Schnabel Engineering

# Consolidated Drained Direct Shear Test

ASTM D3080

Project: *Calvert Cliffs Nuclear Power Plant*

Location: *Calvert County, MD*

Schnabel Contract: *06120048*
Boring No.: *B-307*
Depth: *178.5-180.4ft.*
Effective Normal Stress (psi): *40.0*

Date: *10/20/2006*
Elev: *-59.2 to -61.1*
Reviewed by: *CJS*

Soil Description: *Fine to medium CLAYEY SAND (SC), contains shell fragments - green gray*

Specimen Type: *Tube Sample*

Remarks:

| | |
|---|---|
| Liquid Limit: | *41* |
| Plasticity Index: | *16* |
| % finer that No. 200: | *37.7* |
| Specific Gravity: | *2.67* |
| Initial Moisture, %: | *30.5* |
| Final Moisture, %: | *35.2* |

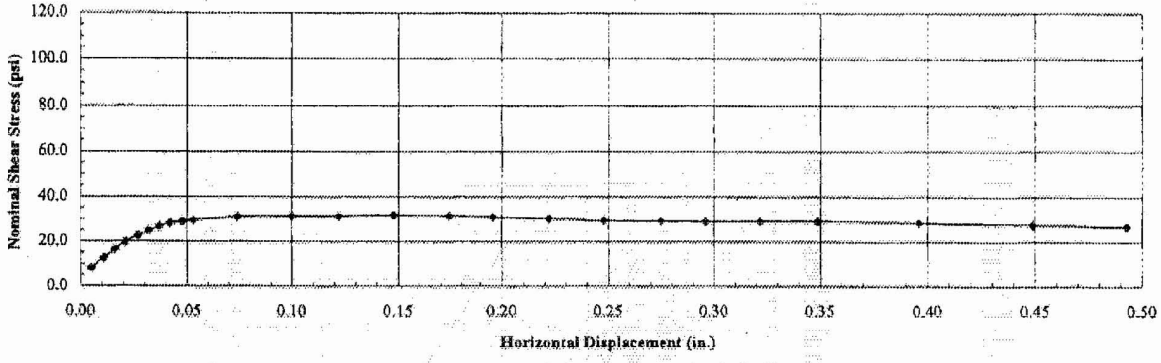
| | Specimen Conditions | |
|---|---|---|
| | Initial | Consolidated |
| Diameter (in) | 2.50 | 2.50 |
| Height (in) | 0.975 | 0.96 |
| Area ($in^2$) | 4.91 | 4.91 |
| Volume ($in^3$) | 4.8 | 4.7 |
| Weight (lbs) | 0.32 | 0.33 |
| $\rho_{wet}$ (pcf) | 114.9 | 120.7 |
| $\rho_{dry}$ (pcf) | 88.0 | 89.3 |
| Void Ratio | 0.89 | 0.86 |
| Saturation, % | 92 | 100 |

| Shear Testing Conditions | |
|---|---|
| Effective Normal Stress (psi): | 40.0 |
| Consolidation Stress (psi): | 40.0 |
| $t_{50}$ (min.): | 0.1 |
| Rate of Displ. (in./min): | 0.00313 |

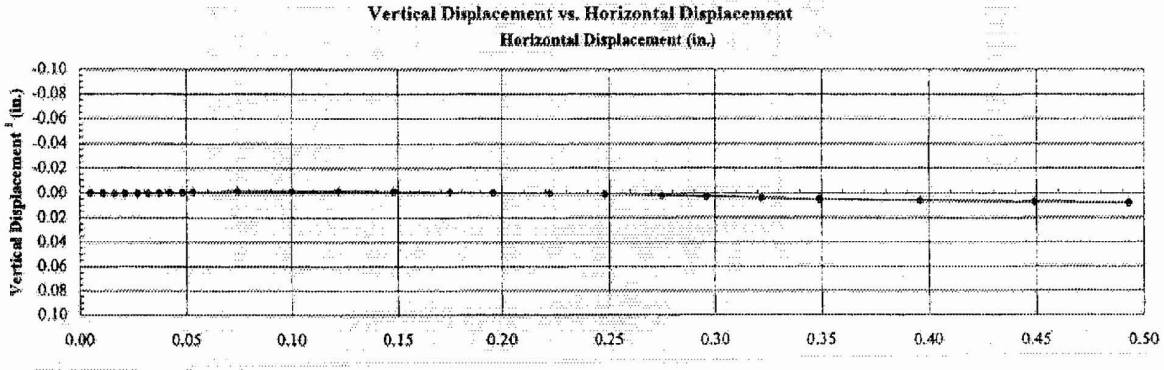
| Reading No. | Horizontal Displacement (in.) | Vertical Displacement[1] (in.) | Shear Force (lbs) | Nominal Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.005 | 0.0002 | 38.9 | 7.9 |
| 2 | 0.011 | 0.0004 | 61.2 | 12.5 |
| 3 | 0.016 | 0.0005 | 80.4 | 16.4 |
| 4 | 0.021 | 0.0006 | 96.8 | 19.7 |
| 5 | 0.027 | 0.0006 | 110.6 | 22.5 |
| 6 | 0.032 | 0.0004 | 121.7 | 24.8 |
| 7 | 0.037 | 0.0002 | 130.9 | 26.7 |
| 8 | 0.042 | 0.0000 | 138.1 | 28.1 |
| 9 | 0.048 | -0.0003 | 141.6 | 28.8 |
| 10 | 0.053 | -0.0007 | 144.5 | 29.4 |
| 11 | 0.074 | -0.0012 | 152.1 | 31.0 |
| 12 | 0.100 | -0.0014 | 153.3 | 31.2 |
| 13 | 0.122 | -0.0014 | 153.8 | 31.3 |
| 14 | 0.148 | -0.0010 | 155.7 | 31.7 |
| 15 | 0.174 | -0.0005 | 154.1 | 31.4 |
| 16 | 0.196 | 0.0000 | 151.9 | 30.9 |
| 17 | 0.222 | 0.0004 | 148.6 | 30.3 |
| 18 | 0.248 | 0.0011 | 144.3 | 29.4 |
| 19 | 0.275 | 0.0022 | 143.4 | 29.2 |
| 20 | 0.296 | 0.0031 | 142.4 | 29.0 |
| 21 | 0.322 | 0.0042 | 143.2 | 29.2 |
| 22 | 0.349 | 0.0050 | 143.0 | 29.1 |
| 23 | 0.396 | 0.0062 | 140.0 | 28.5 |
| 24 | 0.449 | 0.0072 | 135.4 | 27.6 |
| 25 | 0.493 | 0.0079 | 130.9 | 26.7 |

Notes: 1 - Positive vertical displacement represents compression.

**Nominal Shear Stress vs. Horizontal Displacement**




**Vertical Displacement vs. Horizontal Displacement**



Schnabel Engineering

# Consolidated Drained Direct Shear Test

ASTM D3080

Project: *Calvert Cliffs Nuclear Power Plant*

Location: *Calvert County, MD*

Schnabel Contract: *06120048*
Boring No.: *B-307*
Depth: *178.5-180.4 ft*
Effective Normal Stress (psi): *80.0*

Date: *10/20/2006*
Elev: *-59.2 to -61.1*
Reviewed by: *CJS*

Soil Description: *Fine to medium CLAYEY SAND (SC), contains shell fragments - green gray*

Specimen Type: *Tube Sample*

Remarks:

| | |
|---|---|
| Liquid Limit: | 41 |
| Plasticity Index: | 16 |
| % finer that No. 200: | 37.7 |
| Specific Gravity: | 2.67 |
| Initial Moisture, %: | 29.3 |
| Final Moisture, %: | 32.9 |

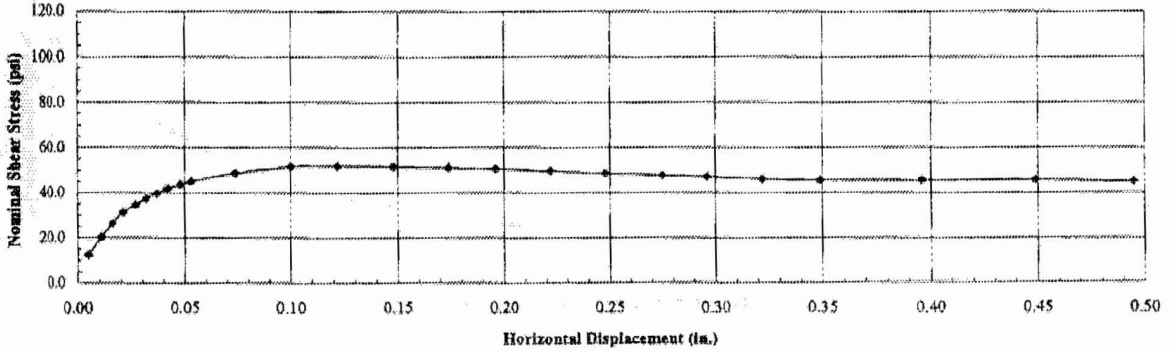
| | Specimen Conditions | |
|---|---|---|
| | Initial | Consolidated |
| Diameter (in) | 2.50 | 2.50 |
| Height (in) | 0.971 | 0.94 |
| Area ($in^2$) | 4.91 | 4.91 |
| Volume ($in^3$) | 4.8 | 4.6 |
| Weight (lbs) | 0.32 | 0.33 |
| $\rho_{wet}$ (pcf) | 115.9 | 123.4 |
| $\rho_{dry}$ (pcf) | 89.6 | 92.9 |
| Void Ratio | 0.85 | 0.79 |
| Saturation, % | 92 | 100 |

| Shear Testing Conditions | |
|---|---|
| Effective Normal Stress (psi): | 80.0 |
| Consolidation Stress (psi) | 80.0 |
| $t_{50}$ (min.): | 0.1 |
| Rate of Displ. (in./min): | 0.00313 |

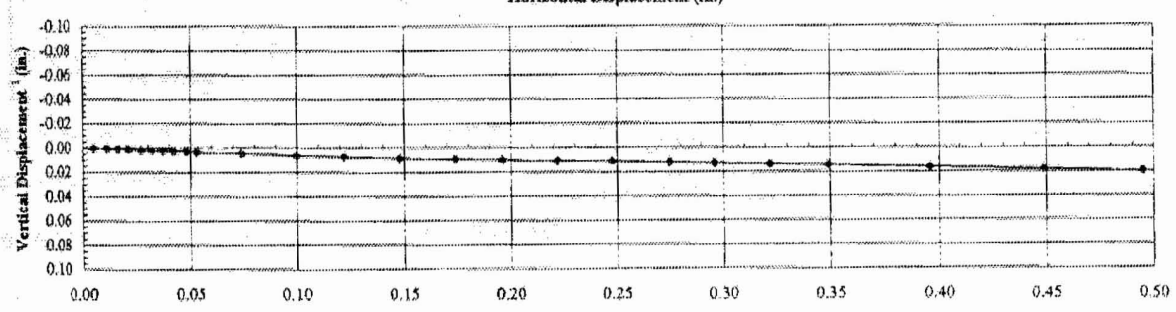
| Reading No. | Horizontal Displacement (in.) | Vertical Displacement (in.) | Shear Force (lbs) | Nominal Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.005 | 0.0003 | 61.6 | 12.5 |
| 2 | 0.011 | 0.0007 | 100.2 | 20.4 |
| 3 | 0.016 | 0.0011 | 128.6 | 26.2 |
| 4 | 0.021 | 0.0016 | 152.7 | 31.1 |
| 5 | 0.027 | 0.0019 | 169.3 | 34.5 |
| 6 | 0.032 | 0.0023 | 183.1 | 37.3 |
| 7 | 0.037 | 0.0026 | 194.6 | 39.6 |
| 8 | 0.042 | 0.0029 | 204.9 | 41.7 |
| 9 | 0.048 | 0.0032 | 213.9 | 43.6 |
| 10 | 0.053 | 0.0035 | 220.9 | 45.0 |
| 11 | 0.074 | 0.0046 | 239.9 | 48.9 |
| 12 | 0.100 | 0.0063 | 253.5 | 51.6 |
| 13 | 0.122 | 0.0074 | 255.2 | 52.0 |
| 14 | 0.148 | 0.0086 | 254.7 | 51.9 |
| 15 | 0.174 | 0.0096 | 251.9 | 51.3 |
| 16 | 0.196 | 0.0103 | 249.5 | 50.8 |
| 17 | 0.222 | 0.0110 | 244.8 | 49.9 |
| 18 | 0.248 | 0.0117 | 239.6 | 48.8 |
| 19 | 0.275 | 0.0124 | 235.4 | 47.9 |
| 20 | 0.296 | 0.0131 | 232.3 | 47.3 |
| 21 | 0.322 | 0.0136 | 226.6 | 46.1 |
| 22 | 0.349 | 0.0146 | 223.9 | 45.6 |
| 23 | 0.396 | 0.0164 | 224.2 | 45.7 |
| 24 | 0.449 | 0.0183 | 225.0 | 45.8 |
| 25 | 0.495 | 0.0199 | 221.5 | 45.1 |

Notes: 1 - Positive vertical displacement represents compression.

**Nominal Shear Stress vs. Horizontal Displacement**




**Vertical Displacement vs. Horizontal Displacement**



Schnabel Engineering

# Consolidated Drained Direct Shear Test

ASTM D3080

Project: *Calvert Cliffs Nuclear Power Plant*

Location: *Calvert County, MD*

Schnabel Contract: *06120048*
Boring No.: *B-307*
Depth: *178.5-180.4 ft*
Effective Normal Stress (psi): *160.0*

Date: *10/20/2006*
Elev: *-59.2 to -61.1*
Reviewed by: *CJS*

Soil Description: *Fine to medium CLAYEY SAND (SC), contains shell fragments - green gray*

Specimen Type: *Tube Sample*

Remarks:

| | |
|---|---|
| Liquid Limit: | *41* |
| Plasticity Index: | *16* |
| % finer that No. 200: | *37.7* |
| Specific Graivty: | *2.67* |
| Initial Moisture, %: | *30.5* |
| Final Moisture, %: | *33.2* |

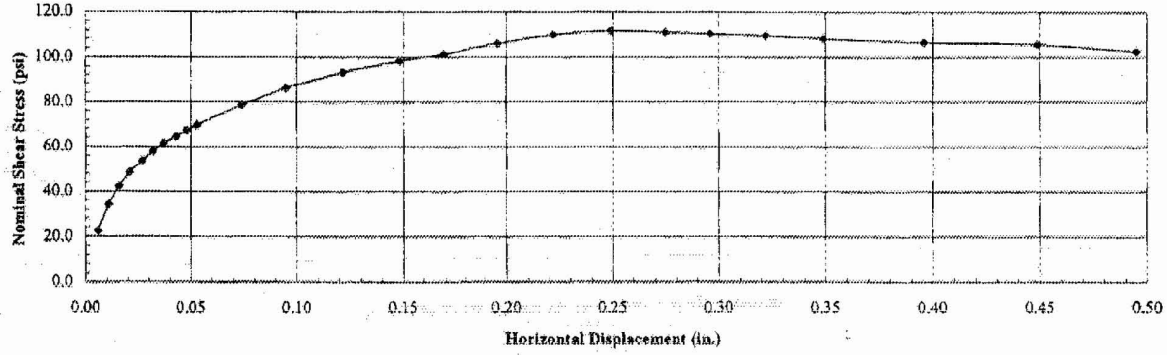
| | Specimen Conditions | |
|---|---|---|
| | Initial | Consolidated |
| Diameter (in) | 2.50 | 2.50 |
| Height (in) | 0.973 | 0.93 |
| Area ($in^2$) | 4.91 | 4.91 |
| Volume ($in^3$) | 4.8 | 4.6 |
| Weight (lbs) | 0.32 | 0.32 |
| $\rho_{wet}$ (pcf) | 115.0 | 123.2 |
| $\rho_{dry}$ (pcf) | 88.1 | 92.5 |
| Void Ratio | 0.88 | 0.80 |
| Saturation, % | 92 | 100 |

| Shear Testing Conditions | |
|---|---|
| Effective Normal Stress (psi): | 160.0 |
| Consolidation Stress (psi): | 160.0 |
| $t_{50}$ (min.): | 0.5 |
| Rate of Displ. (in./min): | 0.0031 |

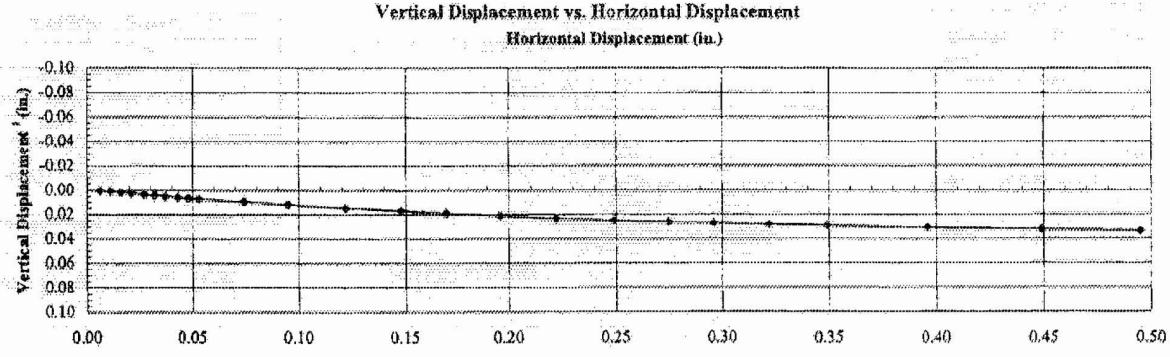
| Reading No. | Horizontal Displacement (in.) | Vertical Displacement[1] (in.) | Shear Force (lbs) | Nominal Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.006 | 0.0003 | 110.8 | 22.6 |
| 2 | 0.011 | 0.0009 | 168.2 | 34.3 |
| 3 | 0.016 | 0.0018 | 207.9 | 42.3 |
| 4 | 0.021 | 0.0027 | 238.6 | 48.6 |
| 5 | 0.027 | 0.0035 | 263.0 | 53.6 |
| 6 | 0.032 | 0.0043 | 284.0 | 57.8 |
| 7 | 0.037 | 0.0051 | 301.6 | 61.4 |
| 8 | 0.043 | 0.0058 | 316.5 | 64.5 |
| 9 | 0.048 | 0.0065 | 329.9 | 67.2 |
| 10 | 0.053 | 0.0071 | 342.2 | 69.7 |
| 11 | 0.074 | 0.0097 | 385.3 | 78.5 |
| 12 | 0.095 | 0.0121 | 423.1 | 86.2 |
| 13 | 0.122 | 0.0148 | 457.4 | 93.1 |
| 14 | 0.148 | 0.0171 | 482.8 | 98.3 |
| 15 | 0.169 | 0.0189 | 496.7 | 101.1 |
| 16 | 0.196 | 0.0213 | 520.7 | 106.0 |
| 17 | 0.222 | 0.0237 | 539.7 | 109.9 |
| 18 | 0.249 | 0.0254 | 548.9 | 111.8 |
| 19 | 0.275 | 0.0266 | 545.6 | 111.1 |
| 20 | 0.296 | 0.0276 | 542.6 | 110.5 |
| 21 | 0.322 | 0.0287 | 538.0 | 109.6 |
| 22 | 0.349 | 0.0296 | 531.6 | 108.3 |
| 23 | 0.396 | 0.0311 | 523.3 | 106.6 |
| 24 | 0.449 | 0.0325 | 518.5 | 105.6 |
| 25 | 0.495 | 0.0338 | 504.0 | 102.6 |

Notes: 1 - Positive vertical displacement represents compression.

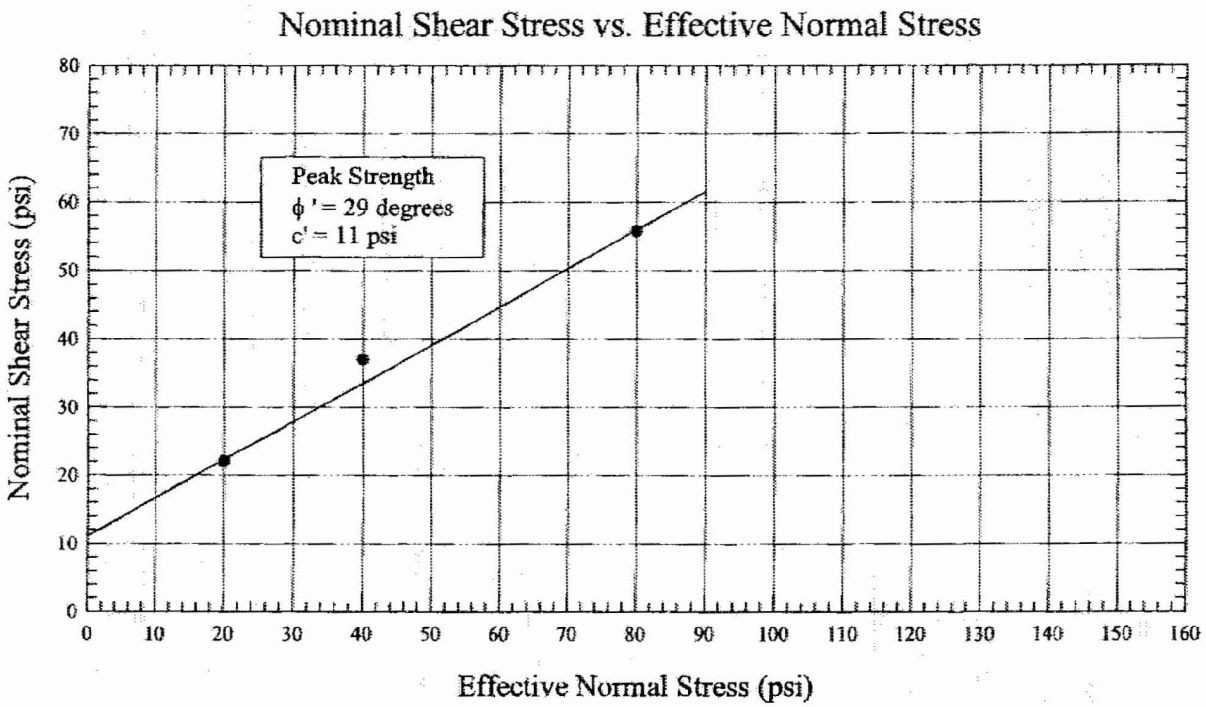
**Nominal Shear Stress vs. Horizontal Displacement**




**Vertical Displacement vs. Horizontal Displacement**



# Consolidated Drained Direct Shear (ASTM D3080)




Boring No.: *B-313* Depth: *93.5-94.7 ft* SEI Contract: *06120048* Date: *12/12/06*

Sample Description: *Sandy LEAN CLAY (CL), contains shells - gray* Reviewed By: *CJS*

Specimen Type: *Tube Sample* Specific Gravity: *2.69* LL: *49* PI: *24* %<200: *NA*

Schnabel Engineering

*Calvert Cliffs Nuclear Power Plant*
*Calvert County, MD*

Schnabel Engineering

# Consolidated Drained Direct Shear Test

ASTM D3080

Project: *Clavert Cliffs Nuclear Power Plant*

Location: *Calvert County, MD*

Schnabel Contract: *06120048*
Boring No.: *B-313*
Depth: *93.5-94.7ft.*
Elev: *-42.8 to -44.0 ft*
Effective Normal Stress (psi): *20.0*

Date: *11/9/2006*
Reviewed by: *CJS*

Soil Description: *Sandy LEAN CLAY(CL) contains shells - gray*

Specimen Type: *Tube Sample*

Remarks:

| | |
|---|---|
| Liquid Limit: | *49* |
| Plasticity Index: | *24* |
| % finer that No. 200: | *na* |
| Specific Graivty: | *2.69* |
| Initial Moisture, %: | *34.5* |
| Final Moisture, %: | *44.8* |

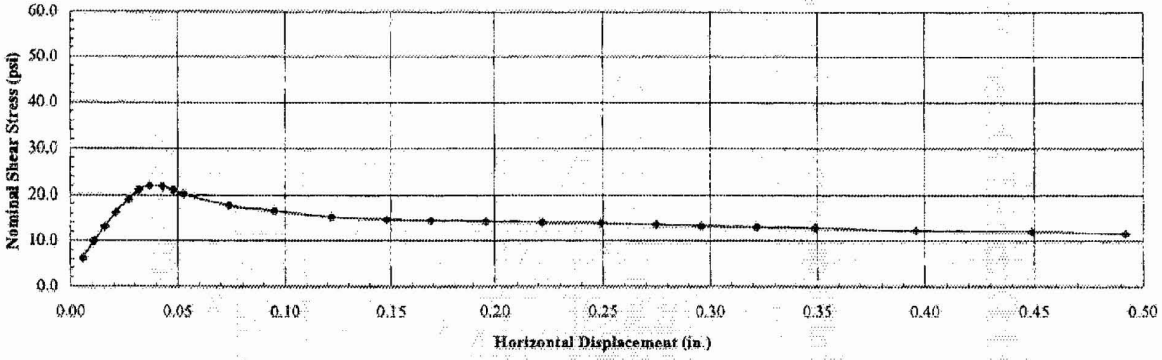
| | Specimen Conditions | |
|---|---|---|
| | Initial | Consolidated |
| Diameter (in) | 2.50 | 2.50 |
| Height (in) | 0.974 | 0.97 |
| Area ($in^2$) | 4.91 | 4.91 |
| Volume ($in^3$) | 4.8 | 4.7 |
| Weight (lbs) | 0.30 | 0.32 |
| $\rho_{wet}$ (pcf) | 108.0 | 117.3 |
| $\rho_{dry}$ (pcf) | 80.3 | 81.0 |
| Void Ratio | 1.09 | 1.07 |
| Saturation, % | 86 | 100 |

| Shear Testing Conditions | |
|---|---|
| Effective Normal Stress (psi): | 20.0 |
| Consolidation Stress (psi): | 20.0 |
| $t_{50}$ (min.): | 0.1 |
| Rate of Displ. (in./min): | 0.00417 |

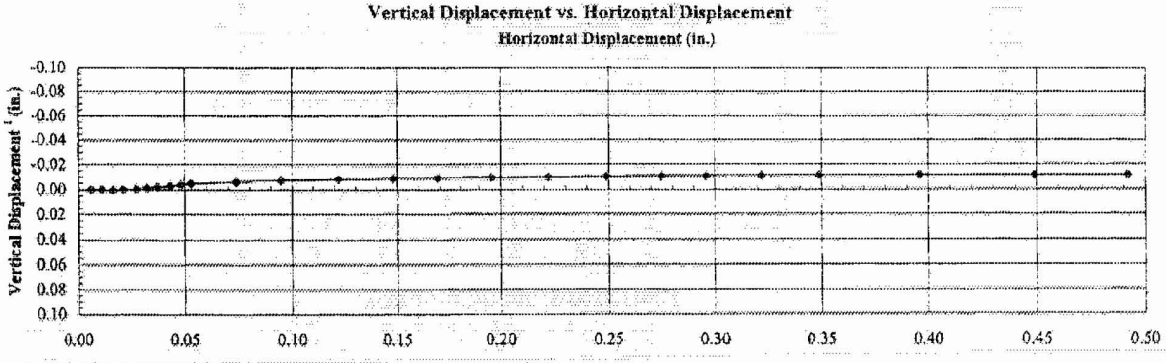
| Reading No. | Horizontal Displacement (in.) | Vertical Displacement[1] (in.) | Shear Force (lbs) | Nominal Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.006 | 0.0002 | 29.9 | 6.1 |
| 2 | 0.011 | 0.0002 | 48.6 | 9.9 |
| 3 | 0.016 | 0.0003 | 64.4 | 13.1 |
| 4 | 0.021 | 0.0002 | 79.3 | 16.1 |
| 5 | 0.027 | -0.0003 | 93.2 | 19.0 |
| 6 | 0.032 | -0.0010 | 103.5 | 21.1 |
| 7 | 0.037 | -0.0019 | 107.9 | 22.0 |
| 8 | 0.043 | -0.0029 | 107.1 | 21.8 |
| 9 | 0.048 | -0.0038 | 103.3 | 21.0 |
| 10 | 0.053 | -0.0045 | 99.2 | 20.2 |
| 11 | 0.074 | -0.0061 | 86.9 | 17.7 |
| 12 | 0.095 | -0.0073 | 81.3 | 16.6 |
| 13 | 0.122 | -0.0081 | 74.8 | 15.2 |
| 14 | 0.148 | -0.0086 | 72.0 | 14.7 |
| 15 | 0.169 | -0.0090 | 70.7 | 14.4 |
| 16 | 0.196 | -0.0094 | 69.8 | 14.2 |
| 17 | 0.222 | -0.0097 | 68.5 | 13.9 |
| 18 | 0.249 | -0.0101 | 67.9 | 13.8 |
| 19 | 0.275 | -0.0104 | 66.6 | 13.6 |
| 20 | 0.296 | -0.0106 | 65.2 | 13.3 |
| 21 | 0.322 | -0.0108 | 64.2 | 13.1 |
| 22 | 0.349 | -0.0111 | 63.4 | 12.9 |
| 23 | 0.396 | -0.0112 | 60.3 | 12.3 |
| 24 | 0.449 | -0.0112 | 59.2 | 12.1 |
| 25 | 0.492 | -0.0111 | 57.0 | 11.8 |

Notes: 1 - Positive vertical displacement represents compression.

**Nominal Shear Stress vs. Horizontal Displacement**




**Vertical Displacement vs. Horizontal Displacement**



Schnabel Engineering

# Consolidated Drained Direct Shear Test

ASTM D3080

Project: *Calvert Cliffs Nuclear Power Plant*

Location: *Calveert County, MD*

Schnabel Contract: *06120048*
Boring No.: *B-313*
Depth: *93.5-94.7ft.*
Effective Normal Stress (psi): *40.0*

Date: *11/9/2006*
Elev: *-42.8 to -44.0 ft*
Reviewed by: *CJS*

Soil Description: *Sandy LEAN CLAY(CL) contains shells - gray*

Specimen Type: *Tube Sample*

Remarks:

| | |
|---|---|
| Liquid Limit: | *49* |
| Plasticity Index: | *24* |
| % finer that No. 200: | *na* |
| Specific Graivty: | *2.69* |
| Initial Moisture, %: | *38.2* |
| Final Moisture, %: | *43.1* |

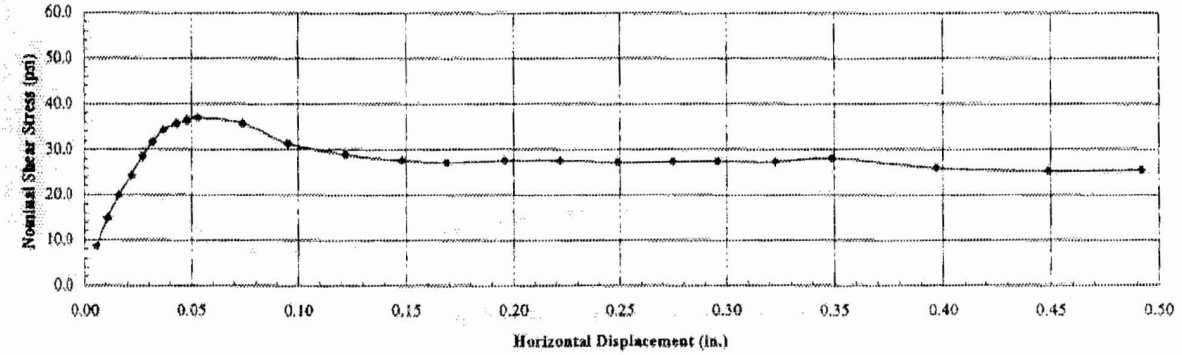
| | Specimen Conditions | |
|---|---|---|
| | Initial | Consolidated |
| Diameter (in) | 2.50 | 2.50 |
| Height (in) | 0.972 | 0.95 |
| Area ($in^2$) | 4.91 | 4.91 |
| Volume ($in^3$) | 4.8 | 4.7 |
| Weight (lbs) | 0.30 | 0.31 |
| $\rho_{wet}$ (pcf) | 108.9 | 114.9 |
| $\rho_{dry}$ (pcf) | 78.8 | 80.3 |
| Void Ratio | 1.12 | 1.08 |
| Saturation, % | 91 | 100 |

| Shear Testing Conditions | |
|---|---|
| Effective Normal Stress (psi): | 40.0 |
| Consolidation Stress (psi) | 40.0 |
| $t_{50}$ (min.): | 0.1 |
| Rate of Displ. (in./min): | 0.00417 |

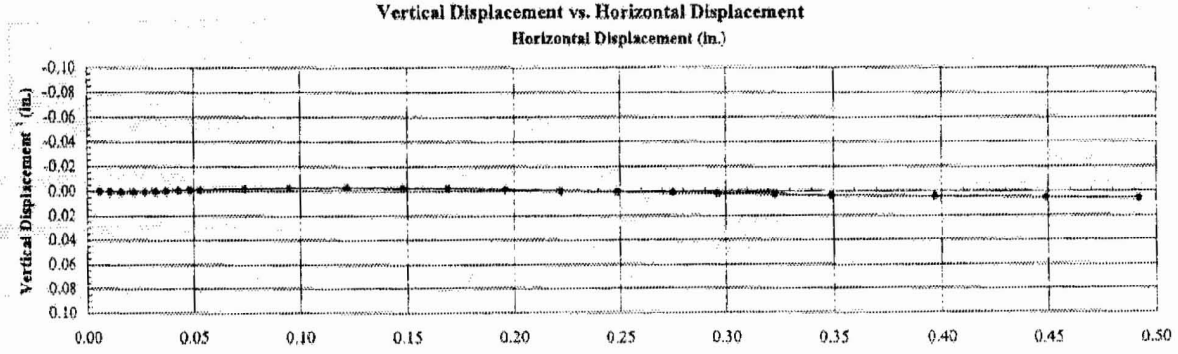
| Reading No. | Horizontal Displacement (in.) | Vertical Displacement[1] (in.) | Shear Force (lbs) | Nominal Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.006 | 0.0003 | 42.4 | 8.6 |
| 2 | 0.011 | 0.0006 | 73.1 | 14.9 |
| 3 | 0.016 | 0.0008 | 97.6 | 19.9 |
| 4 | 0.022 | 0.0008 | 119.6 | 24.4 |
| 5 | 0.027 | 0.0008 | 139.6 | 28.4 |
| 6 | 0.032 | 0.0005 | 155.9 | 31.7 |
| 7 | 0.037 | 0.0001 | 168.2 | 34.3 |
| 8 | 0.043 | -0.0003 | 175.0 | 35.6 |
| 9 | 0.048 | -0.0006 | 178.8 | 36.4 |
| 10 | 0.053 | -0.0009 | 181.5 | 37.0 |
| 11 | 0.074 | -0.0018 | 175.8 | 35.8 |
| 12 | 0.095 | -0.0024 | 154.3 | 31.4 |
| 13 | 0.122 | -0.0025 | 141.6 | 28.8 |
| 14 | 0.148 | -0.0024 | 135.9 | 27.7 |
| 15 | 0.169 | -0.0021 | 133.2 | 27.1 |
| 16 | 0.196 | -0.0013 | 135.6 | 27.6 |
| 17 | 0.222 | -0.0003 | 136.3 | 27.8 |
| 18 | 0.249 | 0.0004 | 133.5 | 27.2 |
| 19 | 0.275 | 0.0012 | 134.3 | 27.3 |
| 20 | 0.296 | 0.0018 | 134.5 | 27.4 |
| 21 | 0.323 | 0.0026 | 134.0 | 27.3 |
| 22 | 0.349 | 0.0035 | 138.0 | 28.1 |
| 23 | 0.397 | 0.0043 | 127.5 | 26.0 |
| 24 | 0.449 | 0.0052 | 124.4 | 25.3 |
| 25 | 0.492 | 0.0062 | 125.0 | 25.5 |

Notes: 1 - Positive vertical displacement represents compression.

**Nominal Shear Stress vs. Horizontal Displacement**




**Vertical Displacement vs. Horizontal Displacement**



Schnabel Engineering

# Consolidated Drained Direct Shear Test

ASTM D3080

Project: *Calvert Cliffs Nuclear Power Plant*

Location: *Calvert County, MD*

Schnabel Contract: *06120048*
Boring No.: *B-313*
Depth: *93.5-94.7ft.*
Effective Normal Stress (psi): *80.0*

Date: *11/9/2006*
Elev: *-42.8 to -44.0 ft.*
Reviewed by: *CJS*

Soil Description: *Sandy LEAN CLAY(CL) contains shell - gray*

Specimen Type: *Tube Sample*

Remarks:

| | |
|---|---|
| Liquid Limit: | *49* |
| Plasticity Index: | *24* |
| % finer that No. 200: | *na* |
| Specific Graivty: | *2.69* |
| Initial Moisture, %: | *35.3* |
| Final Moisture, %: | *39.3* |

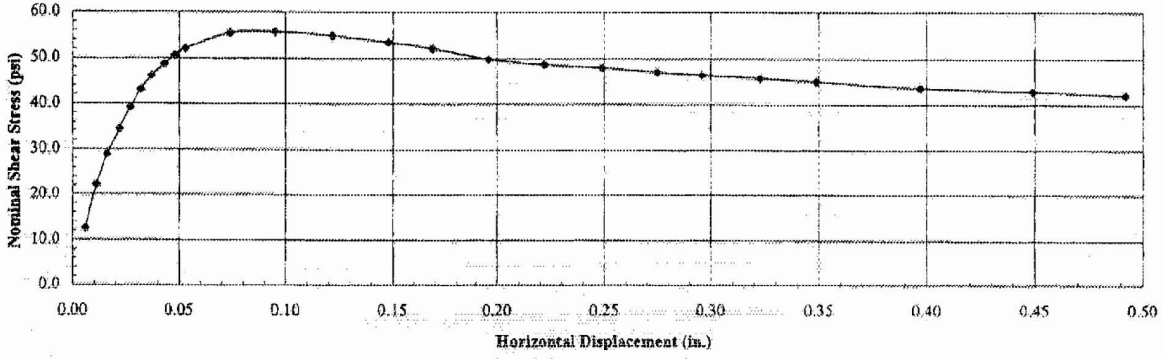
| | Specimen Conditions | |
|---|---|---|
| | Initial | Consolidated |
| Diameter (in) | 2.50 | 2.50 |
| Height (in) | 0.976 | 0.93 |
| Area ($in^2$) | 4.91 | 4.91 |
| Volume ($in^3$) | 4.8 | 4.6 |
| Weight (lbs) | 0.29 | 0.30 |
| $\rho_{wet}$ (pcf) | 106.3 | 114.8 |
| $\rho_{dry}$ (pcf) | 78.6 | 82.4 |
| Void Ratio | 1.13 | 1.03 |
| Saturation, % | 84 | 100 |

| Shear Testing Conditions | |
|---|---|
| Effective Normal Stress (psi): | 80.0 |
| Consolidation Stress (psi): | 80.0 |
| $t_{50}$ (min.): | 0.1 |
| Rate of Displ. (in./min): | 0.00417 |

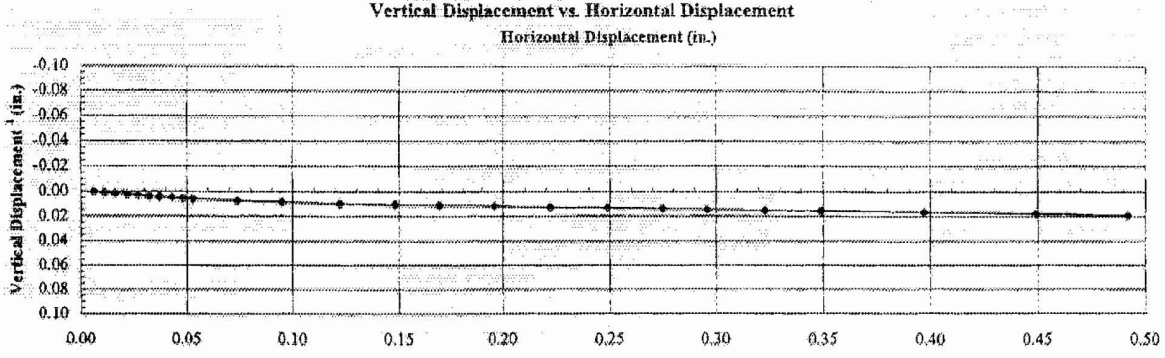
| Reading No. | Horizontal Displacement (in.) | Vertical Displacement[1] (in.) | Shear Force (lbs) | Nominal Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.006 | 0.0003 | 61.7 | 12.6 |
| 2 | 0.011 | 0.0011 | 108.7 | 22.1 |
| 3 | 0.016 | 0.0019 | 141.8 | 28.9 |
| 4 | 0.022 | 0.0027 | 169.3 | 34.5 |
| 5 | 0.027 | 0.0034 | 192.2 | 39.1 |
| 6 | 0.032 | 0.0040 | 211.6 | 43.1 |
| 7 | 0.037 | 0.0046 | 226.4 | 46.1 |
| 8 | 0.043 | 0.0051 | 238.8 | 48.6 |
| 9 | 0.048 | 0.0057 | 248.4 | 50.6 |
| 10 | 0.053 | 0.0061 | 255.5 | 52.0 |
| 11 | 0.074 | 0.0076 | 272.3 | 55.5 |
| 12 | 0.095 | 0.0086 | 273.6 | 55.7 |
| 13 | 0.122 | 0.0098 | 269.6 | 54.9 |
| 14 | 0.148 | 0.0106 | 262.8 | 53.5 |
| 15 | 0.169 | 0.0112 | 255.9 | 52.1 |
| 16 | 0.196 | 0.0118 | 244.5 | 49.8 |
| 17 | 0.222 | 0.0125 | 238.9 | 48.6 |
| 18 | 0.249 | 0.0132 | 235.6 | 48.0 |
| 19 | 0.275 | 0.0139 | 231.3 | 47.1 |
| 20 | 0.296 | 0.0145 | 228.2 | 46.5 |
| 21 | 0.323 | 0.0151 | 224.8 | 45.8 |
| 22 | 0.349 | 0.0156 | 221.2 | 45.0 |
| 23 | 0.397 | 0.0167 | 214.6 | 43.7 |
| 24 | 0.449 | 0.0179 | 210.3 | 42.8 |
| 25 | 0.492 | 0.0193 | 206.3 | 42.0 |

Notes: 1 - Positive vertical displacement represents compression.

**Nominal Shear Stress vs. Horizontal Displacement**




**Vertical Displacement vs. Horizontal Displacement**



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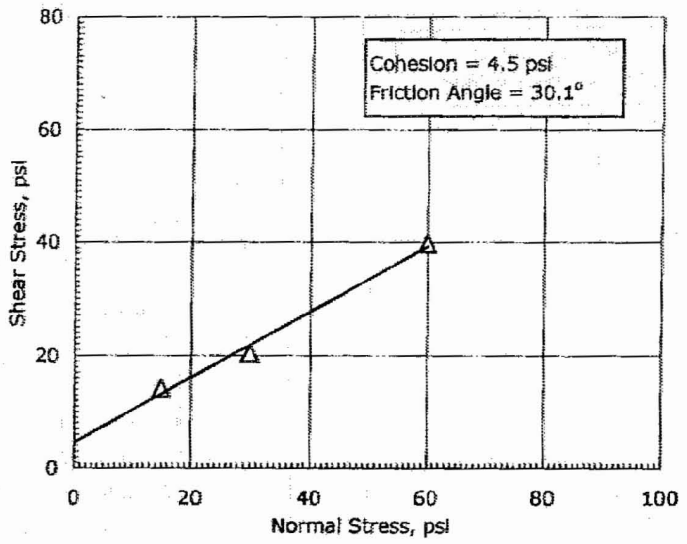
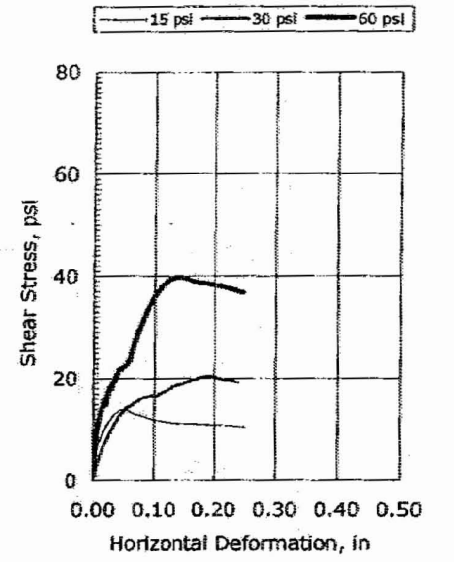
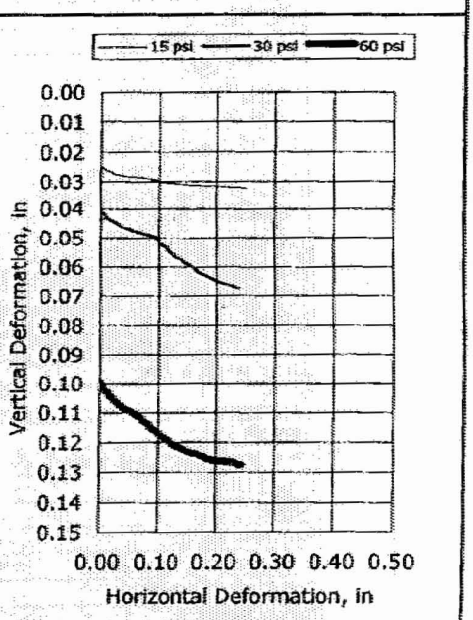
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 9/5/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-316 |
| Sample ID: | S-14 |
| Depth, ft: | 53.5-55.5 |
| Visual Description: | Moist, dark olive gray sandy clay |

# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS1 | DS2 | DS3 |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 144.7 | 138.5 | 145.7 |
| Initial Dry Density, pcf: | 84.6 | 80.3 | 84.5 |
| Initial Moisture Content, %: | 32.8 | 33.8 | 33.7 |
| Initial Bulk Density, pcf: | 112 | 107 | 113 |
| Initial Degree of Saturation: | 86.9 | 81.2 | 89.3 |
| Initial Void Ratio: | 0.978 | 1.15 | 1.05 |
| Final Dry Density, pcf: | 87.4 | 86.1 | 96.9 |
| Final Moisture Content, %: | 36.7 | 41.87 | 33.52 |
| Final Bulk Density, pcf: | 119.5 | 122.1 | 129.4 |
| Normal Stress, psi: | 15.0 | 30.0 | 60.0 |
| Maximum Shear Stress, psi | 14.1 | 20.4 | 39.7 |
| Shear Rate, in/min: | 0.0005 | 0.0005 | 0.0005 |
| $t_{50}$: | --- | --- | 0.5 |




| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.77 |
| Liquid Limit: | 33 |
| Plastic Limit: | 11 |
| Plasticity Index: | 22 |
| % Passing #200 sieve: | 50 |
| Soil Classification: | Sandy Lean Clay |
| Group Symbol: | CL |

Notes:
Moisture content obtained before shear from sample trimmings
Moisture Content determined by ASTM D 2216
Specific Gravity determined by ASTM D 854
Percent passing #200 sieve determined by ASTM D 422

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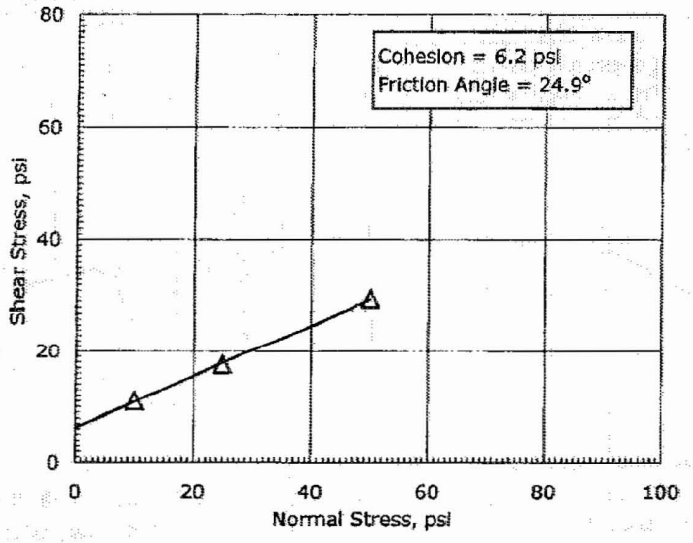
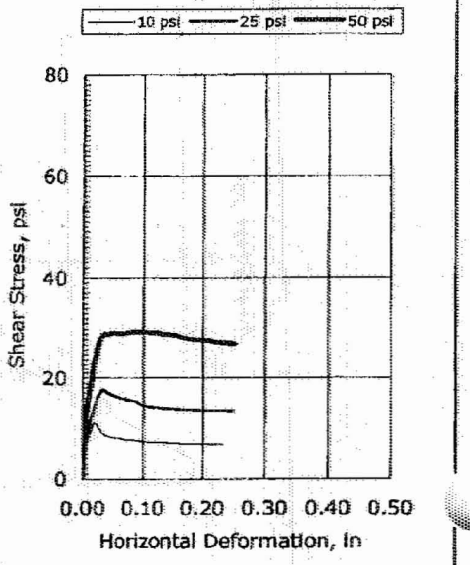
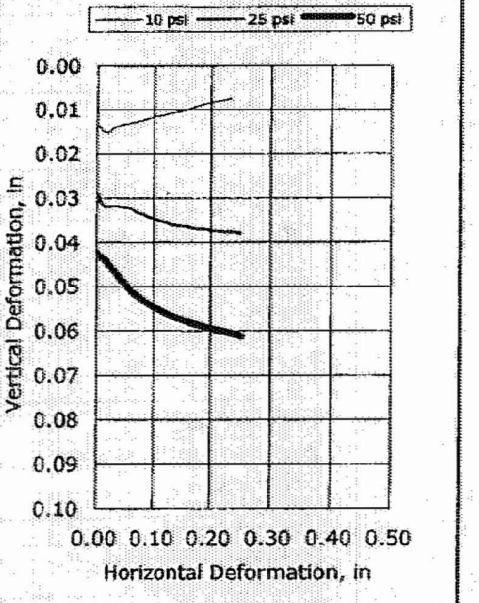
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 9/8/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-319 |
| Sample ID: | S-10 |
| Depth, ft: | 33.5-35.5 |
| Visual Description: | Moist, dark gray clay with sand |

# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS7 | DS8 | DS9 |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 154.5 | 156.0 | 154.5 |
| Initial Dry Density, pcf: | 92.6 | 93.1 | 93.5 |
| Initial Moisture Content, %: | 29.5 | 30.0 | 28.3 |
| Initial Bulk Density, pcf: | 120 | 121 | 120 |
| Initial Degree of Saturation: | 98.4 | 99.6 | 93.7 |
| Initial Void Ratio: | 0.800 | 0.078 | 0.783 |
| Final Dry Density, pcf: | 93.3 | 97.6 | 99.6 |
| Final Moisture Content, %: | 32.3 | 29.6 | 30.1 |
| Final Bulk Density, pcf: | 123.5 | 126.4 | 129.5 |
| Normal Stress, psi: | 10.0 | 25.0 | 50.0 |
| Maximum Shear Stress, psi | 11.0 | 17.5 | 29.5 |
| Shear Rate, in/min: | 0.0005 | 0.0005 | 0.0005 |
| $t_{50}$: | --- | --- | 1.0 |




| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.67 |
| Liquid Limit: | 49 |
| Plastic Limit: | 12 |
| Plasticity Index: | 37 |
| % Passing #200 sieve: | 72 |
| Soil Classification: | Lean Clay with Sand |
| Group Symbol: | CL |

Notes:
Moisture content obtained before shear from sample trimmings
Moisture Content determined by ASTM D 2216
Specific Gravity determined by ASTM D 854
Percent passing #200 sieve determined by ASTM D 422

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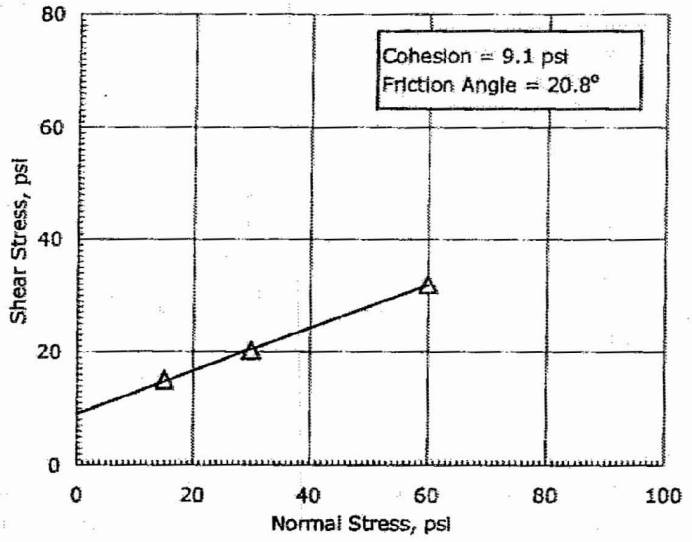
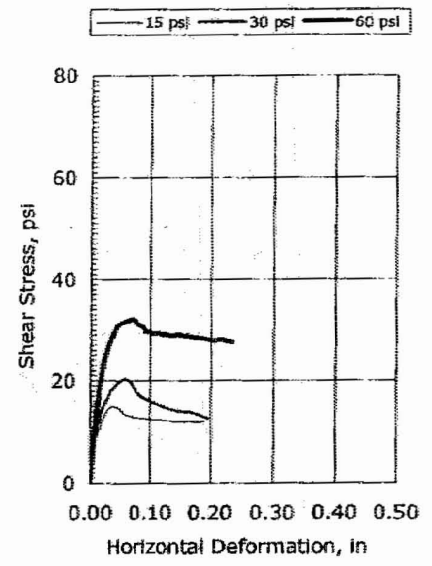
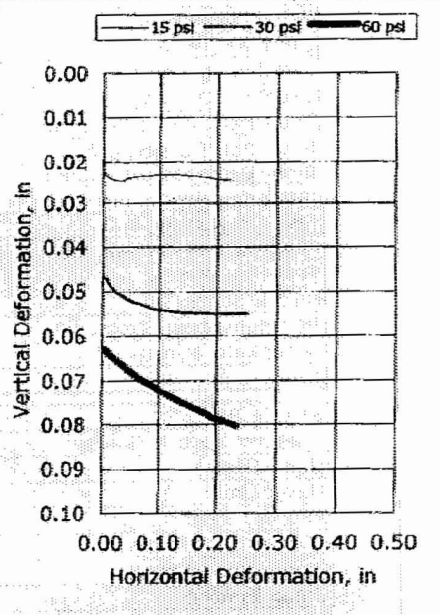
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 9/7/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-319 |
| Sample ID: | S-12 |
| Depth, ft: | 43.5-45.2 |
| Visual Description: | Moist, dark gray clay |

# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS4 | DS5 | DS6a |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 149.8 | 146.8 | 149.0 |
| Initial Dry Density, pcf: | 86.0 | 85.3 | 85.8 |
| Initial Moisture Content, %: | 35.1 | 33.6 | 34.7 |
| Initial Bulk Density, pcf: | 116 | 114 | 116 |
| Initial Degree of Saturation: | 97.7 | 91.9 | 96.1 |
| Initial Void Ratio: | 0.981 | 0.999 | 0.985 |
| Final Dry Density, pcf: | 88.2 | 90.2 | 93.3 |
| Final Moisture Content, %: | 37.12 | 37.5 | 32.2 |
| Final Bulk Density, pcf: | 120.9 | 124.0 | 123.3 |
| Normal Stress, psi: | 15.0 | 30.0 | 60.0 |
| Maximum Shear Stress, psi | 15.0 | 20.2 | 32.0 |
| Shear Rate, in/min: | 0.001 | 0.001 | 0.001 |
| $t_{50}$: | --- | --- | 1.2 |




| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.73 |
| Liquid Limit: | 58 |
| Plastic Limit: | 13 |
| Plasticity Index: | 45 |
| % Passing #200 sieve: | 87 |
| Soil Classification: | Fat Clay |
| Group Symbol: | CH |

Notes:
- Moisture content obtained before shear from sample trimmings
- Moisture Content determined by ASTM D 2216
- Specific Gravity determined by ASTM D 854
- Percent passing #200 sieve determined by ASTM D 422

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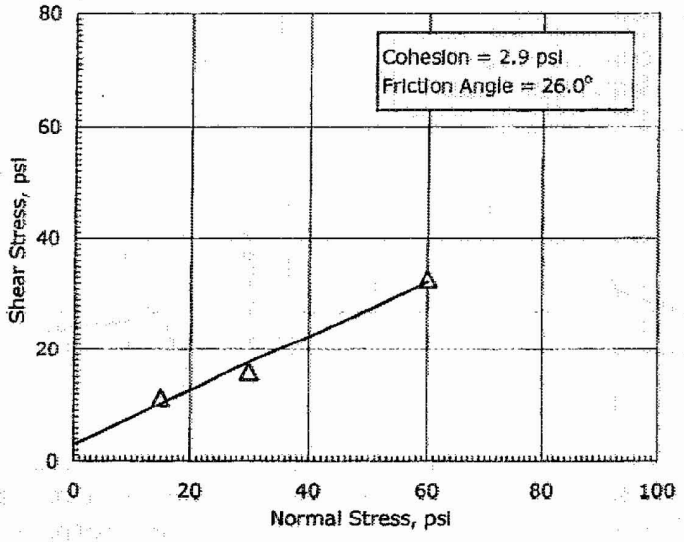
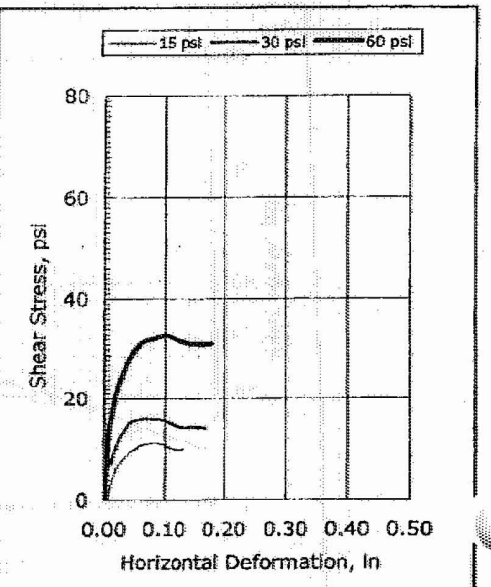
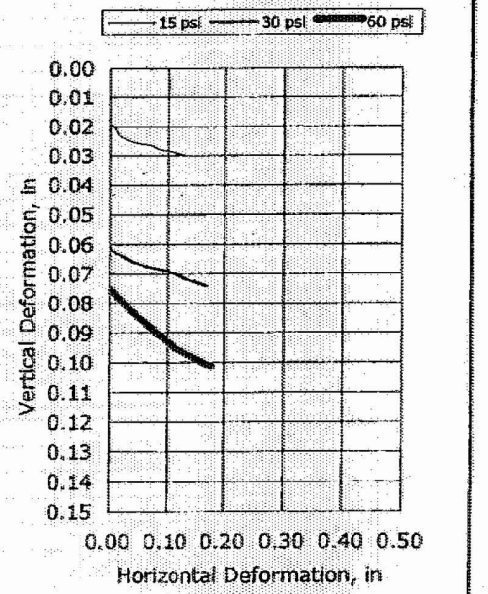
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 10/17/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-320 |
| Sample ID: | S-11 |
| Depth, ft: | 38.5-40.5 |
| Visual Description: | Moist, very dark gray clayey sand |

# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS136 | DS137 | DS138 |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 148.2 | 154.6 | 152.8 |
| Initial Dry Density, pcf: | 89.5 | 94.5 | 92.9 |
| Initial Moisture Content, %: | 28.5 | 27.0 | 27.6 |
| Initial Bulk Density, pcf: | 115 | 120 | 119 |
| Initial Degree of Saturation: | 89.8 | 96.2 | 94.7 |
| Initial Void Ratio: | 0.835 | 0.738 | 0.767 |
| Final Dry Density, pcf: | 92.7 | 102.3 | 103.9 |
| Final Moisture Content, %: | 32.65 | 29.1 | 27.2 |
| Final Bulk Density, pcf: | 122.9 | 132.0 | 132.2 |
| Normal Stress, psi: | 15.0 | 30.0 | 60.0 |
| Maximum Shear Stress, psi | 11.3 | 16.0 | 32.8 |
| Shear Rate, in/min: | 0.0004 | 0.0004 | 0.0004 |
| $t_{50}$: | --- | --- | 0.4 |




| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.63 |
| Liquid Limit: | 36 |
| Plastic Limit: | 16 |
| Plasticity Index: | 20 |
| % Passing #200 sieve: | 49 |
| Soil Classification: | Clayey Sand |
| Group Symbol: | SC |

Notes:
- Moisture content obtained before shear from sample trimmings
- Moisture Content determined by ASTM D 2216
- Specific Gravity determined by ASTM D 854
- Percent passing #200 sieve determined by ASTM D 422

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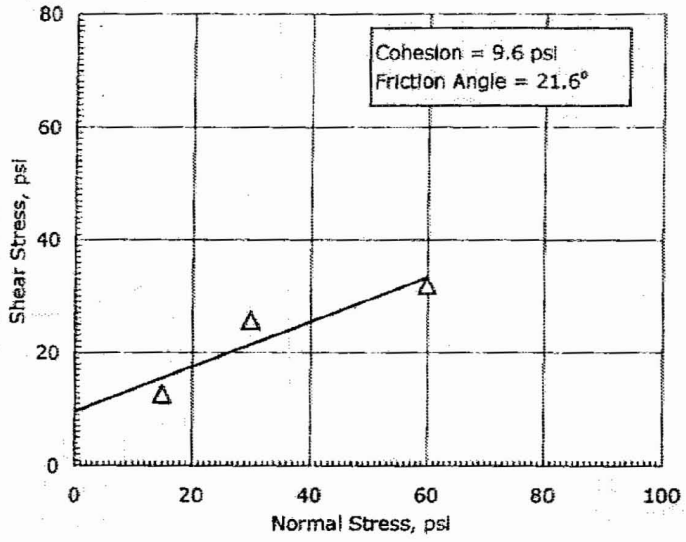
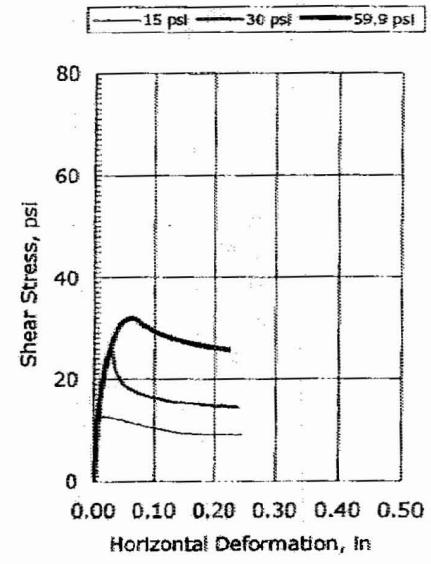
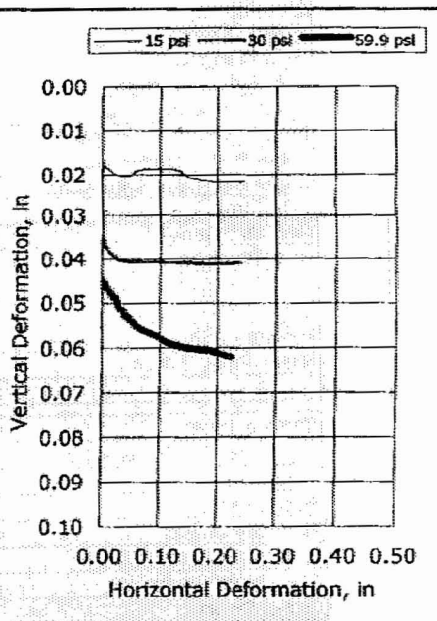
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 9/24/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-320 |
| Sample ID: | S-13 |
| Depth, ft: | 48.5-50.0 |
| Visual Description: | Moist, dark olive gray clay with sand |

# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS136 | DS137 | DS138 |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 146.4 | 146.4 | 145.8 |
| Initial Dry Density, pcf: | 84.0 | 83.7 | 84.1 |
| Initial Moisture Content, %: | 35.3 | 35.8 | 34.6 |
| Initial Bulk Density, pcf: | 114 | 114 | 113 |
| Initial Degree of Saturation: | 93.3 | 93.9 | 91.6 |
| Initial Void Ratio: | 1.037 | 1.044 | 1.034 |
| Final Dry Density, pcf: | 85.9 | 87.2 | 85.6 |
| Final Moisture Content, %: | 39.18 | 38.0 | 36.3 |
| Final Bulk Density, pcf: | 119.5 | 120.4 | 116.7 |
| Normal Stress, psi: | 15.0 | 30.0 | 59.9 |
| Maximum Shear Stress, psi | 12.7 | 25.7 | 31.9 |
| Shear Rate, in/min: | 0.0003 | 0.0003 | 0.0003 |
| $t_{50}$: | --- | --- | 0.4 |




| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.74 |
| Liquid Limit: | 59 |
| Plastic Limit: | 19 |
| Plasticity Index: | 40 |
| % Passing #200 sieve: | 82 |
| Soil Classification: | Fat Clay with Sand |
| Group Symbol: | CH |

Notes:
- Moisture content obtained before shear from sample trimmings
- Moisture Content determined by ASTM D 2216
- Specific Gravity determined by ASTM D 854
- Percent passing #200 sieve determined by ASTM D 422

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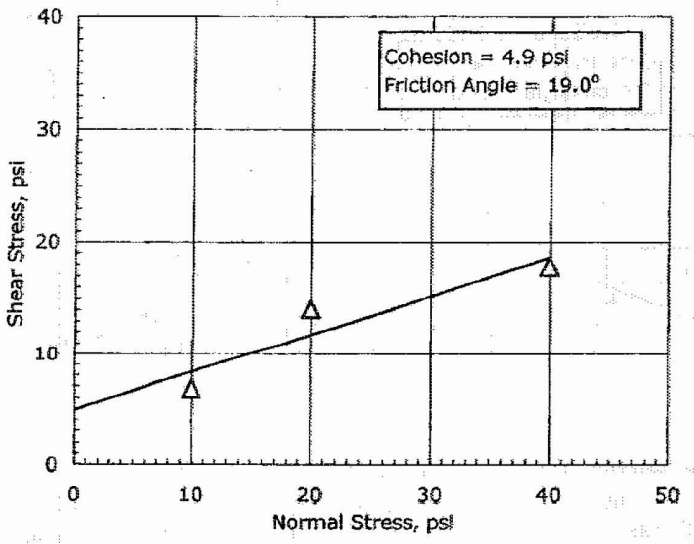
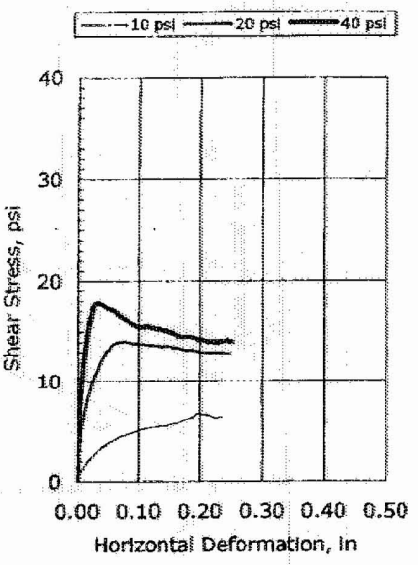
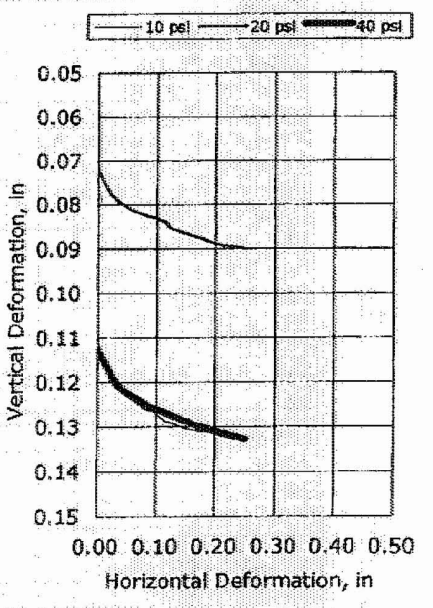
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 10/13/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-326 |
| Sample ID: | S-12 |
| Depth, ft: | 43.5-45.5 |
| Visual Description: | Moist, very dark gray organic clay |

# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS133 | DS134 | DS135 |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 144.3 | 145.6 | 142.0 |
| Initial Dry Density, pcf: | 87.3 | 87.2 | 81.5 |
| Initial Moisture Content, %: | 28.2 | 29.6 | 35.2 |
| Initial Bulk Density, pcf: | 111.9 | 113.0 | 110.2 |
| Initial Degree of Saturation: | 81.9 | 85.6 | 89.0 |
| Initial Void Ratio: | 0.930 | 0.933 | 1.068 |
| Final Dry Density, pcf: | 100.4 | 95.8 | 94.0 |
| Final Moisture Content, %: | 39.1 | 34.0 | 37.7 |
| Final Bulk Density, pcf: | 139.6 | 128.4 | 129.5 |
| Normal Stress, psi: | 10.0 | 20.0 | 40.0 |
| Maximum Shear Stress, psi | 6.7 | 14.1 | 17.8 |
| Shear Rate, in/min: | 0.0004 | 0.0004 | 0.0004 |
| $t_{50}$: | --- | --- | 4.7 |




| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.70 |
| Liquid Limit: | 63 |
| Plastic Limit: | 22 |
| Plasticity Index: | 41 |
| % Passing #200 sieve: | 89 |
| Soil Classification: | Organic Clay |
| Group Symbol: | OH |

Notes:
- Moisture content obtained before shear from sample trimmings
- Moisture Content determined by ASTM D 2216
- Specific Gravity determined by ASTM D 854
- Percent passing #200 sieve determined by ASTM D 422

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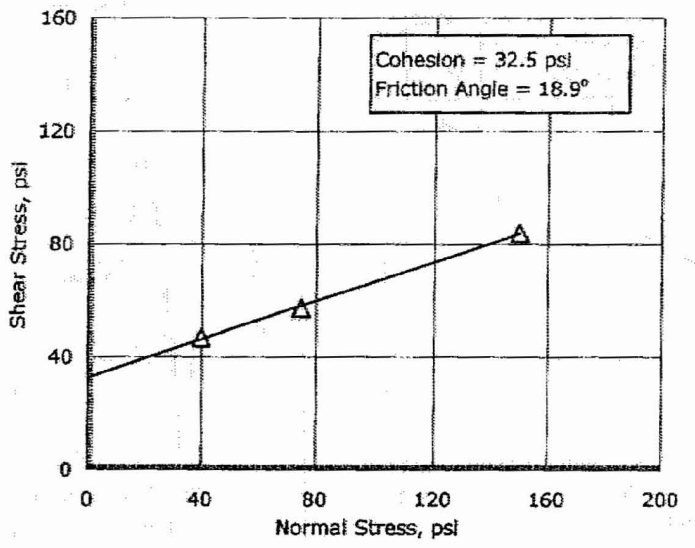
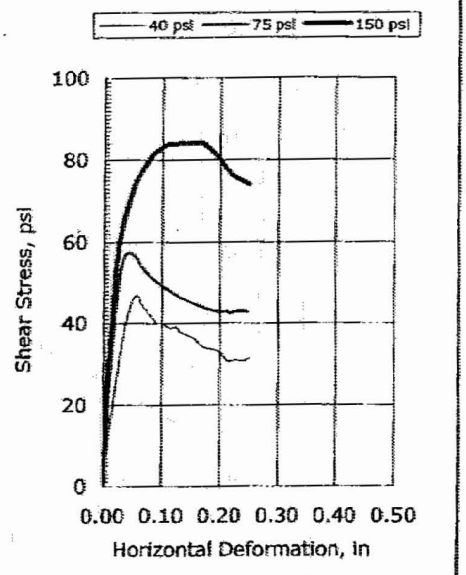
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 9/19/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-401 |
| Sample ID: | S-37 |
| Depth, ft: | 173.5-174.4 |
| Visual Description: | Moist, dark greenish gray clay |

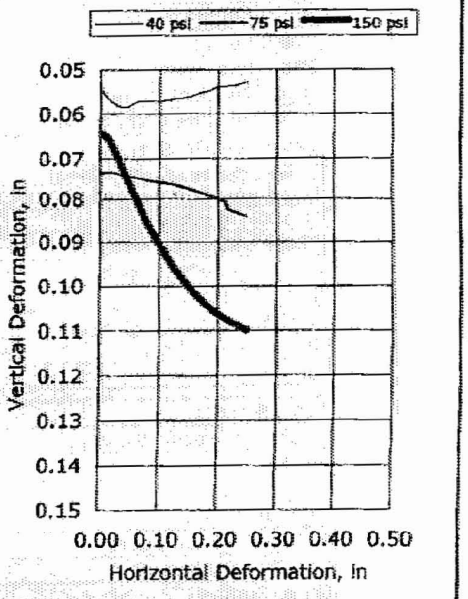
# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS300 | DS301 | DS302 |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 117.3 | 120.0 | 115.1 |
| Initial Dry Density, pcf: | 50.6 | 52.2 | 50.0 |
| Initial Moisture Content, %: | 80.1 | 78.6 | 78.6 |
| Initial Bulk Density, pcf: | 91.1 | 93 | 89 |
| Initial Degree of Saturation: | 91.8 | 94.1 | 88.7 |
| Initial Void Ratio: | 2.408 | 2.304 | 2.443 |
| Final Dry Density, pcf: | 53.4 | 56.9 | 56.2 |
| Final Moisture Content, %: | 89.1 | 82.6 | 79.2 |
| Final Bulk Density, pcf: | 100.9 | 103.9 | 100.8 |
| Normal Stress, psi: | 40.0 | 75.0 | 150.0 |
| Maximum Shear Stress, psi | 46.8 | 57.3 | 84.1 |
| Shear Rate, in/min: | 0.0003 | 0.0006 | 0.0006 |
| $t_{50}$: | --- | --- | 1.4 |

| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.76 |
| Liquid Limit: | 57 |
| Plastic Limit: | 17 |
| Plasticity Index: | 40 |
| % Passing #200 sieve: | 98 |
| Soil Classification: | Fat Clay |
| Group Symbol: | CH |

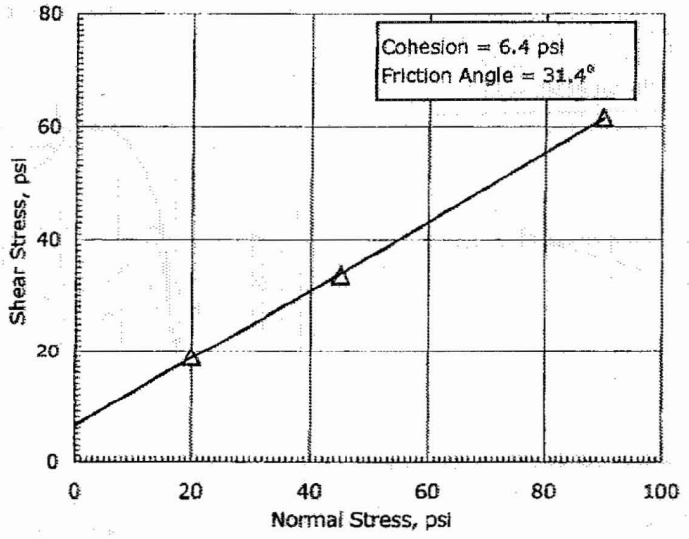


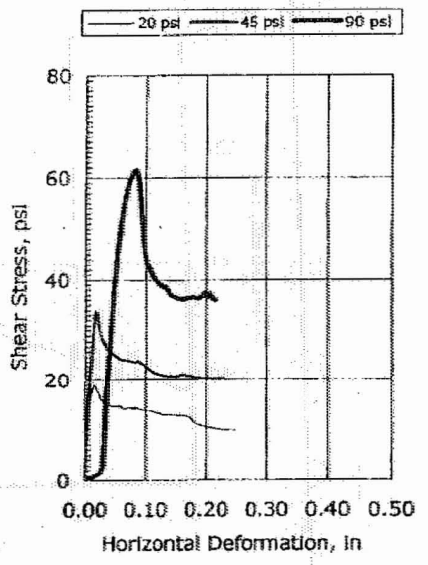

Notes:
- Moisture content obtained before shear from sample trimmings
- Moisture Content determined by ASTM D 2216
- Specific Gravity determined by ASTM D 854
- Percent passing #200 sieve determined by ASTM D 422

**GeoTesting express**
a subsidiary of Geocomp Corporation

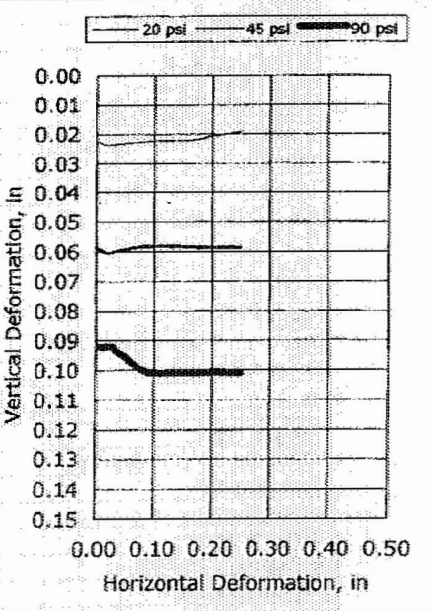
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 9/27/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-413 |
| Sample ID: | S-17 |
| Depth, ft: | 73-75 |
| Visual Description: | Moist, dark greenish gray clay |

# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS101 | DS102 | DS103 |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 143.7 | 144.8 | 146.4 |
| Initial Dry Density, pcf: | 81.8 | 83.0 | 85.1 |
| Initial Moisture Content, %: | 36.4 | 35.3 | 33.5 |
| Initial Bulk Density, pcf: | 111.5 | 112 | 114 |
| Initial Degree of Saturation: | 91.7 | 91.6 | 91.2 |
| Initial Void Ratio: | 1.084 | 1.053 | 1.002 |
| Final Dry Density, pcf: | 83.4 | 88.2 | 94.7 |
| Final Moisture Content, %: | 46.0 | 39.4 | 40.3 |
| Final Bulk Density, pcf: | 121.7 | 122.9 | 132.8 |
| Normal Stress, psi: | 20.0 | 45.0 | 90.0 |
| Maximum Shear Stress, psi | 18.8 | 33.6 | 61.5 |
| Shear Rate, in/min: | 0.0005 | 0.0005 | 0.0005 |
| $t_{50}$: | --- | --- | 0.7 |




| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.73 |
| Liquid Limit: | 59 |
| Plastic Limit: | 16 |
| Plasticity Index: | 43 |
| % Passing #200 sieve: | 98 |
| Soil Classification: | Fat Clay |
| Group Symbol: | CH |

Notes:
Moisture content obtained before shear from sample trimmings
Moisture Content determined by ASTM D 2216
Specific Gravity determined by ASTM D 854
Percent passing #200 sieve determined by ASTM D 422

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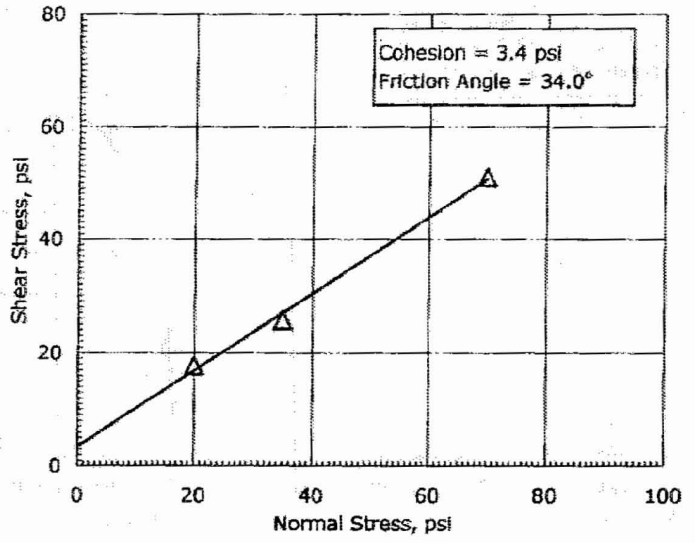
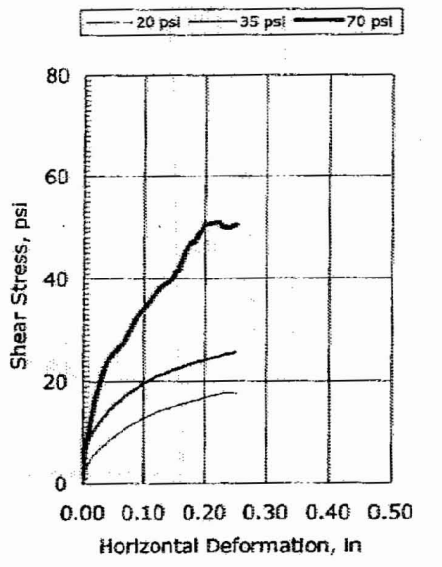
| | |
|---|---|
| Client: | Schnabel Engineering, Inc. |
| Project Name: | Subsurface Investigation Calvert Cliffs Nuclear PP |
| Project Location: | Calvert County, MD |
| GTX #: | 6880 |
| Test Date: | 9/11/2006 |
| Tested By: | md |
| Checked By: | jdt |
| Boring ID: | B-420 |
| Sample ID: | S-16 |
| Depth, ft: | 63.5-65.5 |
| Visual Description: | Moist, olive gray clayey sand |

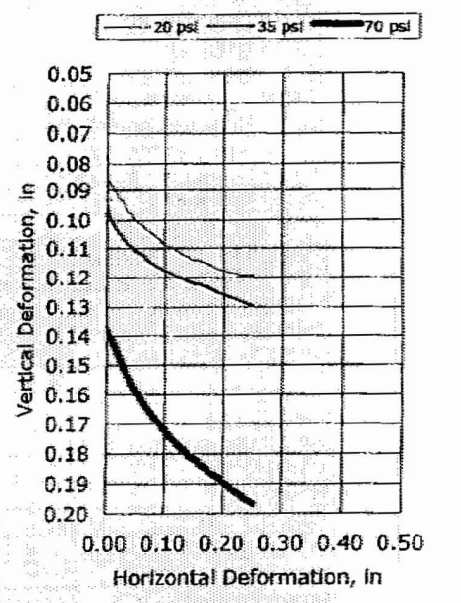
# Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D 3080-04




| Test No.: | DS10 | DS11 | DS12 |
|---|---|---|---|
| Initial Diameter, in: | 2.5 | 2.5 | 2.5 |
| Initial Height, in: | 1.0 | 1.0 | 1.0 |
| Initial Mass, grams: | 127.6 | 132.4 | 130.8 |
| Initial Dry Density, pcf: | 73.8 | 75.4 | 74.7 |
| Initial Moisture Content, %: | 34.1 | 36.3 | 36.0 |
| Initial Bulk Density, pcf: | 99.0 | 103 | 102 |
| Initial Degree of Saturation: | 70.8 | 78.2 | 76.1 |
| Initial Void Ratio: | 1.325 | 1.278 | 1.300 |
| Final Dry Density, pcf: | 83.9 | 86.6 | 92.9 |
| Final Moisture Content, %: | 38.9 | 39.6 | 36.9 |
| Final Bulk Density, pcf: | 116.5 | 120.9 | 127.2 |
| Normal Stress, psi: | 20.0 | 35.0 | 70.0 |
| Maximum Shear Stress, psi | 17.7 | 25.8 | 51.0 |
| Shear Rate, in/min: | 0.0003 | 0.0003 | 0.0003 |
| $t_{50}$: | --- | --- | 0.8 |

| | |
|---|---|
| Sample Type: | Tube |
| Measured Specific Gravity: | 2.75 |
| Liquid Limit: | 49 |
| Plastic Limit: | 11 |
| Plasticity Index: | 38 |
| % Passing #200 sieve: | 19 |
| Soil Classification: | Clayey Sand |
| Group Symbol: | SC |




Notes:
Moisture content obtained before shear from sample trimmings
Moisture Content determined by ASTM D 2216
Specific Gravity determined by ASTM D 854
Percent passing #200 sieve determined by ASTM D 422