GEOLOGICAL AND GEOTECHNICAL CHARACTERISTICS OF THE SOILS IN THE REGION OF SÉTIF

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Abstract:

Given its strategic location, the wilaya of Setif is the crossroads between the IS and the center of one side and the coastal towns of South and other side. it occupies the second round of a national demographic point of view and a large socioeconomic pole, hence the expansion into new land for urban or industrial activities or for the inevitable.

The majorises of this expansion is focused on the meridian Sétif El Eulma due to the topography and other predisposing infrastructure already interesting recently reinforced by the East-West. Several geotechnical studies have been done on this area has been chosen four different sites geographically distant to characterize these deposits.

Éternitaire three sites on the east-west highway, it is the points of interchanges and toll point Near the town of El eulma and agglomeration Ain sfiga and near the town of Ain Arnet, the fourth site is the foundation of a wastewater treatment plant Bazer Sakhra.

The approach in this study is geological soil description of Setif, we also tested through several geotechnical brought to the region, to characterize these soils by hand is an in situ testing and secondly by testing the laboratory.

This study has shown that the Setif high plains generally consist of deposits by fluviolacustres Mioplioquaternaire age, are from top to bottom of arable brown silty clays, limestone crusts villafranchiennes and red clay.

Geotechnical data have shown that the soils are classified into two categories:

O 2 meters sand gravel BC, inferior to 2 meters considered stiff clays Class B.

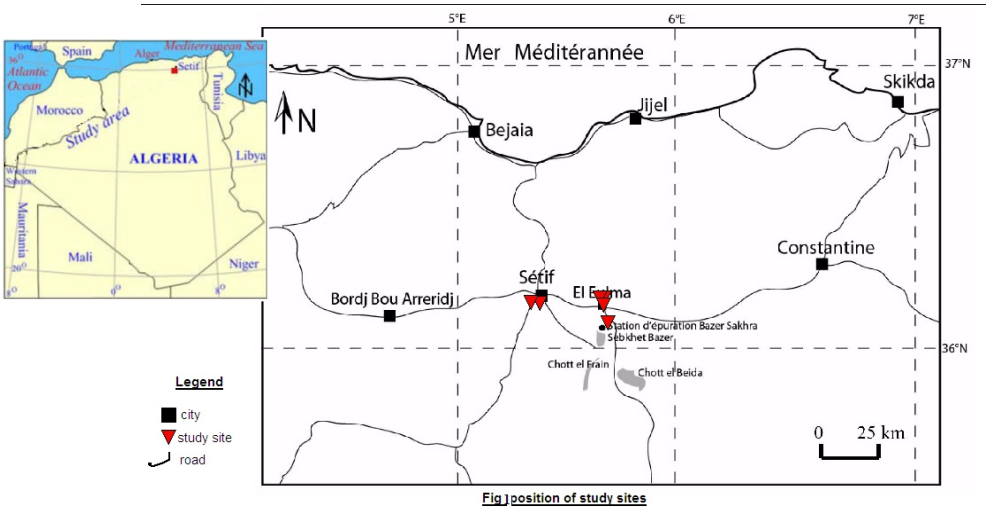
Key Words: Soil mioplioquaternaire, plasticity, sétif

Introduction

The area of study is located in the East of Algeria (Fig.1).

Setif high plains are vast deposits composed mainly by mioplioquaternaire. Several geotechnical studies have been made on this area.

We chose four different sites geographically distant to characterize these formations.



Fig] position of study sites

Éternitaire three sites on the east-west highway, it is the points of interchanges and toll points Near the city of El eulma and agglomeration Ain sfiga and near the town of Ain Arnet, the fourth site is the foundation of a wastewater treatment plant Bazer Sakhra.

In this paper we puts review the geological soil Sétif, moreover on trial through several points of geotechnical this region, characterize these soils by in situ tests and other laboratory tests by . Opportunities for future correlations between these parameters are underway we will later.

We began the study site by site and concluding with a comparison between the pressuremeter different sites.

2-Geology of the area:

Setif high plains, which reports the study area, are between the Saharan Atlas to the south and the north dome Setif. From a geological point of view they belong to the external domain of the Alpine orogeny of eastern Algeria (Fig. 2).

And local geology is summarized as follows:

Soils are generally sandy to clayey in texture and mostly classified as Aridisol and are calcareous. Mineralogically, most of the soils are dominated by kaolinite, illite, smectite, and chlorite—typical for most arid and semi-arid soils.

Rocks and unconsolidated deposits in the area can be divided into three geologic units: (1) upper Cretaceous (Senonian); (2) Eocene; and (3) Mio-Plio-Quaternary. Senonian (upper Cretaceous) is generally found in the northern part of the study area. Senonian units are composed of Santonian-Campanian formation and upper Senonian formation. These formations consist of various rocks with differing compositions including limestone and marl of about 550m thick. Eocene units are composed of Ypresian–Lutetian formation (Fig.2). Eocene rocks consist of a succession of marine, limestone, and silt of about 80m thick. The Mio-Plio-Quaternary is a heterogeneous continental detrital sedimentation;

The miopliocène is composed of sands, silts and clays, reddish gravel and conglomerates;

A calcareous crust of variable thickness up to 1 m doubled sometimes attributed to villafranchien;

Finally, a recent Quaternary unknown are:

Alluvium and old arable land: arable land are installed on veneers loamy brown soil and support little or no limestone.

Current or recent alluvial deposits: it is sand, silt and gravel developed along the wadis.

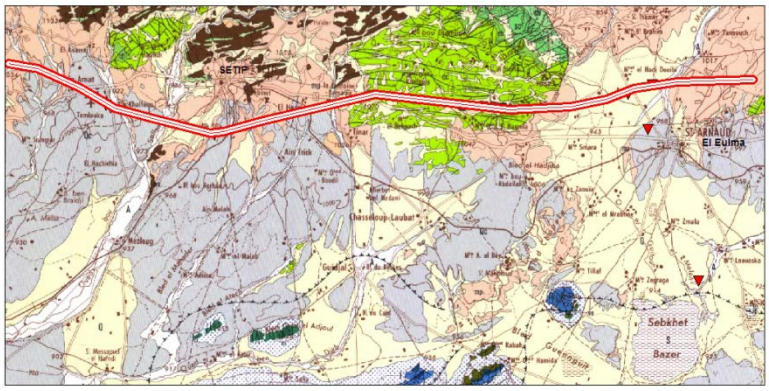
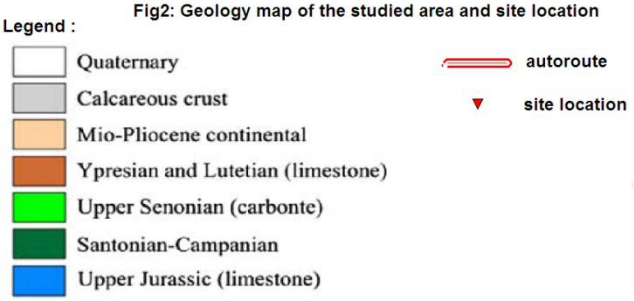


Fig2: Geology map of the studied area and site location



Station Bazer Sakhra

Station wastewater studied is located àBazer Sakhra agglomeration distant 5 km south-east of the city of El Eulma (Wilaya de Setif) (Fig 1). the site area is about 11 hectares.

a. organization

Recognition in situ soil was established on the basis of:

12 core drilling rig using a DB850. Depth of core drilling up to 25 m. tests SPT (Standard Penetration Test) 13 pressuremeter tests carried every 2 meters in auger drilling φ 63 mm conducted to 23m;

5 open wells depth of 3 m each, made using a hydraulic shovel. Finally samples were paraffined and not subject to the testing laboratory.

Synthesis of results

These operations have enabled us to recognize the nature of the different layers of soil and review of logs and core drilling augers let us distinguish:

• Soil cover: in all core holes, topsoil 0.40m thick overcomes the modern alluvium.

• The modern and recent alluvium: they are represented by brown silty clays and clays yellowish black. These alluvial deposits are developed to a depth of 2.00 to 3.00 m.

• The old alluvium: clay are gravelly to clayey and have a thickness of 0.30 to 1.50 m.

• Substratum: we meet the substratum clay Miopliocène age from 4 m.

We note the presence of water in our core drilling at shallow depths between 1.55 and 1.90 m. Pressuremeter test results obtained show that the pressuremeter characteristics are regular and tight. Layers tested can be divided into two parts:

Deposits of top: soils cover, modern alluvium, old alluvium, and the first two meters of the underlying clay

Underlying clay formations that proved moderately compact fig1.

c-analyzes of physical results

The fine fraction (0.08 mm) remains dominant with over 85% of the granular composition consisting mainly of clay and silt. Regarding therefore a soil fines content is 85% and the three granular fractions are 36% clay, 35% silt and 14% for sands, we consider the point of view of granularity, the soil in depth is clay. The mean and standard deviation of these components are shown in Table 2. The water content ranges between 14 and 26.5% with an average of 20.3%. Degree of saturation between 92.3 and 100% except item SC9 3 m depth where a Sr = 20.3%, this same point has a elevated dry density compared to all this that seems to be gravelly sand. Such thresholds characterizing a saturated state.

The dry density value measured on the same samples takes place in a range of 1.5 to 1.8 with an average of 1.71 t / m 3. This leads to a wet density of 2 t/m3.

According to the standard geotechnical (XP P 94-011), the clay is in the family of dense soils.

According to the plasticity chart (Fig. 3), it is indeed a highly plastic clay (At), of hard consistency.

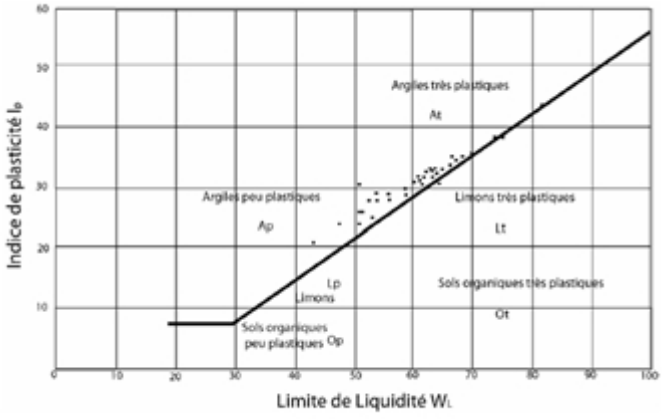


Fig 3:plasticity diagramm

d-analyzes mechanical results:

One shear test, unconsolidated undrained gives us a value of friction angle equal to 8 ° with a cohesion of 0.95 bar. They check the quality of the clay. It therefore appears that the soil tested has good cohesion.

after test data œnométriques ;the soil is classified in the category of normally consolidated soil to consolidated compressible ,non-swelling and swelling ,compressible medium in a few points.

For clays miopliocène:

The fine fraction (0.08 mm) remains dominant with over 91% of the granular composition consisting mainly of clay and silt, the water content ranges from 17.6 to 32.1% with an average of 23 4% l, the degree of saturation is 89 to 100% which means a saturated soil.

The dry density value measured on the same samples takes place in the range from 1.4 to 1.8 with an average of 1.63 t / m 3. Which leads to a wet density of 2 t/m3. According to the standard geotechnical (XP P 94-011), the clay is in the family of dense soils.

According to the plasticity chart (Figure 5), it is indeed a highly plastic clay (At).

For shear testing was a slight decrease in cohesion provided drained;

The shear tests, unconsolidated undrained gives us a value of friction angle equal to 9 ° with a cohesion of 0.72 bar. They check the quality of the clay. It therefore appears that the soil tested has good cohesion. Test data œnométriques classify the soil in the category of normally consolidated soil to consolidated compressible compressible medium non-swelling and swelling in few points.

station Ain Sfiha

Sfiha Ain is a small town south of Sétif, two studies specific to the highway here on the subject, it is a highway junction and a point of payment.

In total three holes pressuremeter up to 30 m deep core drilling four mechanical jusqu'un 25 m from two wells and shovel 3.5 m intact samples and redesign were also taken at different depths for tests laboratory.

Synthesis of results

From the surface to a depth of 30 can be distinguished (fig: 4)

• Land cover: Land végitale 30 to 45 cm,

• The modern and recent alluvium: they are represented by brown silty clays and clays yellowish black.

• The old alluvium: clay are gravelly to clayey in some places covered by crusts. These Quaternary formations have a thickness of 3 m

• Substratum: we find the clay substratum Miopliocène age from 3 m. it is occasionally very plastic red clay encrusted gravel overlying clays.

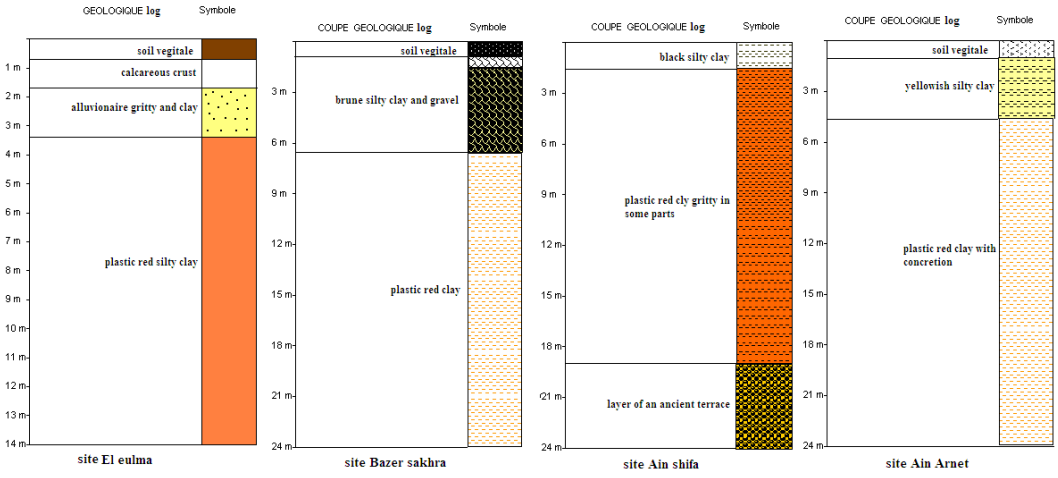


Fig 4: site lithogical's colonne

Pressuremeter tests give mean values for the first four meters to the underside become higher with 21m net values, reflecting the well stratigraphy determined by core drilling.

c-analyzes of the results of laboratory tests:

The fine fraction (0.08 mm) remains dominant with over 85% of the granular composition consisting mainly of clay and silt. We therefore, a point of view granularity, the soil in depth is clayey (tab 5a-b), its density is 1.45 to 1.78 t/m3,

the water content ranges between 17 and 30% with an average of 23.6%. Degree of saturation between 84 and 96% thresholds characterizing such a saturated state.

According to the diagram of plasticity, it is indeed a highly plastic clay (At), of hard consistency.

Mechanical characteristics give a value of friction angle equal to average 22.5 ° and cohesion of 0.126 bar to 0.929 bar respectively classifying them the soil medium to stiff consistency.

test data œnométriques classify the soil in the category of consolidated normally consolidated compressible medium compressible, non-swelling swelling.

station Ain Arnet

Located west of Setif, two studies specific to the highway here on the subject, it is a highway junction and a point of payment.

In total three pressuremeter up to 25 m deep, three core samples from mechanical jusqu'un 20 m and four wells shovel 3.5 m deep, intact samples were intact and not also taken at different depth for laboratory tests.

Synthesis of results

From the surface to 25 m depth can be distinguished:

• Land cover: Land végitale 30 to 45 cm,

• The modern and recent alluvium: they are represented by brown silty clays black to yellowish.

• crust, clay, gravel and clay tuff these Quaternary formations have a thickness of 3 m

• Substratum: we meet the substratum clay Miopliocène age from 3 m. it is occasionally very plastic red clay crusted.

Pressuremeter tests give mean values for the first four meters to the underside become higher with net values to 21m deep, well reflecting the stratigraphy determined by core samples.

c-analyzes of the results of laboratory tests:

Deposits of the surface are characterized by variable percentages (91% 15to 0.08 mm)

This fine fraction has a plasticity index of 16 to 30%.

Clays underlying the fine fraction (tab 2) remains dominant with over 83% of the granular composition consisting mainly of clay and silt. We therefore consider a granularity point of view, the soil in depth is clay, its dry density of 1.81 to 1.99 t/m3,

The water content ranges between 21 and 34% with an average of 25.5%. Degree of saturation between 84 and 96% thresholds characterizing such a saturated state.

The plasticity range is very large, it is indeed a highly plastic clay to hard consistency.

The mechanical properties provide a value quite variable friction angle of 8 ° to 44 ° and a cohesion of 0.44 bar to 0.926 bar respectively classifying them the soil medium to stiff consistency.

According to data from oedometer tests the soil is classified as normally consolidated soil on consolidated compressible quite compressible, non-swelling swelling.

Tab 1a: means values of the physical characteristics of clays miopliocene

site	(Wn %)	γd t/m3	(Sr %)	2mm	80µ	WL%	WP%	IP%
Bazer sakhra	23,47	1,63	95,62	91,54	84,15	60,73	29,57	31,66
Ainsfiha	23,66	1,59	92	91	84,83	72,64	34,32	38,35
Ain Arnet	25,5	1,54	91,75	88,85	83,14	75,33	35,98	40,61
El eulma	21,66	1,64	95	87	82	60,48	30,2	30,06

Tab 1b: means values of the mecanical characteristics of clays miopliocene

site	Pc	Cc	Cg	Cuu (Bars)	ϕuu°	Ccd (Bars)	ϕcd°	
Bazer sakhra	1,214	0,105	0,045	0,72	9,16	0,52	16,5	
Ainsfiha	2,993	0,213	0,05	0,504	22,5			
Ain Arnet	2,785	0,186	0,034	0,621	26			

Tab 2: means values of the physical & mecacanical characteristics of quaternairy

site	2mm	80µ	WL%	WP%	IP%	(Wn %)	γd t/m3	(Sr %)	Pc	Cc	Cg
Bazer sakhra	85,53	65,84	59,21	28,97	30,18	20,3	1,71	86,44	1,03	0,09	0,02
Ainsfiha	97,5	91,5	66,69	31,69	35	23,5					
Ain Arnet	59,88	58,12	43,11	21,28	21,83						
El Eulma	49	35	39,66	18,63	21,03						

station El eulma

Located 27 km EAST of Setif, three studies, two for highway and headquarters CASNOS.

In total 17 points pressuremeter 8m to 14 m depth, core sampling DE19 m deep wells and two shovel 3.5 m deep, intact samples were intact and not also taken at different depths for testing the laboratory.

Synthesis of results

Lithological same configuration as the other sites.

c-analyzes of the results of laboratory tests:

We have a single core sampling and two wells, testing of physical properties have been made.

From top to bottom in meeting:

alluvial deposits, or crusts with sand fraction values of 31 to 67% and the clay fraction of 18-52%. The plasticity index of 20% A22.

-red clays have a water content of 20-24%, a saturation of 96%, the fine fraction is quite present with an average of over 82% a plasticity index of 25 to 35% (TAB7). and end a dry density of 1.6 to 1.65 t/m3, it is indeed a highly plastic clay saturated more or less dense. pressuremeter tests gave the mean values of limit pressure of 23 bar for first meter and 17 to 18 bar for two meters follows then increased with depth, it clearly explains the lithology of the region is generally villafranchiennes calcareous a flagstone near the surface are then tuff surmounting silty clay reddish clay.

We comparing the different profiles presiometriques (fig4) all sites shows that they generally characterize three successive horizons from top to bottom, it is recent alluvium, and crusting villafranchien red clay with lenses of conglomerate Mioplicène;

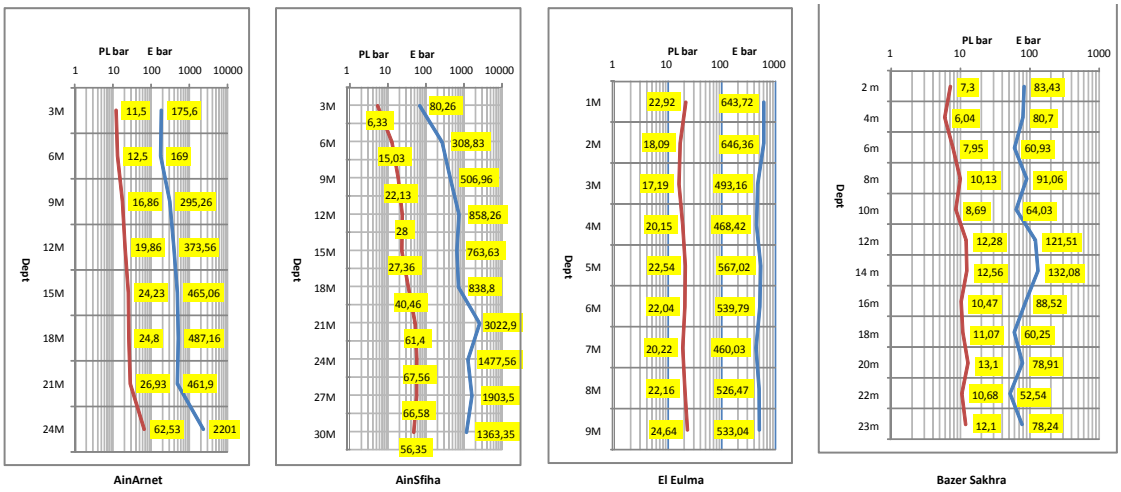


Fig7 :Parameter values of pressiometric test

The values of the pressure limits of El eulma, Ain Ain and Sfiha Arnet are homogeneous in the first ten meters and grow significantly in depth and Ain Ain Sfiha Arnet this is due to the state of this highly plastic clay and the presence conglomeratic beds also very dense.

low values of Bazer Sakhra (relative to other sites) is probably due to the presence of groundwater close to the surface.

Conclusion

The soils of the Setif region generally consist of three layers: a brown clay silt of Quaternary age, a calcareous crust thickness up to 1 meter villafranchien age and finally red clay encrusted in some places with depth, gravel and sands beveling mioplicène age, these deposits have been disposed in an environment fluiviolacustre.

Geotechnical studies made at different points in the region are character appear moderately dense plastic clay slightly compressible, however it is reported that clays in the region of Ain Arnet have a character swelling.

Pressure limits to them and they reflect the lithology encountered in core samples logs.

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