

# STRUCTURAL CALCULATIONS: SITE RETAINING WALL DESIGN

PROJECT:  
SWC COLORADO BLVD. & THORNTON PKWY.  
THORNTON, CO

PROJECT NO.:  
4665

SUBMITTAL:  
APRIL 25, 2016



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## Cantilevered Retaining Wall

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 ENERCAL, INC. 1983-2016, Build:6.16.4.15, Ver:6.16.4.15  
 Licensee : GALLOWAY & COMPANY, INC.

Lic. # : KW-06011271

Description : 6-FT- Wall "1"

Calculations per ACI 318-11, ACI 530-11, IBC 2012,  
 CBC 2013, ASCE 7-10

### Criteria

|  |   |          |
|--|---|----------|
| Retained Height  | = | 6.00 ft  |
| Wall height above soil   | = | 0.00 ft  |
| Slope Behind Wall  | = | 3.00 : 1 |
| Height of Soil over Toe  | = | 22.00 in |
| Water height over heel   | = | 0.0 ft   |
| Vertical component of active<br>Lateral soil pressure options: |   |          |
| USED for Soil Pressure.  |   |          |
| USED for Sliding Resistance.                                   |   |          |
| USED for Overturning Resistance.                               |   |          |

### Soil Data

|   |   |              |
|---|---|--------------|
| Allow Soil Bearing                            | = | 2,800.0 psf  |
| Equivalent Fluid Pressure Method              |   |              |
| Heel Active Pressure                          | = | 46.0 psf/ft  |
| Toe Active Pressure                           | = | 46.0 psf/ft  |
| Passive Pressure                              | = | 300.0 psf/ft |
| Soil Density, Heel                            | = | 125.00 pcf   |
| Soil Density, Toe                             | = | 125.00 pcf   |
| Friction Coeff btwn Ftg & Soil                | = | 0.400        |
| Soil height to ignore<br>for passive pressure | = | 22.00 in     |

### Design Summary

|   |     |              |
|---|-----|--------------|
| Wall Stability Ratios                   |     |              |
| Overturning                             | =   | 2.32 OK      |
| Sliding                                 | =   | 1.95 OK      |
| Total Bearing Load                      | =   | 3,373 lbs    |
| ...resultant ecc.                       | =   | 6.14 in      |
| Soil Pressure @ Toe                     | =   | 1,809 psf OK |
| Soil Pressure @ Heel                    | =   | 118 psf OK   |
| Allowable                               | =   | 2,800 psf    |
| Soil Pressure Less Than Allowable       |     |              |
| ACI Factored @ Toe                      | =   | 1,885 psf    |
| ACI Factored @ Heel                     | =   | 123 psf      |
| Footing Shear @ Toe                     | =   | 1.3 psi OK   |
| Footing Shear @ Heel                    | =   | 16.2 psi OK  |
| Allowable                               | =   | 82.2 psi     |
| Sliding Calcs (Vertical Component Used) |     |              |
| Lateral Sliding Force                   | =   | 1,125.4 lbs  |
| less 100% Passive Force                 | = - | 845.8 lbs    |
| less 100% Friction Force                | = - | 1,349.0 lbs  |
| Added Force Req'd                       | =   | 0.0 lbs OK   |
| ....for 1.5 : 1 Stability               | =   | 0.0 lbs OK   |
| Load Factors                            |     |              |
| Dead Load                               |     | 1.200        |
| Live Load                               |     | 1.600        |
| Earth, H                                |     | 1.600        |
| Wind, W                                 |     | 1.600        |
| Seismic, E                              |     | 1.000        |

### Stem Construction

|                          |        |           |
|--------------------------|--------|-----------|
|                          |        | Top Stem  |
| Design Height Above Ftg  | ft =   | 0.00      |
| Wall Material Above "Ht" | =      | Concrete  |
| Thickness                | in =   | 14.00     |
| Rebar Size               | =      | # 5       |
| Rebar Spacing            | in =   | 18.00     |
| Rebar Placed at          | =      | User Spec |
| Design Data              |        |           |
| fb/FB + fa/Fa            | =      | 0.256     |
| Total Force @ Section    | lbs =  | 1,201.1   |
| Moment....Actual         | ft-l = | 2,574.0   |
| Moment....Allowable      | ft-l = | 10,041.0  |
| Shear.....Actual         | psi =  | 9.1       |
| Shear.....Allowable      | psi =  | 82.2      |
| Wall Weight              | psf =  | 175.0     |
| Rebar Depth 'd'          | in =   | 11.00     |
| Lap splice if above      | in =   | 21.36     |
| Lap splice if below      | in =   | 9.59      |
| Hook embed into footing  | in =   | 9.59      |
| Concrete Data            |        |           |
| f'c                      | psi =  | 3,000.0   |
| Fy                       | psi =  |           |

### Cantilevered Retaining Wall

File=H:\4665\CO\_THO~2.01-\3D02D~1.BID\35869~1.27S\466~1.EC6  
 ENERCAL, INC. 1983-2016, Build:6.16.4.15, Ver:6.16.4.15

Lic. #: KW-06011271

Licensee: GALLOWAY & COMPANY, INC.

Description: 6-FT- Wall "1"

#### Footing Dimensions & Strengths

|                          |   |            |
|--------------------------|---|------------|
| Toe Width                | = | 1.00 ft    |
| Heel Width               | = | 2.50       |
| Total Footing Width      | = | 3.50       |
| Footing Thickness        | = | 14.00 in   |
| Key Width                | = | 0.00 in    |
| Key Depth                | = | 0.00 in    |
| Key Distance from Toe    | = | 0.00 ft    |
| $f'_c$                   | = | 3,000 psi  |
| $F_y$                    | = | 60,000 psi |
| Footing Concrete Density | = | 150.00 pcf |
| Min. As %                | = | 0.0018     |
| Cover @ Top              | = | 2.00       |
| @ Btm.                   | = | 3.00 in    |

#### Footing Design Results

|                    |   | <u>Toe</u>     | <u>Heel</u> |
|--------------------|---|----------------|-------------|
| Factored Pressure  | = | 1,885          | 123 psf     |
| Mu' : Upward       | = | 859            | 0 ft-lb     |
| Mu' : Downward     | = | 243            | 1,973 ft-lb |
| Mu: Design         | = | 616            | 1,973 ft-lb |
| Actual 1-Way Shear | = | 1.27           | 16.19 psi   |
| Allow 1-Way Shear  | = | 82.16          | 82.16 psi   |
| Toe Reinforcing    | = | # 5 @ 18.00 in |             |
| Heel Reinforcing   | = | # 5 @ 18.00 in |             |
| Key Reinforcing    | = | None Spec'd    |             |

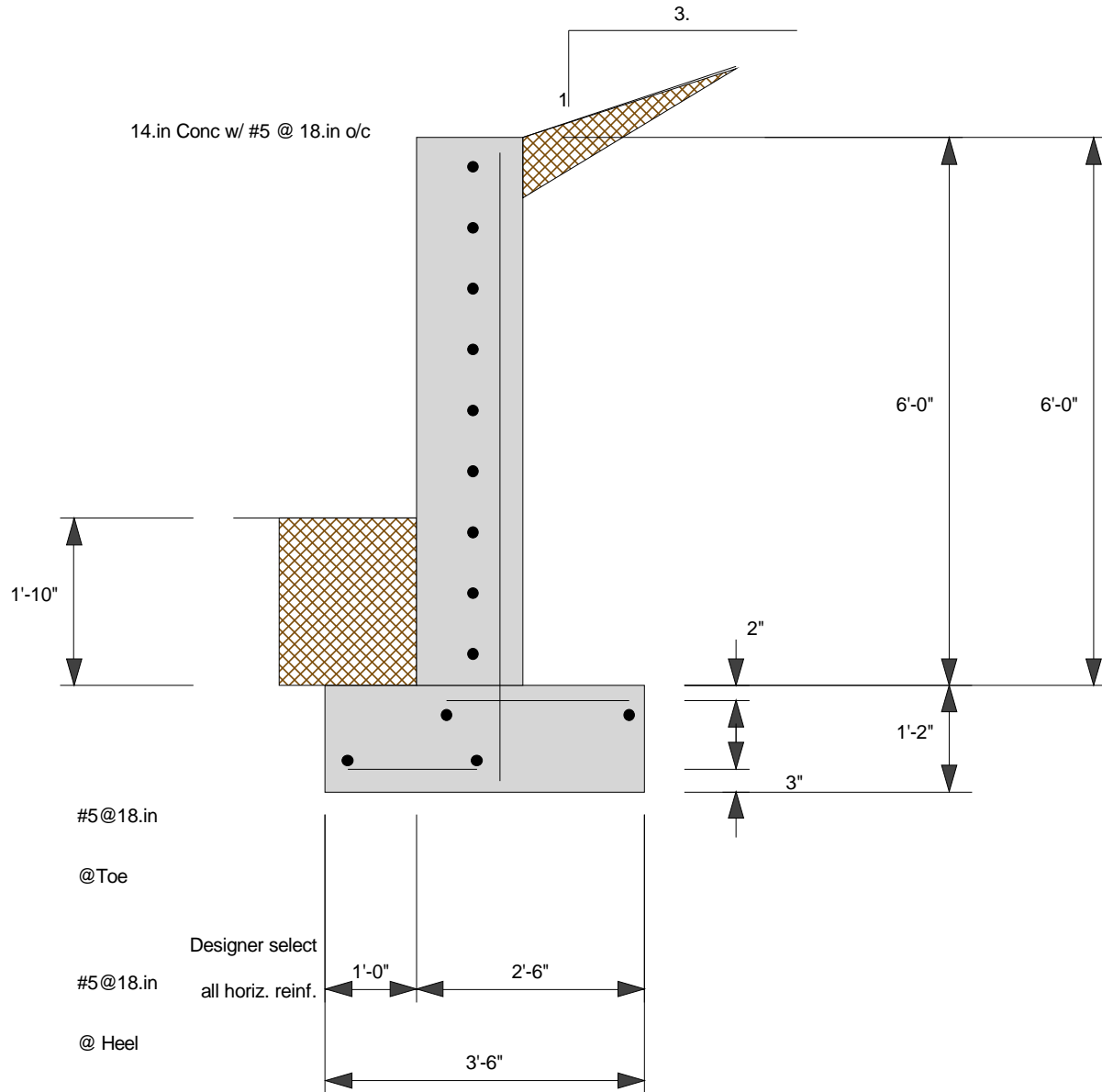
Other Acceptable Sizes & Spacings  
 Toe: Not req'd,  $M_u < S * F_r$   
 Heel: Not req'd,  $M_u < S * F_r$   
 Key: No key defined

#### Summary of Overturning & Resisting Forces & Moments

| Item   | .....OVERTURNING..... |                |                   | .....RESISTING..... |                |                 |
|--|-----------------------|----------------|-------------------|---------------------|----------------|-----------------|
|  | Force<br>lbs          | Distance<br>ft | Moment<br>ft-lb   | Force<br>lbs        | Distance<br>ft | Moment<br>ft-lb |
| Heel Active Pressure   | =                     | 1,332.4        | 2.54              | 3,380.3             |                |                 |
| Surcharge over Heel  | =                     |                |                   |                     |                |                 |
| Toe Active Pressure  | =                     | -207.0         | 1.00              | -207.0              |                |                 |
| Surcharge Over Toe   | =                     |                |                   |                     |                |                 |
| Adjacent Footing Load  | =                     |                |                   |                     |                |                 |
| Added Lateral Load   | =                     |                |                   |                     |                |                 |
| Load @ Stem Above Soil                                       | =                     |                |                   |                     |                |                 |
| <b>Total</b>   | =                     | <b>1,125.4</b> | <b>O.T.M. =</b>   | <b>3,173.3</b>      |                |                 |
| Resisting/Overturning Ratio                                  |                       |                | =                 | 2.32                |                |                 |
| Vertical Loads used for Soil Pressure                        | =                     | 3,372.6        | lbs               |                     |                |                 |
| Vertical component of active pressure used for soil pressure |                       |                |                   |                     |                |                 |
| Soil Over Heel   | =                     | 1,000.0        | 2.83              | 2,833.3             |                |                 |
| Sloped Soil Over Heel  | =                     | 37.0           | 3.06              | 113.2               |                |                 |
| Surcharge Over Heel  | =                     |                |                   |                     |                |                 |
| Adjacent Footing Load  | =                     |                |                   |                     |                |                 |
| Axial Dead Load on Stem                                      | =                     |                |                   |                     |                |                 |
| * Axial Live Load on Stem                                    | =                     |                |                   |                     |                |                 |
| Soil Over Toe  | =                     | 229.2          | 0.50              | 114.6               |                |                 |
| Surcharge Over Toe   | =                     |                |                   |                     |                |                 |
| Stem Weight(s)   | =                     | 1,050.0        | 1.58              | 1,662.5             |                |                 |
| Earth @ Stem Transitions                                     | =                     |                |                   |                     |                |                 |
| Footing Weight   | =                     | 612.5          | 1.75              | 1,071.9             |                |                 |
| Key Weight   | =                     |                |                   |                     |                |                 |
| Vert. Component  | =                     | 443.9          | 3.50              | 1,553.8             |                |                 |
| <b>Total</b>   | =                     | <b>3,372.6</b> | <b>lbs R.M. =</b> | <b>7,349.2</b>      |                |                 |

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

# RETAINING WALL "1": 6-FT RETAINED HEIGHT CONDITION



**Cantilevered Retaining Wall**

File=H:\4665\CO\_THO~2.01~\3D02D~1.BID\35869~1.27S\466~1.EC6  
 ENERCAL, INC. 1983-2016, Build:6.16.4.15, Ver:6.16.4.15

Lic. #: KW-06011271

Licensee: GALLOWAY & COMPANY, INC.

Description: 9-FT- Wall "1"

Calculations per ACI 318-11, ACI 530-11, IBC 2012,  
 CBC 2013, ASCE 7-10

**Criteria**

|  |   |          |
|--|---|----------|
| Retained Height  | = | 9.00 ft  |
| Wall height above soil   | = | 0.00 ft  |
| Slope Behind Wall  | = | 4.00 : 1 |
| Height of Soil over Toe  | = | 18.00 in |
| Water height over heel   | = | 0.0 ft   |
| Vertical component of active<br>Lateral soil pressure options: |   |          |
| USED for Soil Pressure.  |   |          |
| USED for Sliding Resistance.                                   |   |          |
| USED for Overturning Resistance.                               |   |          |

**Soil Data**

|   |   |              |
|---|---|--------------|
| Allow Soil Bearing                            | = | 2,800.0 psf  |
| Equivalent Fluid Pressure Method              |   |              |
| Heel Active Pressure                          | = | 46.0 psf/ft  |
| Toe Active Pressure                           | = | 46.0 psf/ft  |
| Passive Pressure                              | = | 300.0 psf/ft |
| Soil Density, Heel                            | = | 125.00 pcf   |
| Soil Density, Toe                             | = | 125.00 pcf   |
| Friction Coeff btwn Ftg & Soil                | = | 0.400        |
| Soil height to ignore<br>for passive pressure | = | 18.00 in     |

**Design Summary**

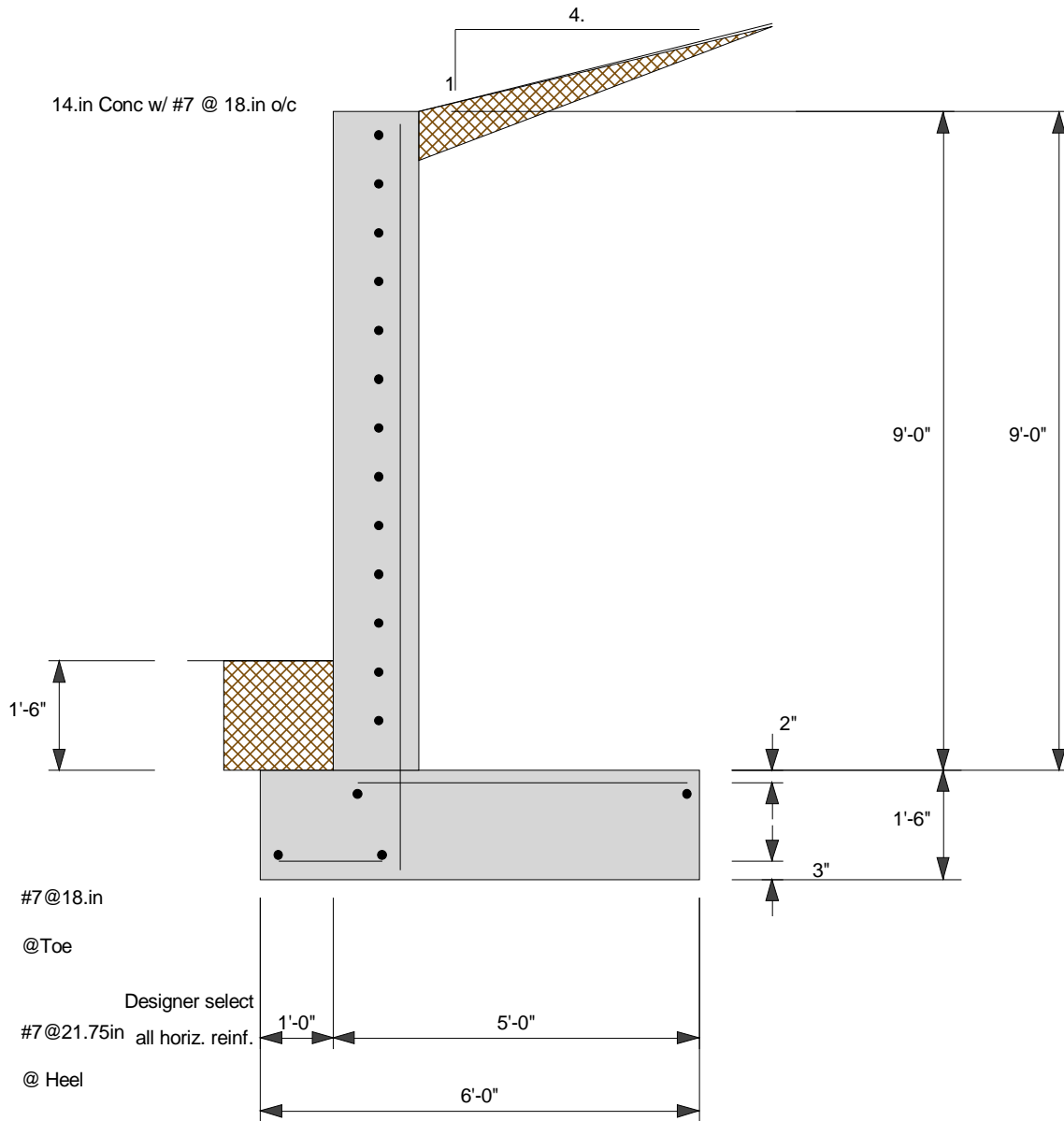
|   |     |              |
|---|-----|--------------|
| Wall Stability Ratios                   |     |              |
| Overturning                             | =   | 2.68 OK      |
| Sliding                                 | =   | 1.57 OK      |
| Total Bearing Load                      | =   | 8,487 lbs    |
| ...resultant ecc.                       | =   | 9.14 in      |
| Soil Pressure @ Toe                     | =   | 2,491 psf OK |
| Soil Pressure @ Heel                    | =   | 338 psf OK   |
| Allowable                               | =   | 2,800 psf    |
| Soil Pressure Less Than Allowable       |     |              |
| ACI Factored @ Toe                      | =   | 2,696 psf    |
| ACI Factored @ Heel                     | =   | 366 psf      |
| Footing Shear @ Toe                     | =   | 0.0 psi OK   |
| Footing Shear @ Heel                    | =   | 42.0 psi OK  |
| Allowable                               | =   | 82.2 psi     |
| Sliding Calcs (Vertical Component Used) |     |              |
| Lateral Sliding Force                   | =   | 2,812.7 lbs  |
| less 100% Passive Force                 | = - | 1,012.5 lbs  |
| less 100% Friction Force                | = - | 3,398.0 lbs  |
| Added Force Req'd                       | =   | 0.0 lbs OK   |
| ....for 1.5 : 1 Stability               | =   | 0.0 lbs OK   |
| Load Factors                            |     |              |
| Dead Load                               |     | 1.200        |
| Live Load                               |     | 1.600        |
| Earth, H                                |     | 1.600        |
| Wind, W                                 |     | 1.600        |
| Seismic, E                              |     | 1.000        |

**Stem Construction**

|                          |        |           |
|--------------------------|--------|-----------|
|                          |        | Top Stem  |
| Design Height Above Ftg  | ft =   | 0.00      |
| Wall Material Above "Ht" | =      | Concrete  |
| Thickness                | in =   | 14.00     |
| Rebar Size               | =      | # 7       |
| Rebar Spacing            | in =   | 18.00     |
| Rebar Placed at          | =      | User Spec |
| Design Data              |        |           |
| fb/FB + fa/Fa            | =      | 0.466     |
| Total Force @ Section    | lbs =  | 2,898.0   |
| Moment....Actual         | ft-l = | 8,901.0   |
| Moment....Allowable      | ft-l = | 19,092.0  |
| Shear.....Actual         | psi =  | 22.0      |
| Shear.....Allowable      | psi =  | 82.2      |
| Wall Weight              | psf =  | 175.0     |
| Rebar Depth 'd'          | in =   | 11.00     |
| Lap splice if above      | in =   | 37.57     |
| Lap splice if below      | in =   | 13.42     |
| Hook embed into footing  | in =   | 13.42     |
| Concrete Data            |        |           |
| f'c                      | psi =  | 3,000.0   |
| Fy                       | psi =  |           |



**RETAINING WALL "1":**  
**9-FT RETAINED HEIGHT CONDITION**





## Cantilevered Retaining Wall

File=H:\4665\CO\_THO~2.01~3D02D~1.BID\35869~1.27S\466~1.EC6  
 ENERCAL, INC. 1983-2016, Build:6.16.4.15, Ver:6.16.4.15  
 Licensee : GALLOWAY & COMPANY, INC.

Lic. # : KW-06011271

Description : 10.5-FT- Wall "1"

Calculations per ACI 318-11, ACI 530-11, IBC 2012,  
 CBC 2013, ASCE 7-10

### Criteria

|  |   |                                  |
|--|---|----------------------------------|
| Retained Height  | = | 10.50 ft                         |
| Wall height above soil   | = | 0.00 ft                          |
| Slope Behind Wall  | = | 3.00 : 1                         |
| Height of Soil over Toe  | = | 18.00 in                         |
| Water height over heel   | = | 0.0 ft                           |
| Vertical component of active<br>Lateral soil pressure options: |   |                                  |
|  |   | USED for Soil Pressure.          |
|  |   | USED for Sliding Resistance.     |
|  |   | USED for Overturning Resistance. |

### Soil Data

|   |   |              |
|---|---|--------------|
| Allow Soil Bearing                            | = | 2,800.0 psf  |
| Equivalent Fluid Pressure Method              |   |              |
| Heel Active Pressure                          | = | 46.0 psf/ft  |
| Toe Active Pressure                           | = | 46.0 psf/ft  |
| Passive Pressure                              | = | 300.0 psf/ft |
| Soil Density, Heel                            | = | 125.00 pcf   |
| Soil Density, Toe                             | = | 125.00 pcf   |
| Friction Coeff btwn Ftg & Soil                | = | 0.400        |
| Soil height to ignore<br>for passive pressure | = | 18.00 in     |

### Design Summary

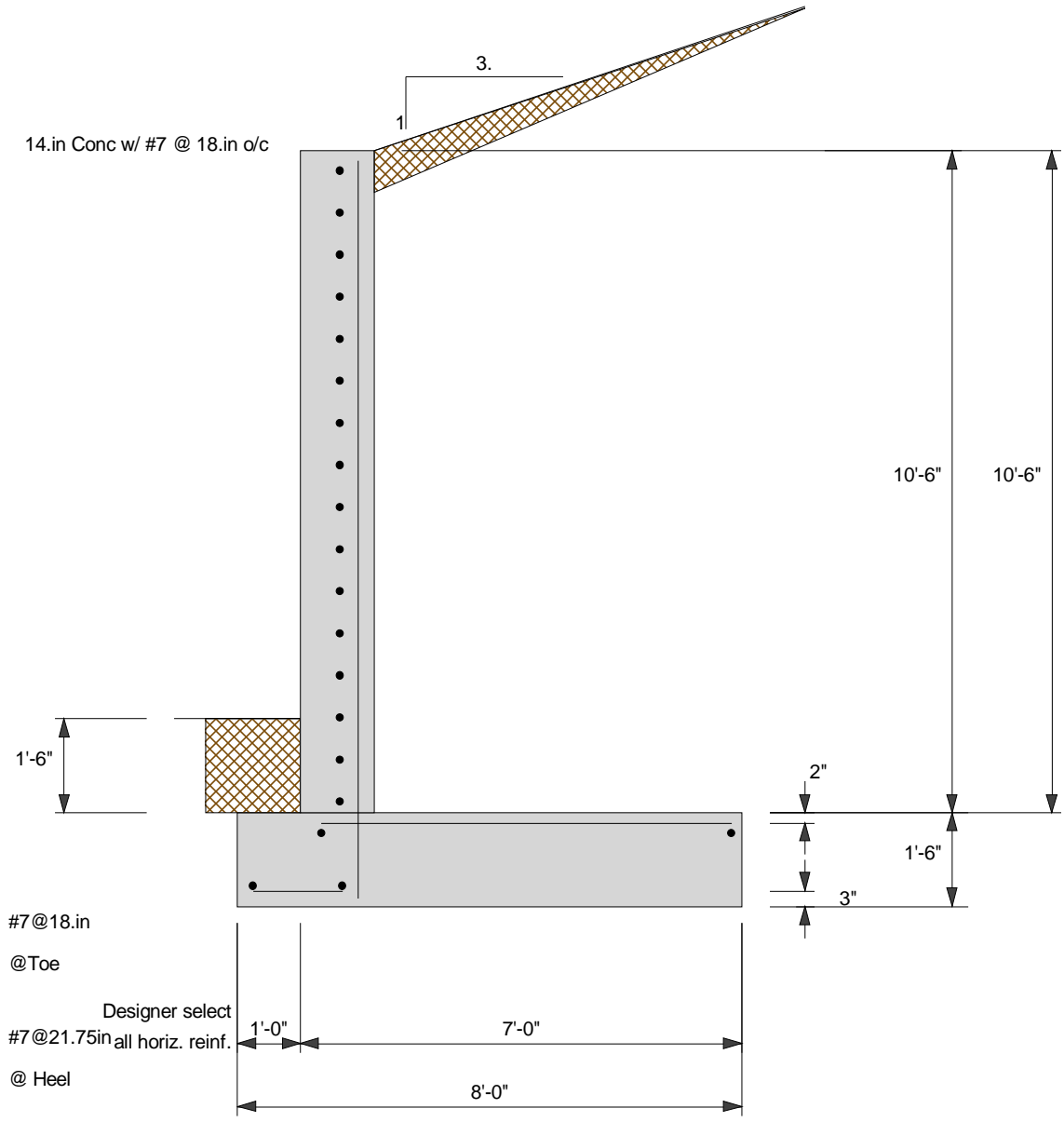
|   |     |                                   |
|---|-----|-----------------------------------|
| Wall Stability Ratios                   |     |                                   |
| Overturning                             | =   | 3.17 OK                           |
| Sliding                                 | =   | 1.52 OK                           |
| Total Bearing Load                      | =   | 13,680 lbs                        |
| ...resultant ecc.                       | =   | 8.74 in                           |
| Soil Pressure @ Toe                     | =   | 2,644 psf OK                      |
| Soil Pressure @ Heel                    | =   | 776 psf OK                        |
| Allowable                               | =   | 2,800 psf                         |
|   |     | Soil Pressure Less Than Allowable |
| ACI Factored @ Toe                      | =   | 2,828 psf                         |
| ACI Factored @ Heel                     | =   | 829 psf                           |
| Footing Shear @ Toe                     | =   | 0.0 psi OK                        |
| Footing Shear @ Heel                    | =   | 75.3 psi OK                       |
| Allowable                               | =   | 82.2 psi                          |
| Sliding Calcs (Vertical Component Used) |     |                                   |
| Lateral Sliding Force                   | =   | 4,265.3 lbs                       |
| less 100% Passive Force                 | = - | 1,012.5 lbs                       |
| less 100% Friction Force                | = - | 5,470.0 lbs                       |
| Added Force Req'd                       | =   | 0.0 lbs OK                        |
| ....for 1.5 : 1 Stability               | =   | 0.0 lbs OK                        |
| Load Factors                            |     |                                   |
| Dead Load                               |     | 1.200                             |
| Live Load                               |     | 1.600                             |
| Earth, H                                |     | 1.600                             |
| Wind, W                                 |     | 1.600                             |
| Seismic, E                              |     | 1.000                             |

### Stem Construction

|                          |        |           |
|--------------------------|--------|-----------|
|                          |        | Top Stem  |
| Design Height Above Ftg  | ft =   | 0.00      |
| Wall Material Above "Ht" | =      | Concrete  |
| Thickness                | in =   | 14.00     |
| Rebar Size               | =      | # 7       |
| Rebar Spacing            | in =   | 18.00     |
| Rebar Placed at          | =      | User Spec |
| Design Data              |        |           |
| fb/FB + fa/Fa            | =      | 0.742     |
| Total Force @ Section    | lbs =  | 3,974.4   |
| Moment....Actual         | ft-l = | 14,158.8  |
| Moment....Allowable      | ft-l = | 19,092.0  |
| Shear.....Actual         | psi =  | 30.1      |
| Shear.....Allowable      | psi =  | 82.2      |
| Wall Weight              | psf =  | 175.0     |
| Rebar Depth 'd'          | in =   | 11.00     |
| Lap splice if above      | in =   | 37.57     |
| Lap splice if below      | in =   | 13.42     |
| Hook embed into footing  | in =   | 13.42     |
| Concrete Data            |        |           |
| f'c                      | psi =  | 3,000.0   |
| Fy                       | psi =  |           |



**RETAINING WALL "1":  
10.5-FT RETAINED HEIGHT CONDITION**



## Cantilevered Retaining Wall

File=H:\4665\CO\_THO~2.01~3D02D~1.BID\35869~1.27S\466~1.EC6  
 ENERCAL, INC. 1983-2016, Build:6.16.4.15, Ver:6.16.4.15  
 Licensee : GALLOWAY & COMPANY, INC.

Lic. # : KW-06011271

Description : 12.5-FT- Wall "1"

Calculations per ACI 318-11, ACI 530-11, IBC 2012,  
 CBC 2013, ASCE 7-10

### Criteria

|  |   |          |
|--|---|----------|
| Retained Height  | = | 12.50 ft |
| Wall height above soil   | = | 0.00 ft  |
| Slope Behind Wall  | = | 3.00 : 1 |
| Height of Soil over Toe  | = | 12.00 in |
| Water height over heel   | = | 0.0 ft   |
| Vertical component of active<br>Lateral soil pressure options: |   |          |
| USED for Soil Pressure.  |   |          |
| USED for Sliding Resistance.                                   |   |          |
| USED for Overturning Resistance.                               |   |          |

### Soil Data

|   |   |              |
|---|---|--------------|
| Allow Soil Bearing                            | = | 2,800.0 psf  |
| Equivalent Fluid Pressure Method              |   |              |
| Heel Active Pressure                          | = | 47.0 psf/ft  |
| Toe Active Pressure                           | = | 47.0 psf/ft  |
| Passive Pressure                              | = | 300.0 psf/ft |
| Soil Density, Heel                            | = | 125.00 pcf   |
| Soil Density, Toe                             | = | 125.00 pcf   |
| Friction Coeff btwn Ftg & Soil                | = | 0.400        |
| Soil height to ignore<br>for passive pressure | = | 12.00 in     |

### Design Summary

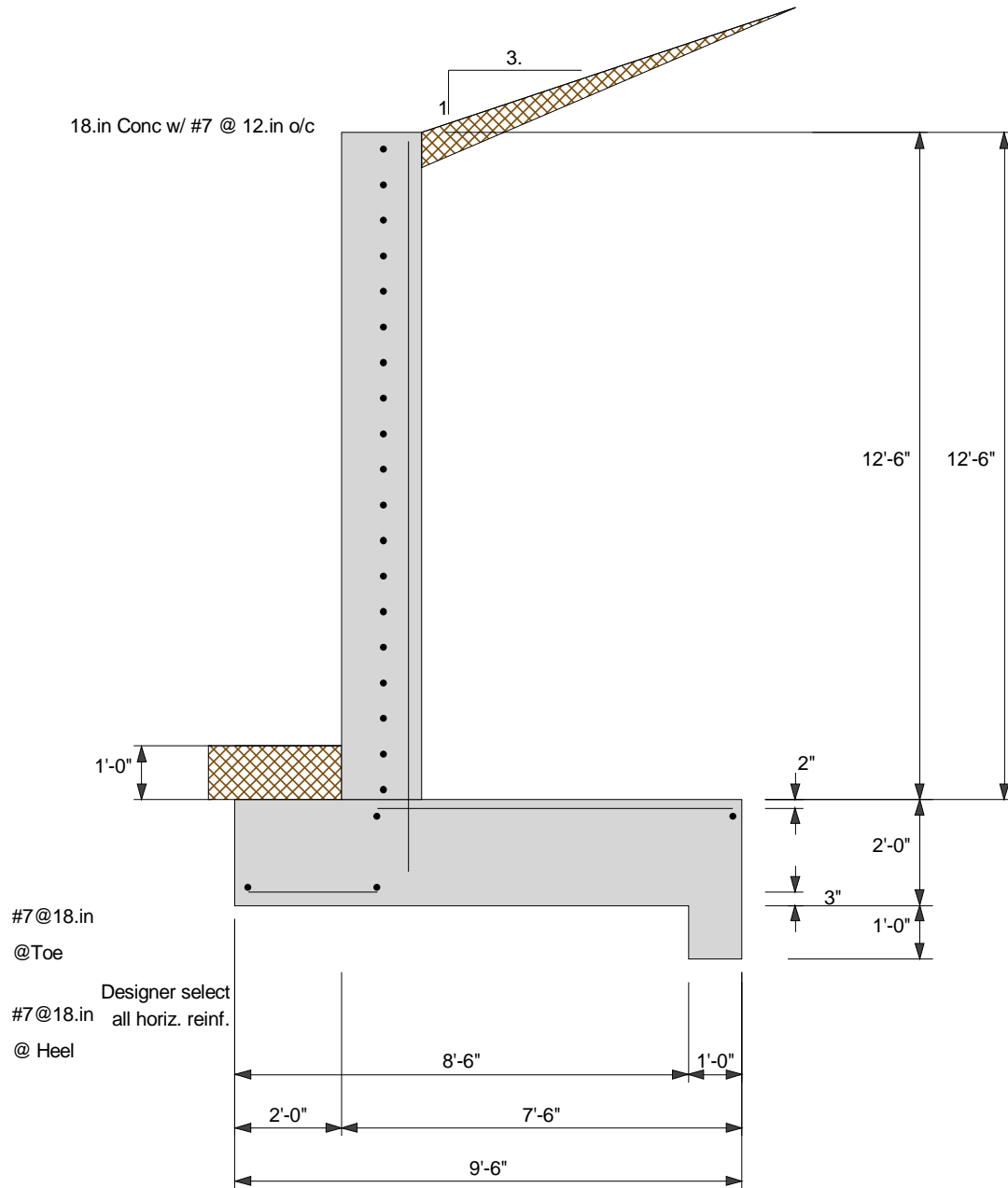
|   |     |              |
|---|-----|--------------|
| Wall Stability Ratios                   |     |              |
| Overturning                             | =   | 3.14 OK      |
| Sliding                                 | =   | 1.55 OK      |
| Total Bearing Load                      | =   | 18,319 lbs   |
| ...resultant ecc.                       | =   | 8.06 in      |
| Soil Pressure @ Toe                     | =   | 2,747 psf OK |
| Soil Pressure @ Heel                    | =   | 1,110 psf OK |
| Allowable                               | =   | 2,800 psf    |
| Soil Pressure Less Than Allowable       |     |              |
| ACI Factored @ Toe                      | =   | 2,912 psf    |
| ACI Factored @ Heel                     | =   | 1,177 psf    |
| Footing Shear @ Toe                     | =   | 2.8 psi OK   |
| Footing Shear @ Heel                    | =   | 68.7 psi OK  |
| Allowable                               | =   | 82.2 psi     |
| Sliding Calcs (Vertical Component Used) |     |              |
| Lateral Sliding Force                   | =   | 6,186.4 lbs  |
| less 100% Passive Force                 | = - | 2,250.0 lbs  |
| less 100% Friction Force                | = - | 7,320.0 lbs  |
| Added Force Req'd                       | =   | 0.0 lbs OK   |
| ....for 1.5 : 1 Stability               | =   | 0.0 lbs OK   |
| Load Factors                            |     |              |
| Dead Load                               |     | 1.200        |
| Live Load                               |     | 1.600        |
| Earth, H                                |     | 1.600        |
| Wind, W                                 |     | 1.600        |
| Seismic, E                              |     | 1.000        |

### Stem Construction

|                          |        |           |
|--------------------------|--------|-----------|
|                          |        | Top Stem  |
| Design Height Above Ftg  | ft =   | 0.00      |
| Wall Material Above "Ht" | =      | Concrete  |
| Thickness                | in =   | 18.00     |
| Rebar Size               | =      | # 7       |
| Rebar Spacing            | in =   | 12.00     |
| Rebar Placed at          | =      | User Spec |
| Design Data              |        |           |
| fb/FB + fa/Fa            | =      | 0.629     |
| Total Force @ Section    | lbs =  | 5,837.4   |
| Moment....Actual         | ft-l = | 24,466.6  |
| Moment....Allowable      | ft-l = | 38,907.0  |
| Shear.....Actual         | psi =  | 32.4      |
| Shear.....Allowable      | psi =  | 82.2      |
| Wall Weight              | psf =  | 225.0     |
| Rebar Depth 'd'          | in =   | 15.00     |
| Lap splice if above      | in =   | 37.57     |
| Lap splice if below      | in =   | 13.42     |
| Hook embed into footing  | in =   | 13.42     |
| Concrete Data            |        |           |
| f'c                      | psi =  | 3,000.0   |
| Fy                       | psi =  |           |



**RETAINING WALL "1":  
12.5-FT RETAINED HEIGHT CONDITION**



## Cantilevered Retaining Wall

File=H:\4665\CO\_THO~2.01~\3D02D~1.BID\35869~1.27S\466~1.EC6  
 ENERCAL, INC. 1983-2016, Build:6.16.4.15, Ver:6.16.4.15

Lic. #: KW-06011271

Licensee: GALLOWAY & COMPANY, INC.

Description: 6-FT- Wall "2"

Calculations per ACI 318-11, ACI 530-11, IBC 2012,  
 CBC 2013, ASCE 7-10

### Criteria

|  |   |          |
|--|---|----------|
| Retained Height  | = | 6.00 ft  |
| Wall height above soil   | = | 0.00 ft  |
| Slope Behind Wall  | = | 0.00 : 1 |
| Height of Soil over Toe  | = | 18.00 in |
| Water height over heel   | = | 0.0 ft   |
| Vertical component of active<br>Lateral soil pressure options: |   |          |
| USED for Soil Pressure.  |   |          |
| USED for Sliding Resistance.                                   |   |          |
| USED for Overturning Resistance.                               |   |          |

### Soil Data

|   |   |              |
|---|---|--------------|
| Allow Soil Bearing                            | = | 2,800.0 psf  |
| Equivalent Fluid Pressure Method              |   |              |
| Heel Active Pressure                          | = | 35.0 psf/ft  |
| Toe Active Pressure                           | = | 35.0 psf/ft  |
| Passive Pressure                              | = | 300.0 psf/ft |
| Soil Density, Heel                            | = | 125.00 pcf   |
| Soil Density, Toe                             | = | 125.00 pcf   |
| Friction Coeff btwn Ftg & Soil                | = | 0.400        |
| Soil height to ignore<br>for passive pressure | = | 18.00 in     |

### Surcharge Loads

|  |   |           |
|--|---|-----------|
| Surcharge Over Heel                      | = | 150.0 psf |
| NOT Used To Resist Sliding & Overturning |   |           |
| Surcharge Over Toe                       | = | 0.0 psf   |
| Used for Sliding & Overturning           |   |           |

### Axial Load Applied to Stem

|                         |   |         |
|-------------------------|---|---------|
| Axial Dead Load         | = | 0.0 lbs |
| Axial Live Load         | = | 0.0 lbs |
| Axial Load Eccentricity | = | 0.0 in  |

### Design Summary

|   |   |               |
|---|---|---------------|
| Wall Stability Ratios                   |   |               |
| Overturning                             | = | 3.02 OK       |
| Sliding                                 | = | 2.14 OK       |
| Total Bearing Load                      | = | 3,936 lbs     |
| ...resultant ecc.                       | = | 7.79 in       |
| Soil Pressure @ Toe                     | = | 1,632 psf OK  |
| Soil Pressure @ Heel                    | = | 117 psf OK    |
| Allowable                               | = | 2,800 psf     |
| Soil Pressure Less Than Allowable       |   |               |
| ACI Factored @ Toe                      | = | 1,958 psf     |
| ACI Factored @ Heel                     | = | 141 psf       |
| Footing Shear @ Toe                     | = | 0.0 psi OK    |
| Footing Shear @ Heel                    | = | 27.7 psi OK   |
| Allowable                               | = | 82.2 psi      |
| Sliding Calcs (Vertical Component Used) |   |               |
| Lateral Sliding Force                   | = | 1,075.4 lbs   |
| less 100% Passive Force                 | = | - 729.2 lbs   |
| less 100% Friction Force                | = | - 1,570.0 lbs |
| Added Force Req'd                       | = | 0.0 lbs OK    |
| ...for 1.5 : 1 Stability                | = | 0.0 lbs OK    |
| Load Factors                            |   |               |
| Dead Load                               |   | 1.200         |
| Live Load                               |   | 1.600         |
| Earth, H                                |   | 1.600         |
| Wind, W                                 |   | 1.600         |
| Seismic, E                              |   | 1.000         |

### Lateral Load Applied to Stem

|                     |   |         |
|---------------------|---|---------|
| Lateral Load        | = | 0.0 plf |
| ...Height to Top    | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |

Wind on Exposed Stem = 0.0 psf

### Adjacent Footing Load

|                       |   |           |
|-----------------------|---|-----------|
| Adjacent Footing Load | = | 0.0 lbs   |
| Footing Width         | = | 0.00 ft   |
| Eccentricity          | = | 0.00 in   |
| Wall to Ftg CL Dist   | = | 0.00 ft   |
| Footing Type          |   | Line Load |
| Base Above/Below Soil | = | 0.0 ft    |
| at Back of Wall       |   |           |
| Poisson's Ratio       | = | 0.500     |

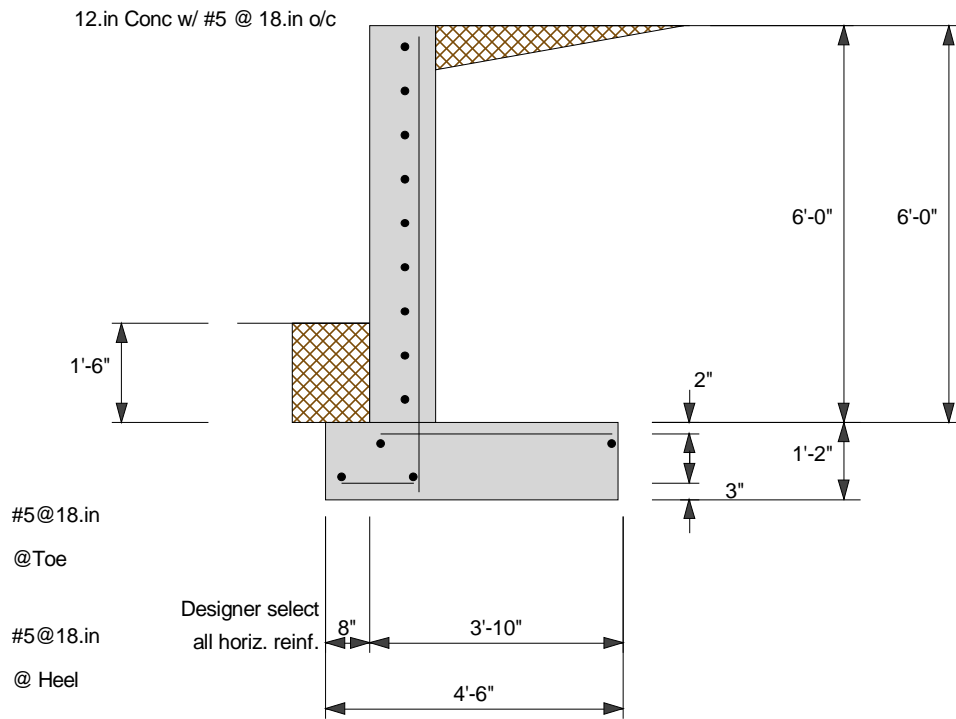
### Stem Construction

|                          |        |                 |
|--------------------------|--------|-----------------|
|                          |        | Top Stem        |
| Design Height Above Ftg  | ft =   | Stem OK<br>0.00 |
| Wall Material Above "Ht" | =      | Concrete        |
| Thickness                | in =   | 12.00           |
| Rebar Size               | =      | # 5             |
| Rebar Spacing            | in =   | 18.00           |
| Rebar Placed at          | =      | User Spec       |
| Design Data              |        |                 |
| fb/FB + fa/Fa            | =      | 0.390           |
| Total Force @ Section    | lbs =  | 1,348.2         |
| Moment....Actual         | ft-l = | 3,194.1         |
| Moment....Allowable      | ft-l = | 8,181.0         |
| Shear.....Actual         | psi =  | 12.5            |
| Shear.....Allowable      | psi =  | 82.2            |
| Wall Weight              | psf =  | 150.0           |
| Rebar Depth 'd'          | in =   | 9.00            |
| Lap splice if above      | in =   | 21.36           |
| Lap splice if below      | in =   | 9.59            |
| Hook embed into footing  | in =   | 9.59            |
| Concrete Data            |        |                 |
| f'c                      | psi =  | 3,000.0         |
| Fy                       | psi =  |                 |





**RETAINING WALL "2":  
6-FT RETAINED HEIGHT CONDITION**



## Cantilevered Retaining Wall

File=H:\4665\CO\_THO~2.01~\3D02D~1.BID\35869~1.27S\466~1.EC6  
 ENERCAL, INC. 1983-2016, Build:6.16.4.15, Ver:6.16.4.15  
 Licensee : GALLOWAY & COMPANY, INC.

Lic. # : KW-06011271

Description : 10-FT- Wall "2"

Calculations per ACI 318-11, ACI 530-11, IBC 2012,  
 CBC 2013, ASCE 7-10

### Criteria

|  |   |          |
|--|---|----------|
| Retained Height  | = | 10.00 ft |
| Wall height above soil   | = | 0.00 ft  |
| Slope Behind Wall  | = | 0.00 : 1 |
| Height of Soil over Toe  | = | 18.00 in |
| Water height over heel   | = | 0.0 ft   |
| Vertical component of active<br>Lateral soil pressure options: |   |          |
| USED for Soil Pressure.  |   |          |
| USED for Sliding Resistance.                                   |   |          |
| USED for Overturning Resistance.                               |   |          |

### Soil Data

|   |   |              |
|---|---|--------------|
| Allow Soil Bearing                            | = | 2,800.0 psf  |
| Equivalent Fluid Pressure Method              |   |              |
| Heel Active Pressure                          | = | 35.0 psf/ft  |
| Toe Active Pressure                           | = | 35.0 psf/ft  |
| Passive Pressure                              | = | 300.0 psf/ft |
| Soil Density, Heel                            | = | 125.00 pcf   |
| Soil Density, Toe                             | = | 125.00 pcf   |
| Friction Coeff btwn Ftg & Soil                | = | 0.400        |
| Soil height to ignore<br>for passive pressure | = | 18.00 in     |

### Surcharge Loads

|  |   |           |
|--|---|-----------|
| Surcharge Over Heel                      | = | 150.0 psf |
| NOT Used To Resist Sliding & Overturning |   |           |
| Surcharge Over Toe                       | = | 0.0 psf   |
| Used for Sliding & Overturning           |   |           |

### Lateral Load Applied to Stem

|                     |   |         |
|---------------------|---|---------|
| Lateral Load        | = | 0.0 plf |
| ...Height to Top    | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |

### Adjacent Footing Load

|  |   |           |
|--|---|-----------|
| Adjacent Footing Load                    | = | 0.0 lbs   |
| Footing Width                            | = | 0.00 ft   |
| Eccentricity                             | = | 0.00 in   |
| Wall to Ftg CL Dist                      | = | 0.00 ft   |
| Footing Type                             |   | Line Load |
| Base Above/Below Soil<br>at Back of Wall | = | 0.0 ft    |
| Poisson's Ratio                          | = | 0.500     |

### Axial Load Applied to Stem

|                         |   |         |
|-------------------------|---|---------|
| Axial Dead Load         | = | 0.0 lbs |
| Axial Live Load         | = | 0.0 lbs |
| Axial Load Eccentricity | = | 0.0 in  |

### Wind on Exposed Stem

|                      |   |         |
|----------------------|---|---------|
| Wind on Exposed Stem | = | 0.0 psf |
|----------------------|---|---------|

### Design Summary

|   |   |               |
|---|---|---------------|
| Wall Stability Ratios                   |   |               |
| Overturning                             | = | 3.16 OK       |
| Sliding                                 | = | 1.88 OK       |
| Total Bearing Load                      | = | 9,905 lbs     |
| ...resultant ecc.                       | = | 11.99 in      |
| Soil Pressure @ Toe                     | = | 2,626 psf OK  |
| Soil Pressure @ Heel                    | = | 203 psf OK    |
| Allowable                               | = | 2,800 psf     |
| Soil Pressure Less Than Allowable       |   |               |
| ACI Factored @ Toe                      | = | 3,152 psf     |
| ACI Factored @ Heel                     | = | 244 psf       |
| Footing Shear @ Toe                     | = | 0.0 psi OK    |
| Footing Shear @ Heel                    | = | 55.8 psi OK   |
| Allowable                               | = | 82.2 psi      |
| Sliding Calcs (Vertical Component Used) |   |               |
| Lateral Sliding Force                   | = | 2,639.9 lbs   |
| less 100% Passive Force                 | = | - 1,012.5 lbs |
| less 100% Friction Force                | = | - 3,960.0 lbs |
| Added Force Req'd                       | = | 0.0 lbs OK    |
| ...for 1.5 : 1 Stability                | = | 0.0 lbs OK    |

### Stem Construction

|                          |        |           |
|--------------------------|--------|-----------|
| Design Height Above Ftg  | ft =   | 0.00      |
| Wall Material Above "Ht" | =      | Concrete  |
| Thickness                | in =   | 14.00     |
| Rebar Size               | =      | # 7       |
| Rebar Spacing            | in =   | 16.00     |
| Rebar Placed at          | =      | User Spec |
| Design Data              |        |           |
| fb/FB + fa/Fa            | =      | 0.592     |
| Total Force @ Section    | lbs =  | 3,409.0   |
| Moment....Actual         | ft-l = | 12,661.8  |
| Moment....Allowable      | ft-l = | 21,378.9  |
| Shear.....Actual         | psi =  | 25.8      |
| Shear.....Allowable      | psi =  | 82.2      |
| Wall Weight              | psf =  | 175.0     |
| Rebar Depth 'd'          | in =   | 11.00     |
| Lap splice if above      | in =   | 37.57     |
| Lap splice if below      | in =   | 13.42     |
| Hook embed into footing  | in =   | 13.42     |
| Concrete Data            |        |           |
| f'c                      | psi =  | 3,000.0   |
| Fy                       | psi =  |           |

### Load Factors

|            |       |
|------------|-------|
| Dead Load  | 1.200 |
| Live Load  | 1.600 |
| Earth, H   | 1.600 |
| Wind, W    | 1.600 |
| Seismic, E | 1.000 |



**RETAINING WALL "2":**  
**10-FT RETAINED HEIGHT CONDITION**

