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Model Research Report on the Dynamic Compaction of the Reinforcement of the Hydraulic Reinforcement Base

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Abstarct: A well-known and efficient method of earth improvement is dynamic compacting. This method is often restricted to structural engineering due to its noise, vibration and building environment. The objects of dynamic consolidation treatment (including the base soil) are very complex, and universal sense theory cannot be built, but suitable for all types of soil. The present paper dealt with the transfer mechanism of dynamic vibrations and choosing a harmful index, the transfer from the research vibration of dynamic compaction for hypothecary filling foundations by model check, a four-strike ramming attack (1000 KN oscillating in the horizontal and vertical vibration acceleration), a research vibration transfer of dynamic compaction for the hydraulic filling foundation by model test, and a testing method. Use the test data from the formula for acceleration attenuation of horizontal and vertical vibration. The findings of dynamic compaction in the application of hydraulic filling foundations are important.

Keywords: Acceleration, Dynamic compaction, Hydraulic filling foundation, Structural engineering, Vibration.

INTRODUCTION

Originally developed and used by France as a technology company in the 1960s, dynamic compaction is used. The method uses heavy hammer (normally 100~400 KN), which falls unrestrictedly from a height (distance usually 6~40 m), which provides the foundation for the strength and vibration of the impact and reduces the filling compressibility not only. Dynamic methods of compaction have obvious impact, easy machinery, convenient construction, large application, viable economy and saved materials, etc. This can not only enhance soil strength and minimize friction, it can also enhance the resistance to vibrating sand forming sludge, remove collapse and eliminate the collapse of collapsible looseness. The dynamic compaction in the soils causes an elastic wave in the soil in process of the basic treatment with dynamic combination, which causes the soil to spread elastically [1–3]. As the vibration exceeds certain limits, it causes adverse environmental effects especially in large and mid-sized cities such as buildings and underground utilities in dense areas when building, the strong ground vibration can not only impact on the finishing of goods by neighborhood precision instrument. Engineering and associated departments involved caused adverse environmental effects from complex building compaction vibration.

Construction vibration hazard evaluation indexes:

In order to manage vibration in construction, people should know that the protective object (including buildings, indoor people and equipment) allows vibration value. Even though technical standards or regulations (e.g., ISO2631, Germany standard

DIN4150, Chinese national standards GB6722-86, etc.) have been promulgated and implemented both at home and abroad, most of these include vibration calculation, or research and statistical analysis, of actual working conditions, rather than vibration measurements. The construction vibration such as pile drive, dynamic compaction, dynamic structural response and damage mechanisms, more superficial understanding, countries and between different industries, is a vibrational harm to assessment index and quantitative aspects, and is very different compared with research results for individuals or devices with simple, harmonic movement capabilities [4][5].

$$\sigma = (E/C)V$$

For elastic modulus of the medium E and C respectively, elastic wave size.

Now, in different countries and sectors, they have not decided with respect to the building test. Since the sampling of blasting vibrances in the American mineral department usually takes the maximum component of the vibration in three mutually orthogonal directives, three directions, relative to the blasting vibration centre.

$$V_t = \sqrt{x_t^2 + y_t^2 + z_t^2}$$

Where several components from the same period use the maximum Vt-t curve value as a vibratory effect of the assessment index.

The measurement index of construction vibration Vr, consisting of a part for maximum pea (Vx, Vy, Vz) of three orthodontic directions measured according to the following formula, was used by Switzerland and Germany and other countries almost estranged: Vr Particle vibration speed:

$$V_r = \sqrt{V_x^2 + V_y^2 + V_z^2}$$

In practical situations, because the maximum three particles of the same particle never occur together, the above definition of Vr has no physical significance.

Dynamic vibration transfer mechanism:

The factor affecting buildings around is that, as a result of tremendous ramming energy, the center of the point will settle rapidly (settlement accumulations are even up to 1 m above sea level), the soil around the pot will usually rise, soil causes significant distortion under the influence of ramming energy, and soil deformation will defy the earth. The rammer applies impact energy to the soil and spreads it into the air as a vibration wave and alters the physical and mechanical characteristics of the soil. The vibration wave spreads out in a wave system of body and surface waves, from the point of the rammer, and a wave field in the foundation will be generated [6–9]. Waves include longitudinal waves and shear waves (also known as waves, P waves) (also known as shear wave, S waves). Body waves. Longitudinal waves apply tensile, pressure effects to the soil, increase pore water pressure, causing a disintegration of the soil skeleton, and the S-wave then coming makes the disintegrated soil particle far more narrow grains. The waves are radially spread over the hemisphere. The surface wave mainly consists of Rayleigh wave (R wave) and Los Wave (L wave), the surface wave energy spreading in the area close to the surface layer. The surface wave can loosen the ground surface and create a relaxing area. The surface wave does not affect the consolidation of the base's strain, but rather induces large vibrations on constructions, classified as harmful. From above it is easy to understand from the study theory that the compactness and surface deformation of the soils due to the effect of the shockwave induces the deformations of the soil of the base. The effect of a large portion of the energy (equivalent to a tamping point core, equivalent to rambling strike can) on earthquake buildings in fluctuating form spreading. Also in the form of body waves and waves, seismic waves spread to the founding soil. Also, wave vibration destroys the ground of buildings. The base intensity of the vibration of both waves is linked with

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vibration source energy and vibration source distance. Geological terrain and other factors have affected vibration parameters significantly. The soil compaction theory and the concept of dynamic analysis are essentially the same as the earthquake on the soil vibration analysis.

Monitor project selection:

As the level of evaluation of risks to buildings is more acceptable, the dynamic compaction transfer method increases seismic intensity. Due to the different equipment specifications for vibratory hazards in buildings and structures, the impact of construction standards should be different. The seismic intensity list of Chinese population (GB/T17742-1999) contains the following definitions: Most people usually feel indoors and outdoors; most people wake, the doors and windows, the roof, the quaver, the dust drops, the plaster looks imperceptible, the tile flaps, the roof and fireplace are not stable when the brick falls, and the tools are stirred or overturned. The peak acceleration of horizontal ground movement is 22~44 cm/m^2. The warehouse for this project is general buildings that are challenged with the seismic intensity level V [10] [11].

The acceleration, the speed and the effect of dynamic compaction on buildings are calculated by evaluating the safe distance of horizontal vibration. Compaction deforms the soil and can also be used to measure the degree of compaction in buildings by using the vertical and lateral displacement. In the seismetic structure standard TEI, it stipulates that, when structures suffer affecting less than the strength of seismic fortification of this region, there is usually no damage or no repair required but can still be used if structures have an earthquake that is so intense as the intensity of seismic fortification of such area that damage, but may still be used in general or no repair. A seismic activity of the league structures should be measured with seismic design vibration parameters, and seismic function should be determined only if the intensity of the compliance is 6 degrees.

Typically, when measuring the earthquake-resistant structures, the horizontal forces are measured in an earthquake and the unit is aseismatically tested for 2 main axes. If you use the time-history method to make the seismic structures, the site conditions are close to the real acceleration records or the corresponding response continuum, according to the engineering. In compliance with the seismic architecture standard in buildings, Table 2, which offers their planned basic value of earthquake acceleration, should be used to measure earthquake activity by using horizontal acceleration [11–13]. So we believe that when seismic accelerations resulting from dynamic compaction are under 0.1 g, building protection is almost non-hazardous and we can find the distance from this point to the middle of the dynamic point to be a safe distance from the effect of dynamic vibration on structures.

In conclusion, this experiment mainly measures vibration acceleration information.

Design of model experiment:

Dynamic compaction three-dimensional model test-bed: The three-dimensional dynamic compact model test bed is our own large model device used in dynamic vibration control. Can be used under various working conditions (tamping strength, ramming distance, soil status, etc.) to detect effects on underground and soil structures under dynamic compaction vibratory. Design test beds are of 4000 mm bis 3000 mm hasta 1500 mm. Geometrical dimensions: The sixty mm thick sponge was laid on four walls in the test bed to reduce vibration in the four walls.

Equipment and components:

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Figure 1. Strainbook616 data acquisition instrument

Table 1. Testing components

Testing components	specification	Type	precision
Strainbook	616		
Data acquisition instrument	SDA-810c		
Strain gauge	5×3mm	BX120-5AA	2.08±1%（sensitivity coefficient）
Soil pressure sensor	ϕ 17×7mm	BX-1	0~<600 $F \cdot S$
One-way acceleration sensor	ϕ 14×20.5mm	SG1701	160Hz30.3 mV/g
Two-way acceleration sensor	ϕ 14×20mm 18×18mm	SG2702	X;160Hz26.5 mV/g Y; 160Hz55.0 mV/g

Test scheme:

(1) Model materials

Hydraulic fill foundation soils of CaoFeidian coastal area used in model test, its basic physics index of soil is measured in soil mechanics laboratory, whose physical mechanics indexes by next table shows.

Table 2. Soil physical mechanics indexes

Density γ g/cm³	Water content ω %	Internal friction angle Φ °	Cohesion C kPa	Compressibility α_{1-2}	Void ratio e_0	Compression modulus E_{S1-2} MPa
1.5	4.4	29.44	3.09	0.15	0.65	6.7

(2) Similarity ratio and tamping energy

A geometrical effect of 1 to 25, might use the four pads (rammer weight 30 kg, drop away from 2 m— or 1 m to 0.5 m— or 9375 KN to pad energy — or the other KN to paddle energy — KN to paddle energy 2343.75 KN to petrol energy 1000 KN to paddling energy, and each paddle energy impact three times. The measuring data through low-pass filter processing to reduce the noise effects of the dynamic tensile gauge acquisition process, respectively. Print data are all conversion data by a similar ratio, unless explicitly labelled outside.

(3) Test methods and testing components layout

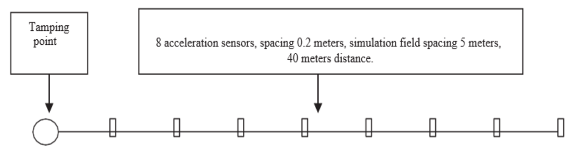

Figure 2. Arrangement diagram of acceleration sensor horizontal

The test takes the size of each acceleration point simultaneously, it shows that graphically the vibrational wave produced by the dynamic compaction is reduced in the horizontal direction at attenuation level. It shows that the horizontal acceleration of the vibration is reduced gradually by dynamic vibration effects and the distance between the increases of the packing points. This shows that the dynamic vibration transmission has been diminished rapidly during the process. The vibration waves 90 percent after 35 meters simple attenuation. We obtained a calculation formula following the model check, taking into account tamping energy and horizontal distances by fitting results.

$$a_H \ (0.263\ln Q - 1.599) \square d^{-0.0921\ln Q + 0.244}$$

Where: a_H —The horizontal acceleration, g;

Q —Tamping energy, KN .m;

d —The horizontal distance from tamping points on the soil surface, m; E—10^{-6}

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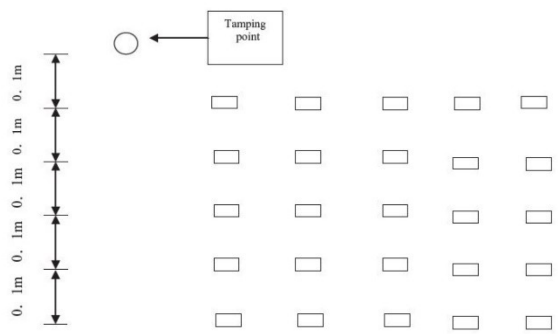

Figure 3. Arrangement diagram of acceleration sensor vertical

EXPERIMENTAL RESULTS AND ANALYSIS

The change law of horizontal acceleration under different tamping energy:

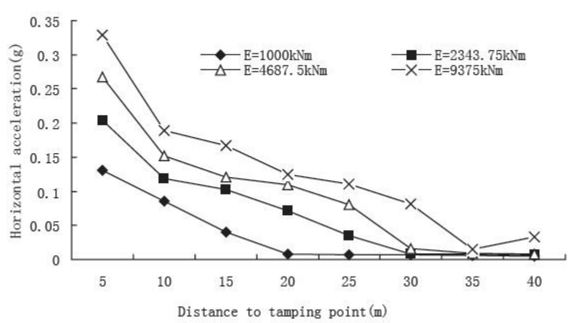

Figure 4. Attenuation condition of ground horizontal direction vibration acceleration under different tamping energy

The change law of vertical acceleration under different tamping energy:

In the model test, the changing laws of vertical acceleration within the scope of 0.5 meters (namely the 12.5-meter simulated scope in the field) were determined according to the previous method, see the model test design for the acceleration sensor arrangements. Table 5-3 shows the model experiment measured changes of acceleration.

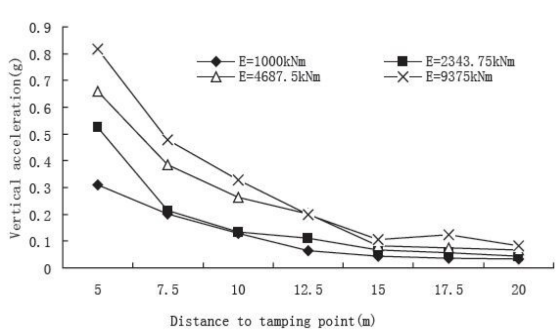

Figure 5. Attenuation condition of ground vertical direction vibration acceleration under different tamping energy

In the study, in order to be able to calculate the acceleration of each point, we can consider the acceleration of the vertical vibration with the distance between the growth of space tamping points and the peak acceleration slowly reduced in dynamic vibration effects. This shows that the dynamically compacted vibration wave produced by attenuation trend in the vertical direction has a peak value of 1--5 observation points which, apparently, are closest to the paddocks above the peak sensor value, which is located in that same row but far removed from padding points. The horizontal acceleration in the attenuation was also shown. The dynamic vibration in the vertical direction attenuation case of the vibration wave is similar to the horizontal vibration wave diminution case. The acceleration attenuated rapidly, the farther the distance, attenuated slowing in close proximity to paddle points.

The data-fitting formula is given as follows in accordance with model test data, considered two ramming energy factors and the distance from tamping points:

$$a_V = 0.0001e^{-0.159d} \cdot Q + 6.8d^{-1.845}$$

Where: a_V —The vertical acceleration, g;

Q —Tamping energy, KN.m;

d —The vertical distance from tamping points on the soil surface, m

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Table. 3 Along depth change of vertical acceleration under 1000kN.m

Horizontal distance (m)		5	7. 5	1
	0	0. 311	0. 203	0. 1
	2. 5	0. 182	0. 119	0. (
depth	5	0. 092	0. 088	0.
	7. 5	0. 056	0. 052	0.
m	10	0. 037	0. 042	0.

Table. 4 Along depth change of vertical acceleration under 2343kN.m

Horizontal distance (m)		5	7. 5	10
	0	0. 525	0. 185	0. 135
	2. 5	0. 304	0. 1	0. 07
depth	5	0. 134	0. 09	0. 07
	7. 5	0. 137	0. 06	0. 06
m	10	0. 098	0. 052	0. 04

Table. 5 Along depth change of vertical acceleration under 4687.5kN.m

Horizontal distance (m)		5	7. 5	10
	0	0. 659	0. 306	0. 265
	2. 5	0. 394	0. 189	0. 138
depth	5	0. 392	0. 105	0. 112
	7. 5	0. 308	0. 093	0. 085
m	10	0. 189	0. 1	0. 078

The Table 3-6 shows that the acceleration of the vertical direction along a depth direction attenuated rapidly, when the depth of 5 meters already attained approximately 50% to 60%, when 10 meters already attenuation 80 ~ 90%.

Table. 6 Along depth change of vertical acceleration under 9375kN.m

Horizontal distance (m)		5	7. 5	10
	0	0. 818	0. 473	0. 329
	2. 5	0. 49	0. 293	0. 196
depth	5	0. 318	0. 273	0. 113
	7. 5	0. 258	0. 221	0. 102
m	10	0. 087	0. 109	0. 09

CONCLUSION

According to the CaoFeiDian industry zone's dynamic compaction project, the CaoFeiDian industry area has performed model tests and collected valuable data specific to coastal hydraulic fillers. The horizontal acceleration in the attenuation was also shown. The dynamic vibration in the vertical direction attenuation case of the vibration wave is similar to the horizontal vibration wave diminution case. The acceleration attenuated rapidly, the farther the distance, attenuated slowing in close proximity to paddle points. Have the acceleration attenuation law in respect of the hydraulic base for filling and presents the calculation formula for the vertical and horizontal direction acceleration attenuation law. Technical support is given for further work on complex compact vibrations and vibrations in underground engineering.

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