IASJ المجلات الاكاديمية العراقية

Tikrit Journal of Pure Science

ISSN: 1813 – 1662 (Print) --- E-ISSN: 2415 – 1726 (Online)

Journal Homepage: http://tjps.tu.edu.iq/index.php/j

Study the Geotechnical Properties for Recent Deposits/AL-Fursan Area North of Tikrit

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https://doi.org/10.25130/tjps.v24i5.414

ARTICLE INFO.

Article history:

-Received: 28 / 1 / 2018

-Accepted: 14 / 1 / 2019

-Available online: / / 2019

Keywords: Physical and engineering properties, recent deposits soil, soil improvement, AL- Fursan area.

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ABSTRACT

Four sites with different depth in AL-Fursan area/ North Tikrit city were selected for recent deposits sampling. The geotechnical properties of soil were tested and improvement of engineering properties of soil by cement was carried out. The geotechnical properties test results revealed that the moisture content ranges between (0.53 -1.45)% which is low because of sampling in summer season, while the grain size analysis show that the soil at the study area is coarse soil (sand) with fines. The soil type in the first site is clayey sand (SC), the second site contains sand with equal percentage of silt and clay (SC- SM) , the third and fourth site types are silty sand (SM). The specific gravity ranges between (2.46- 2.72) sites (1,2,3) are low liquid limit and low swelling index but the fourth site is moderate. The value of cohesion strength for the four sites are (16, 13, 1, 8)kPa respectively, sites (1) and (2) are moderate cohesion while sites (3) and (4) are non-cohesion, none plastic and un active.

The low values of cohesion strength belongs to high percentage of coarse particles in the area. The values of internal friction angles ranges between (30^0- 37^0). The consolidation test results revealed that all sites were moderate compressive index except the first site which is low compressive and low swelling. The study area soil are neutral and high content of gypsum and soluble Dissolved salts and also high organic content. The soil improvement by cement tests results show increasing of cohesion and internal friction angle and the compaction test results show the samples are well sorted.

Introduction

This research included study the geotechnical properties of soil which four sites were selected with different depths in AL-Fursan area in north Tikrit. The physical properties for determining the type of grain size, specific gravity, optimum moisture content and maximum dry density of soil through modified compaction test, Also from Atterberge tests it is possible to determine liquid and plastic limits and plasticity index which leads to classify the clayey soil, and determine its cohesion and swelling. The aims of this research is studying and improvement the geotechnical properties of Quaternary deposits (physical, chemical and Engineering properties) and improvement of engineering properties of soil (Cohesion strength and angle of internal friction) by adding cement.

Location of study area

The study area located within Salahaddin governorate north of Iraq in AL-Fursan area which (UTM) coordinates are (374202- 374492) East and (3836402-383693) North and on the road connects Baiji city and Salah aL-Den governorate , Figure (1).

Methodology

Geotechnical tests were carried out after sampling from four sites which included physical tests (grain size analysis, Atterberge limits, specific gravity and water content) and engineering tests (consolidation, direct shear tests) also the soil improvement by adding cement were done with modified compact test and direct shear test according to specification including the tests.

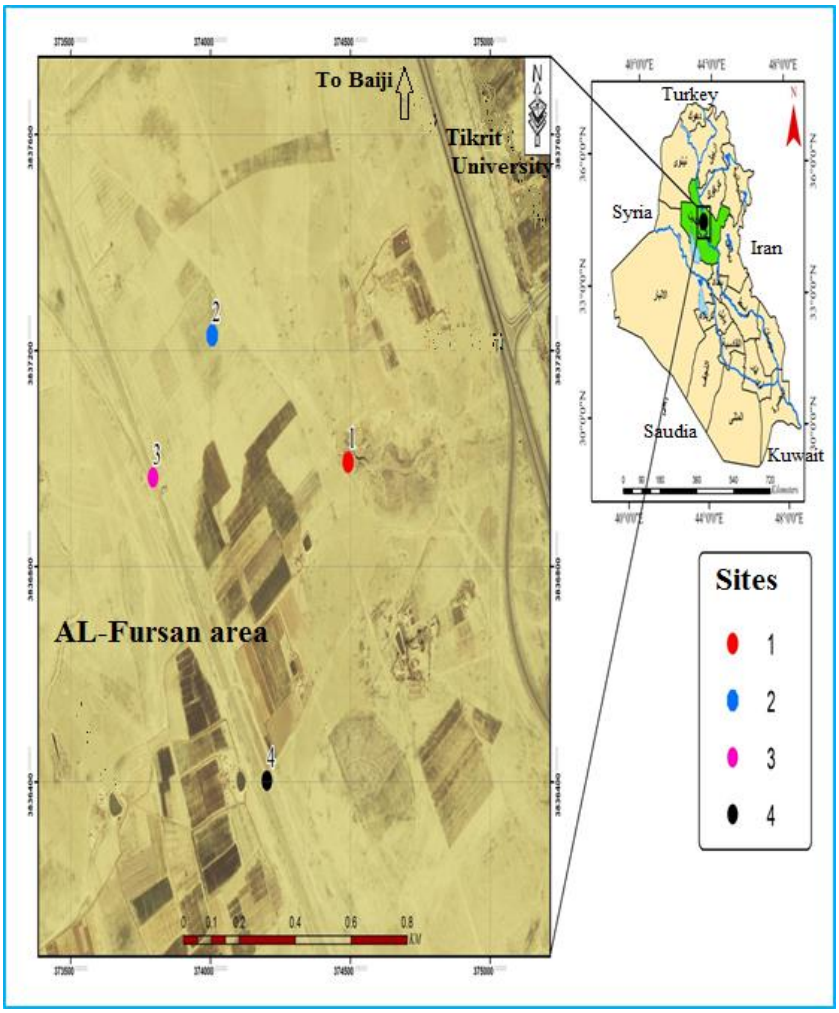


Figure (1) Location map of the research area

Geology of the research area

The recent sediments of the research area are related to Quaternary age [1] which is more common in sediment plains in Iraq as slope sediments [2] which is resulted from weathering and erosion processes of the outcrop rocks in the srounded area that is a mixture of gypsum, limestone and fragments of sandstone and claystone, also valley filling deposits which is formed by weathering the rocks of injana and AL-Fatha formations near the research area and the regolith transported to the vallyes by surface water, gravity and soil creep

Results and Discussions

The physical, engineering and chemical and mineral tests were carried on for detail understanding the behavior of the soil through the different properties and carrying on the soil improvement.

Physical tests

Physical tests were carried on soil for four sites table (1) included (moisture content, specific gravity, Grain size analysis, Atterberge limits).

moisture content

This tests were carried on according to [3],the moisture content of the sediment of the research area are range between (0.53-1.45)% which are low values, this relates to the season of soil sampling which was in hot and dry climate and far from the ground water table levels.

Specific gravity

This test was carried out according to[4].The Gs is important in engineering fields as in classifying the soil, hydrometer analysis and in consolidation test. The values ranged between (2.46-2.72) which indicates the high content of gypsum in the samples of sites (3,4) while are low in sites (1,2).

Grain size analysis

This test was carried out based on [5], almost all soil can be classified according to its grain size analysis which is important because the stability of soil depends on its grain size analysis.[6] pointed to that fine soils are less stable than coarse soils. According to Unified classification soil system all the soil samples are coarse soil with fines. The grain size analysis test result reveals that the soil of the first site is clayey sand (SC), the second site is silty sand (SM) with very little of gravel while the soil in third site is sandy- silty sand with very little of gravel but in the fourth site is sandy-silty sand, Figures (2,3,4,5) shows grain size analysis.

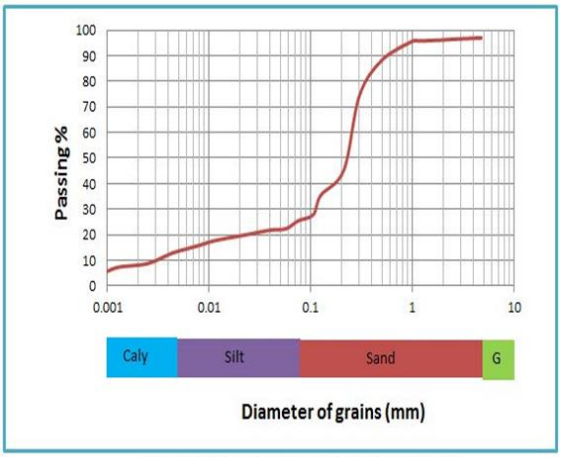
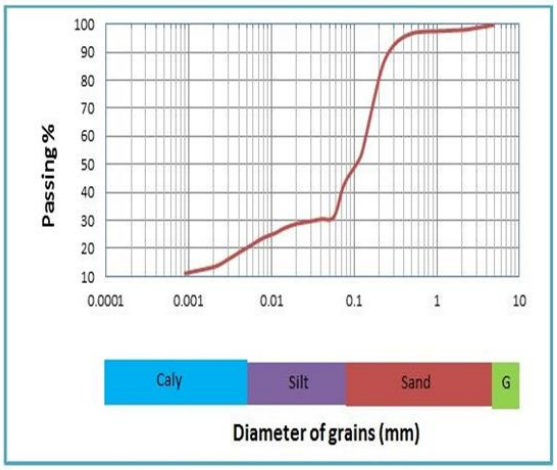


Figure (2) Grain size analysis for first site



Figur (3) Grain size analysis for secon site

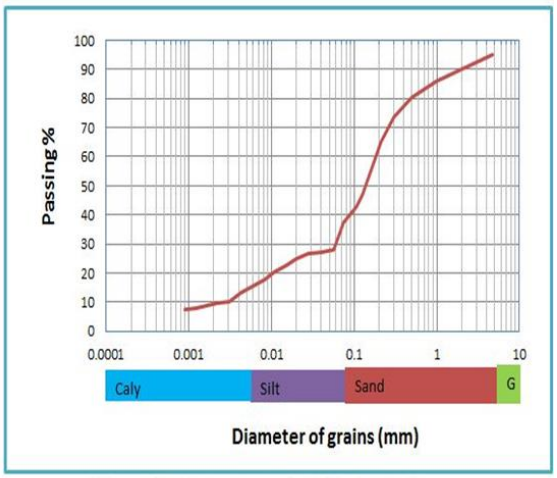


Figure (4) Grain size analysis for third site

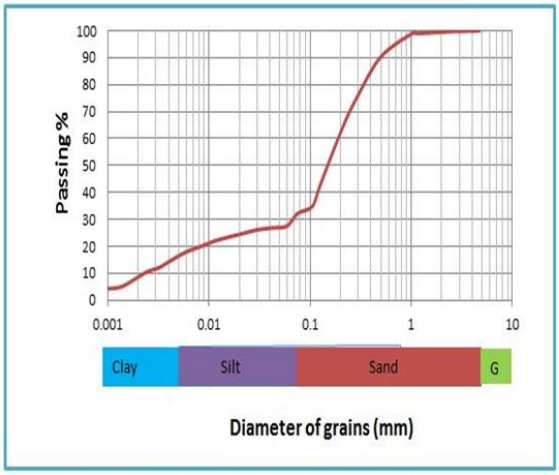


Figure (5) Grain size analysis for fourth site

Atterberge limit

These tests were done according to[7]. The results show that the deposits are low liquidity in the first, second and third sites but it is moderate liquidity in the fourth site according to [8]. The soil in the first, the second sites are moderate cohesive while in the third and fourth sites are non cohesive soil. Also the soil in the first and second site are low plasticity and non plastic in the third and fourth sites. The type of the fine particles of the soil are (CL)low plasticity clay in the first site, (ML-CL) in the second site, the third and fourth non plasticity, according to [9], and all the samples are low swelling.

Table (1) Some Physical and engineering properties of the study area deposits

Site	First	Second	Third	Forth
Depth (m)	1	2	1.5	0.5
Moisture content%	0.66%	1.08%	0.53%	1.45%
Gravel%	2.988	0.303%	4.843%	0
Sand%	71.581	56.993%	57.517	67.875%
Silt%	11.03	21.485%	22.159	16.738%
Clay%	14.401	21.219%	15.481	15.387%
Specific gravity	2.72	2.69	2.48	2.46
Liquid Limit%	23.35	22.20	22.73	28.38
Plastic Limit%	15.36	17.62		-
Plasticity Index%	7.99	4.58		-
Friction angle Ø)°	34	37	31	30
swelling Index ,Cr	0.0322	0.0833	0.0666	0.08
Compression Index ,Cc	0.1290	0.3076	0.2777	0.25
Preconsolidation Pressure Kg/cm^2 (P_c)	1.35	2.6	1.2	3.6
Max Dry Density gm/cm^3	2.012	2.01	1.625	1.672
Optimam moisture Content %(O.M.C)	8.8%	10.2%	13.8%	14.1%

Engineering Tests:

Consolidation Tests

These tests were carried out based on[10], the tests results revealed that the study area deposits are low swelling based on [11] the deposits are low compressibility in first site, medium compressibility in the other three sites. Table (1) and Fig. (6).

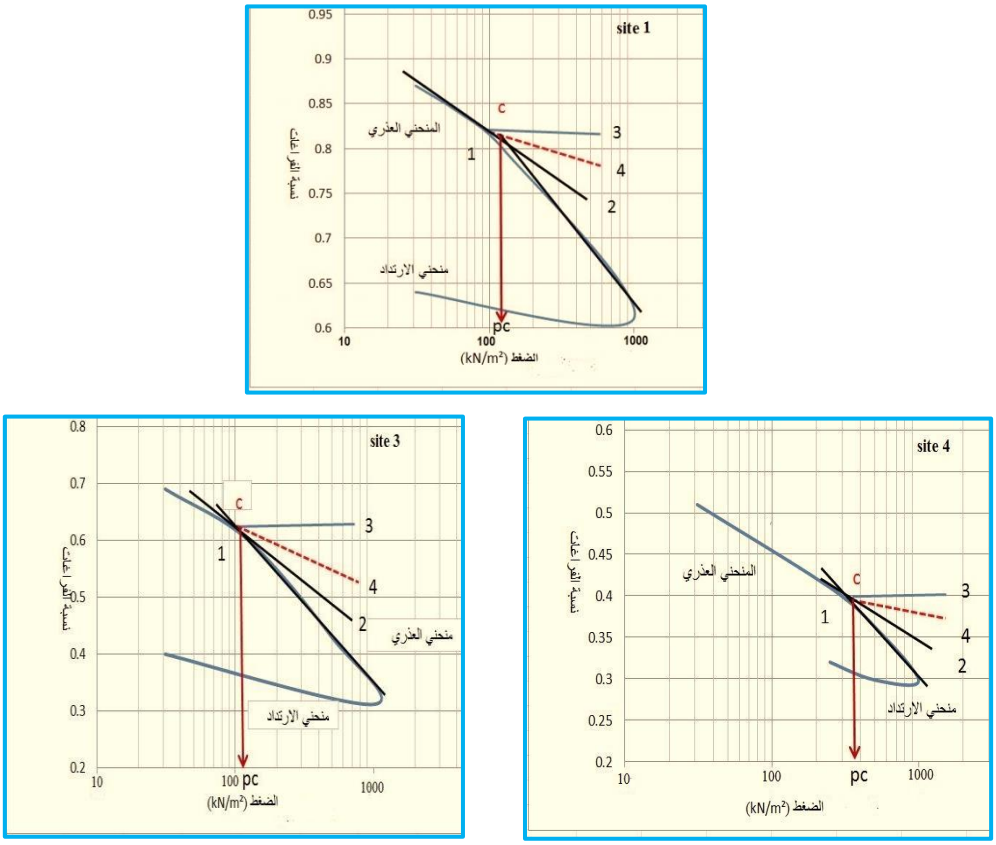


Figure (6) show the Consolidation tests for sites (1,3and 4).

Direct shear test

This test carried out according to[13]. The results show decreasing in cohesion because of the sandy soil which the value of the cohesion decrease in coarse soil. The values of cohesion are (16,13,1 and 8) kPa for sites (1,2,3 and 4) respectively while the values of angle of internal friction (34, 37, 31 and 30) degree for sites (1,2,3 and 4) Figure (7) respectively. The cohesion strength is low in site 1 and 2 because of high sand content in the soil sample leads to low

cohesion strength and increasing internal friction angle. In sites, 3 and 4 the cohesion strength are very low because presence of high gypsum and sand which leads to increasing in internal friction angle and decrease in cohesion value.

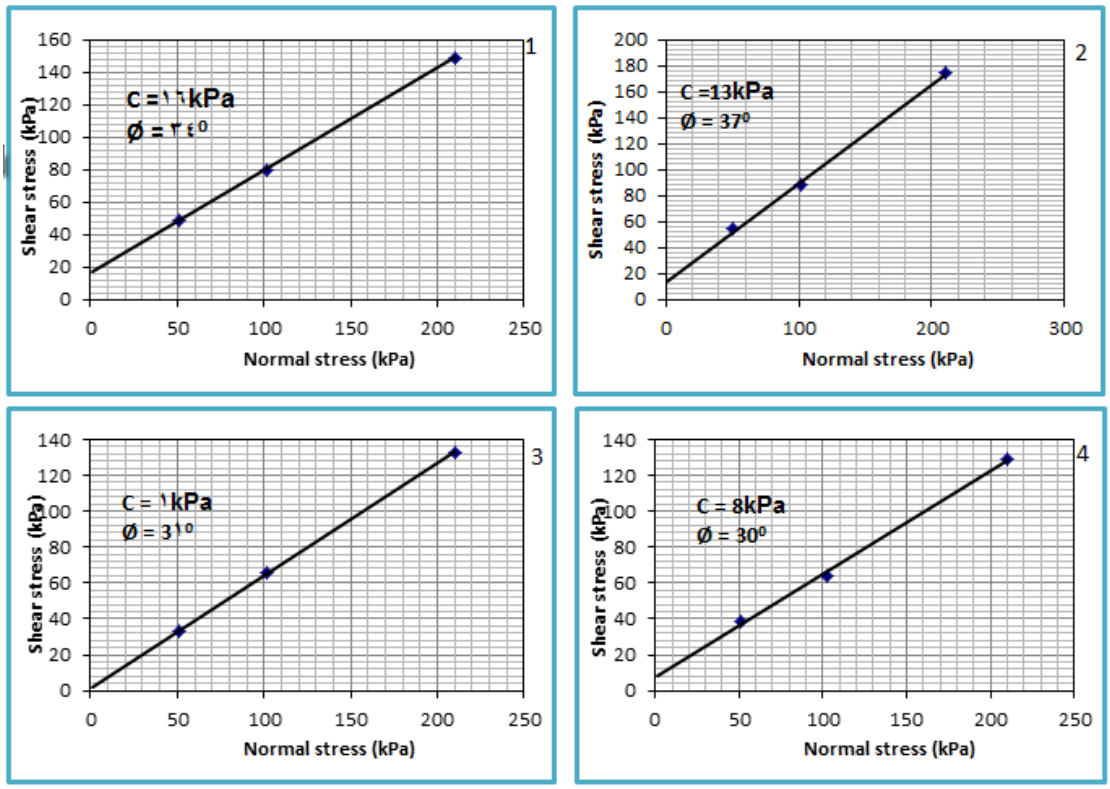


Figure (7) show the direct shear tests for sites (1,2,3,and 4).

Soil improvement

The standard compaction test was carried out according to [14,15]. For reduce the soil permeability and increasing density .Table(1)show the moisture content and optimum dry density in sites (1,2,3,4), site 1 and site 2 are almost same this indicate that the grain size distribution and mineral composition are the same. This state is the same for the soil sample in 3 and site 4.

For the soil improvement cement was added with 3% ,6% and 9% which resulted in increasing in cohesion strength and internal friction angle of the soil samples in sites(1,4).

In the site. 1 the cohesion strength was (16) kPa before adding the cement, after adding 9% the cohesion strength became (21) kPa and the internal friction angle was (34^0) before adding the cement and after adding the cement 9% the internal friction became (37°).

For site. 4 the cohesion strength increased from (8) kPa to (12) kPa and internal friction angle became (33^0), after adding 9% cement. Figures (8) and (9) show the increasing of cohesion strength and (Ø) of the soil by adding the cement.

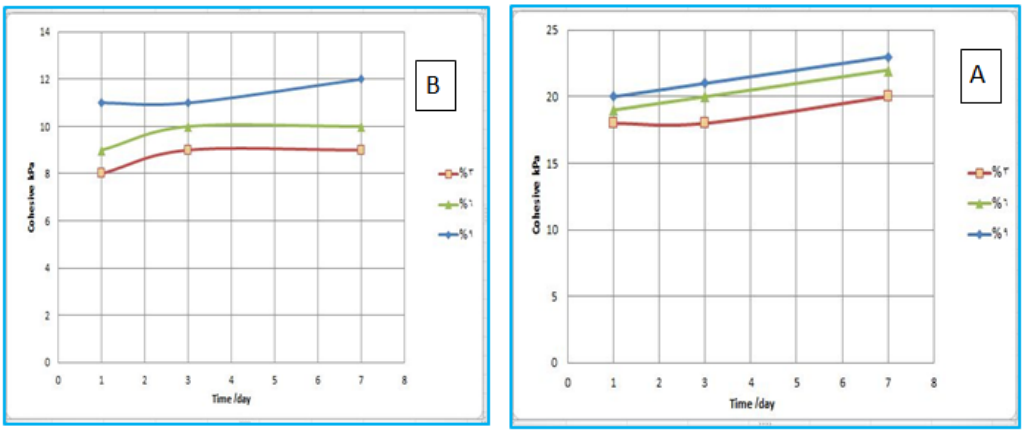


Figure (8) show the increasing of cohesion strength of the soil by adding the cement.(A) First site, (B) Fourth site.

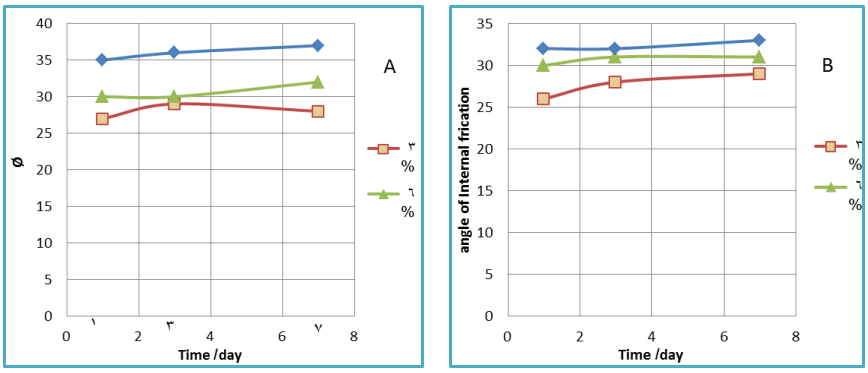


Figure (9) show the increasing of internal friction of the soil by adding the cement.(A) First site, (B) Fourth site.

Conclusions

1- The grain size analysis test concluded that the type of soil is coarse with fine particles which is silty sand to clayey sand.

2- The moisture content of the soil are very low because of low precipitation and sampling was done in dry season that lead to the presence of gypsum and organic material in a high percent in the area which effects the when water existence.

3- Atterberge limit test result that the fine soil ranges from (ML) and (CL -ML) .

4- The engineering tests reveals that the decreasing in soil cohesion because of coarse soil type and increasing of salt in the study area.

The compaction index and swelling index show that site- 1 is low compression index and the other sites are medium compression index and all the sites soil are low swelling.

5-The max dry density ranges between (1.625-2.012) gm/cm^3 and the optimum moisture content ranges between (8.8-14.1)% the values are same may be became semi similar in grain size distribution and other properties but the soil improvement revealed that cement to the soil leads to increasing in cohesion strength.

6-Adding portaland cement to the soil adding in percentages (3.6,9)% indicates improvement in engineering properties of the soil especially at adding cement with percentage 9% which lead to increasing cohesion and Ø values

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الخواص الجيوتكنيكية للترسبات الحديثة / منطقة الفرسان شمال تكريت

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قسم علوم الارض التطبيقية ، كلية العلوم ، جامعة تكريت ، تكريت ، العراق

الملخص

تم اختيار اربعة مواقع باعماق مختلفة في منطقة الفرسان شمال تكريت لنمذجة الترسبات الحديثة لدراسة الخواص الجيوتكنيكية للتربة وكذلك تم تحسين الخواص الجيوتكنيكية للتربة بواسطة اضافة السمنت، اظهرت نتائج الفحوصات في منطقة الدراسة ان المحتوى الرطوبي يتراوح ما بين (0.53-1.45)% تكون هذه القيم منخفضة سبب المناخ الجاف التي تمت فيه عملية النمذجة. بينما اظهرت نتائج تحليل التدرج الحجمي ان ترب منطقة الدراسة في الموقع الاول رمل طيني (SC)، والموقع الثاني يحتوي على نسب متعادلة من الغرين والطين ونوعها (SC-SM)، والموقع الثالث والرابع تحتوي على تربة خشنة (رملية)،مع نواعم في نوعهما رمل غريني (SM). كانت قيم الوزن النوعي (2.46-2.72)، وان المواقع (1، 2، 3) واطئة السيولة وواطئة الانتفاخ فقط المواقع الرابع متوسط السيولة، يكون الموقع الاول واطئ اللدونة والموقع الثاني لدنة نوع ما ، الفحوصات الهندسية مقاومة التماسك للمواقع (1،2،3،4) تكون (16,13,1,8) كيلوباسكال على التوالي ان انخفاض قيم قوة التماسك وذلك لارتفاع نسبة المواد الخشنة في مواقع الدراسة كلما زادت المواد الناعمة زادت قوة التماسك، وتراوحت قيم زاوية الاحتكاك الداخلي ($37^0 - 30^0$) اظهرت نتائج فحص الانضمام متوسطة الانضغاطية في جميع المواقع فقط الموقع الاول واطئة الانضغاطية وواطئة الانتفاخ. وتكون ترب منطقة الدراسة متعادلة القلوية وارتفاع نسبة الجبس والاملاح القابلة للذوبان وكذلك ارتفاع نسبة المواد العضوية،. دلت نتائج فحوصات تحسين التربة على ارتفاع قوة التماسك وزاوية الاحتكاك الداخلي وهذا دلالة على التحسين بينما دلت نتائج الرص القياسي على التقارب الحجمي للنماذج بسبب النتائج المتقاربة.

من خلال هذه النتائج اذا كانت التربة غير محسنة يجب استبدال التربة بتربة اخرى وبعمق (2-3) متر فقط واذا كانت محسنة بالاسمنت نضيف نسبة قياسية (9%) اسمنت خلطها مع التربة.