

Geotechnical and Radiometric Studies for Third Manufacturing Area -6th October – EgyptAhmed, M., Saad¹, Osama, M., Draz² and Mohamed Sakr¹¹, Geology Department, Faculty of Science, Al-Azhar University, Cairo, Egypt², Exploration Dept. Nuclear Material Authority, El-Kattamia, Cairo, EgyptDrsakr_2020@yahoo.com

Abstract: This research involves geotechnical and radiometric studies for third manufacturing area -6th October - Egypt. The studied area is mainly composed of sand enriched soil cover the rock with large thickness. Laboratory tests were performed on representative soil and rock samples to determine their physical, mechanical and chemical characteristics such as: Grain size distribution, specific gravity, free swell and chemical analysis, and uranium and thorium concentration of rocks and soils that increase in localized areas hosting these radionuclides. One hundred and forty-three sediment samples from 18 boreholes (137 samples friable sand, and 6 samples mudstone which passed from sieve No (200) have been taken at a depth from 1 to 15 m. Grain size parameters are Uniformity Coefficient (Cu) and Curvature Coefficient (Cc) used as principles classification of soil. Uniformity coefficient (C_u) is range from (3.7mm) to (6.5mm) with an average (5.1mm) and Curvature Coefficient (Cc) is range from (3.46mm) to (5.86mm) with an average (4.66mm). Grain size parameters indicate well-graded soil, and that from the standpoint of classification engineering geology. While free swell test are range between 30 to 120% with an average (75%), and specific gravity range from 2.46 to 3.70 with an average 3.08. The geotechnical studies include direct shear test for each test, the relationship between the shear stress and horizontal displacement and the relationship between horizontal displacement and vertical displacement are plotted to determine the shear stress(τ), and normal stress(σ) at failure (defined as peak stress). Then, the shear stress and normal stress at failure are plotted for each of the three tests to determine the slope (effective friction angle, Φ) and intercept (effective cohesion, c) from the best linear fit of the data. The effective friction angle (Φ) is range from 21 to 45. Radiometric studies including gamma-ray logging and quantitative uranium and thorium analyses are carried out in order to give an idea about the distribution of uranium and thorium in the drilled rocks. Uranium unlimited detected (ULD), while thorium is range from 2ppm to 7ppm at different depths from 0 to 15m.

[Ahmed, M., Saad, Osama, M., Draz and Mohamed Sakr. **Geotechnical and Radiometric Studies for Third Manufacturing Area -6th October – Egypt**. *Nat Sci* 2015;13(5):33-46]. (ISSN: 1545-0740). <http://www.sciencepub.net/nature>. 5

Keywords: Soil, shear test, Radiometric, free swell.

1. Introduction and Geologic Setting

The 6th of October City is one of the new cities in Egypt. The area is approximately 10.16 km² and 160 to 200 m. above sea level. The geological studies of Six October City show that, several times by the sea "Tethys". This old geologic sea probably began to form in the pre - Cambrian era and is considered the antecedent of the Mediterranean sea. It has always encroached upon the land of Egypt from the north. This means that Egypt's past land - sea distribution has not always been the same as it is today. The proof is the great quantity of sea shells spread over the surface of the City.

The sedimentary column is thick. In the Abu Gharadig basin it reaches between 8 and 9 km, while to the north it may reach 3 to 6 km. The complicated structure and the great thickness of the sedimentary column, when compared with the areas to the south, justify the use of the terms stable and unstable shelves. The eastern Mediterranean basin evolved as a result of plate motions responding to the opening of the Atlantic Ocean starting from the Jurassic and resulting in the

destruction of the Paleotethys and the opening of the Neotethys. The north Western Desert forms part of the African plate. At present it is characterized by having a narrow continental shelf which is bound by a steep continental slope representing a major fault separating the continental crust from the continental (Fig.2).

Ground material is formed mainly of yellowish to reddish brown calcareous slightly cemented sand. The observed binding materials are carbonates, iron oxides, sometimes salt and gypsum. Unconformities in these formations between many stages and of all magnitudes are found. This could be due to the turbulence in the sedimentation process according to the varying movement of water courses. Figure 1 shows the different sedimentation in the vicinity of the city that leads to the great difference in the soil distribution within the city. In general, the surface sediments in the studied area are loose to very loose mixture of sand, gravel silt.

2. Sedimentological Investigation

The sedimentological studies in this work include two main parts: grain size analysis and mineralogical composition with diagenesis.

2.1-Grain Size Analysis

Grain size analysis used for different purposes, such as textural, description, testing and the behavior of sediment during transportation, deposition and to interpret the depositional environments under which these sediments were deposited and evaluation of soil for engineering use.

Histogram is the simple type of the graphical representation. It is constructed by plotting the weight percentage of the particle size with grade size. The constructed histogram (Fig.3) indicate that the grain size of a third manufacturing area of October city are generally bimodal with the exception of only (8) samples which show unimodal and (3) samples are trimodal characteristics.

Cumulative curves were carried out by plotting the total weight percentage of particle size against the phi units on the probability paper.

From the cumulative curves, the values of ϕ_5 , ϕ_{16} , ϕ_{25} , ϕ_{50} , ϕ_{75} , ϕ_{84} , and ϕ_{95} were obtained and the grain size parameters were calculated according to the formulas of (Folk and ward (1957), the results are shown in table (1) these parameters are discussed as follows :

The values of mean size for the sediments of the third manufacturing area of (1.87 ϕ) with an average of (1.5 ϕ) falling in the "medium sand" grade, the graphic standard deviation values are range from (1.24 ϕ) poorly sorted to (1.86 ϕ) poorly sorted with an average (1.55 ϕ) falling in the poorly sorted. From Table (1) the values of inclusive skewness are range from (-0.005 (symmetrical) to (0.18 ϕ) (fine skewed) with an average (0.08 ϕ) the studied samples are fine to symmetrical skewed.

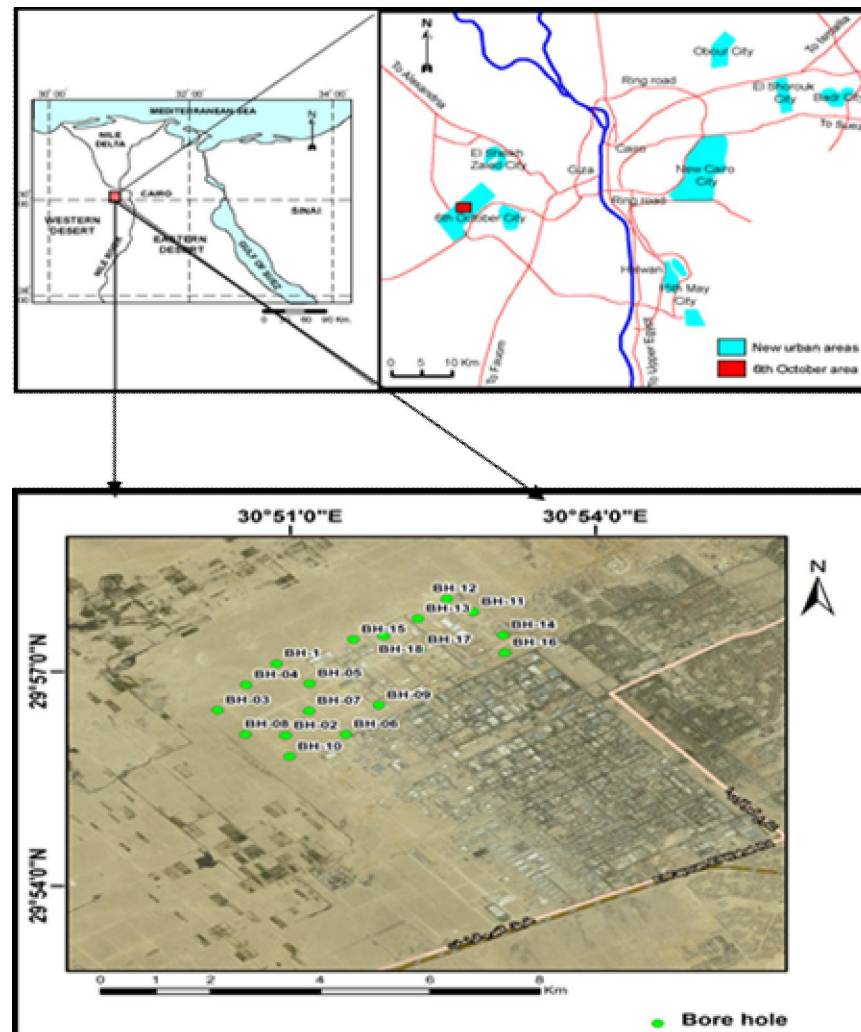


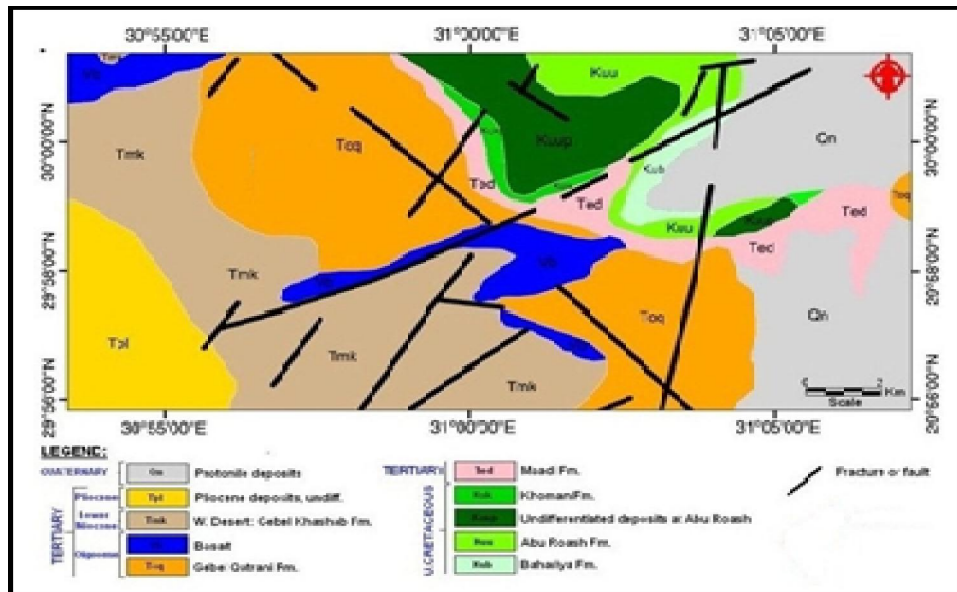
Fig. 1: Location map of the study area.

Table 1: Grain size data of the studied samples at third industrial zone of October City.

Textures parameters	KG	0.84	0.73	0.82	1.04	1.00	1.05	1.10	0.86	1.10	0.96	0.94	1.008	0.99	1.012	0.94	1.09
	SK	0.08	0.03	0.13	0.02	0.12	0.08	0.03	0.13	0.06	-0.095	0.14	0.17	0.14	0.09	0.10	0.14
	σ	1.58	1.78	1.84	1.62	1.57	1.49	1.47	1.59	1.41	1.24	1.52	1.48	1.59	1.60	1.65	1.57
	Mz	1.24	1.34	1.67	1.71	1.36	1.50	1.70	1.53	1.39	1.13	1.76	1.68	1.27	1.27	1.65	1.36
Grain size percentiles	95 Φ	4.0	4.5	4.5	4.6	4.4	4.6	4.3	4.3	4.0	3.0	4.4	4.7	4.4	4.5	4.6	4.6
	84 Φ	2.9	3.3	3.8	3.3	2.8	2.9	3.2	3.3	2.8	2.4	3.45	3.0	2.9	2.8	3.3	2.8
	75 Φ	2.5	2.7	2.9	2.7	2.4	2.5	2.7	2.7	2.35	1.9	2.8	2.6	2.4	2.4	2.8	2.4
	50 Φ	1.34	1.56	1.48	1.72	1.28	1.48	1.69	1.42	1.38	1.23	1.60	1.56	1.19	1.25	1.54	1.28
	25 Φ	0.2	0.00	0.3	0.72	0.3	0.5	0.75	0.4	0.5	0.3	0.72	0.62	0.25	0.19	0.45	0.28
	16 Φ	-0.45	-0.9	-0.73	0.1	-0.2	0.19	0.35	-0.1	0.12	-0.2	0.32	0.2	-0.2	-0.25	0.00	-0.19
	5 Φ	-1.8	-1.85	-0.9	-1.2	-0.9	-0.65	-0.7	-1.5	-0.75	-1.1	-0.5	-0.4	-0.9	-1.1	-0.8	-0.87
	>0.074	6.91	10.23	13.42	11.95	8.55	9.46	8.42	7.31	4.91	2.05	7.92	12.37	7.96	8.44	10.55	11.10
Weight % of fraction	0.125-0.074	8.04	8.65	11.32	5.71	6.04	4.25	8.61	12.38	5.09	2.96	13.01	4.49	6.31	4.53	8.81	3.14
	0.25-0.125	18.51	22.34	16.70	24.75	18.14	21.30	23.94	16.40	19.30	17.10	17.54	22.18	17.06	19.12	20.45	16.22
	0.5-0.25	24.83	19.50	16.13	25.39	23.32	25.11	29.61	23.97	31.56	34.58	27.61	24.95	22.65	23.53	21.40	26.30
	1-0.5	19.35	14.18	22.16	16.39	25.02	22.97	20.01	22.68	23.17	22.35	23.77	28.00	25.23	23.22	22.04	24.84
	2-1	11.15	10.02	15.93	8.08	14.31	10.88	7.94	8.42	11.80	12.74	7.54	7.49	16.29	15.43	13.02	13.27
	4-2	10.82	14.60	3.82	6.41	3.47	1.98	3.14	8.45	2.56	5.49	1.46	0.32	3.84	4.87	2.64	3.75
	Sample No.	1-1	1-2	2-1	2-2	3-1	3-2	4-1	4-2	5-1	5-2	6-1	6-2	7-1	7-2	8-1	8-2

Table 1: Continue

Textures parameters	KG	0.92	0.983	0.94	1.035	1.08	0.977	0.77	0.929	0.69	0.937	0.95	1.06	0.83	1.04	0.96	1.01
	SK	0.13	0.096	0.08	0.068	0.08	0.117	0.08	0.018	0.005	0.159	0.08	0.091	0.18	0.135	0.10	0.079
	σ	1.53	1.57	1.44	1.49	1.45	1.78	1.63	1.42	1.86	1.62	1.63	1.52	1.64	1.43	1.60	1.56
	Mz	1.14	1.87	1.67	1.25	1.39	1.68	1.17	1.33	1.85	1.84	1.38	1.40	1.43	1.43	1.29	1.45
Grain size percentiles	95 Φ	4.3	4.7	4.4	4.0	4.3	4.7	4.2	3.9	4.8	4.6	4.5	4.4	3.9	3.9	4.4	4.5
	84 Φ	2.8	3.3	3.2	2.7	2.8	3.45	3.0	2.85	3.9	3.45	3.0	2.85	3.3	2.9	2.8	2.9
	75 Φ	2.2	2.8	2.8	2.2	2.4	2.8	2.5	2.45	3.6	2.8	2.6	2.45	2.6	2.35	2.5	2.5
	50 Φ	1.14	1.78	1.62	1.23	1.37	1.52	1.30	1.43	1.87	1.66	1.35	1.36	1.15	1.31	1.25	1.43
	25 Φ	0.19	0.7	0.75	0.3	0.45	0.42	0.00	0.4	0.43	0.6	0.35	0.4	0.2	0.48	0.2	0.39
	16 Φ	-0.35	0.3	0.29	-0.2	0.00	-0.1	-0.8	-0.2	-0.3	0.25	-0.25	0.00	-0.26	0.1	-0.2	-0.1
	5 Φ	-1.4	-0.5	-0.5	-1.0	-0.8	-1.1	-1.8	-1.5	-1.2	-0.48	-1.2	-0.9	-0.9	-0.8	-0.95	-0.88
	>0.074	6.16	12.57	7.41	5.26	6.54	13.55	6.46	4.90	13.50	13.64	8.54	7.80	4.84	5.38	7.38	9.19
Weight % of fraction	0.125-0.074	5.55	7.24	9.87	6.18	5.16	5.78	9.25	6.27	29.90	5.82	7.62	5.74	17.61	9.21	6.57	6.21
	0.25-0.125	16.90	25.42	24.60	17.78	19.14	19.30	17.28	21.56	4.42	24.26	18.87	18.80	6.44	15.21	17.68	20.12
	0.5-0.25	24.73	21.99	21.58	27.36	29.30	22.17	24.56	30.24	16.30	17.13	22.95	27.17	25.00	29.52	22.38	24.84
	1-0.5	23.46	24.12	27.68	24.57	23.40	20.52	18.10	19.33	16.98	29.25	22.10	23.65	26.48	27.39	22.26	22.48
	2-1	14.63	7.39	7.24	14.20	12.03	11.80	11.16	7.90	12.91	7.98	14.15	12.34	15.46	1.96	16.41	12.89
	4-2	7.91	1.04	1.39	4.74	2.90	5.04	13.37	9.72	5.71	0.77	5.29	3.83	4.01	2.50	3.91	3.41
	Sample No.	9-1	9-2	10-1	10-2	11-1	11-2	12-1	12-2	13-1	13-2	14-1	14-2	15-1	15-2	16-1	16-2

Fig.2: Geological map of 6th October City (after Conco Coral, 1987).

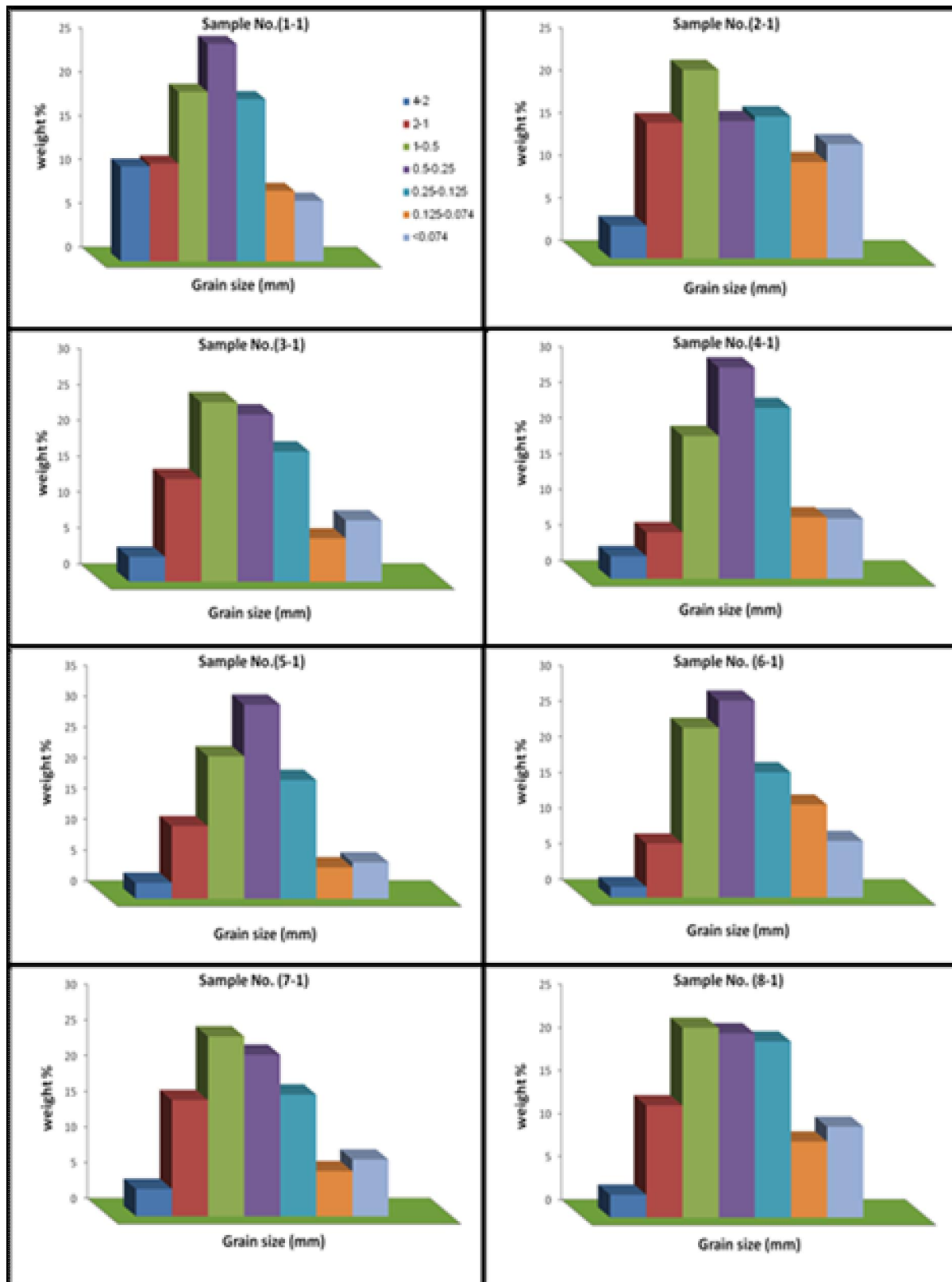


Fig.3: Histograms showing the particle size distribution of (samples No.1-1 to 8-1) at study area.

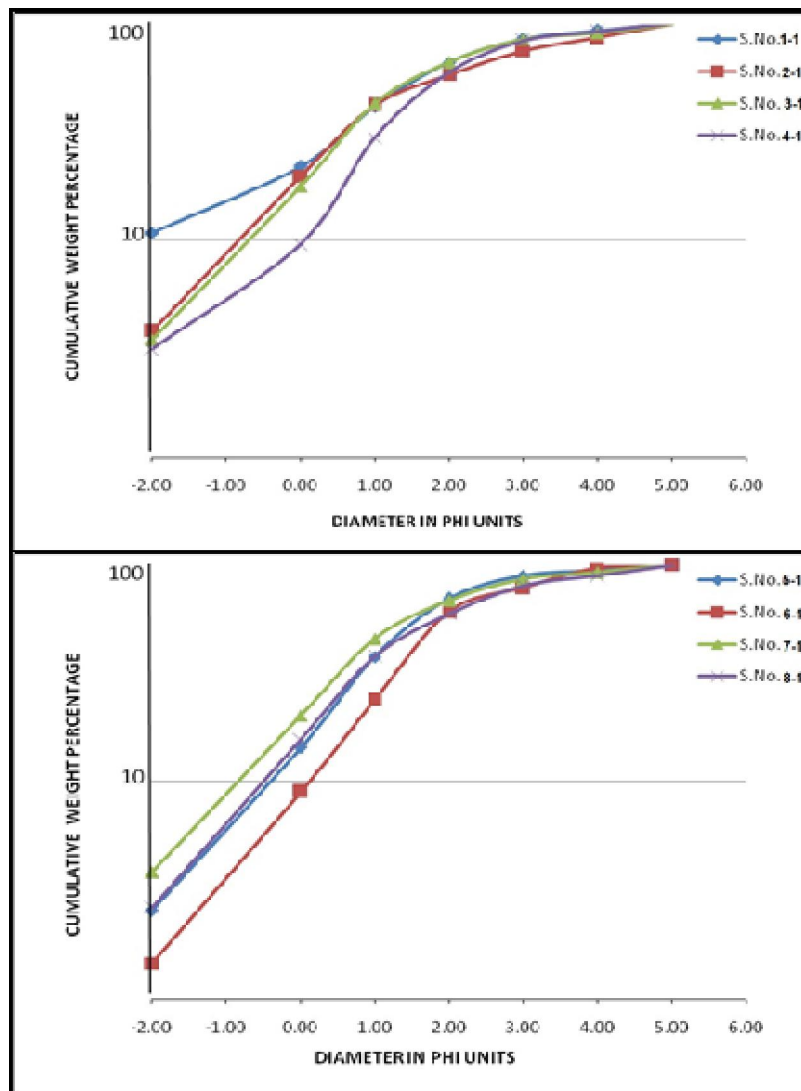


Fig. 4: Cumulative curves (phi) of the studied samples (No. 1-1 to 8-1)

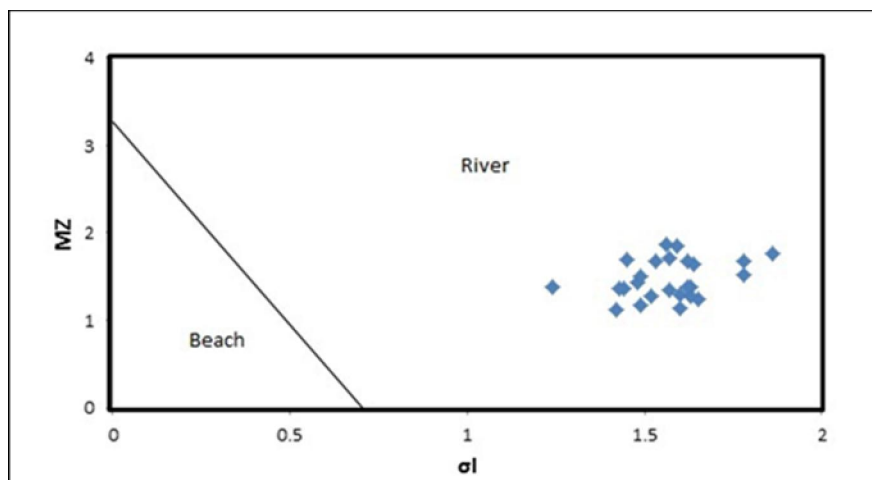


Fig. 5: Bivariant plot of standard deviation (σ_i) vs. mean size (M_z) of studied samples (diagram after Moliola and Weiser, 1968).

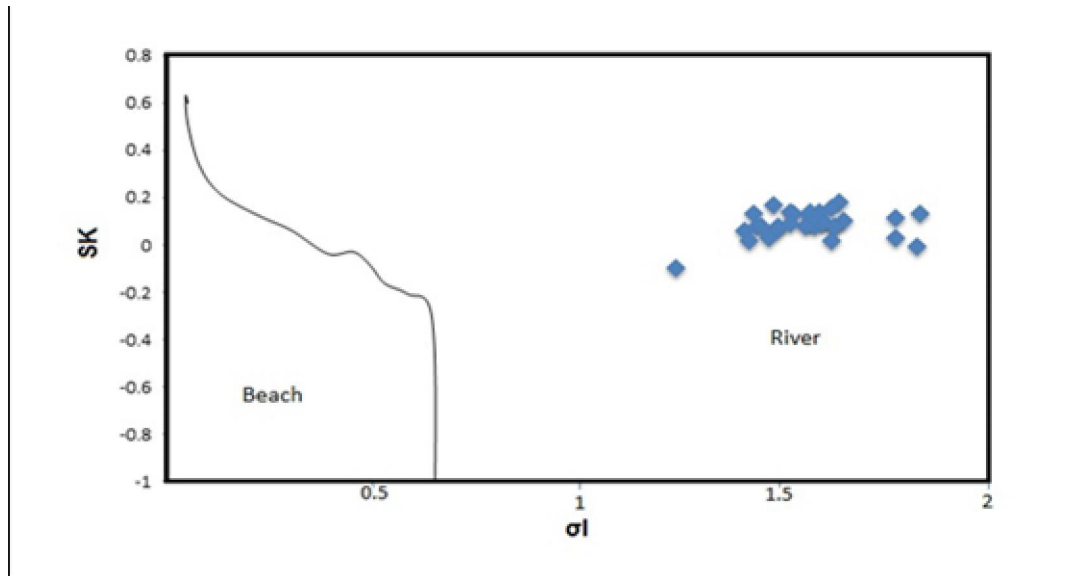


Fig.6: Bivariant plot of standard deviation (σ_I) vs. skewness (Sk) of studied samples (diagram after Friedman, 1967).

Kurtosis ranges between 0.69 ϕ (platykurtic) to 1.10 ϕ (mesokurtic) with an average 0.89 ϕ proving (platykurtic). The studied samples are platykurtic to mesokurtic.

2.2- Bivariant Relations:

The relationships between the various grain-size parameters have long been used to determine the depositional environment of sands (e.g. **Friedman, 1967** and **Moiola and Weiser, 1968**).

These relationships were determined for the studied sand samples to identify their environment of deposition.

2.2. a- Mean Size Versus Standard Deviation

Moiola and Weiser (1968) applied the relationship between standard deviation (σ_I) and mean size (M_z) to discriminate between river and beach sand. The plotting of the studied sand samples on their diagram (Fig. 5) reveals that the samples lie in the river field.

2.2. b-Standard Deviation Versus

The relationship between standard deviation (σ_I) and skewness (Sk) was applied by **Friedman (1967)** to differentiate between river and beach environments (Fig.6). Applying the same relationship for the studied samples shows that all of the samples fall in the river field. From relationships between different grain size parameters, we can conclude that the study area deposited in river environment.

3. Geotechnical Studies

In the present work the laboratory tests on sands and sand with gravels are sieves analysis, specific gravity, free swell, direct shear test and chemical analysis.

3.1-Grain Size Distribution Curve

The cumulative percentage quantities finer than certain sizes (e.g. passing a given size sieve mesh) are

determined by weighing. Points are then plotted of % finer (passing) against log size. A smooth S-shaped curve drawn through these points is called a grading curve. The position and shape of the grading curve determines the soil class. Geometrical grading characteristics can be determined also from the grading curve.

From the particle size distribution curve, the values of D_{10} , D_{25} , D_{30} , D_{50} , D_{60} , D_{75} and D_{90} were obtained and the mathematical values were calculated according to the formulas of **Hazen (1892)**. The most common procedure based on numerical values is known as Allen Hazen's method. On the basis of a great number of tests with filter sands, **Hazen (1892)** found that the permeability of these sands in a loose state depends on two quantities that he called the effective size and the uniformity coefficient. The effective size is the diameter D_{10} that corresponds to $P = 10\%$ on the grain-size diagram. In other words, 10% of the particles are finer and 90% coarser than the effective size. The uniformity coefficient C_u is equal to D_{60} / D_{10} . Wherein is the grain size corresponding to $P = 60\%$. A third characteristic of the grain-size distribution, useful in the classification of soils are the coefficient of curvature C_c , defined as $D_{30}^2 / (D_{10} D_{60})$. The results are shown in table (2) these parameters are discussed as follows:

The effective diameter values shown in table (2) It ranges from (0.14mm) to (0.24mm) with an average of (0.19mm), while the values of uniformity coefficient are range from (3.7mm) to (6.5mm) with an average (5.1mm), and the values of curvature coefficient are range from (3.46mm) to (5.86mm) with an average (4.66mm). These values indicate the soil is well-graded soil.

The distribution in Table (2) has a D50 from (0.5mm) to (0.8mm) with an average (0.65mm), the values of kurtosis coefficient are range from (0.14mm) to (0.31mm) with an average (0.22mm), and the values of sorting coefficient are range from (1.88mm) to (3.16mm) with an average (2.52mm). The sorting coefficient is not frequently used as a parameter by geotechnical engineers, and the values of skewness coefficient are range from (0.16mm) to (0.51mm) with an average (0.33mm).

3.2-Specific Gravity (Gs)

The specific gravity (Gs) is the ratio of the weight of the soil solids to the weight of water of equal volume Table (3) gives the calculated values of specific gravity of the third industrial zone of the October city, its value range from 2.46 to 2.71 with an average 2.59.

3.3-Free Swell Test

The free swell test is one of the simplest identifying testes for recognizing the soil expansively. From table 4 the free swell values are range between 30 to 120% with an average (75%).

3.4-Degree of Aggressive for Soil

The chemical analysis, in its simplest sense, is mainly used to determine the degree of aggressive of soils. By determine the organic, sulphate and chloride salts content. The water extraction method can be used for the sulphate, chloride, and P_H values. These values are occasionally required to confirm the degree of aggressive for soil.

From Table (5) the studied samples at third industrial zone of October City according to So3 classified as non-aggressive soil, as (4-1,6-1,7-1,15-1 and 16-1) while some samples as (1-1,3-1,5-1,8-1,10-1,11-1 and 14-1) classified as moderately aggressive soil and samples (2-1,9-1,12-1 and 13-1) are classified as aggressive soil. The PH values indicate all of the

samples are non aggressive soil, while Cl values indicate the most of the samples are non aggressive except sample (10-1) is moderately aggressive.

3.5-Direct Shear Test

A direct shear test is a laboratory or field test used by geotechnical engineers to measure the shear strength properties of soil or rock material, or of discontinuities in soil or rock masses. The direct shear test values shown in table (6).

For each test, the relationship between the shear stress and horizontal displacement and the relationship between horizontal displacement and vertical displacement are plotted to determine the shear stress and normal stress at failure (defined as peak stress). Then, the shear stress and normal stress at failure are plotted for each of the three tests to determine the slope (effective friction angle, Φ) and intercept (effective cohesion, c) from the best linear fit of the data.

3.6-Clay Mineral Composition

Mineralogical studies of x-ray diffraction analysis of collected samples reveal that, the sediments are consisting of montmorillonite, kaolinite and illite.

3.6.1-Montmorillonite

It is the most common mineral of the montmorillonite group, which has important Base Exchange properties, is built up of 3 layer units comprising two silicon layer separated by an aluminum layer. Some aluminum usually replaced by magnesium or iron, and small amounts of sodium or calcium are then attached, as ions lying between the three layer units or around the edges of the minute crystals, the layers are held together by weak Van der Waals forces and exchangeable ons. Water can easily enter the bond and separate the layers in montmorillonite, causing swelling. The montmorillonite is the most predominant in the studied samples.

Table 2: Grain size data of the studied samples.

Mathematical values	C.C	4.83	3.87	3.61	5.60	4.94	5.00	5.19	4.29	5.42	4.62	5.41	5.42	4.82	4.44	4.26	5.86
	C.U	5.29	5.00	6.5	4.6	5.6	5.00	4.00	5.00	4.6	3.75	3.7	5.6	5.8	5.5	5.3	6.06
	S.C	0.17	0.12	0.1	0.19	0.16	0.2	0.23	0.16	0.24	0.28	0.23	0.2	0.16	0.18	0.16	0.2
	K.C	0.15	5.2-	0.27	0.18	0.25	0.23	0.21	0.16	0.22	0.17	0.17	0.29	0.24	0.20	0.22	0.22
	SK	0.75	0.82	0.19	0.63	0.74	0.65	0.43	0.57	0.73	1.02	0.32	0.56	0.72	0.75	0.62	0.73
	D90	4.8	0.00	3.1	3.00	3.1	2.5	2.00	4.00	2.5	3.5	2.00	1.9	3.2	3.6	3.00	3.00
	D75	1.7	2.00	1.8	1.3	1.8	1.4	1.00	1.5	1.4	1.6	0.85	1.3	1.8	1.7	1.5	1.6
	D60	0.9	0.85	0.91	0.69	0.91	0.8	0.68	0.85	0.84	0.9	0.63	0.79	1.00	1.00	0.85	0.91
	D50	0.65	0.58	0.6	0.51	0.7	0.6	0.53	0.65	0.65	0.7	0.53	0.6	0.75	0.7	0.6	0.7
	D30	0.37	0.28	0.23	0.29	0.36	0.32	0.3	0.31	0.41	0.5	0.29	0.3	0.41	0.4	0.29	0.4
	D25	0.29	0.24	0.18	0.25	0.29	0.28	0.23	0.25	0.34	0.45	0.2	0.26	0.3	0.31	0.25	0.32
	D10	0.17	0.17	0.14	0.15	0.16	0.16	0.17	0.17	0.18	0.24	0.17	0.14	0.17	0.18	0.16	0.15
	>0.074	6.91	10.23	13.42	11.95	8.55	9.46	8.42	7.31	4.91	2.05	7.92	12.37	7.96	8.44	10.55	11.10
	0.125-0.074	8.04	8.65	11.32	5.71	6.04	4.25	8.61	12.38	5.09	2.96	13.01	4.49	6.31	4.53	8.81	3.14
Weight % of fraction	0.25-0.125	18.51	22.34	16.70	24.75	18.14	21.30	23.94	16.40	19.30	17.10	17.54	22.18	17.06	19.12	20.45	16.22
	0.5-0.25	24.83	19.50	16.13	25.39	23.32	25.11	29.61	23.97	31.56	34.58	27.61	24.95	22.65	23.53	21.40	26.30
	1-0.5	19.35	14.18	22.16	16.39	25.02	22.97	20.01	22.68	23.17	22.35	23.77	28.00	25.23	23.22	22.04	24.84
	2-1	11.15	10.02	15.93	8.08	14.31	10.88	7.94	8.42	11.80	12.74	7.54	7.49	16.29	15.43	13.02	13.27
	4-2	10.82	14.60	3.82	6.41	3.47	1.98	3.14	8.45	2.56	5.49	1.46	0.32	3.84	4.87	2.64	3.75
Sample No.		1-1	1-2	2-1	2-2	3-1	3-2	4-1	4-2	5-1	5-2	6-1	6-2	7-1	7-2	8-1	8-2

Table 2: Continue

Mathematical values	C.C	4.14	5.38	4.37	4.35	5.35	5.35	4.58	5.26	3.46	5.00	4.57	5.22	4.55	5.11	4.33	5.00
	C.U	6.1	4.9	4.5	5.2	4.7	5.7	5.3	4.2	5.00	5.7	5.2	4.7	5.5	4.9	5.5	5.3
	S.C	0.18	0.16	0.19	0.20	0.23	0.16	0.15	0.22	0.10	0.16	0.17	0.21	0.13	0.25	0.12	0.18
	K.C	0.20	0.29	0.30	0.22	0.21	0.21	-4.7	0.12	0.21	0.31	0.19	0.20	0.24	0.22	0.23	0.21
	SK	0.83	0.57	0.59	0.83	0.80	0.62	0.85	0.83	0.54	0.61	0.65	0.73	0.57	0.73	0.58	0.68
	D90	4.00	2.00	1.9	3.2	2.9	3.1	0.00	4.9	3.5	2.00	3.5	3.00	3.4	2.5	3.5	3.00
	D75	1.9	1.3	1.3	1.7	1.5	1.5	2.00	1.5	1.6	1.4	1.6	1.5	1.8	1.4	1.8	1.5
	D60	1.1	0.69	0.78	0.99	0.85	0.8	0.97	0.8	0.7	0.8	0.9	0.85	1.00	0.89	1.00	0.85
	D50	0.8	0.5	0.55	0.71	0.65	0.6	0.7	0.61	0.5	0.52	0.68	0.65	0.75	0.69	0.71	0.61
	D30	0.41	0.26	0.29	0.41	0.41	0.3	0.40	0.4	0.17	0.28	0.35	0.4	0.41	0.41	0.39	0.34
	D25	0.35	0.22	0.25	0.35	0.35	0.25	0.3	0.34	0.17	0.23	0.28	0.32	0.24	0.36	0.23	0.28
	D10	0.18	0.14	0.17	0.19	0.18	0.14	0.18	0.19	0.14	0.14	0.17	0.18	0.18	0.18	0.18	0.16
Weight % of fraction	>0.074	6.16	12.57	7.41	5.26	6.54	13.55	6.46	4.90	13.50	13.64	8.54	7.80	4.84	5.38	7.38	9.19
	0.125-0.074	5.55	7.24	9.87	6.18	5.16	5.78	9.25	6.27	29.90	5.82	7.62	5.74	17.61	9.21	6.57	6.21
	0.25-0.125	16.90	25.42	24.60	17.78	19.14	19.30	17.28	21.56	4.42	24.26	18.87	18.80	6.44	15.21	17.68	20.12
	0.5-0.25	24.73	21.99	21.58	27.36	29.30	22.17	24.56	30.24	16.30	17.13	22.95	27.17	25.00	29.52	22.38	24.84
	1-0.5	23.46	24.12	27.68	24.57	23.40	20.52	18.10	19.33	16.98	29.25	22.10	23.65	26.48	27.39	22.26	22.48
	2-1	14.63	7.39	7.24	14.20	12.03	11.80	11.16	7.90	12.91	7.98	14.15	12.34	15.46	1.96	16.41	12.89
Sample No.		9-1	9-2	10-1	10-2	11-1	11-2	12-1	12-2	13-1	13-2	14-1	14-2	15-1	15-2	16-1	16-2

Table 3: Specific gravity of the studied samples.

SAMPLE NO.	SPECIFIC GRAVITY (G /CC)	SAMPLE NO.	SPECIFIC GRAVITY (G /CC)
1-1	2.70	9-1	2.53
1-2	2.63	9-2	2.46
2-1	2.57	10-1	2.59
2-2	2.46	10-2	2.47
3-1	2.56	11-1	2.57
3-2	2.48	11-2	2.50
4-1	2.53	12-1	2.63
4-2	2.60	12-2	2.50
5-1	2.56	13-1	2.71
5-2	2.60	13-2	2.60
6-1	2.47	14-1	2.59
6-2	2.56	14-2	2.47
7-1	2.55	15-1	2.56
7-2	2.53	15-2	2.50
8-1	2.51	16-1	2.50
8-2	2.52	16-2	2.50

Table 4: Free swell of the studied samples.

SAMPLE NO.	FREE SWELL (%)	SAMPLE NO.	FREE SWELL (%)
1-1	100	9-1	60
1-2	80	9-2	90
2-1	70	10-1	100
2-2	90	10-2	70
3-1	50	11-1	60
3-2	40	11-2	70
4-1	110	12-1	90
4-2	60	12-2	110
5-1	30	13-1	30
5-2	50	13-2	30
6-1	120	14-1	60
6-2	80	14-2	40
7-1	60	15-1	50
7-2	50	15-2	60
8-1	100	16-1	70
8-2	40	16-2	30

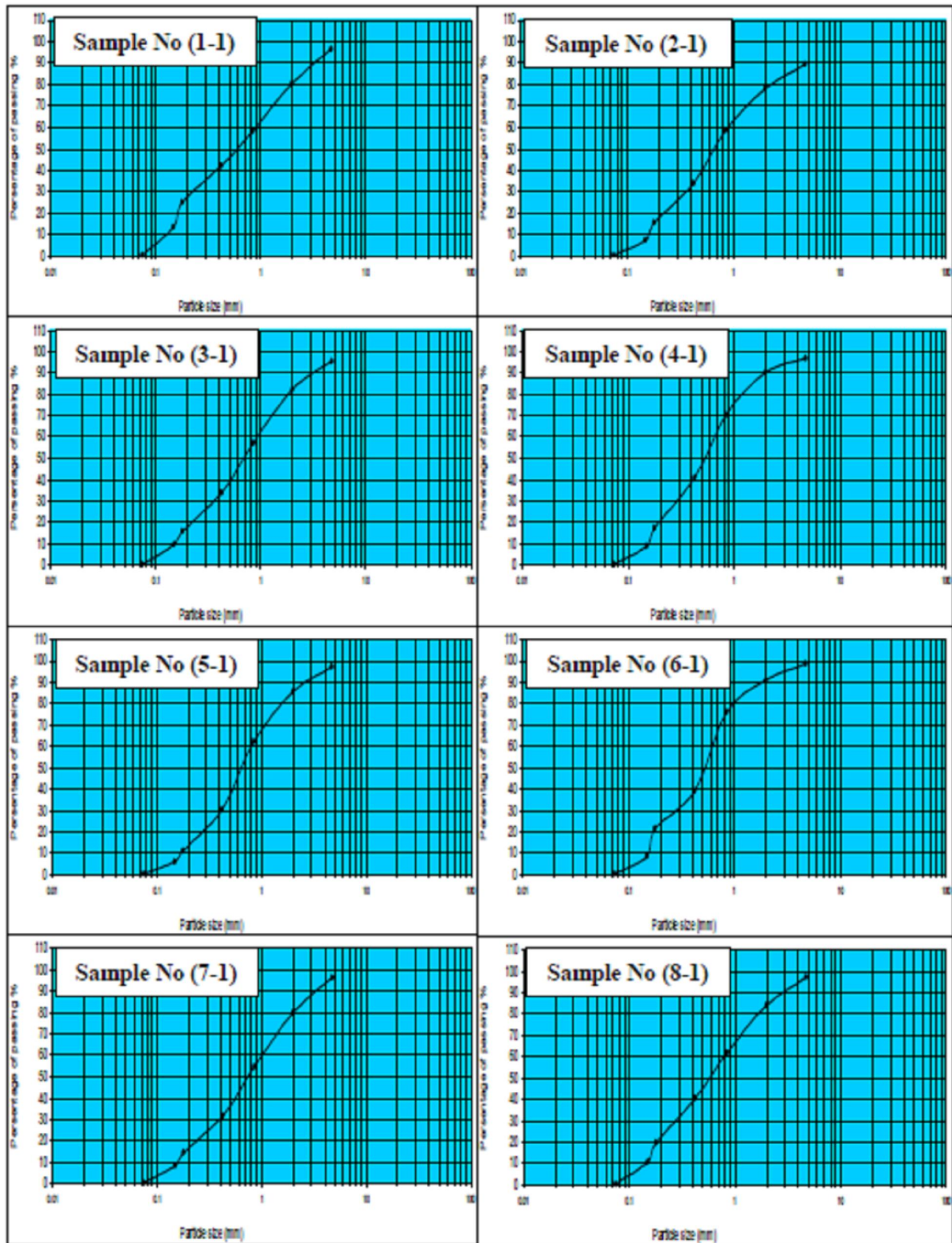


Fig.7: Grain size distribution curve of (samples No. 1-1 to 8-1).

3.6.2. Kaolinite:

Kaolinite, $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ is composed of a single tetrahedral and a single alumina octahedral sheet combined in units, the kaolinite mineral is formed stacking the layer of 7\AA thick one above the other with base of the silica sheet bonding to hydroxyls of the gibbsite sheet by hydrogen bond, the kaolinite sheets are difficult to dislodge.

Kaolinite is generally formed in warm moist regions as a residual weathering product or sometimes by hydrothermal alteration of other aluminosilicates.

Kaolinite is the second mineral of abundance in the studied clay samples.

3.6.3- Illite

Illite is characterized by a series of weak broad peaks of lines 9.9\AA , 4.44\AA and 3.35\AA that are not appreciable affected by glycolation or heat treatment. It is similar in many respects to white mica, but has less potassium and more water in its composition. It has a much lower Base Exchange capacity than montmorillonite. Illite consists of repeated layers of one alumina sheet sandwiched by two silicate sheets.

Table 5: Guiding values for some aggressive elements and factors determining aggressive degrees of the soil in third industrial zone of October City.

End of October City.

SAMPLE NO.	CONC MG/L					PH	DEGREE OF AGGRESSIVE
	TDS (mg/l)	Cl		SO3			
		meq/l	mg/l	meq/l	mg/l		
1-1	234	0.465	16.500	2.919	0.14	8.9	M. Agg.
2-1	1032	2.222	78.780	12.708	0.61	8.75	Agg.
3-1	843	4.248	150.600	8.378	0.40	8.65	M. Agg.
4-1	177.2	0.528	18.700	2.055	0.098	9.00	Non agg.
5-1	318.0	2.734	96.900	2.257	0.10	8.83	M. Agg.
6-1	161.2	0.697	24.700	1.705	0.08	9.00	Non agg.
7-1	130.3	0.550	19.490	1.390	0.06	8.95	Non agg.
8-1	485.1	0.674	23.900	6.298	0.30	8.8	M. Agg.
9-1	2081.2	0.908	32.200	28.553	1.37	8.5	Agg.
10-1	1294.3	18.083	641.000	3.355	0.16	8.79	M. Agg.
11-1	312.2	2.756	97.700	2.129	0.10	8.78	M. Agg.
12-1	861.6	0.759	26.900	11.508	0.55	8.78	Agg.
13-1	1726.8	2.923	103.600	21.919	1.05	8.5	Agg.
14-1	298	0.985	34.900	3.371	0.16	8.75	M. Agg.
15-1	185.7	1.088	38.570	1.722	0.08	8.83	Non agg.
16-1	48.0	0.158	5.600	0.547	0.03	8.88	Non agg.

Table 6: Shear box data of the studied samples.

Sample No.	Normal load (Kg)	Shear load (Kg)	Normal Stress (σ) (Kg/cm ²)	Shear Stress (τ) (Kg/cm ²)	Friction Angle (Φ)
17-1	5	0.27	0.185	0.01	28
	10	0.68	0.370	0.025	
	15	1.08	0.555	0.04	
17-2	5	0.34	0.185	0.01	21
	10	0.40	0.370	0.015	
	15	0.62	0.555	0.02	
18-1	5	0.36	0.185	0.01	26
	10	0.54	0.370	0.02	
	15	0.81	0.555	0.03	
18-2	5	0.26	0.185	0.009	34
	10	0.37	0.370	0.014	
	15	0.57	0.555	0.02	
6-2	5	0.18	0.185	0.006	45
	10	0.21	0.370	0.008	
	15	0.42	0.555	0.01	

Table 7: Averages of annual effective radiation dose from natural sources (ICRP, 2004)

Source	Average Annual Effective Dose (mSv)	Typical Range (mSv)
1) External exposure:		
Cosmic rays	0.4	0.3-1.0 ^a
Terrestrial gamma rays	0.5	0.3-0.6 ^b
2) Internal exposure:		
Inhalation (mainly radon)	1.2	0.2-10 ^c
Ingestion	0.3	0.2-0.8 ^d
Total	2.4	1-10

a: Range from sea level to high ground elevation.

b: Depending on radionuclide composition of soil and building materials.

c: Depending on indoor accumulation of radon gas.

d: Depending on radionuclide composition of foods and drinking water.

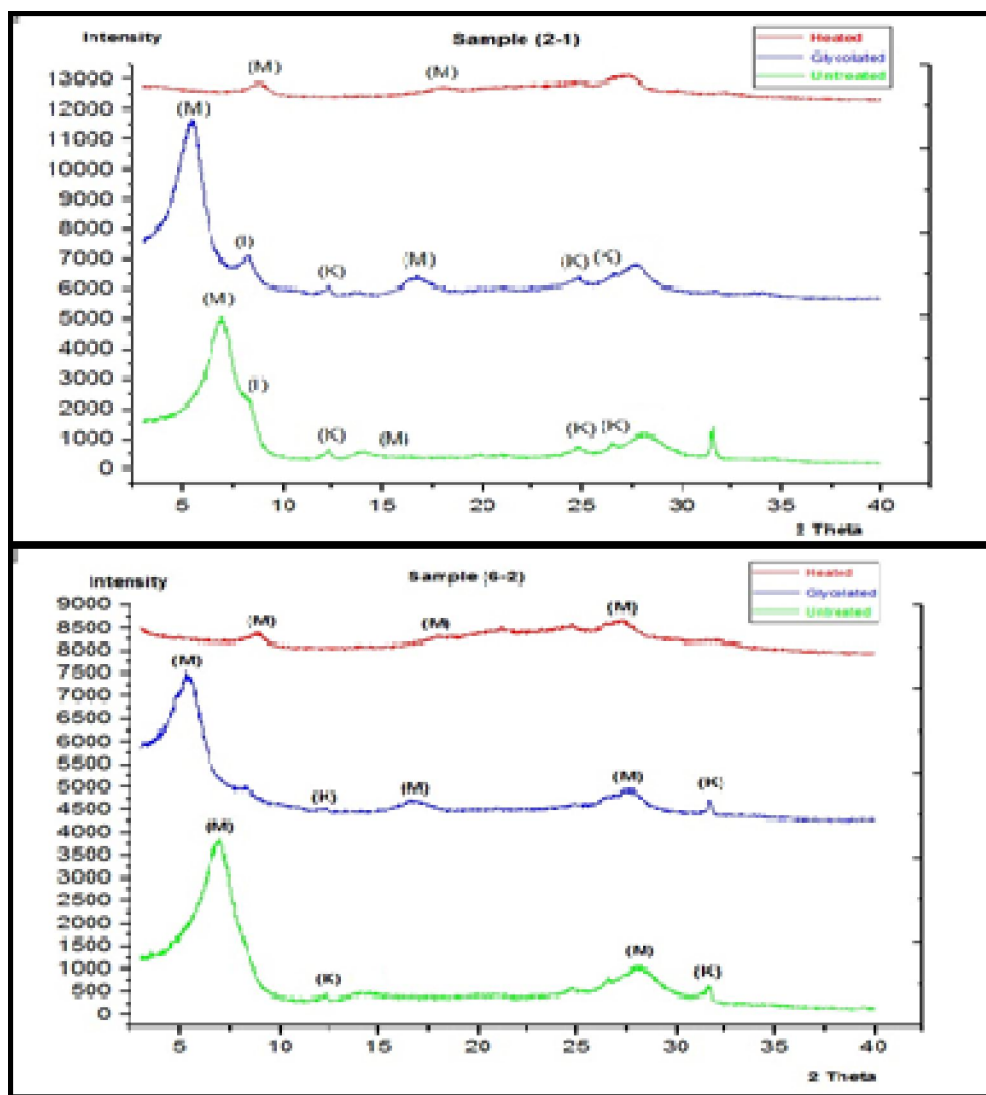


Fig 8: X-ray diffraction of the studied clay minerals, Samples (2-1) and (6-2).

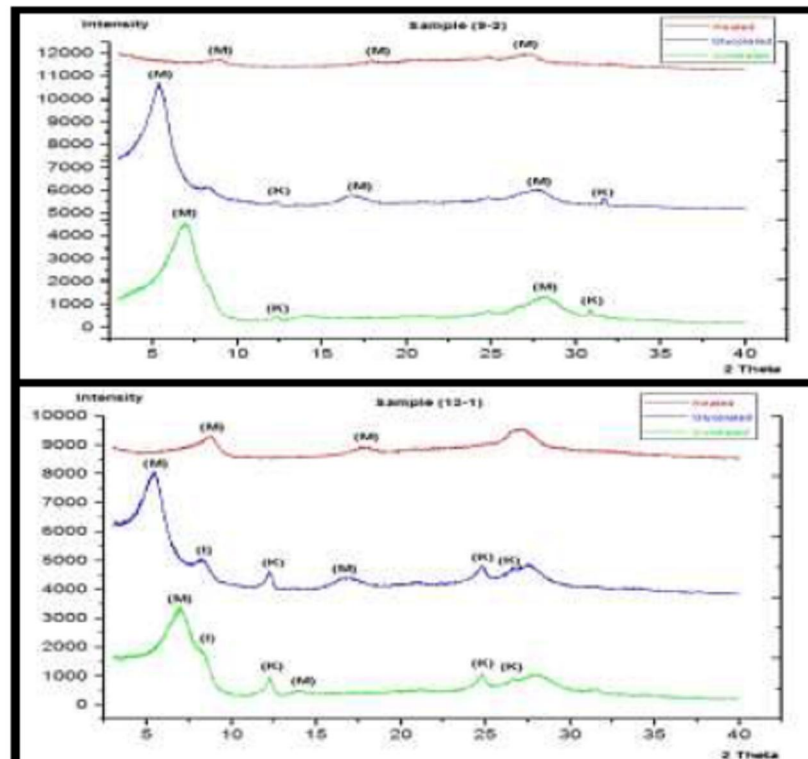


Fig 9: X-ray diffraction of the studied clay minerals, Samples (9-2) and (13-1).

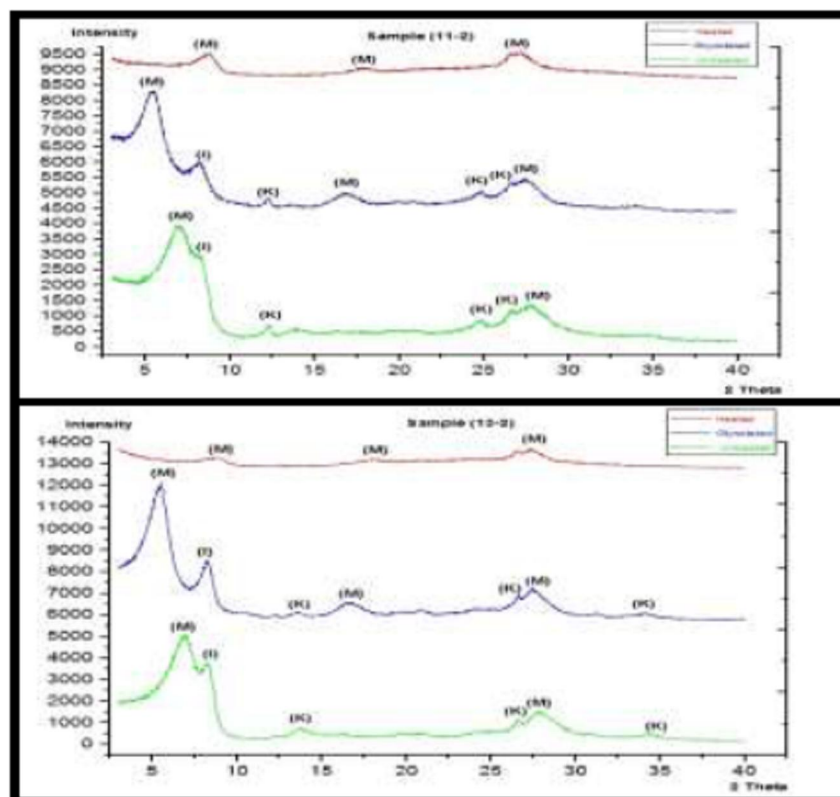


Fig 10: X-ray diffraction of the studied clay minerals, Samples (11-2) and (13-2).

4. Radioactivity

Exposures can also vary as a result of human activities and practices. In particular, the building materials of houses and the design of ventilation systems strongly control levels of radiation. Consequently, the averages of radiation doses are usually different depending on the source and type of radiation (Table 7).

The average global exposure doesn't specify to any one alone since there is a wide distribution of exposures from each source. Consequently, the effective doses share in various ways at each location; depend essentially on the specific concentration of radionuclides in the environment and in the body, the latitude and altitude of the location.

For the measured samples whether it can be useful in the commercial field so the area may be utilized, so turned into a working area then the limits for the working areas are listed below.

The occupational exposure of any worker shall be so controlled that the following limits be not exceeded. An effective dose of 20 mSv per year averaged over five consecutive years. An effective dose of 50 mSv in any single year. An equivalent dose to the lens eye of 150 mSv in a year, and an equivalent dose to the extremities (hand and feet) or the skin of 500 mSv in a year. (ICRP.2004, Radioprotection, 2010).

For non-workers (i.e. individuals doesn't related to radiation by any mean) the annual limit is 1 mSv/y.

Table 8: Radioactivity of samples at 0.0 level of third industrial zone of October City.

Sample No.	eU ppm	eTh ppm	eRa ppm	K%	Annual dose (mSv/y)
1-1	ULD	4	4	1.89	0.0984
5-1	ULD	3	4	1.72	0.0740
8-1	ULD	4	3	1.82	0.0740
12-1	ULD	2	4	1.6	0.0980
17-1	ULD	5	3	1.82	0.0988

Table 9: Radioactivity of samples at -5.0 m depth.

Sample No.	eU ppm	eTh ppm	eRa ppm	K%	Annual dose (mSv/y)
2-2	ULD	6	3	1.82	0.0977
6-2	ULD	4	4	1.75	0.0888
10-2	ULD	ULD	3	1.77	0.0798
13-2	ULD	ULD	1	1.69	0.0930
18-2	ULD	4	3	1.75	0.0871

Table 10: Radioactivity of samples at -10.0 m.

Sample No.	eU ppm	eTh ppm	eRa ppm	K%	Annual dose (mSv/y)
3-2	ULD	6	3	1.82	0.0977
7-1	ULD	4	4	1.75	0.0888
9-2	ULD	ULD	3	1.77	0.0798
11-1	ULD	ULD	1	1.69	0.0930
12-3	ULD	4	3	1.75	0.0871

Table 11: Radioactivity of samples at -15.0 m depth.

Sample No.	eU ppm	eTh ppm	eRa ppm	K%	dose Annual (mSv/y)
6-3	ULD	3	2	1.85	0.0834
9-1	ULD	3	4	1.79	0.0912
13-1	ULD	2	4	1.79	0.0856
17-3	ULD	ULD	2	1.73	0.0922
18-1	ULD	ULD	3	1.72	0.0889

In the end from the sedimentological, geotechnical and radiometric studies show that, the soil of a third industrial zone of October City is suitable for direct foundation above them, because they have a high foundation strength. So, it is recommended here to build a lot of buildings.

References

1. AASHTO (2001): Standard method of test for direct shear test of soil under consolidated drained conditions. T 236-92. Washington, D.C.
2. Amaral, E.J. And Pryor, W.A. (1977): Depositional environment of the st. Peater sandstone deduced by textural analysis Jour. Sed. Petrol., 47(1): 32-52.
3. ASTM (2004): Standard test method for direct shear test of soils under consolidated drained conditions. Annual book of ASTM standards. D 3080, Sect. 4, Vol. 04.08. Philadelphia, Pa.
4. Barron, T. (1907): The topography and geology of the district between Cairo and Suez Egypt, Surv. Department, Cairo; 133p.
5. Beadnell, H. J. L. (1902): The Cretaceous region of Abu Roash, near the Pyramids of Giza, Egypt. 48p. Survey Department, Egypt.
6. Darnely, A. G., (1982): Hot granites, some general remarks in Uranium in granites, (ed.) Y. T., Maurice; Geological Survey of Canada, Paper. 18-23, 1-10.
7. Egyptian Code. (2001): Fore soil mechanic, design and construction foundation.
8. Faris, M.I. (1948): Contributions to stratigraphy of Abu Roash and the history of the Upper Cretaceous in Egypt. Bull. Fac., Cairo univ., V.27, P.221-239.
9. Folk, R.L. and Ward, W.C. (1957): Brazes River bar, a study in the significance of grain size parameters. Journal sed. Petrol., 27 pp. 3-27.
10. Friedman G. M. (1961): Distinction between dune, beach and river sands from their textural characteristics. Journal of Sedimentary Petrology, Vol. 31, pp. 515-529.
11. Gibbe, R.J.(1968): Clay mineral mounting techniques for x-ray diffraction analysis, Jour. Sed. Pet.V.38 PP. 242-244.
12. Hazen, A. (1892): Some physical properties of sands and gravels with special reference to their

- use in filtration. The 24th Annual Report of the State Board of Health of Massachusetts. Public Document No. 34, Boston, Wright and Potter Printing Co., p. 553.
13. Moiola, R.J. and Weiser, D. (1968): Textural parameters an evaluation. *Jour. Sed. Petrology*, V. 28, P. 211-226.
 14. Friedman G.m., (1967): Dynamic processes and statistical parameters compared for size frequency distribution of beach and river sands. *Jour. Sed. Petrology*. V.37, No. 2, pp. 327- 354.
 15. CONOCO, (1987): Conoco Coral, and Egyptian General Petroleum Company, 1987.
 16. Geological map of Egypt, scale 1:500,000, Cairo, Egypt.
 17. ICRP, 2004a. Managing patient dose in digital radiology. ICRP Publication 93. *Ann. ICRP* 34 (1).
 18. ICRP, 2004b. Release of patients after therapy with unsealed radionuclides. ICRP Publication 94. *Ann. ICRP* 34 (2).
 19. ICRP, 2010. Preventing Accidental Exposures from New External Beam Radiation Therapy Technologies. ICRP Publication 112.

4/15/2015