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Reports

IPA Press-in Seminar in Tokyo 2020

(2) TC3 "Expansion of Applicability and Assessment of Seismic Performance of PFS Method"

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1. Introduction

Annual IPA Press-in Seminar was held on November 30, 2020 and because of the COVID-19, this time of seminar was organized by online presentations. TC3 which is the title of "Technical Committee on Expansion of Application Conditions and Evaluation of Seismic Behavior of PFS (**P**artial **F**loating **S**heet pile) Method" was asked to organize one of the technical sessions in this seminar. The basic idea of TC3 session was the presentations of all WG (Working Group) and those are WG1: Field investigation, WG2: Laboratory test, WG3: Numerical analysis, WG4: Design and WG5: Overseas. At the beginning of this session, the contents of this session were introduced by the chair of TC3 in which the PFS method as shown in Fig. 1 which is one of the main topics was also introduced. And then, the presentations by the head of each WG were followed. In this report, those contents are summarized including the final conclusions although the activities of WG5 was briefly introduced in the presentation by the chair at the beginning of the session.

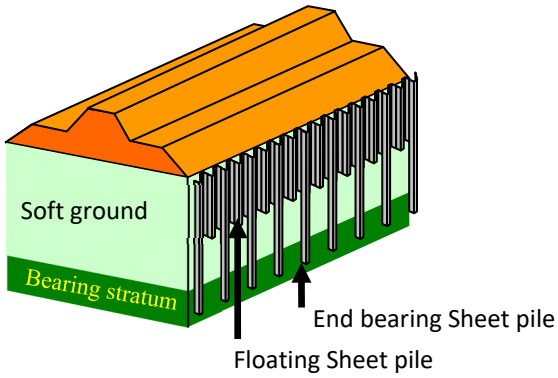


Fig. 1. PFS method

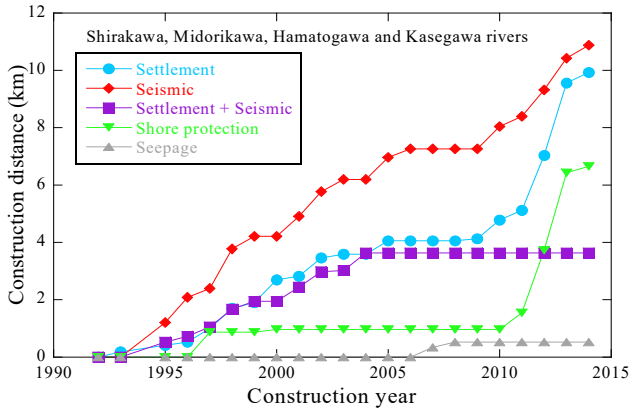


Fig. 2. Purpose of countermeasures

2. The contents of the presentations

(1) Field investigation WG (WG1) by Prof. Kasama of Tokyo Institute of Technology

In order to evaluate the effect of various steel sheet pile construction methods on the suppression of deformation during earthquakes, the settlement behavior of river embankments reinforced by steel sheet pile methods under the 2016 Kumamoto earthquake was summarized focusing on the type of steel sheet pile method, shape, location of countermeasures (inside and outside of the embankment), and combination of each method. In addition, quantitative analysis of the settlement of river embankments was carried out focusing on the liquefaction of the embankment and its foundation soil. Fig.2 shows total number of annual changes on the steel sheet pile methods in Kumamoto with the purposes of the countermeasures.

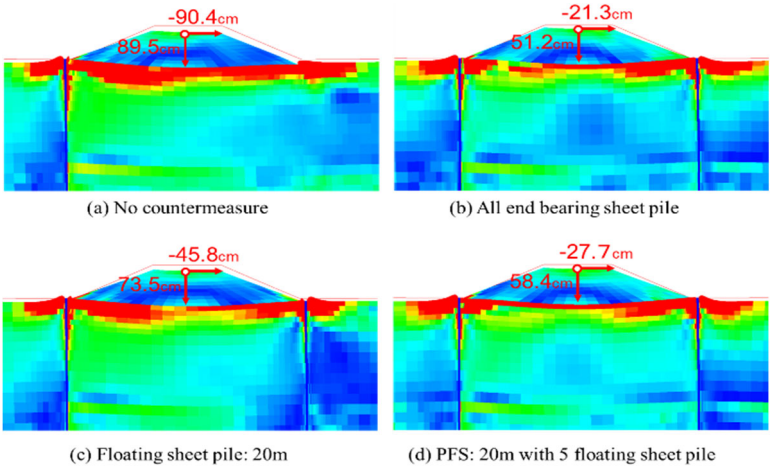
(2) Laboratory test WG (WG2) by Prof. Tobita of Kansai University

In order to investigate the seismic performance of PFS method, model shaking tests were conducted at a centrifuge. Target ground conditions were 1). clayey ground and 2). two layers of loosely packed saturated sand (upper part) and clay (lower part). Followings are the summary of those two cases:

1)Clayey soil: Although PFS sheet piles are less effective in preventing lateral flow than full-bottomed sheet piles because of their lower bending rigidity, they are as effective as full-bottomed sheet piles in reducing the settlement of the top of the embankment during excitation.
2)Two-layer ground: The lateral displacement of the sheet pile was reduced by about 30% by rooting the lower end of the floating part of the sheet pile into the clay layer.

(3) Numerical analysis WG (WG3) by Prof. Nakai of Nagoya University

Here, 2-D or 3-D finite element methods were used and the following points was verified numerically:
1) Verification of the effectiveness of the countermeasure for controlling lateral flow during embankment construction
2) Seismic performance verification at the time of an earthquake
Fig. 3 shows the shear strain distribution 10 years after the occurrence of the earthquake (enlarged display around the embankment) along with the amount of subsidence and horizontal displacement at the top of the embankment.



(a) No countermeasure (b) All end bearing sheet pile
(c) Floating sheet pile: 20m (d) PFS: 20m with 5 floating sheet pile

Fig. 3. Comparison of embankment deformation

Table 1. Table of contents for design manual

1. General remarks	
1.1	Objectives
1.2	Positioning of the construction method
1.3	Scope of application
1.4	About this manual
1.5	Related standards
1.6	Basic concept of PFS method
1.7	Investigation, design, and construction procedures
2. Site investigation	
2.1	Objectives
2.2	Contents and items
2.3	Planning
3 .Design	
3.1	Basic concept
3.2	Determination of applicability
3.3	Setting basic specifications
3.4	Consideration of earthquake
3.5	Consideration of countermeasures for surrounding ground
3.6	Sheet pile head treatment
4. Construction	
4.1	Installation of sheet pile
4.2	Construction procedure
4.3	Points to note for the use of water jet

(4) Design WG (WG4) by Prof. Nishioka of Chuo University

The PFS method is a close construction countermeasure method to suppress settlement of the surrounding ground where consolidation settlement is more dominant than horizontal displacement due to the presence of sandy ground on the surface layer in response to increased load. In the case that the sandy ground on the surface layer may liquefy, the countermeasure is necessary. As for the seismic reinforcement method using steel sheet piles for embankments on liquefied ground, design methods and development policies have been developed to some extent in each field under the condition that it is not PFS method (e.g. Soil Mechanics Laboratory Manual for river embankments). The mission of the WG4 was to revise the design manual so that it can be easily used for practical design of seismic reinforcement and construction in close proximity. In this presentation, the basic idea and flow chart of the revised design method was introduced. Table 1 shows the proposed design manual for the sheet pile method under earthquake.

(5) Conclusions by Dr. Taenaka of Nippon Steel Corporation

At the end of session, the activities by TC3 were concluded and the contents of all the presentations were summarized. The summaries of all presentations were listed as follows:
1) WG1: a) Survey on the actual situation of river bank reinforcement (regions and project results), b) Survey of bank subsidence after the Kumamoto Earthquake

2) WG2: a) Evaluation of seismic behavior of PFS method in clayey ground, b) Evaluation of seismic behavior of PFS method in liquefied layer ground

3) WG3: a) Investigation of the effect of lateral displacement during raising and its range of application, b) Proposal of 2D analysis model by comparison with 3D analysis, c) Confirmation of the seismic effect of the PFS method by comparing the methods of no countermeasures, floating, PFS, and end bearing.

4) WG4: a) Introduction of seismic design (liquefaction design) (*Ensure consistency with the 2016 Guide to Liquefaction Countermeasures for River Embankments), b) Provide information that contributes to technical judgment on the scope of application.

3. Conclusions

Steel sheet pile method had been used more temporally works but recently, the use as a permanent structure has been considered. At the same time, PFS method which was originally developed for the countermeasures of ground subsidence due to river embankment constructions. In addition to those, the effective installation method which is “Press-in technique” makes it enhanced. Those were the motivation of TC3. We hope that more wide variety of the use of steel sheet pile including the countermeasure on earthquake are increased from now on.

Reports

Technical assessment on the design and construction method for rotary press-in pile by Japan Society of Civil Engineers

Mitsuhiro Okada

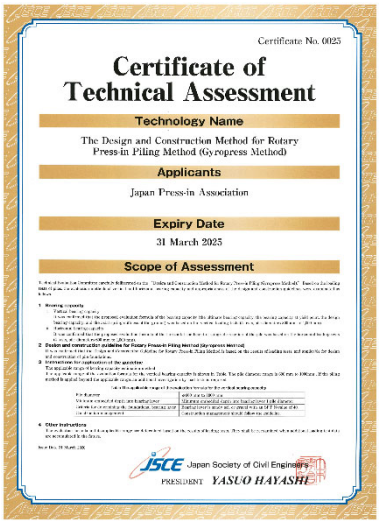
Engineer, Japan Press-in Association (JPA)

JPA has received a technical assessment for the rotary press-in piling method by the Japan Society of Civil Engineers (Japanese version in 2020, and English translated version in 2021).

The assessment was conducted by the Technical Evaluation Committee consisting of six experts, specializing in earthquakes, ports, roads, railroads, and piles (chair: Prof. M. Hamada). In this assessment, it was confirmed that the formula for calculating the bearing capacity of rotary press-in piles is on the safe side with respect to the results of the vertical and horizontal loading tests.

The rotary press-in piling method has been used in more than 400 projects in Japan, most of which were for building earth retaining walls. In the future, we would like to propose and expand the application of the piling method to construction projects that require vertical bearing capacity, such as foundations for roads and bridges.
Please contact us by e-mail for more information.

international@giken.com


Certificate No. 0023

Certificate of Technical Assessment

Technology Name

The Design and Construction Method for Rotary Press-in Piling Method (Gyropress Method)

Applicants

Japan Press-in Association

Expiry Date

31 March 2025

Scope of Assessment

JSCE Japan Society of Civil Engineers

PRESIDENT YASUO HAYASHI

Certificate by JSCE