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ASSESSMENT OF SOIL BANKS OF PART FROM SHATT AL-HILLA IN AL HILLA CITY / BABYLON GOVERNORATE

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ABSTRACT

A study of the physical, engineering, chemical, properties of the soil properties of Shaat Al-Hilla banks in Al-Hilla city center in Hilla District/Babylon governorate /Iraq ,the study has been carried out, (9)Boreholes(hand dig) for geotechnical properties studied. Soil analysis was done in Laboratory of BABYLON UNIVERSITY /COLLEGE OF SCIENCE/CONSULTATIVE BUREAU *,the results of Samples tests from (9) bore holes drilled along of the study area for the year (2018) from the ground surface to depth 1m at interval(0-10m)depth .According to Unified Soil Classification System (USCS) showed that fine grained soil consist mainly of (ML) types , the site soil can in general, is classified as poor to well graded sand (SP to SW).Depend on Casagrande classification result of Atterberg Limit Test shows the soil is ML "low plasticity sand "The liquid limit values ranges between (41.5 – 43.8 %) and fluctuates with depth. Plasticity Index values ranges between (12.4 – 15.9%).Values of Activity (A ranges between (0.51 -0.93) with average 0.71. Normally active have activities between 0.75-1.25. The samples with activity more than 1.25 are active clays. The test results indicate that most of the soil samples have activity of less than 0.75. And the others between the ranges that means some of samples are inactive soil and the others are active.*

The chemical tests of the soil showed that the percentages of sulfate as SO_3 % is the min. value in st I1(0.1)and the Max in st H2 (0.37),the average (0.16) ,range of chloride content is the min. value in st I1(0.215)and the Max in st H2 (0.795),the average (0.395)Organic matter of soil samples is the min. value in st I1(0.58)and the Max in st H2 (0.95),the average (0.83)the TDS and gypsum content were found to the Min. value in st I1(1200)and the Max in st H2 (3240),the average (2130)

Key Word: Physical Chemical Tests of Soil, Geotechnical Properties

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1. INTRODUCTION

The study of soil properties of **Shaat Al-Hilla banks in Al-Hilla city center** in Babylon Governorate/Iraq were made , A study of the physical, engineering, chemical, properties of the soil of selected part from both two river banks of Shaat Al- Hilla has carried out, (9)samples for geotechnical properties studied.

The main target for performing this study is to have a clear idea about the soil behaviors for the future projects in Shaat Al-Hilla river banks same like tourism, coffee shops building, bridges and other main projects in the city near from the river.

2. LOCATION OF STUDY AREA

Al-Hilla city located (100 Km) southern of Baghdad is part of Quaternary sediments. The site in general is flat area. The boreholes coordinates are as shown in Table (1), and site plan for boreholes location is shown in Fig.(1) .

Table 1 boreholes coordination

Station	Latitude	Longitude
St. A	N 32 33' 45.850"	E 44 24' 12.262"
St. B	N 32 32' 20.445"	E 44 24' 42.816"
St. C	N 32 31' 54.339"	E 44 25' 00.814"
St. D	N 32 29' 15.392"	E 44 26' 21.200"
St. E	N 32 28' 37.303"	E 44 26' 25.341"
St. F	N 32 28' 02.477"	E 44 26' 24.496"
St. G	N 32 27' 29.179"	E 44 26' 50.733
St. H	N 32 24' 59.396"	E 44 29' 19.856"
St. I	N 32°39'35.53	E 44°19' 27.9"

Figure 1 Satellite image of the study area

3. AIM OF THE STUDY AREA

The purpose of the study is to determine soil behaviors at the site, evaluate these conditions with respect to the proposed construction and to make engineering recommendations for site preparation, and foundations. Furthermore, to obtain soil design parameters that may be used in the civil and structural design of facilities at the building project around Shaat Al-Hilla Banks. Otherwise, the purposes of the study program can be summarized to identify profile section for the soil, and ground water level closed to the river, the subsoil engineering, physical and chemical properties up to certain predetermined depth and to identify additional requirements for design to provide durability based on the chemical test results.

4. CLIMATE

Climate differs from winter to summer and south to north in Iraq. Summer is long, hot and arid in the south. Temperature is up to 46°C. Short and cool in the North. Winter is short and cool in the south and it is snowy and long in the north. In Mesopotamia average rainfall is 178 mm but it is 1016 mm in the mountainous districts. The desert districts had rainfalls only when a global hard winter happened. Babylon is a city of Iraq in 100 km south of Baghdad. The Hilla city is the capital of Babylon governorate. Babylon governorates has a hot desert climate, summers are extremely hot and dry and winters are cold. Although there are rainfalls every month, all precipitation is gained between January and April.

5. GEOLOGY AND GEOMORPHOLOGY OF THE STUDY AREA

The surface of the investigated area is covered with recent of flood plain deposit by Al-Euphrates River (Alluvial Environment) with some sediments came by air as dust during the end of spring and the beginning of summer. The recent sediment is of silt and clay and some fine sand in the east part of this region and the "Mesopotamia Plain" is covered by different "Quaternary Sediments" that range in age from Pleistocene to Holocene, and in thickness from few meters up to 180 m. They are represented by Sediments of the Tigris and Euphrates Rivers: and its distributaries (Domas, 1985).. The CGG (1974), using magnetic and gravity data, estimated the depth of the basement to be between 8 km to 14 km, in the area and contain almost a complete sedimentary succession without significant breaks (Jassim and Buday in Jassim and Goff, 2006) as in Fig.(2). The Quaternary sediments exhibit an exceptional development in the Mesopotamia Plain. There are consist of gravels, sands, silts and clay were mainly related to the cyclic sediment of the two rivers Tigris and Euphrates. These sediment form extensive, flood plain with a complex network of natural levees, channel, and terraces. The Quaternary sediments of the Mesopotamia Plain, exhibit progressive thicken from north-west to south-east.The most obvious topographic indication for the presence of a growing subsurface anticline, in the Mesopotamia Plain is that of Samarra subsurface anticline. The area involved is covered by Quaternary sediments (Sissakian, 2000), but the presence of the subsurface anticline is proved by geophysical studies (C.E.S.A., 1992 and Al-Kadhimi

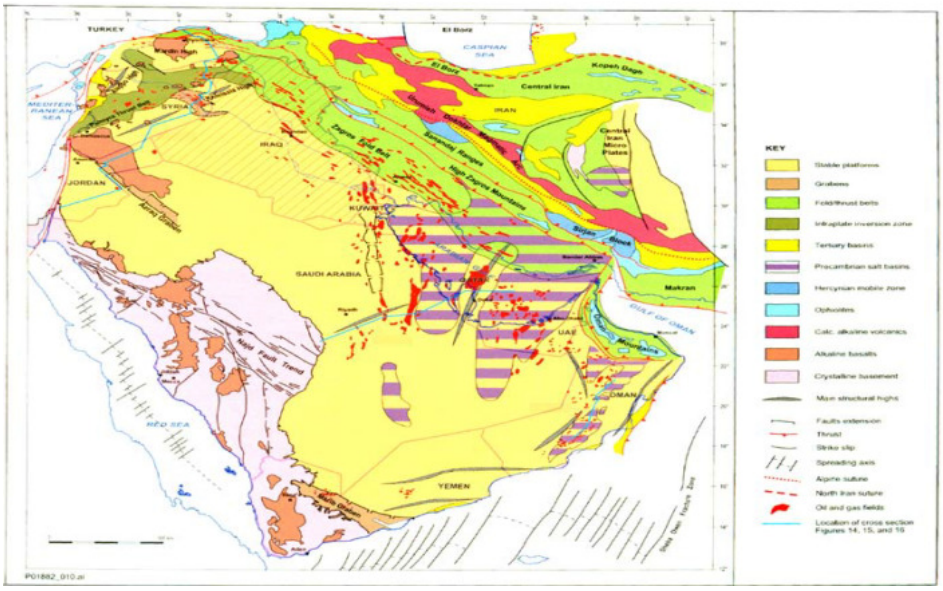


Figure 2 Arabian plate and geological map of Iraq (Jassim et al., 2001).

et al., 1996), besides the morphology of the area that indicates clearly a double plunging anticline. The Tigris River has abandoned channels in different places within the Mesopotamia Plain. The main one is between Al-Euphrates River and the current river channel (Sissakian, 2000). This abandoned channel is either the old course of the Tigris River or that of Al-Euphrates River. The authors believe that the growing of the subsurface anticlines in the area was the main factor for abandoning of the river its original channel. Many authors (Al-Sakini, 1993; Mello *et al*., 1999; Bhattacharya *et al*., 2005 and Philip and Virdi, 2007) recorded such cases. The Euphrates River has also abandoned its channel, between Babylon and Babylon cities; it is south of the current river course (Sissakian, 2000). The authors believe that the main reason for abandoning of the channel is the activity of the Abu Jir Fault Zone. The activity of this fault is proved by Fouad (2007). As in Fig (1-2)

6. SITE WORK

6.1. Drilling and Sampling in the Study Area

(9) Hand dug has been made during January -2018 as in Fig, (2-1) by using auger (1m) length to use in drill method. The method of drilled which are used for toke the samples. The depth of boring were selected by the student to extend from the surface to depth 1m in order to determine the soil behavior of subsurface. As in Figure (1). The types of sample was taken, is (DS) that taken according to (ASTM D-1586) ,there are two samples was taken from each station ,the first sample taken from ground surface and the other one from depth 1m ,it is require to determine the classification of the soil layer. All samples sent to the soil lab. In order to tests.

Figure 3 some from Boreholes of study area of Shaat Al-Hilla Banks

7. LABORATORY WORKS

The laboratory works including some tests for determining physical, engineering and chemical properties was carried out on selected disturbed soil samples from boreholes. The tests that's used in this study shows as following: of the laboratory testing is summarized in Table (3)

8. LABORATORY TESTING:

The soil laboratory testing for determining physical, engineering and chemical properties was carried out on the soil samples obtained from the boreholes was tested in consultative bureau/Babylon university /college of science. A full list of tests conducted for this study shown in table (2)

Table 2 boreholes coordination

Type	Test	Testing Standard
Classification Tests	Atterberg Limits (LL and PL) Grain Size Analysis	ASTM D 4318 ASTM D 422
Physical Properties	Specific Gravity	ASTM D 854
Chemical Test	Gypsum Sulphate Content Organic Matter Content Total Soluble Salts (TSS) Chloride Content	BS 1377: 1990 Part 3

9. CHEMICAL ANALYSIS ON SOIL

The tests include different types of chemical tests to detect types and amounts of some chemical constituents in soil samples. They include:

* Gypsum content, Total Dissolve salt, Organic matter and Sulphats content, the tests were conducted according to the British standards of BS1377.

10. EVALUATION OF RESULTS

Results of site and laboratory are evaluated according to ASTM and B.S specifications by Table and graph. The results as follows:

10.1. Grain size and soil Classification

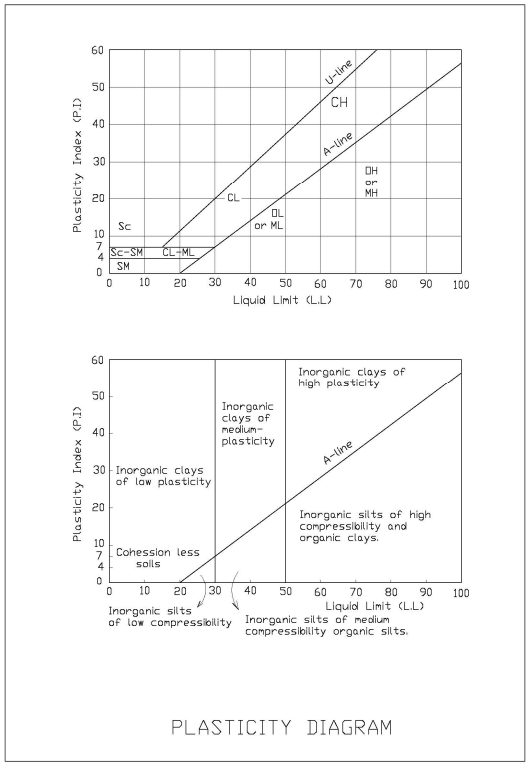
This test of soil samples were taken from the boreholes at site by using sieve analysis.. Percent fraction by weight according to USCS and ASTM D-2488 and ASTM D-2487, Hydrometer analysis was carried also to determine the grain size distribution of fine –grained soils having particle sizes smaller than 0.075 mm and when percentage of finer is greater than 12% with weight approximately equalto50gm.The test equipment and procedure are defined also in Bowles 1991.).According to Unified Soil Classification System (USCS) showed that fine grained soil consist mainly of (ML) types , the soil of river banks can be classified as well to poorly graded sand (SW -SP).

10.2. Soil Classification based on Casagrande:

The (LL) and (PI) values ploted on Casagrande Chart as in table (9) to make classification the results of Atterberg Limit Test is **ML "low plasticity sand "** was taken from table (3).

Table 3 Casagrande plasticity Chart

Grain size (No.200 >%50)	**Low Plasticity Silts and Clays (W_L < %50)**	**ML**	**Low plasticity inorganic silts and clayey silts**	
		CL	**Low plasticity inorganic Clays and Silty Clays**	
		OL	**Low plasticity organic Silts and Clayey Silts**	
	High plasticity Silts and Clays (W_L> % 50)	**MH**	**High plasticity inorganic Silts and Clayey Silts**	
		CH	**High plasticity inorganic**	

			clays and Silty Clays	
		OH	**High plasticity organic Clays and Silts**	
	Organic soils	**Pt**	**Peat soils and other organic soils**	

10.3. Soil Activity:

From the (LL) and (PI) in the Casagrande plasticity chart shown the cohesive soil classified (CL) clays with low plasticity) and CH (clay with high plasticity) and OL or ML, Results generally indicate that the value of moisture content is closer to the plastic limit than to the liquid limit. This trend suggests that the cohesive less layer is loose dense and cohesive layer and cohesive layer is consolidation. Linear shrinkage results are from 11.0 to 14.0 percent which indicate that the cohesive layer might exhibit swelling and shrinkage potential as in table (4) and table (5)

Table 4 shows the Atterberg limits with some physical tests

Type of examination		Sample A1	Sample A2	Sample B1	Sample B2	Sample C1	SAmple C2	Sample D1	Sample D2	Sampl E1
Dry density(g/c3)		1.81	1.81	1.79	1.79	1.76	1.76	1.77	1.77	1.74
Atterberg	L.L	0	0	0	0	0	0	0	0	0
Limits	P.L	0	0	0	0	0	0	0	0	0
	P.I	0	0	0	0	0	0	0	0	0
water	Content%	22.5	25	22	28	23.9	26.2	22.7	23.5	22.3
Clay%		02	01	05	04	0	07	07	09	06
Silt%		03	04	03	02	04	03	04	04	06
Sand%		95	95	92	94	96	90	89	87	88
Grav%		0	0	0	0	0	0	0	0	0
A		0	0	0	0	0	0	0	0	0

Type of examination		Sample E2	Sample F1	Sample F2	Sample G1	Sample G2	Sample H1	Sample H2	Sample I1	Sampl I2
Dry density(g/c3)		1.74	1.75	1.75	1.70	1.70	1.69	1.69	1.86	1.86
Atterberg Limits	L.L	0	41	40.5	41.9	40.7	39.7	43.8	0	0
	P.L	0	29	28.3	27.1	26	26.9	27.3	0	0
	P.I	0	13	12.2	13.6	14.7	12.8	15.9	0	0
water	Content %	24.4	24.2	29.1	24.5	33.1	23.6	34.7	20.7	21
Clay%		0.8	12	13	19	17	25	24	12	13
Silt%		03	14	12	11	12	12	18	12	15
Sand%		89	74	75	70	71	63	68	67	62
Grav%		0	0	0	0	0	0	0	0	0
A		0	0	0.93	0.71	0.86	0.51	0.66	0	0

Table 5 shows the Averages values of Atterberg limits with some physical tests

Limitations of the Standard	Minimum	Average	Maximum
Dry density(g/c3)	1.69	1.75	1.86
L.L	41.5	41.9	43.8
P.L	26	27.4	29
P.I	12.4	13.9	15.9
Water Content%	21	26.2	34.7
A	0.51	0.71	0.93

The results of (LL), (PL) and (WC) are put on the charts with the depth. The results of Activity (A) are shown in Table (5), the values of activity ranges between (0.51 -0.93) with average 0.71. Normally active have activities between 0.75-1.25. The samples with activity more than 1.25 are active clays. The test results indicate that most of the soil samples have activity of less than 0.75. And the others between the ranges that means some of samples are inactive soil and the others are active.

Where:

LI: Liquidity Index (L.I=Mc-P.L./P.I), A: Activity (A=P.I./clay fraction)

LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index

M.C.: Natural moisture Content (water content)

11. CHEMICAL TEST

The following chemical tests of the soil of river banks were tests are sulphates, , organic matters content, TDS and gypsum content. The results are shown in table (6),the Min. value of sulfate in st I1(0.1), the Max in st H2 (0.37)and average (0.16)for the soil samples while the chloride values is the Min. value in st I1(0.215), the Max in st H2 (0.795) and the average (0.395) ,the Organic matter is the Min. value in st I1(0.58)and the Max in st H2 (0.95)and the average (0.83)

the TDS and gypsum content were found to the min.value in st I1(1200)and the Max in st H2 (3240)and the average (2130)

Table (6) Results of chemical analysis for soil

Type of examination	Sample A1	Sample A2	Sample B1	Sample B2	Sample C1	Sample C2	Sample D1	Sample D2	Sample E1
Sulphat ratio %	0.11	0.12	0.125	0.13	0.12	0.10	0.12	0.13	0.14
Gypsum ratio %	0.236	0.258	0.247	0.279	0.258	0.215	0.258	0.279	0.311
T.D.S ratio (ppm)	1440	1500	1420	1460	1580	1620	1640	1700	1620
Organic materials %	0.95	0.90	0.87	0.85	0.88	0.82	0.92	0.90	0.88

Type of examination	Sample E2	Sample F1	Sample F2	Sample G1	Sample G2	Sample H1	Sample H2	Sample I1	Sampl I2
Sulphat ratio %	0.145	0.15	0.17	0.18	0.28	0.25	0.37	0.1	0.12
Gypsum ratio %	0.311	0.322	0.365	0.387	0.602	0.537	0.795	0.215	0.258
T.D.S ratio (ppm)	1740	1840	1900	2200	2420	2240	3240	1200	1320
Organic materials %	0.87	0.89	0.79	0.72	0.68	0.73	0.65	0.60	0.58

12. CONCLUSIONS

1. Geotechnical study have been carried out for the Lab. tests have been undertaken to determine Atterberg limits, (grain size), (physical and chemical) tests for soils (sulphate, organic matter, TDS, and chloride). From the work sites.
2. Depends on USCS the soil classified as sand with low plasticity (ML). As well as thin layers of cohesion less soil of sandy silt was noticed at different locations and poorly graded sand silt (SW, SP).
3. The liquid limit values ranges between (41.5 – 43.8 %) and fluctuates with depth. Plasticity Index values ranges between (12.4 – 15.9%).
4. Values of Activity (A ranges between (0.51 -0.93) with average 0.71. Normally active have activities between 0.75-1.25. The samples with activity more than 1.25 are active clays. The test results indicate that most of the soil samples have activity of less than 0.75. and the others between the ranges that means some of samples are inactive soil and the others are active
5. The chemical tests of the soil showed that the percentages of sulfate as SO_3 % is the Min.value in st I1(0.1)and the Max in st H2 (0.37),the average (0.16)for soil and the chloride is the Min.value in st I1(0.215)and the Max in st H2 (0.795),the average (0.395)Organic matter of soil samples is the Min.value in st I1(0.58)and the Max in st H2 (0.95),the average (0.83)
6. the TDS and gypsum content were found to the Min.value in st I1(1200)and the Max in st H2 (3240),the average (2130)

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