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Non-monotonic piezocone dissipation curves of backfills in a soil-bentonite slurry trench cutoff wall

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soil-bentonite slurry trench cutoff wall

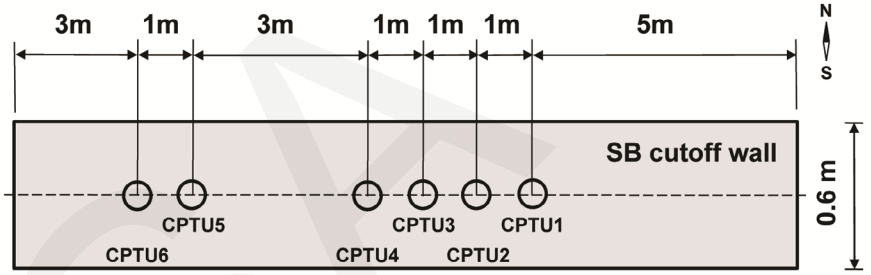
■ Construction of a soil-bentonite cutoff wall

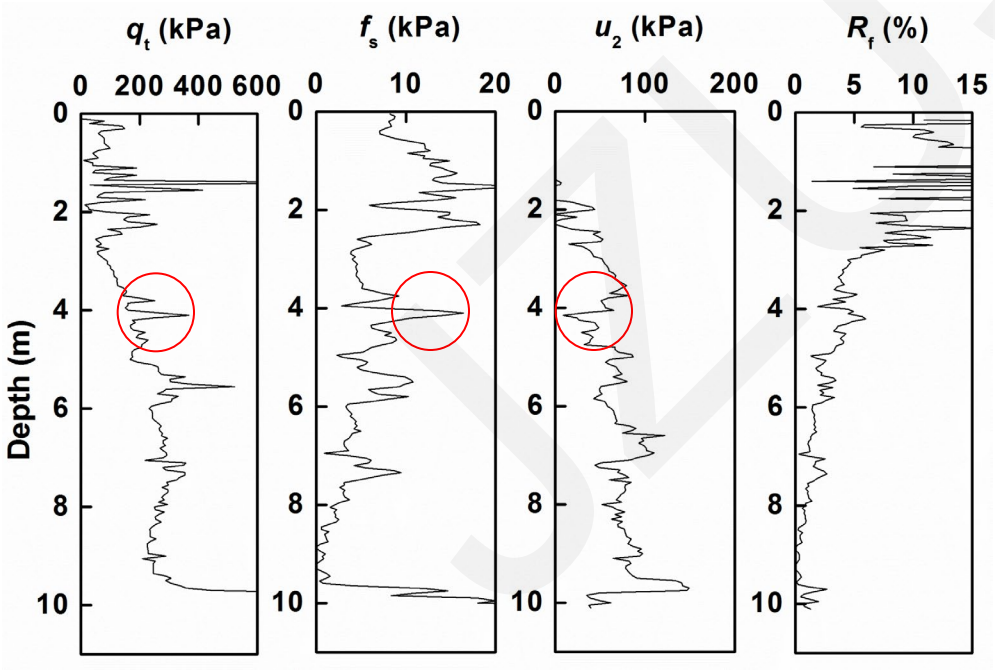


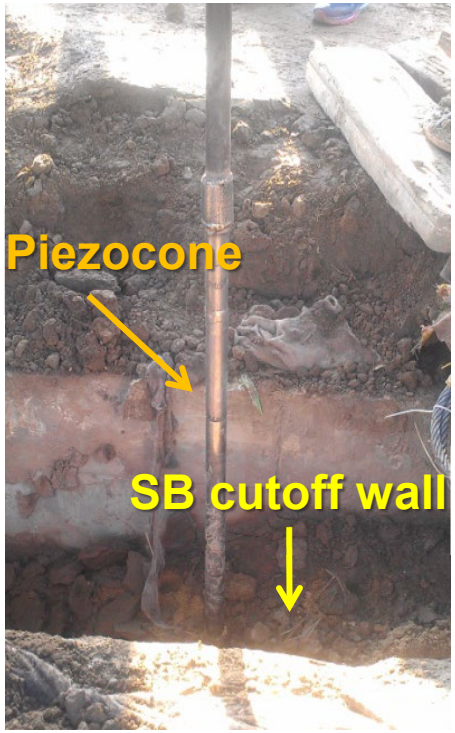
A soil-bentonite slurry trench cutoff wall with a length of 15 m, a width of 0.6 m and a depth of 10 m, was built in Jiangsu province in 2014.

CPTU Test

■ The peaks in the curves of q_t and f_s and the valleys in the curve of u_2 occur simultaneously.





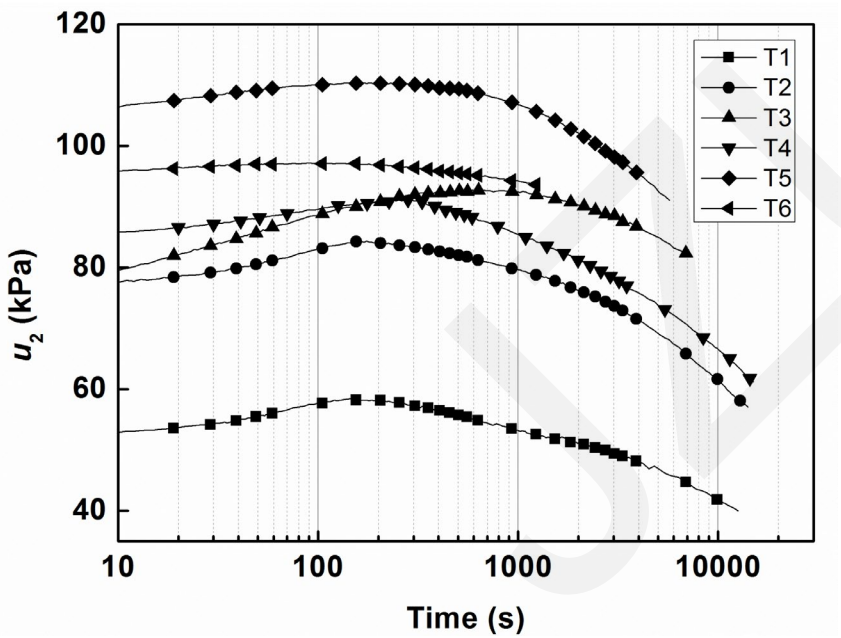


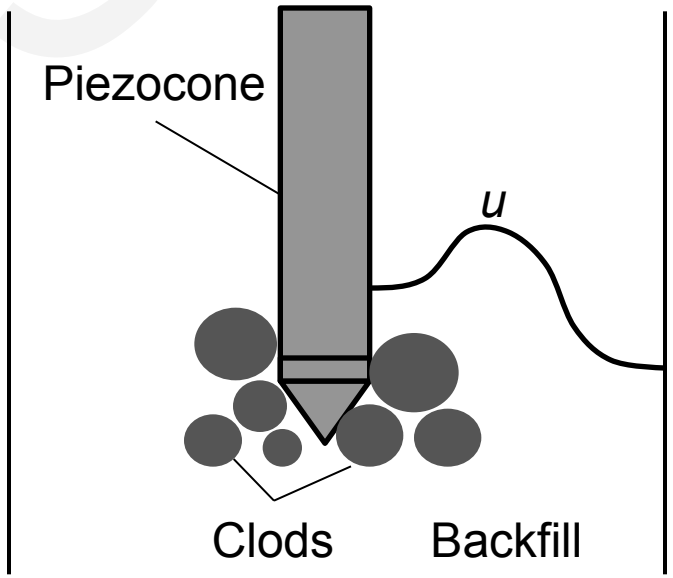
CPTU测试结果

CPTU Test

- Non-monotonic dissipation curves were obtained during the pore pressure dissipation tests in SB cutoff walls.

- The mechanism is explained as the redistribution of excess pore pressure (*u*) near the peizocone.

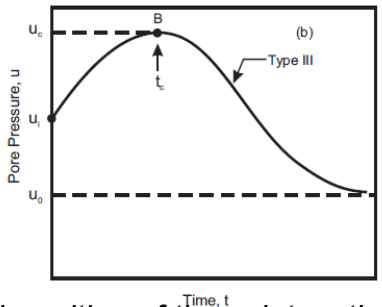




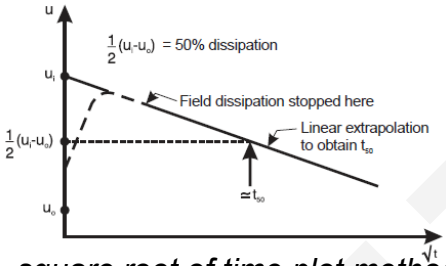
CPTU测试结果

Existing methods

t_{50c} ⇨ **c_h** ⇨ **k_h**



logarithm of time plot method



square root of time plot method

(Sully et al., 1999)

$$t_{50c} = \frac{t_{50}}{1+18.5\left(\frac{t_{u\max}}{t_{50}}\right)^{0.67}\left(\frac{I_r}{200}\right)^{0.3}},$$

(Chai et al., 2012)

$$c_h = \frac{T^* r^2 \sqrt{I_r}}{t_{50}},$$

(Teh and Houlsby, 1991)

$$c_h = \frac{r^2\left(r_p / r\right)^{1.25} T_{50}^*}{t_{50i}},$$

(Ha et al., 2014)

$$k_h = \frac{c_h \gamma_w}{E_s},$$

(Terzaghi et al., 1996)

$$k_h = \frac{\gamma_w}{2.3\sigma'_{v0}} R_R c_h,$$

(Baligh and Levadoux ,1980)

$$k_h = \left(251 t_{50}\right)^{-1.25},$$

(Parez and Fauriel, 1988)

$$k = \frac{1}{2.976\beta e^{0.076\beta}} \cdot \frac{K_D U r \gamma_w}{\sigma'_{v0}},$$

(Shen et al., 2015)

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Comparison

t_{50c}/t_{i50} and c_h of SB backfills evaluated by four existing interpretation methods

Test No.	Depth (m)	$t_{u\,max}$ (s)	Sully et al.'s method I# (1999)		Sully et al.'s method II* (1999)		Chai et al.'s method (2012)		Ha et al.'s method (2014)	
			t (min)	c_h (cm²/s)	t (min)	c_h (cm²/s)	t (min)	c_h (cm²/s)	t_{50i} (min)	c_h (cm²/s)
T1	2.0	150	377.8	3.2×10^{-4}	360.2	3.4×10^{-4}	251.6	4.8×10^{-4}	472.1	4.4×10^{-3}
T2	4.0	175	264.3	4.6×10^{-4}	238.9	5.1×10^{-4}	154.9	7.8×10^{-4}	328.3	3.2×10^{-3}
T3	6.0	593	420.3	2.9×10^{-4}	353.3	3.4×10^{-4}	193.5	6.3×10^{-4}	743.4	1.5×10^{-3}
T4	5.0	281	213.7	5.7×10^{-4}	179.1	6.8×10^{-4}	100.9	1.2×10^{-3}	241.6	1.5×10^{-3}
T5	7.0	185	178.6	6.8×10^{-4}	151.9	8.0×10^{-4}	91.4	1.3×10^{-3}	224.4	2.8×10^{-3}
T6	9.0	90	124.2	9.8×10^{-4}	110.0	1.1×10^{-3}	70.9	1.7×10^{-3}	152.6	6.1×10^{-3}

k_h estimated for SB backfills by four existing methods

Depth (m)	k_h (cm/s)			
	Terzaghi et al's method (1996)	Baligh and Levadoux 's method (1980)	Parez and Fauriel's method (1988)	Shen et al.'s method (2015)
2.0	5.4×10^{-8}	2.2×10^{-8}	3.6×10^{-9}	1.7×10^{-7}
4.0	7.7×10^{-8}	1.9×10^{-8}	5.6×10^{-9}	8.2×10^{-7}
5.0	9.5×10^{-8}	2.1×10^{-8}	7.3×10^{-9}	1.2×10^{-6}
6.0	4.8×10^{-8}	9.9×10^{-9}	3.1×10^{-9}	1.3×10^{-5}
7.0	1.1×10^{-7}	2.2×10^{-8}	9.2×10^{-9}	3.3×10^{-6}
9.0	1.6×10^{-7}	2.7×10^{-8}	1.4×10^{-8}	4.8×10^{-4}

Conclusions

- The measured initial increase of pore pressure perhaps results from the redistribution of excess pore pressure around the cone which is affected by the ununiformity of the backfill.

- c_h obtained by the logarithm of time plot method and the square root of time plot method (Sully *et al*., 1999) are close and in good agreement with the results of fixed-ring consolidometer tests.

- The relation of consolidation theory (Terzaghi et al., 1996) gives k_h closest to the results of flexible wall permeameter tests.

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