CHAPTER V
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I- Summary

The present work deals with the geotechnical and petrological studies on the upper middle Eocene (Gehannam Formation) and Quaternary deposits occurring as foundation base of the present area. The area under investigation located at west Fayum depression, (Latitudes 29° 15` and 29° 19` N and Longitudes 30° 33` and 30° 38` E). Geomorphologically, the area of study is considered as a plateau divided by Wadi El Nazla and the buildings were constructed on the cliff of this plateau.

The base materials of the area under study are suffered from instability, for example settlement as well as slope failure due to the induced of swelling and shrinkage by wetting or drying out of water. So that the engineering behaviour of rock type of clayey rich materials and their weathering products at different water contents are examined in this study as well as the factors affecting the slope to failure.

The slope gradient, the geotechnical properties of the material involved, the presence of discontinuities (joints, fractures and faults), the amount of water entering a slope which is a function of the vegetation cover, drainage, soil type, rock structure and weathering process were discussed in this work with emphasis on the engineering behaviours of rocks and/or weathering products base materials.

This study has concerned on the presence of extensive reactive with water and/or swelling soils across the project area. The study has also highlighted the influence of environmental factors such as water supply, vegetation cover and drainage on the nature and behaviour of the soils in

situ. A range of soil index and engineering properties as well as chemical/ mineralogical composition consistent with the geological diversity of the project area has been obtained and recorded. The variability of index properties and of the soil under consideration is generally examined with depth and across the study area. Most soil index properties could be characterised and/or estimated with a high degree of approximation through correlation with results of Atterberg limits and other index tests performed on disturbed and fractioned samples.

The field and laboratory investigations of the rocks and their weathering products under study have provided a vast data base on soil index and engineering properties as well as chemical/mineralogical composition. This data will provide the basis for on-going and future research on the characterisation of the soil materials under consideration, especially as regards their engineering geological/civil engineering and social-economic implications

Geologically, the sedimentary succession occurring at Wadi El Nazla-Roba area belongs to middle Eocene to late Eocene (Gehannam Formation), upper Eocene (Qarun Formation) and Quaternary deposits. Generally, the most common rock types in the studied area belong to middle to late Eocene and Quaternary ages. Three cross sections (A, B and C) were selected in the studied area to show the relation between petrographical and engineering properties for the rocks and their weathering products outcropping in the studied area. These rocks represented by argillaceous limestone, marl, limestone and stratified shale with gypsum intercalation (Gehannam Formation) and greyish-white to light-grey calcareous shale and dark grey cultivated land (Quaternary deposits). Unconformity surface of sand occurs between the two formations and it attains the maximum thickness of about

1.5 m. The maximum thickness of the succession increases towards the north where Gehannam Formation in the study area measures 22 m to the north (Section C) and it ranges from 8 to 15 m thick to the south at Roba area (Section A and B). It is mainly composed of repeated cycles of argillaceous limestone, marl, limestone and stratified shale with gypsum intercalation, cracked shale and jointed calcareous shale. Birket Qarun Formation is exposed at the northern, southeastern and western portions of the Fayum province. It overlies the Gehannam Formation and underlies the Qasr El Sagha Formation and it composed of sandstones and shale with minor bands of limestone. In the present study the Birket Qarun Formation is exposed at Nazzaza area at the eastern side of Wadi El Nazla. Quaternary deposits have a thickness of 5 m and 10 m at the southern side of the area at Roba area of sections A and B respectively. It is mainly composed of greyish-white to light-grey calcareous shale and dark grey shale (cultivated land) showing columnar and stratified features. Generally the area under investigation shows clear lateral variation in the thickness of both Gehannam Formation and Quaternary deposits where the Quaternary deposits thickness ranges from 5m to 10m and late middle Eocene (Gehannam Formation) thickness shows maximum thickness of 22m at the north.

Mineralogically, using X-ray diffraction charts for both Gehannam Formation and Quaternary deposits samples are composed mainly of clay minerals (illite, kaolinite and illite/smectite mixed layer), calcite, gypsum, quartz, albite and halite. Kaolinite is the major clay mineral in Gehannam Formation, whearas Illite is the major clay mineral in Quaternary deposits. Accordingly, the studied rock materials and their weathering products can be classified into two groups:

1-Kaolinite and illite/smectite mixed layers with illite bearing Gehannam Formation.

2-Illite, kaolinite and illite/smectite mixed layers bearing Quaternary deposits.

Using thin section microscopy, Gehannam Formation rocks are classified as argillaceous fossiliferous biomicrite (Wackestone) and Quaternary deposits as sandy calcareous mudstone and massive mudstone.

Using scanning with an electron probe across a specimen, the clay minerals contents include illite, illite/smectite mixed layers and kaolinite in Gehannam Formation. Illite clay mineral in Gehannam Formation samples is originated as the intensive weathering of euhedral cleavable crystals of k-feldspar crystals. Illite/smectite mixed layer clay minerals occur as ribbons filamentous needle crystals like shape with high distribution of major elements like Si, Al, Ca and Fe. Non clay minerals contain carbonate minerals and quartz crystals. Quaternary deposits are composed mainly of kaolinite, illite and k-feldspar of blocky crystal of k-feldspar embedded in the clay minerals groundmass. Kaolinite clay mineral occurs mainly as pseudohexagonal plates or book like shape. Kaolinite occurs as the weathering of k-feldspar and it is observed the replacement of k-feldspar by kaolinite. Illite occurs as flaky and sheet like crystals with the high concentrations of Si, Al, K, Ca, Fe and Ti.

The occurrence of K in the illite minerals suggested that, it were formed as the alteration of k-feldspar due to the relative peak height of K is more or less approached the peak height of Al.

Geochemically, Si/Al ratios are corresponding to 1:2 to 1:3 clay minerals structure (T-O-T), Quaternary deposits more alumina and potash content than Gehannam Formation because of the fact that, Quaternary deposits more illitic than Gehannam Formation. However, Quaternary

deposits contain silica more than required for illite mineral (Si/Al) due to presence of free silica (Quartz).

Soil engineering properties such as grain size analysis, Atterbeg limits, consistency of clay, clay activity, swelling and shrinkage were determined for three sections (A, B and C). The engineering parameters of clays have been investigated due to their effects on foundations problems and slope failure. Clay content presents problems to geotechnical engineers due to its complex nature and its swelling-shrinkage behaviour when it contacted with water. It is shown from the results obtained in this study, that almost all the material passes the 2 mm sieve. The average percentage of the material passing 63 μm sieve is 96.96 % and 99.54 % for Gehannam Formation (silt to mud fields) and Quaternary deposits (silt to mud) samples. The unconformity surface between the two Formations is relatively rich in sand fraction (up to about 58.57%). Most of Gehannam samples under investigation range from silt to clay fraction. The Quaternary samples are located between silty clay with sand to clay in composition.

The liquid limit for Gehannam shale samples range between 30.5 % and 86 % with an average of 57.542 % while it ranges between 63 % and 108.3 % with an average of 87.55 % for Quaternary deposits. The characteristics difference between the two type of soils have been attributed to higher percentage of I/smectite mixed layer and illite in the Quaternary deposits more than Gehannam Formation, or to the higher content of kaolinite in Gehannam Formation samples more than Quaternary samples. Another factor is the gypsum and lime content, where it is more distributed in Gehannam Formation samples more than in the Quaternary samples.

The plastic limit ranges from 12.1 % to 24.3 % and 12.9 % to 16.1 % in Gehannam Formation and Quaternary deposits respectively. The plasticity

index values range from 17.6% to 69.6% with an average of 41.128% for Gehannam Formation while it ranges from 50.1% to 92.2% with an average of 73.075% for Quaternary deposits samples supporting the findings in clay mineralogy results. Gehannam Formation ranges from low plasticity to very high plasticity while Quaternary deposits range from high plasticity to extremely high plasticity with liquidity index ranging from -0.56 and 0.242 with an average of -0.2085 for Gehannam Formation while it ranges from -0.178 to 0.190 with an average of 0.0175 for Quaternary deposits. The activity ranges from inactive (0.637) to highly active (11.925) with an average of 3.472. The Average of activity supports Active clay is the main dominate for Gehannam Formation samples. The activity index in Quaternary samples ranges from (1.658) to (2.09) with an average of 1.439. These results support that the active clay is the only clay type within Quaternary deposits. Soil consistency ranges from 0.77 to 1.56 for Gehannam Formation samples with an average of 1.21 while it ranges from 0.81 to 1.18 with an average of 0.98 for Quaternary deposits samples. It is indicated that Quaternary and Gehannam samples range from solid to semi-solid state.

The results of linear shrinkage range from 5.290 % to 18.071 % and from 17.36 % to 18.140 % for Gehannam Formation and Quaternary deposits respectively, which means that Gehannam Formation samples range from marginal to critical degree of expansion while all the studied samples within Quaternary deposits represent a critical degree of expansion . It was concluded that, the Quaternary deposits have higher linear shrinkage more than Gehannam Formation samples which support the results of mineralogical compositions specially clay mineral contents variation between the two types of the Formations.

Values of free swelling attains the maximum values of 160 % and 97 % in Gehannam Formation and Quaternary deposits respectively. The lowest values of free swell in Gehannam Formation are due to the occurrences of Gypsum mineral and lime materials (swelling value is 3 %).

According to the spatial variability of the engineering parameters of the rocks and their weathering products under consideration, Gehannam Formation and Quaternary deposits can be classified into four groups according to swelling percentages and plasticity index values. The first three groups (1- 3) follow Gehannam Formation while the fourth group (4) follows Quaternary deposits as follows:

1) Low swelling group (Group A), the swelling values range from 3 % to 47 % and the plasticity index values range from 17.6 to 45.4.

2) Moderate swelling group (Group B), in which the swelling % ranges from 80 % to 123 % plasticity index between 46.8 and 62.

3) High swelling group (Group C), where the swelling % ranges from 140 % to 160 % and plasticity from 57.6 to 69.6.

4) Moderate swelling group (Group D), in which the swelling % ranges from 43 % to 97 % and plasticity index from 50.1 to 92.2.

The results obtained in the cluster groups supporting that the soil under study are considered to have a construction problems due to the soils having free swell values greater than 100 % are considered potential problems (have strong tendency to swell or shrink considerably even under light), whereas soils with free swell values below 50 % are not likely to show expansive properties (BS 1377: 1975, Gibbs and Holtz, 1956). However, Dawson (1953) reported free swell values of about 50 % of several Texas clays showed extensive expansion. The changes in moisture

content may lead to heave or differential settlement of foundation and corresponding structural damage of building.

II- CONCLUSION

The Eocene rocks outcropping at the western part of Fayum depression are unfavourable as building ground and construction materials as well as problematic to engineering structure because of their tendency to heave and may decay and change to soil during the wet season or even the water content changes. Such change in wetting and drying out of water may cause structure damage and this process is further if the parent rock contains swelling clay minerals. The mechanism of the interaction between soil and water depends primarily on the type of clay minerals which influenced on the engineering parameters. One of the major interests of a construction or foundation engineer engaged in the design of structures on swelled soils is to predict the stress volume change of the soil base materials when subjected to change in moisture content as well as stress parameter. Pavements are in particular susceptible to damage by swelling soil even shallow foundation in the study area. Similarly, earth structure such as foundations, road base, canal, tunneling etc built above these decayed rocks and their weathering products suffering slip and damage.

The area under study is an example of such typical sites which needs many developments and planning work in Fayum province. Besides, it is generally found in the studied area a serious of geological problems, the foundation were built on steep slope and the occurrence of soft clay materials underneath the foundation. Another factor to the foundation problem is the weathering of rock mass base materials. It generally known that, rock weathering process increases the degree of geological complexity in rock mass materials and makes the site characterization in the most place

of the area under study more difficult and unfavourable to building ground. The major problem is the occurrences of swelling clay minerals which demonstrated that the light structure are suffering from adverse effects of expansion and shrinkage of the foundation ground. As the vertical swelling causes heave of the base like structure of the foundations and lateral expansion as well as shrinkage also cause significant damage to retaining structures and basement walls. Instability of unsupported excavations in swelling/shrinkage clayey rich materials are results of deformation characteristics of the soil when it come in contact with water or due to excessive loss of water by drying out.

The susceptibility of a slope to failure is dependent on many factors including the gradient of the slope, the geotechnical properties of the material involved, cohesion, the presence of discontinuities and the amount of water entering a slope, which is a function of the vegetation cover, drainage, soil type and rock structure.

The sliding in the area of study could be caused by many factors:

- **Human activity**

Human activities play an important role in affecting the susceptibility of a slope to failure in Wadi El Nazla area, where slopes are extensively farmed for agriculture. As a result of liquefaction by sewage water drainage and irrigation, rocks and their weathering products lose its shear strength, stiffness and bearing capacity and cannot support structures and it could be result in settlement, tilting or overturning of structures (Gostelow, 1991, Dai et al., 2002 and Mollamahmutoglu, et al., 2003).

- **Lithological features**

The sensitive clays (clay minerals grains are held together by precipitated of salts in the pore space between them) exhibit deformation softening behaviours like liquefaction (Kramer, 1996). On water infiltration into the pore spaces, the salts holding can dissolve away and this may causes a loss in shear strength of the soil and result in seepage down slope or liquefaction. For the area under investigation according to lithological features, gypseferous shale at Wadi El Nazla area can be considered as sensitive clay and it may be liquefied by the same manner where dissolution of gypsum salts can cause soil collapse or settlement in the area.

- **Weathering**

Expansive behaviour of soil is one factor that influence slope stability. Expansive and hydrocompacting soils are soils that contain a high proportion of semctitic clay, such clay minerals expand when they become wet as water enters the crystal structure and increases the volume of the mineral, when such clays dry out the loss of water causes the volume to decrease and the clays to shrink. In the study area, the XRD analysis indicates presence of illite/smectite mixed layers and illite in considerable amount that gives affective values of swelling and shrinkage supporting the

role of shrinkage-swelling in the weathering of rock mass which leads to settlement and rockfall problems.

- **Morphological causes**

a) The slope angle is an essential component of slope stability analysis, as the slope angle increases, the shear stress in soil or other unconsolidated material generally increases as well. Gentle slopes are expected to have a low frequency of landslides because of generally lower shear stresses associated with low gradients (Lee and Min, 2001; Frattini et al., 2004; Lee et al., 2004 and Lan et al., 2004). In this study, steep slope at Wadi El Nazla area increases the effect of the buildings by the gravity force; thereby the object will move down-slope.

b) Water in Wadi El Nazla itself can cause erosion which affects the cliff instability.

- **Structure causes**

Presences of discontinuities such as faults, joints and fractures not only weaken the foundations rocks but also allow have the water to penetrate the rocks easily and both of them affected the cliff instability. Argillaceous shale of Eocene rocks shows highly cracked and jointed at Wadi El Nazla which represents important factor in sliding of rock mass.

Collapse can be avoided by:

- The hazards from landslides can be reduced by avoiding the construction on steep slopes and existing landslides, or by stabilizing the slope (Slope stability is also increased when a retaining structure is placed at the toe of the landslide).
- Drainage pipes could be inserted into the slope to more easily allow water to get out and avoid increases in fluid pressures.
- Planting trees within about ten feet from the house is not recommended. Trees extract moisture from soil causing shrinkage. Greater separation is appropriate for larger trees. Plants that require a large amount of moisture are also not recommended near buildings.
- Minimize the surface irrigation
- Soil compaction as a solution for overcoming the gypsum problem (that occurs as shale-gypsum intercalation), then keeping of the moisture content to the allowed range.
- The slope can be reduced by pining where suitable filling material can be used for this purpose.

REFERENCES

RFERENCES

- **Abd Allah, A., Aboul Ela, N., Shamah, K. and Abd El-Aziz, S.** (1997): Biostratigraphy of the Temple Member (Qasr El Sagha Formation, Late Eocene) North El Fayum depression, Egypt. J. Geol., 41 (1), p. 541-578.
- **Abd El-Aziz, S. M.** (1995): Geologic studies of the upper Eocene and Oligocene formations, North El-Fayum province, Egypt. M. Sc. Thesis, Fac. Sci., Cairo Univ, Egypt, 225 p.
- **Abd El-Aziz, S. M.** (2002): Stratigraphy of the Eocene sequences of Fayum-Minia district (new Road) Egypt. Ph. D. Thesis, Fac. Sci, Cairo Univ, Fayoum Branch, 439 p.
- **Abd El-Aziz, S. M and Abd El-Gaied, I. M.** (2007): Middle and Late Eocene planktonic foramineferal study of Wadi El NAZLA and Wadi El Batts Sections, Fayum Depression, Egypt. 2nd inter. Conf. Geo-resource in the Middle East and North Africa, Cairo University.
- **Abd El-Aziz, W. and Zahra H.** (2002): Tectonics of Qarun area using potential field data. 20th Annu. Meet. Geoph. Soc. Cairo, p.8.
- **Abd El-Gaied I. M and Abd El-Aziz. S. M** (2007): Ostracodes of the Middle and Upper Eocene rocks of Wadi El Nazla and Wadi El Batts sections, Fayum depression, Egypt. 2nd Inter. Conf. Geology of the Tethys, Cairo University, p. 277-302.
- **Abd El-Ghany, O. A.** (1990): Micropaleontology and biostratigraphy of the Eocene rocks in the southern Fayum area. M. Sc. Thesis, Fac. Sci. Ain Shams Univ., Cairo, 122 p.

- **Abd El-Meguid, A. A, Fayed, L. A, Mostafa, M. E and Mostafa, M.S.** (1998): Geotechnical and environment hazards in desert new cities: A case study of El-Minia El-Gedida Site, Egypt. Natural Hazards, 17, p.47-67.
- **Abd El-Salam, M. A., Harga, A. A and Rabie, F. H.** (1973): Mineralogical composition of the Fayum-Beni Suef soils. A.R.E Bull. Desert. Inst., Egypt, 22 (1), p.117-130.
- **Abd El-Tawab, S. and Ibrahim, H. A. M.** (1992): Unfavorable geologic setting of a New Minia city, Upper Egypt. Ain shams Sci. Bull., p.221-229.
- **Allam, A., Shamah, K. and Zalat, A.** (1991): Biostratigraphy of the middle Eocene succession at Gabel Mishgigah, Wadi Rayan, Libyan Desert, Egypt. J. African Earth, Sci., 12 (3), p.449-459.
- **Al-Rawas, A., Guba, I. and Mcgwan, A.** (1998): Geological and engineering characteristics of expansive soils and rocks northern Oman. Engineering geology, 50, p. 267-281.
- **Altmeyer, W. T.** (1955): Discussion of engineering properties of expansive clays, Transaction ASCE, V, 81 (658), pp. 17–19.
- **Anderson, J. U., El Fadil, K. F. and O'Connor, G. A.** (1973): Factors affecting the coefficient of linear extensibility in Vertisols. Soil Sci. Soc. Am. Proc., 37, p 298-299.
- **Ansary, S. E.** (1955): Report on the foraminiferal fauna from the Upper Eocene of Egypt. Publ. Inst. Desert, Egypt, 6, p. 1-160.

- **Awad, G. H., Faris, M. I. and Abbas, H. L.** (1953): Contribution to the stratigraphy of the Mokattam Area, east of Cairo. Bull. Inst. Desert, Egypt, III (2), p.105-107.
- **Basta, F .Z., Philip, W. R., Khalil, J. B.** (1974): Clay mineralogy of some soil sediments from Fayum Area and the Nile Valley, Egypt. Egypt, J. Soil Sci., 14 (1), p.75-91.
- **Beadnell, H. J. I.** (1905): The topography and Geology of the Fayum province of Egypt. Geol. Surv. Egypt, p 1-101.
- **Borchardt, G.** (1989): Smectites. In J. B. Dixon and S. B. Weed (ed.), Minerals in soil environments. 2nd ed. Soil Sci. Soc. Am. Book Ser. No. 1. Madison, WI. p. 675-727.
- **Bown, T. M. and Kraus, M. J.** (1988): Geology and paleoenvironment of the Oligocene Jebel Qatrani Formation and adjacent rocks, Fayum depression, Egypt. U. S. Geol. Surv. Prof. Paper (1452): 60 p.
- **British standards institution** (1975): Linear shrinkage. BS 1377, London, p. 93-94.
- **British standards institution** (1975): Moisture content and index tests. BS 1377, London, p. 51.
- **British standards institution** (1975): Moisture content and index tests. BS 1377, London, p. 50-100.
- **British standards institution** (1975): Particle size. - BS 1377, London, 143-216.
- **Carothers, H. P.** (1965): Engineered foundations in expansive clay, in engineering effects of moisture changes in soils. – International research and engineering conference on expansive clay soils, concluding proceedings, college station, Texas (A and M press), Texas, p. 302-323.

- **Conoco** (1987): Geological map of Egypt, Scale 1: 500,000 NH 36 SW. Beni Suef. Egypt. General Petroleum Corporation.
- **Dai, F.C., Lee, C.F., Ngai, Y.Y.** (2002): Landslide risk assessment and management: an overview. Eng. Geol, 64 (1), p.65–87.
- **Dawson, R. F.** (1953): Movement of small houses erected on an expansive clay soil. Proc. 3rd Int. Conf. Soil Mech. Found. Eng, 1, p.346-350.
- **Day, R. W.** (1994): Swell- shrink behavior of compacted clay. J. Geotech. Eng. 120 (3), p. 618- 623.
- **Deer, W. A., Howie, R. A. and Zussman, J.** (1966): An Introduction to Rock-forming Minerals. New York (Wiley and Sons), 528 p.
- **Deer, W. A., Howie, R. A. and Zussman, J.** (1978): Rock-Forming Minerals: Single-Chain Silicates. The Geological Society, London, 2. Ed., 668 p.
- **Deer, W. A., Howie, R. A. and Zussman, J.** (1997): Rock-Forming Minerals: Double-Chain Silicates. The Geological Society, London, 2. Ed., 764 p.
- **DIN- Taschenbuch 113, Erkundung und Untersuchung des Baugrunds** (1998): Bestimmung der Korngrößenverteilung. DIN 18123 (1), Deutsches Institut für Normung e.V., Wiesbaden, p. 273-284.
- **Dixon, J. B.** (1989): Kaolin and serpentine group minerals. p. 467-525. In J. B. Dixon and S. B. Weed., Minerals in soil environment. 2nd ed. Soil Sci. Soc. Am Book Ser, No. 1. Madison, WI.
- **Douglas, L.A.** (1989): Vermiculites. p. 635-674. In J.B. Dixon and S.B. Weed (ed.) Minerals in soil environments. 2nd ed. Soil Sci. Soc. Am. Book Ser. No. 1. Madison, WI.

- **El-Anbaawy, M. I.** (1989): Comparative sedimentological studies on some Tertiary and Quaternary argillaceous rocks from Fayoum, Egypt. J. Geol., 33 (1-2), p. 141-172.
- **El-Behiry, M. G.** (1995): Role of seismic velocity in evaluating the proposed site of the New Fayum City. Bull Fac. Sci. Cairo Univ. Egypt, 63, p. 89-104.
- **El-Dakkak, M. W. and Rifai, R. I.** (1984): Geologic study of Gebel El Qalamun area, Western Desert, Egypt, Ann. Geol. Surv. Egypt, 14, p. 191-215.
- **EL-Demerdash, S., Abd El-Aal, S. I., Khalil, M. N. and Aboul-Naga, M. A.** (1976): Mineralogical study of soil- aggregates of Fayum soils, A. R. Egypt: Desert Inst. Bull. Egypt, 26 (2), p. 407-419.
- **El-Hefnawy, M. A. Loukina, S. M and Abayzeed, S. D.** (1994): Mineralogy and Geochemistry of Smectite Clays from Fayum Region, Egypt: The Mineralogical Society of Egypt-the 1st international Symposium on Industrial Applications of Clays, p. 128-150.
- **El-Younsy, A., Mansour, H., Youssef, M. and Makram, M.** (1999): Facies, paleoenvironments and mineralogy of the upper Eocene-Oligocene sequences northwest Birket Qarun. Fayum depression. Weastern desert, Egypt, 1st Inter., Conf on the geology of Africa, Assuit-Egypt, I, p. 137-159.
- **Elewa, A. M., Omar, A. A. and Dakrory, A. M.** (1998): Biostratigraphical and Paleoenvironmental studies on some Eocene ostracodes and Foraminifera from the Fayoum depression, Western Desert, Egypt. Egypt. J. Geol., 42(2): 439-469.

- **Fanning, D. S., V. Z. Keramidas, and M. A. El-Desoky** (1989): Micas. In Dixon, J. B., and Weed, S. B., Minerals in soil environments, Soil Science of America, Madison, WI, p. 551-634.
- **Fecker, E. and Reik, G.** (1996): Baugeologie. Stuttgart (Enke), 429 p.
- **Folk, R. L.** (1954): The distinction between grain size and mineral composition in sedimentary rock nomenclature. J. Geol., 62, p. 344 - 359
- **Frattini, P., Crosta, G. B., Fusi, N. and Dal Negro, P.** (2004): Shallow landslides in pyroclastic soils: a distributed modelling approach for hazard assessment. Eng. Geol., 73 (3–4), p. 277–295.
- **Gibbs, H. J and Holtz, W. G.** (1956): "Engineering properties of Expansive clays". Trans. Am. Soc. Civ. Eng., No.1, p.2814
- **Gostelow, P.** (1991): Rainfall and landslides. In: Almeida-Teixeira, M.E., Fantechi, R., Gomes Coelho, A. (Eds.), Prevention and Control of Landslides and Other Mass Movements. Commis. European Communities, Brussels, p. 139–161.
- **Gramko, G. J.** (1974), "Review of Expansive Soils," JGED, ASCE, vol. 100, GT 6, June, pp. 667-687.
- **Güven, N., Hower, W. F and Davies, D. K.** (1980): Nature of authigenic illites in sandstone reservoir. J. Sed. Petrol., 50, p.761–766.
- **Hammad, M. A., Abu El-Einane, S. A. and Abed, F.** (1983): Pedological studies on the Fayum Area, Egypt. J. Soil Sci., 23, No.2, p. 99 - 114.

- **Hardt, G.** (1985): Basisabdichtungen aus Ton, Veröffentlichungen des Grundbauinstituts der Landesgerbeanstalt Bayern. Heft, 44, p. 47- 68.
- **Harvey, C. C. and Browne, P. R.** (1991): Mixed-layer clay geothermometry in the Wairakei geothermal field, New Zealand, Clays and Clay Miner., 39, p. 614-621.
- **Hassan, N. M., Hamouda, H., and Mohamed, H. F.** (1997): Seismic evaluation of the subsurface structural settings in west Qarun Area, Western Desert. Egypt. Proc 15th Annu. meet Egypt, Geoph. Soc. (EGS), Mar 25 - 26, p. 21-44.
- **Hillel, D. (1980)**: Soil physics. Academic Press, New York. Linear extensibility in Vertisols. Soil Sci. Soc. Am. Proc, 37, p. 298-299.
- **Holtz, W. G. and Bara, J. P.** (1965): Comparison of expansive clays in the central valley, California, in engineering effects of moisture change in soils.- International research and engineering conference on expansive clay soils, concluding proceeding, college station, Texas (A and M press), Texas, p. 120- 151.
- **Hudyma, N. and Burcin Avar, B.** (2006): Changes in swell behavior of Expansive Clay Soils from dilution with sand, Environmental and Engineering Geoscience, XII (2), February, 2006, p. 137-145.
- **Hume, W. F.** (1912): Explanatory notes to a company the geological map of Egypt. Geol. Surv. Egypt, 50 p.
- **Imam, M. B.** (1994): X-Ray Diffraction Study on Noegene Shales from Patharia Anticline, Eastern Bangladesh, with emphasis on Smectite clay Dehydration and Implications. J. Geol Soc., India, 44, p. 547–561.

- **Ingles, O. G. and Metcalf, J. B.** (1972): Soil stabilization, principles and practice. Sydney-Melbourne-Brisbane (Butterworths), 374 p.
- **Ismail, A. I. M.** (2004): Engineering and Petrological Chracherieristic of clay silt soils to be used as Road Base and the Improvement by Lime and Cement. Ph. D. Thesis, Cluasthal University, Germany, 192 p.
- **Ismail, A. I. M.** (2006): Influence of lime and cement stabilizers on the engineering properties of the Quaternary soil, South Germany. J. Appl. Geophys., Vol. 5, No. 1, September 2006, 333- 347.
- **Ismail, A. I. M.** (2007): The impact of additives for the improvement of engineering properties of soil materials: 4th International Conference of Appl. Geophys, National Research Centre, Egypt.
- **Issawi, B. and McCauley. J. F.** (1993): The Cenozoic Landscape of Egypt and its River System. Ann. Geol. Survey, Egypt, 19, p. 357-384.
- **Jasmund, K. and Lagaly, G.** (1993): Tonminerale und Tone. Darmstadt (Steinkopff), Germany, 490 p.
- **Khatter, E. A.** (1988): Water movement conditions in some soils of Fayum Governorate, Egypt. Egypt J. Soil Sci., 28 (1), p. 103-114.
- **Kramer, S. L.** (1996): Geotechnical Earthquake Engineering. Prentice-Hall, New Jersey, 354 p.
- **Lambe, T.W. and Whitman, R.V.** (1969): Soil mechanics. New York, (John wiley and Sons), 548 p.
- **Lambe, T.W and Whitman, R.V.** (1979): Soil mechanics. New York (John wiley and Sons), 553 p.

- **Lan, H. X., Zhou, C. H., Wang, L. J., Zhang, H. Y. and Li, R. H.** (2004): Landslide hazard spatial analysis and prediction using GIS in the Xiaojiang watershed,Yunnan, China. Eng.Geol, 76(1–2), p. 109 –128.
- **Lee, S., Min, K.** (2001): Statistical analysis of landslide susceptibility at Yongin, Korea. Environ. Geol. 40, p. 1095–1113.
- **Lee, S., Choi, J., Min, K.** (2004): Probabilistic landslide hazard mapping using GIS and remote sensing data at Boun, Korea. Int. J. Remote Sens., 25 (11), p. 2037–2052.
- **Liu, D., Yang, Q., Tang, D., Kang, X. and Huang, W.** (2000): Geochemistry of sulfur and elements in coals from the Antaibao surface mine, Pingshuo, Shanxi Province, International Journal of Coal Geology, 46, p. 51–64.
- **Mackenzie, W. S. and Guilford, C.** (1980): Atlas of Rock-forming Minerals in thin section. New York (Wiley and Sons), 98 p.
- **Mishra, A. K. and Dhawan, S. and Rao, S. M.** (2008): Analysis of swelling and shrinkage behaviour of compacted clays, Geotech. Geol. Eng., 26, 289-298.
- **Mitchell, J. K. and Soga, K.** (2005): Fundamentals of soil behavior, 3rd Edition, John Wiley and Sons, 577 p.
- **Mollamahmutoglu, M., Kayabali, K., Beyaz, T. and Kolay, E.** (2003): Liquefaction-related building damage in Adapazari during the Turkey earthquake of August 17, 1999. Engineering Geology, 67, p. 297–307.
- **Moore, D. M. and Reynolds, R. C.** (1989): X-ray diffraction and the identification and analysis of clay minerals. New York (Oxford University Press), 332 p.

- **Moustafa, A. R., El-Nahas, F. and Abd El-Tawab, S.** (1991): Engineering geology of Mokattam city and vicinity, eastern greater Cairo, Egypt: Engineering geology, 31, p. 327-334.
- **Naga, M. A., Noman, K. I., Abd El-Aal, Sh. I., Khalil, J. B.** (1981): A Study on the Clay Fraction of Fayum Soils. Egypt. J. Soil. Sci., 21 (1). p. 37-52.
- **Nelson, J. and Miller, D. J (1997):** Expansive soils problems and practice in foundation and pavement engineering. John Willey and sons Ltd, New York, 284 p.
- **Nesse, W.D.** (1991): Introduction to optical mineralogy. 2nd Ed.- New York (Oxford Press), 335 p.
- **Refaie, A.** (2003): Geotechnical studies on the limestone Beds of Beni Suef El-Gedida city. M. Sc. Geol, Fac. Sci., Cairo Univ, Egypt: 196 p.
- **Reik, G. and Ismail, A. I. M.** (2003): Improvement of some engineering properties of silty clay soils to be used as road base by lime and cement, 5th International Conference on the Geology of the Middle East, Cairo, Egypt, p. 441 454.
- **Said, R.** (1962): The Geology of Egypt. Elsevier, Amsterdam, New York, 377 p.
- **Said, R.** (1990): Cenozoic. In (SAID, R., ed.): The Geology of Egypt. A. A. Balkema, Rotterdam, p. 451-486.
- **Samir, A. M.** (1986): Stratigraphy of some Eocene sections in northern Egypt. Ph. D. Thesis, Fac. Sci., Alexandria Univ., Egypt: 222 p.
- **Senosy, M., Riad, S., Youssef, M. and Abdel AAI, G.** (1999): Interaction of earth resistivity methods in geotechnical studies on El-Salam suburb area, Kharaga, Egypt. 1st Inter., Conf on the geology of Africa. Assuit- Egypt, I, p. 579-603.

- **Shelley, D.** (1985): Optical mineralogy - New York (Elsevier), 321 p.linear extensibility in Vertisols. Soil Sci. Soc. Am. Proc, 37, p. 298-299
- **Skempton, A.W.** (1953): The colloidal activity of clays. Proc. 3rd Int. Conf. Soil Mech. Found. Eng., 1, p. 57-61.
- **Sridharan, A. and Gurtung, Y.** (2004): Swelling behavior of compacted fine grained soils, Eng. Geol., 72, p. 9- 18.
- **Strougo, A.** (1992): The Middle Eocene/Upper Eocene transition in Egypt reconsidered. N. Jb. Geol. Paläont. Abh. vol. 186 (1-2): 71-89.
- **Terzaghi, K. and Peck, R. B.** (1948): Soil Mechanics in Engineering practice. Jon Wiley and Sons, New York, 566p.
- **Thomas, P. J., Baker, J. C. and Zelazny, L. W.** (2000): An Expansive Soil Index for Pre-dicting Shrink–Swell Potential. Soil Science Society of America J., 64 (1), p. 268-274.
- **Thomas, P. J.** (1998): Quantifying Properties and Variability of Expansive Soils in Selected Map Units. Ph. D. Thesis, Faculty of Virginia Polytechnic Institute and state University, 79 p.
- **Tromp, S. W.** (1951): Preliminary compilation of the macro-stratigraphy of Egypt. Bull., Soc. Georg. Egypt, 25, p. 55-103.
- **Weaver, C. E. (1956)**: Distribution and identification of mixed-layer clays in sedimentary rocks. Am. Mineral. , 41, p. 202–221.
- **Welton, J. E.** (1984): SEM Petrology Atlas. The American Association of Petroleum geologists Tulsa, Oklahoma, USA, 237p.

- **Williams, A. A. B. and Donaldson, G. W.** (1980): Building on expansive soils in South Africa, 1976–1980, Proceedings of 4th International Conference on Expansive Soils, ASCE Publication, V. 2.
- **Yalcin, A.** (2007): The effects of clay on landslides: A case study. Applied Clay Science, 38, p. 77–85.
- **Yong, R. N. and Warkentin, B. P.** (1975): Soil properties and behavior. New York (Elsevier), 499 p.

ARABIC SUMMARY

جامعة الزقازيق
كلية العلوم
قسم الجيولوجيا

دراسات جيو هندسية لمنطقة غرب منخفض الفيوم، مصر

رسالة مقدمه من

الطالب/ إبراهيم سعيد شحات

(بكالوريوس العلوم 2002)

إلى

كلية العلوم – جامعة الزقازيق

لاستكمال متطلبات الحصول على درجة الماجستير فى العلوم

جيولوجيا (صخور رسوبية)

2008

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إلى

قسم الجيولوجيا – كلية العلوم – جامعة الزقازيق

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د/ على إسماعيل محمد

باحث فى الجيولوجيا الهندسيه – قسم العلوم الجيولوجيا – المركز القومى للبحوث

صفحة الموافقة على الرسالة

دراسات جيو هندسية لمنطقة غرب منخفض الفيوم، مصر

رسالة مقدمة من

الطالب/ إبراهيم سعيد شحات

بكالوريوس العلوم (٢٠٠٢)

لنيل درجة الماجستير فى العلوم - جيولوجيا (صخور رسوبية)

وقد تمت مناقشة الرسالة والموافقة عليها.

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الملخص العربي

الملخص العربى

دراسات جيوهندسيه لمنطقة غرب منخفض الفيوم- مصر.

موضوع الرساله يتناول دراسة الخواص الهندسيه والبتروجرافيه لرواسب عصر الإيوسين العلوى والاوسط (تركيب جهنم) ورواسب الرباعى كاساس للمبانى بمنطقة وادى النزله والربع، غرب منخفض الفيوم، حيث تتواجد معادن الطين فى التتابعات المكونه للمنطقه ونتيجة التغير فى المحتوى المائى للصخور بالمنطقه وحدوث عملية الإنتفاش والانكماش ونتيجه لتكرار عملية إكتساب التربه للماء وفقدها قد يحدث تهشم المبانى فوقها، كذلك درجة الانحدار، الصدوع والفواصل والتشققات بصخور الاساس بالإضافه الى تاثير مياه الصرف والرى كعوامل تجويه لصخور المنطقه. ولذلك كان من الضرورى دراسة الخواص الجيوهندسيه للتربه، التركيب المعدنى والكيميائى وكذلك العلاقه بين الخواص الهندسيه وبعضها وتغير هذه الخواص الهندسيه مع تغير التركيب المعدنى والكيميائى، حتى تكون هذه الدراسات مرشدا" جيدا" لاى مشروع خاص بالتنميه العمرانيه وكقاعدة بيانات جيوتقنيه تفيد فى الإنشاءت المستقبليه فى ظل التوسع العمرانى بمنطقة الفيوم.

تتكون المنطقه من الناحيه الجيولوجيه من رواسب الإيوسين العلوى والأوسط (تركيب جهنم) والمكون من الطفله مع الجبس ورواسب الرباعى والتى تتواجد فى شكل طفله سوداء وأرض زراعيه، يفصل بين الإيوسين والرباعى سطح عدم توافق من الرمل يصل سمكه الى ١،٥ متر و يشهد الجانب الشمالى للمنطقه أعلى سمك لرواسب الايوسين والرباعى. تم جمع العينات للدراسه الهندسيه والمعدنيه من ثلاثة قطاعات (A, B and C) وكانت نتائج الدراسه على النحو التالى:

تم تقسيم رواسب المنطقه بناء على التركيب المعدنى الى مجموعتين

1- **Kaolinite and illite/smectite mixed layers with illite bearing Gehannam Formation.**
2- **Illite, kaolinite and illite/smectite mixed layers bearing Quaternary deposits.**

وظهر أثر الاختلاف المعدنى بين صخور المنطقه واضحا" فى الخواص الهندسيه لهذه الرواسب، حيث تزداد قيم الخواص الهندسيه فى رواسب الرباعى عنها فى رواسب الايوسين، مثل حد السيوله، حد اللدونه ونسبة الانكماش الطولى.

وخلصت الدراسه الى تصنيف العينات بكل من الايوسبن والرباعى الى ٤ مجموعات (من ١- ٣ تتبع الايوسين والمجموعه الرابعه تتبع الرباعى)

١- منخفضة الانتفاش ويتراوح فيها حد اللدونه من ١٧,٦ الى ٣٥,٨

٢- متوسطة الانتفاش ويتراوح فيها حد اللدونه من ٤٦,٨ الى ٦٢

٣- عالية الانتفاش ويتراوح حد اللدونه من ٥٧,٦ الى ٦٩,٦

٤- متوسطة الانتفاش ويتراوح حد اللدونه من ٥٠ الى ٩٢,٢.