Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte

Band: 55 (1987)

Artikel: Quality control of in-situ concrete spread pile

Autor: Miyamura, Atsunori

DOI: https://doi.org/10.5169/seals-42776

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. Mehr erfahren

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. En savoir plus

Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. Find out more

Download PDF: 21.11.2025

ETH-Bibliothek Zürich, E-Periodica, https://www.e-periodica.ch



Quality Control of In-Situ Concrete Spread Pile

Contrôle de la qualité de pieux forés en béton

Qualitätskontrolle bei Ortsbetonpfählen mit Pfahlkopverbreiterung

Atsunori MIYAMURA Associate Professor Meijo University Nagoya, Japan



Atsunori Miyamura, born in 1937, received his Doctor's degree in 1971 from Kyoto University, spent twenty years working on structural ingineering including foundation engineering with consulting firms.

SUMMARY

The present paper deals with the realization of the geometric management of in-situ concrete spread piles. Such spread piles are constructed under strict quality control of their geometrical shape and concrete strength. The field experiments on several spread piles show good results of quality control on their geometric shape especially of pull-out test concrete piles.

RÉSUMÉ

Ce rapport expose la réalisation du contrôle géométrique des pieux forés en béton. Ces pieux forés sont exécutés sous contrôle strict de la forme géométrique et de la résistance du béton. Les essais in-situ de quelques pieux forés montrent de bons résultats de la qualité contrôlée, spécialement pour la forme géométrique et les essais d'extraction.

ZUSAMMENFASSUNG

Im Beitrag wird gezeigt, wie die Kontrolle der Geometrie und der Abmessungen bei Ortsbetonpfählen mit Pfahlkopfverbreiterung erfolgt. Die strikten Qualitätskontrollen umfassen auch die Betonqualität. Die Feldversuche zeigen die Effizienz der durchgeführten Qualitätskontrollen.

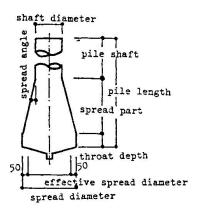


1. INTRODUCTION

Since the mid-sixties buildings have become larger in the size and number with development of construction technology against earthquakes and soft soil layers as alluvium in Japan. This demands the development of more sophisticated foundation. Since the ramming piling provides noise and vibration to surroundings, the earth augering piling including the in-situ concrete pile are applied especially in the urban dense area. The vertical strength formula of piles is recommended by AIJ as,

$$R_a = \frac{1}{3} R_u - W, \qquad R_u = R_p + R_f$$

where R_a means the permissible vertical strength of pile for the long term, $\ensuremath{\mathtt{R}}_u$, the ultimate supporting strength, $\ensuremath{\mathtt{R}}_p$, the bearing capacity, R_f ,the friction resistance, and W, weight of pile, respectively. This formula can provide the larger strength the more the tip area of pile becomes large. Thus, economically it is better to spread the tip of pile as the in-situ spread concrete one. The present paper deals with the realization of the geometric control on concrete figure of in-situ spread pile. The Fig.1 Spread pile construction of in-situ spread pile can be



accomplished by augering machine and versatile technique under strict quality control. After confirmation of boring hole geometry by the ultrasonic measuring device the concrete placing can be made under the standardized working chart. By the field experiments with measurement of concrete piles mechanical properties of material tests the present management method is appropriately realised.

2. IN-SITU SPREAD CONCRETE PILE

The present spread piling system consists of the cutting bit, stabilizer, drill pipe, swivel joint, rotary table and power unit. The construction process is divided into the two the pile augering of shaft and spread part as the formwork, and the concrete placing. The pile shaft augering are made by such as an earth drilling or reverse circulation with stability mud The following discussion concentrates on the spread water. augering and concrete placing. After the shaft augering the spreading machine, which has hydraulic drilling cutters, is inserted in the bottom of bored shaft. Fig. 1 shows details of spread part, which provides the concrete figure with the important geometries of spread angle, concentricity and throat Furthermore, the centering, verticality and the slime treatment are necessary for the appropriate piling foundation. The present spread piling has the spread ratio r=A/Ao less 3.20, due to the maximum expected soil strength $f=250t/cm^2$ the concrete permissive stress $s\!=\!800t/_{cm}2$, where A means the spread area, Ao, the shaft area, respectively. The range of spreading possesses shaft diameters, 1,200 to 1,600mm with effective spread diameters, 1,500 to 2,300mm, reduced 50mm from



actual augering diameter, The spread augering has the following three processes:

Shaft vertical augering---after shaft augering at depth 300 to 500mm upon the spread bottom to make vertical extension augering by the spread machine.

Spread augering——to make spread augering against shaft hole by the spread cutter with hydraulic cylinders. Spread completion probe device can predict the augering level corresponding to the prescribed spread angle and pressure gauge level on the rotary table with the standard throat depth, D=300mm.

Spread extension augering---necessary under the extended state of spread cutters when D needs larger than 300mm. The ring soil on the bottom is extracted by the trimming augering.

Since the above three processes provide necessary concrete figure, mud water exchange and a suction pump can extract remaining soil with bit racing. This corresponds to the primary slime treatment. Then an ultrasonic measuring device provides shaft and spread figures. When this geometry becomes proper within the prescribed errors, reinforcement basket is inserted and the secondary slime treatment is made by air lift or suction through a tremie pipe. Then concrete placing is implemented.

Since each augering process and concrete placing become invisible, it is necessary to develop the refined geometric control techniques on the following items closely correlated each other.

Stability mud water---material, quality control

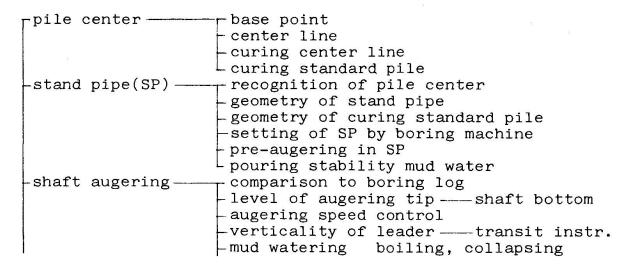
Spread augering---quality control, optimal slime treatment, figure measurement

Reinforcement basket---spacer

Concrete---coarse aggregate grading, proportioning, slump, air content, tremie pipe inserting, concrete placing, curing, surplus concrete-slime

3. GEOMETRIC CONTROL PROCESS

Analysis of work processes on the disordered construction site leads to the standardization of work units, whose combination can accomplish the geometric management of spread pile with the aid of the human engineering and AI techniques. Thus the following work units are obtainable from the observation of field works and the knowledge of field experts.





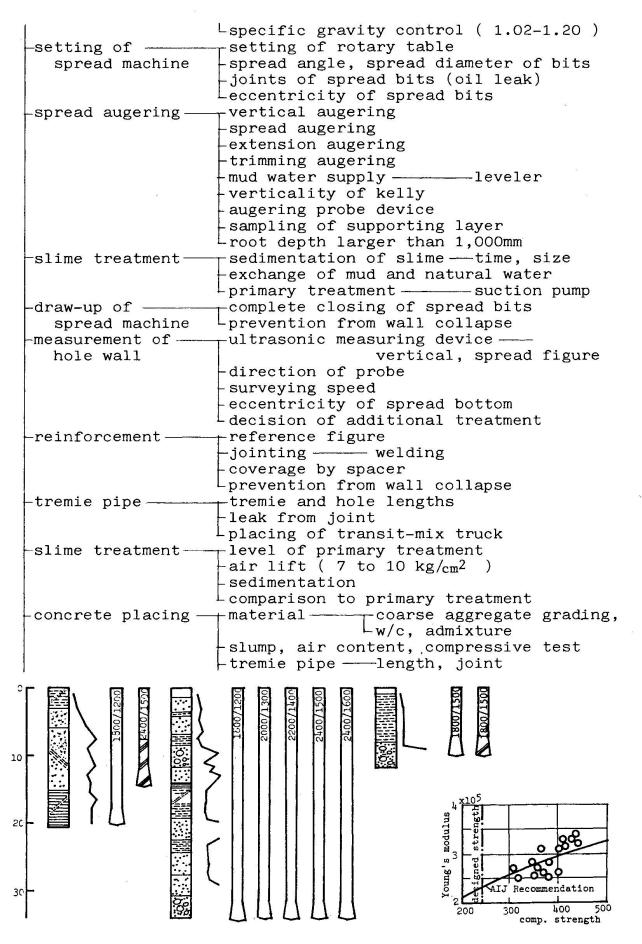
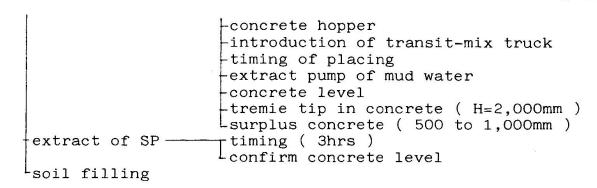


Fig.2 Field experiment

Fig.6 E-F relations





The above work units can be summarized in a form of check sheet, which is filled as the progress of field works. Thus the concrete geometry control can be completed.

4. FIELD EXPERIMENT

evaluate the present geometric management method nine in-situ augering including two concrete piles are carried out as in Fig. Three experimental sites are chosen; the rather uniform sandy layer for the preliminary augering, the relatively hard with successive sand and clay sublayers typical in alluvium, the supporting thick layer with coarse sand and gravel for actual concrete piling. Fig. 3 shows the figures of boring wall by the ultrasonic diameter measuring device in two directions the primary slime treatment. Various measurements these figures are summarized in Table, which provides proper evaluation to the prescribed verticality, spread angle and throat depth necessary for the geometric control. Material including compression strength and elastic modulus are made the boring cores from the concrete solid specimens. Fig. 4 shows histogram of compressive strength after four weeks providing the satisfactory strength and weak diversion not influenced mud water and soil. Fig. 5 illustrates the compressive strength along pile depth, which provides gradual increase of strength at the lower bottom of pile though sparsed relatively. This tendency results from the influence of concrete gravity. Fig. 6 shows the relationships between compressive strength and static elastic modulus resulting weak diversion. Furthermore, the bonding tests shows 2.25 times bonding stress in average to the permissible value.

5. CONCLUDING REMARKS

The typical alluvium in Japan distributes sometimes thick more than 40m with successive sand and clay sublayers, which demands construction of deep foundation such as an in-situ concrete spread pile necessarily with strict geometric management. Not only on the shaft but also on the spread part this geometric control becomes important because natural soil surface with mud film should be alternated by the ordinary wooden formwork. Hence it is more difficult to ensure the specified concrete figure. To control the geometry of spread pile from the ground level needs the proper implementation of centering of pile, verticality, concentricity of spread bottom and throat depth. This implies rigorous augering without any boring wall collapse, slime



maltreatment on the bottom and with the quality control of concrete placing. The present management method pursues their completeness through the standardized work units from the analysis of field job processes. According to this method satisfactory results can be obtained which are demonstrated by the field experiment on the geometry of spread pile and material tests.

6. ACKNOWLEDGMENT

The author expresses his deep gratitude to Mr. E. Ohyama, Mie Juhki-Unyu Ltd with his enthusiastic support of the present engineering development.

REFERENCES

- 1. K. FLEMING and E. H. STEGER, Large diameter pile foundations: Settlement considerations. Proc. of the Symposium on Large Bored Piles, ICE, Feb. 1966.
- 2. Z. J. SLIWINDKI and T. A. PHILPOT, Conditions for effective end bearing of bored, cast in situ piles. Proc. of Conference on Recent Developments in the Design and Construction of Piles ICE, March 1979

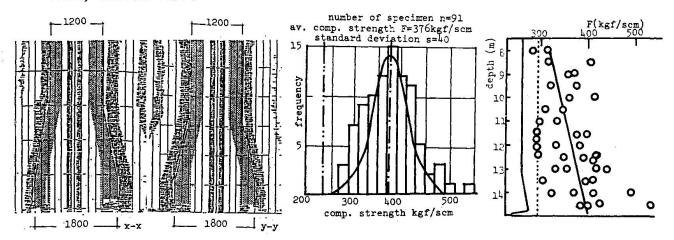


Fig.3 Ultrasonic measurement Fig.4 Histogram Fig.5 F-H relations

No	verticality		spread diameter			spread angle			throat depth			
	Х	Y	targt	X	Y	targt	X	Y	targ	t X	Y	
1	1/225	1/1:00	1800	1800	1820	9010'	9010'	90181	500	500	500	Ed
2	1/183	1/800	2400	2480	2500		12000'	12000'	700	730	710	Rv
3	1/650	1/1060	1800	1800	1800	9°10'	9001'	9005	500	560	500	Ed
4	1/1320	1/940	2000	2050	2050	12°00'	11°55'	12000'	300	400	480	Ac
5	1/450	1/2]00	2200	2250	2310	10000'	90561	9050'	300	350	330	Rv
6	1/650	1/440	2400	2470	2420	12000'	11048'	11055'	300	360	330	Ed
7	1/470	1/600	2400	2420	2450	12000'	-	11055'	300	360	330	Rv
8	1/530	1/155	1800	1800	1800	9 ⁰ 10'	9010'	9010'	300	300	300	Ed
9	1/870	1/400	1800	1800	1800	9010'	9010'	9010	300	300	300	Ed

Ed; earth drilling Rv; reverse circulation Ac; all casing