APPENDIX H
WICK/EQ DRAIN EVALUATION – SLIMES AREA

PREFABRICATED VERTICAL DRAIN DESIGN

A. Purpose:

- Determine the Wick drain spacing to achive 90% primary consolidation within 1-2 weeks.
- Estimate the installed cost for the chosen methods, spacing, etc...

B. References:

- Reference 1: FHWA (1986). "Prefabricated Vertical Drains".
- Reference 2: Bergado et al (1996). "Soft Ground Improvement"

C. Methodology:

- Terzaghi-Barron
- Barron-Hansbo

D. Design:

- Define variables:

t	=	Time to achive degree of consolidation
Uh	=	Design average degree of horizontal consolidation
De	=	Diameter of zone of influence of drain
ch	=	Horizontal coefficient of consolidation
Fn	=	Drain spacing factor
dw	=	Well/drain diameter
Fs	=	Soil disturbance factor
kh	=	Coefficient of horizontal permeability
kv	=	Coefficient of vertical permeability
ks	=	Coefficient of permeability in the disturbed soil zone
ds	=	Diameter of idealized disturbed zone around drain
Fr	=	Drain resistance factor (typically of minor importance)
S	=	Spacing
dm	=	Mandrel diameter
a	=	Width of drain
b	=	Thickness of drain

- Assumptions:
  - Fr (drain resistance factor) considered insignificant and is ignored
  - ds = 2*dm = 2*dw
  - Triangular pattern (De=1.05*S)
  - Ks = Kv

- Calculations:

Inputs

For t<<<t90, Uave ~= Uh

$Uh := 90\%$ $\quad S := 6\ ft$ $\quad De := 1.05 \cdot S$

$a := 3\ in$ $\quad b := 3\ in$ $\quad dw := \frac{(a+b)}{2}$

$dm := dw$ $\quad ds := 2 \cdot dm$ $\quad Kv := 10^{-6}\ \frac{cm}{s}$

$Cv := 1\ \frac{ft^2}{day}$ $\quad Kh := 5 \cdot Kv$ $\quad Ch := \left(\frac{Kh}{Kv}\right) \cdot Cv$

$Ks := Kv$ $\quad Fn := \ln\left(\frac{De}{dw}\right) - .75$ $\quad Fs := \left(\frac{Kh}{Ks} - 1\right) \cdot \ln\left(\frac{ds}{dw}\right)$

Results

$dw = 3\ in$ $\quad ds = 6\ in$ $\quad De = 6.3\ ft$

$Ks = \left(1 \cdot 10^{-6}\right)\ \frac{cm}{s}$ $\quad Kh = \left(5 \cdot 10^{-6}\right)\ \frac{cm}{s}$ $\quad Ch = 5\ \frac{ft^2}{day}$

$Fs = 2.77$ $\quad Fn = 2.48$

$$t := \left(\frac{De^2}{8 \cdot Ch}\right) \cdot (Fn + Fs) \cdot \ln\left(\frac{1}{1 - Uh}\right)$$

$$t = 12\ day$$

- Calculations:

Inputs

For t<<<t90, Uave ~= Uh

$Uh := 90\%$

$S := 6\ ft$

$De := 1.05 \cdot S$

$a := 3\ in$

$b := 3\ in$

$dw := \frac{(a+b)}{2}$

$dm := dw$

$ds := 2 \cdot dm$

$Kv := 10^{-6}\ \frac{cm}{s}$

$Cv := 1\ \frac{ft^2}{day}$

$Kh := 1 \cdot Kv$

$Ch := \left(\frac{Kh}{Kv}\right) \cdot Cv$

$Ks := Kv$

$Fn := \ln\left(\frac{De}{dw}\right) - .75$

$Fs := \left(\frac{Kh}{Ks} - 1\right) \cdot \ln\left(\frac{ds}{dw}\right)$

Results

$dw = 3\ in$

$ds = 6\ in$

$De = 6.3\ ft$

$Ks = \left(1 \cdot 10^{-6}\right)\ \frac{cm}{s}$

$Kh = \left(1 \cdot 10^{-6}\right)\ \frac{cm}{s}$

$Ch = 1\ \frac{ft^2}{day}$

$Fs = 0$

$Fn = 2.48$

$$t := \left(\frac{De^2}{8 \cdot Ch}\right) \cdot (Fn + Fs) \cdot \ln\left(\frac{1}{1 - Uh}\right)$$

$$t = 28.3\ day$$