张忠苗[1]，张乾青[1]，刘俊伟[1]，俞 峰[1,2]

(1. + , - ' # $ % & . / 0 1 2 $ 3 4 5 $ % 6 7 8 9 : ; < = > + , ? @ 310058 A 2. + , B % - ' C D % & ' E > + , ? @ 310018)

F G H % & ; I J K L M N O P Q R S T U V W X > Y Z L M N O P Q T U V [B \ ] ^ M N O P Q Q _ T U Q V [B \ ] ` F a b N b c d e f P Q V g h T U i j A k l m 0 n P Q o p q N r s c t u Q v w x i j y z { | } A ~ l f • P Q T U w x i j n m V [B ^ m 9 T U V Q o p Q [B A m T U Q v d V Q o p T [B A m T U - Q v n w x V Q o p b T > P Q [B > [B l V Q O W O V 60% A m T U Q 8 U > [B l O N o p Q [B ^ % & [B l C D ; c ~ - ` 13 mm ` > > n ^

F M N O P Q A T U A Q v w x A T A A

TU473.1 A 1000 4548(2010)06 0975 06

F (1961) > > + , > % ' > 6 > S > % & 3 Q . / 6 ' c % ^ E-mail: zjuzzm@163.com ^

Treatment of sloping prestressed pipe piles in soft soil

ZHANG Zhong-miao[1] > ZHANG Qian-qing[1] > LIU Jun-wei[1] > YU Feng[1>2]

1. MOE Key Laboratory of Soft Soils and Geoenvironment Engineering, Institute of Geotechnical Engineering, Zhejiang University, Hangzhou 310027, China; 2. School of Civil Engineering and Architecture, Zhejiang Sci-Tech University, Hangzhou 310018, China

Abstract: Based on an engineering example, the reason of sloping prestressed pipe piles (PPPs) and the treatment method for the sloping PPPs are given. First of all, the sloping condition of each pile should be made clearly, then the damaged position of each pile is found out using low strain dynamic tests, and finally, treatment measures are put forward. For the piles with serious deviation of pile tops and rupture of pile shafts, they must be replaced by bored piles. For the piles with smaller slope of pile tops and soundness of pile shafts, they can be directly used after rectification and righting. For the piles with larger deviation of pile tops and defect of pile shafts, the first step is rectification and righting, and then strengthening the pile shafts by placing reinforcement cage and pouring concrete in the cores of piles. The ultimate bearing capacity of the treated single pile accounts for 60% of the design capacity. For the piles with treatment because of serious shortage of bearing capacity, the bearing capacity should be strengthened by adding bored piles. The measured settlement of buildings is small and uniform, and the maximum settlement is only 13 mm, indicating that the treatment method achieves the desired results, and it can be used for reference.

Key words: prestressed pipe pile; deviation; pile shaft defect; rectification; concrete pouring; settlement

0

M N O P Q n Q O > ! " > % # $ S R % Q Q v d n & ' > (Q %) } * + , : > - L " . V / " N [1-4] ^ 0 > M N O P Q N 1 & 2 3 4 5 6 7 8 F 9 M N O P Q s O (Q : ; Q 1 & < R S = $ N > > % b (P Q R S ? > @ Q 8 J A B > Q _ : Q v R S (Q w x + 7 8 A C M N O P Q D E Q F G H I O J G K L } q > M $ 1 & N O P Q g / = : M $ R S T U M N O P Q R S V > Q U T W > Q v w x > X Q > U Q O I Y Z ^ [G H 1 $ \ ] ^ 18 _ _ C D V % & ; I > m M N O P Q V T W Q v w x + % & 7 8 V W X o p L J K > n m V ` a L [ B ^ b c d _ C D e f % g h U > ~ - d ` 13 mm > Y Z U ^ % &

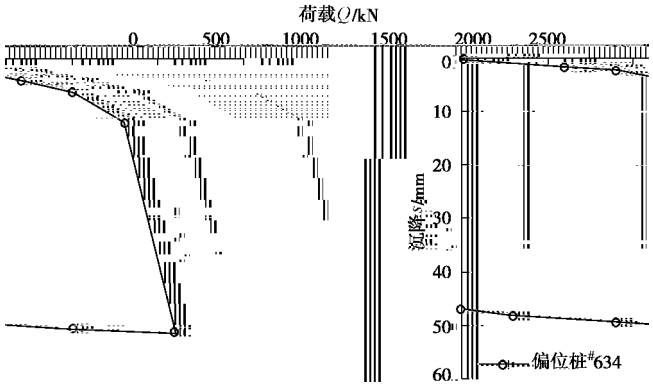
2008 12 22

1

Table 1 Physical and mechanical parameters of soil strata

_ i	$ _ j k	l } /m	w /%	γ /(kN m^{-3})	I_p	I_L	c /kPa	φ /(m)	E_s /MPa	q_{sk} /kPa	q_{pk} /kPa

a S ^ 8 J M N O P Q T U F y q N r s c B C
V Q v | } 4 5 3 ^ N \ \ ] ^ m 8 5 f T U y
[B V M N O P Q # 634 o p A ! < > 8 T U y [
B Q V A < G 4 E 2 ^

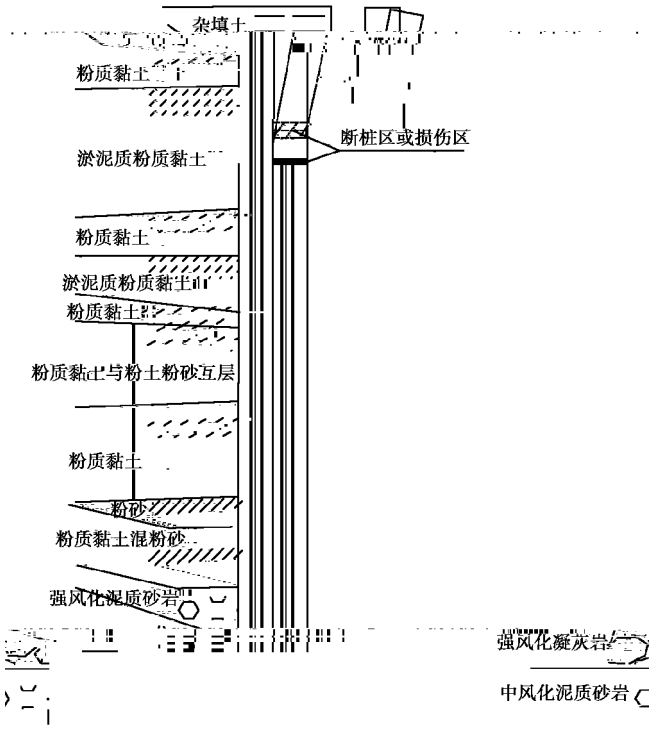


2

Fig. 2 Load-settlement curves of sloping PPS[illegible]

E 2 F G a >_ T U y [B M N O P Q # 634
D2
Q _ ! D 1800 kN ` 2000 kN

UuRSL h > > % OPhZSTU^
53 FGa>MNOPQ-8J>lh mhT
W> n>OhTW> OhTU)>%
QTUV 5 9 WX^
4 JM1& >DEM$R VM
$ _>>%M$R mMNOPQVST> 2o
>%MNOuw$PQVTU^

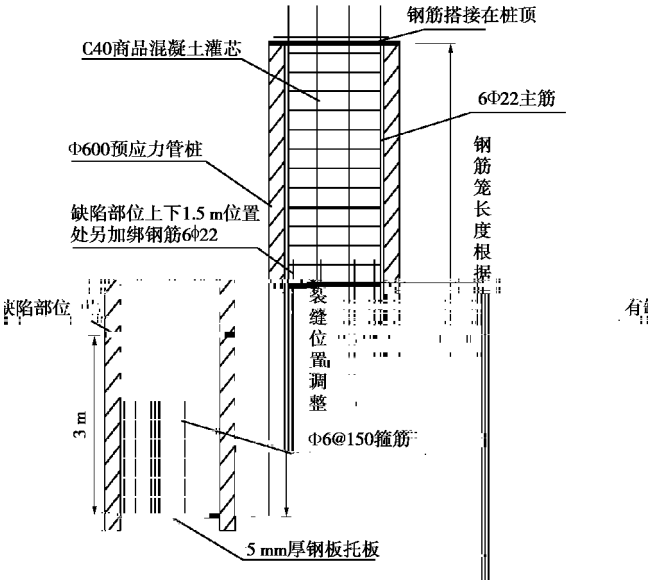


3

Fig. 3 Geological section and damaged position of PPPs

4 ! "
MNOPQQ_TU Qvwx Q[B\
5 F" F
5 FMVY_WFl>bcdefPQVQ
_TUij>~ aPQTUV+ EA
Fm0nPQopqNrsc>f Qv
wxijyz{8UA
Ff•TU wxij n m V[
B ^m 9TU VQop Q[BAmT
Ur1 Qv d VQop [BAm
ETU - QvnwxVQopb T >
PQ uw$ [BAm Q-h
0TUwx8J>DE[Bl O
t z Q[B JMV\"=Y_W
(MNOPQ % ^

TUwxQV D Ty L[B\] "^
1 ab \ zR PQTUV \>5
z > T ^
2 8i B XwxPQ V $y QV
z{PhF"4m[>kl P V
z{PhF"3m[> 6 22> N
U "1.5mV ! > "V
U "<3m[^ W B 5mmlV X>
_ } u Q_^
3 P xC40p uw$>U 3W
uw$P GH^ D4PQ %E4^

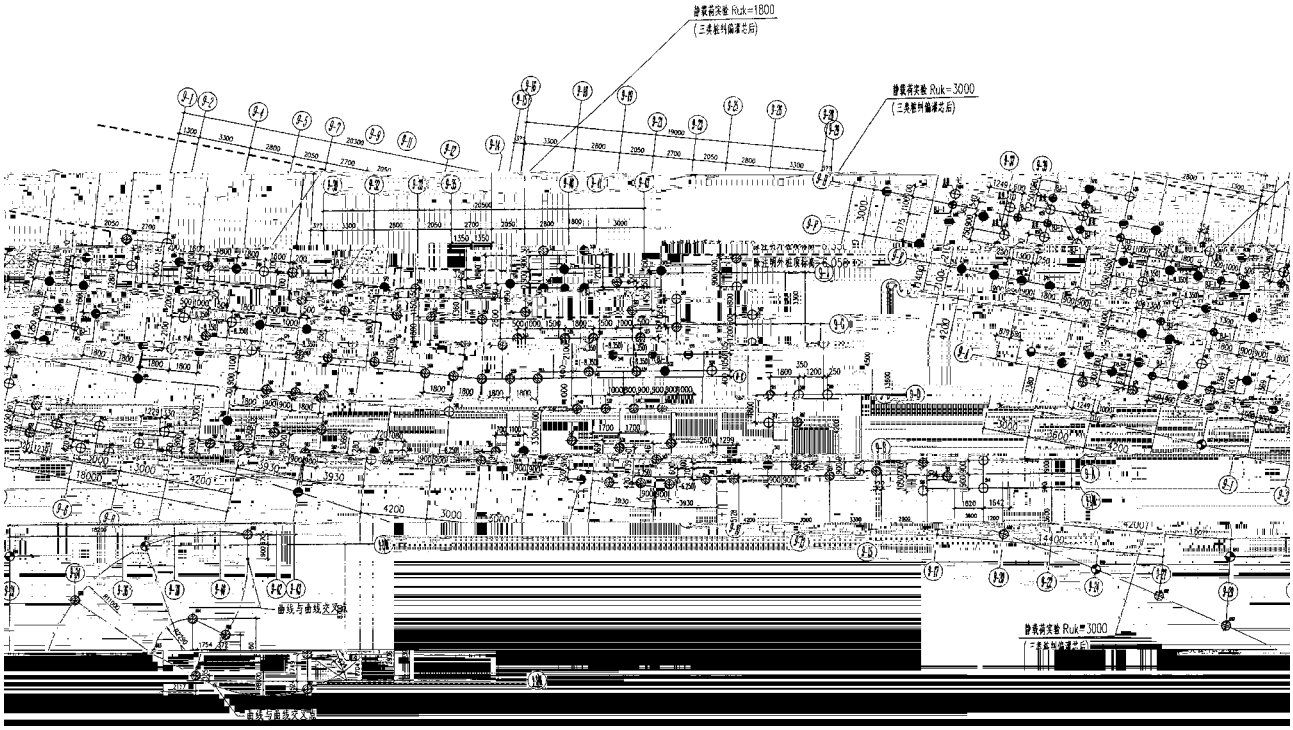


4 #$%&'

Fig. 4 Reinforcement of PPPs with concrete pouring treatment

mE Q TUQ[Bl IYZ OV>
z xQ Q[B^ %& 500z xQ
op Q>L Q15f>Q F10-2a_ v$r s
#`:O_> Q o;:O_ E1sQF>n
Q}43p44m> DQ}f•\ tu^
Q=> O,? 2000kN>Qv C25u
w$> 8 16 } > ` 8@150>
uw$ 7 1.10p1.30 ! ^QWuw
$; d 12%p15%VPEA xQ >
) -Q >=;QW >` O^E5
` Q TUQQUE>E :`TUQ>BJ-1Q
` Q^

5 (
m2fTU[BlVQ#565 #573opL
iA <>A <G 4E6 55^



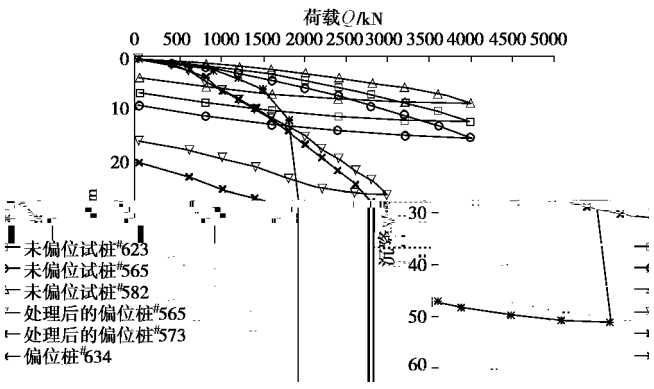
5 . . . . .

Fig. 5 Positions of sloping PPPs and substituted piles

5 . .

Table 5 Static load test results of sloping PPPs with treatment

Q |	Q } /m	Q F /mm	u w $ ~ |	• " /d	O /kN	! " d Q _ # $ r % /mm	& ' (/mm	/%
#565	42	600	C80	184	3000	26.30	15.88	39.62
#573	42	600	C80	195	3000	31.13	20.20	35.11



6 (. . . -

Fig. 6 Load-settlement curves of sloping PPPs with treatment

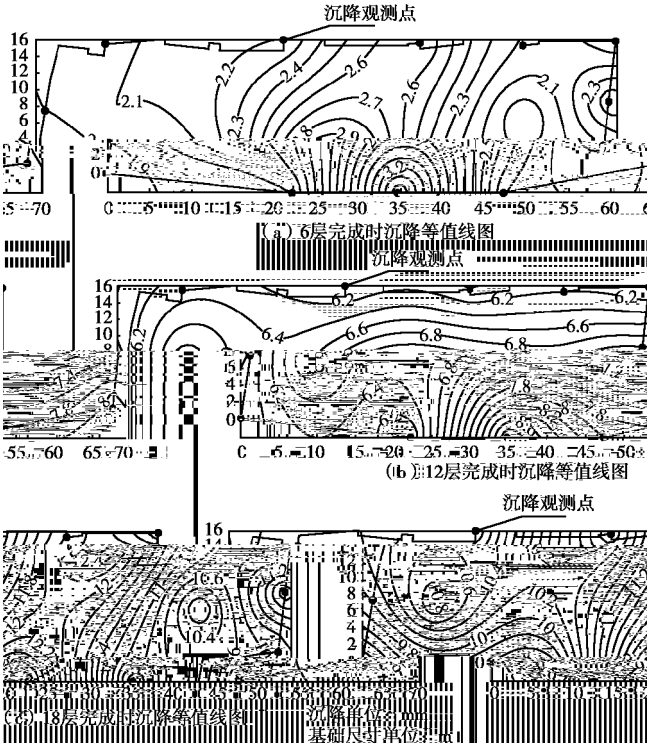
E 6 5 5 F G a > m T U - Q v n w x V Q o p b T > P Q u w $ [B l O < ` 3000 kN > ` W O 4000 kN V 75% ^ Ⅲ u T U Q [B l r % ` Ⅱ u Q > L [ B V b V ^ T U Q [ B N l > m l V Ⅲ u Q 8 n 6 f l V Ⅲ u Q y s c o p L q N r s O c ^ c G B C > 67 f Ⅲ u f [ B l r % ` Ⅱ u Q ^ ~ T U [B Q V g O W Q O V 60% \| o p Q ^ Q o p L N r s c > ' ; z x Q Q O > k l X % ^

6) * + , -

% & T U w x Q I \ ] o p [B l > - . o p L y D % ^ ` L d C D % 1 & V i j > C D L c : > 2007 ) 12 * - . 1 _ C > J c > e _ c > 2008 ) 10 * 18 _ C > % ` > - L - d V c 7 • ^ [d C D 6 _ 12 _ 18 _ % 0 n c : 7 • > 6 7 • % + E > E 7 0 C ^

+ E 7 F G a > d - . 6 _ % ~ - ` 3.5 mm > ~ ` 2.0 mm > ~ -

J ` 1.5 mm A 12 _ % > ~ - ` 9.0 mm > ~ ` 6.0 mm > ~ - J ` 3.0 mm A 18 _ % ~ - ` 13.0 mm > ~ ` 9.0 mm > ~ - J ` 4.0 mm ^ ; c B C d - . > ` > Y Z U > d C D P Q T U w x 1 T L y Q [B l V L M " b V ^



7 . / 0 1

Fig. 7 Contours of settlement

7 2

1 m 1 $ \ ] + , ^ 18 _ C D M N O P Q T U [B V J K 5 F

1 M N O P Q 1 $ \ ] (Q M $ % < R S Q _ T U Q v w x S > 8 W X 5 ` 8 $ J (Q = $ N $ G 3 l (Q m b (Q V = ; ; Q R V } m \ ; O J R S V = ; M $ % M $ R S T : T U m Q R S V Q g = ; Q R S T U w x V ^

2 % & A < 5 F T U w x y [B Q V O ` H Q V 45% A [ B T U w x Q V O < ` H Q V 75% ^ Q T U w x P Q O , ? ` H Q V 60% > Z 8 J z x Q [B > - h 0 T U 8 J 2 z x Q [B ^

3 T U Q V [B \ ] ^ 5 F M V Y _ W F l > b c d e f P Q V T U i j A F m 0 n P Q o p q N r s c > f Q v V w x i j y z { 8 U A F f • T U w x i j n m V [B ^ m 9 T U m E [T U Q > T U > 1000 mm V Q o p Q [B A m T U r 1 m E [T U Q > T U < 400 mm Q v d V Q o p [B A m E T U - m E [T U Q > 400 mm < T U < 1000 mm Q v n w x V Q o p b T > P Q u w $ [B A m Q - h 0 T U w x 8 J D E [B l O t Q [B ^

4 % & T U Q H [B l > ; c B C d C D 18 _ % ~ - ` 13.0 mm > ~ ` 9.0 mm > ~ - J ` 4.0 mm ^ C D 6 D > ` > Y Z U > d C D P Q T U 1 T L y Q [B l V L M " b V ^ % &) 1 $ \ ] _ C D M N O P Q T U [B V % * I ^

3

[1] . Q % & [M]. m : C D % a , 2007. (ZHANG Zhong-miao. Pile foundation engineering[M]. Beijing: China Architecture and Building Press, 2007. (in Chinese))

[2] ,