

Ultra Multi Grouting Method as a Countermeasure against Liquefaction



(1)

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LIQCA

NKK are developing a countermeasure against liquefaction for existing structures, combining following two new technologies : (1)“Multiple Permeation Grouting Method”, which is capable of grouting into multiple points in a sandy ground simultaneously ; and (2)Silica type grouting materials with durability and high permeability in sandy soils. This paper describes the test results of the grouting test using a large container, and presents the design method of tank foundation using a liquefaction analysis method, LIQCA.

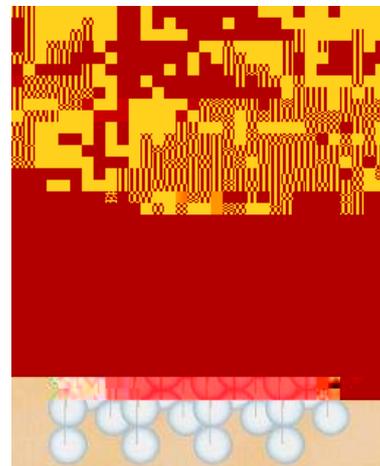
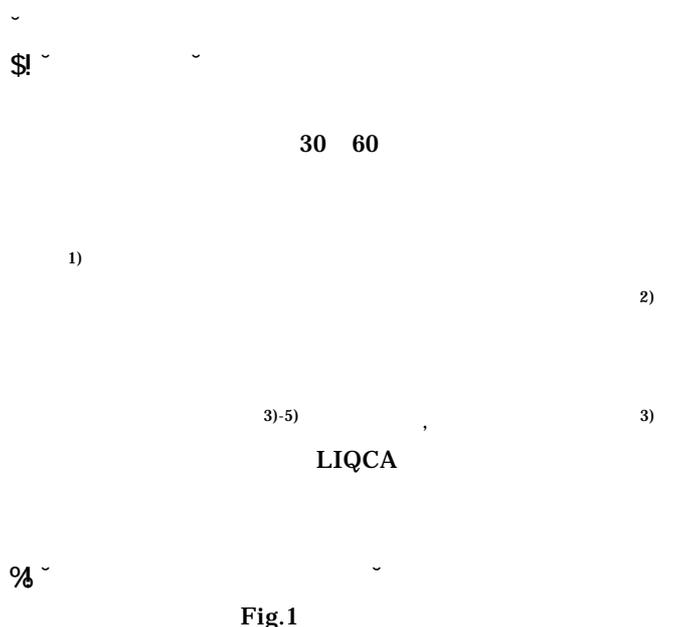


Fig.1 Conceptual configuration of the ultra multiple grouting method



Photo 1 Injection nozzle

& ~

5.0m 2.0m 2.5m
 1 6 3) 25cm
 Uc=2.44 Fc=6.25%
 D₅₀=0.32mm
 Dr 70.0%
 ASF 4)
 3 2
 500mm 24



Photo 2 Improved soil formed from grouting test using a large container

Photo 2

c=50kPa 74.3%
 74.0%
 Fig.2 7.5%

Fig.3 (a)
 (b) Fig.3 (b)

'! ~
'! \$

1G

2.5

5)
LIQCA⁶⁾

11)

2

'! %

10m

1m

40m

20m

25000kl

Table 1

6

3

(1)

(2)

(3)

Fig.4

(2)

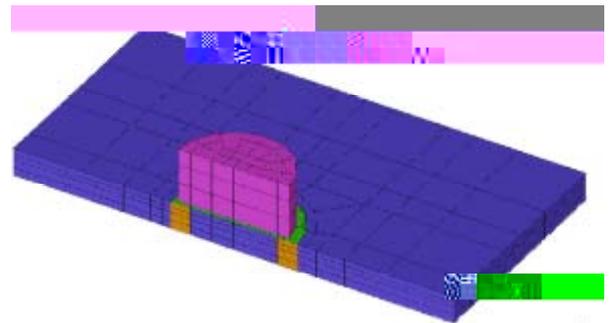


Table 1 Cases of 3D liquefaction analysis

(1)

31.4m, 46.0m

=1.4

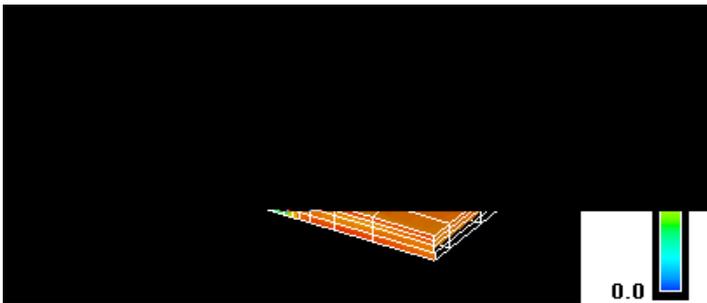


Fig.A (a), (b)

$$F_s z^{3D} = \frac{c_d \frac{R_{out}^2}{2} R_{in}^2 \tan \delta z W_{tank} W_{umg} z P_{umg} z}{P_{in} z P_{out} z} \dots\dots(1)$$

$P_{in}(z)$ $P_{out}(z)$

$W_{umg}(z)$

W_{tank}

$P_{umg}(z)$

C_d, δ

1) 34

. pp.1415-1416(1999).

2) ASF

(1999).

3) 44

pp.371-376(1999).

4) 4

Fig.A View of ring type improvement of tank foundation and forces acting on the improved soil after excitation