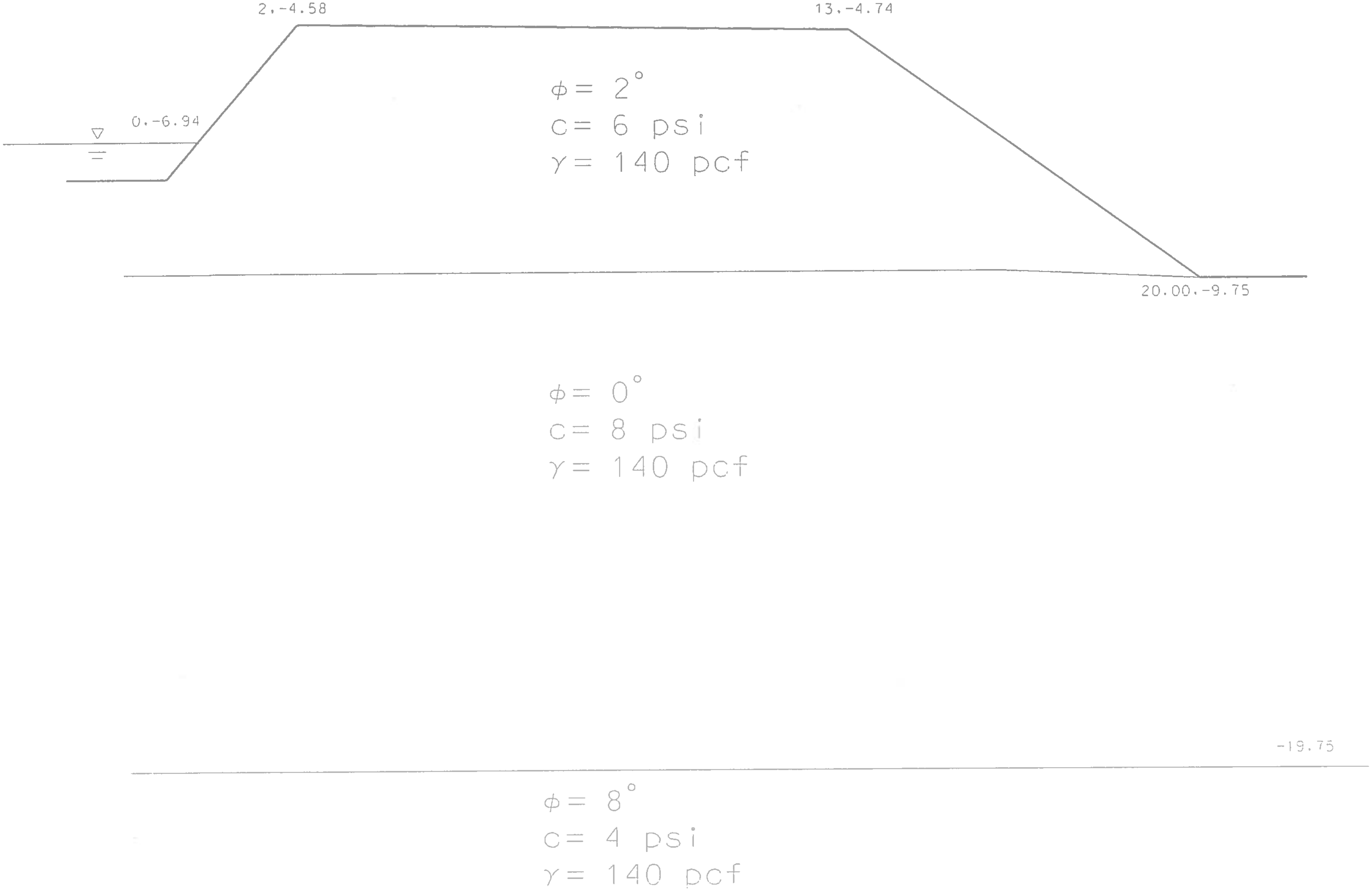
AP - 111

EVAPORATION
POND REPAIRS
REV. 1 (3 of 4)

2017

Section 1

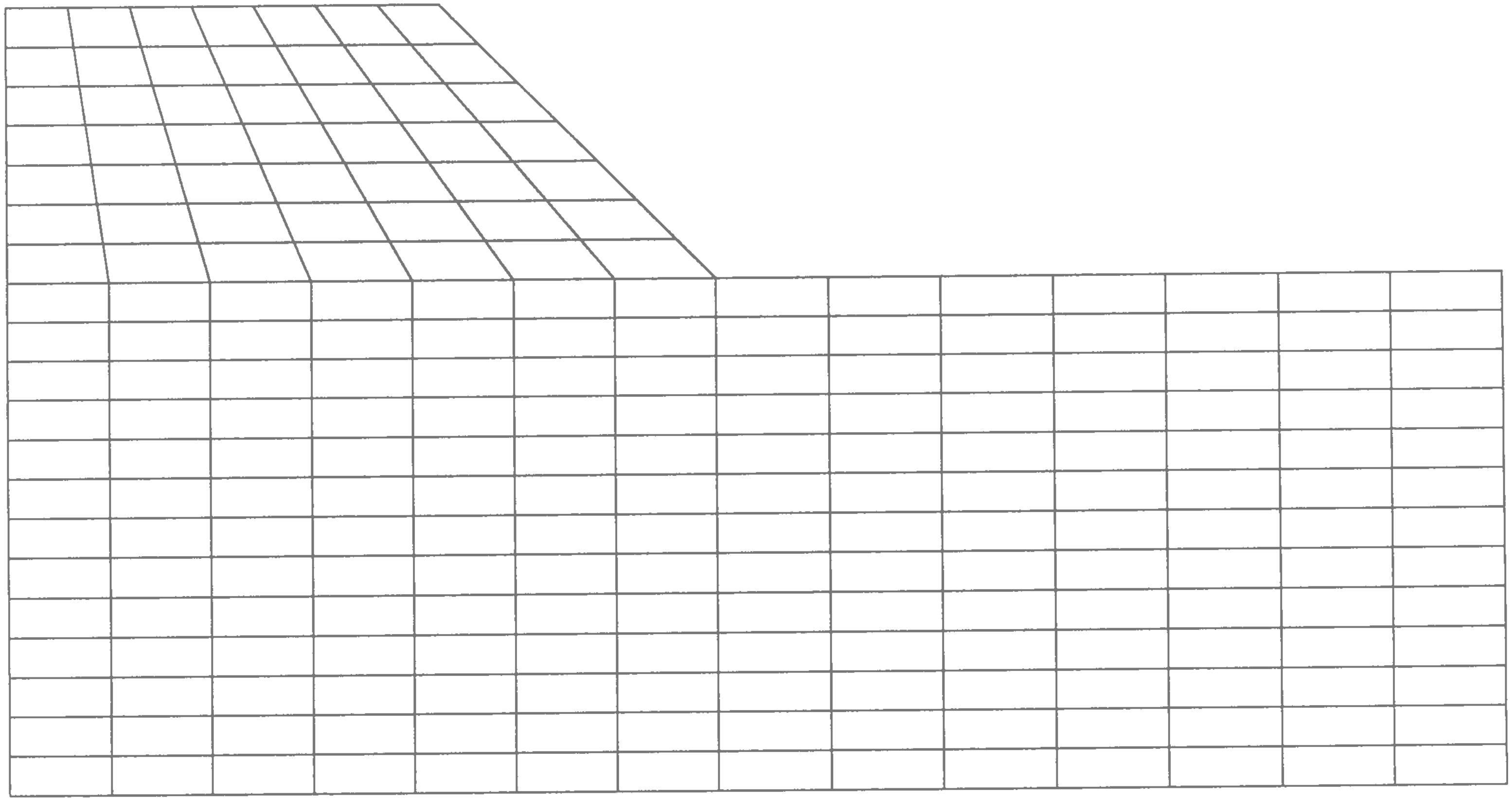
Factor Of Safety = 5.5



```
Section 1 Profile

w1=   11.00
s1=    7.00
w2=   20.00
h1=    7.00
h2=   13.00

nx1=    7
nx2=    7
ny1=    7
ny2=   13

Group  phi      c       psi    gamma      e          v
  1    2.00  864.00    0.00   140.00  0.1000E+06    0.30
  2    0.00 1152.00    0.00   145.00  0.1000E+06    0.30
  3    8.00  576.00    0.00   135.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   2   2   2   2   2   2   2
   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   3   3   3   3   3   3   3   3   3   3   3   3   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3

 tol=  0.000100
 limit= 1000

       trial factor    max displacement    iterations
       0.4500E+01      0.4536E+00              51
       0.5000E+01      0.4976E+00              74
       0.5250E+01      0.5456E+00             162
       0.5500E+01      0.2521E+01            1000
```

Section 1

Mesh



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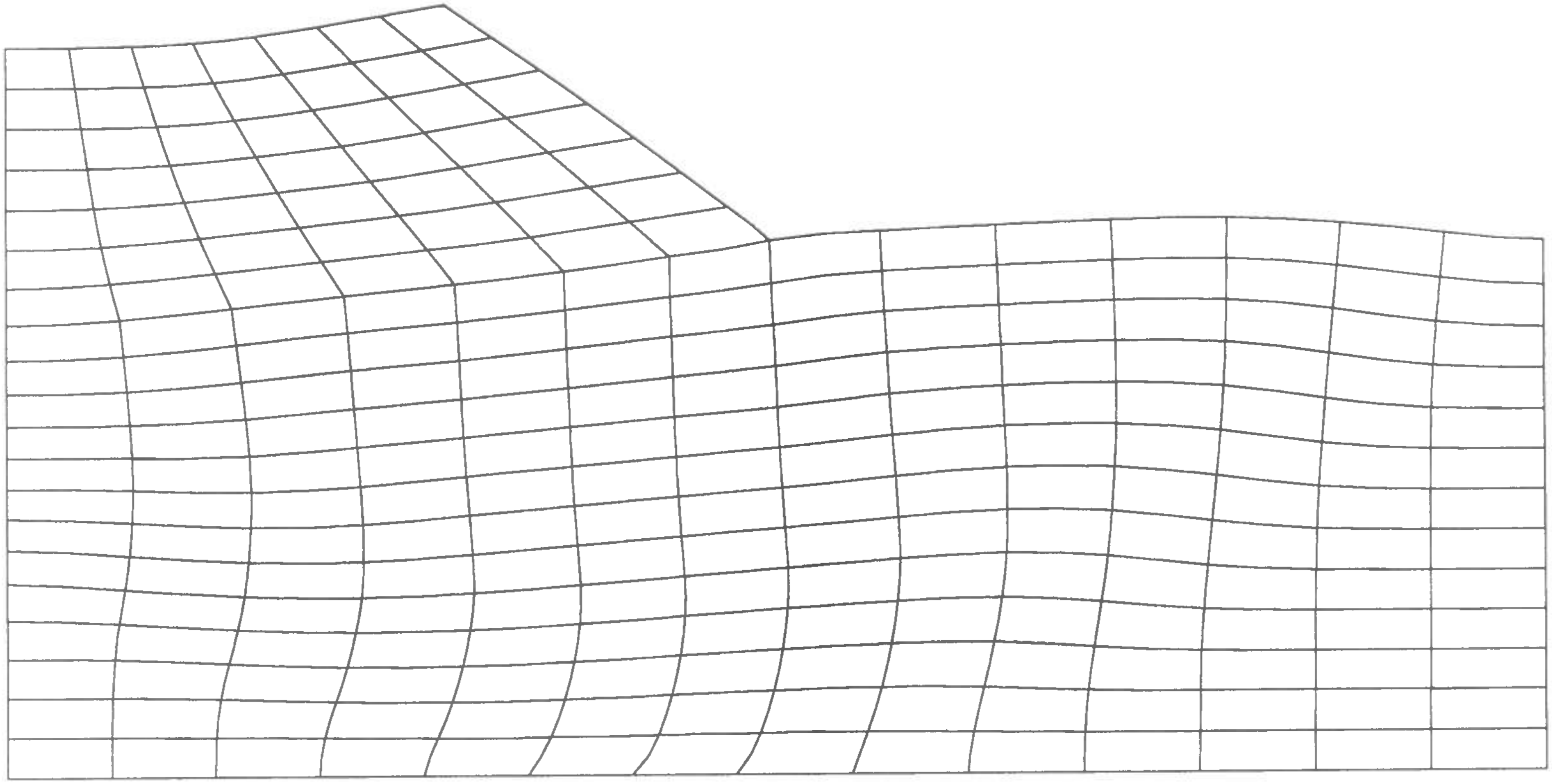
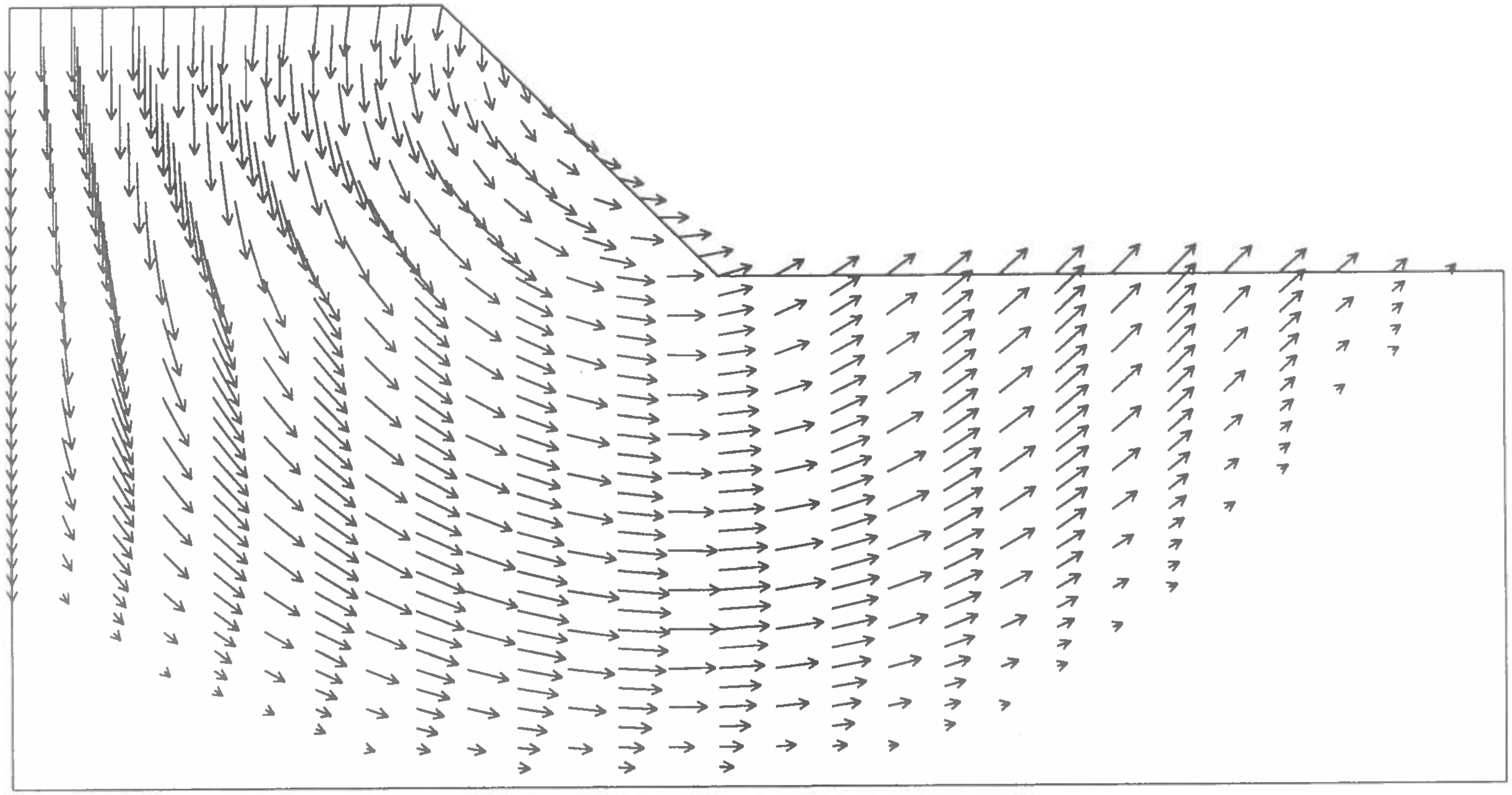
Section 1
Deformed Mesh

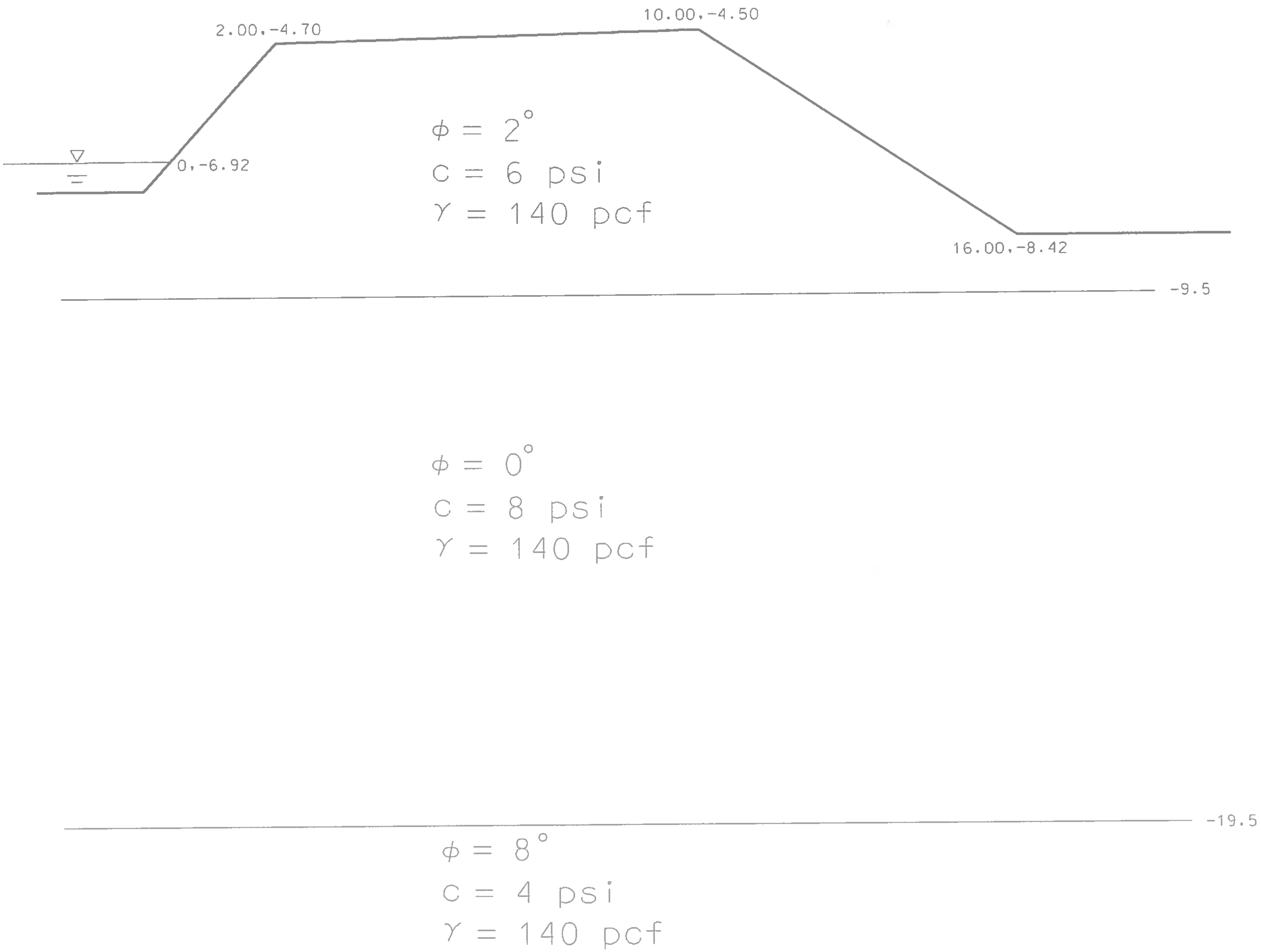


Section 1
Vector Trace



Section 2

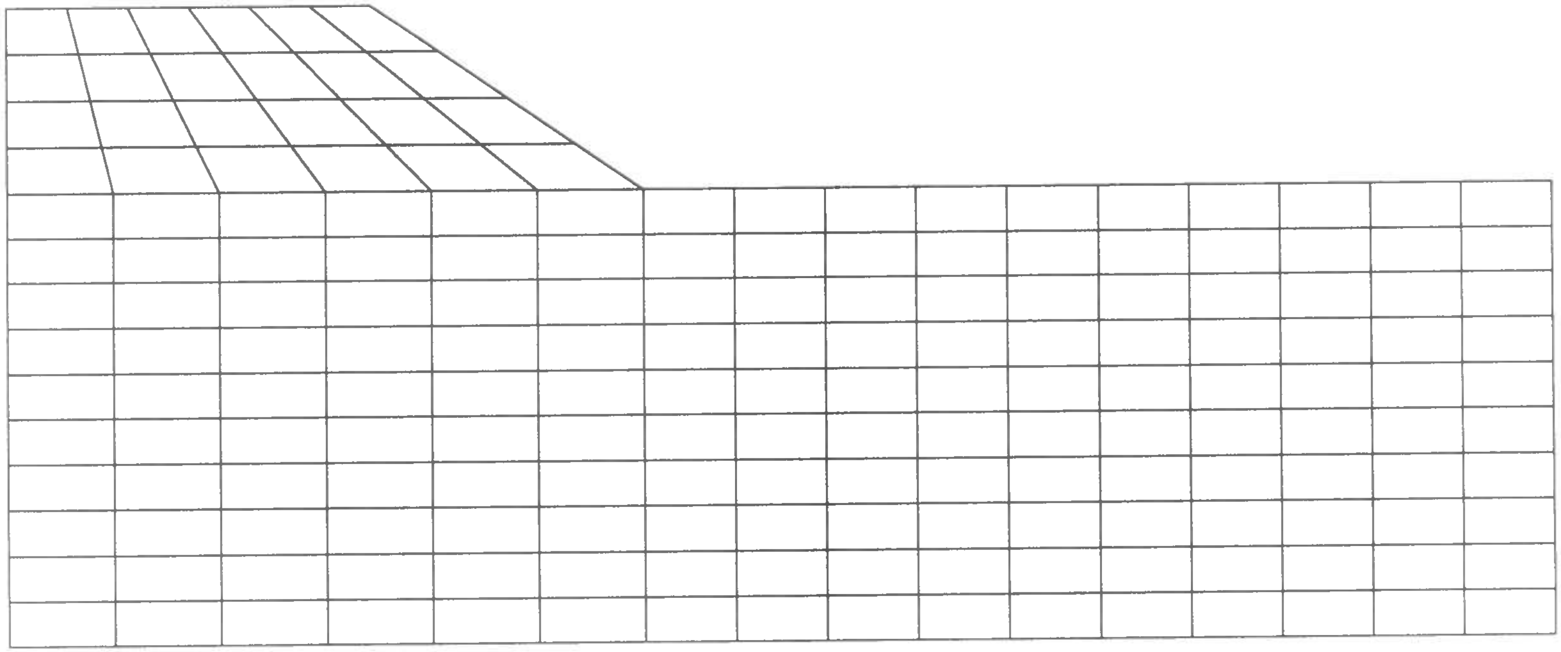
Factor Of Safety = 10.0



```
Section 2 Profile

w1=    8.00
s1=    6.00
w2=   20.00
h1=    4.10
h2=   10.00

nx1=    6
nx2=   10
ny1=    4
ny2=   10

Group  phi       c      psi    gamma       e          v
  1    2.00  864.00    0.00  140.00  0.1000E+06    0.30
  2    0.00 1152.00    0.00  145.00  0.1000E+06    0.30
  3    8.00  576.00    0.00  135.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2

tol=  0.000100
limit= 1000

      trial factor    max displacement   iterations
      0.9000E+01      0.2518E+00             83
      0.9500E+01      0.2638E+00            182
      0.1000E+02      0.3798E+00           1000
```

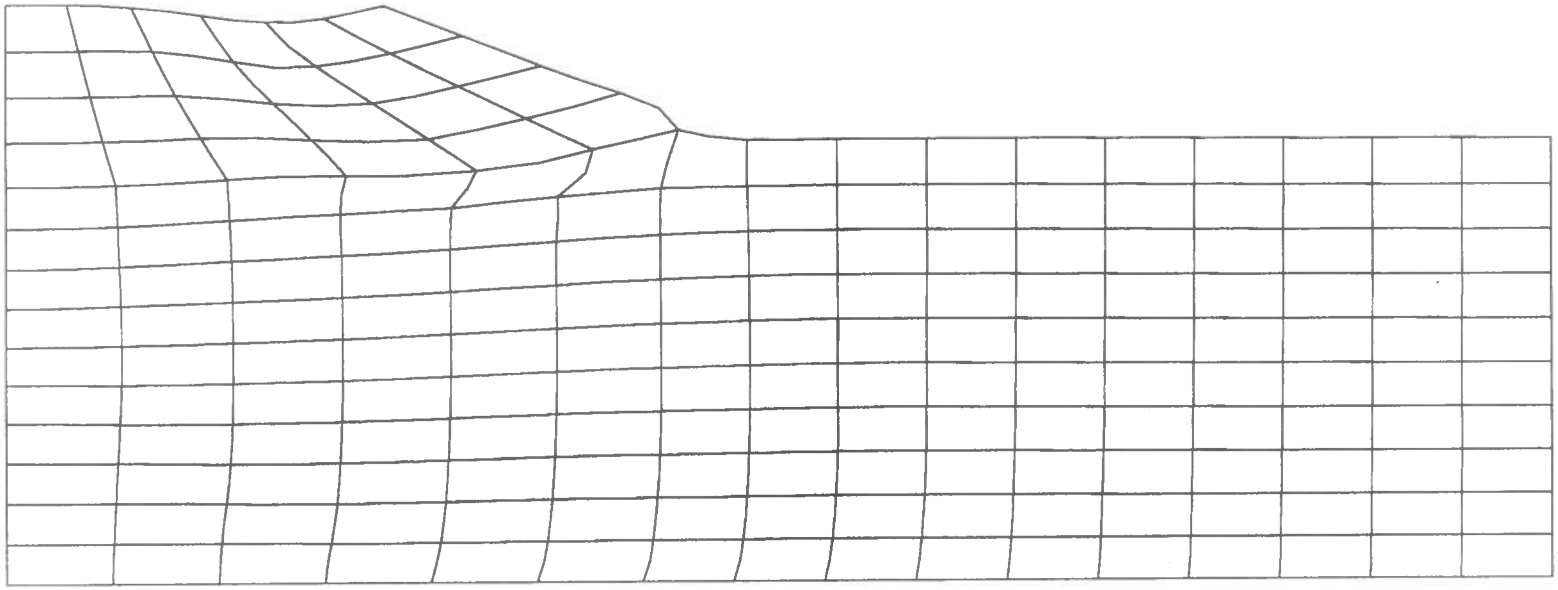
Section 2

Mesh

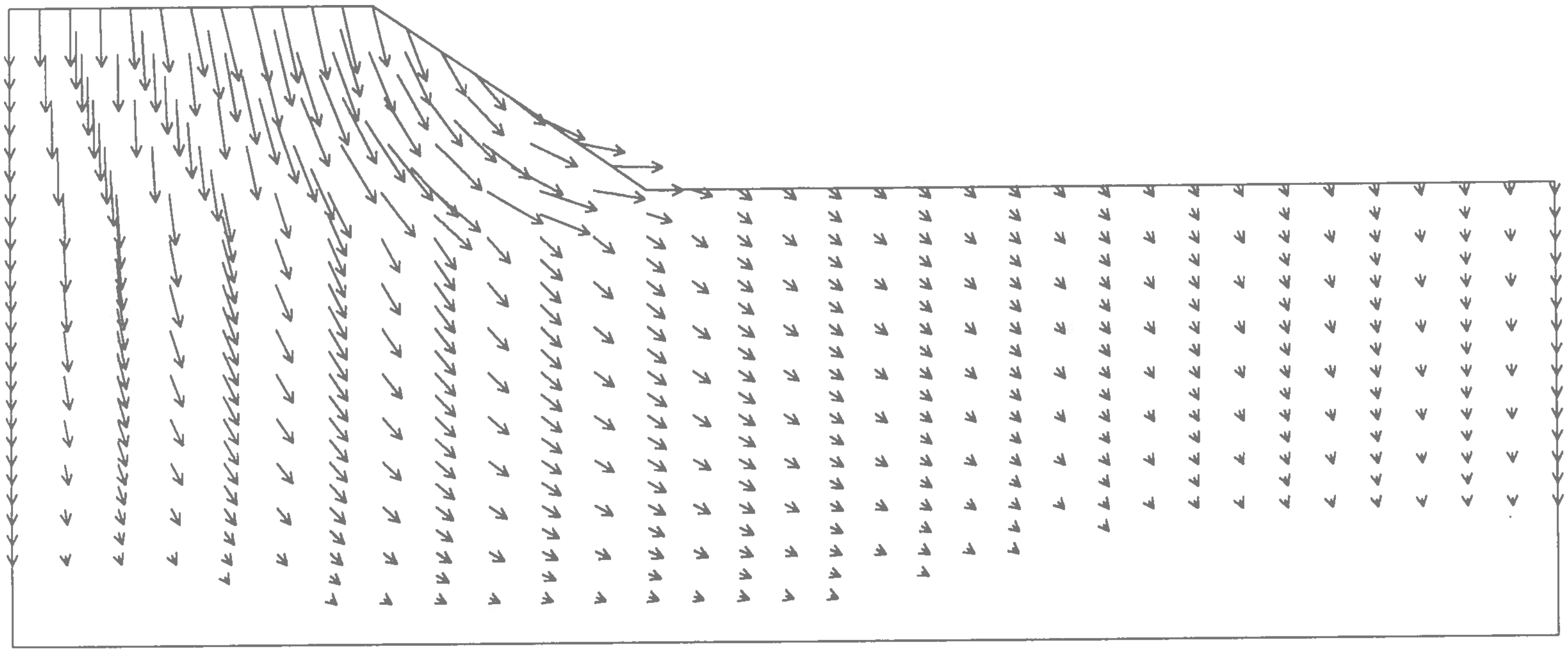


Section 2

Deformed Mesh

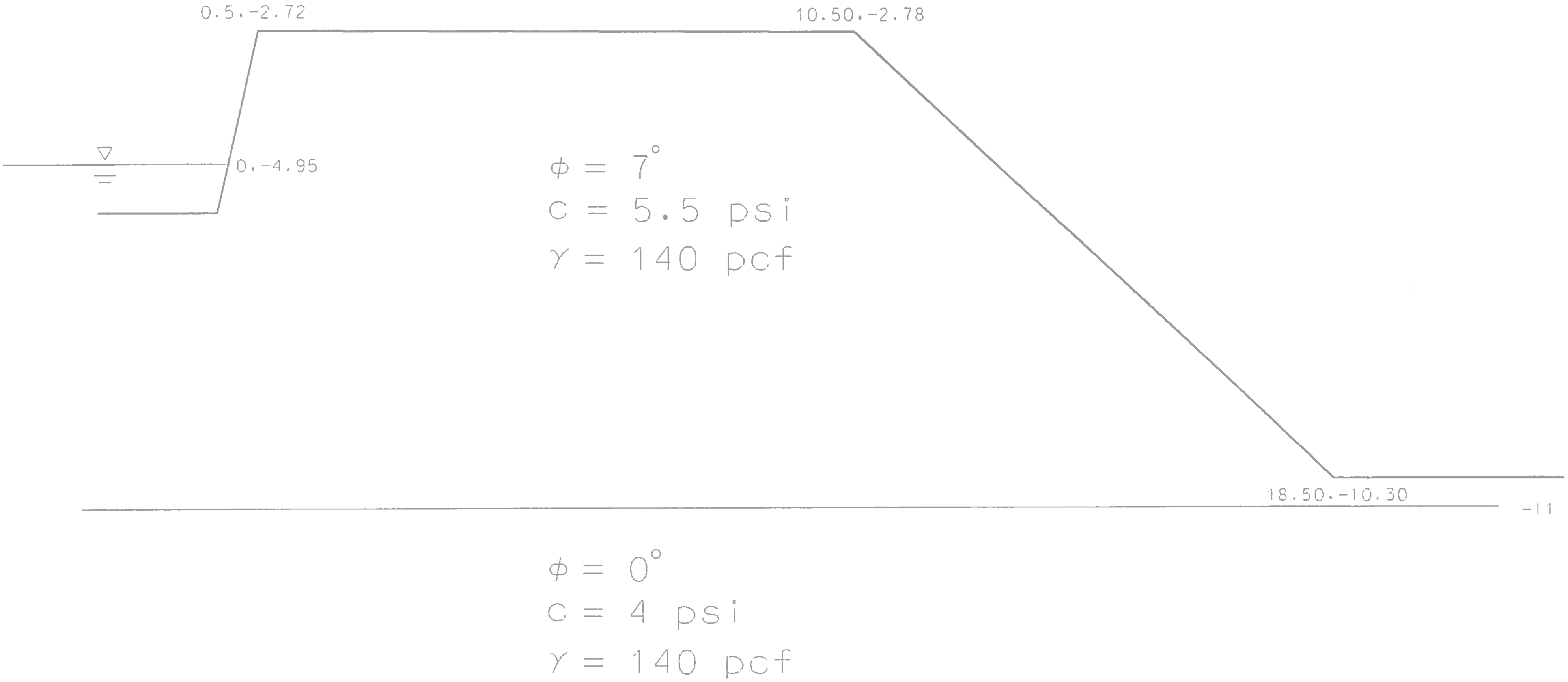


Section 2
Vector Trace



Section 3

Factor Of Safety = 3.0

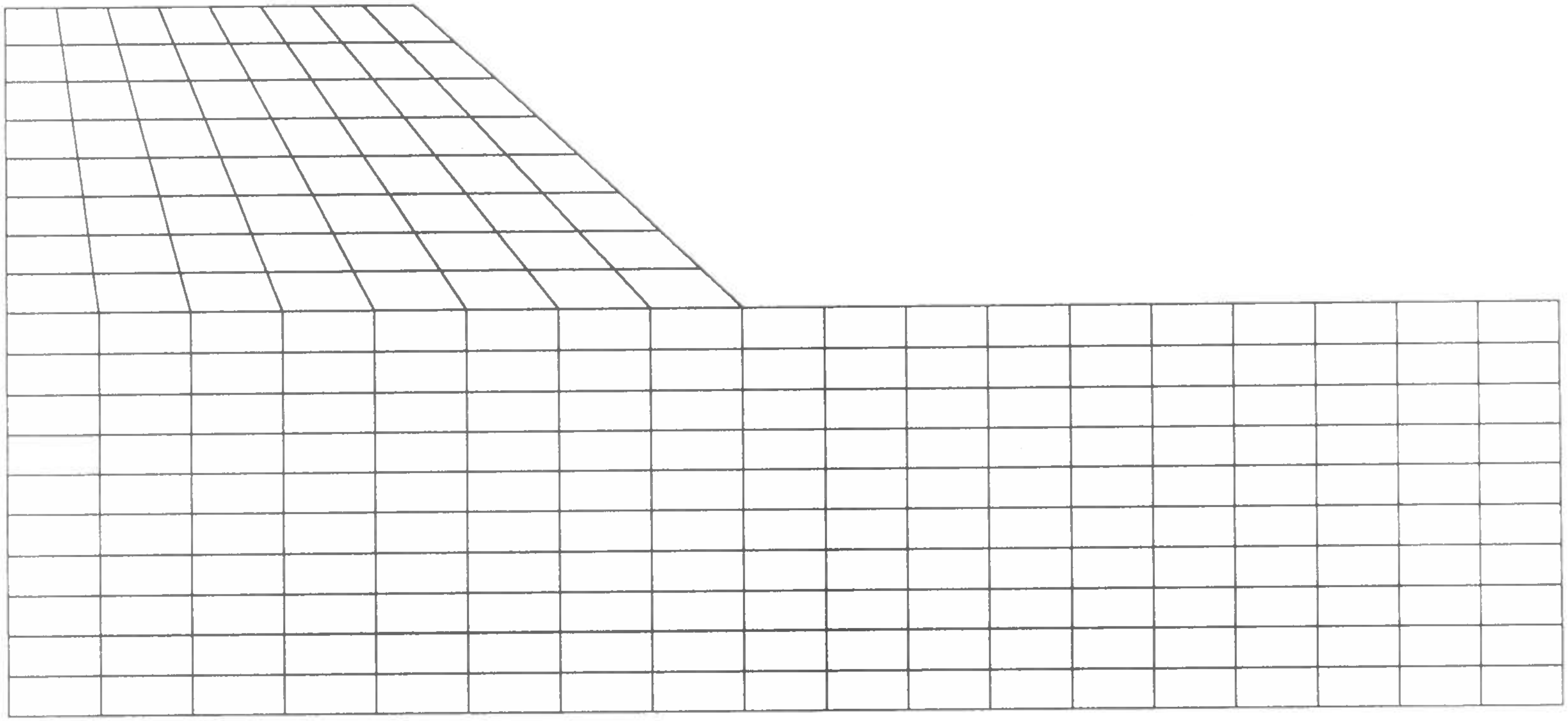


```
Section 3 Profile

w1=   10.00
s1=    8.00
w2=   20.00
h1=    7.50
h2=   10.00

nx1=    8
nx2=   10
ny1=    8
ny2=   10

Group  phi      c      psi    gamma       e          v
  1    7.00  792.00    0.00  140.00  0.1000E+06    0.30
  2    0.00  576.00    0.00  130.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2

tol=  0.000100
```

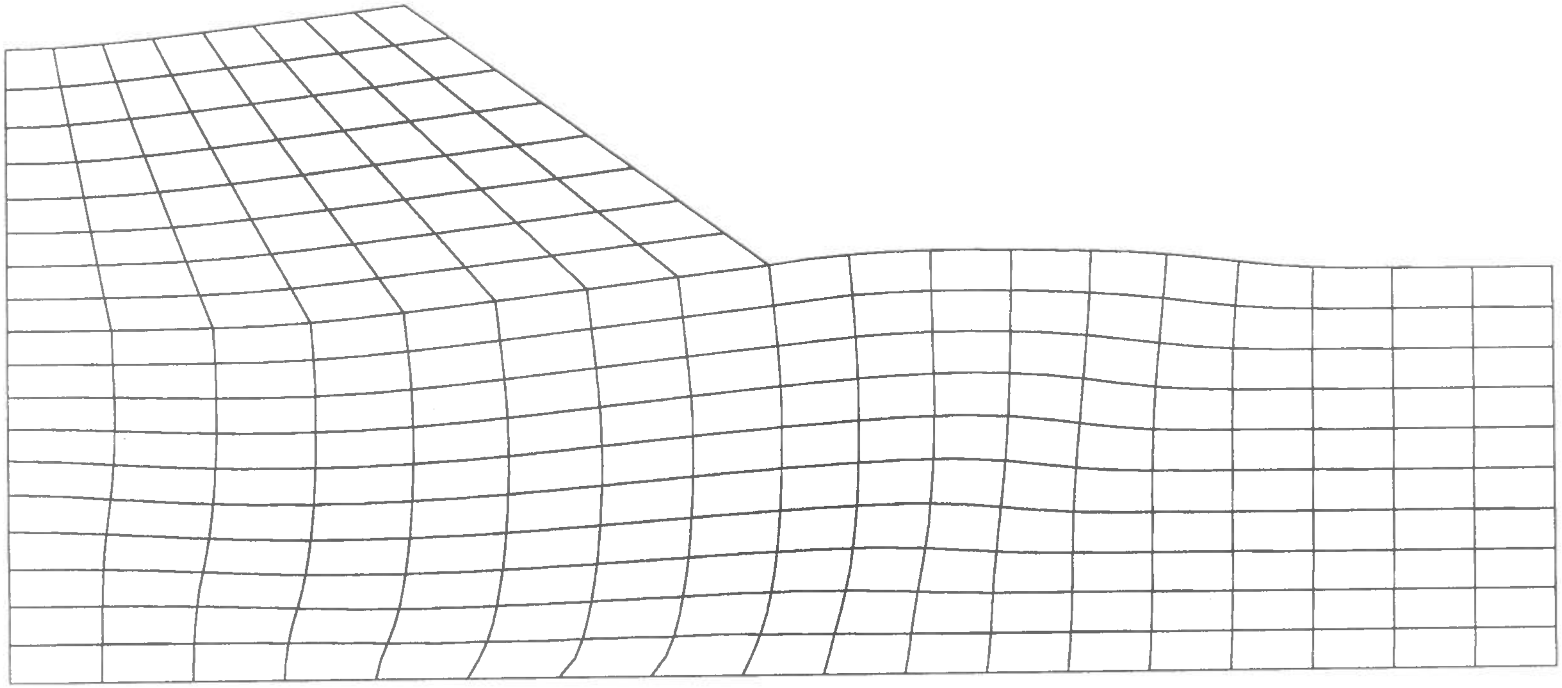
```
limit= 1000

      trial factor    max displacement   iterations
      0.2000E+01      0.2554E+00             40
      0.2500E+01      0.3177E+00             62
      0.2750E+01      0.3490E+00             70
      0.3000E+01      0.8735E+00           1000
```

Section 3

Mesh



Section 3
Deformed Mesh



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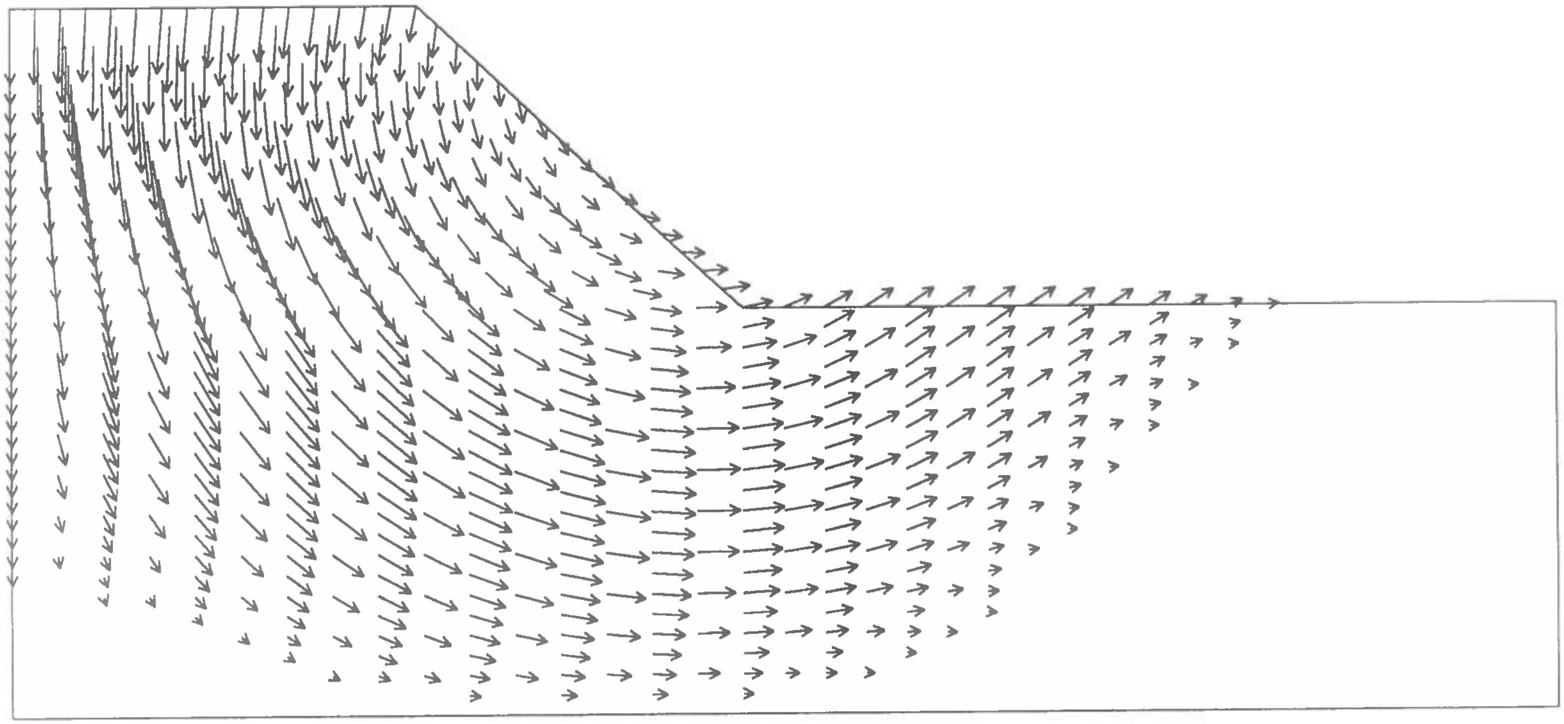
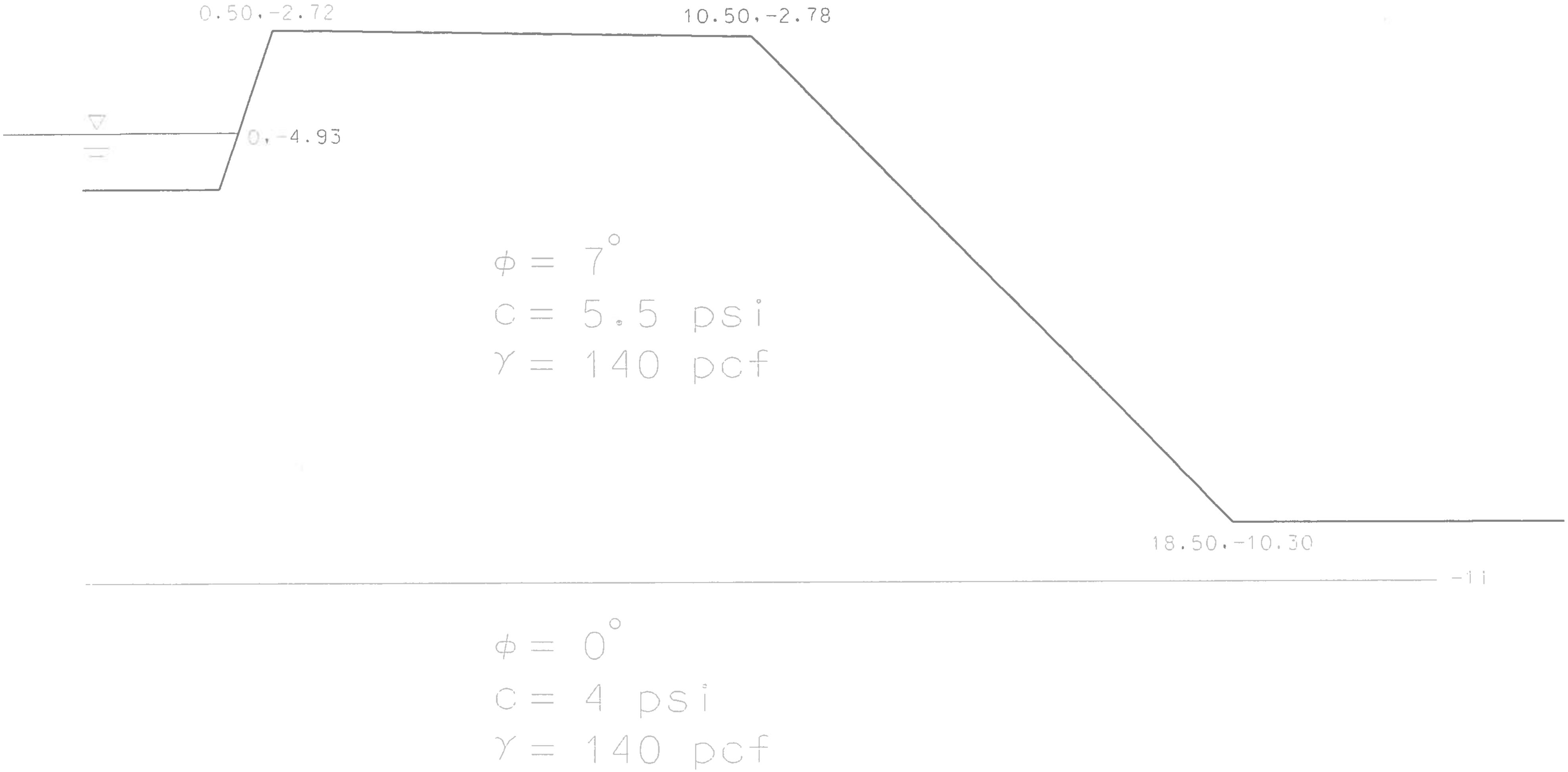
Section 3
Vector Trace



Section 4

Factor Of Safety = 3.0

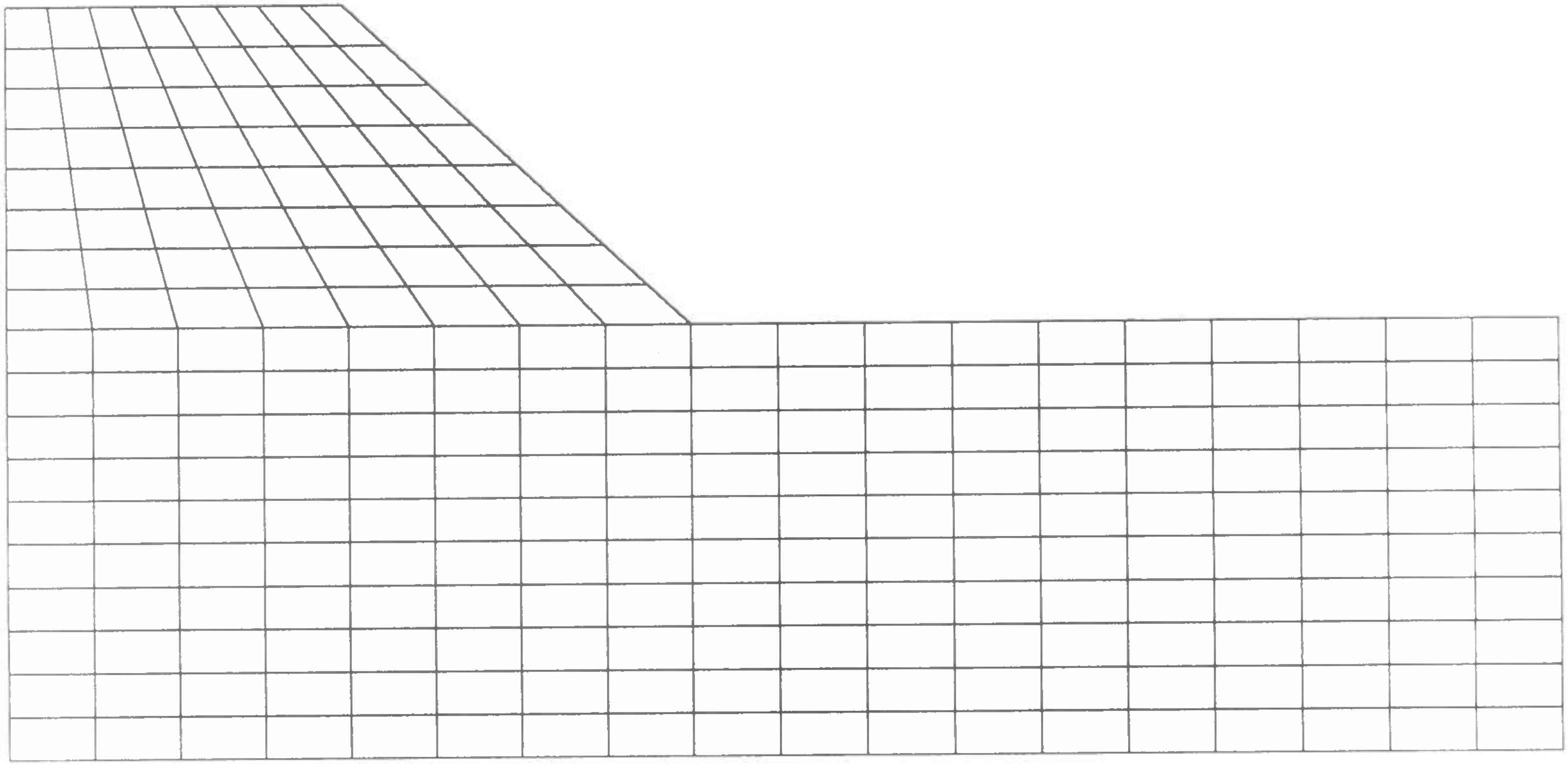


```
Section 4 Profile

w1=    7.75
s1=    8.00
w2=   20.00
h1=    7.50
h2=   10.00

nx1=    8
nx2=   10
ny1=    8
ny2=   10

Group  phi       c      psi    gamma       e          v
  1    7.00  792.00    0.00  140.00  0.1000E+06    0.30
  2    0.00  576.00    0.00  130.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1
   2   2   2   2   2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2

 tol=  0.000100
```

```
limit= 1000

      trial factor    max displacement   iterations
      0.2000E+01      0.2529E+00             37
      0.2500E+01      0.3136E+00             56
      0.2750E+01      0.3458E+00             65
      0.3000E+01      0.6995E+00           1000
```

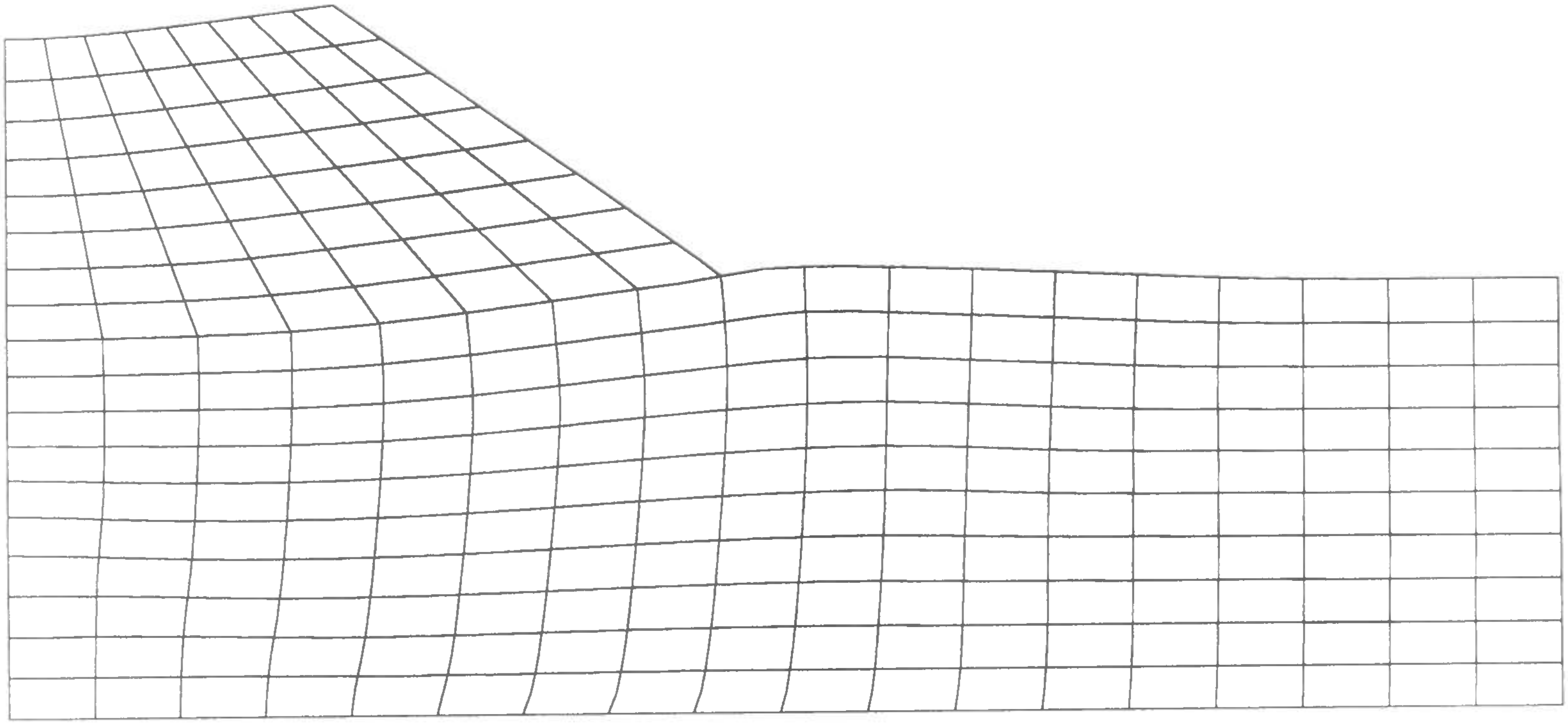
Section 4

Mesh

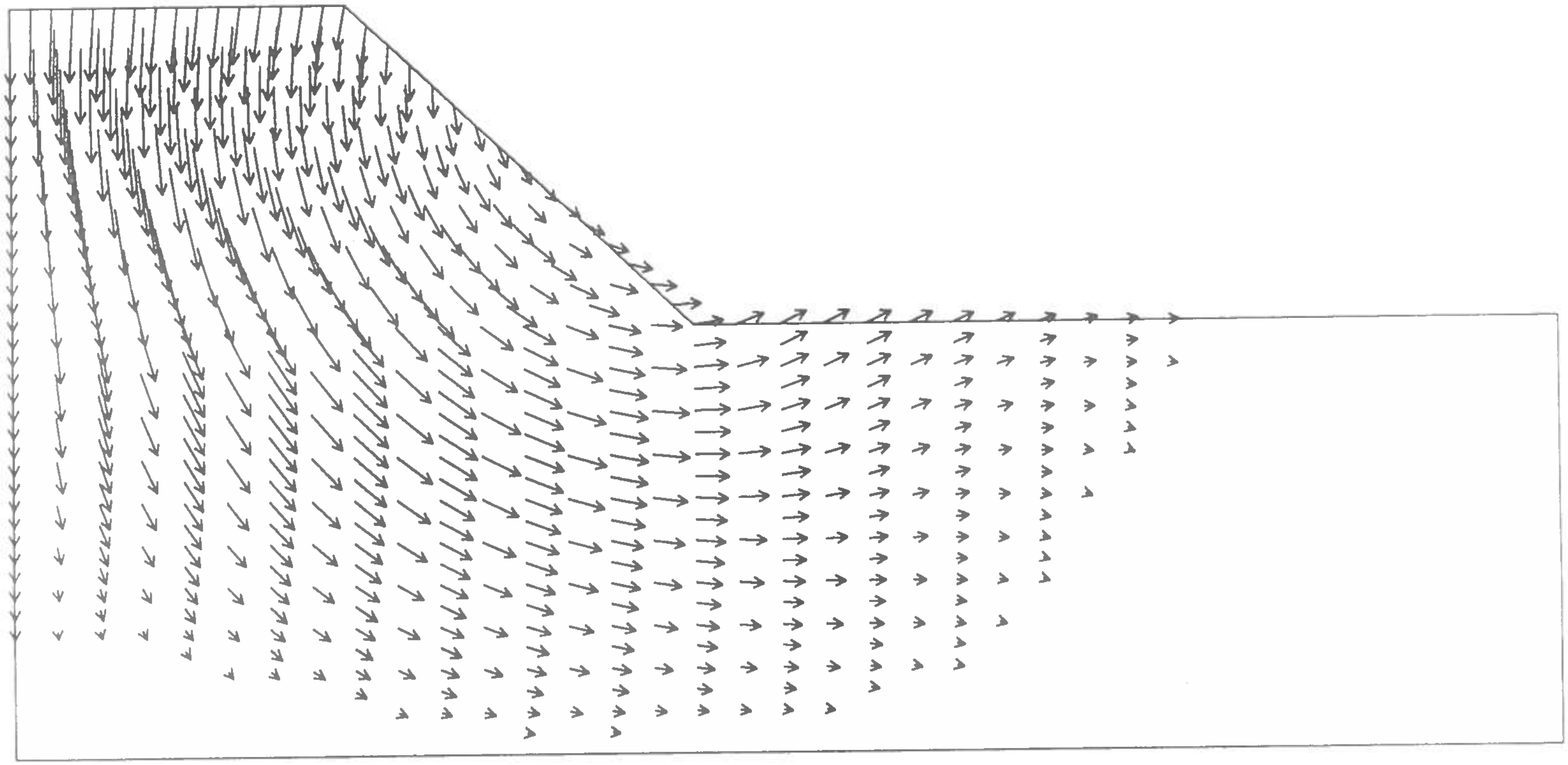


Section 4

Deformed Mesh

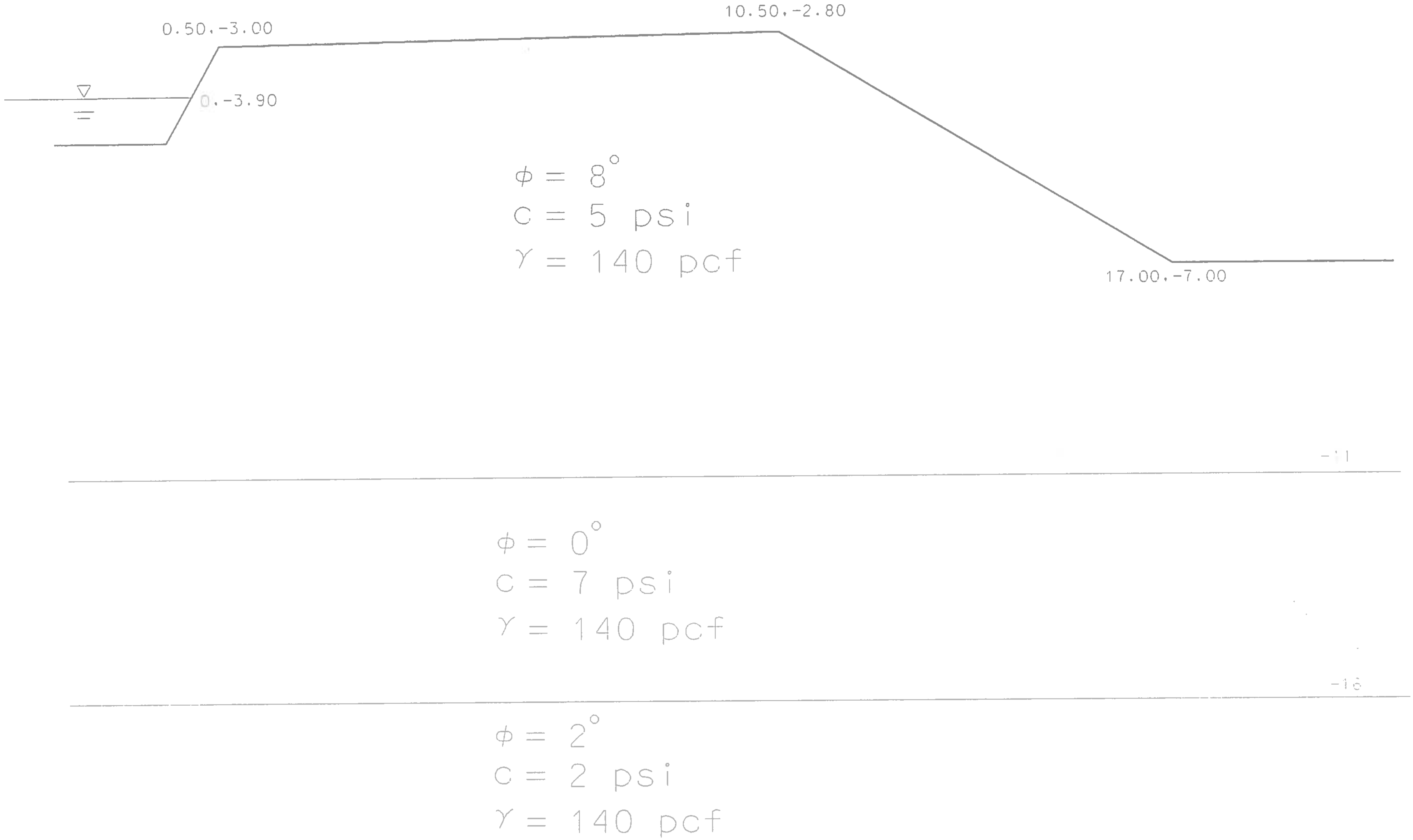


Section 4
Vector Trace



Section 5

Factor Of Safety = 6.2

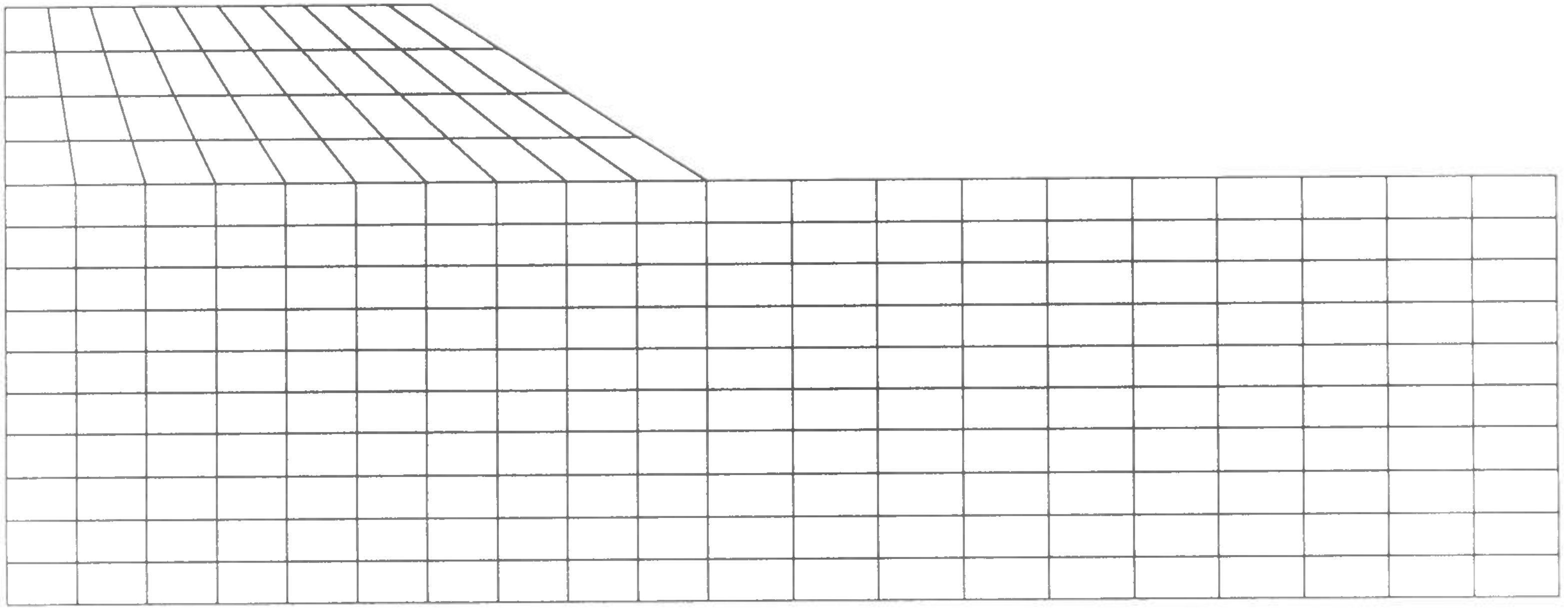


```
Section 5 Profile

w1=   10.00
s1=    6.50
w2=   20.00
h1=    4.20
h2=   10.00

nx1=   10
nx2=   10
ny1=    4
ny2=   10

Group  phi      c      psi    gamma      e          v
  1    8.00  720.00    0.00  140.00  0.1000E+06    0.30
  2    0.00 1008.00    0.00  140.00  0.1000E+06    0.30
  3    2.00  288.00    0.00  140.00  0.1000E+06    0.30

Property group assigned to each element
    1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
    2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
    2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
    2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
    3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
  3   3   3   3
    3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
  3   3   3   3

tol=  0.000100
limit= 1000

      trial factor    max displacement   iterations
```

```
     0.5800E+01      0.2946E+00           127
     0.6000E+01      0.3065E+00           168
     0.6100E+01      0.3191E+00           252
     0.6200E+01      0.3918E+00          1000
```

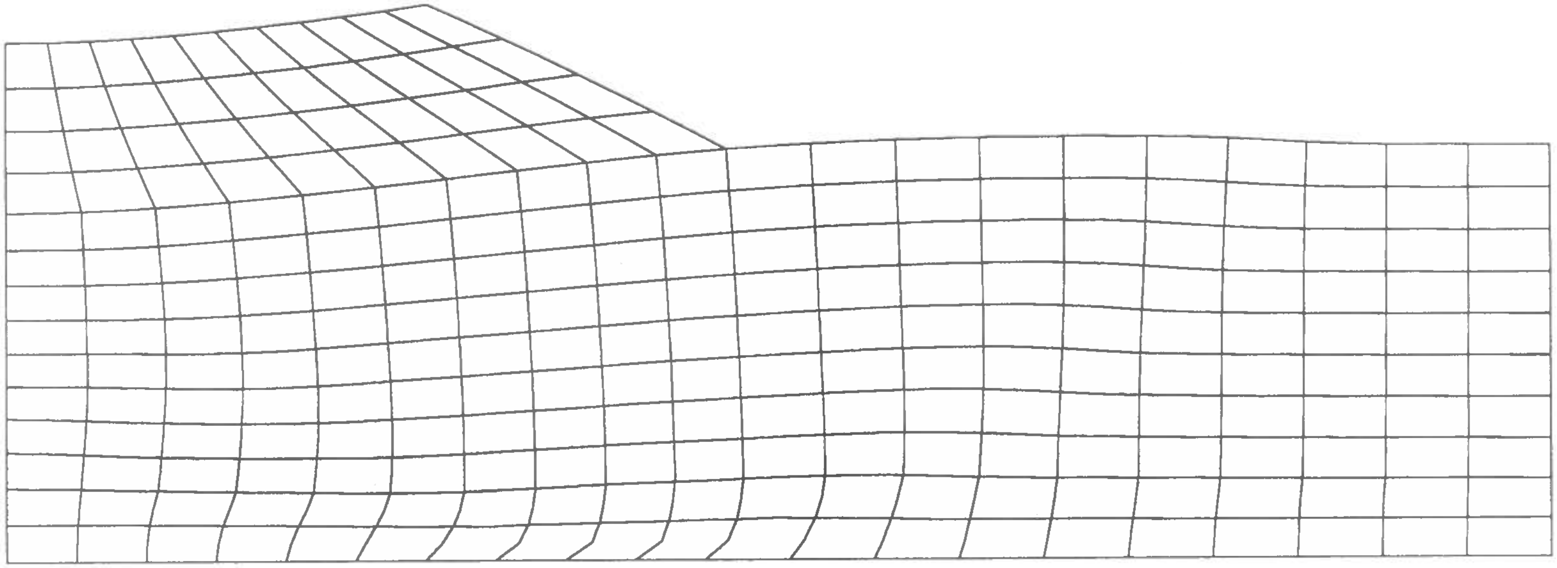
Section 5

Mesh



Section 5

Deformed Mesh



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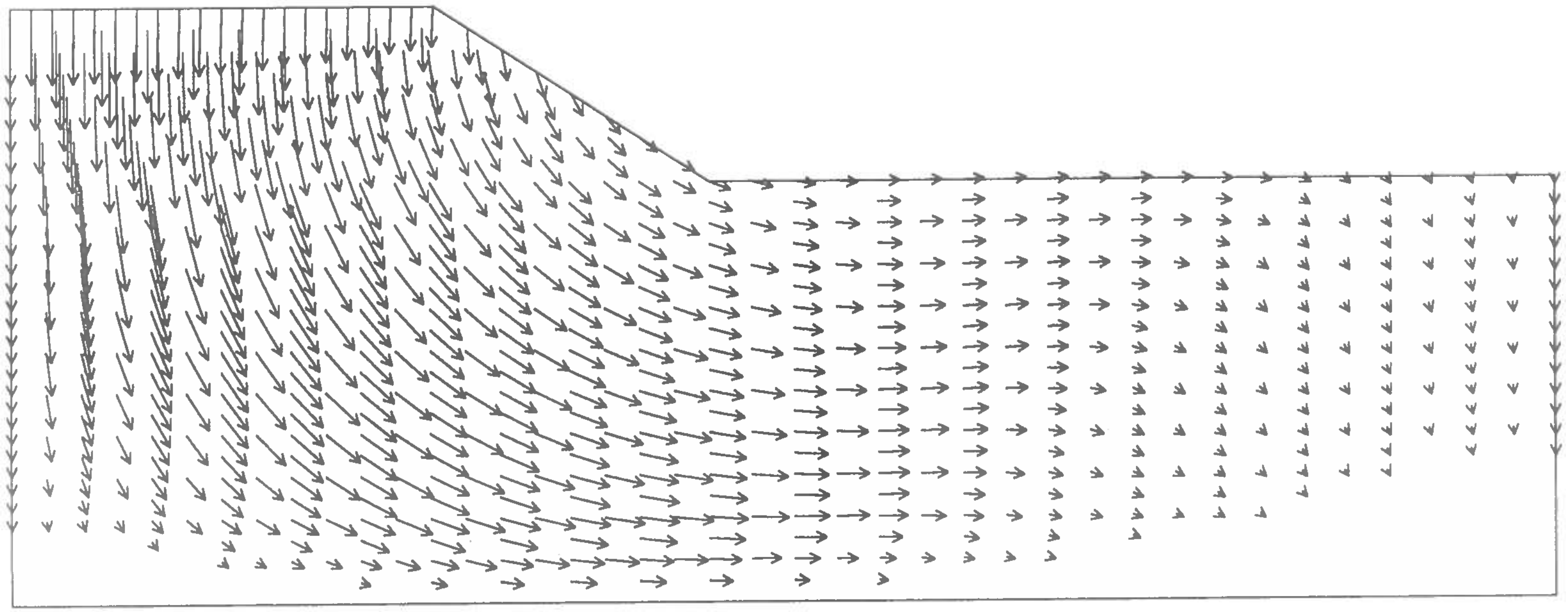
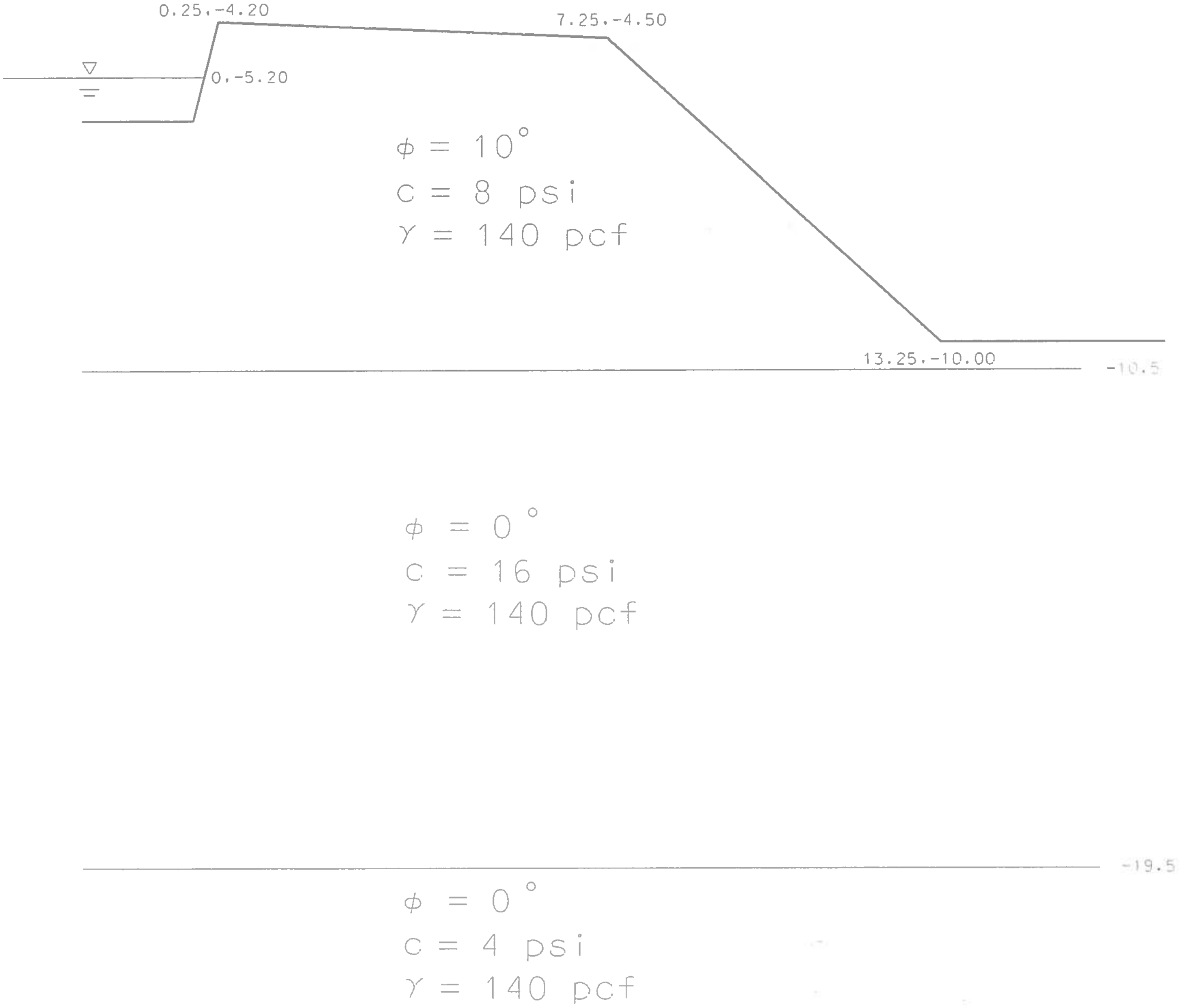
Section 5

Vector Trace



Section 6

Factor Of Safety = 10.0

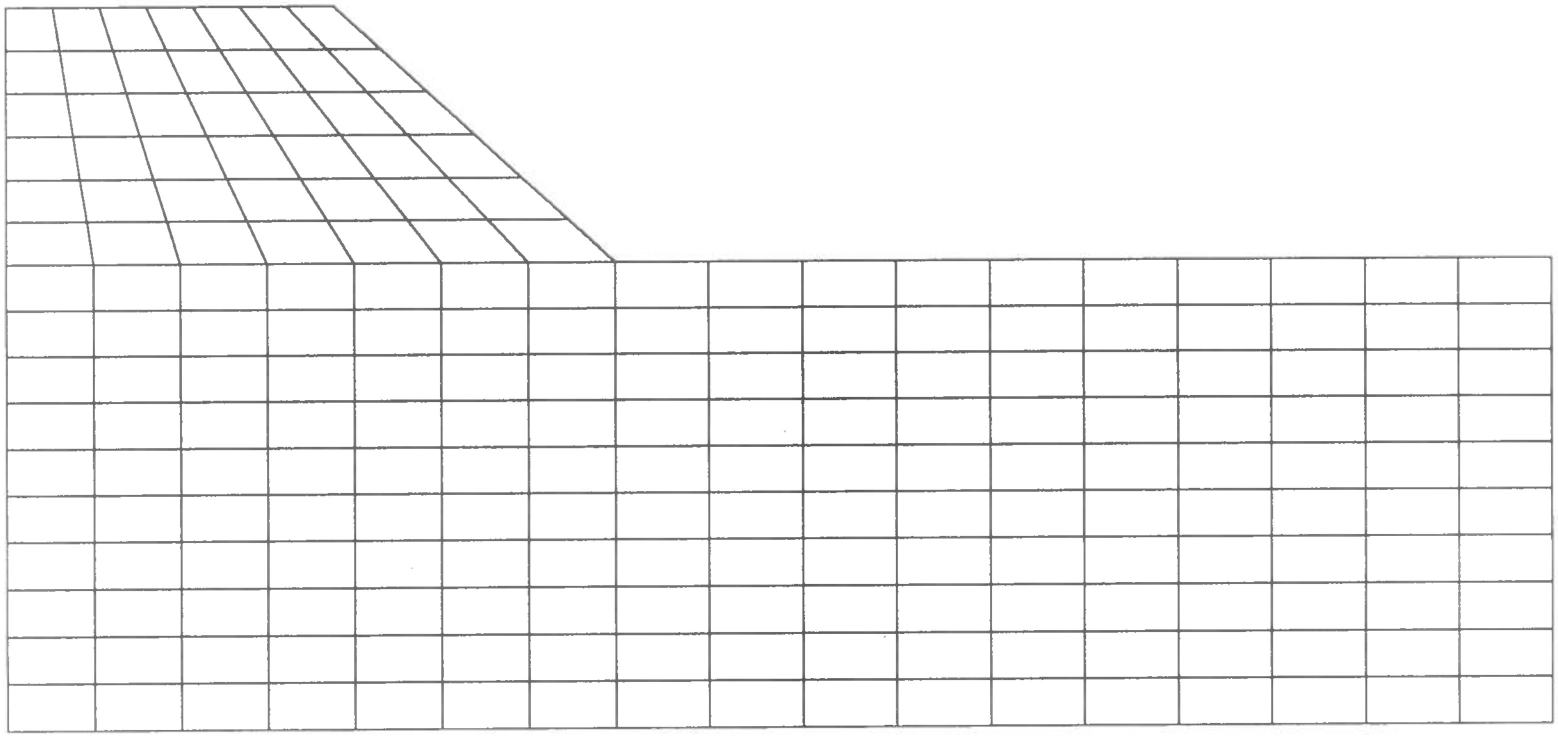


```
Section 6 Profile

w1=    7.00
s1=    6.00
w2=   20.00
h1=    5.50
h2=   10.00

nx1=    7
nx2=   10
ny1=    6
ny2=   10

Group  phi      c      psi    gamma       e         v
  1   10.00 1152.00     0.00  140.00  0.1000E+06    0.30
  2    0.00 2304.00     0.00  140.00  0.1000E+06    0.30
  3    0.00  576.00     0.00  140.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   1   1   1   1   1   1   1
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
 3

tol=  0.000100
limit= 1000
```

```
trial factor    max displacement   iterations
0.9000E+01      0.3093E+00            149
0.1000E+02      0.3472E+00            324
0.1010E+02      0.3636E+00            584
0.1020E+02      0.4050E+00           1000
```

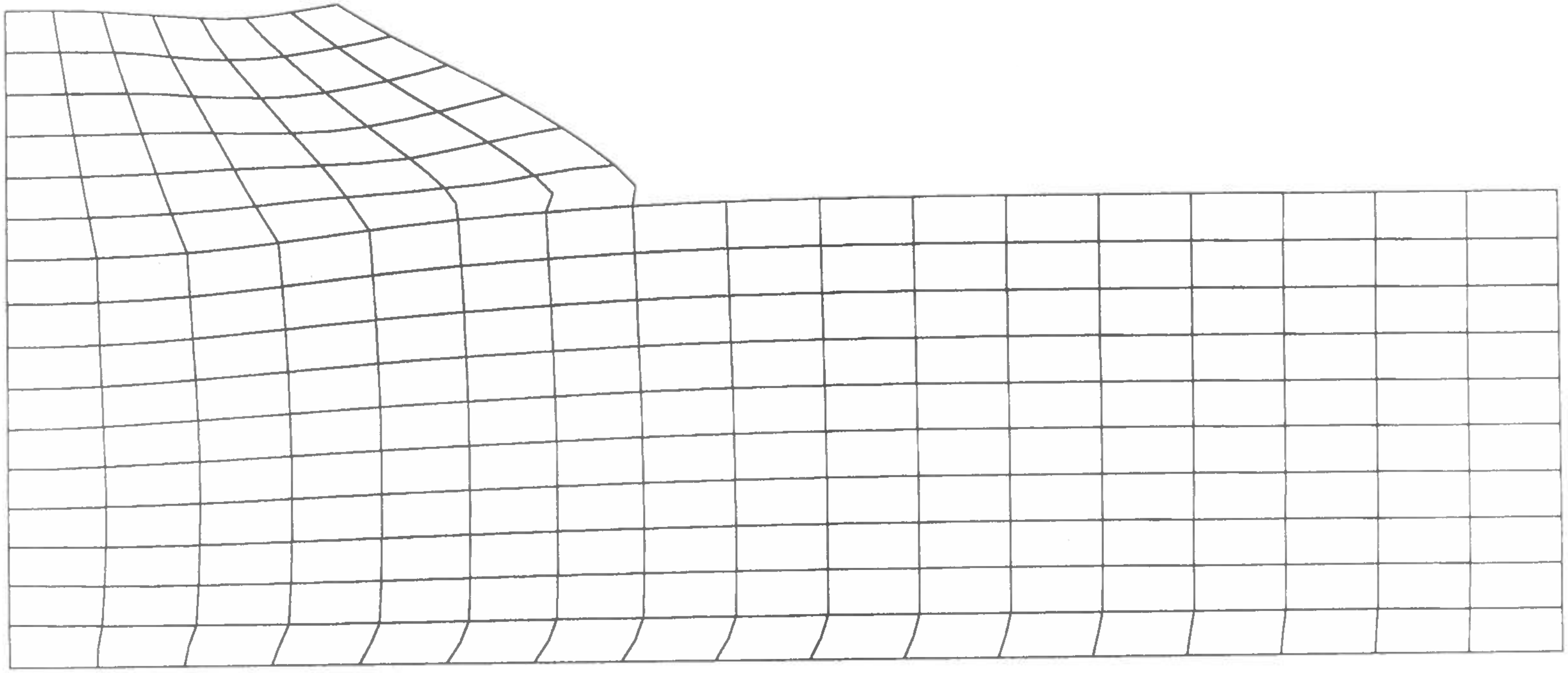
Section 6

Mesh



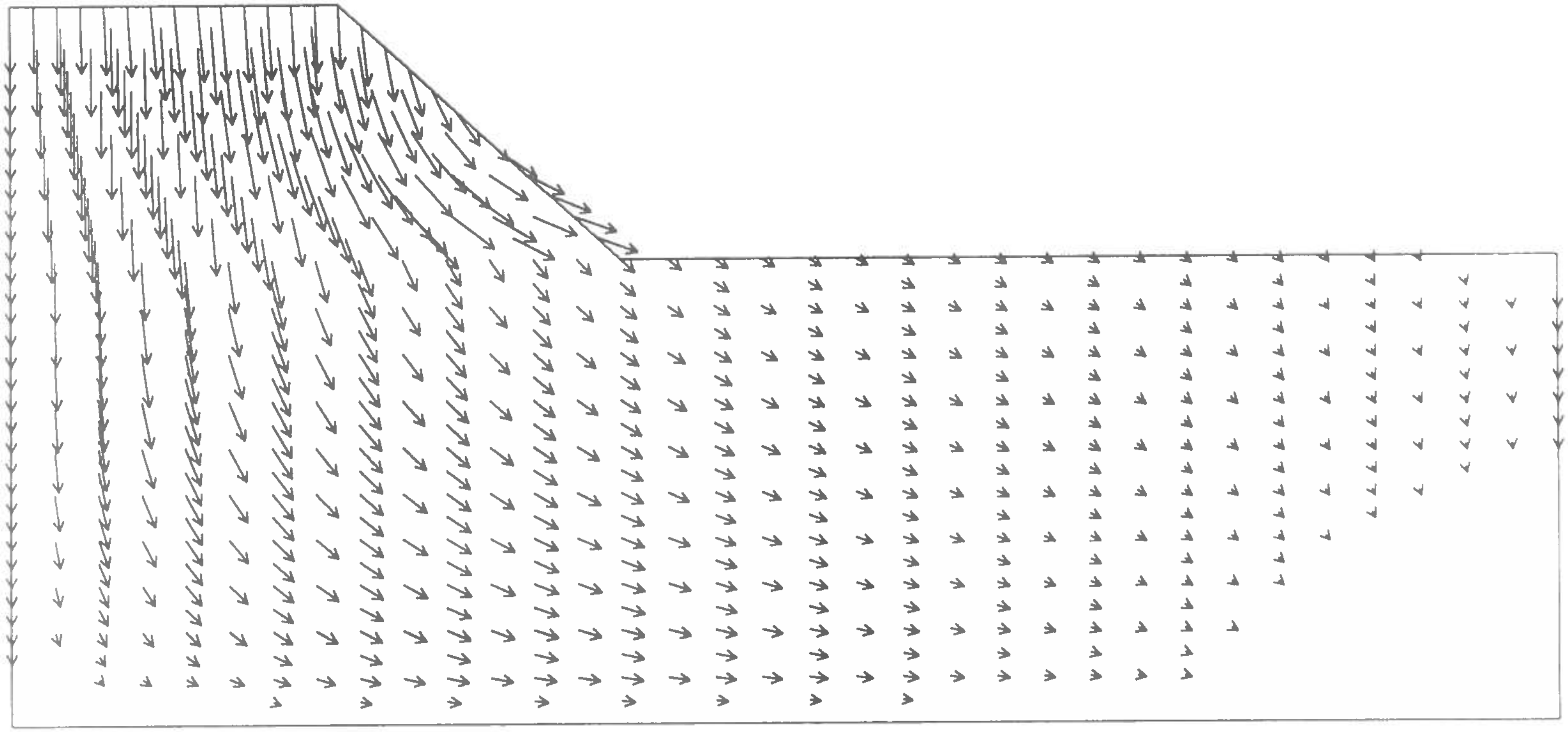
Section 6

Deformed Mesh



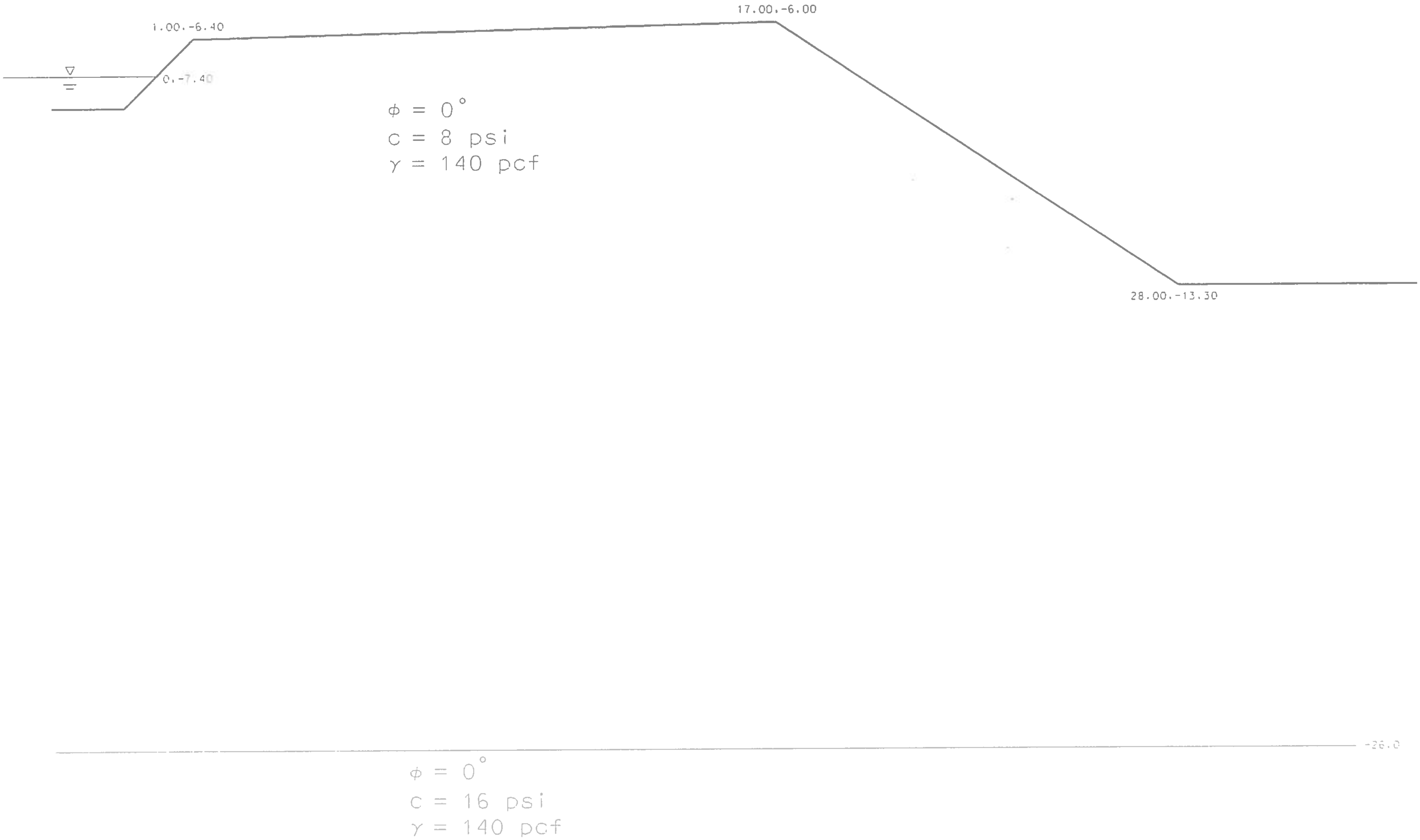
Section 6

Vector Trace



Section 7

Factor Of Safety = 6.0

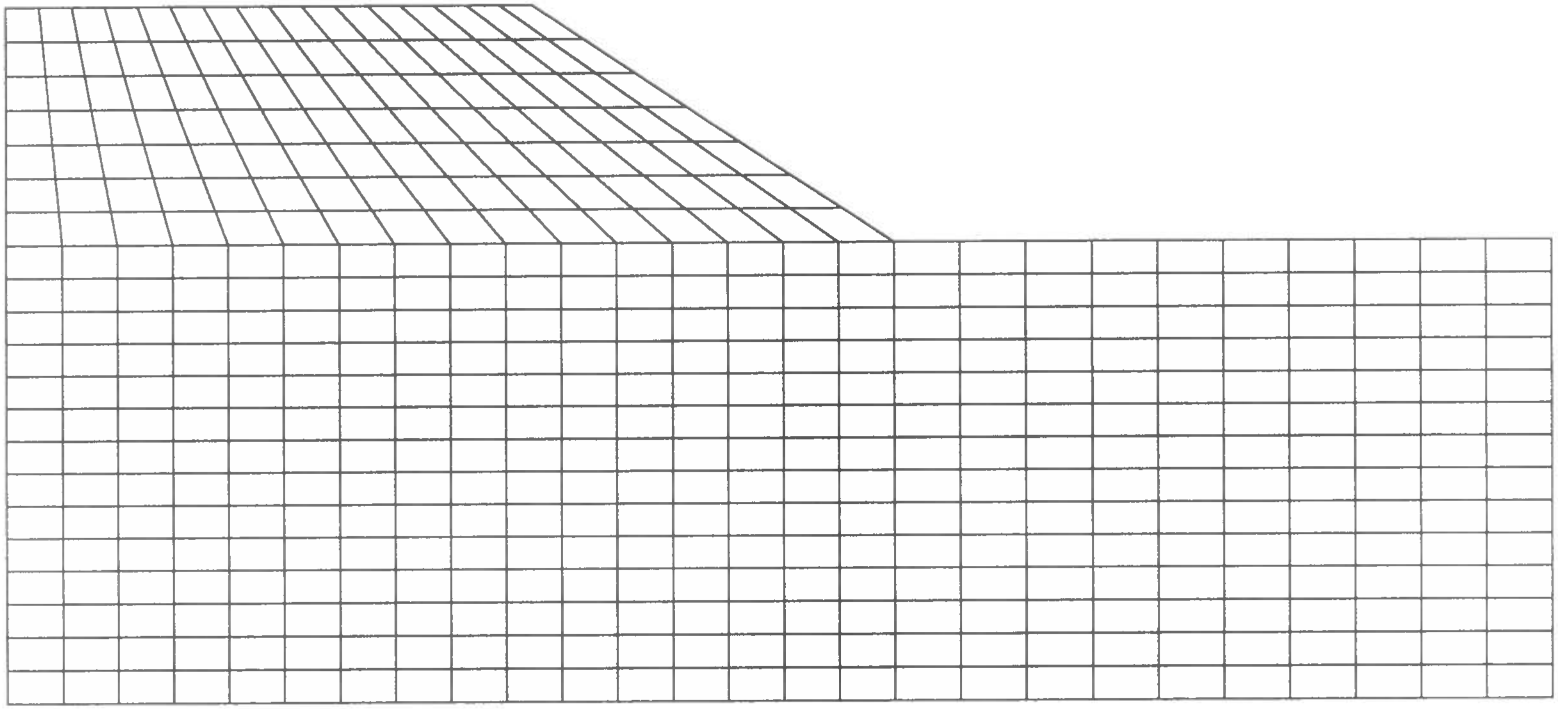


```
Section 7 Profile

w1=   16.00
s1=   11.00
w2=   20.00
h1=    7.30
h2=   14.00

nx1=   16
nx2=   10
ny1=    7
ny2=   14

Group  phi       c      psi    gamma      e          v
  1    0.00 1152.00     0.00  140.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
```

```
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1   1

tol=  0.000100
limit= 1000

      trial factor    max displacement   iterations
      0.5500E+01      0.5128E+00              74
      0.5700E+01      0.5294E+00              83
      0.5800E+01      0.5405E+00              93
      0.5900E+01      0.5552E+00             110
      0.6000E+01      0.6942E+00            1000
```

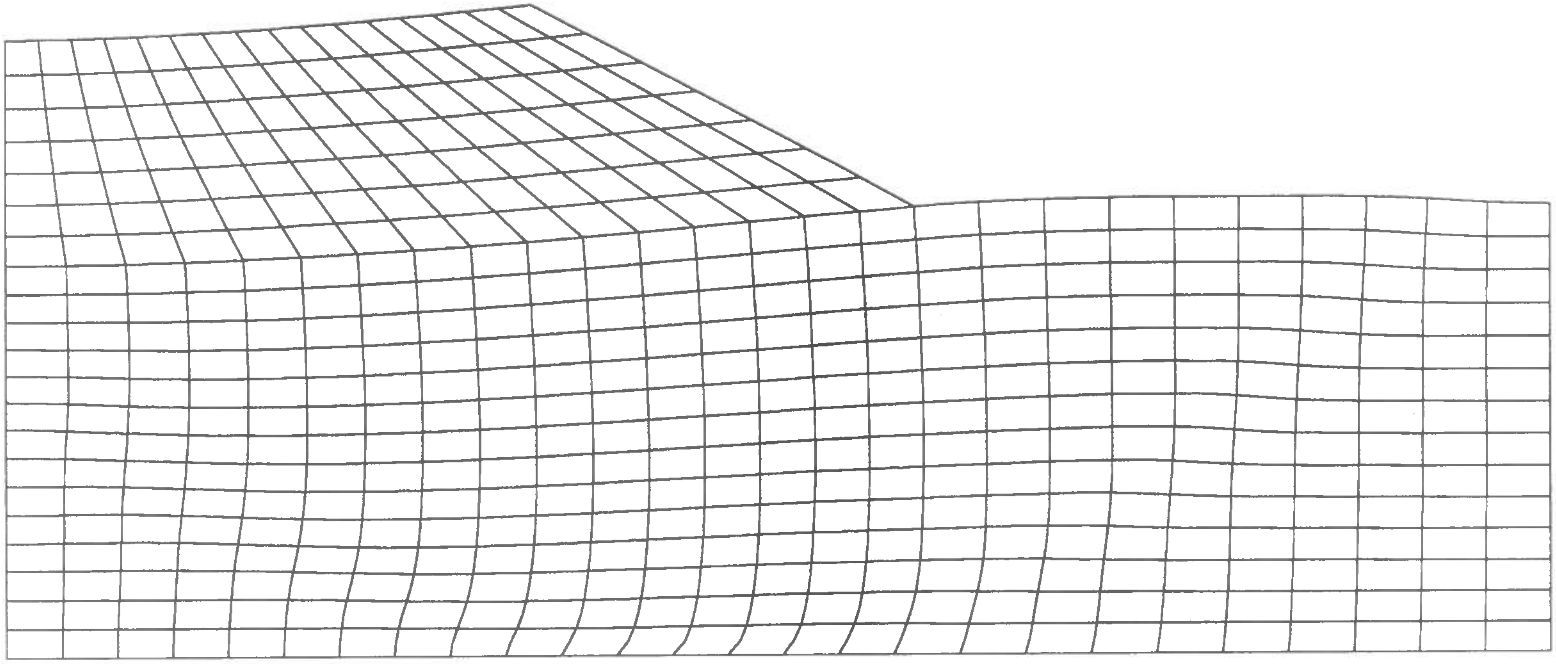
Section 7

Mesh

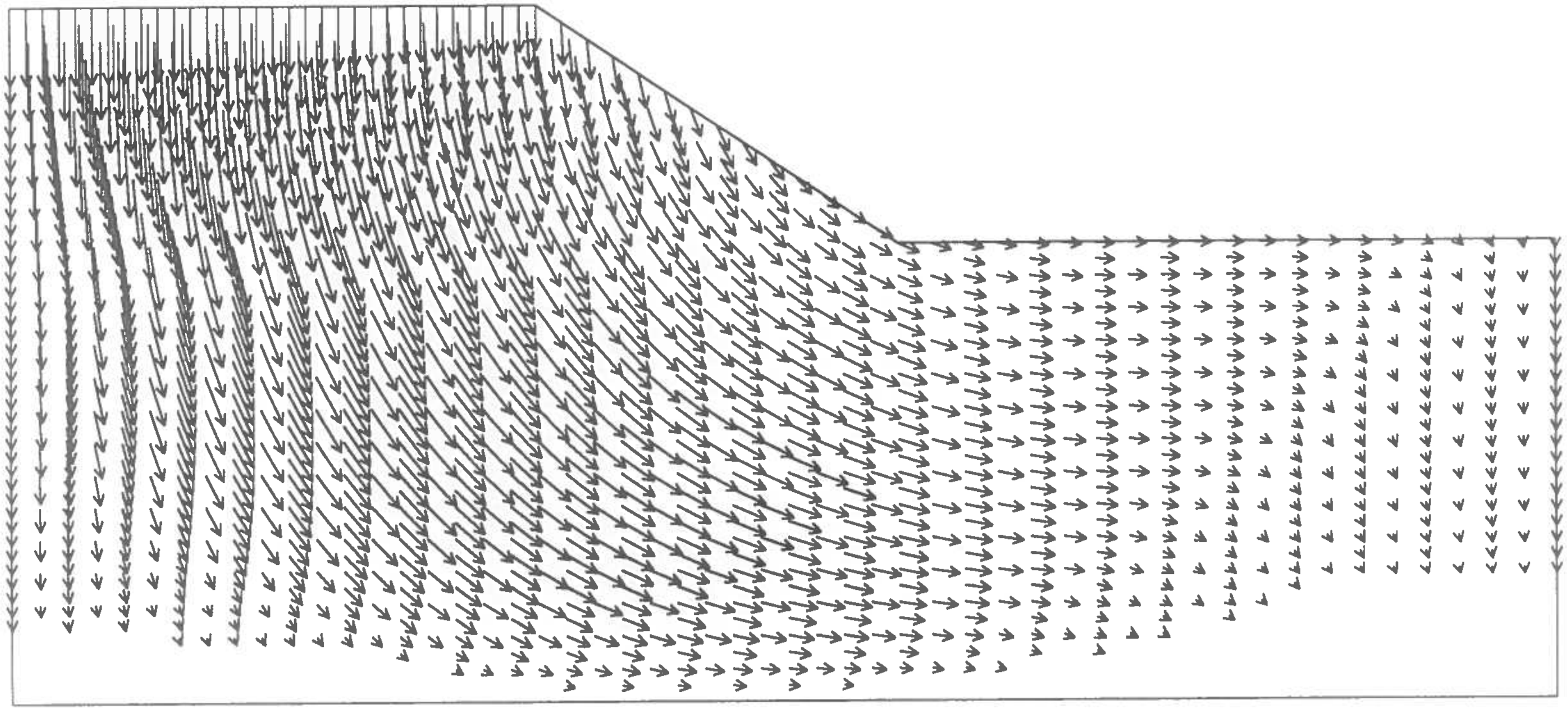


Section 7

Deformed Mesh

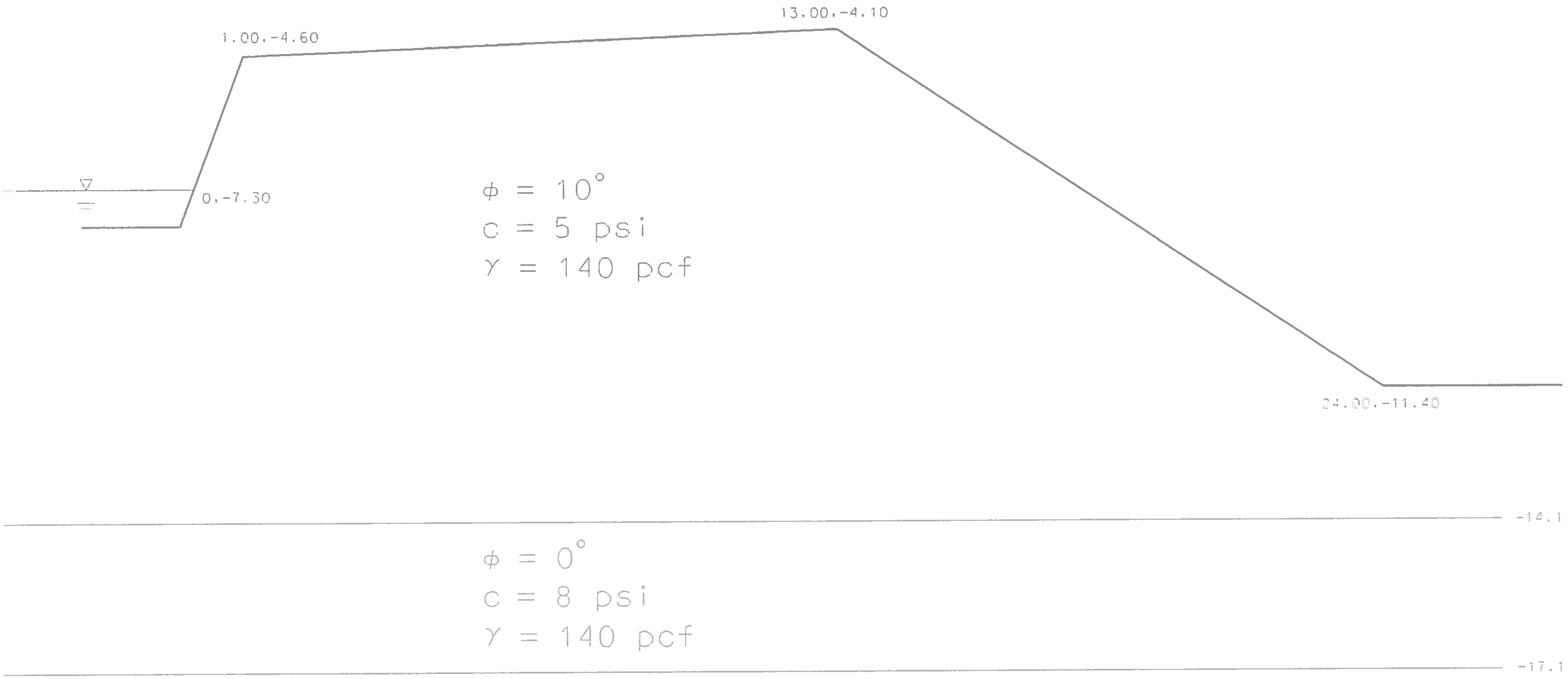


Section 7
Vector Trace



Section 8

Factor Of Safety = 4.9

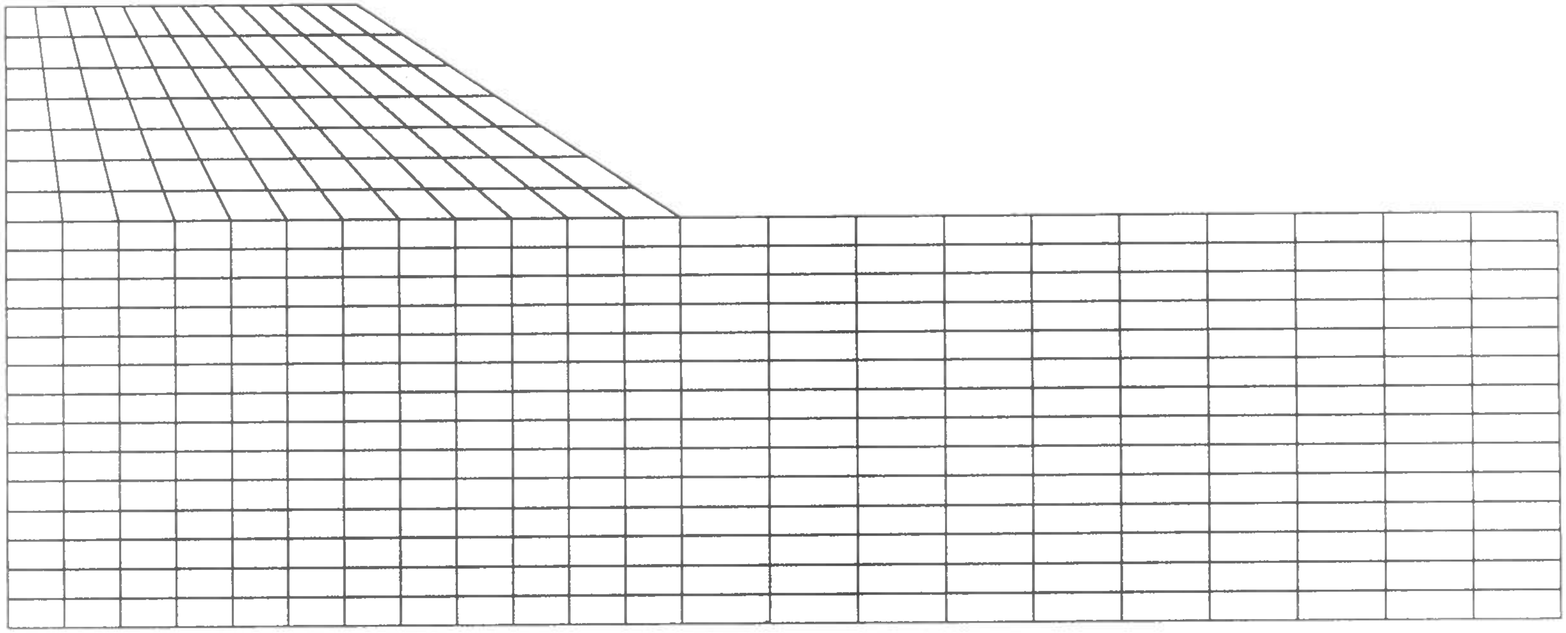


```
Section 8 Profile

w1=   12.00
s1=   11.00
w2=   30.00
h1=    7.30
h2=   14.00

nx1=   12
nx2=   10
ny1=    7
ny2=   14

Group  phi       c      psi    gamma      e          v
  1   10.00  720.00    0.00  140.00  0.1000E+06    0.30
  2    0.00 1152.00    0.00  140.00  0.1000E+06    0.30
  3    0.00 2304.00    0.00  140.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2
   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2
   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2
   2   2
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
 3   3   3   3
   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
```

```
 3   3   3   3
   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
 3   3   3   3
   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
 3   3   3   3
   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
 3   3   3   3
   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
 3   3   3   3
   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
 3   3   3   3
   3   3
   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
 3   3   3   3
   3   3

tol=  0.000100
limit= 1000

      trial factor    max displacement   iterations
      0.4600E+01      0.3695E+00               55
      0.4700E+01      0.3768E+00               89
      0.4800E+01      0.3859E+00              151
      0.4900E+01      0.4922E+00             1000
```

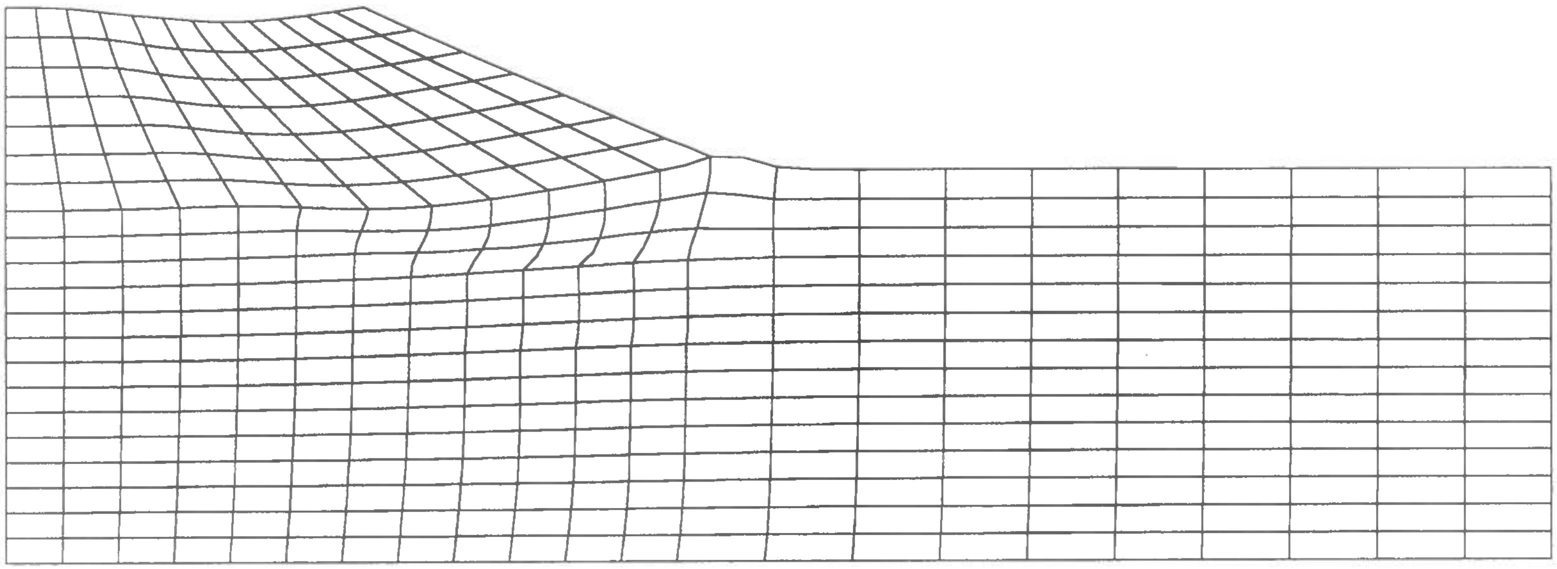
Section 8

Mesh

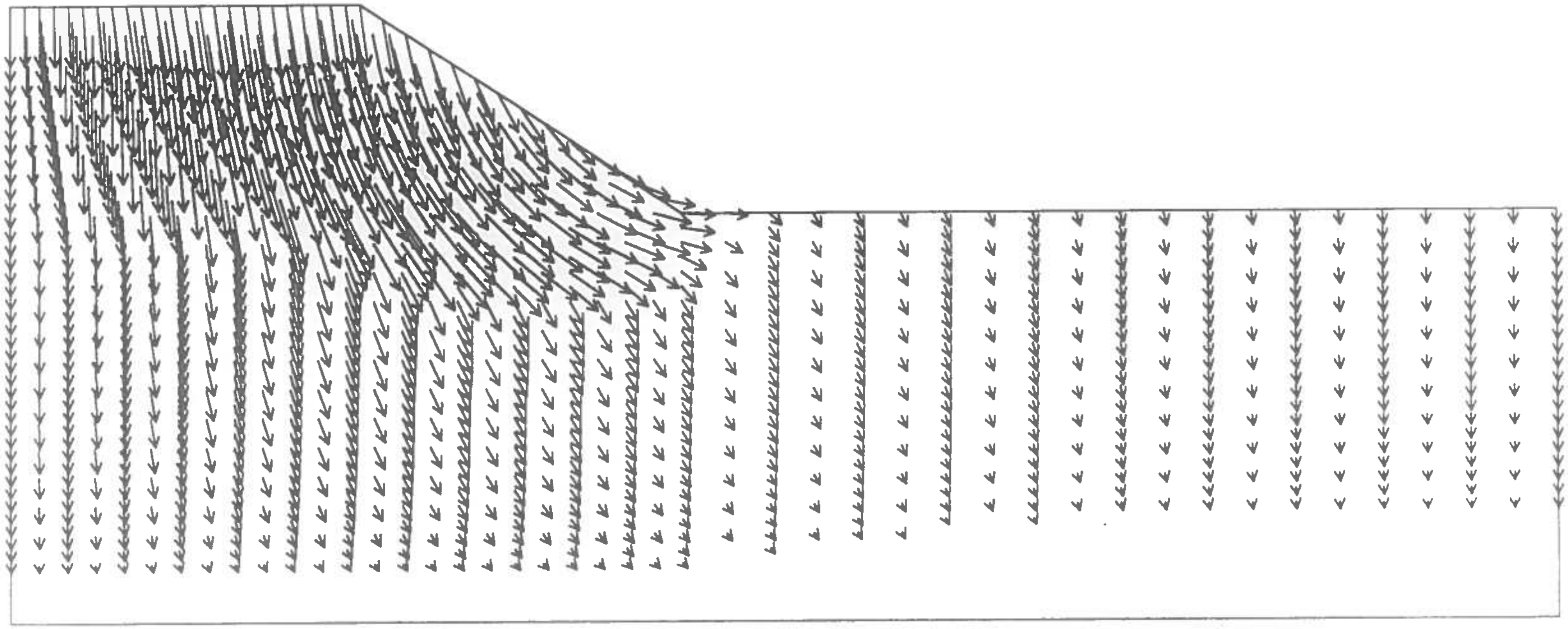


Section 8

Deformed Mesh

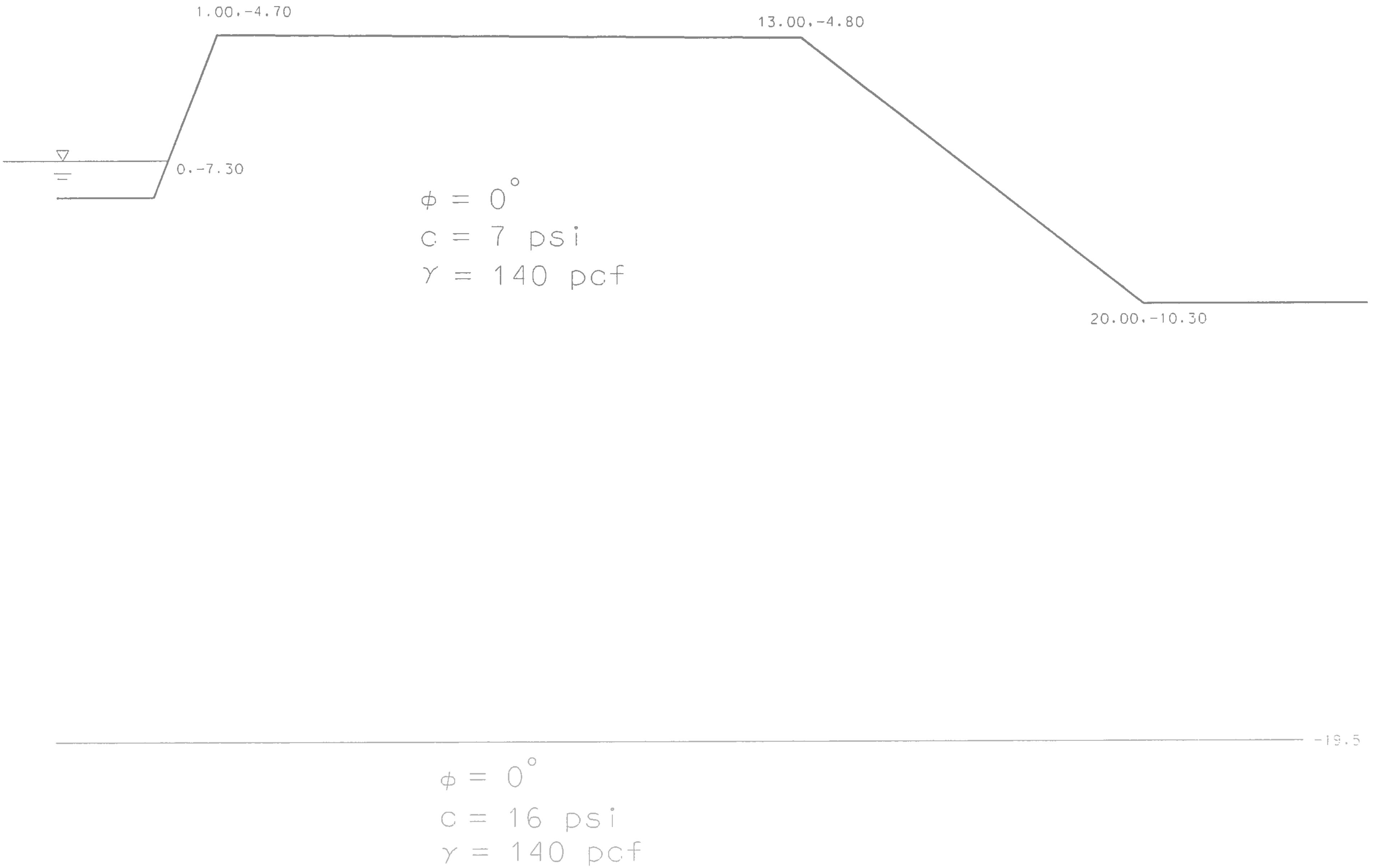


Section 8
Vector Trace



Section 9

Factor Of Safety = 7.0

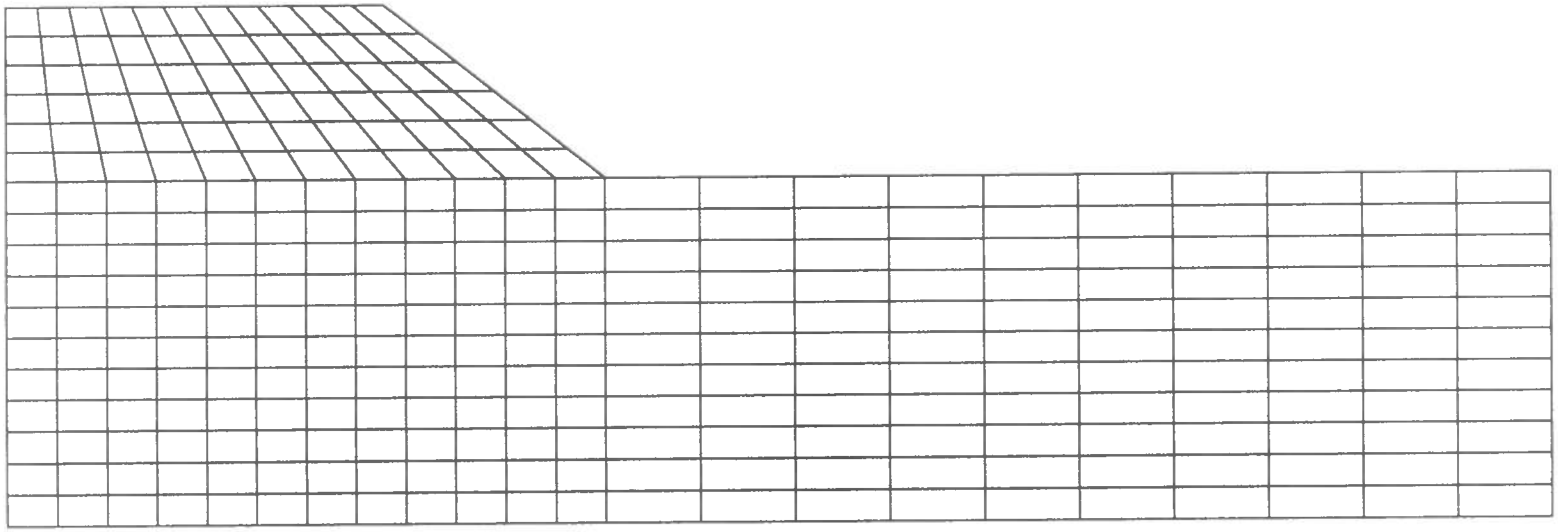


```
Section 9 Profile

w1=   12.00
s1=    7.00
w2=   30.00
h1=    5.50
h2=   11.00

nx1=   12
nx2=   10
ny1=    6
ny2=   11

Group  phi      c       psi    gamma      e           v
  1    0.00 1008.00     0.00  140.00  0.1000E+06     0.30
  2    0.00 2304.00     0.00  140.00  0.1000E+06     0.30

Property group assigned to each element
    1   1   1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1
    1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
    1   1
```

```
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2
   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2
   2   2

tol=  0.000100
limit= 1000

      trial factor    max displacement   iterations
      0.6500E+01      0.3177E+00            100
      0.6600E+01      0.3227E+00            104
      0.6700E+01      0.3283E+00            111
      0.6800E+01      0.3352E+00            122
      0.6900E+01      0.3451E+00            149
      0.7000E+01      0.4483E+00           1000
```

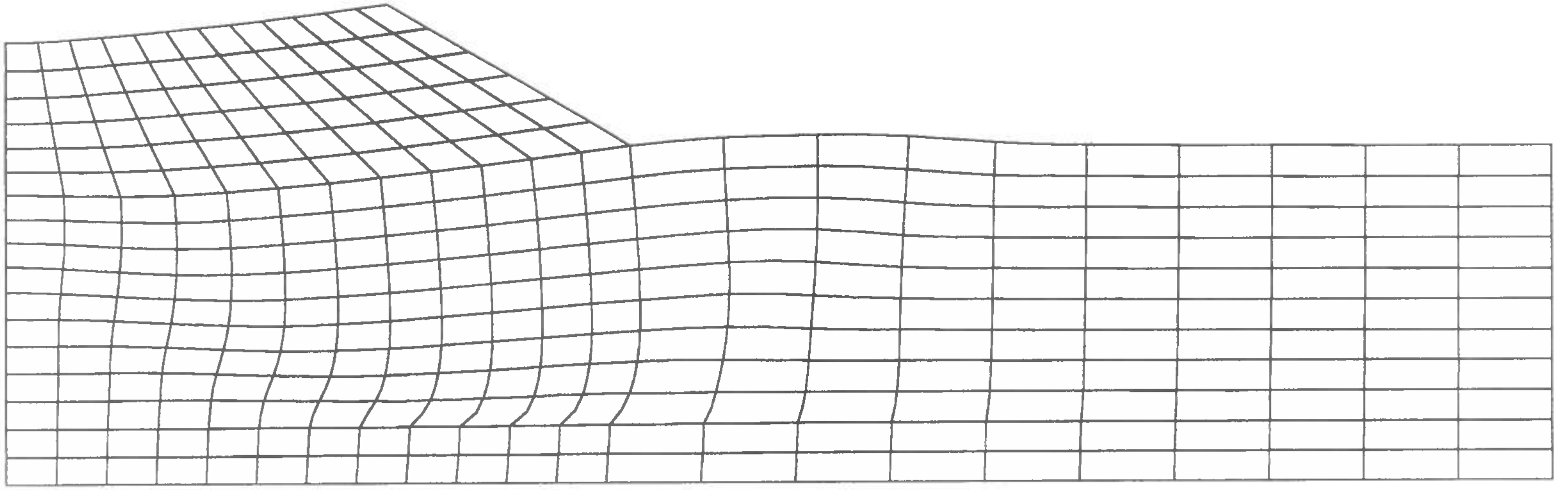
Section 9

Mesh



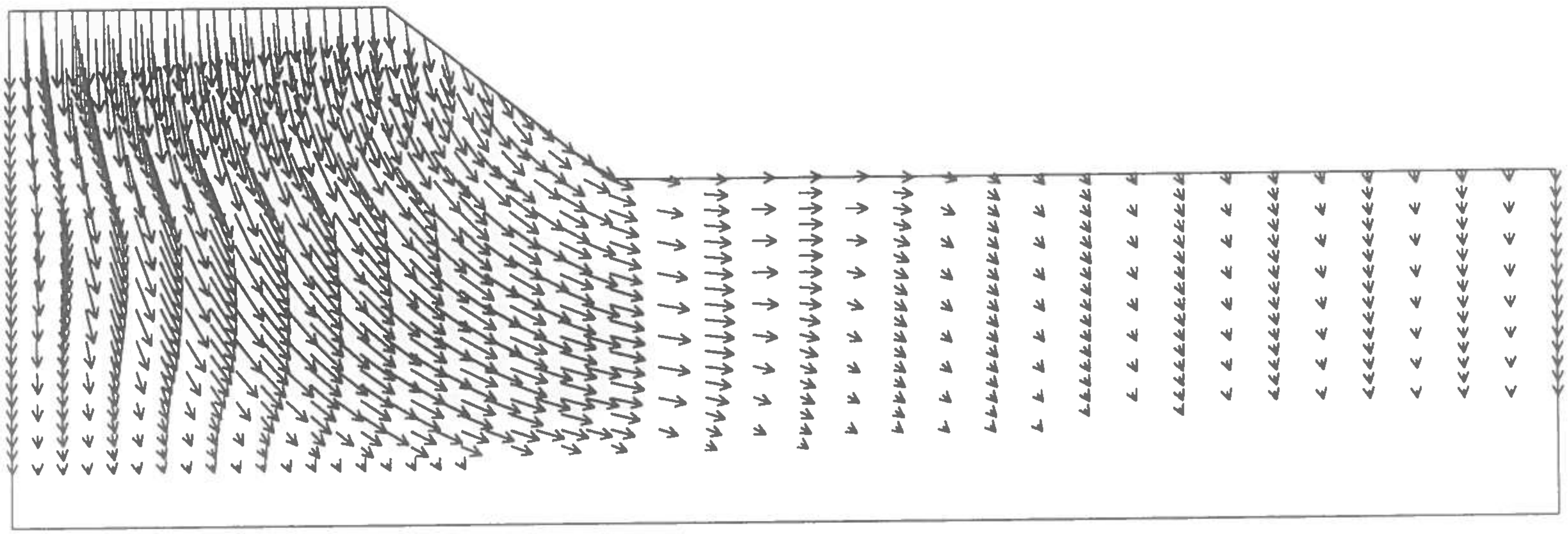
Section 9

Deformed Mesh



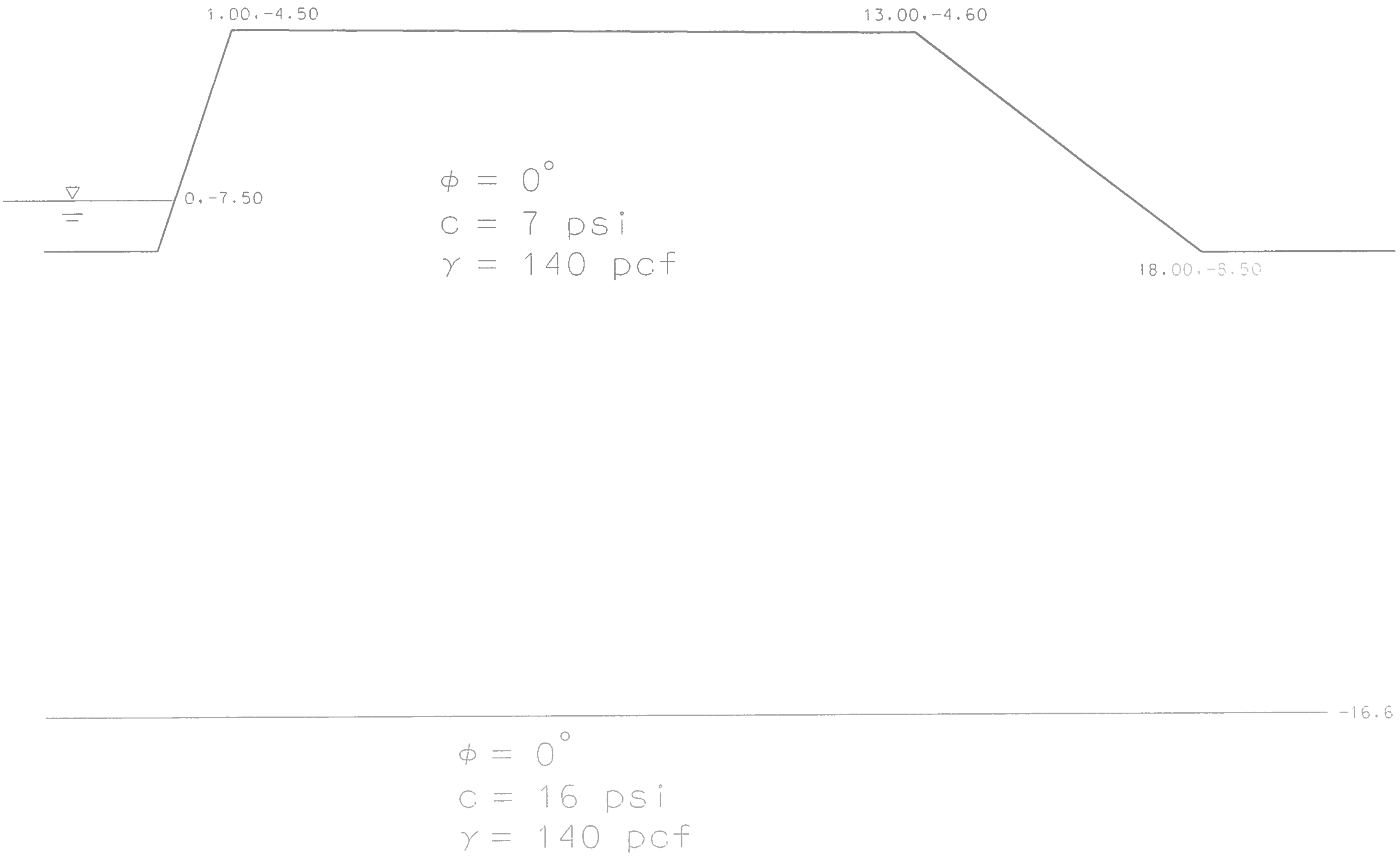
Section 9

Vector Trace



Section 10

Factor Of Safety = 10.0

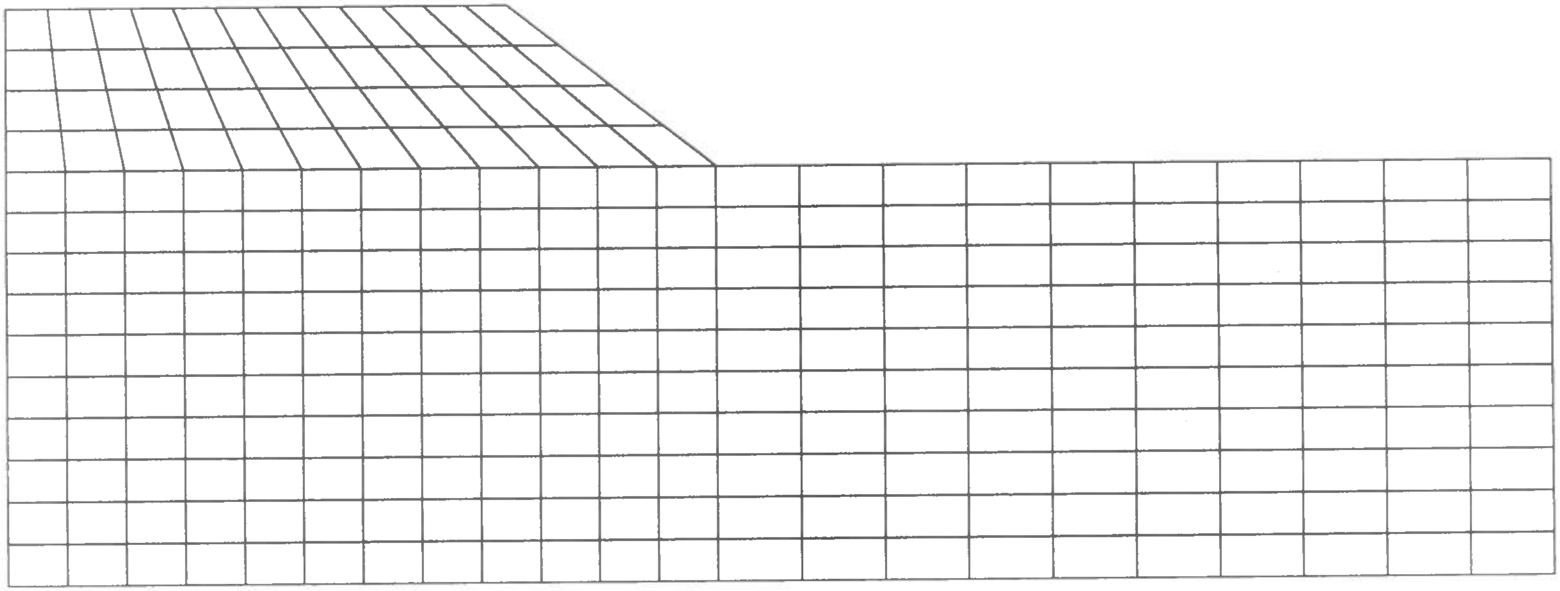


```
Section 10 Profile

w1=   12.00
s1=    5.00
w2=   20.00
h1=    3.90
h2=   10.00

nx1=   12
nx2=   10
ny1=    4
ny2=   10

Group  phi      c      psi    gamma      e          v
  1    0.00 1008.00    0.00  140.00  0.1000E+06    0.30
  2    0.00 2304.00    0.00  140.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2
```

```
   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2
   2   2

tol=  0.000100
limit= 1000

      trial factor    max displacement   iterations
      0.9500E+01      0.2121E+00             101
      0.9600E+01      0.2150E+00             110
      0.9700E+01      0.2184E+00             121
      0.9800E+01      0.2229E+00             144
      0.9900E+01      0.2381E+00             417
      0.1000E+02      0.3642E+00            1000
```

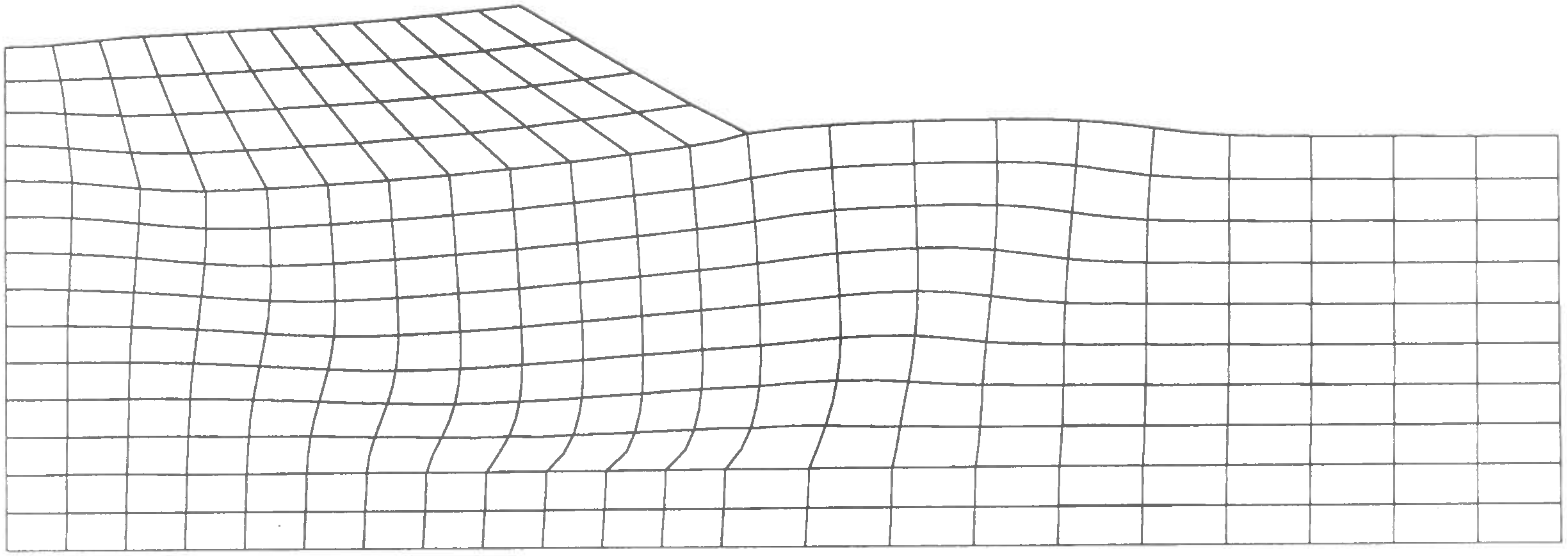
Section 10

Mesh



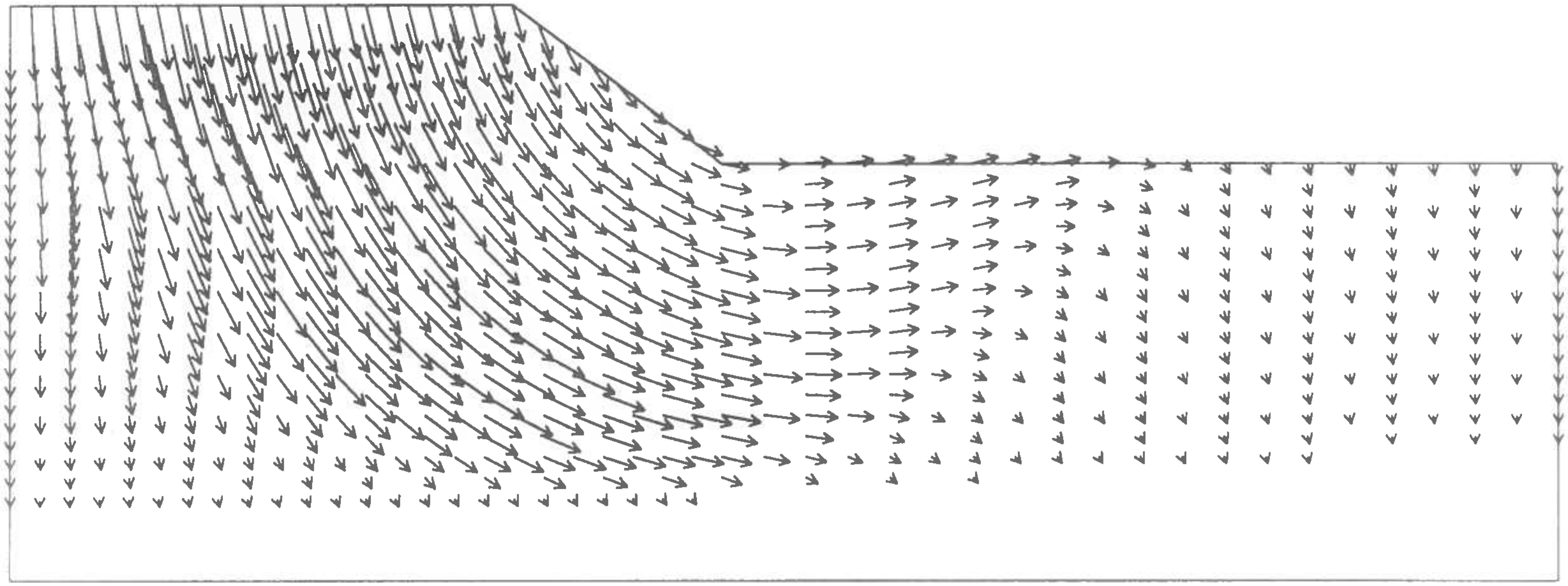
Section 10

Deformed Mesh



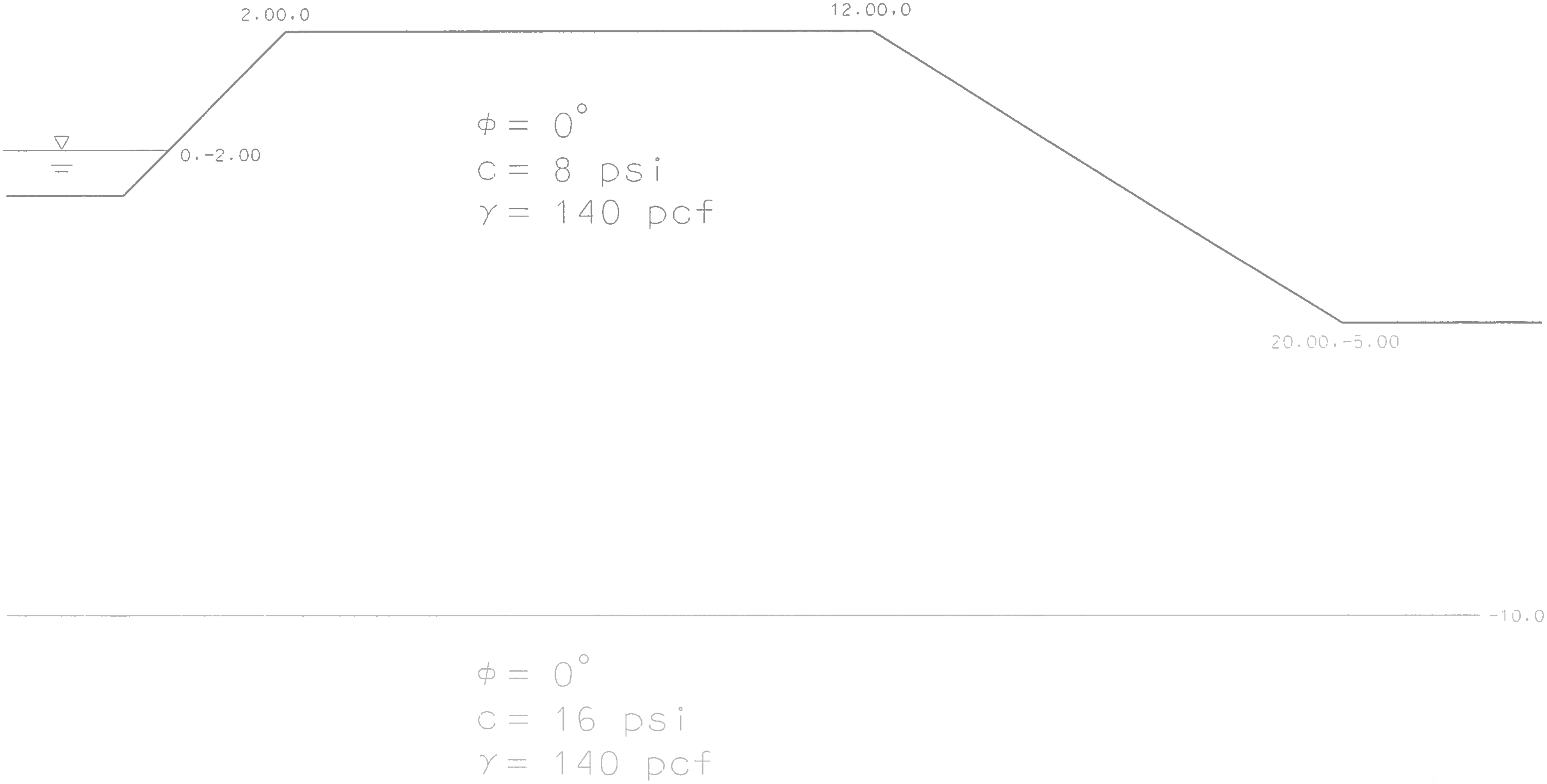
Section 10

Vector Trace



Section 11

Factor Of Safety = 9.4

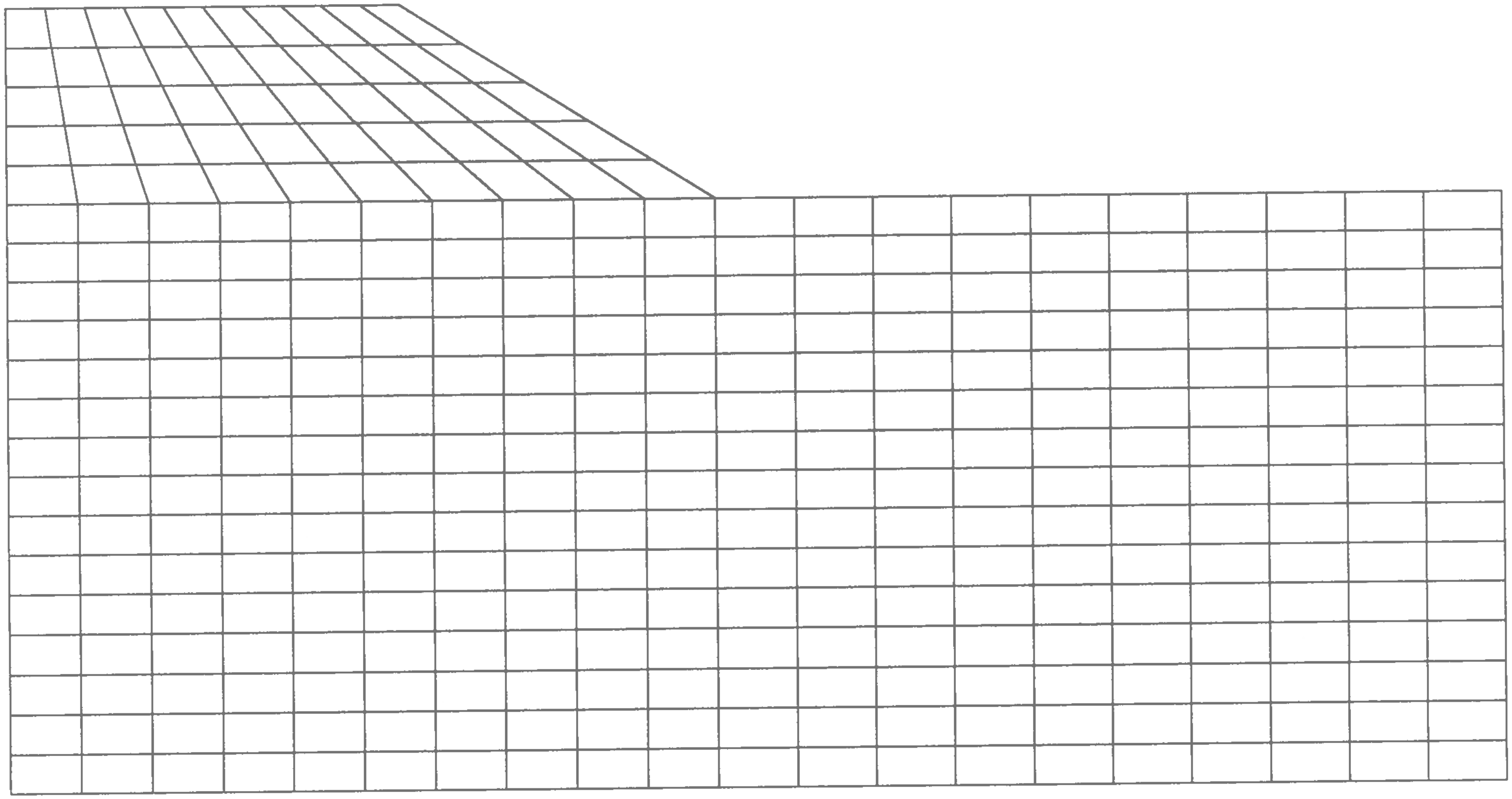


```
Section 11 Profile

w1=   10.00
s1=    8.00
w2=   20.00
h1=    5.00
h2=   15.00

nx1=   10
nx2=   10
ny1=    5
ny2=   15

Group  phi       c      psi    gamma      e          v
  1    0.00 1152.00     0.00   140.00  0.1000E+06    0.30
  2    0.00 2304.00     0.00   140.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
  2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
```

```
 2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2
   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2   2
 2   2   2   2

tol=  0.000100
limit= 1000

      trial factor    max displacement   iterations
      0.9000E+01      0.4058E+00            83
      0.9100E+01      0.4124E+00           110
      0.9200E+01      0.4204E+00           148
      0.9300E+01      0.4331E+00           231
      0.9400E+01      0.5048E+00          1000
```

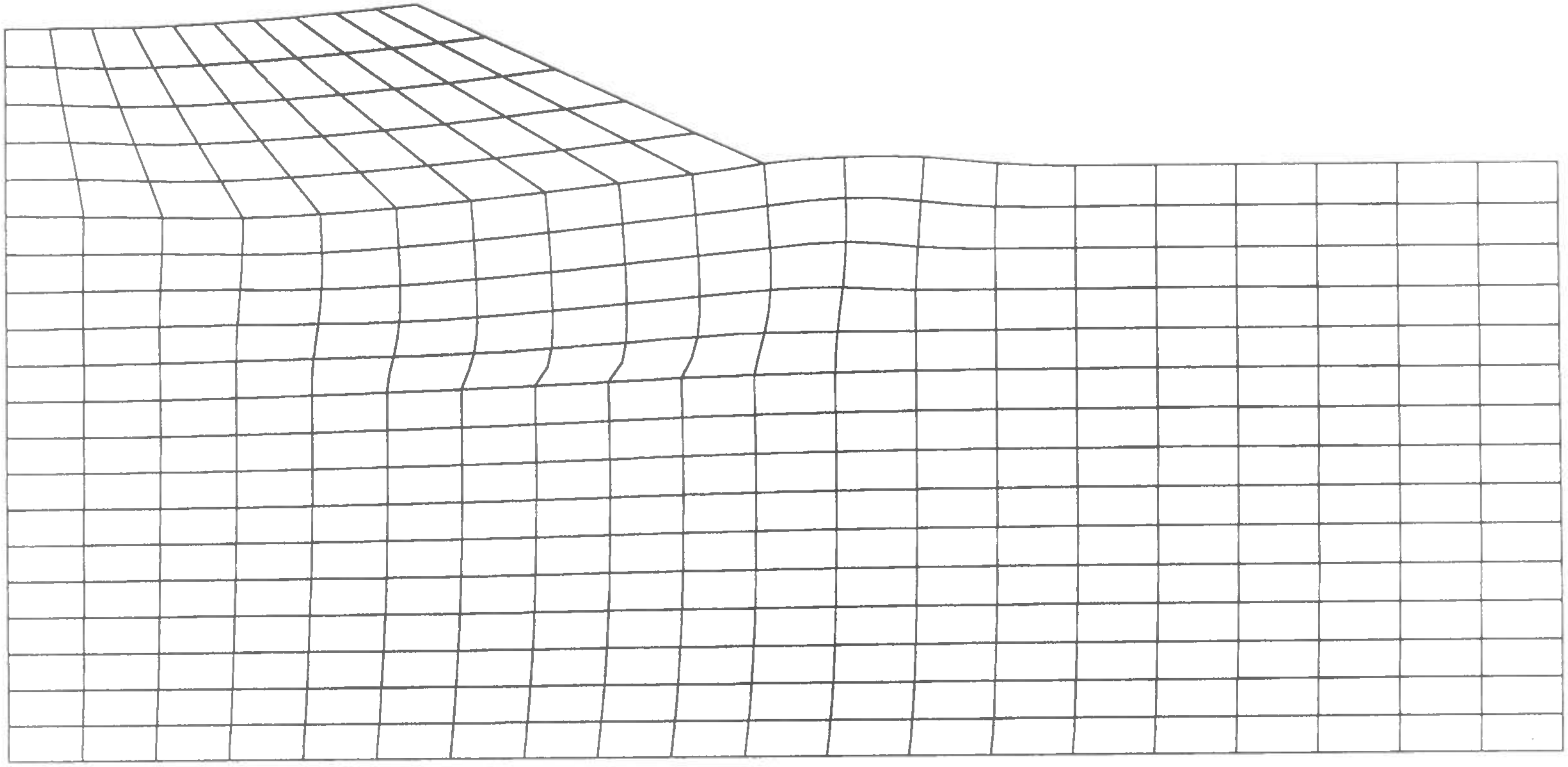
Section 11

Mesh



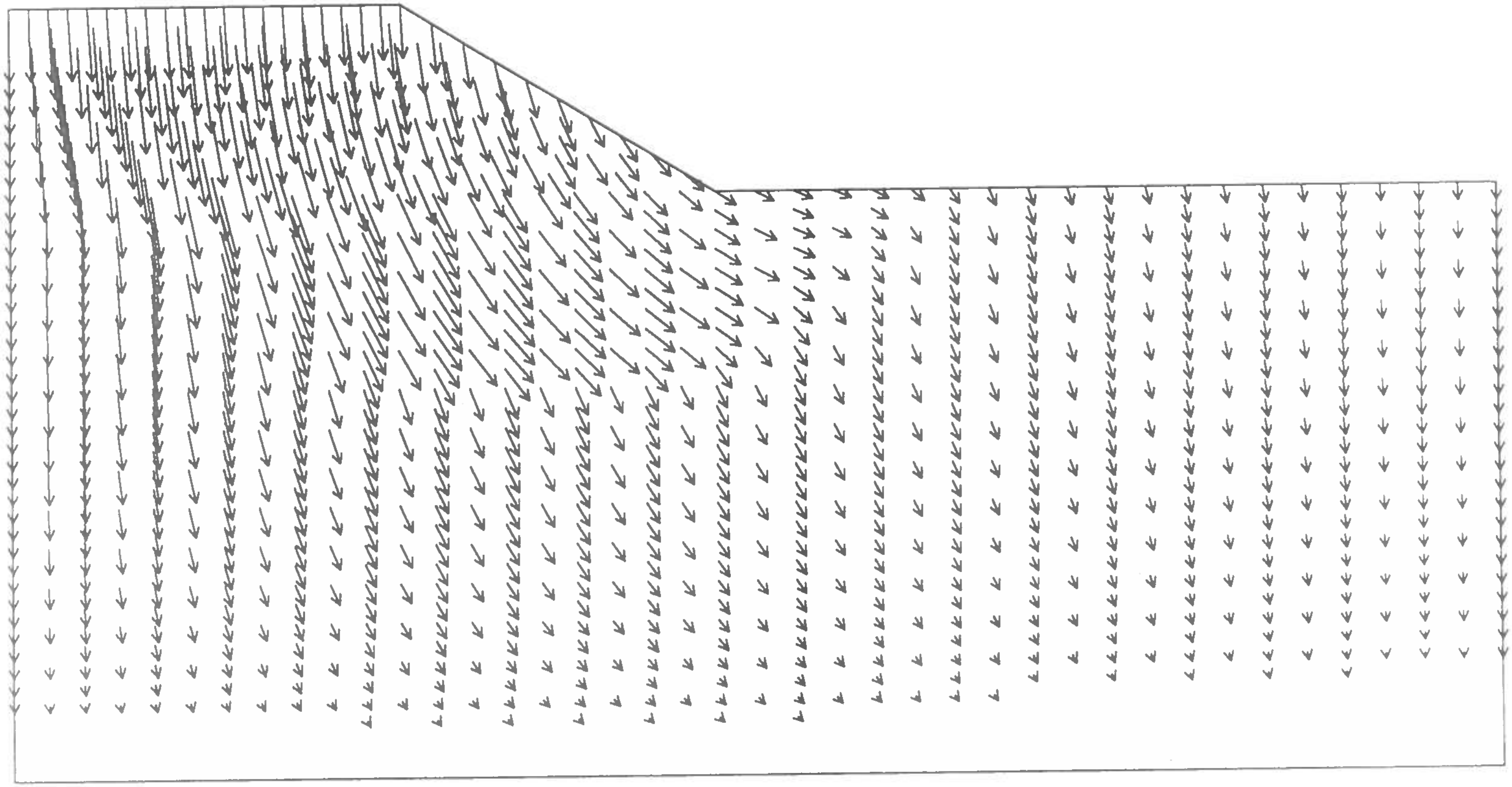
Section 11

Deformed Mesh



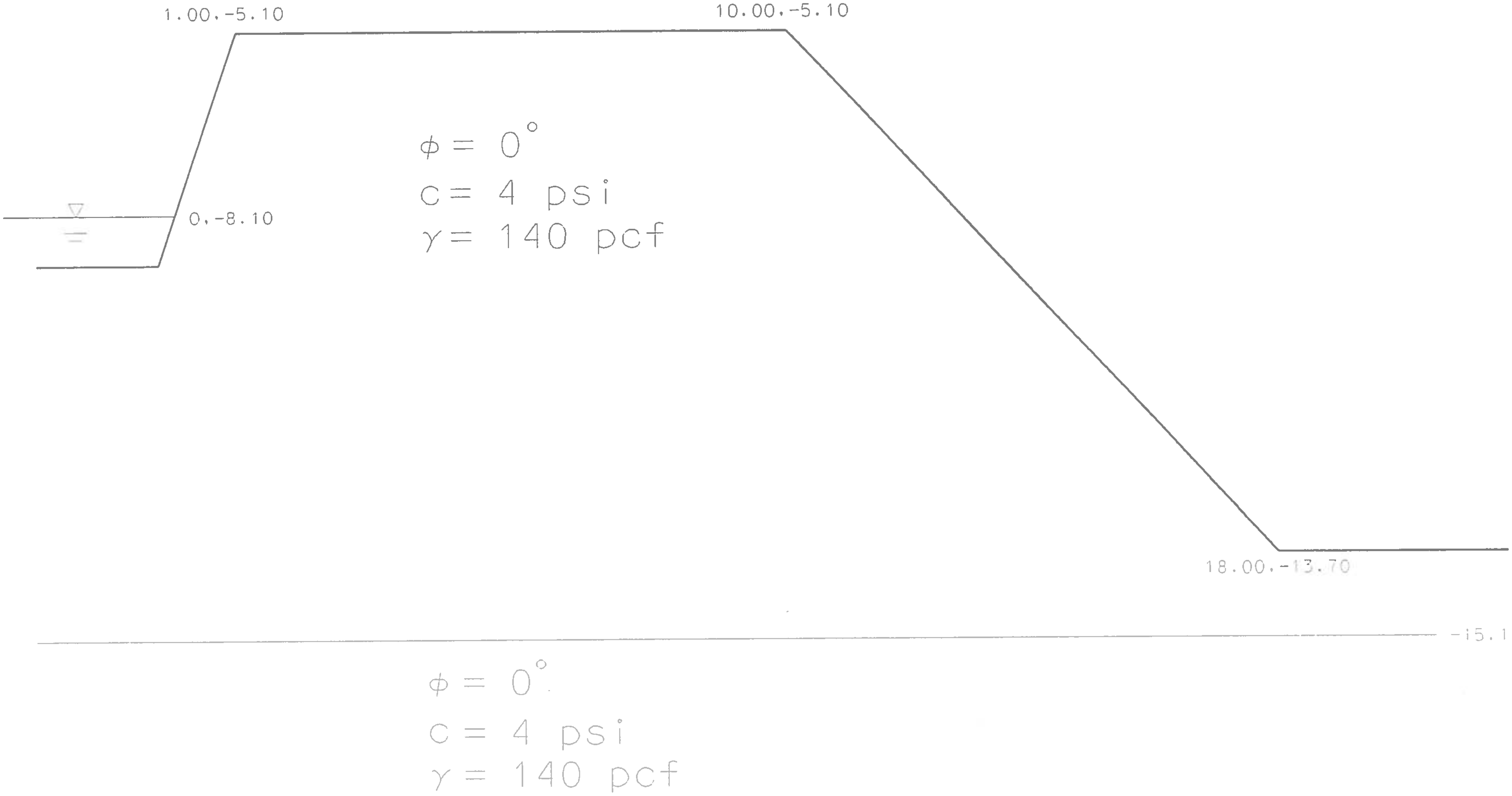
Section 11

Vector Trace



Section 12

Factor Of Safety = 2.5



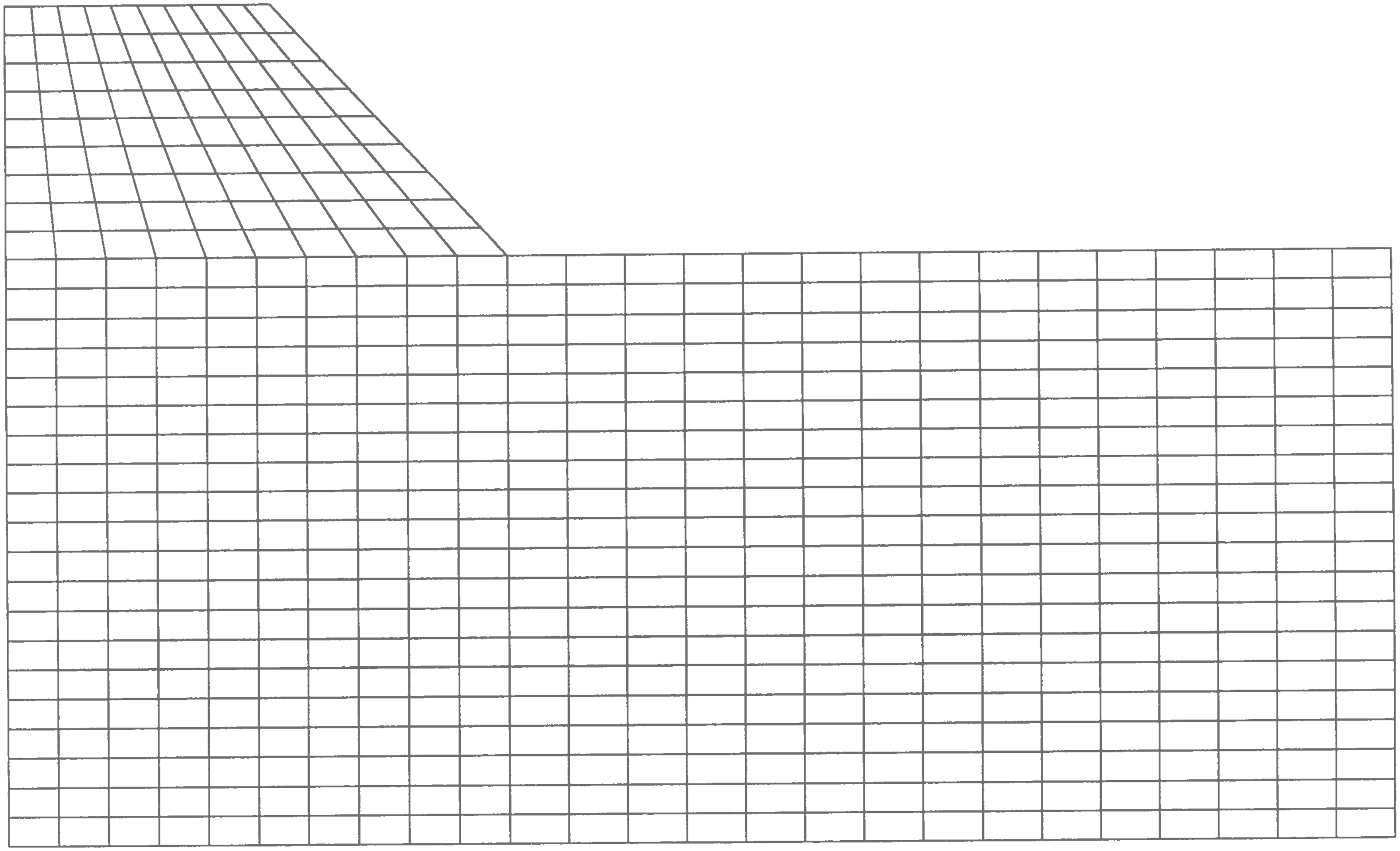
```
Section 12 Profile

w1=    9.00
s1=    8.00
w2=   30.00
h1=    8.60
h2=   20.00

nx1=   10
nx2=   15
ny1=    9
ny2=   20

Group  phi      c      psi    gamma      e          v
  1    0.00  576.00    0.00  140.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
  1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
```

```
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
 1   1   1   1
   1   1   1   1   1

tol=  0.000100
limit= 1000

      trial factor    max displacement    iterations
      0.2000E+01      0.8471E+00               53
      0.2100E+01      0.8825E+00               60
      0.2200E+01      0.9211E+00               68
      0.2300E+01      0.9667E+00               76
      0.2400E+01      0.1049E+01              115
```

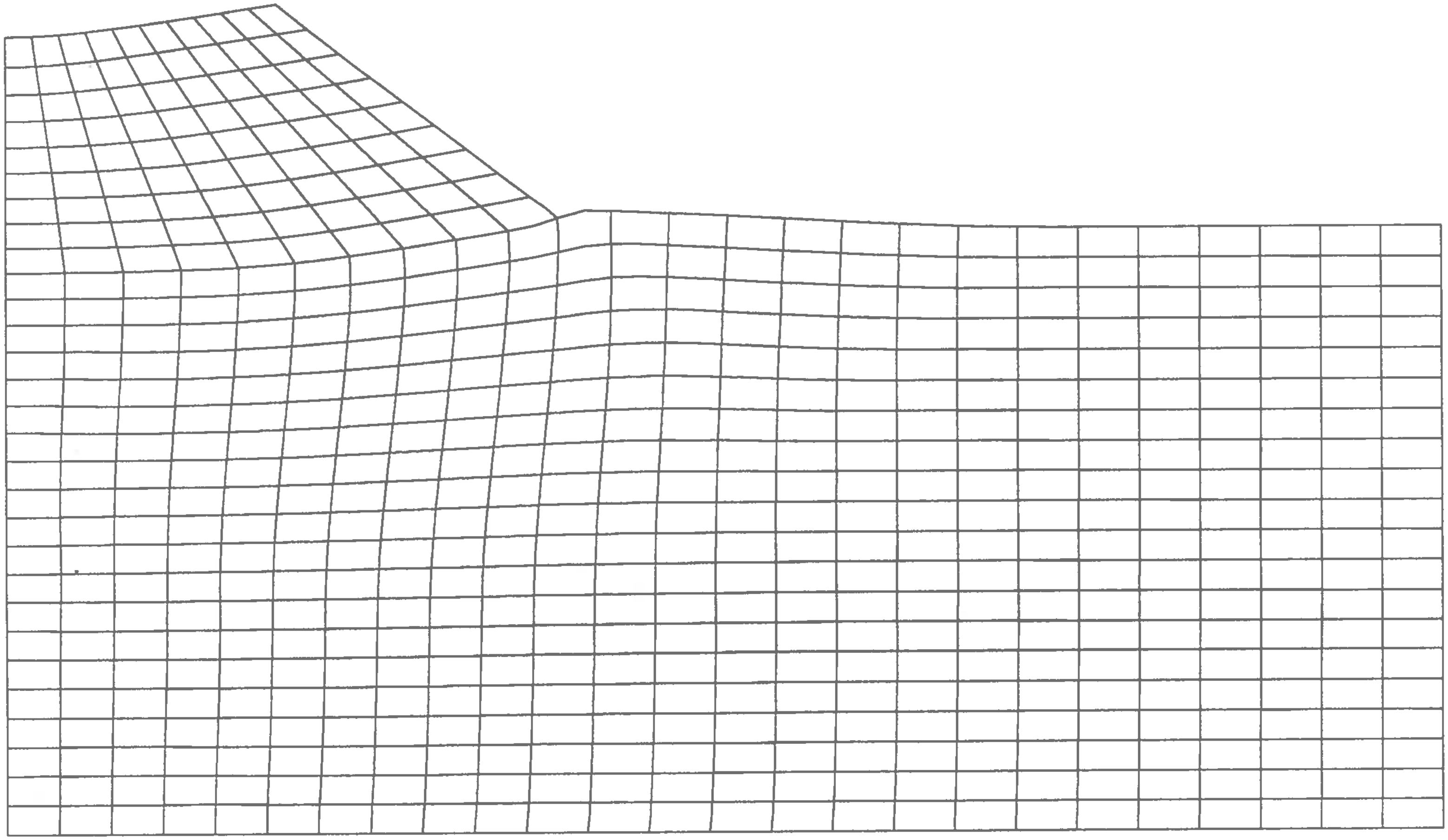
```
  0.2500E+01      0.2617E+01           1000
```

Section 12

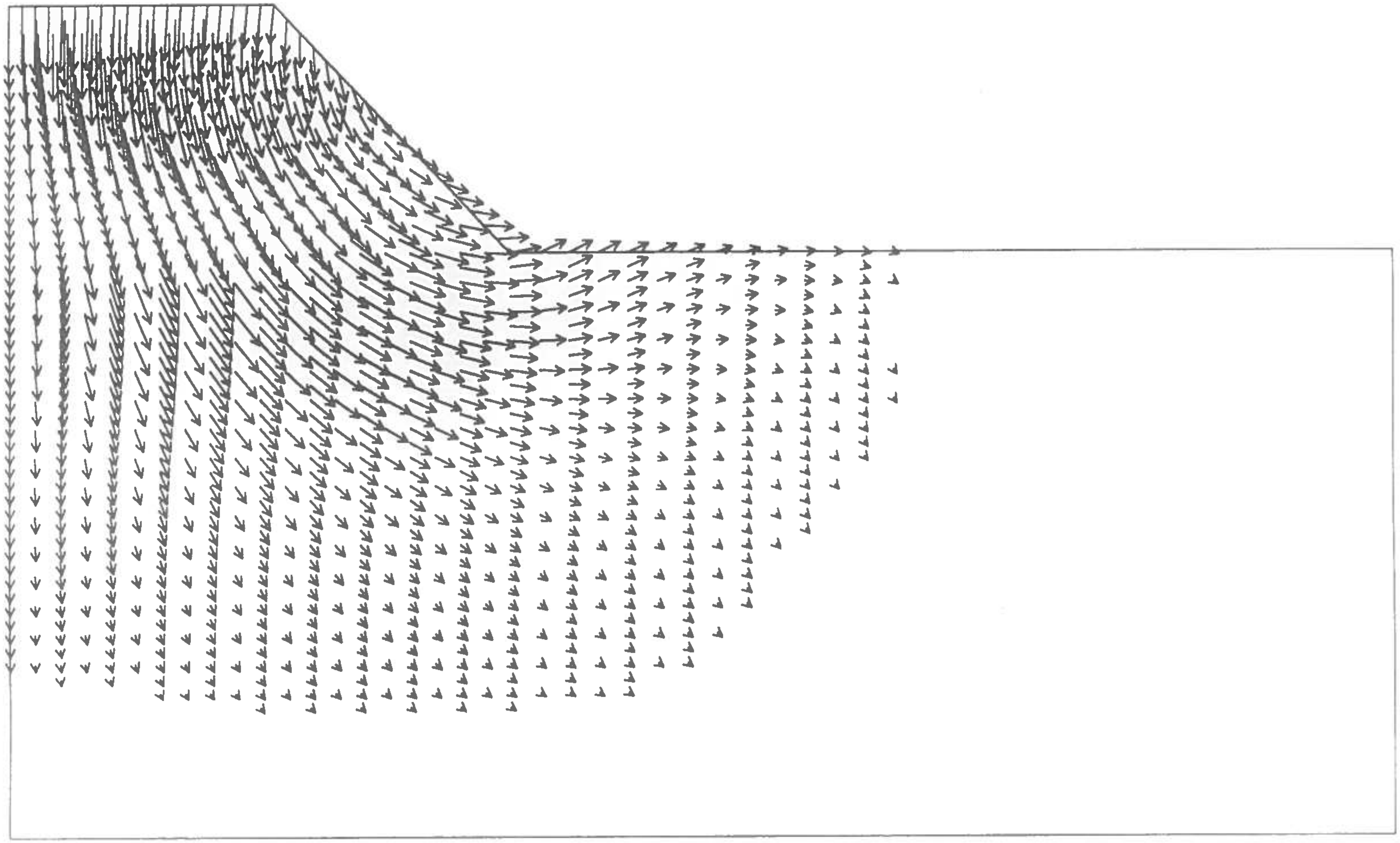
Mesh



Section 12
Deformed Mesh

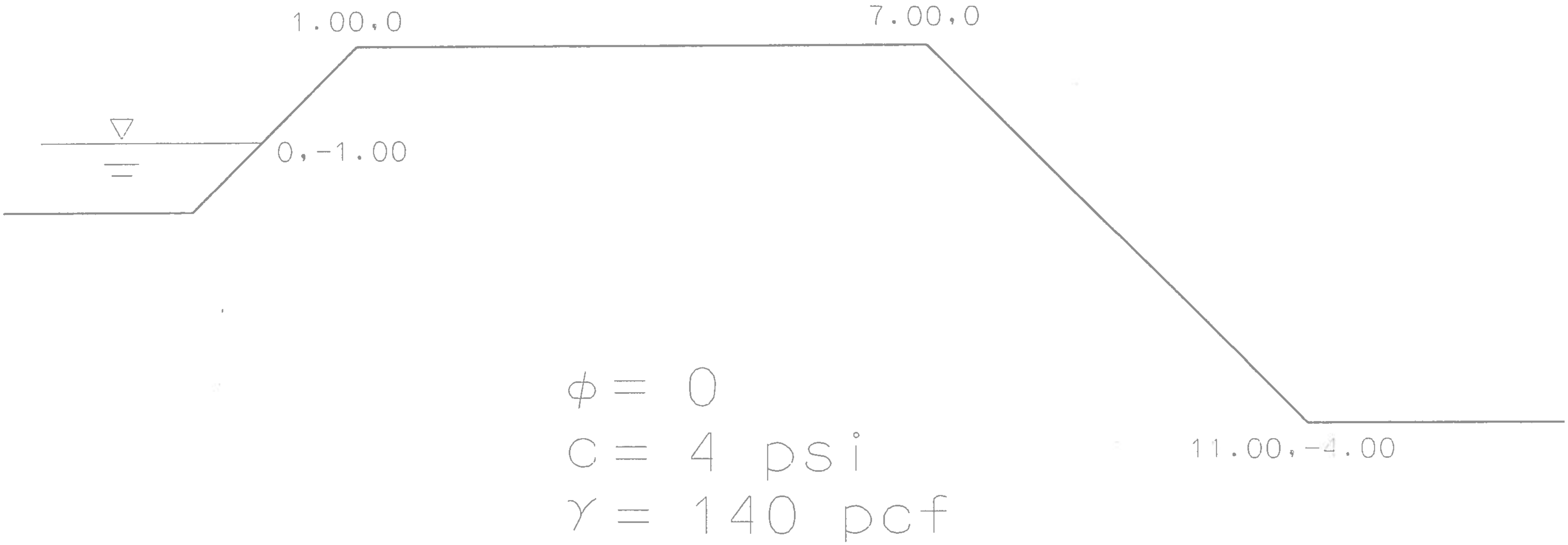


Section 12
Vector Trace



Section 13

Factor Of Safety = 5.4



$\phi = 0$

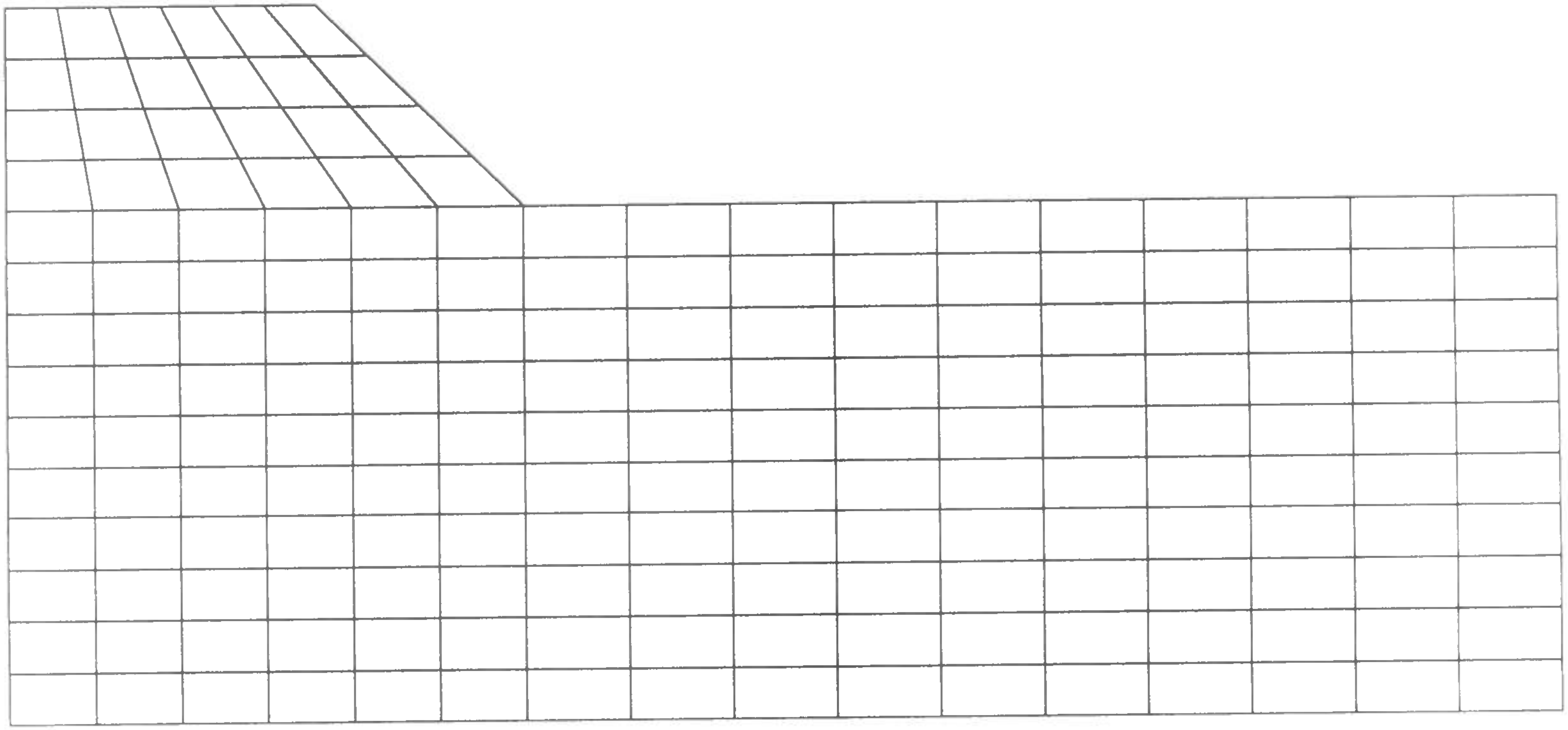
$c = 4$ psi

$\gamma = 140$ pcf

```
Section 13 Profile

w1=    6.00
s1=    4.00
w2=   20.00
h1=    4.00
h2=   10.00

nx1=    6
nx2=   10
ny1=    4
ny2=   10

Group  phi       c      psi    gamma       e          v
  1    0.00  576.00    0.00  140.00  0.1000E+06    0.30

Property group assigned to each element
   1   1   1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1

tol=  0.000100
limit= 1000

      trial factor    max displacement   iterations
      0.5000E+01      0.2583E+00            75
      0.5100E+01      0.2652E+00            82
      0.5200E+01      0.2768E+00           105
      0.5300E+01      0.3485E+00           570
      0.5400E+01      0.8591E+00          1000
```

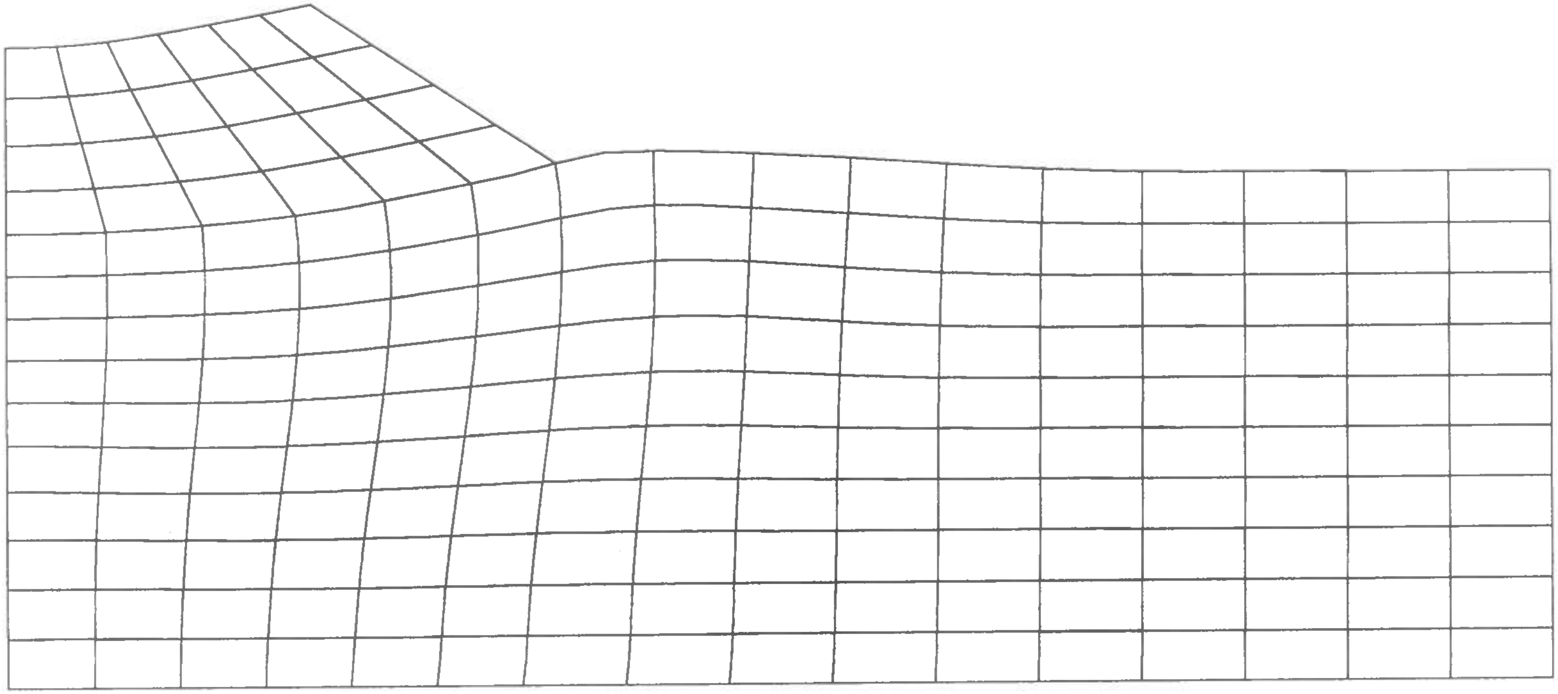
Section 13

Mesh



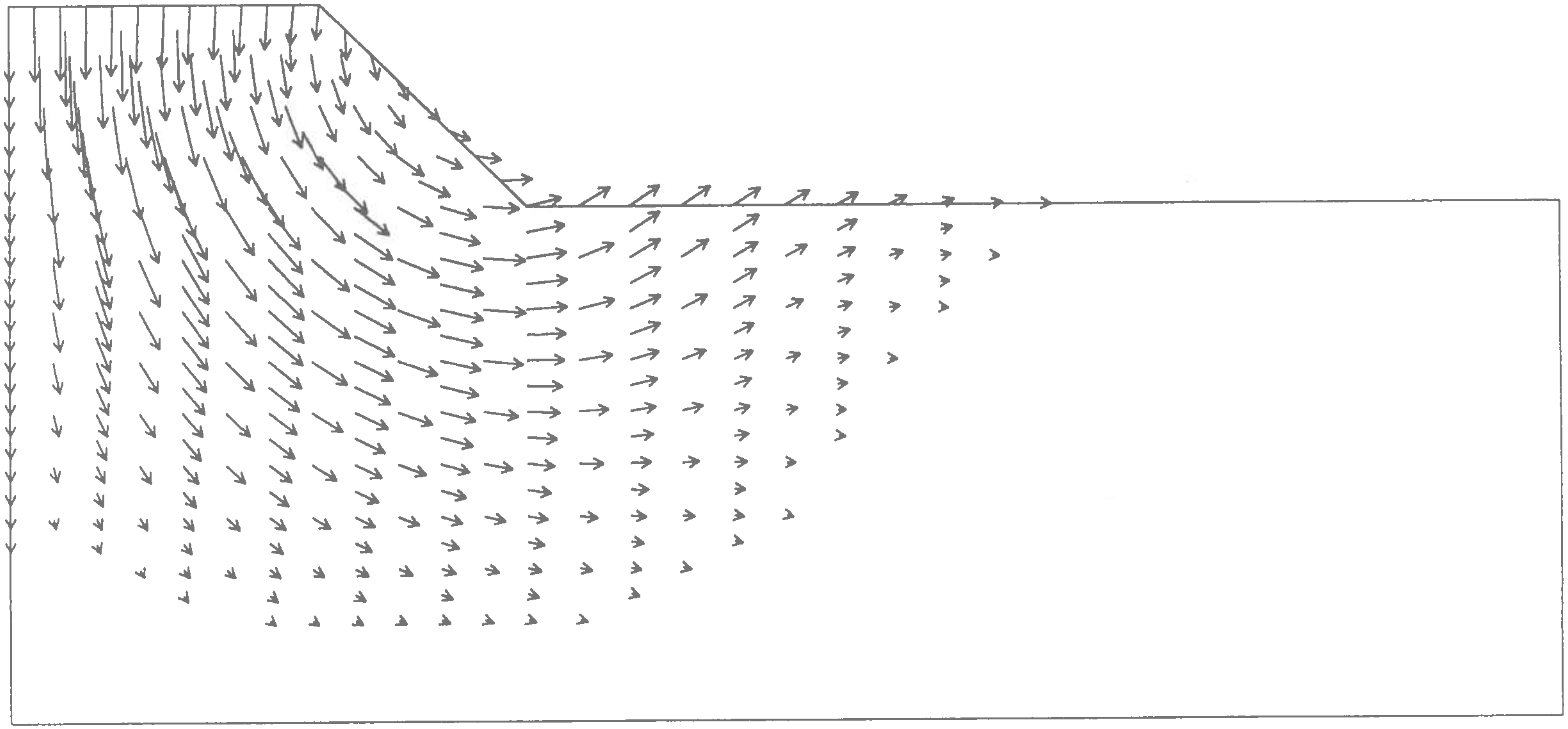
Section 13

Deformed Mesh



Section 13

Vector Trace



Triaxial Shear Results

Project: Ciniza Evaporation Lagoons

Project Number: 00-141

Sample #: 38631

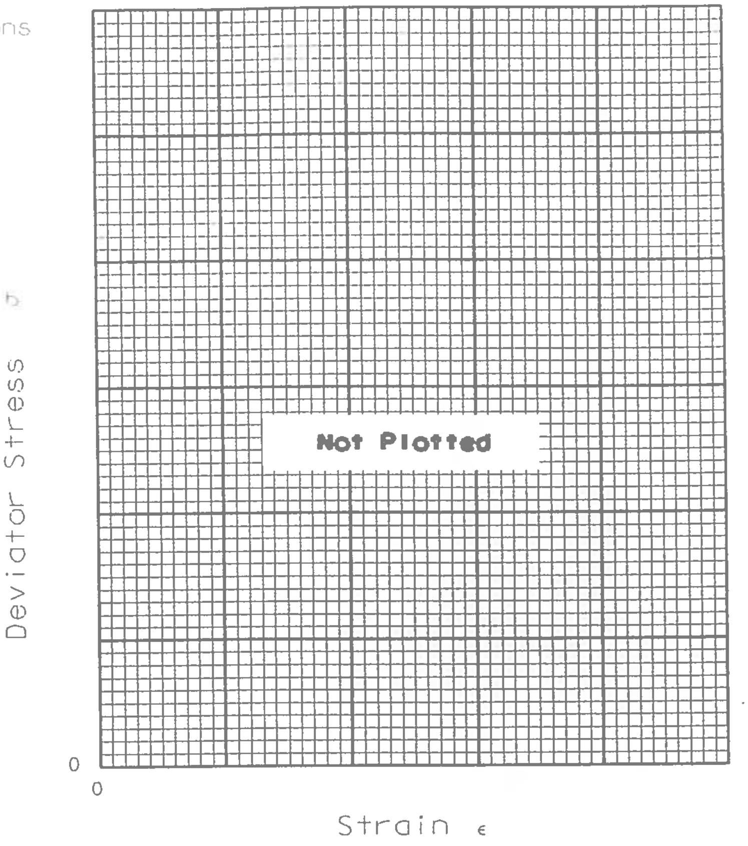
Unit Weight (pcf): 137.3 wet

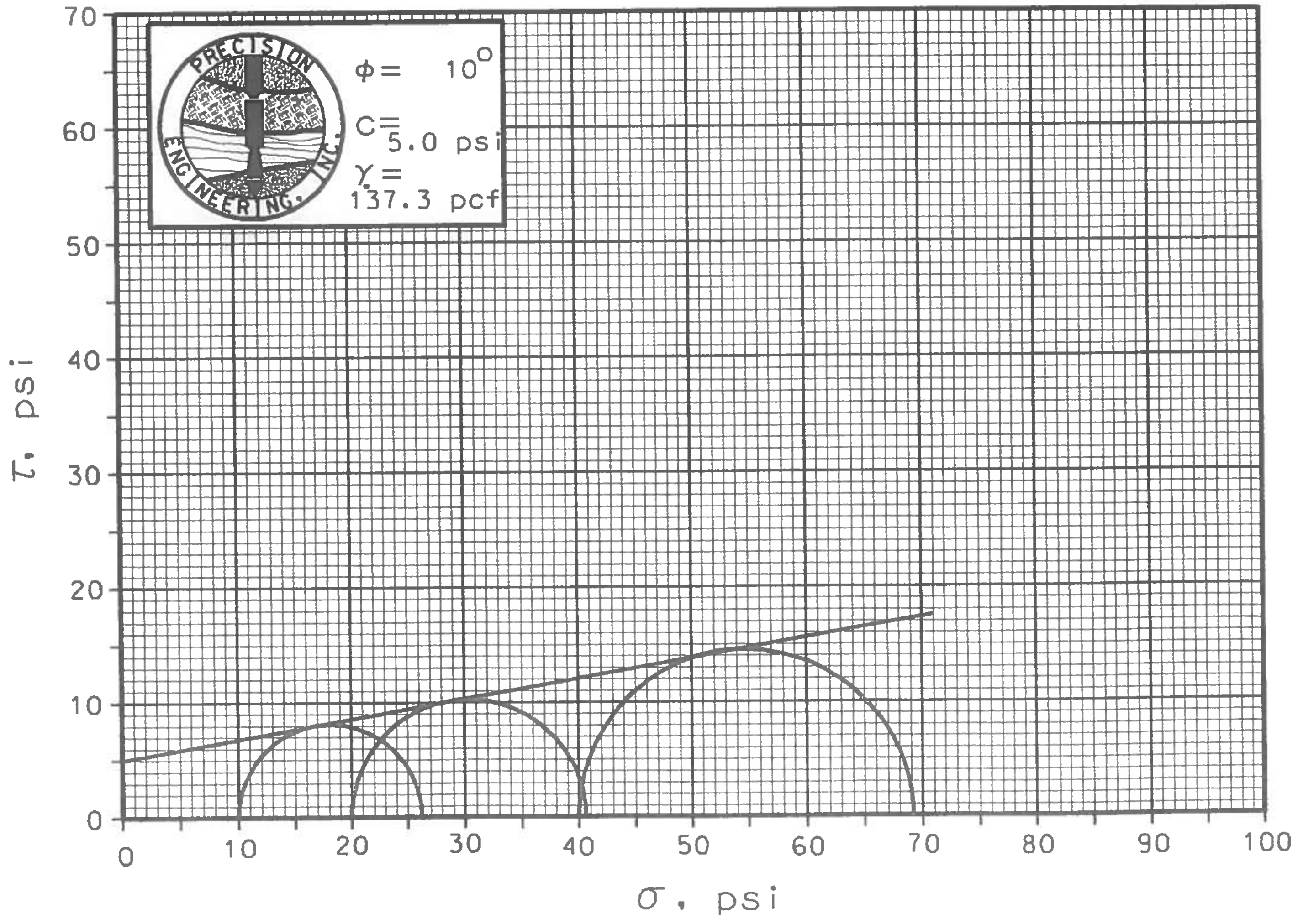
Lateral Pressure = σ_3

Max. Deviator Stress = σ

Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	16.2	26.2
2	20	20.8	40.8
3	40	29.1	69.1





Triaxial Shear Results

Project: Ciniza Evaporation Lagoons

Project Number: 00-141

Sample #: 38640

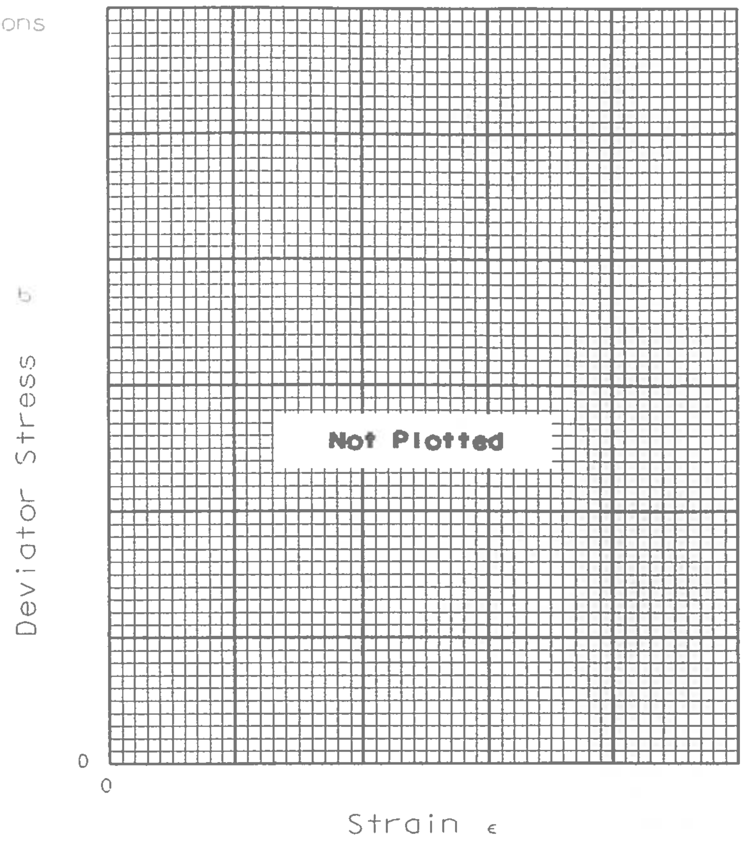
Unit Weight (pcf): 140.1 wet

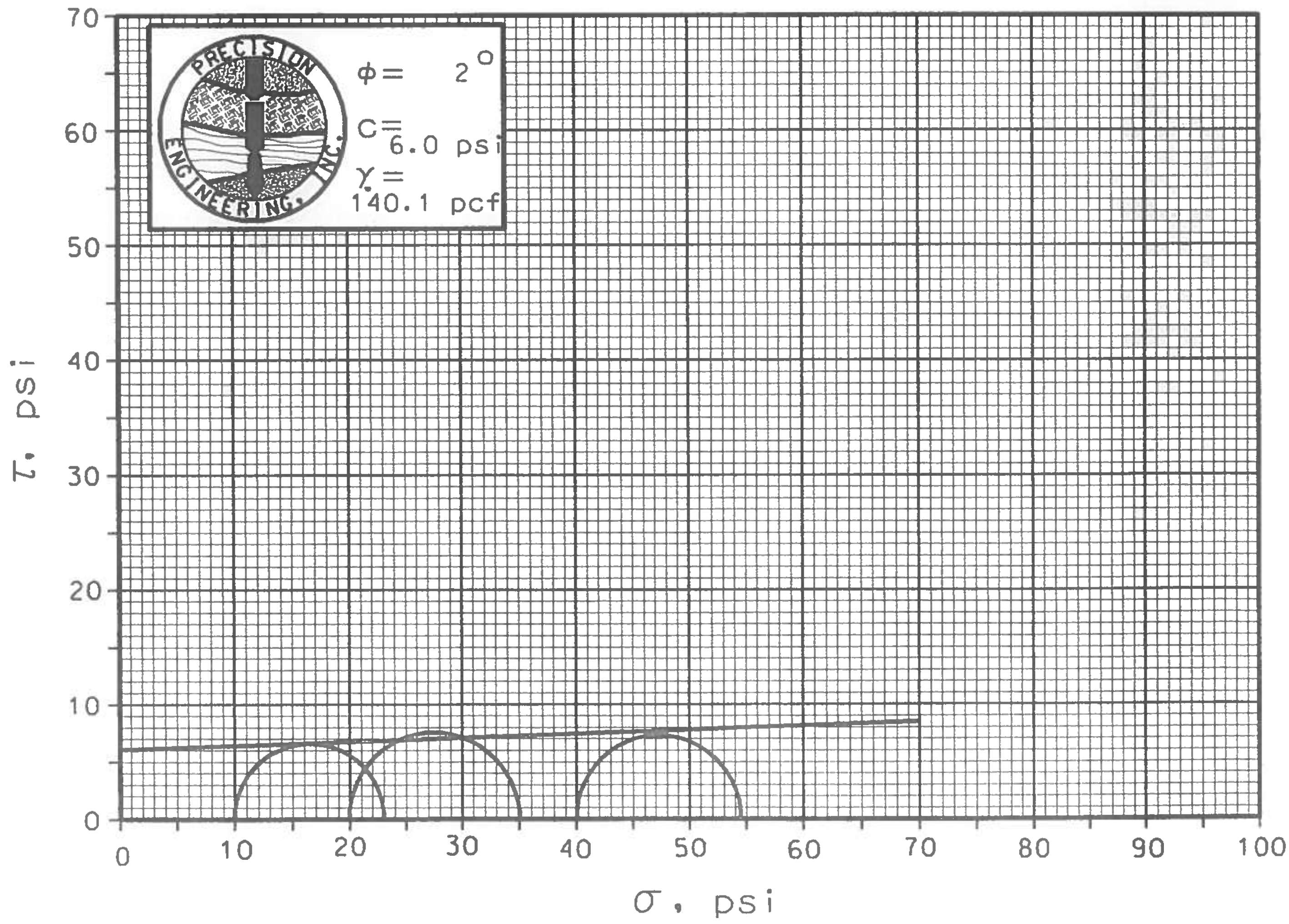
Lateral Pressure = σ_3

Max. Deviator Stress = σ

Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	24.0	23.0
2	20	29.9	35.0
3	40	24.1	54.5





Triaxial Shear Results

Project: Ciniza Evaporation Lagoons

Project Number: 00-141

Sample #: 38641

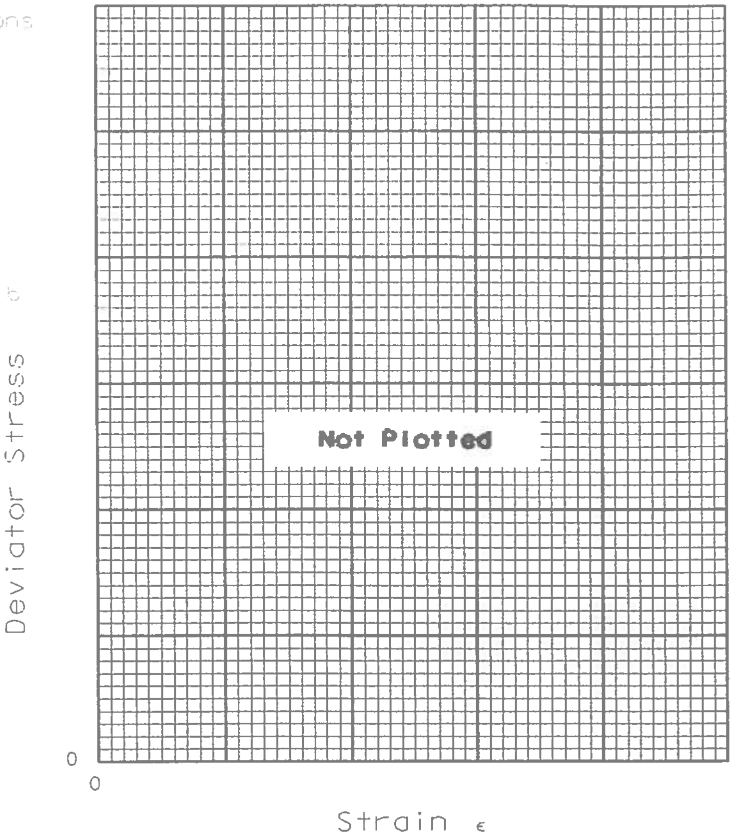
Unit Weight (pcf): 141.3 wet

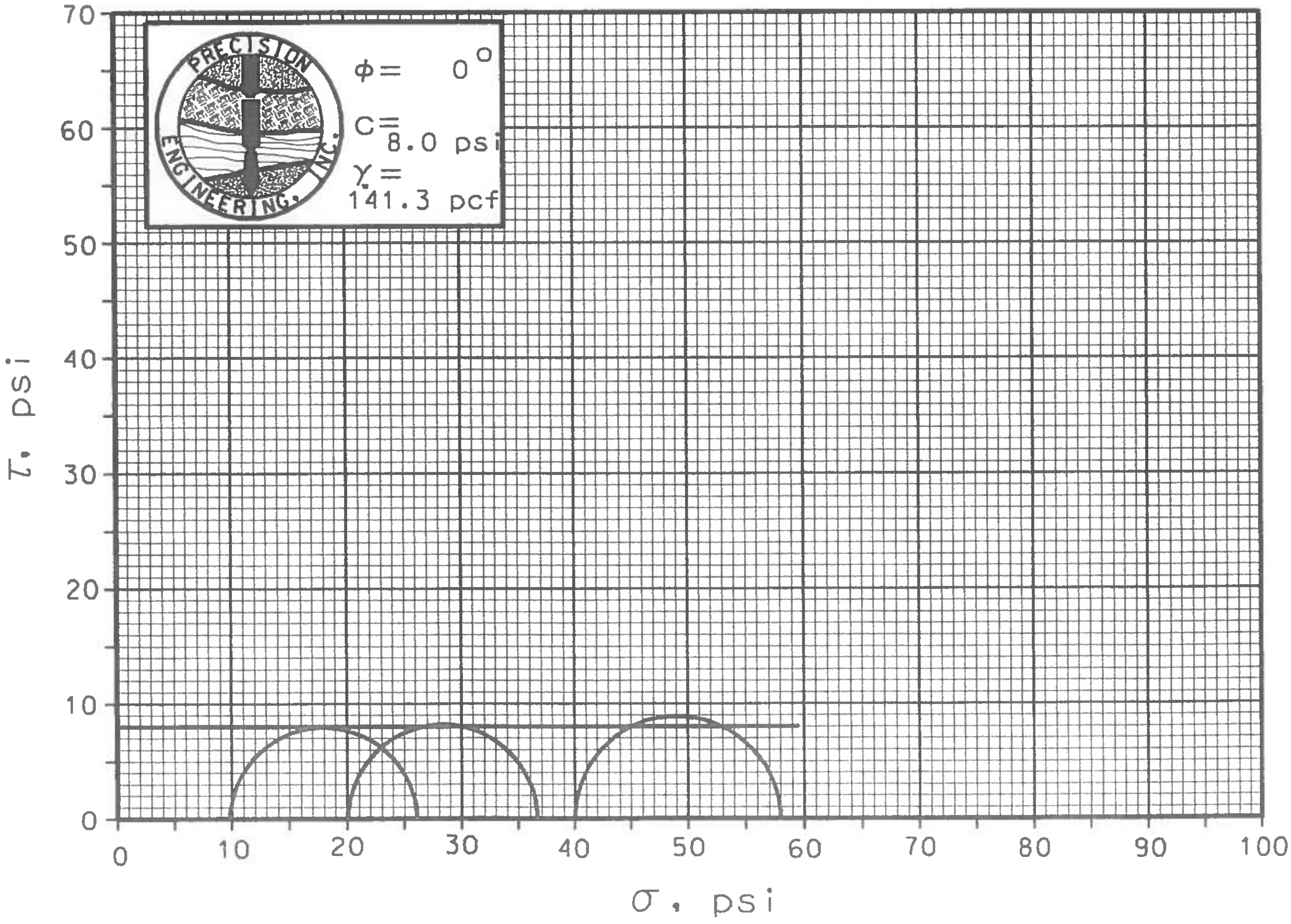
Lateral Pressure = σ_3

Max. Deviator Stress = σ

Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	16.1	26.1
2	20	16.7	36.7
3	40	18.0	58.0





Triaxial Shear Results

Project: Ciniza Evaporation Lagoons

Project Number: 00-141

Sample #: 3864

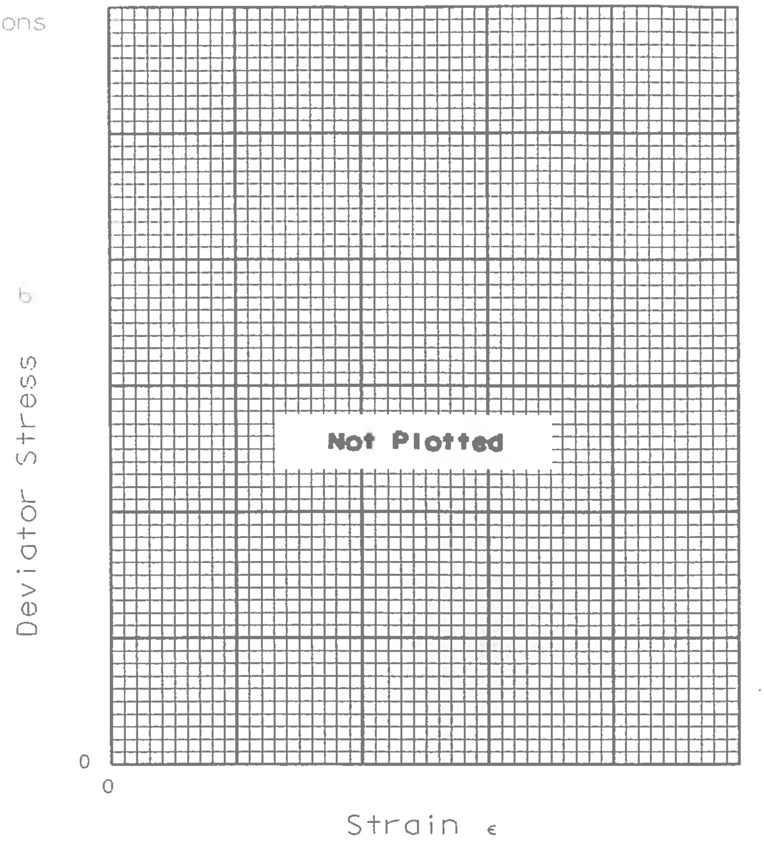
Unit Weight (pcf): 140.0 wet

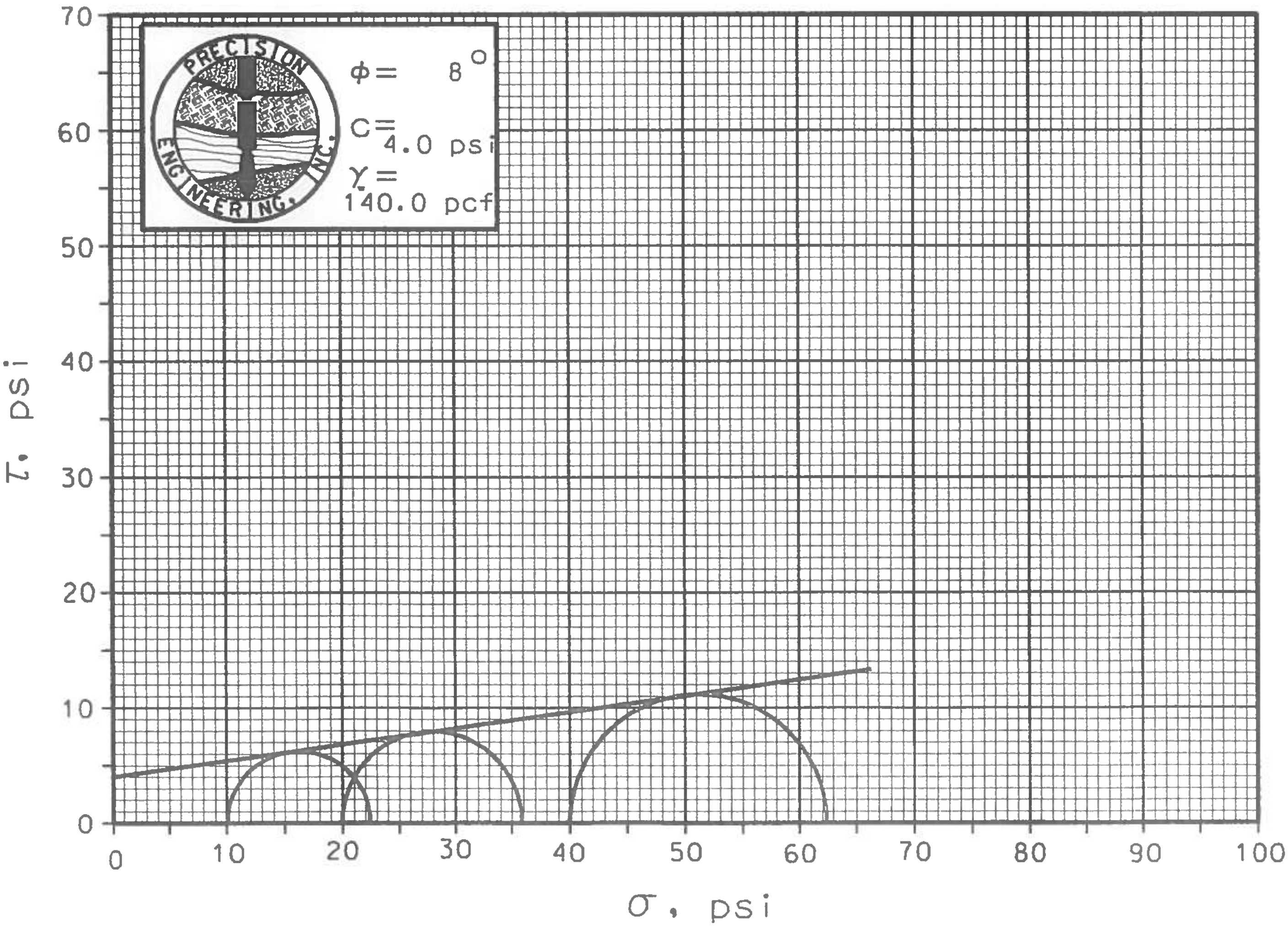
Lateral Pressure = σ_3

Max. Deviator Stress = σ b

Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	12.3	22.3
2	20	15.9	35.9
3	40	22.4	62.4





Triaxial Shear Results

Project: Ciniza Evaporation Lagoons

Project Number: 00-141

Sample #: 38645

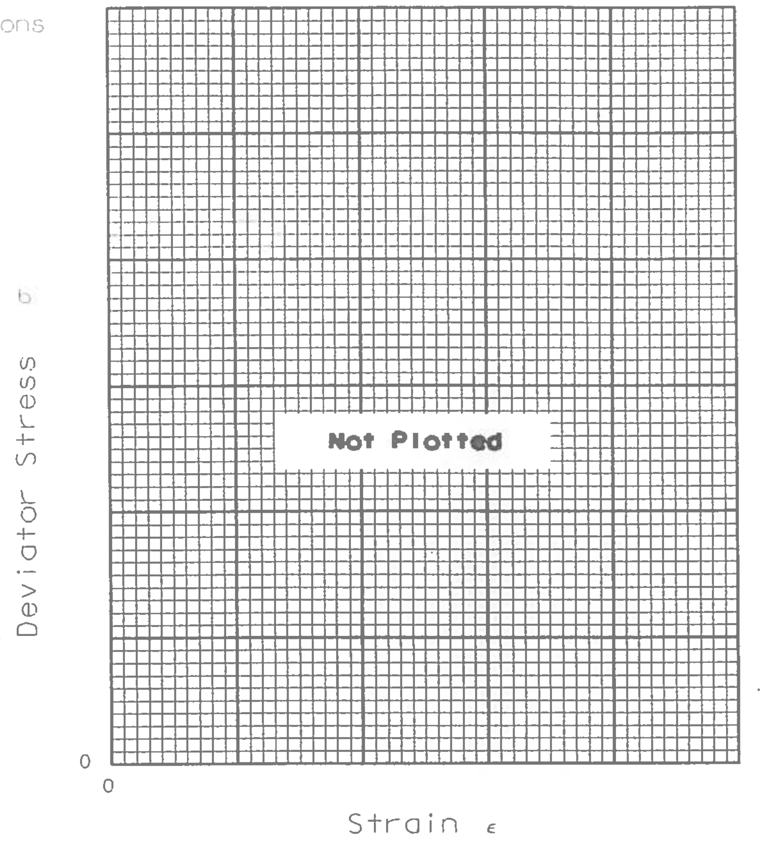
Unit Weight (pcf): 137.4 wet

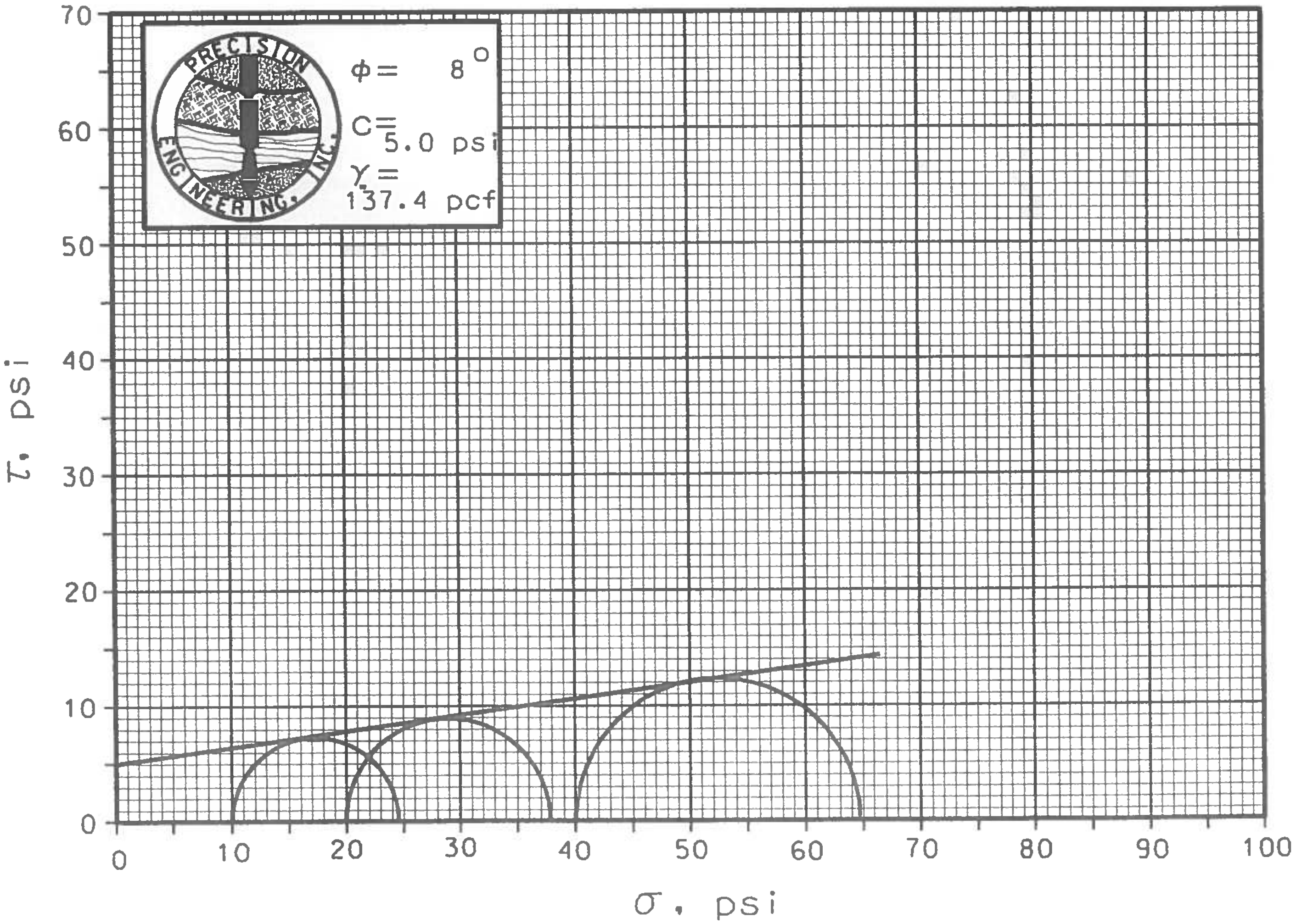
Lateral Pressure = σ_3

Max. Deviator Stress = σ

Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	14.5	24.5
2	20	17.9	37.9
3	40	24.8	64.8





Triaxial Shear Results

Project: Ciniza Evaporation Lagoons

Project Number: 00-141

Sample #: 38647

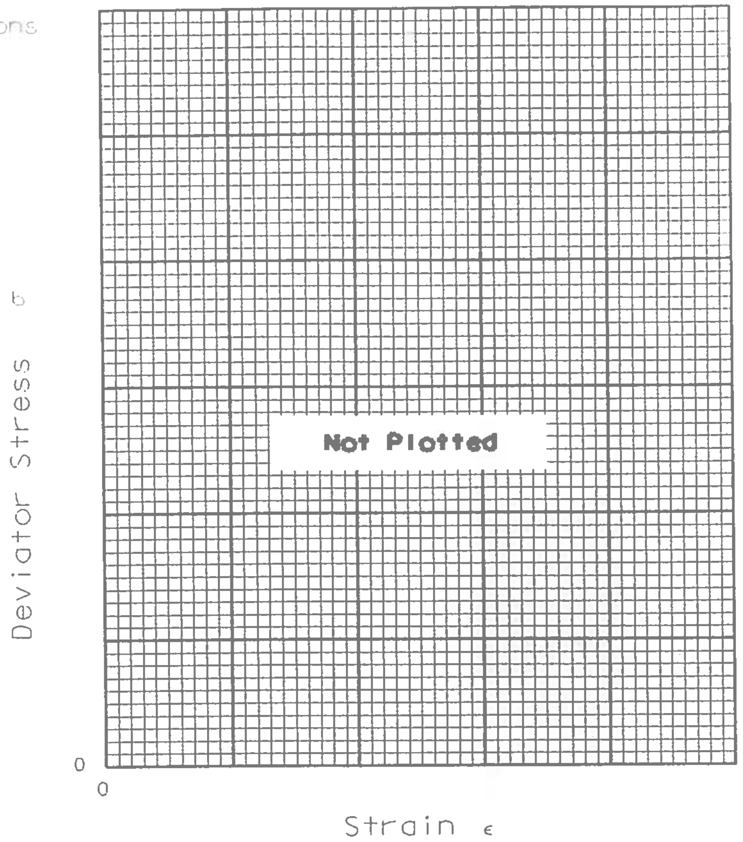
Unit Weight (pcf): 138.9 wet

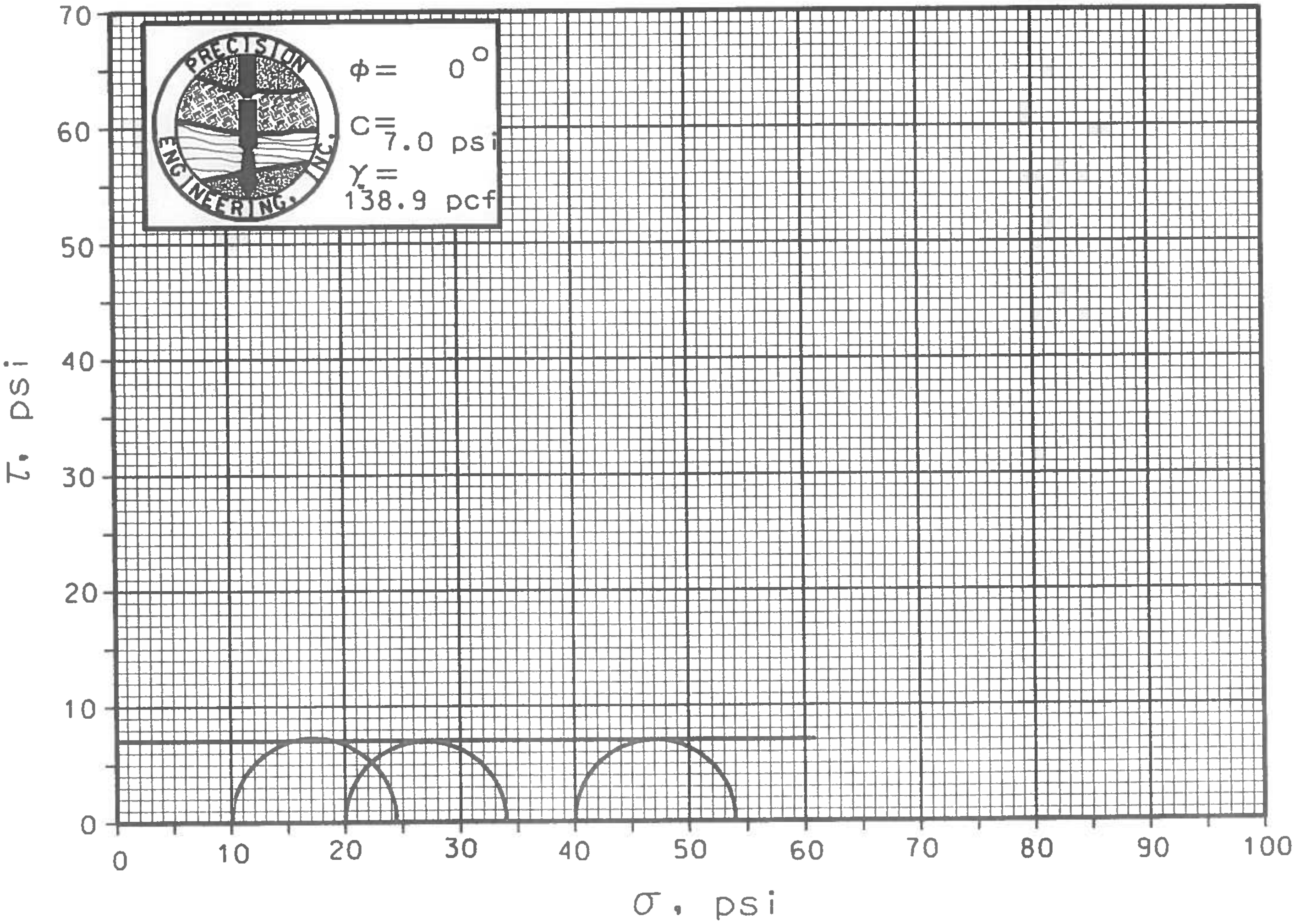
Lateral Pressure = σ_3

Max. Deviator Stress = σ

Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	14.4	24.4
2	20	14.0	34.0
3	40	14.0	54.0

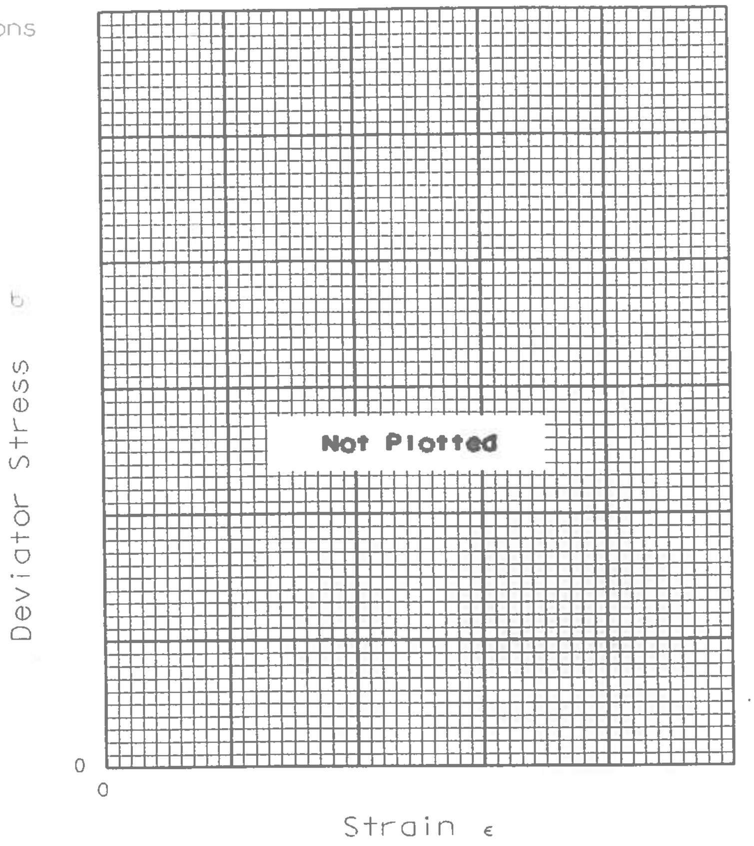


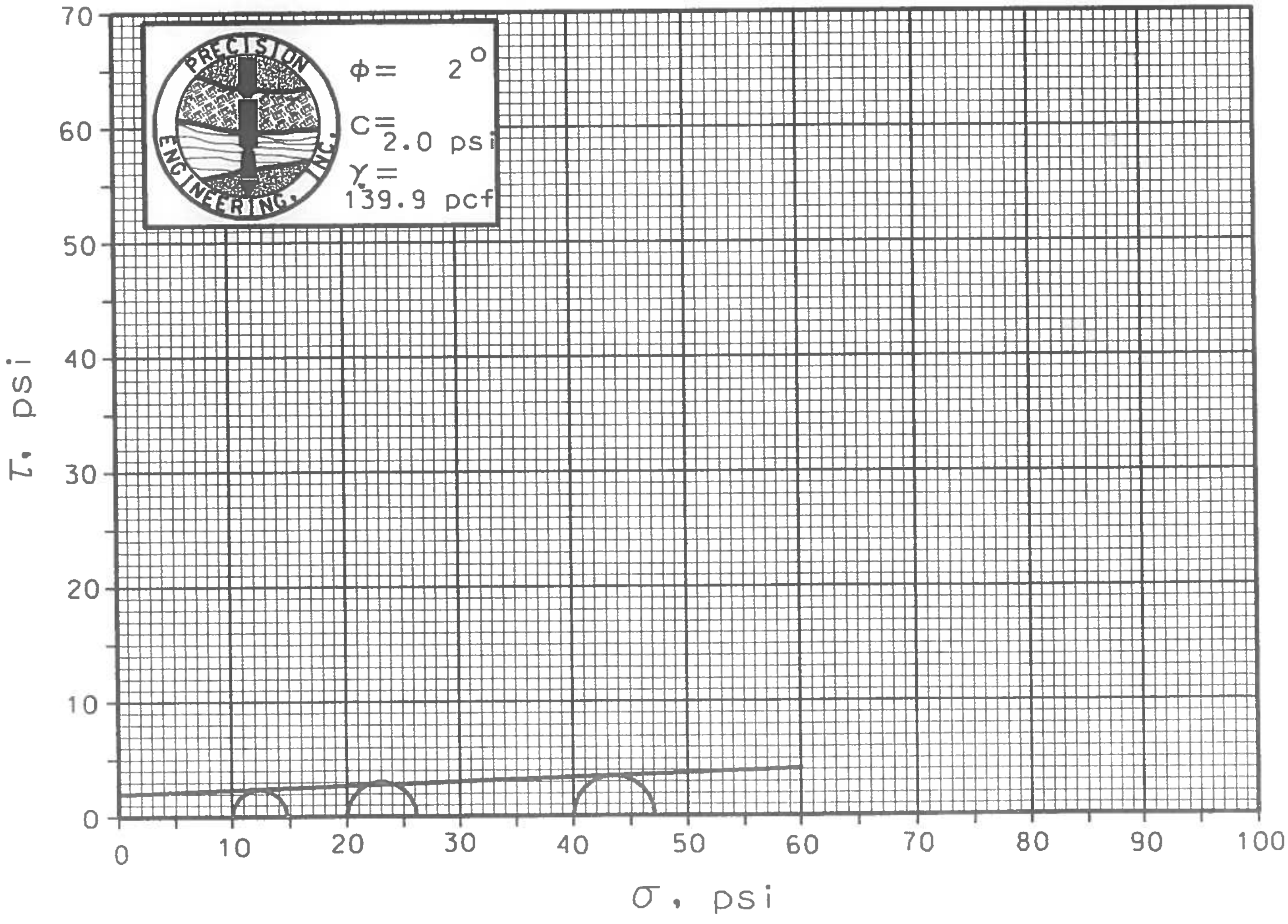


Triaxial Shear Results

Project: Ciniza Evaporation Lagoons
Project Number: 00-141
Sample #: 38648
Unit Weight (pcf): 139.9 wet
Lateral Pressure = σ_3
Max. Deviator Stress = σ
Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	4.9	14.9
2	20	6.1	26.1
3	40	7.1	47.1

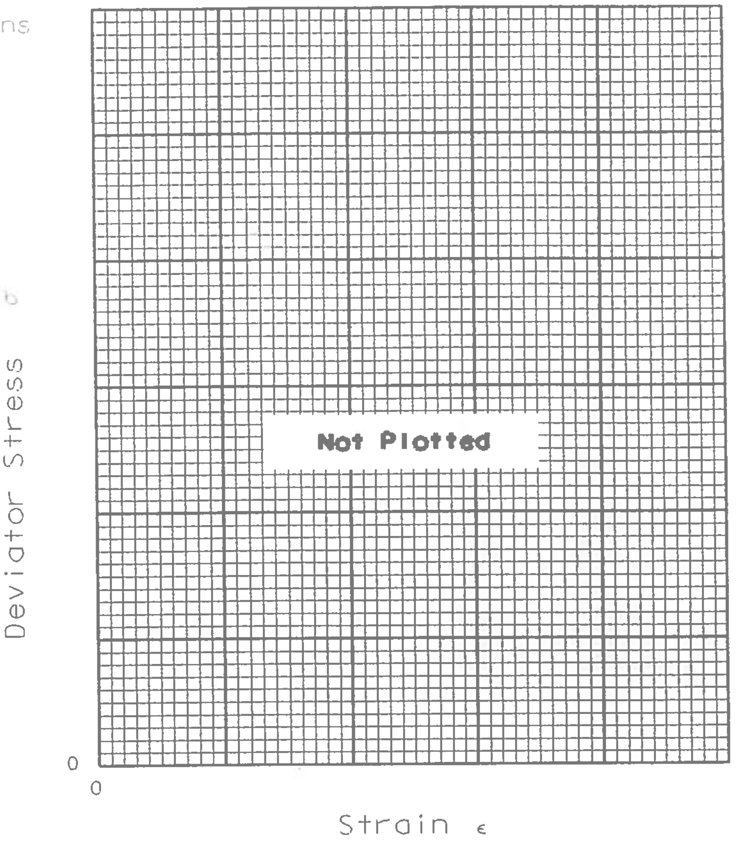


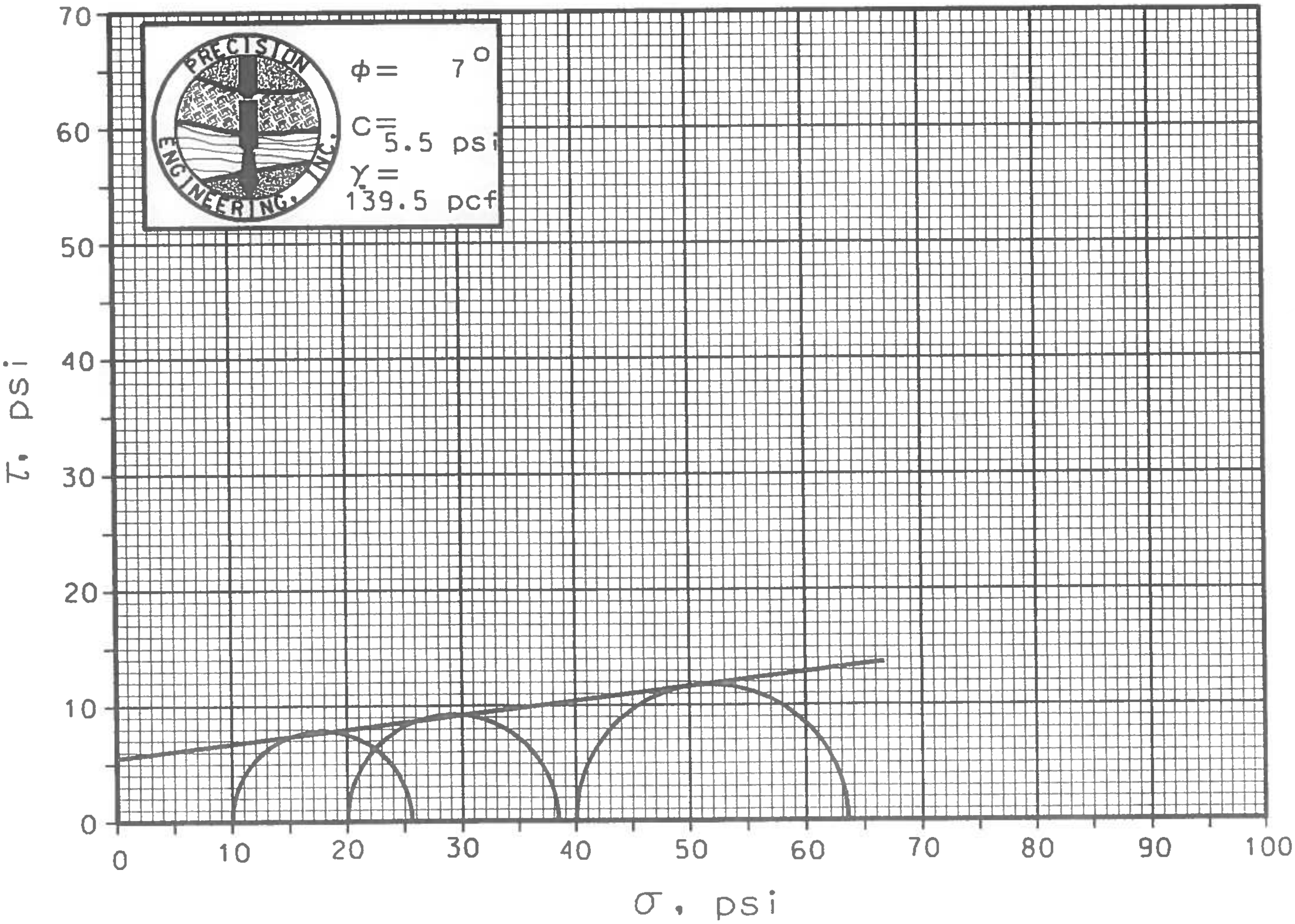


Triaxial Shear Results

Project: Ciniza Evaporation Lagoons
Project Number: 00-141
Sample #: 38650
Unit Weight (pcf): 139.5 wet
Lateral Pressure = σ_3
Max. Deviator Stress = σ
Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	15.7	25.7
2	20	18.3	38.3
3	40	23.4	63.4





Triaxial Shear Results

Project: Ciniza Evaporation Lagoons

Project Number: 00 141

Sample #: 38652

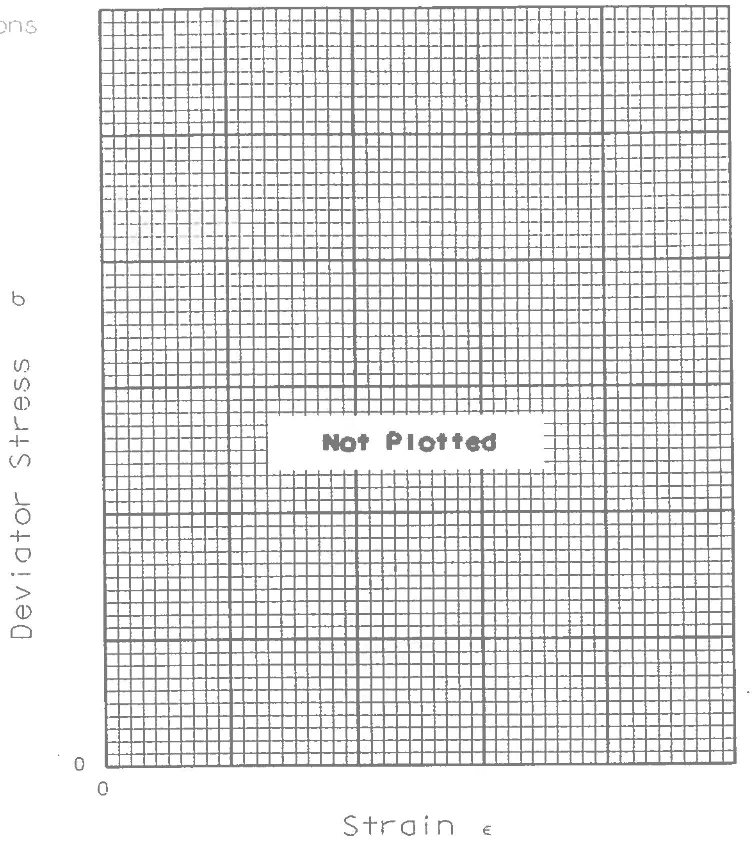
Unit Weight (pcf): 141.4 wet

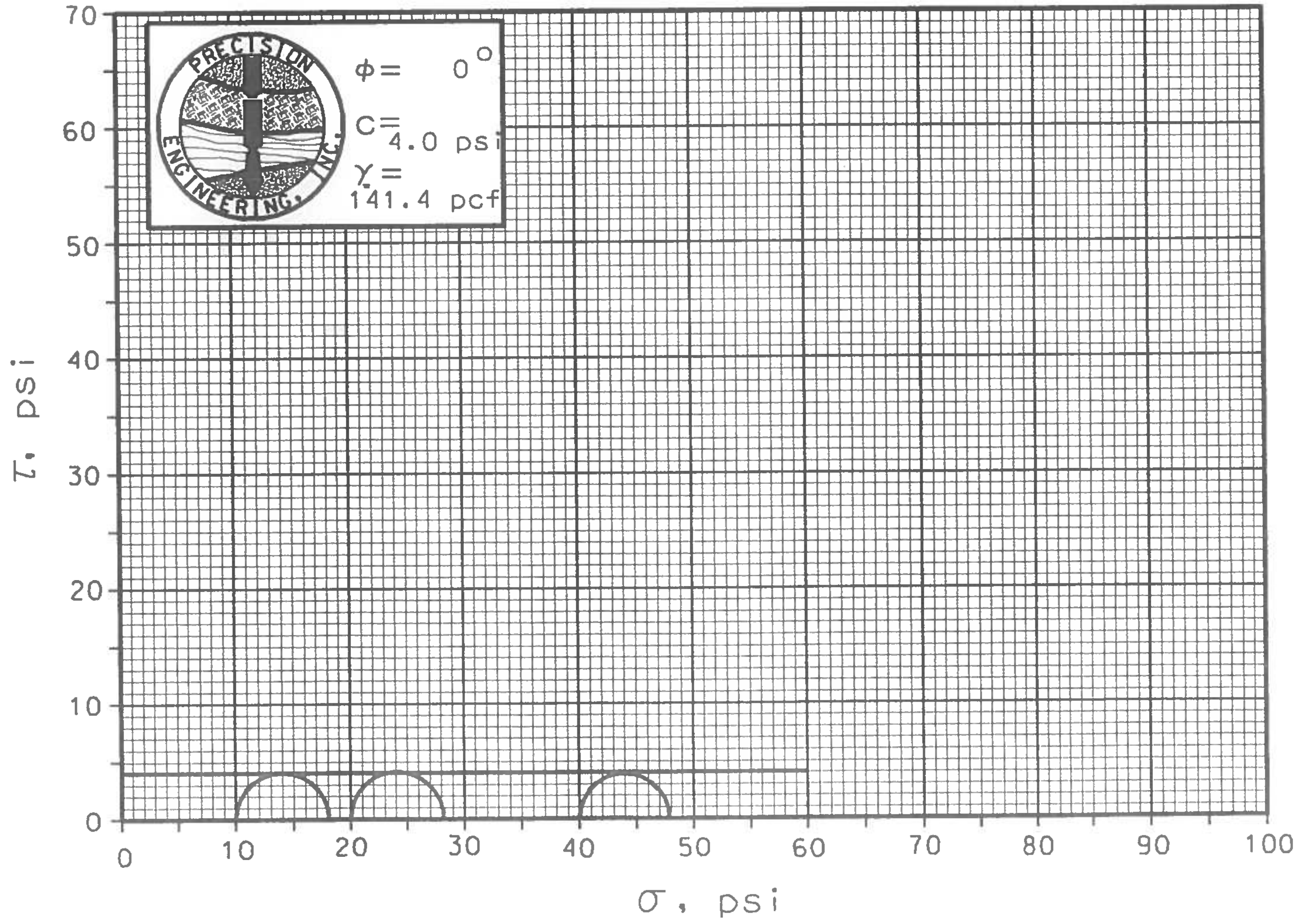
Lateral Pressure = σ_3

Max. Deviator Stress = σ

Max. Vertical Stress = σ_1

Sample	σ_3	σ	σ_1
1	10	8.0	18.0
2	20	8.2	28.2
3	40	7.9	47.9





KEY TO SOIL CLASSIFICATION AND SYMBOLS

SOIL TYPE / SAMPLE TYPE

```
GRAVEL    SAND    SILT    CLAY

 _____    _____   _____   _____   _____       _____    _____   _____    _____
¦O O¦    ¦* *¦   ¦- -¦   ¦/ /¦   ¦+ +¦       ¦ U ¦    ¦ R ¦   ¦ S ¦    ¦ G ¦
¦O O¦    ¦* *¦   ¦- -¦   ¦/ /¦   ¦+ +¦       ¦ U ¦    ¦ R ¦   ¦ S ¦    ¦ G ¦
¦---¦    ¦---¦   ¦---¦   ¦---¦   ¦+ +¦       ¦ U ¦    ¦ R ¦   ¦ S ¦    ¦ G ¦
¦ O ¦    ¦ * ¦   ¦ - ¦   ¦ / ¦   ¦+ +¦       ¦ U ¦    ¦ R ¦   ¦ S ¦    ¦ G ¦
¦_O_¦    ¦_*_¦   ¦_-_¦   ¦_/_¦   ¦+_+¦       ¦_U_¦    ¦_R_¦   ¦_S_¦    ¦_G_¦
GRAVELLY SANDY   SILTY  CLAYEY CALCAREOUS  UNDIS-    ROCK  SPLIT    GRAB
                                INDURATION TURBED    CORE  SPOON    AUGER
```

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOIL

(major portion retained on #200 sieve)

Includes (1) clean gravels and sands described as fine, medium, or coarse,depending on grain size distribution and (2) silty or clayey gravels or sands.

Penetration Resistance**	Descriptive Term
0 - 5	Very Loose
6 - 10	Loose
11 - 15	Moderately Dense
16 - 30	Medium Dense
31 - 50	Dense
over 50	Very Dense

FINE GRAINED SOILS

(major portion passing a #200 sieve)

Includes (1) inorganic and inorganic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency rated according to shear strength.

Penetration Resistance**	Descriptive Term
1 - 3	Very Soft
4 - 6	Soft
7 - 11	Firm
12 - 19	Stiff
20 - 30	Very Stiff
over 30	Hard

Descriptive Term (in terms of % moisture)

Dry 0-4%, Damp 4-8%, Moist 8-20%, Wet >20%, Water Bearing is below water table

** Measured in blows/foot by a 140# hammer falling 30".

PRECISION ENGINEERING INC.

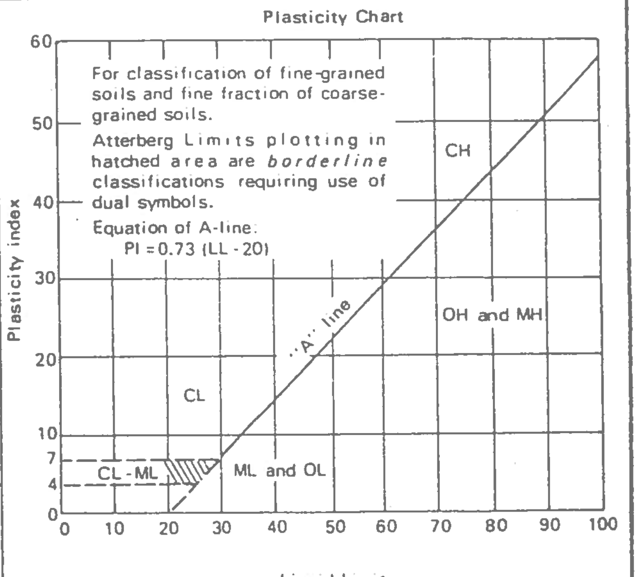
GEOTECHNICAL • MATERIALS • TESTING LABORATORY

Ph: (505) 523-7674 • FAX: (505) 523-7248

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 – 69 AND D 2488 – 69

(Unified Soil Classification System)

Major divisions			Group symbols	Typical names	Classification criteria		
Coarse-grained soils More than 50% retained on No. 200 sieve*	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines Less than 5% pass No. 200 sieve . . . . . . GW, GP, SW, SP More than 12% pass No. 200 sieve . . . . . . GM, GC, SM, SC 5 to 12% pass No. 200 sieve . . . . *Borderline* classifications requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are *borderline* classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		Sands with fines	SM	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are *borderline* classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils 50% or more passes No. 200 sieve*	Silts and clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	Plasticity Chart  For classification of fine-grained soils and fine fraction of coarse-grained soils. Atterberg Limits plotting in hatched area are *borderline* classifications requiring use of dual symbols. Equation of A-line: PI = 0.73 (LL - 20) 		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
	Highly organic soils		Pt	Peat, muck and other highly organic soils	*Based on the material passing the 3 in. (76 mm) sieve.		

APPENDIX D

Boring logs

Boring/Well Log

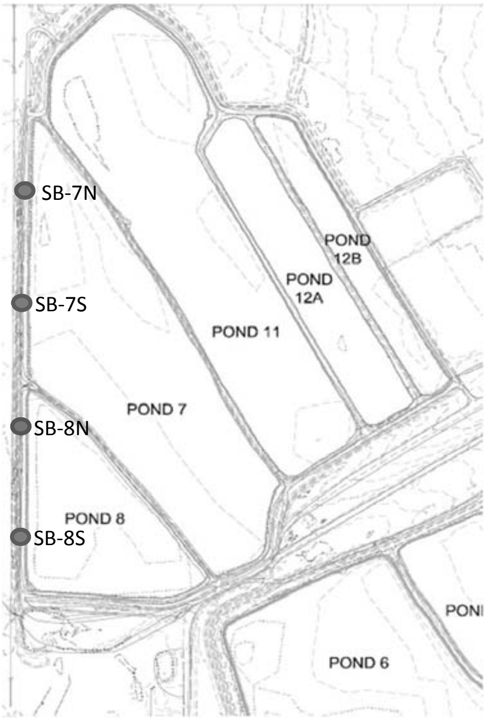
Well/Boring ID: SB-8N

Sheet: 1 of 2

Project: **Gallup, NM Berm Upgrades**	Drilling Contractor: **Envirodrill**	Ground Elevation:
Project #: **15-110**	Drilling Method: **Hollow Stem Auger**	TOC Elevation: **NA**
Customer: **Western Refining**	Sampling Method: **Split Spoon**	Filter Pack: **NA**
Study Area: **Pond 7/8**	Boring Diameter: **6.25 inch**	Bentonite Seal: **NA**
Start Date/Time: **Mon 10/12/15 1400**	Well Diameter: **NA**	Grout: **NA**
End Date/Time: **Mon 10/12/15 1445**	Well Material: **NA**	Casing: **NA**
Logged By: **Deborah Coakley**	Total Depth (ft) **14**	Screen: **NA**

Blow Counts *(6 inches)*	**Recovery** *(inches)*	**PID** *(ppm)*	**Well Diagram**	**Depth** *(feet)*	**Soil Log**	***Soil and Rock Description USCS/ASTM Classification***
2 , 2	18"			1		Red SILT, little Clay, dry (Berm Fill)
2 , 2				2		
1 , 1	0"			3		Red SILT, little Clay, moist (Berm Fill)
1 , 1				4		
1 , 1	18"			5		Red Silty CLAY, moist (Berm Fill)
1 , 1				6		
1 , 1	3"			7		Red Silty CLAY, trace Gravel, moist (Berm Fill)
1 , 2				8		
1 , 1	24"			9		Red SILT, some Clay, moist (Berm Fill) Red SILT, some Clay, little fine Sand, moist (Berm Fill)
1 , 1				10		
1 , 1	8"			11		Red SILT, some fine Sand, wet (Berm Fill)
1 , 1				12		Gray fine SAND, wet, organic odor (Berm Fill)
1 , 3	8"			13		Red Silty CLAY, hard, wet (Native Soil)
4 , 5				14		
				15		

Well/Boring Location Map



Set Up on Soil Boring SB-8N - Looking North

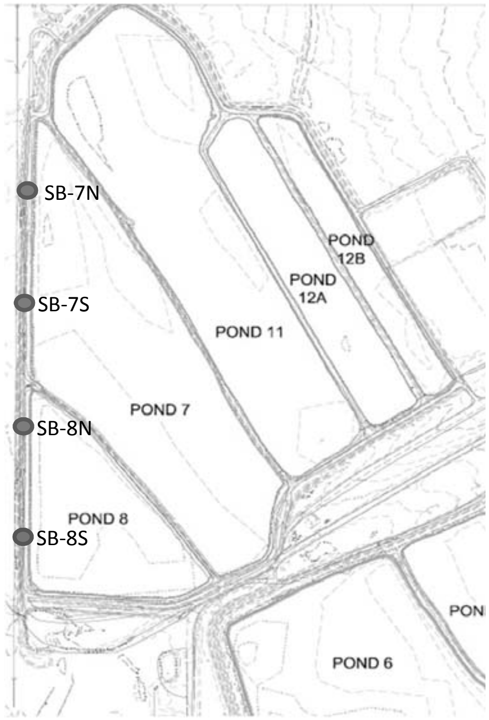
Bottom of Split Spoon Sample from 10 to 12 Feet Deep

Boring/Well Log

Well/Boring ID: **SB-8S**

Sheet: **1** *of* **2**

Project:	**Gallup, NM Berm Upgrades**	Drilling Contractor:	**Envirodrill**	Ground Elevation:	
Project #:	**15-110**	Drilling Method:	**Hollow Stem Auger**	TOC Elevation:	**NA**
Customer:	**Western Refining**	Sampling Method:	**Split Spoon**	Filter Pack:	**NA**
Study Area:	**Pond 7/8**	Boring Diameter:	**6.25 inch**	Bentonite Seal:	**NA**
Start Date/Time:	**Mon 10/12/15 1500**	Well Diameter:	**NA**	Grout:	**NA**
End Date/Time:	**Mon 10/12/15 1550**	Well Material:	**NA**	Casing:	**NA**
Logged By:	**Deborah Coakley**	Total Depth (ft)	**14**	Screen:	**NA**

Blow Counts *(6 inches)*	**Recovery** *(inches)*	**PID** *(ppm)*	**Well Diagram**	**Depth** *(feet)*	**Soil Log**	***Soil and Rock Description USCS/ASTM Classification***	***Well/Boring Location Map***
2 , 2 1 , 2	6"			1 2		Red SILT, little Clay, dry (Berm Fill)	
1 , 1 1 , 1	6"			3 4		Red SILT, little Clay, dry, wood fragments (Berm Fill)	
1 , 1 2 , 1	8"			5 6		Red CLAY and Silt, moist (Berm Fill)	
1 , 2 1 , 2	6"			7 8		Red CLAY and Silt, trace Gravel, moist (Berm Fill)	
1 , 2 3 , 2	12"			9 10		Red CLAY and Silt, moist (Berm Fill)	
1 , 2 3 , 4	8"			11 12		Red CLAY and Silt, moist (Berm Fill)	
3 , 7 10 , 12	6"			13 14		Dk Gray Fine Sand, wet, odor Red CLAY, little Silt, hard, moist (Native Soil)	
				15			

Bottom of Split Spoon Sample from 0 to 2 Feet Deep

Bottom of Split Spoon Sample from 4 to 6 Feet Deep

Boring/Well Log

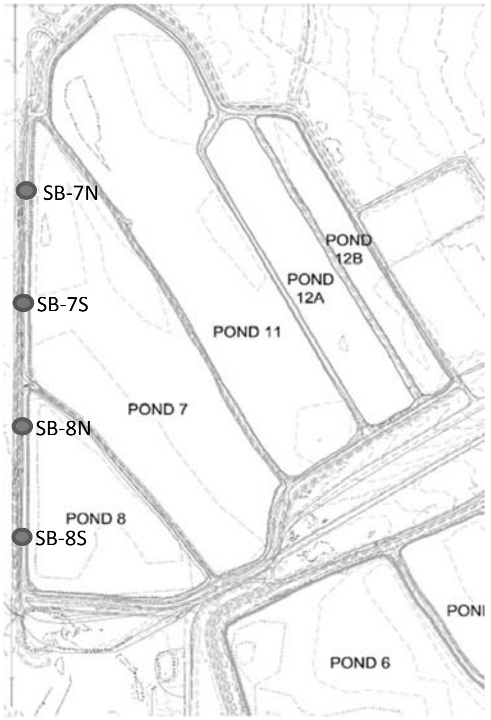
Well/Boring ID: **SB-7S**

Sheet: **1** of **2**

Project:	**Gallup, NM Berm Upgrades**	Drilling Contractor:	**Envirodrill**	Ground Elevation:	
Project #:	**15-110**	Drilling Method:	**Hollow Stem Auger**	TOC Elevation:	**NA**
Customer:	**Western Refining**	Sampling Method:	**Split Spoon**	Filter Pack:	**NA**
Study Area:	**Pond 7/8**	Boring Diameter:	**6.25 inch**	Bentonite Seal:	**NA**
Start Date/Time:	**Mon 10/13/15 0800**	Well Diameter:	**NA**	Grout:	**NA**
End Date/Time:	**Mon 10/13/15 0900**	Well Material:	**NA**	Casing:	**NA**
Logged By:	**Deborah Coakley**	Total Depth (ft)	**14**	Screen:	**NA**

Blow Counts (6 inches)	**Recovery** (inches)	**PID** (ppm)	**Well Diagram**	**Depth** (feet)	**Soil Log**	**Soil and Rock Description USCS/ASTM Classification**
2 , 2	6"			1		Red SILT, little Clay, dry (Berm Fill)
2 , 3				2		
3 , 4	18"			3		Red CLAY and Silt, hard, moist at 4', (Berm Fill)
5 , 7				4		
2 , 3	18"			5		Red CLAY and Silt, moist (Berm Fill)
3 , 3				6		
1 , 2	0"			7		
2 , 3				8		
2 , 2	20"			9		Red CLAY and Silt, moist (Berm Fill)
3 , 3				10		Red-Brown SILT, some fine Sand, little Clay
2 , 3	24"			11		Red SILT, some Clay, little fine Sand, wet, odor, blk staining at 11.5' (Berm Fill)
2 , 2				12		
3 , 5	20"			13		Red CLAY and Silt, moist, hard at 13', (Native Soil)
7 , 10				14		
				15		

Well/Boring Location Map



Bottom of Split Spoon Sample from 2 to 4 Feet Deep

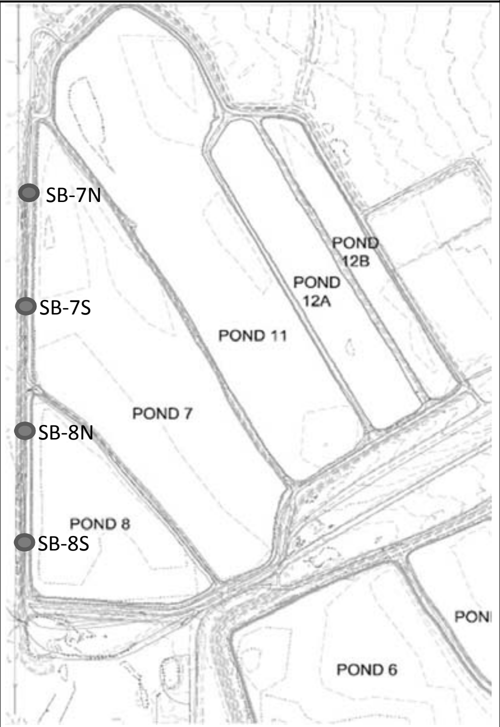
Bottom of Split Spoon Sample from 8 to 10 Feet Deep

Boring/Well Log

Well/Boring ID: **SB-7N**

Sheet: **1** of **2**

Project:	**Gallup, NM Berm Upgrades**	Drilling Contractor:	**Envirodrill**	Ground Elevation:	
Project #:	**15-110**	Drilling Method:	**Hollow Stem Auger**	TOC Elevation:	**NA**
Customer:	**Western Refining**	Sampling Method:	**Split Spoon**	Filter Pack:	**NA**
Study Area:	**Pond 7/8**	Boring Diameter:	**6.25 inch**	Bentonite Seal:	**NA**
Start Date/Time:	**Mon 10/13/15 0910**	Well Diameter:	**NA**	Grout:	**NA**
End Date/Time:	**Mon 10/13/15 1000**	Well Material:	**NA**	Casing:	**NA**
Logged By:	**Deborah Coakley**	Total Depth (ft)	**14**	Screen:	**NA**

Blow Counts *(6 inches)*	**Recovery** *(inches)*	**PID** *(ppm)*	**Well Diagram**	**Depth** *(feet)*	**Soil Log**	***Soil and Rock Description USCS/ASTM Classification***	***Well/Boring Location Map***
2 , 2	6"			1		Red SILT, some Clay, dry (Berm Fill)	
2 , 3				2			
3 , 4	18"			3		Red SILT, some Clay, dry, hard (Berm Fill)	
5 , 7				4			
2 , 3	18"			5		Red CLAY and Silt, moist (Berm Fill)	
3 , 3				6			
1 , 2	0"			7		Red CLAY and Silt, trace white gravel fill, moist (Berm Fill)	
2 , 3				8			
2 , 2	20"			9		Red CLAY and Silt, trace white gravel fill, moist (Berm Fill)	
3 , 3				10			
2 , 3	24"			11		Red CLAY and Silt, moist (Native Soil)	
2 , 2				12			
3 , 5	20"			13		Red CLAY and Silt, moist (Native Soil)	
7 , 10				14			
				15			

Bottom of Split Spoon Sample from 8 to 10 Feet Deep

Bottom of Split Spoon Sample from 12 to 14 Feet Deep

APPENDIX E

Piezometer log forms

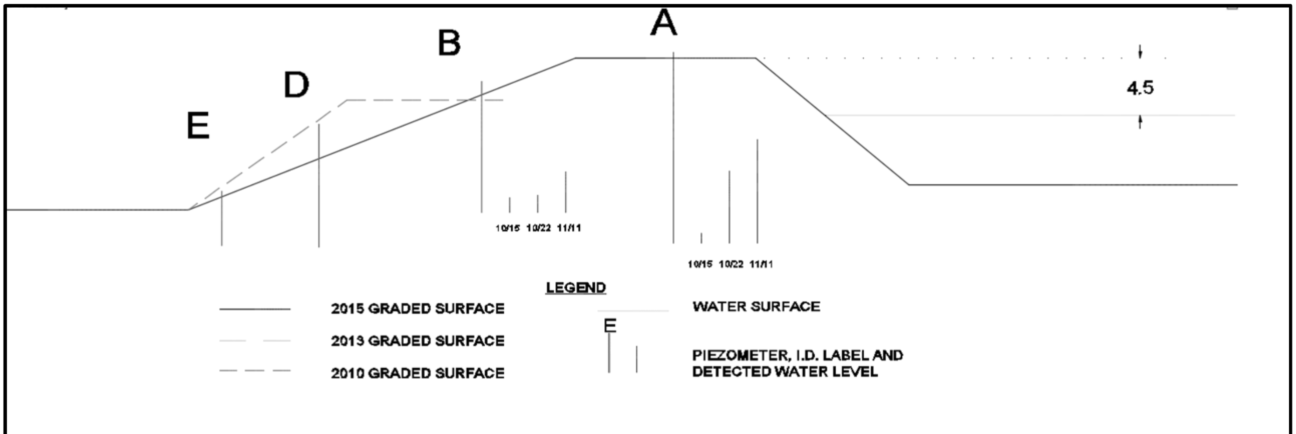
WELL/PIEZOMETER SAMPLING SHEET

PAGE 1 OF 1

PROJECT NAME GALLUP PHREATIC SURFACE **PROJECT NUMBER** 15-112 **CROSS SECTION** POND 7

POND WATER LEVEL (FROM STAFF GAUGE)

CROSS SECTION



Pond 7 Cross Section (West to East)

PIEZOMETER READINGS

	PIEZOMETER DEPTH TO WATER (FROM TOP OF CASING)				
DATE	A	B	C	D	E
10/15/2015	14'	9'		DRY	DRY
10/22/2015	9.15'	8.8'		DRY	DRY
11/11/2015	6.7'	7.0'		DRY	DRY

PIEZOMETER DESCRIPTIONS

PIEZOMETER NAME 7A **LOCATION:** **NORTHING** **EASTING** **ELEVATION** 6883.56
CASING TYPE STEEL **CASING HEIGHT** 4.5" **TOTAL DEPTH** 14.75'
CASING CONDITION

PIEZOMETER NAME 7B **LOCATION:** **NORTHING** **EASTING** **ELEVATION** 6881.36
CASING TYPE STEEL **CASING HEIGHT** 12" **TOTAL DEPTH** 10.1'
CASING CONDITION

PIEZOMETER NAME 7D **LOCATION:** **NORTHING** **EASTING** **ELEVATION** 6878.05
CASING TYPE STEEL **CASING HEIGHT** 31.25" **TOTAL DEPTH** 9.5'
CASING CONDITION

PIEZOMETER NAME 7E **LOCATION:** **NORTHING** **EASTING** **ELEVATION** 6872.45
CASING TYPE STEEL **CASING HEIGHT** 5" **TOTAL DEPTH** 4.2'
CASING CONDITION

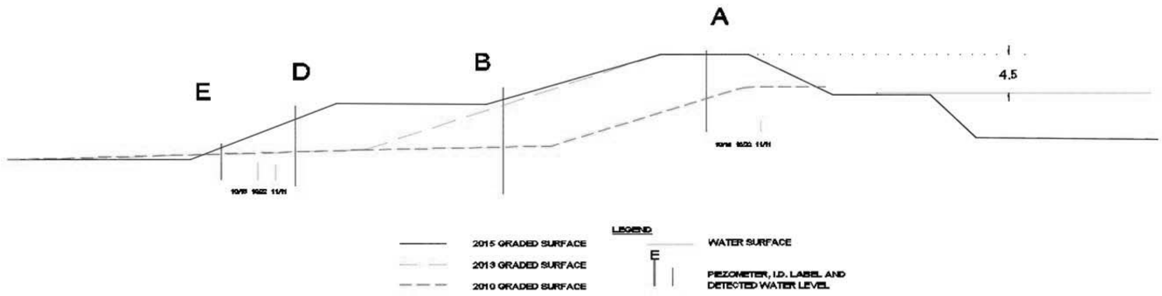
WELL/PIEZOMETER SAMPLING SHEET

PAGE 1 OF 1

PROJECT NAME GALLUP PHREATIC SURFACE **PROJECT NUMBER** 15-112 **CROSS SECTION** POND 8

POND WATER LEVEL (FROM STAFF GAUGE) ____________

CROSS SECTION



Pond 8 Cross Section (South to North)

PIEZOMETER READINGS

PIEZOMETER DEPTH TO WATER (FROM TOP OF CASING)					
DATE	A	B	C	D	E
10/15/2015	DRY	DRY		DRY	DRY
10/22/2015	DRY	DRY		DRY	2.2' **
11/11/2015	8.3	DRY		DRY	2.45

PIEZOMETER DESCRIPTIONS

PIEZOMETER NAME 8A **LOCATION:** **NORTHING** ______ **EASTING** ______ **ELEVATION** 6882.58
CASING TYPE STEEL **CASING HEIGHT** 5" **TOTAL DEPTH** 9.5'
CASING CONDITION ______

PIEZOMETER NAME 8B **LOCATION:** **NORTHING** ______ **EASTING** ______ **ELEVATION** 6878.12
CASING TYPE STEEL **CASING HEIGHT** 16" **TOTAL DEPTH** 12.42'
CASING CONDITION ______

PIEZOMETER NAME 8D **LOCATION:** **NORTHING** ______ **EASTING** ______ **ELEVATION** 6875.88
CASING TYPE STEEL **CASING HEIGHT** 18" **TOTAL DEPTH** 9.25'
CASING CONDITION ______

PIEZOMETER NAME 8E **LOCATION:** **NORTHING** ______ **EASTING** ______ **ELEVATION** 6871.76
CASING TYPE STEEL **CASING HEIGHT** 10" **TOTAL DEPTH** 6.33'
CASING CONDITION **Surface water entering casing.

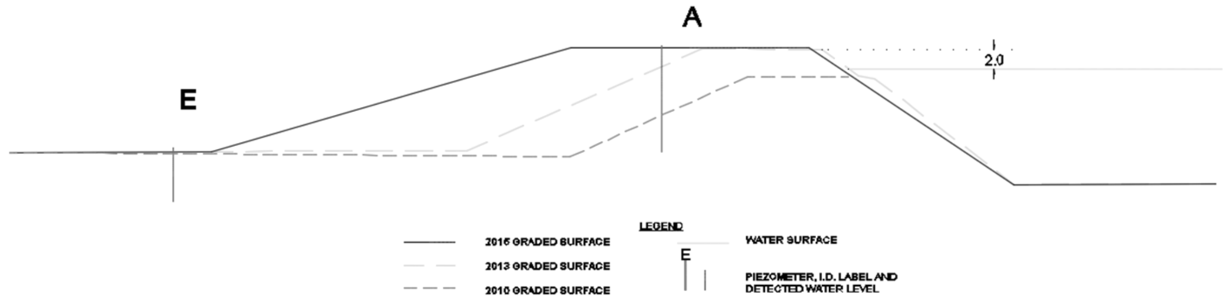
WELL/PIEZOMETER SAMPLING SHEET

PAGE 1 OF 1

PROJECT NAME GALLUP PHREATIC SURFACE **PROJECT NUMBER** 15-112 **CROSS SECTION** POND 6N

POND WATER LEVEL (FROM STAFF GAUGE) ____________

CROSS SECTION



Pond 6 Cross Section (North to South)

PIEZOMETER READINGS

	PIEZOMETER DEPTH TO WATER (FROM TOP OF CASING)				
DATE	A	B	C	D	E
10/15/2015	14'				DRY
10/22/2015	DRY				0.65' **
11/11/2015	DRY				1"

PIEZOMETER DESCRIPTIONS

PIEZOMETER NAME 6N-A **LOCATION:** **NORTHING** ________ **EASTING** ________ **ELEVATION** 6886.56
CASING TYPE STEEL **CASING HEIGHT** 3" **TOTAL DEPTH** 10.45
CASING CONDITION ____________

PIEZOMETER NAME 6N-E **LOCATION:** **NORTHING** ________ **EASTING** ________ **ELEVATION** 6875.06
CASING TYPE STEEL **CASING HEIGHT** 4.8" **TOTAL DEPTH** 4.7
CASING CONDITION **Water entering casing at surface (10/22/15).

PIEZOMETER NAME ________ **LOCATION:** **NORTHING** ________ **EASTING** ________ **ELEVATION** ________
CASING TYPE ________ **CASING HEIGHT** ________ **TOTAL DEPTH** ________
CASING CONDITION ____________

PIEZOMETER NAME ________ **LOCATION:** **NORTHING** ________ **EASTING** ________ **ELEVATION** ________
CASING TYPE ________ **CASING HEIGHT** ________ **TOTAL DEPTH** ________
CASING CONDITION ____________

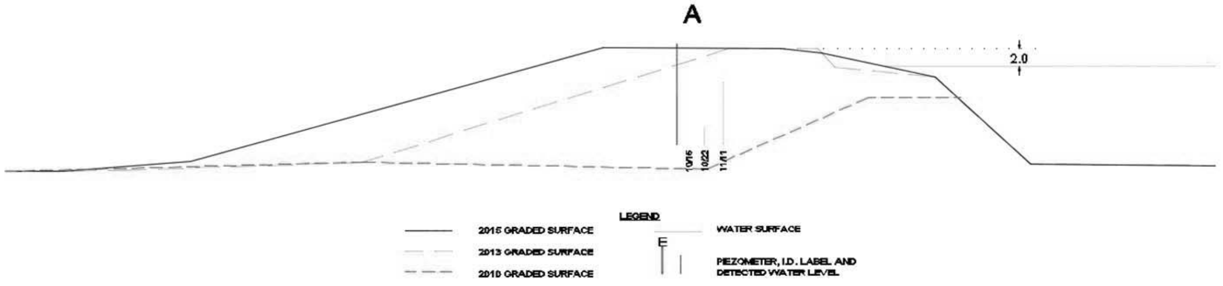
WELL/PIEZOMETER SAMPLING SHEET

PAGE 1 OF 1

PROJECT NAME GALLUP PHREATIC SURFACE **PROJECT NUMBER** 15-112 **CROSS SECTION** POND 6W

POND WATER LEVEL (FROM STAFF GAUGE)

CROSS SECTION



Pond 6 Cross Section (West to East)

PIEZOMETER READINGS

	PIEZOMETER DEPTH TO WATER (FROM TOP OF CASING)				
DATE	A	B	C	D	E
10/15/2015	Dry				
10/22/2015	9.65'				
11/11/2015	4.45				

PIEZOMETER DESCRIPTIONS

PIEZOMETER NAME 6W-A **LOCATION:** **NORTHING** **EASTING** **ELEVATION** 6886.23
CASING TYPE STEEL **CASING HEIGHT** 5" **TOTAL DEPTH** 11.58'
CASING CONDITION

PIEZOMETER NAME **LOCATION:** **NORTHING** **EASTING** **ELEVATION**
CASING TYPE **CASING HEIGHT** **TOTAL DEPTH**
CASING CONDITION

PIEZOMETER NAME **LOCATION:** **NORTHING** **EASTING** **ELEVATION**
CASING TYPE **CASING HEIGHT** **TOTAL DEPTH**
CASING CONDITION

PIEZOMETER NAME **LOCATION:** **NORTHING** **EASTING** **ELEVATION**
CASING TYPE **CASING HEIGHT** **TOTAL DEPTH**
CASING CONDITION

APPENDIX F

2015 Slope Stability Analysis
Updating the 2002 Slope Stability Analysis

F-1 Updates to the 2002 Slope Stability Analysis

In the original Summary Report, Evaporation Pond Repairs (December 2015), Western updated the 2002 numerical slope stability analysis using the following:

- Morgenstern Price limit-equilibrium analysis via GeoStudio 2012
- Updated berm topography at slope stability cross-sections
- Updated phreatic surface based on temporary drive-point piezometers
- Existing soil properties confirmed during 2015 geotechnical investigation
- Existing total stress soil strength parameters cohesion (c) and angle of internal friction, phi (Ø)

Based on the updated slope stability modeling, the earth berms remain stable against a circular slip-type failure with Factor of Safety values ranging from 4.7 to 7.1.

The soil strength parameters used in the numerical analysis included the total stress parameters for cohesion (c) and the angle of internal friction, phi (Ø). It is recognized that total stress strength parameters are appropriate for numerical slope stability analysis for end-of-construction analysis and for partially saturated soil. Based on historical and current soil borings, the soil in the berms is best categorized as partially saturated and therefore, the analysis method is considered appropriate.

Because significant berm improvement work was conducted since 2002, the configurations of the berms (i.e. berm crest widths and outer slopes) were different in many locations. Additionally the pond water elevations have increased since 2002.

Accordingly, Western (via Hammon Enterprises Inc.) conducted an updated topographic land survey of the earth berms. The updated topography was used to track the changes to the earth berms and create the cross-section geometry required for the updated slope stability analysis described in this section. Figure 7b provides cross-sections that illustrate changes in the geometry of the earth berms with time and shows the current surface at the end of 2015.

Prior to performing the updated slope stability analysis, Western conducted a field investigation to collect current soil geotechnical material properties and determine the phreatic surface (i.e. water table surface) within the berms. The methods and results of this field investigation are described in Section 2.3 of this report.

The model used to conduct the slope stability analysis was GeoStudio 2012 produced by Geo-slope International. Western used the limit-equilibrium analysis, Morgenstern-Price Method of Slices to analyze the numerical Factor of Safety for stability of the slopes.

The soil material used in constructing and upgrading the earth berms is a uniform material. Accordingly, Western numerically analyzed the slopes using an arc-type or circular slip-type of failure. Based on the updated slope stability modeling, the earth berms remain stable against an arc-type failure with Factor of Safety values ranging from 4.7 to 7.1. The sections below provide a discussion of the methods and soil values used in the updated slope stability modeling work.

F-2 Soil Characterization Properties

Soil characterization properties from the previous investigation (Precision, 2002) were compared to the soil characterization properties from the 2014 and 2015 borrow and berm soil investigations. The 2002 soil investigation results are consistent with the current geotechnical characterization data. Accordingly, the previous soil investigation data were used in the 2015 slope stability analysis.

Slope stability modeling data input includes soil type, unit weight, angle of internal friction (phi angle), shear strength, and cohesion values. The 2002 data included triaxial sheer strength values and were classified into two categories:

1. Berm material ranging from a depth of 5-7 feet; and
2. Subgrade material ranging from 10-17 feet.

This resulted in two sets of soil properties for the berm slope stability analysis:

1. Berm material (unit weight 140 pcf, cohesion 720 psf, phi 8 degrees); and
2. Native soil (unit weight 140 pcf, cohesion 1152 psf, phi 0 degrees).

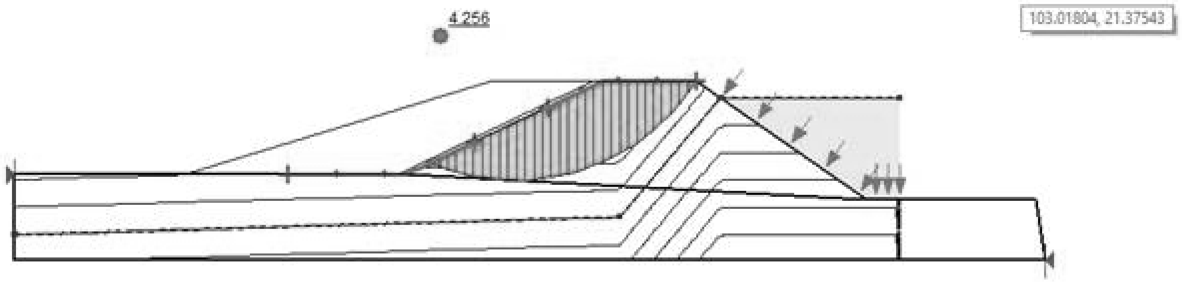
The phreatic surface used for the analysis was derived from current water level data measured in the drive-point piezometers installed along the cross sections of the berms.

F-3 2015 Slope Stability Results

A Factor of Safety greater than 1.0 indicates that the slope is numerically stable from a typical arc-type slope failure. Factors of Safety against a deep slip surface failure in the berms before and after repair work are shown on Table 3.

Based on the slope stability modeling, the berms are stable against an arc-type failure with Factor of Safety values ranging from 4.5 to 7.1. Note that the Factor of Safety from the previous investigation ranged from 2.5 to 10. The change in the Factor of Safety values is largely the result of changes in the berm geometry and the elevation of the water within the ponds. Detailed results from the numerical slope stability modeling are included below.

Slope Stability



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Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Morgenstern-Price
Settings

- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: No
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Search Method: Root Finder
- Tolerable difference between starting and converged F of S: 3
- Maximum iterations to calculate converged lambda: 20
- Max Absolute Lambda: 2

Materials

2013 berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

Native

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 1,152 psf
- Phi': 0 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (32.08628, 0) ft
Left-Zone Right Coordinate: (54, 3.82609) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (62.56701, 7.92335) ft
Right-Zone Right Coordinate: (80, 11) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft
Right Coordinate: (121, -10) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-7
Coordinate 2	71	-5
Coordinate 3	82.85714	9
Coordinate 4	104	9

Points

	X (ft)	Y (ft)
Point 1	20	0
Point 2	46	0
Point 3	69	11
Point 4	80	11
Point 5	100	-3
Point 6	0	0
Point 7	0	-10
Point 8	121	-10
Point 9	120	-3

Regions

	Material	Points	Area (ft²)
Region 1	2013 berm material	3,4,5,2	408.5
Region 2	Native	6,7,8,9,5,2,1	1,062.5

Current Slip Surface

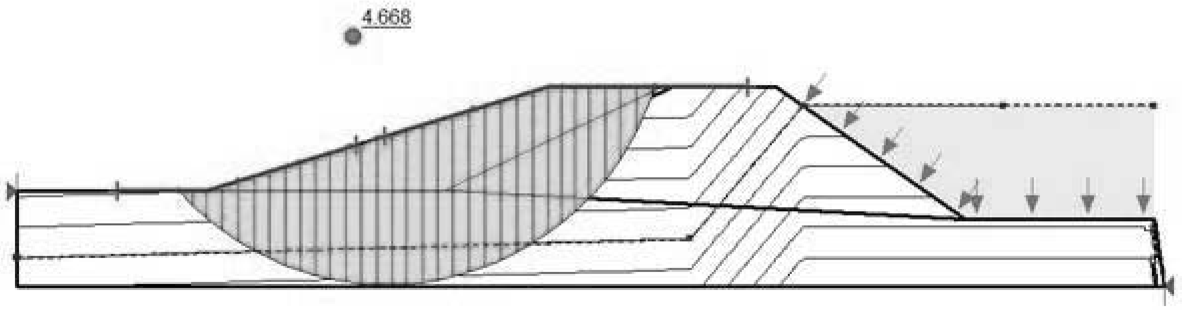
Slip Surface: 98
F of S: 4.256
Volume: 186.85492 ft³
Weight: 26,159.689 lbs
Resisting Moment: 733,232.93 lbs-ft
Activating Moment: 172,277.76 lbs-ft
Resisting Force: 25,838.676 lbs
Activating Force: 6,071.1629 lbs
F of S Rank: 1
Exit: (48.86199, 1.3687779) ft
Entry: (80, 11) ft
Radius: 25.103668 ft
Center: (58.788583, 24.426464) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	49.362812	1.1658329	-422.78067	136.38963	19.168312	720
Slice 2	50.364454	0.78443531	-397.22082	259.31661	36.444572	720
Slice 3	51.366097	0.45093538	-374.64979	376.67057	52.937596	720
Slice 4	52.36774	0.16335379	-354.94407	487.6084	68.528891	720
Slice 5	53.369382	-0.079929263	-338.00257	591.35892	83.110076	720
Slice 6	54.371025	-0.28022487	-323.74349	687.26253	96.588449	720
Slice 7	55.372668	-0.43857373	-312.10189	774.80172	108.89128	720
Slice 8	56.374311	-0.55577484	-303.0279	853.62083	119.96858	720
Slice 9	57.396383	-0.6331324	-296.40425	924.79978	129.97213	720
Slice 10	58.421378	-0.66946161	-292.33562	986.97834	138.71076	720
Slice 11	59.428866	-0.66397737	-290.90693	1,039.0783	146.03293	720
Slice 12	60.436354	-0.61797906	-292.00632	1,082.5774	152.14634	720
Slice 13	61.443842	-0.53124232	-295.64778	1,117.8649	157.10566	720
Slice 14	62.45133	-0.40333951	-301.85801	1,145.407	160.97646	720
Slice 15	63.458817	-0.23362901	-310.67704	1,165.7154	163.83061	720
Slice 16	64.466305	-0.021238609	-322.15929	1,179.3138	165.74175	720

Slice 17	65.473793	0.23495788	-336.37504	1,186.7072	166.78083	720
Slice 18	66.481281	0.53637253	-353.41241	1,188.352	167.01198	720
Slice 19	67.488768	0.88474581	-373.37999	1,184.6275	166.48854	720
Slice 20	68.496256	1.282203	-396.41041	1,175.809	165.24918	720
Slice 21	69.5	1.7294597	-422.55491	1,131.1423	158.97168	720
Slice 22	70.5	2.2292286	-451.98274	1,050.9474	147.70102	720
Slice 23	71.5	2.7867377	-449.05387	965.66162	135.71489	720
Slice 24	72.5	3.406597	-414.05597	874.38546	122.88686	720
Slice 25	73.5	4.0945319	-383.30597	775.85148	109.03881	720
Slice 26	74.5	4.8577553	-357.25399	668.321	93.926391	720
Slice 27	75.5	5.7055272	-336.47783	549.42079	77.216056	720
Slice 28	76.5	6.650028	-321.73756	415.87352	58.447212	720
Slice 29	77.5	7.7077957	-314.06513	263.02715	36.966055	720
Slice 30	78.5	8.9022527	-314.92212	83.969198	11.801101	720
Slice 31	79.5	10.268557	-326.50236	-132.3188	-18.596195	720

Slope Stability



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Last Edited By: Eric Lundborg
Revision Number: 6
Date: 11/3/2015
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File Name: Pond 6 North.gsz
Directory: C:\Users\ELundborg\Desktop\Gallup\ponds\
Last Solved Date: 11/3/2015
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Project Settings

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Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Morgenstern-Price
Settings

  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °
  - Driving Side Maximum Convex Angle: 5 °
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- F of S Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Number of Slices: 30
  - F of S Tolerance: 0.001
  - Minimum Slip Surface Depth: 0.1 ft
  - Search Method: Root Finder
  - Tolerable difference between starting and converged F of S: 3
  - Maximum iterations to calculate converged lambda: 20
  - Max Absolute Lambda: 2

Materials

2013 berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2015 berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

Native

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 1,152 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (10.56397, 0) ft
Left-Zone Right Coordinate: (35.81772, 4.83319) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (38.8435, 5.75774) ft
Right-Zone Right Coordinate: (77, 11) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft
Right Coordinate: (121, -10) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-7
Coordinate 2	71	-5
Coordinate 3	82.85714	9
Coordinate 4	104	9
Coordinate 5	120	9

Points

	X (ft)	Y (ft)
Point 1	20	0
Point 2	46	0
Point 3	69	11
Point 4	80	11
Point 5	100	-3
Point 6	0	0

Point 7	0	-10
Point 8	121	-10
Point 9	120	-3
Point 10	56	11

Regions

	Material	Points	Area (ft²)
Region 1	2013 berm material	3,4,5,2	408.5
Region 2	Native	6,7,8,9,5,2,1	1,062.5
Region 3	2015 berm material	1,2,3,10	214.5

Current Slip Surface

Slip Surface: 44

F of S: 4.668

Volume: 592.03017 ft³

Weight: 82,884.224 lbs

Resisting Moment: 1,973,474.5 lbs-ft

Activating Moment: 422,744.94 lbs-ft

Resisting Force: 55,461.219 lbs

Activating Force: 11,880.392 lbs

F of S Rank: 1

Exit: (17.05789, 0) ft

Entry: (67.265117, 11) ft

Radius: 29.522783 ft

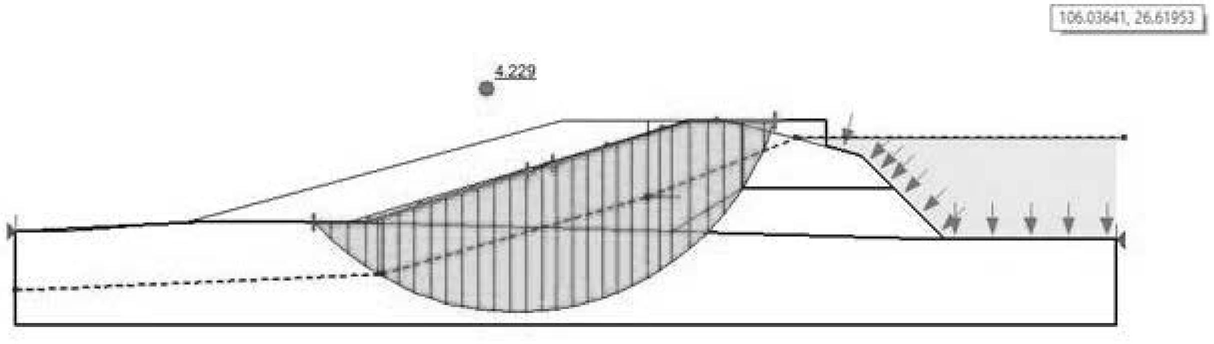
Center: (39.051617, 19.694432) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	17.793417	-0.76427093	-357.83318	370.98069	0	1,152
Slice 2	19.264472	-2.1934748	-266.06511	555.52999	0	1,152
Slice 3	20.840921	-3.5181267	-180.63584	769.79816	0	1,152
Slice 4	22.522764	-4.7465409	-101.02654	1,012.5134	0	1,152
Slice 5	24.204607	-5.8048642	-32.030913	1,233.3735	0	1,152
Slice 6	25.85147	-6.6975891	26.56989	1,428.3156	0	1,152
Slice 7	27.463352	-7.4448172	76.030202	1,598.122	0	1,152
Slice 8	29.075235	-8.0784529	118.40235	1,747.4076	0	1,152
Slice 9	30.687117	-8.6061609	154.16461	1,876.4342	0	1,152
Slice 10	32.298999	-9.033802	183.6827	1,985.6852	0	1,152
Slice 11	33.910882	-9.3658102	207.23329	2,075.8471	0	1,152

Slice 12	35.522764	-9.6054475	225.01994	2,147.7783	0	1,152
Slice 13	37.134647	-9.7549761	237.1838	2,202.4661	0	1,152
Slice 14	38.746529	-9.8157699	243.81062	2,240.9759	0	1,152
Slice 15	40.358412	-9.7883796	244.93474	2,264.3984	0	1,152
Slice 16	41.970294	-9.6725576	240.54073	2,273.7942	0	1,152
Slice 17	43.582176	-9.467247	230.56263	2,270.1388	0	1,152
Slice 18	45.194059	-9.1705323	214.88092	2,254.2677	0	1,152
Slice 19	46.84985	-8.766169	192.5591	2,225.7376	0	1,152
Slice 20	48.54955	-8.2443988	162.98829	2,184.3521	0	1,152
Slice 21	50.24925	-7.606923	126.19744	2,130.5729	0	1,152
Slice 22	51.94895	-6.8453627	81.663717	2,063.9358	0	1,152
Slice 23	53.64865	-5.9485994	28.693329	1,983.3083	0	1,152
Slice 24	55.24925	-4.9718351	-29.443317	1,893.3778	0	1,152
Slice 25	56.717809	-3.9423469	-91.102025	1,766.7551	0	1,152
Slice 26	58.153427	-2.7962032	-160.09794	1,596.0535	0	1,152
Slice 27	59.589044	-1.4906885	-239.03861	1,403.5068	0	1,152
Slice 28	61.136365	0.14212642	-338.20646	1,219.384	171.37324	720
Slice 29	62.795389	2.205245	-464.02891	931.37602	130.89636	720
Slice 30	64.454414	4.7405382	-619.31507	565.94114	79.53784	720
Slice 31	66.113438	8.0829289	-824.9641	49.416237	6.9449992	720
Slice 32	67.104033	10.508097	-974.55335	-365.23379	-51.330262	720

Slope Stability



File Information

File Version: 8.14
Created By: Eric Lundborg
Last Edited By: Eric Lundborg
Revision Number: 16
Date: 11/5/2015
Time: 12:13:05 PM
Tool Version: 8.14.1.10087
File Name: Pond 6 West old.gsz
Directory: P:\15-110 - Western Gallup Berm Upgrades\Slope Stability\
Last Solved Date: 11/5/2015
Last Solved Time: 12:13:08 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Morgenstern-Price

- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °
  - Driving Side Maximum Convex Angle: 5 °
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- F of S Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Number of Slices: 30
  - F of S Tolerance: 0.001
  - Minimum Slip Surface Depth: 0.1 ft
  - Search Method: Root Finder
  - Tolerable difference between starting and converged F of S: 3
  - Maximum iterations to calculate converged lambda: 20
  - Max Absolute Lambda: 2

Materials

old berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2013 berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

Native

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 1,152 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (35, 1) ft
Left-Zone Right Coordinate: (60, 7) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (63, 7.94737) ft
Right-Zone Right Coordinate: (89, 13) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft
Right Coordinate: (129, -1) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-7
Coordinate 2	43	-5
Coordinate 3	74	4
Coordinate 4	91.5	11
Coordinate 5	130	11

Points

	X (ft)	Y (ft)
Point 1	21	1
Point 2	41	1
Point 3	79	13
Point 4	95	13
Point 5	99	9

Point 6	103	5
Point 7	85	5
Point 8	77	0
Point 9	109	-1
Point 10	129	-1
Point 11	129	-11
Point 12	0	-11
Point 13	0	0
Point 14	95	10

Regions

	Material	Points	Area (ft²)
Region 1	2013 berm material	3,4,14,5,6,7,8,2	412
Region 2	old berm material	6,7,8,9	138
Region 3	Native	9,10,11,12,13,1,2,8	1,431.5

Current Slip Surface

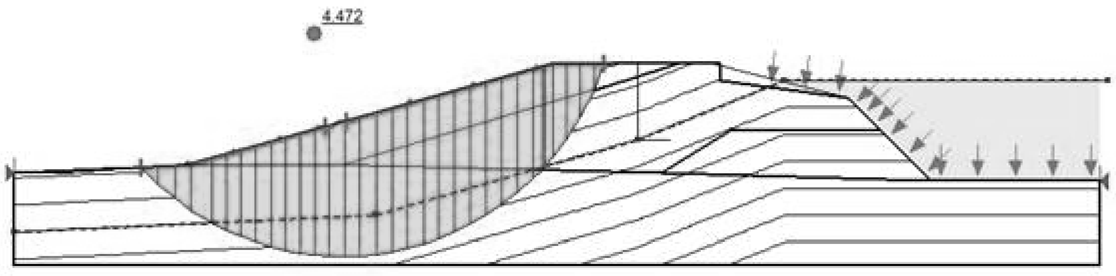
Slip Surface: 24
F of S: 4.229
Volume: 654.34485 ft³
Weight: 91,608.279 lbs
Resisting Moment: 2,272,298.8 lbs-ft
Activating Moment: 537,282.33 lbs-ft
Resisting Force: 59,369.947 lbs
Activating Force: 14,037.723 lbs
F of S Rank: 1
Exit: (35, 1) ft
Entry: (89, 13) ft
Radius: 31.821878 ft
Center: (58.586312, 22.361596) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	36	-0.009615077	-331.7163	427.57961	0	1,152
Slice 2	38	-1.8688358	-209.89627	670.81895	0	1,152
Slice 3	40	-3.4388293	-106.12403	884.04509	0	1,152
Slice 4	41.693554	-4.5938618	-29.134752	1,074.9566	0	1,152
Slice 5	42.693554	-5.2051781	11.913709	1,205.0971	0	1,152
Slice 6	43.934366	-5.8668318	71.0174	1,352.4218	0	1,152
Slice 7	45.803099	-6.7619359	160.7261	1,557.2495	0	1,152
Slice 8	47.671831	-7.5134176	241.47275	1,736.6316	0	1,152

Slice 9	49.540563	-8.1319519	313.92349	1,890.7274	0	1,152
Slice 10	51.409296	-8.6255378	378.57745	2,020.0564	0	1,152
Slice 11	53.278028	-9.0000999	435.80432	2,125.4694	0	1,152
Slice 12	55.146761	-9.2598843	485.86906	2,208.0941	0	1,152
Slice 13	57.015493	-9.407717	528.94802	2,269.2609	0	1,152
Slice 14	58.884225	-9.4451647	565.13896	2,310.4189	0	1,152
Slice 15	60.752958	-9.3726195	594.46633	2,333.0449	0	1,152
Slice 16	62.566801	-9.1979005	616.42368	2,338.8463	0	1,152
Slice 17	64.325755	-8.9256408	631.30011	2,329.9498	0	1,152
Slice 18	66.084708	-8.5509736	639.78631	2,307.8469	0	1,152
Slice 19	67.843662	-8.0701031	641.64542	2,273.1491	0	1,152
Slice 20	69.602616	-7.4778753	636.55584	2,226.1387	0	1,152
Slice 21	71.361569	-6.7674692	624.09193	2,166.6825	0	1,152
Slice 22	73.120523	-5.9299396	603.69552	2,094.1171	0	1,152
Slice 23	74.75	-5.0356447	582.54423	2,014.6932	0	1,152
Slice 24	76.25	-4.0923779	561.12438	1,928.5751	0	1,152
Slice 25	78	-2.8206654	525.44952	1,808.2831	0	1,152
Slice 26	80.049765	-1.0889243	468.55102	1,593.1691	0	1,152
Slice 27	82.074648	0.9411427	392.41591	1,363.0531	136.41416	720
Slice 28	84.024883	3.3125948	293.11515	1,033.0983	103.99786	720
Slice 29	85.127387	4.807397	227.35801	820.68321	83.386419	720
Slice 30	86.467884	7.2361986	109.25958	458.84591	49.131155	720
Slice 31	88.340496	11.236199	-93.6	-184.99057	-25.998729	720

Slope Stability



File Information

File Version: 8.14

Created By: Eric Lundborg

Last Edited By: Eric Lundborg

Revision Number: 10

Date: 11/5/2015

Time: 12:09:05 PM

Tool Version: 8.14.1.10087

File Name: Pond 6 West.gsz

Directory: P:\15-110 - Western Gallup Berm Upgrades\Slope Stability\

Last Solved Date: 11/5/2015

Last Solved Time: 12:09:07 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: No
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Search Method: Root Finder
- Tolerable difference between starting and converged F of S: 3
- Maximum iterations to calculate converged lambda: 20
- Max Absolute Lambda: 2

Materials

old berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2013 berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2015 berm material

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 720 psf
Phi': 8 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

Native

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 1,152 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (15, 0.71429) ft
Left-Zone Right Coordinate: (37, 5.46512) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (39.43733, 6.1453) ft
Right-Zone Right Coordinate: (70, 13) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft
Right Coordinate: (129, -1) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-7
Coordinate 2	43	-5
Coordinate 3	74	4
Coordinate 4	91.5	11
Coordinate 5	130	11

Points

	X (ft)	Y (ft)
Point 1	21	1
Point 2	41	1
Point 3	79	13
Point 4	64	13
Point 5	84	13
Point 6	99	9
Point 7	103	5
Point 8	85	5
Point 9	77	0
Point 10	109	-1
Point 11	129	-1
Point 12	128	-40
Point 13	0	-38
Point 14	0	0
Point 15	84	11

Regions

	Material	Points	Area (ft²)
Region 1	2015 berm material	1,2,3,4	210
Region 2	2013 berm material	3,5,15,6,7,8,9,2	381
Region 3	old berm material	7,8,9,10	138
Region 4	Native	10,11,12,13,14,1,2,9	5,025

Current Slip Surface

Slip Surface: 24
F of S: 4.472
Volume: 660.70349 ft³
Weight: 92,498.489 lbs
Resisting Moment: 2,381,313.2 lbs-ft
Activating Moment: 532,444.45 lbs-ft
Resisting Force: 60,902.035 lbs
Activating Force: 13,616.869 lbs
F of S Rank: 1
Exit: (15, 0.71428572) ft
Entry: (70, 13) ft
Radius: 32.437199 ft
Center: (38.997068, 22.538873) ft

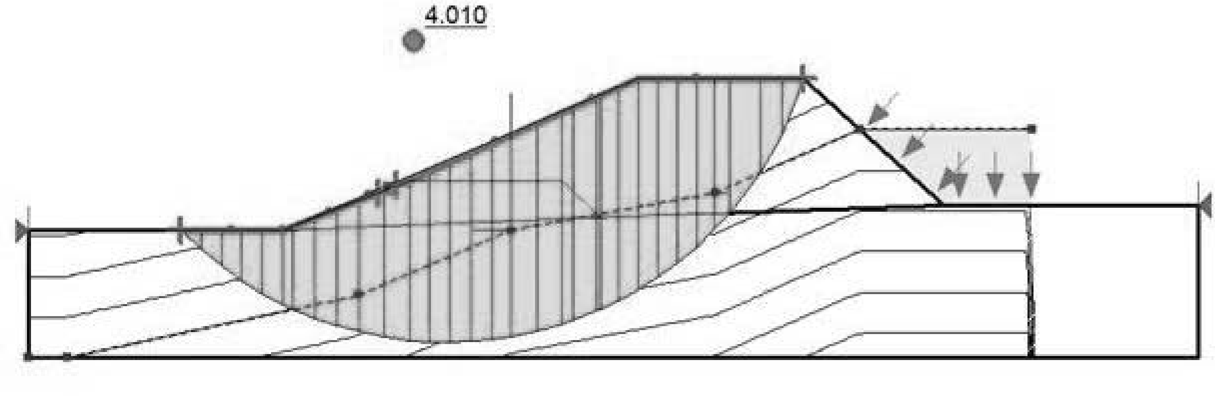
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	16	-0.29295165	-372.08261	418.07102	0	1,152

Slice 2	18	-2.150634	-250.35858	677.68574	0	1,152
Slice 3	20	-3.7244107	-146.35026	908.01202	0	1,152
Slice 4	22.2078	-5.1793224	-49.156016	1,167.3849	0	1,152
Slice 5	24.29482	-6.3582313	30.465109	1,415.9922	0	1,152
Slice 6	26.05326	-7.1883891	87.370524	1,599.1047	0	1,152
Slice 7	27.8117	-7.8943647	136.52697	1,759.8412	0	1,152
Slice 8	29.57014	-8.4846744	178.46586	1,898.3918	0	1,152
Slice 9	31.32858	-8.9658462	213.59454	2,015.2162	0	1,152
Slice 10	33.08702	-9.3428398	242.22251	2,111.0244	0	1,152
Slice 11	34.84546	-9.6193314	264.57915	2,186.7375	0	1,152
Slice 12	36.6039	-9.7979073	280.82585	2,243.4385	0	1,152
Slice 13	38.36234	-9.8801904	291.06388	2,282.3132	0	1,152
Slice 14	40.12078	-9.8669164	295.33915	2,304.5882	0	1,152
Slice 15	42	-9.7434073	293.08629	2,310.9027	0	1,152
Slice 16	43.934366	-9.5064262	298.12809	2,301.2638	0	1,152
Slice 17	45.803099	-9.1618611	310.48143	2,276.5363	0	1,152
Slice 18	47.671831	-8.7018058	315.62817	2,237.7934	0	1,152
Slice 19	49.540563	-8.1210406	313.24262	2,185.5257	0	1,152
Slice 20	51.409296	-7.4125127	302.88468	2,119.7605	0	1,152
Slice 21	53.278028	-6.5668453	283.96923	2,039.9357	0	1,152
Slice 22	55.146761	-5.5715897	255.71948	1,944.7263	0	1,152
Slice 23	57.015493	-4.4100586	217.09414	1,831.7784	0	1,152
Slice 24	58.884225	-3.0594254	166.66882	1,697.273	0	1,152
Slice 25	60.752958	-1.4874515	102.43185	1,535.1464	0	1,152
Slice 26	62.194589	-0.12210508	43.351012	1,389.1829	0	1,152
Slice 27	62.903503	0.61707514	10.068943	1,360.3513	189.76981	720
Slice 28	63.552576	1.3556313	-24.258277	1,282.5053	180.24437	720
Slice 29	64.803689	2.9321063	-99.964992	1,081.925	152.05465	720
Slice			-			

30	66.411067	5.2654325	216.44508	754.25379	106.00346	720
Slice 31	68.018444	8.1634361	-368.16105	326.83844	45.934147	720
Slice 32	69.411067	11.392968	-544.45494	-191.43689	-26.904701	720

Slope Stability



File Information

File Version: 8.14

Created By: Eric Lundborg

Last Edited By: Eric Lundborg

Revision Number: 15

Date: 11/3/2015

Time: 3:26:49 PM

Tool Version: 8.14.1.10087

File Name: Pond 7 West Berm.gsz

Directory: C:\Users\ELundborg\Desktop\Gallup\ponds\

Last Solved Date: 11/3/2015

Last Solved Time: 3:26:52 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Slope Stability

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °
  - Driving Side Maximum Convex Angle: 5 °
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- F of S Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Number of Slices: 30
  - F of S Tolerance: 0.001
  - Minimum Slip Surface Depth: 0.1 ft
  - Search Method: Root Finder
  - Tolerable difference between starting and converged F of S: 3
  - Maximum iterations to calculate converged lambda: 20
  - Max Absolute Lambda: 2

Materials

old berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2013 berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure

Piezometric Line: 1

Native

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 1,152 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (12, 0) ft
Left-Zone Right Coordinate: (27.5, 3) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (29, 3.6) ft
Right-Zone Right Coordinate: (61, 12) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft
Right Coordinate: (92, 2) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-10
Coordinate 2	3	-10
Coordinate 3	26	-5
Coordinate 4	38	0
Coordinate 5	54	3
Coordinate 6	65.4	8
Coordinate 7	79	8

Points

	X (ft)	Y (ft)
Point 1	0	0

Point 2	20	0
Point 3	45	1
Point 4	72	2
Point 5	92	2
Point 6	92	-10
Point 7	0	-10
Point 8	30	4
Point 9	42	4
Point 10	48	12
Point 11	61	12

Regions

	Material	Points	Area (ft²)
Region 1	Native	1,2,3,4,5,6,7	1,013
Region 2	old berm material	2,8,9,3	63
Region 3	2013 berm material	8,10,11,4,3,9	281

Current Slip Surface

Slip Surface: 24

F of S: 4.010

Volume: 537.44787 ft³

Weight: 75,242.702 lbs

Resisting Moment: 1,913,922.1 lbs-ft

Activating Moment: 477,246.29 lbs-ft

Resisting Force: 54,288.645 lbs

Activating Force: 13,537.043 lbs

F of S Rank: 1

Exit: (12, 0) ft

Entry: (61, 12) ft

Radius: 29.344763 ft

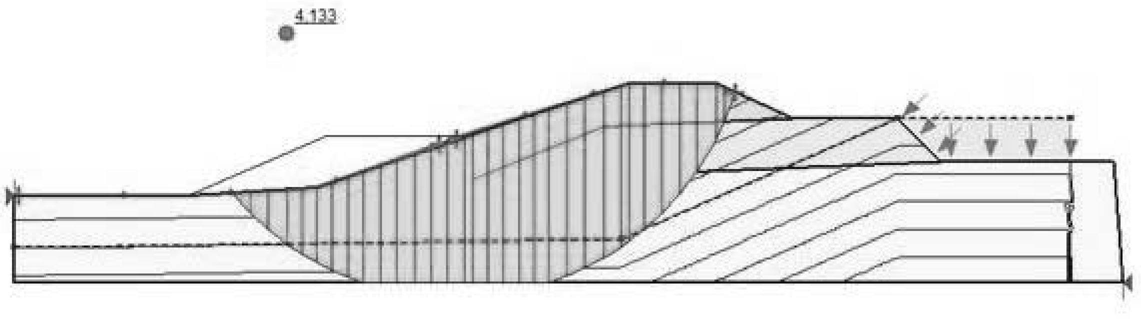
Center: (32.933039, 20.565092) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	12.8	-0.75544219	-443.92128	386.32275	0	1,152
Slice 2	14.4	-2.1632176	-334.37174	567.58737	0	1,152
Slice 3	16	-3.3812502	-236.66216	729.79407	0	1,152
Slice 4	17.6	-4.4375548	-149.0444	872.6481	0	1,152
Slice 5	19.2	-5.3520658	-70.27457	995.97981	0	1,152
Slice 6	20.382549	-5.956997	-16.48534	1,098.4587	0	1,152
Slice 7	21.637581	-6.5021199	34.555116	1,241.1545	0	1,152
Slice 8	23.382549	-7.1666902	99.695172	1,422.6953	0	1,152

Slice 9	25.127516	-7.7080346	157.14593	1,581.1225	0	1,152
Slice 10	27	-8.1554842	222.90221	1,724.9382	0	1,152
Slice 11	29	-8.4973926	296.2373	1,850.926	0	1,152
Slice 12	30.8	-8.6910503	355.12154	1,946.3411	0	1,152
Slice 13	32.4	-8.7639171	401.26843	2,017.7682	0	1,152
Slice 14	34	-8.749339	441.95875	2,073.1591	0	1,152
Slice 15	35.6	-8.6471846	477.18432	2,113.5461	0	1,152
Slice 16	37.2	-8.4565262	506.88724	2,139.9419	0	1,152
Slice 17	39	-8.1274574	518.85334	2,153.1862	0	1,152
Slice 18	41	-7.6298968	511.20556	2,150.7796	0	1,152
Slice 19	42.440678	-7.1928426	500.78931	2,139.8435	0	1,152
Slice 20	43.809099	-6.6714364	484.26409	2,117.2162	0	1,152
Slice 21	44.868421	-6.2423887	469.88558	2,097.5687	0	1,152
Slice 22	45.75	-5.8194752	453.81025	2,073.7885	0	1,152
Slice 23	47.25	-5.035715	422.45361	2,027.1315	0	1,152
Slice 24	48.75	-4.1360358	383.86363	1,924.2743	0	1,152
Slice 25	50.25	-3.1071376	337.21039	1,763.0766	0	1,152
Slice 26	51.75	-1.9311529	281.37894	1,583.7101	0	1,152
Slice 27	53.25	-0.58330182	214.82303	1,380.5706	0	1,152
Slice 28	54.566832	0.75626672	155.52227	1,177.9168	0	1,152
Slice 29	56.325645	2.9590693	66.203297	932.12996	121.69806	720
Slice 30	58.388218	6.0718877	-71.587193	473.45171	66.539299	720
Slice 31	60.129406	9.8004789	-256.59772	-126.74339	-17.812621	720

Slope Stability



File Information

File Version: 8.14
Created By: Eric Lundborg
Last Edited By: Eric Lundborg
Revision Number: 9
Date: 11/3/2015
Time: 3:28:24 PM
Tool Version: 8.14.1.10087
File Name: Pond 8 north old.gsz
Directory: C:\Users\ELundborg\Desktop\Gallup\ponds\
Last Solved Date: 11/3/2015
Last Solved Time: 3:28:26 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Morgenstern-Price
Settings

  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °
  - Driving Side Maximum Convex Angle: 5 °
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- F of S Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Number of Slices: 30
  - F of S Tolerance: 0.001
  - Minimum Slip Surface Depth: 0.1 ft
  - Search Method: Root Finder
  - Tolerable difference between starting and converged F of S: 3
  - Maximum iterations to calculate converged lambda: 20
  - Max Absolute Lambda: 2

Materials

Native

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 1,152 psf
- Phi': 0 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

Original Berm Material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2013 berm Material

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 720 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.44805, 0) ft
Left-Zone Right Coordinate: (49, 5.94118) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (51.1184, 6.68885) ft
Right-Zone Right Coordinate: (83.25, 12) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft
Right Coordinate: (128, -10) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-6
Coordinate 2	70	-5
Coordinate 3	102	9
Coordinate 4	122	9

Points

	X (ft)	Y (ft)
Point 1	20	0
Point 2	52	7
Point 3	35	1
Point 4	0	0
Point 5	107	4
Point 6	127	4
Point 7	128	-10

Point 8	0	-10
Point 9	71	13
Point 10	81	13
Point 11	90	9
Point 12	68	8
Point 13	53	1.75
Point 14	102	9

Regions

	Material	Points	Area (ft²)
Region 1	Native	4,1,3,13,5,6,7,8	1,544.5
Region 2	2013 berm Material	9,10,11,12,13,3,2	202.13
Region 3	Original Berm Material	5,14,11,12,13	245.38

Current Slip Surface

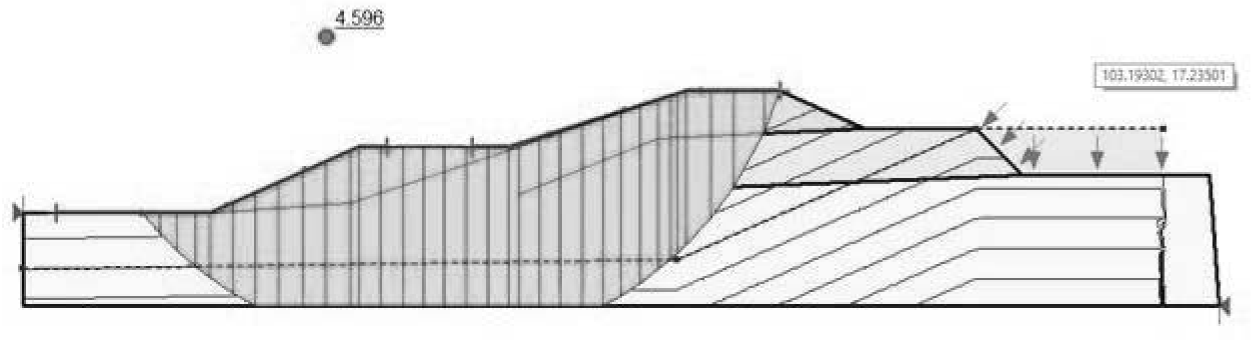
Slip Surface: 74
F of S: 4.133
Volume: 780.2475 ft³
Weight: 109,234.65 lbs
Resisting Moment: 2,622,602.8 lbs-ft
Activating Moment: 634,597.48 lbs-ft
Resisting Force: 65,296.576 lbs
Activating Force: 15,799.871 lbs
F of S Rank: 1
Exit: (25.15243, 0.34349536) ft
Entry: (83.25, 12) ft
Radius: 33.738921 ft
Center: (51.026123, 21.996828) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	26.217824	-0.81513356	-300.16435	487.15934	0	1,152
Slice 2	28.348611	-2.9425312	-165.51529	783.95164	0	1,152
Slice 3	30.479397	-4.7303301	-52.057198	1,046.5475	0	1,152
Slice 4	32.408593	-6.1212996	36.459039	1,256.7849	0	1,152
Slice 5	34.136198	-7.1930546	104.87659	1,420.76	0	1,152
Slice 6	35.887471	-8.1386932	165.44557	1,602.0689	0	1,152
Slice 7	37.662412	-8.9675341	218.74748	1,800.5516	0	1,152
Slice 8	39.437354	-9.675276	264.4928	1,977.3297	0	1,152
Slice 9	41.297756	-10	286.414	1,948.48	0	1,152
Slice 10	43.243618	-10	288.1486	2,039.8	0	1,152

Slice 11	45.189481	-10	289.88319	2,129.4451	0	1,152
Slice 12	47.135343	-10	291.61779	2,217.4449	0	1,152
Slice 13	49.081206	-10	293.35239	2,303.8547	0	1,152
Slice 14	51.027069	-10	295.08699	2,388.7553	0	1,152
Slice 15	52.5	-10	296.4	2,449.5212	0	1,152
Slice 16	53.872742	-10	297.6237	2,500.6942	0	1,152
Slice 17	55.618227	-10	299.17968	2,564.94	0	1,152
Slice 18	57.363711	-10	300.73565	2,628.3327	0	1,152
Slice 19	59.109196	-10	302.29163	2,691.002	0	1,152
Slice 20	60.85468	-10	303.8476	2,753.0903	0	1,152
Slice 21	62.772852	-9.6114826	281.31403	2,557.5895	0	1,152
Slice 22	64.863711	-8.7525088	229.57791	2,486.6004	0	1,152
Slice 23	66.95457	-7.7217267	167.12096	2,397.9729	0	1,152
Slice 24	69	-6.5313618	94.665547	2,292.2948	0	1,152
Slice 25	70.5	-5.5478261	47.834351	2,203.0926	0	1,152
Slice 26	71.900619	-4.4843942	19.713085	2,064.6911	0	1,152
Slice 27	73.799077	-2.8602834	-29.803514	1,825.2012	0	1,152
Slice 28	75.794756	-0.86504518	-99.824335	1,531.7315	0	1,152
Slice 29	77.790436	1.5202646	-194.18562	1,173.7354	0	1,152
Slice 30	79.894138	4.6666153	-333.08684	799.03698	112.29732	720
Slice 31	81.503554	7.5727029	-470.48964	334.20221	46.969058	720
Slice 32	82.628554	10.318343	-611.1051	-191.41524	-0	720

Slope Stability



File Information

File Version: 8.14
Created By: Eric Lundborg
Last Edited By: Eric Lundborg
Revision Number: 8
Date: 11/3/2015
Time: 3:29:59 PM
Tool Version: 8.14.1.10087
File Name: Pond 8 north.gsz
Directory: C:\Users\ELundborg\Desktop\Gallup\ponds\
Last Solved Date: 11/3/2015
Last Solved Time: 3:30:02 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Morgenstern-Price

- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °
  - Driving Side Maximum Convex Angle: 5 °
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- F of S Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Number of Slices: 30
  - F of S Tolerance: 0.001
  - Minimum Slip Surface Depth: 0.1 ft
  - Search Method: Root Finder
  - Tolerable difference between starting and converged F of S: 3
  - Maximum iterations to calculate converged lambda: 20
  - Max Absolute Lambda: 2

Materials

Native

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 1,152 psf
- Phi': 0 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

Original Berm Material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2013 berm Material

Model: Mohr-Coulomb

Unit Weight: 140 pcf

Cohesion': 720 psf

Phi': 8 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

2015 Berm Material

Model: Mohr-Coulomb

Unit Weight: 140 pcf

Cohesion': 720 psf

Phi': 7 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range

Left-Zone Left Coordinate: (3.51928, 0) ft

Left-Zone Right Coordinate: (39, 7) ft

Left-Zone Increment: 4

Right Projection: Range

Right-Zone Left Coordinate: (48, 7) ft

Right-Zone Right Coordinate: (81, 13) ft

Right-Zone Increment: 4

Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft

Right Coordinate: (128, -10) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-6
Coordinate 2	70	-5
Coordinate 3	102	9
Coordinate 4	122	9

Points

	X (ft)	Y (ft)
Point 1	20	0
Point 2	36	7
Point 3	52	7
Point 4	35	1
Point 5	0	0
Point 6	107	4
Point 7	127	4
Point 8	128	-10
Point 9	0	-10
Point 10	71	13
Point 11	81	13
Point 12	90	9
Point 13	68	8
Point 14	53	1.75
Point 15	102	9

Regions

	Material	Points	Area (ft²)
Region 1	2015 Berm Material	1,2,3,4	92.5
Region 2	Native	5,1,4,14,6,7,8,9	1,544.5
Region 3	2013 berm Material	10,11,12,13,14,4,3	202.13
Region 4	Original Berm Material	6,15,12,13,14	245.38

Current Slip Surface

Slip Surface: 49
F of S: 4.596
Volume: 957.24499 ft³
Weight: 134,014.3 lbs
Resisting Moment: 3,414,988.8 lbs-ft
Activating Moment: 743,046.74 lbs-ft
Resisting Force: 76,776.681 lbs
Activating Force: 16,708.051 lbs
F of S Rank: 1
Exit: (12.755522, 0) ft
Entry: (81, 13) ft
Radius: 39.369411 ft
Center: (43.41024, 24.703012) ft

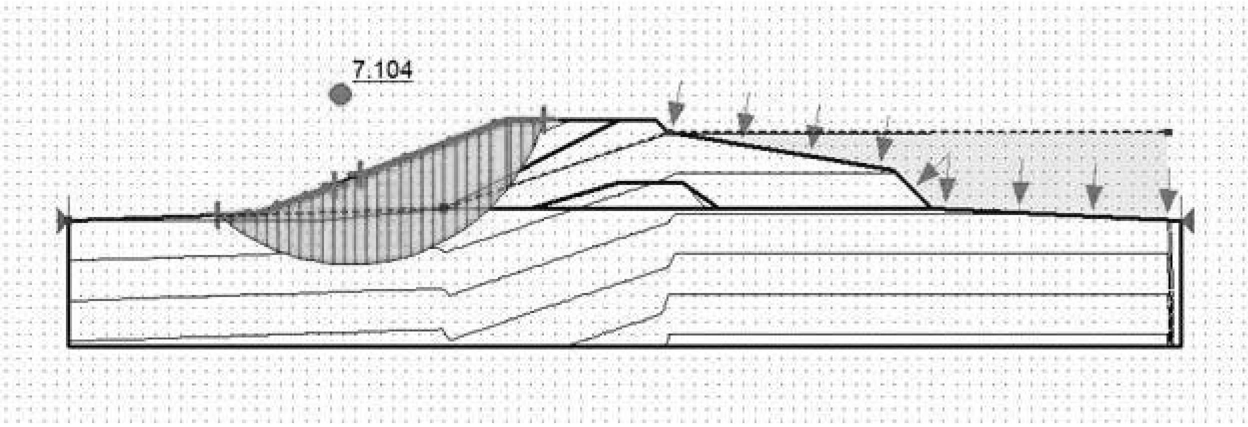
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	13.703364	-1.0916003	-294.06857	450.63349	0	1,152

Slice 2	15.599046	-3.1302891	-165.16452	720.72695	0	1,152
Slice 3	17.494729	-4.9069562	-52.610633	965.16289	0	1,152
Slice 4	19.221285	-6.3432517	38.55331	1,167.2935	0	1,152
Slice 5	21.204634	-7.7736262	129.57669	1,447.7712	0	1,152
Slice 6	23.613901	-9.2986418	226.88535	1,819.0952	0	1,152
Slice 7	26.091218	-10	272.85846	1,862.6203	0	1,152
Slice 8	28.636584	-10	275.12747	2,018.384	0	1,152
Slice 9	31.181951	-10	277.39648	2,172.2976	0	1,152
Slice 10	33.727317	-10	279.66549	2,324.3114	0	1,152
Slice 11	35.5	-10	281.24571	2,429.1151	0	1,152
Slice 12	37.142857	-10	282.7102	2,455.3044	0	1,152
Slice 13	39.428571	-10	284.74776	2,447.9079	0	1,152
Slice 14	41.714286	-10	286.78531	2,439.0499	0	1,152
Slice 15	44	-10	288.82286	2,428.8058	0	1,152
Slice 16	46.285714	-10	290.86041	2,417.2742	0	1,152
Slice 17	48.571429	-10	292.89796	2,404.5764	0	1,152
Slice 18	50.857143	-10	294.93551	2,390.8548	0	1,152
Slice 19	52.5	-10	296.4	2,402.5801	0	1,152
Slice 20	54.125243	-10	297.84879	2,463.7421	0	1,152
Slice 21	56.375729	-10	299.85494	2,547.9806	0	1,152
Slice 22	58.626216	-10	301.86108	2,631.8299	0	1,152
Slice 23	60.876702	-10	303.86723	2,715.4932	0	1,152
Slice 24	63.001621	-9.4261497	269.95319	2,435.9985	0	1,152
Slice 25	65.000973	-8.1962441	194.98936	2,332.2245	0	1,152
Slice 26	67.000324	-6.7914074	109.10982	2,209.3232	0	1,152
Slice 27	68.618623	-5.5267612	31.638501	2,095.2866	0	1,152
Slice 28	69.618623	-4.6706155	-20.893562	2,015.623	0	1,152
Slice		-	-			

29	70.5	3.8560586	57.731942	1,937.5838	0	1,152
Slice 30	72.266134	-2.0143018	-124.44212	1,698.782	0	1,152
Slice 31	74.798401	1.0321007	-245.40674	1,261.2944	0	1,152
Slice 32	77.680701	5.6122581	-452.52177	687.02169	96.554602	720
Slice 33	80.148434	10.756747	-706.16877	-87.47698	-12.294088	720

Slope Stability



File Information

File Version: 8.14
Created By: Eric Lundborg
Last Edited By: Eric Lundborg
Revision Number: 11
Date: 11/5/2015
Time: 12:44:13 PM
Tool Version: 8.14.1.10087
File Name: Pond 9 north rebuild.gsz
Directory: P:\15-110 - Western Gallup Berm Upgrades\Slope Stability\
Last Solved Date: 11/5/2015
Last Solved Time: 12:44:16 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Morgenstern-Price

Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: Yes
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Search Method: Root Finder
- Tolerable difference between starting and converged F of S: 3
- Maximum iterations to calculate converged lambda: 20
- Max Absolute Lambda: 2

Materials

old berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2013 berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2015 berm material

Model: Mohr-Coulomb

Unit Weight: 140 pcf

Cohesion': 720 psf

Phi': 8 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Native

Model: Mohr-Coulomb

Unit Weight: 140 pcf

Cohesion': 1,152 psf

Phi': 0 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range

Left-Zone Left Coordinate: (12, 0.4) ft

Left-Zone Right Coordinate: (21.24658, 2.84247) ft

Left-Zone Increment: 4

Right Projection: Range

Right-Zone Left Coordinate: (23.32877, 3.62329) ft

Right-Zone Right Coordinate: (38, 8) ft

Right-Zone Increment: 4

Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft

Right Coordinate: (89, 0) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	0
Coordinate 2	30	1
Coordinate 3	48	7
Coordinate 4	88	7

Points

	X (ft)	Y (ft)
Point 1	30	1
Point 2	44	8
Point 3	47	8
Point 4	48	7
Point 5	66	4
Point 6	69	1
Point 7	52	1
Point 8	49	3
Point 9	44	3
Point 10	37	1
Point 11	0	0
Point 12	0	-10
Point 13	89	-10
Point 14	89	0
Point 15	35	8
Point 16	15	0.5

Regions

	Material	Points	Area (ft²)
Region 1	2013 berm material	1,2,3,4,5,6,7,8,9,10	142
Region 2	Native	11,12,13,14,6,7,10,1,16	954
Region 3	old berm material	10,9,8,7	20
Region 4	2015 berm material	2,15,16,1	82.75

Current Slip Surface

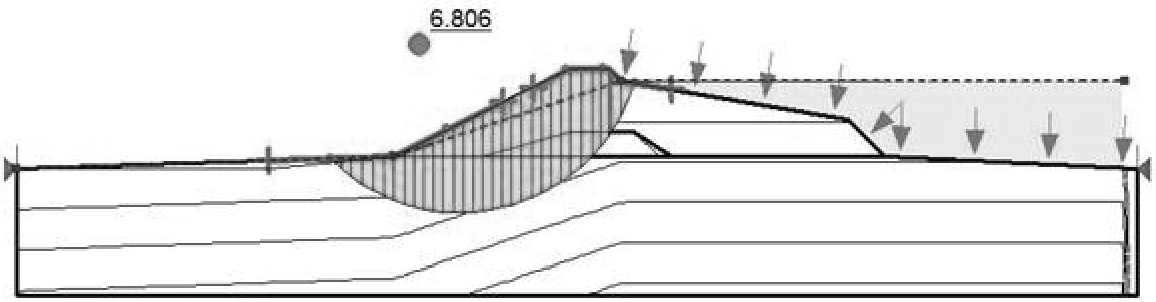
Slip Surface: 24
F of S: 7.104
Volume: 141.31869 ft³
Weight: 19,784.616 lbs
Resisting Moment: 544,677.92 lbs-ft
Activating Moment: 76,671.884 lbs-ft
Resisting Force: 28,318.099 lbs
Activating Force: 3,986.1217 lbs
F of S Rank: 1
Exit: (12, 0.4) ft
Entry: (38, 8) ft
Radius: 16.141931 ft
Center: (22.536086, 12.62918) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	12.5	0.0025815736	25.83891	194.08599	0	1,152

Slice 2	13.5	-0.73295957	73.816677	298.90084	0	1,152
Slice 3	14.5	-1.3583414	114.9205	391.86631	0	1,152
Slice 4	15.441176	-1.8616072	148.11736	489.94597	0	1,152
Slice 5	16.323529	-2.2616754	174.88717	594.25104	0	1,152
Slice 6	17.205882	-2.6001469	197.81761	687.69252	0	1,152
Slice 7	18.088235	-2.8810724	217.16116	769.72191	0	1,152
Slice 8	18.970588	-3.107546	233.11068	840.08487	0	1,152
Slice 9	19.852941	-3.2819014	245.81164	898.81066	0	1,152
Slice 10	20.735294	-3.4058443	255.37035	946.18297	0	1,152
Slice 11	21.617647	-3.4805422	261.85958	982.69612	0	1,152
Slice 12	22.5	-3.5066809	265.32209	1,009.0017	0	1,152
Slice 13	23.382353	-3.4844976	265.77264	1,025.8507	0	1,152
Slice 14	24.264706	-3.4137912	263.19871	1,034.0352	0	1,152
Slice 15	25.147059	-3.2939132	257.55989	1,034.3324	0	1,152
Slice 16	26.029412	-3.1237376	248.78597	1,027.4528	0	1,152
Slice 17	26.911765	-2.9016054	236.77357	1,013.992	0	1,152
Slice 18	27.794118	-2.6252386	221.38068	994.38411	0	1,152
Slice 19	28.676471	-2.2916116	202.41871	968.85372	0	1,152
Slice 20	29.558824	-1.8967614	179.64066	937.36041	0	1,152
Slice 21	30.466364	-1.4202273	144.6503	898.21362	0	1,152
Slice 22	31.399092	-0.8503433	130.10628	850.14582	0	1,152
Slice 23	32.33182	-0.18725464	110.32788	792.26585	0	1,152
Slice 24	33.264548	0.58459607	84.441414	721.63078	0	1,152
Slice 25	34.365456	1.6859257	43.199746	658.23977	86.438237	720
Slice 26	35.159889	2.5725552	8.2784149	568.09953	78.677728	720
Slice 27	35.789363	3.4513666	-29.291877	446.06861	62.690854	720
Slice 28	36.694211	4.9298716	-95.385959	229.37079	32.235962	720
Slice 29	37.564737	6.8651346	-187.77408	-93.70203	-13.168962	720

Slope Stability



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Last Edited By: Eric Lundborg
Revision Number: 4
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Tool Version: 8.14.1.10087
File Name: Pond 9 north.gsz
Directory: P:\15-110 - Western Gallup Berm Upgrades\Slope Stability\
Last Solved Date: 11/5/2015
Last Solved Time: 12:16:18 PM

Project Settings

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Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °
  - Driving Side Maximum Convex Angle: 5 °
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- F of S Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Number of Slices: 30
  - F of S Tolerance: 0.001
  - Minimum Slip Surface Depth: 0.1 ft
  - Search Method: Root Finder
  - Tolerable difference between starting and converged F of S: 3
  - Maximum iterations to calculate converged lambda: 20
  - Max Absolute Lambda: 2

Materials

old berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure
  - Piezometric Line: 1

2013 berm material

- Model: Mohr-Coulomb
- Unit Weight: 140 pcf
- Cohesion': 720 psf
- Phi': 8 °
- Phi-B: 0 °
- Pore Water Pressure

Piezometric Line: 1

Native

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 1,152 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (20, 0.66667) ft
Left-Zone Right Coordinate: (38.64226, 5.32113) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (41, 6.5) ft
Right-Zone Right Coordinate: (52, 6.33333) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 0) ft
Right Coordinate: (89, 0) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	0
Coordinate 2	30	1
Coordinate 3	48	7
Coordinate 4	88	7

Points

	X (ft)	Y (ft)
Point 1	30	1
Point 2	44	8
Point 3	47	8
Point 4	48	7

Point 5	66	4
Point 6	69	1
Point 7	52	1
Point 8	49	3
Point 9	44	3
Point 10	37	1
Point 11	0	0
Point 12	0	-10
Point 13	89	-10
Point 14	89	0

Regions

	Material	Points	Area (ft²)
Region 1	2013 berm material	1,2,3,4,5,6,7,8,9,10	142
Region 2	Native	11,12,13,14,6,7,10,1	954
Region 3	old berm material	10,9,8,7	20

Current Slip Surface

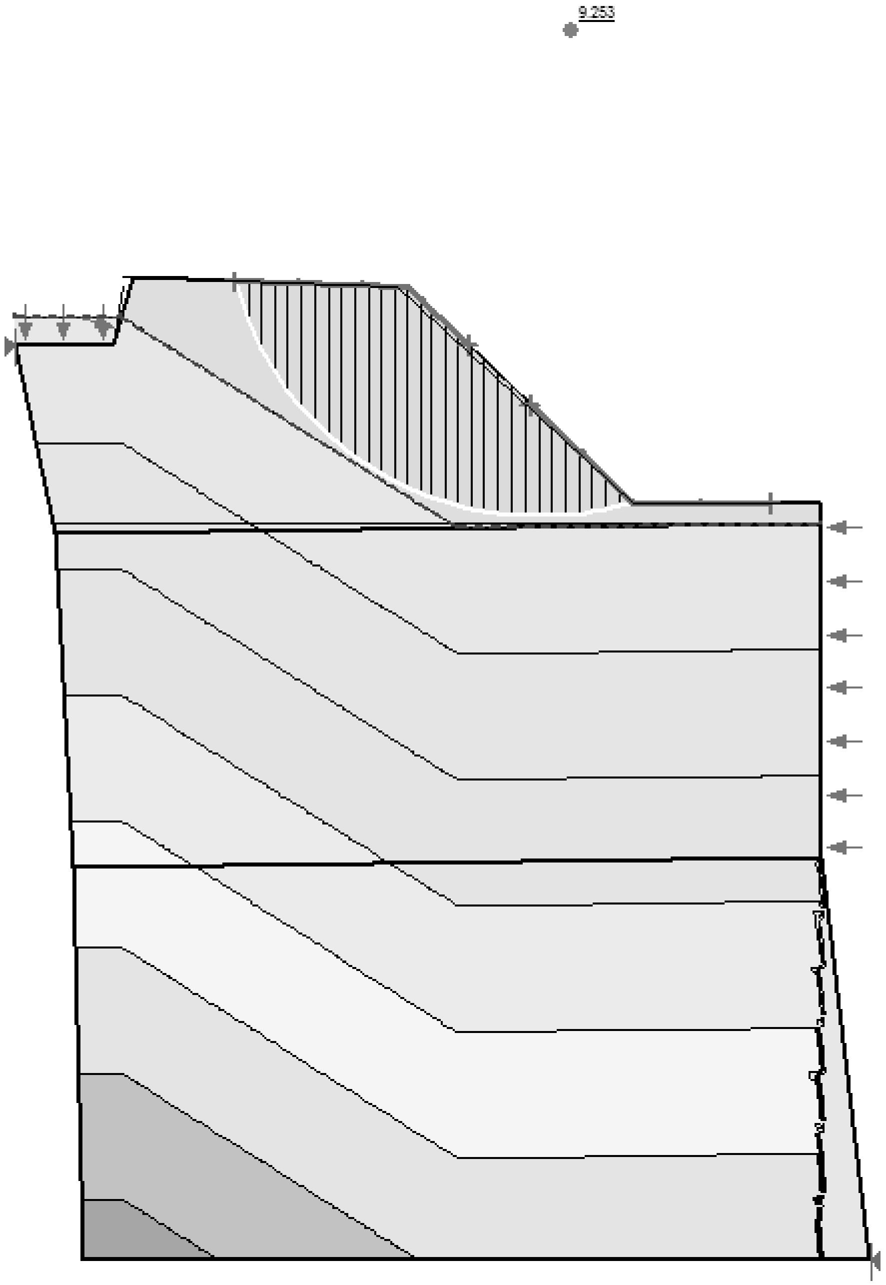
Slip Surface: 44
F of S: 6.806
Volume: 138.41056 ft³
Weight: 19,377.479 lbs
Resisting Moment: 458,653.94 lbs-ft
Activating Moment: 67,392.201 lbs-ft
Resisting Force: 26,445.114 lbs
Activating Force: 3,885.647 lbs
F of S Rank: 1
Exit: (24.914244, 0.83047481) ft
Entry: (49.084346, 6.8192757) ft
Radius: 14.505246 ft
Center: (35.209397, 11.048694) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	25.338057	0.43625788	25.480667	221.1464	0	1,152
Slice 2	26.185683	-0.29509226	72.879978	319.26588	0	1,152
Slice 3	27.033309	-0.92170066	113.7434	407.20522	0	1,152
Slice 4	27.880935	-1.4594852	149.06422	484.35491	0	1,152
Slice 5	28.728561	-1.9195929	179.538	550.29718	0	1,152
Slice 6	29.576187	-2.310107	205.66914	604.80083	0	1,152
Slice 7	30.388889	-2.625912	234.3458	672.89016	0	1,152
Slice 8	31.166667	-2.8759074	266.12329	755.47936	0	1,152
Slice 9	31.944444	-3.0786889	294.95463	828.31586	0	1,152

Slice 10	32.722222	-3.2362743	320.96574	891.47369	0	1,152
Slice 11	33.5	-3.3501522	344.2495	945.18958	0	1,152
Slice 12	34.277778	-3.4213579	364.87051	989.83561	0	1,152
Slice 13	35.055556	-3.4505218	382.86811	1,025.8867	0	1,152
Slice 14	35.833333	-3.4378986	398.25821	1,053.8852	0	1,152
Slice 15	36.611111	-3.3833784	411.03392	1,074.4052	0	1,152
Slice 16	37.388889	-3.2864817	421.16535	1,088.0164	0	1,152
Slice 17	38.166667	-3.1463381	428.59816	1,095.2499	0	1,152
Slice 18	38.944444	-2.9616456	433.25113	1,096.564	0	1,152
Slice 19	39.722222	-2.7306068	435.01209	1,092.3112	0	1,152
Slice 20	40.5	-2.4508332	433.73199	1,082.7007	0	1,152
Slice 21	41.277778	-2.1192056	429.21621	1,067.7572	0	1,152
Slice 22	42.055556	-1.7316683	421.21166	1,047.2653	0	1,152
Slice 23	42.833333	-1.2829212	409.38762	1,020.6927	0	1,152
Slice 24	43.611111	-0.76594372	393.306	987.07155	0	1,152
Slice 25	44.41752	-0.14596426	371.3926	915.46695	0	1,152
Slice 26	45.252561	0.5987328	342.29235	801.62473	0	1,152
Slice 27	46.002561	1.3707939	309.71574	738.01576	60.193642	720
Slice 28	46.66752	2.1706924	273.63322	626.19694	49.549599	720
Slice 29	47.138369	2.7998985	244.1644	518.37236	38.537415	720
Slice 30	47.638369	3.6037238	204.40571	333.03405	18.077535	720
Slice 31	48.542173	5.5133616	92.766234	-42.431396	-19.000787	720

Slope Stability



File Information

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Last Solved Time: 3:35:05 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Bishop
Settings
    PWP Conditions Source: Piezometric Line
    Apply Phreatic Correction: No
    Use Staged Rapid Drawdown: No
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
F of S Distribution
    F of S Calculation Option: Constant
Advanced
    Number of Slices: 30
    F of S Tolerance: 0.001
    Minimum Slip Surface Depth: 0.1 ft

Materials

berm

Model: Mohr-Coulomb

Unit Weight: 140 pcf
Cohesion': 1,152 psf
Phi': 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

subgrade

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 2,304 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

base

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion': 576 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (3.104592, -4.343021) ft
Left-Zone Right Coordinate: (9.068182, -6) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (10.66042, -7.52301) ft
Right-Zone Right Coordinate: (16.75, -10) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-2.5, -6) ft
Right Coordinate: (19.25, -29.25) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-2.5	-5.25
Coordinate 2	0.214286	-5.25
Coordinate 3	8.75	-10.61859
Coordinate 4	18	-10.5

Points

	X (ft)	Y (ft)
Point 1	-2.5	-6
Point 2	-1.5	-10.75
Point 3	18	-10.5
Point 4	18	-10
Point 5	13.25	-10
Point 6	7.5	-4.5
Point 7	0.5	-4.25
Point 8	0	-6
Point 9	-1	-19.25
Point 10	18	-19
Point 11	-0.75	-29.25
Point 12	19.25	-29.25

Regions

	Material	Points	Area (ft^2)
Region 1	berm	1,2,3,4,5,6,7,8	78.188
Region 2	subgrade	2,9,10,3	163.69
Region 3	base	9,11,12,10	197.53

Current Slip Surface

Slip Surface: 14
F of S: 9.253
Volume: 31.251063 ft^3
Weight: 4,375.1488 lbs
Resisting Moment: 124,944.11 lbs-ft
Activating Moment: 13,502.726 lbs-ft
F of S Rank: 1
Exit: (13.219833, -9.9711447) ft
Entry: (3.104592, -4.3430211) ft
Radius: 8.0223547 ft
Center: (10.863166, -2.3027491) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	3.2736461	-	-145.2013	-285.36011	-50.316686	1,152

		4.8472595				
Slice 2	3.6117545	-5.7111613	-104.56352	-72.901045	-12.854421	1,152
Slice 3	3.9498628	-6.3589565	-77.410789	63.750572	11.240946	1,152
Slice 4	4.2879711	-6.8894342	-57.578674	167.53817	29.5415	1,152
Slice 5	4.6260794	-7.3410577	-42.667062	252.05744	44.444527	1,152
Slice 6	4.9641877	-7.7339497	-31.420289	323.52057	57.045406	1,152
Slice 7	5.302296	-8.0802787	-23.079053	385.3354	67.945028	1,152
Slice 8	5.6404043	-8.3880846	-17.141657	439.5937	77.512231	1,152
Slice 9	5.9785126	-8.6630088	-13.256076	487.68137	85.991384	1,152
Slice 10	6.3166209	-8.9091846	-11.164395	530.56871	93.553579	1,152
Slice 11	6.6547292	-9.1297395	-10.671463	568.96378	100.32367	1,152
Slice 12	6.9928375	-9.3270981	-11.625976	603.40005	106.39571	1,152
Slice 13	7.3309458	-9.5031755	-13.908437	634.28961	111.84237	1,152
Slice 14	7.65625	-9.6542664	-17.247535	641.03772	113.03225	1,152
Slice 15	7.96875	-9.782887	-21.486256	624.05871	110.03839	1,152
Slice 16	8.28125	-9.8964734	-26.663106	604.64075	106.61448	1,152
Slice 17	8.59375	-9.9956931	-32.736442	582.92735	102.78582	1,152
Slice 18	8.9219167	-10.084673	-33.178918	557.73416	98.343581	1,152
Slice 19	9.26575	-10.162499	-28.047508	528.94232	93.266803	1,152
Slice 20	9.6095833	-10.224643	-23.894598	497.7483	87.766455	1,152
Slice 21	9.9534166	-10.271475	-20.697251	464.23929	81.857912	1,152
Slice 22	10.29725	-10.303262	-18.438652	428.48488	75.553446	1,152
Slice 23	10.641083	-10.320185	-17.107615	390.53926	68.862608	1,152
Slice 24	10.984917	-10.322337	-16.698257	350.44278	61.792517	1,152
Slice 25	11.32875	-10.30973	-17.209834	308.22318	54.348062	1,152
Slice 26	11.672583	-10.282295	-18.646718	263.89629	46.532036	1,152
Slice	12.016417	-	-	217.46653	38.345217	1,152

27		10.239877	21.018523			
Slice 28	12.36025	-10.182235	-24.340377	168.92704	29.786394	1,152
Slice 29	12.704083	-10.109028	-28.633368	118.25948	20.852336	1,152
Slice 30	13.047916	-10.019815	-33.925191	65.433656	11.537719	1,152

February 12, 2002

PRECISION ENGINEERING INC.

GEOTECHNICAL EVALUATION OF EVAPORATION PONDING CONTAINMENT BERMS

GIANT REFINING COMPANY
CINIZA REFINERY

FILE NO. 00-141

Submitted To:

Ms. Dorinda Mancini
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico
87301

GEOTECHNICAL EVALUATION OF EVAPORATION PONDING CONTAINMENT BERMS

GIANT REFINING COMPANY
CINIZA REFINRY
GALLUP, NEW MEXICO

FILE NO: 00-141

PREPARED BY
PRECISION ENGINEERING, INC.
P.O. BOX 422
LAS CRUCES, NEW MEXICO

APPROVED BY

WILLIAM H. KINGSLEY, PE
PE NO. 8313
FEBRUARY 12, 2002

Index

Appendix Contents

1.0 General

An evaluation of the structural integrity of the evaporation lagoon berms located at the Giant Refining Company's Ciniza Refinery has been performed. There are a total of twelve (12) lagoons located in three (3) impoundment areas. Within the major impoundment areas individual lagoons are separated by interior dikes. The structural analysis of the exterior containment berms was performed using a conventional method of slices as well as finite element analyses of the berm sections. A total of thirteen (13) sections were evaluated for stability at the lagoons. Critical section locations were established based on visual inspection of the lagoons as well as a survey of the lagoon berms.

Soil profiles were established based on information obtained from ten subsurface investigation locations. Representative samples were obtained from borings through the berms. The boring depths range from fifteen (15) to twenty (20) feet. The borings were advanced using a truck-mounted CME 75 drill equipped with eight and five-eighths (8-$\frac{5}{8}$) inch outside diameter, continuous flight, hollow-stemmed auger. The borings were completed in accordance with ASTM D-1452: Standard Method for Soil Investigation and Sampling by Auger Methods.

As the auger was advanced, continuous visual inspection of cutting returns was maintained. Samples were taken at five (5) foot intervals throughout the boring and at major soil changes. Standard penetration resistance determinations were accomplished in accordance with ASTM D-1586: Standard Method for Penetration Test and Split-Barrel Sampling of Soils. Relatively undisturbed samples were obtained using Shelby tubes in accordance with ASTM D-1587: Thin-Walled Tube Sampling of Soils for Geotechnical Purposes. Following field classification, the samples were identified and transported to the laboratory for further study.

In addition to borings Dutch Cone soundings were used to evaluate the insitu soil properties and stratigraphy of the embankments and founding soils. Soundings were advanced in accordance with ASTM D-3441: Deep, Quasi-Static, Cone and Friction-Cone Penetration Tests of Soil. Soundings were taken at one (1) foot intervals from the surface through the total depth of the sounding. The soundings were advanced using the hydraulic push capabilities of the CME 75D drill unit.

The logs for the auger borings, and the boring location plan are provided in the appendix of this report. The locations of the sections used for the analysis of the berm embankments are also shown on the boring plan.

2.0 Laboratory Investigation

Representative soil samples obtained from the field investigation were examined and classified based on the Unified Classification System (ASTM D-2487) and the AASHTO Classification System (AASHTO M-145). Particle size analyses were conducted on representative samples. Moisture content determinations were made on all samples to establish moisture content profiles. Atterberg Limits were established on representative samples that exhibited a cohesive nature. All of the above indicator tests were used to aid in defining soil stratification and general insitu soil conditions. The mechanical grain size analyses and soil classification summaries are provided in the appendix of this report.

Unit weight and triaxial shear testing was performed on representative samples to determine strength properties for structural analysis of the soils in the embankments. Test results are shown in the appendix of this report. All testing was conducted in accordance with procedures outlined in the ASTM Standard Methods.

3.0 General Site and Soil Conditions

The evaporation lagoons are located at the southern edge of a broad valley formed as the result of the weathering of relatively soft shales (mudstones and siltstones) of the Petrified Forest Member of the Chinle Formation. These siltstones and mudstones of the Chinle have a high montmorillonite clay content. As a result the soils that have developed at the site are comprised of clays of moderate to high plasticity. All boring and soundings indicate the embankments have been constructed of clay taken from the valley floor. The embankments are founded on the native clays of the valley floor.

The Chinle Formation serves as the bedrock formation at this site. Generally, the formation dips to the north-northwest at approximately three (3) degrees. At the southerly edge of the lagoons the formation was encountered at approximately fifteen (15) feet below the natural ground elevation. At the northerly side of the lagoon site the formation has been encountered in past studies at a depth on the order of sixty (60) feet.

Groundwater was not encountered in any of the embankments. The only groundwater that was encountered during the investigation was a boring eight (8). This location is at the extreme southerly edge of the valley floor. During the drilling the groundwater was encountered at a depth of eighteen

(18) feet below the top of the berm. After twenty-four hours the water level had risen to slightly greater than six (6) feet below the boring elevation (top of the containment berm). At that location the berm height is approximately five (5) feet in height, making the water level approximately one (1) foot below the toe of the embankment. It should be noted that no free water was encountered during the drilling of boring eight (8) until the eighteen (18) foot depth. At that depth a water bearing sandy layer approximately two (2) feet in thickness was encountered. This sandy zone immediately overlies the Chinle Formation. The mudstone of the Chinle Formation is not water bearing. The sandy zone is a confined water bearing zone that is artesian. Nearly every boring that has been drilled to the undisturbed Chinle Formation at the Ciniza site has penetrated this overlying sand zone. The zone serves as an excellent marker for the top of the Chinle. There is no evidence of water migration at this location, or the other investigation locations, which can be attributed to leakage from the ponds.

4.0 Analysis

Thirteen (13) sections through the exterior embankments have been analyzed for stability. Both interior as well as exterior stability of the embankments has been checked. Because the interior height of the embankments are low, factors of safety for the interior slopes are very high. The controlling failure mechanism is associated with the geometry of the exterior slope (the slope that defines the outside or nonwetted face of the lagoon group).

The analyses demonstrate that the berms are structurally stable. Factors of safety against failure for the sections analyzed range from a high of 10.0 to a low of 2.5. Typical minimum desirable factors of safety for this type of structure are in the range of 1.3 to 1.5. As mentioned previously the embankments were evaluated using the method of slices (Bishop's Modified Method) as well as finite element evaluation. A computer program developed by the New York State Highway Department named SLOPES was used to evaluate the berms with Bishop's Modified Method. A program developed at the Colorado School of Mines, Geomechanics Research Center by D. V. Griffiths was used to perform the finite element evaluation. The program, named SLOPE1 is well documented in the book "Programming the Finite Element Method" by I. M. Smith and D. V. Griffiths. Plots of the finite element (FE) mesh, deflection data, and vector traces of the deflected mesh were made using a separate plotting program and are presented in the appendix of this report. The deflected mesh graphically shows the result of the FE analysis at the most critical factor of safety identified. There was excellent correlation between the two analysis types where a circular failure provided the critical factor of safety.

The program SLOPES forces a circular failure where the FE program evaluates translation of nodes of the finite element mesh. The finite element program in this respect provides a more critical evaluation of the failure mode. It may be seen with the FE program that although the higher embankments show the critical failure mode to be a circular failure, the lower embankments tended to identify settlement as a more likely failure mode. The observation is somewhat academic, however, since the associated factors of safety against failure are 2.5 at the worst. Structurally, the berms are sound.

The soils comprising the embankments were tested to evaluate their propensity for being dispersive. Pinhole dispersion testing was performed on the materials in the constructed embankments. The soils were found to be in the category of nondispersive. Piping failure is unlikely to occur in the exterior containment embankments.

5.0 Observations and Recommendations

5.1 Wave Damage

A visual examination of the ponds was performed as a portion of the field investigation. Notes made during the field observation indicated there is no obvious structural failure that is occurring on the embankments. It was noted, however, that although the lagoon depth tended to not exceed two to three feet in total depth substantial wave erosion is occurring on the interior portion of the exterior containment embankments. Similarly, wave erosion is occurring along the interior pond separation dikes. Some, generally minor, erosion is occurring on the exterior faces of the perimeter containment berms.

A conscientious effort of embankment maintenance will easily control the exterior erosion of the containment berms. Although continual maintenance of the interior wave damage on the outside containment berms could also be made, over time significant pond volume loss would be realized as material is continually added to the interior of the lagoons at wave damage locations. It is recommended that a more permanent interior wave energy dissipation system be considered.

Wave damage may be reduced by plating the active wave areas with nonerosive material such as rock, grout blankets, or similar materials. If rock is selected at this site it should be placed on a geogrid material such as Tensar®, in Maccaferri® Reno Mattresses, or similar geotextile materials. These materials will prevent the rock from sinking into the soft soils or sliding off the slope where it will be ineffective against wave damage. It is recommended that wave protection be placed such that it extends from the top of the embankment to a minimum of twenty-four (24) inches below the lowest water level.

Where twenty four (24) inches extends below the bottom of the interior slope elevation, the slope protection material should key into the bottom of the lagoon impoundment a minimum of eight (8) inches. Because the lagoons are used as evaporation ponds the slope protection will likely be required on the entire interior face of the outside containment lagoons. Because of the lack of high quality aggregates in the Gallup area, rip-rap type energy dissipation, although permanently effective, will be costly to install.

An alternate wave protection system involves dissipation of the wave energy prior to reaching the embankment berms. Such systems involve the use of geogrids, fabrics, or liner materials constructed as a fence approximately three (3) to five (5) feet away from the wave impact area of the containment berms. It is the intent that these materials reflect or dissipate the majority of the wave energy prior to reaching the embankment material. Floating systems have also been used to reduce minor wave action. Materials such as partially submerged plastic drums have been successfully used to reduce the effects of wave action. These systems should be used to protect interior pond separation dikes as well as the exterior containment berms.

Should Giant Refining Company require assistance in design of these systems or require design review, Precision Engineering, Inc. can assist as required.

5.2 Berm Height

It was noted during the visual inspection that at some locations the impounded water level was within one (1) foot of the containment berm crest elevation. Should an interior dike be breached or high winds cause large waves the exterior containment dike could easily be overtopped. It is strongly