مكتب الأبراج الأستشاري لفحص الركائز

ABRAJ FOR PILE TESTING

DYNAMIC LOAD TEST REPORT

(DLT-2014-KUH01)

KARBALA UNIVERSITY HOSPITAL

KARBALA, IRAQ

BAGHDAD 2014

مكتب الابـراج الاستشاري لفحص الركائز

ABRAJ
PILE TESTING BUREAU

PILE QUALITY ASSURANCE

JOB REF DLT-2014-KUH01	DATE November 30,2014
PROJECT NAME KURBALA UNIVERSITY HOSPITAL	
PROJECT LOCATION KARBALA	
REPORT FOR DYNAMIC LOAD TEST	

Report No. DLT-2014-KUH01

Issue	Date	Description	Prepared By	Approved By
01	30th NOVEMBER, 2014	Report	Eng. A. K. J.	Eng. A. K. J.

مكتب الابراج الاستشاري للفحص الركائز
ABRAJ
858
REGISTERD
ABRAJ for Pile Testing

CONSULTANT: A.M.Tech

MAIN CONTRACTOR: FOURTH DIAMENSION FOR GENERAL CONTRACTS

DYNAMIC PILE LOAD TEST REPORT

KARBALA UNIVERSITY HOSPITAL
KARBALA UNIVERSITY, KARBALA
IRAQ

Email: abraj.piletesting@gmail.com
Mobile: 07822277666

مكتب الابـراج الاستشاري لفحص الركائز

ABRAJ
PILE TESTING BUREAU

PILE QUALITY ASSURANCE

JOB REF DLT-2014-KUH01	DATE November 30,2014
PROJECT NAME KURBALA UNIVERSITY HOSPITAL	
PROJECT LOCATION KARBALA	
REPORT FOR DYNAMIC LOAD TEST	

M/s FOURTH DIAMENSION FOR GENERAL CONTRACTS
Project Name: KARBALA UNIVERSITY HOSPITAL.

Dear Sirs,

This report summaries the result obtained from dynamic load measurements performed on **4 working piles** at the above-mentioned site. Field-testing took place on **23thNovember 2014** under the supervision of **the Engineer (A.M.Tech).** Field measurement was performed using a Pile Driving Analyzer (PDA) - PAX Model, which uses the Case Method and CAPWAP analysis for the numerical computations. Please refer to *appendix A & B* for a method statement & complete description of the field testing equipment and analytical procedures.

PURPOSE:

The purpose of the testing was to estimate the bearing capacity, pile load carrying capacity, structural integrity, pile movement and pile-soil transfer relationship.

TEST METHOD:

ASTM D 4945; 2000 "Standard Test Method for High-Strain Dynamic Testing of Piles"

EOUIPMENT USED:

Pile Driving Analyzer™ (PDA) - PAX Model. Dynamic Analysis of the field recorded data was also performed using CAPWAP® (Case Pile Wave Analysis Program) software.

PILES INTEGITY:

Integrity of the piles was checked either before or during the dynamic pile load test especially the dynamic load test can give a good integrity results including length of pile and pile diameter as well as the continuity and consistency of material used in piles.

TEST DETAILS:

Dynamic Load Test has been performed for the Piles listed in the table below (Dia. 80cm) on **23th** November, 2014. The tested piles were cast in place concrete pile.

Email: abraj.piletesting@gmail.com
Mobile: 07822277666

JOB REF DLT-2014-KUH01	DATE November 30,2014
PROJECT NAME KURBALA UNIVERSITY HOSPITAL	
PROJECT LOCATION KARBALA	
REPORT FOR DYNAMIC LOAD TEST	

Ser. No.	Pile No.	Diameter (mm)	Working Load (ton)	Test Load (ton)
1	A 40	800	275	550
2	A 18	800	275	550
3	A 11	800	275	550
4	A 10	800	275	550

The reported design compression load for Piles 275 tons as shown in the table and measurements indicated the dynamic stress wave speed for the pile averaged 4200 (m/s).Using a specific weight of 2.4 ton/m^3, the dynamic elastic modulus for the concrete in the pile was 440 ton/cm^2 given the observed stress wave.
The testing was accomplished using a free falling hammer system, with ram weight of about 7.75 tons. Such ram was released vertically from about (1.5m to 2.2m) height. The pile top was protected with 18mm of plywood cushion.

TEST ANALYSIS:

Using PDA field data such as measured force and calculated maximum stress, Transferred Energy, Efficiency of the Hammer Blow and the mobilized Static Capacity of the pile using Case Method Calculation were obtained. The outputs are presented in Appendix C.
CAPWAP analysis was conducted on the tested pile. The output is presented in Appendix C. The activated total static, skin friction and toe resistance capacity, as well as the pile top deflection at the activated capacity for the pile are tabulated in Table 1.

Table 1

Pile No.	Pile Nominal Diameter (mm)	Activated Total Static Capacity (ton)	Activated Skin Friction Capacity (ton)	Activated Toe Resistance Capacity (ton)	Deflection at Activated Capacity (mm)	Net Settlement After release Of the load (mm)
A 40	800	920.6	794.2	126.4	9.1	0.86
A 18	800	565.3	530.6	34.7	11.73	1.00
A 11	800	824.7	760.15	64.55	9.70	2.00
A 10	800	871.3	826.15	45.15	8.30	1.00

JOB REF DLT-2014-KUH01	DATE November 30,2014
PROJECT NAME KURBALA UNIVERSITY HOSPITAL	
PROJECT LOCATION KARBALA	
REPORT FOR DYNAMIC LOAD TEST	

Based on the CAPWAP analysis, the deflections at the corresponding static applied loads are tabulated in the Table 2 below.

Table 2

Pile No.	Pile Nominal Diameter (mm)	Settlement at working load (mm)	Settlement at 2.0 working load (mm)
A 40	**800**	**1.45**	**3.80**
A 18	**800**	**3.60**	**8.40**
A 11	**800**	**1.60**	**4.20**
A 10	**800**	**1.35**	**3.80**

CONCLUSION

According to the obtained test results, it is concluded that the tested Piles No. **A40, A18, A11& A10 have no integrity problems and can safely carry the design load with settlements limited to those mentioned in the table above.**

It should be noted that dynamic pile load testing just as static pile load testing, gives capacity of the individual pile tested. Geo-technical and structural considerations pertaining to the overall foundation design (such a pile group effects, long-term settlement etc.) are outside the scope of this report and it is assumed that they were considered by others.

Tested by **A. K. J.**

We have appreciated the opportunity to be of assistance to you on this project. If you have further need of our services, or if you have any questions regarding the results presented in this report, please feel free to contact our office.

Respectfully Yours,

Ali Kadhim Jassim
TECHNICAL MANAGER

ABRAJ 858 REGISTERD ABRAJ for Pile Testing

Email: abraj.piletesting@gmail.com
Mobile: 07822277666

APPENDIX-"A"

METHOD STATEMENT

Email: abraj.piletesting@gmail.com
Mobile: 07822277666

CONTENTS

Figures

Attachments

1- SCOPE

High-strain dynamic testing is performed by obtaining and analyzing records of shaft force and velocity under drop weight impacts for evaluations of pile load carrying capacity, structural integrity ,and load-movement and pile-soil load transfer relationship. The following are specifications and method statement for high-strain dynamic testing of drilled and cast-in-place foundation piles.
The work shall consist of furnishing all materials, equipment and labor necessary for conducting high-strain dynamic tests on piles. The contractor will be required to supply material and labor as hereinafter specified and including prior to, during, and after the load test. High-strain dynamic testing is a non-destructive quick test and it is intended that the test pile be left in a condition suitable for use in production. The procedure to be adopted shall be in accordance with the guidance given in ASTM D4945-2000 standard procedure unless as otherwise noted below.

2- TEST PILE REQUIREMENTS

- The dynamic load test shall not commence until 7 days or more have elapsed since the casting date of the concrete or as approved by the Engineer. This can be confirmed by concrete test cube reports.

- If a permanent casing is not used as a feature to construct the pile or where reinforcement rods extend above the pile top, then a pile top extension, consisting of a thin walled casing or equivalent (a steel mesh surrounding pile top could be used with extra pile top reinforcements using close spacing spiral and extra longitudinal reinforcement or any other measurements to ensure enough capability of pile top to resist the impacts), shall be used to extend the test pile equal to a minimum of one and a half times the pile diameter. This top length, defined as the "test area", must be properly reinforced with steel reinforcement, exposed and readily accessible by the testing engineer at the time of the test. If the pile top is below grade, then the surrounding soil shall be removed (creating a safe-working-environment) so as to completely expose a test area of the pile as described above.

- The pile top shall be made of sound solid concrete, flat and axial to shaft.

- A hole at the center of the pile top with a diameter of 110 mm and depth of 200 mm is to be made for placing the testing rod (guide of hammer) at the center of the test area, thus allowing concentric impact blows.

- The testing firm shall smooth (by grinding) the areas around the pile circumference such that proper gage attachment can be accomplished. These areas shall be chosen on the original concrete pile and not on the buildup area.

3- APPARATUS

The testing firm must supply the following testing equipment and instrumentation;

1. A shaft top cushion consisting of sheets of plywood with total thickness between 10 and 50mm to be applied on top of the pile to be tested to absorb the hammer impact.

2. A driving system consisting of the following: A drop weight up to 8 Tons, suitable to achieve the required proof load of piles having diameter between 600 and 1000 mm, a guide constructed of a steel hollow pipe of 90 mm external diameter allowing variable drop heights attached to a hammer striker plate to be placed on top of the pile to be tested. The top of such pile shall be protected with plywood cushion. The area of the hammer striker plate shall not be less than the area of the impacting surface of the drop weight. For more information about our Driving system, please refer to Table -1: "Hammer/Cushion Data File" as well as to the enclosed figure -1 showing more technical information about the driving system and requirements for pile top preparations. Such system is proved capable of generating a net measurable pile penetration or an estimated mobilized static resistance in the bearing strata which exceeds to a sufficient degree the working load assigned to the pile as judged by the testing Engineer. However for higher test loads an appropriate loading system as agreed by the Client/ Consultant / Contractor shall be used.

TABLE -1: HAMMER/CUSHION DATA FILE

HAMMER	Manufacturer		ABRAJ CONSULTANT P.T.
	Hammer type		FREE FALLING
	Ram weight	Tons	2.0 / 8.0
	Ram length	mm	1000
	Ram width *(which yield the effective ram stiffness)*	mm	1000
	Efficiency		25 - 40
STRIKER PLATE	Weight	Tons	0.6198,0.3967
	Diameter	mm	1000,800
	Thickness	mm	50
	WEAP Modulus	Mpa	205820
	Coefficient of restitution		0.8
PILE CUSION	Material name		Plywood cushion
	Cross section	cm^2	7854,5026
	Thickness	mm	18-50
	WEAP Modulus	Mpa	207
	Coefficient of restitution		0.5

3. Hammer dropping device provided generally by the Contractor. Usually a mechanical crane of sufficient capacity to carry the rammer system as per the testing Engineer instructions. It will raise the hammer and drop freely and strike the pile.

4. Leveling equipment and accessories for measurements of pile set under each impact.

5. Grinding equipment in order to smooth areas around pile circumference.

6. Equipment to drill holes at pile circumference prior to inserting anchors in order to attach the accelerometers and the strain gages.

7. Pile Driving Analyzer ,shown in figure-2 ,(PDA manufactured by Pile Dynamics, Inc. model PAX-8 installed with the necessary software for signal transmission, recording, displaying and recording of the measured data. The PDA is a robust enclosure, aluminum frame ,having a compatible processor with math coprocessor and 8 Mb RAM. The PDA have the possibility to make an internal calibration check for the attached transducers. For more information, please refer to page 18 "PAX Users Manual 2008 ".

8. Two strain transducers capable of independently measuring strain versus time at a specific location along the pile axis during the impact event. These, sensitive strain gages shall be handled carefully and calibrated as per an acceptable method statement given by the manufacturer, Pile Dynamics Inc. USA, For more information, please refer to Appendix A of this manual.

9. Two acceleration transducers capable of measuring acceleration versus time which can be integrated to velocity. These accelerometers shall be handled carefully and calibrated as per an acceptable method statement given by the manufacturer, Pile Dynamics Inc. USA.

10. A cable to transmit the signals from the transducers to the PDA equipment.

11. Safety measures are the responsibility of the Contractor as well as of the testing agency. The Contractor is requested to take appropriate safety and health measures since the tests involve the handling of hazardous operations and equipment.

4- TEST PROCEDURE

- Prior to the dynamic test, the testing Engineer must be provided with soil borings, pile installation records, concrete properties .

- The testing engineer is required to perform wave equation analyses to determine an acceptable range of ram drop heights based on the GRLWEAP program from GRL File Dynamics U,S.A. This program simulates a foundation pile under the action of an impact pile driving hammer. The following major information are required:

  1. Pile specifics and design data as given in the soil investigation report),
  2. Soil strata {from Borehole log sheet and from daily drilling reports of piles).
  3. Hammer and driving system (as given in the enclosed Hammer/Cushion data file).

- Provide the Testing Engineer access to attach the gages to the exposed concrete and/or

steel casing and examine the pile or shaft top to insure the concrete or grout is flush with or above the casing.

- Position the guide and drop weight assembly and apply a minimum of two (2) drop weight impacts to the pile top. The first drop height should be minimal to allow the testing Engineer to assess the testing equipment, the driving system, and pile stresses. Subsequent impacts may then be applied by utilizing higher drop heights, not to exceed a maximum of ten impacts, until either stresses in the foundation are excessive or the pile permanent set for the applied impact exceeds 2.5 mm.

- Place plywood cushion on top of the pile to be tested and then the hammer striker plate to the shaft top.

- Gages must be attached by the testing Engineer in a secure manner as to prevent slippage under impact- This shall be done by drilling holes and then inserting steel anchors to allow the attachment of such sensors.

- Strain transducers and accelerometers are mounted in pairs and diametrically opposite to each other in the original pile at a minimum distance of 1.5 times the pile diameter below the pile top. Anyway, the exact location will be decided by the testing Engineer depending on the site conditions,

- The hammer shall be lifted up to the required level (as per instructions of the Testing Engineer) as given on the graduated guide and released freely on the pile top.

- Set measurements shall be taken before and after each blow by means of an optical level monitoring the movement of a scale attached on the pile shaft.

- During the dynamic testing, the following items should be checked: Driving stresses, integrity of the tested pile and its achieved static capacity under hammer impact based on the Case method.

- With the strain transducers and the PDA PAK model, the strain can be converted to force. This can be done by using the following equation:

$$\Delta\varepsilon_I = \Delta O_I \, (K_I) \, G_{PAK}$$

Where:

$\Delta\varepsilon_I$ is the change of strain,
ΔO_I is the change of PAK Offset reading of S_I as strain is applied,
K_I is the PDI strain transducer calibration, and
G_{PAK} is the PAK calibration Gain fixed constant (always equal to 4.38).

5- ANALYSIS PROCEDURE

CAPWAP (CAse Pile Wave Analysis Program) is a rigorous numerical analysis procedure which uses the derived force and velocity data to solve for soil resistance parameters. The pile is divided into segments of approximately one meter in length and soil resistance are assigned to every embedded pile element to model the shaft friction and an additional below the pile toe to model The toe bearing. The soil model for each soil element contains a static resistance represented by an elastic-plastic spring with an ultimate resistance, and, a limiting elastic displacement termed the quake. Soil damping is modeled as a viscous dashpot with a damping factor which relates the magnitude of dynamic soil resistance to the pile loading velocity as shown in figure -3.

The measured pile top velocity is traditionally imposed as an input and trial values are assigned to all soil model parameters. The required pile top force Is then computed and the solution compared with the measured force. The agreement between computed and measured pile top force is iteratively improved by modifying the assumed soil model parameters (total capacity and its distribution, damping factors and quakes) until good matching is, obtained between computed and field measured records. The final soil parameters then represent the best match dynamic soil model.

6- TEST REPORT

The testing Engineer must submit a comprehensive report on the results within 14 days of the completion of testing. This report shall provide the following analysis :

6.1 GENERAL

6.1.1 Project identification,
6.1.2 Project location,
6.1.3 Owner Name

6.2 RAMMER SYSTEM

6.2.1 Make, model and type.
6.2.2 Weight of hammer, and height of drop.

6.3 TEST PILES

6.3.1 Identification of test pile(s),
6.3.2 Working load of pile(s).
6.3.3 Type of pile(s),
6.3.4 Dimensions of pile(s),