

TITLE OF THE INVENTION: EVALUATION METHOD OF COEFFICIENT OF EARTH PRESSURE AT REST IN PILE OR SAND COMPACTION PILE DRIVING GROUND AND EVALUATION METHOD OF COEFFICIENT OF EARTH PRESSURE AT REST IN THE SAND COMPACTION PILE ITSELF OF THE SAND COMPACTION PILE DRIVING GROUND

BACKGROUND OF THE INVENTION:

The present invention concerns an evaluation method of a coefficient of earth pressure at rest in a pile or a Sand Compaction Pile driving ground to be performed for reflecting the elevation of ground strength obtained by driving a pile or a Sand Compaction Pile in a ground on the designing of Civil Engineering works, for contributing to the cost down.

Conventionally, in general, it is largely known that the coefficient (K_0) of earth pressure at rest in a ground increases and the ground strength elevates, if a pile or a Sand Compaction Pile (SCP) is driven in the ground; however, actually, such advantage is not taken into consideration during the designing.

It should be noted that the Sand Compaction Pile (SCP) increases the ground strength by penetrating into a ground compressing the sand, as it is well known, without evacuating clay constituting a soft ground and with elevating the ground density, and is adopted largely in Civil Engineering works because it can be carried out in a relatively short period of time, and the execution can be managed by instruments or the others.

In short, increase of the coefficient (K_0) of earth pressure at rest in a ground results in increase of the shear strength of the ground. In Fig. 7A and Fig. 7B, the relation between the increase rate of shear strength of sand, clay or the like due to the increase of this K_0 and the ground replacement ratio (a_s) for a composite ground wherein the SCP is driven, or the area a_s of composite ground occupied by the SCP is illustrated by diagrams taking the coefficient K_0



of earth pressure at rest as parameter.

Fig. 7B shows that, for the Sand Compaction Pile SCP in the sand ground, the shear strength under the coefficient $K_0 = 1.0$ of earth pressure at rest and $a_s = 0.4$ is substantially equal to the shear strength under $K_0 = 0.4$ and $a_s = 0.7$, while in a normally consolidated clay of Fig. 7A, for the same a_s value, it is shown that the shear strength under the coefficient of earth pressure at rest $K_0 = 1.0$ attains about 1.5 times of the shear strength under $K_0 = 0.5$, respectively.

Namely, in either case, though the replacement ratio a_s could be reduced respectively from 0.7 to 0.5 or 0.4 if the increase of a coefficient K_0 of earth pressure at rest were evaluated appropriately, an appropriate evaluation method of a coefficient K_0 of earth pressure at rest, and a simple application method for the designing are not established yet for the moment.

SUMMARY OF THE INVENTION:

It has been remarked that an appropriate evaluation of such increase of a coefficient of earth pressure at rest and its appropriate application to the designing would contribute naturally to the cost down of the related works, and the evaluation method of a coefficient of earth pressure at rest of present invention has been attained.

The present invention has an object of providing an evaluation method of a coefficient of earth pressure at rest in a pile or a Sand Compaction Pile driving ground allowing to evaluate the increase of a coefficient of earth pressure at rest combining an electric static Cone Penetration Test (CPT) and a Direct Shear Test (DST), in order to evaluate appropriately the increase of the coefficient of earth pressure at rest in the ground due to the driving of the pile or the Sand Compaction Pile, and to apply the coefficient of earth pressure at rest

appropriately and simply to the designing.

In order to achieve the aforementioned object, the evaluation method of sand ground of the present invention comprises the steps of; selecting a representative point in an construction area, obtaining a cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving a pile or a Sand Compaction Pile, by performing an electric static Cone Penetration Test (CPT) , driving a plurality of test piles or test Sand Compaction Piles in a way to surround the representative point after the execution of the CPT, then performing the CPT at a plurality of points at the middle between the piles or the Sand Compaction Piles or in the vicinity of the piles or the Sand Compaction Piles for obtaining a cone resistance $(q_T - \sigma_{vo})_{(1)}$ after driving the pile or the Sand Compaction Pile, and thereafter, calculating and evaluating a coefficient $K_{0(1)}$ of earth pressure at rest in the sand ground after driving the pile or the Sand Compaction Pile from a relational expression between cone resistances $(q_T - \sigma_{vo})_{(0)}$ and $(q_T - \sigma_{vo})_{(1)}$ before and after driving the pile or the Sand Compaction Pile and a coefficient $K_{0(0)}$ of earth pressure at rest before driving the pile or the Sand Compaction Pile and the coefficient $K_{0(1)}$ of earth pressure at rest after driving the pile or the Sand Compaction Pile :

$$\frac{1+2K_{0(1)}}{1+2K_{0(0)}} = \frac{(q_T - \sigma_{vo})_{(1)}}{(q_T - \sigma_{vo})_{(0)}} \times \frac{\tan \phi_{(0)}}{\tan \phi_{(1)}} \quad (1)$$

wherein $\phi_{(0)}$ represents the internal friction angle before driving, while $\phi_{(1)}$ the internal friction angle after driving, respectively;

or

$$\frac{1+2K_{0(1)}}{1+2K_{0(0)}} = \frac{(q_T - \sigma_{vo})_{(1)}}{(q_T - \sigma_{vo})_{(0)}} \quad (2)$$

It should be appreciated that the electric static Cone Penetration Test CPT can be performed based on the standard (No. JGS1435-1995) defined by

SHADANHOJIN JIBANKOUGAKUKAI (JGS: The Japanese Geotechnical Society), the symbol q_T indicates the point resistance obtained by the electric static Cone Penetration Test CPT, while σ_{VO} is the full overburden stress in the ground penetration depth of the electric static cone.

Moreover, the evaluation method of clay ground of the present invention comprises the steps of; selecting a representative point in the construction area, obtaining the cone resistance $(q_T - \sigma_{VO})_{(0)}$ before driving a Sand Compaction Pile, by performing the electric static Cone Penetration Test CPT, at the same time, sampling undisturbed samples at the same point, performing a Direct Shear Test DST by the recompression method to all undisturbed samples (can be performed based on No. JGS0560-2000), obtaining an undrained shear strength $S_{u(B)}$ before driving the Sand Compaction Pile, determining the correlation of the undrained shear strength $S_{u(B)}$ and the cone resistance $(q_T - \sigma_{VO})_{(0)}$ before driving, thereafter, performing the DST under the normally consolidated state with a representative undisturbed sample, obtaining an increment ratio of shear strength $(S_{un(DST)}/\sigma'_v)$ of the normally consolidated state, next driving a plurality of test Sand Compaction Piles in a way to surround the representative point, and, performing the CPT at a plurality of points after the consolidation, obtaining a cone resistance $(q_T - \sigma_{VO})_{(1)}$ after driving the Sand Compaction Pile, obtaining the undrained shear strength $S_{u(D)}$ by applying the correlation of the undrained shear strength $S_{u(B)}$ and the cone resistance $(q_T - \sigma_{VO})_{(0)}$ before driving to the relation of the undrained shear strength $S_{u(D)}$ after driving the Sand Compaction Pile and the cone resistance $(q_T - \sigma_{VO})_{(1)}$ after driving, and thereafter, calculating and evaluating the coefficient $K_{0(1)}$ of earth pressure at rest in the clay ground after driving the Sand Compaction Pile from a relational expression between the coefficient $K_{0(0)}$ of earth pressure at rest and a coefficient $K_{0(1)}$ of earth pressure at rest respectively before driving

and after driving the Sand Compaction Pile, the undrained shear strength $S_{u(D)}$, and $S_{un(DST)}/\sigma'_{vo}$:

$$\frac{1+2K_{0(1)}}{1+2K_{0(0)}} = \frac{S_{u(D)}}{(S_{un(DST)}/\sigma'_{vo}) \times \sigma'_{vo}} \quad (3)$$

Moreover, the method of the present invention consists in evaluating the coefficient of earth pressure at rest used for the aforementioned calculation after driving the Sand Compaction Pile as the coefficient of earth pressure at rest in the Sand Compaction Pile itself.

Furthermore, the method of the present invention consists in performing the electric static Cone Penetration Test CPT in the vicinity of the boundary between a plurality of Sand Compaction Piles and clay, determining the average of the plurality of cone resistance $(q_T - \sigma_{vo})_{(1)}$ obtained and evaluating as a coefficient of earth pressure at rest obtained according to the method of present invention.

BRIEF DESCRIPTION OF THE DRAWINGS:

Fig. 1 illustrates CPT test execution positions before driving and after driving four piles in an embodiment for evaluating the increment of a coefficient K_0 of earth pressure at rest in a sand ground due to a pile or a SCP driving according to the method of the present invention;

Fig. 2 is a diagram showing the point resistance by the CPT before and after driving piles in the embodiment of Fig. 1;

Fig. 3 is a flow chart showing procedures of the evaluation method in the embodiment of Fig. 1;

Fig. 4 is a relational diagram of cone resistance $(q_T - \sigma_{vo})_{(0)}$ and undrained shear strength $S_{un(DST)}$ according to the CPT obtained from clay at two locations in another an embodiment for evaluating the increment of a

coefficient K_0 of earth pressure at rest in a clay ground due to SCP driving according to the method of the present invention;

Fig. 5 illustrates CPT test execution positions before driving and after driving four SPCs in an embodiment for evaluating the increment of a coefficient K_0 of earth pressure at rest in a clay ground due to SCP driving according to the method of the present invention;

Fig. 6 is a flow chart showing procedures of the evaluation method in the embodiment of Fig. 5;

Fig. 7A is a diagram showing the increment ratio of clay shear strength due to the increase of a coefficient K_0 of earth pressure at rest in the ground by the replacement ratio of the composite ground wherein SCPs are driven; and

Fig. 7B is a diagram showing the increment ratio of sand shear strength due to the increase of a coefficient K_0 of earth pressure at rest in the ground by the replacement ratio of the composite ground wherein SCPs are driven.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Now, embodiments where the evaluation method of a coefficient of earth pressure at rest in a pile or a Sand Compaction Pile driving ground of the present invention shall be described referring to drawings, and terms to be used in the following description, symbols and brief explanation thereof are compiled in the following Table.

Tabl 1

Terms	Symbol	Brief Explanation
electric static Cone Penetration Test	CPT	measurement of point resistance, skin friction and excess pore water pressure
Direct Shear Test	DST	measurement of undrained shear stress
coefficient of earth pressure at rest	$K_{a(0)}$	before pile or SCP driving
coefficient of earth pressure at rest	$K_{a(1)}$	after pile or SCP driving
point resistance of CPT	$(q_T - \sigma'_{v0})_{(0)}$	before pile or SCP driving
point resistance of CPT	$(q_T - \sigma'_{v0})_{(1)}$	after pile or SCP driving
Internal friction angle	$\phi_{(0)}$	before pile or SCP driving
Internal friction angle	$\phi_{(1)}$	after pile or SCP driving
undrained shear strength	$S_{u(B)}$	before SCP driving
undrained shear strength	$S_{u(D)}$	after consolidating by SCP driving
effective vertical stress	σ'_v	
effective overburden stress	σ'_{v0}	$= \gamma z$ (z is Depth, γ is unit weight of ground)
increment ratio of shear strength of normally consolidated state	(S_{un}/σ'_v)	(S_{un}/σ'_v) is value obtained by DST
Sand Compaction Pile	SCP	
SCP replacement ratio	a_s	SCP replacement ratio for a composite ground

There, procedures for investigation and evaluation method to obtain the increment of a coefficient K_0 of earth pressure at rest for a sand ground wherein a pile or SCP is driven concerning the evaluation method of the increment of a coefficient K_0 of earth pressure at rest for the sand ground due to a pile or a SCP driving in one embodiment of the present invention shall be described, referring to Fig. 3 and, according to the flow of the following clause 1 to clause 5.

Starting from the evaluation operation of the coefficient $K_{0(1)}$ of earth pressure at rest after driving the pile or SCP of this embodiment;

1. A trial CPT is performed in the whole construction area, and the cone resistance $(q_T - \sigma_{vo})_{(0)}$ before pile driving and the soil profile are grasped. However, unnecessary in case where a sufficient soil investigation has been carried out preliminarily, and representative points of the whole construction area can be selected.

2. Representative points are selected (a plurality of points as necessary) based on the aforementioned investigation, and CPT is performed. At this moment, it is preferable to perform the CPT twice or more per point, and the execution state of this CPT is as shown in Fig. 1. $(q_T - \sigma_{vo})_{(0)}$ before driving a pile 1 or SCP can be obtained from this test.

3. After the execution of CPT, test piles or test SCP are driven in a way to surround the representative point. It should be appreciated that this embodiment shown in Fig. 1 is a case of driving in four piles 1 in a square arrangement; however, there could be a case of driving three piles in a triangular arrangement, or a case of driving five or more piles in a polygonal arrangement.

4. Next, CPT is performed at a plurality of points including the middle

portion between piles 1 or SCPs, or in the vicinity of piles 1 or SCPs. This test allows to obtain a cone resistance $(q_T - \sigma_{vo})_{(1)}$ after the driving. It should be appreciated in Fig 2 that an example of measurements of the cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving and the cone resistance $(q_T - \sigma_{vo})_{(1)}$ after driving for respective driving depths.

5. The coefficient $K_{0(1)}$ of earth pressure at rest is calculated from the cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving and the cone resistance $(q_T - \sigma_{vo})_{(1)}$ after driving by the expression (1). Nevertheless, in general, it is often supposed that $K_{0(0)} = 0.4$.

$$\frac{1+2K_{0(1)}}{1+2K_{0(0)}} = \frac{(q_T - \sigma_{vo})_{(1)}}{(q_T - \sigma_{vo})_{(0)}} \times \frac{\tan \phi_{(0)}}{\tan \phi_{(1)}} \quad (1)$$

In practice, ϕ increment may be included in the increment of a coefficient K_0 of earth pressure at rest, and simplified as the expression (2).

$$\frac{1+2K_{0(1)}}{1+2K_{0(0)}} = \frac{(q_T - \sigma_{vo})_{(1)}}{(q_T - \sigma_{vo})_{(0)}} \quad (2)$$

It should be appreciated that the CPT shall be carried out at such a velocity that the excess pore water pressure be 0 during the penetration for a ground of low draining rate such as silty sand or clayey sand, regardless of the standard penetration speed (1 to 2 cm/s) indicated in JGS1435-1995 "Electric Static Cone Penetration Test Method".

As a concrete example of application of the coefficient $K_{0(1)}$ of earth pressure at rest after driving obtained by the aforementioned evaluation, the calculation of pile skin friction by the following expression can be cited.

$$\tau = \sigma'_{vo} \tan \phi_{(1)} K_{0(1)}$$

Next, procedures for investigation and evaluation method to obtain the increment of a coefficient K_0 of earth pressure at rest for a clay wherein a SCP is driven concerning the evaluation method of the increment of a coefficient K_0

of earth pressure at rest for the clay ground due to SCP driving in another embodiment of the present invention shall be described, referring to Fig. 6 and, according to the flow of the following clause 1 to clause 6.

1. CPT is performed in the whole construction area, and the cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving and the soil profile are grasped. However, they are unnecessary in case where a sufficient soil investigation has been carried out preliminarily, and representative points of the whole construction area can be instituted.

2. The CPT is performed by selecting representative points (a plurality of points as necessary) based on the aforementioned investigation. The cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving a SCP 2 is obtained from this test.

3. At the same time, undisturbed samples are collected at the same point, and a Direct Shear Test DST is performed by the recompression method to all undisturbed samples, to obtain an undrained shear strength $S_{u(B)}$. Then, the correlation of the cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving and the undrained shear strength $S_{u(B)}$ is determined. Supposing the obtained correlation coefficient as k , the following expression (4) can be obtained.

$$S_{u(B)} = \frac{1}{k} (q_T - \sigma_{vo})_{(0)} \quad (4)$$

It should be appreciated that the recompression method consists in performing the test after consolidating the sample with the in-situ full overburden stress. The relation of the cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving and the undrained shear strength $S_{u(B)}$ obtained from clay of two points is shown in Fig. 4. Normally, a satisfactory correlation as shown in the drawing is observed between them.

4. A DST under the normally consolidated state is performed with a

representative undisturbed sample to obtain $(S_{u(B)(DST)} / \sigma'_v)$.

5. Test SCPs 2 are driven in a way to surround the representative point. It should be appreciated that this embodiment shown in Fig. 5 is a case of driving four piles; however, there could be a case of driving three piles in a triangular arrangement, or a case of driving five or more piles in a polygonal arrangement. After completion of consolidation by driving, the CPT is performed at a plurality of points as shown in Fig. 5. This test allows to obtain a cone resistance $(q_T - \sigma_{vo})_{(1)}$ after the driving. The undrained shear strength $S_{u(D)}$ is determined by the expression (5) using the average cone resistance $(q_T - \sigma_{vo})_{(1)}$ after driving and k obtained by the expression (4).

$$S_{u(D)} = \frac{1}{k} (q_T - \sigma_{vo})_{(1)} \quad (5)$$

6. The coefficient $K_{0(1)}$ of earth pressure at rest is calculated by the expression (3), using the undrained shear strength $S_{u(D)}$. Nevertheless, it is often supposed that $K_{0(0)} = 0.5$.

$$\frac{1 + 2K_{0(1)}}{1 + 2K_{0(0)}} = \frac{S_{u(D)}}{(S_{un(DST)} / \sigma'_v) \times \sigma'_{vo}} \quad (3)$$

As a concrete example of application of the coefficient $K_{0(1)}$ of earth pressure at rest obtained by the aforementioned evaluation method, the calculation of clay ground shear strength $S_{u(M)}$ taking into consideration the strength increment due to filling to be executed after driving SCP by the following expression can be cited. It should be appreciated that $\Delta \sigma_v$ is a load increased by filling.

$$S_{u(M)} = (S_{un(DST)} / \sigma'_v) \times \sigma'_{vo} (1 + 2K_{0(1)}) / (1 + 2K_{0(0)}) + (S_{un(DST)} / \sigma'_v) \times \Delta \sigma_v$$

Furthermore, the evaluation method of the coefficient K_0 of earth pressure at rest in the Sand Compaction Pile SCP itself is to be described, in a composite ground composed of Sand Compaction Pile SCP and clay, the

evaluation of the coefficient K_0 of earth pressure at rest in the SCP itself also becomes important. The horizontal stress developed by the SCP driving is high at the SCP center as shown in Fig. 5, and decreases toward the clay ground. The following two methods are to be shown as the evaluation method of the coefficient K_0 of earth pressure at rest in SCP itself. Which to adopt will be left to the designer's judgment.

A) The coefficient $K_{0(1)}$ of earth pressure at rest in clay obtained from the expression (5) shall be considered as a coefficient K_0 of earth pressure at rest in the SCP itself.

B) The CPT shall be carried out in the vicinity of the boundary of the SCP and clay (No.1' to No.4' in Fig. 5). The average cone resistance $(q_T - \sigma_{vo})_{(1)}$ after driving is determined, and the coefficient $K_{0(1)}$ of earth pressure at rest obtained from the expression (4) and expression (5) shall be taken as a coefficient K_0 of earth pressure at rest in the SCP itself.

As mentioned hereinabove, the evaluation method of a coefficient of earth pressure at rest in a pile or a Sand Compaction Pile driving ground of the present invention consists in testing the state before driving a test pile 1 or Sand Compaction Pile SCP2 in a ground of an actual site by a predetermined test method, thereafter, the state after driving the test pile 1 or Sand Compaction Pile SCP2 by a similar test method, and intending to evaluate the coefficient $K_{0(0)}$ of earth pressure at rest and a coefficient $K_{0(1)}$ of earth pressure at rest, from these before driving and after driving results, characterized by that, in case of evaluating increment of a coefficient K_0 of earth pressure at rest in a sand ground as the embodiment shown in Fig. 3, it is evaluated by performing the test comprising only the electric static Cone Penetration Test CPT, while, in case of evaluating increment of a coefficient K_0 of earth pressure at rest in a clay ground as the embodiment shown in Fig. 6, it is evaluated by performing

two tests of the electric static Cone Penetration Test CPT and a Direct Shear Test DST.

According to the evaluation method of a coefficient of earth pressure at rest in a pile or a Sand Compaction Pile driving ground of the present invention described hereinabove, the coefficient of earth pressure at rest in a ground due to the driving of a pile or a Sand Compaction Pile can be evaluated appropriately, and applied conveniently and simply to the designing, the cost down of related works can be achieved, and the economy of works can be enhanced.

CLAIMS

1. An evaluation method of a coefficient of earth pressure at rest in a pile or a Sand Compaction Pile driving ground, comprising the steps of; selecting a representative point in an construction area, obtaining a cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving the pile or the Sand Compaction Pile, performing an electric static Cone Penetration Test CPT, driving a plurality of test piles or test Sand Compaction Piles in a way to surround said representative point after the practice of said CPT, then performing the CPT at a plurality of points at the middle between said piles or Sand Compaction Piles or in the vicinity of the piles or Sand Compaction Piles for obtaining a cone resistance $(q_T - \sigma_{vo})_{(1)}$ after driving the pile or the Sand Compaction Pile, and thereafter, calculating and evaluating a coefficient $K_{0(1)}$ of earth pressure at rest in the sand ground after driving the pile or the Sand Compaction Pile from a relational expression between cone resistances $(q_T - \sigma_{vo})_{(0)}$ and $(q_T - \sigma_{vo})_{(1)}$ before and after driving said pile or Sand Compaction Pile and a coefficient of $K_{0(0)}$ earth pressure at rest before driving the pile or the Sand Compaction Pile and the coefficient $K_{0(1)}$ of earth pressure at rest after driving the pile or the Sand Compaction Pile :

$$\frac{1+2K_{0(1)}}{1+2K_{0(0)}} = \frac{(q_T - \sigma_{vo})_{(1)}}{(q_T - \sigma_{vo})_{(0)}} \times \frac{\tan \phi_{(0)}}{\tan \phi_{(1)}} \quad (1)$$

or

$$\frac{1+2K_{0(1)}}{1+2K_{0(0)}} = \frac{(q_T - \sigma_{vo})_{(1)}}{(q_T - \sigma_{vo})_{(0)}} \quad (2)$$

2. An evaluation method of a coefficient of earth pressure at rest in a Sand Compaction Pile driving ground, comprising the steps of; selecting a representative point in the construction area, obtaining a cone resistance $(q_T - \sigma_{vo})_{(0)}$ before driving the Sand Compaction Pile, by performing the electric

static Cone Penetration Test CPT, at the same time, sampling undisturbed samples at the same point, performing a Direct Shear Test DST by a recompression method to all undisturbed samples, obtaining an undrained shear strength $S_{u(B)}$ before driving the Sand Compaction Pile, determining a correlation of the undrained shear strength $S_{u(B)}$ and the cone resistance $(q_T - \sigma_{VO})_{(0)}$ before driving, thereafter, performing the DST under the normally consolidated state with a representative undisturbed sample, obtaining an increment ratio of shear strength $(S_{un(DST)}/\sigma'_v)$ of the normally consolidated state, next, driving a plurality of test Sand Compaction Piles in a way to surround the representative point, performing the CPT at a plurality of points after the consolidation, obtaining a cone resistance $(q_T - \sigma_{VO})_{(1)}$ after driving the Sand Compaction Pile, obtaining the undrained shear strength $S_{u(D)}$ by applying the correlation of the undrained shear strength $S_{u(B)}$ and the cone resistance $(q_T - \sigma_{VO})_{(0)}$ before driving to the relation of the undrained shear strength $S_{u(D)}$ after driving the Sand Compaction Pile and the cone resistance $(q_T - \sigma_{VO})_{(1)}$ after driving, and thereafter, calculating and evaluating the coefficient $K_{0(1)}$ of earth pressure at rest in the clay ground after driving the Sand Compaction Pile from a relational expression between the coefficient $K_{0(0)}$ of earth pressure at rest and the coefficient $K_{0(1)}$ of earth pressure at rest respectively before driving and after driving the Sand Compaction Pile, and the undrained shear strength $S_{u(D)}$, and $S_{un(DST)}/\sigma'_v$:

$$\frac{1 + 2K_{0(1)}}{1 + 2K_{0(0)}} = \frac{S_{u(D)}}{(S_{un(DST)}/\sigma'_v) \times \sigma'_{vo}} \quad (3)$$

3. An evaluation method of a coefficient of earth pressure at rest in a Sand Compaction Pile itself of a Sand Compaction Pile driving ground, wherein the coefficient of earth pressure at rest according to claim 2 calculated after said driving of Sand Compaction Pile is evaluated as the coefficient of earth

pressure at rest in the Sand Compaction Pile itself.

4. An evaluation method of a coefficient of earth pressure at rest in a Sand Compaction Pile itself of a Sand Compaction Pile driving ground, comprising the steps of; performing an electric static Cone Penetration Test CPT in the vicinity of a boundary between a plurality of Sand Compaction Piles and clay, determining an average value of a plurality of cone resistances $(q_T - \sigma_{vo})_{(1)}$ after driving obtained and evaluating the coefficient of earth pressure at rest to be obtained according to the method of claim 2 or 3 as a coefficient of earth pressure at rest in the Sand Compaction Pile itself.