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مكتب التصميمات والإستشارات الهندسية
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كلية الهندسة – جامعة أسوان - قسم الهندسة المدنية

Technical Report

On Implementation of Mechanical Boreholes , Soil Resarch , and Foundation Recommendations Network Rehabilitaon in El Zaydab Qebly and Ezab Kima (PA3)

Potable Water Management Programme in Upper Egypt – Phase 2 - Aswan

Program Funder : Swiss Agency for Development and Cooperation SDC

Owner : Aswan Water and Sanitation Compny (AWSC)

February 2023

المهندس الاستشارى
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قيد استشارى: ١/٥٩٩٤ سجل هندسى: ٤/٧٣٥٦

مكتب التصميمات والإستشارات الهندسية

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Attachments :-

1- Figure (1) : layout sketch , locations , coordinates (X , Y , Z) , and depths of the boreholes .

2- Figures from (2) to (19) : verical sections of the boreholes and results of field & laboratory tests .

3- Figure (20) & (21) particle size distribution curves .

4- Table (1) : results of chemical tests for soil samples .

5- Identifications of soil classification , symboles used in Soil Sectors , and remarks .

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First - Introduction and purpose of the report :-

The report was prepared at the request of the Swiss Agency for Development and Cooperation (SDC) to carry out mechanical boreholes and soil research , including the study of the natural , mechanical , and chemical properties of the soil , as well as to prepare foundation recommendations for the construction of water line networks (pipes with diameters of 100 , 150 , 200 , and 355 mm) in El Sail and El Zaydab Qeply (PA3) , as part of the Potable Water Management Programme in Upper Egypt – Phase 2 – Aswan .

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Second - Mechanical Boreholes works :-

The boreholes carried out in the paths of the water lines in the El Sail and El Zaydab Qebly areas were numbered (18) , The boreholes were carried out at the required depth (7 m) were numbered only (3) , the other boreholes were carried out at a depth of less than the required depth due to the presence of layers of high hardness granite rocks at the site of these boreholes . The numbers and the executed depths of all boreholes given in table in the figure No. (1) attached to the report .

All the boreholes were carried out from the ground level at the site of each borehole using the

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mechanical tube and its attachments to the equipment necessary for drilling . Soil samples were extracted , preserved , and transported to our laboratories . Equipment for conducting the standard penetration test (S.P.T.) was used , and ground water levels were monitored at the site of each borehole .

All the boreholes were identified at the site , and the depth was received by the supervisor of the entity requesting the report . Figure No. (1) shows a sketch of the general location , locations , and coordinates of the boreholes .

Third - field tests and their results :-

Standard penetration tests were carried out at the site (S.P.T.) at different depths of the sandy soil layers . The results of the tests are given in the tables attached to the boreholes sectors in figures from (2) to (19) , respectively , which are the number of beats (N) for every 30 cm of penetration .

Fourth - Laboratory tests and their results :-

Laboratory tests were conducted on selected samples of soil extracted from the boreholes according to the Egyptian standard specifications and using standard devices . The tests and their results are as follows :-

1. Tests for determining the liquid limit (L.L.) , the plastic limit (P.L.) , and the plasticity index (Ip) .

2. Tests to determine the percentage of free swelling (F.S. %) .

3. Tests for determining the unconfined compression value (q_{un}) .

4. determine the Rock Quality Designation (R.Q.D.) .

The results of the above mentioned tests are given in the tables attached to the boreholes sectors in figures from No. (2) to No. (19) , respectively .

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5. Gradual gradation tests : were performed on selected samples of sandy soil using standard sieves . The results of the tests are represented graphically by the gradation curves in Figures No. (20) and No. (21) .

6. Chemical tests for soil samples : Chemical tests were conducted to determine the sulphate content in the form of sulphur trioxide (SO3) and chloride content (CI) , determine the hydrogen number (pH) , and determine the electrical resistivity . The results of chemical tests of the soil samples are shown in the table. No. (1) .

Fifth - the nature of the soil at the sites of the boreholes:-

Through the apparent examination of the soil samples extracted from the boreholes and by studying and analysing the results of the field and laboratory tests that were conducted on some of these samples , it was possible to classify and draw the verticality of the sequence of soil layers at the sites of the boreholes , as shown in figures from No. (2) to No. (19) , respectively . Through the study , it is clear that the soil layers at the sites of the investigations are dominated by coarse soil consisting of sand with different sizes , some of fine gravel , tafla and silt . It is noted that the appearance of layers of loamy soil (tafla – expansive clay) with varying degrees of cohesion strength and some of broken rocks of granite . It is noted that the appearance of layers of medium hardness sand stones in the site of the borehole No. (37) as shown in Fig (18) .

From studying the results of the chemical tests shown in Table No. (1) , becomes clear soils vary between weak to mediumly aggressive soils , weakly aggressive soils , and non aggressive soils .

Sixth - Ground water levels (G.W.L):

It was not possible to monitor any level for the ground water at the locations of all the boreholes through the executed depth at the location of each borehole .

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Seventh - Recommendations for incorporation :-

Through the apparent examination of soil samples and the study and analysis of the results of field and laboratory tests that were conducted on some of the soil samples extracted from the boreholes that were carried out along the path of the water line networks in El Sail and El Zaydab Qebly (PA3) , within the work of the the Potable Water Management Programme in Upper Egypt – Phase 2 – Aswan , we recommend as follows :-

(a) Recommendations for construction 0f water networks for all diameters of pipes :-

1. Excavation should be done until a depth is reached by the thickness of the soil replacement below the levels of the bottom tracer of the pipes , which are determined according to the hydraulic designs of the project .

2. The width of the excavation for the pipeline networks shall be determined according to the diameters of the pipes and in accordance with the instructions of the companies producing the pipes .

3. The thickness of the soil replacement below the pipe lines (pillow) is 75 cm in the case of a foundation on expansive clay (tafla) ; otherwise , the thickness of the soil replacement is 30 cm .

4. The soil replacement below the pipelines must consist of clean , coarse sand .

5. Excavation outputs shall not be used in backfilling works above and around the pipe networks . Backfilling must be done using clean sand with a thickness of not less than 50 cm above the levels of the upper plotter of the pipes or according to the catalogues of the company producing the pipes , whichever is greater , provided that the backfilling works are completed until reaching the surface of the earth using the Layers of valid excavation output , and the backfill must be well compacted in layers of 25 cm thickness .

(b) Recommendations for chambers:

1. Excavation should be done until a depth is reached by the thickness of the soil replacement below the plain concrete bottom levels of the chambers , which are determined according to the hydraulic

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designs of the project .

2. The excavation at the locations of the chambers must be done with a surface that allows for the soil replacement to flutter at least 30 cm from the plain concrete limits of the room foundations .

3. The thickness of the soil replacement from clean , coarse sand at the bottom of the chambers shall be in accordance with what is contained in paragraph (a) of the recommendations in items No. (3) .

4. The permissible net stress of the soil at the surface level of the soil replacement should not be more than 0.60 kg / cm^2 (six tenths of a kilogramme per square centimeter) .

5. The external surfaces of the chambers must be isolated against moisture in accordance with the technical specifications of the project .

6. Excavation outputs shall not be used in backfilling around the chambers ; instead , clean sand shall be used , which shall be well compacted in layers of 25 cm thickness .

(c) General recommendations :-

1. In the case of executing pipelines in narrow streets & in the case of excavations in collapsible soils, the sides of the excavations must be supported by suitable wooden wrenches, and the formwork must be strong enough to support the sides of the excavations and to maintain the integrity of the neighboring facilities , if any .

2. In the case of neighboring buildings adjacent to the paths of pipelines , the inspection must be carried out for these buildings and their structural condition monitored before excavation works are carried out , the necessary measures must be taken to maintain the structural integrity of the neighboring buildings . The conditions of the buildings must also be monitored during excavation and implementation works .

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3. The natural soil at the bottom levels of the excavations , at the locations of the pipeline networks and chambers , must be compacted well and sprayed with water.

4. The stone layers must be examined if they appear at the foundation levels , and make sure that there are no dents , cracks , or breaks on the surface of these layers .

5. To clearly define the areas in which the loamy soil (tafla) will appear at the foundation levels of the pipeline networks and the champers , in which the replacement soil will be implemented with a thickness of 75 cm . Excavation works must be carried out in the entire lengths of the networks and refer back to us for inspection and identification of these areas on the sites .

6. Soil replacement (pillow) at the bottom of the pipes and at the bottom of the chambers , with a thickness of 30 cm , it is lowered in one layer , and with a thickness of 75 cm , it is lowered in three equal layers , and each layer must be thoroughly compacted by spraying with water until the field dry density reaches a rate of not less than 95 % of the maximum dry density according to Proctor laboratory experiment .

7. The average diameter of the grains of coarse sand used in replacement soil works ranges from 0.60 mm to 2.00 mm & the average diameter of the grains of graded gravel used in replacement soil works ranges from 6.00 mm to 20.00 mm .

8. The average diameter of the grains of sand used in backfilling works ranges from 0.60 mm to 2.00 mm .

9. To compact the replacement soil below the pipelines and at the bottom of the champers , likewise to compact the soil used in the backfilling works for all cases including implementation in narrow streets , a compactor weighing no less than 250 kg must be used .

10. The necessary field and laboratory tests must be conducted to verify the efficiency of compaction

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for each layer of the soil replacement and for each layer of the soil backfilling .

11. Sulfate resistant portland cement should be used with a content of not less than 250 kg per cubic meter for plain concrete works , and the fracture strength of standard cubes at the age of 28 days should not be less than 200 kg / cm^2 .

12. Sulfate resistant portland cement with a content of not less than 350 kilograms per cubic meter should be used for reinforced concrete works , and the fracture strength of standard cubes at the age of 28 days should not be less than about 250 kg / cm^2 .

13. The materials used in concrete works from sand , gravel , and cement must be free of impurities , salts , and organic matter , and conform to the Egyptian standard specifications .

14. The technical specifications must be followed in the operations of mixing , pouring , compacting and curing the concrete .

15. The technical specifications of the project must be followed .

16. All work must be carried out under the supervision of a specialised technician .

17. All the recommendations mentioned in paragraph " Seventh " above shall be followed in the implementation of home networks and connections .

Adopted ,,,

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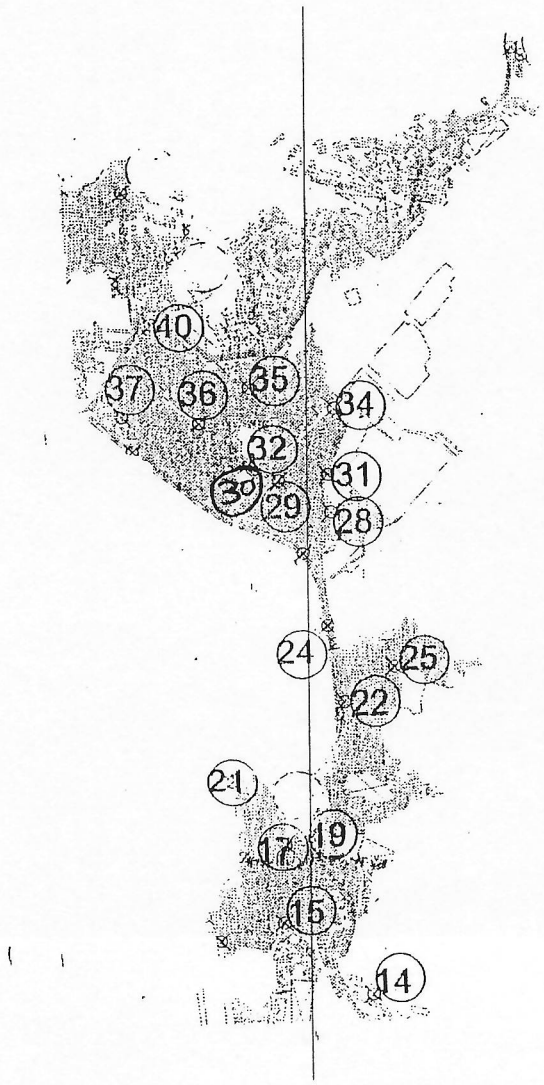

Point	Easting	Northing	Z	Depth
14	24.0584972	32.9264116	156	1.00
15	24.0611849	32.9228518	121	1.00
17	24.064223	32.9229391	115	5.00
19	24.0645025	32.9239736	111	3.00
21	24.0665824	32.9208874	114	4.00
22	24.0696055	32.9254428	110	6.00
24	24.0717461	32.9251128	108	5.00
25	24.07086	32.9274491	116	5.00
28	24.0765731	32.9250175	108	7.00
29	24.0777166	32.9229212	110	4.00
30	24.0860702	32.918819	113	7.00
31	24.0779344	32.9248979	114	7.00
32	24.0783345	32.9217406	109	5.00
34	24.0804535	32.9251479	112	4.00
35	24.0812368	32.9217753	126	1.00
36	24.0799054	32.9197795	123	1.00
37	24.08017	32.9166673	108	5.00
40	24.0836176	32.917924	104	5.00

Figure (1) : layout sketch , locations , coordinates (X , Y , Z) , and depths of the boreholes

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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم^2)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
----	14	11	25	----			Low cohesion light brown silt and		0.0
———	———	———	———	(End of	Borehole)	33	coarse sand and broken rocks	-	1.0
									2.0
									4.0
									6.0
									8.0
									10.0
									12.0

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Figure (2) : Section of Borehole No (14) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم^2)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
						34	Coarse sand , fine gravel , and		0.0
———	———	———	———	(End of	Borehole)	———	some of yellow tafla and broken rocks	-	1.0
									2.0
									4.0
									6.0
									8.0
									10.0
									12.0

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Figure (3) : Section of Borehole No (15) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q un (كجم/سم٢)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
									0.0
						46	Coarse sand , fine gravel , and		
----							Some of light brown silt		2.0
						49			4.0
——	——	——	——	——	——	——	—— (End of Borehole) ——	-	5.0
									6.0
									8.0
									10.0
									12.0

Figure (4) : Section of Borehole No (17) and Results of Field and Laboratory Tests

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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q un (كجم/سم٢)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
									0.0
						30	Medium to coarse sand		
30							and some of brown clay		2.0
——	——	——	——	——	——	——	—— (End of Borehole) ——	-	3.0
									4.0
									6.0
									8.0
									10.0
									12.0

Figure (5) : Section of Borehole No (19) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
							Fill : silt , broken stones , and dust	-	0.0
								-	1.0
40						18	Fine sand and yellow tafla		2.0
							(End of Borehole)	-	4.0
									6.0
									8.0
									10.0
									12.0

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Figure (6) : Section of Borehole No (21) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		0.0
45						18	Fine sand and light brown tafla	-	1.0
									2.0
75	13	19	32	1.20			Low cohesion light brown tafla ,		4.0
									5.0
80	12	15	27	(End of	Borehole)		Low cohesion brown tafla , broken rocks	-	6.0
									8.0
									10.0
									12.0

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Figure (7) : Section of Borehole No (22) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q un (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
70	13	18	31	1.00			Low cohesion light brown tafla , and little of fine sand	-	0.0
								-	2.0
75	12	17	29	0.90			Low cohesion dark brown tafla, organic matter	-	3.0
85	19	27	46	----			Medium to low cohesion light brown tafla		4.0
							(End of Borehole)	-	5.0
									6.0
									8.0
									10.0
									12.0

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Figure (8) : Section of Borehole No (24) and Results of Field and Laboratory Tests

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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم^2)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		0.0
----						37	Medium to coarse sand , some of light brown silt , and little of fine gravel		2.0
						39			4.0
——	——	——	——	——	——	——	—— (End of Borehole) ——	-	5.0
									6.0
									8.0
									10.0
									12.0

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Figure (9) : Section of Borehole No (25) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q un (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		0.0
65	14	19	33	1.10			Low cohesion light brown tafla and some of fine sand		2.0
									4.0
—	—	—	—	—	—	—	—	-	6.0
30	—	—	—	—	—	29	Medium to fine sand , some light brown tafla	-	7.0
									8.0
									10.0
									12.0

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Figure (10) : Section of Borehole No (28) and Results of Field and Laboratory Tests

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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم^2)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		0.0
55	14	17	31	0.90			Low cohesion light brown tafla and some of fine sand		2.0
—	—	—	—	—	—	—	— (End of Borehole) —	-	4.0
									6.0
									8.0
									10.0
									12.0

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Figure (11) : Section of Borehole No (29) and Results of Field and Laboratory Tests

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Ground Water Level G.W.L. (Initial = None & Final = - 3.15)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم^2)	Rock Quality Designation R.Q.D. (%)	Penetration Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
							Fill : dust , gravel , broken stones	-	0.0
—	—	—	—	—	—	—	—	-	1.0
30	—	—	—	—	—	34	Medium to coarse sand and some of tafla*	-	2.0
25	—	—	—	—	—	42	Coarse sand , fine gravel and some of tafla	-	3.0
						36	Medium to coarse sand and		4.0
30							some of tafla light brown		
									6.0
—	—	—	—	—	—	—	— (End of Borehole) —	-	7.0
									8.0
									10.0
									12.0

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Figure (12) : Section of Borehole No (30) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q un (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		0.0
65	14	18	32	0.90			Low cohesion light brown tafla and little of fine sand		2.0
									4.0
									6.0
—	—	—	—	—	—	—	(End of Borehole)	-	7.0
									8.0
									10.0
									12.0

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Figure (13) : Section of Borehole No (31) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial = None & Final = - 2.70)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q un (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		0.0
70	25	32	57	2.7			High cohesion light brown tafla		2.0
									4.0
———	———	———	———	———	———	———	——— (End of Borehole) ———	-	5.0
									6.0
									8.0
									10.0
									12.0

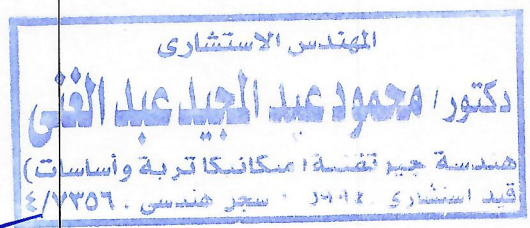

Figure (14) : Section of Borehole No (32) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial = None & Final = - 2.70)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
							Fill : fine tafla and broken stones	-	0.0
								-	
40	17	21	38				Medium cohesion tafla light brown	-	2.0
60	24	29	53	2.4			High cohesion tafla light brown to brown		4.0
									6.0
							(End of Borehole)	-	7.0
									8.0
									10.0
									12.0

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Figure (15) : Section of Borehole No (34) and Results of Field and Laboratory Tests

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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q un (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
						39	Coarse sand , fine gravel , broken		0.0
———	———	———	———	(End of	Borehole)	———	rocks , and little light brown silt	-	1.0
									2.0
									4.0
									6.0
									8.0
									10.0
									12.0

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Figure (16) : Section of Borehole No (35) and Results of Field and Laboratory Tests
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Ground Water Level G.W.L. (Initial : None & Final : None)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم^2)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
						42	Coarse sand , fine gravel , broken		0.0
———	———	———	———	(End of	Borehole)	———	rocks , and some light brown silt	-	1.0
									2.0
									4.0
									6.0
									8.0
									10.0
									12.0

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Figure (17) : Section of Borehole No (36) and Results of Field and Laboratory Tests

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Ground Water Level G.W.L. (Initial = None & Final = - 4.00)									
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q un (كجم/سم²)	Rock Quality Designation R.Q.D. (%)	Penetra-tion Number N	Soil layers Description		Depth (m)
							Ground Surface Level		
					52		Medium hardness sand stones		0.0
								-	2.0
٣٥						44	Coarse sand , fine gravel , light brown tafla , and broken rocks		4.0
							(End of Borehole)	-	5.0
									6.0
									8.0
									10.0
									12.0

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Figure (18) : Section of Borehole No (37) and Results of Field and Laboratory Tests
Network Rehabilitaon in El Zaydab Qeply and Ezab Kima (PA3)
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Ground Water Level G.W.L. (Initial : None & Final : None)								
Free Swelling FS (%)	Plasticity Index Ip (%)	Plastic Limit PL (%)	Liquid Limit LL (%)	Unconfined Compression q_{un} (كجم/سم^2)	Rock Quality Designation R.Q.D. (%)	Penetration Number N	Soil layers Description	Depth (m)
							Ground Surface Level	
35						39	Coarse sand , some of light brown tafla , and little of fine gravel	0.0
								2.0
55	13	16	29	0.90			Low cohesion light gray tafla , and some of coarse sand	4.0
							(End of Borehole)	5.0
								6.0
								8.0
								10.0
								12.0

Figure (19) : Section of Borehole No (40) and Results of Field and Laboratory Tests
Network Rehabilitaon in El Zaydab Qeply and Ezab Kima (PA3)
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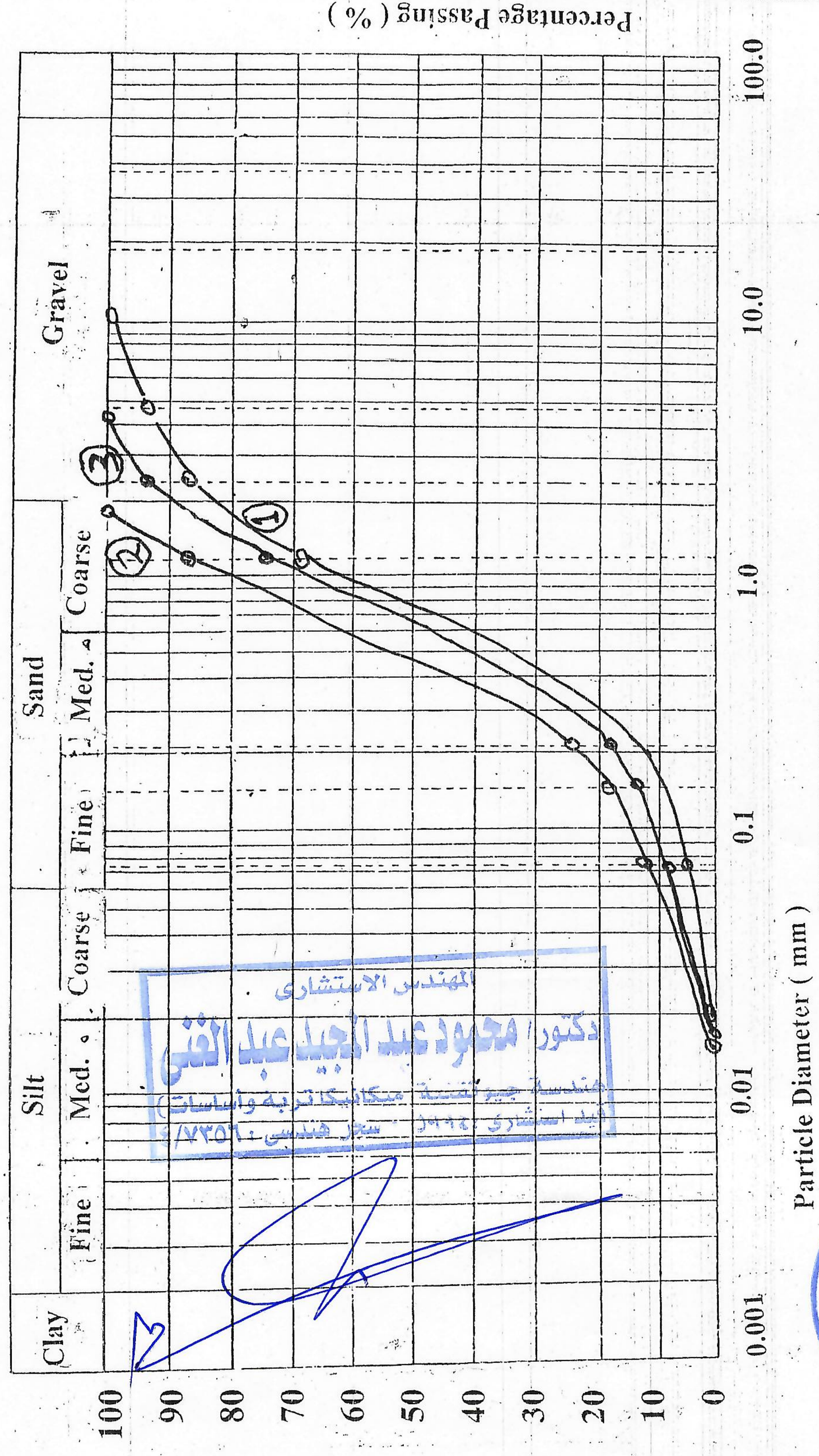

Curve No.	1	2	3	2
Borehole No.	17	19	25	30
Depth (m)	0-5	0-3	0-5	1-2

Figure (20) : Particle Size Distribution Curves
Network Rehabilitaon in El Zaydab Qeply and Ezab Kima (PA3)
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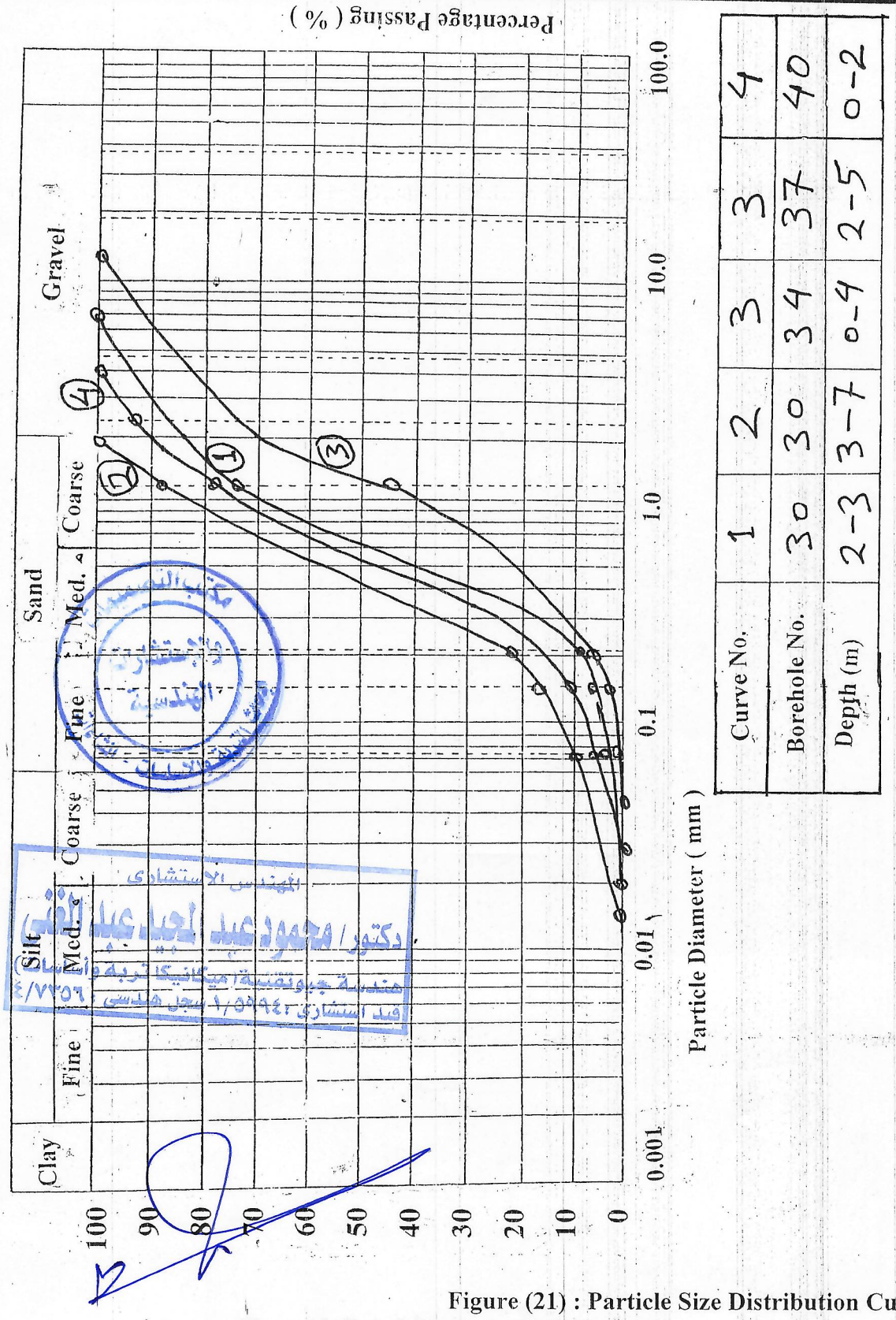

Figure (21) : Particle Size Distribution Curves
Network Rehabilitaon in El Zaydab Qeply and Ezab Kima (PA3)
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Table (1)

Results of Chemical Tests for Soil Samples

Network Rehabilitaon in El Zaydab Qeply and Ezab Kima (PA3)
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Borehole Number	Depth (m)	Sulphats Content (SO_3) (% - by Weight)	Chlorides Content (CI) (Part in Milion)	Hydrogen Number (pH)	Electrical Resistivity (Ohm . cm)
14	0.0 – 1.0	0.08	240	7.90	3250
15	0.0 – 1.0	0.26	470	7.10	2400
17	0.0 – 5.0	0.09	260	7.80	3110
19	0.0 – 3.0	0.11	275	7.60	2950
21	1.0 – 4.0	0.43	780	6.30	1670
22	2.0 – 5.0	1.90	1200	5.30	1350
24	2.0 – 3.0	2.05	1460	5.20	1250
25	0.0 – 5.0	0.10	265	7.70	2960
28	0.0 – 6.0	1.75	910	6.40	1640
29	0.0 – 4.0	1.60	840	6.50	1530
30	2.0 – 3.0	0.12	290	7.50	3050
31	0.0 – 7.0	1.65	890	6.30	1720
32	0.0 – 5.0	1.95	1310	5.10	1140
34	0.0 – 4.0	0.10	270	7.80	3060
35	0.0 – 1.0	0.09	255	7.90	3260
36	0.0 – 1.0	0.12	285	7.60	3080
37	2.0 – 5.0	0.46	890	6.60	1480
40	2.0 – 5.0	1.35	710	6.10	1350

المهندس الاستشارى
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قيد استشارى : ١/٥٩٩٤ سجل هندسى : ٤/٧٣٥٦

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Identifications of Soil Classification

1- Symboles Used in Soil Sections

S.P.T. : Standard Penteration Test in field (for case of coarse soil)
N / 30 cm : Number of blows for peterate the device 30 cm in soil
LL % : Liquid Limit .
PL % : Liquid Limit .
I_p % : Plasticity Index = LL - PL:
W_n : Natural Moisture Content of Soil .
γ_b : Natural Bulk Density of Soil .
FS % : Percentage of Free Swelling of Soil .

2- Relative Density (D_r) of Coarse Soil According to Number of blows in Standard Penteration Test :-

Relative Density (D_r)	0.00 – 0.15	0.15 – 0.35	0.35 – 0.65	0.65 – 0.85	0.85 – 1.00
Number of blows	1 - 4	4 - 10	10 - 30	30 - 50	> 50
Description	Very Loose	Loose	Medium	Dense	Very Dense

3- Remarks :-

a – Description of soil layers and its properties given in the vertical sections in the report simulate the soil taken out from boreholes carried out in the field and given its locations in the figures attached in the report .
b – Ground water level in place of borehole record at the end of work in borehole (Initial Level) and record after 24 hours from the end of work in borehole (Final Level) .

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