be extended inside the frame concrete with a distance not less than 10 cm if the required length is unavailable; and in case of making joints, they must be according to the technical principles. Welding for entrance angles will be impermissible except by the NSDO approval.

4- The Contractor must use wooden wedges for each one meter to be fixed before pouring the concrete for ceiling or slab, provided that they will be removed and to install fixing studs which must be extended in the concrete to a distance not less than 20 cm. These studs must be fixed by a method to prevent instability of the angles, their movement or vibration during the passing of vehicles.

5- Full alignment must be observed in all angles, and any deviation is not allowed. Also, the levels should be corresponding to the drawings.

6- Costs of the works of entrance angles and joints are included in the Contract rates, and nothing of them shall be paid to the Contractor. The costs include supply, install, fix, paint and all requirements of work need of material, workmanship, and all what is required for finishing the work according to the industry principles.

17- Joints:

1- With respect to cross-joints, this joint must continue also in the slab, frame and handrail.

2- Maximum care should be exerted in fixing joint angles. The material must be asphalt mixture or from any other suitable material. Filling will be till under road surface by a distance of 5 cm, but in the pavements, a vertical metal sheet 6 mm thick is enough between the iron angles, and it should be fixed with great care, and to leave the joint without filling if a part of it is suspended, but if a part of it is centered on a beam, the joint will be filled as mentioned before.

3- These angles will be painted four times by paint.

4- Costs of joint works for both entrances and pavements are included in the Contract rates, and nothing for them shall be paid to the Contractor. They include supply, install, fix, and painting together with all what is required for work need of materials, workmanship, equipment and all what is required for finishing the work according to the technical principles.

18- Draining Rain Water at Bridges:

The Contractor must take measures to drain rain or washing water or any water from the upper surface of the bridge or entrances by carrying out the following:

1- In the horizontal direction, a distension will be made in the road upper surface over the bridge in such a manner that the slope will not be less than 1%. Also, a slope in the longitudinal direction amounting to one half percent so that water can be drained to two entrances, and also cross slope must be made to the pavements towards the road at the amount of 2%.

2- Bridges entrances at their intersection with the main road will be provided with side outlets to receive drainage water. These outlets will be made of steel pipes with a diameter not less than 10 cm.

3- Costs of these works are included in the Contract rates and nothing for them will be paid to the Contractor.

19- Coating Paint Works (like bitumen) :

1- It must be observed to supply all materials required for isolating paints in such a manner that their specifications will be corresponding to the Egyptian Standard Specifications.

2- Rates of isolating paints with all their kinds include all equipment, materials, and workmanship required for them whether brush, gun or roll and the like.

3- Surfaces that shall be painted must be cleaned of dusts, fat materials and other impurities.

4- The first coat will be painted in the longitudinal direction and the other coat in the horizontal direction.

5- All isolating paints will be measured geometrically.

20- Marble Works:

1- Cementing will be made by cement and sand mortar at a rate of 350 (Three Hundred and Fifty) kg cement to one cubic meter clean sand.

2- Marble imported from Carara is of the best qualities, and of the required kind and thickness. It will be solid and free from defects, veins, cracks and scratches. It will be of a homogenous color, and the sample will be approved before supply.

21- Works of Concrete Pipes:

1- The concrete pipes used will be complete with joints. It will be perfectly made, free from cracks and gaps, with smooth surface from inside, and corresponding to the specifications. This is with respect to the materials entering in its manufacturing, as well as for pressures lying on them and borne and for reinforcement steel inside them.

2- The pipes shall be of a diameter less than 40 cm of plain concrete, compressed according to the industry principles.

3- Pipes with a diameter of 40 cm and more of reinforced concrete.

4- It shall not be allowed to use concrete pipes less than 20 cm.

5- Caulking thoroughly must be done on joints welding for pipes with cement and sand mortar at a rate of 700 Kg cement for one cubic meter sand, according the industry principles and at a state which prevent water leakage from the joints.

6- In case of connecting concrete pipes with other iron pipes, this will be done through a joint of reinforced concrete with a thickness not less than 25 cm and a width not less than 50 cm, and to place an isolating layer 1.5 mm thick to be approved by the NSDO.

7- Rate is given by linear meter and it includes and is charged with supply, transport, installation, excavation, water draining works, and the whole equipment, machines and manpower required to finish the work perfectly.

8- A certificate must be provided from the factory indicative of the quality of these pipes and testing their safety.

22- Kilometer Signs Works:

N.B. Stipulation of this item shall coincide with drawings.

1- It is necessary to have the approval of the Department on the quality of these kilometer signs before being supplied by the Contractor.

2- The Contractor is bound to exclude any signs having splits, breaks or cracks.

3- The signs must be of the red Abbasa stones, and writing the numbers indicative of the kilometer numbering on them from both sides shall be by engraving and painting with oil paints two coats.

4- These signs must be placed in the outer limits of the embankments, and according to instructions, and after fixing locations by measuring by the Contractor and at his own cost and under the supervision of the Department.

5- Kilometer signs rates shall include all earthworks, of excavation, back filling, pattering, leveling, compaction and spray with water. Also, they include pouring a base of ordinary concrete composed of 0.8 M3 gravel to 0.4 M3 sand, and adding to them 250 (Two Hundred and Fifty) kilograms ordinary Portland cement with dimensions not less than 0.80 x 0.80 x 0.4 meter to each sign according to the drawings. The rate will be given by number including everything.

23- <u>Fortification Works for Embankments to Establish Sub Base Course :</u>

1- This layer will be made of laterite soil, or of graded crushed stone. It shall be mixed with the required binding materials in such a manner that these materials after mixing them thoroughly and spreading them on the road or embankment or berm, and which was previously prepared and the required water was added to it, compressed and plowed in order to become a compacted tenacious body.

2- The operation of spreading and leveling must be carried out by compacting these materials with the full width by using rubber rollers. Then, an iron masher will finally mash it. The layer sides must be mashed first, and then to be directed gradually toward the axis till the completion of compaction for the sector. If it is impossible to use mashers, for example, when the area is near walls or structures, other manual instruments can be used to reach the maximum possible density.

3- The Contractor shall verify – under the supervision of the Department – of the correctness of density results in the layer after the completion of mashing, by carrying out standard compaction tests will be included in work rates, and nothing of them will be paid to the Contractor. If it is found out that they are less 95% of the density (Revised Proctor), the Contractor is bound to re-compact till reaching the required density.

4- Care should be observed during spreading and mixing the materials of sub base course so that this process will not affect the upper layer of embankments or berms.

5- Continual maintenance of this layer - whether by spraying or by using mashing equipment and leveling which must continue till final handing over of the work will be included in work rates, and nothing of it will be paid to the Contractor.

6- The NSDO has the right to entrust the Contractor to carry out all or some of these tests by the number, which it determines and regards as sufficient for perfect work control. They are: Sieve analysis – Revised Proctor Experiment – Test of defining dry density of the layer after compaction on nature – specific weight, and percentage of absorption – Granular Gradation experiment for what passes through sieve No. 200 – any other additional tests that are required for work.

7- The rate includes and is charged with removal of dissolved materials and those in disagreement with the specifications, extraction of materials of stone quarries, transport and stowing, as well as all works of workmanship, such as spreading materials, supply and adding water, and works of mixing, leveling, mashing, and continual maintenance works, providing machines, equipment and manpower, and all what is required for finishing work perfectly.

8- The materials supplied for establishing the base course must be of the big stone of the natural gravel, or crushed, or crushed stones and fine binding materials required to fill the gaps, and which in total form a graded mixture complying with the following specifications:

a) **Thick Materials:**

1- They consist of the retained materials on sieve No. 10 of strong solid stone, whether they were rigid or stony, or from furnace slag.

2- Loss percentage in Los Angeles instrument shall not be more than 50% according the standard test.

3- Percentage of materials liable to fragmentation in water of the retained thick and thin materials on sieve No. 4 must not be more than 5% of its weight.

4- On flooding a sample of the layer in maximum dry density according to the amended sand, it ought to be free of distention by the presence of discs over them which balances the paving weight which comes over the layer for standard testing.

5- Percentage of absorption by water after 24 hours shall not be more than 10% of the thick materials. Experiment will be made for testing the suitability of materials to resist dissolution in sulphate sodium or magnesium solution after 5 successive rounds, and the loss must not be less than 15%.

6- California bearing percentage to a dipped sample must not be less than 50%.

b) **Thin materials:**

1- They shall be of natural sand and the outcome of breakage of crushers of thin materials from sieve No. 200 (0.075 mm).

2- The part passing through sieve No. 200 (0.075 mm) must not be more that one third of the part passing through sieve No. 40 (0.425 mm).

3- Plasticity of the part passing from sieve No. 40.
Liquidity limit Maximum 30%
Plasticity limit Maximum 8%
Longitudinal Shrinkage not more than 7%

a- All materials must be free from organic materials, balls, and muddy accumulations.
b- Compaction, mashing and pressing the base course must be carried out by iron mashers weighing 10 tons with triple wheels, in such a manner that it gives a density of 95% of the laboratory density.
c- A complete group of equipment must be designated, and to continue water spray works and mashing with the addition of any new quantities the gravely soil corresponding to the specifications for base course in the falling down areas if it is necessary, and not to leave it without maintenance.

Gradation Averages for Materials
Extracted from Stone Quarries or After Mixing

Spacing or Number of Sieve	Percentage		
	Maximum Volume 2	Maximum Volume – 1	Maximum Volume 1
2 Inches	100	100	100
1.5 Inches	70 – 100	100	100
1 Inch	55 – 85	70 – 100	100
¾ Inch	50 – 80	60 – 90	70 – 100
3/8 Inch	40 – 70	40 – 75	50 –80
Number 4	30 – 60	30 – 60	35 – 65
Number 10	20 – 50	20 – 50	25 – 50
Number 40	10 – 30	10 – 30	05 – 35
Number 200	5 – 15	5 – 15	5 – 15

Soil Replacement Works
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1- Replacement layer must be of gravel and sand or sand only. The gravel must be graded, homogenous and free from impurities, soils, organic materials, shells, tenacious masses; also, the used sand must be natural siliceous formation, clean and free from organic materials and tenacious masses.

2- The item rates are include the Contractor carrying out at his own cost test boring in the appurtenant structure site through a consultant office and under the supervision of the NSDO. Reports and Calculations shall be submitted purporting the necessity of making replacement layer, its thickness and its method of execution. These reports and calculations will be submitted to the NSDO for revision and approval.

3- The rate includes and is charged with all what is required of excavation and back filling works, water draining, construction, maintenance and removal of barriers, bracing and wooden forms, and all what is required for finishing the work and reaching the designed levels and dimensions. Cubic meter will give the rate.

4- The item rates are charged with compaction of replacement layer to reach the maximum possible density by using all required and suitable equipment, and all types of hand rammers, provided that compaction tests prescribed in the Standards Specifications for Roads and Bridges shall be carried out whenever the Contractor is requested to do so, in approved laboratories at his own cost, to make sure of the compliance of compaction works for each replacement layer with the specifications. The Contractor has no right to object whatever the costs reached.

   The Standard Specifications and Standard Tests of the Roads and Bridges – print of the year 1990 are the basic reference to the method of taking samples and carrying out tests, and the results that ought to be obtained.

5- The Contractor account shall be settled geometrically on the basis of the cubes he placed as replacement soil with the thickness mentioned in the drawings or specifications, or what the NSDO shall approve.