

APPENDIX B

K_{fs} , ϕ_m and S Calculations

TEST 1: GP97-5a (Hole Depth = 25.4 cm)

Richards Equation (Simultaneous Equations) (Elrick et al., 1989)

R1 1.05 = 1.75E-02 cm/s
R2 7 = 1.17E-01 cm/s

X = 35.42 cm²
Y =

Kfs = 1.36E-02 cm/s
PHI m = -6.25E-02 cm²/s

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 5 cm

H1 = 5 cm
a = 3 cm
Q1 = 0.61985 cm³/s
Pi = 3.141593
C = 0.717605
(Kfs/PHI)* = 12 (estimated)

Kfs1 = 2.47E-03 cm/s
PHI m1 = 2.06E-04 cm²/s

For Head 2 = 10 cm

H2 = 10 cm
a = 3 cm
Q2 = 4.132333 cm³/s
Pi = 3.141593
C = 1.173908
(Kfs/PHI)* = 12 (estimated)

Kfs2 = 7.28E-03 cm/s
PHI m2 = 6.06E-04 cm²/s

Average of Single Height Solutions

Kfs (avg) = 4.87E-03 cm/s
PHI (avg) = 4.06E-04 cm²/s

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

Delta theta = 0.18 cm³/cm³
Sorptivity = 0.012 cm/(s)-1/2

TEST 2: GP97-5a (Hole Depth = 77.5 cm)

Richards Equation (Simultaneous Equations)(Elrick et al., 1989)

$$R1 \quad 0.4 = 6.67E-03 \text{ cm/s}$$

$$R2 \quad 0.5 = 8.33E-03 \text{ cm/s}$$

$$X = 35.42 \text{ cm}^2$$

$$Y =$$

$$Kfs = -6.5E-05 \text{ cm/s}$$

$$PHI \ m = 6.51E-03 \text{ cm}^2/\text{s}$$

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 10 cm

$$H1 = 10 \text{ cm}$$

$$a = 3 \text{ cm}$$

$$Q1 = 0.236133 \text{ cm}^3/\text{s}$$

$$Pi = 3.141593$$

$$C = 1.173908$$

$$(Kfs/PHI)^* = 12 \text{ (estimated)}$$

$$Kfs1 = 4.16E-04 \text{ cm/s}$$

$$PHI \ m1 = 3.5E-05 \text{ cm}^2/\text{s}$$

For Head 2 = 15 cm

$$H2 = 15 \text{ cm}$$

$$a = 3 \text{ cm}$$

$$Q2 = 0.295167 \text{ cm}^3/\text{s}$$

$$Pi = 3.141593$$

$$C = 1.492634$$

$$(Kfs/PHI)^* = 12 \text{ (estimated)}$$

$$Kfs2 = 3.01E-04 \text{ cm/s}$$

$$PHI \ m2 = 2.5E-05 \text{ cm}^2/\text{s}$$

Average of Single Height Solutions

$$Kfs \text{ (avg)} = 3.58E-04 \text{ cm/s}$$

$$PHI \text{ (avg)} = 3E-05 \text{ cm}^2/\text{s}$$

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

$$\Delta \theta = 0.18 \text{ cm}^3/\text{cm}^3$$

$$\text{Sorptivity} = 0.003 \text{ cm}/(\text{s})^{-1/2}$$

TEST 3: GP97-5b (Hole Depth = 22.9 cm)

Richards Equation (Simultaneous Equations)(Erick et al., 1989)

$$R1 \quad 0.5 = 8.33E-03 \text{ cm/s}$$

$$R2 \quad 1.8 = 3.00E-02 \text{ cm/s}$$

$$X = 35.42 \text{ cm}^2$$

$$Y =$$

$$Kfs = 2.76E-03 \text{ cm/s}$$

$$PHI \ m = -8.30E-03 \text{ cm}^2/\text{s}$$

Single-Height Solution (Erick et al., 1989)

For Head 1 = 5 cm

$$H1 = 5 \text{ cm}$$

$$a = 3 \text{ cm}$$

$$Q1 = 0.295167 \text{ cm}^3/\text{s}$$

$$Pi = 3.141593$$

$$C = 0.717605$$

$$(Kfs/PHI)^* = 12 \text{ (estimated)}$$

$$Kfs1 = 1.18E-03 \text{ cm/s}$$

$$PHI \ m1 = 9.81E-05 \text{ cm}^2/\text{s}$$

For Head 2 = 10 cm

$$H2 = 10 \text{ cm}$$

$$a = 3 \text{ cm}$$

$$Q2 = 1.0626 \text{ cm}^3/\text{s}$$

$$Pi = 3.141593$$

$$C = 1.173908$$

$$(Kfs/PHI)^* = 12 \text{ (estimated)}$$

$$Kfs2 = 1.87E-03 \text{ cm/s}$$

$$PHI \ m2 = 1.56E-04 \text{ cm}^2/\text{s}$$

Average of Single Height Solutions

$$Kfs \text{ (avg)} = 1.52E-03 \text{ cm/s}$$

$$PHI \text{ (avg)} = 1.27E-04 \text{ cm}^2/\text{s}$$

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

$$\Delta \theta = 0.18 \text{ cm}^3/\text{cm}^3$$

$$\text{Sorptivity} = 0.007 \text{ cm}/(\text{s})^{-1/2}$$

TEST 4: GP97-5b (Hole Depth = 95.3 cm)

R1 0 = 0 cm/s
R2 0 = 0 cm/s

X =
Y = 2.18 cm²

For Head 1 = 5 cm
No water movement after 15 min.

For Head 2 = 10 cm
No water movement after 20 min.

For Head 3 = 15 cm
No water movement after 20 min.

Abandoned hole after fifty-five minutes

TEST 5: GP97-4a (Hole Depth = 48.3 cm)

R1 0.35 = 5.83E-03 cm/s
R2 0 = no stabilized value

X =
Y = 2.18 cm²

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 5 cm

H1 = 5 cm
a = 3 cm
Q1 = 0.012717 cm³/s
Pi = 3.141593
C = 0.717605
(Kfs/PHI)* = 12 (estimated)

Kfs1 = 5.07E-05 cm/s
PHI m1 = 4.2E-06 cm²/s

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

Delta theta = 0.18 cm³/cm³
Sorptivity = 0.001 cm/(s)^{-1/2}

TEST 6: GP97-4b (Hole Depth = 19.1 cm)

Richards Equation (Simultaneous Equations)(Elrick et al. , 1989)

R1 2.6 = 4.33E-02 cm/s
R2 6 = 1.00E-01 cm/s

X = 35.42 cm²
Y =

Kfs = 6.23E-03 cm/s
PHI m = 3.85E-03 cm²/s

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 5 cm

H1 = 5 cm
a = 3 cm
Q1 = 1.5348667 cm³/s
Pi = 3.1415927
C = 0.7176053
(Kfs/PHI)* = 12 (estimated)

Kfs1 = 6.12E-03 cm/s
PHI m1 = 5.10E-04 cm²/s

For Head 2 = 10 cm

H2 = 10 cm
a = 3 cm
Q2 = 3.542 cm³/s
Pi = 3.1415927
C = 1.1739076
(Kfs/PHI)* = 12 (estimated)

Kfs2 = 6.24E-03 cm/s
PHI m2 = 5.20E-04 cm²/s

Average of Single Height Solutions

Kfs (avg) = 6.18E-03 cm/s
PHI (avg) = 5.15E-04 cm²/s

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

Delta theta = 0.18 cm³/cm³
Sorptivity = 0.037 cm/(s)^{-1/2}

TEST 7: GP97-4b (Hole Depth = 99.1 cm)

R1 5.4 = 9.00E-02 cm/s
R2 0 = 0.00E+00 cm/s

X =
Y = 2.18 cm²

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 10 cm

H1 = 10 cm
a = 3 cm
Q1 = 0.1962 cm³/s
Pi = 3.141593
C = 1.173908
(Kfs/PHI)* = 12 (estimated)

Kfs1 = 3.45E-04 cm/s
PHI m1 = 2.88E-05 cm²/s

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

Delta theta = 0.18 cm³/cm³
Sorptivity = 0.003 cm/(s)^{-1/2}

TEST 8: GP97-4c (Hole Depth = 99.1 cm)

R1 0 = 0 cm/s
R2 0 = 0 cm/s

X =
Y = 2.18 cm²

For Head 1 = 5 cm
No water movement after 15 min.

For Head 2 = 10 cm
No water movement after 20 min.

For Head 3 = 15 cm
No water movement after 17 min.

For Head 4 = 20 cm
No water movement after 45 min.

Abandoned hole after one hour and thirty-seven minutes

TEST 9: GP97-4d (Hole Depth = 44.5 cm)

Richards Equation (Simultaneous Equations)(Elrick et al., 1989)

R1 0.5 = 8.33E-03 cm/s
R2 0.9 = 1.50E-02 cm/s

X = 35.42 cm²

Y =

Kfs = 5.84E-04 cm/s
PHI m = 4.29E-03 cm²/s

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 5 cm

H1 = 5 cm

a = 3 cm

Q1 = 0.295167 cm³/s

Pi = 3.141593

C = 0.717605

(Kfs/PHI)* = 12 (estimated)

Kfs1 = 1.18E-03 cm/s

PHI m1 = 9.8E-05 cm²/s

For Head 2 = 10 cm

H2 = 10 cm

a = 3 cm

Q2 = 0.5313 cm³/s

Pi = 3.141593

C = 1.173908

(Kfs/PHI)* = 12 (estimated)

Kfs2 = 9.35E-04 cm/s

PHI m2 = 7.80E-05 cm²/s

Average of Single Height Solutions

Kfs (avg) = 1.06E-03 cm/s

PHI (avg) = 8.80E-05 cm²/s

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

Delta theta = 0.18 cm³/cm³

Sorptivity = 0.039 cm/(s)^{-1/2}

TEST 10: GP97-Scarp A (Hole Depth = 25.4 cm)

R1 46 = 7.67E-01 cm/s
R2 41 = 6.83E-01 cm/s
R3 40 = 6.67E-01 cm/s

X = 35.42 cm²
Y =

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 5 cm (Test 1)

H1 = 5 cm
a = 3 cm
Q1 = 27.15533 cm³/s
Pi = 3.141593
C = 0.717605
(Kfs/PHI)* = 12 (estimated)

Kfs1 = 1.08E-01 cm/s
PHI m1 = 9.02E-03 cm²/s

For Head 1 = 5 cm (Test 2)

H1 = 5 cm
a = 3 cm
Q1 = 24.20367 cm³/s
Pi = 3.141593
C = 0.717605
(Kfs/PHI)* = 12 (estimated)

Kfs1 = 9.65E-02 cm/s
PHI m1 = 8.04E-03 cm²/s

For Head 1 = 5 cm (Test 3)

H1 = 5 cm
a = 3 cm
Q1 = 23.61333 cm³/s
Pi = 3.141593
C = 0.717605
(Kfs/PHI)* = 12 (estimated)

Kfs1 = 9.41E-02 cm/s
PHI m1 = 7.85E-03 cm²/s

Average of Single Height Solutions (Test 1 and Test 2)

Kfs (avg) = 9.53E-02 cm/s
PHI (avg) = 7.94E-03 cm²/s

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

Delta theta = 0.18 cm³/cm³
Sorptivity = 0.053 cm/(s)^{-1/2}

TEST 11: GP97-Scarp B (Hole Depth = 35.6 cm)

Richards Equation (Simultaneous Equations)(Elrick et al., 1989)

R1 0.2 = 3.33E-03 cm/s

R2 0.55 = 9.17E-03 cm/s

X = 35.42 cm²

Y =

Kfs = 6.94E-04 cm/s

PHI m = -9.42E-04 cm²/s

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 5 cm

H1 = 5 cm

a = 3 cm

Q1 = 0.1180667 cm³/s

Pi = 3.1415927

C = 0.7176053

(Kfs/PHI)* = 12 (estimated)

Kfs1 = 4.71E-04 cm/s

PHI m1 = 3.923E-05 cm²/s

For Head 2 = 10 cm

H2 = 10 cm

a = 3 cm

Q2 = 0.3246833 cm³/s

Pi = 3.1415927

C = 1.1739076

(Kfs/PHI)* = 12 (estimated)

Kfs2 = 5.72E-04 cm/s

PHI m2 = 4.76E-05 cm²/s

Average of Single Height Solutions

Kfs (avg) = 5.21E-04 cm/s

PHI (avg) = 4.34E-05 cm²/s

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

Delta theta = 0.18 cm³/cm³

Sorptivity = 0.004 cm/(s)-1/2

TEST 12: GP97-Scarp C (Hole Depth = 45.7 cm)

Richards Equation (Simultaneous Equations)(Elrick et al., 1989)

$$R1 \quad 0.75 = 1.25E-02 \text{ cm/s}$$

$$R2 \quad 1.3 = 2.17E-02 \text{ cm/s}$$

$$X = 35.42 \text{ cm}^2$$

$$Y =$$

$$Kfs = 7.56E-04 \text{ cm/s}$$

$$PHI \ m = 7.14E-03 \text{ cm}^2/\text{s}$$

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 5 cm

$$H1 = 5 \text{ cm}$$

$$a = 3 \text{ cm}$$

$$Q1 = 0.44275 \text{ cm}^3/\text{s}$$

$$Pi = 3.141593$$

$$C = 0.717605$$

$$(Kfs/PHI)^* = 12 \text{ (estimated)}$$

$$Kfs1 = 1.77E-03 \text{ cm/s}$$

$$PHI \ m1 = 1.47E-04 \text{ cm}^2/\text{s}$$

For Head 2 = 10 cm

$$H2 = 10 \text{ cm}$$

$$a = 3 \text{ cm}$$

$$Q2 = 0.767433 \text{ cm}^3/\text{s}$$

$$Pi = 3.141593$$

$$C = 1.173908$$

$$(Kfs/PHI)^* = 12 \text{ (estimated)}$$

$$Kfs2 = 1.35E-03 \text{ cm/s}$$

$$PHI \ m2 = 1.13E-04 \text{ cm}^2/\text{s}$$

Average of Single Height Solutions

$$Kfs \text{ (avg)} = 1.56E-03 \text{ cm/s}$$

$$PHI \text{ (avg)} = 1.30E-04 \text{ cm}^2/\text{s}$$

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

$$\Delta \theta = 0.18 \text{ cm}^3/\text{cm}^3$$

$$\text{Sorptivity} = 0.051 \text{ cm}/(\text{s})^{-1/2}$$

TEST 13: GP97-4e (Hole Depth = 58.4 cm)

Richards Equation (Simultaneous Equations)(Elrick et al., 1989)

R1 2.6 = 4.33E-02 cm/s
R2 6 = 1.00E-01 cm/s

X = 35.42 cm²
Y =

Kfs = 6.23E-03 cm/s
PHI m = 3.85E-03 cm²/s

Single-Height Solution (Elrick et al., 1989)

For Head 1 = 5 cm

H1 = 5 cm
a = 3 cm
Q1 = 1.534867 cm³/s
Pi = 3.141593
C = 0.717605
(Kfs/PHI)* = 12 (estimated)

Kfs1 = 6.12E-03 cm/s
PHI m1 = 5.10E-04 cm²/s

For Head 2 = 10 cm

H2 = 10 cm
a = 3 cm
Q2 = 3.542 cm³/s
Pi = 3.141593
C = 1.173908
(Kfs/PHI)* = 12 (estimated)

Kfs2 = 6.24E-03 cm/s
PHI m2 = 5.20E-04 cm²/s

Average of Single Height Solutions

Kfs (avg) = 6.18E-03 cm/s
PHI (avg) = 5.15E-04 cm²/s

Sorptivity Calculation (Soilmoisture Equipment Corp., 1986)

Delta theta = 0.18 cm³/cm³
Sorptivity = 0.037 cm/(s)^{-1/2}