Journal of Scientific Research

Refereed Scientific Journal

Issued Twice Annually By:

Africa University for Human and Applied Sciences

Tripoli – Libya

Issue No. (5) Third Year 2018

Journal of Scientific Research Issued By:

Africa University for Human and Applied Sciences

Libya - 2018

Journal of Scientific Research Issued By:

Africa University for Human and Applied Sciences

General Advisor

Dr.Mabruk Muftah Abushina

Head of the Editorial Committee

Dr. Abdin A. Sharif

Members of the Editorial Committee

Dr. Abdelhamed Ali Magrus

.Akram H. Mom Moamer

Abdarzag Almabrok Alkanony .

Language review and correction:

Mr. Abdurrahman Ahmed Melad

Journal of Scientific Research Issued By:

Africa University for human and Applied Sciences

Principles and Regulation

A brief about the Journal

It is an evaluated-based, quarterly journal issued **Africa University for human and Applied Sciences** – Libya - in Arabic and English. It is interested in publishing research papers and scientific studies, as well as, presenting books and periodicals summaries, Doctorate or Master Theses, conferences and workshops reporters inside and outside Libya.

Journal Objectives

Activating and enriching scientific research in all scientific fields related to the University majors Paying attention to the comprehensive development issues in the light of the local, regional and international changes offering a chance for researchers to publish their studies and to convey their ideas in order to expand the circle of knowledge among researchers, decision makers and practitioners inside and outside Libya creating a scientific dialogue among researchers and those who are interested in updated issues in all scientific fields related to the University majors

Publishing principles, regulations and criteria

Studies and research papers presented to publication in the journal should accordance with the following principles and regulations:

1. **Research and studies:**

These should be :

- ✓ original in terms of the research ideas and them; they should neither be published nor part of a Doctorate or a Master thesis
- ✓ written in a correct methodology and
- ✓ written in a clear and correct language; they should be coherent and cohesive

2. **Referencing:**

Sources should be cited and documented chronologically accordance with the following:

- ✓ **Reference to a book**

Elements to cite:
Full name of the author, title of the book, place of publication, publisher, year and page/s.

- ✓ **Reference to an article in a journal**

Elements to cite:
Full name of the author, name of the journal, volume number, date of publication, research or article pages:

- ✓ **Reference to indirect quotation (a contribution in a book):** cite the original source

3. **Footnotes:**

Footnotes are restricted to explaining or clarifying ambiguous points which cannot be included in text and in order to be highlighted. Each page should be numbered independently. Footnotes should appear at the bottom of the page.

4. **References and bibliography:**

Arabic references should be cited first. References should include only what have been actually cited in text by the researcher. They should be ordered alphabetically as follows:

First: Arabic references

- المهدي غنية مبادئ التسويق، (طرابلس: الجامعة المفتوحة (2002).
- عبد السلام ابوقحف مقدمة في إدارة الأعمال الدولية، (الإسكندرية: مطبعة الإشعاع الفنية (1998)
- محمد المكي "أهمية المراقبة الداخلية للمراجع الخارجي"، (طرابلس: مجلة دراسات في الإدارة والأعمال المصرفية)، العدد 6 (1984)، ص ص: 15-18.

Second: foreign references

- Drury, Colin (2000), Management and Cost Accounting, 5th edition, (London: Thomson Learning).
- Kaplan, Robert (2000), Balance without profit, Financial Management, (January), 23-26

Third: Material from the Web

For citing material from the Web, two additional pieces of information are usually needed:

- **The electronic address or URL of the site (e.g. http ://...)**
- **the date you accessed the site or database**

5. General and technical principles:

- ✓ Researchers should write their names, degrees, occupations, place of work in the first page of their research. It is also important to mention the correspondent address, fax and phone number, and e- mail.
- ✓ Research papers and studies should be written in Arabic and English provided that a summary in Arabic, of not more than 150 words, is enclosed.
- ✓ the number of pages, including tables, references, and graphs should not exceed 20 pages
- ✓ Research papers and studies should be printed in Microsoft Word on one side paper of (A4) single-spaced. A (CD) of the work and a Curriculum Vita (CV) of the researcher should be enclosed.
- ✓ Works presented in Arabic should be in **(Simplified Arabic)**.Works presented in English should be in **(Times New Roman)**.
- ✓ Font size should be as follows:
    - Size 18 for the main headlines
    - Size 16 for the subtitles
    - Size 14 for the text
    - Size 12 for the abstract in *italic*
    - Size 10 for the footnotes
- ✓ Margins should be as follows:
    - Up and bottom 2.5 cm
    - Right 3 cm
    - Left 2.5 cm

The research papers and the studies presented to the journal are subject to the evaluation by specialized professors assigned confidentially by the editorial committee. The journal has the right to ask the researcher to make the necessary corrections required by the evaluators. The journal has the right to make minor correction, when necessary, without an advanced permission from the researcher. The editorial committee has the right to seek assistance of more than one referee if necessary and the researchers will be informed whether their work has been accepted or not according to the referees' reports.

Unaccepted works for publication will not be returned to the researchers.

The researcher vow never to publish the research or the study by any other means for a period of two years from the date of publishing.

All points of view published in the journal represent the writers and do not necessarily represent the view of the journal.

The journal assures to inform the researcher with receiving and forwarding his work to the editorial committee in two weeks time.

The journal assures to inform the researcher of the acceptance of his work in two weeks time from receiving the referrers' reply.

The journal informs the researcher in which issue the work will be published.

Publication rights will be transferred to the journal when the researcher is informed of the acceptance of his work.

Publishing of research or studies in the journal is ordered according to the technical considerations, and to the submission date, not to the importance of the work or status of the researcher.

The researcher obtains three copies of the issue when his research or study is published.

6. **Correspondence addresses:**

All studies, research and correspondences should be sent to the Head of the Editorial Committee of **University Journal of Scientific Research:**

Africa University for human and Applied Sciences

On the following address: P. pox 83060 Tripoli – Libya

E-mail: Info@africanuniversityedu.ly

Phone: +218217291428- **Fax:** +218217291428

The University web site: www. africuniversityedu.ly

Content Issue No. 5

Assessment of the Modes of Soil Shear Failures that occurs in Jadu and Elrohibat

1- Eng. Anwar Ahmed Ramadan Abuasara
NalotUniversity,Faculty of Engineering, Jadu ,Libya
2- Eng . Khaled Ali Asheik
Azzaytuna University, Faculty of Engineering,Libya.
3 - Dr. Basheer Musbah Khalifa Alnnaas
Azzaytuna University, Faculty of Engineering, Libya.

المستخلص

تقييم نمط انهيار القص للتربة بمنطقة (جادو و الرحيبات)(

تهدف الدراسة الي التحري عن انماط إنهيارت القص التي تحدث للتربة في منطقة جبلية محصورة بين مدينتي جادو والرحيبات بالجبل الغربي، بهدف إيجادقدرة تحمل التربة التي تصميم عندها اساسات المباني . حيث تشهد منطقة الدراسة تطورعمراني وتجاري في المباني الحديثة والقديمة دون النظر إلى نوع وخصائص التربة المحمل عليها هذه المباني،وكذلك الدرسات الشحيحة في هذا المجالوو جودنقص شديد في توفر المعلومات الكافية عن خواص التربة التي تمكن المصمم من فهم السلوك الا نشائي للتربة وانماط الانهيار في هذه المناطق، نتيجة لذلك لوحظ وجود بعض انماط انهيار القص للتربة لبعض المباني والتي جعلت من تلك المباني غير صالحة للاستخدام.

بناءا علي ذلك تم عمل سلسلة من الاختبارات المعملية والتي تشير نتائجهاالي ان نمط الانهيار للتربة بالمنطقة سيأخذ نوع انهيار القص العام (General shear failure)فيما اذا زاد التحميل لاساسات المبني عن ذلك المسموح به.كما تشيرنتائج الاختبارات بأنقوة احتكاك التربة (C) وتماسكها (Ø) من العوامل الرئيسية لتحديد وفهم سلوك التربة تحت تأثير الأحمال مع الأخذ في الاعتبار عمق التربة، قيمة الحمل الرأسي و نوع التربة بحيث كان العامل الاساسي المؤثرعلي قدرة تحمل التربة بمنطقة الدراسة هو قوة التماسك لحبيبات التربة الناعمة.

Abstract:

This paper presents an investigation into soil shear failure in particular area in order to serve structural designer in regard to foundation design. As far as bearing capacity is concerned, design of a shallow foundation is dependent on two essential criterions that include the ultimate bearing capacity of the subsurface and the excessive settlement for the foundation. The determination of these two criterions relies on the footing geometry and several soil properties that need to be precisely determined before foundation design. As the soil properties are challenging to be specified, an excessive exploration must be carried out when interpreting laboratory or field tests. Incorrect predictions would be the result of insufficient information about the soil. Therefore, the proper bearing capacity factors can be obtained when the soil properties are understood.

The objective of this paper is to investigate the soil properties for the area of study that is experiencing a development of construction activities with a lack of soil information. It was noticed that several building experienced shear failures as a result of insufficient soil information. As several laboratory tests were conducted, results showed that general shear failure would occur when the foundation is exposed to excessive loading conditions. It was concluded that the cohesion of soil (C) is the

main affect factor to the value of bearing capacity in order to using modified Terzaghi equation as presented in table (10) result of study,As concluded that both parameters cohesion and angle of friction for the soil are crucial to making alogical prediction for the soil behaviour. The required parameters are considered withrespect to the depth, load and soil type.

Keywords:- Site Investigation, Bearing capacity of soil, Modes of Shear failure, Geotechnical Engineer.

1. Introduction:

In order to design a shallow foundation, the behaviour of the underlying soil bearing must understand. Generally, the soil will fail as the settlement increases dueto an increase in load forces and as shear planes develop [1]. Nevertheless, as the soil type and shallow foundation vary, determining particular bearing capacity factors is a key issue when attempting to predict accurately how specific soil would fail. In contrast, the ultimate load that a shallow foundation can withstand may lie in the degree of settlement[2]. Consequently, bearing capacity prediction can be particularly difficult without the understanding of the soil physical parameters such as relative density, cohesion (C) and angle of friction (Ø).

2. Aims and objective.

The aims ofthis paper to investigate an area of a growing interest in construction activities. This area is located between two cities(Jadu and Elrohibat) up in the mountain of Al-Jabal Al-Gharbi.Figure (1) shows the location of the study area. As the targeted area is expected to have a high bearing capacity values, general shear failures for several building was noticed, particularly when increasing the stories for an existing building without taking this into account for the bearing capacity of soil. Because the mountain cities, in general, lack of soil information needed for foundation design, an intensive studies for the soil properties is highly needed as this may serve engineers for foundation design.

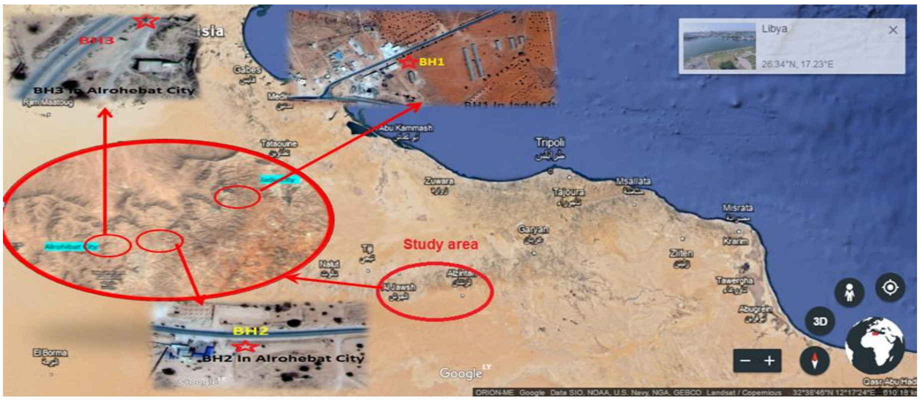
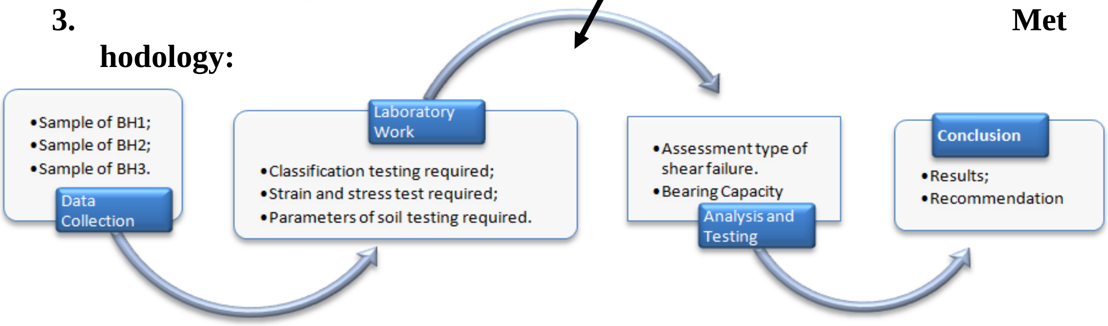


Figure (1),illustrated location of Boreholes in Study area.

Elrohibat City

Study area 200 Km from Tripoli

3. Methodology:



3.1. Modes of shear failure

The bearing soil can experience different modes of shear failure according to the compressibility of the soil.When a shallow foundation is exposed to an increasing load, a triangular zone will be created under the base due to a development of three shear planes as shown in Figure (2).

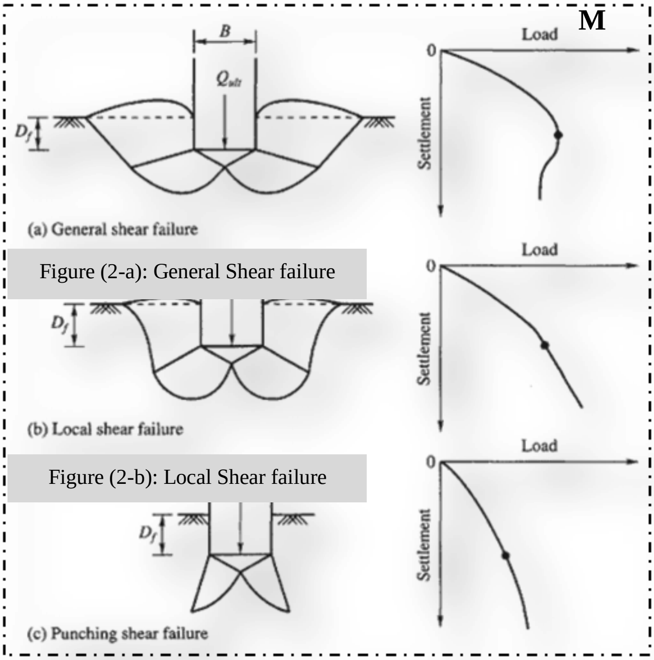


Figure (2-a): General Shear failure

Figure (2-b): Local Shear failure

Figure (2-c): Punching Shear failure

Figure (2): Modes of shear failure,[Vesic 1963].

As The footing moves downwards, the surrounding soil will consequently yield and soil will reach its ultimate b incompressible, a general shear planes developed to the surface as shown in Figure (2-a). On the other hand, for a compressible soil that is able to fill its own void, a punching shear failure will occur as illustrated in Figure (2-c). When the soil condition is in between previous two cases, local shear failure will occur as shear planes will be a mix of general and punching shear failures as shown in figure (2-b),[2].To determine the modes of shear failure for a soil, sophisticated field tests have emerged to classify these modes of failure according to thesoil properties[2,3]. As a result, classifying the soil in terms of the mode of shear failure is considered to be a vital issue when defining the bearing capacity. Table (1) demonstrates the differences between general shear failure, local and punching shear failure according to the soil properties.

3.2. Laboratory Work and Analysis.

This study involves laboratory tests that are required to determine the mode of shear failure and ultimate bearingcapacity.Table(2) shows the tests were conducted in this study.

Figure (3) Shows the Laboratory of Soil Mechanics at Faculty of Engineering - Jadu

the differences between Local/Punching and general shear failure[2,7].

General Shear Failure	Local/Punching Shear Failure
Occurs in dense/stiff soil $\Phi>36^o$, N>30, D_r>70%, C_u>100 kPa	Occurs in loose/soft soil $\Phi<28^o$, N<5, D_r<20%, C_u<50 kPa
Results in small strain (<5%)	Results in large strain (>20%)
Failure pattern well defined & clear	Failure pattern not well defined
Well defined peak in P-Δ curve	No peak in P-Δ curve
Bulging formed in the neighbourhood of footing at the surface	No Bulging observed in the neighbourhood of footing
Extent of horizontal spread of disturbance at the surface large	Extent of horizontal spread of disturbance at the surface very small
Observed in shallow foundations	Observed in deep foundations
Failure is sudden & catastrophic	Failure is gradual
Less settlement, but tilting failure observed	Considerable settlement of footing observed

Table (2) indicates all the laboratory tests that are conducted in this study.

Name of test	The Amis of this test	Type of test
Atterberg Limits tests	Classification of soil	Lab. Test
Sieve analysis test	Classification of soil	Lab. Test
Specific gravity test	To determined the G_s Value	Lab. Test

Standard Proctor test	($\gamma_{d\ max}$ + $\gamma_{d\ min}$)	Lab. Test
Unconfined compression test	To determine the stress-strainε	Lab. Test
Sand cone test	(γ_d) in field	Field test
Direct shear test	C & Ø, C̈ & Ø̈	Lab. Test

3.2.1. Classification of soil.

The classification of soil in this study is carried out using (USC & AASHTO Systems). These systems have substantial acceptance worldwide, as well as in Libya. Both USC and AASHTO systems are governed by the determination of the liquid and plastic limits of the soil, where the relationship between the number of blows and water content is plotted to obtain Liquid limit in 25 blows. In addition, USC & AASHTO systems are influenced by the sieve analysis test and the percent of passing through sieve No 200. The following table (3) summarises testes' result and the classification of soil for each Borehole (BH).

Table (3) illustrates the Classification of Soil according to laboratory tests.[study result]

Sieve Analysis Test					**Liquid & Plastic Limits**			
		BH1	**BH2**	**BH3**		**BH1**	**BH2**	**BH3**
Percentage Passing Sieve No.	No. 4	70.4	60.8	62.6	L.L	19.67	23.29	20.38
	No. 10	60.8	37.2	51.34	P.L	16.49	16.65	17.15
	No.40	44.1	22.8	30.3	P.I	3.18	6.64	3.23
	No.100	0.81	4.17	10.6	L.I	-3.05	-1.38	-3.51
	No.200	0.072	2.81	2.81	**Natural Water Content**			
Coefficients	D10%	0.19	0.27	0.15		**BH1**	**BH2**	**BH3**
	D30%	0.32	0.55	0.43	W_c	6.79	7.51	5.80
	D60%	2	4.93	4.05	**Specific Gravity**			
	C_c	0.27	0.23	0.30		**BH1**	**BH2**	**BH3**
	C_u	10.53	18.26	27	G_s	2.47	2.61	2.56

Systems	UCS		AASHTO			**Classification**
	Table	Chart	Table	Chart	Group Index	

BH1	SW	CL-ML	A-1-b	A-2-4	-2.4 = 0	Course Sand Well graded with Inorganic Silts low plasticity
BH2	SW	CL-ML	A-1-a	A-2-4	-3.3 = 0	Sand Well graded with Inorganic Silts low plasticity
BH3	SW	CL-ML	A-3	A-2-4	-2.4 = 0	Fine Sand well graded with Inorganic silts low plasticity

3.2.2. Relative density.

Relative density of a soil reflects its compressibility. For instance, higher values of relative density indicate that the soil is incompressible in regard to low values for soils of the same magnitude. As a result, relative density can be used to determine the mode of shear failure, [4,5]. Figure (4) which shows the relationship between relative density and modes of shear failure in regard to the foundation depth. Consequently, relative density can be determined using Equation,(D. M. Barrister, Equation).

$$Dr = \left(\frac{\gamma_{df}-\gamma_{dmin}}{\gamma_{dmax}-\gamma_{dmin}}\right)\left(\frac{\gamma_{dmax}}{\gamma_{dmin}}\right) \qquad (1), [9,10].$$

Where:-D_r : Relative density.

γ_{dmax} : Maximum dry density (Laboratory).

γ_{df} : Field dry density (Field).

γ_{dmin} :Minimum dry density (Laboratory).

Figure (5) indicating the data from a standard Proctor test with OMC and γ_{dry} to obtain the $\gamma_{d\,max}$ inthelaboratory (AASHTO T99-10)

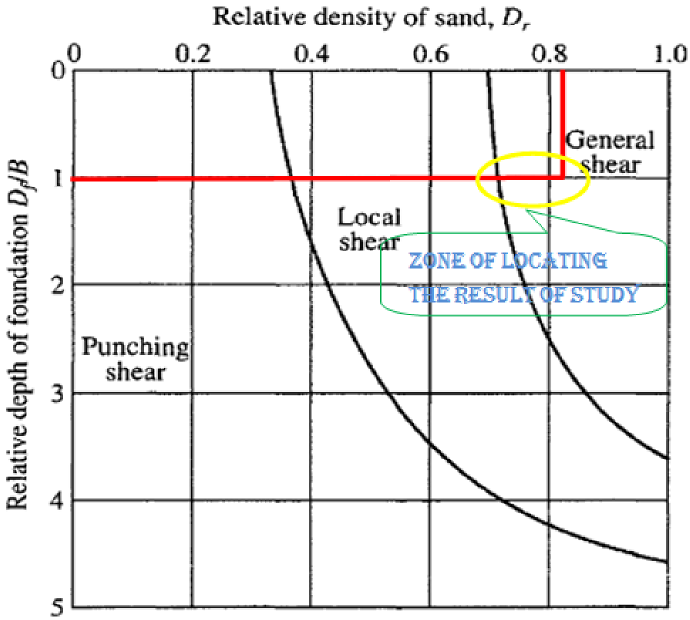


Figure (4):Modes of shear failure at different Relative densities & depths of foundations[Vesic,1963 and 1973].

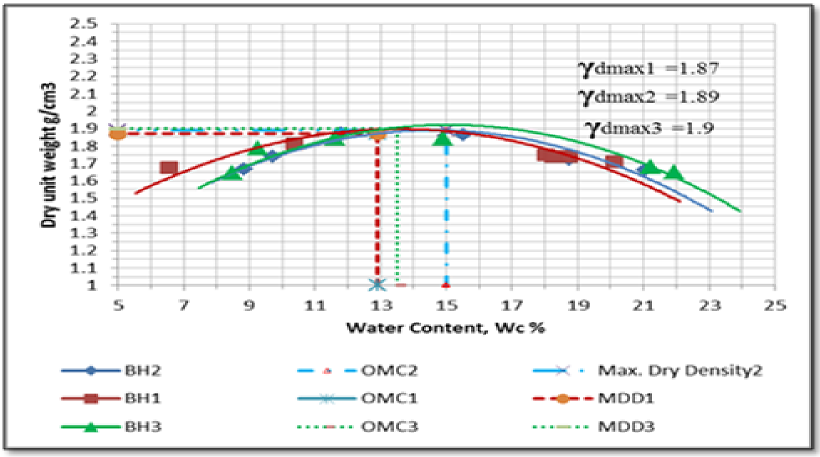
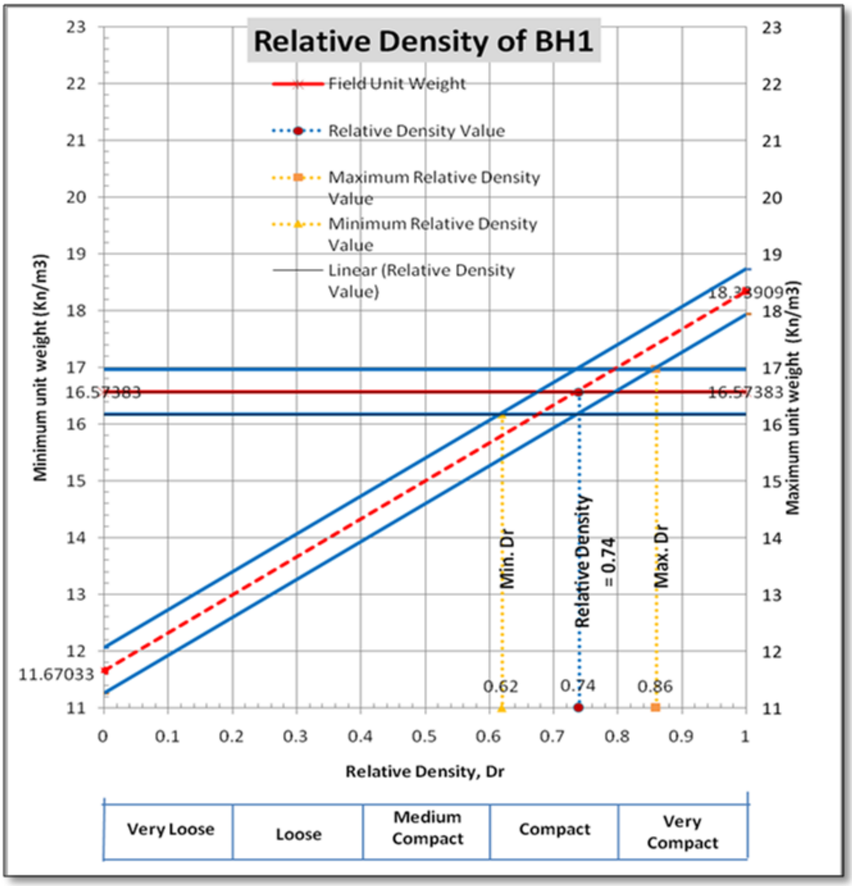


Figure (5), illustrated relationship between water content and dry unit weight in Standard Proctor test.[study result].

According to, Bowles, J.E., (1992), Relative density can be obtained also from applying the result of maximum, minimum and field density into chart of relative density as showing in Figure (6) where the limits of relative density are indicated.

Table (4) shows the obtained values of relative densities for the Soil samples. The values indicate that the soil in the study area is dense enough to ensure that a general shear failure would occur if the foundation experience an excessive loading conditions. In addition, the obtained relative densities from figure (4) are also indicates that soil will experience general shear failure.



Relative Density of BH1
Field Unit Weight
Relative Density Value
Maximum Relative Density Value
Minimum Relative Density Value
Linear (Relative Density Value)
Minimum unit weight (Kn/m3)
Maximum unit weight (Kn/m3)
16.57383
11.67033
18.38909
Min. Dr
Relative Density = 0.74
Max. Dr
0.62
0.74
0.86
Relative Density, Dr
Very Loose
Loose
Medium Compact
Compact
Very Compact

Figure (6) Shows Chart of D_r as an example of the limits of relative density for BH1[study result].

3.2.3. Evaluating the strain of soil.

The strain of soil is also considered as a key factor to categorize the mode of shear failure that may occur in the study area. Consequently, an unconfined compression test was carried out for samples of soil from the three locations according to (AASHTO T208-90). Figure (7) demonstrate the relationship between stress and strain which obtained from the unconfined compression test for the three different samples of the study area.

Table (4): Results of both methods used to obtain Relative Density for three different samples of study area. [study result]

		BH1	BH2	BH3
Name of Test	**Dry Unit Weight**			
Stander Proctor	$\gamma_{d\ max}$ gm/cm^3	**1.87**	**1.89**	**1.9**
Stander Mold	$\gamma_{d\ min}$ gm/cm^3	**1.19**	**1.23**	**1.335**
Sand Cone	$\gamma_{d\ f}$ gm/cm^3	**1.69**	**1.72**	**1.71**
OptemumMostiture Content				
Figure (4) Chart No (a),(b),(c)	**OMC**	**12.9**	**15**	**13.5**
Relative Density				
(D. M. Burmister, Equation). Equ.No(1)	**Dr %**	**81**	**81**	**74**
Figure (5) Chart of Dr.	**Dr_{max} %**	**86**	**87**	**81**
	Dr %	**74**	**72**	**66**
	Dr_{min} %	**62**	**62**	**51**
Ringe of compaction		**Compact to very Compact**		
Type of shear failure		**General Shear Failure**		

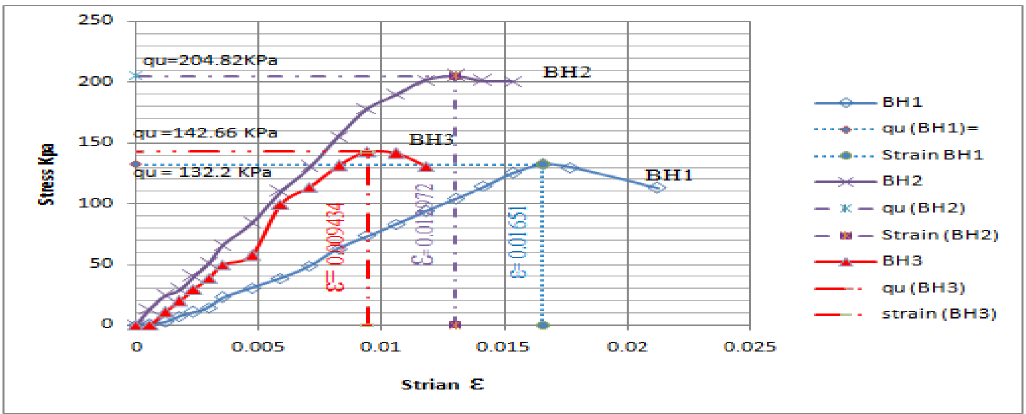


Figure (7): Relationship between stress and strain obtained from unconfined compression test for the three samples [study result]

From figure (7), the factors that determine the mode of shear failure can be summarised as showing instable (5). As the strain ε<5% for the three samples, this can also insure a general shear failure for the studied soil.

Table (5): the ultimate values of compression stress, and strain resulted from the unconfined compression test,[study result]

	BH1	BH2	BH3
$q_{u\,(KPa)}$	132.2	204.82	142.66
$C_{u\,(KPa)}$	66.1	102.41	71.33
ε%	1.65	1.29	0.94

3.2.4. Determining the value of Cohesion & Internal angle friction(C),(Ø):

The cohesion and angle of friction are also essential parametric properties to classify the mode of shear failure and determine the bearing capacity of the soil. In this study, a direct shear test was conducted to estimate these parametric properties according to(AASHTO T 236-90). Figure (8) indicates the relationship between shear Stress and horizontal displacement from direct shear test for three samples exposed to three normal stresses of 4,8,16 kg respectively.The peak value of shear stress was taken for the corresponding displacement of 10mm considered as a failure shear stress, [10].

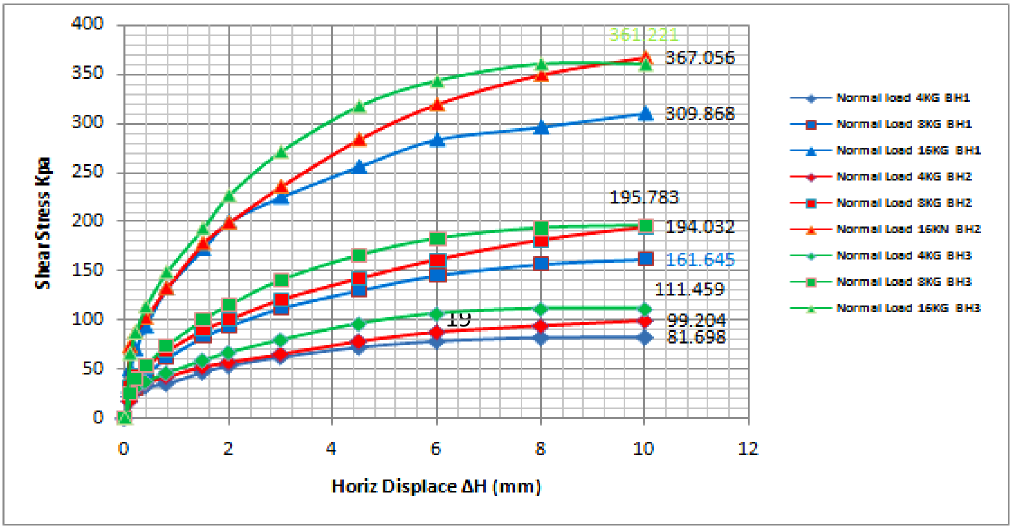


Figure (8): Result of direct shear test under three normal loading conditions shear stress and corresponding horizontal displacement to obtain the failure shear test, from.[study result]

Table (6) review the ultimate shear values at failure in correspondence to the normal stresses for each sample and loading condition. This shear failure stress can be used to determine the cohesion and angle of fraction as in figure (9) by using Coulomb's shear strength equation.

Table (6): Ultimate shear values and corresponding strains for each sample. [study result]

BH No	**BH1**			**BH2**			**BH3**		
Case of Loading	Normal Load			Normal Load			Normal Load		
	4KG	8KG	16KG	4KG	8KG	16KG	4KG	8KG	16KG
Shear Failure	**81.7**	**309.9**	**161.7**	**99.2**	**194.0**	**367.1**	**111.5**	**195.8**	**361.2**
ΔH (mm)	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
Normal Stress	**109**	**218**	**436**	**109**	**218**	**436**	**109**	**218**	**436**

The cohesion (C) and internal angle friction of soil (Ø) can be obtained from Coulomb's equation (2,3) which depends on the values of shear stress failure (τ_f) and normal stress (σn) identified from figure (9).

. The values of cohesion and angle of friction are summarized in table (7).

$$\tau_f = C + \sigma_f \tan(\emptyset) \quad \text{.......(2).[2,7,11]}$$

$$\emptyset = \tan^{-1}\left(\frac{\tau_f - C}{\sigma_f}\right) \quad \text{.......(3) [2,7,11]}$$

Where: τ_f = Shearing resistant of soil at failure.

C = apparent cohesion of soil.

σ_f = Total normal stress on failure plane.

Ø = angle of shearing resistance of soil (angle of internal friction).

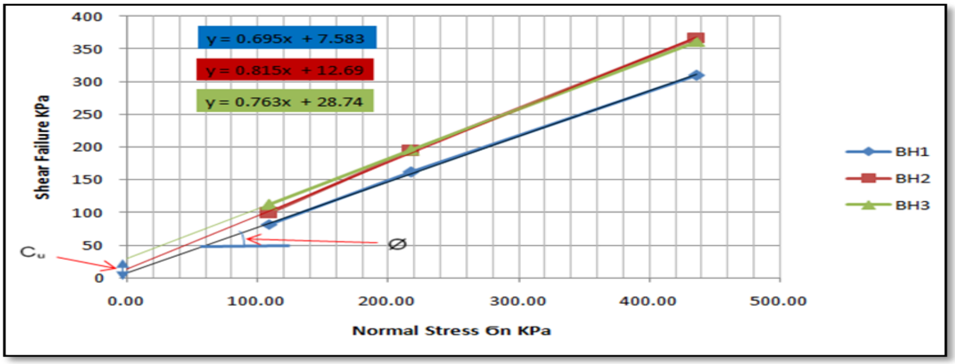


Figure (9). Relationship between shears tress failure(τ_f) and normal stress (σ_n)

[study result]

Table (7). Illustrated the values of cohesion and angle of friction [study result]

	BH1	BH2	BH3
Shear stress failure τ_f	309.9KPa	367.1 KPa	361.2 KPa
Normal stress on failure σ_f	436 KPa	436 KPa	436 KPa
Cohesion of soil C	7.5KPa	7 KPa12.	28.7KPa
Friction of soil Ø	38.59°	43.45°	41.48°
Type of shear failure	G.S.F	G.S.F	G.S.F

According to Table (1), the obtained values of C & Ø in this study indicates that the type of shear failure is General Shear Failure.

3.3. Bearing Capacity of Soil:-

The bearing capacity of shallow foundations has received the attention of several investigators over the last century. Prandtl (1921) was one of the earliest investigators who studied the bearing capacity of soils by loading a strip footing until it penetrated into the soil[6]. The applied stress at which stability failure occurs was defined as the ultimate bearing capacity of the soil. Several techniques and empirical procedures that followed Prandtl's research were valuable to provide a comprehensive understanding of the bearing capacity of soils (Terzaghi 1943, Terzaghi and Peck 1948, Meyerhof 1951, Meyerhof 1956, Lawrence 1968, Vesić1973, and Bolton and Lau 1993). These studies were used in the estimation of the bearing capacity based on the saturated shear strength parameters of the soil, dimensions of the footing and its shape, depth and inclination factors and the groundwater table depth.

Based on previous researches and theories, the equation for ultimate bearing capacity have providedas follows.

$$q_u = CN_cS_cd_ci_c + qN_qS_qd_qi_q + 0.5\gamma BN_\gamma S_\gamma d_\gamma i_\gamma \qquad (4)$$

[11]

According to (Ressner (1924), Prandtl (1921), Meyerhof (1963)), the bearing capacity factors are given by the following expressions which depend on Ø.

$$N_q = \left(e^{\pi \tan \emptyset}\right)\tan^2(45 + \frac{\emptyset}{2}) \qquad (5)$$

$$N_c = \left(N_q - 1\right)\cot\emptyset \qquad (6)$$

$$N_\gamma = 1.5\left(N_q - 1\right)\tan\emptyset \qquad (7)$$

There C =cohesion

γ = unit weight of soil

q = Surcharge at the ground level

B = Width of foundation

N_c, N_q, N_γ = Bearing Capacity factors.

Equations are available for shape factors (s_c, s_q, s_γ), depth factors (d_c, d_q, d_γ) and load inclination factors (i_c, i_q, i_γ). The effects of these factors are to reduce the bearing capacity, and the following are Meyerhof's equations to determine factors.

- <u>Shape Factors:-</u>

$[S_c = 1 + \frac{B}{L}\frac{N_q}{N_C}]$,$[S_q = 1 + \frac{B}{L}tan\emptyset]$,$[S_\gamma = 1 - 0.4\frac{B}{L}]$..(8)

- <u>Depth Factors $D_f/B \le 1$:-</u>

$[d_c = 1 + 0.4\frac{D_f}{B}]$, $[d_q = 1 + 2tan\emptyset(1 - sin\emptyset)^2\left(\frac{D_f}{B}\right)]$,

$[d_\gamma = 1]$.................................(9)

- <u>Depth Factors $D_f/B > 1$:-</u>

$[d_c = 1 + 0.4tan^{-1}\left(\frac{D_f}{B}\right)]$,$[d_q = 1 + 2tan\emptyset(1 - sin\emptyset)^2 tan^{-1}(\frac{D_f}{B})]$,

$[d_\gamma = 1]$..............(10)

- Inclination Factors with β is the inclination of load with respect to the vertical<u>:-</u>

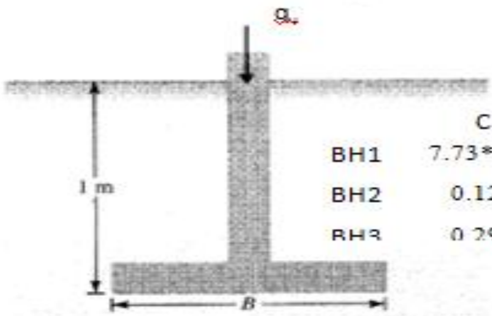
$[i_c = i_q = \left(1 - \frac{\beta}{90^2}\right)^2]$, $[i_\gamma = \left(1 - \frac{\beta}{\emptyset}\right)^2]$

....(11)

(Note:i_v, i_q and $i_\gamma$are all equal to 1 because the load is vertical.)

<u>Assumptions:-</u>

Based on the depth of taken samples and as the foundations at the study are usually foundon1m depth, hence the foundation depth $D_f$and width of footing B are assumed to be 1m as shown in figure (10). Table(8) summarise the parameters of soil and bearing capacity factors for the three samples of the study area.



	C	Ø	γ
BH1	7.73*10⁻⁴	°39.34	1.69*10⁻³
BH2	0.129	°44.55	1.72*10⁻³
BH3	0.293	°44.05	1.71*10⁻³

Figure (10): illustrated the Soil's profile [study result]

Table (8): parameters' of Soil and Bearing Capacity factors [study result].

BH No.	Parameters of soil			D_f	Foundation dimension		$\times D_f$ Kg/	Factors		
	γ Kg/cm^3	Ø	C Kg/cm^2		B	L		N_q	N_C	N_γ
BH1	1.69*10^{-3}	38.59°	7.73*10^{-2}	1	1	1	1.69*10^{-3}	22.37	14.81	22.22
BH2	1.72*10^{-3}	43.45°	0.129	1	1	1	1.72*10^{-3}	38.66	30.61	45.92
BH3	1.71*10^{-3}	41.48°	0.293	1	1	1	1.71*10^{-3}	30.81	22.74	42.87

Table (9): Values of Factors obtained from Meyerhof's equations Bearing Capacity [study result].

BH No.	Factors of Shape			Factors of Depth			Factors of Inclination			q_u Kg/cm^2
	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	
BH1	2.51	1.69	0.6	1.4	1.25	1	1	1	1	4.122
BH2	2.26	1.81	0.6	1.4	1.21	1	1	1	1	12.66
BH3	2.35	1.76	0.6	1.4	1.24	1	1	1	1	22.06

4. Conclusion:

As the study area between Jade and Alrohibathave a growing interest of structural activates, an assessment of shear failure in the soil is highly needed for foundation design. Although the laboratory results indicates relatively high values of bearing capacities, in comparison to soils in Tripoli, all laboratory results indicate that the soil is expected to experience general shear failure when exposed to high loading conditions. This is duo to having a high relative density.

The studied soil also showed that the cohesion and angel of friction have an essential contribution to the value of bearing capacity. As summarised in table (10), the bearing capacity is significantly higher in borehole (BH3) where the cohesion is higher for fine sand.The lowest value of bearing capacity are obtain from coarse sand soil sample of borehole (BH1). However, it is predicted for the studied area that the soil will fail in general shear before reaching the ultimatebearing capacity.

Table (10) illustrated the summary of study.

Borehole No	Classification of sample	Cohesion CKpa	Angle friction Ø	Modes of shear failure	Bearing Capacity Kg/cm^2
BH1	Coarse Sand	7.58	38.59°	G.S.F	4.122
BH2	Sand	12.69	43.45°	G.S.F	12.66
BH3	Fine Sand	28.74	41.48°	G.S.F	22.057

4.1. Recommendation.

To consider more accurate results, the soil properties should be studied at various depths. Moreover, site tastes such as the plate load test should be involved in such studies to have a combination of laboratory and site results.

5. References:

1. Bowles, J. E. (1977) "Foundation Analysis and Design", Mc Graw Hill Publications, New York.
2. Craig, R. F. (1983) "Soil Mechanics", 3rd Edition, English Language Book Society & Van Nostrand Reinhold Co. Ltd., London.
3. Das, B. M. (2007) "Principles of Foundation Engineering", Thomson India Edition, New Delhi.
4. IS6403-1981
5. Punmia, B. C. (2005) "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., Bangalore
6. Som, N. N. and Das, S. C. (2003) "Theory and Practice of Foundation Design", Prentice Hall of India, New Delhi
7. Vesic, A.B., 1963. Bearing capacity of deep foundations in sand. *Highway research record*, (39).
8. Burmister, D.M., 1934. *Notes of Soil Mechanics: Soil Mechanics and Engineering Applications Prepared for the Course CE 117*. Columbia University, Department of Civil Engineering.
9. Das, B.M., 2013. *Advanced soil mechanics*. Crc Press.
10. Bowles, J.E., 1992. *Engineering properties of soils and their measurement*. McGraw-Hill, Inc.
11. Shield, R.T., 1955. On Coulomb's law of failure in soils. *Journal of the Mechanics and Physics of Solids*, *4*(1), pp.10-16.