Evaluate the Efficiency of Plate Load Test of ASTM Standard Procedure of Stone Piles

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Abstract

The last studies has been studied a general behavior of stone piles and found that behavior is be very complicated if compare with that of other types of piles. Since the field studies are regarded to be the better way to describe such behavior, by using the ASTM standard procedure.

The present paper discusses the efficiency of ASTM standard procedure in case of full-scale tests on stone piles. The field study here included installing observation points on soil surface neighboring pile face.

The results of study establish that ,the procedure is need to a perform a some moderation in dimensions of loading system.

تقييم كفاءة المواصفة القياسية ال(ASTM) على فحوص كاملة المقياس على ركائز حجرية

الخلاصة

من الدراسات السابقة التي درست التصرف العام للركائز الحجرية stone piles والتي وجدته معقد جدا" أذا ما قورن بالأنواع الأخرى من الركائز.

ولما كانت الدراسات الموقعية هي الأفضل من بين الطرق لوصف ذلك التصرف فقد استخدم فحص تحميل الصفيحة plate load test وذلك بتطبيق خطوات فحص التحميل القياسي (ASTM) .

وكذلك مناقشة المواصفات القياسية ASTM في حالة فحوص التحميل الموقعية للركائز الحجرية ، من خلال زرع عدد من نقاط الملاحظة الموقعية observation points على سطح التربة المجاورة لوجه الركيزة .

نتائج الدراسة المقدمة أثبتت أنه المواصفة القياسية للتحميل (ASTM) تحتاج الى قليل من التعديل خصوصا" في الجزء المتعلق بأبعاد نظام التحميل.

1-Introduction

A semi-direct method to estimate the bearing capacity of a soil in the field is to apply a load to a model footing and measure the amount of load necessary to induce a given amount of settlement A plate load testing is available (see Bowels,1988) .

The method of performing this test is outlined in some details as ASTM standard procedure as shown in Fig.1.

In case of piles , the test should continue until a total settlement of 25 mm is obtained, or the capacity of the testing apparatus is reached.

Since both the rate and amount of settlement of stone piles are the greatest if compare with other type of piles as it come in all last studies, it expected that the plate load test is not proper in such type of piles during loading and unloading process. That may be back to the settlement of soil neighboring pile body which effected by settlement

of pile body that extended in most times to tenths of centimeters during loading test.

However, most of last studies were depended ASTM standard procedure where it was employed in their field tests ,see (Hughes et al,1975; Goughnour and Bayuk,1979;Engelhardt and Golding,1975; Dayte and Nagaraju,1981; Ahmed,1998; Al-Recabi,1999;and Al-obaidy,2000).

In this paper, six observation points were installed during loading and unloading process. Installing these points to study the behavior of soil neighboring pile body in area between pile face and reference beam (loading system support).

The aim of present study to perform a some moderation on ASTM standard in case of field load test on stone piles.

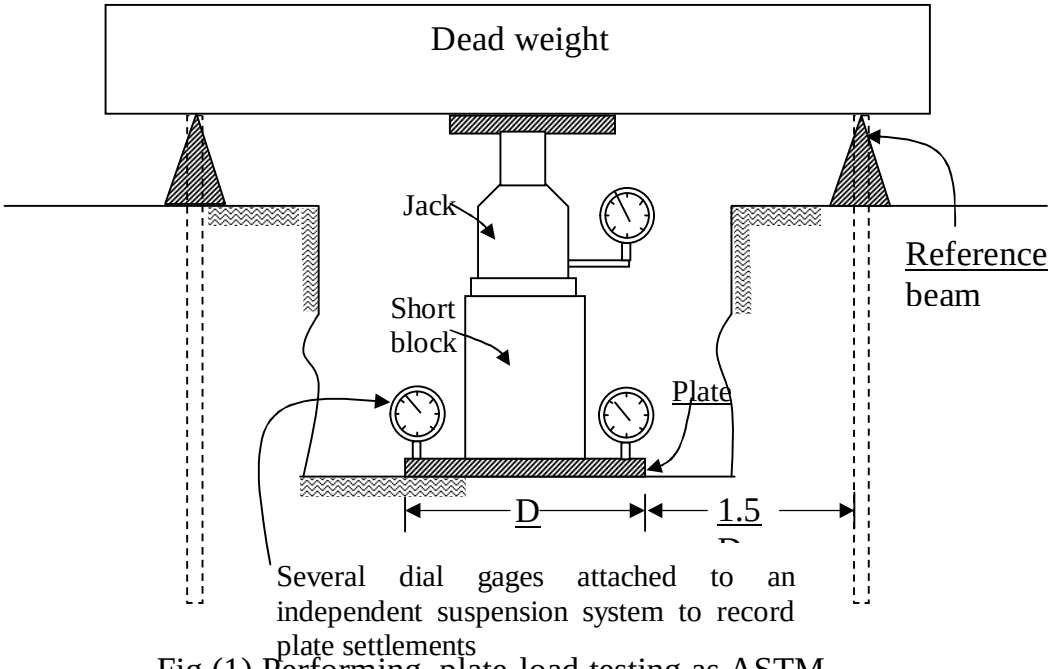


Fig.(1) Performing plate-load testing as ASTM standard procedure

2-Site Condition and Soil Properties

The test program was carried out at the old Al-Muthanna airport area in Baghdad governorate.

In position of testing area a bore hole was made, at the laboratory of NNCL[national center for construction laboratories] , the porogram was set to test the obtained disturbed and undisturbed sample in order to revealsoil properties.

Table (1) A Complete Summary of Laboratory Test Results

Samples		**U.C. Test KN/m^2**	**Drained Shear**		**Consolidation Tests**				**Chemical Tests**		
No.	**Type**		**C (kN/ m^2)**	f^0	**E_0**	**C_c**	**C_r**	**Pc (k N/ m^2)**	So_3 %	pH	Cl %
1	D										
2	SS								0.35	7.73	.0 6
3	D										
4	U		27	30	0.7 5	0.12	0.0 23	15 5	.13		
5	SS	19									
6	SS										
7	SS								.12	7.79	.0 5
8	SS										
9	D										
10	SS										
11	D										
12	SS										
13	D										
14	SS		0	32					0.1		
15	D										
16	SS								0.23	7.73	

3-Stone Pile Properties

A graduated Cino stone added by a boulder represent a main backfilling of a pile that decided to be in test .

Dimensions of this pile body are (6*1.5)m [see Fig.2]

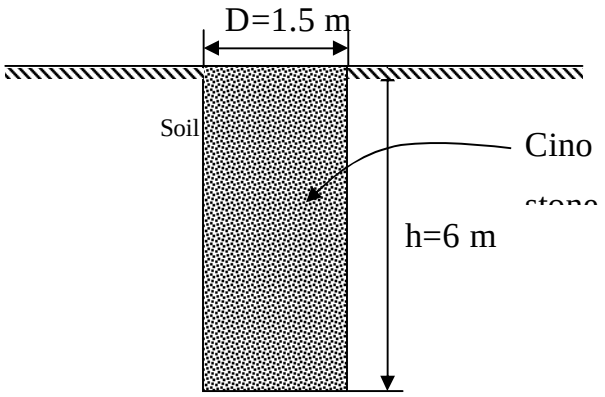


Fig.(2) Dimensions of stone pile body

4- Equipment

The equipment are included the following:

1- All equipment of dead load "Kentledge" system [loads,supports(references beam),hydraulic jucks,steel plates ,dial gauges,etc…] .
2- Six dial gauges of 0.01 mm accuracy.
3- Six steel bars .
4- Six circular block of concrete.

5-Installation Technique

The stone pile was constructed and the load was placed centrally and vertically by means of dead load "Kentledge" system.

Six observation points were fixed in two orthogonal directions, each point consists of the following:

-A dial gauge for monitoring the readings of settlement,

-Steel bar for establish the gauge,

-Concrete block fixed on soil surface and conducted with the steel bar,Fig.3 shows the main sketch of one observation point.

In addition, that six points arranged at distances equal to (0.5,1,and1.75m) respectively far from pile face, see figures 4 &5 where the first figure represents a top view of points from pile perimeter and the second shows the cross section of loading system gives positions of points.

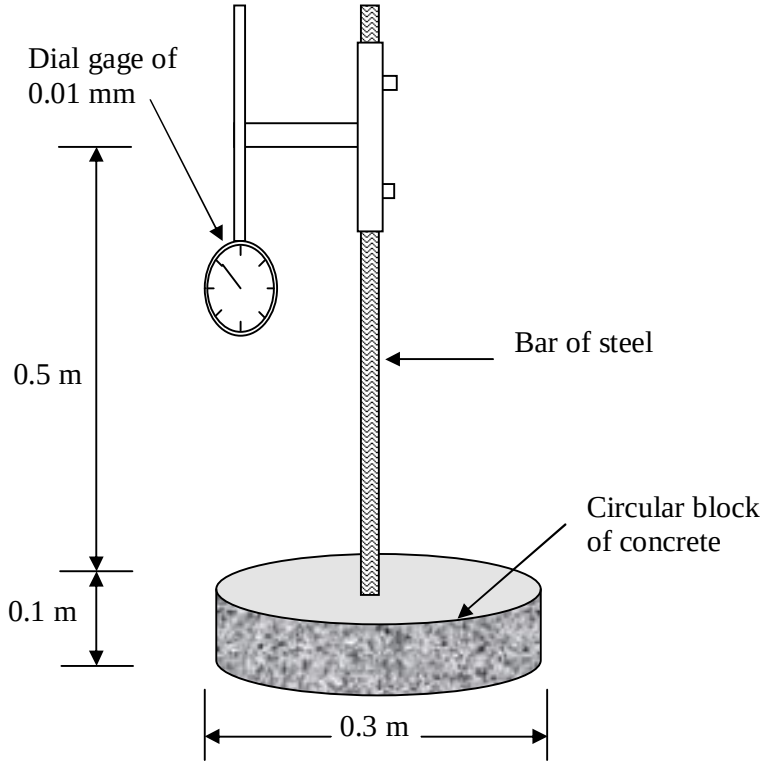


Fig.(3) observation point

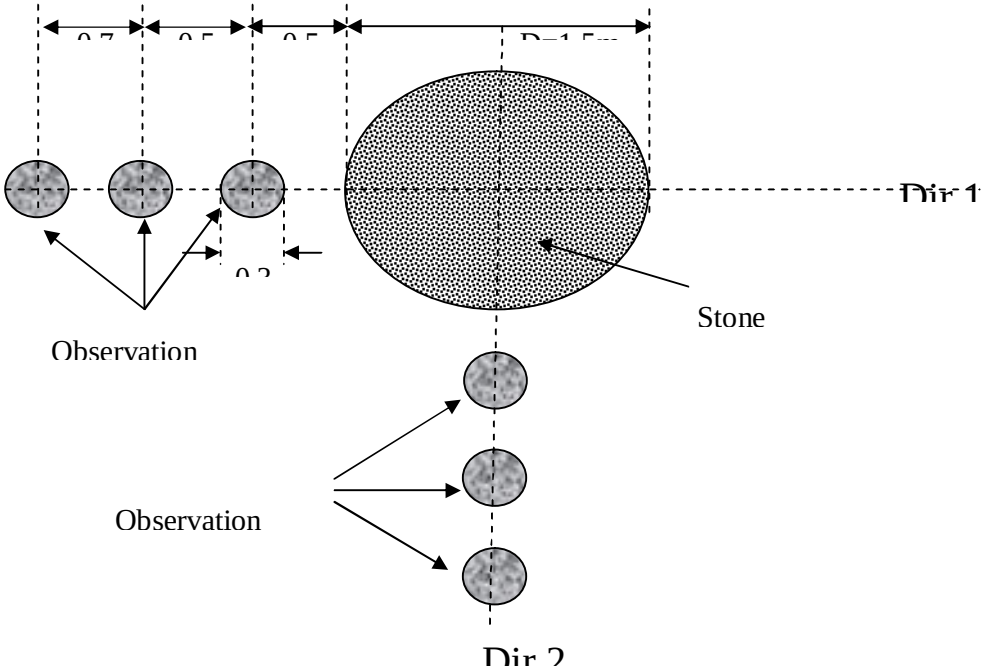


Fig.(4) Top view to position of observation

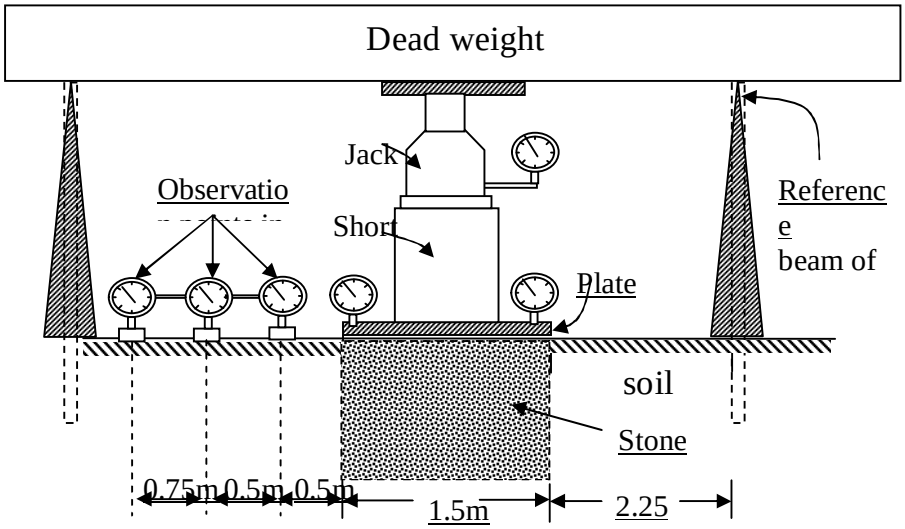


Fig.(5) Cross section in loading system shows positions of observation points

6-Testing Program

To study the influence area around pile body, it has been chosen the observation points in a distances far from pile face as seen in last section, then tend to monitor readings of settlement under loading and unloading process.

Points1, 2,and3 placed in direction (1)which is perpendicular with reference beam of 6 m long (see plate-1-) whereas the other points 4,5,and6 placed in direction (2) which is perpendicular with reference beam of 18 m long (see plate –2-)

The specification ASTM No.D1143-87 was employed. During testing process, the load was placed centrally and vertically on a circular plate above stone pile body. The axial load was applied on the piles by means of hydraulic jacks and two type of reference beams 6 and 18 m long were used as above illustration.

The piles were loaded to 200% of design load with (8) increments, each one is equal to 25% of design load maintained for one hour, the final load increment maintained more than 12 hr… Then the unloading process was performed by four equal decrements, each one is 50% of design load.

The readings of dial gauges of observation points were taken.

Plate (1) Positions of Points of dir.1 (1,2,and3) orthogonal to reference beam of 6 m long

Plate (2) Positions of Points of dir.2 (4,5,and6) orthogonal to reference beam of 18m long

7-Presentation and discussion the results

Fig.(6) shows the load-settlement relationships and Fig.(7) shows the corresponding time –settlement curves for chosen observation points during the first cycle of loading and unloading of stone pile.

From previous figure and after application the load increment on pile body, it can be observed that the settlement of a certain point in one direction gradually increases with time interval in amount proportional with a distance far away pile face.

If we take direction-1, we found that the nearest point (1) suffer from high settlement if it compare with two other points in same direction. In such away point (2) settles with amount greater than that of point (3).

In the same manner, it can be found all three points in direction-2- but with a little amount of settlement.

If we traced the behavior of these points in the two direction during unloading process, we almost found that it continued in settle, that may be go back to voids which are formed in pile body during it unloading such that soil particles push toward pile body to fill the forming spaces.
In addition to re –arrangement for pile material causes a sudden movement for soil neighboring pile body.

Therefore, the settlement of observation points in area between pile body and reference beam increases during loading and unloading. so the chosen distance 2.25 m between pile body and a reference beam of 6 m long according ASTM specification is consider to be so near and improper ,so it must to adopt anew specification is different from available specification take in consideration the high sum and rate of settlement for stone pile or at least select anew dimension for the distance between pile face and reference beam, see plate-3- which describe the soil surrounding pile body effected by loading system in moment of finishing testing program .
Here, it is benefit to suggest the dimension between pile body and reference beam as 2.5D instead of 1.5D dependent on the laboratory study of Al- Mosawe et al in 1985.

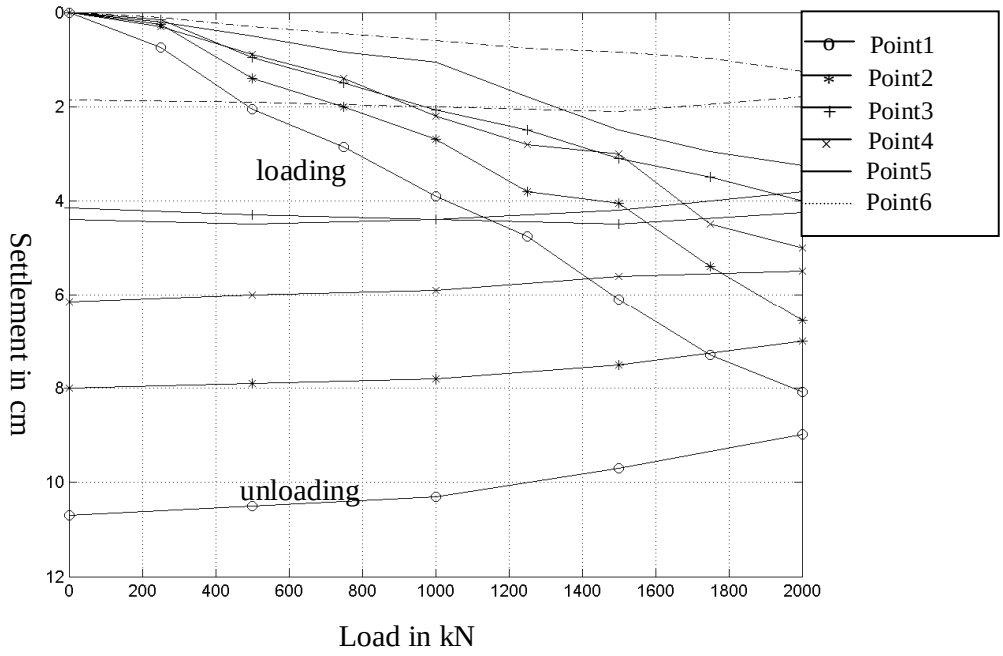
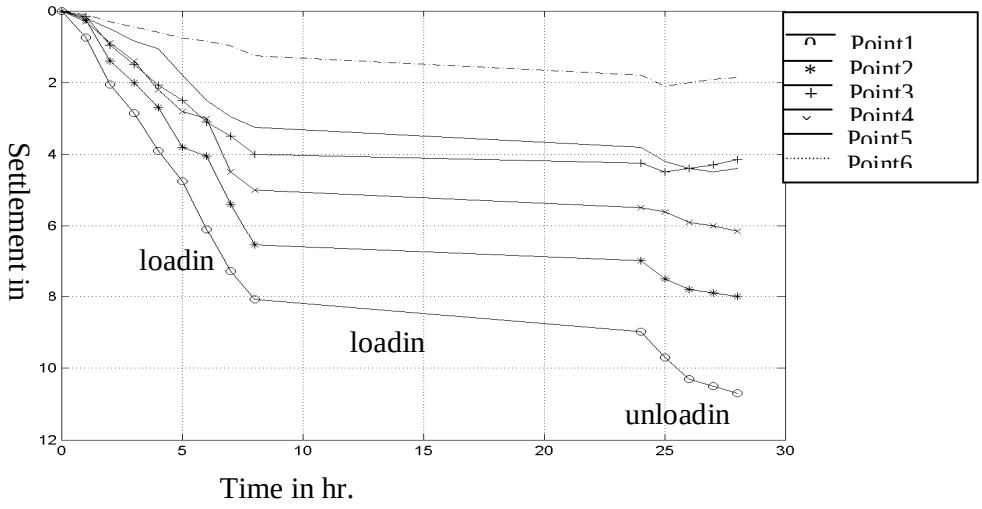


Fig.(6) load- settlement curves of observation points during loading and unloading



Fig(7). Time-settlement curves of observation points during loading and unloading

Plate-3-. Soil neighboring pile body effected by loading system after finishing the test

Recommendations

1- Study the efficiency of standard specification in case of group stone piles.
2- Perform axial loading test on stone pile according ASTM specification with make a moderation by take the distance between pile body and reference beam equal to 2.5D.
3- Install a large number of observation points in different directions and it can monitor the dissipation of pore water pressure of surrounding soil to pile body.

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